C. 0814

THE LAKEVIEW
ENVIRONMENTAL SITE ASSESSMENT
LOT 1, PARCEL 1, PLAN 9506
VILLAGE OF LAC DU BONNET

JANUARY, 1995

PREPARED BY
UMA ENVIRONMENTAL
A DIVISION OF
UMA ENGINEERING LTD.
1479 BUFFALO PLACE
WINNIPEG, MANITOBA
R3T 1L7

UMA JOB NO. 15 73 9759 001 01 01

The Lakeview *Beachview Accomodations - Steak Pit & Pub*
Box 189
Lac du Bonnet, MB
R0E 1A0
Ph. 204-345-8661 Fax 204-345-2313
E-Mail: lakeview@cancom.net www.canadiana.com\lakeview

April 1/97

Manitoba Environment
Via Rail Station
Winnipeg, MB

Att: Mr. Edwin Yee

Re: Lot, 1 Parcel 1, Plan 9506 Village of Lac du Bonnet

Dear Mr Yee:

Please find enclosed Environmental Site Assessment conducted by UMA Engineering. The site investigation drawings on the last page of the study, show the areas of contamination. I have outlined an area where the proposed building would be located.
The areas around Sites # 1 & # 2 would be taken up with access roads, visitor parking and landscaping. The area around Site # 2 would probably remain as a lawn or possibly boathouse/storage.
I look forward to meeting with you next week to discuss this situation.
Should you have any questions or concerns in the meantime, please feel free to call.
Thank you

Yours truly
John Enright

UMA Environmental
A Division of UMA Engineering Ltd.
1479 Buffalo Place, Winnipeg, Manitoba, Canada R3T 1L7
Telephone (204) 284-0580, Fax (204) 475-3646

Our File: 15 73 9759 001 01 01

January 11, ~~1994~~ 1995

The Lakeview
Box 189
Lac du Bonnet, Manitoba
R0E 1A0

Attention: Mr. John Enright

Dear Sir:

Reference: Environmental Site Assessment - Lot 1, Parcel 1, Plan 9506 Village of Lac du Bonnet

UMA Environmental are pleased to submit our report summarizing the environmental site assessment completed at Lot 1, Parcel 1, Plan 9506 in the Village of Lac du Bonnet. This report follows the format identified by the Federal Business Development Bank for studies of this nature.

We would like to thank you for the opportunity to work on this project. Should you have any questions or require additional information, please do not hesitate to call.

Yours truly,

UMA ENVIRONMENTAL

R.V. [signature]

for T. Wingrove, P.Eng.
Regional Manager
UMA Environmental
LB/dh

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

LIMITATIONS

The information and data contained in this report, including without limitation the results of any sampling and analyses conducted by UMA Engineering Ltd. ("UMA") pursuant to its Agreement with the Client, have been set forth to the best of UMA's knowledge, information and belief. Although every effort has been made to confirm that all such information and data is factual, complete and accurate, UMA makes no guarantees or warranties whatsoever, whether expressed or implied, with respect to such information or data and accepts no responsibility for any loss or damage arising therefrom or related thereto.

UMA shall not by the act of issuing this report be deemed to have represented thereby that any sampling and analyses conducted by it have been exhaustive, and persons relying on the results thereof do so at their own risk.

SECTION 1.0
INTRODUCTION

UMA Environmental were retained by The Lakeview to complete a site assessment for possible petroleum hydrocarbon contamination on Lot 1, Parcel 1, Plan 9506 in the Village of Lac du Bonnet. The basis for this assessment is the historical use of the property as a concrete batch plant and bulk fuel depot.

The following report summarizes the results of the investigations conducted including site and background information, subsurface investigation, methodology, laboratory results, site sensitivity ranking and recommendations for site remediation.

SECTION 2.0
BACKGROUND

2.1 Current Setting

The property under review is located at Lot 1, Parcel 1 of Plan 9506 in the Village of Lac du Bonnet. The property fronts on Provincial Highway No. 502 and backs onto the Winnipeg River. The lot is currently vacant. A gravel traffic area covers the front third of the property. The remaining property is grassed to the river. There is a public reserve and residential development along the Winnipeg River to the south. The Village operate and maintain a public boat launch to the north. There is undeveloped property along the west side of PR 502. A concrete slab from an old pump island is situated across the north property line near the front of the property.

2.2 Historical Review

A review of historical development and land use at the site was conducted consisting of discussions, inquiries and literature search of available information from the following sources:

- Manitoba Department of Environment - personal communication, Mr. Dale Hiltz
- Airphoto library
- Province of Manitoba Archives - Fire Commissioner's Atlases
- Province of Manitoba - Land Titles
- The Lakeview Representative - personal communication, Mr. John Enright

A brief overview of the key findings of the historical property development and land use follows:

Discussions were held with the local environment officer from Manitoba Environment, Mr. Dale Hiltz. He indicated that he was not aware of any information on file regarding the property in question and therefore a detailed file search through the Winnipeg office was not completed.

A historical review of air photos was completed to assess past site development on the property. The following air photos and site information were compiled.

- Photo A13582-84-1951
  - Development on site consisted of four horizontal above grade storage tanks located at the northwest corner of the property.

- Photo A21993-234-1970
  - Development on site consisted of four horizontal and four vertical above grade storage tanks located at the northwest corner of the property. Gravel stockpiles were located in the southeast corner.

- Photo MA1072-1460-1976
  - Development same as 1970.

- Photo MA85501404-72-1985
  - Development on site consisted of a concrete batch plant, gravel stockpile and office building to the south. The bulk plant operation had been dismantled.

A review of the Province of Manitoba Archives - Fire Commissioner's Atlases indicated that there was no coverage for the area northeast of downtown Lac du Bonnet.

A review of previous activities was also completed by The Lakeview representative, Mr. John Enright. The following anecdotal information was provided:

- Referring to Figure 1:
  - Part Parcel 2, Plan 7728 and Parcel 1, Plan 9506 purchased together
  - Parcel 2, Plan 5355 purchased to swap for southerly half of Parcel 1, Plan 5355
  - Following subdivision of Parcel 1, Plan 5355, it was consolidated with the other properties to form Lot 1, Parcel 1, Plan 9506
  - Bulk plant was located on Parcel 1, Plan 5355

- The bulk plant was originally owned by Shell Canada. Several large above grade tanks were located near the front of the property. A below grade tank(s) was located in the vicinity of the concrete slab. The property was eventually sold to a local lawn and garden operation. The Village took over the property approximately 10 years ago for payment of back taxes. The above grade tanks were removed when the plant was dismantled. Status on the underground storage tank(s) was previously unknown. Subsequent to UMA's investigation, the Village recently hired B. A. Robinson to remove the tank(s). However, no tank(s) was found and it was concluded that the tank(s) had already been removed.

- The concrete batch plant was located on Parcel 1, Plan 9506. The plant was owned and operated by E. Lavoie Construction Ltd. A small above grade storage tank was apparently located at the northeast corner of the property.

A historical title search of the property was completed. The following property owners were identified.

Parcel 1, Plan 9506

- Property originally owned by Alexander Ramsay McIntosh of the Village of Lac du Bonnet, Manitoba
- Transferred to E. Lavoie Construction Limited on April 19, 1967
- Transferred to 2498988 Manitoba Ltd. on January 30, 1991
- Transferred to Enright Holdings on October 8, 1992

Parcel 1 (Southerly Half) Plan 5355

- Property originally owned by Alexander Ramsay McIntosh of the Village of Lac du Bonnet, Manitoba
- Transferred to North Star Oils Ltd. on January 26, 1952
- Transferred to Shell Canada Ltd. on February 1, 1965
- Transferred to Casimir Leo Drabyk of the Municipality of Lac du Bonnet, Manitoba on August 28, 1978
- Transferred to 502 Farm and Garden Ltd. on June 12, 1979
- Transferred to Edward Frederick Sherbrook of the City of Winnipeg on November 10, 1983
- Transferred to May Agnes Sherbrook of the City of Winnipeg on January 18, 1985
- Transferred to the Village of Lac du Bonnet on June 13, 1988

2.3 *Environmental Issues*

Based on a review of the current setting and historical land use, there are three areas of environmental concern.

- The former above grade storage tanks from the bulk fuel plant
- The above grade storage tank associated with the concrete batch plant
- The former underground storage tank(s) located in the vicinity of the concrete pad

To evaluate the impact from these fuel handling areas, a subsurface investigation was undertaken as presented in the following sections.

SECTION 3.0
FIELD PROGRAM

3.1 Changes to the Initial Work Plan and Sampling Program

The approach described in UMA Environmental's October 28, 1994 proposal was closely followed. Deviations in the work program included:

- Review of current setting and historical land use.
- Deletion of the piezometer installations and groundwater sampling.

3.2 Geophysical Survey

Geophysical surveys were not completed for this study as the fuel handling areas were well defined from historical data.

3.3 Drilling and Soil Sampling

Twenty-two test holes were drilled to investigate for the presence of petroleum hydrocarbon contamination in the subsurface soils at the identified areas of concern. The test hole locations are shown on Figure 2. A truck mounted auger drill rig operated by Paddock Drilling Ltd. was used to drill the holes. Soil samples were collected as grab samples from the auger flights at approximately 0.75 metre intervals, pared and then placed in plastic bags. The holes were sealed with bentonite pieces at the bottom and top to avoid the creation of artificial conduits for contaminant migration. The remaining annular space was backfilled with drill cuttings.

An organic vapour survey using a portable photoionization detector (HNu) was completed on the collected soil samples as a guide to identifying zones of petroleum hydrocarbon contamination and in selecting samples for laboratory analysis. The headspace procedure was used to screen for the presence of volatile organic compounds released from the collected soil samples. The sample inside the plastic bag was broken up to assist in the release of organic vapours and then screened by inserting the probe tip into the plastic bag. If a sample indicated a positive reading, the sample was quickly transferred to a glass container, sealed and the lid secured with electrical tape. The container was then placed on ice packs and stored in a cooler. A geologic log for each test hole is presented in Appendix A. Organic vapour concentrations as measured with the HNu are profiled on each log.

3.4 Installation of Observation Wells

Observation wells were not installed as part of the study based on the fine grained nature of the soils, the lack of groundwater seepage into the drill holes and limited vertical extent of soil contamination.

3.5 Groundwater Sampling

Observation wells were not installed, therefore groundwater sampling was not relevant.

3.6 Surface Water Sampling

The collection of surface water samples was not considered relevant in this study as the surrounding surface water body, the Winnipeg River, is remote from the affected areas.

3.7 Sediment Sampling

The collection of sediment samples was not relevant as there are no surface water bodies within the affected areas.

3.8 Waste Sampling

No hazardous wastes were identified at the site, therefore, the collection of waste samples was not relevant. Sampling was limited to the contaminated soils.

3.9 Levelling

Levelling measurements were not considered relevant in this situation. All excavation depths are referenced from existing grade.

3.10 Permeability Tests

In-situ permeability tests were not completed. It is estimated that the field permeability of the underlying clay soils is in the order of 10^{-7} to 10^{-8} cm/sec. Due to the naturally low permeability of these deposits and the subsurface conditions encountered, it was considered unnecessary to verify the permeability for the purpose of this study.

SECTION 4.0
ANALYTICAL METHODS

4.1 Analytical Methods

The following section summarizes the analytical methods employed to quantify the concentration for selected petroleum hydrocarbon constituents according to Manitoba Environment and CCME guidelines.

4.2 Soil Samples

The parameters analyzed included:

Parameter	Detection Limit (mg/kg)
Benzene	0.05
Toluene	0.05
Ethylbenzene	0.05
Xylene	0.05
Total purgeable hydrocarbon (C_5 - C_{10})	0.10
Total extractable hydrocarbon (C_{10} - C_{30})	50.0

The analysis was carried out in accordance with U.S. Environmental Protection Agency Methods 5030/8240 (#SW 946, 3rd Edition, Washington, DC), which involves purge and trap extraction of the volatile components followed by analysis by capillary gas chromatography using a mass selective detector. Analysis of the extractable components was carried out in accordance with Alberta Environment Method G108.0 involving extraction of the sample with methylene chloride

(EPA 3540) followed by analysis by capillary gas chromatography using a flame ionization detector. Norwest Labs, certified by the Canadian Association of Environmental Analytical Laboratories performed the analyses.

4.3 Groundwater Samples

Not relevant. No groundwater samples were collected.

4.4 Surface Water Samples

Not relevant. No surface water samples were collected.

4.5 Waste Samples

Not relevant. No waste samples were collected.

4.6 Sediment Samples

Not relevant. No sediment samples were collected.

4.7 Quality Assurance and Quality Control

Surrogate-spike samples were prepared and analyzed by the laboratory to determine if the GC-MS equipment operated at an acceptable level of accuracy. The surrogate spike recoveries for the submitted samples were acceptable to EPA standards. The sample analysis and QA/QC procedures were performed by the following laboratory:

Norwest Labs
203 - 20771 Langley By-Pass
Langley, B.C.
V3A 5E8

Phone: (604) 530-4344
Fax: (604) 534-9966

Lab Manager: Randy Reichle
Certified by CAEAL

SECTION 5.0
GEOLOGICAL AND HYDROGEOLOGICAL CONDITIONS

5.1 Soil Stratigraphy

The soil stratigraphy in the vicinity of the site consists of a thin veneer of topsoil overlying lacustrine silt and clay and glacial till. Precambrian bedrock underlies the region at depths ranging from 15 to 30 metres (based on water well records). On site, granular fill can be found overlying the topsoil in the traffic areas. A brief description of the key stratigraphic units encountered on site follows.

Granular Fill

Approximately 0.3 to 0.75 metres of granular fill was found overlying the area investigated. The fill is a medium to coarse gravel and relatively free of any miscellaneous debris.

Topsoil

A layer of topsoil was encountered beneath the granular fill at most test hole locations. The thickness of the topsoil varies from 0.1 to 0.5 metres. The soil is black, moist and contains organics.

Silt

Approximately 0.9 to 1.7 metres of silt was found underlying the topsoil at most test hole locations. The silt is grey in colour, contains some clay, is generally moist and soft. At some locations the silt was moist to wet and occasionally soft to firm.

Clay

A brown clay can be found underlying the site at all test hole locations. The clay is generally moist, firm, plastic and contains some silt. All test holes ended in this unit. The maximum depth investigated was 6.1 metres. Based on water well records in the area, the clay layer can extend to between 10 and 25 metres below ground surface. The unit is underlain by glacial till, with an overall overburden thickness of 15 to 30 metres.

5.2 *Hydrogeology*

No monitoring wells were installed as part of this investigation. Based on Provincial Groundwater Records and Groundwater Availability Studies, the prime aquifers in this area consist of:

- Extensive areas of sand and gravel
- Lenses of sand and gravel
- Bedrock

The extensive areas of sand and gravel can be found to the west of Lac du Bonnet. The thickness of this unit ranges from 1 to 25 metres with water bearing zones from 0 to 30 metres below ground surface. The aquifers classified as lenses of sand and gravel are generally isolated units which are randomly scattered throughout the surficial deposits. These aquifers are found both north and south of Lac du Bonnet. They are more common on the west side of the Winnipeg River and located between 0 and 30 metres of ground surface. Groundwater within the underlying bedrock is generally limited to the fracture zones. The availability of these zones varies considerably from place to place and with depth (from less than 15 metres to more than 100 metres).

In the vicinity of the site, groundwater is predominantly found in the underlying bedrock and on occasion within a granular seam in the glacial till. In either case there is a substantial thickness of low permeability soil overlying these water bearing zones thereby creating limited pollution hazards. It is estimated that the permeability of the clay soils is in the range of 10^{-7} to 10^{-8} cm/sec with the water table at 3 to 4 metres below ground surface. Flow gradients within the overburden are likely downward with little horizontal flow. Within the bedrock localized flow systems will exist.

SECTION 6.0
APPLICABLE ENVIRONMENTAL LAWS, REGULATIONS AND GUIDELINES

6.1 Federal

The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Criteria for Contaminated Sites are intended to provide general technical guidance in the evaluation and remediation of contaminated sites in Canada. CCME Report EPC-C534, 1991 was utilized and referenced for the following investigation. Applicable remediation criteria are presented in Appendix B.

6.2 Provincial

A guideline for the Environmental Investigation and Remediation of Petroleum Storage Sites in Manitoba, 1993 was followed in conducting the site investigation. Provincial remediation criteria for soil are also contained in Appendix B.

SECTION 7.0
ANALYTICAL RESULTS

7.1 Soil Samples

Soil samples releasing organic vapours were identified at each of the three petroleum handling areas as follows:

- Bulk Above Grade Tanks - Test Holes LDB5, LDB7, LDB17
- Small Above Grade Tank - Test Hole LDB14
- Underground Storage Tank(s) - Test Holes LDB6, LDB11 to LDB13, LDB19 to LDB21

Vapour measurements on the soil samples collected in these test holes ranged from 0 to 120 ppm as measured by the HNu. The highest HNu readings were recorded near surface in the area of the above grade tanks and at a depth of 3 to 4 metres in the area of the underground storage tank(s). In all cases concentrations were noted to drop off with depth and in several cases zero HNu readings were obtained within the limit of vertical investigation. HNu readings are profiled on the test hole logs presented in Appendix A.

To define the magnitude and type of petroleum hydrocarbons encountered in the soil at these locations, six samples were submitted for laboratory analysis. The submitted samples were selected based on the measured headspace concentrations of organic vapours in air released from the soil as measured by the HNu. The samples were analyzed for benzene, toluene, ethylbenzene and xylene (BTEX), total purgeable hydrocarbon (C_5 - C_{10}) and total extractable hydrocarbon (C_{10} - C_{30}). The HNu measurements for the selected samples and analytical results are summarized in Table 7-1 along with Manitoba Environment and CCME Remediation Criteria for Soil. A copy of the laboratory data sheet is contained in Appendix C.

TABLE 7-1
ANALYTICAL RESULTS - SOIL

LOCATION	DEPTH (m)	HNU (ppm)	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYLBENZENE (mg/kg)	XYLENE (mg/kg)	TOTAL PURGEABLE HYDROCARBON (mg/kg)	TOTAL EXTRACTABLE HYDROCARBON (mg/kg)
LDB-5	0.75	70	0.26	2.27	7.35	9.98	591	19338
LDB-7	1.50	8	ND	ND	ND	ND	0.94	2235
LDB-10	4.50	0	ND	ND	ND	ND	ND	ND
LDB-11	6.10	9	ND	ND	ND	TRACE	0.87	TRACE
LDB-14	0.75	70	ND	1.02	0.44	20.2	1209	38458
LDB-19	6.10	35	1.27	3.03	1.93	10.21	58.9	275
DETECTION LIMIT	-	-	0.05	0.05	0.05	0.05	0.1	50
MANITOBA ENVIRONMENT								
LEVEL I	-	-	0.05	0.1	0.1	0.1	100	500
LEVEL II	-	-	0.5	3	5	5	150	2000
LEVEL III	-	-	5	30	50	50	800	2000
CCME GUIDELINES								
AGRICULTURAL	-	-	0.05	0.1	0.1	0.1	-	-
RESIDENTIAL/ PARKLAAND	-	-	0.5	3	5	5	-	-
COMMERCIAL/ INDUSTRIAL	-	-	5	30	50	50	-	-

ND = CONCENTRATION BELOW DETECTION LIMIT

Measured concentrations in the soil samples exceeding Manitoba Environment Level I, II or III criteria are as follows:

LDB5	-	Benzene	-	Level I
	-	Toluene	-	Level I
	-	Ethylbenzene	-	Level II
	-	Xylene	-	Level II
	-	TPH	-	Level II
	-	TEH	-	Level II/III
LDB7	-	TEH	-	Level II/III
LDB14	-	Toluene	-	Level I
	-	Ethylbenzene	-	Level I
	-	Xylene	-	Level II
	-	TPH	-	Level II/III
	-	TEH	-	Level II/III
LDB19	-	Benzene	-	Level II
	-	Toluene	-	Level II
	-	Ethylbenzene	-	Level I
	-	Xylene	-	Level II

All other parameters/locations are below the Level I Criteria. CCME Agricultural, Residential/Parkland and Commercial/Industrial remediation criteria correspond to Manitoba Environment Level I, II and III criteria, respectively. Due to the soil concentrations exceeding Level I criteria, this property would be considered a contaminated site by Manitoba Environment.

7.2 Groundwater Samples

Not relevant. No groundwater samples were collected as part of the investigation.

7.3 Surface Water Samples

Not relevant. No surface water samples were collected as part of the investigation.

7.4 Waste Samples

Not relevant. No waste found on site.

7.5 Sediment Samples

Not relevant. No sediment samples were collected as part of the investigation.

7.6 QA/QC Results

Surrogate-spike samples were prepared and analyzed by the laboratory. The results for this QA/QC testing are found in Appendix C. The surrogate-spike recoveries for the submitted samples are acceptable to EPA standards.

SECTION 8.0
CONTAMINATED ZONES, SITE SENSITIVITY AND REMEDIATION OPTIONS

8.1 Contaminated Zones

Based on the test drilling program, it would appear that three sites have been affected by the release of petroleum hydrocarbon product. These sites are shown on Figure 2 and are based on the analytical data and detectable organic vapours measured in the field. The outer limits shown for each site have been interpreted to be halfway between test holes with soil samples releasing detectable organic vapours and those which showed no detectable organic vapours. A brief discussion on each area follows.

Site 1 - Bulk Above Grade Storage Tanks

The estimated area affected at this site is 170 m^2. The maximum vertical limit appears to extend to a depth of 3 metres, based on HNu measurements, bringing the affected volume to approximately 510 m^3. The concentrations as reported by the laboratory are in excess of Level III criteria for total extractable hydrocarbons (LDB5, LDB7), Level II criteria for total purgeable hydrocarbons, xylene and ethylbenzene (LDB5) and Level I criteria for benzene and toluene (LDB5). The type of petroleum product would appear to be in the C_{10} - C_{30} range which is reflective of diesel fuels.

Site 2 - Small Above Grade Storage Tank

The area affected at Site 2 is estimated at 75 m^2. This is based on the concentrations noted at LDB14 and zero readings at LDB22. Due to concrete

rubble located at surface in the vicinity of LDB14, it was not possible to advance additional test holes at this site to accurately define the limit of the affected area. The maximum vertical limit appears to extend to 3.0 metres based on HNu measurements. This equates to an affected volume of soil of approximately 225 m^3. The concentrations as reported by the laboratory are in excess of Level I criteria for toluene and ethylbenzene, Level II criteria for xylene and Level III criteria for total purgeable and total extractable hydrocarbons. The type of petroleum product would appear to be in the C_{10} - C_{30} range which is reflective of diesel fuels.

Site 3 - Underground Storage Tank(s)

The estimated area affected at this site is 275 m^2. The affected area also appears to extend beyond the north property line but this has not been included in the above estimate. Based on HNu readings, the vertical limit of hydrocarbons in soil would appear to be 3 to 5 metres. Assuming an average depth of 4 metres, this would equate to an affected volume at this site of 1,100 m^3. The type of petroleum product would appear to be in the C_5 - C_{10} range or gasoline. Gasoline is considerably more purgeable than diesel based fuels, therefore the HNu readings correlate better with the laboratory results. This can be seen in the samples collected at LDB11 and LDB19 where low HNu values correspond to non-detect and low level concentrations for the BTEX parameters, respectively. This would suggest that the low HNu readings measured at LDB12, LDB13 and LDB20 may also be below the Level I criteria and that the affected area may be limited to test holes LDB6, LDB11, LDB19 and LDB21. At this time, the more conservative volume estimate should still be considered.

The estimated in-place volume of soil affected at each site is summarized below. These volumes are based on the field and laboratory results and may vary during actual site remediation.

	Area (m^2)	Depth (m)	Volume (m^3)
Site 1	170	3	510
Site 2	75	3	225
Site 3	275	4	1,100
Total Volume			1,835

8.2 Site Sensitivity

Based on the review of the gathered site information and analytical results, the following site sensitivity assessment has been completed. The sensitivity analysis applies to all three sites.

8.2.1 Site Information

Site Description

- Abandoned bulk fuel storage facility, concrete batch plant, service repair station
- Proposed future hotel development

Surrounding Land Use

- Public reserve and residential development to the south
- Public boat launch/rural residential development to the north

- Undeveloped land to the west
- Winnipeg River to the east

Groundwater Usage

- Domestic wells in underlying bedrock aquifer (locations unknown)

Surface Water

- Limited surface drainage along PR 502
- Winnipeg River located adjacent to east property line

Underground Structures

- Buried cables located parallel to front property line

Other Special Environmental Conditions

- None

Subsurface Conditions

- Granular fill overlying a thin layer of topsoil, followed by lacustrine silt and clay, glacial till and Precambrian bedrock
- Overburden thickness ranges from 15 to 30 metres
- Permeability of the clay soils estimated at 10^{-7} to 10^{-8} cm/sec
- Water table at 3 to 4 metres below ground surface

8.2.2 *Sensitivity Assessment*

Ingestion (Groundwater/Surface Water)

Receptor	Receptor Sensitivity	Likelihood of Impact	Sensitivity Ranking
Usable Aquifer	High	Low	SS*
Winnipeg River	High	Low	SS*
Local Drainage Courses	Low	Low	NR**
* Site specific cleanup criteria may be considered. ** No cleanup response may be necessary. Site Sensitivity Ranking - Ingestion: Site Specific			

Inhalation (Vapours From Soil)

Receptor	Receptor Sensitivity	Likelihood of Impact	Sensitivity Ranking
Commercial/ Industrial/Public (indoor)	Medium	High	Moderate
Outdoor-On Site	Low	Medium	Low
Outdoor-Off Site	Low	Low	Low
Site Sensitivity Ranking - Inhalation (Soil): Moderate			

Inhalation (Vapours From Groundwater)

Receptor	Receptor Sensitivity	Likelihood of Impact	Sensitivity Ranking
Commercial/ Industrial/Public (indoor)	Medium	Low	Low
Outdoor-On Site	Low	Low	Low
Outdoor-Off Site	Low	Low	Low
Site Sensitivity Ranking - Inhalation (Groundwater): Low			

8.2.3 Cleanup Criteria

The site sensitivity ranking for soil is moderate for the proposed commercial land use, therefore, cleanup to Level II is required. The potential impact on groundwater and surface water is low.

8.3 Remediation Options

Based on the field screening and laboratory results, the investigated site would be considered contaminated under Manitoba Environment Criteria. Based on the site sensitivity assessment, site remediation is required. To meet the requirements of the proposed development, Manitoba Environment would likely require remediation to Level II criteria. Options for site remediation include:

- Excavation, transport and treatment of the contaminated soil at an off-site landfarming facility.
- Excavation, transport and disposal of the contaminated soil at an existing landfill facility.

The latter would require review with the Village of Lac du Bonnet to determine whether they would be willing to accept the contaminated soil and what disposal fee may apply. Treatment at an off-site landfarming facility would involve constructing a lined treatment cell, placing the excavated soil within the cell, and tilling the soil to enhance volatilization of the contaminants. Treatment is achieved through volatilization and microbial degradation. Treatment time will vary from site to site and may take up to two years.

Conventional earth moving equipment such as a backhoe capable of reaching a depth of at least four to five metres will be required to excavate the contaminated soil above the Manitoba Environment Level II Criteria. The excavations should be monitored using field organic vapour screening equipment to direct the excavation activities. Soil samples should be collected from the sides and bottom of each completed excavation and submitted to the laboratory for analysis to verify that the contaminated soil has been removed. The excavation can be backfilled and compacted using off-site borrow materials. Covered trucks should be used to transport the contaminated soil to the selected disposal facility (landfarm operation or landfill facility). Approximately one to two weeks will be required to complete the excavation, backfilling and transportation of the soil to the selected disposal site.

8.4 ***Estimated Costs of Remediation***

The following is a breakdown of the estimated costs to complete site remediation assuming treatment at an off-site landfarm facility. The costs are approximate and will depend on the final location selected for disposal of the contaminated soils.

Treatment Site Selection	$6,000.00
Development of Technical Specifications	$4,000.00

Site Inspection/Excavation Monitoring	
(includes laboratory analysis)	$5,000.00
Excavation/Backfilling/Disposal	$25,000.00
Construction of a Temporary Landfarm Treatment Facility	$15,000.00
Soil Treatment	$15,000.00

The total estimated cost to implement all the activities associated with the proposed remedial strategy is $70,000.00. This cost includes all engineering associated with development of the technical specifications, casual inspection of the landfarm construction and full time inspection of the excavation monitoring. There is no engineering allowance associated with the operation of the landfarm and no allowance for purchase of a suitable property for the construction of the landfarm. The estimated costs are based on the assumed volume of contaminated soil. This may vary during actual site remediation when field screening of the excavations is completed.

If accepted at the landfill, the remediation costs would be in the range of $30,000.00 (Site Inspection / Excavation Monitoring and Excavation / Backfill / Disposal). Any cost for disposal at the landfill would have to be reviewed with the Village of Lac du Bonnet and would be additive to the $30,000.

SECTION 9.0
CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

- The overburden soils have been affected by the release of petroleum hydrocarbon products at three isolated locations.

- Manitoba Environment Remediation Criteria Levels I, II and III have been exceeded for specific parameters measured in the submitted soil samples.

- An estimated 1,800 m^3 of soil has been affected and requires remediation. This does not include the affected area beyond the property line to the north of Site 3.

- The site sensitivity ranking for the soils is moderate based on Manitoba Environment Guidelines and the proposed future commercial land use. This will require cleanup be completed to Level II criteria. The potential impact on groundwater and surface water is low.

- Remedial options include excavation, transport and disposal of the contaminated soils at an existing landfill facility or at an off-site landfarm treatment facility.

9.2 Recommendations

- Inform Manitoba Environment of the results of this investigation.

- Based on the site sensitivity ranking for the soil and proposed future development, remediate the site to a minimum of Manitoba Environment Level II criteria.

- Remediation strategies should involve the development of a temporary landfarming operation for treatment of the contaminated soils or disposal at an existing landfill facility. The latter will have to be reviewed with the Village of Lac du Bonnet to see if they will accept the contaminated soil and at what cost.

Respectfully Submitted,

UMA ENVIRONMENTAL

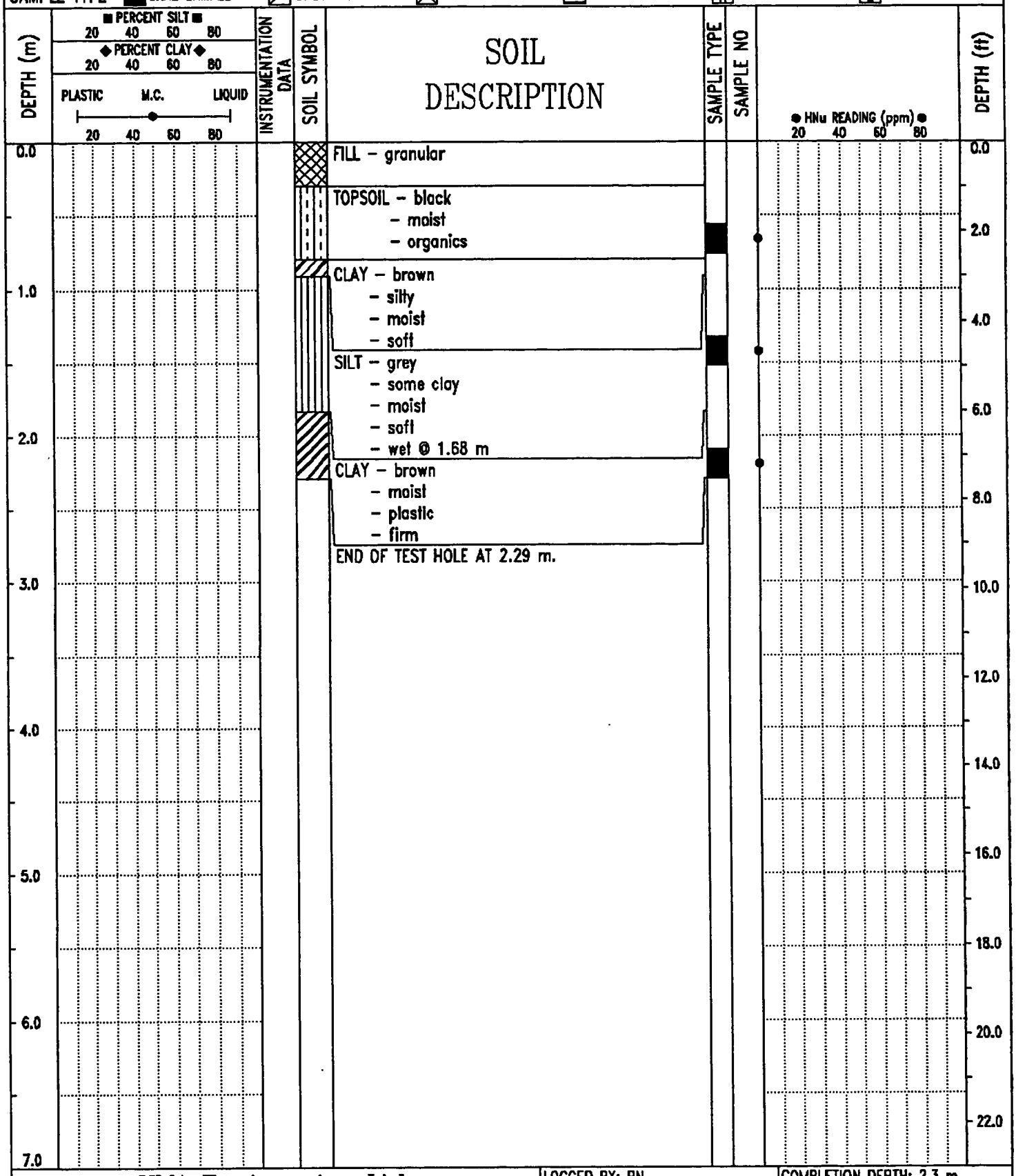
L. Bielus, M.Sc., P.Eng.
Senior Project Engineer
UMA Environmental

APPENDIX A

TEST HOLE LOGS

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB1
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ⊘ SHELBY TUBE ⊠ DISTURBED ☰ NO RECOVERY ▯ CORE BARREL ▮ WIRE LINE TYPE



UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 2.3 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/09 11:45AM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB2
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▮ WIRE LINE TYPE

DEPTH (m)	■ PERCENT SILT ■ 20 40 60 80 / ◆ PERCENT CLAY ◆ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	INSTRUMENTATION DATA	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● HNu READING (ppm) ● 20 40 60 80	DEPTH (ft)
0.0				FILL – granular				0.0
				TOPSOIL – organics – black – moist				2.0
1.0				SILT – clayey – grey – moist to wet – soft				4.0
								6.0
2.0				CLAY – brown – plastic – moist – firm				8.0
				END OF TEST HOLE AT 2.29 m.				10.0
3.0								12.0
4.0								14.0
5.0								16.0
								18.0
6.0								20.0
								22.0
7.0								

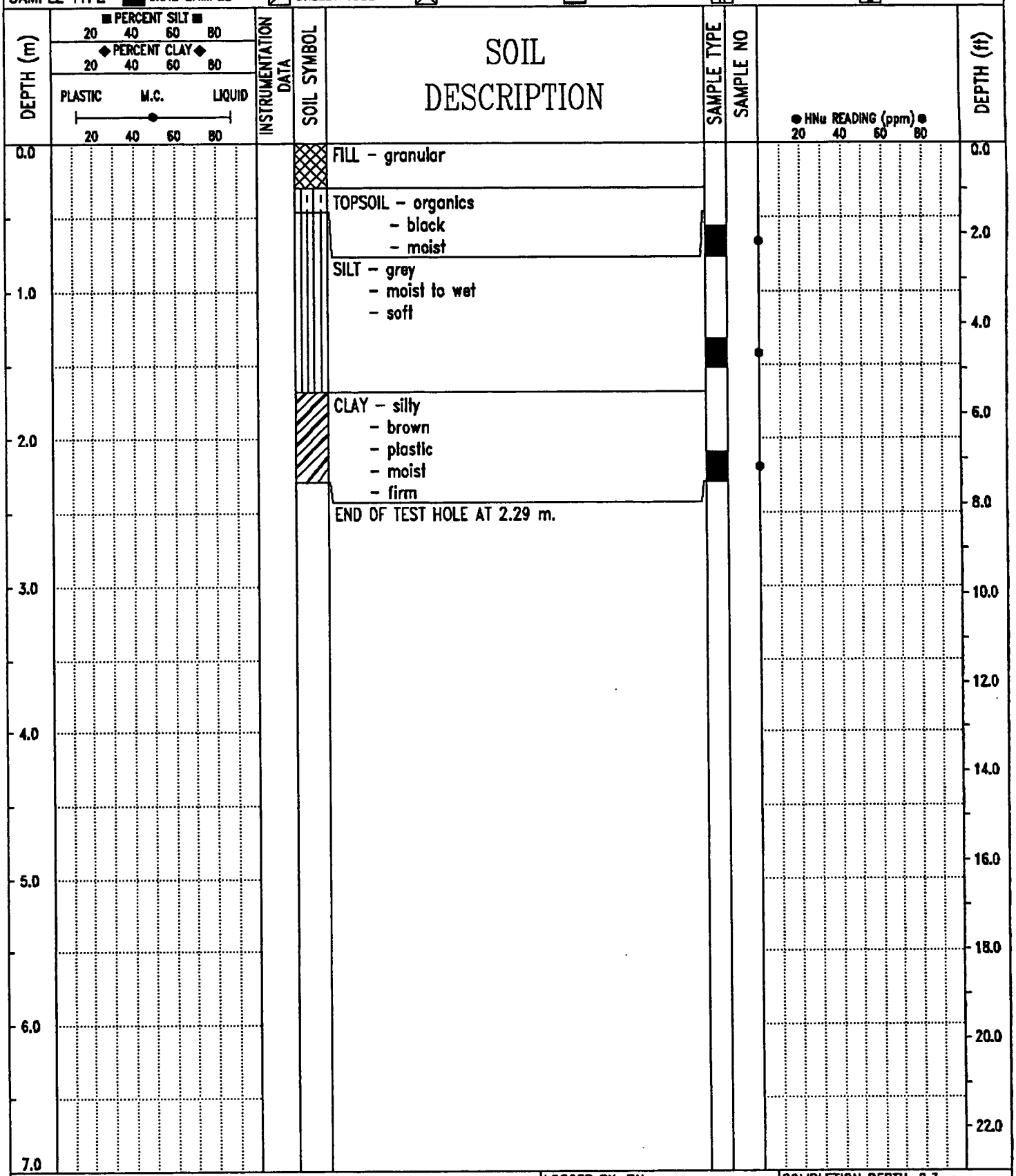
UMA Engineering Ltd.
Winnipeg, Manitoba

LOGGED BY: RN	COMPLETION DEPTH: 2.3 m
REVIEWED BY: LB	COMPLETE: 02/11/94
Fig. No:	Page 1 of 1

95/01/05 11:48AM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB3
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▦ WIRE LINE TYPE



UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 2.3 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 11:15AM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB4
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SHELBY TUBE | DISTURBED | NO RECOVERY | CORE BARREL | WIRE LINE TYPE

■ PERCENT SILT ■ 20 40 60 80
◆ PERCENT CLAY ◆ 20 40 60 80
PLASTIC M.C. LIQUID 20 40 60 80

● HNu READING (ppm) ● 20 40 60 80

DEPTH (m)	INSTRUMENTATION DATA	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	DEPTH (ft)
0.0			FILL – granular			0.0
			TOPSOIL – organics – black – moist			2.0
1.0			SILT – grey – moist to wet – soft to firm			4.0
						6.0
2.0			CLAY – some silt – brown – plastic – moist – firm			8.0
			END OF TEST HOLE AT 2.29 m.			10.0
3.0						12.0
4.0						14.0
5.0						16.0
6.0						18.0
						20.0
7.0						22.0

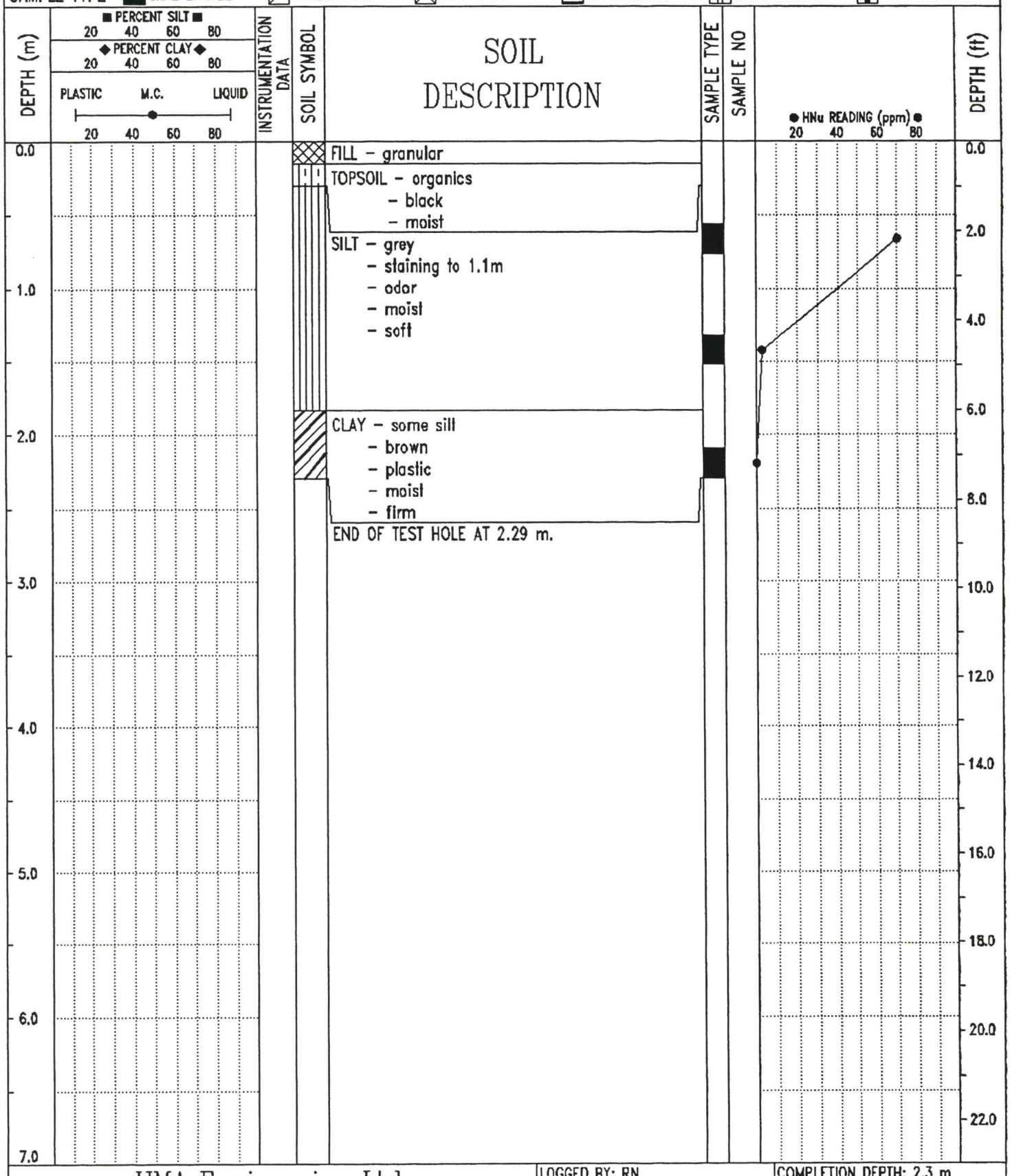
UMA Engineering Ltd.
Winnipeg, Manitoba

LOGGED BY: RN	COMPLETION DEPTH: 2.3 m
REVIEWED BY: LB	COMPLETE: 02/11/94
Fig. No:	Page 1 of 1

95/01/05 11:55AM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB5
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▮ WIRE LINE TYPE

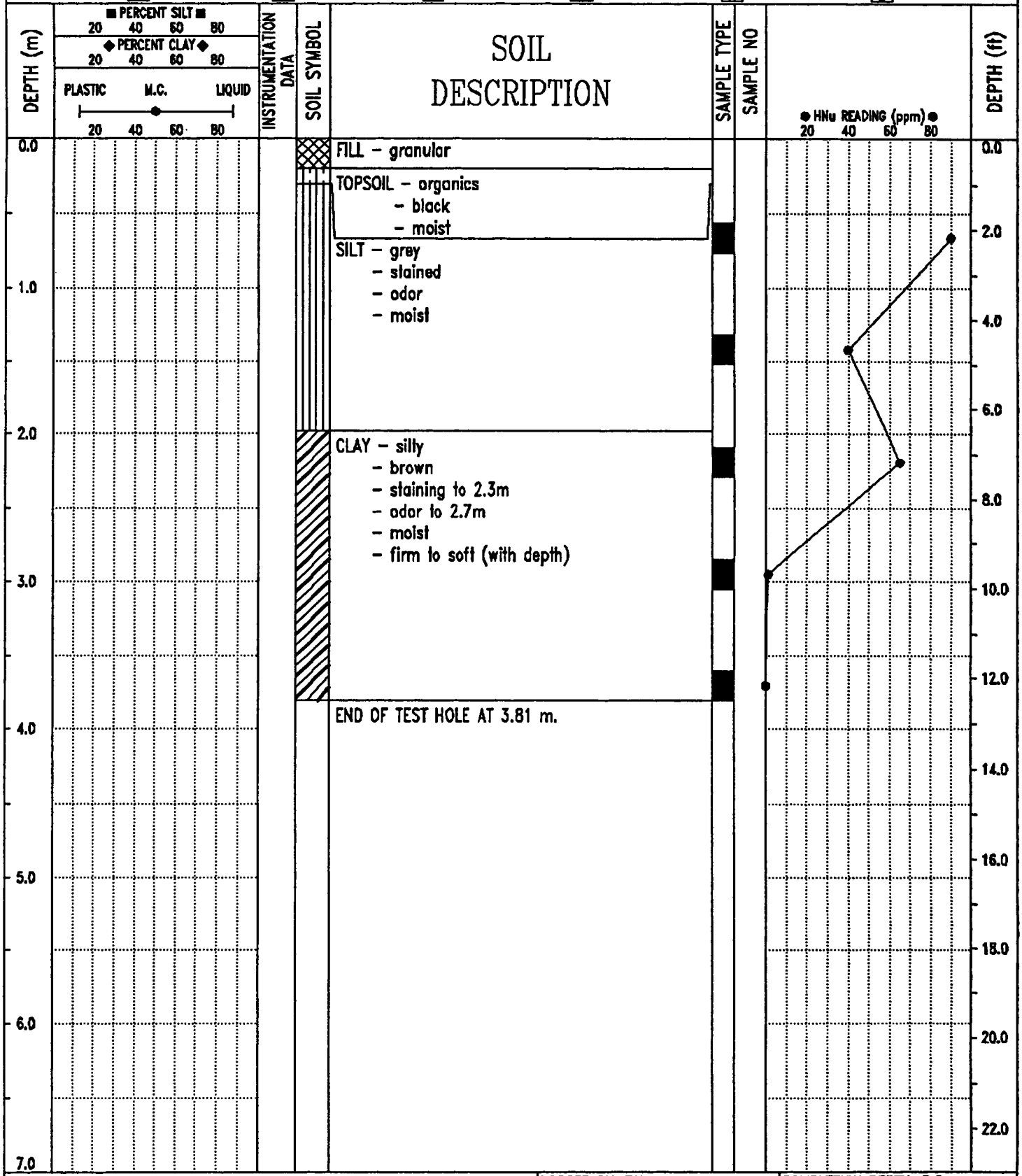


UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 2.3 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 11:59AM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB6
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SHELBY TUBE | DISTURBED | NO RECOVERY | CORE BARREL | WIRE LINE TYPE

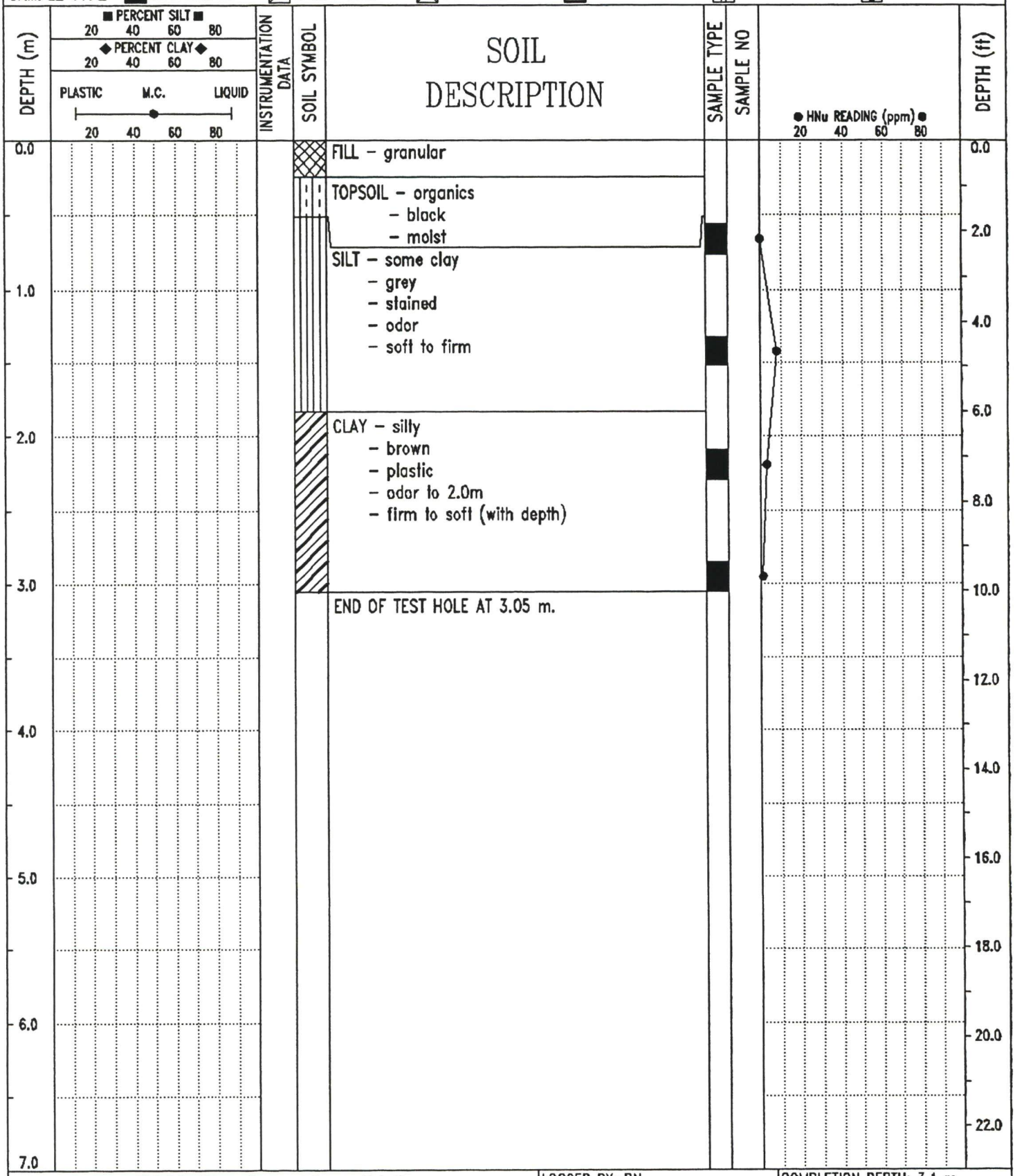


UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 3.8 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 12:03PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB7
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▮ WIRE LINE TYPE



UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 3.1 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 01:49PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB8
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▦ WIRE LINE TYPE

DEPTH (m) | ■ PERCENT SILT ■ 20 40 60 80 | ◆ PERCENT CLAY ◆ 20 40 60 80 | PLASTIC M.C. LIQUID 20 40 60 80 | INSTRUMENTATION DATA | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NO | ● HNu READING (ppm) ● 20 40 60 80 | DEPTH (ft)

Depth (m)	Depth (ft)	Description
0.0	0.0	FILL – granular
		TOPSOIL – organics – black – moist
1.0	2.0	SILT – some clay – grey – moist – soft
2.0	6.0	CLAY – silty – brown – moist – firm to soft (with depth)
	8.0	END OF TEST HOLE AT 2.29 m.
3.0	10.0	
4.0	12.0	
	14.0	
5.0	16.0	
	18.0	
6.0	20.0	
	22.0	
7.0		

UMA Engineering Ltd.
Winnipeg, Manitoba

LOGGED BY: RN	COMPLETION DEPTH: 2.3 m
REVIEWED BY: LB	COMPLETE: 02/11/94
Fig. No:	Page 1 of 1

95/01/05 01:45PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB9
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SHELBY TUBE | DISTURBED | NO RECOVERY | CORE BARREL | WIRE LINE TYPE

DEPTH (m) | ■ PERCENT SILT ■ 20 40 60 80 | ◆ PERCENT CLAY ◆ 20 40 60 80 | PLASTIC M.C. LIQUID 20 40 60 80 | INSTRUMENTATION DATA | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NO | ● HNu READING (ppm) ● 20 40 60 80 | DEPTH (ft)

0.0 (0.0)
FILL – granular

TOPSOIL – organics
- black
- moist

1.0 (4.0)
SILT – some clay
- grey
- staining faint odor to 0.6m
- moist
- soft

2.0 (6.0)
CLAY – some silt
- brown
- plastic
- firm

3.0 (10.0)
END OF TEST HOLE AT 3.05 m.

4.0 (14.0)
5.0 (16.0)
6.0 (20.0)
7.0 (22.0)

UMA Engineering Ltd.
Winnipeg, Manitoba

LOGGED BY: RN	COMPLETION DEPTH: 3.1 m
REVIEWED BY: LB	COMPLETE: 02/11/94
Fig. No:	Page 1 of 1

95/01/05 01:43PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB10
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SHELBY TUBE | DISTURBED | NO RECOVERY | CORE BARREL | WIRE LINE TYPE

PERCENT SILT 20 40 60 80
PERCENT CLAY 20 40 60 80
PLASTIC M.C. LIQUID 20 40 60 80

DEPTH (m)	INSTRUMENTATION DATA	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	HNu READING (ppm) 20 40 60 80	DEPTH (ft)
0.0			FILL – granular				0.0
			TOPSOIL – organics – black – moist				
1.0			SILT – grey – some staining – faint odor – moist – soft				2.0 4.0
2.0			CLAY – brown – plastic – moist – soft to firm (with depth)				6.0 8.0
3.0							10.0
4.0							12.0 14.0
5.0			END OF TEST HOLE AT 4.57 m.				16.0
6.0							18.0 20.0
7.0							22.0

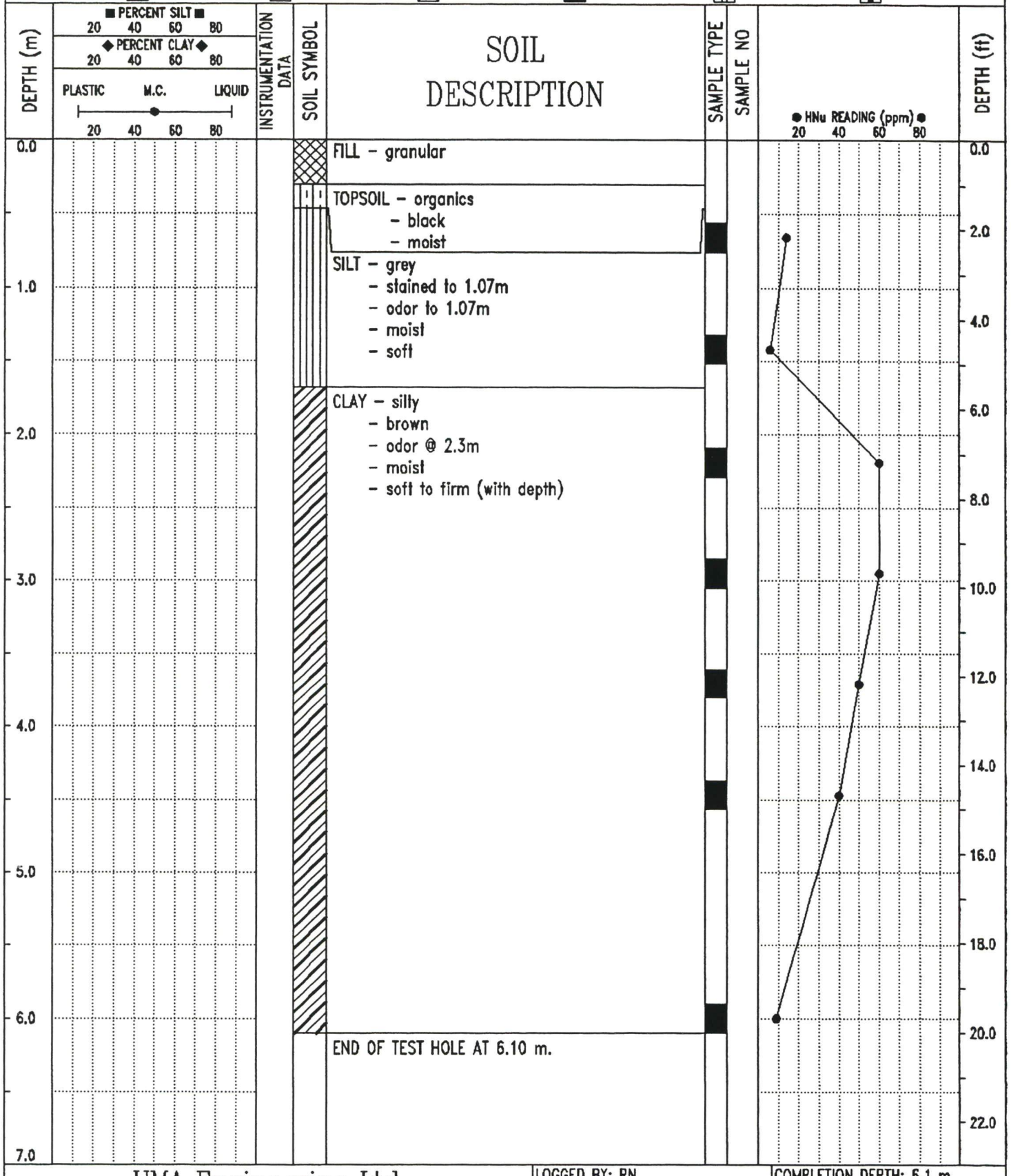
UMA Engineering Ltd.
Winnipeg, Manitoba

LOGGED BY: RN	COMPLETION DEPTH: 4.6 m
REVIEWED BY: LB	COMPLETE: 02/11/94
Fig. No:	Page 1 of 1

95/01/06 08:44AM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB11
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▧ WIRE LINE TYPE

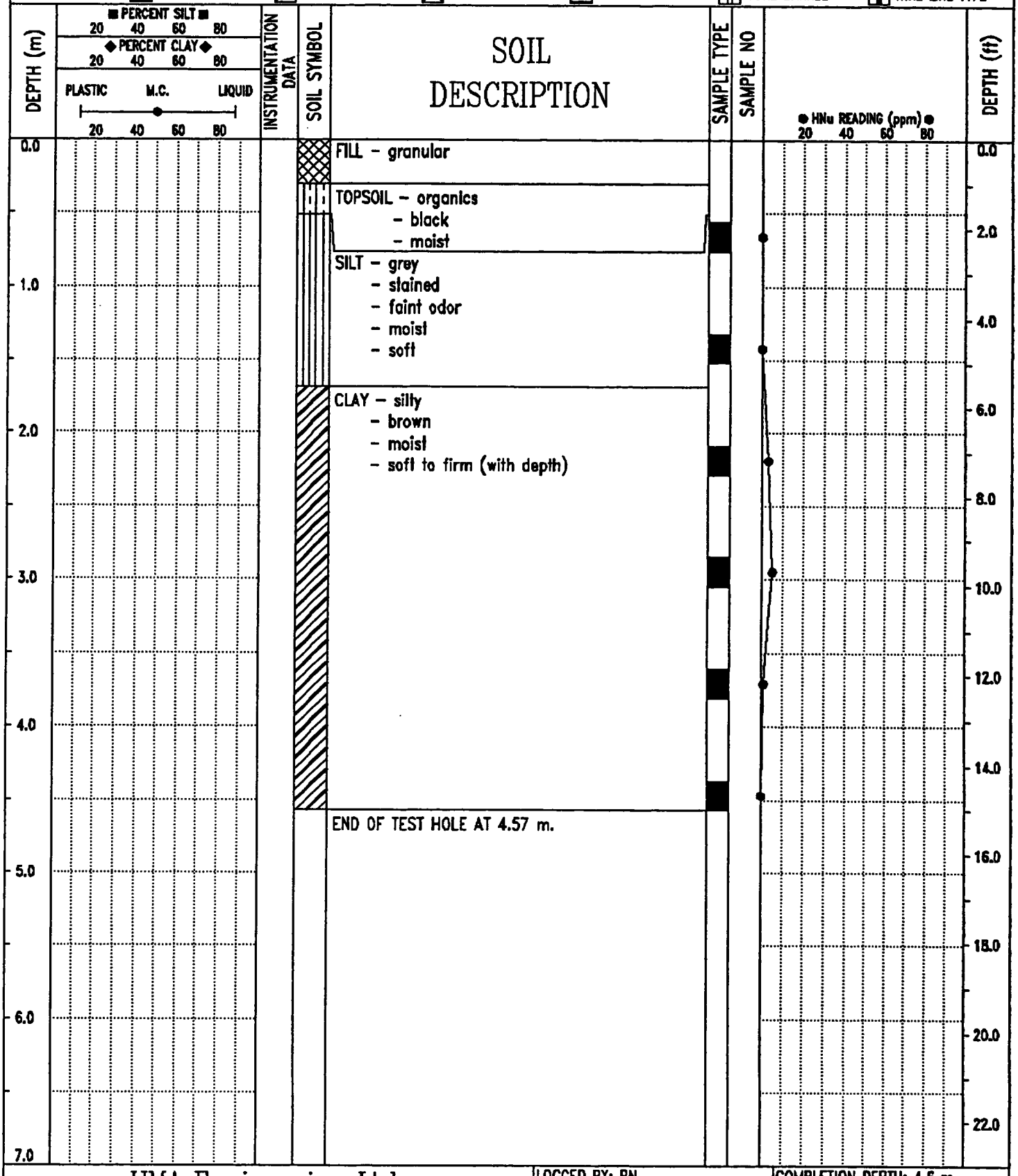


UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 01:37PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB12
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SHELBY TUBE | DISTURBED | NO RECOVERY | CORE BARREL | WIRE LINE TYPE

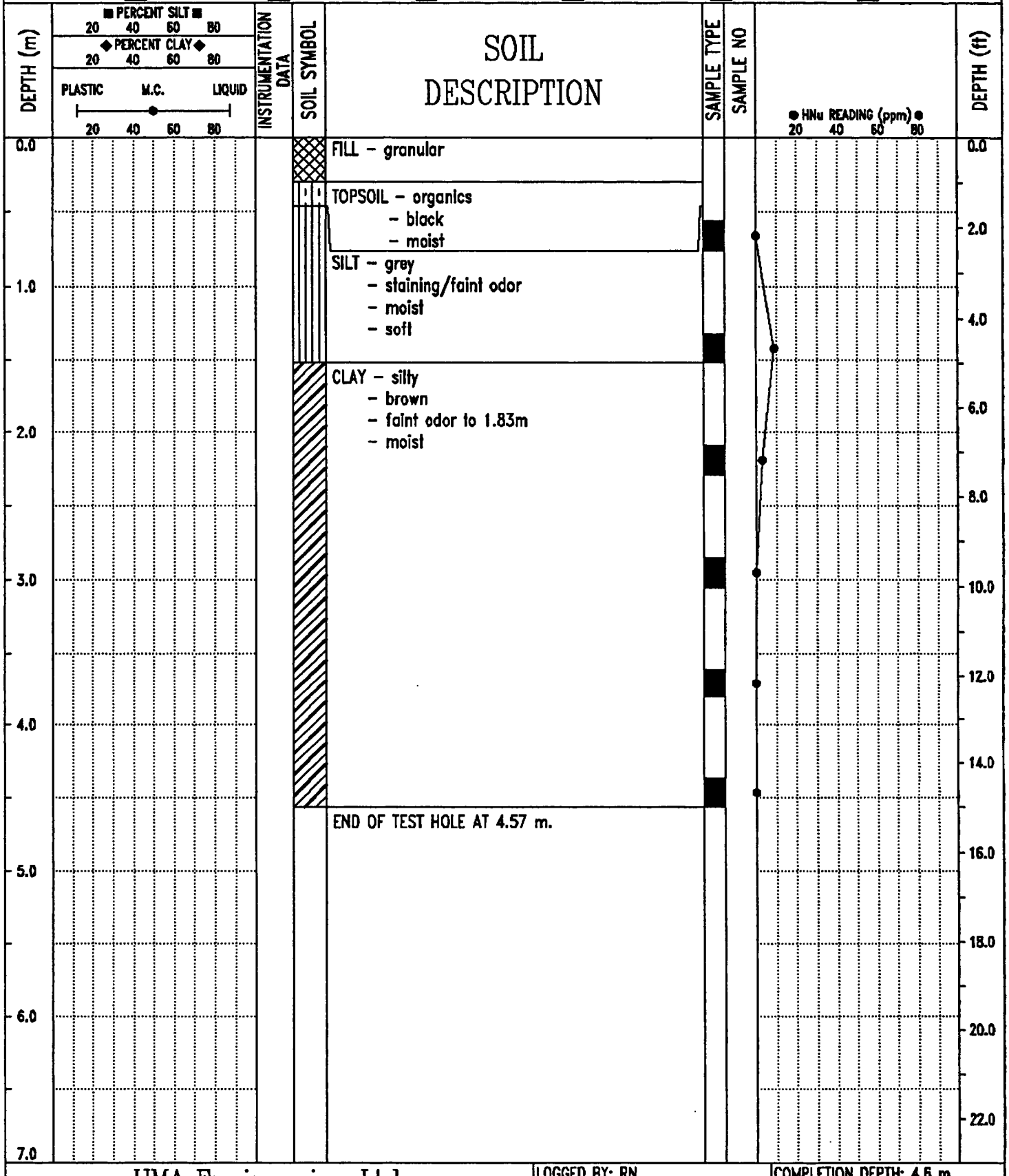


UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 4.6 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

05/01/05 01:33PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB13
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▧ WIRE LINE TYPE



UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 4.6 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 01:50PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB14
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ☒ DISTURBED ☰ NO RECOVERY ▯ CORE BARREL ▮ WIRE LINE TYPE

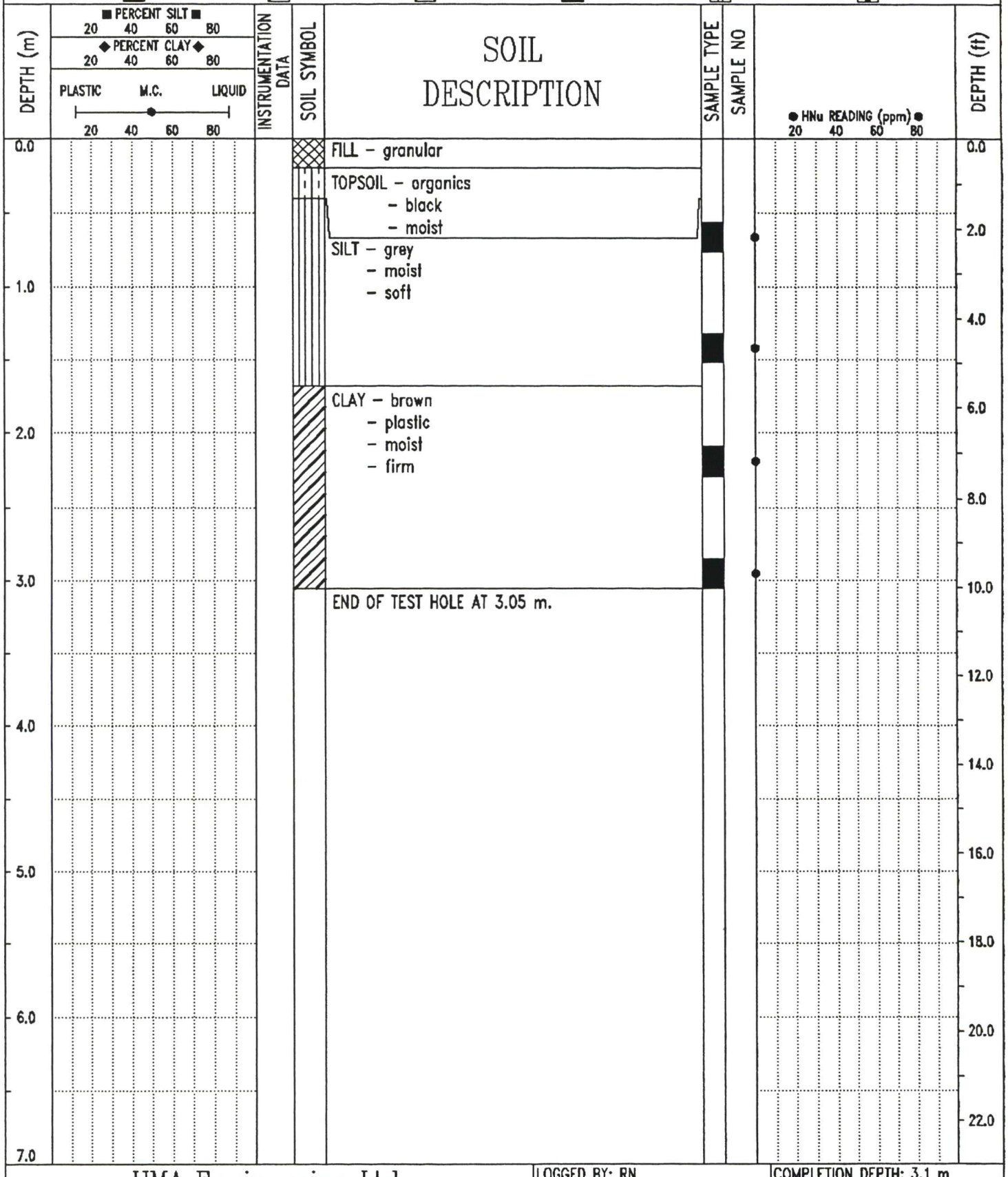
DEPTH (m)	PERCENT SILT / PERCENT CLAY / PLASTIC – M.C. – LIQUID (20 40 60 80)	INSTRUMENTATION DATA	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	HNu READING (ppm) (20 40 60 80)	DEPTH (ft)
0.0				FILL – granular				0.0
1.0				CLAY – silty – brown – plastic – stained/odor to 1.83m – moist – soft to firm (with depth)				2.0
2.0								4.0
3.0								6.0
4.0								8.0
5.0								10.0
6.0								12.0
7.0				END OF TEST HOLE AT 4.57 m.				14.0
								16.0
								18.0
								20.0
								22.0

UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 4.6 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

05/01/05 01:27PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB15
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▮ WIRE LINE TYPE

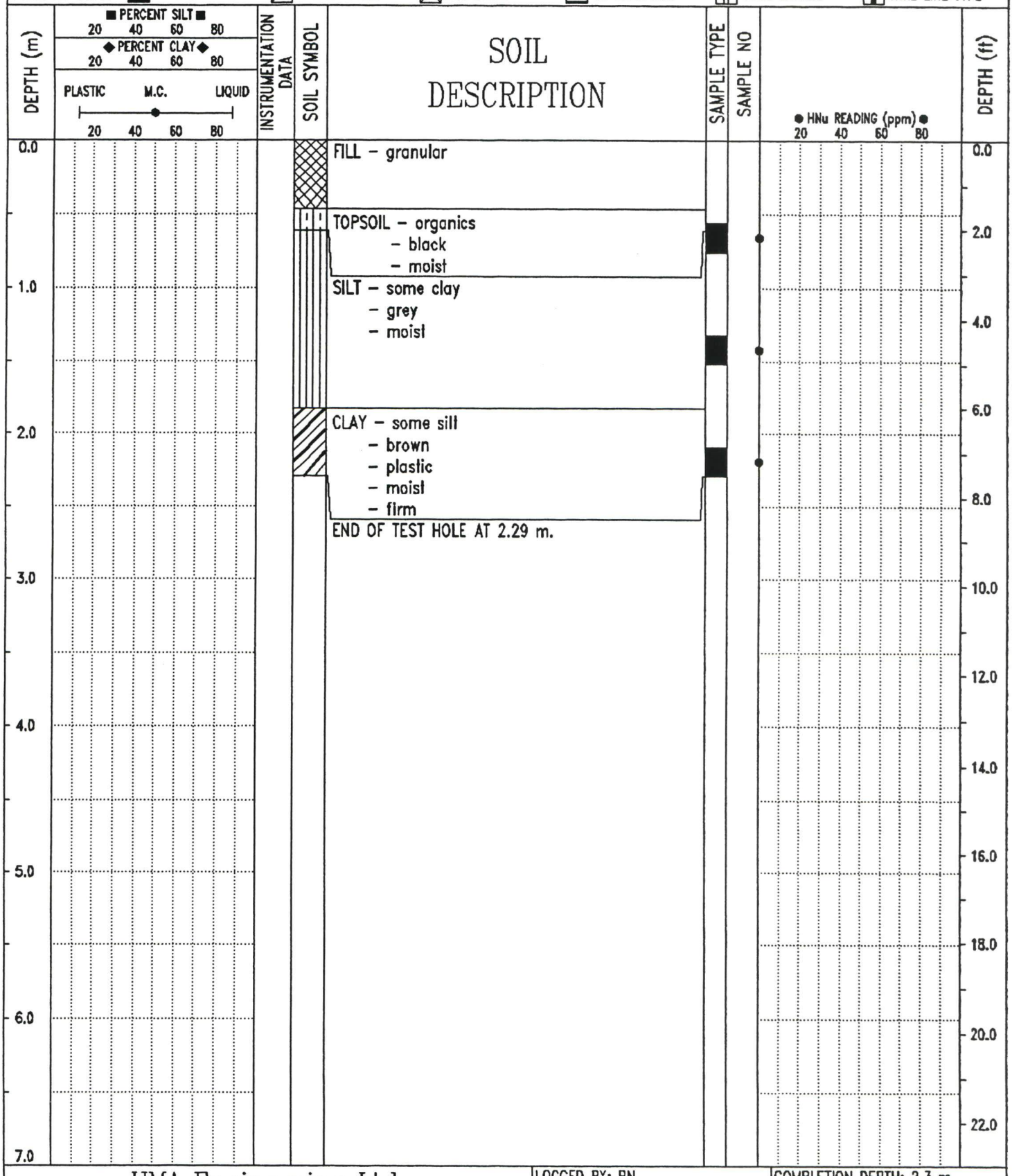


UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 3.1 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 01:24PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB16
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▮ WIRE LINE TYPE

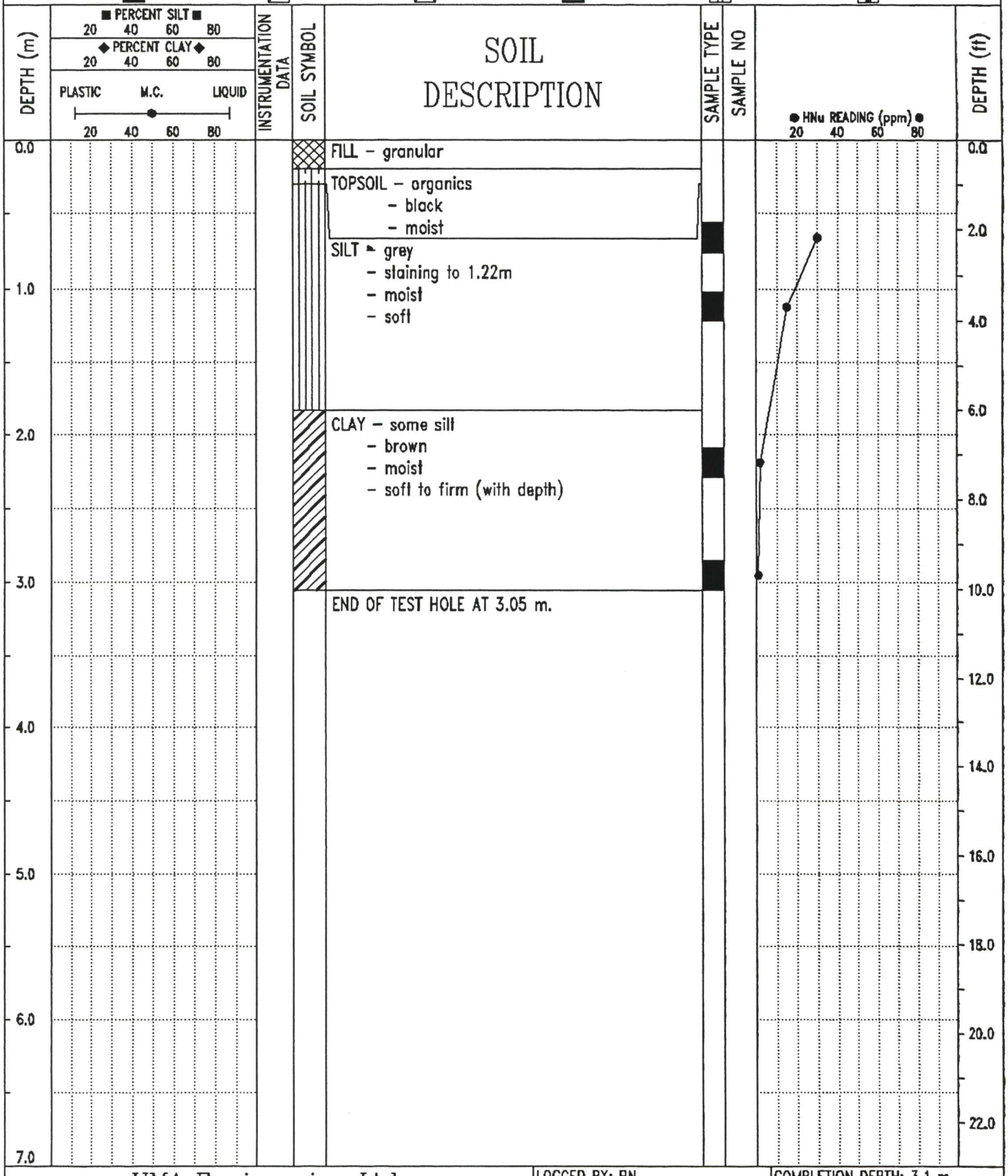


UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 2.3 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 01:20PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB17
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▮ WIRE LINE TYPE



UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 3.1 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 01:17PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB18
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▦ WIRE LINE TYPE

DEPTH (m) | ■ PERCENT SILT ■ 20 40 60 80 | ◆ PERCENT CLAY ◆ 20 40 60 80 | PLASTIC M.C. LIQUID 20 40 60 80 | INSTRUMENTATION DATA | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NO | ● HNu READING (ppm) ● 20 40 60 80 | DEPTH (ft)

0.0 — FILL – granular

TOPSOIL – organics
- black
- moist

SILT – some clay
- grey
- moist
- soft

CLAY – some silt
- brown
- moist
- firm

END OF TEST HOLE AT 3.05 m.

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0

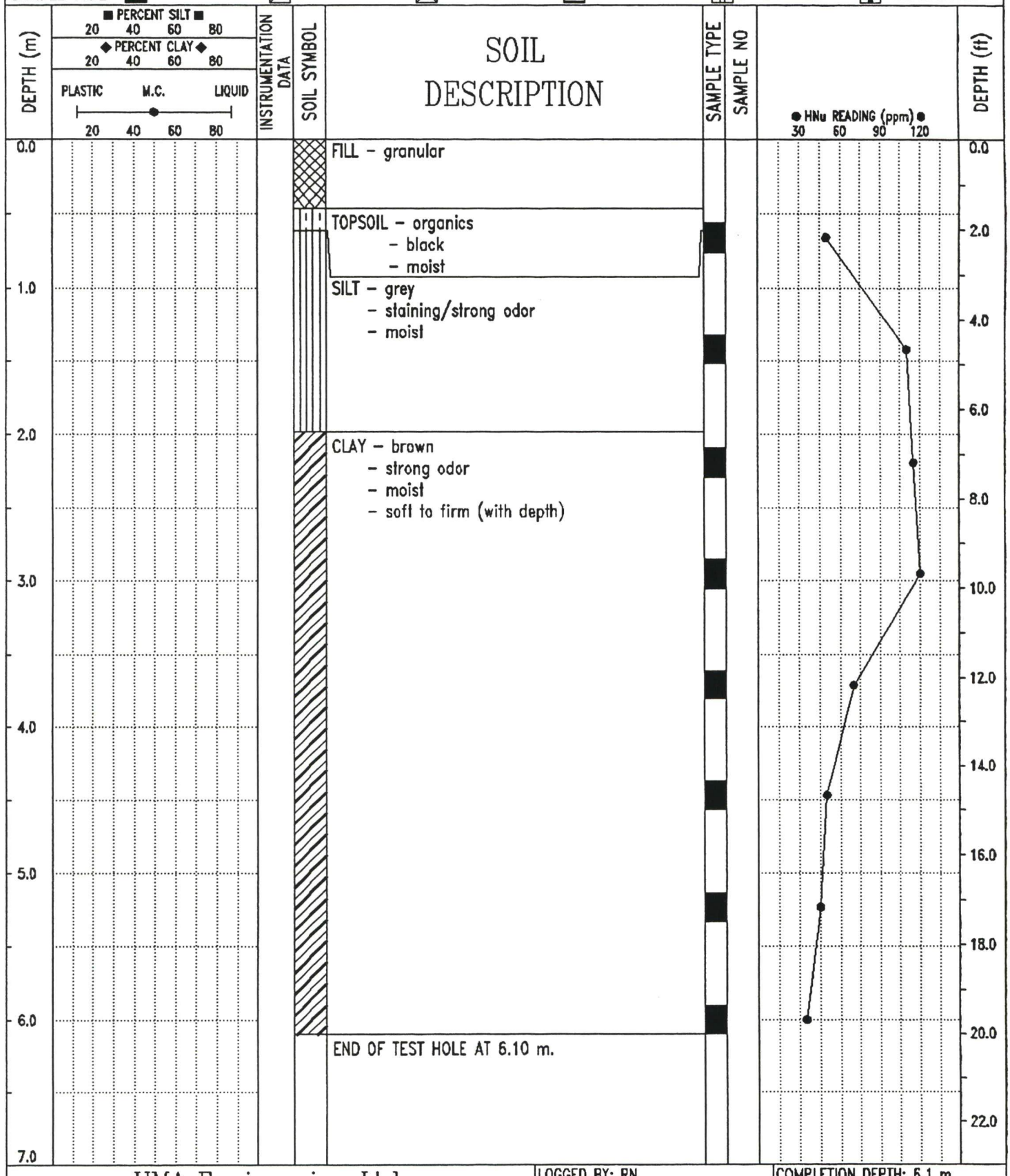
UMA Engineering Ltd.
Winnipeg, Manitoba

LOGGED BY: RN	COMPLETION DEPTH: 3.1 m
REVIEWED BY: LB	COMPLETE: 02/11/94
Fig. No:	Page 1 of 1

95/01/05 01:13PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB19
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▮ WIRE LINE TYPE



UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 11:40AM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB20
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SHELBY TUBE | DISTURBED | NO RECOVERY | CORE BARREL | WIRE LINE TYPE

PERCENT SILT 20 40 60 80
PERCENT CLAY 20 40 60 80
PLASTIC M.C. LIQUID 20 40 60 80

DEPTH (m)	INSTRUMENTATION DATA	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	HNu READING (ppm) 20 40 60 80	DEPTH (ft)
0.0			FILL – granular				0.0
			TOPSOIL – organics – black – moist				2.0
1.0			SILT – grey – stained @ surface – faint odor – moist – soft				4.0
							6.0
2.0			CLAY – silty – brown – plastic – moist – firm				8.0
3.0			END OF TEST HOLE AT 3.05 m.				10.0
4.0							12.0
							14.0
5.0							16.0
							18.0
6.0							20.0
							22.0
7.0							

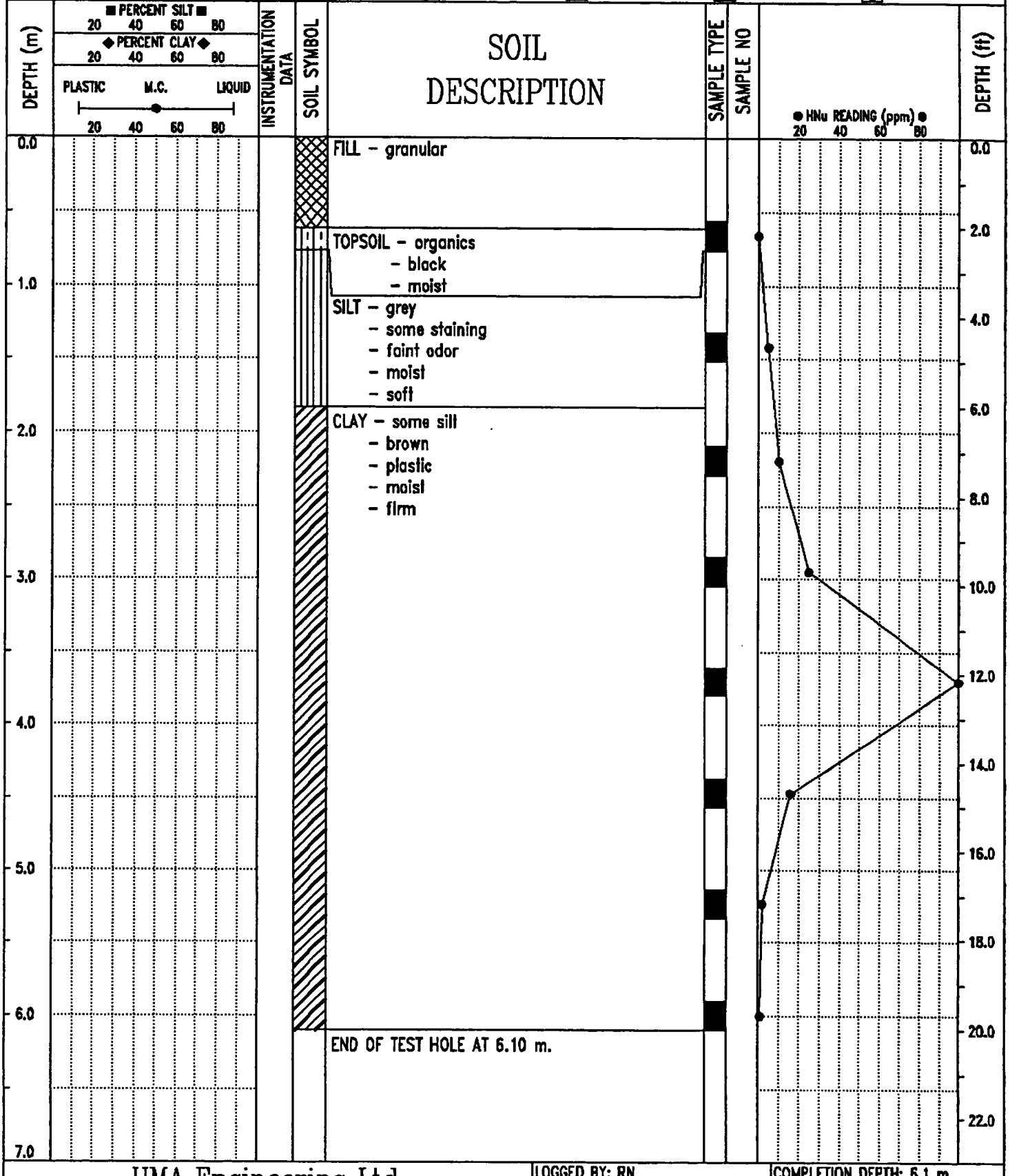
UMA Engineering Ltd.
Winnipeg, Manitoba

LOGGED BY: RN	COMPLETION DEPTH: 3.1 m
REVIEWED BY: LB	COMPLETE: 02/11/94
Fig. No:	Page 1 of 1

95/01/05 01:09PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB21
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE ■ GRAB SAMPLE ▨ SHELBY TUBE ▩ DISTURBED ▤ NO RECOVERY ▥ CORE BARREL ▦ WIRE LINE TYPE



UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

95/01/05 01:04PM

PROJECT: REMEDIAL INVESTIGATION	DRILLED BY:PADDOCK DRILLING LTD.	TEST HOLE NO: LDB22
CLIENT:THE LAKEVIEW	DRILL TYPE:ACKER	Project No: 9759 001 01 01
PROJECT ENGINEER: LB	AUGER TYPE:125mm SOLID STEM	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SHELBY TUBE | DISTURBED | NO RECOVERY | CORE BARREL | WIRE LINE TYPE

DEPTH (m) | ■ PERCENT SILT ■ 20 40 60 80 | ◆ PERCENT CLAY ◆ 20 40 60 80 | PLASTIC M.C. LIQUID 20 40 60 80 | INSTRUMENTATION DATA | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NO | ● HNu READING (ppm) ● 20 40 60 80 | DEPTH (ft)

0.0 — FILL – granular

CLAY – silty
- brown
- plastic
- soft to firm (with depth)

END OF TEST HOLE AT 2.29 m.

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0

UMA Engineering Ltd. Winnipeg, Manitoba	LOGGED BY: RN	COMPLETION DEPTH: 2.3 m
	REVIEWED BY: LB	COMPLETE: 02/11/94
	Fig. No:	Page 1 of 1

94/11/28 02:12PM

APPENDIX B

REMEDIATION CRITERIA

MANITOBA ENVIRONMENT

A GUIDELINE FOR THE ENVIRONMENTAL INVESTIGATION AND REMEDIATION OF PETROLEUM STORAGE SITES IN MANITOBA

July, 1993

Table 1

Remediation Criteria for Soil

(all concentrations are in mg/kg)

Parameter	Level I	Level II	Level III
Benzene	0.05	0.5	5.0
Toluene	0.1	3.0	30.0
Ethylbenzene	0.1	5.0	50.0
Xylene	0.1	5.0	50.0
Total Semi-Volatile Hydrocarbons	500	2000	2000
Total Volatile Hydrocarbons	100	150	800
Mineral Oil and Grease	1000	5000	5000
Lead	375	500	1000

Remediation Criteria for Groundwater

TO BE DEVELOPED

At the present time, Manitoba does not have comprehensive guidelines for groundwater or surface water quality that reference specific levels of total hydrocarbons. The following points should be noted:

1. Where water is or may be used for domestic consumption, the levels of BTEX components and lead should not exceed the Canadian Drinking Water Guidelines criteria at the point of withdrawal.

2. Contaminant levels in surface water should not adversely affect aquatic organisms. This will typically involve a site specific determination.

3. Where water is to be used for irrigation or livestock watering, the contaminant levels must be within safe limits to ensure the protection of crops and livestock.

Interim
Canadian Environmental Quality Criteria for Contaminated Sites

Canadian Council of Ministers of the Environment

prepared by the
CCME Subcommittee on Environmental Quality Criteria for Contaminated Sites

CCME EPC-CS34
Winnipeg, Manitoba
September 1991

APPENDIX A

Assessment and Remediation Criteria Tables

Table A-1. Interim Assessment Criteria for Soil and Water

	Soil	Water
General Parameters		
pH	6 to 8	---
conductivity	2 dS/m	---
sodium adsorption ratio	5	---
Inorganic Parameters		
antimony	20[1]	---
arsenic	5	5
barium	200	50
beryllium	4	---
boron (hot water soluble)	1	---
cadmium	0.5	1
chromium (+6)	2.5	---
chromium (total)	20	15
cobalt	10	10
copper	30	25
cyanide (free)	0.25	40
cyanide (total)	2.5	40
fluoride (total)	200	---
lead	25	10
mercury	0.1	0.1
molybdenum	2	5
nickel	20	10
selenium	1	1

Notes: All values in µg/g dry weight or µg/L unless otherwise stated.

Interim assessment criteria are largely based on ambient or background concentrations for most general and inorganic parameters and on analytical detection limits for most organic parameters.

--- value not established.

See page 7 for numbered footnotes.

Table A-1. Interim Assessment Criteria for Soil and Water (Continued)

	Soil	Water
Inorganic Parameters (cont'd)		
silver	2	5
sulphur (elemental)	250	---
thallium	0.5	---
tin	5	10
vanadium	25	---
zinc	60	50
Monocyclic Aromatic Hydrocarbons		
benzene	0.05	0.5
chlorobenzene	0.1	0.1
1,2-dichlorobenzene	0.1	0.2
1,3-dichlorobenzene	0.1	0.2
1,4-dichlorobenzene	0.1	0.2
ethylbenzene	0.1	0.5
styrene	0.1	0.5
toluene	0.1	0.5
xylene	0.1	0.5
Phenolic Compounds		
non-chlorinated[2] (each)	0.1	0.1
chlorophenols[3] (each)	0.05	1.0
Polycyclic Aromatic Hydrocarbons (PAHs)		
benzo(a)anthracene	0.1	0.01
benzo(a)pyrene	0.1	0.01
benzo(b)fluoranthene	0.1	0.01
benzo(k)fluoranthene	0.1	0.01
dibenz(a,h)anthracene	0.1	0.01
indeno(1,2,3-c,d)pyrene	0.1	0.1
naphthalene	0.1	0.2
phenanthrene	0.1	0.2
pyrene	0.1	0.2
Chlorinated Hydrocarbons		
chlorinated aliphatics[4] (each)	0.1	0.1
chlorobenzenes[5] (each)	0.05	0.3
hexachlorobenzene	0.1	0.1
hexachlorocyclohexane	0.01	---
PCBs[6]	0.1	0.1
PCDDs and PCDFs[7]	0.00001	---

Table A-1. Interim Assessment Criteria for Soil and Water (Continued)

	Soil	Water
Miscellaneous Organic Parameters		
non-chlorinated aliphatics (each)	0.3	---
phthalic acid esters (each)	30	---
quinoline	0.1	---
thiophene	0.1	---

Table A-1 footnotes.

[1]Set equal to the Agricultural Remediation Criteria value (see Table A-2).

[2]Non-chlorinated phenolic compounds include
2,4-dimethylphenol
2,4-dinitrophenol
2-methyl 4,6-dinitrophenol
nitrophenol (2-, 4-)
phenol
cresol

[3]Chlorophenols include
chlorophenol isomers (ortho, meta, para)
dichlorophenols (2,6- 2,5- 2,4- 3,5- 2,3- 3,4-)
trichlorophenols (2,4,6- 2,3,6- 2,4,5- 2,3,5- 2,3,4- 3,4,5-)
tetrachlorophenols (2,3,5,6- 2,3,4,5- 2,3,4,6-)
pentachlorophenol

[4]Aliphatic chlorinated hydrocarbons include
chloroform
dichloroethane (1,1- 1,2-), dichloroethene (1,1- 1,2-)
dichloromethane
1,2-dichloropropane, 1,2-dichloropropene (cis and trans)
1,1,2,2-tetrachloroethane, tetrachloroethene
carbon tetrachloride
trichloroethane (1,1,1- 1,1,2-), trichloroethene

[5]Chlorobenzenes include
all trichlorobenzene isomers
all tetrachlorobenzene isomers
pentachlorobenzene

[6]PCBs include mixtures 1242, 1248, 1254, and 1260.

[7]PCDDs and PCDFs expressed in 2,3,7,8,-TCDD equivalents. NATO International Toxicity Equivalency Factors (I-TEFs) for congeners and isomers of PCDDs and PCDFs are as follows:

Congener	TEF	Congener	TEF
2,3,7,8-T_4CDD	1.0	2,3,7,8-T_4CDF	0.1
1,2,3,7,8-P_5CDD	0.5	2,3,4,7,8-P_5CDF	0.5
1,2,3,4,7,8-H_6CDD	0.1	1,2,3,7,8-P_5CDF	0.05
1,2,3,7,8,9-H_6CDD	0.1	1,2,3,4,7,8-H_6CDF	0.1
1,2,3,6,7,8-H_6CDD	0.1	1,2,3,7,8,9-H_6CDF	0.1
1,2,3,4,6,7,8-H_7CDD	0.1	1,2,3,6,7,8-H_6CDF	0.1
O_8CDD	0.001	2,3,4,6,7,8-H_6CDF	0.1
		1,2,3,4,6,7,8-H_7CDF	0.1
		1,2,3,4,7,8,9-H_7CDF	0.01
		O_8CDF	0.001

Table A-2. Interim Remediation Criteria for Soil

	Agricultural	Residential/ Parkland	Commercial/ Industrial
General Parameters			
pH	6 to 8	6 to 8	6 to 8
conductivity	2	2	4
sodium adsorption ratio	5	5	12
Inorganic Parameters			
antimony	20	20	40
arsenic	20	30	50
barium	750	500	2000
beryllium	4	4	8
boron (hot water soluble)	2	---	---
cadmium	3	5	20
chromium (+6)	8	8	---[1]
chromium (total)	750	250	800
cobalt	40	50	300
copper	150	100	500
cyanide (free)	0.5	10	100
cyanide (total)	5	50	500
fluoride (total)	200	400	2000
lead	375	500	1000
mercury	0.8	2	10
molybdenum	5	10	40
nickel	150	100	500
selenium	2	3	10
silver	20	20	40
sulphur (elemental)	500	---	---
thallium	1	---	---
tin	5	50	300
vanadium	200	200	---[1]
zinc	600	500	1500

Notes: All values in µg/g dry weight unless otherwise stated.

--- value not established.

See page 10 for numbered footnotes.

Table A-2. Interim Remediation Criteria for Soil (Continued)

	Agricultural	Residential/ Parkland	Commercial/ Industrial
Monocyclic Aromatic Hydrocarbons			
benzene	0.05	0.5	5
chlorobenzene	0.1	1	10
1,2-dichlorobenzene	0.1	1	10
1,3-dichlorobenzene	0.1	1	10
1,4-dichlorobenzene	0.1	1	10
ethylbenzene	0.1	5	50
styrene	0.1	5	50
toluene	0.1	3	30
xylene	0.1	5	50
Phenolic Compounds			
non-chlorinated[2] (each)	0.1	1	10
chlorophenols[3] (each)	0.05	0.5	5
Polycyclic Aromatic Hydrocarbons (PAHs)			
benzo(a)anthracene	0.1	1	10
benzo(a)pyrene	0.1	1	10
benzo(b)fluoranthene	0.1	1	10
benzo(k)fluoranthene	0.1	1	10
dibenz(a,h)anthracene	0.1	1	10
indeno(1,2,3-c,d)pyrene	0.1	1	10
naphthalene	0.1	5	50
phenanthrene	0.1	5	50
pyrene	0.1	10	100
Chlorinated Hydrocarbons			
chlorinated aliphatics[4] (each)	0.1	5	50
chlorobenzenes[5] (each)	0.05	2	10
hexachlorobenzene	0.05	2	10
hexachlorocyclohexane	0.01	---	---
PCBs[6]	0.5	5	50
PCDDs and PCDFs[7]	0.00001	0.001	---
Miscellaneous Organic Parameters			
non-chlorinated aliphatics (each)	0.3	---	---
phthalic acid esters (each)	30	---	---
quinoline	0.1	---	---
thiophene	0.1	---	---

Table A-2 footnotes.

[1]Criteria not recommended for commercial/industrial. One possible recourse is to use the residential/parkland value.

[2]Non-chlorinated phenolic compounds include
- 2,4-dimethylphenol
- 2,4-dinitrophenol
- 2-methyl 4,6-dinitrophenol
- nitrophenol (2-, 4-)
- phenol
- cresol

[3]Chlorophenols include
- chlorophenol isomers (ortho, meta, para)
- dichlorophenols (2,6- 2,5- 2,4- 3,5- 2,3- 3,4-)
- trichlorophenols (2,4,6- 2,3,6- 2,4,5- 2,3,5- 2,3,4- 3,4,5-)
- tetrachlorophenols (2,3,5,6- 2,3,4,5- 2,3,4,6-)
- pentachlorophenol

[4]Aliphatic chlorinated hydrocarbons include
- chloroform
- dichloroethane (1,1- 1,2-), dichloroethene (1,1- 1,2-)
- dichloromethane
- 1,2-dichloropropane, 1,2-dichloropropene (cis and trans)
- 1,1,2,2-tetrachloroethane, tetrachloroethene
- carbon tetrachloride
- trichloroethane (1,1,1- 1,1,2-), trichloroethene

[5]Chlorobenzenes include
- all trichlorobenzene isomers
- all tetrachlorobenzene isomers
- pentachlorobenzene

[6]PCBs include mixtures 1242, 1248, 1254, and 1260.

[7]PCDDs and PCDFs expressed in 2,3,7,8-TCDD equivalents. NATO International Toxicity Equivalency Factors (I-TEFs) for congeners and isomers of PCDDs and PCDFs are as follows:

Congener	TEF
2,3,7,8-T_4CDD	1.0
1,2,3,7,8-P_5CDD	0.5
1,2,3,4,7,8-H_6CDD	0.1
1,2,3,7,8,9-H_6CDD	0.1
1,2,3,6,7,8-H_6CDD	0.1
1,2,3,4,6,7,8-H_7CDD	0.1
O_8CDD	0.001
2,3,7,8,-T_4CDF	0.1
2,3,4,7,8,-P_5CDF	0.5
1,2,3,7,8,-P_5CDF	0.05
1,2,3,4,7,8,-H_6CDF	0.1
1,2,3,7,8,9,-H_6CDF	0.1
1,2,3,6,7,8-H_6CDF	0.1
2,3,4,6,7,8-H_6CDF	0.1
1,2,3,4,6,7,8-H_7CDF	0.1
1,2,3,4,7,8,9-H_7CDF	0.01
O_8CDF	0.001

Table A-3. Remediation Criteria for Water[1]

	Freshwater Aquatic Life[2]	Irrigation[2,3]	Livestock Watering[2]	Drinking Water[4,5]
General Parameters				
oxygen, dissolved	5–9.5 mg/L	---	---	---
pH (unitless)	6.5–9.0	---	---	6.5–8.5
total dissolved solids	---	500–3500 mg/L	3000 mg/L	≤500 mg/L[6,7]
Inorganic Parameters				
aluminum	5–100[8]	5000	5000	---[6]
ammonia	1.37–2.2 mg/L[9]	---	---	---
antimony	---	---	---	---
arsenic	50	100	500–5000	25[10]
barium	---	---	---	1000[10]
beryllium	---	100	100[11]	---
boron (hot water soluble)	---	---	---	---
boron (total)	---	500–6000	5000	5000[6]
cadmium	0.2–1.8[12]	10	20	5
calcium	---	---	1000 mg/L	---
chloride (total)	---	100–700 mg/L	---	≤250 mg/L
chloride (total residual)	2	---	---	---
chromium (+6)	---	---	---	---
chromium (total)	2–20	100	1000	50
cobalt	---	50	1000	---
copper	2–4[12]	200–1000[13]	500–5000	≤1000[6]
cyanide (free)	5	---	---	---
cyanide (total)	---	---	---	200[6]
fluoride (free)	---	---	---	---
fluoride (total)	---	1000	1000–2000	1500[6]
iron	300	5000	---	≤300[10]
lead	1–7[12]	200[11]	100	10[10]
lithium	---	2500	---	---
manganese	---	200	---	≤50[10]
mercury	0.1	---	3	1
molybdenum	---	10–50	500	---
nickel	25–150[12]	200	1000	---
nitrate	---[14]	---	---	45 mg/L[10,15]
nitrate and nitrite	---	---	100 mg/L	---
nitrite	0.06 mg/L	---	10 mg/L	4.5 mg/L[10,15]

Notes: All values in µg/L unless otherwise stated.

--- value not established.

See pages 15–16 for numbered footnotes.

Table A-3. Remediation Criteria for Water (Continued)

	Freshwater Aquatic Life[2]	Irrigation[2,3]	Livestock Watering[2]	Drinking Water[4,5]
Chlorinated Hydrocarbons				
chlorinated aliphatics				
dichloroethane, 1,2-	100	---	---	5[10,11]
dichloromethane	---	---	---	50
hexachlorobutadiene	0.1	---	---	---
hexachlorocyclohexane isomers	0.01	---	---	---
tetrachloroethylene	260[11]	---	---	---[6]
trichloroethylene	20	---	---	50[10]
chlorinated benzenes				
monochlorobenzene	15[11]	---	---	80[10]; ≤30[10]
dichlorobenzene,1,2-	2.5[11]	---	---	200; ≤3
dichlorobenzene 1,3-	2.5[11]	---	---	---
dichlorobenzene, 1,4-	4[11]	---	---	5; ≤1
trichlorobenzene, 1,2,3-	0.9[11]	---	---	---
trichlorobenzene, 1,2,4-	0.5[11]	---	---	---
trichlorobenzene, 1,3,5-	0.65[11]	---	---	---
tetrachlorobenzene, 1,2,3,4-	0.1[11]	---	---	---
tetrachlorobenzene, 1,2,3,5-	0.1[11]	---	---	---
tetrachlorobenzene, 1,2,4,5-	0.15[11]	---	---	---
pentachlorobenzene	0.03[11]	---	---	---
hexachlorobenzene	0.0065[11]	---	---	---
PCBs[22]	1 ng/L	---	---	---[6]
PCDDs and PCDFs[23]	---	---	---	---
Halogenated Methanes				
carbon tetrachloride	---	---	---	5
trihalomethanes	---	---	---	350[6]
Phthalate Esters				
DBP	4	---	---	---
DEHP	0.6	---	---	---
other phthalate esters	0.2	---	---	---
Pesticides				
aldicarb	---	---	---	9
aldrin and dieldrin	4 ng/L	---	---	0.7[6]
atrazine	2	---	---	60[11]
azinphos-methyl	---	---	---	20
bendiocarb	---	---	---	40

Table A-3. Remediation Criteria for Water (Continued)

	Freshwater Aquatic Life[2]	Irrigation[2,3]	Livestock Watering[2]	Drinking Water[4,5]
Inorganic Parameters (cont'd)				
selenium	1	20–50	50	10
silver	0.1	---	---	---
sodium	---	---[16]	---	≤200 mg/L[10]
sulphate	---	---	1000 mg/L	≤500 mg/L[10]
sulphur (total)	---	---	---	---
thallium	---	---	---	---
tin	---	---	---	---
uranium	---	10[11]	200	100
vanadium	---	100	100	---
zinc (total)	30[11]	1000–5000[17]	50 000	≤5000[10]
Monocyclic Aromatic Hydrocarbons				
benzene	300[11]	---	---	5
ethylbenzene	700[11]	---	---	≤2.4
styrene	---	---	---	---
toluene	300	---	---	≤24
xylenes	---	---	---	≤300
Phenolic Compounds				
non-chlorinated[18] (each)	---	---	---	---
phenols (total)	1	---	---	---
chlorinated phenols				
monochlorophenol	7	---	---	---
dichlorophenols	0.2	---	---	900[19]; ≤0.3[19]
trichlorophenols	18	---	---	5[20]; ≤2[20]
tetrachlorophenols	1	---	---	100[21]; ≤1[21]
pentachlorophenol	0.5	---	---	60; ≤30
Polycyclic Aromatic Hydrocarbons (PAHs)				
benzo(a)anthracene	---	---	---	---
benzo(a)pyrene	---	---	---	0.01
benzo(b)fluoranthene	---	---	---	---
benzo(k)fluoranthene	---	---	---	---
dibenz(a,h)anthracene	---	---	---	---
indeno(1,2,3-c,d) pyrene	---	---	---	---
naphthalene	---	---	---	---
phenanthrene	---	---	---	---
pyrene	---	---	---	---

Table A-3. Remediation Criteria for Water (Continued)

	Freshwater Aquatic Life[2]	Irrigation[2,3]	Livestock Watering[2]	Drinking Water[4,5]
Pesticides (cont'd)				
bromoxynil	---	---	---	5[11]
carbaryl	---	---	---	90
carbofuran	1.75	---	---	90
chlordane	6 ng/L	---	---	7[6]
chlorpyrifos	---	---	---	90
cyanazine	2[11]	---	---	10[11]
2,4-D	4	---	---	100[6]
DDT	1 ng/L	---	---	30[6,26]
diazinon	---	---	---	20
dicamba	---	---	---	120
diclofop-methyl	---	---	---	9
dimethoate	---	---	---	20[11]
diquat	---	---	---	70
diuron	---	---	---	150
endosulfan	0.02	---	---	---
endrin	2.3 ng/L	---	---	---
glyphosate	65	---	---	280[11]
heptachlor (+ metabolite)	0.01	---	---	3[6]
lindane	---	---	---	4[6]
malathion	---	---	---	190
methoxychlor	---	---	---	900
metolachlor	---	---	---	50[11]
metribuzin	1	---	---	80
paraquat	---	---	---	10[11]
parathion	---	---	---	50
phorate	---	---	---	2[11]
picloram	29[11]	---	---	190[10,11]
simazine	---	---	---	10[11]
2,4,5-T	---	---	---	280; ≤20
temephos	---	---	---	280[11]
terbufos	---	---	---	1[11]
toxaphene	8 ng/L	---	---	---
triallate	---	---	---	230
trifluralin	---	---	---	45[10,11]

Table A-3. Remediation Criteria for Water (Continued)

	Freshwater Aquatic Life[2]	Irrigation[2,3]	Livestock Watering[2]	Drinking Water[4,5]
Radiological Parameters				
^{137}cesium	---	---	---	50 Bq/L[6]
^{131}iodine	---	---	---	10 Bq/L[6]
^{226}radium	---	---	---	1 Bq/L[6]
^{90}strontium	---	---	---	10 Bq/L[6]
^{3}tritium	---	---	---	40 000 Bq/L[6]

Table A-3 footnotes.

[1] Guidelines for freshwater aquatic life, irrigation, and livestock watering (columns 1, 2, and 3, respectively) are taken from the Canadian Water Quality Guidelines (CWQG) (CCREM 1987). The CWQG also recommends guidelines for recreational uses and several specific industrial uses, which are not included in this table. Guidelines for drinking water (column 4) are taken from the Guidelines for Canadian Drinking Water Quality (GCDWQ) (Health and Welfare Canada 1989).

[2] Guidelines for heavy metals and trace ions are reported as total concentrations in an unfiltered sample.

[3] Applies to all soils; for details on neutral to alkaline soils, refer to CCREM (1987).

[4] Drinking water guidelines are expressed as maximum acceptable concentrations (MAC), and are for unfiltered samples at the point of consumption. Heavy metals and trace ions are expressed as total concentrations (particulate and dissolved) unless otherwise indicated.

[5] Several parameters also have aesthetic objectives; these are indicated by a "≤" symbol.

[6] Guideline under review for addition to the GCDWQ or possible changes to the current value. Refer to the latest edition of the GCDWQ.

[7] The total dissolved solids concentration of 500 mg/L is approximately equal to a conductivity of 1 dS/m.

[8] Guideline varies with pH, calcium, and dissolved organic carbon concentrations.

[9] Guideline changes with temperature and pH.

[10] A modification to the previous guideline is proposed. If after one year, no evidence is presented that questions the suitability of this proposal, it will be adopted as the guideline. Refer to the latest edition of the GCDWQ.

[11] Tentative water quality guideline/interim drinking water guideline because of insufficient evidence; refer to the latest edition of the CWQG or GCDWQ.

[12] Guideline changes with hardness.

[13] Guideline varies depending on crop.

[14] Avoid concentrations that stimulate prolific weed growth.

[15] Equivalent to 10.0 mg/L nitrate as nitrogen. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 4.5 mg/L (1.0 mg/L as nitrogen).

[16] Refer to CCREM (1987).

[17] Guideline changes with pH.

Table A-3 footnotes continued.

[18]Non-chlorinated phenolic compounds include
2,4-dimethylphenol
2,4-dinitrophenol
2-methyl 4,6-dinitrophenol
nitrophenol (2-, 4-)
phenol
cresol

[19]As 2,4-dichlorophenol.

[20]As 2,4,6-trichlorophenol.

[21]As 2,3,4,6-tetrachlorophenol.

[22]Total PCB analysis only for freshwater aquatic life guidelines.

[23]Quoted as 2,3,7,8-TCDD equivalents. PCDDs and PCDFs expressed in 2,3,7,8-TCDD equivalents. NATO International Toxicity Equivalency Factors (I-TEFs) for congeners and isomers of PCDDs and PCDFs are as follows:

Congener	TEF
2,3,7,8-T_4CDD	1.0
1,2,3,7,8-P_5CDD	0.5
1,2,3,4,7,8-H_6CDD	0.1
1,2,3,7,8,9-H_6CDD	0.1
1,2,3,6,7,8-H_6CDD	0.1
1,2,3,4,6,7,8-H_7CDD	0.1
O_8CDD	0.001
2,3,7,8-T_4CDF	0.1
2,3,4,7,8-P_5CDF	0.5
1,2,3,7,8-P_5CDF	0.05
1,2,3,4,7,8-H_6CDF	0.1
1,2,3,7,8,9-H_6CDF	0.1
1,2,3,6,7,8-H_6CDF	0.1
2,3,4,6,7,8-H_6CDF	0.1
1,2,3,4,6,7,8-H_7CDF	0.1
1,2,3,4,7,8,9-H_7CDF	0.01
O_8CDF	0.001

[24]Includes DDT metabolites.

APPENDIX C

ANALYTICAL RESULTS

Norwest Labs

REVISED

"We Solve Problems"

203 - 20771 Langley By-Pass
Langley, B.C. V3A 5E8
Phone (604) 530-4344
Fax: (604) 534-9996

WO (Lang.) : 10372
WO (Other) : 6677

PO # :
Date Rec'd. : 9-Nov-94
Date Comp. : 24-Nov-94

"Added Duplicate Sample Analysis"

Client		Received From	
Name	: Norwest Labs	Name	: UMA Engineering Ltd.
Address	: 203-545 University Cr. Winnipeg, Manitoba CANADA R3T 5S6	Address	: 1479 Buffalo Place Winnipeg, Manitoba CANADA R3T 1L7
Phone	: (204) 982-8630	Phone	: (204) 284-0580
Fax	: (204) 275-6019	Fax	: (204) 475-3646
Attn.	: Jim Hicks	Attn.	:
Project	:		

Petroleum Hydrocarbons in Soil

Parameter	10372-1 Sample #4	10372-2 Sample #9	10372-3 Sample #15	Detection Limit
Non-halogenated Aromatics				
Benzene	0.26	N.D.	N.D.	0.05
Toluene	2.27	N.D.	N.D.	0.05
Ethylbenzene	7.35	N.D.	N.D.	0.05
m- & p- Xylene	8.82	N.D.	N.D.	0.05
o- Xylene	1.16	N.D.	N.D.	0.05
Total Purgeables (C5-C10)	591	0.94	N.D.	0.10
Total Extractables (C10-C30)	19338	2235	N.D.	50.0
Percent Moisture	19.5	24.02	24.82	

Results are expressed in ppm (mg/kg), dry weight.
N.D. = Not Detectable (less than detection limit).
Trace = Present, but less than Limit of Quantitation.
---------- = Not Determined.

Jc. L. Bullus
Orig - Cen File
9734-001-01-01

Certified by the CANADIAN ASSOCIATION OF ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL) for Pesticides and PCBs in water.

Norwest Labs

"We Solve Problems"

203 - 20771 Langley By-Pass
Langley, B.C. V3A 5E8
Phone (604) 530-4344
Fax: (604) 534-9996

WO (Lang.) : 10372
WO (Other) : 6677

PO # :
Date Rec'd. : 9-Nov-94
Date Comp. : 24-Nov-94

Petroleum Hydrocarbons in Soil (cont.)

Parameter	10372-4(dup) Sample #19	10372-4 Sample #19	10372-5 Sample #25	10372-6 Sample #34	Detection Limit
Non-halogenated Aromatics					
Benzene	N.D.	N.D.	N.D.	1.27	0.05
Toluene	N.D.	N.D.	1.02	3.03	0.05
Ethylbenzene	N.D.	N.D.	0.44	1.93	0.05
m- & p- Xylene	N.D.	Trace	12.7	6.76	0.05
o- Xylene	N.D.	N.D.	7.48	3.46	0.05
Total Purgeables (C5-C10)	1.17	0.87	1209	58.9	0.1
Total Extractables (C10-C30)	Trace	Trace	38458	275	50.0
Percent Moisture	24.69	24.69	6.85	23.72	

Results are expressed in ppm (mg/kg), dry weight.
N.D. = Not Detectable (less than detection limit)
Trace = Present, but less than Limit of Quantitation.
---------- = Not Determined.

Certified by the CANADIAN ASSOCIATION OF ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL) for Pesticides and PCBs in water.

Norwest Labs

"We Solve Problems"

203 - 20771 Langley By-Pass
Langley, B.C. V3A 5E8
Phone (604) 530-4344
Fax: (604) 534-9996

WO (Lang.) : 10372
WO (Other) : 6677

PO # :
Date Rec'd. : 9-Nov-94
Date Comp. : 24-Nov-94

Petroleum Hydrocarbons in Soil (cont.)

Definitions / Methods

Total Purgeables: Summation of the C5 to C10 carbon range determined using a calibrated standard. This analysis is carried out in accordance with U. S. Environmental Protection Agency Methods 5030/8240 (#SW 846, 3rd Edition, Washington DC) which involves purge and trap extraction of the volatile components followed by analysis by capillary gas chromatography using a mass selective detector. (semi-qualitative)

Total Extractables: Summation of the C10 to C30 carbon range determined using a calibrated diesel standard. This analysis is carried out in accordance with Alberta Envrionment Method G108.0 which involves extraction of the sample with methylene chloride (EPA 3540) followed by analysis by capillary gas chromatography using a flame ionization detector. (semi-quantitative)

Percent Moisture: Percentage of the total wet weight of the sample as received. This analysis is carried out gravimetrically by drying the sample to constant weight at 105 C.

Comments

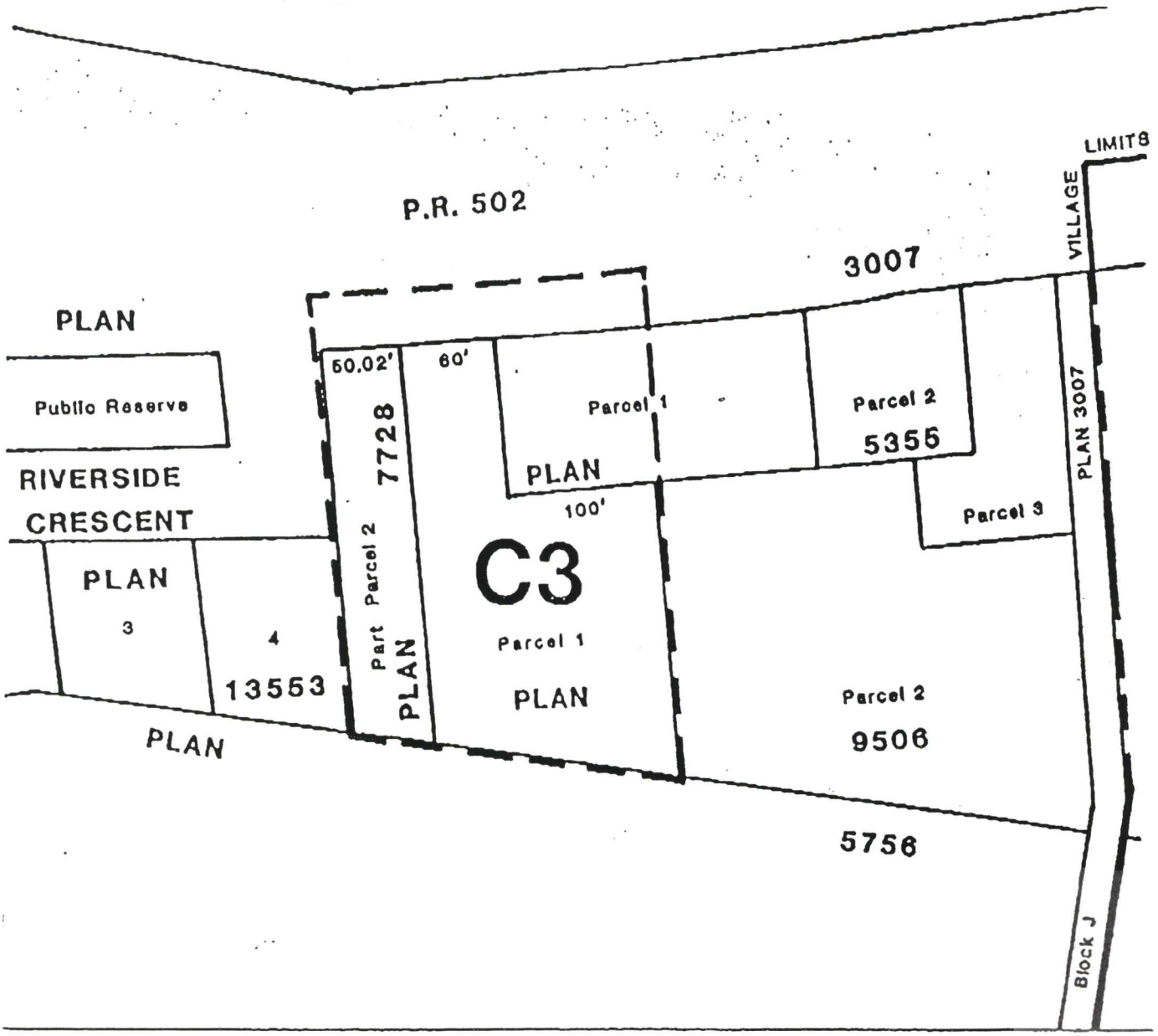
Quality Control Results

QA/QC		Analyst		
Compound	% Recovery	Analysis	Date	Analyst
pentefluorobenzene	101	BTEX, TP	12-Nov-94	Randy R
fluorobenzene	98	TEH	14-Nov-94	Cathy H
diesel fuel	98			
motor oil	99			

Supervisor

Note: All samples will be disposed of after 30 days following analysis unless other arrangements are made.

FIGURES



APPENDIX "A"
ATTACHED TO BY-LAW NO. 6-93
OF THE
VILLAGE OF LAC DU BONNET
AMENDING DISTRICT MAP NO. ONE
OF THE LAC DU BONNET DISTRICT
PLANNING SCHEME 1970,
AS AMENDED.

SCALE: 1" = 100'

LEGEND:
"C3" HIGHWAY COMMERCIAL DISTRICT
— — — LIMITS OF AREA AFFECTED

MANITOBA
RURAL DEVELOPMENT
COMMUNITY ECONOMIC DEVELOPMENT SERVICES
DATE: JUNE 21, 1993
DWG. NO. 333-58-129

UMA Environmental
Engineers & Planners
1479 Buffalo Place, Winnipeg, Manitoba, Canada R3T 1L7

THE LAKEVIEW
ENVIRONMENTAL SITE ASSESSMENT

TITLE:	LEGAL PLAN		
JOB No.	9759-001-01-01	DATE:	Jan. 1995
DRAWN:	RN	DWG. No.	01
CHECKED:	LB		

#13 #12 #21

CONCRETE PAD

NORTH PROPERTY LINE

#19 #20

#11

#10

SITE 3

#9 #6 #3

FENCE

#22

42.5 m

PROPERTY PIN

#14

AUGER REFUSAL ON CONCRETE RUBBLE

SITE 2

Proposed Site of Structure

64.008m TO SOUTH PROPERTY LINE

P.R. 502

FRONT PROPERTY LINE

#18 #15

#8 #5 #2

SITE 1

#17 #16

#7 #4 #1

South

LEGEND

#14 – TESTHOLE LOCATION

– ESTIMATED LIMIT OF AFFECTED SOIL (INTERPRETATION BASED ON ANALYTICAL AND ORGANIC VAPOUR SCREENING RESULTS)

SCALE: 1:200

0 5 10
METRES

UMA Environmental
Engineers & Planners
1479 Buffalo Place, Winnipeg, Manitoba, Canada R3T 1L7

THE LAKEVIEW ENVIRONMENTAL SITE ASSESSMENT

TITLE:	SITE INVESTIGATION		
JOB No.	9759-001-01-01	DATE:	Jan. 1995
DRAWN:	RN	DWG. No.	02
CHECKED:	LB		