HAZARD RANKING SYSTEM (HRS)
DOCUMENTATION RECORD - COVER SHEET

Name of Site:	Gelman Sciences Inc.
SEMS ID No.:	MID005341813

Contact Persons

Site Investigation:	Nuria Muniz, Section Manager, EPA Reg. 5 (312) 886-4439 (Telephone)
Documentation Record:	Erica Aultz, NPL Coordinator, EPA Reg. 5 (312) 353-7209 (Telephone)

Pathways, Components, or Threats Not Scored

1) **Surface Water Pathway:** Although site sources are known to have historically overflowed and discharged to surface water via adjacent wetlands, evaluation of the Surface Water Migration Pathway would not significantly affect the listing decision as the Ground Water Migration Pathway scores sufficient for listing [**Section 3.1** of this HRS documentation record]. Unauthorized discharge of process water from site sources to adjacent HRS surface water bodies was documented during multiple historic regulatory inspections. On February 19, 1969, the Michigan Water Resource Commission (MWRC) conducted an inspection at the facility and noted that Pond 2 was discharging to a swampy area adjacent to a small tributary of Honey Creek [Refs. 4; 6, p.36; 61, p. 1; 119, p. 70]. The effluent flow was estimated at 20 gallons per minute and the effluent was blackish or dark gray in color and exhibited a septic odor [Ref. 61, p. 1]. This discharge was noted as being in violation of an existing Order of Determination against Gelman forbidding discharge to waters of the state [Ref. 61, p. 1].

   In 1977, Gelman violated the terms of its discharge permit by allowing surface runoff from the spray irrigation field to discharge at the west property boundary [Ref. 38, p. 1]. In 1984, documentation noted that the spray irrigation discharge contained 1,4-dioxane [Ref. 68, p. 33]. A study by the University of Michigan in 1984 determined that runoff from the Gelman's spray irrigation field had impacted Third Sister Lake to the west of the facility via detections of 1,4-dioxane [Ref. 13, pp. 1–10].

   On July 13, 1986, Gelman discharged an estimated 18,000 gallons of process water from a surface impoundment onto the ground near the north property line [Ref. 66, p. 1]. MDNR indicated that this discharge was a violation of Gelman's groundwater discharge permit (Permit No. M00337) [Ref. 66, p. 1]. The wetlands that received the unpermitted discharges are contiguous with the Honey Creek tributary [Ref. 4, p. 1; 82, p. 9; 83, p. 1]. The Surface Water Migration Pathway is of concern to EPA and may be considered during a future evaluation.

2) **Soil Exposure and Subsurface Intrusion Pathway:** Based on information available at this time, evaluation of the Soil Exposure component would not significantly affect the listing decision as the Ground Water Migration Pathway scores sufficient for listing [**Section 3.0** of this HRS documentation record]. In 2016, Gelman performed a shallow groundwater investigation in Scio Township and Ann Arbor to characterize select locations where the top of the groundwater table was believed to be located within 20 feet of the ground surface, and to evaluate the potential for subsurface intrusion [Ref., 95, pp. 3, 9, 30]. Samples were collected from temporary monitoring wells using low-flow sampling methods [Ref. 95, pp. 3, 4, 37–44, 46–49, 51, 53–55]. Sample analyses performed by Gelman's laboratory showed only two detections of 1,4-dioxane (3.3 micrograms per liter [µg/L] and 1.9 µg/L) out of 16 groundwater samples [Ref. 95, pp. 27, 28, 86]. Split sample analyses performed by Michigan Department of Environmental Quality (MDEQ) Environmental Laboratory correlated with these results (2.7 µg/L and 2.0 µg/L) [Ref. 95, pp. 5, 27, 164, 173].

3) **Air Migration Pathway**: Based on information available at this time, evaluation of the Air Migration Pathway would not significantly affect the listing decision as the Ground Water Migration Pathway scores sufficient for listing [**Section 3.0** of this HRS documentation record].

HRS DOCUMENTATION RECORD

Name of Site:	Gelman Sciences Inc.
EPA Site ID No.:	MID005341813
EPA Region:	5
Date Prepared: Revised:	March 2024 March 2026
Street Address of Site*: City, County, State, and Zip:	600 S Wagner Road Ann Arbor, Washtenaw County, MI 48103 [Ref. 3, p. 1]
General Location within the State:	Southeastern Michigan, west of Detroit (See HRS Documentation Record Figure 1).
Topographic Map(s):	The following U.S. Geological Survey (USGS) 7.5-minute series topographic map was used in locating the site: Ann Arbor, Michigan (2017) [Ref. 4, p. 1].
Latitude/Longitude*:	+42.276144, -83.799940

Latitude and Longitude coordinates correspond to contaminated soil sample location G-SS09. [Ref. 14, p. 3; see HRS Documentation Record **Figures 1 and 2**].

	Scores
Ground Water Pathway[1]	100.00
Surface Water Pathway	Not Scored
Soil Exposure and Subsurface Intrusion Pathway	Not Scored
Air Pathway	Not Scored

HRS SITE SCORE 50.00

*The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area where the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, disposed, or placed, or has otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

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[1] "Ground water" and "groundwater" are synonymous; the spelling is different due to "ground water" being codified as part of the HRS, while "groundwater" is the modern spelling.

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	100	10,000
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	NS	NS
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	NS	NS
2c.	Surface Water Migration Pathway Score (S_{sw}) (Enter the larger of lines 2a and 2b as the pathway score)	NS	NS
3a.	Soil Exposure Component Score (S_{se}) (from Table 5-1, line 22)	NS	NS
3b.	Subsurface Intrusion Component Score (S_{ssi}) (from Table 5-11, line 12)	NS	NS
3c.	Soil Exposure and Subsurface Intrusion Pathway Score (S_{sessi}) Enter the sum of lines 3a and 3b as the pathway score.	NS	NS
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	NS	NS
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_{sessi}^2 + S_a^2$	----	10,000
6.	HRS Site Score: Divide the value on line 5 by 4 and take the square root.		**50.00**

Notes:

S	Score
S^2	Score squared
NS	Not scored

GROUND WATER MIGRATION PATHWAY SCORESHEET
Gelman Sciences Inc.

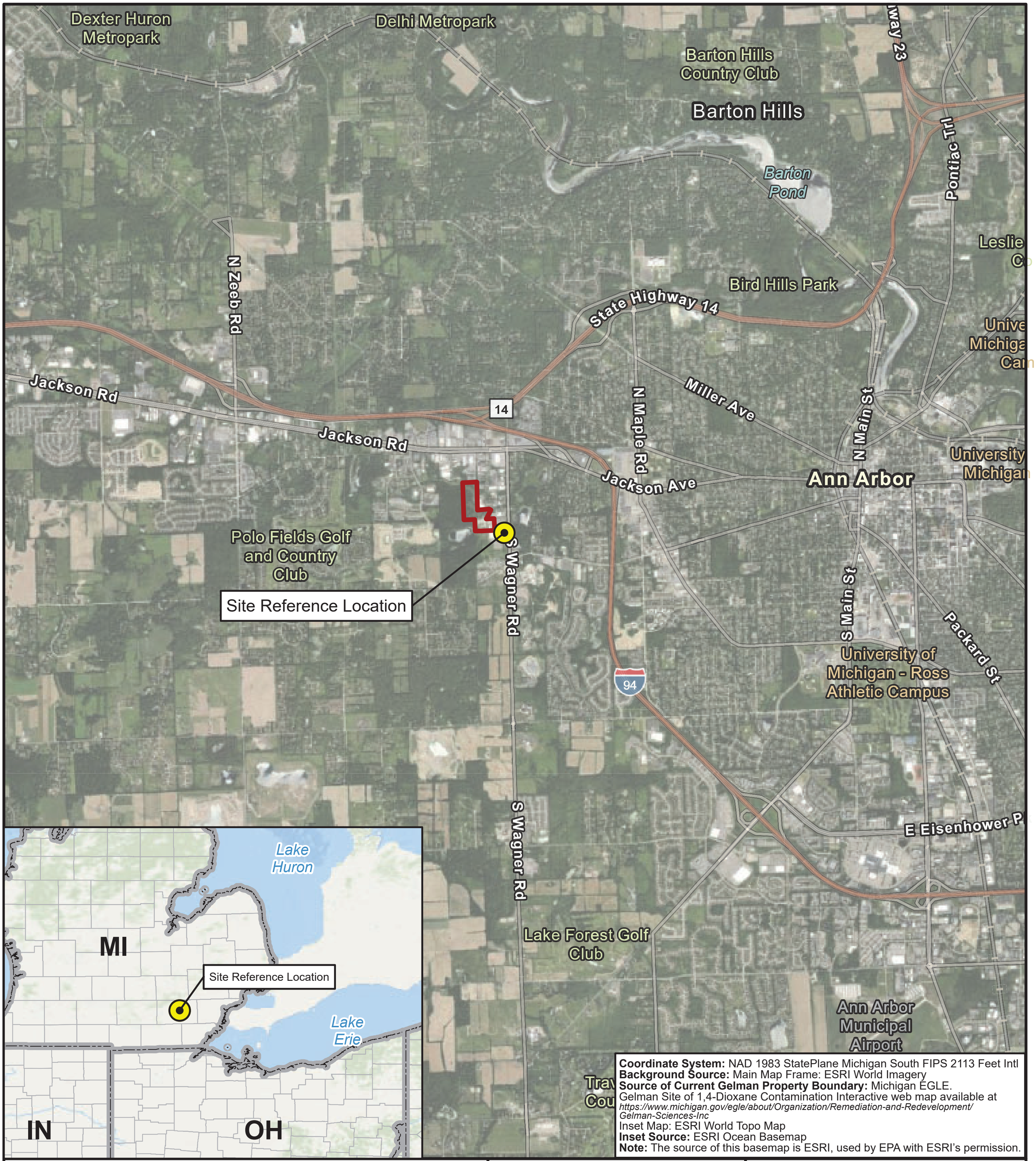
GROUND WATER MIGRATION PATHWAY Factor Categories & Factors	MAXIMUM VALUE	VALUE ASSIGNED
Likelihood of Release		
1. Observed Release	550	550
2. Potential to Release		
2a. Containment	10	not scored
2b. Net Precipitation	10	not scored
2c. Depth to Aquifer	5	not scored
2d. Travel Time	35	not scored
2e. Potential to Release [lines 2a(2b+2c+2d)]	500	not scored
3. Likelihood of Release	550	550
Waste Characteristics		
4. Toxicity/Mobility	*	100
5. Hazardous Waste Quantity	*	10,000
6. Waste Characteristics	100	32
Targets		
7. Nearest Well	50	50
8. Population		
8a. Level I Concentrations	**	37,678.45
8b. Level II Concentrations	**	19.12
8c. Potential Contamination	**	not scored
8d. Population (lines 8a+8b+8c)	**	37,697.57
9. Resources	5	not scored
10. Wellhead Protection Area	20	20
11. Targets (lines 7+8d+9+10)	**	37,767.57
12. Aquifer Score (lines 3x6x11 divided by 82,500)	100	100
13. Ground Water Migration Pathway Score (Sgw)	100	100

Notes:

* Maximum value applies to waste characteristics category.

** Maximum value not applicable.

FIGURES



Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
Background Source: Main Map Frame: ESRI World Imagery
Source of Current Gelman Property Boundary: Michigan EGLE.
Gelman Site of 1,4-Dioxane Contamination Interactive web map available at
https://www.michigan.gov/egle/about/Organization/Remediation-and-Redevelopment/Gelman-Sciences-Inc
Inset Map: ESRI World Topo Map
Inset Source: ESRI Ocean Basemap
Note: The source of this basemap is ESRI, used by EPA with ESRI's permission.

Legend

●	Site Reference Location (2022 Sample Location G-SS09)	Latitude: 42.276144 Longitude: -83.799940
▭	Current Gelman Property Boundary	
▭	State Boundary	
▭	County Boundary	

0 0.5 1 2
Miles

N

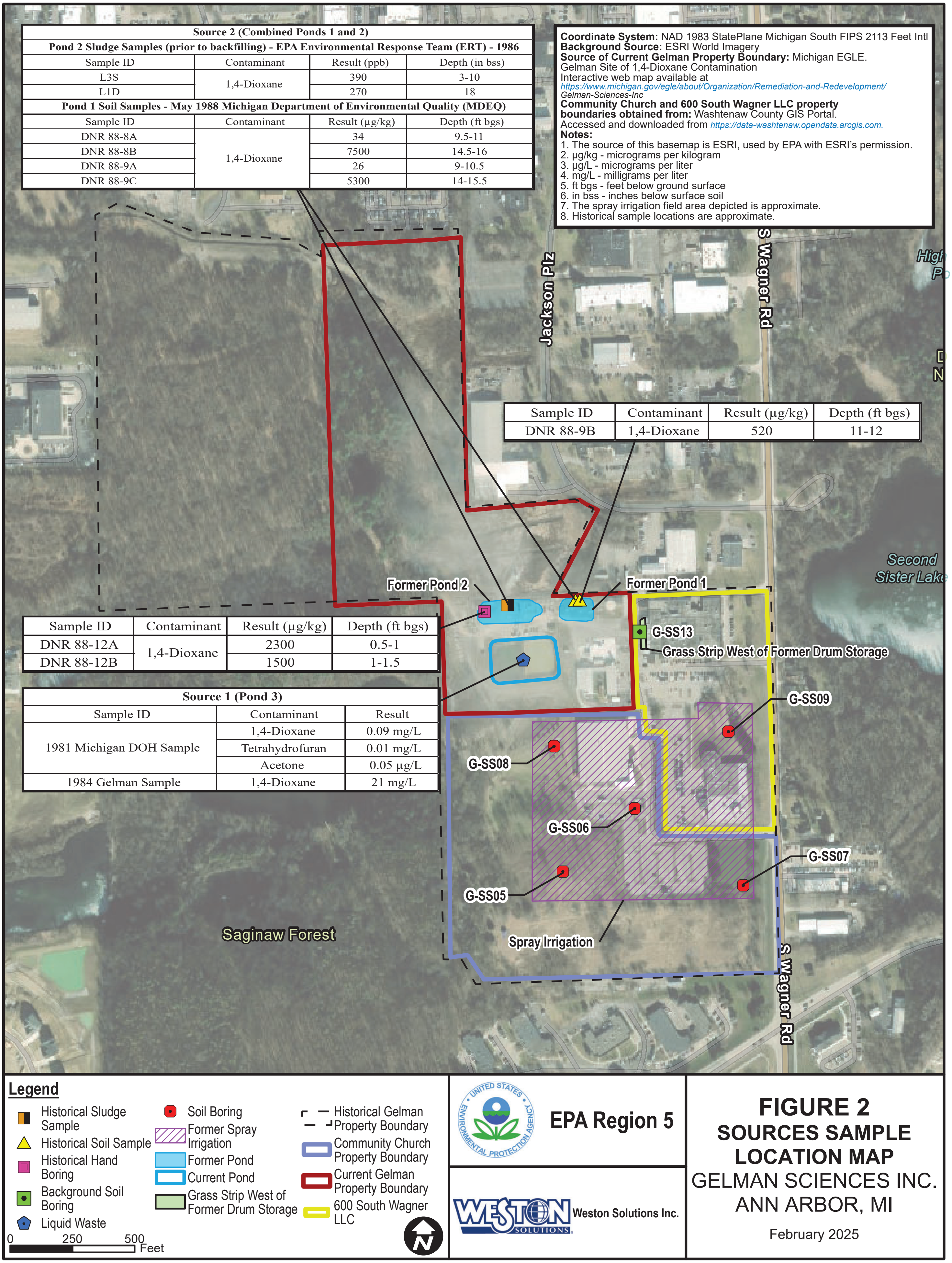
EPA Region 5

Weston Solutions Inc.

FIGURE 1
SITE LOCATION MAP

GELMAN SCIENCES INC.
ANN ARBOR, MI

February 2024



Source 2 (Combined Ponds 1 and 2)			
Pond 2 Sludge Samples (prior to backfilling) - EPA Environmental Response Team (ERT) - 1986			
Sample ID	Contaminant	Result (ppb)	Depth (in bss)
L3S	1,4-Dioxane	390	3-10
L1D		270	18
Pond 1 Soil Samples - May 1988 Michigan Department of Environmental Quality (MDEQ)			
Sample ID	Contaminant	Result (µg/kg)	Depth (ft bgs)
DNR 88-8A	1,4-Dioxane	34	9.5-11
DNR 88-8B		7500	14.5-16
DNR 88-9A		26	9-10.5
DNR 88-9C		5300	14-15.5

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
Background Source: ESRI World Imagery
Source of Current Gelman Property Boundary: Michigan EGLE.
Gelman Site of 1,4-Dioxane Contamination
Interactive web map available at
https://www.michigan.gov/egle/about/Organization/Remediation-and-Redevelopment/Gelman-Sciences-Inc
Community Church and 600 South Wagner LLC property boundaries obtained from: Washtenaw County GIS Portal.
Accessed and downloaded from *https://data-washtenaw.opendata.arcgis.com.*
Notes:
1. The source of this basemap is ESRI, used by EPA with ESRI's permission.
2. µg/kg - micrograms per kilogram
3. µg/L - micrograms per liter
4. mg/L - milligrams per liter
5. ft bgs - feet below ground surface
6. in bss - inches below surface soil
7. The spray irrigation field area depicted is approximate.
8. Historical sample locations are approximate.

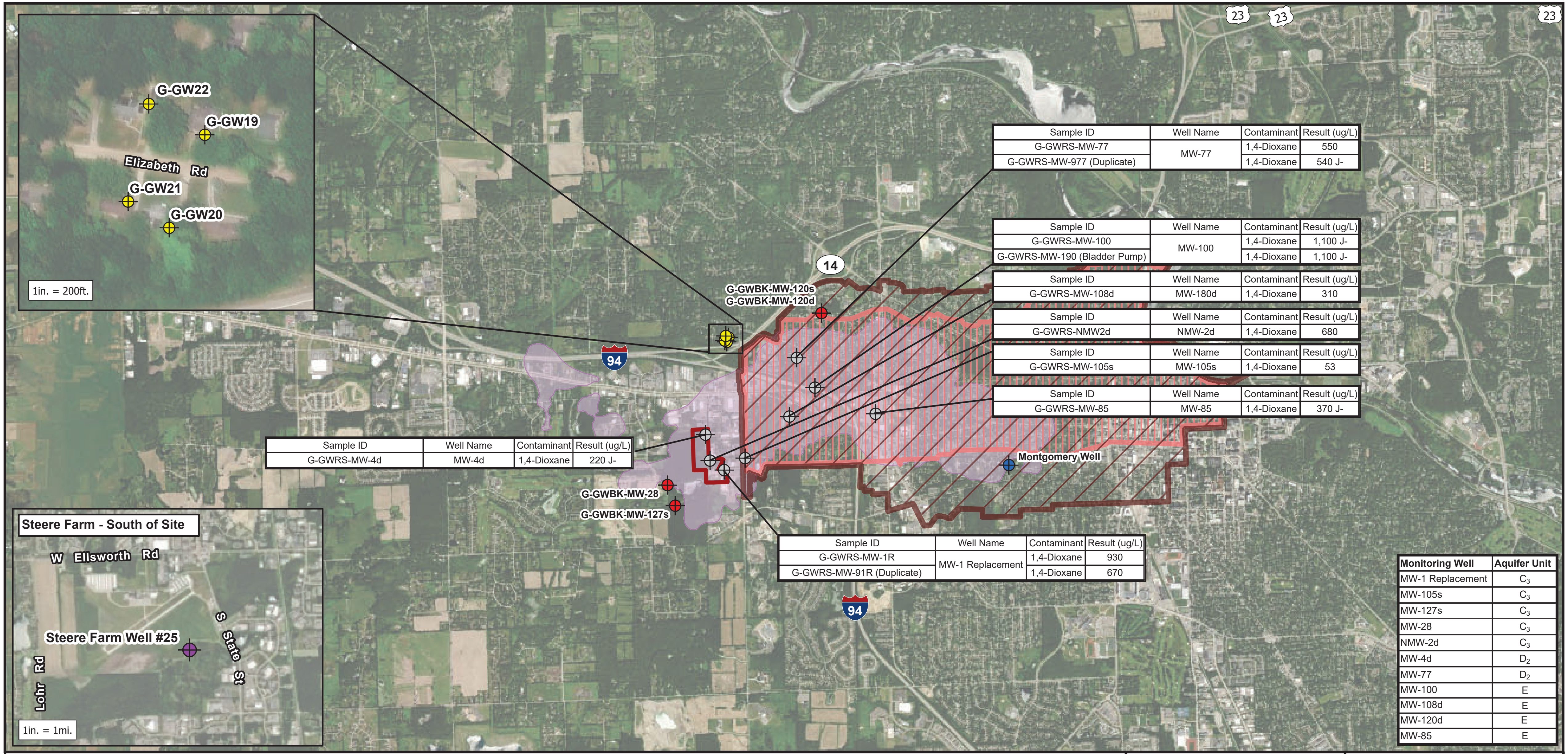
Sample ID	Contaminant	Result (µg/kg)	Depth (ft bgs)
DNR 88-9B	1,4-Dioxane	520	11-12

Sample ID	Contaminant	Result (µg/kg)	Depth (ft bgs)
DNR 88-12A	1,4-Dioxane	2300	0.5-1
DNR 88-12B		1500	1-1.5

Source 1 (Pond 3)		
Sample ID	Contaminant	Result
1981 Michigan DOH Sample	1,4-Dioxane	0.09 mg/L
	Tetrahydrofuran	0.01 mg/L
	Acetone	0.05 µg/L
1984 Gelman Sample	1,4-Dioxane	21 mg/L

FIGURE 2
SOURCES SAMPLE LOCATION MAP
GELMAN SCIENCES INC.
ANN ARBOR, MI

February 2025



Sample ID	Well Name	Contaminant	Result (ug/L)
G-GWRS-MW-77	MW-77	1,4-Dioxane	550
G-GWRS-MW-977 (Duplicate)		1,4-Dioxane	540 J-

Sample ID	Well Name	Contaminant	Result (ug/L)
G-GWRS-MW-100	MW-100	1,4-Dioxane	1,100 J-
G-GWRS-MW-190 (Bladder Pump)		1,4-Dioxane	1,100 J-

Sample ID	Well Name	Contaminant	Result (ug/L)
G-GWRS-MW-108d	MW-180d	1,4-Dioxane	310

Sample ID	Well Name	Contaminant	Result (ug/L)
G-GWRS-NMW2d	NMW-2d	1,4-Dioxane	680

Sample ID	Well Name	Contaminant	Result (ug/L)
G-GWRS-MW-105s	MW-105s	1,4-Dioxane	53

Sample ID	Well Name	Contaminant	Result (ug/L)
G-GWRS-MW-85	MW-85	1,4-Dioxane	370 J-

Sample ID	Well Name	Contaminant	Result (ug/L)
G-GWRS-MW-4d	MW-4d	1,4-Dioxane	220 J-

Sample ID	Well Name	Contaminant	Result (ug/L)
G-GWRS-MW-1R	MW-1 Replacement	1,4-Dioxane	930
G-GWRS-MW-91R (Duplicate)		1,4-Dioxane	670

Monitoring Well	Aquifer Unit
MW-1 Replacement	C_3
MW-105s	C_3
MW-127s	C_3
MW-28	C_3
NMW-2d	C_3
MW-4d	D_2
MW-77	D_2
MW-100	E
MW-108d	E
MW-120d	E
MW-85	E

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
Background Source: ESRI World Imagery
Source of Dioxane Plume Extent, Prohibition Zone, and Current Gelman Property Boundary:
Michigan EGLE. Gelman Site of 1,4-Dioxane Contamination Interactive web map available at
https://www.michigan.gov/egle/about/Organization/Remediation-and-Redevelopment/Gelman-Sciences-Inc

Notes:
1. The source of this basemap is ESRI, used by EPA with ESRI's permission.
2. ug/L - micrograms per liter
3. J- - The analyte was positively identified-the associated numerical value is the approximate biased low concentration of the analyte in the sample.
4. Only showing groundwater results significantly above background.
5. Steere Farm Well inset can be seen on Figure 5.

0 0.4 0.8 1.6
Miles

Legend

Groundwater Sample Location

- 🔴 Background Monitoring Well
- 🟣 Background Water-Supply Well
- ⚪ Release Monitoring Well
- 🔵 Release Target Well
- 🟡 Other Contaminated Well
- ▭ Dioxane Plume Extent (2020)
- ▭ Current Gelman Property Boundary
- ▭ Prohibition Zone Boundary (2021)
- ▭ Prohibition Zone Boundary (2011)

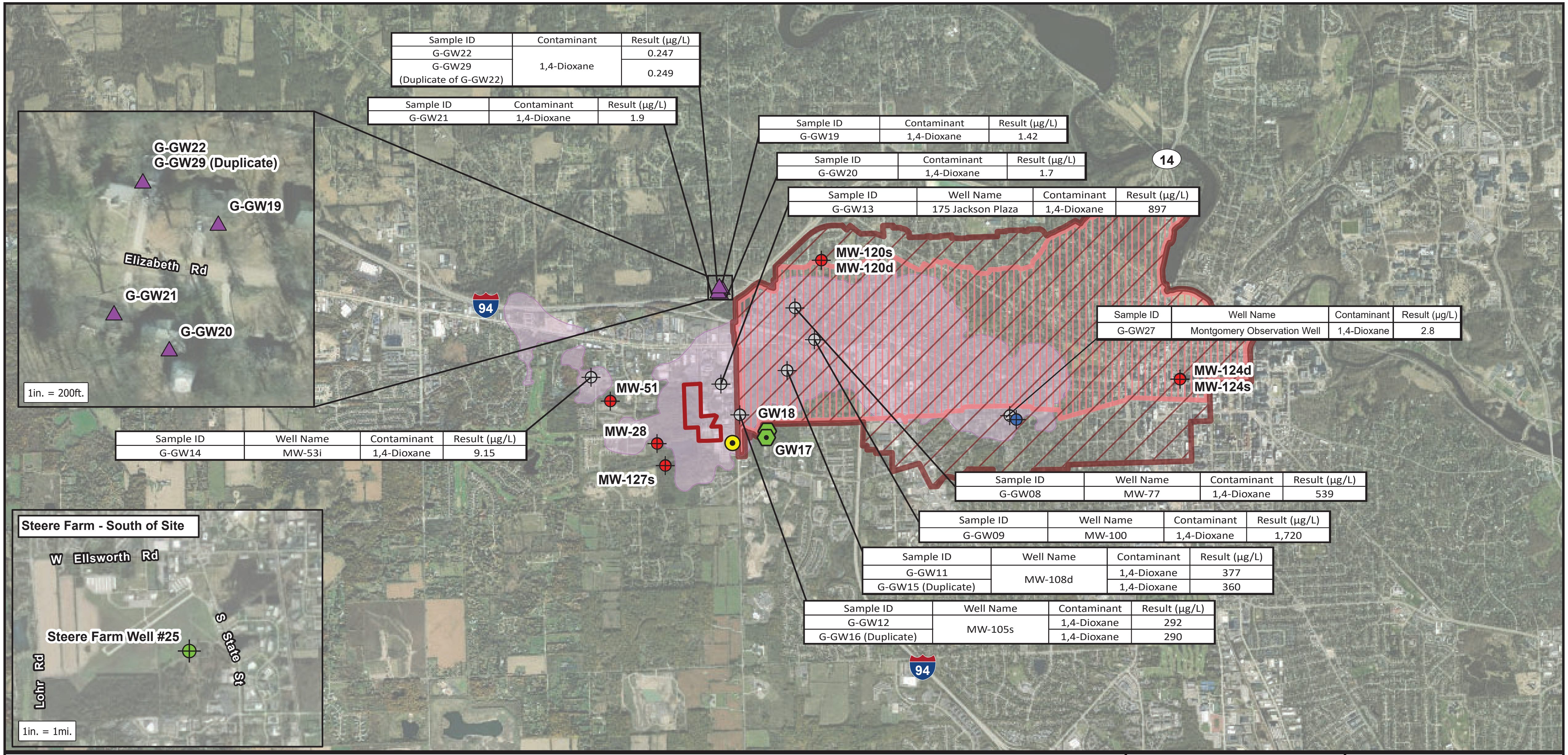
EPA Region 5

Weston Solutions Inc.

FIGURE 3

2022 GROUNDWATER SAMPLE LOCATIONS MAP
GELMAN SCIENCES INC.
ANN ARBOR, MI

February 2024



Sample ID	Contaminant	Result (µg/L)
G-GW22	1,4-Dioxane	0.247
G-GW29 (Duplicate of G-GW22)		0.249

Sample ID	Contaminant	Result (µg/L)
G-GW21	1,4-Dioxane	1.9

Sample ID	Contaminant	Result (µg/L)
G-GW19	1,4-Dioxane	1.42

Sample ID	Contaminant	Result (µg/L)
G-GW20	1,4-Dioxane	1.7

Sample ID	Well Name	Contaminant	Result (µg/L)
G-GW13	175 Jackson Plaza	1,4-Dioxane	897

Sample ID	Well Name	Contaminant	Result (µg/L)
G-GW27	Montgomery Observation Well	1,4-Dioxane	2.8

Sample ID	Well Name	Contaminant	Result (µg/L)
G-GW14	MW-53i	1,4-Dioxane	9.15

Sample ID	Well Name	Contaminant	Result (µg/L)
G-GW08	MW-77	1,4-Dioxane	539

Sample ID	Well Name	Contaminant	Result (µg/L)
G-GW09	MW-100	1,4-Dioxane	1,720

Sample ID	Well Name	Contaminant	Result (µg/L)
G-GW11	MW-108d	1,4-Dioxane	377
G-GW15 (Duplicate)		1,4-Dioxane	360

Sample ID	Well Name	Contaminant	Result (µg/L)
G-GW12	MW-105s	1,4-Dioxane	292
G-GW16 (Duplicate)		1,4-Dioxane	290

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
Background Source: ESRI World Imagery
Source of Dioxane Plume Extent, Prohibition Zone, and Current Gelman Property Boundary:
Michigan EGLE.
Gelman Site of 1,4-Dioxane Contamination Interactive web map available at
https://www.michigan.gov/egle/about/Organization/Remediation-and-Redevelopment/Gelman-Sciences-Inc

Notes:
1. The source of this basemap is ESRI, used by EPA with ESRI's permission.
2. ug/L - micrograms per liter
3. J- - The analyte was positively identified-the associated numerical value is the approximate biased low concentration of the analyte in the sample.
4. Only showing groundwater results significantly above background.
5. The area represented in the Steere Farm inset can be seen on Figure 5.

0 0.75 1.5 Miles

Legend

Groundwater Sample Location

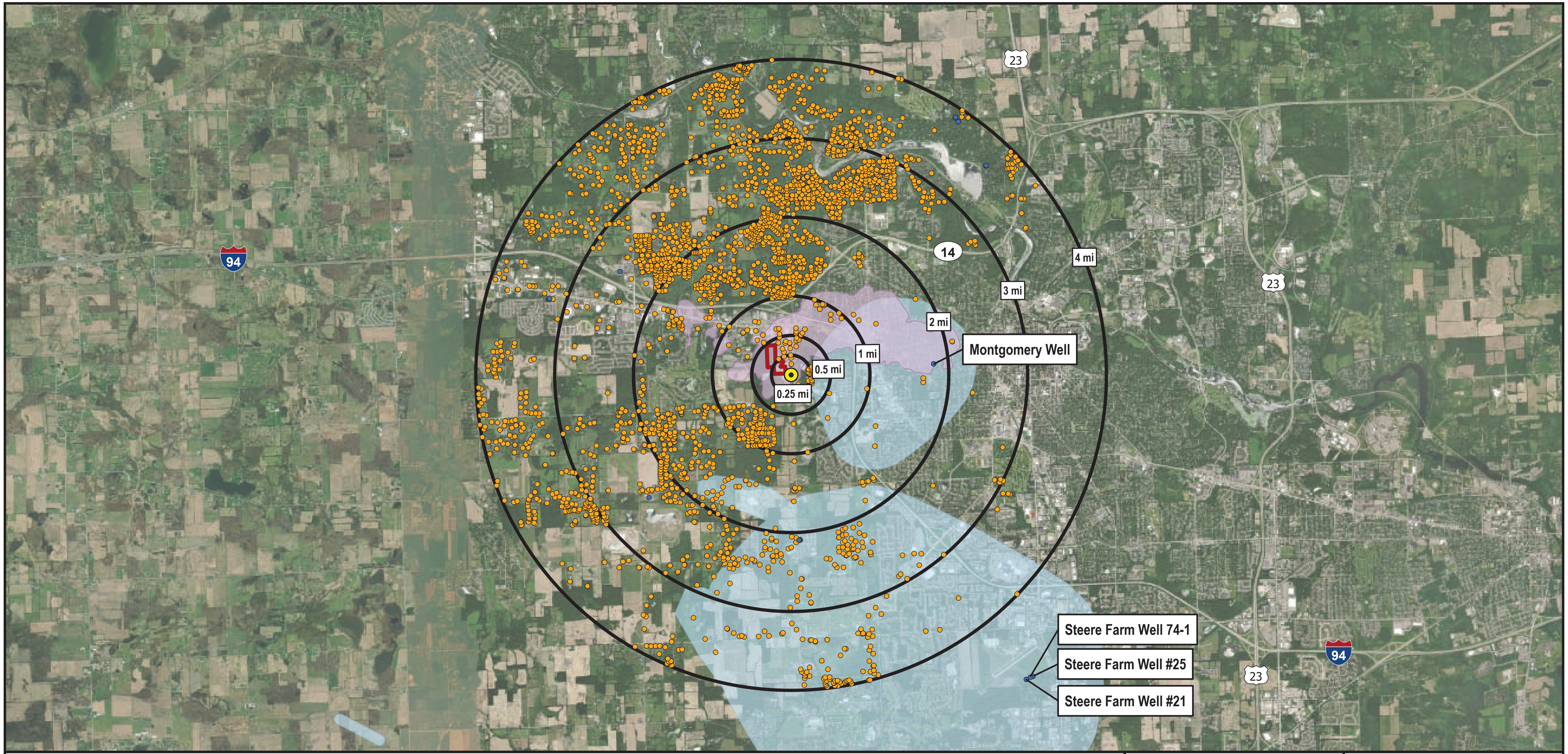
- 🔴 Background Monitoring Well
- 🟢 Background Water-Supply Well
- ⊕ Release Monitoring Well
- 🔵 Municipal Supply Target Well
- ▲ Residential Target Well
- ● Site Reference Location (Sample Location G-SS09)
- ⬢ Background Residential Well
- ▨ Dioxane Plume Extent (2020)
- ▭ Current Gelman Property Boundary
- ▬ Prohibition Zone Boundary (2021)
- ▬ Prohibition Zone Boundary (2011)

EPA Region 5

Weston Solutions Inc.

FIGURE 4
2023 GROUNDWATER SAMPLE LOCATIONS MAP
GELMAN SCIENCES INC.
ANN ARBOR, MI

February 2025



Legend

- ● Site Reference Location (2022 Sample Location G-SS09) Latitude: 42.276144 Longitude: -83.799940
- ● Private Residential Well
- ● Type I Community Public Water-Supply Well
- ▭ Current Gelman Property Boundary
- ▨ Wellhead Protection Area (WHPA)
- ▨ Dioxane Plume Extent (2020)

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
Source of Dioxane Plume Extent and Current Gelman Property Boundary:
Michigan EGLE.
Gelman Site of 1,4-Dioxane Contamination Interactive web map available at
https://www.michigan.gov/egle/about/Organization/Remediation-and-Redevelopment/Gelman-Sciences-Inc

Sources:
1. Background: ESRI World Imagery
2. Well Types and Locations, and Wellhead Protection Areas obtained from: State of Michigan.
GIS Open Data. Accessed and downloaded from *https://gis-michigan.opendata.arcgis.com*.

Notes:
1. The source of this basemap is ESRI, used by EPA with ESRI's permission.
2. Type I community public water-supply wells provide water to at least 25 residents or 15 living units year-round. Some examples are municipalities (cities, towns, etc.), apartments, nursing homes and manufactured housing communities.

EPA Region 5

Weston Solutions Inc.

FIGURE 5
4-MILE RADIUS MAP
GELMAN SCIENCES INC.
ANN ARBOR, MI

February 2024

FIGURE REFERENCE SHEET

Figure 1: Site Location Map

- Basemap: Esri World Topo Map and Ocean Basemap; used by EPA with ESRI's permission.
- Map annotated by EPA Superfund Technical Assessment and Response Team (START) to depict site reference point.
    - Ref. 4, p. 1
    - Ref. 16, p. 7
    - Ref. 14, p. 3

Figure 2: Source Sample Locations Map

- Basemap: Esri World Imagery; used by EPA with Esri's permission.
- Map annotated by EPA START to depict 2022 EPA Site Inspection Source Sampling Results.
    - Ref. 4, p. 1
    - Ref. 16, p. 7
    - Ref. 17, pp. 26–28
    - Ref. 32, pp. 5, 7, 14, 15
    - Ref. 35, pp. 1–9, 16, 26, 38, 63, 65
    - Ref. 36, pp. 3, 4, 32, 41, 59
    - Ref. 40, pp. 1–9, 11, 17, 19, 21, 25, 27, 29, 50, 52, 54, 55
    - Ref. 41, pp. 2, 3, 471, 477, 480, 486, 489, 495, 498, 501
    - Ref. 45, pp. 7, 26, 27
    - Ref. 59, pp. 3, 6
    - Ref. 93, pp. 1–3
    - Ref. 94, pp. 24, 26, 27
    - Ref. 119, p. 67

Figure 3: 2022 Groundwater Sample Locations Map

- Basemap: Esri World Imagery; used by EPA with Esri's permission.
- Map annotated by EPA START to depict 2022 EPA Site Inspection Groundwater Sampling Results.
    - Ref. 4, p. 1
    - Ref. 11, pp. 4–6
    - Ref. 12, pp. 4–6
    - Ref. 16, p. 7
    - Ref. 17, pp. 5, 11, 12, 13, 19, 32
    - Ref. 29, pp. 1, 2
    - Ref. 46, pp. 9, 10, 11, 12, 13, 15–18, 19–22, 23–26, 27
    - Ref. 47, pp. 1–12, 16, 19, 43, 55, 58, 61, 82, 83, 85, 86
    - Ref. 48, pp. 5, 6, 8, 9, 12, 83, 91, 119, 135, 143, 151
    - Ref. 49, pp. 1–7, 17, 31
    - Ref. 50, pp. 3, 21
    - Ref. 51, pp. 1–14, 37, 40, 100
    - Ref. 52, pp. 11, 14, 107, 119
    - Ref. 53, p. 5
    - Ref. 54, pp. 1–8, 13, 16, 38
    - Ref. 55, pp. 3, 52, 60
    - Ref. 106, p. 5, 6
    - Ref. 107, p. 4
    - Ref. 119, pp. 67, 69

Figure 4: 2023 Groundwater Sample Locations Map

- Basemap: Esri World Imagery; used by EPA with Esri's permission.
- Map annotated by EPA START to depict 2023 EPA Site Inspection Groundwater Sampling Results.

  - Ref. 4, p. 1
  - Ref. 14, pp. 2, 3
  - Ref. 16, p. 7
  - Ref. 46, pp. 2, 3, 5–8, 10–12, 15–22, 28–36, 40, 42, 43
  - Ref. 105, pp. 7, 8, 12, 13, 17, 18, 19
  - Ref. 108, pp. 9, 46–49
  - Ref. 109, pp. 9, 10, , 60, 61, 62, 63
  - Ref. 110, pp. 9, 49–52, 55, 56
  - Ref. 111, pp. 8, 36, 37, 38
  - Ref. 112, pp. 1–7
  - Ref. 113, pp. 1–7
  - Ref. 114, pp. 1–8
  - Ref. 115, pp. 1–6
  - Ref. 116, pp. 2-5
  - Ref. 119, pp. 67, 69

Figure 5: 4-Mile Radius Map

- Basemap: ESRI Topographic Map; used by EPA with Esri's permission.
- Wells and Wellhead Protection Areas: Michigan Department of Environment, Great Lakes, and Energy
- Wetlands: National Wetland Inventory
  - Ref. 4, p. 1
  - Ref. 14, p. 3
  - Ref. 16, p. 7
  - Ref. 84, p. 13
  - Ref. 56, p.1
  - Ref. 120, pp. 1, 2
  - Ref. 121, pp. 1, 2

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2. EPA. Superfund Chemical Data Matrix (SCDM) Query: Factor Values and Benchmarks, Ground Water Pathway, January 2024. Query accessed January 25, 2024. A complete copy of SCDM is available at http://www.epa.gov/superfund/superfund-chemical-data-matrix-scdm. [6 pages]

3. EPA. Superfund Site Information: Gelman Sciences Inc, EPA ID: MID005341813. Accessed and downloaded from https://cumulis.epa.gov/supercpad/CurSites/csitinfo.cfm?id=0502257 on July 25, 2023. [1 page]

4. U.S. Geological Survey (USGS). Ann Arbor West Quadrangle, Michigan, 7.5-minute Series (Topographic) (as modified by Weston Solutions, Inc. [WESTON®] to indicate approximate Gelman facility location). 2017. [1 map]

5. EPA. RCRAInfo, Nationally-Defined Values – Waste Code (excerpts). Accessed and downloaded from https://rcrainfo.epa.gov/rcrainfo-help/application/publicHelp/nationallydefinedvalues/crossmodule/ndv-crossmodulewastecode.htm on July 28, 2023. [4 pages]

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7. EPA Region 5. Field Standard Operating Procedures, Ground Water Sampling Procedures (R5-SFD-0006-r0). May 13, 2021. [34 pages]

8. Snyder, Scott, WESTON. Project Note to Gelman Sciences Inc Site File, Subject: 2023 Michigan EGLE Residential Well Data; with attached e-mail chain, summary table, data validation memo, and laboratory data packages. January 31, 2024. [1068 pages]

9. Environmental Data Resources (EDR). The EDR Radius Map™ Report with GeoCheck®, Gelman Sciences Inc, 600 S Wagner Road, Ann Arbor, MI 48103, Inquiry Number: 7509620.1s. December 04, 2023. [981 pages]

10. EDR. The EDR Aerial Photo Decade Package, Gelman Sciences Inc, 600 S Wagner Rd, Ann Arbor, MI 48103, Inquiry Number: 7403524.8. July 31, 2023. [19 pages]

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SITE SUMMARY

The Gelman Sciences Inc. (Gelman) site as scored for HRS purposes consists of two sources of hazardous substances (1,4-dioxane) at the Gelman facility in Ann Arbor, Washtenaw County, Michigan, as well as groundwater contaminated with site-attributable 1,4-dioxane as a result of releases from site sources. Sources include a surface impoundment and a set of buried/backfilled surface impoundments [see **Figures 1 and 2 and Sections 2.2 and 3.1** of this HRS documentation record]. Thirty-one residential wells and a public supply well have been evaluated at observed release concentrations [see **Section 3.3 and Tables 16, 18 and 20** of this HRS documentation record]. A Site Location Map is presented as **Figure 1** of this HRS documentation record. Site sources are presented in **Figure 2** of this HRS documentation record.

A release to groundwater of a hazardous substance attributable to operations at the Gelman facility is documented by chemical analysis and direct observation based on past waste disposal practices and sampling and analysis by the U.S. Environmental Protection Agency (EPA) in 2022 and 2023 and by Michigan Department of Environment, Great Lakes, and Energy (EGLE) and Washtenaw County Health Department in 2023 [see **Section 3.1** of this HRS documentation record]. Groundwater results show concentrations of 1,4-dioxane related to releases from the Gelman facility at concentrations significantly above background in nearby monitoring wells [see **Section 3.1** of this HRS documentation record]. A municipal water-supply well (i.e., Montgomery Well) was closed in 2001 due to contamination with site-attributable 1,4-dioxane [Ref. 78, p. 10; 84, p. 5; 123, pp. 1–20]. An observed release is documented in this well [see **Section 3.1** of this HRS documentation record]. The Montgomery Well served an apportioned population of 3,712.8750 people at the time of closure [Ref. 89, p. 1]. EPA sample results in September 2023 from an observation well near the closed Montgomery Well show that 1,4-dioxane continues to persist in the aquifer at that location at an observed release concentration. 1,4-Dioxane contamination is documented in multiple residential wells [see **Section 3.3** of this HRS documentation record]. Population targets evaluated in scoring include the population associated with the closed Montgomery well at Level I concentrations (3,712.8750 people); population associated with 23 residential wells at Level I concentrations (54.97 people); and the population associated with 8 residential wells at Level II concentration (19.12 people) [see **Section 3.3** of this HRS documentation record].

Facility Operations

Gelman began operations at the Ann Arbor facility in 1963; historical aerial photographs show the facility property was used for agricultural purposes prior to Gelman's operations [Ref. 10, p. 15; 28, p. 1; 58, p. 5]. Gelman manufactured membrane filtration material and related products for the medical, biomedical, and laboratory industries [Ref. 97, pp. 2, 3]. Site operations were conducted in four on-site buildings, including the main manufacturing building at 600 South Wagner Road, the medical devices division manufacturing building at 674 South Wagner Road, the warehouse at 666 South Wagner Road, and the chemical storage building at 642 South Wagner Road [Ref. 97, pp. 2, 3]. In February 1997, Pall Acquisitions, Inc. (Pall), acquired Gelman and the facility was known as Pall/Gelman Sciences, Inc. until 2001, when the company changed its name to Pall Life Sciences (all operating companies of the facility are hereinafter collectively referred to as Gelman) [Ref. 70, p. 1]. Gelman continued operations until 2013 when manufacturing ceased [Ref. 58, p. 5].

On October 15, 2015, Gelman sold 26.67 acres of its property located at 666 South Wagner Road to 242 Community Church for worship services and a community center [Ref. 98, pp. 5, 23]. In 2015, Gelman also sold the building and associated parcel located at 600 South Wagner Road to 600 South Wagner, LLC for unspecified research and development, warehouse, and general office operations [Ref. 58, p. 5]. The Michigan Innovation Headquarters, a shared office space, is currently located at the 600 South Wagner Road building, which is owned by 600 South Wagner, LLC [Ref. 28, p. 22].

Previous Gelman manufacturing operations included the use of leaching tanks and coating lines to apply and wash various solvents onto filters [Ref. 58, p. 6]. A variety of organic solvents were handled at the facility, including 1,4-dioxane, tetrahydrofuran, acetone, perchloroethylene (PCE), and methylene chloride [Ref. 97, pp. 8, 9]. Between 1966 and May 1986, 1,4-dioxane was used for cellulose triacetate filter production and cleaning process lines [Ref. 28, p. 1]. Tetrahydrofuran and acetone were used after May 1986, when 1,4-dioxane use was discontinued [Ref. 28, p. 2]. A 1984 process wastewater effluent sample contained 1,4-dioxane at a concentration of 1,600 parts per million (ppm) [Ref. 59, p. 3].

Waste Management Operations

Process wastewater, which included 1,4-dioxane, tetrahydrofuran, and acetone, was managed at the facility in ponds (i.e., surface impoundments) throughout Gelman's operational history, by spray irrigation beginning with a 1976 pilot test and a 1977 permit, and in a deep underground injection well beginning in 1981 [Refs. 6, pp. 6, 7; 28, pp. 1, 2; 31, p. 1; 45, pp. 7, 26–27; 69, p. 1; 93, pp. 1–3; 94, pp. 2, 23, 24, 26-27, 34–36]. Additional process wastes, including membrane filters, cellulose acetate solutions, miscellaneous research solutions, and waste solvent, were managed in a facility burn pit [Refs. 23. p. 1; 24, p.1; 25, p. 1]. In 1969, the estimated volume of process wastewater discharged to the unlined Former Ponds 1 and 2 was 50,000 gallons per day [Refs. 6, p. 6; 30, p. 1; 72, p. 1]. Pond 3 was used for the aeration of process wastewater beginning in 1973 [Refs. 6, p. 7; 20, p. 1]. From 1977 to 1981, Pond 3 received approximately 27.8 million gallons of wastewater [Ref. 60, p. 1]. After 1981, Pond 3 received process wastewater overflow not disposed of by underground injection well (see below) [Refs. 6, p. 7; 20, p. 6]. Pond 3 was lined on the sides only and the bottom consisted of compacted clay until at least November 1984 [Ref. 19, p. 1]. Sometime after that, Pond 3 was converted into two fully-lined ponds (i.e., Red Pond and Green Pond) [Ref. 6, pp. 7, 48, 49]. The Red Pond half of Pond 3 remains in use at the site, receiving groundwater extraction system water for storage prior to treatment [Ref. 6, p. 48]. In 1981, 1,4-dioxane (0.09 milligram per liter [mg/L]), tetrahydrofuran (0.01 mg/L), and acetone (0.05 µg/L) were detected in Pond 3 water [Ref. 93, pp. 1–3]. In 1984, 1,4-dioxane was detected in Pond 3 water at a concentration of 21 mg/L [Ref. 59, pp. 3, 6].

Regulatory Actions

On February 19, 1969, the MWRC conducted an inspection at the facility and noted that Pond 2 was discharging to the wetland area and small tributary adjacent to the northwest corner of the developed portion of the facility [Ref. 61, p. 1]. The effluent flow was estimated at 20 gallons per minute and the effluent was blackish or dark gray in color and exhibited a septic odor [Ref. 61, p. 1]. This discharge was noted as being in violation of an existing Order of Determination against Gelman forbidding discharge to waters of the state [Ref. 61, p. 1].

On May 27, 1977, Gelman received a discharge permit from the MWRC to discharge up to 44,000 gallons per day of process wastewater and non-contact cooling water to the ground and groundwater by spray irrigation [Ref. 37, pp. 1–3]. In 1977, Gelman violated the terms of its discharge permit by allowing surface runoff from the spray irrigation field to discharge at the west property boundary [Ref. 38, p. 1]. In 1984, it was documented that the spray irrigation discharge contained 1,4-dioxane [Ref. 68, p. 33].

Beginning in 1981, Gelman began using deep well injection for disposal of untreated facility wastewater as a periodic alternative to the spray irrigation [Ref. 39, p. 1; 68, p. 2, 24]. Between October 1983 and October 1984, about 9 million gallons of process wastewater was disposed of in the underground injection well and 2.6 million gallons was disposed of by spray irrigation [Ref. 60, p. 51]. The injection zone of this deep well (Stofer – Marshall No. 1) is 5,460 to 5,794 feet below ground surface (bgs) in sandstone bedrock [Refs. 68, pp. 24; 69, p. 1]. This discharge depth is significantly below the depth of the unconsolidated glacial strata aquifer scored as part of HRS evaluation; the maximum thickness of the glacial deposits in the site area is more than 300 feet [Refs. 69, p. 1; 82, pp. 8, 9; 84, pp. 8–12].

In May 1986, EPA Region 5 performed an assessment of the Gelman site that included the collection of soil and water-supply well samples [Ref. 94, p. 24]. EPA collected a grab soil sample from the spray irrigation field and groundwater samples from two commercial water-supply wells located to the north of the Gelman facility [Ref. 94, p. 24]. Laboratory analyses showed the presence of 1,4-dioxane at a concentration of 1,620 ppm in the soil sample, and at concentrations of 228 ppm and 183 ppm in the two water-supply wells to the north [Ref. 94, pp. 24, 54]. Additional samples were collected and split by EPA's Environmental Response Team (ERT) and Gelman [Ref. 94, p. 24]. The sampling included collection of soil samples from the spray irrigation field, sludge samples from Pond 2 ("the old lagoon"), and groundwater samples from on-site monitoring wells [Ref. 94, pp. 24, 27]. Groundwater sample results indicated the presence of 1,4-dioxane in the A, C, and E aquifer units as they were defined at the time [see **Section 3.0.1** of this HRS documentation record; Ref. 94, pp. 24, 25, 63–65]. A maximum concentration of 220,000 µg/L was detected in the Gelman split sample collected from aquifer Unit C [Ref. 94, pp. 20, 24, 25, 54, 64]. Analyses of the soil samples from the spray irrigation field showed the presence of 1,4-dioxane at a maximum concentration of 27 parts per billion (ppb) [Ref. 94, pp. 24, 26, 27]. Concentrations of 1,4-dioxane in Pond 2 sludge were 390 ppb (depth: 3 to 10 inches below sludge surface [bss]) and 270 ppb (depth: 18 inches bss) [Ref. 94, pp. 24, 26]. In 1988, MDEQ conducted soil boring and sampling activities in the facility source areas; 1,4-dioxane was detected at concentrations of 7,500 micrograms per kilogram (µg/kg) and 2,300 µg/kg in the area of Former Ponds 1 and 2, respectively [Ref. 32, pp. 5, 7, 14, 15]. In the former burn pit area, 1,4-dioxane was detected up to 220,000 µg/kg [Ref. 32, pp. 6, 9].

On July 13, 1986, Gelman discharged an estimated 18,000 gallons of process water from a surface impoundment onto the ground near the north property line [Ref. 66, p. 1]. MDNR indicated that this discharge was a violation of Gelman's groundwater discharge permit (Permit No. M00337) [Ref. 66, p. 1].

As of 1986, 30 domestic and commercial water-supply wells in the vicinity of the Gelman facility were identified as being contaminated with 1,4-dioxane at concentrations greater than 1 µg/L [Ref. 94, pp. 8, 10–15, 17, 18]. The samples were analyzed by Michigan Department of Public Health (MDPH) and Gelman-subcontracted laboratories [Ref. 94, p. 9]. The contamination was detected primarily north of Gelman, extending to Jackson Avenue north of the facility, to Nancy Drive northwest of the facility, and to the Westover neighborhood northeast of the facility [Ref. 94, pp. 10–15, 17, 18]. Water-supply wells contaminated with 1,4-dioxane were also identified southeast of Gelman along South Wagner Road [Ref. 94, pp. 15, 17, 18]. The highest concentration (180 mg/L) was detected just north of Gelman at 300 Jackson Plaza [Ref. 94, pp. 11, 17, 18]. Gelman provided bottled water to a number of area residents and businesses where wells had become contaminated and paid for the extension of municipal water supplies for these areas [Ref. 72, p. 2].

In 1992, Gelman, Michigan Natural Resources Commission (MNRC), MWRC, and Michigan Department of Natural Resources (MDNR) entered into a consent judgement requiring Gelman to conduct groundwater remediation, including design, installation, operation, and maintenance of groundwater pump-and-treat systems, and to conduct a soil investigation and subsequent remediation [Ref. 74, pp. 1–63]. The consent judgment divided groundwater remediation areas into three separate systems with specific requirements for each. The objective of the Core Area groundwater extraction system (aquifer Unit C_3), located north of the site in the vicinity of Jackson Plaza where portions of the aquifer Unit C_3 contained 1,4-dioxane concentrations exceeding 500 µg/L, was to: a) intercept and contain the migration of groundwater from the Core Area; b) remove contaminated groundwater from the Core Area until termination criterion for the Core System was satisfied; and c) prevent the discharge of contaminated groundwater into the Honey Creek Tributary at concentrations in excess of 100 µg/L or in excess of a concentration which would cause groundwater contamination at any location along or adjacent to the entire length of Honey Creek or the Honey Creek Tributary [Refs. 70, p. 4; 74, p. 11]. The objective of the Evergreen Subdivision Area groundwater extraction system (aquifer Unit D_2), located northeast of the site, was to: a) intercept and control the leading edge of the plume of 1,4-dioxane groundwater contamination; b) remove the contaminated groundwater from the affected aquifer unit; and c) remove all groundwater contaminants from the affected aquifer unit or upgradient aquifers units within the site that is not otherwise removed by the Core Area system [Refs. 70, p. 5; 74, pp. . 4, 6, 7]. The objective of the Western Plume groundwater extraction system (aquifer Unit D_0), located outside the Core Area and west, northwest, and southwest of the Core Area, was to: a) contain downgradient migration of any plume(s) of groundwater contamination emanating from the Gelman property that are located outside the Core Area and to the northwest, west, or southwest of the Gelman facility; b) remove groundwater contaminants from the affected aquifer unit(s); and c) remove all groundwater contaminants from the affected aquifer unit or upgradient aquifer units within the site that are not otherwise removed by the Core Area system [Refs. 70, p. 6; 74, p. 15].

The consent judgement also required Gelman to address soil contamination at the facility by: a) preventing the migration of 1,4-dioxane from contaminated soils into any aquifer at concentrations that cause groundwater contamination; b) preventing discharge of groundwater into Honey Creek Tributary; and c) preventing discharge of groundwater contamination to Third Sister Lake [Ref. 74, p. 24]. The consent judgment divided the site into three separate systems: a) the Marshy Area System north of Former Ponds 1 and 2; b) the Spray Irrigation Field System; and c) the Soil System for remediation of additional identified source areas (burn pit, Former Ponds 1 and 2, Pond 3, and former Lift Station area) [Ref. 70, pp. 8, 9; 74, pp. 24, 26, 29]. Subsequent amendments to the consent judgement and court opinions revised state benchmarks for 1,4-dioxane contamination of groundwater and soil, and required installation and operation of additional extraction wells and monitoring wells (1996 and 2000); changes to treatment infrastructure and methods (1999 and 2000); remediation of the Unit E aquifer unit (2004); establishment of the Prohibition Zone (an area within City of Ann Arbor, Ann Arbor Township, and Scio Townships where use of groundwater is restricted), identification of drinking water wells within the zone, providing access to municipal water supply, and abandonment and replacement of existing drinking water wells (2005); and modifications to remedial objectives (2011) [Ref. 75, pp. 1–11; 76, pp. 1–4; 77, pp. 4, 5; 78, pp. 7–14; 79, pp. 1–6; 80, pp. 4–28; 81, p. 4; 84, p. 6].

On April 2, 2001, the City of Ann Arbor announced that use of its Montgomery Well was discontinued pending further investigation into 1,4-dioxane contamination [Ref. 86, pp. 1–3]. Subsequent samples collected from the Montgomery Well in April 2001 and December 2001 also indicated detections of 1,4-dioxane at a concentration of 2 µg/L [Ref. 86, p. 3]. The background well (i.e., Steere Farm [SF # 25W]) did not have detectable concentrations of 1,4-dioxane [Ref. 86, p. 3]. Both Montgomery and Steere Farms wells are screened in the aquifer being evaluated (i.e., the glacial aquifer system; see **Section 3.0.1** of this HRS documentation record) [Ref. 84, p. 11, 12, 14]. According to the City of Ann Arbor, the Montgomery Well was closed because of the 1,4-dioxane contamination from the Gelman facility, and the well remains closed [Ref. 78, p. 10; 84, p. 5; 123, pp. 1–20]. In 2006, Gelman acknowledged that they were not aware of any other source of 1,4-dioxane in the Unit E aquifer unit within the Prohibition Zone or in the vicinity of the Northwest Supply Well (i.e., Montgomery Well) [Ref. 88, p. 2]. As historical analytical data from March and December 2001 show concentrations of 1,4-dioxane in the Montgomery Well significantly above background levels in the Steere Farm Well and as the Montgomery Well was closed specifically because of site-related contamination, the population at the time of closure in 2001 (3,712.8750) is scored based on actual contamination [see **Sections 3.1.1 and 3.3** of this HRS documentation record].

EPA 2022 Site Inspection (SI) Sampling

In order to address data gaps related to historical source characterization at Gelman, EPA conducted Site Inspection (SI) sampling activities at and in the vicinity of the Gelman facility from September 26 through October 7, 2022 [Ref. 17, pp. 1–34]. EPA collected mostly subsurface soil samples from the areas of Former Ponds 1 and 2, the burn pit, and spray irrigation field [Ref. 119, p. 68]. One liquid waste sample (G-SWSS-01) was collected from Pond 3 [Ref. 119, pp. 70, 100]. Analysis of the waste sample from Pond 3 showed the presence of 1,4-dioxane, arsenic, and manganese [Ref. 119, pp. 208, 210]. Analysis of subsurface soil samples in the area of Former Pond 2 showed the presence of polycyclic aromatic hydrocarbons (PAH) [Ref. 119, pp. 68, 188]. PAHs are likely components of fill material used to backfill the former surface impoundments [Ref. 28, p. 6]. Benzene was detected in a subsurface soil sample collected from the former burn pit [Ref. 119, pp. 68, 192]. Subsurface soil samples from the spray irrigation field showed the presence of acetone. The two sources under consideration are the Historical Pond 3 surface impoundment (Source 1); and Former Ponds 1 and 2 (combined surface impoundment) (Source 2 [see **Section 2.2, Sources 1-2** of this HRS documentation record]. The spray irrigation field is considered another possible source at the site.

Although the release of 1,4-dioxane from site sources to the glacial aquifer system is well-documented by the information presented above, EPA also collected groundwater samples from the study area monitoring wells, as well as residential, commercial, and public water-supply wells, in order to obtain recent, validated, Contract Laboratory Program (CLP)-quality groundwater data to confirm the release [see **Sections 3.1.1 and 3.3** of this HRS documentation record]. 1,4-Dioxane was detected at observed release concentrations in eight monitoring wells screened in the C_3, D_2, or E aquifers units [see **Section 3.1.1** of this HRS documentation record]. The sampling also showed that 1,4-dioxane persists in the Montgomery Well at a detectable level [see **Section 3.1.1** of this HRS documentation record]. Groundwater sample results documenting the observed release are presented on **Figure 3**. 1,4-Dioxane was detected in four residential wells along Elizabeth Road; however, the results for background residential well samples collected along Lakeview Avenue were rejected as unusable during data validation [Ref. 90, pp. 1–5, 7, 9, 10–13, 15, 25; 91, pp. 9, 13, 14, 16, 35, 37–41, 43]. Therefore, these wells are not included in the observed release or actual contamination evaluations.

EPA 2023 Supplemental Sampling

From September 11 through 15 and 17, 2023, EPA resampled most of the monitoring and water-supply wells sampled during the 2022 SI; two additional monitoring wells (MW-51 and MW-53i) were also sampled to obtain data from Unit D_0 [Refs. 17, pp. 2-13; 105, pp. 6-20; 106, p. 4; 107, p. 4; see **Section 3.1.1** of this HRS documentation record]. Three of the monitoring wells (MW-1 Replacement, NMW-2d and MW-4d) sampled in 2022 were not resampled [Ref. 105, pp. 6-20; 119, pp. 22, 23, 34-36, 50]. The objective of the sampling was to provide validated analytical data to supplement the rejected results from 2022, and to achieve a lower detection limit utilizing EPA Method 522 [see **Section 3.1.1** of this HRS documentation record; Refs. 47, pp. 1-12, 22, 25, 28; 105, pp. 6-20; 108, pp. 2, 46, 47, 48, 49; 109, pp. 2, 3, 54, 55, 64, 65; 110, pp. 2, 3, 11, 49, 50, 51, 52, 55; 111, pp. 2, 36, 37.] 1,4-Dioxane was detected at observed release concentrations in six monitoring wells, and an observation well near the closed Montgomery Well (2.8 µg/L), and four residential wells along Elizabeth Road [see **Tables 12 through 14** in **Section 3.1.1** of this HRS documentation record]. Groundwater sample results documenting the observed release are presented on **Figure 4**.

Michigan Department of Environment 2023 Sampling

In June 2023, Michigan Department of Environment, Great Lakes, and Energy (EGLE) and Washtenaw County Health Department's Scio Township collected groundwater samples from residential water-supply wells [Ref. 8, p. 1]. Samples were analyzed for 1,4-dioxane by Michigan EGLE Drinking Water Laboratory using EPA Method 8260 [Ref. 8, pp. 1-21]. Observed release concentrations range from 0.5 µg/L to 1.9 µg/L **[see section 3.1.1** of this HRS documentation record; Ref. 8, pp. 12, 13].

Aquifer of Concern

Regional geology is characterized by glacial deposits (lakebeds, outwash, deltas, and moraines) that range in total thickness from about 50 feet to about 450 feet [Ref. 125, pp. 2, 4]. Moraines (clay, silt, sand, and gravel mixtures) and outwash (principally sand and gravel) predominate in most of the county, including Ann Arbor and Scio Township [Refs. 84, p. 6; 125, p. 4; 126, p. 21]. Within the 4-mile target distance limit (TDL) for the Gelman site, the glacial deposits range in total thickness from approximately 175 to more than 300 feet, and consist of discontinuous layers and lenses of gravel, sand, silty or clayey sand, silt, and clay [Refs. 82, pp. 8, 9; 84, pp. 8–12; 127, pp. 24, 44; see **Figure 5** of this HRS documentation record]. Underlying the glacial deposits are sedimentary rocks (i.e., shale and sandstone) of Mississippian and Devonian age [Refs. 84, pp. 8–11; 125, pp. 2, 4].

The aquifer being evaluated consists of a series of glacial depositional units (identified on behalf of Gelman as Units B, C, D, and E in descending order) that have been identified at and in the vicinity of the Gelman facility. A separate Unit A overlying Unit B was identified during the 1986 interim hydrogeologic investigation; however, the unit was eliminated as a stratigraphic unit and combined with Units B and C [Ref. 44, p. 61]. Units C and D have been further divided into subunits, including C_1, C_2, C_3, D_0, D_1, D_2, and D_3 [see **Section 3.0.1** of this HRS documentation record]. A multi-phase hydrogeologic investigation performed on behalf of Gelman identified Unit C_1, C_3, Unit D_0, Unit D_2, and Unit E as aquifer units, while Units B, C_2, D_1, and D_3 were identified as aquitards (i.e., leaky confining beds) [see **Section 3.0.1** of this HRS documentation record]. Interconnection between all the glacial deposits has been established based on the potential downward migration of groundwater through the various units characterized as aquitards and the presence of 1,4-dioxane throughout the glacial sequence; therefore, all depositional units identified as aquifers are evaluated as one hydrologic unit (i.e., the aquifer of concern; hereafter referred to as the "glacial aquifer system") for HRS scoring purposes [see **Section 3.0.1** of this HRS documentation record]. All domestic wells within 4 miles of the site withdraw water from the glacial aquifer system as groundwater contained in the underlying shale is of poor quality and no water-supply wells are known to be completed in bedrock in the vicinity of the site [Refs. 43, p. 14; 44, p. 18].

The complexity of the groundwater flow regime in the glacial aquifer system indicates why the 1,4-dioxane contamination is dispersing in directions other than the apparent primary northeastward groundwater flow direction [Refs. 43, pp. 16, 23, 24; 44, pp. 22, 23, 25, 67, 70]. Groundwater flow in Unit C_1 is northward across the Gelman facility and westward in the vicinity of Jackson Road [Ref. 43, p. 16]. Groundwater in the Unit C_3 aquifer unit beneath the Gelman facility flows in directions ranging from northeast to west; flow is north-northwest in the remainder of the study area [Ref. 44, pp. 22, 23, 67]. Groundwater in Unit D_2 flows northeast and northwest in a U-shaped trough which trends southwest to northeast [Ref. 44, pp. 25, 70]. Unit E groundwater flow is to the northeast [Ref. 43, pp. 23, 24].

Gelman continues to sample monitoring wells throughout the study area on a monthly, quarterly, semi-annual, and annual basis [Refs. 11, p. 1; 12, p. 1; 96, pp. 1, 2]. The monitoring wells have been installed for the specific purpose of monitoring and evaluating the 1,4-dioxane contamination in groundwater [Refs. 11, p. 1; 12, p. 1; 96, p. 1]. The monitoring wells are screened throughout the glacial aquifer system [Refs. 11, pp. 4–6; 12, pp. 4–6]. The latest data posted by Michigan Department of Environment, Great Lakes, and Energy (EGLE) (May and June 2023) shows 1,4-dioxane is still present throughout the aquifer of concern [Ref. 11, pp. 4–6; 12, pp. 4–6]. According to information released by Washtenaw County Health Department (WCHD), analysis of drinking water well samples collected between July 2021 and July 2023 show the 1,4-dioxane contamination continues to migrate northeastward toward Huron River [Ref. 102, pp. 1, 4]. A 4-Mile Radius Map is presented as **Figure 5**.

2.2 SOURCE CHARACTERIZATION

Number of the source: 1

Source Type of the source: Surface Impoundment

Name and description of the source: Historical Pond 3

Source 1 consists of a surface impoundment used for the aeration of process wastewater beginning in 1973 [Refs. 6, p. 7; 20, p. 1]. From 1977 to 1981, Pond 3 received approximately 27.8 million gallons of wastewater [Ref. 60, p. 1]. After 1981, Pond 3 received process wastewater overflow not disposed of by underground injection well [Refs. 6, p. 7; 20, p. 6]. Pond 3 was lined on the sides only and the bottom consisted of compacted clay until at least November 1984 [Ref. 19, p. 1]. Sometime after that, Pond 3 was converted into two fully-lined ponds (i.e., Red Pond and Green Pond) [Ref. 6, pp. 7, 48, 49]. Activated sludge for the pond was obtained and added periodically [Ref. 20, p. 1]. Historical Pond 3 had a capacity of 3 million gallons (14,853 cubic yards [yd^3]) [Ref. 28, p. 3]. According to analytical data cited by MDOH in 1981, a wastewater sample collected from Pond 3 in May 1981 indicated the presence of 1,4-dioxane (0.09 mg/L), tetrahydrofuran (0.01 mg/L), and acetone (0.05 µg/L) [Ref. 93, pp. 1–3]. A sample from Pond 3 collected by Gelman in 1984 indicated the presence of 1,4-dioxane at a concentration of 21 mg/L [Ref. 59, pp. 3, 6]. Currently, Pond 3 is divided into two separate ponds, known as Red Pond and Green Pond [Ref. 6, pp. 7, 48, 49]. Red Pond receives Gelman's groundwater extraction system water prior to treatment [Ref. 6, p. 48]. Green Pond is currently unused [Ref. 6, p. 49].

Location of the source, with reference to a map of the site:

Pond 3 is located in the northwestern corner of the developed portion of the facility. The location is depicted on **Figure 2** of this HRS documentation record.

Containment

Release to ground water:

In 1979, during a response to neighborhood complaints regarding foam from Pond 3 being picked up by wind and blown across the area, Gelman noted that Pond 3 was their primary treatment facility for storage and aeration of membrane manufacture wastewater and that the impoundment liner was torn vertically [Ref. 67, p. 1–3]. Prior to 1984, the liner within Pond 3 was incomplete. The surface impoundment was lined on the sides only, and the bottom consisted of compacted clay [Ref. 19, p. 1]. Based on a lack of complete containment measures (e.g., a liner), a containment factor of 10 is assigned [Ref. 1, Table 3-2].

TABLE 1. SOURCE 1 CONTAINMENT

Containment Description	Containment Factor Value	References
Gas release to air:	NS	
Particulate release to air:	NS	
Release to ground water: Prior to 1984, the liner within Pond 3 was incomplete. The surface impoundment was lined on the sides only, and the bottom consisted of compacted clay. At times, the side liner became torn as documented in 1979.	10	Refs. 1, Table 3-2; 19, p. 1; 67, pp. 1–3

TABLE 1. SOURCE 1 CONTAINMENT		
Containment Description	**Containment Factor Value**	**References**
Release via overland migration and/or flood:	NS	

2.4.1 Hazardous Substances

As discussed above, analytical data cited by MDOH in 1981 indicated that a wastewater sample collected from Pond 3 in May 1981 showed the presence of 1,4-dioxane (0.09 mg/L), tetrahydrofuran (0.01 mg/L), and acetone (0.05 µg/L) [Ref. 93, pp. 1–3]. A sample from Pond 3 collected by Gelman in 1984 indicated the presence of 1,4-dioxane at a concentration of 21 mg/L [Ref. 59, pp. 3, 6]. The data for the historical samples discussed above are being considered for source documentation. These samples are waste samples; therefore, a comparison to background is not applicable.

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Tier A – Hazardous Constituent Quantity

The hazardous constituent quantity for Source 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, Section 2.4.2.1.1]. There are insufficient historical and current data [manifests, potentially responsible party (PRP) records, State records, permits, waste concentration data, etc.] available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source 1 with reasonable confidence. As a result, the evaluation of hazardous waste quantity proceeds to the evaluation of *Tier B*, Hazardous Wastestream Quantity [Ref 1, Section 2.4.2.1.1].

Hazardous Constituent Quantity (C) Value: NS

2.4.2.1.2 Tier B – Hazardous Wastestream Quantity

The hazardous wastestream quantity for Source 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all hazardous wastestreams plus the mass of any additional CERCLA pollutants and contaminants in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, Section 2.4.2.1.2]. There are insufficient historical and current data (manifests, PRP records, State records, permits, waste concentration data, etc.) available to adequately calculate the total mass or partial mass of the hazardous wastestreams plus the mass of all CERCLA pollutants and contaminants in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous wastestream quantity for Source 1 with reasonable confidence. Scoring proceeds to the evaluation of *Tier C*, Volume [Ref. 1, Section 2.4.2.1.2].

Hazardous Wastestream Quantity (W) Value: NS

2.4.2.1.3 Tier C - Volume

Sampling and analytical results show that Source 1 was contaminated with 1,4-dioxane prior to November 1984 when a new, complete liner was proposed [Ref. 19, p. 1; 59, p. 6; 93, pp. 1–3. The pond had a capacity of 3 million gallons (14,853 yd^3) [Ref. 28, p. 3]. The source type is “Surface Impoundment”. In accordance with Table 2-5 of the HRS, a volume (Tier C) quantity value of 5,941.2 is assigned (i.e., 14,853 / 2.5) [Ref. 1, Section 2.4.2.1.3].

Volume (V) Assigned Value = 14,853 yd^3
Volume (V) Assigned Value: 14,853/2.5 = 5,941.2

2.4.2.1.4 Tier D - Area

As the volume of Source 1 can be determined, an area measure value of 0 is assigned [Ref. 1, Section 2.4.2.1.3].

Area (A) Value: 0

2.4.2.1.5 Source Hazardous Waste Quantity Value

The source hazardous waste quantity value for Source 1 is 46,370.4 for Tier C – Volume [Ref. 1, Section 2.4.2.1.2].

Source Hazardous Waste Quantity Value: 5,941.2

2.2 SOURCE CHARACTERIZATION

Number of the source: 2

Source Type of the source: Surface Impoundments (buried and backfilled)

Name and description of the source: Former Ponds 1 and 2

Source 2 consists of former unlined surface impoundments (Pond 1 and Pond 2) that were used for storage and disposal of Gelman's process wastewater in the 1960s and 1970s [Refs. 6, pp. 6-7; 10, pp. 13, 14; 94, pp. 2, 36]. These former surface impoundments, also referred to in historical documents as "Sludge Pond # 1" and "Sludge Pond # 2", "first lagoon" and "second lagoon", or "existing lagoon" and "secondary lagoon", were located in the northwestern portion of the developed part the Gelman facility [Refs. 10, pp. 13, 14; 31, p. 1; 61, p. 1; 62, p. 1; **Figure 2** of this HRS documentation record]. As shown in this section and in **Section 2.4.1** below, Former Ponds 1and 2 can be classified as the same source type (i.e., surface impoundment [buried/backfilled]) with the same containment for the ground water migration pathway (i.e., no liner). The ponds received the same waste material and contained the same hazardous substance available to the pathway (i.e., 1, 4-dioxane), and, as shown in **Section 3.0**, they overlie the same aquifer (i.e., the glacial aquifer system) and affect the same target populations for the pathway. Based on these considerations, Former Ponds 1 and 2 are aggregated and considered as one discrete source (i.e., Source 2) for evaluation of the ground water migration pathway.

In 1965, MWRC issued an Order of Determination that allowed Gelman to discharge 9,000 gallons per day of process wastewater to the ground [Ref. 94, p. 2]. Gelman initially constructed Pond 1 to fulfill the Order and added Pond 2 in 1968 [Refs. 6, p. 6; 61, p. 1; 94, p. 2]. MWRC reported in February 1969 that "the plant has installed an aeration apparatus in their existing lagoon and excavated a secondary lagoon to receive the aerated waste" [Ref. 61, p. 1]. During an October 1969 inspection, MDNR observed that the aeration apparatus in Pond 1 was not operating [Ref. 62, p. 1]. Gelman later described these surface impoundments as "an unlined anaerobic digestion pond" and "an unlined settling pond" [Ref. 94, p. 36].

Gelman has reported that its process wastewater was discharged to Ponds 1 and 2 and allowed to seep into the ground from 1965 through 1972; the process wastewater contained 1,4-dioxane beginning in 1968 [Ref. 94, pp. 2, 36]. In 1969, the estimated volume of process wastewater discharged to Ponds 1 and 2 was 50,000 gallons per day [Refs. 6, pp. 6, 7; 30 p. 1]. The company has also reported that it performed periodic dredging of the ponds to promote percolation of the wastewater into the ground [Ref. 94, p. 36].

In 1969, Gelman reported discharging 50,000 gallons per day of wastewater into Ponds 1 and 2, most of which (35,000 to 42,000 gallons per day) was disposed through seepage from the lagoons into the ground; the remaining 8,000 to 15,000 gallons per day were overflowing Pond 2 into the Honey Creek tributary at that time [Ref. 30, p. 1]. During an investigation at the Gelman facility on February 19, 1969, MWRC observed dark-gray wastewater with a septic odor discharging at a rate of 20 gallons per minute from Pond 2, through the overflow pipe (a corrugated metal pipe installed by Gelman), and into the wetland area contiguous to the Honey Creek tributary at the northwestern corner of the developed portion of the facility [Refs. 61, p. 1; 94, p. 2]. MWRC noted that this direct discharge to waters of the state was a violation of the existing Order of Determination against Gelman [Ref. 61, p. 1]. On October 10, 1969, MDNR conducted an inspection to investigate a complaint that Gelman's ponds were emitting a "noxious odor" and overflowing onto the adjacent industrial park area [Ref. 62, pp. 1–2]. MDNR confirmed the odor and confirmed that Pond 2 was overflowing at an estimated rate of 10 gallons per minute onto the adjacent industrial park area [Ref. 62, p. 1]. Sample analysis of the discharge showed wastewater of poor quality, including 1,032 mg/L of total volatile solids and 46 mg/L of chloroform extractables [Ref. 62, p. 1].

Ponds 1 and 2 continued to receive wastewater at least periodically after Gelman installed its partially-lined surface impoundment (Pond 3) in 1973 [Refs. 60, pp. 2, 4, 5, 6, 10; 94, p. 2]. Both ponds were included on a plot plan of the facility drawn in February 1976 and revised in April 1977 [Ref. 31, p. 1]. In November 1976, Gelman reported that Pond 2 was serving as an overflow pond [Ref. 60, p. 2]. In April 1977, Gelman indicated that storage space was needed for 35,000 to 40,000 gallons of process wastewater per day that would be generated during the non-growing season when spray irrigation was not permitted (i.e., the months of November through March) [Ref. 60, p. 4]. In May 1977, Gelman reported adding more than 1 million gallons of wastewater to "the ponds" and estimated that the pond water would be disposed of via spray irrigation within about 60 days [Ref. 60, p. 5]. In June 1978, Gelman reported to MWRC that they were holding Ponds 1 and 2 empty for emergency use or for repair of Pond 3; however, Gelman reported to MWRC three months later, in September 1978, that wastewaters were being stored in Pond 2 for later treatment [Ref. 60, pp. 6, 10]. It was not until November 1984 that Gelman reported to MDNR they had blocked off the emergency overflow pipe from Pond 3 to Pond 2, eliminating the route for partially treated wastewater to enter Pond 2; the company also reported that Pond 1 was never connected to the overflow [Ref. 19, p. 2].

An aerial photograph from Spring 1999 shows that Former Ponds 1 and 2 had both been backfilled by that time [Refs. 6, p. 36; 10, pp. 13, 14; 124, p. 4; see **Figure 2** of this HRS documentation record]; however, the exact dates and depths of backfilling are unknown. In May 1986, EPA observed that Pond 1 had been backfilled and that a chemical shed had been built on top of it, and that Pond 2 contained "very dark, sludgy waste with an algal-like scum near the periphery of the pond" [Ref. 94, pp. 2, 20, 23]. In May 1988, MDEQ completed soil borings DNR 88-8 and DNR 88-9 inside the boundary of the backfilled Pond 1 [Ref. 32, p. 5]. The material at 9.5 to 11 feet bgs in soil boring DNR 88-8 exhibited a dark, bluish-gray color unlike other soils at the site, and dark blue-gray clayey material with "an organic smell" was encountered at approximately 11 feet bgs in soil boring DNR 88-9 [Ref. 32, p. 5]. Sampling results for the Former Pond 1 soil borings indicate the presence of 1,4-dioxane in the discolored material and in the soils beneath it down to approximately 14 to 16 feet [Ref. 32, pp. 5, 14]. The color change and observed odor, as well as rising 1,4-dioxane concentrations at and beneath the discolored material, indicate that Former Pond 1 was backfilled with approximately 9.5 to 11 feet of soil [Ref. 32, pp. 5, 14]. Former Pond 2 had a depth of approximately 15 feet, but it had not yet been backfilled during the 1988 investigation, when MDEQ observed water in Pond 2 and sampling results indicated that high levels of 1,4-dioxane were present in the Pond 2 soil at depths of 0 to 1.5 feet [Refs. 6, p. 18; 32, pp. 7, 15; 43, p. 41]. Based on this available information, Former Pond 1 was backfilled with 9.5 to 11 feet of soil sometime between 1978 and 1986, and Former Pond 2 was backfilled with approximately 15 feet of soil sometime between May 1988 and Spring 1999 [Refs. 6, p. 36; 32, pp. 5, 7, 14, 15; 43, p. 41; 60, pp. 6, 10; 94, pp. 2, 20, 23; 124, p. 4]. In May 2017, EPA observed that the locations of Former Ponds 1 and 2 were grass-covered and did not exhibit evidence of the former ponds [Ref. 6, pp. 17–18, 44].

Location of the source, with reference to a map of the site:

Source 2 (Former Ponds 1 and 2) is located in the northwestern portion of the developed part of the Gelman facility [Refs. 31, p. 1; 62, p. 1]. The location is depicted in **Figure 2**.

Containment

Release to ground water:

Former Ponds 1 and 2 were unlined surface impoundments designed to allow wastewater to seep into the ground, and the ponds were periodically dredged to promote this percolation [Refs. 6, p. 6; 94, pp. 2, 36]. In 1986, Gelman identified the former unlined ponds as a possible source of groundwater contamination [Ref. 94, pp. 34–36]. According to Gelman's reporting in 1987, Pond 2 was excavated through stratigraphic Units B and C_1 and the bottom of the ponds coincided with the top of Unit C_2 [Ref. 43, p. 41]. In February 1986, Gelman reported that water below the water table and covering the bottom of Pond 2 ("the old unlined lagoon") showed 1,4-dioxane levels of about 5 ppm [Ref. 94, pp. 2, 23, 34–36], indicating that contamination from Source 2 was in direct contact with the glacial aquifer system (i.e., the aquifer being evaluated; see **Section 3.0.1** of this HRS documentation record).

Based on the absence of a liner in Former Ponds 1 and 2, a containment factor of 10 is assigned to Source 2 [Ref. 1, Table 3-2].

TABLE 2. SOURCE 2 CONTAINMENT

Containment Description	Containment Factor Value	References
Gas release to air:	NS	

TABLE 2. SOURCE 2 CONTAINMENT		
Containment Description	**Containment Factor Value**	**References**
Particulate release to air:	NS	
Release to ground water: Former Ponds 1 and 2 were unlined surface impoundments designed to allow wastewater to seep into the ground, and the ponds were periodically dredged to promote this percolation.	10	Refs. 1, Table 3-2; 6, pp. 6, 27; 94, pp. 2, 36
Release via overland migration and/or flood:	NS	

2.4.1 Hazardous Substances

As discussed above, the process wastewater discharged to Ponds 1 and 2 and allowed to seep into the ground contained 1,4-dioxane beginning in 1968 [Ref. 94, pp. 2, 36]. In February 1986, Gelman reported that water covering the bottom of Pond 2 (“the old unlined lagoon”) below the water table showed 1,4-dioxane levels of about 5 ppm [Ref. 94, pp. 2, 23, 34–36]. In May 1986, EPA and Gelman collected and split sludge samples from Pond 2 (“the unlined lagoon”), and concentrations of 1,4-dioxane in the Pond 2 sludge were 390 ppb (sample number: L3S, depth: 3 to 10 inches bss) and 270 ppb (sample number: L1D, depth: 18 inches bss) [Refs. 45, pp. 7, 26–27; 94, pp. 24, 26–27]. In 1988, MDEQ conducted soil boring and sampling activities in facility source areas; 1,4-Dioxane was detected at depths up to 16 feet bgs and at concentrations up to 7,500 µg/kg in the backfilled Former Pond 1, and at depths up to 1.5 feet below the pond sediment surface and at concentrations up to 2,300 µg/kg in Former Pond 2, which was approximately 15 feet deep (Pond 2 was no longer in use at the time, but it had not yet been backfilled at the time of sampling) [Refs. 6, p. 13; 32, pp. 5, 7, 14, 15; 43, p. 41].

During the 1988 MDEQ investigation, soil boring DNR 88-8 was completed in the center of Former Pond 1 and showed 1,4-dioxane concentrations of 34 µg/kg (sample ID: DNR 88-8A, depth: 9.5-11 ft bgs) and 7,500 µg/kg (sample ID: DNR 88-8B, depth: 14.5-16 ft bgs), and soil boring DNR 88-9 was completed within the boundary of Former Pond 1 and about 25 feet east of DNR 88-8, and showed 1,4-dioxane concentrations of 26 µg/kg (sample ID: DNR 88-9A, depth: 9-10.5 ft bgs), 520 µg/kg (sample ID: DNR 88-9B, depth: 11-12 ft bgs), and 5,300 µg/kg (sample ID: DNR 88-9C, depth: 14-15.5 ft bgs) [Ref. 32, pp. 5, 14]. Soil boring DNR 88-12 was a hand boring in Pond 2 about 2 or 3 feet from the water and showed 1,4-dioxane concentrations of 2,300 µg/kg (sample ID: DNR 88-12A, depth: 0.5-1 ft bgs) and 1,500 µg/kg (sample ID: DNR 88-12B, depth: 1-1.5 ft bgs) [Ref. 32, pp. 7, 15].

These samples are waste samples; therefore, a comparison of these sample results to background levels is not applicable.

2.4.2 **Hazardous Waste Quantity**

2.4.2.1.1 Tier A – Hazardous Constituent Quantity

The hazardous constituent quantity for Source 2 could not be adequately determined according to the HRS requirements; that is, the total mass of all Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, Section 2.4.2.1.1]. There are insufficient historical and current data [manifests, potentially responsible party (PRP) records, State records, permits, waste concentration data, etc.] available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source 1 with reasonable confidence. As a result, the evaluation of hazardous waste quantity proceeds to the evaluation of *Tier B*, Hazardous Wastestream Quantity [Ref 1, Section 2.4.2.1.1].

Hazardous Constituent Quantity (C) Value: NS

2.4.2.1.2 Tier B – Hazardous Wastestream Quantity

The process wastewater discharged to Source 2 and allowed to seep into the ground contained 1,4-dioxane, a CERCLA hazardous substance, beginning at an unspecified date in 1968; according to Gelman, the disposal of wastewater to Source 2 ended as the main wastewater disposal method at an unspecified date in 1973, when Gelman built an additional 3 million gallon lagoon (Pond 3) and began using it for wastewater disposal [Refs. 6, pp. 6-7; 21, p. 26; 94, pp. 2, 36]. In 1969, the estimated volume of process wastewater discharged to Ponds 1 and 2 was 50,000 gallons per day [Ref. 6, p. 6; 30, p. 1]. Wastestream data are not available for the other years that these ponds were operational; however, MWRC's 1965 Order of Determination allowed discharge of 9,000 gallons per day of process wastewater to the ground [Ref. 94, p. 2]. In 1976 and 1977, by which time Pond 2 had become the overflow pond, Gelman reported wastewater generation and disposal rates of 29,000 to 70,000 gallons per day [Ref. 60, pp. 2, 4, 5; 94, p. 2]. The company later reported annual wastewater discharge totals of 3.1 to 8.2 million gallons (about 8,493 to 22,465 gallons per day when averaged over 365 days) [Ref. 60, p. 1].

The Source 2 hazardous wastestream volumes for 1968 and 1972 are indeterminate because the available information does not indicate the date in 1968 at which the wastewater discharge to Source 2 began to contain 1,4-dioxane, nor does it specify the date in 1973 when Gelman stopped using Source 2 for daily wastewater discharge (Refs. 6, pp. 6-7; 94, pp. 2, 36). Therefore, the Source 2 hazardous wastestream volume can only be estimated for the years 1969, 1970, and 1971. Based on the minimum annual wastewater discharge of 3.1 million gallons (about 8,493 gallons per day) reported by Gelman, the minimum hazardous wastestream volume discharged through Ponds 1 and 2 is estimated as follows:

(3 years) × (3.1M gallons per year) = 9,300,000 gallons

The wastewater volume is converted to mass (W) as follows:

(9,300,000 gallons) × (2,000 pounds per 200 gallons) = 93,000,000 pounds [Ref. 1, Table 2-5]

The mass (W) is divided by 5,000 to assign the value of 18,600 for hazardous wastestream quantity [Ref. 1, Section 2.4.2.1.2].

Hazardous Wastestream Quantity (W) Value: 18,600

2.4.2.1.3 Tier C - Volume

Tier B, hazardous wastestream quantity is scored; Tier C was not scored.

Volume (V) Value: NS

2.4.2.1.4 Tier D - Area

Tier B, hazardous wastestream quantity is scored; Tier D was not scored.

Area (A) Value: NS

2.4.2.1.5 Source Hazardous Waste Quantity Value

The source hazardous waste quantity value for Source 2 is 18,600 for Tier B – Hazardous Wastestream Quantity [Ref. 1, Section 2.4.2.1.2].

Source Hazardous Waste Quantity Value: 18,600

SITE SUMMARY OF SOURCE DESCRIPTIONS

TABLE 6. HAZARDOUS WASTE QUANTITY AND CONTAINMENT					
Source Number	**Source Hazardous Waste Quantity Value**	**Containment**			
		Ground Water	**Surface Water**	**Air (Gas)**	**Air (Particulate)**
1	5,941.2	10	NS	NS	NS
2	18,600	10	NS	NS	NS

NS = Not Scored

Areas of Concern

Lift Station

The lift station, located near the northwest corner of the main Gelman building located at 600 South Wagner Road, consisted of a cement block enclosure that was used as a pumping station for processing wastewater piped to the on-site treatment areas [Ref. 99, p. 8]. After May 1986, tetrahydrofuran and acetone were part of Gelman's waste stream as they were used for cellulose triacetate filter production and cleaning process lines [Ref. 28, pp. 1, 2]. In February 1987, a crack in the concrete of the lift station tank was detected and reported to the MDNR [Ref. 99, p. 8]. Gelman reportedly removed the cracked lift station and approximately 1,000 yd^3 of surrounding soil for disposal at a landfill as non-hazardous waste [Ref. 99, p. 8]. In addition to 1,4-dioxane, tetrahydrofuran, and acetone, PCE, methylene chloride, and other solvents were handled at the facility [Ref. 97, pp. 8, 9]. Groundwater samples collected from monitoring wells installed downgradient of the Lift Station by MDNR in 1987 indicated the presence of benzene (3.7 µg/L), chloroform (1.5 µg/L), cis-1,2-dichloroethene (DCE) (2.2 µg/L), 1,1-dichloroethane (2.7 µg/L), ethylbenzene (0.5 µg/L), toluene (7.1 µg/L), trans-1,2-DCE (2.2 µg/L), and xylene (0.9 µg/L) [Ref. 44, p. 55].

Drum Storage Area

In 1981, Gelman submitted a Notification of Hazardous Waste Site to EPA identifying F-, P-, and U-listed organic solvent waste, including 1,4-dioxane (U-108), managed in drums, as well as a drum storage area located in the northeast corner of the former Gelman building located at 600 South Wagner Road [Refs. 5, p. 4; 63, pp. 1, 2]. The facility was designated a Small Quantity Generator (SQG) under the Resource Conservation and Recovery Act (RCRA) and assigned Handler ID No. MID005341813 [Ref. 64, p. 2].

Chemical Storage Building

The former chemical storage building was a separate building designed to store chemicals, which was located at 642 South Wagner Road [Ref. 97, p. 3]. According to Gelman, in 1983 the chemical storage building contained the following materials: 2-ethanol; ethylene glycol monomethyl ether; ethylene glycol; acetone; ethyl alcohol; glycerine; methyl acetate; dimethyl formamide; tetrahydrofuran; dioxane; methylpyrrolidone; ethylene oxide; potassium silicate; 2-ethoxyethanol; polyethylene glycol; methyl alcohol; n-propyl alcohol; methylene chloride; azeotrope of Freon; trichloro trifluoroethane; ethylsilicate; and tetrachloroethylene [Ref. 97, pp. 8-9].

Former Burn Pit

In 1968, the MDPH prepared a memorandum detailing observations of thick black smoke rising from an open fire on the Gelman facility resulting from the burning of pigments and solvents [Ref. 22, pp. 1–3]. MDOH investigation revealed that this was a continuing process at the facility [Ref. 22, pp. 1, 3]. In 1979, MDNR responded to the Gelman facility based on complaints from an employee that workers were dumping small amounts of unknown chemicals in a pit near the facility water tower [Ref. 23, pp. 1, 2]. During a follow-up visit, MDNR observed waste material in the pit [Ref. 23, p. 1]. A company official explained that white solids in the pit were cellulose acetate used for making the membrane filters [Ref. 23, p. 1]. MDNR noted that the pit was unlined and also contained fluids and the smell of solvents [Ref. 23, p. 1]. A November 1979 internal Gelman memorandum indicated that in addition to the process waste, "almost any of the usual materials of a research laboratory might be discarded there" [Ref. 25, p. 1]. In a November 1979 letter to MDNR, Gelman acknowledged the disposal practice and indicated that the waste material would be removed to an off-site landfill facility and the pit would be backfilled [Ref. 24, p. 1].

The 1988 MDEQ soil boring and sampling activities indicated the presence of 1,4-dioxane in the former burn pit area up to 220,000 µg/kg [Ref. 32, pp. 6, 9].

Benzene was detected at a significant concentration at a depth of 7 to 8 feet bgs within boring G-SS12 advanced within the Former Burn Pit during the 2022 EPA SI [Refs. 17, p. 28; 35, pp. 1–9, 44, 46, 38, 63, 64; 36, pp. 4, 5, 59, 68, 71]. Benzene is used as precursor to other chemicals in the manufacture of plastics, resins, and dyes, and is a byproduct of combustion [Ref. 26, p. 1]. Process waste including plastic filters, cellulose acetate solutions, miscellaneous research solutions, and waste solvent were burned in this unit [Refs. 22, pp. 1, 2; 24, p. 1; 25, p. 1].

Spray Irrigation Field

The Spray Irrigation Field is a land treatment area used for process wastewater irrigation beginning in 1977 [Ref. 37, pp. 1, 2, 3]. In addition to facility surface impoundments and underground injection well, process waste containing 1,4-dioxane, tetrahydrofuran, and acetone, was managed by irrigation of approximately 490,000 square feet (ft^2) of vegetated portions of the facility [Refs. 28, pp. 1, 2; 42, p. 1]. Between October 1983 and October 1984, approximately 2.6 million gallons of process wastewater was disposed of by spray irrigation [Ref. 60, p. 51]. In September of 1984, it was noted that 1,4-dioxane was present in the spray irrigation discharge [Ref. 68, p. 33]. A variety of organic solvents were handled at the facility, including acetone [Ref. 97, p. 8]. Tetrahydrofuran and acetone were used for cellulose triacetate filter production and cleaning process lines after May 1986, when 1,4-dioxane use was discontinued [Ref. 28, pp. 1, 2]. Use of the spray irrigation field continued until at least November 1986 [Ref. 118, p. 1]

When irrigation activities commenced in 1977, the spray field was characterized as a grassy area overgrown in some places [Ref. 38, p. 1]. In October 2015 Gelman sold 26.67 acres of its property that was formerly part of the main spray irrigation field to 242 Community Church [**Figure 2** of this HRS documentation record; Ref. 98, pp. 5, 23]. The 242 Community Church building was constructed in 2017 [Ref. 28, p. 21]. Currently, the southwestern portion of the main spray irrigation field remains a vegetated field covered with overgrown grasses and scattered trees [**Figure 2** of this HRS documentation record; Refs. 28, p. 15; 119, p. 78]. The northwestern, northeastern, and southeastern portions are covered by manicured grasses and scattered trees [**Figure 2** of this HRS documentation record; Ref. 119, pp. 80, 81, 82, 83]. The remainder of the main spray irrigation field has been developed and is covered by buildings (242 Community Church and 600 South Wagner Road) and their associated parking lots [**Figure 2** of this HRS documentation record; Ref. 28, p. 20]. In September 2022, EPA advanced five soil borings (G-SS05, G-SS06, G-SS07, G-SS08, and G-SS09) within the undeveloped portions of the mapped main spray irrigation field boundary, and one soil boring (G-SS13) within a grass-covered divider within the parking lot [**Figure 2** of this HRS documentation record**;** Refs. 17, pp. 2, 26, 27; 27, pp. 9-18; 119, pp. 78, 79, 80, 82, 83]. Soil types encountered in borings advanced in the spray irrigation field consisted mostly of alternating layers of clay, sand, silt, and clayey sand, with minor amounts of gravel [Ref. 27, pp. 9–18].Acetone is associated with borehole locations G-SS05, G-SS06, G-SS07, G-SS08, and G-SS09, at concentrations ranging from 8.7 µg/kg to 19 µg/kg at depths ranging from 5 to 31 feet bgs [Refs. 17, pp. 26, 27; 35, pp. 16, 26; 40, pp. 11, 21, 29].

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 General Considerations

Ground Water Migration Pathway Description

Regional Geology/Aquifer Description:

Washtenaw County is underlain by glacial deposits (lakebeds, outwash, deltas, and moraines) that range in total thickness from about 50 feet to about 450 feet [Ref. 125, pp. 2, 4]. Moraines (clay, silt, sand, and gravel mixtures) and outwash (principally sand and gravel) predominate in most of the county, including Ann Arbor and Scio Township [Refs. 84, p. 6; 125, p. 4; 126, p. 21]. Within the 4-mile target distance limit (TDL) for the Gelman site, the glacial deposits range in total thickness from approximately 175 feet (Montgomery Well) to more than 300 feet (wells MW-76D, S36-01, and EMU-1, all located 1.5 to 2 miles from the site), and consist of discontinuous layers and lenses of gravel, sand, silty or clayey sand, silt, and clay [**Figure 5** of this HRS documentation record; Refs. 84, pp. 8–12; 127, pp. 24, 44]. Underlying the glacial deposits are sedimentary rocks (i.e., shale and sandstone) of Mississippian and Devonian age [Refs. 84, pp. 8–11; 125, p. 2, 4].

Glacial deposits are among the principal aquifers for the State of Michigan, with sand and gravel outwash typically being the principal water-producing units [Refs. 127, pp. 16, 24; 128, pp. 17, 22; 129, pp. 5, 41, 47]. The glacial deposits in most areas can yield more than 100 gallons per minute to wells, and in some places the yield from sand and gravel deposits exceeds more than 3,000 gallons per minute [Refs. 127, p. 16; 128, pp. 17, 22]. As of 1976, the three wells being used for water supply by the City of Ann Arbor tapped the glacial drift deposits to depths of 91 to 196 feet and yielded 1,050 to 4,860 gallons per minute [Ref. 129, p. 38]. The glacial aquifer system continues to supply water for the City of Ann Arbor—the well screens for the City's active Steere Farm Well and closed Montgomery Well are installed in glacial sand [Ref. 84, p. 11]. Although sedimentary rocks have also been reported to be among Michigan's principal aquifers, groundwater in the shale bedrock formation beneath the site is generally of poorer quality, and no water-supply wells are known to be completed in bedrock in the area [Refs. 43, p. 14; 84, pp. 8–12; 127, p. 17; 128, pp. 17, 18, 22, 23; 129, pp. 38, 41, 47]. Saline water underlies freshwater at depths ranging from 100 to 900 feet throughout the State; at and in the vicinity of the Gelman site, the approximate depth to the freshwater-saltwater interface is 400 feet bgs [Ref. 128, pp. 17, 24; **Figure 1** of this HRS documentation record].

Site Geology/Aquifer Description:

Site-specific investigations and characterization confirm that the aquifer of concern for the Gelman site comprises the glacial deposits. Beginning in 1986, Keck Consulting Services, Inc. was retained to conduct an in-depth, multi-phase hydrogeologic investigation on and in the vicinity of the Gelman facility [Ref. 45, pp. 5, 6]. The findings of the initial 1986 Interim Report were refined, updated, and reported in 1987 Phase II and 1988 Phase III reports of the investigation [Refs. 43, pp. 1, 5, 6; 44, pp. 2, 7]. The glacial sequence underlying the study area was characterized using several methods of investigation, including installation of monitoring wells and hydrogeologic test holes; water level data acquisition; natural gamma logging; water sampling; slug/aquifer performance tests; and in-situ permeability testing [Refs. 43, pp. 6–10, 40–138; 44, pp. 6, 8, 9, 61, 64–71, 75–248;45, pp. 6–8].

As shown below in the descriptions of the various strata, a series of glacial depositional units (Units B, C, D, and E) have been identified at and in the vicinity of the Gelman facility. A separate Unit A overlying Unit B was identified during the 1986 interim hydrogeologic investigation; however, based on additional data obtained during the Phase II investigation, the unit was eliminated as a stratigraphic unit and combined with other units [Refs. 43, pp. 36, 138; 44, p. 61]. Units C and D were further divided into subunits, including C_1, C_2, C_3, D_0, D_1, D_2, and D_3 [Ref. 44, p. 61]. Based on the findings of Phase II and Phase III, Unit C_1, C_3, Unit D_0, Unit D_2, and Unit E were considered aquifer units, while Units B, C_2, D_1, and D_3 were evaluated as aquitards (i.e., leaky confining beds) [Refs. 43, pp. 15–17, 20, 22, 23, 138; 44, pp. 12, 15, 19, 20, 21, 22, 25, 26, 42]. Interconnection between all glacial deposits has been established based on the potential downward migration of groundwater though the various units characterized as aquitards and the presence of 1,4-dioxane throughout the glacial sequence; therefore, all depositional units identified as aquifers are evaluated as one hydrologic unit (i.e., the glacial aquifer system) for HRS scoring purposes [Ref. 43, pp. 16, 20, 23].

Groundwater flow in Unit C_1 is northward across the Gelman facility and westward in the vicinity of Jackson Road [Ref. 43, pp. 16, 158]. Based on information obtained during Phase II, surface water bodies west and east of the facility property (i.e., First, Second, and Third Sister Lakes, and Honey Creek Tributary) are hydraulically connected to Unit C_1 [Refs. 43, pp. 16, 41, 158; 119, p. 72]. Although Unit C_2 is characterized as an aquitard, there is the potential for downward migration from Units C_1

to C_3 through Unit C_2, in addition to the horizontal movement within each unit [Ref. 43, p. 16]. Data obtained during Phase III indicate that portions of Unit C_2 are sandy enough to be classified as an aquifer and in places, merge with aquifer Unit C_3 [Ref. 44, pp. 12, 22]. Unit C_3 in some portions of the study area is divided into three subunits, including an upper sandy member, an intermediate silty to clayey sand member, and a lower sandy member [Ref. 44, p. 12]. Groundwater in Unit C_3 beneath the Gelman facility flows in directions ranging from northeast to west; flow is north-northwest in the remainder of the study area [Ref. 44, pp. 22, 23, 67].

Unit D_0 was identified during Phase III [Ref. 44, p. 15]. The previously unnamed unit had been identified as being present in the Parkland Plaza area after analysis of gamma and drilling logs of 110 Parkland Plaza and 231 Little Lake Drive [Refs. 43, pp. 13, 14, 158; 44, p. 15; 119, p. 67]. Gamma logging of 3990 Jackson Road suggest Unit D_0 may extend further north and may be relatively thick [Ref. 44, p. 15]. Unit D_0 may also extend south but is of limited extent to the east [Ref. 44, p. 15]. Keck reported that Unit D_0 appears to truncate the glacial stratigraphic units B_1 (where present), B_2, B_3, C_1, C_2, C_3, and possibly D_1 and D_2 [Ref. 44, p. 15]. Water level data indicate that Unit D_0 allows hydraulic communication between Unit C_3 and Unit D_2 [Ref. 44, p. 15].

Potential for downward migration was also noted for Units D_1 and D_3 [Ref. 43, pp. 20, 22, 23]. In addition, portions of Unit D_1 may be permeable enough to supply low volumes of water [Ref. 43, p. 20]. Unit D_2 serves as one of the principal aquifer units of the study area [Ref. 43, pp. 20, 42]. Residential and commercial wells completed in this aquifer unit are generally found north of Jackson Plaza and in the Westover Subdivision areas [Refs. 43, pp. 20, 42; 94, p. 4]. Groundwater in Unit D_2 flows northeast and northwest in a U-shaped trough which trends southwest to northeast [Ref. 44, pp. 25, 70]. Unit E is utilized by residences, commercial businesses, and current and former public wells in the study area [Refs. 43, pp. 23, 42; 78, pp. 1, 10]. Unit E is the lowest usable aquifer unit and is relatively deep in the glacial drift sequence; groundwater flow is to the northeast [Ref. 43, pp. 23, 24]. Hydrogeologic conditions exist within the study area which would allow horizontal and vertical migration of the 1,4-dioxane from the vicinity of the Gelman facility to the adjacent areas where the compound has been found in both ground and surface waters [Ref. 43, pp. 37, 41].

The total thickness of glacial deposits in the Honey Creek basin (i.e., the site-specific study area) ranges from approximately 200 to 270 feet [Ref. 82, p. 8; **Figure 1** of the HRS documentation record]. Beneath the surficial glacial depositional units in the site vicinity lies Coldwater Shale bedrock consisting of blue-gray and occasionally red shales with lenticular sandstones and blue sandy shales [Refs. 43, p. 14; 82, p. 8]. Groundwater in this bedrock formation is generally of poor quality; no water-supply wells are known to be completed in bedrock in the vicinity of the site [Refs. 43, p. 14; 84, pp. 8–12].

Stratum 1 (shallowest)

Stratum/Aquifer Name: Unit B (upper discontinuous confining layers) [Ref. 44, pp. 10, 11]

- **B_1**: Uppermost identifiable deposit of the glacial aquifer system within the study area; only present in localized areas [Ref. 44, pp. 10, 61].
  Description: Weathered silty clay with a fine sand fraction [Ref. 44, pp. 10, 61].
- **B_2**: Where present, unit ranges in thickness from 3 to 22 feet [Ref. 44, pp. 10, 61].
  Description: Sand with varying amounts of gravel, silt, and clay [Ref. 44, pp. 10, 61].
- **B_3**: Present throughout most of the study area; varies in thickness from 2 to 20 feet [Ref. 44, pp. 11, 61].
  Description: Varying composition from a silty clay with a fine sand fraction to a till-like material with a silty clay matrix with fine sands and some granules and pebbles [Ref. 44, pp. 11, 61].

Stratum 2 (intervening layers)

Stratum/Aquifer Name: Unit C (shallow aquifer sequence)

- **C_1** (aquifer unit not used): Appears to be present throughout most of the study area and varies in thickness from 0 to 14 feet [Refs. 43, p. 15; 44, pp. 11, 61].
  Description: Fine to coarse gravel and very coarse sands with various amounts of fine sand and silt [Ref. 44, pp. 11, 61].
- **C_2** (aquitard): Appears to be present throughout most portions of the study area and varies in thickness from 20 to 30 feet [Refs. 43, pp. 11, 12, 16; 44, pp. 11, 12, 61].
  Description: Appears to be composed of three distinct members having an upper silty clay member, an intermediate sandy member, and a lower silty clay member [Ref. 44, pp. 11, 12, 61]. The lower member is often sandy in nature

making the contact between Unit C_2 and Unit C_3 gradational [Ref. 44, p. 12]. Portions of Unit C_2 are sandy enough to be classified as an aquifer and in places, merge with the C_3 aquifer [Ref. 44, p. 12].

- **C_3** (aquifer unit): Unit C_3 is the sandy member of a group of glacial stratigraphic units whose orientations are similar to each other. Stratigraphically downward, these units would be Unit B_2, Unit B_3, Unit C_1, Unit C_2, Unit C_3 and Unit D_1. The spatial distribution of Unit C_3 is a result of complex interactions with all of these units. Unit C_3 appears to range in thickness from 0 to 35 feet [Ref. 43, p. 17; 44, p. 13].
  Description: In some portions of the study area C_3 is divided into three subunits including an upper sandy member, an intermediate silty to clayey sand member, and a lower sandy member [Ref. 44, p. 12].

Stratum 3 (intervening layers)

Stratum/Aquifer Name: Unit D (middle aquifer sequence)

- **D_1** (aquitard): Encountered directly below Unit C_3 in the glacial aquifer system [Refs. 43, p. 20; 44, p. 16]. Where C_3 is not present, Unit D_1 is encountered directly below Unit C_2 [Ref. 44, p. 16]. Appears to be present throughout most of the study area, ranging in thickness from 21 to 70 feet [Ref. 44, p. 16].
  Description: Till-like characteristics having a gray silty clay matrix and a fine sand to gravel fraction. Unit D_1 may also exhibit more lacustrine-like characteristics, with massive silty clay having some floating sand grains [Ref. 44, pp. 16, 61].
  - **D_0** (aquifer unit): The unit is present in the Parkland Plaza area and may extend further north and south [Ref. 44, p. 15]. D_0 appears to be of limited extent to the east [Ref. 44, p. 15]. Keck reported that Unit D_0 appears to truncate several of the stratigraphic units and allow hydraulic communication between the C_3 and D_2 aquifers [Ref. 44, p. 15]. As study area monitoring wells are screened in this unit, it is evaluated as an aquifer [Ref. 106, p. 4; 107, pp. 4, 5].
    Description: Fine to medium, well-sorted light brown sand [Ref. 44, p. 15, 61].
- **D_2** (aquifer unit): Where present Unit D_2 is encountered directly below D_1 in the glacial aquifer system [Ref. 43, p. 20; 44, p. 16]. Unit D_2 may also be interbedded with Unit D_1 [Ref. 44, p. 16]. Unit D_2 ranges in thickness from 0 to 34 feet [Ref. 44, p. 16].
  Description: Medium to very coarse sand and medium to coarse gravel [Ref. 44, p. 16].
- **D_3** (aquitard): Encountered directly below either Units D_1 or D_2 in the glacial aquifer system [Ref. 43, p. 22; 44, pp. 17]. The unit appears to be present throughout the study area [Ref. 44, p. 17]. Unit D_3 ranges in thickness from 35 to 70 feet; however, only limited data exists on the unit because of its greater depth in the sequence [Ref. 44, p. 17].
  Description: Made up of three members, an upper silty clay member, an intermediate sand and/or gravel, and a lower clay member [Ref. 44, p. 17].

Stratum 4 (deepest)

Stratum/Aquifer Name: Unit E (lower aquifer unit) [Ref. 43, p. 23].

Description: Unit E is encountered directly below Unit D_3 and is the basal unit in the glacial aquifer system [Ref. 44, p. 18]. It appears to be present throughout the study area; however, only limited deep boring data exist to determine the continuity of the unit [Ref. 44, p. 18]. Unit E appears to vary in thickness from 20 to 85 feet, thinning in the western portion of the study area [Ref. 44, p. 18]. The unit has been described as a fine to cobble-size gravel deposit with varying amounts of very fine to very coarse sands [Ref. 44, p. 18].

Aquifer Interconnection

The hydrogeologic investigation conducted on behalf of Gelman documents interconnection throughout the glacial sequence at and in the vicinity of the site based on geophysical and chemical analytical data [Refs. 43, pp, 26-28, 37; 45, pp. 17-18]. Hydraulic head elevations observed during the initial phase of the investigation indicated that hydraulic head elevation in Unit C was greater than that for Unit E, demonstrating the potential for groundwater flow under natural conditions from Unit C to Unit E [Ref. 45, pp. 14, 15]. Groundwater head elevation data observed in study area monitoring wells during Phase II indicates all intervening units characterized as aquitards (also referred to as aquicludes in Phase III) (i.e., Units B, C_2, D_1, and D_3) between the water-bearing units allow downward movement of groundwater in addition to the horizontal components, including downward migration from Units C_1 to C_3 through Unit C_2, through Unit D_1 to Unit D_2, and through Unit D_3 to Unit E; Unit D_0 also allows hydraulic communication between Unit C_3 and Unit D_2 [Ref. 43, pp. 16–20, 22, 23, 95–101; 44, pp. 19, 20, 23–26, 61, 65, 67, 70]. Available well logs and geologic cross-sections show that the clay layers are discontinuous within 2 miles of site sources [Refs. 44, pp. 10–26, 65, 67, 70; 84, pp. 8–10].

During Phase III, monitoring wells and test borings were evaluated to further understand the hydraulic characteristics and interactions of the units [Ref. 44, p. 20]. The data indicated that although Units C_1 and B_2 appear to be separated by the Unit B_3 aquitard, hydraulic head elevation values of the two units are comparable [Ref. 44, p. 20]. Based on these findings, Keck reported that hydraulic communication between the units may be occurring [Ref. 44, p. 20]. Due to the sandy nature of the lower intermediate and lower members of Unit C_2 at some locations, Unit C_1 may be hydraulically communicating with Unit C_3 [Ref. 44, p. 20]. Drilling data indicated this may occur in the northern portion of the Gelman property including the bog and pond (i.e., source) areas [Ref. 44, p. 21]. Aquifer Unit D_0 allows hydraulic communication between Unit C_3 and other aquifer units [Ref. 44, p. 23]. Because the potentiometric surface of Unit C_3 and Unit D_2 are similar in this area, communication between these two units exists [Ref. 44, pp. 23, 24]. Pump tests conducted during the Phase III indicate Unit D_2 and D_3 are in communication [Ref. 44, pp. 32-42].

Keck noted that previous sampling of study area monitoring wells by various agencies have detected 1,4-dioxane in all water-bearing units extending from Unit C_1 to Unit E [Ref. 43, pp. 26–28]. Contamination extending all the way down to Unit E is also documented in the Consent Judgement. Further, recent groundwater monitoring data collected by Gelman within 2-miles of the sources also document 1,4-dioxane in Unit E [Refs. 78, pp. 3-4; 84, pp. 8, 9; 107, pp. 5, 6; 123, pp. 4-6]. Based on the geophysical and chemical data presented above, aquifer interconnection occurs within 2 miles of sources at the site, and the entire glacial sequence is evaluated as a single hydrologic unit for HRS scoring purposes (i.e., the glacial aquifer system) [Refs. 1, Section 3.0.1.2.1; 43, p. 157; 44, p. 65, 67, 68, 70, 71; **Figure 5** of the HRS documentation record].

Aquifer Discontinuities

No aquifer discontinuities or physical barriers to groundwater flow within the glacial aquifer system between site sources and target wells were identified in the hydrogeologic study or in other available well logs and geologic cross-sections, which confirm an absence of continuous confining layers between the water-bearing glacial units within the 4-mile TDL [Refs. 44, pp. 10–26, 65, 67, 70; 84, pp. 8–10]. The Huron River is located between 2 to 3 miles north-northeast of site sources; however, the vertical extent of the glacial aquifer system exceeds 200 feet, and the Huron River is not an aquifer discontinuity because it does not completely transect the aquifer of concern within the 4-mile TDL [Refs. 1, Section 3.0.1.2.2; 43, p. 40; 84, pp. 8–11]. In addition, both site sources and target wells lie to the south-southwest of Huron River; therefore, even if the Huron River formed an aquifer discontinuity, it would not disrupt the flow of groundwater and hazardous substances from sources to target wells [see **Figures 3 and 4** of this HRS documentation record].

3.1 LIKELIHOOD OF RELEASE

3.1.1 Observed Release

Aquifer Being Evaluated: glacial aquifer system

An observed release is documented for the Gelman site. Chemical analyses for groundwater samples collected from monitoring wells located in multiple locations within the Gelman study area confirm the presence of site-attributable 1,4-dioxane throughout the aquifer of concern [see "Chemical Analysis" below].

Direct Observation

Former Ponds 1 and 2 were unlined surface impoundments designed to allow wastewater to seep into the ground, and the ponds were periodically dredged to promote this percolation [Refs. 6, pp. 6, 27; 94, pp. 2, 36]. In 1986, Gelman identified the former unlined ponds as a possible source of groundwater contamination [Ref. 94, pp. 34–36]. According to Gelman's reporting in 1987, Pond 2 was excavated through stratigraphic Units B and C_1 and the bottom of the ponds coincided with the top of Unit C_2 [Ref. 43, p. 41]. In February 1986, Gelman reported that water below the water table and covering the bottom of Pond 2 ("the old unlined lagoon") showed 1,4-dioxane levels of about 5 ppm [Ref. 94, pp. 2, 23, 34–36], indicating that contamination from Source 2 was in direct contact with the glacial aquifer system. Although not known to be used as a supply unit in the study area, Unit C_1 is characterized as a water- producing zone composed primarily of sandy deposits. The entire glacial sequence, which includes Unit C_1, is evaluated as a single hydrologic unit (i.e., the glacial aquifer system) for HRS scoring purposes [Refs. 43, p. 15; 44, p. 19].

Chemical Analysis

2001 Montgomery Well Sampling

On March 7, 2001, a sample collected from the Montgomery Well indicated a concentration of 1,4-dioxane of 2 μg/L [Ref. 86, p. 3]. On April 2, 2001, the City of Ann Arbor announced that use of the Montgomery Well was discontinued pending further investigation [Ref. 86, pp. 1–3]. Subsequent samples collected from the Montgomery Well in April 2001 and December 2001 indicated concentrations of 1,4-dioxane at a concentration of 2 μg/L [Ref. 86, p. 3]. Results for the March sampling of the background well (i.e., Steere Farm Well # 25W) indicated no detectable concentration of 1,4-dioxane above the 1 μg/L detection limit [Ref. 86, p. 3]. The Steere Farm Well is evaluated as representing background conditions as both wells are screened at similar elevations within poorly sorted sand [Ref. 84, p. 11].

EPA 2022 SI Sampling

Sampling and analysis by EPA in 2022 document an observed release of 1,4-dioxane to the aquifer of concern (i.e., glacial aquifer system), specifically 1,4-dioxane at observed release concentrations in eight study area monitoring wells [see **Figure 3**; **Tables 7–10** of this HRS documentation record]. Groundwater samples used to evaluate background conditions were collected from Monitoring Wells MW-127s and MW-28, which are screened in Unit C_3 aquifer; and MW-120d, which is screened in Unit E aquifer [see **Table 7** of this HRS documentation record]. MW-127s and MW-28 lie west-southwest of the mapped 2020 contaminant boundary, and MW-120d is located north of the mapped contaminant boundary [see **Figure 3** of this HRS documentation record]. Samples intended to be evaluated as background were also collected from Unit D_2 (MW-120s and MW-124s), as well as a second background sample from Unit E (MW-124d); however, the 1,4-dioxane results were rejected during data validation due to exceedances of sample technical holding times (non-detects were qualified as unusable) [Ref. 47, pp. 1–12, 22, 25, 28]. Although background samples were not evaluated from every water-bearing unit, as described above the entire glacial sequence is evaluated as one hydrologic unit for HRS scoring purposes [see **Section 3.0.1** of this HRS documentation record].

Analysis of background groundwater sample G-GWBK-MW-127s showed an estimated concentration (1 J- μg/L) of 1,4-dioxane below the sample-specific reporting limit (2.0 μg/L) [see **Table 8** of this HRS documentation record]. Monitoring well MW-127s was designated as a background well; however, there is a westward component to groundwater flow in the C_3 aquifer, and 1,4-dioxane may now be encroaching on the well [Ref. 44, pp. 23, 23, 67]. There are no other known sources of 1,4-dioxane in the area [Refs. 9, pp. 2-672; 15, pp. 1-42; 88, p. 2]. The 1 J- μg/L (10 μg/L adjusted) 1,4-dioxane detection is designated as the background level for observed release comparison [see **Table 8** of this HRS documentation record].

As shown in **Tables 9 and 10** below, observed release concentrations of 1,4-dioxane were detected in groundwater samples from eight monitoring wells screened in the C_3 (shallow), D_2 (middle), and E (deep) aquifer units at concentrations ranging from 53 to 1,100 J- µg/L; the maximum concentration was detected in duplicate samples collected from the MW-100, which is screened in Unit E. The background and release samples were all collected during the same sampling event, using the same methodologies as outlined in the EPA Region 5 sampling SOP [Refs. 7, pp. 5, 10, 12, 13, 22–27; 17, pp. 3–5, 11–13, 19, 22, 32]. The samples were all collected from monitoring wells screened within the glacial aquifer system [see **Tables 7 and 9** of this HRS documentation record]. In addition, most of the background and release monitoring wells are screened at similar elevations within their respective aquifer units and screened in predominantly sand and gravel deposits [see **Tables 7 and 9** of this HRS documentation record]. The groundwater samples were all analyzed for TAL SVOCs by CLP laboratories under CLP SOW SFAM01.1 and the results validated according to EPA Region 5 data validation guidelines [**Tables 8 and 10**; Refs. 47, p. 3; 48, p. 1; 49, p. 2; 50, p. 1, 51, p. 3; 52, p. 2; 55, p. 2]. Although release samples were not collected from Unit D_0, as described above the entire glacial aquifer system is evaluated as one hydrologic unit for HRS scoring purposes [see **Section 3.0.1** of this HRS documentation record].

The hazardous substance 1,4-dioxane is man-made and attributable to historical facility operations [Refs. 28, pp. 1, 2; 57, p. 1]. Gelman utilized 1,4-dioxane from 1966 to 1986 as a solvent for cellulose triacetate filters and cleaning process lines [Ref. 28, p. 1].

Background Monitoring Well Samples

On September 26 and 27, and October 4, 2022, EPA collected groundwater samples G-GWBK-MW-127s, G-GWBK-MW-28, and G-GWBK-MW-120d from Gelman study area monitoring wells. Analysis reported a maximum 1,4-dioxane background concentration of 1 J- µ/L. The adjusted result (10 µg/L) is compared to the 1,4-dioxane results reported for release monitoring wells [see **Tables 8 and 10** of this HRS documentation record].

TABLE 7. BACKGROUND SAMPLE INFORMATION

Well Location	**Top of Casing Elev. (ft MSL)**	**Screened Interval (ft MSL)***	**Aquifer**	**Sample ID**	**Date Sampled**	**Reference(s)**
MW-127s	911.02	876.5–871.5 fine to medium sand	C_3	G-GWBK-MW-127s	9/26/2022	11, p. 4; 17, p. 3; 46, p. 2
MW-28	917.4	867.9–864.9 fine to coarse sand and some gravel	C_3	G-GWBK-MW-28	10/4/2022	11, p. 4; 17, pp. 22, 34; 46, p. 3
MW-120d	930.03	708.5–703.5 fine to coarse gravel, cobbles	E	G-GWBK-MW-120d	9/27/2022	17, pp. 4, 5; 46, pp. 5–8; 53, p. 5

ft MSL = feet above mean sea level.
* measured from ground elevation.

TABLE 8. BACKGROUND SAMPLE RESULTS						
Field Sample ID	**CLP Sample ID**	**Laboratory Sample ID**	**Hazardous Substance**	**Result (µg/L)**	**Sample Adjusted CRQL (µg/L)**	**Reference(s)**
G-GWBK-MW-127s	EYB60	22J0010-01	1,4-Dioxane	**1 J- (10)**	2.0	47, pp. 1–13, 81; 48, pp. 2, 75
G-GWBK-MW-28	EYB77	200-65201-5	1,4-Dioxane	1.9 U	1.9	51, pp. 1–14, 34, 99; 52, pp. 10, 99
G-GWBK-MW-120d	EYB62	0003237-01	1,4-Dioxane	2.0 U	2.0	49, pp. 1–7, 8, 30; 50, pp. 3, 13

µg/L = micrograms per liter.
J- = The result is an estimated quantity due to the analyte result being greater than or equal to the detection limit (MDL) and below the quantitation limit (CRQL) [Ref. 47, pp. 8, 12]. The result may be biased low due to sample extraction being performed outside the extraction holding time, or the extract is analyzed outside the analysis technical holding time [Ref. 47, pp. 4, 12].
U = The analyte was analyzed for but was not detected above the reported sample quantitation limit [Ref. 49, p. 7; 51, p. 14].
The Sample Adjusted CRQL for each CLP result is the CRQL adjusted for sample and method [Ref. 18, pp. 2, 131, 188, 333, 366; 47, p. 81; 49, p. 30; 51, p. 99]. Since the samples were analyzed through the CLP, the adjusted CRQLs presented above are HRS-defined SQLs [Ref. 1, Sections 1.1 and 2.3].
Result in parentheses is adjusted based on EPA's Fact Sheet, *Using Qualified Data to Document and Observed Release and Observed Contamination* (November 2022). [Ref. 101, pp. 3, 5, 8, 9].
Bold = evaluated as maximum background concentration.

Contaminated Monitoring Well Samples

From September 27 through 29, and October 2 through 4, 2022, EPA collected 11 groundwater samples (including three environmental duplicate samples) from eight release monitoring wells. Analysis reported 1,4-dioxane concentrations ranging from 53 to 1,100 J- µg/L. These results are compared to the maximum adjusted background 1,4-dioxane result reported for G-GWBK-MW-127s (10 µg/L) [see **Tables 8, 9 and 10** of this HRS documentation record].

TABLE 9. RELEASE SAMPLE INFORMATION						
Well Location	**Top of Casing Elev. (ft MSL)**	**Screened Interval (ft MSL)***	**Aquifer**	**Sample ID**	**Date Sampled**	**Reference(s)**
MW-1 Replacement	919.64	861.79–856.79 fine to coarse sand	C_3	G-GWRS-MW-1R/G-GWRS-MW-91R (Duplicate)	9/29/2022	**Figure 3**; 12, p. 4, 5; 29, pp. 1, 2; 46 p. 9
MW-105s	911.97	872.43–867.43 fine to medium sand	C_3	G-GWRS-MW-105s	9/27/2022	**Figure 3**; 11, p. 4; 17, p. 5; 46, p. 10; 119, p. 197
NMW-2d	906.2	892.9–889.9 unknown	C_3	G-GWRS-NMW2d	9/29/2022	**Figure 3**; 12, p. 4, 5; 17, p. 32; 46, pp. 1, 27
MW-77	932.01	772.5–762.5 medium to coarse sand	D_2	G-GWRS-MW-77/G-GWRS-MW-977 (Duplicate)	9/28/2022	**Figure 3**; 11, p. 5; 17, p. 19; 46, pp. 11, 12
MW-4d	911.58	848.08–838.08 Clean, coarse sand	D_2	G-GWRS-MW-4d	9/28/2022	**Figure 3**; 11, p. 5; 17, p. 19; 46, p. 13
MW-100	940.89	723–718 Fine to coarse sand, with coarse gravel	E	G-GWRS-MW-100/G-GWRS-MW-190 (Duplicate)	10/2/2022	**Figure 3**; 11, p. 5; 17, p. 11; 46, pp. 15–18
MW-108d	910.64	733.46–728.46 gravel and cobbles	E	G-GWRS-MW-108d	10/3/2022	**Figure 3**; 53, p. 5; 17, p. 12; 46, pp. 1, 19–22

TABLE 9. RELEASE SAMPLE INFORMATION						
Well Location	**Top of Casing Elev. (ft MSL)**	**Screened Interval (ft MSL)***	**Aquifer**	**Sample ID**	**Date Sampled**	**Reference(s)**
MW-85	917.64	760–755 fine to coarse sand	E	G-GWRS-MW-85	10/4/2022	**Figure 3**; 17, p. 13; 46, pp. 23–26; 131, p. 4, 6

ft MSL = feet above mean sea level.
* Measured from ground elevation.

TABLE 10. RELEASE SAMPLE RESULTS						
Field Sample ID	**CLP Sample ID**	**Laboratory Sample ID**	**Hazardous Substance**	**Result (µg/L)**	**Sample Adjusted CRQL (µg/L)**	**Reference(s)**
G-GWRS-MW-1R	EYBA1	22J0010-14	1,4-Dioxane	930	80	47, pp. 1–12, 61, 86; 48, pp. 12, 151
G-GWRS-MW-91R	EYB61	22J0010-02	1,4-Dioxane	670	80	47, pp. 1–12, 16, 82; 48, pp. 9, 83
G-GWRS-MW-105s	EYB64	0003237-02	1,4-Dioxane	53	9.8	49, pp. 1–7, 17, 31; 50, pp. 3, 21
G-GWRS-NMW2d	EYB98	22J0010-12	1,4-Dioxane	680	80	47, pp. 1–12, 55, 85; 48, pp. 8, 135
G-GWRS-MW-77	EYBA0	22J0010-13	1,4-Dioxane	550	40	47, pp. 1–12, 58, 85; 48, pp. 5, 143
G-GWRS-MW-977	EYB82	22J0010-09	1,4-Dioxane	540 J-	40	47, pp. 1–12, 43, 83; 48, pp. 5, 119
G-GWRS-MW-4d	EYB63	22J0010-03	1,4-Dioxane	220 J-	40	47, pp. 1–12, 19, 83; 48, pp. 6, 91
G-GWRS-MW-100	EYB80	200-65226-1	1,4-Dioxane	1,100 J-	100	54, pp. 1–8, 13, 38; 55, pp. 3, 52
G-GWRS-MW-190	EYBE7	200-65226-2	1,4-Dioxane	1,100 J-	100	54, pp. 1–8, 16, 38; 55, pp. 3, 60
G-GWRS-MW-108d	EYB81	200-65201-7	1,4-Dioxane	310	20	51, pp. 1–14, 37, 100; 52, pp. 11, 107
G-GWRS-MW-85	EYB83	200-65201-12	1,4-Dioxane	370 J-	39	51, pp. 1–14, 40, 100; 52, pp. 14, 119

µg/L = micrograms per liter.
J- = The result is an estimated quantity, but the results may be biased low due to sample extraction being performed outside the extraction technical holding time, or the extract is analyzed outside the analysis technical holding time [Ref. 47, pp. 4, 12; 51, pp. 4, 14; 54, pp. 3, 8].
The RL for each CLP result is the CRQL adjusted for sample and method [Ref. 18, pp. 2, 131, 188, 333, 366; 47, pp. 82, 83, 85, 86; 49, p. 31; 51, pp. 100; 54, p. 38]. Since the samples were analyzed through the CLP, the adjusted CRQLs presented above are HRS-defined SQLs [Ref. 1, Sections 1.1 and 2.3].

EPA 2023 Supplemental Sampling

Supplemental sampling and analysis by EPA in 2023 confirm the observed release of 1,4-dioxane to the aquifer of concern (i.e., glacial aquifer system), specifically 1,4-dioxane at observed release concentrations in six study area monitoring wells, four residential water-supply wells, and an observation well near the closed Montgomery Well [see **Figure 4**; **Tables 11–14, and 17-18** of this HRS documentation record]. The maximum background concentration (0.0572 µg/L) was detected in MW-120s [see **Table 12** of this HRS documentation record].

As shown in **Tables 11 through 14** below, observed release concentrations of 1,4-dioxane were detected in groundwater samples from six monitoring wells screened in the C_3 (shallow), D_0 and D_2 (middle), and E (deep) aquifers units at concentrations ranging from 9.15 to 1,720 µg/L; as with the 2022 results, the maximum concentration was detected in MW-100 [see **Tables 14** of this HRS documentation record]. The background and release samples were all collected during the same sampling event, using the same methodologies as outlined in the EPA Region 5 sampling SOP [Refs. 7, pp. 5, 10, 12, 13, 22–27; 105, pp. 7, 8, 12, 13, 17–19]. The samples were all collected from monitoring wells screened within the glacial aquifer system [see **Tables 11 and 13** of this HRS documentation record]. In addition, most of the background and release monitoring wells are screened at similar elevations within their respective aquifer units and screened in predominantly sand and gravel deposits [see **Tables 11 and 13** of this HRS documentation record]. The groundwater samples were all analyzed for 1,4-dioxane by a private, subcontracted laboratory using EPA Method 522, and the results were validated according to EPA Region 5 data validation guidelines [**Tables 12 and 14**; Refs. 108, p. 2; 109, pp. 2, 3; 110, pp. 2, 3; 111, p. 2; 112, p. 1; 113, p. 1; 114, p. 1; 115, p. 1].

Background Monitoring Well Samples

On September 11, 13, and 15, 2023, EPA collected groundwater samples G-GW01, G-GW02, G-GW03, G-GW04, G-GW05, G-GW06, and G-GW07 from Gelman study area monitoring wells [Ref. 105, pp. 7, 8, 12, 17, 18; **Figure 4** of this HRS documentation record]. Analysis reported a maximum 1,4-dioxane background concentration in G-GW02 (MW-120s). The result (0.0572 µg/L) is compared to the 1,4-dioxane results reported for release monitoring wells [see **Tables 12 and 14** of this HRS documentation record].

TABLE 11. BACKGROUND SAMPLE INFORMATION

Well Location	Top of Casing Elev. (ft MSL)	Screened Interval (ft MSL)*	Aquifer	Sample ID	Date Sampled	Reference(s)
MW-127s	911.02	876.5–871.5 fine to medium sand	C_3	G-GW06	9/13/2023	11, p. 4; 46, p. 2; 105, p. 12
MW-28	917.4	867.9–864.9 fine to coarse sand	C_3	G-GW01	9/15/2023	11, p. 4; 46, p. 3; 105, p. 18
MW-51	898.24	874.04–865.04 ** Silty clay to fine to very coarse grained sand	D_0	G-GW07	9/15/2023	46, p. 37-40; 107, p. 4; 105, p. 18
MW-124s	854.28	740.5–735.5 fine to medium sand, silt	D_2	G-GW04	9/15/2023	46, pp. 28–30; 105, p. 17; 106, p. 4
MW-120s	930.07	830.5–825.5 fine to medium sand	D_2	G-GW02	9/11/2023	46, pp. 31, 32; 105, pp. 7, 8; 106, p. 4
MW-120d	930.03	708.5–703.5 fine to coarse gravel, cobbles	E	G-GW03	9/11/2023	46, pp. 5–8; 53, p. 5; 105, pp. 7, 8
MW-124d	853.88	679–674 fine to coarse sand	E	G-GW05	9/15/2023	46, pp. 33–36; 105, p. 17; 106, p. 5

ft MSL = feet above mean sea level.
* measured from ground elevation.
** estimated based on well depth.

TABLE 12. BACKGROUND SAMPLE RESULTS					
Field Sample ID	**Laboratory Sample ID**	**Hazardous Substance**	**Result (µg/L)**	**MRL (µg/L)**	**Reference(s)**
G-GW06	R2308509-002	1,4-Dioxane	0.0400 U	0.0400	108, pp. 8, 9, 46; 113, pp. 1–7
G-GW01	R2308527-011	1,4-Dioxane	0.0400 U	0.0400	109, pp. 8, 10, 64; 114, pp. 1–8
G-GW07	R2308527-012	1,4-Dioxane	0.0343 J	0.0400	109, pp. 8,1 0, 65; 114, pp. 1–8
G-GW04	R2308527-001	1,4-Dioxane	0.0400 U	0.0400	109, pp. 8, 9, 54; 114, pp. 1–8
G-GW02	R2308463-001	1,4-Dioxane	**0.0572**	0.0400	110, pp. 8, 9, 49; 112, pp. 1–7
G-GW03	R2308463-002	1,4-Dioxane	0.0400 U	0.0400	110, pp. 8, 9, 50; 112, pp. 1–7
G-GW05	R2308527-002	1,4-Dioxane	0.0400 U	0.0400	109, pp. 8, 9, 55; 114, pp. 1–8

µg/L = micrograms per liter.
J (no bias) = The result is estimated due to the reported concentration falling between the MRL and MDL [Refs. 109, pp. 5, 13; Ref. 114, p. 5].
U = Analyte was analyzed for but not detected. [Refs. 108, p. 12; 109, p. 13; 110, p. 15].
MRL = method reporting limit, a.k.a. Limit of Quantitation (LOQ); defined as the lowest concentration at which the analyte may be reliably quantified under the method conditions (i.e., a sample- and matrix-dependent quantitation limit equivalent to sample quantitation limit as defined in the HRS Rule) [Refs. 1, Sections 1.1 and 2.3; 109, p. 13].
Bold = evaluated as maximum background concentration.

Contaminated Monitoring Well Samples

On September 11, 13, and 17, 2023, EPA collected eight groundwater samples (including two environmental duplicate samples) from six release monitoring wells and one observation well [Ref. 105, pp. 7, 9, 12, 13, 19]. Analysis reported 1,4-dioxane concentrations ranging from 9.15 to 1,720 µg/L. These results are compared to the maximum background 1,4-dioxane result reported G-GW02 (0.0572 µg/L) [see **Tables 12 and 14** of this HRS documentation record].

TABLE 13. RELEASE SAMPLE INFORMATION						
Well Location	**Top of Casing Elev. (ft MSL)**	**Screened Interval (ft MSL)***	**Aquifer**	**Sample ID**	**Date Sampled**	**Reference(s)**
MW-105s	911.97	872.43–867.43 fine to medium sand, trace silt	C_3	G-GW12/G-GW16 (Duplicate)	9/11/2023	**Figure 4**; 11, p. 4; 46, p. 10; 105, p. 7
175 Jackson Plaza	930.02	837.43–826.43 unknown	D_2	G-GW13	9/17/2023	**Figure 4**; 12, p. 5; 46, p. 43; 105, p. 19
MW-53i	926.56	826.82–816.82 sand and gravel	D_0	G-GW14	9/17/2023	**Figure 4;** 46, p. 41-42; 106, p. 4; 105, p. 19
MW-77	932.01	772.5–762.5 medium to coarse sand	D_2	G-GW08	9/13/2023	**Figure 4**; 11, p. 5; 46, pp. 11, 12; 105, p. 13
MW-100	940.89	723–718 Fine to coarse sand, with some coarse gravel	E	G-GW09	9/13/2023	**Figure 4**; 11, p. 5; 46, pp. 15–18; 105, pp. 12, 13

TABLE 13. RELEASE SAMPLE INFORMATION						
Well Location	**Top of Casing Elev. (ft MSL)**	**Screened Interval (ft MSL)***	**Aquifer**	**Sample ID**	**Date Sampled**	**Reference(s)**
MW-108d	902	725–720 gravel and cobbles	E	G-GW11/G-GW15 (Duplicate)	9/13/2023	**Figure 4**; 53, p. 5; 46, pp. 19–22; 105, p. 13
Observation well for Montgomery Well**	843.5	688.5–668.5 sand	E	G-GW27	9/12/2023	84, p. 6, 11; 105, p. 9; 132, pp. 1-5

ft MSL = feet above mean sea level.
* Measured from ground elevation.
**Sample G-GW27

TABLE 14. RELEASE SAMPLE RESULTS					
Field Sample ID	**Laboratory Sample ID**	**Hazardous Substance**	**Result (µg/L)**	**MRL (µg/L)**	**Reference(s)**
G-GW12	R2308463-007	1,4-Dioxane	292	0.400	110, pp. 8, 9, 55; 112, pp. 1–7
G-GW16	R2308463-003	1,4-Dioxane	290	0.400	110, pp. 8, 9, 51; 112, pp. 1–7
G-GW13	R2308617-001	1,4-Dioxane	897	0.400	111, pp. 7, 8, 36; 115, pp. 1–6
G-GW14	R2308617-002	1,4-Dioxane	9.15	0.0400	111, pp. 7, 8, 37; 115, pp. 1–6
G-GW08	R2308509-005	1,4-Dioxane	539	0.400	108, pp. 8, 9, 49; 113, pp. 1–7
G-GW09	R2308463-004	1,4-Dioxane	1,720	0.800	110, pp. 8, 9, 52; 112, pp. 1–7
G-GW11	R2308509-003	1,4-Dioxane	377	0.400	108, pp. 8, 9, 47; 113, pp. 1–7
G-GW15	R2308509-004	1,4-Dioxane	360	0.400	108, pp. 8, 9, 48; 113, pp. 1–7
G-GW27	R2308463-008	1,4-Dioxane	2.8	0.0400	110, pp. 8, 9, 56; 112, pp. 1–7

µg/L = micrograms per liter.
MRL = reporting limit, a.k.a. LOQ; defined as the lowest concentration at which the analyte may be reliably quantified under the method conditions (i.e., a sample- and matrix-dependent quantitation limit equivalent to sample quantitation limit as defined in the HRS Rule) [Refs. 1, Sections 1.1 and 2.3; 108, p. 12; 110, p. 15; 111, p. 11].

Contaminated Residential Water-Supply Wells – September 2023 EPA Sampling

On September 11, 13, 14, and 17, 2023, EPA collected seven groundwater samples (including one environmental duplicate sample) from six residential water-supply wells along Lakeview Avenue and Elizabeth Road [Ref. 105, pp. 8, 13, 14, 15, 16, 19, 20]. The two residential wells sampled on Lakeview Avenue are evaluated as representing background. Analysis reported 1,4-dioxane concentrations in the four residential wells along Elizabeth Road at concentrations ranging from 0.247 to 1.9 µg/L. These results are compared to the maximum background 1,4-dioxane result reported G-GW18 (0.0337 µg/L). The samples were all collected from residential wells screened within the glacial aquifer system [see **Table 17** of this HRS documentation record]. The residential samples were all analyzed for 1,4-dioxane by a private, subcontracted laboratory using EPA Method

522 and the results validated according to EPA Region 5 data validation guidelines [see **Table 18** of this HRS documentation record].

TABLE 17. RESIDENTIAL WATER-SUPPLY WELL SAMPLE INFORMATION (EPA)				
Well Location	**Screened Interval (ft MSL)***	**Sample ID**	**Date Sampled**	**Reference(s)**
Background Residential Water Supply Wells				
Lakeview Avenue	855.8–851.8 sand	G-GW18	9/11/2023	105, p. 8; 116, pp. 2, 3
Lakeview Avenue	861.9–857.9 sand	G-GW17	9/13/2023	105, pp. 13, 14; 116, pp. 4, 5
Observed Release Residential Water Supply Wells				
Elizabeth Road	792.3–788.3 gray sand	G-GW19	9/14/2023	105, p. 15, 16; 116, p. 6, 7
Elizabeth Road	Unknown**	G-GW20	9/17/2023	105, pp. 19, 20; 116, p. 8
Elizabeth Road	791.0–786.0 sand and gravel	G-GW21	9/14/2023	105, p. 16; 116, p. 9, 10
Elizabeth Road	791.3–787.3	G-GW22/GW29 (Duplicate)	9/14/2023	105, p. 16; 116, p. 11

ft MSL = feet above mean sea level.
* Measured from ground elevation.
** Assumed to be at a similar interval as the other Elizabeth Road wells.

TABLE 18. RESIDENTIAL WATER-SUPPLY WELL SAMPLE RESULTS (EPA)					
Field Sample ID	**Laboratory Sample ID**	**Hazardous Substance**	**Result (µg/L)**	**MRL (µg/L)**	**Reference(s)**
Background Residential Water Supply Wells					
G-GW18	R2308463-006	1,4-Dioxane	**0.0337 J**	0.0400	110, pp. 8, 9, 54; 112, pp. 1–7
G-GW17	R2308509-006	1,4-Dioxane	0.0262 J	0.0400	108, pp. 8, 9, 50; 113, pp. 1–7
Observed Release Residential Water Supply Wells					
G-GW19	R2308527-007	1,4-Dioxane	1.42	0.0400	109, pp. 8, 9, 60; 114, pp. 1–8
G-GW20	R2308617-003	1,4-Dioxane	1.7	0.0400	111, pp. 7, 8, 38; 115, pp. 1–6
G-GW21	R2308527-008	1,4-Dioxane	1.9	0.0400	109, pp. 8, 9, 61; 114, pp. 1–8
G-GW22	R2308527-009	1,4-Dioxane	0.247	0.0400	109, pp. 8, 10, 62; 114, pp. 1–8
G-GW29	R2308527-010	1,4-Dioxane	0.249	0.0400	109, pp. 8, 10, 63; 114, pp. 1–8

µg/L = micrograms per liter.
J (no bias) = The result is estimated due to the reported concentration falling between the MRL and MDL [Refs. 112, pp. 4–6; 113, p. 4-6].
MRL = Method reporting limit, a.k.a. LOQ; defined as the lowest concentration at which the analyte may be reliably quantified under the method conditions (i.e., a sample- and matrix-dependent quantitation limit equivalent to sample quantitation limit as defined in the HRS Rule) [Ref. 1, Sections 1.1 and 2.3; 108, p. 12; 109, p. 13; 110, p. 15; 111, p. 11].
Bold = evaluated as maximum background concentration.

Contaminated Residential Water-Supply Wells - Michigan EGLE 2023 Supplemental Sampling

In June 2023, Michigan Department of Environment, Great Lakes, and Energy (EGLE) and Washtenaw County Health Department collected groundwater samples from residential water-supply wells in Scio Township including wells along Breezewood Drive, Cottontail Court, Craig Road, Elizabeth Road, Miller Road, North Wagner Road, Robinwood Drive, Wagner Woods Court, Dexter Ann Arbor Road, Waterman Drive, Westview Way, Cole Drive, West Delhi, South Wagner Road, Coventry Square, Bradford Square, W. Liberty, Myrtle Avenue, Pratt Road, Saginaw Court, Burton, Southwood Court, Rose Drive, Thornapple Drive, Wagner Woods Court, Woodlea Drive, Calvin Street, Parkridge Drive, Bay Ridge Drive, Woodrow Street, Leroy Boulevard, Mable Drive, Cottontail Lane, Woodrow Street, etc. (Ref. 8, pp. 1, 4, 5, 10, 22, 23, 25, 31, 38, 48, 52, 72, 75, 77, 78, 79, 80, 90, 91, 122, 123, 124, 125, 132, 141, 157, 160, 161, 162, 164, 168, 169, 189). Samples were analyzed by Michigan EGLE Drinking Water Laboratory using EPA Method 8260 and validated according to guidance presented in EPA National Functional Guidelines for Organic Superfund Methods Data Review OLEM 9240.0-51 EPA 540-R-20-005, November 2020. (Ref. 8, pp. 1, 13, 19, 20). Samples collected from several residences along N. Wagner, Miller, Elizabeth, Breezewood, Wagner Woods, Craig, Myrtle Avenue, Burton Avenue, Cottontail Ct, Robinwood, W. Liberty and other residences indicated non-detect values for 1,4-dioxane at a reporting limit of 0.5 ug/L (Ref. 8, pp. 22, 26, 28, 30, 32, 37, 50, 78, 91, 95, 128, 129, 142, 143, 315, 485, 486, 589, 590, 1060-1068). All samples were all collected from residential wells screened within the unconsolidated glacial aquifer system [see **Table 19** and **Section 3.0.1** of this HRS documentation record]. Three samples listed below (LK70609, LK70622, LK70626) are used to establish a 1,4-dioxane background level of non-detect at a reporting limit of 0.5 µg/L which is used to evaluate an observed release in this Michigan EGLE/Washtenaw County Health Department sampling. Results reported as not-detected are results that were not detected at or above the reporting limit (Ref. 8, p. 19, 22, 78, 91, 95). Observed release concentrations range from 0.5 µg/L to 1.9 µg/L. Samples meeting observed release are in **Table 20** of this HRS documentation record.

TABLE 19. RESIDENTIAL WATER-SUPPLY WELL SAMPLE INFORMATION (EGLE)

Well Location	Sample ID	Elevation (ft msl)	Well Depth (ft bgs)	Screened Interval*	Reference(s)
Background					
Myrtle Avenue	LK70609	882	65	817-821 ft msl	8, pp. 78, 1061; 100, pp. 1, 22
Burton Avenue	LK70622	--	57	53-57 ft bgs	8, pp. 91, 1060; 100, pp. 1, 21
W. Liberty	LK70626	936.31	160	776.31-786.31 ft msl	8, pp. 95, 315; 100, pp. 1, 23
Release					
Breezewood Drive	LK70573	868	51	821-825 ft msl	8, pp. 43, 1049; 100 pp. 1, 2
Cottontail Court	LK71405	--	170	162-170 ft bgs	8, pp. 826, 924; 100, pp. 1, 3
Cottontail Court	LK71257	--	140	132-140 ft bgs	8, pp. 504, 594; 100, pp. 1, 4
Cottontail Court	LK71423	--	164	151-164 ft bgs	8, pp., 844, 942; 100, pp. 1, 5
Craig Road	LK71276	--	154	150-154 ft bgs	8, pp. 613, 707; 100, pp. 1, 6
Craig Road	LK71428	--	166	162-166 ft bgs	8, pp. 947, 1038; 100, pp. 1, 7
Craig Road	LK71418	--	--	--	8, pp. 839, 1058
Craig Road	LK71427	--	--	--	8, pp. 946, 1037
Craig Road	LK71243	--	175	168-175 ft bgs	8, pp. 353, 1056; 100, pp. 1, 8
Craig Road	LK71419	--	190	184–190 ft bgs	8, pp. 840, 1059; 100, pp. 1, 9
Craig Road	LK71246	--	--	--	8, pp. 493, 583
Elizabeth Road	LK70590	--	196	186-196 ft bgs	8, pp. 60, 1051; 100, pp. 1, 10
Elizabeth Road	LK70569	956.47	--	--	8, pp. 39, 1048; 100, pp. 1, 18
Miller Road	LK70639	915	160	755-763 ft msl	8, pp. 238, 1055; 100, pp. 1, 11
Miller Road	LK70556	--	161	157-161 ft bgs	8, pp. 25, 1044; 100, pp. 1, 12
Miller Road	LK70578	--	--	--	8, pp. 48, 1050
Miller Road	LK70566	--	171	166-171 ft bgs	8, pp. 35, 1046; 100, pp. 1, 13
Miller Road	LK70638	--	--	--	8, pp. 237, 327
Miller Road	LK70560	--	--	--	8, pp. 29, 1045
Miller Road	LK70567	--		--	8, pp. 36, 1047
N. Wagner Road	LK70647	--	152	144-152 ft bgs	8, pp. 336, 473; 100, pp. 1, 14
N. Wagner Road	LK70612	--	152 or 182**	154-182 ft bgs**	8, pp. 81, 1052; 100, pp. 1, 15
N. Wagner Road	LK70618	--	--	--	8, pp. 87, 1053
N. Wagner Road	LK70619	--	190	186-190 ft bgs	8, pp. 88, 1054; 100, pp. 1, 19
N. Wagner Road	LK71411	--	--	--	8, pp. 832, 930

TABLE 19. RESIDENTIAL WATER-SUPPLY WELL SAMPLE INFORMATION (EGLE)					
Well Location	**Sample ID**	**Elevation (ft msl)**	**Well Depth (ft bgs)**	**Screened Interval***	**Reference(s)**
Robinwood Drive	LK71382	--	144	134-144 ft bgs	8, pp. 620, 1057; 100, pp. 1, 16
Wagner Woods Court	LK71387	--	153	145-158 ft bgs	8, pp. 719, 809; 100, pp. 1, 17

* The well screen interval is presented in feet below ground surface when the elevation at the well location is not in the Wellogic record. The well screen interval is converted to feet above mean sea level when the elevation at the well location and the depth of the well screen interval in feet below ground surface are provided in the Wellogic record. For example, a well located at an elevation of 882 ft msl, with a screen interval located 61-65 feet below ground surface, would have a well screen interval of 817-821 feet above mean sea level (Ref. 100, pp. 1-23).
**Accuracy of well depth and screened interval could be determined from Wellogic record (Ref. 100, pp. 1, 15).
ft msl = feet above mean sea level.
ft bgs = feet below ground surface.

TABLE 20. RESIDENTIAL WATER-SUPPLY WELL SAMPLE RESULTS (EGLE)					
Street Name	**Sample ID**	**1,4-Dioxane (µg/L)**	**Reporting Limit (µg/L)**	**Sample Date**	**Reference(s)**
Background Residential Water Supply Wells					
Myrtle Avenue	LK70609	0.5 U	0.5	6.6.23	8, pp. 1, 12-21, 78, 1061
Burton Avenue	LK70622	0.5 U	0.5	6.6.23	8, pp. 1, 12-21, 91, 1060
W. Liberty	LK70626	0.5 U	0.5	6.6.23	8, pp. 1, 12-21, 95, 315
Observed Release Residential Water Supply Wells					
Breezewood Drive	LK70573	1.4	0.5	6.6.2023	8, pp. 12, 15–21, 43, 1049
Cottontail Court	LK71405	0.8 J-	0.5	6.7.2023	8, pp. 12, 15–21, 826, 924
Cottontail Court	LK71257	0.7	0.5	6.7.2023	8, pp. 12, 15–21, 504, 594
Cottontail Court	LK71423	0.8 J-	0.5	6.7.2023	8, pp. 12, 15–21, 844, 942
Craig Road	LK71276	1.3 J-	0.5	6.7.2023	8,pp. 12, 15–21, 613, 707
Craig Road	LK71428	0.8 J-	0.5	6.7.2023	8, pp. 12, 15–21, 947, 1038
Craig Road	LK71418	1.0 J-	0.5	6.7.2023	8, pp. 12, 15–21, 839, 1058
Craig Road	LK71427	0.8 J-	0.5	6.7.2023	8, pp. 12, 15–21, 946, 1037
Craig Road	LK71243	0.6	0.5	6.7.2023	8, pp. 12, 15–21, 353, 1056
Craig Road	LK71419	0.9 J-	0.5	6.7.2023	8, pp. 12, 15–21, 840, 1059
Craig Road	LK71246	0.8	0.5	6.7.2023	8, pp. 12, 15–21, 493, 583
Elizabeth Road	LK70590	0.8	0.5	6.6.2023	8, pp. 12, 15–21, 60, 1051
Elizabeth Road	LK70569	1.9	0.5	6.6.2023	8, pp. 12, 15–21, 39, 1048
Miller Road	LK70639	0.9	0.5	6.6.2023	8, pp. 12, 15–21, 238, 1055
Miller Road	LK70556	1.2	0.5	6.6.2023	8, pp. 12, 15–21, 25, 1044
Miller Road	LK70578	1.2	0.5	6.6.2023	8, pp. 12, 15–21, 48, 1050
Miller Road	LK70566	1.1	0.5	6.6.2023	8, pp. 12, 15–21, 35, 1046
Miller Road	LK70638	1.2	0.5	6.6.2023	8, pp. 12, 15–21, 237 327
Miller Road	LK70560	1.0	0.5	6.6.2023	8, pp. 12, 15–21, 29, 1045

TABLE 20. RESIDENTIAL WATER-SUPPLY WELL SAMPLE RESULTS (EGLE)					
Street Name	**Sample ID**	**1,4-Dioxane (µg/L)**	**Reporting Limit (µg/L)**	**Sample Date**	**Reference(s)**
Miller Road	LK70567	0.7	0.5	6.6.2023	8, pp. 12, 15–21, 36, 1047
N. Wagner Road	LK70647	1.0	0.5	6.6.2023	8, pp. 12, 15–21, 336, 473
N. Wagner Road	LK70612	0.6	0.5	6.6.2023	8, pp. 12, 15–21, 81, 1052
N. Wagner Road	LK70618	0.7	0.5	6.6.2023	8, pp. 12, 15–21, 87, 1053
N. Wagner Road	LK70619	0.9	0.5	6.6.2023	8, pp. 12, 15–21, 88, 1054
N. Wagner Road	LK71411	0.6 J-	0.5	6.7.2023	8, pp. 12, 15–21, 832, 930
Robinwood Drive	LK71382	0.8 J-	0.5	6.7.2023	8, pp. 12, 15–21, 620, 1057
Wagner Woods Court	LK71387	0.5 J-	0.5	6.7.2023	8, pp. 12, 15–21, 719, 809

J- = The result is an estimated quantity, but the results may be biased low. Samples were analyzed beyond the 7-day holding time (Ref. 8, pp. 19, 20). No adjustment is need for bias low observed release concentrations according to the EPA factsheet, *Using Qualified Data to Document an Observed Release and Observed Contamination* (Ref. 101, pp. 5, 8).
RL – Reporting Limit (Ref. 8, p. 22).
U = The analyte was analyzed for but was not detected at or above the reported sample quantitation limit/reporting limit (Ref. 8, pp. 19, 22).

Attribution:

Based on the decades-long period of operation (1963 to 2013) and the documented poor waste handling practices, the release of 1,4-dioxane is attributable to the Gelman facility [Refs. 28, p. 1; 58, p. 5]. Historical Gelman manufacturing operations included the use of leaching tanks and coating lines to apply and wash various solvents onto filters [Refs. 28, p. 1; 58, p. 6]. Solvents used at the facility included 1,4-dioxane [Ref. 28, p. 1]. In 1981, Gelman submitted a Notification of Hazardous Waste Site to EPA identifying organic and solvent waste managed in drums, as well as a drum storage area located in the northwest corner of the former Gelman building located at 600 S. Wagner Road [Refs. 6, p. 35; 63, pp. 1, 2]. The notification to EPA specifically listed 1,4-dioxane (RCRA Waste Code: U-108) as a specific waste type generated at the facility [Refs. 5, p. 4; 63, p. 1, 2]. The facility was determined to be an SQG and assigned RCRA Handler ID MID005341813 [Ref. 64, p. 2].

Between 1966 and May 1986, 1,4-dioxane was used for cellulose triacetate filter production and cleaning process lines [Ref. 28, p. 1]. Tetrahydrofuran and acetone were used after May 1986 [Ref. 28, p. 2]. Process wastewater containing 1,4-dioxane was managed at the facility in ponds, by spray irrigation, and in a deep underground injection well [Ref. 28, p. 1]. The injection zone of this deep well is 5,460 to 5,794 feet below ground surface (bgs) in sandstone bedrock [Refs. 68, p. 24; 69, p. 1] This discharge depth is significantly below the depth of the unconsolidated glacial strata aquifer scored as part of HRS evaluation; the maximum thickness of the glacial deposits in the site area is more than 300 feet [Refs. 82, p. 8, 9; 84, pp. 8–12].

The process wastewater discharged to Source 2 and allowed to seep into the ground contained 1,4-dioxane, a CERCLA hazardous substance, beginning at an unspecified date in 1968; according to Gelman, the disposal of wastewater to Source 2 ended as the main source of disposal at an unspecified date in 1973, when Gelman built an additional 3 million gallon lagoon (Pond 3) and began using it for wastewater disposal [Refs. 6, p. 6-7; 21, p. 26; 94, pp. 2, 36]. In 1969, the estimated volume of process wastewater discharged to Former Ponds 1 and 2 (i.e., Source 2) was 50,000 gallons per day [Refs. 6, p. 6; 30, p. 1]. Between October 1983 and October 1984, about 2.6 million gallons were disposed of by spray irrigation [Ref. 60, p. 51]. A 1984 process wastewater effluent sample contained 1,4-dioxane at 1,600 ppm [Ref. 59, p. 3]. According to Gelman, this result represented the average concentration flowing into Pond 3 (i.e., Source 1) [Ref. 59, p. 3].

On July 13, 1986, Gelman discharged an estimated 18,000 gallons of process water from an unspecified surface impoundment onto the ground near the north property line [Ref. 66, p. 1]. MDNR indicated that this discharge was a violation of Gelman's groundwater discharge permit (Permit No. M00337) [Ref. 66, p. 1]. The wetlands that received the unpermitted discharges are contiguous with the Honey Creek tributary [Refs. 4, p. 1; 82, p. 9; 83, p. 1]. According to USGS, small, upstream reaches of the Honey Creek tributary may be losing reaches at times and act as areas of recharge for the underlying aquifer [Ref. 82, pp. 7, 9, 11, 19].

In 1979, during a response to neighborhood complaints regarding foam from Source 1 being picked up by wind and blown across the area, Gelman noted that Source 1 was their primary treatment facility for storage and aeration of membrane manufacture wastewater and that the impoundment liner was torn vertically [Ref. 67, p. 1-3]. Prior to 1984, Source 1 was lined on the sides only and the bottom consisted of compacted clay [Ref. 19, p. 1].

Additional process wastes, including membrane filters, cellulose acetate solutions, miscellaneous research solutions, and waste solvent, were managed in an on-site burn pit [Refs. 23, p. 1; 24, p. 1; 25, p. 1]. Former Gelman burn pit operations were documented during several historic regulatory inspections. In 1968, MDPH observed an open fire in a depression on the ground and a black smoke plume over 500 feet high at the site resulting from open burning of four barrels of solvents and pigments [Ref. 22, pp. 1–3]. At the time, it was noted that four barrels of solvents were burned each week [Ref. 22, p. 2]. On November 14, 1979, MDNR visited the Gelman facility to investigate a complaint regarding open dumping of cellulose acetate membrane filters, solvents, and other fluids in an unlined pit [Ref. 23, pp. 1, 2]. Gelman was advised that the pit was an illegal means of waste disposal [Ref. 23, p. 1]. On November 27, 1979, Gelman responded by indicating that the practice of open dumping has ceased, and the contents of the pit would be removed [Ref. 24, p. 1].

On May 27, 1977, Gelman received a discharge permit from the MWRC to discharge up to 44,000 gallons per day of process wastewater and non-contact cooling water to the ground and groundwater by spray irrigation, under Permit No. M00337 [Ref. 37, pp. 1–4]. In 1977, Gelman violated the terms of its discharge permit by allowing surface runoff from the spray irrigation field to discharge at the west property boundary [Ref. 38, p. 1]. On August 16, 1984, Michigan Department of Environmental Quality (MDEQ) was notified that 1,4-dioxane was a component of the spray irrigation discharge [Ref. 68, p. 33]. MDEQ determined that the discharge of dioxane violated Gelman's existing permit and could not reissue the permit until Gelman was in compliance with the existing permit. [Ref. 68, p. 33]. A 1984 study by the University of Michigan determined that runoff from the Gelman's spray irrigation field had impacted Third Sister Lake to the west of the facility via detections of 1,4-dioxane [Ref. 13, pp. 1–10].

In November 1985, sampling conducted by WCHD revealed the presence of 1,4-dioxane in certain private drinking water wells in the vicinity of the Gelman property [Ref. 72, pp. 1, 2]. On January 24, 1986, WCHD informed MDOH that 1,4-dioxane was detected in drinking water wells at Gelman in the 100 ppm range, as well as in wells located at Redskin Industries and A.D.P along Jackson Plaza adjacent to the north facility boundary [Ref. 73, p. 1]. Gelman also provided bottled water to a number of area residents and businesses where wells had become contaminated and paid for the extension of municipal water supplies for these areas [Ref. 72, p. 2].

In 1992, Gelman, MNRC, MWRC, and MDNR entered into a consent judgement requiring Gelman to conduct groundwater remediation, including design, installation, operation, and maintenance of groundwater pump and treat systems, and to conduct a soil investigation and subsequent remediation [Ref. 74, pp. 1–63]. The consent judgment divided groundwater remediation areas into three separate systems with specific requirements for each [Ref. 74, pp. 6-17]. The objective of the Core Area groundwater extraction system (aquifer Unit C_3), located north of the Gelman facility in the vicinity of Jackson Plaza where portions of the aquifer Unit C_3 contained 1,4-dioxane concentrations exceeding 500 µg/L, was to: a) intercept and contain the migration of groundwater from the Core Area; b) remove contaminated groundwater from the Core Area until termination criterion for the Core System was satisfied; and c) prevent the discharge of contaminated groundwater into the Honey Creek Tributary at concentrations in excess of 100 µg/L or in excess of a concentration which would cause groundwater contamination at any location along or adjacent to the entire length of Honey Creek or the Honey Creek Tributary [Refs. 16, pp. 63, 64; 70, p. 4; 74, p. 11; 94, p. 4]. The objective of the Evergreen Subdivision Area groundwater extraction system (aquifer Unit D_2), located northeast of the Gelman facility was to: a) intercept and control the leading edge of the plume of 1,4-dioxane groundwater contamination; b) remove the contaminated groundwater from the affected aquifer unit; and c) remove all groundwater contaminants from the affected aquifer unit or upgradient aquifer units within the site that is not otherwise removed by the Core Area system [Refs. 16, pp. 63, 64; 70, p. 5; 74, pp. 6, 7; 119, p. 67]. The objective of the Western Plume groundwater extraction system (aquifer Unit D_0), located outside the Core Area and west, northwest, and southwest of the Core Area, was to: a) contain downgradient migration of any plume(s) of groundwater contamination emanating from the Gelman property that are located outside the Core Area and to the northwest, west, or southwest of the Gelman facility; b) remove groundwater contaminants from the affected aquifer unit(s); and c) remove all groundwater contaminants from the affected aquifer unit or upgradient aquifer units within the site that are not otherwise removed by the Core Area system [Refs. 16, pp. 63, 64; 70, p. 6; 74, p. 15].

The consent judgement also required Gelman to address soil contamination at the facility by: a) preventing the migration of 1,4-dioxane from contaminated soils into any aquifer unit at concentrations that cause groundwater contamination; b) preventing discharge of groundwater into Honey Creek Tributary; and c) preventing discharge of groundwater contamination to Third Sister Lake [Ref. 74, p. 24]. The consent judgment divided the site into three separate systems: a) the Marshy Area System to address the wetlands north of Former Ponds 1 and 2; b) the Spray Irrigation Field System to prevent discharge into Third Sister Lake; and c) the Soil System for remediation of additional identified source areas (burn pit, Former Ponds 1 and 2, Pond 3, and former Lift Station area) [Refs. 70, pp. 8, 9; 74, pp. 24, 26, 29]. Subsequent amendments to the consent judgement and court opinions revised state benchmarks for 1,4-dioxane contamination of groundwater and soil, and required installation and operation of additional extraction wells and monitoring wells (1996 and 2000); changes to treatment infrastructure and methods (1999 and 2000); remediation of aquifer Unit E (2004); establishment of the Prohibition Zone, identification of drinking water wells within the zone, providing access to municipal water supply, and abandonment and replacement of existing drinking water wells (2005); and modifications to remedial objectives (2011) [Refs. 75, pp. 1–11; 76, pp. 1–4; 77, pp. 4, 5; 78, pp. 7–14; 79, pp. 1–6; 80, pp. 4–28; 81, p. 4]. In a 2006 Release of Claims and Settlement Agreement entered into between Gelman and the City of Ann Arbor, Gelman acknowledged that they were not aware of any other source of 1,4-dioxane in aquifer Unit E within the Prohibition Zone or in the vicinity of the Northwest Supply Well (i.e., Montgomery Well) [Ref. 88, p. 2]. There are likely multiple diffuse sources of 1,4-dioxane in the vicinity of Gelman and the Montgomery Well, such as the disposal of domestic wastewater (i.e., septic systems) and as a component of various commercial applications [Ref. 122, pp. 2, 3; 130, pp. 1–3]. However, a search and review of Federal and State databases in December 2023 indicates that there are no other known significant historical or current sources or releases of 1,4-dioxane within 3 miles of the Gelman facility and the Montgomery Well [Refs. 9, pp. 2–672; 15, pp. 1-42].

Between 1966 and May 1986, 1,4-dioxane was used for cellulose triacetate filter production and cleaning process lines [Ref. 28, p. 1]. A 1984 process wastewater effluent sample contained 1,4-dioxane at a concentration of 1,600 parts per million (ppm) [Ref. 59, p. 3]. Wastewater containing 1,4-dioxane was disposed of in Sources 1 (Pond 3) and 2 (Ponds 1 and 2) [Refs. 6, pp. 6, 7; 20, pp. 1, 6; 30, p. 1; 59, pp. 3, 9; 93, pp. 1–3; 94, pp. 2, 36]. The liner for Source 1 was incomplete or damaged during portions of its operating period; Source 2 was unlined and designed to allow wastewater to seep into the ground, and the ponds were periodically dredged to promote this percolation [Refs. 6, p. 6, 7; 19, p. 1; 67, p. 2; 94, pp. 2, 36; see **Section 2.2** for Sources 1 and 2 of this HRS documentation record]. Unauthorized discharge of process water from site surface impoundments to adjacent wetlands was documented by MWRC [Ref. 61, p. 1]. This discharge was noted as being in violation of an existing Order of Determination against Gelman forbidding discharge to waters of the state [Ref. 61, p. 1]. In October1996, it was noted that effluent from the Evergreen Treatment System containing 1,4-dioxane at 4 and 2 parts per billion had been injected into the aquifer on August 9 and 12, 1996, in violation of the groundwater exemption permit [Ref. 71, p. 1].

In 2022 and 2023, EPA collected groundwater samples from study area monitoring wells as part of the SI and supplemental sampling performed in the vicinity of Gelman. Validated analytical data for groundwater samples collected in 2022 and 2023 document an observed release of 1,4-dioxane to the glacial aquifer system [see **Tables 11-14** of this HRS documentation record]. The 2023 sampling also shows observed release concentrations of 1,4-dioxane in four residential wells along Elizabeth Avenue and in an observation well for the closed Montgomery Well [see **Tables 13-14 and 17–18** of this HRS documentation record]. Additionally, 2023 sampling collected by EGLE and Washtenaw County shows observed release concentration of 1,4-dioxane in 27 residential wells [see **Tables 19 and 20** of this HRS documentation record].

Other Possible Nearby Sites

PAH-Contaminated Soil

Analytical results of 2022 SI soil samples from soil boring G-SS03 advanced within the footprint of Former Pond 2 indicated the presence of PAHs in the form of benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, fluoranthene, and pyrene at elevated concentrations at depths ranging from 4 to 5 feet and 17 to 18 feet bgs. PAHs are not known to have been associated with facility operations and are likely attributable to fill material placed into the former pond when it was taken out of service and backfilled [Refs.17, pp. 25, 26; 33, pp. 1–15, 45, 49, 77, 81, 85, 108, 109; 33, p. 2; 34, pp. 3, 4, 5, 1689, 1690, 1698–1700].

Hazardous Substance Released:

1,4-dioxane

==

Ground Water Observed Release Factor Value: 550

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

TABLE 21. TOXICITY/MOBILITY					
Hazardous Substance	**Source Number**	**Toxicity Factor Value**	**Mobility Factor Value**	**Toxicity/ Mobility**	**Reference(s)**
1,4-Dioxane	1, 2, OR	100	1	100	2, p. 3

OR = Observed Release

3.2.2 Hazardous Waste Quantity

TABLE 22. HAZARDOUS WASTE QUANTITY – GROUND WATER PATHWAY		
Source Number	**Source Hazardous Waste Quantity (HWQ) Value (Section 2.4.2.1.5)**	**Is source hazardous constituent quantity data complete? (yes/no)**
1	5,941.2	No
2	18,600	No
Sum of Values:	24, 541.2	

The sum corresponds to a hazardous waste quantity factor value of 10,000 in Table 2-6 of the HRS [Ref. 1, Section 2.4.2.2]. Therefore, a hazardous waste quantity factor value of 10,000 is assigned for the ground water pathway.

Hazardous Waste Quantity Factor Value: 10,000

3.2.3 Waste Characteristics Factor Category Value

1,4-Dioxane corresponds to the toxicity/mobility factor value of 100, as shown previously (see **Section 3.2.1** of this HRS documentation record).

Toxicity/Mobility Factor Value (100) x Hazardous
Waste Quantity Factor Value (10,000): 1 x 10^6

The product (1 x 10^6) corresponds to a Waste Characteristics Factor Category Value of 32 in Table 2-7 of the HRS [Ref. 1, Section 2.4.3.1].

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Waste Characteristics Factor Category Value: 32

3.3 TARGETS

Currently, the City of Ann Arbor maintains two surface water intakes on the Huron River at Barton Pond [Ref. 84, p. 4]. Potable water from these intakes provides approximately 85 percent of the municipal water supply [Ref. 85, p. 1]. Fifteen percent of the municipal supply comes from three wells located south of Ann Arbor at the Ann Arbor Airport (i.e., Steere Farm Wellfield) [**Figures 3, 4 and 5**; Refs. 84, p. 4; 85, p. 1]. The City of Ann Arbor supplies water to Scio Township [Ref. 87, p. 2].

Beginning in 1985, 1,4-dioxane was discovered in private drinking water wells in the vicinity of the Gelman facility [Refs. 70, p. 1; 72, p. 1]. As of 2004, approximately 124 private water supply wells were closed because of groundwater contamination attributable to the Gelman site [Ref. 70, p. 1]. The City of Ann Arbor's Montgomery Well was closed due to the encroaching 1,4-dioxane contamination and the 2001 detections of 1,4 dioxane at 2 µg/L [Refs. 78, p. 10; 84, p. 5; 123, pp. 1–20]. Residential, commercial, and public wells utilize the glacial aquifer system in the study area [Refs. 43, pp. 17, 20, 23, 42; 78, pp. 1, 10; 84, p. 11; 88, p. 2].

On April 2, 2001, the City of Ann Arbor announced that use of the Montgomery Well for water supply was discontinued pending further investigation [Ref. 86, pp. 1–3]. Subsequent samples collected from the Montgomery Well in April 2001 and December 2001 also indicated concentrations of 1,4-dioxane at a concentration of 2 µg/L [Ref. 86, p. 3]. The background well (i.e., SF # 25W, Steere Farm well) did not have detectable concentrations of 1,4-dioxane above the 1 µg/L detection limit [Ref. 86, p. 3]. Both the Mongomery and Steere Farm supply wells are screened at similar elevations in poorly sorted sand, which coincides with Unit E of the glacial aquifer system [Ref. 84, p. 11]. According to the City of Ann Arbor, the Montgomery Well was closed because of the 1,4-dioxane contamination from the Gelman facility [Ref. 78, p. 10; 84, p. 5; 123, pp. 1–20]. Montgomery Well is permanently closed [Ref. 84, p. 5]. In a 2006 Release of Claims and Settlement Agreement entered into between Gelman and the City of Ann Arbor, Gelman acknowledged that they were not aware of any other source of 1,4-dioxane in aquifer Unit E within the Prohibition Zone or in the vicinity of the Northwest Supply Well (i.e., Montgomery Well), including concentrations below the 85 µg/L benchmark in effect at the time [Ref. 88, p. 2]. As historical analytical data from March, April and December 2001 show concentrations of 1,4-dioxane in the Montgomery Well significantly above background, and the well was closed because of site-related contamination, the Montgomery Well is scored based on actual contamination [Refs. 78, p. 10; 84, p. 5; 86, p. 3; 123, pp. 1–20]. Based on data provided by the Ann Arbor Water Department regarding population served and the relative contributions of system inputs in 2001, the apportioned population for the Montgomery Well at the time of closure is 3,712.8750 people [Ref. 89, pp. 1–3]. Level I contamination is established for the Montgomery Well, which was closed in 2001 due to 1,4-dioxane contamination; 1,4-dioxane was detected at a concentration of 2 µg/L, which is above the HRS Level I benchmark of 0.779 µg/L [Refs. 1, Section 3.3.2.1, Table 3-10; 2, p. 3; 86, pp. 1–3].

Analytical results for sample G-GW27 collected by EPA from an observation well near the closed Montgomery Well confirm that 1,4-dioxane persists in the aquifer in the vicinity of the closed water supply well (2.8 µg/L) [see **Table 14** of this HRS documentation record]. 1,4-Dioxane concentrations in the 31 residential wells range from 0.247 to 1.9 µg/L [see **Table 18** of this HRS documentation record]. As of March 2004, 124 private wells were closed due to 1,4-dioxane contamination and the residences were connected to the municipal supply system [Ref. 70, p. 1].

TABLE 23. TARGETS – GROUND WATER PATHWAY

Well/ Sample ID	Distance from Source (mi.)*	Population	Level I Conc. (Y/N)**	Level II Conc. (Y/N)	Potential Contam. (Y/N)	Reference(s)
Public Supply Wells						
Montgomery Well/2001 sampling	1.81	3,712.8750	Y	N	N	2, p. 3; 86, p. 3; 86, p. 3; 89, pp. 1–3;
Residential Wells						
Elizabeth Road / G-GW19	1.0	2.39**	Y	N	N	2, p. 3; 109, pp. 8, 9, 60; 114, pp. 1–8
Elizabeth Road / G-GW20	0.97	2.39**	Y	N	N	2, p. 3; 111, pp. 7, 8, 38; 115, pp. 1–6
Elizabeth Road / G-GW21	0.98	2.39**	Y	N	N	2, p. 3; 109, pp. 8, 9, 61; 114, pp. 1–8

TABLE 23. TARGETS – GROUND WATER PATHWAY						
Well/ Sample ID	**Distance from Source (mi.)***	**Population**	**Level I Conc. (Y/N)****	**Level II Conc. (Y/N)**	**Potential Contam. (Y/N)**	**Reference(s)**
Elizabeth Road / G-GW22/GW-29	1.01	2.39**	N	Y	N	2, p. 3; 109, pp. 8, 10, 62, 63; 114, pp. 1–8
Breezewood Drive/ LK70573	1.63	2.39**	Y	N	N	8, pp. 12, 15–21, 43, 1049
Cottontail Court/ LK71405	2.24	2.39**	Y	N	N	8, pp. 12, 15–21, 826, 924
Cottontail Court/ LK71257	2.29	2.39**	Y	N	N	8, pp. 12, 15–21, 504, 594
Cottontail Court/ LK71423	2.23	2.39**	N	Y	N	8, pp. 12, 15–21, 844, 942
Craig Road/ LK71276	2.12	2.39**	Y	N	N	8, pp. 12, 15–21, 613, 707
Craig Road/ LK71428	2.17	2.39**	Y	N	N	8, pp. 12, 15–21, 947, 1038
Craig Road/ LK71418	2.11	2.39**	Y	N	N	8, pp. 12, 15–21, 839, 1058
Craig Road/ LK71427	2.11	2.39**	Y	N	N	8, pp. 12, 15–21, 946, 1037
Craig Road/ LK71243	2.17	2.39**	N	Y	N	8, pp. 12, 15–21, 353, 1056
Craig Road/ LK71419	2.10	2.39**	Y	N	N	8, pp. 12, 15–21, 840, 1059
Craig Road/ LK71246	2.11	2.39**	Y	N	N	8, pp. 12, 15–21, 493, 583
Elizabeth Road/ LK70590	1.00	2.39**	Y	N	N	8, pp. 12, 15–21, 60, 1051
Elizabeth Road/ LK70569	0.96	2.39**	Y	N	N	8, pp. 12, 15–21, 39, 1048
Miller Road/ LK70639	1.80	2.39**	Y	N	N	8, pp. 12, 15–21, 238, 1055
Miller Road/ LK70556	1.92	2.39**	Y	N	N	8, pp. 12, 15–21, 25, 1044
Miller Road LK70578	2.03	2.39**	Y	N	N	8, pp. 12, 15–21, 48, 1050
Miller Road/ LK70566	1.94	2.39**	Y	N	N	8, pp. 12, 15–21, 35, 1046
Miller Road/ LK70638	2.01	2.39**	Y	N	N	8, pp. 12, 15–21, 237 327
Miller Road/ LK70560	1.97	2.39**	Y	N	N	8, pp. 12, 15–21, 29, 1045
Miller Road/ LK70567	2.03	2.39**	N	Y	N	8, pp. 12, 15–21, 36, 1047
N. Wagner Road/ LK70647	1.67	2.39**	Y	N	N	8, pp. 12, 15–21, 336, 473
N. Wagner Road/ LK70612	1.71	2.39**	N	Y	N	8, pp. 12, 15–21, 81, 1052
N. Wagner Road/ LK70618	1.71	2.39**	N	Y	N	8, pp. 12, 15–21, 87, 1053
N. Wagner Road/ LK70619	1.74	2.39**	Y	N	N	8, pp. 12, 15–21, 88, 1054
N. Wagner Road/ LK71411	2.05	2.39**	N	Y	N	8, pp. 12, 15–21, 832, 930

TABLE 23. TARGETS – GROUND WATER PATHWAY						
Well/ Sample ID	**Distance from Source (mi.)***	**Population**	**Level I Conc. (Y/N)****	**Level II Conc. (Y/N)**	**Potential Contam. (Y/N)**	**Reference(s)**
Robinwood Drive/ LK71382	2.34	2.39**	Y	N	N	8, pp. 12, 15–21, 620, 1057
Wagner Woods/ LK71387	1.50	2.39**	N	Y	N	8, pp. 12, 15–21, 719, 809

* Distance is measured from waste sample location G-SWSS09 (see **Figure 4** of this HRS documentation record).
** Washtenaw County average persons per household [Ref. 1, Section 3.3.2; 117, p. 1].
Maximum Contaminant Levels (MCLs), Cancer Risk Screening Concentrations (CRSC) and Noncancer Risk Screening Concentrations (NRSC) are used as HRS screening concentration benchmarks to evaluate the level of contamination for the ground water migration pathway. The cancer risk screening concentration is the lowest available HRS benchmark for 1,4-dioxane, and it is used to evaluate the Level I concentrations scored at this site [Refs. 1, , Sections 2.5.2, 3.3.2.1, Table 3-10; 2, p. 3].

Applicable HRS screening concentration benchmarks for the hazardous substance detected in the observed release are as follows:

TABLE 24. HRS BENCHMARKS – GROUND WATER PATHWAY				
Substance	**MCL**	**Cancer Risk**	**Non-Cancer Risk**	**Reference(s)**
1,4-Dioxane	NA	0.779	602	2, p. 3

Concentrations presented in µg/L for consistency with reported analytical data.
NA=Not Available

Level I Samples

TABLE 25. LEVEL I CONCENTRATIONS						
Well	**Sample**	**Substance**	**Conc. (µg/L)**	**RL/MRL (µg/L)**	**HRS Benchmark Cancer Risk (µg/L)**	**Reference(s)**
Montgomery Well	Unknown	1,4-Dioxane	2*	1	0.779	2, p. 3; 86, p. 3
Elizabeth Road Residential	G-GW19	1,4-Dioxane	1.42	0.04	0.779	2, p. 3; 109, pp. 9, 60; 114, pp. 1–8
Elizabeth Road Residential	G-GW20	1,4-Dioxane	1.9	0.04	0.779	2, p. 3; 111, pp. 8, 38; 115, pp. 1–6
Elizabeth Road Residential	G-GW21	1,4-Dioxane	1.7	0.04	0.779	2, p. 3; 109, pp. 9, 61; 114, pp. 1–8
Breezewood Residential	LK70573	1,4-Dioxane	1.4	0.5	0.779	2, p. 3. 3; 8, pp. 12, 15–21, 43, 1049
Cottontail Residential	LK71405	1,4-Dioxane	0.8 J-	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 826, 924
Cottontail Residential	LK71423	1,4-Dioxane	0.8 J-	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 844, 942
Craig Residential	LK71276	1,4-Dioxane	1.3 J-	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 613, 707
Craig Residential	LK71428	1,4-Dioxane	0.8 J-	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 947, 1038
Craig Residential	LK71418	1,4-Dioxane	1.0 J-	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 839, 1058

TABLE 25. LEVEL I CONCENTRATIONS						
Well	**Sample**	**Substance**	**Conc. (µg/L)**	**RL/MRL (µg/L)**	**HRS Benchmark Cancer Risk (µg/L)**	**Reference(s)**
Craig Residential	LK71427	1,4-Dioxane	0.8 J-	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 946, 1037
Craig Residential	LK71419	1,4-Dioxane	0.9 J-	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 840, 1059
Craig Residential	LK71246	1,4-Dioxane	0.8	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 493, 583
Elizabeth Residential	LK70590	1,4-Dioxane	0.8	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 60, 1051
Elizabeth Residential	LK70569	1,4-Dioxane	1.9	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 39, 1048
Miller Residential	LK70639	1,4-Dioxane	0.9	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 238, 1055
Miller Residential	LK70556	1,4-Dioxane	1.2	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 25, 1044
Miller Residential	LK70578	1,4-Dioxane	1.2	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 48, 1050
Miller Residential	LK70566	1,4-Dioxane	1.1	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 35, 1046
Miller Residential	LK70638	1,4-Dioxane	1.2	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 237 327
Miller Residential	LK70560	1,4-Dioxane	1.0	0.5	0.779	82, p. 3; 8, pp. 12, 15–21, 29, 1045
N. Wagner Residential	LK70647	1,4-Dioxane	1.0	0.5	0.779	2, p. 3; 8, pp. 12, 15-12, 336, 473
N. Wagner Residential	LK70619	1,4-Dioxane	0.9	0.5	0.779	2, p. 3; 8, pp. 12, 14–20, 88, 1054
Robinwood Residential	LK71382	1,4-Dioxane	0.8 J-	0.5	0.779	2, p. 3; 8, pp. 12, 14–20, 620, 1057

*The result was reported in 2001, and the 2004 Court Order regarding remediation of aquifer Unit E confirms that Gelman reported the result of 2 µg/L for the Montgomery Well [Ref. 78, p. 10; 86, pp. 1–3].

<u>Level II Samples</u>

TABLE 26. LEVEL II CONCENTRATIONS						
Well	**Sample**	**Substance**	**Conc. (µg/L)**	**RL (µg/L)**	**HRS Benchmark Cancer Risk (µg/L)**	**Reference(s)**
Elizabeth Road Residential	G-GW22	1,4-Dioxane	0.247	0.04	0.779	2, p. 3; 109, pp. 10, 62; 114, pp. 1–8
	G-GW29 (Duplicate)	1,4-Dioxane	0.249	0.04	0.779	2, p. 3; 109, pp. 10, 63; 114, pp. 1–8
Cottontail Road Residential	LK71257	1,4-Dioxane	0.7	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 504, 594
Craig Road Residential	LK71243	1,4-Dioxane	0.6	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 353, 1056
Miller Road Residential	LK70567	1,4-Dioxane	0.7	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 36, 1047
N. Wagner Road Residential	LK70612	1,4-Dioxane	0.6	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 81, 1052

TABLE 26. LEVEL II CONCENTRATIONS						
Well	**Sample**	**Substance**	**Conc. (µg/L)**	**RL (µg/L)**	**HRS Benchmark Cancer Risk (µg/L)**	**Reference(s)**
N. Wagner Road Residential	LK70618	1,4-Dioxane	0.7	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 87, 1053
N. Wagner Road Residential	LK71411	1,4-Dioxane	0.6 J-	0.5	0.779	2, p. 3; 8, pp. 12, 15–21, 832, 930
Wagner Woods Court Residential	LK71387	1,4-Dioxane	0.5 J-	0.5	0.779	82, p. 3, pp. 12, 15–21, 719, 809

3.3.1 Nearest Well

As identified in **Section 3.3** of this HRS documentation record, the closed drinking water-supply well, Montgomery Well for the City of Ann Arbor and 23 residential wells, are subject to Level I concentrations [see **Table 25** of this HRS documentation record]. Therefore, a nearest well factor value of 50 is assigned [Ref. 1, Section 3.3.1, Table 3-11].

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Nearest Well Factor Value: 50

3.3.2 Population

3.3.2.2 Level I Concentrations

As identified in **Section 3.3** of this HRS documentation record, the closed drinking water supply well (i.e., Montgomery Well for the City of Ann Arbor) and 23 residential wells are subject to Level I concentrations. The populations assigned to these wells are presented below and in **Section 3.3** of this HRS documentation record [see **Tables 25 and 27** of this HRS documentation record].

TABLE 27. LEVEL I POPULATIONS		
Level I Well*	**Population**	**Reference(s)**
Mongomery Well	3,712.8750	89, p. 1
Elizabeth Road Residential	2.39	117, p. 1
Elizabeth Road Residential	2.39	117, p. 1
Elizabeth Road Residential	2.39	117, p. 1
Breezewood Residential	2.39	117, p. 1
Cottontail Residential	2.39	117, p. 1
Cottontail Residential	2.39	117, p. 1
Craig Residential	2.39	117, p. 1
Craig Residential	2.39	117, p. 1
Craig Residential	2.39	117, p. 1
Craig Residential	2.39	117, p. 1
Craig Residential	2.39	117, p. 1
Craig Residential	2.39	117, p. 1
Elizabeth Residential	2.39	117, p. 1
Elizabeth Residential	2.39	117, p. 1
Miller Residential	2.39	117, p. 1
Miller Residential	2.39	117, p. 1
Miller Residential	2.39	117, p. 1
Miller Residential	2.39	117, p. 1
Miller Residential	2.39	117, p. 1
Miller Residential	2.39	117, p. 1
N. Wagner Residential	2.39	117, p. 1

TABLE 27. LEVEL I POPULATIONS		
Level I Well*	**Population**	**Reference(s)**
N. Wagner Residential	2.39	117, p. 1
Robinwood Residential	2.39	117, p. 1

*See **Tables 23 and 25** of this HRS documentation record for sample information.

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Sum of Population Served by Level I Wells: 3,767.845
Sum of Population Served by Level I Wells x 10 = 37,678.45
[Ref. 1, Section 3.3.2.2]

Level I Concentrations Factor Value: 37,678.45
[Ref. 1, Section 3.3.2.2]

3.3.2.3 Level II Concentrations

As identified in **Section 3.3** of this HRS documentation record, eight residential wells are subject to Level II concentrations [see **Table 26** of this HRS documentation record]. The population assigned to these wells are presented in below and in **Section 3.3** of this HRS documentation record [see **Tables 25 and 28** of this HRS documentation record].

TABLE 28. LEVEL II POPULATIONS		
Level II Well*	**Population**	**Reference(s)**
Elizabeth Road Residential	2.39	117, p. 1
Cottontail Residential	2.39	117, p. 1
Craig Residential	2.39	117, p. 1
Miller Residential	2.39	117, p. 1
N. Wagner Residential	2.39	117, p. 1
N. Wagner Residential	2.39	117, p. 1
N. Wagner Residential	2.39	117, p. 1
Wagner Woods Residential	2.39	117, p. 1

*See **Tables 23 and 26** of this HRS documentation record for sample information.

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Sum of Population Served by Level II Wells: 19.12
[Ref. 1, Section 3.3.2.4]

Level II Concentrations Factor Value: 19.12
[Ref. 1, Section 3.3.2.4]

3.3.2.4 Potential Contamination

Since targets subject to Level I and Level II concentrations result in a maximum score of 100.00 for the ground water migration pathway, the Potential Contamination Factor Value was not scored.

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Potential Contamination Factor Value: NS

3.3.3 <u>Resources</u>

Since targets subject to Level I and Level II concentrations result in a maximum score of 100.00 for the ground water migration pathway, the Resources Factor Value was not scored.

Resources Factor Value: NS

3.3.4 Wellhead Protection Area

Michigan’s Wellhead Protection Program (WHPP) was developed in response to 1986 amendments to the Federal Safe Drinking Water Act (SDWA) and was approved by EPA in 1994 [Refs. 120, p. 1; 121, p. 1]. The State’s WHPP is based on a groundwater travel time of 10 years surrounding public water supply wells [Ref. 121, p. 2]. The City of Ann Arbor has designated a WHPA surrounding the Montogomery Well; therefore, observed groundwater contamination attributable to the site lies, either partially or fully, within the designated WHPA [**Figures 3, 4, and 5**; Ref. 84, p. 13].

Table 29. WELLHEAD PROTECTION AREA

Area	Use	References	Value
Montgomery Wellfield	Closed public drinking water supply	**Figure 5**; 1, Section 3.3.4; 84, p. 13; 120, p. 1; 121, pp. 1, 2	20

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Wellhead Protection Area Factor Value: 20
[Ref. 1, Section 3.3.4]