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REPORT OF INVESTIGATION

WELL POLLUTION BY
LANDFILLS LOCATED IN
THE TOWN OF FRANKLIN

MANITOWOC COUNTY, WISCONSIN

Prepared by Ayres Associates Inc.
for
Radosivich, Mozinski, Mozinski & Cashman
March, 1986

TABLE OF CONTENTS

- A. Introduction
- B. List of Major Documents Included in Review
- C. Regional Setting of Landfills
- D. Findings
 - 1. T & H Site
 - 2. Fly Ash Site
 - 3. Ridgeview Site
- E. Conclusion

LIST OF TABLES

- 1. Summary of VOA Results, Lemberger Fly Ash Site
- 2. Zimpro Inc., Ridgeview Leachate Analyses Results

LIST OF FIGURES

- 1. Site Location Map
- 2. Proposed Site Layout Plan, Ridgeview Site
- 3. Cross Section Locations, Ridgeview Site
- 4. Cross Section D-D'
- 5. Cross Section E-E'
- 6. East-West Cross Section, Ridgeview Site
- 7. North-South Cross Section, Ridgeview Site
- 8. Generalized Ground Water Flow

A. Introduction

Numerous wells on privately owned property in the Town of Franklin, Manitowoc County, which are in the general area West and North of three landfills, have been polluted by organic compounds not found in a natural subsurface setting. The pollutants, halogenated hydrocarbons, are man made products which after use, were deposited into the three landfills. Halogenated chemicals are by nature very persistent to decomposition and therefore will migrate through waste deposits and into the soils and groundwater beneath the landfill.

Once the chemicals reach the ground water, migration will occur down gradient from the landfill from areas of recharge to areas of discharge like springs, lakes, rivers and wells.

B. List of Major Documents Included in Review

In the review of the contamination of the private wells, the following major documents contributed to the data presented herein:

1. "Sanitary Landfill Plan for Lemberger Transport Recycling Inc." dated 1975 and prepared by Foth and Van Dyke (F&VD).
2. "Plan of Operation for Lemberger Transport Recycling, Inc." dated September 12, 1975 and prepared by F&VD.
3. "Application for Vertical Expansion" dated June 21, 1977 and prepared by F&VD.

4. "Site Operation Plan Addendum", for Lemberger Landfill Site Incorporated, dated September 24, 1980 and prepared by Residuals Management Technology (RMT).
5. "Revised Site Operations Plan Addendum," for Lemberger Landfill Site Incorporated, dated April 29, 1981 and prepared by RMT.
6. "Proposed Environmental Improvements Plan, Ridgeview Landfill", dated May 13, 1982 for Waste Management Inc. (WMI) by F&VD.
7. "Gas Venting System, Ridgeview Landfill", dated October 1, 1982 for WMI by F&VD.
8. "Final Feasibility Study Report", dated November 28, 1979 for Manitowoc County by Warzyn Engineering, Inc. (WEI).
9. "Lemberger Landfill Site Incorporated, Horizontal Expansion", for Harold & George Radant, dated October 16, 1981 and prepared by RMT.
10. "Ridgeview Landfill, Horizontal Expansion" for WMI dated April 1, 1983 and prepared by WMI.
11. Final Report, "Preliminary Remedial Investigation, Franklin Township, Manitowoc, Wisconsin," dated September 12, 1985 and prepared by Soil Exploration Company (SEC) a sister corporation to Twin City Testing.
12. "Preliminary In-Field Conditions Analysis of the Closed Transport Recycling Inc., Landfill" dated August 31, 1981 and prepared by RMT. This site is referred to as the T & H Site.

13. "Environmental Investigation Report For: The Lemberger Landfills, Inc., Fly Ash Site #0753," dated July 28, 1982 and prepared by F&VD.
14. "Department of Natural Resources (DNR) Reports of Sampling and analysis of Private Wells in the Vacinity of the Landfill."
15. "Determination of Site Feasibility For a Proposed Vertical Expansion, DNR, February 28, 1984."
16. Sabel, Gretehen V., and Clark, Thomas P., "Volatile Orgnic Compounds as Indicators of Municipal Solid Waste Leachate Contamination," Sixth Annual Madison Conference, September 14-15, 1983.
17. Kmet, Peter, and McGinley, Paul M., "Chemical Characteristics of Leachate from Municipal Solid Waste Landfills in Wisconsin," Fifth Annual Madison Conference, September 22-24, 1982.

The above information and documents are hereinafter referenced by a superscript number, i.e.(1). In addition to the above list of major documents, numerous file memoranda and correspondence contributed to the data provided herein.

C. Regional Setting Of Landfill

Three landfill sites are located in Franklin Township in the adjacent Sections, 34, 27, and 26, Township 20N, Range 22E. From south to north they are the Lemberger Toxic and Hazardous (T & H) Site, the Lemberger Fly Ash Site and, the Waste Management of Wisconsin Ridgeview Site.

The location of each site is shown on Figure 1, "Site Location Map". Also shown in Figure 1 is the zone of pollution of the ground water by halogenated organic compounds as detected in the studies conducted by the Wisconsin Department of Natural Resources(14) and Soil Exploration Company(11).

The Niagara Dolomite is the bedrock unit that underlies the area. At the Ridgeview Site it generally lies at a depth of 40 feet or more and slopes to the west. This rock is the primary aquifer throughout the area and is the most common water source for private wells. Above the bedrock are soils of glacial origin. These soils vary in grain size and often consist of a mixture of sand, silt and clay sizes in any one place. However, there is a tendency of the soil column to show layers of predominately fine grained soils (silt and clay) alternating with layers of generally coarse grained soils (sand and gravel). These alternating layers have irregular thicknesses and boundaries but, have a distinct slope downward to the west. One of these coarse grained layers is a significant sand and gravel outwash layer in the range of 10 to 13 feet thick that is frequently penetrated by soil borings and monitoring wells on the Ridgeview Site(1), (5), (11). This layer is typically separated from the Niagara Dolomite by a layer of silt and clay and is water saturated. One or more coarse soil zones (probably outwash) lie at positions above the sand and gravel outwash and are also saturated. Water levels in the various soil layers were measured in soil borings and continued to be measured in observation wells and piezometers.

LEGEND
 ⊗ VOLATILE ORGANIC COMPOUND
 CONTAMINATION DETECT

● MONITORING WELL OR OBSERVATION
 WELL USED IN THIS STUDY
 ▲ INCOMPLETE DATA ON PRIVATE WATER WELL
 ■ COMPLETE DATA ON PRIVATE WATER WELL

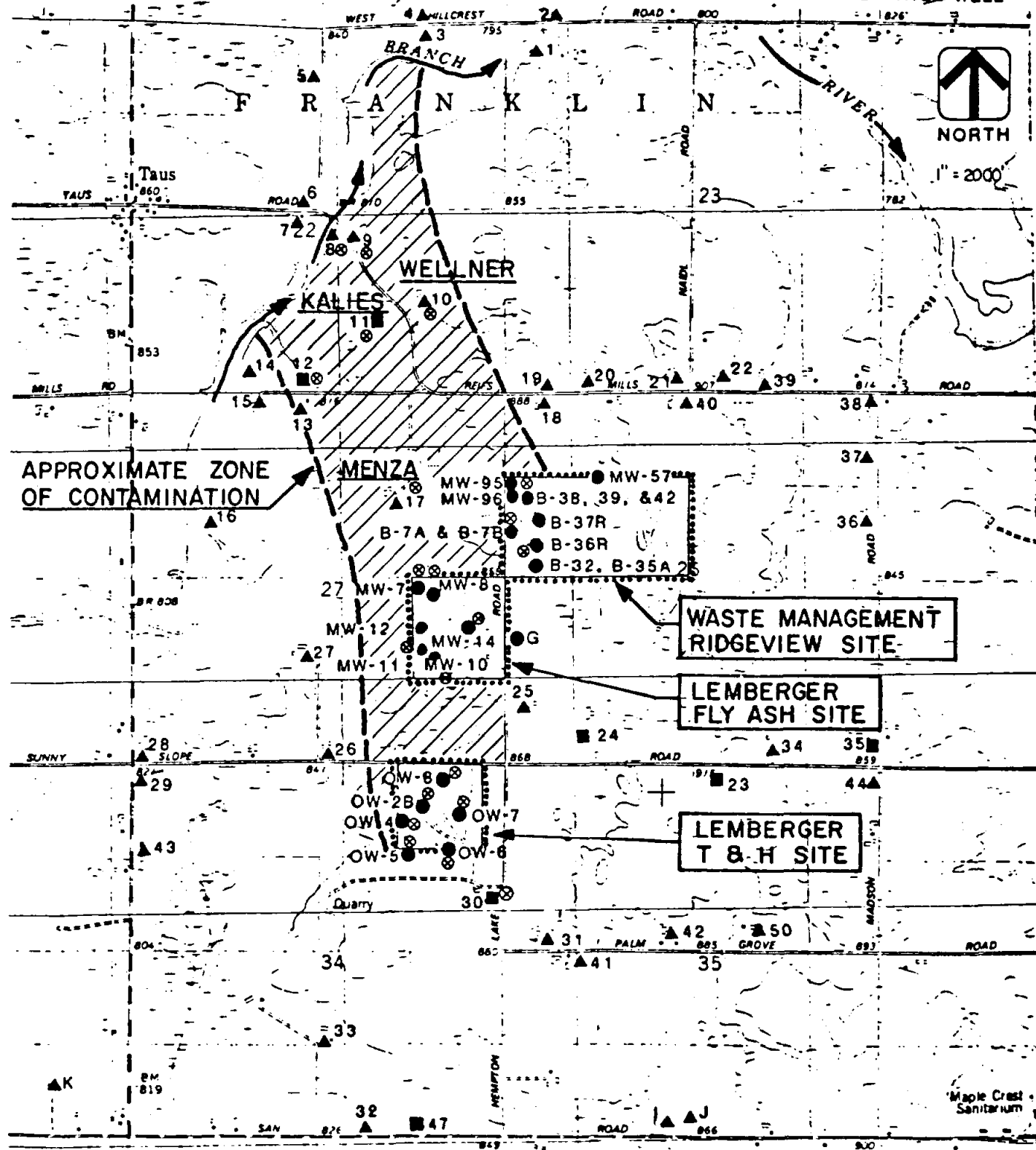


FIGURE #1
 SITE LOCATION MAP
 FRANKLIN TOWNSHIP

MAP BASE
 FROM SOIL EXPLORATION REPORT, SEP. 12, 1985 - 5 -

AYRES
 ASSOCIATES
 Engineers
 Architects
 Planners
 Surveyors

A particular importance of this geologic setting is that it is common to the Fly Ash and T & H Sites as well as the Ridgeview Site. The depth to any specific geologic unit will certainly vary from one site to another but the forces that shaped the geologic environment at all three sites were the same and acted at the same time. The end result is that the geologic conditions at all three sites are very similar.

D. Findings

A review of the available documents indicates that the three landfills, identified and located as shown in Figure 1, have released leachate which contains the contaminants observed in the wells on private properties to the West and Northwest of the sites.

1. T and H Site

The infield conditions, as defined by RMT, lists numerous industrial wastes which were dumped at this southern most site. This site was operated as a Wisconsin DNR licensed "Toxic and Hazardous" waste site from 1970 through 1976. During this period several hundred thousands of gallons of liquid and semi liquid wastes were dumped into the site.(12).

Groundwater sampling and analyses conducted by the DNR and SEC confirm that the contaminants found in the polluted private wells were also found in groundwater beneath the T & H site(11), (14). The data also documents the West-Northwest flow of groundwater from this site to the area of the impacted wells.

2. Fly Ash Site

The Environmental Investigation Report(13) presents the findings of the historical review, the in-field investigations and the laboratory analyses conducted on this site. The site was licensed by the DNR from 1969 to 1976. Prior to 1976 the site was operated by the Township of Franklin as a municipal refuse dump.

Conclusions in this report indicate that groundwater flowing through coarse grained outwash deposits has been contaminated by leachate which was moving to the west of the site(13).

Groundwater sampling data reported by SEC shows five of the six monitoring wells sampled to contain volatile organic compounds. This data is included in Table 1. Of these five wells, four are screened in the soil overburden and one is screened in the Niagara Dolomite. The compounds reported include those found in the impacted private wells. The report also documents the bedrock groundwater piezometric gradient to the northwest, in the general direction of the impacted private wells.

Table 1
From Table 7 of Reference (11).

PP Volatile Compounds <u>ug/l = ppb</u>	Lemberger Fly Ash Site					
	<u>MW-7</u>	<u>MW-8</u>	<u>MW-10</u>	<u>MW-11</u>	<u>MW-12</u>	<u>MW-14</u>
Benzene			31.9	15.6		8.8
Carbon Tetrachloride						
Chlorobenzene						
Chlorodibromomethane						
Chloroethane			49.3	37.3		
Chloroform						
Dichlorobromoethane						
Dichlorodifluoromethane						
1,1 Dichloroethane	6.1		1016	69.6		6.5
1,2 Dichloroethylene						
1,1 Dichloroethylene						
1,2 Dichloropropane			14.9			
Ethyl Benzene			234.7			52.4
Methylene Chloride			22470			
Tetrachloroethylene						63.4
Toluene			2215			28.1
1,2-Trans-Dichloroethylene	1.8	2.4	7988	25.8		266.4
1,1,1-Trichloroethane			10.4	54.2		
1,1,2-Trichloroethane						
Trichloroethylene			51	12.6		17.0
Vinyl Chloride			357.5			49.8
Note: MW-10 results are averaged over 2 duplicates MW-10 phenol concentration of 3300 ppb						
Total VOC	7.8	2.4	34438.6	215.1	0	492.4

3. Ridgeview Site

The Ridgeview Sanitary Landfill has been licensed by the DNR and operated since 1975. Since that time typical municipal refuse from the surrounding region and various industrial wastes have been placed in the landfill(1),(3),(5),(15). Leachate has been generated, as at all landfills, by downward percolation of precipitation through the refuse. The amount of percolation is greatest during the landfilling phase of the operation and continues after final covering(8),(9),(10).

On December 12, 1985 the leachate generated at the Ridgeview site was sampled by Ayres Associates and forwarded to Zimpro Inc. in Rothchild for testing of volatile organic compounds. The results, included in Table 2, confirm the presence of numerous organic compounds and specifically four of the pollutants found in the private wells, namely; 1,1-Dichloromethane, 1,2-Dichloroethylene, 1,1,1-Trichloroethane and Trichloroethylene.

~~WELL~~ THE SAMPLE WAS TAKEN FROM THE LEACHATE LIFT STATION.

Table 2

Ayres Associates
 VOC Analysis (ug/l)

~~WATER TAP SAMPLES~~
~~OF THE...~~

	<u>Detection Limit</u>	<u>Ayres #768 Leachate - Lift Station</u>
Benzene	2.0	71.
Bromoform	5.0	X
Bromomethane	10.0	X
Carbon Tetrachloride	1.0	X
Chlorobenzene	1.0	X
Chloroethane	10.0	24.
2-Chloroethylvinyl Ether	20.0	X
Chloroform	1.0	X
Chloromethane	60.0	X
Dibromochloromethane	1.0	X
1,2-Dichlorobenzene	3.0	X
1,3-Dichlorobenzene	3.0	X
1,4-Dichlorobenzene	3.0	8.0
Dichlorobromomethane	1.0	X
1,1-Dichloroethane	1.0	137.
1,2-Dichloroethane	3.0	7.0
1,1-Dichloroethylene	5.0	X
1,2-Dichloroethylene	3.0	133.
Dichloromethane	2.0	2,030.
1,2-Dichloropropane	5.0	22.
cis-1,3-Dichloropropene	3.0	X
trans-1,3-Dichloropropene	10.0	X
Ethylbenzene	2.0	72.
1,1,2,2-Tetrachloroethane	1.0	X
Tetrachloroethylene	1.0	23.
Toluene	1.0	440.
1,1,1-Trichloroethane	1.0	10.
1,1,2-Trichloroethane	1.0	X
Trichloroethylene	1.0	37.
Vinyl Chloride	5.0	19.
Trichlorofluoromethane	2.0	X
Dichlorodifluoromethane	200.0	X
Zimpro Analytical No.		15561

X = Analyzed but not detected

Table 2
(Continued)

Ayres Associates
VOC Analysis (ug/l)

	<u>Detection Limit</u>	<u>Ayres #767 L-3 Leachate</u>
Benzene	5.0	590.
Bromoform	13.0	X
Bromomethane	25.0	X
Carbon Tetrachloride	2.5	X
Chlorobenzene	2.5	X
Chloroethane	25.0	X
2-Chloroethylvinyl Ether	50.0	X
Chloroform	2.5	X
Chloromethane	150.0	X
Dibromochloromethane	2.5	X
1,2-Dichlorobenzene	7.5	X
1,3-Dichlorobenzene	7.5	X
1,4-Dichlorobenzene	7.5	X
Dichlorobromomethane	2.5	X
1,1-Dichloroethane	2.5	15.
1,2-Dichloroethane	7.5	X
1,1-Dichloroethylene	13.0	X
1,2-Dichloroethylene	7.5	13.
Dichloromethane	5.0	56.
1,2-Dichloropropane	13.0	X
cis-1,3-Dichloropropene	7.5	X
trans-1,3-Dichloropropene	25.0	X
Ethylbenzene	5.0	X
1,1,2,2-Tetrachloroethane	2.5	X
Tetrachloroethylene	2.5	X
Toluene	2.5	150.
1,1,1-Trichloroethane	2.5	X
1,1,2-Trichloroethane	2.5	X
Trichloroethylene	2.5	X
Vinyl Chloride	13.0	27.
Trichlorofluoromethane	5.0	X
Dichlorodifluoromethane	500.0	X
Zimpro Analytical No.		15563

X = Analyzed but not detected

U.S. EPA investigations, reports of the Wisconsin DNR and reports of other out-of-state agencies show that typical leachate from municipal sanitary landfills contain many halogenated organic compounds including those detected in the impacted private wells to the west and northwest. Sabel and Clark(16) report, " leachate analysis show some volatiles to be ubiquitous in leachates". Kmet and McGinley(17), indicate that, "Because of the wide variety of organic chemicals utilized in manufacturing processes and products one would expect to also find numerous synthetic organic compounds in MSW leachate." Other on-going studies of the presence of halogenated compounds in municipal solid waste leachates also show that the leachates commonly do contain the contaminants found in the impacted wells.

The original Ridgeview Site layout(1), as proposed in 1974 is shown in Figure 2 which is contained in the pocket of the back cover of this report. The groundwater contours of the overburden water table, as determined by soil borings done in 1974, is also included in this figure. The groundwater flow direction was generally westward across the site and then to the southwest as the water leaves the site. Overburden water level monitoring included in documents, References 1 through 10 covering the period of 1974 through 1983, and the levels of 8 of 12 wells measured in the SEC report(11), April, 1985 shows the levels presented in Figure 2 have been consistent over the eleven years of record.

The site, as originally licensed, was designed to contain about 100,000 cubic yards of refuse(2). Through vertical expansion the original licensed acreage now contains approximately 1,000,000 cubic yards of waste, nearly 10 times the original design(10).

Figure 3 (back pocket) is a plan view of the site as presented in the Revised Site Operations Plan Addendum, April 29, 1981, and shows the location of several geologic cross-sections. Two of the cross-sections, labeled D-D' and E-E', are shown in Figures 4 and 5, respectively. These sections depict the upper 30-50 feet of the sub-surface soil information across the site in an east-west direction. Alternating coarse and fine grained soil layers are present and the positioning of the landfill trench bottoms with respect to the coarse grained, outwash soils can be seen. Also shown on Figure 3 are the locations of two additional hydrogeologic sections which were prepared by Ayres Associates from the available data. These two cross-sections are shown in Figures 6 and 7 (back pocket). Figure 7 is a north-south trending cross-section located on the Ridgeview site west of the refuse filled area. Figure 6 is a typical east-west trending cross-section. This section extends from the eastern side of the site, to the area of the impacted wells to the west and northwest of the site.

Both figures depict the sub-surface conditions beneath and west of the landfill including the alternating coarse and fine soils, the Niagara Dolomite, the overburden water table and the deeper dolomite aquifer. The waste containment area and typical leachate levels are shown in Figure 6. Leachate head monitoring well, L-3 is represented on this section and documents the leachate's presence in the Area 3 portion of the landfill base. These two cross-sections clearly show the presence of coarse grained, outwash soils underlying the landfill and sloping downwardly to the west and northwest. Also, the gradients of both the overburden and the bedrock aquifers indicate that the groundwater flow direction is to the west and northwest. Well pairs 7A and 7B, and 38 and 39 show the existence of a head differential of the near surface (10-12 ft.) and intermediate depth (25 ft.) water levels that clearly indicate downward vertical components of the near surface water in the soils along the western edge of the site. This is shown in Figure 7.

Of great importance to the consideration of leachate migration from the Ridgeview site is the fact that Areas 1 through 4 are unlined. Rather than having a low hydraulic conductivity compacted clay barrier beneath the refuse to impede leachate migration, this site is designed with the intended migration of leachate through the soil.

how do you know.

Another consideration in the review of the Ridgeview site is the positioning of the refuse fill areas with respect to surface

drainage paths leading from the site. Figure 6 shows the downward sloping surface topography to the west. Surface drainage from the west side of the site crosses under Hempton Lake Road through a culvert and drains off to the west in swales to a low lying area west of the Ridgeview site and north of the Fly Ash side.

What is the horizontal scale of Figure 6

On-going leachate seeps at the toe of the west berm on the west edge of the site are documented by numerous DNR inspection reports to have occurred since early in the site life, and have been observed as recently as August 27, 1985 during a site inspection by Ayres Associates personnel. A typical location of the leachate seeps is shown in Figure 6.

E. Conclusion

A generalized groundwater flow map is shown in Figure 8. The arrows show the general direction of groundwater flow from the vicinity of the three landfill sites. The flow direction has been obtained from the data in the documents listed herein(11),(13).

LEGEND

● VOLATILE ORGANIC COMPOUND
CONTAMINATION DETECT

LEGEND

● MONITORING WELL OR OBSERVATION
WELL USED IN THIS STUDY

▲ INCOMPLETE DATA ON PRIVATE WATER WELL

■ COMPLETE DATA ON PRIVATE WATER WELL

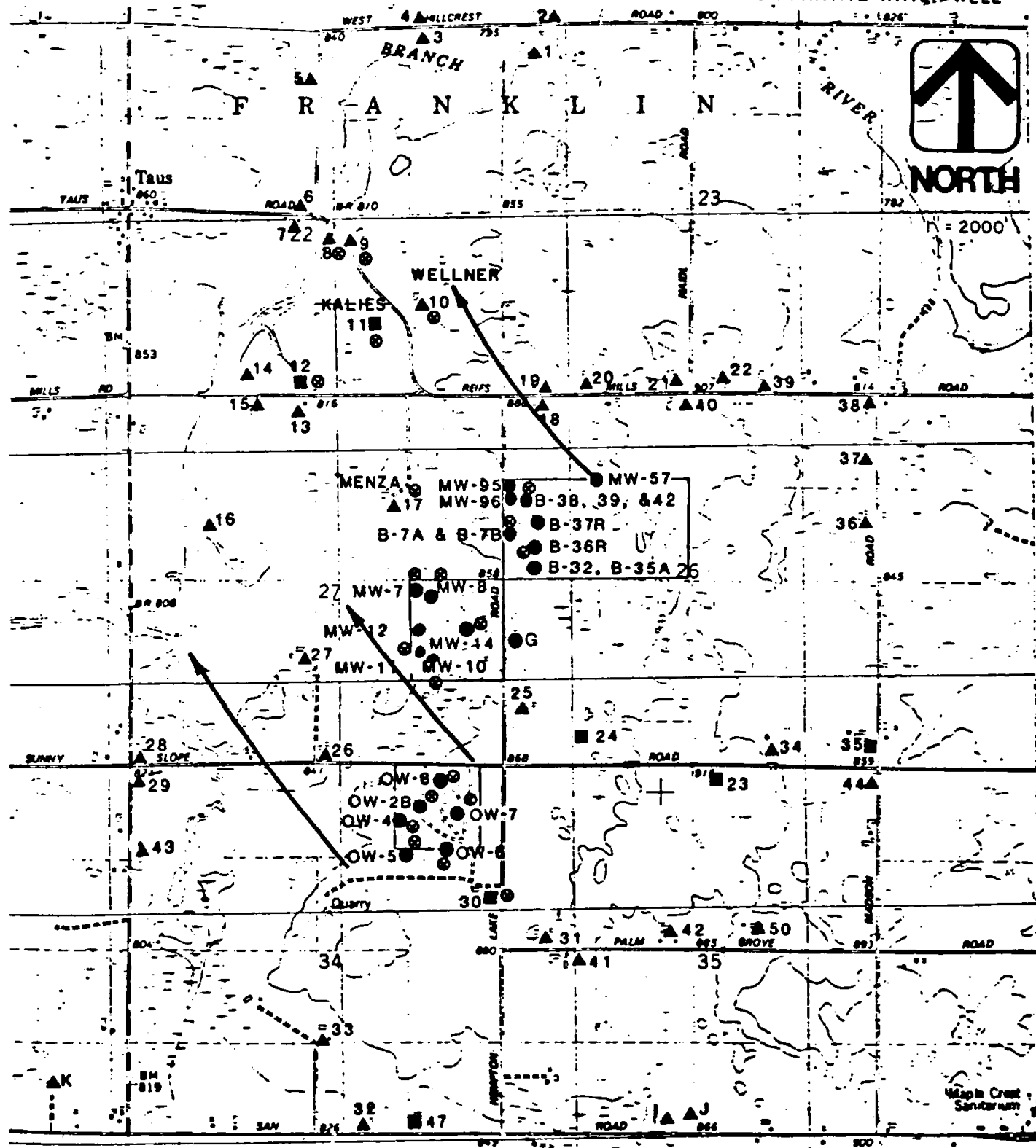


FIGURE 8
GENERALIZED GROUNDWATER FLOW

As detailed herein, many similarities exist among the three landfills discussed. These similarities include: soil conditions; the downward slope toward the impacted wells of the site surfaces, the bedrock beneath them and the groundwater beneath each; and the presence of organic compounds at each landfill that were found in the impacted wells. Along with the conclusion in the SEC report, that "The available data suggest that ground water contamination occurring in the private wells located northwest of the three landfills is originating from either the T & H Site and/or from portions of the Lemberger Fly Ash Site", it is herein further concluded that the Ridgeview Site is also highly likely a cause of the documented groundwater contamination to the West and Northwest.



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5	Master Project Number <u>GLO 67340</u>	6 Project Start Date (mon/yr) <u>6, 87</u>
7	Site Name <u>Lemberger Transport & Recycling</u>	
8	Site Location <u>Whitelaw, WI</u>	
9	Description (limited to 100 characters/spaces) <u>Report of Investigation (March, 1986)</u>	
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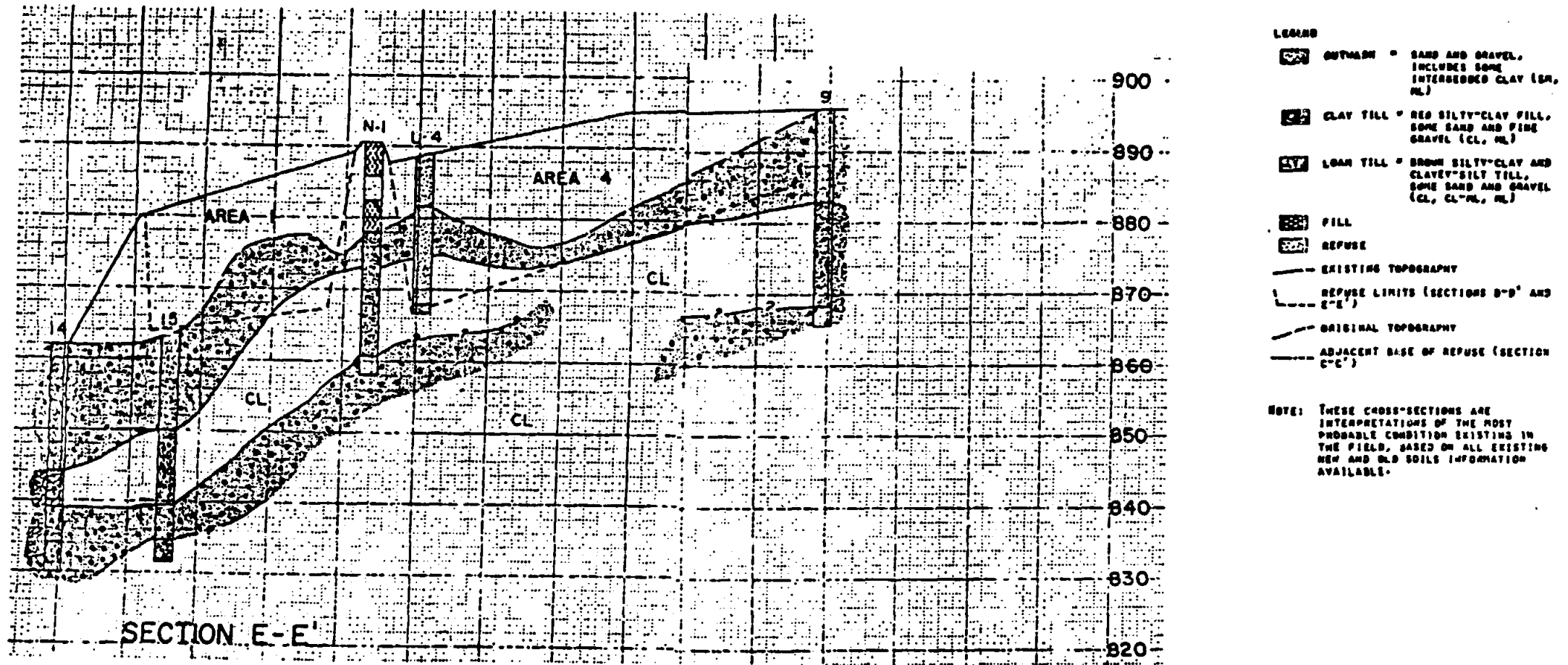
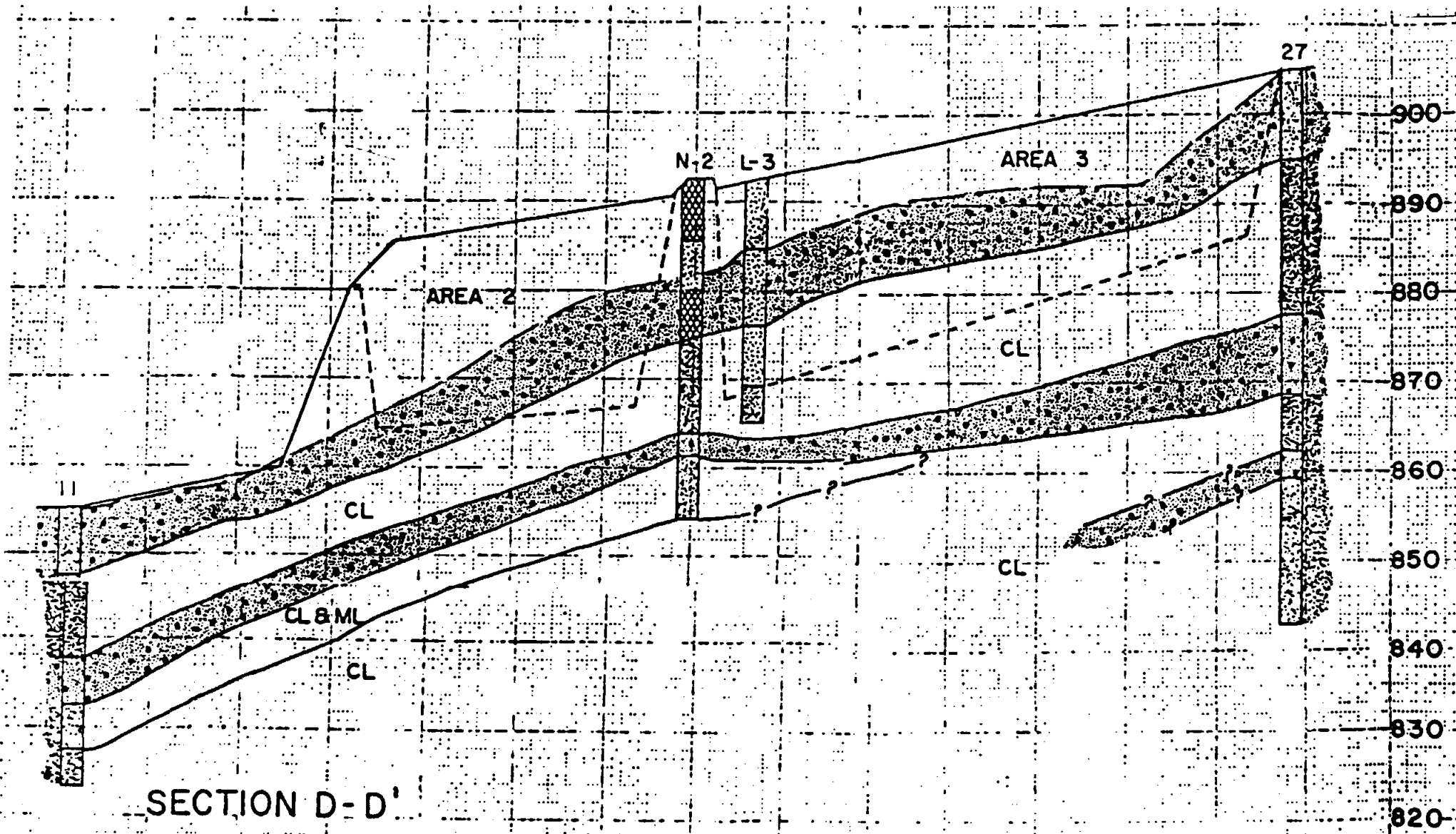


FIGURE 5

FROM: REVISED SITE OPERATIONS PLAN ADDENDUM APRIL 29, 1981 - RMT



- LEGEND**
- OUTWASH** = SAND AND GRAVEL, INCLUDES SOME INTERBEDDED CLAY (SM, ML)
 - CLAY TILL** = RED SILTY-CLAY FILL, SOME SAND AND FINE GRAVEL (CL, ML)
 - LOAM TILL** = BROWN SILTY-CLAY AND CLAYEY-SILT TILL, SOME SAND AND GRAVEL (CL, CL-ML, ML)
 - FILL**
 - REFUSE**
 - EXISTING TOPOGRAPHY**
 - REFUSE LIMITS (SECTIONS D-D' AND E-E')**
 - ORIGINAL TOPOGRAPHY**
 - ADJACENT BASE OF REFUSE (SECTION C-C')**

NOTE: THESE CROSS-SECTIONS ARE INTERPRETATIONS OF THE MOST PROBABLE CONDITIONS EXISTING IN THE FIELD, BASED ON ALL EXISTING NEW AND OLD SOILS INFORMATION AVAILABLE.

FIGURE 4

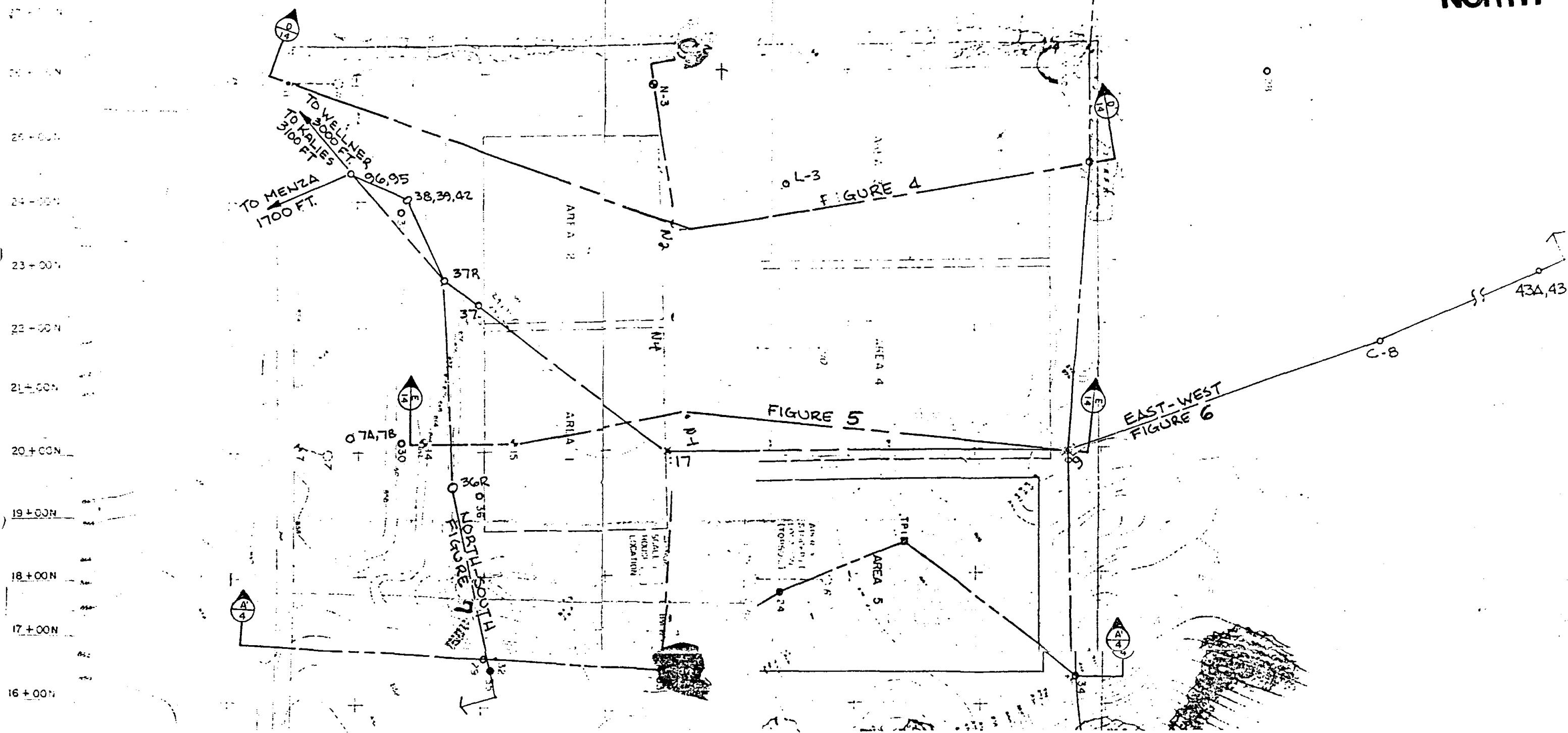


FIGURE 3
CROSS-SECTION LOCATIONS

FROM: REVISED SITE OPERATIONS PLAN ADDENDUM APRIL 29, 1981 - RMT
(PRESENT RIDGEVIEW SITE)



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3	Work Assignment Number 164 - 5LJ4	4 EPA Region IV
5	Master Project Number GLO 67340	6 Project Start Date (mon/yr) 6, 87
7	Site Name Lemberger Transport & Recycling	
8	Site Location Whitelaw, WI	
9	Description (limited to 100 characters/spaces) Report of Investigation (March, 1986)	
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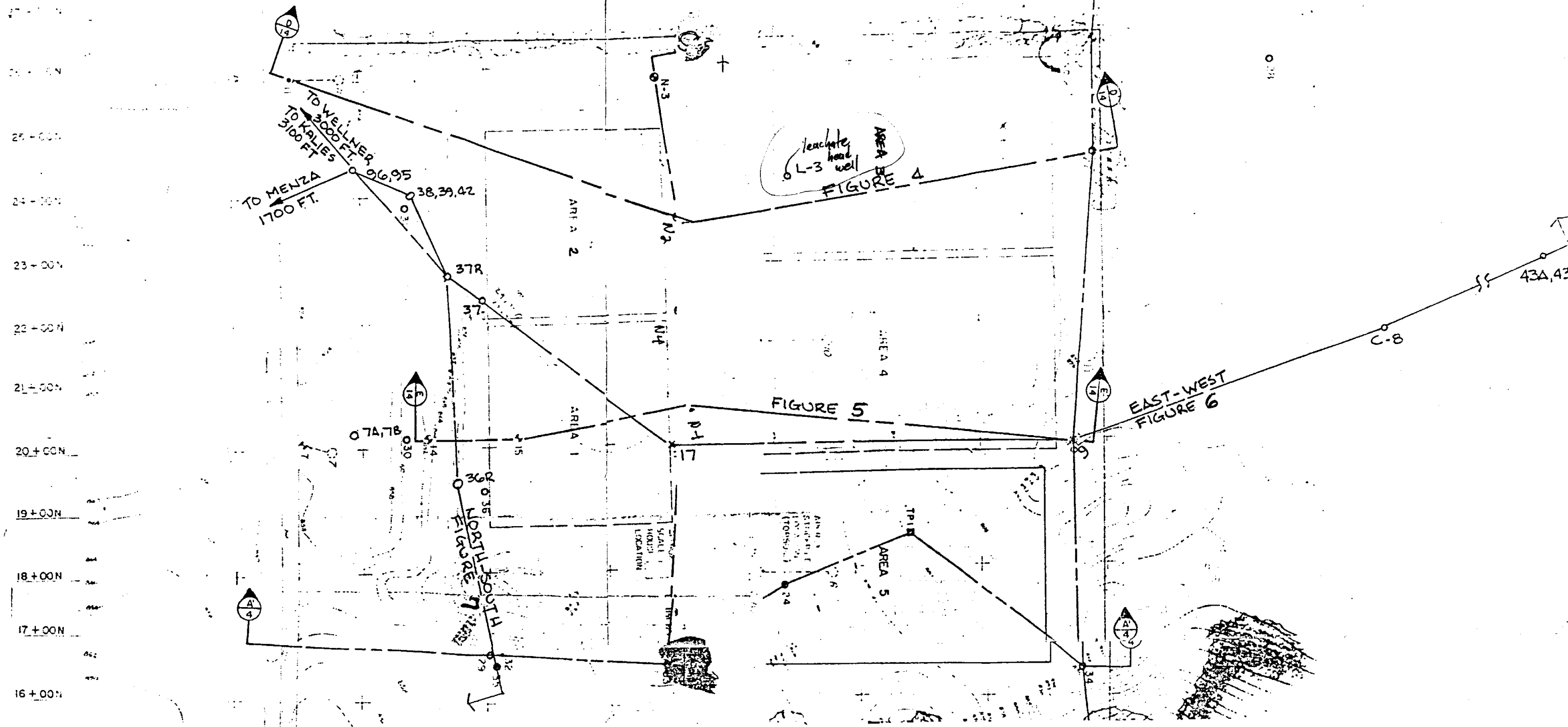


FIGURE 3
CROSS-SECTION LOCATIONS

FROM: REVISED SITE OPERATIONS PLAN ADDENDUM APRIL 29, 1981 - RMT
(PRESENT RIDGEVIEW SITE)



Engineers
Architects
Planners
Surveyors



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File Originator	Team Member's Firm CH2M HILL <input type="checkbox"/> B&V <input checked="" type="checkbox"/> E&E <input type="checkbox"/> ICF <input type="checkbox"/> PRC <input type="checkbox"/> Subcontractor <input type="checkbox"/> _____	
2	Site Manager's Name <u>Anestis S. Avramidis</u>	Office Location <u>Chicago</u>
Site Manager	Site Manager's Firm CH2M HILL <input type="checkbox"/> B&V <input checked="" type="checkbox"/> E&E <input type="checkbox"/> ICF <input type="checkbox"/> PRC <input type="checkbox"/>	
3	Work Assignment Number <u>164 - 5LJ4</u>	4 EPA Region <u>II</u>
5	Master Project Number <u>GLO 67340</u>	6 Project Start Date (mon/yr) <u>6, 87</u>
7	Site Name <u>Lemberger Transport & Recycling</u>	
8	Site Location <u>Whitelaw, WI</u>	
9	Description (limited to 100 characters/spaces) <u>Report of Investigation (March, 1986)</u>	
Section/ Subsection	_____	
10	(These comments will not become part of the indexing information.)	
Comments	_____	
_____	_____	
_____	_____	
FOR ZPMO USE	(Oversize Documents) <p style="text-align: center;"><u>2</u> OVERSIZE PAGE(S) WERE REMOVED FROM THIS LOCATION FOR 35MM FILMING.</p> <p style="text-align: center;">REFERENCE: <u>OS-5</u> <u>OS-6</u></p>	

CERTIFICATE OF AUTHENTICITY

I N T E N T A N D P U R P O S E

This is to certify that the microphotographic images appearing on this microfilm record, starting with the CH2M HILL Index Form for REM IV File Closeout through to the end of the section heading, are accurate reproductions of the actual records of the Zone II REM IV Contract, U.S. Environmental Protection Agency Contract No. 68-01-7251.

I further certify that the photographic processes used for microfilming these records were accomplished in a manner and on microfilm that meet the recommended requirements of the National Bureau of Standards for permanent microphotographic reproductions.

B+B RECORDS CTR.

Service Bureau

Sherry Long

Camera Operator

Supervisor

Peg Gunglach

Date Microfilmed

March, 1991

Note to Service Bureau: Return the records microphotographed on the microfilm record to CH2M HILL only after you have inspected the microfilm record for completeness of coverage.

**CH2M HILL
INDEX FORM
FOR REM IV FILE CLOSEOUT**
(Please print legibly or type.)

If it is more convenient, when indexing the file, complete those sections that will remain the same through the majority of the site file (nos. 1 through 8). Then photocopy this form onto colored paper (to make it more obvious in the file) and complete nos. 9 and 10 as necessary.

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Section/ Subsection		
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Comments	<u>This references site Lemberger Fly Ash</u> <u>W.A.# 164-5LJ4</u>	
FOR ZPMO USE	(Oversize Documents) <p style="text-align: center;">OVERSIZE PAGE(S) WERE REMOVED FROM THIS RECORD FOR 35MM FILMING. SEE END OF RECORD FOR 35MM FICHE.</p>	