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*Rec. Sept 6/91
By Courier*

September 5, 1991

Mr. D.L. Wotton
Director, Winnipeg Region
Environmental Operations
Building 2
139 Tuxedo Avenue
Winnipeg, Manitoba
R3N 0H6

Dear Mr. Wotton:

RE: Manitoba Department of Environment Order #0457

Please find enclosed a copy of the report detailing the results of Section 2 of the aforementioned order. This report is submitted on behalf of our client in accordance with the provisions of the order.

Once your staff has reviewed the report, we would appreciate a meeting to discuss the contents.

Yours truly,

I.D. SYSTEMS LTD.

A handwritten signature in blue ink, appearing to read 'G.B. Murray'.

G.B. Murray, P. Eng.

cc: C. Chappel - Aikens, MacAuley & Thorvaldson
attach.

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**INVESTIGATION INTO LEAD
CONTAMINATION AT NORTH WEST
SMELTING & REFINING LTD.
2185 LOGAN AVENUE
WINNIPEG, MANITOBA**

Prepared for:

Mr. C.L. Chappell
Aikens, MacAulay & Thorvaldson
30th Floor
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August 1991

Report Distribution: Environment- 1 copy; Aikens, MacAulay
& Thorvaldson -2 copies; I.D. Systems Ltd.- 2 copies

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Executive Summary:

On January 21, 1991 Manitoba Environment issued an order (Order #0457) to North West Smelting and Refining Ltd (NWSR) to perform an investigation to determine the degree and extent of lead contamination in the soil, the leachability of the lead in the soil and if the groundwater has been contaminated with lead.

Nine (9) piezometers and eight (8) shallow test holes were installed on the North West Smelting and Refining property.

Each piezometer is constructed of slotted 508 mm (2 in) PVC pipe covered with geosox, the upper 0.6 M (2 ft) of the piezometer is solid PVC pipe. The piezometers were installed into the water table or the undisturbed till, the piezometer depths range from 2.4 to 5.2 M (8 - 17 ft). Piezometer boreholes were not extended deeper than the upper 2 M (6 ft) of the undisturbed till interface as to minimize the migration of lead contamination deeper into the overburden.

Soil samples were collected at the following intervals:

0 - 0.2 M
0.2 - 0.5 M
0.9 - 1.1 M
1.4 - 1.5 M
1.8 - 2.0 M
2.3 - 2.4 M
2.7 - 2.9 M
3.5 - 4.1 M
4.9 - 5.2 M

A total of sixty-six (66) soil samples were analyzed for total lead and leachate (concentration in extract) concentration.

The total lead concentration varied from 197,000 ug/g to 30 ug/g and the leachate concentration varied from 166 mg/L to <0.04 mg/L. TH8 had the highest concentration of lead contamination and TH1 had the lowest lead concentration. All testholes were found to be contaminated, the lead concentration varied with depth.

From the surface to a depth of 0.2 M (0.6 ft) all testholes were contaminated except TH1, TH2 and TH6, as shown on FIGURE 2. At a depth of 0.6 - 1.5 M (2-5 ft) the contamination is limited to total lead in the area surrounding TH10 and total lead and leachate contamination in portions of the north half of the property.

At a depth of 2.0 - 2.5 M (6.5-8.2 ft) the total lead and leachate contamination is concentrated in the northern third of the property, the area of landfilled refinery and battery recycling debris and an area of total lead contamination is centred around TH14 and 15. At a depth of 2.5 - 3.5 M (8.2-11.5 ft) total lead and leachate contamination exists

in the north west third of the property, a small plume of total lead contamination is centred around TH14.

The vertical extent of contamination was not delineated in TH1, TH5, TH8 and TH14. To minimize the further migration of contamination into the undisturbed overburden the test holes were extended into the water table or into the undisturbed till. It was originally expected that the contamination had not migrated into the undisturbed overburden.

Nine ground water samples collected from the piezometers were submitted for analysis of dissolved lead concentration. All water samples were revealed to be contaminated, they contained dissolved lead concentrations in excess of the Guidelines for Canadian Drinking Water Quality of 0.01 mg/L. The dissolved lead concentration ranged from 0.055 for TH8 and TH12 to 3.0 mg/L for TH10. Retesting of the groundwater has been initiated.

Surface ground water was encountered in seven of the seventeen testholes. All piezometers contained water after they were allowed to sit undisturbed for two weeks. Depth to water level readings were collected on three occasions. The ground water table elevations indicates that the surface ground water tends to flow towards the northwest corner of the property

1.0 INTRODUCTION

On January 21, 1991 Manitoba Environment issued an order (Order #0457) to North West Smelting and Refining Ltd (NWSR) to perform an investigation to determine the degree and extent of lead contamination in the soil, the leachability of the lead in the soil and if the groundwater has been contaminated with lead. The order issued by Manitoba Environment is included as APPENDIX A. North West Smelting and Refining requested I.D. Systems Ltd. (IDS) to perform the investigation.

IDS began the site drilling program on May 15, 1991 due to rain the drilling program was not completed until May 21, 1991. Water sampling was completed on June 4, 1991.

2.0 INVESTIGATION PROGRAM

2.1 SOIL INVESTIGATION

Nine (9) piezometers and eight (8) shallow test holes were installed on the North West Smelting and Refining property. The locations of the piezometers and test holes are shown as FIGURE 1. Each piezometer is constructed of slotted 508 mm (2 in) PVC pipe covered with geosox, the upper 0.6 M (2 ft) of the piezometer is solid PVC pipe. The piezometers were installed into the water table or the undisturbed till, the piezometer depths range from 2.4 to 5.2 M (8 - 17 ft). Piezometer boreholes were not extended deeper than the upper 2 M (6 ft) of the undisturbed till interface as to minimize the migration of lead contamination deeper into the overburden. The borehole annulus was backfilled with pea stone to 0.6 M (2 ft) of the surface, the remainder of the annulus was backfilled with bentonite enviropug. The piezometer was capped with a screw cap and then a steel protector cap.

The piezometer boreholes were logged, the logs are contained in APPENDIX B. Soil samples were collected at the following intervals:

0 - 0.2 M
0.2 - 0.5 M
0.9 - 1.1 M
1.4 - 1.5 M
1.8 - 2.0 M
2.3 - 2.4 M
2.7 - 2.9 M
3.5 - 4.1 M
4.9 - 5.2 M

The debris and stones in the upper 2.3 M of the overburden made it impossible to collect soil samples utilizing a split spoon sampler, therefore the soil samples were collected from the auger flight. Once the clayey till was encountered samples were collected utilizing a split spoon sampler. The auger flight and split spoon were cleaned between holes with a high pressure water wash.

The shallow testholes were augured to a depth of 1 M (3 ft). Soil samples were collected from the auger flight at the surface (0 - 0.2 M) and at the bottom of the testhole (0.9 - 1.1 M). The shallow testholes were abandoned by backfilling with bentonite enviroplug.

2.2 GROUND WATER INVESTIGATION

The piezometers were allowed to sit undisturbed for two weeks to allow the ground water to reach a static level. The depth to water level was recorded and the piezometers were evacuated and allowed to return to the static level, water samples were then collected. This procedure insures that the sample is collected from the surrounding overburden and has not been compromised by concentrating the contaminants in the piezometer. The water samples were submitted for laboratory analysis in containers supplied by the laboratory.

3.0 RESULTS

3.1 SITE FEATURES

The NWSR site is located at 2185 Logan Avenue, Winnipeg. The battery recycling operation is housed on the south end of the property in a complex of buildings that was formerly a refinery. The land behind the buildings is vacant with some piles of metal and plastic battery case debris. The northern third of the property is approximately 0.5 M (1.6 ft) higher in elevation than the existing property and approximately 1.3 M (4.3 ft) higher in elevation than the property to the north. This area consists of clay capped debris fill from the refinery and the battery recycling operation. A drainage ditch runs

along the northern property boundary.

3.2 GEOLOGY

The NWSR property is underlain by the Ordovician age, Gunn Member of the Stony Mountain Formation which consists of a calcareous shale with thin limestone interbeds, which is also the Upper Carbonate Aquifer. The overburden consists of 9 to 12 M (30 - 40 ft) of glacial till.

The northern part of the property consists of grass growing in a stoney topsoil overlying 0.5 M (1.5 ft) of clayey fill with stones, overlying 1 M (3 ft) of fill consisting of foundry debris, plastic battery case debris and clayey soil. This fill overlays the original black organics and clayey till. The undisturbed till was encountered at a depth of 2 - 3 M (6-10 ft).

The remainder of the property consists of approximately 1 M (3.2 ft) of gravel road fill, overlaying approximately 2 M (6.4 ft) of grey clay, overlaying silty stoney till which extends to the bottom of the test hole.

3.3 LABORATORY ANALYSIS

3.3.1 SOIL ANALYSIS

A total of sixty-six (66) soil samples were analyzed for total lead and leachate (concentration in extract) concentration, the laboratory report is attached as APPENDIX C. The analysis was staged, in order to minimize costs and to give an early indication of the extent of contamination. The first stage involved analysis of the upper three samples from each piezometer testhole and both samples collected from each shallow testhole. The second stage analysis continued the analysis consecutively down the testhole, the analysis continued to one sample past the criteria of lead, total of 1000 ug/g (soil, dry weight) and lead, leachate of 5 mg/L (concentration in extract) cited by Manitoba Environment. The results of the laboratory analysis are presented as TABLE 1.

The total lead concentration varied from 197,000 ug/g to 30 ug/g and the leachate concentration varied from 166 mg/L to <0.04 mg/L. TH8 had the highest concentration of lead contamination and TH1 had the lowest lead concentration. All testholes were found to be contaminated, the lead concentration varied with depth.

From the surface to a depth of 0.2 M (0.6 ft) all testholes were contaminated except TH1, TH2 and TH6, as shown on FIGURE 2. At a depth of 0.6 -1.5 M (2-5 ft) the contamination is limited to total lead in the area surrounding TH10 and total lead and leachate contamination in portions of the north half of the property, as shown on FIGURE 3.

TABLE 1: NWSR - Laboratory Soil Analysis

Sample Description	Depth (M)	Depth (ft)	Leachate (mg/L)	Total Lead (ug/g)
1R1	0 - 0.2	0 - 0.5	0.15	37
1R2	0.3 - 0.5	1.0 - 1.5	0.06	30
1R3	0.6 - 0.8	2.0 - 2.5	424	115000
1R7	2.3 - 2.4	7.5 - 8.0	59.1	65800
1R8	2.9 - 3.2	9.5 - 10.5	57.6	13100
1R9	3.8 - 4.1	12.5 - 13.5	0.14	503
1R10	4.9 - 5.2	16.0 - 17.0	<0.04	68
2R1	0 - 0.2	0 - 0.5	0.45	235
2R2	0.6 - 0.9	2.0 - 3.0	152	5700
3R1	0 - 0.2	0 - 0.5	44.6	5820
3R2	0.3 - 0.5	1.0 - 1.5	37.7	725
3R3	0.9 - 1.1	3.0 - 3.5	55.8	2370
3R6	2.3 - 2.4	7.5 - 8.0	15.6	20200
3R7	2.7 - 2.9	9.0 - 9.5	1.0	244
3R8	3.5 - 3.7	11.5 - 12	2.21	629
4R1	0 - 0.2	0 - 0.5	0.76	138
4R3	0.9	3.0	101	18800
5R1	0 - 0.2	0 - 0.5	15.1	1440
5R2	0.3 - 0.5	1.0 - 1.5	27.2	6620
5R3	0.9 - 1.1	3.0 - 3.5	60.0	17500
5R6	2.1 - 2.7	7.0 - 9.0	82.0	39800
6R1	0 - 0.2	0 - 0.5	1.03	286
6R2	0.6 - 1.1	2.0 - 3.5	56.0	158000
7R1	0 - 0.2	0 - 0.5	40.0	2950
7R3	1.2 - 1.5	4.0 - 5.0	110	57100
8R1	0 - 0.2	0 - 0.5	142	85500
8R2	0.3 - 0.5	1.0 - 1.5	65.6	51900
8R4	1.4 - 1.5	4.5 - 5.0	166	197000
8R6	2.3 - 2.4	7.5 - 8.0	58.8	40900
8R7	2.7 - 2.9	9.0 - 9.5	7.45	2970

TABLE 1: NWSR - Laboratory Soil Analysis Con't

Sample Description	Depth (M)	Depth (ft)	Leachate (mg/L)	Total Lead (ug/g)
9R1	0 - 0.2	0 - 0.5	113	12100
9R3	0.8 - 1.1	2.5 - 3.5	2.00	510
10R1	0 - 0.2	0 - 0.5	76.0	77000
10R2	0.2 - 0.5	0.5 - 1.5	74.0	62500
10R3	0.9 - 1.1	3.0 - 3.5	61.8	45700
10R4	1.4 - 1.7	4.5 - 5.5	7.2	2590
10R5	1.8 - 2.1	6.0 - 7.0	1.51	84
10R6	2.3 - 2.4	7.5 - 8.0	0.16	92
11R1	0 - 0.2	0 - 0.5	62.2	69800
11R2	0.9 - 1.1	3.0 - 3.5	0.59	754
12R1	0 - 0.2	0 - 0.5	62.8	75100
12R2	0.3 - 0.6	1.0 - 2.0	104	31200
12R3	0.9 - 1.2	3.0 - 4.0	0.14	54
12R4	1.4 - 1.5	4.5 - 5.0	1.85	96
13R1	0 - 0.2	0 - 0.5	92.6	95700
13R2	0.9 - 1.1	3.0 - 3.5	23.0	701
14R1	0 - 0.2	0 - 0.5	99.6	93800
14R2	0.2 - 0.5	0.5 - 1.5	98.0	78900
14R3	0.9 - 1.1	3.0 - 3.5	92.0	10100
14R4	1.4 - 1.5	4.5 - 5.0	20.0	8280
14R5	1.8 - 2.0	6.0 - 6.5	1.42	1010
14R6	2.3 - 2.4	7.5 - 8.0	0.04	2170
15R1	0 - 0.2	0 - 0.5	53.2	107000
15R2	0.3 - 0.5	1.0 - 1.5	32.4	90700
15R3	0.9 - 1.1	3.0 - 3.5	97.6	10900
15R5	1.8 - 2.0	6.0 - 6.5	97.8	20000
15R6	2.3 - 2.4	7.5 - 8.0	2.77	1660
15R7	2.7 - 2.9	9.0 - 9.5	.052	188

TABLE 1: NWSR - Laboratory Soil Analysis Con't

Sample Description	Depth		Leachate (mg/L)	Total Lead (ug/g)
	(M)	(ft)		
16R1	0 - 0.2	0 - 0.5	85.5	45400
16R2	0.3 - 0.5	1.0 - 1.5	51.2	105000
16R3	0.9 - 1.1	3.0 - 3.5	130	40900
16R5	1.8 - 2.0	6.0 - 6.5	0.15	203
16R6	2.3 - 2.4	7.5 - 8.0	0.14	395
16R7	2.7 - 2.9	9.0 - 9.5	0.31	111
17R1	0 - 0.2	0 - 0.5	27.5	5870
17R2	0.7 - 1.1	2.5 - 3.5	0.79	293

At a depth of 2.0 - 2.5 M (6.5-8.2 ft) the total lead and leachate contamination is concentrated in the northern third of the property, the area of landfilled refinery and battery recycling debris and an area of total lead contamination is centred around TH14 and 15, as shown on FIGURE 4. At a depth of 2.5 - 3.5 M (8.2-11.5 ft) total lead and leachate contamination exists in the north west third of the property, a small plume of total lead contamination is centred around TH14, as shown on FIGURE 5.

The vertical extent of contamination was not delineated in TH1, TH5, TH8 and TH14. To minimize the further migration of contamination into the undisturbed overburden the test holes were extended into the water table or into the undisturbed till. It was originally expected that the contamination had not migrated into the undisturbed overburden.

3.3.2 GROUND WATER ANALYSIS

Nine ground water samples collected from the piezometers were submitted for analysis of dissolved lead concentration. The laboratory report is attached as APPENDIX C. The results of the analysis are presented as TABLE 2. All water samples were revealed to be contaminated, they contained dissolved lead concentrations in excess of the Guidelines for Canadian Drinking Water Quality of 0.01 mg/L. The dissolved lead concentration ranged from 0.055 for TH8 and TH12 to 3.0 mg/L for TH10.

TABLE 2: NWSR - Laboratory Ground Water Analysis

SAMPLE DESCRIPTION	LEAD (mg/L)
TH1	0.085
TH3	0.035
TH5	0.150
TH8	0.055
TH10	3.00
TH12	0.055
TH14	0.075
TH15	0.060
TH16	0.110

The dissolved lead concentration of 3.0 mg/L revealed for TH10 during the laboratory analysis is surprisingly high, as the subsurface total lead concentration, 77,000 ug/g and leachate concentration, 76.0 mg/L were high but not the highest found on the property. With this in mind it has been decided to resample and analyze the groundwater. The results will confirm/dispel the relatively high reading obtained from TH10. Results of this resampling will be forwarded upon their availability.

3.4 GROUND WATER CONDITIONS

Surface ground water was encountered in seven of the seventeen testholes. All piezometers contained water after they were allowed to sit undisturbed for two weeks. Depth to water level readings were collected on three occasions. From these readings the elevation of the ground water table was determined, the ground water table elevations are presented as TABLE 3.

TABLE 3: NWSR - Ground Water Elevations

Date	Location								
	TH1	TH3	TH5	TH8	TH10	TH12	TH14	TH15	TH16
May 30, 1991	98.608	98.617	98.616	98.835	98.699	99.073	98.793	98.585	97.868
June 4, 1991	98.548	98.593	98.599	98.835	98.879	99.063	99.037	98.687	99.148
Aug. 13, 1991	98.183	98.435	98.541	98.81	98.744		98.732		98.818

The ground water table elevations indicates that the surface ground water tends to flow towards the northwest corner of the property, as shown on FIGURES 6 and 7.

4.0 DISCUSSION

A total of sixty-six (66) soil samples were analyzed for total lead and leachate (concentration in extract) concentration.

The total lead concentration varied from 197,000 ug/g to 30 ug/g and the leachate concentration varied from 166 mg/L to <0.04 mg/L. TH8 had the highest concentration of lead contamination and TH1 had the lowest lead concentration. All testholes were found to be contaminated, the lead concentration varied with depth.

From the surface to a depth of 0.2 M (0.6 ft) all testholes were contaminated except TH1, TH2 and TH6, as shown on FIGURE 2. At a depth of 0.6 -1.5 M (2-5 ft) the contamination is limited to total lead in the area surrounding TH10 and total lead and leachate contamination in portions of the north half of the property.

At a depth of 2.0 - 2.5 M (6.5-8.2 ft) the total lead and leachate contamination is concentrated in the northern third of the property, the area of landfilled refinery and battery recycling debris and

an area of total lead contamination is centred around TH14 and 15. At a depth of 2.5 - 3.5 M (8.2-11.5 ft) total lead and leachate contamination exists in the north west third of the property, a small plume of total lead contamination is centred around TH14.

The vertical extent of contamination was not delineated in TH1, TH5, TH8 and TH14. To minimize the further migration of contamination into the undisturbed overburden the test holes were extended into the water table or into the undisturbed till. It was originally expected that the contamination had not migrated into the undisturbed overburden.

Nine ground water samples collected from the piezometers were submitted for analysis of dissolved lead concentration. All water samples were revealed to be contaminated, they contained dissolved lead concentrations in excess of the Guidelines for Canadian Drinking Water Quality of 0.01 mg/L. The dissolved lead concentration ranged from 0.055 for TH8 and TH12 to 3.0 mg/L for TH10.

The dissolved lead concentration of 3.0 mg/L revealed for TH10 during the laboratory analysis is surprisingly high, as the subsurface total lead concentration, 77,000 ug/g and leachate concentration, 76.0 mg/L were high but not the highest found on the property. With this in mind it has been decided to resample and analyze the groundwater. The results will confirm/dispel the relatively high reading obtained from TH10. Results of this resampling will be forwarded upon their availability.

Surface ground water was encountered in seven of the seventeen testholes. All piezometers contained water after they were allowed to sit undisturbed for two weeks. Depth to water level readings were collected on three occasions. The ground water table elevations indicates that the surface ground water tends to flow towards the northwest corner of the property

With the permission of our client, we would be pleased to meet with the Environment Department at their earliest convenience to discuss these findings and further investigation requirements.

APPENDIX A

Manitoba Environment Order



Environment

Building 2
139 Tuxedo Avenue
Winnipeg, Manitoba, CANADA
R3N 0H6

January 21, 1991

Mr. William Holt
North West Smelting & Refining Ltd.
314 Bower Blvd.
Winnipeg, Manitoba
R3P 0L5

Dear Sir:

Re: Manitoba Department of Environment Order #0457

This order is issued to you as principal of North West Smelting and Refining Ltd., at 2185 Logan Avenue, Winnipeg, Manitoba by the Director, Winnipeg Region, Environmental Operations Division, Manitoba Department of Environment.

Based on the results of tests performed by Department Environment Officers at 2185 Logan Avenue, and on the past practice of disposing of battery wastes on the site, we have concerns regarding soil contamination as well as the potential for groundwater contamination. Concentrations of lead in soil were far above interim remediation criteria currently being used by this Department.

Our present criteria for commercial industrial properties is as follows:

Lead, Total - 1000 ug/g (soil, dry weight)
Lead, Leachate - 5 mg/l (concentration in extract)

Under the terms of Section 16 of The Manitoba Dangerous Goods Handling and Transportation Act, North West Smelting and Refining Ltd. is hereby ordered to:

1. Retain the services of an approved environmental consultant to develop a soil and ground water monitoring plan for the property at 2185 Logan Avenue. The purpose of this plan is to determine *i)* the degree and extent of lead contamination in the soil; *ii)* the leachability of the lead in the soil; and *iii)* if the groundwater has been contaminated with lead. The plan must meet with the approval of the Department of Environment.
2. Carry out the sampling plan under the supervision of an Environment Officer.
3. Develop a plan regarding storage and disposal of batteries that will eliminate the potential for future contamination of the site.

Section 1 and Section 3 must be completed by March 31, 1991. A report detailing the results of Section 2 must be submitted to the Department of Environment by August 1, 1991.

If you have any questions regarding this matter, please contact me at 945-7081, Dave Ediger at 945-7039, Don Labossiere at 945-7094 or Brian Durupt at 945-7016.

Yours truly,

D. L. Wotton
Director, Winnipeg Region
Environmental Operations



APPENDIX B

Testhole and Piezometer Soil Logs

North West Smelting and Refining Soil Logs

75 - 167

<u>Sample No.</u>	<u>Feet</u>	<u>Metre</u>	<u>Description</u>
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North West Smelting and Refining Soil Logs

File: 75-167

TH #1 - Northwest corner of property.

1R1	0 - 0.5	0 - 0.2	- clayey, stony topsoil, samples collected from auger flight due to stony soil conditions
1R2	1.0 - 1.5	0.3 - 0.5	- clayey fill, with large stones, up to 0.3 M
1R3	2.0 - 2.5	0.6 - 0.8	- foundry slag and clayey soil
1R4	3.0 - 3.5	0.9 - 1.1	- foundry slag and clayey soil
1R5	4.5 - 5.0	1.4 - 1.5	- foundry slag and clayey soil, water
1R6	6.0 - 6.5	1.8 - 2.0	- clay, with black organics
1R7	7.5 - 8.0	2.3 - 2.4	- clay, with black organics and some stones, split spoon
1R8	9.5 - 10.5	2.9 - 3.2	- clay, with black organics and some stones
1R9	12.5 - 13.5	3.8 - 4.1	- tan clay with some stones
1R10	16.0 - 17.0	4.9 - 5.2	- tan clay with some stones

TH #2 - Shallow hole, centre of north property line.

2R1	0 - 0.5	0 - 0.2	- clayey topsoil
2R2	2.0 - 3.0	0.6 - 0.9	- clayey fill with stones, large stone at 3'

North West Smelting and Refining Soil Logs

75 - 167

<u>Sample No.</u>	<u>Feet</u>	<u>Metre</u>	<u>Description</u>
TH #3 - Northeast corner of property.			
3R1	0 - 0.5	0 - 0.2	- grass, clayey topsoil
3R2	1.0 - 1.5	0.3 - 0.5	- stoney clay
3R3	3.0 - 3.5	0.9 - 1.1	- black clay with stones
3R4	4.5 - 5.0	1.4 - 1.5	- black clay with foundry fill, pieces of plastic likely battery cases
3R5	6.0 - 6.5	1.8 - 2.0	- clay with black organics and stones
3R6	7.5 - 8.0	2.3 - 2.4	- tan clay
3R7	9.0 - 9.5	2.7 - 2.9	- tan clay with pockets of silt
3R8	11.5 - 12	3.5 - 3.7	- tan clay

TH #4 - Shallow hole on east side of property.

4R1	0 - 0.5	0 - 0.2	- grass, clayey topsoil with silt pockets
	2.0 - 2.5	0.6 - 0.8	- brown, stoney clay
4R3	3.0	0.9	- foundry fill, including pieces of plastic

TH #5 - Southeast corner of property jog.

5R1	0 - 0.5	0 - 0.2	- sandy topsoil
5R2	1.0 - 1.5	0.3 - 0.5	- sandy clay topsoil
5R3	3.0 - 3.5	0.9 - 1.1	- stoney clay and foundry fill including pieces of plastic

North West Smelting and Refining Soil Logs

75 - 167

<u>Sample No.</u>	<u>Feet</u>	<u>Metre</u>	<u>Description</u>
5R4	4.5 - 5.0	1.4 - 1.5	- black clay and foundry fill
	6.5 - 7.0	2.0 - 2.1	- granular material with water, no sample obtained, it kept washing out of split spoon
	7.0	2.1	- granular material with some black clay
5R6	7.0 - 9.0	2.1 - 2.7	- grey clay

TH #6 - Shallow hole in centre of north piece of property.

6R1	0 - 0.5	0 - 0.2	- grass, sandy topsoil
6R2	2.0 - 3.5	0.6 - 1.1	- foundry fill with some black clay

TH #7 - Shallow hole on northwest property edge.

7R1	0 - 0.5	0 - 0.2	- grass, sandy topsoil
	2.0 - 3.0	0.6 - 0.9	- silt and clay, 3' start of foundry fill
7R3	4.0 - 5.0	1.2 - 1.5	- foundry fill including pieces of plastic

TH #8 - Southwest jog of property, near centre.

8R1	0 - 0.5	0 - 0.2	- sandy, clay fill including pieces of battery case plastic
8R2	1.0 - 1.5	0.3 - 0.5	- foundry fill
	3.0 - 3.5	0.9 - 1.1	- no sample, battery cable wrapped around the auger
8R4	4.5 - 5.0	1.4 - 1.5	- black powdery material, likely coal dust, water
8R5	6.0 - 6.5	1.8 - 2.0	- clay with black organics

North West Smelting and Refining Soil Logs

75 - 167

<u>Sample No.</u>	<u>Feet</u>	<u>Metre</u>	<u>Description</u>
TH #11 - Shallow hole on east side of building.			
11R1	0 - 0.5	0 - 0.2	- gravel road fill
11R2	3.0 - 3.5	0.9 - 1.1	- clay with black organics, gumbo
TH #12 - East side of building, near north end.			
12R1	0 - 0.5	0 - 0.2	- gravel road fill, samples collected from the auger flight
12R2	1.0 - 2.0	0.3 - 0.6	- gravel road fill
12R3	3.0 - 4.0	0.9 - 1.2	- clay with black organics, water, samples collected utilizing a split spoon
12R4	4.5 - 5.0	1.4 - 1.5	- grey clay
12R5	6.0 - 7.0	1.8 - 2.1	- grey clay with stony till inclusions
12R6	7.5 - 8.0	2.3 - 2.4	- grey clay with stoney till inclusions
TH #13 - Shallow hole, north east corner of the building.			
13R1	0 - 0.5	0 - 0.2	- clay fill, samples collected from the auger flight
13R2	3.0 - 3.5	0.9 - 1.1	- clay with black organics and sand
TH #14 - North of building			
14R1	0 - 0.5	0 - 0.2	- gravel fill, samples collected from auger flight
14R2	0.5 - 1.5	0.2 - 0.5	- gravel fill

North West Smelting and Refining Soil Logs

75 - 167

<u>Sample No.</u>	<u>Feet</u>	<u>Metre</u>	<u>Description</u>
14R3	3.0 - 3.5	0.9 - 1.1	- sandy organic fill, water
14R4	4.5 - 5.0	1.4 - 1.5	- grey clay, with some black organics
14R5	6.0 - 6.5	1.8 - 2.0	- grey clay
14R6	7.5 - 8.0	2.3 - 2.4	- grey clay, with small stoney inclusions, sample collected utilizing a split spoon

TH #15 - Centre of yard.

15R1	0 - 0.5	0 - 0.2	- granular fill with black organics, samples collected from the auger flight
15R2	1.0 - 1.5	0.3 - 0.5	- granular fill
15R3	3.0 - 3.5	0.9 - 1.1	- gravelly clay fill, with some black organics, water, samples collected utilizing a split spoon
15R4	4.5 - 5.0	1.4 - 1.5	- clay with black organics and some stones, very wet, samples collected from auger flight due to debris
15R5	6.0 - 6.5	1.8 - 2.0	- clay with black organics
15R6	7.5 - 8.0	2.3 - 2.4	- grey clay with stone inclusions
15R7	9.0 - 9.5	2.7 - 2.9	- grey clay with stone inclusions, sample collected utilizing a split spoon

TH #16 - Near concrete bunker.

16R1	0 - 0.5	0 - 0.2	- granular fill with plastic debris, samples collected from the auger flight
16R2	1.0 - 1.5	0.3 - 0.5	- granular fill with plastic debris

North West Smelting and Refining Soil Logs

75 - 167

<u>Sample No.</u>	<u>Feet</u>	<u>Metre</u>	<u>Description</u>
16R3	3.0 - 3.5	0.9 - 1.1	- clay with black organics, gumbo, water
16R4	4.4 - 5.0	1.4 - 1.5	- clay with black organics, gumbo, samples collected utilizing a split spoon
16R5	6.0 - 6.5	1.8 - 2.0	- clay with black organics grading into grey clay
16R6	7.5 - 8.0	2.3 - 2.4	- grey clay
16R7	9.0 - 9.5	2.7 - 2.9	- grey clay

TH #17 - Shallow hole, on west side of property.

17R1	0 - 0.5	0 - 0.2	- granular fill with plastic debris, samples collected from the auger flight
	0.5 - 2.5	0.2 - 0.7	- clayey granular fill with plastic debris
17R2	2.5 - 3.5	0.7 - 1.1	black clayey granular material, likely coal dust, water



NORWEST LABS

9938-67 Avenue
Edmonton, AB
T6E 0P5
(403) 438-5522

75-1167

DATE	11 JUL 91 15:50
P.O. NO.	
W.O. NO.	3 43504

I.D. SYSTEMS LTD.
905 WAVERLEY STREET
WINNIPEG, MB
R3T 5P4

G B MURRAY

SAMPLE DESCRIPTION			DIS HTLS 82104 Pb mg/L	METALS EPA 3050 Pb mg/kg
1	1R1		0.15	37
2	1R2		0.06	30
3	1R3		424	115000
7	1R7		59.1	65800
8	1R1	8	57.6	13100
9	1R1	9	0.14	503
10	1R1	10	< 0.04	68
11	2R1		0.45	235
12	2R2		152	57000
13	3R1		44.6	5820
14	3R2		37.7	725
15	3R3		55.8	2370
18	3R6		15.6	20200
19	3R1	7	1.00	244
20	3R1	8	2.21	629
21	4R1		0.76	138
22	4R3		101	18800
23	5R1		15.1	1440
24	5R2		27.2	6620
25	5R3		60.0	17500
27	5R6		82.0	39800
28	6R1		1.03	284
29	6R2		56.0	158000
30	7R1		40.0	2950
31	7R3		110	57100
32	8R1		142	85500
33	8R2		65.6	51900
34	8R1		166	197000
36	8R6		58.8	40900
37	8R1	7	7.45	2970
38	9R1		113	12100
39	9R3		2.00	510
40	10R1		76.0	77000
41	10R2		74.0	62500
42	10R3		61.8	45700

Att. G.B. Murray
1264 453 9012
Regards
E.C.V.

ANALYST



NORWEST LABS

9938-67 Avenue
Edmonton, AB
T6E 0P5
(403) 438-5522

75-16✓

DATE	11 JUN 91 12:19
P.O. NO.	8179
W.O. NO.	3 43753

I.D. SYSTEMS LTD.
905 WAVERLEY STREET
WINNIPEG, MB
R3T 5P4

NWSR
GWEN
04 06 91

DISS'VED
FURN' AAS

82104

PR
Lead

mg/L

SAMPLE DESCRIPTION

1	TH 1	0.085
2	TH 3	0.035
3	TH 5	0.150
4	TH 8	0.055
5	TH 10	3.00
6	TH 12	0.055
7	TH 14	0.075
8	TH 15	0.060
9	TH 16	0.110

Guidelines for Canadian
Drinking Water Quality
0.01 mg/L.

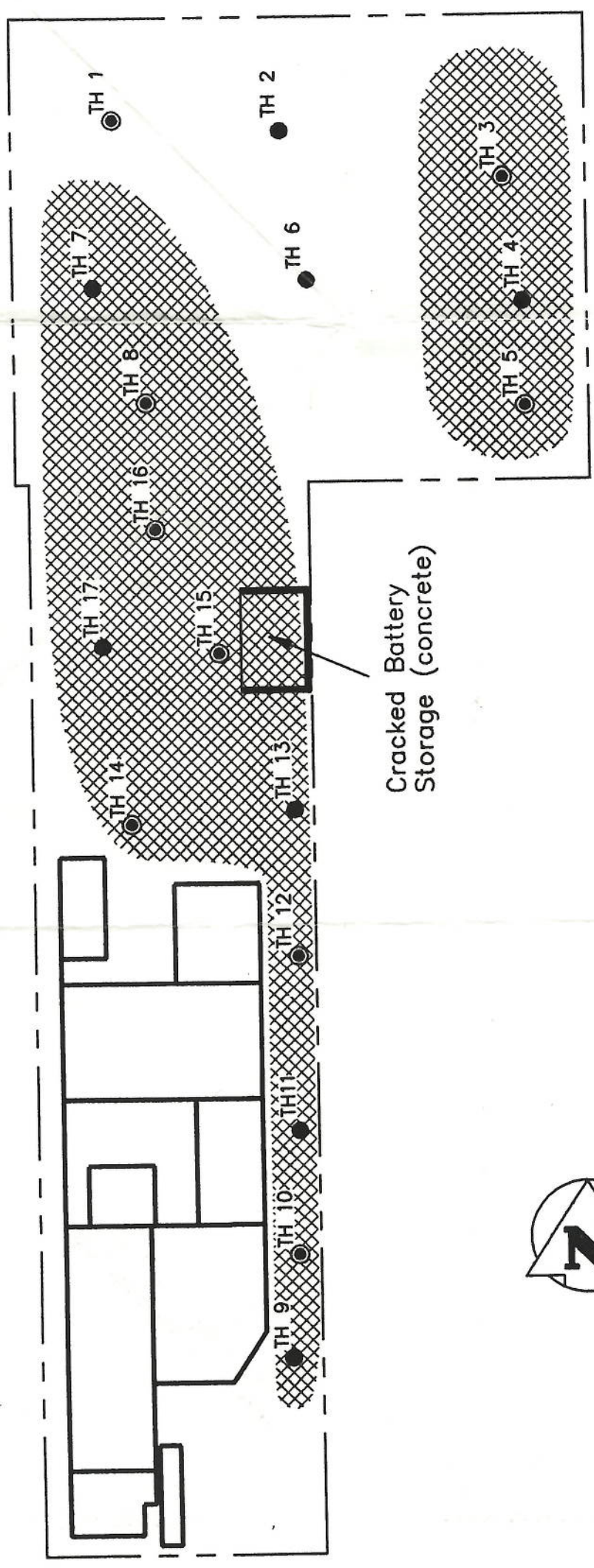
Atk Gwen

FAX 204.453.9012

Regards,

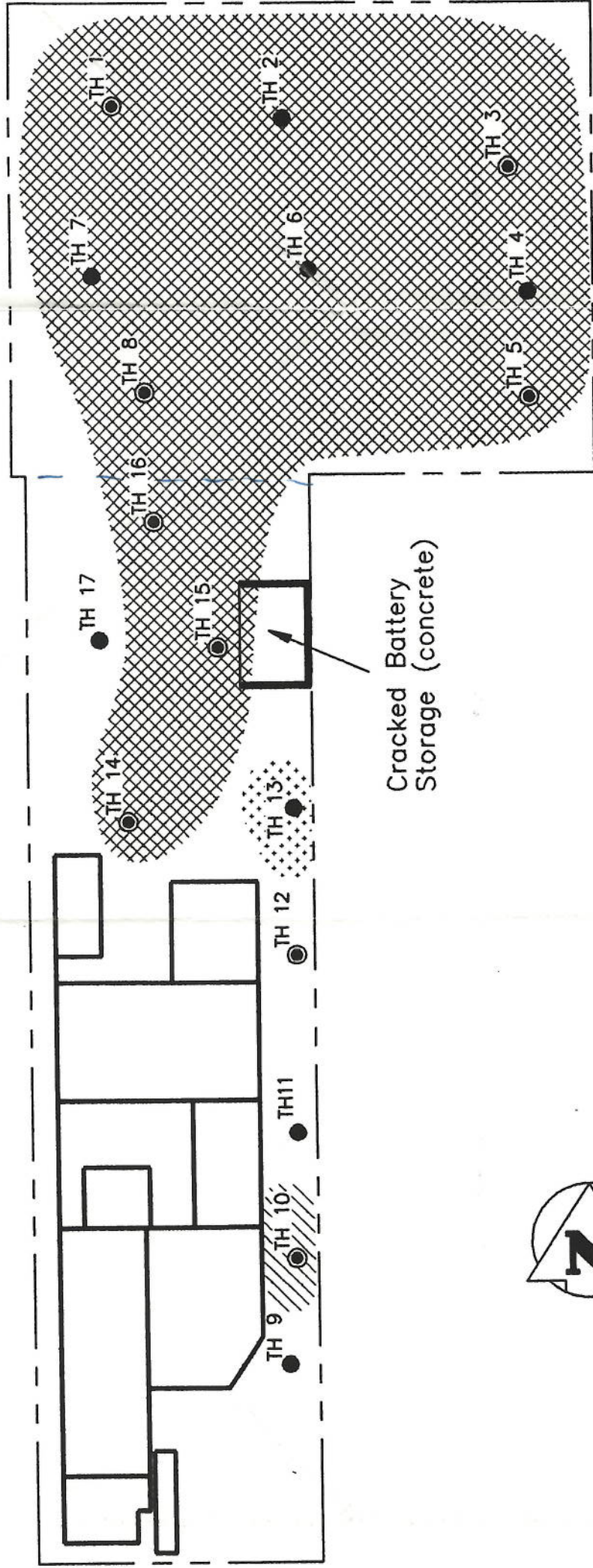
EW

ANALYST



- LEGEND**
- PIEZOMETER ●
 - TESTHOLE ●
 - TOTAL LEAD CONCENTRATION >1000 mg/kg and LEACHATE >5mg/L

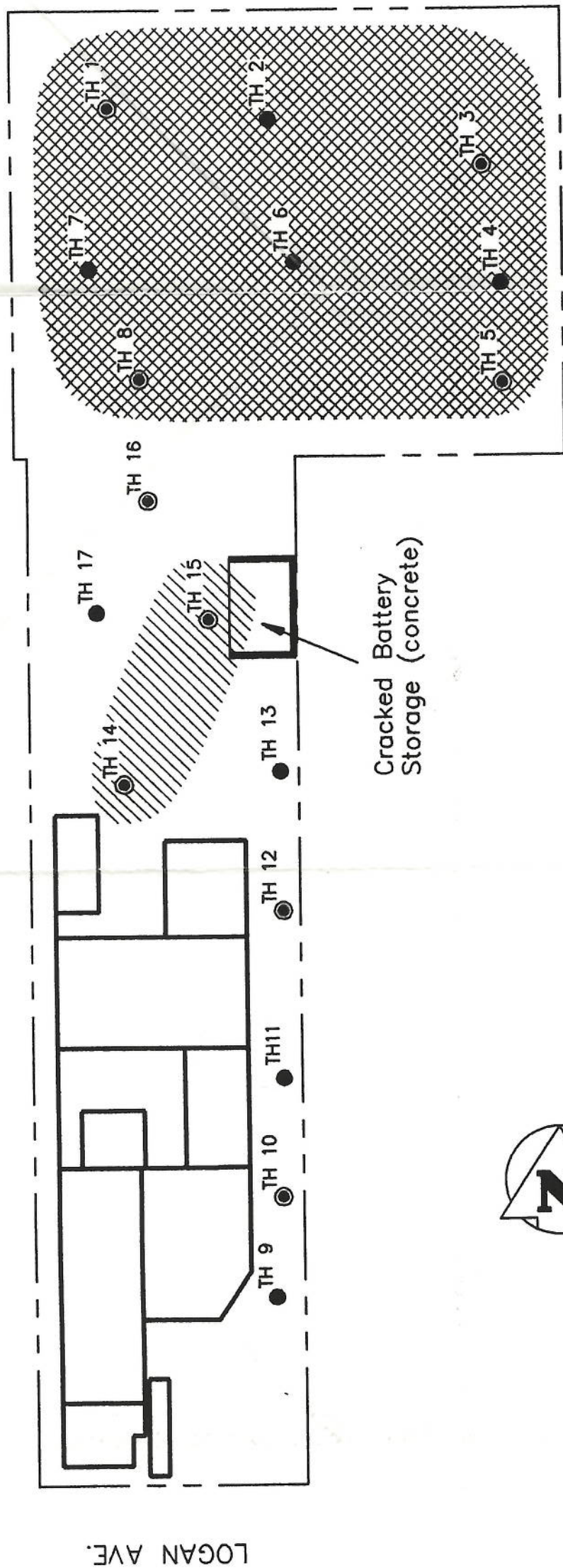
FIGURE 2 NORTH WEST SMELTING & REFINERY LTD ESTIMATED AREA OF TOTAL LEAD AND LEACHATE CONTAMINATION AT DEPTH OF 0-0.2 M 2185 LOGAN AVENUE, WINNIPEG, MANITOBA	
	DATE: JUNE 23/91 SCALE: 1:1000
DRAWN BY: T.S.H.	CHECKED BY: G.K.W. PROJ. NO.: 75-167



LEGEND

- PIEZOMETER ●
- TESTHOLE •
- TOTAL LEAD CONCENTRATION >1000 mg/kg
- TOTAL LEAD CONCENTRATION >1000 mg/kg and LEACHATE >5mg/L
- LEACHATE >5mg/L

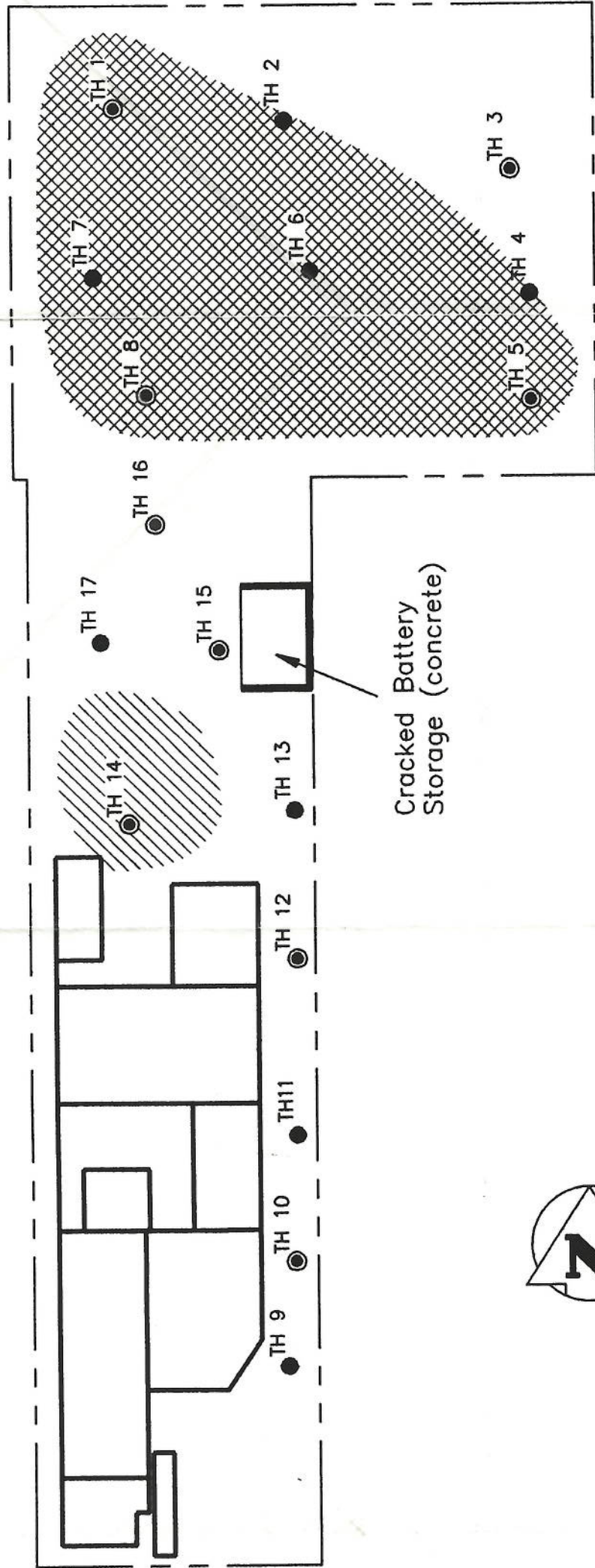
FIGURE 3 NORTH WEST SMELTING & REFINERY LTD ESTIMATED AREA OF TOTAL LEAD AND LEACHATE CONTAMINATION AT DEPTH OF 0.6-1.5 M 2185 LOGAN AVENUE, WINNIPEG, MANITOBA		IIDS I.D. SYSTEMS LIMITED ENVIRONMENTAL CONSULTANTS WINNIPEG, MANITOBA, CANADA		DATE: JUNE 23/91 SCALE: 1:1000
DRAWN BY: T.S.H.	CHECKED BY: G.K.W.	PROJ. NO.: 75-167		



LEGEND

- PIEZOMETER ●
- TESTHOLE ●
- TOTAL LEAD CONCENTRATION >1000 mg/kg
- TOTAL LEAD CONCENTRATION >1000 mg/kg and LEACHATE >5mg/L

FIGURE 4 NORTH WEST SMELTING & REFINERY LTD ESTIMATED AREA OF TOTAL LEAD AND LEACHATE CONTAMINATION AT DEPTH OF 2.0-2.5 M 2185 LOGAN AVENUE, WINNIPEG, MANITOBA		I.D. SYSTEMS LIMITED ENVIRONMENTAL CONSULTANTS WINNIPEG, MANITOBA, CANADA	DATE: JUNE 23/91 SCALE: 1:1000
DRAWN BY: T.S.H.	CHECKED BY: G.K.W.	PROJ. NO.: 75-167	



LEGEND

- PIEZOMETER
- TESTHOLE
- TOTAL LEAD CONCENTRATION >1000 mg/kg
- TOTAL LEAD CONCENTRATION >1000 mg/kg and LEACHATE >5mg/L

FIGURE 5 NORTH WEST SMELTING & REFINERY LTD

ESTIMATED AREA OF TOTAL LEAD AND LEACHATE CONTAMINATION AT DEPTH OF 2.5-3.5 M

2185 LOGAN AVENUE, WINNIPEG, MANITOBA

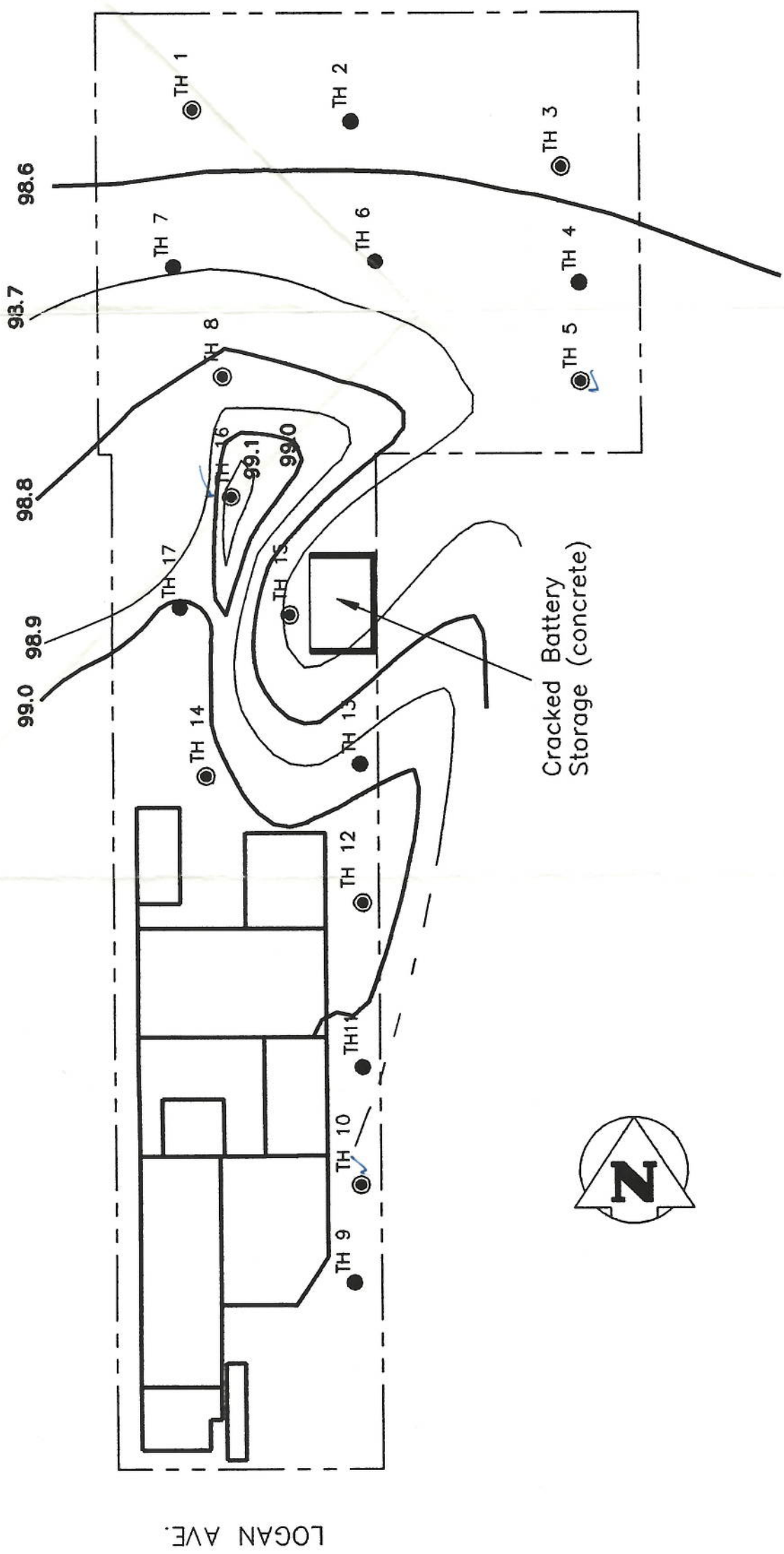
I.D. SYSTEMS LIMITED
ENVIRONMENTAL CONSULTANTS
WINNIPEG, MANITOBA, CANADA

DATE: JUNE 23/91
SCALE: 1:1000

DRAWN BY: T.S.H.

CHECKED BY: G.K.W.

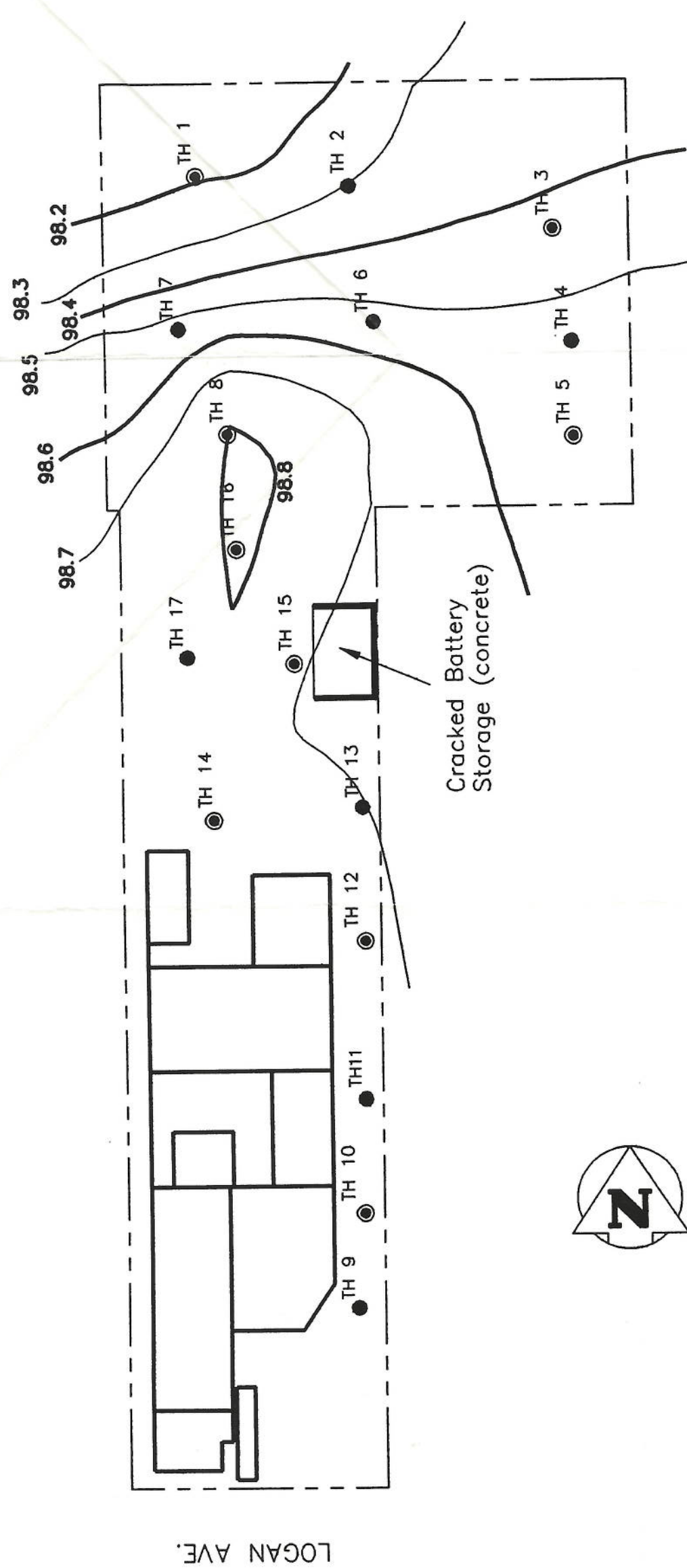
PROJ. NO.: 75-167



LEGEND

- PIEZOMETER ●
- TESTHOLE ●

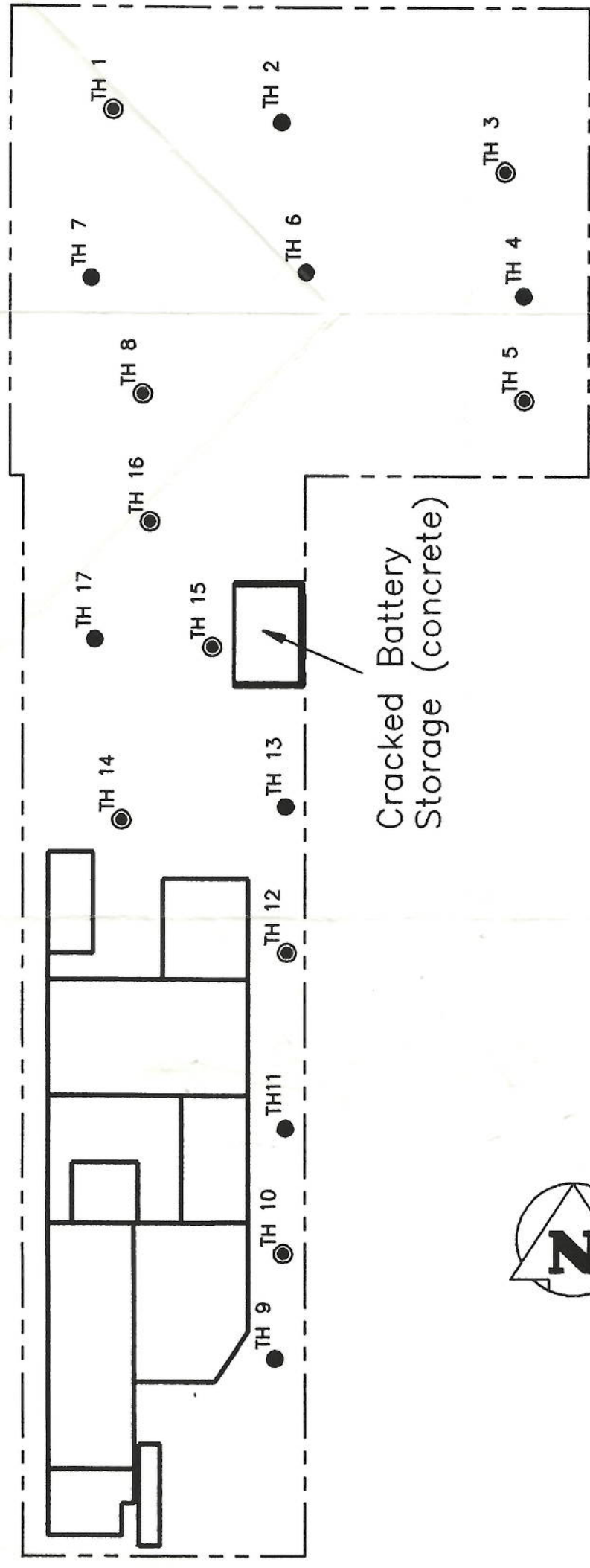
FIGURE 6 NORTH WEST SMELTING & REFINERY LTD GROUNDWATER PROFILE, JUNE 4, 1991 2185 LOGAN AVENUE, WINNIPEG, MANITOBA			
	I.D. SYSTEMS LIMITED ENVIRONMENTAL CONSULTANTS WINNIPEG, MANITOBA, CANADA		DATE AUG. 27, 1991 SCALE 1:1000
	DRAWN BY: T.S.H.	CHECKED BY: G.K.W.	PROJ. NO.: 75-167



LEGEND

- PIEZOMETER ●
- TESTHOLE ●

FIGURE 7 NORTH WEST SMELTING & REFINERY LTD			
GROUNDWATER PROFILE, AUGUST 13,1991			
I.D.S. SYSTEMS LIMITED ENVIRONMENTAL CONSULTANTS WINNIPEG, MANITOBA, CANADA		2185 LOGAN AVENUE, WINNIPEG, MANITOBA	
DATE AUG. 27,1991 SCALE 1:1000		PROJ. NO.: 75-167	
DRAWN BY: T.S.H.		CHECKED BY: G.K.W.	



Cracked Battery
Storage (concrete)



LEGEND

- PIEZOMETER ●
- TESTHOLE ●

FIGURE 1 NORTH WEST SMELTING
& REFINERY LTD

TESTHOLE LOCATIONS

2185 LOGAN AVENUE, WINNIPEG, MANITOBA

DATE: JUNE 23/91
SCALE: 1:1000

DRAWN BY: T.S.H. CHECKED BY: G.K.W. PROJ. NO.: 75-167