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FINAL REPORT A
QUALITY OF FILL DEPOSITED
AT LESLIE STREET SPIT
1963 to 1986

Prepared for:-
THE ONTARIO MINISTRY OF THE ENVIRONMENT

TROW HYDROLOGY CONSULTANTS LTD.

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FINAL REPORT A

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QUALITY OF FILL DEPOSITED
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1.0 INTRODUCTION

Trow Hydrology Consultants Ltd. (THCL) was retained by the Ontario Ministry of the Environment (MOE) to undertake a Borehole Reconnaissance program at the Outer Headland Harbour, Leslie Street Spit, on February 19, 1987, by telephone conversation and authorized by a meeting with Ministry officials on February 24, 1987.

The Terms of Reference for this investigation were to sample lakefill placed during construction of the Leslie Street Spit for the period from 1963 to 1986 and to characterize the quality of the fill as compared to the present fill quality guidelines introduced in 1982 by the MOE. This was undertaken by augering holes through the fill into the original lakebed at locations selected by the MOE.

This report documents the field program and is a factual summation of fill quality with some interpretation of the chemical data appended.

The borehole reconnaissance program commenced March 16, 1987 and was completed on April 1, 1987. During this program twenty (20) boreholes were advanced and two piezometers were installed, as requested by the MOE, at Boreholes 18 and 19 (Drawing 1 and Figure 1). Field notes, as requested, are summarized in Appendix A.

2.0 SITE DESCRIPTION

Construction of the Leslie Street Spit commenced in 1956, using non-controlled fill. Shorelines were armoured using rubble to minimize erosion by wave action. In the 1970's material from dredging operations in the Inner Harbour, was deposited along the northern shore of the Spit (Figure 2). Commencing in 1979, incoming fill was controlled by visual and olfactory inspection. In 1982, the MOE introduced the Lakefill Quality Assurance Program (LQAP) containing chemical fill quality guidelines. Lakefill tested after 1982 was reported to generally conform to the LQAP. In 1987 the proposed future activities at the Leslie Street Spit will include infilling of the interior cells using dredged fill and construction of an Inner Harbour Marina pier using incoming fill.

3.0 METHODOLOGY

3.1 Field Program

The borehole reconnaissance program commenced March 16, 1987 utilizing a CME 75 drill rig (from Atcost Soil Drilling Inc.) with a hollow stem auger. Continuous sampling was performed using a split-spoon sampler. The heterogeneity of fill encountered during drilling controlled the extent of borehole penetration at the Spit. As per our letter dated March 12, 1987 and telephone conversation with the Ministry's Mr. Choo-Ying, P. Eng. on March 18, 1986, "two attempts were to be made at each borehole location. If auger refusal occurred at both attempts, each hole should be logged and sampled and then the equipment moved to the next borehole location. Boreholes not experiencing refusal were to be advanced 0.5 m into the original lake bottom". The resultant depths of penetration at each borehole are included in Appendix B. Only Borehole 5 did not require off-setting. Boreholes 5, 8, 10, 16, 17 and 20 penetrated the original lake bottom.

Wash boring was required at boreholes situated within the hydraulically placed sands, to remove sand injected into the hollow stem auger by hydrostatic pressure. As indicated in Appendix B, wash boring was used in the drilling of Boreholes 6 and 7. Due to the fluid nature of the material encountered, deep samples were not obtained from these boreholes.

Each sample of fill was described and photographed. The samples were then composited over approximately every three (3) metre interval of core produced as outlined in the MOE's request for proposal.

The composited samples were divided in triplicate. One of the triplicate samples was sent to Technical Services Laboratory for analysis and the other two were stored at Trow's Storage Building as per the MOE's request.

On completion of each borehole, all down-the-hole equipment (auger flytes, split spoons, rods, etc.) was steam cleaned with a pressure jenny. The split spoon was cleaned after each use to minimize cross-contamination of samples.

Borehole elevations, as indicated on Drawing 1, were obtained with reference to the benchmarks on the hydro poles located along the road on the spine of the Spit. The benchmark geodetic elevations were recorded March 1981 by the Toronto Harbour Commissioners (THC).

All boreholes were backfilled to ground surface unless instrumented. The piezometers were constructed of flushed mounted, 38 mm (1½ inch) diameter PVC pipe and covered with a metal cap to deter instrument vandalism.

3.2 Laboratory Testing

The composited samples were analyzed by Technical Service Laboratories (TSL) using the method of "AQUA REGIA" as indicated in the LQAP. The parameters analyzed and their respective LQAP guidelines are listed in Appendix C. The methodology used by TSL for analysis is summarized in Appendix D.

3.3 Fill

The fill encountered at each borehole location was described using visual description and physical characterization and is summarized in Appendix B. Generally, the fill encountered ranged from clay to gravel with construction debris (concrete, brick and wood fragments). Organics and garbage (porcelain, glass, metal) were also observed. A cross-section of the Spit is included in Drawing 2 with the fill quality superimposed.

4.0 PROBLEMS ENCOUNTERED

During the drilling program, delays were encountered due to inclement weather conditions and periodic drilling problems. Because of delays in authorization for access by THCL to the Leslie Street Spit, the project did not start until March 16, 1987.

During the actual drilling, auger refusal on competent material (rubble, concrete, etc.) at depth, resulted in offsetting of the drill rig and redrilling. This caused increased drilling time then proposed.

5.0 DISCUSSION

Comparing the chemical results of the samples to the LQAP guidelines introduced in 1982, indicate that the lakefill generally does not meet the criteria with exception to the hydraulically placed sands that only marginally exceed the guidelines. Table 5.1 summarizes these data.

The MOE Lakefill Quality Guidelines specify that four (4) parameters: mercury (Hg), polychlorinated biphenyls (PCB's), lead (Pb) and cadmium (Cd) are High Priority Chemical Parameters (HPCP). Exceedance of any of these parameters renders the material unsuitable for lakefilling. Thirty-nine of the fifty-four samples analyzed exceed one or more of the HPCP. Seven of the remaining fifteen samples exceeded the parameters designated "under strict control".

Only two samples, from Boreholes 6 (BH6-1) and 7 (BH7-2), conformed to the MOE guidelines. Table 5.1 summarizes the samples and the respective chemical exceedances.

TABLE 5.1

Concentration of Chemical Parameters that Exceed LQAP Guidelines

Chemical Parameters and Concentrations

Borehole and Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease %	Volatile Solids ppm	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Ni ppm	Ag ppm	Total CN ppm
MOE Lakefill Quality Guidelines		0.3	0.05	50	1.0	1500	6	8.0	25.0	100.0	2000	25.0	25.0	0.5	0.1
BH 1-1	1963		0.053	310		1640			72			43			
BH 2-1	1964		0.063	610		1580	6.6		220	1120		81		3.1	
BH 2-2	1964					4200			42			53			
BH 3-1	1965		0.177	62					26			49			
BH 3-2	1965		0.063	73		1860			36			67			
BH 3-3	1965	0.40	0.222	130		4160			37			32			2.1
BH 4-1	1966		0.137	490		2340			30			46			

*High Priority Chemical Parameters

Chemical Parameters and Concentrations/Continue

Borehole and Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease %	Volatile Solids ppm	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Ni ppm	Ag ppm	Total CN ppm
MOE Lakefill Quality Guidelines		0.3	0.05	50	1.0	1500	6	8.0	25.0	100.0	2000	25.0	25.0	0.5	0.1
BH 4-2	1966		0.094	54		1980									
BH 5-1	1967			75				13	57			51			
BH 5-2	1967											41			
BH 5-3	1967			71								49			
BH 5-4	1967		0.270	65					31			48			1.6
BH 8-1	1968			430		6380	6.8		34			43			
BH 8-2	1968			80				42	28			51			0.11
BH 10-1	1969			190			12.0	25	32			45			
BH 10-2	1969						11.5	42							

*High Priority Chemical Parameters

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Chemical Parameters and Concentrations/Continue

Borehole and Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease %	Volatile Solids ppm	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Ni ppm	Ag ppm	Total CN ppm
MOE Lakefill Quality Guidelines		0.3	0.05	50	1.0	1500	6	8.0	25.0	100.0	2000	25.0	25.0	0.5	0.1
BH 10-3	1969			52			8.8	15							
BH 10-4	1969			150			11.3	13				27			
BH 10-5	1969			830			8.4	17				63			
BH 14-1	1971		7.23	170		2380		18	41			39			
BH 14-2	1971					5680	13.8								
BH 14-3	1971						11.4	10				32			
BH 13-1	1972			150			13.4	8.6	28			31			
BH 13-2	1972			2000			13.1	22	38			26			
BH 13-3	1972			250				17	39			34			

*High Priority Chemical Parameters

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Chemical Parameters and Concentrations/Continue

Borehole and Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease %	Volatile Solids ppm	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Ni ppm	Ag ppm	Total CN ppm
MOE Lakefill Quality Guidelines		0.3	0.05	50	1.0	1500	6	8.0	25.0	100.0	2000	25.0	25.0	0.5	0.1
BH 11-1	1973			54			9.0								0.28
BH 11-2	1973			72			9.0					29			
BH 12-1	1973		0.073	270			6.2					26			
BH 12-2	1973		0.106	130					39			36			0.15
BH 12-3	1973		0.104	200		2160	6.7								
BH 9-1	1973	1.54	8.600	960		6180	9.1	20	530	250		43	27	1.0	0.87
BH 9-2	1973	2.5	0.200	630	2.9	12820	15.7	20	180	340	3800	80		7.9	0.87
BH 9-3	1973	0.52	0.300	210		3140	9.0	16	130	330	2400	32		1.1	39

*High Priority Chemical Parameters

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Chemical Parameters and Exceedance

Borehole and Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Ni ppm	Ag ppm	Total CN ppm
MOE Lakefill Quality Guidelines		0.3	0.05	50	1.0	1500	6	8.0	25.0	100.0	2000	25.0	25.0	0.5	0.1
BH 6-2	1973											41			
BH 7-1	1974											56			
BH 17-1	1979			120		4620						51			
BH 17-2	1979											47			
BH 17-3	1979			17		1960						33			
BH 17-4	1979	0.36										53			
BH 18-1	1980			140					52			51			
BH 19-1	1981					1660			34			36			
BH 19-2	1981						6.3		29			41			

*High Priority Chemical Parameters

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Chemical Parameters and Exceedance/Continue

Borehole and Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Ni ppm	Ag ppm	Total CN ppm
MOE Lakefill Quality Guidelines		0.3	0.05	50	1.0	1500	6	8.0	25.0	100.0	2000	25.0	25.0	0.5	0.1
BH 19-3	1981					2140						44			
BH 20-1	1983	0.95	0.080			13820			27			56			
BH 20-2	1983			55					36			48			
BH 20-3	1983			56					110			82			
BH 20-4	1983								28			43			
BH 16-1	1984	0.52					11.4					35			
BH 16-2	1984			55			14.2		27			45			
BH 16-3	1984					1520	17.5								
BH 16-4	1984			51			12.8		30			46			
BH 15-1	1986			170		1810	12.5		110			47		2.4	0.30

*High Priority Chemical Parameters

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6.0 CONCLUSIONS

Generally, the quality of the fill deposited at the Leslie Street Spit during the period 1963 to 1986 does not conform to the MOE Lakefill Quality Guidelines.

Polychlorinated Biphenols (PCB's) and lead, both designated as High Priority Chemical Parameters, exceeded their respective criteria more frequently than mercury and cadmium. Lead exceedances spanned the entire time period studied. However, only five (5) of the 36 samples that exceeded the guidelines occurred after the MOE introduced the Lakefill Quality Assurance Program (LQAP). PCB exceedances occurred generally in the period 1963 to 1973, prior to initiation of the LQAP.

Oil and grease and volatile solids, both parameters under strict control, exceeded their respective criteria most frequently. Volatile solids exceeded the criteria generally after 1969 while oil and grease was exceeded between the time periods of 1963 to 1966 and 1973 to 1983.

Of the remaining parameters, chromium and copper generally exceeded the criteria throughout the period 1963 to 1986.

With the introduction of visual and olfactory inspection in 1979 and implementation of the Lakefill Quality Assurance Program, the exceedances of chemical parameters were generally reduced, except for chromium, copper and volatile solids.

This report has been presented in accordance with the Terms of Reference outlined in the introduction. Should you wish to discuss any aspect of this submission, please do not hesitate to contact this office.

Respectfully Submitted,
TROW HYDROLOGY CONSULTANTS LTD.

Robert Ferris, B.Sc.

Kevin J.D. Ridley, Ph.D., P. Geol.,
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RF/ird
Enc.

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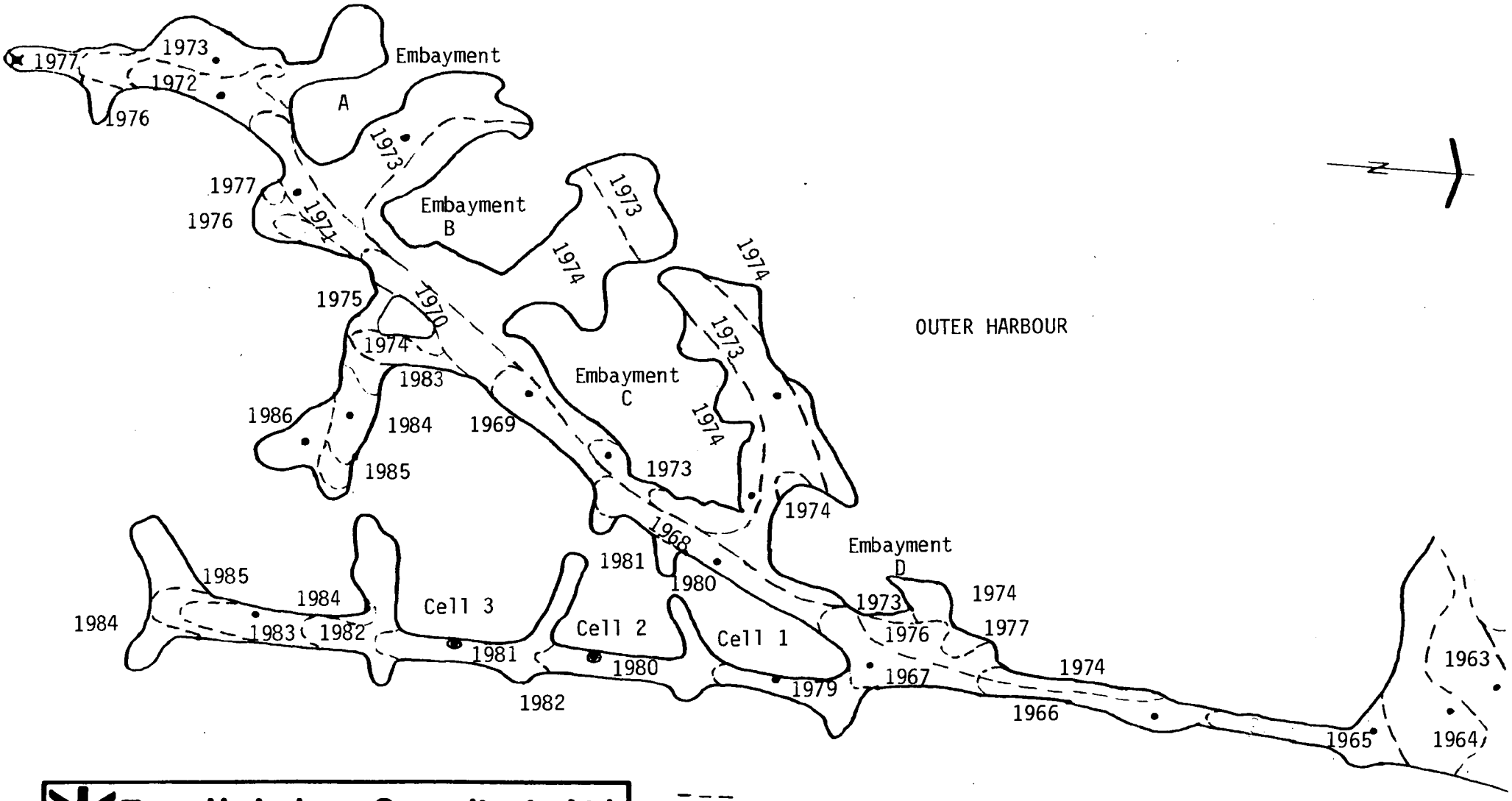
FIGURES



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Outer Harbour Headland
Leslie Street Spit
Piezometer Locations
And Limits of Annual
Lakefilling

Proj No	W87-1209-A
Scale	NTS
Drawn by	R.F.
Appr by	
Revised	
Date	April 8,1987
	Figure 1

- **Boreholes** (Numbering Scheme Provided on Drawing 1)
- **Borehole with Piezometer Installed**
- **Lighthouse**

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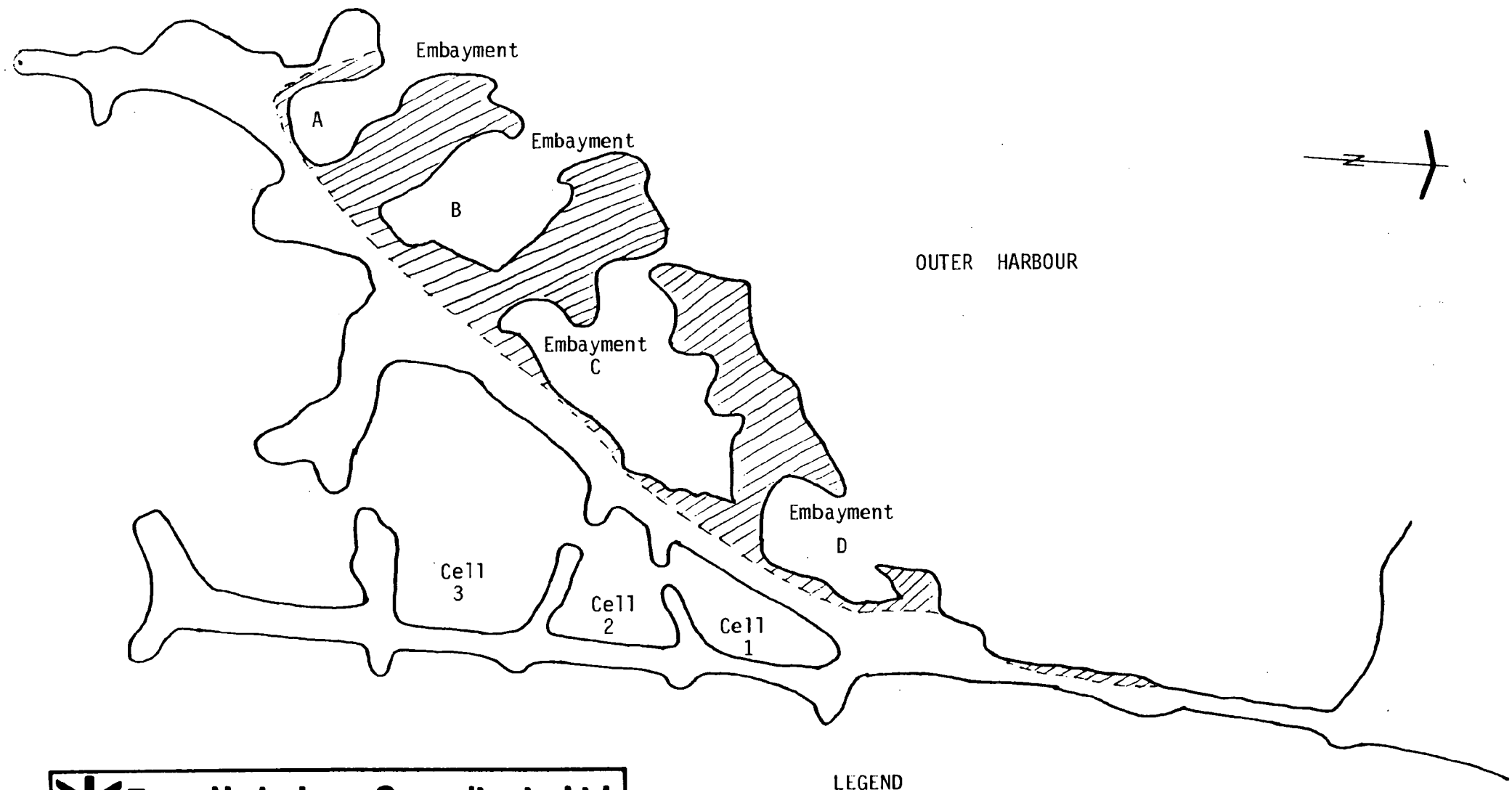

Trow Hydrology Consultants Ltd.

Outer Headland Harbour
Leslie Street Spit
Hydraulically Placed
Lakefill

Proj No	W87-1209-A
Scale	NTS
Drwn by	R.F.
Appr by	
Revised	
Date	April 10,1987
	Figure 2

LEGEND

Lakefill

Hydraulically Placed Lakefill
(approximate boundary)

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APPENDIX A
FIELD NOTES

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APPENDIX A

FIELD NOTES
Leslie Street Spit Site

March 16, 1987

7:00 am At Leslie Street Spit
Driller have not arrived
Flatbed with a Nodwell T75 track drilling rig in parking lot.

7:30 am Met Foreman Mr. Tommy Cambell (THC) and informed him of our intentions. Gates are open 7:30 am - 4:45 pm daily; no work on weekends.

8:00 am Drillers arrived

9:20 am Called Direct Insurance with regards to status of letter of General Liability Insurance. He (Mr. McKenzie) informed me that he had contacted J. Hanbridge and presented waivers to cashier at gate. Began drilling program.

9:59 am Informed that steam cleaning equipment was not onboard drilling rig. Driller did not know that job required continuous sampling. Since material heterogeneous including concrete, cannot use wireline. Require use of split spoon.

10:15 am Stan Sunkunda is going to arrange for a steam cleaning truck to come down to the site and clean equipment prior to initiation of drilling. Tomorrow driller will bring cleaning unit to site.

1:08 pm Wash truck arrives

2:27 pm Drilling began at Borehole 12.

4:20 pm Drilling stops, clean up site, put equipment away, rig left at Borehole 12 with augers in hole.

4:40 pm Drillers left site. Reported status to head office.

5:00 pm Left site.

Field Notes/Continue

March 17, 1987

7:35 am	Drillers arrived at gate, proceeded to Borehole 12
8:00 am	Drilling commenced
8:40 am	Sampler refusal at Borehole 12 at 32 ft; attempt to drill through not successful.
8:50 am	Removed auger and relocated
9:45 am	Auger refusal at 12½ ft. in the new hole (Borehole 12a); moved on to next borehole.
10:00 am	Moved rig over and cleaned augers using steam cleaning unit with lake water.
11:15 am	Began drilling Borehole 13.
12:15 pm	Stopped for Lunch
12:45 pm	Continued drilling, Mike Sukunda on site to see if everything is O.K.
1:15 pm	Auger refusal at 26 ft. Stopped drilling and removed auger. Clean and prepare to move to next hole.
2:40 pm	Moved to Borehole 14
3:15 pm	At Borehole 14, began setting up.
3:30 pm	Began drilling
4:20 pm	Stopped drilling and began packing up for evening
4:45 pm	Phoned office and reported daily activities.

Field Notes/Continue

March 18, 1987

7:30 am	Drillers arrived at Borehole 14
7:45 am	Drilling began
8:53 am	Auger refusal at 27 ft. Removed equipment and cleaned.
9:05 am	Called Mr. Choo Ying of MOE and informed him of progress.
10:50 am	At Borehole 11, cleaned augers and components.
12:00 noon	Lunch
1:13 pm	Drilling began at Borehole 11.
1:45 pm	Messrs. Choo Ying and J.D'Cruz of MOE visited site. - Piezometers at Holes 18 and 19 installed only to depth penetrated. If not too deep only installed one. - Storage of samples, if possible, stored for a few months at THCL Laboratory until they can make room at MOE.
2:30 pm	MOE representatives left.
2:35 pm	Borehole standing up at 18 ft. auger becoming clogged, do not have adequate hosing to commence wash boring. Removed augers, cleaned and moved to Borehole 16.
3:15 pm	Stopped on transit to fill up drilling rig's 500 gallon water tanks.
3:50 pm	Filled tank and moved to Borehole 16.
4:10 pm	At Hole 16, began setting up equipment and commenced drilling.
4:30 pm	Stopped drilling at 5 ft, drillers left.

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Field Notes/Continue

March 19, 1987

7:15 am Truck counting and fill monitoring day. Met J. Huma and Rob DeFrancesca from **THCL** for truck sampling. (Objective B)

7:30 am Driller on site

7:50 am Began drilling Borehole 15

8:40 am Stopped drilling, auger refusal at 9 ft. Material around hole mostly concrete and brick debris so penetration not expected. Pulled up auger and moved to Borehole 15.

9:15 am At Borehole 15 and began setting up rig, cleaned augers and sampling unit.

9:32 am Auger refusal at 2 ft.

9:35 am Moved rig and re-attempted drilling. Drill continued to advance but some concrete was encountered.

11:54 am Lunch

1:04 pm Drillers returned, continued drilling.

2:30 pm Penetrated original lake bottom 36 ft (Borehole 15) abundant organics. Dismantled drill and cleaned downhole equipment and ready for movement to Borehole 10.

3:40 pm Moved to Hole 10

4:15 pm At Borehole 10 and set up. Note: Road cut between TP36 and TP34 for barge channel. Not much fill remained to be excavated before removing paved road.

4:30 pm Drillers left. See Report B. John Huma (sampling truck fill) indicated too much and too dangerous for one man (sampling and obtaining pertinent information).

5:00 pm Left site.

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Field Notes/Continue

March 20, 1987

7:00 am	On site
7:30 am	Drillers arrived at rig
7:50 am	Comenced drilling Borehole 10
10:07 am	Called K. Ridley with regards to progress
10:16 am	Back to rig
11:47 am	Stopped drilling, penetrated original lake bottom at 45 ft. Removed augers and cleaned downhole equipment.
12:40 pm	Moved to Borehole 9
12:59 pm	At Hole 9 and setting up
1:15 pm	Began drilling
1:17 pm	Stopped drilling. Mike Sukunda arrived to check on project progress. He indicated he will bring hoses next week for wash boring.
2:11 pm	Drilling resumed
2:52 pm	Auger refusal at 9 ft. in Borehole 9, offset rig and tried second attempt. Penetration to 28 ft.
4:20 pm	Drilling stopped. Made out bills for week's work and secured equipment for weekend.
4:45 pm	Drillers left. Called K. Ridley, informed him of progress.

Field Notes/Continue

March 23, 1987

7:00 am	Arrived at site. Trucks have already began to line up.
7:30 am	Trucks began to enter site. No drillers.
8:30 am	Driller's helper arrived, informed us that driller was stuck in Huntsville with car problems and would be at site "in about one hour".
11:00 am	Driller still has not arrived, called K. Ridley and informed him of situation.
11:07 am	Back to rig. Driller's helper drilling Borehole 9 and refusal at 30 ft. Began disassembling equipment and cleaned downhole equipment.
12:15 pm	Mike Sukunda arrived as I was on the phone to K. Ridley again with regards to situation.
12:30 pm	Continued cleaning augers and sampler
1:10 pm	Stopped for lunch
1:30 pm	Resumed work
1:40 pm	Moved rig to Borehole 8
2:00 pm	Started drilling Borehole 8
3:30 pm	Reached lake bottom, organic sands in Hole 8 at 26 ft. Cleaned augers.
4:10 pm	Moved rig to Borehole 7 and set-up for drilling
4:30 pm	Drillers left

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Field Notes/Continue

March 24, 1987

7:15 am	Arrived at site
7:30 am	Drillers on site and proceeded to rig
7:45 am	Began drilling Borehole 7
8:45 am	Stopped drilling to fill tank so may commence with wash boring.
10:05 am	Started wash boring. Tried to retrieve samples while using wash boring method, not successful, (no sample beyond 14 ft) bored to 22 ft. Cleaned augers and readied for transporting.
11:10 am	Phoned K. Ridley with regards to wash boring unsuccessfullness.
11:30 am	Driller moved rig to Borehole 6 and began drilling
12:10 pm	Stopped drilling at 22 ft. Sanding of auger at 10 ft. Wash boring unsuccessful in obtaining samples beyond 18 ft. Cleaned augers.
12:15 pm	Moved to Borehole 5
12:25 pm	At Borehole 5
12:35 pm	Lunch
1:30 pm	Drillers returned from lunch and began drilling
4:00 pm	Advanced Borehole 5 to 45 ft (original lake bottom). Began removing augers and cleaning.
4:30 pm	Drillers left. Phoned K. Ridley with regards to progress.

Field Notes/Continue

March 25, 1987

7:15 am	Arrived on site. J. Huma and helper on site for second day of sampling truck loads brought onto site.
7:30 am	Drillers arrived. Began cleaning augers at Borehole 5. Road excavation for dredging access to cells commenced.
9:05 am	Began moving equipment down Spit Endykement to Borehole 20.
9:50 am	Began setting up over Borehole 20. Borehole locations on Endykement will have to be surveyed back to light poles on Spit Spine.
10:01 am	Began drilling, refusal at 1 ft. offset and retry.
10:20 am	Commenced second attempt.
11:50 am	Drillers went to lunch. Summarized field notes.
1:15 pm	Drillers returned and continued drilling.
3:05 pm	Reached lake bottom at 45 ft. in Borehole 20.
3:10 pm	Began removing equipment and clean downhole equipment.
4:30 pm	Drillers left, continued surveying and call in progress.
5:00 pm	Left site

Field Notes/Continue

March 26, 1987

7:30 am	Arrived at site. Proceeded to Borehole 20 with drillers to move rig to Borehole 19.
8:05 am	Began drilling Borehole 19
10:10 am	Auger refusal at 32 ft, as per discussion with Mr. Choo Ying of the MOE, on March 18, 1987, will install only one piezometer with 10 ft. screen.
10:20 am	Driller back to flatbed to pickup piezometer pipe required.
10:35 am	Back at rig, began cleaning hole for piezometer installation - 10 ft. screen with silica sand sealed with 1½ ft. of bentonite. Native materials used to fill hole. Bentonite gravel used for top seal.
12:30 pm	Finished and drillers went for lunch. Continued surveying.
1:15 pm	Drillers returned from lunch, cleaned downhole equipment and moved rig to Borehole 18.
1:35 pm	Began drilling Borehole 18
2:02 pm	Refusal at 9 ft. Offset and retried.
2:40 pm	Auger refusal at 13½ ft. Water level in hole shallow so installed one piezometer with a 5 ft. screen as per discussion with Mr. Choo Ying.
2:55 pm	Began washing hole, cannot produce flowing conditions in hole. Probably in contact with very permeable gravel layers.
3:05 pm	Installed piezometer with 5 ft. screen using silica sand and 1½ ft. bentonite seal. Backfilled with native material.
3:45 pm	Began cleaning equipment and readying rig to move to next hole.
4:20 pm	Moved to next hole (Borehole 17)
4:30 pm	Driller left site, finished off surveying, informed K. Ridley of progress.
5:00 pm	Left site

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Field Notes/Continue

March 27, 1987

7:30 am Drillers arrived and proceeded to rig.

7:50 am Began drilling Borehole No. 17

8:03 am Refusal at 2 ft. Offset and continued drilling.

10:15 am Reached lake bottom at 37 ft. Removed augers and cleaned downhole equipment.

11:45 am Moved to Borehole 4. Surveyed Holes 4 and 17.

12:30 pm Drillers went to lunch after arriving at Borehole 4. THCL staff proceeded to THC Works Department to obtain Benchmark elevations (62 Villier Street). Talked to Sandy Wallace and he informed me that can obtain elevation on Monday. Back to Spit and entered events into diary.

2:00 pm Drillers returned and began installing protective pipes for piezometers at Boreholes 19 and 18. Used sand to pack protective pipes.

3:20 pm Back to drill rig. Drilling commences.

4:00 pm Hit refusal at 22 ft in Borehole 4. Began cleaning unit and packing up gear for weekend.

4:30 pm Drillers left. Informed K. Ridley of progress.

Field Notes/Continue

March 30, 1987

7:15 am	Arrived on site
7:30 am	Went to rig to see if drillers arrived.
7:40 am	Went to front gate, asked Tommy Campbell if he has seen drillers. He did not.
7:45 am	Back to rig, appears as if someone had attempted to enter rig on weekend. Inspected rig - cables all twisted, some tools scattered. Back to front gate.
8:30 am	Called S. Sukunda with regards to absence of drillers. The drillers' Union specifies that they do not have to work in the rain. He was informed that the rig was tampered with.
9:00 am	Back to rig and began surveying remaining holes.
10:00 am	Informed K. Ridley of situation.
10:10 am	K. Ridley returned call and indicated drillers would be coming down. Continued plotting boreholes on map.
10:46 am	Drillers arrived at front gate after inspecting rig. Nothing seems out of order. Said they were not working in the rain.
10:52 am	Drillers left.
10:56 am	Informed K. Ridley of situation and proceeded to THC office to obtain benchmarks elevation and appropriate maps.
11:17 am	Left for Office
12:02 pm	At head office, prepare samples.
3:45 pm	Delivered samples to TSL for analysis.
5:00 pm	Left office.

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Field Notes/Continue

March 31, 1987

7:30 am	Arrived on site
8:00 am	Drillers arrived and began setting up at Borehole 2.
8:10 am	Commenced drilling
9:15 am	Penetrated well-sorted sands with organics at 17.5 ft. at lake bottom.
9:20 am	Began pulling up augers and cleaning unit.
9:40 am	Moved to Borehole 1 and set up.
9:50 am	Began drilling.
10:15 am	Refusal at 6 ft. Offset and continued drilling.
11:20 am	Refusal at 14 ft.
11:30 am	Began pulling up rig and dismantling equipment.
12:00 noon	Drilling program finished. Called K. Ridley and left job site.

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APPENDIX B

FILL ENCOUNTERED AND DEPTH OF PENETRATION
BOREHOLES 1 to 20

Project: W87-1209-A

APPENDIX B
FILL ENCOUNTERED AT BOREHOLES 1 to 20
Leslie Street Spit Site

Borehole	Year	Composite Sample No.	Depth (m)	Description
1	1963	1	0 - 4.6	Grey silty sand and silty clay with some asphalt, brick and concrete fragments, rubber products, some gravel and organics, diesel odour.
2	1964	1	0 - 3	Dark grey silty clay to silty sand with concrete, brick (red) and asphalt fragments, some organics.
		2	3 - 5.7	Dark grey silty sand to sand, few brick fragments, base of sample sorted sands occasional pebbles. Lake bottom.
3	1965	1	0 - 3	Brick (red, cream) with concrete and silty sand, some organics and wood, faint odour.
		2	3 - 6	Dark grey silty clay and silt sand with asphalt and brick fragments gravel.
		3	6 - 10.5	Silty sand with organics, brick, gravel, concrete, metal wire, some clay. Refusal.
4	1966	1	0 - 3	Grey silty clay to silty sand with brick, concrete and asphalt fragments, some gravel.
		2	3 - 7.5	Grey silty clay to brown sand with brick and concrete debris, gravel, occasional asphalt and shale fragments, fuel odour. Refusal.

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Borehole Log Description/Continue

Borehole	Year	Composite Sample No.	Depth (m)	Description
5	1967	1	0 - 3	Brown silty sand with occasional brick and concrete debris, glass, gravel, roots and organics.
		2	3 - 6	Grey silt clay to brown fine sand with brick and concrete debris, occasional gravel.
		3	6 - 9	Brown silty clay to grey silty sand with grey fine sand, some brick and concrete debris.
		4	9 - 14.7	Grey-brown silty sand with grey clayey silt cinders and concrete fragments. Strong odour organics. Base fine-sorted sand, organics. Lake bottom.
6	1973	1	0 - 3	Grey-brown, fine to medium sand with some pebbles (hydraulically placed).
		2	3 - 7.2	Brown, coarse to medium sand, poor sample recovery below 5.9 m (hydraulically placed).
7	1974	1	0 - 3	Grey, silty sand to medium-brown, medium sand, occasional organics, pebbles (hydraulically placed).
		2	3 - 7.2	Coarse sand with occasional pebbles. No sample recovery below 4.6 m.
8	1968	1	0 - 3	Grey, brown to black silty sand with gravel, brick and concrete debris, gravel and occasional asphalt fragments.

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Borehole Log Description/Continue

Borehole	Year	Composite Sample No.	Depth (m)	Description
		2	3 - 8.5	Brown silty sand to sand with some grey silty clay with concrete, gravel at base of borehole, grey, brown sand with layered silty clay organics. Lake bottom.
9	1973	1	0 - 3	Brown, silty sand to fine sand with concrete and brick fragments, some coal, gravel, occasional organics.
		2	3 - 6	Grey to black silty sand with gravel, ash, some garbage and organics.
		3	6 - 10.5	Grey, silty sand to silty clay with black gravel, organics, wood, faind odour. Refusal.
10	1969	1	0 - 3	Black to brown silty sand to fine sand with brick, coal, concrete fragments, organics, gravel, shale.
		2	3 - 6	Brown silty sand to fine sand with gravel, asphalt, coal cinder and garbage fragments, wood.
		3	6 - 9	Grey silty clay to brown fine sand, some brick and coal fragments with organics, concrete, strong odour.
		4	9 - 12.1	Grey silty clay to sand with brick fragments, wood, gravel.
		5	12.1 - 13.7	Silty clay to fine sand with pebbles, concrete rubble, organics. Lake bottom.

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Borehole Log Description/Continue

Borehole	Year	Composite Sample No.	Depth (m)	Description
11	1973	1	0 - 3	Brown sandy silt to medium sand with brick and concrete in top section, abundant organics. Hydraulically placed gravel/pebbles.
		2	3 - 5.5	Brown medium sand, occasional pebbles. Hydraulically placed auger sanding 5.5 m.
12	1973	1	0 - 3	Brown sand to silty sand with brick and concrete debris, asphalt, some organics.
		2	3 - 6	Brown silty sand to sand, tar noudles, brick fragments, gravel, organics, concrete.
		3	6 - 9.8	Brown silty sand with occasional brick debris, gravel, some concrete organics, odour (faint). Refusal.
13	1972	1	0 - 3	Brown silty sand with gravel, organics, asphalt concrete, brick fragments.
		2	3 - 6	Brown sand to grey silty clay with gravel and brick debris, some organics, shale and asphalt.
		3	6 - 7.9	Brown silty sand to dark grey clay with some gravel, asphalt, glass fragments, concrete. Refusal.
14	1971	1	0 - 3	Brown silty sand with black silty sand (abundant organics at surface), brick, concrete, gravel shale, organics throughout.

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Borehole Log Description/Continue

Borehole	Year	Composite Sample No.	Depth (m)	Description
		2	3 - 6	Grey clay silt to brown sand with minor sand, gravel, ash, brick, asphalt.
		3	6 - 8.4	Dark green silty sand with brick and concrete debris, organics. Refusal.
15	1986	1	0 - 2.7	Brown silty sand with brick and concrete, gravel, asphalt, shale. Refusal.
16	1984	1	0 - 3	Brown silty sand, concrete, brick and asphalt, gravel, occasional grey clayey silt.
		2	3 - 6	Grey silty clay to silty sand, organics, gravels, concrete, porcelain.
		3	6 - 9.1	Grey silt and clay, some gravel, concrete and porcelain.
		4	9.1 - 11.0	Grey silty clay to brown silty sand, gravel, brick debris, organics. Lake bottom.
17	1979	1	0 - 3	Brown silty clay to grey sand with rubble, asphalt, brick fragments.
		2	3 - 6	Brown to black sand to silty sand, rubble, gravel, brick debris, some organics.
		3	6 - 9.1	Brown silty clay to silty sand, gravel and asphalt brick concrete, organics.

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Borehole Log Description/Continue

Borehole	Year	Composite Sample No.	Depth (m)	Description
		4	9.1 - 11.3	Brown to grey silty clay to silt with occasional brick and concrete fragments, organics with silty clay. Lake bottom.
18	1980	1	0 - 4.1	Brown silty sand to gravel with brick, concrete shale and some organics. Refusal.
19	1981	1	0 - 3	Grey silty clay to brown silty sand, brick debris, concrete, organics, gravel.
		2	3 - 6	Grey to brown silty clay, occasional gravel, brick, concrete, asphalt.
		3	6 - 9.7	Grey silty clay to brown silty sand, gravel, asphalt, gravel, shale, concrete, organics. Refusal.
20	1983	1	0 - 3	Brown silty sand with asphalt, concrete, brick, wood, gravel.
		2	3 - 6	Brown silty sand, gravel, asphalt, some wood.
		3	6 - 9.1	Grey to brown silty clay, brick, gravel with fuel odour.
		4	9.1 - 13.7	Grey silty clay to silty sand, some brick debris, gravel, shale, concrete cinders, organics. Base silty clay with concentrated organics. Lake bottom.

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APPENDIX C

CHEMICAL RESULTS

Project: W87-1209-A

APPENDIX C

Leslie Street Spit Borehole Reconnaissance
Laboratory Results

Borehole & Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	Total P	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Fe ppm	Ni ppm	Co ppm	Ag ppm	Total CN- ppm	NH_4 ppm	Mo ppm	Se ppm	TOC %
MOE Lakefill Quality Guidelines		0.3	0.05	50	1.0	1500	6	1000	8.0	25.0	100.0	2000	25.0	40,000	25.0	50.0	0.1	0.1	100	-	-	-
BH 1-1	1963	0.30	0.053	310	L1.0	1640	4.6	250	5.1	72	89	2000	43	18550	16	6.1	0.5	0.01	20	L1.0	0.08	2.3
BH 2-1	1964	0.22	0.063	610	L1.0	1580	6.6	450	4.9	220	1120	2000	81	25070	25	7.9	3.1	0.01	18	L1.0	0.18	3.0
BH 2-2	1964	0.14	L0.001	50	L1.0	4200	4.4	200	3.3	42	26	700	53	13640	16	6.2	L0.1	0.01	12	L1.0	0.10	1.3
BH 3-1	1965	0.20	0.177	62	L1.0	660	5.5	230	3.0	26	51	1100	49	14940	16	6.1	L0.1	0.01	24	L1.0	0.12	2.2
BH 3-2	1965	0.20	0.063	73	L1.0	1860	54	190	3.4	36	32	2000	67	15140	17	5.6	L0.1	0.01	15	L1.0	0.08	2.3
BH 3-3	1965	0.40	0.222	130	L1.0	4160	4.9	120	3.1	37	70	1400	32	11840	10	4.3	0.3	2.1	15	L1.0	0.10	2.7
BH 4-1	1966	0.12	0.137	490	L1.0	2340	5.2	210	6.1	30	35	1400	46	27300	21	8.4	L0.01	0.04	15	1.6	0.17	2.2

*High Priority Chemical Parameters L = Less than ____Underline, guideline exceedance

Trow

Project: W87-1209-A

Laboratory Results/Continue

Borehole & Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	Total P	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Fe ppm	Ni ppm	Co ppm	Ag ppm	Total CN- ppm	NH_4 ppm	Mo ppm	Se ppm	TOC %
MOE Lakefill Quality Guidelines		0.3	0.05	50	1.0	1500	6	1000	8.0	25.0	100.0	2000	25.0	40,000	25.0	50.0	0.1	0.1	100	-	-	-
BH 4-2	1966	0.14	0.094	54	L1.0	1980	5.6	150	4.3	5.6	13	800	14	4760	6.0	2.4	0.2	L0.01	10	L1.0	C.30	2.5
BH 5-1	1967	0.08	0.020	75	L1.0	820	4.8	230	13	57	28	1100	51	22020	17	6.2	0.1	L0.01	11	L1.0	0.82	2.8
BH 5-2	1967	0.10	0.004	30	L1.0	540	4.5	220	6.3	23	20	2000	41	19800	18	7.0	0.1	0.02	20	L1.0	0.30	1.7
BH 5-3	1967	0.14	0.008	71	L1.0	1280	3.5	200	3.4	19	26	1000	49	15090	15	5.3	0.1	0.02	15	L1.0	0.22	1.2
BH 5-4	1967	L0.005	0.270	65	L1.0	1480	3.5	270	4.1	31	53	1000	48	15490	16	5.5	0.5	1.6	15	L1.0	0.22	1.6
BH 6-1	1973	L0.005	L0.001	13	L1.0	420	0.7	120	2.3	4.7	1.7	800	14	6470	6.4	2.4	L0.1	0.02	9	L1.0	0.06	0.3
BH 6-2	1973	L0.005	L0.001	15	L1.0	540	0.0	120	2.2	5.1	2.8	1100	41	6900	6.3	2.4	0.1	L0.01	7	L1.0	0.06	0.3

*High Priority Chemical Parameters L - Less than Underline, guideline exceedance

Trow

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Laboratory Results/Continue

Borehole & Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	Total P	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Fe ppm	Ni ppm	Co ppm	Ag ppm	Total CN- ppm	NH_4 ppm	Mo ppm	Se ppm	TOC %
MOE Lakefill Quality Guideline		0.3	0.05	50	1.0	1500	6	1000	8.0	25.0	100.0	2000	25.0	40,000	25.0	50.0	0.5	0.1	100	-	-	-
BH 7-1	1974	L0.005	0.005	42	L1.0	480	1.3	130	4.8	9.7	3.9	600	56	9300	8.4	3.0	0.2	L0.01	5	L1.0	0.06	0.4
BH 7-2	1974	0.08	0.006	41	L1.0	560	0.6	120	2.2	6.4	2.1	400	22	7060	6.8	2.2	L0.1	L0.01	5	L1.0	0.08	0.3
BH 8-1	1968	0.21	0.009	430	L1.0	6380	6.8	200	7.3	34	58	800	43	20485	19	6.3	0.1	0.02	7	L1.0	0.23	3.6
BH 8-2	1968	0.14	0.003	80	L1.0	700	4.6	260	42	28	32	700	51	24880	22	8.2	0.1	0.11	8	5.3	0.80	2.0
BH 9-1	1973	1.54	8.600	960	L1.0	6180	9.1	210	20	530	250	1800	43	29750	27	8.5	1.0	0.87	5	4.2	1.35	6.5
BH 9-2	1973	2.5	0.200	630	2.9	12820	15.7	430	20	180	340	3800	80	18310	20	7.9	7.9	0.87	83	2.3	1.80	8.1
BH 9-3	1973	0.52	0.300	210	L1.0	3140	9.0	270	16	130	330	2400	32	25120	11	6.6	1.1	39	31	2.4	1.00	4.4

*High Priority Chemical Parameters L = Less than _____ Underline, guideline exceedance

Trow

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Laboratory Results/Continue

Borehole & Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	Total P	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Fe ppm	Ni ppm	Co ppm	Ag ppm	Total CN- ppm	NH_4 ppm	Mo ppm	Se ppm	TOC %
MOE Lakefill Quality Guideline		0.3	0.05	50	1.0	1500	6	1000	8.0	25.0	100.0	2000	25.0	40,000	25.0	50.0	0.5	0.1	100	-	-	-
BH 10-1	1969	0.08	0.011	190	L1.0	1420	12.0	240	25	32	65	1100	45	20540	12	7.5	0.3	0.01	5	3.4	0.5	3.4
BH 10-2	1969	0.04	0.008	35	L1.0	680	11.5	230	42	22	8.3	2000	23	17500	10	6.5	0.2	L0.01	11	2.1	1.6	2.8
BH 10-3	1969	0.06	0.016	52	L1.0	1000	8.8	210	15	20	23	1400	24	17700	10	6.4	0.2	0.09	7	L1.0	0.26	2.5
BH 10-4	1969	0.04	L0.001	150	L1.0	240	11.3	230	13	22	13	600	27	21200	13	8.8	0.2	L0.01	8	2.5	0.34	2.6
BH 10-5	1969	0.06	0.047	830	L1.0	140	8.4	210	17	20	13	800	63	22800	8.5	5.6	0.3	L0.01	11	1.8	L0.01	2.9
BH 11-1	1973	L0.005	L0.001	54	L1.0	640	9.0	140	1.96	6.7	22	400	21	7200	4.9	3.0	0.2	0.28	3	1.6	L0.01	0.4
BH 11-2	1973	L0.005	L0.001	72	L1.0	280	9.0	140	1.78	5.9	4.0	600	29	8100	4.5	2.5	0.2	L0.01	1	1.1	L0.01	0.4

*High Priority Chemical Parameters L = Less than Underline, guideline exceedance

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Laboratory Results/Continue

Borehole & Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	Total P	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Fe ppm	Ni ppm	Co ppm	Ag ppm	Total CN- ppm	NH_4 ppm	Mo ppm	Se ppm	TOC %
MOE Lakefill Quality Guideline		0.3	0.05	50	1.0	1500	6	1000	8.0	25.0	100.0	2000	25.0	40,000	25.0	50.0	0.5	0.1	100	-	-	-
BH 12-1	1973	0.04	0.073	270	L1.0	960	6.2	210	5.6	19	16	700	26	12420	7.7	5.5	0.2	0.07	3	L1.0	0.08	1.3
BH 12-2	1973	0.12	0.106	130	L1.0	1380	4.3	230	6.0	39	27	800	36	20570	12	6.3	0.3	0.15	3	1.2	0.010	1.7
BH 12-3	1973	0.10	0.104	200	L1.0	2160	6.7	210	6.4	19	60	800	21	12720	9.0	5.7	0.2	L0.01	8	L1.0	0.10	1.9
BH 13-1	1972	0.06	0.037	150	L1.0	1000	13.4	240	8.6	28	45	1000	31	18760	13	8.6	0.3	L0.01	1	1.2	0.06	2.0
BH 13-2	1972	0.06	L0.001	2000	L1.0	1380	13.1	220	22	38	32	800	26	17600	14	8.2	0.3	0.03	10	L1.0	0.14	1.8
BH 13-3	1972	0.06	0.020	250	L1.0	820	3	210	17	39	30	1300	34	17260	12	7.6	0.4	L0.01	10	1.4	0.04	1.5
BH 14-1	1971	0.08	7.23	170	L1.0	2380	4.7	230	18	41	37	1000	39	18650	14	7.6	0.3	L0.01	10	4.0	0.22	2.7

*High Priority Chemical Parameters L = Less than Underline, guideline exceedance

Trow

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Laboratory Results/Continue

Borehole & Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	Total P	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Fe ppm	Ni ppm	Co ppm	Ag ppm	Total CN- ppm	NH_4 ppm	Mo ppm	Se ppm	TOC %
MOE Lakefill Quality Guideline		0.3	0.05	50	1.0	1500	6	1000	8.0	25.0	100.0	2000	25.0	40,000	25.0	50.0	0.5	0.1	100	-	-	-
BH 14-2	1971	0.04	0.026	40	L1.0	5680	13.8	180	7.6	16	13	1300	21	12000	10	5.3	0.3	0.01	5	1.0	0.14	1.8
BH 14-3	1971	0.06	0.002	30	L1.0	560	11.4	230	10	17	42	1100	32	18800	12	7.2	0.2	0.01	13	L1.0	0.32	1.9
BH 15-1	1986	0.14	L0.001	170	L1.0	1810	12.5	230	7.6	110	81	700	47	27100	14	7.9	2.4	0.30	5	L1.0	0.20	3.7
BH 16-1	1984	0.52	0.020	47	L1.0	960	11.4	210	5.6	22	20	1100	35	15210	9.5	6.1	0.2	L0.01	1	L1.0	0.12	1.8
BH 16-2	1984	0.16	0.008	55	L1.0	1100	14.2	250	5.8	27	34	600	45	18370	15	8.1	0.3	L0.01	10	2.9	0.10	1.7
BH 16-3	1984	0.08	0.033	37	L1.0	1520	17.5	160	6.4	18	15	800	24	12000	10	5.3	0.3	0.04	7	1.7	0.12	1.7
BH 16-4	1984	0.08	0.011	51	L1.0	940	12.8	220	6.4	30	30	1400	46	17460	12	6.9	0.3	L0.01	11	2.5	0.08	2.1

*High Priority Chemical Parameters L = Less than Underline, guideline exceedance

Trow

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Laboratory Results/Continue

Borehole & Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	Total P	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Fe ppm	Ni ppm	Co ppm	Ag ppm	Total CN- ppm	NH_4 ppm	Mo ppm	Se ppm	TOC %
MOE Lakefill Quality Guideline		0.3	0.05	50	1.0	1500	6	1000	8.0	25.0	100.0	2000	25.0	40,000	25.0	50.0	0.5	0.1	100	-	-	-
BH 17-1	1979	0.28	0.048	120	L1.0	4620	3.9	210	4.0	23	37	1800	51	15520	15	5.6	L0.1	0.02	20	L1.0	0.18	2.4
BH 17-2	1979	0.16	0.006	32	L1.0	1000	5.1	200	5.0	19	23	800	47	15140	15	5.8	0.1	L0.01	9	L1.0	0.12	1.2
BH 17-3	1979	0.20	0.020	71	L1.0	1960	4.2	210	4.0	24	35	1800	33	17870	19	7.1	0.1	L0.01	5	L1.0	0.08	1.7
BH 17-4	1979	0.39	0.020	30	L1.0	980	3.5	220	3.5	24	27	1700	53	17890	19	6.8	0.1	0.02	9	2.1	0.08	1.4
BH 18-1	1980	0.24	0.020	140	L1.0	1120	5.6	230	4.5	52	53	1400	51	20760	23	7.7	0.2	0.02	7	2.6	0.12	2.5
BH 19-1	1981	0.14	0.008	33	L1.0	1660	3.0	210	4.0	34	44	600	36	19780	22	8.4	L0.1	L0.01	16	6.0	0.14	2.3
BH 19-2	1981	0.12	0.042	39	L1.0	1240	6.3	250	4.2	29	38	1400	41	23380	24	9.4	L0.1	L0.01	16	6.0	0.14	2.3

*High Priority Chemical Parameters L = Less than ____Underline, guideline exceedance

Trow

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Laboratory Results/Continue

Borehole & Sample Number	Year Deposited	Hg* ppm	PCB* ppm	Pb* ppm	Cd* ppm	Oil and Grease ppm	Volatile Solids %	Total P	As ppm	Cu ppm	Zn ppm	TKN ppm	Cr ppm	Fe ppm	Ni ppm	Co ppm	Ag ppm	Total CN- ppm	NH_4 ppm	Mo ppm	Se ppm	TOC %
MOE Lakefill Quality Guideline		0.3	0.05	50	1.0	1500	6	1000	8.0	25.0	100.0	2000	25.0	40,000	25.0	50.0	0.5	0.1	100	-	-	-
BH 19-3	1981	0.16	0.020	29	L1.0	2140	5.0	220	4.5	23	27	1700	44	18560	18	6.7	0.1	L0.01	24	L1.0	0.18	2.6
BH 20-1	1983	0.95	0.080	36	L1.0	13820	5.0	170	4.5	27	52	2000	56	12260	13	6.7	L0.1	L0.01	34	L1.0	0.09	3.1
BH 20-2	1983	0.22	0.008	55	L1.0	1280	5.9	220	2.7	36	34	700	48	15940	18	7.6	0.1	L0.01	5	2.2	0.14	1.3
BH 20-3	1983	0.22	0.011	56	L1.0	1040	4.4	220	4.6	110	58	800	82	19560	22	9.0	L0.1	L0.01	4	3.9	0.14	2.3
BH 20-4	1983	0.24	L0.01	39	L1.0	820	4.1	250	3.8	28	37	1100	43	18970	21	9.0	L0.1	L0.01	20	3.9	0.14	2.0

*High Priority Chemical Parameters L = Less than Underline, guideline exceedance

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APPENDIX D

CHEMICAL ANALYSIS METHODOLOGY

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METHODOLOGY

1. SAMPLE RECEIVED

A. Moisture percent of sample.
B. Sample dried, pulverized for 15 seconds.
C. Analyzed as received, calculated to dry weight.

A. MOISTURE CONTENT - Ref: MOE Handbook of Analytical Methods, Pg. ME 1.

Weigh 5 grams of sample into a tared aluminum dish.
Place sample in oven set at 105°C for 2 hours.
Weigh and return to oven for 1 hour, reweigh and repeat if necessary until constant weight.

B1. METALS (Ref: MOE Handbook of Analytical Methods Pg. MD 34, MC 11, AD 1 to SA 1).

- Weigh 2 grams of dried pulverized sample into a test tube.
- Add 20 ml. of freshly mixed Aqua Regia.
- Heat to gentle boiling for 2 hours.
- Cool adjust vol. to 40 ml.
- Filter or centrifuge to obtain clear solution.
- Use clear solution for analysis as follows:

INSTRUMENTATION:

ICP: Cu, Pb, Zn, Ni, Cr, Mo, Cd, Ag, TOTAL P, Fe, Co.
AA Hydride Generation: As, Se, Hg.
AA: Ag.

B2. AMMONIA

- Weigh a portion of the dried pulverized soil into a distillation tube.
- Add 300 ml. of ammonia free water and adjust the pH to 9.5 with a potassium phosphate buffer solution.

Methodology/Continue

- Using the BUCHI Distillation Unit B-210 distill the solution into a boric acid trap.
- Determine ammonia by direct titration with standard sulphuric acid solution.

B3. TOTAL KJELDAHL NITROGEN

- Weigh a portion of the dried pulverized soil into a digestion/ distillation tube.
- Add 20 ml. of sulphuric acid concentration and the copper sulphate/potassium sulphate catalyst.
- Digest on the heating block for 1 to 2 hours or until solution turns to a greenish colour.
- Place the tube into a BUCHI B-321 Distillation Unit.
- Add 150 ml. of NaOH and 100 ml. of water and distill the ammonia into a dilute sulphuric acid trap.
- Determine the total nitrogen by back titrating the ammonia sulphuric acid solution with standard sodium hydroxide solution.

B4. OIL AND GREASE

- Weigh 5 grams of dried and pulverized sample into an erlenmeyer flask.
- Add 50 ml of methylene chlorine.
- Shake for 15 minutes.
- Filter off solvent - keep solvent.
- Repeat extraction two (2) more times.
- Add solvent to pre-weighed beaker.
- Evaporate off the solvent.
- Re-weigh beaker and calculate oil and grease by differential of weight.

Methodology/Continue

B5. PERCENT TOTAL ORGANIC CARBON (T.O.C.)

- About four to five grams of the pulverized dry sample was digested in 100 ml of 20 percent HCL, boiled, then a few drops hydrogen peroxide were added.
- The digested sample was then filtered through a tared Gouch crucible, dried and weighed.
- The dry crucible was ashed at 800°C and the percent Total Organic Carbon was calculated as follows:

% Total Organic Carbon =
(dried filtrate weight - ash weight/dry sample weight) x 100

B6. VOLATILE (LOSS ON IGNITION)

- Add approximately 5 grams of dried, pulverized sample to a preweighed crucible.
- Place the crucible into a furnace at 600°C for a minimum of four hours or until constant weight.
- Weigh the crucible.
- Calculate volatiles from the weight loss.

B7. PCB's

- Analyze on a dried but not pulvarized sample.
- Extract and clean up sample by solvent extraction procedure.
- Analyze for PCB's by G.C.

C1. CYANIDES

- Weighed amounts of soil were added to 100 mL of water in a two necked round-bottom flask. After adding mercury (II) chloride solution and magnesium chloride solution, sulphuric acid was added while air was continuously drawn through the solution. The solution was refluxed for two hours, air being continucusly drawn through the solution and passed through the scrubber which traps any HCN evolved.

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Methodology/Continue

- The caustic solutions were analyzed by a titrimetric method. The titrant was a standard silver nitrate solution; 1.00 mL of titrant is equivalent to 0.01 mg/mL CN. The indicator solution was paradimethylaminobenzalrhodamine in acetone.

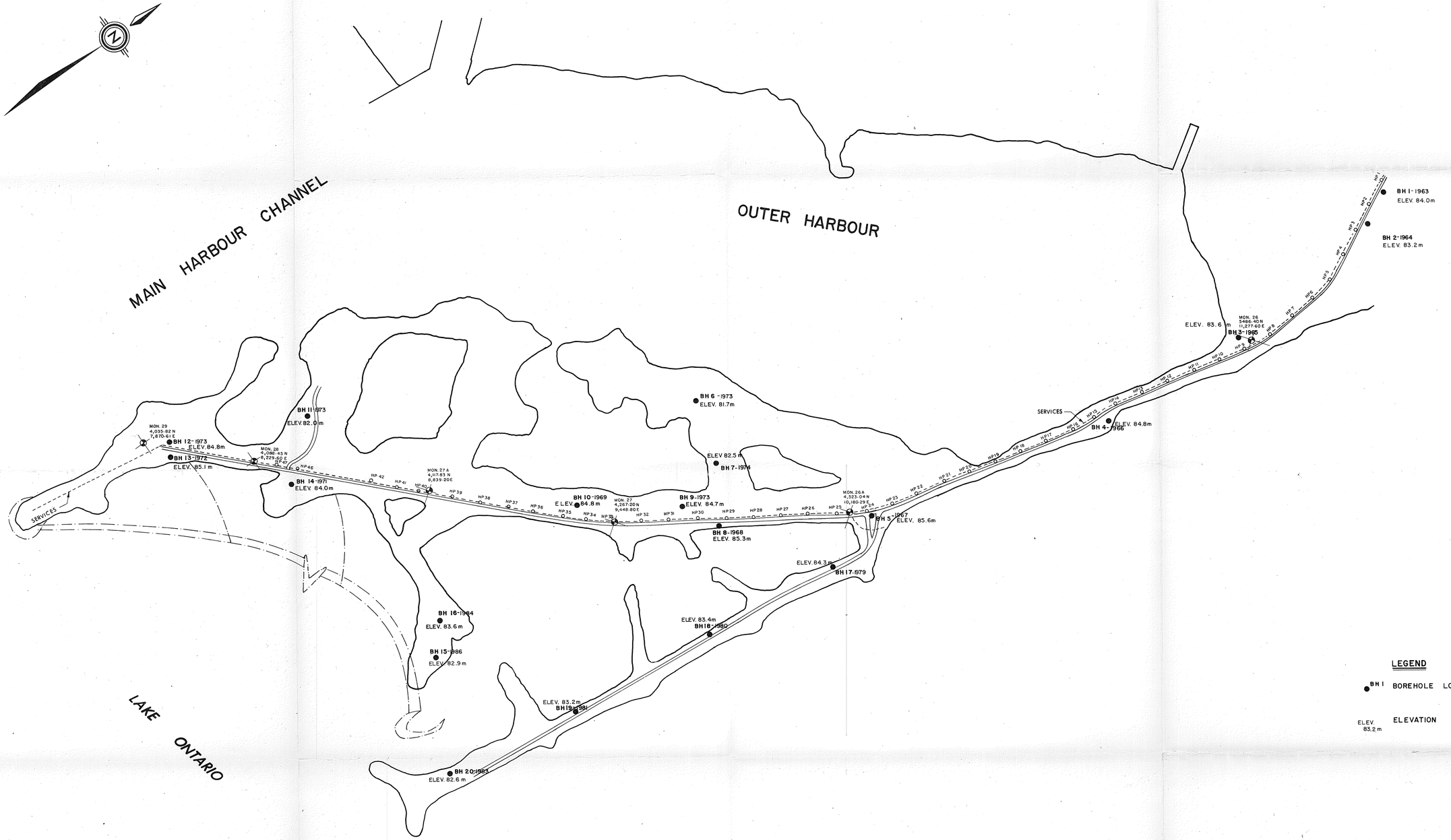
- The samples were analyzed as received and results calculated back to dry weight.

D. **QUALITY CONTROL/QUALITY ASSURANCE - Along with established methodology, the QC/QA program will include:**

- Repeated samples after every 10 samples.

- Blanks analyzed after every 20 samples.

- Certified external reference samples to be analyzed after every 20th sample.



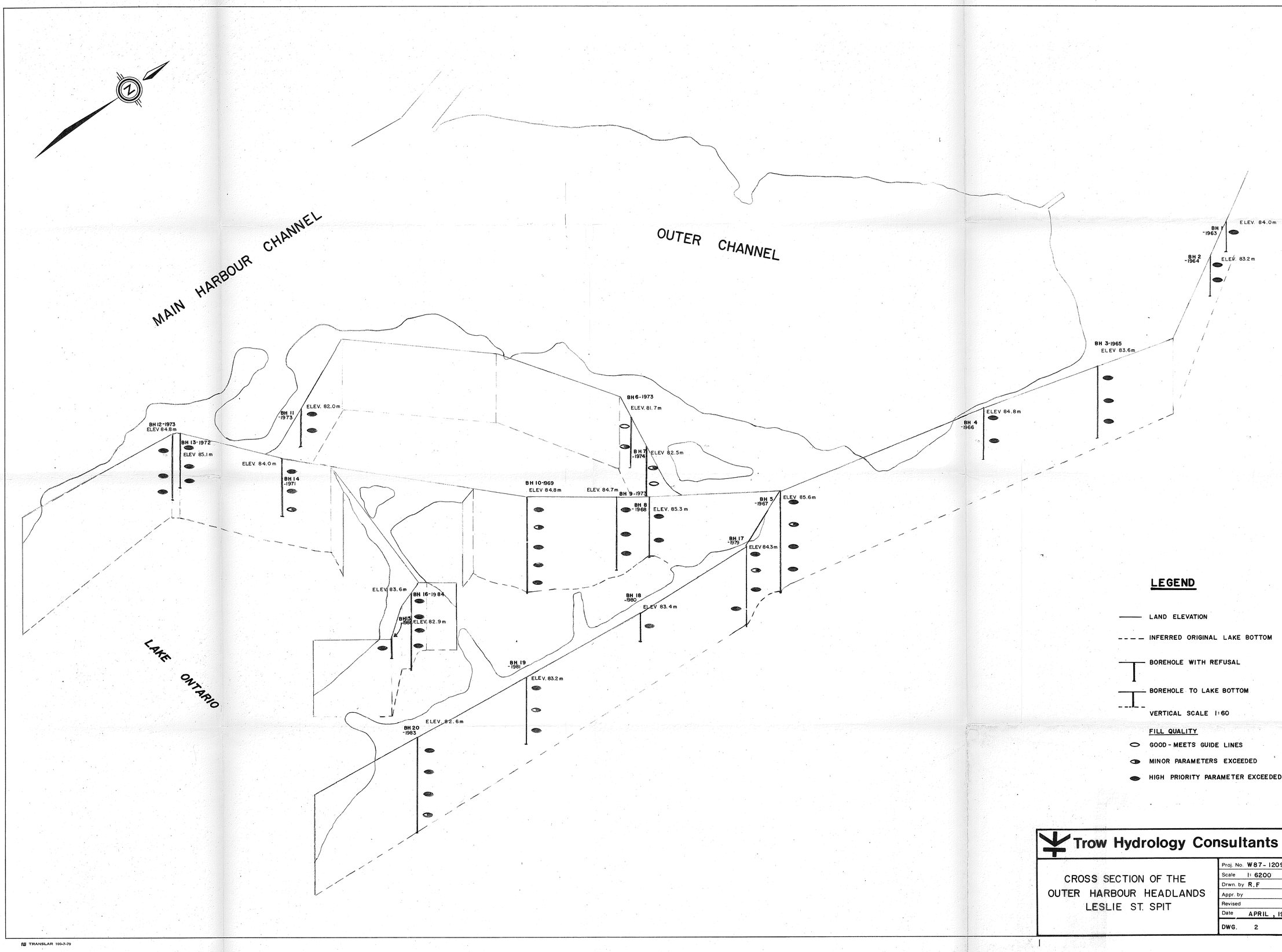
LEGEND

- ● BH 1 — BOREHOLE LOCATION
- ELEV. 83.2 m — ELEVATION

Trow Hydrology Consultants Ltd.

STUDY OF SOIL QUALITY AT THE OUTER HARBOUR HEADLAND
LESLIE ST. SPIT
BOREHOLE RECONNAISSANCE

Proj. No.	W87-1209-A
Scale	1:6200
Drwn. by	R.D.L.
Appr. by	R.F.
Revised	
Date	APRIL, 1987
DWG.	1



LEGEND

- LAND ELEVATION
- INFERRED ORIGINAL LAKE BOTTOM
- BOREHOLE WITH REFUSAL
- BOREHOLE TO LAKE BOTTOM
- VERTICAL SCALE 1:60

FILL QUALITY

- GOOD - MEETS GUIDE LINES
- MINOR PARAMETERS EXCEEDED
- HIGH PRIORITY PARAMETER EXCEEDED

Trow Hydrology Consultants Ltd.

CROSS SECTION OF THE
OUTER HARBOUR HEADLANDS
LESLIE ST. SPIT

Proj. No.	W87-1209 A
Scale	1:6200
Drwn. by	R.F
Appr. by	
Revised	
Date	APRIL, 1987
DWG.	2