#15

PHASE I & PHASE II DATA.

Soil Investigation Report -
Idle City Owned Property at the Former
Imperial Oil Regina Refinery Site

Prepared by: Esso Petroleum Canada

December, 1988

Disclaimer!

NOTICE

The design basis for this study is described in section 2.1.1. Esso Petroleum Canada makes no representation or warranty in respect of the site conditions, the contents of this report, or as to the thoroughness or accuracy of the site investigations and other analysis conducted in the preparation of this report. The actual condition of the lands may not necessarily be reflected in this report and there may be areas of the land subject to environmental contamination other than set forth herein.

Esso Petroleum Canada, its servants and agents, do not accept any responsibility or liability for any errors, omissions, or inaccuracies of any kind in the information, statements, recommendations, results or methodology of the investigations set forth in this report.

The City of Regina is urged to assimilate the results set forth in this report and prepare its own summaries, analysis and conclusions relating to site conditions with the assistance of its own expert consultants.

Finally, Esso Petroleum Canada wishes to make it clear that this site investigation and the report set herein is not and shall not be construed as any admission of responsibility by Esso Petroleum Canada (EPC) for the conditions of the site or commit EPC to any further or other actions of any kind that may be taken or required in respect of these lands.

LEGAL SHOULD ADVISE ON THIS / GN

LIST OF FIGURES

1.0 INTRODUCTION

During the summer of 1988, Esso Petroleum Canada (Esso) conducted a two-phased investigation of the soil quality in the undeveloped lands north of the Winnipeg St. transit garage. This area was sold to the City of Regina (the City) in 1979 and had been part of the former Imperial Oil Regina Refinery. The location of the former refinery and the area investigated in this study are shown in figures 1 and 2 respectively. The objective was to assist the City, on a voluntary basis, in gaining a general indication of the environmental quality of the soil, to enable the City to make responsible redevelopment decisions.

Following discussions with the City, Esso voluntarily, without prejudice, agreed to collect and analyze soil samples from this area and to provide the results to the City. The first phase of the investigation was performed in May 1988. It covered all potential concerns identified by an historical study of the former refinery and site reconnaissance. Based on the results of this phase, Esso believed that a more detailed study of the "old" TEL plant site, was warranted. Additional sampling of this site was performed in August 1988, comprising the second phase of the investigation. The following report documents all activities and analytical data from both field investigations.

It is understood that the City plans to redevelop this area. The following information is provided to assist the City with their plans. The City is encouraged to have the data assessed by an independent environmental professional to determine what, if any, environmental precautions, or additional assessments, are appropriate for the planned redevelopment of the site.

Legend

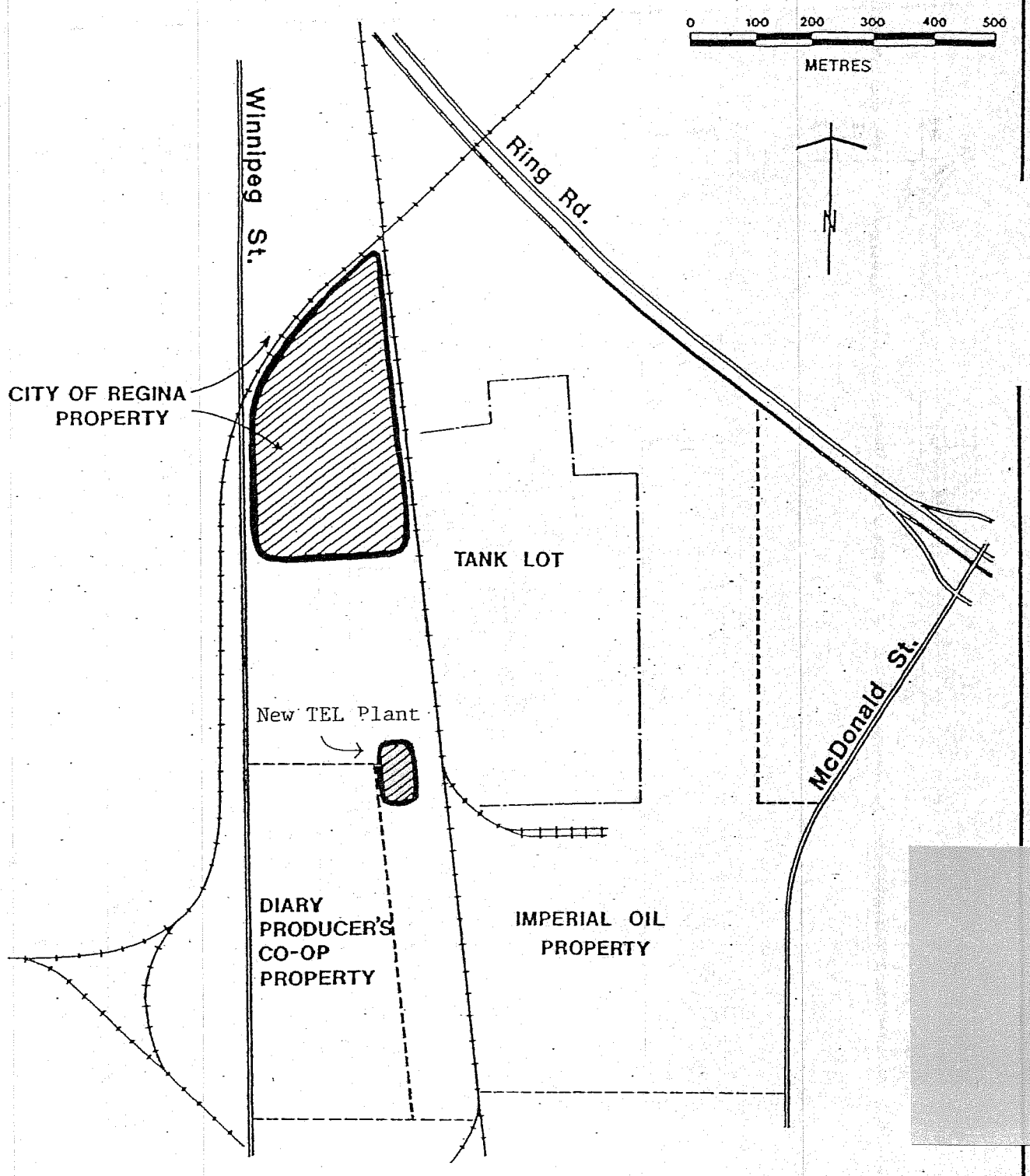
Location of Refinery

Location of City of Regina Municipal Water Wells

Location of Imperial Oil Refinery

FIGURE **1**

FORMER IMPERIAL OIL REFINERY, REGINA, SASKATCHEWAN



Legend

– Area Investigated

FIGURE 2

FORMER IMPERIAL OIL REFINERY, REGINA, SASKATCHEWAN

Project 88-177

Gartner Lee Limited

2.0 FIELD PROGRAM

The field program was conducted in two phases. The first occurred from May 25-28, 1988 and the second on August 19, 1988. Each phase is described separately below.

2.1 Phase One

The bulk of the investigation was performed in phase 1.

2.1.1 Design Basis

Sampling locations were selected to address potential concerns based on current information. The sources of information used to identify these potential concern areas were:

- discussions with some former refinery personnel, both annuitants and those still working for Esso at the Regina Terminal
- inspection of available aerial photographs
- field reconnaissance of site

The historical study identified two potential concern areas for follow-up during the field investigation. These were at each of the former tetraethyl lead (TEL) blending plant sites, which were known as the "old" and "new" TEL plants. In both locations a spill had taken place during the 60's. Clean-up was performed at the time of the spill under the direction of personnel from Ethyl Corporation and following accepted practices of the day. However, as there was the possibility that some residual lead might still be present, an investigation was believed to be the responsible action to take.

The field program was also designed to look at several other areas in addition to the two TEL plant sites (eg. tank farm, asphalt plant). There were no specific concerns identified based on current information in the other locations. However, these sorts of areas are ones where contamination is sometimes found.

For ease of data interpretation, based on experiences in the industry, it was considered prudent to give further examination to these areas. The sampling locations have been divided into seven areas. The former refinery use of each area is listed below.

Area 1 - asphalt plant
Area 2 - cooling tower
Area 3 - tank farm
Area 4 - open area
Area 5 - northern "old" TEL plant
Area 6 - southern "new" TEL plant
Area 7 - waste incineration unit

2.1.2 Trenching Program

Nineteen trenches were excavated and sampled. The trenches were dug using a 1 1/4 cu. yd. excavator. With the exception of one trench in the former asphalt plant, all trenches were excavated until non-odorous or non-discolored soil was reached.

Samples were taken from the sides of each trench. A specially designed sampling scoop, attached to the end of a pole, was used to take the samples. This device was used so that representative samples could be taken without anyone needing to enter the trenches. The samples covered all strata encountered and were taken at approximately 0.3 m (1') intervals. The apparently uncontaminated soil at the base of each test pit was sampled to permit analytical verification of the field observation.

Figure 3 shows the location of all test pits except those in the former "new" TEL plant area. These trenches are on city-owned land adjacent to the north-east corner of the Dairy Producers Co-op property.

A brief description of the trenches dug in each area follows. Detailed test pit logs are included in Appendix I.

Area 1 - Three trenches were dug in the vicinity of the former asphalt plant with all three intersecting a 0.4 m thick asphaltic layer at a 0.4 m depth. Traces of free hydrocarbon were observed in the asphaltic layer. In trench 88-TP-33 some oily asphaltic material with construction debris was noted to a depth of 2.3 metres. This material was found in a limited area adjacent to an old building foundation and the trench did not uncover its final depth. All trenches intersected non-odorous or discolored clay at depths of less than 4.0 metres.

Area 2 - Two long (>15m) trenches were dug in the former cooling tower area of the refinery to check for any heavy metal or other contamination. An odorous, dark grey clay layer was intersected from 0.7 to 2.0 metres.

Area 3 - A total of eight trenches were dug along the northwestern edge of the refinery property in an area that was used as a tank farm. No visual indication of contamination was observed in any of the trenches. Though very mild hydrocarbon odor was detected in a few of the trenches.

Area 4 - One 25 metre long trench was dug in the northern portion of the refinery site. It intersected a continuous 0.5m thick bed of coke-like material located at a 0.5m depth. The coke appeared very "dry" with no visible hydrocarbon associated with it and did not have an odor.

Area 5 - Two 25 meter trenches were dug to test for lead contamination in the vicinity of the former northern or "old" TEL plant. Both trenches intersected a 0.6 to 1.0m thick layer of mixed construction debris/fill and sandy soil which had a strong gasoline-type odor.

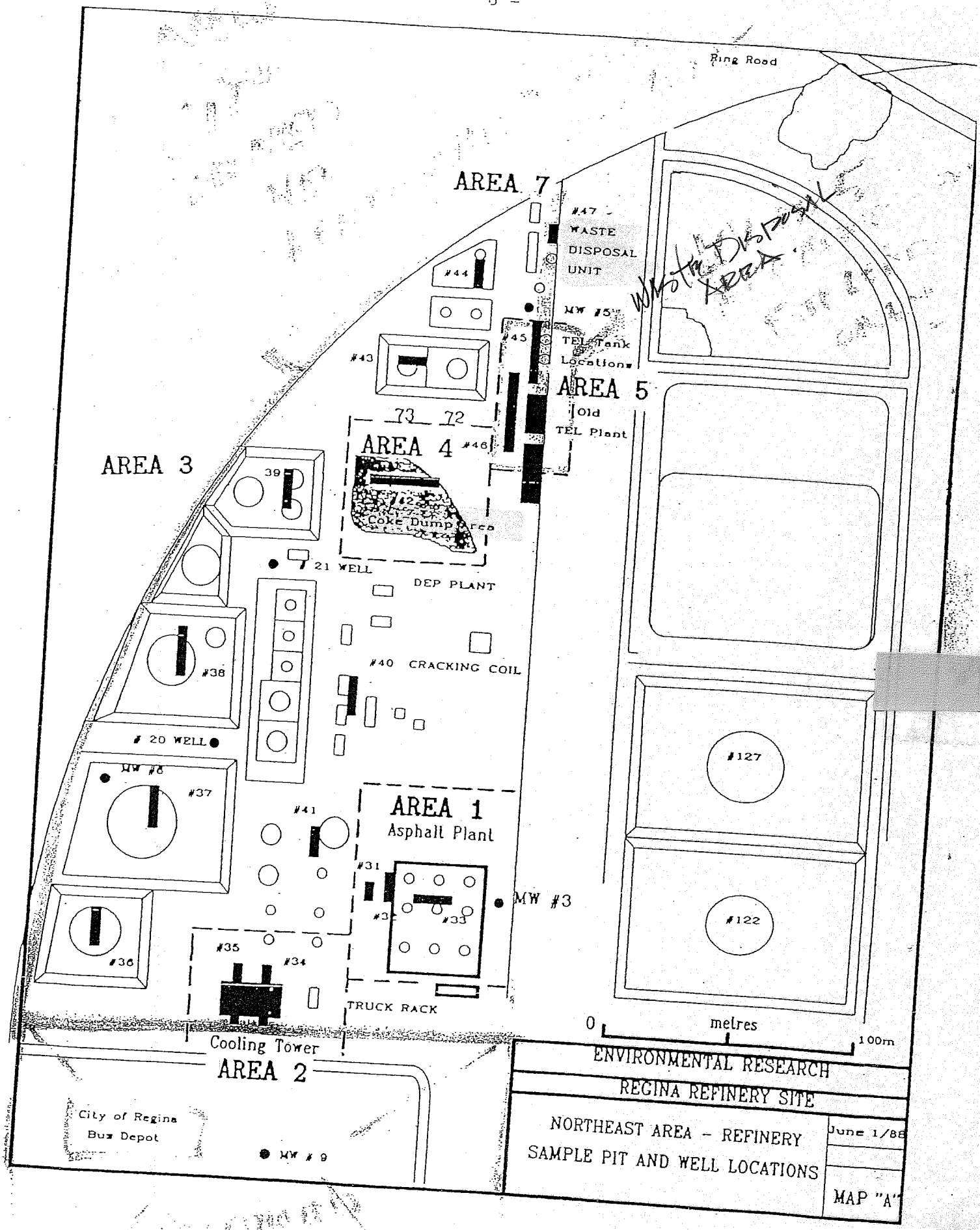

Ring Road
AREA 7
#47
WASTE
DISPOSAL
UNIT
WASTE DISPOSAL AREA
#44
MW #5
#45
TEL Tank
Locations
#43
AREA 5
Old
TEL Plant
73
72
AREA 4
#46
AREA 3
39
42
Coke Dump Area
21 WELL
DEP PLANT
#38
#40 CRACKING COIL
20 WELL
MW #8
#37
#41
AREA 1
Asphalt Plant
#31
MW #3
#32
#33
#35
#34
#36
TRUCK RACK
#127
#122
0
metres
100m
Cooling Tower
AREA 2
City of Regina
Bus Depot
MW # 9
ENVIRONMENTAL RESEARCH
REGINA REFINERY SITE
NORTHEAST AREA - REFINERY
SAMPLE PIT AND WELL LOCATIONS
June 1/88
MAP "A"

Figure 3

Area 6 - Two trenches were dug as close as possible to the location of the former southern or "new" TEL plant. The plant may have been located on what is now Dairy Producers Co-op land. A sandy backfill layer from 0.6 to 1.0m depth was intersected. It was orange-red colored in a few places.

Area 7 - One trench was dug in the location of the old waste incinerator plant located at the very northernmost portion of the refinery area. A yellow-brown, non-odorous scaly layer was encountered at about the 0.5m depth.

2.2 Phase Two

After review of the results of phase one, Esso believed that it would be prudent to do a follow-up study in Area 5, the "old" TEL blending plant.

2.2.1 Design Basis

The objective of phase two was to better delineate the vertical and aerial lead concentration profile and to determine the chemical form of the lead. As additional sampling was planned, it was decided to monitor the quality of the air that the sampling personnel were exposed to. This monitoring was designed to check for TEL vapors.

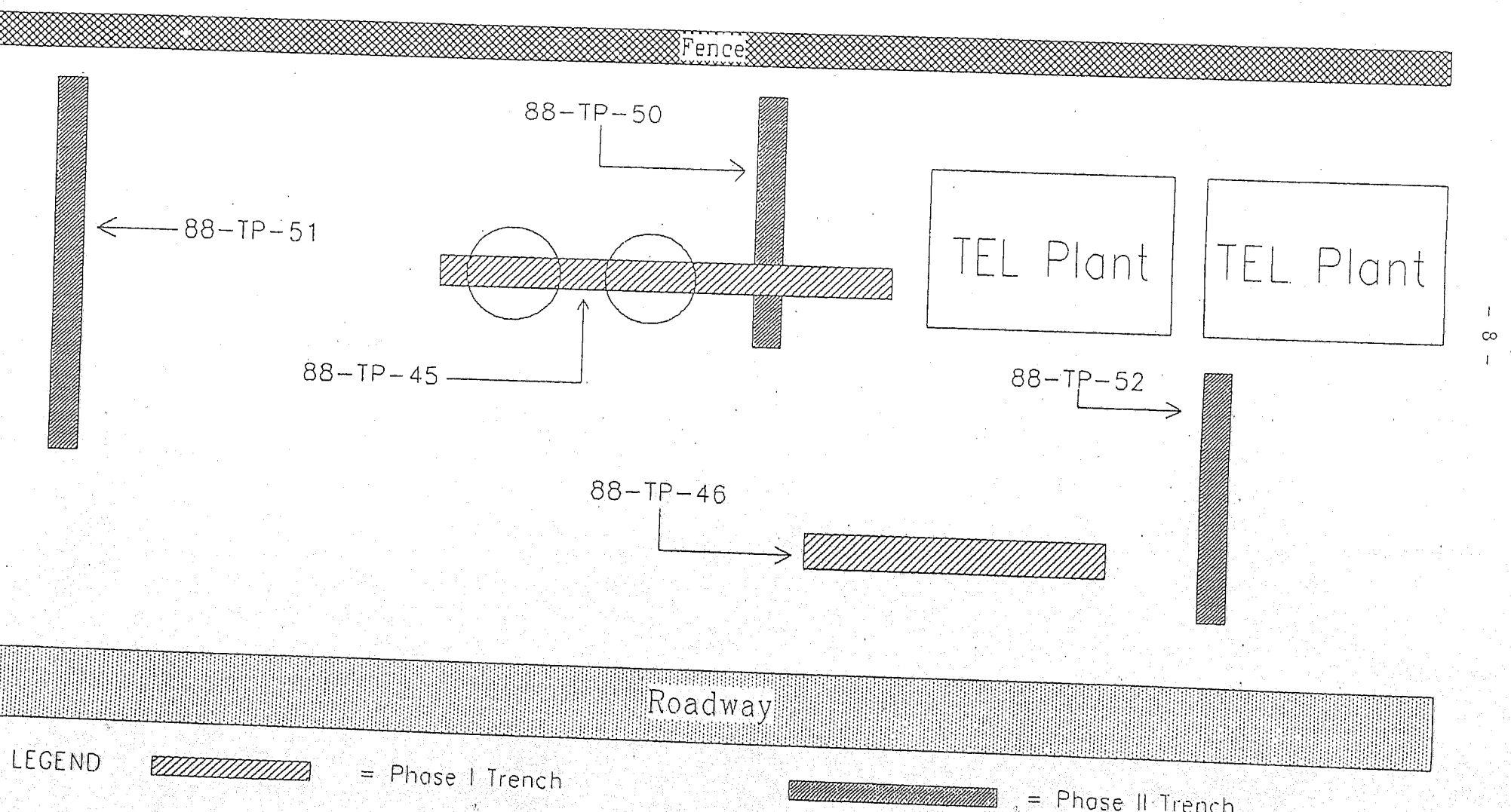
The trenching program for phase two was structured to delineate the northerly and southerly extent of slightly elevated lead. And, it also would address the vertical lead concentration profile by digging deeper than in the first phase.

2.2.2 Trenching Program

Three additional test pits were dug. The same 1 1/4 cu. yd. excavator and operator, as in phase one, were used. Samples were taken from the sides of the trenches at 0.3m (1') intervals, using a specially designed scoop, as in phase one. A total of 31 soil samples were collected.

Figure 4 shows the location of trenches for both phases one and two. Detailed test pit logs are included in Appendix I. In general, the top 0.6-1.0m was comprised of backfill. Beneath which there was an approximately 1 m layer of clay with a strong hydrocarbon odor. The odor decreased with depth becoming mild to non-odorous by approximately 3 m below grade. Native undisturbed green/brown clay was encountered at a depth of about 2 m.

TRENCH LOCATIONS FOR PHASES 1 AND II



According to Esso's standard procedures several precautionary measures were taken to protect the employees while they were sampling. These measures included: wearing neoprene gloves, disposable (Tyvek) coveralls and dual organic cartridge respirators. The respirators were removed briefly, periodically, to obtain odor information. They were worn whenever any work caused the employees to be in close proximity to the soil, eg. filling sample bags and jars. These precautionary measures were subsequently shown to be unnecessary for this location.

The soil vapor hydrocarbon concentration was measured using an hnu organic vapor analyzer. This was done to quantify the subjective odor observations. Results are included on the borehole logs.

Personal air monitoring for exposure to TEL vapors was conducted with low flow Gillian pumps using XAD2 sorbant tubes. The backhoe operator and one of the samplers wore the air monitoring equipment.

3.0 RESULTS

3.1 Phase One

The 159 samples were prioritized, based on appearance and odors, for this stage of the investigation. All apparent deviations from background quality were analyzed. Soil not used during the initial analytical phase is being properly stored to permit analysis in the future, if necessary. The soil samples will be retained for a period of 6 months. Should the City require these samples, arrangements will be made for shipment.

A summary of the analyses performed follows:

Analytical parameter	No. of Analyses *
pH	1
moisture	33
oil and grease	32
total metals (by ICP)	75
polynuclear aromatic hydrocarbons	3
leachate metals (by ICP)	18
leachate phenols	3
leachate F, Cl, Br	5
leachate nitrate, nitrite	5
leachate phosphate, sulphate	5

* including analytical duplicates

All analytical results are presented in Appendix II.

In addition to the soil analyses, a sample of the coke-like material was analyzed. The results were:

Sample	Carbon	Hydrogen	Nitrogen	Sulphur	Ash	Net Heat of Combustion (BTU/lb)
88-TP-42	75.1	4.7	1.0	1.4	7.9	12,358

All analyses were performed by the Esso Petroleum Canada Research Labs, in Sarnia, Ontario, with the exception of the total metals analyses which were performed by Barringer Magenta Labs, in Toronto, Ontario and the polynuclear aromatic hydrocarbon analyses which were performed by Mann Testing Laboratories, in Mississauga, Ontario.

3.2 Phase Two

The samples were shipped to Esso's Research lab in Sarnia, Ontario where homogenization and analysis were commenced upon receipt. A summary of the analyses performed and the analytical labs used follows.

Analytical Parameter	No. of Analyses *	Laboratory
Total metals by ICP	21	Esso Research
Leachate metals by ICP	17	Esso Research
Total lead	6	Ortech International
Alkyl lead	6	Ortech International
Volatile organics	3	Mann Testing

* including analytical duplicates

All analytical results are presented in tabular form in Appendix II.

No TEL vapors were detected during the industrial hygiene survey. The details are presented in Appendix IV.

3.3 Discussions

3.3.1 Phase One

The responsibility for assessing the data and undertaking any appropriate actions, including the requirements for further site assessments based on future development of the site, lies with the City as owner of the land.

The City may wish to compare the results obtained by Esso to available decommissioning guidelines. Although there are no soil decommissioning standards available for Saskatchewan, both the provinces of Ontario and Quebec have developed draft guidelines. A list of the key soil criteria from the Ontario Ministry of the Environment (MOE) and the Ministry of Environment of Quebec (MENVIQ) are shown in Appendix III. In both jurisdictions, the guidelines for industrial reuse have been shown. Leachate results can be compared to current drinking water standards established for Saskatchewan.

If the results from phase one are compared with the draft decommissioning guidelines in Appendix III, it can be seen that there are few exceedances. These are limited to a few elevated total oil levels and some leachate and total lead.

Looking specifically at the Ontario guideline for weathered oil of 1%, it was only exceeded at the former asphalt plant (up to 5.9%). Asphalt is not normally considered an environmental risk, as shown by its widespread use for paving. It may be aesthetically

undesirable for some reuse options. Quebec has a lower guideline for oil - 0.5%. At this lower level, the only additional location where somewhat elevated oil was found, was a sample where residual coke is buried. It contained 0.65% oil.

Esso arranged for a more detailed polynuclear aromatic hydrocarbon (PAH) analysis of the coke (17 PAH's), to assist the City in assessing the risk it might pose. Comparing the results to the only known Canadian guidelines (MENVIQ) shows that only 1 of the 17 PAH's (benzo (g, h, i) perylene) exceeded it's standard. The actual concentration was 11 ppm versus a standard of 10 ppm (method detection limit was 3 ppm).

Throughout the study area total lead levels were below the Ontario decommissioning guideline of 1000 ppm. A few samples were at or slightly above the Quebec guideline of 600 ppm. These samples were all from the two TEL blending plants. In the northern or "old" TEL blending plant site some soluble lead was also found. This was the prime trigger for phase two of this study, which is discussed in section 3.3.2.

SASK. INDICO LIMIT IS 600ppm ABOVE WHICH Soil RESTORATION IS REQ'D. GN

Comparing leachate results to drinking water standards shows few exceedances. Leachable phenol was slightly elevated above the analytical method detection limited and aesthetic standards at the "old" TEL plant and at the asphalt plant. The range was between 6 and 21 ppb. A groundwater study conducted by Gartner Lee in 1988 at the former refinery site did not identify that the former refinery had had any significant impact on phenol concentrations in the Regina aquifer.

Generally, phase one data showed that throughout the site, the soil contained slightly elevated hydrocarbons and odors. The odors tended to dissipate quickly when exposed to air.

3.3.2 Phase Two

Phase two focussed on the "old" TEL blending plant site where some elevated and leachable lead was found during phase one. In the immediate vicinity of the former blending plant and TEL storage tank lead levels were found to be elevated above background. They were, however, all less than the decommissioning guidelines drafted by Ontario and Quebec.

An objective of phase two was to determine if any of the lead was still in an organic state and if so which form it was in. Organic leads tend to be readily absorbed by humans and pose a greater health risk than inorganic forms (eg. oxides). Another objective was to determine the relationship between the soluble lead and organic lead. Total lead was found to be mostly in an inorganic state (see Appendix II, Table 7). Low concentrations of two specific organic forms were found: diethyl lead and triethyl lead. Of significance is that no tetraethyl lead (TEL) was detected. The only sample where any leachable lead was found was also the phase two sample with the greatest total lead content. No organic lead was found in this sample.

Samples taken from the "old" TEL plant site were quite odorous. It was decided that some analysis should be conducted to determine if any volatiles of health concern, such as benzene, were present. Therefore, three samples were analyzed for non-halogenated and halogenated volatile aromatics (34 in total - see Appendix II, Table 8). Those compounds that were detected were found at low levels (< 25 ppb) and were about 3 orders of magnitude lower than their respective Quebec decommissioning guidelines.

3.3.3 Comparison Between Phases One and Two

One of the phase two trenches intersected the location of a phase one trench and another was close to the end of a different phase one trench. By comparing these results one can obtain an indication of the consistency of the data between the two phases.

To facilitate a comparison of data between the two phases, refer to Tables 1 and 2 (total metals and leachate) The results appear to be similar.

Figure 5 shows the lead concentrations in all trenches (ie. from both phases) at various depths.

FIG 5 SHOWS A "LEAD HOTSPOT" THAT WILL LIKELY HAVE TO BE REMOVED GN

3.3.4 Old TEL Blending Plant

Indications of lead in excess of background levels have been found at the "old" TEL blending plant site. The question that must be asked is whether this is environmentally significant and if it is, what ought to be done.

To answer this question certain assumptions must be made. The first assumption relates to the future use of the land. For the purposes of this discussion, it is assumed that the land remains in industrial use and undisturbed. This is believed to be appropriate due to the use of the adjacent land (city transit garage, railway lines, major roadways). Should this area ever be considered for any use other than industrial (eg. residential, school) then a thorough environmental assessment should be conducted.

THE SITE OF THE TEL PLANT SHOULD BE CAVEATED FOR FUTURE TO ENSURE NEVER USED FOR OTHER THAN INDUSTRIAL GN

The total lead content meets the decommissioning guidelines proposed for Ontario. It is close to those proposed by Quebec. Of course, this soil would not be suitable for any agricultural use and thus should not be used in the landscaping of an industrial facility. This is a precautionary measure to ensure that lead does not enter the food chain.

THIS IS THE AREA CITY IS COMPOSTING LEAVES / TREES USED FOR LANDSCAPING PURPS

The greatest potential concern at the "old" TEL plant site is the mobility (leachability) of some of the lead and the risk of it reaching the Regina aquifer. It is Esso's initial evaluation, although we are not experts in this field, that it is unlikely based on the results we have found that the Regina aquifer could be affected by lead from the "old " TEL plant, for the following reasons:

1) a small portion of the total lead is leachable (about 4% (12/322 * 100), from sample 88-TP-50, 2 mid 3'-4', see Appendix III, Table 7)

2) the area containing elevated lead appears to be small (approximately 40 m x 15 m)

3) there are two aquitards between the lead and the Regina aquifer (the Regina Clays and the Upper Floral Till) where attenuation of mobile lead would likely take place

4) the vertical lead concentration profiles (see Figure 5) show little downward migration of lead and no lead was found in either the Condie or Regina aquifer (Gartner Lee 1988)

5) tremendous dilution of precipitation (the source of the water that could pick up lead) takes place by the time it passes through the Condie formation and reaches the Regina aquifer

POTENTIAL CLEANUP AREA @ NORTH T.E.L. SITE

Table 1

REGINA OLD IOL REFINERY SITE
COMPARISON OF PHASE I AND PHASE II DATA
Total Metals (mg/kg)

Analyte	MDL	88-TP-50 Aug 0-3'	88-TP-45 May 2-3'	88-TP-50 Aug 3-4'	88-TP-45 May 3-4'	88-TP-52 Aug 2-4'	88-TP-46 May 2-3'	88-TP-52 Aug 6-8'	88-TP-46 May 4-5'
Ag	2.5	-	-	-		-	-	-	-
Al	7.5	27996	29600	24151	28200	32678	28800	18812	38200
Ba	100	365	299	307	365	261	329	217	307
Be	10	-	-	-	-	-	-	-	-
Ca	2.5	37975	44600	45163	43000	26025	19100	23805	26100
Cd	0.5	-	-	-	-	-	1.10	-	-
Co	2.5	8.6	13.0	8.7	11.0	11.6	19.0	12.3	16.0
Cr	2.5	36.6	43.8	34.2	48.5	38.7	128.0	29.2	47.6
Cu	2.5	62.0	65.9	45.3	67.1	28.7	66.4	30.2	34.4
Fe	2.5	31421	30000	30472	29900	31463	39300	29020	34400
K	50	4319	4560	3688	4630	5926	5440	3063	5880
Mg	2.5	11998	13500	12180	14300	11162	19500	11333	13100
Mn	2.5	439	500	454	481	499	423	455	508
Mo	2.5	-	40.0	-	50.0	-	30.0	-	30.0
Na	250	643	810	548	760	-	370	450	460
Ni	5.0	46.4	55.0	47.7	54.0	30.7	123	32.3	30.0
Pb	25	265	540	322	700	99.0	180	36.4	38
P	50	526	560	460	610	479	670	389	480
Tl	25	-	345	-	328	-	407	-	255
V	5.0	57.9	81.0	46.2	77.5	43.1	75.6	19.4	93.6
Zn	2.5	156	144	139	177	96.9	85	98.7	88

Note: " - " less than estimated Method Detection Limit
" MDL" Method Detection Limit

where is this ↓

REGINA OLD IOL REFINERY

PHASE I AND II COMPARISON

Leachate Metals (mg/L)

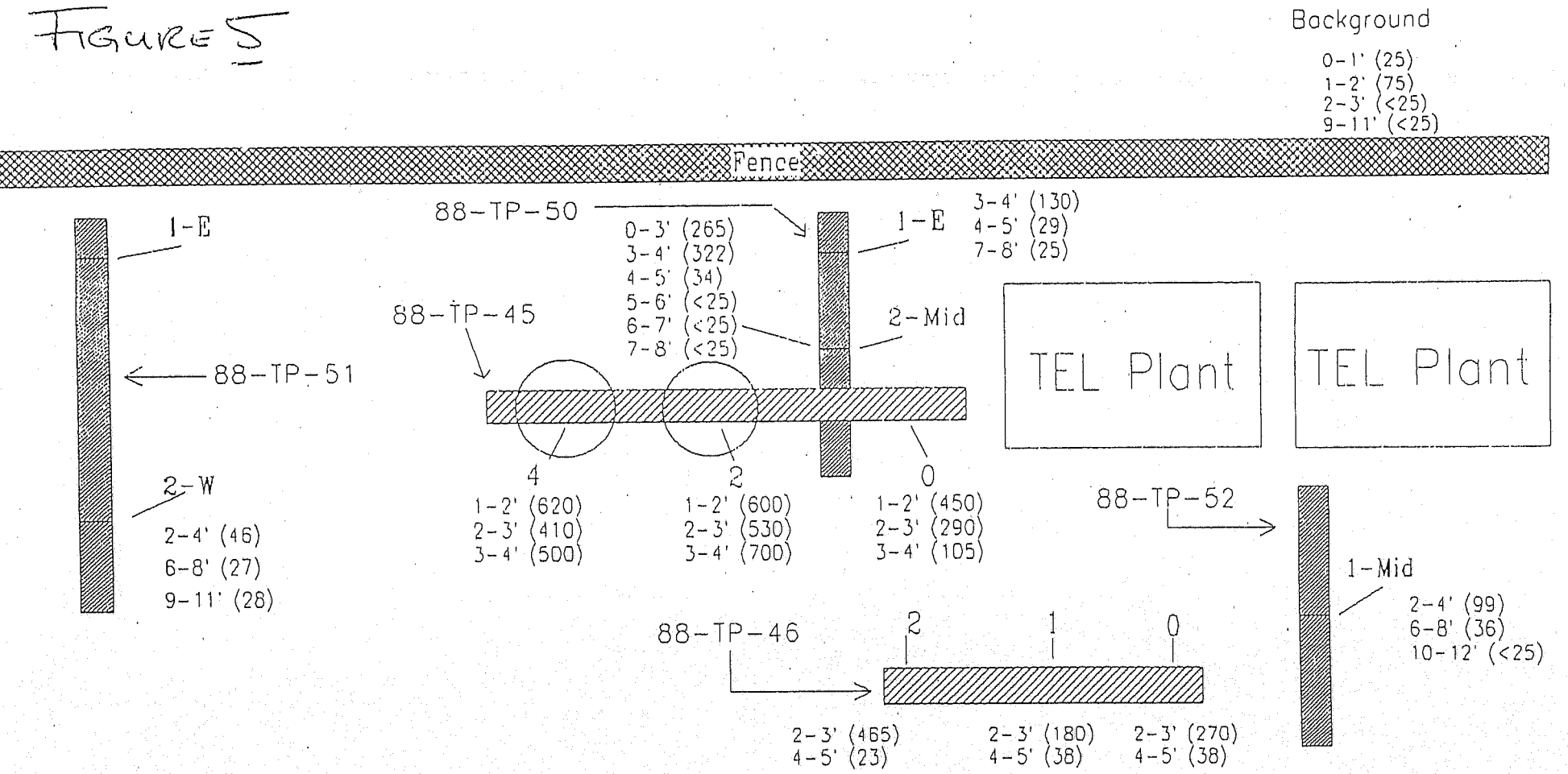
Analyte	MDL	88-TP-50 Aug 0-3'	88-TP-45 May 2-3'	88-TP-50 Aug 3-4'	88-TP-45 May 3-4'	88-TP-52 Aug 6-8'	88-TP-46 May 4-5'		88-TP-24 May 1.5-3'
Ag	0.05	-	-	-	-	-	-		-
Al	0.15	-	-	-	-	-	-		-
As	0.2	-	-	-	-	-	-		-
Ba	2.0	-	-	-	-	-	-		-
Be	0.2	-	-	-	-	-	-		-
B	0.01	0.1	-	-	-	0.1	-		-
Ca	0.05	1318	1381	1523	1205	878	987		891
Cd	0.01	-	-	-	-	-	-		-
Co	0.05	-	-	-	-	-	-		-
Cr	0.05	-	-	-	-	-	-		-
Cu	0.05	-	-	-	-	-	-		-
Fe	0.05	-	-	0.6	-	4.6	1.0		-
Ir	0.5	-	-	-	-	-	-		-
K	1.0	7.2	6.9	7.7	5.6	4.3	1.7		4.0
Mg	0.05	117	112	98.0	118	244	160		40.7
Mn	0.05	5.4	2.6	11.4	3.0	13.2	13		1.3
Mo	0.05	-	-	-	-	-	-		-
Na	5.0	10.5	10.2	7.0	10.2	17.6	6.9		9.6
Ni	0.1	-	-	0.2	-	-	0.1		-
Pb	0.5	-	0.3	0.6	1.7	-	-		58.8
Pd	0.2	-	-	-	-	-	-		-
Pt	0.1	-	-	-	-	-	-		-
P	1.0	-	-	-	-	-	-		-
Sb	0.5	-	-	-	-	-	-		-
Se	0.5	-	-	-	-	-	-		-
Si	0.1	9.0	11.4	7.3	8.5	7.8	5.4		7.0
Sn	0.5	-	-	-	-	-	-		-
Ti	0.01	-	-	-	-	-	-		-
Tl	0.5	-	-	-	-	-	-		-
V	0.1	-	-	-	-	-	-		-
Zn	0.05	0.1	0.1	0.4	0.1	0.1	-		0.8

Note: " - " less than estimated Method Detection Limit
" MDL" Method Detection Limit

1 PPM = 1 MG/KG

TOTAL LEAD TRENCH PROFILES FOR PHASES I AND II

FIGURE 5



4.0 SUMMARY

Esso voluntarily conducted an environmental investigation of the idle land north of the Transit Garage, formerly part of the Imperial Oil Regina Refinery, following discussions with the representatives of the city of Regina. Many test pits were dug, soil samples taken and analyzed for parameters that might have been affected by the previous operation of the refinery. All activities and analytical results have been documented and are presented in this report.

It is the responsibility of the City to ensure that this information is evaluated by a competent environmental professional prior to any future disturbance or redevelopment of these lands and to implement any remedial measures that are recommended by such professionals for the planned redevelopment.

A cursory comparison to draft decommissioning guidelines developed by the Ontario Ministry of the Environment and to similar guidelines developed by the Ministry of Environment in Quebec, shows few exceedances of industrial reuse criteria.

Should the land be used for purposes other than Industrial, consideration should be given to excavation and removal of the soil in the vicinity of the old TEL Plant as a precautionary measure. The city should also ensure that this soil is not permitted to be used for grading, agriculture or residential purpose.

and New T.E.L ?

REGINA MAY 1988 SAMPLING PROGRAM

TEST PIT DESCRIPTION

CITY (REFINERY SITE)

Test Pit	Depth *	Description	Samples		
88-TP-31	0 - 1.8	Silty Backfill			
(Asphalt Plant)	1.8 - 2.1	Asphalt			
	2.1 - 2.6	Sand and Gravel			
	2.6 - 3.6	Asphalt/sand/gravel			
	3.6	Cement			
88-TP-32	0 - 2.0	Silty Backfill	0 - 2	6 - 8	
(Asphalt Plant)	2.0 - 3.2	Asphalt	2 - 3	8 - 10	
	3.2 - 5.6	Black grey, discoloured clay	3 - 4	10 - 12	
	5.6 -12.0	Green clay, odour decreasing towards bottom of trench	4 - 5	+ Oily layer	
			5 - 6		
	12.0-13.0	Odorless clay			
88-TP-33	0 - 1.6	Backfill	0 - 1	5 - 6	
(Asphalt Plant)	1.6 - 3.3	Asphalt	1 - 2	6 - 7	
	3.3 - 7.1	Backfill/bricks with asphaltic matrix	2 - 3	7 - 8	
			3 - 4		
	7.1 -12.0	Odorless clay	4 - 5		
88-TP-34	0 - 2.3	Pebbly gravel	0 - 1	0 - 1	
(Cooling Tower)	2.3 - 3.5	Dark grey discoloured clay strong odour	1 - 2	1 - 2	
			2 - 3	2 - 3	
	3.5 - 6.0	Green-grey clay	3 - 4	3 - 4	
			4 - 5	4 - 5	
88-TP-35	0 - 1.8	Pebbly sand backfill	0 - 1	0 - 1	+ Pipe sample
(Cooling Tower)	1.8 - 6.0	Discoloured grey odorous clay	1 - 2	1 - 2	
	6.0 - 8.0	Dark green-grey clay no odour	2 - 3	2 - 3	
			3 - 4	3 - 4	
			4 - 5	4 - 5	
			5 - 6	5 - 6	
			6 - 7		
88-TP-36	0 - 1.5	Sandy backfill	0 - 1	5 - 6	
(Tank)	1.5 - 5.0	Weakly discoloured black-grey to brown clay	1 - 2	6 - 7	
			2 - 3		
	5.0 - 6.0	Green-grey clay, no odour	3 - 4		
			4 - 5		
88-TP-37	0 - 1.8	Pebbly sand backfill	0 - 1	4 - 5	
(Tank)	1.8 - 4.8	Slightly discoloured grey clay with very mild hydrocarbon odour	1 - 2	5 - 7	
			2 - 3		
	4.8 - 7.0	Green-grey clay, weakly fractured no odour	3 - 4		
88-TP-38	0 - 2.3	Sandy dark grey backfill	0 - 1	5 - 6	
(Tank)	2.3 - 4.1	Yellow/orange backfill with numerous bricks, sandy	1 - 2	6 - 7	
			2 - 3	7 - 8	
	4.1 - 8.3	Dark green-grey clay with medium to strong hydrocarbon odour	3 - 4	8 - 12	
			4 - 5		
	8.3 -12.0	Green-grey clay with weak hydrocarbon odour dissapearing towards bottom			

* all depths in feet

88-TP-39	0 - 3.0	Sandy/gravel backfill	0 - 1	3 - 4
	3.0 - 7.0	Green-grey clay, no odour	1 - 2	4 - 5
			2 - 3	5 - 7
88-TP-40	0 - 2.1	Coarse cobbly backfill	0 - 1	4 - 5
	2.1 - 3.3	Green clay, weakly odorous	1 - 2	5 - 6
	3.3 - 6.1	Grey odorous clay, very friable	2 - 3	6 - 7
	6.1 - 9.0	Green-grey banded clay, no odour	3 - 4	7 - 9
88-TP-41	0 - 1.8	Silty loam, 20% roots	0 - 1	4 - 5
	1.8 - 6.0	Fractured green-grey clay, friable, numerous roots	1 - 2	5 - 6
			2 - 3	
	6.0 - 7.0	Green-grey clay, no odour	3 - 4	
88-TP-42 (Coke Dump)	0 - 1.7	Pebbly sand	0 - 2	
	1.7 - 3.4	Coke, no odour, dry	2 - 4	
	3.4 - 6.0	Green-grey clay, no odour, mildly fractured	4 - 7	
88-TP-43 (Tank)	0 - 2.6	Coarse pebbly loam, minor bricks abundant plant material	0 - 1	3 - 4
			1 - 2	
	2.6 - 5.0	Green-grey clay, well-fractured	2 - 3	
88-TP-44	0 - 1.3	Pebbly/sandy loam with abundant roots	0 - 1	4 - 5
	1.3 - 3.8	Coarse backfill, bricks	1 - 2	5 - 6
	3.8 - 6.5	Pebbly clay backfill, minor bricks	2 - 3	6 - 8
	6.5 - 8.0	Green-grey clay	3 - 4	

			0W	1W	2W	3W	4W
88-TP-45 (TEL Plant)	0 - 1.5	Cobbly loam backfill	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
	1.5 - 3.9	Clay backfill with abundant construction debris, extremely odourous with strong gasoline-type smell	1 - 2	1 - 2	1 - 2	1 - 2	1 - 2
			2 - 3	2 - 3	2 - 3	2 - 3	2 - 3
			3 - 4	3 - 4	3 - 4	3 - 4	3 - 4
		3.0 metres from south end of trench a 2.5m wide triangular shaped zone of yellow/orange coarse sand was intersected, located between location of old TEL tanks					
	3.9 - 5.0	Dark green friable clay					

88-TP-46 (TEL Plant)	0 - 1.8	Pebbly sand backfill	0 - 1	0 - 1	0 - 1
	1.8 - 2.2	Discontinuous coke/railway-bed layer	1 - 2	1 - 2	1 - 2
	2.2 - 5.8	Pebbly sandy clay variable in composition texture with numerous sandy lenses, ranges from sandy to friable clay	2 - 3	2 - 3	2 - 3
			3 - 4	3 - 4	3 - 4
			4 - 5	4 - 5	4 - 5
		Strong hydrocarbon odour	5 - 6	5 - 6	5 - 6
			6 - 7		
88-TP-47 (Incinerator)	0 - 1.5 clean fill		0 - 1.5		
	1.5 - 3.0 yellow brown scaley material non-odorous		1.5 - 3.0		
88-TP-48 (South TEL)	0 - 1.1	Pebbly-loam backfill	0 - 1	0 - 1	
	1.1 - 2.3	Railway roadbed	1 - 2	1 - 2	
	2.3 - 3.1	Coarse backfill (boulders/bricks) in a sand matrix which is discoloured	2 - 3	2 - 3	
			3 - 4	3 - 4	

		dark-orange for the southern portion of the trench	
	3.1 - 4.5	Green-grey clay, no odour	
88-TP-49 (South TEL)	0 - 0.9	Pebbly sand backfill	0 - 1 0 - 1
	0.9 - 2.0	Railway roadbed	1 - 2 1 - 2
	2.0 - 3.0	Coarse sandy backfill, numerous bricks no discolouration, mild odour	2 - 3 2 - 3
	3.0 - 4.0	Green-grey clay no odour	3 - 4 3 - 4

REGINA SOIL SURVEY SAMPLE DESCRIPTIONS - PHASE II

Trench 88-TP-50 (Old TEL Plant)

1-E	0-3'	-cobbly loam backfill
	3-4'	-clay backfill scattered construction debris, strong HC odour (150-200 ppm)
	4-5'	-same as 3-4'
	5-6'	-brown clay backfill, less odourous (90-120 ppm)
	6-7'	-brown clay backfill, less odourous (70-80 ppm)
	7-8'	-green/brown friable clay, mildly odourous (50-70 ppm)
	8-9'	-green/brown mottled friable clay, mild to non-odourous (<40 ppm)
2-Mid	pipe	-black stained soil under flange of pipe (~1' under grade, slight HC odour)
	sand	-non-odourous yellow/orange coarse sand ~ 3 ft. below grade
	0-3'	-cobbly loam backfill
	3-4'	-clay backfill, scattered construction debris, strong HC odour (150-200 ppm)
	4-5'	-same as 3-4'
	5-6'	-brown clay backfill, less odourous (90-120 ppm)
	6-7'	-brown clay backfill, less odourous (70-80 ppm)
	7-8'	-green/brown friable clay, mildly odourous (50-70 ppm)
	8-9'	-green/brown mottled friable clay, mild to non-odourous (<40 ppm)

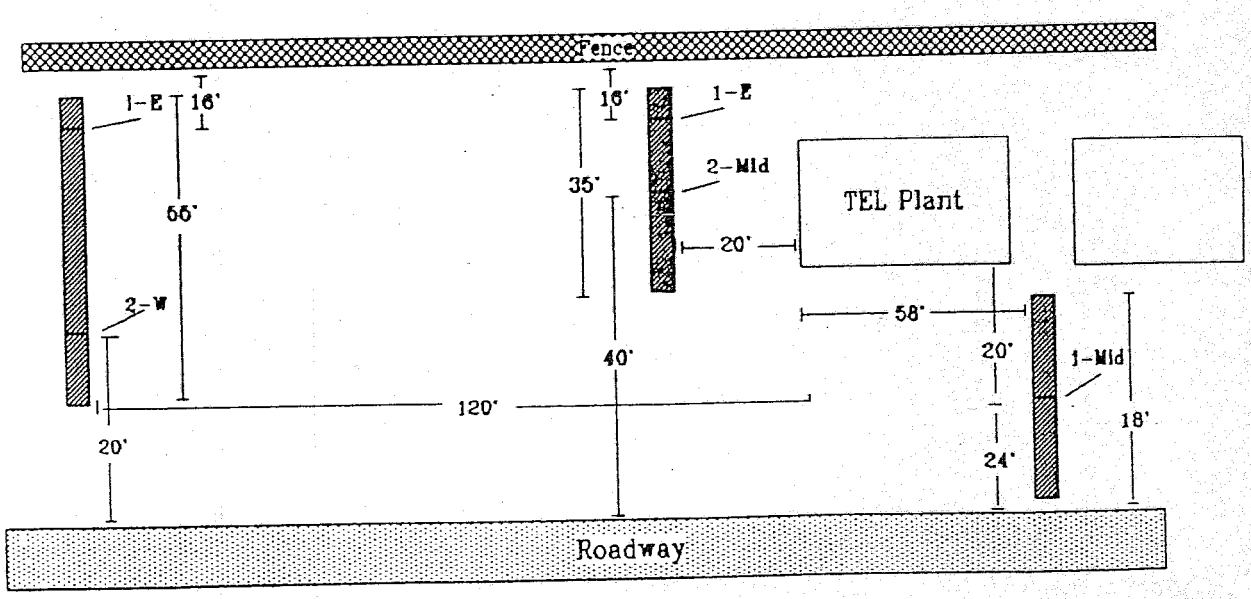
Trench 88-TP-51 (Old TEL Plant)

1-E	0-2'	-clean pebbly loam backfill
	2-3'	-coarse sandy backfill, bricks
	3-7'	-clean dark green clay, no odour
2-W	0-2'	-clean pebbly loam backfill
	2-4'	-black, highly odourous (150 ppm) heavy HC odour, clay-loam
	4-6'	-black and green mottled clay with decreasing odour
	6-8'	-green clay, mildly odourous (40-60 ppm)
	9-11'	-green clay, no odour

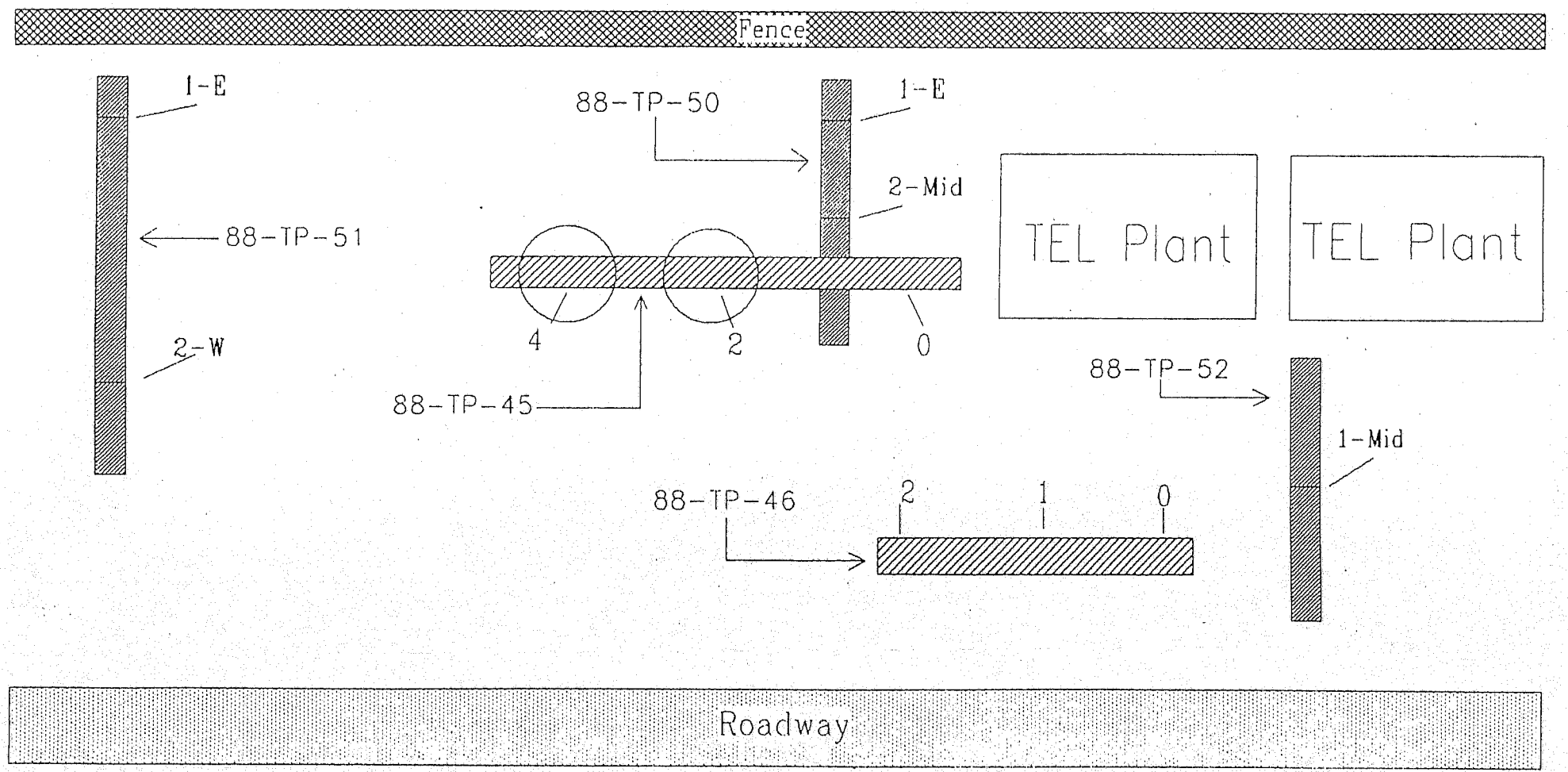
Trench 88-TP-52 (Old TEL Plant)

1-Mid	0-2'	-clean pebbly sand backfill
	2-4'	-dark green/brown extemely friable clay, strong gasoline odour (150-250 ppm)
	4-5'	-dark green friable clay, gasoline odour (130-150 ppm)
	5-6'	-dark green/black friable clay, decreasing gasoline odour (~120 ppm)
	6-8'	-dark green/black friable clay, decreasing gasoline odour (60-80 ppm)
	8-10'	-dark green/brown clay (40-60 ppm)
	10-12'	-dark green with mottled brown clay, slightly odourous (<40 ppm)

OLD TEL PLANT TRENCH LOCATIONS



TRENCH LOCATIONS FOR PHASES I AND II



LEGEND = Phase I Trench = Phase II Trench

APPENDIX II

Soil Analytical Results

Table 1

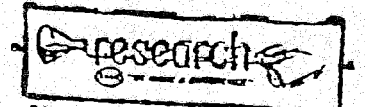
High Hydrocarbon Sites

FORMER IMPERIAL OIL REGINA REFINERY

SOIL ANALYSES (Oil & Grease, pH and Moisture)

CITY OF REGINA PROPERTY

Test Pit	Sample Depth	Oil & Grease (wt%)	pH	Moisture (wt%)
88-TP-32	2 - 3'	5.84	-	14.8
	4 - 5'		-	-
	6 - 8'		-	-
	10 - 12'	0.06	-	26.2
88-TP-33	2 - 3'	3.77	-	18.6
	4 - 5'		-	-
	7 - 8'	1.08	-	23.8
88-TP-34	N 2 - 3'	0.18	7.6	22.5
	N 4 - 5'	0.09	-	21.6
	S 2 - 3'	-	-	18.4
	S 4 - 5'	-	-	21.1
	Pipe sample	0.22	-	11.2
88-TP-35	N 2 - 3'	0.20	-	23.1
	N 4 - 5'	0.09	-	22.8
	N 6 - 7'	-	-	-
	S 2 - 3'	-	-	-
	S 4 - 5'	-	-	23.7
	S 5 - 6'	-	-	-
88-TP-37	2 - 3'	0.03	-	22.7
	5 - 7'		-	-
88-TP-38	4 - 5'	0.24 / 0.19	-	23.1
	7 - 8'	0.04	-	25.6
	8 - 12'		-	-
88-TP-40	2 - 3'		-	-
	4 - 5'	0.24	-	23.9
	7 - 9'	0.02	-	25.2
88-TP-42	0 - 2'		-	-
	2 - 4'	0.65	-	13.0
	4 - 7'	0.24	-	25.8



CITY OF REGINA PROPERTY (con't)

Test Pit	Sample Depth	Oil & Grease (wt%)	pH	Moisture (wt%)
88-TP-44	2 - 3'		-	-
	6 - 8'	0.01	-	27.7
88-TP-45	0 1 - 2'	-	-	-
	0 2 - 3'	0.20	-	20.7
	0 3 - 4'		-	-
	2 1 - 2'	-	-	11.6
	2 2 - 3'	0.17	-	14.5
	2 3 - 4'	0.23	-	15.2
	4 1 - 2'	-	-	-
	4 2 - 3'	0.43	-	15.2
	4 3 - 4'	0.02	-	21.1
88-TP-46	0 2 - 3'		-	-
	0 4 - 5'	0.06 / 0.05	-	23.8
	0 6 - 7'		-	-
	1 2 - 3'		-	-
	1 4 - 5'	0.08	-	24.2
	2 2 - 3'		-	-
	2 4 - 5'	0.04	-	23.8
88-TP-47	0 - 1.5'	-	-	-
	1.5 - 3.0'	0.14	-	27.6
88-TP-48	S 1 - 2'	-	-	-
	S 2 - 3'	0.10	-	14.9
	S 3 - 4'	-	-	-
88-TP-49	N 1 - 2'	-	-	-
	N 2 - 3'	1.04	-	10.6
	N 3 - 4'	0.01/0.01	-	24.1

FORMER IMPERIAL OIL REFINERY

CITY OF REGINA PROPERTY

TOTAL METAL ANALYSIS

EPC ENVIRONMENTAL RESEARCH

Sample ID	Ag	Al	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn
88-TP-32 (2-3')	<.3	22700	269	0.68	26400	0.6	11	31.8	41.2	23800	3770	8450	435
88-TP-32 (4-5')	0.5	38400	346	1.17	35100	<.5	17	50.1	32.5	32800	5970	12700	495
88-TP-32 (6-8')	0.4	34600	266	1.08	23300	1.2	20	44.8	38.5	33900	5560	12900	472
88-TP-32 (10-12')	0.3	28000	241	0.98	25000	1.3	17	40.9	34.8	31900	4760	12300	502
88-TP-33 (2-3')	<.3	30800	266	0.87	25700	0.9	16	40.7	44.6	31400	5030	13700	759
88-TP-33 (4-5')	0.5	34100	264	1.02	16300	2.4	18	43.2	32.1	32500	7540	11400	581
88-TP-33 (7-8')	0.5	31700	249	1.01	24300	0.8	20	54.1	29.5	32600	5260	12400	477
88-TP-34 N (2-3)	0.3	40400	268	1.06	32200	0.8	17	50.4	32.4	33400	6440	12600	494
88-TP-34 N (2-3) dup	0.3	39800	256	1.01	31900	0.7	17	47.5	33.6	33500	6300	12400	499
88-TP-34 N (4-5')	0.4	37300	310	1.04	29400	1	19	45.1	32.5	34300	5640	13000	446
88-TP-34 S (2-3')	0.7	36600	266	0.96	31100	0.9	18	46.4	38.5	31700	6380	11900	573
88-TP-34 S (4-5')	<.3	33100	221	0.85	30900	<.5	14	33.2	32	30600	4750	12100	427
88-TP-34 S (pipe sample)	<.3	15800	155	0.45	47000	<.5	13	18.8	43.4	31400	2390	13200	625
88-TP-35 N (2-3')	<.3	40400	256	0.92	27900	<.5	14	39.7	32.6	33400	6350	12100	520
88-TP-35 N (4-5')	<.3	35600	262	0.99	28600	<.5	15	35.8	32.9	34700	4590	13800	501
88-TP-35 N (6-7')	<.3	33000	223	0.94	22500	0.6	17	35.8	32.1	34300	4690	12600	463
88-TP-35 S (2-3')	<.3	41900	317	0.96	28500	<.5	12	41.7	31.3	32600	6320	12400	422
88-TP-35 S (4-5')	<.3	32600	273	0.96	25600	0.8	15	36.2	37.3	33600	4790	12700	550
88-TP-35 S (4-5') dup	<.3	33900	262	0.95	26100	<.5	14	37.9	38.9	34000	4920	12900	583
88-TP-35 S (5-6')	<.3	34500	230	0.99	28100	<.5	14	38.6	34.4	34900	5030	12800	458
88-TP-37 (2-3')	<.3	42500	303	0.96	24200	<.5	14	38	32.6	35500	6710	12400	551
88-TP-37 (5-7')	<.3	33200	203	0.88	28100	<.5	14	27.7	29.4	34000	4070	12900	506
88-TP-38 (4-5')	<.3	32700	276	0.9	27400	0.5	12	32.5	32.4	33800	4370	12400	505
88-TP-38 (7-8')	0.3	27000	243	0.88	22400	0.9	15	31.1	31	31900	4020	12200	493
88-TP-38 (8-12')	<.3	28700	246	0.89	21500	1.1	15	34.3	33.3	31800	4230	12600	469
88-TP-40 (2-3')	<.3	36800	261	0.79	26300	<.5	12	30.7	29.7	32000	4750	11800	458
88-TP-40 (4-5')	<.3	30800	106	0.94	41900	<.5	14	38.5	30.3	30100	4370	11800	635
88-TP-40 (7-9')	<.3	33000	228	0.94	26600	0.7	14	41.8	31.6	32300	5060	12800	471

table 7

FORMER IMPERIAL OIL REFINERY
CITY OF REGINA PROPERTY
TOTAL METAL ANALYSIS

EPC ENVIRONMENTAL RESEARCH

Sample ID	Mo	Na	Ni	P	Pb	Sr	Th	Tl	V	Zn	Zr
88-TP-32 (2-3')	<10	370	38	520	180	99.7	<3	292	76.8	124	17
88-TP-32 (4-5')	<10	250	32	520	10	99.1	<3	216	97.5	87.3	17
88-TP-32 (6-8')	<10	360	33	490	10	93.3	5	123	85.5	94	11
88-TP-32 (10-12')	<10	390	31	520	10	90.2	4	108	71.9	88.7	10
88-TP-33 (2-3')	<10	310	47	490	95	64.6	<3	192	92.1	122	13
88-TP-33 (4-5')	<10	1780	32	790	75	65.1	11	339	83.9	184	11
88-TP-33 (7-8')	<10	310	35	510	10	86.2	5	47.5	69.8	88.1	7
88-TP-34 N (2-3)	10	700	31	500	10	87.1	<3	351	101	88.7	11
88-TP-34 N (2-3) dup	10	690	30	490	13	85.2	<3	272	91.7	89.6	11
88-TP-34 N (4-5')	<10	760	33	490	10	91.1	<3	171	86	93.9	13
88-TP-34 S (2-3')	<10	520	33	530	55	85.3	<3	237	90.4	101	12
88-TP-34 S (4-5')	<10	740	27	400	15	96.8	<3	195	76.9	90.8	13
88-TP-34 S (pipe sample)	<10	310	26	540	20	66.9	<3	329	47	72.9	11
88-TP-35 N (2-3')	10	450	28	460	13	77.2	<3	343	91.9	87.4	10
88-TP-35 N (4-5')	<10	740	29	470	13	93.4	<3	113	76.9	80.8	10
88-TP-35 N (6-7')	10	870	27	440	10	87.1	<3	115	75.7	77.9	10
88-TP-35 S (2-3')	<10	590	27	440	23	85.5	<3	444	96	79	11
88-TP-35 S (4-5')	<10	800	28	470	15	99.8	<3	97.6	71.2	81.4	10
88-TP-35 S (4-5') dup	<10	780	28	450	13	101	<3	105	75.7	77.4	11
88-TP-35 S (5-6')	<10	940	27	440	8	101	<3	125	80.2	77.5	11
88-TP-37 (2-3')	<10	540	27	470	33	75	<3	345	92.2	105	13
88-TP-37 (5-7')	<10	890	25	410	10	90.6	<3	115	68.3	72.7	9
88-TP-38 (4-5')	<10	220	29	440	23	89.5	<3	86.6	74.8	72.6	11
88-TP-38 (7-8')	<10	500	28	470	13	83.7	4	72	57.5	82.1	8
88-TP-38 (8-12')	<10	250	28	450	13	86.4	4	66.6	62.5	79.8	9
88-TP-40 (2-3')	<10	320	23	430	43	71.1	<3	350	75.8	82.5	7
88-TP-40 (4-5')	20	480	28	410	10	102	<3	129	73.4	73	17
88-TP-40 (7-9')	20	880	27	480	10	92.1	<3	200	79.9	79	14

Sample ID	Ag	Al	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn
88-TP-42 (0-2')	<.3	32800	251	0.94	37400	<.5	14	43.1	49.1	31100	5500	13700	642
88-TP-42 (2-4')	<.3	4680	52.8	0.05	5030	<.5	<3	8.2	25.6	4150	870	1830	134
88-TP-42 (2-4') dup	<.3	4240	46.1	<.02	4170	<.5	<3	7.2	21.6	4340	800	1660	110
88-TP-42 (4-7')	<.3	42000	239	1.05	15200	<.5	15	45.5	31.3	34600	7520	11500	446
88-TP-44 (2-3')	<.3	17200	384	0.65	56800	<.5	12	35.9	78	43400	1940	9290	399
88-TP-44 (6-8')	<.3	41700	223	1.04	24700	<.5	19	48.9	28.6	33500	7570	12100	443
88-TP-45 0 (1-2')	<.3	26300	286	0.88	42600	<.5	14	43.9	68	28400	4210	13800	507
88-TP-45 0 (2-3')	<.3	28600	313	0.95	35300	<.5	12	46.4	56.9	30000	4600	12800	471
88-TP-45 0 (3-4')	<.3	36000	313	0.91	33400	<.5	13	43.9	42.9	32100	5610	12800	504
88-TP-45 2 (1-2')	0.5	27400	318	0.88	45300	<.5	14	46.1	75.2	29400	4400	13100	555
88-TP-45 2 (2-3')	<.3	29600	299	0.91	44600	<.5	13	43.8	65.9	30000	4560	13500	500
88-TP-45 2 (2-3') dup	<.3	26400	277	0.86	40500	<.5	13	48.1	91.1	28700	4480	12700	491
88-TP-45 2 (3-4')	<.3	28200	365	0.93	43000	<.5	11	48.5	67.1	29900	4630	14300	481
88-TP-45 4 (1-2')	0.3	27600	514	1.01	74200	<.5	11	48.7	56.1	28100	3980	16600	657
88-TP-45 4 (2-3')	<.3	18500	408	0.72	44600	<.5	20	119	57.2	49100	2000	20400	425
88-TP-45 4 (3-4')	<.3	33600	396	0.96	18100	1.1	15	42.4	31.6	36100	6140	9630	405
88-TP-46 0 (2-3)	<.3	22300	255	0.62	20000	1.6	14	44.7	55.1	38600	4290	11000	404
88-TP-46 0 (4-5)	<.3	38100	348	1.02	25400	0.8	15	48.5	34.7	33700	5790	12900	482
88-TP-46 0 (4-5) dup	<.3	36800	333	1	25800	0.6	14	49.5	33.9	33100	5570	12700	464
88-TP-46 0 (6-7')	<.3	35300	279	1	24800	0.7	15	46	32.4	32700	5370	12900	457
88-TP-46 1 (2-3')	<.3	28800	329	0.76	19100	1.1	19	128	66.4	39300	5440	19500	423
88-TP-46 1 (4-5')	<.3	38200	307	1.06	26100	<.5	16	47.6	34.4	34400	5880	13100	508
88-TP-46 2 (2-3')	<.3	29900	316	0.84	20400	0.8	15	45.8	52.5	31200	5750	10100	393
88-TP-46 2 (2-3') dup	<.3	28100	311	0.75	23700	0.9	15	41.4	58	30900	5150	12200	423
88-TP-46 2 (4-5')	<.3	32400	310	0.92	28800	<.5	15	42.9	28.1	29800	5110	12300	479
88-TP-47 (0-1.5')	<.3	33500	864	1.47	12400	<.5	<3	4.1	7.6	7490	1520	13000	103
88-TP-47 (1.5-3.0')	<.3	18800	637	0.96	48200	<.5	8	23.4	43.4	19800	1990	4770	431
88-TP-48 S (1-2')	<.3	12200	441	0.35	18900	0.7	10	27.3	356	32000	1310	5060	338
88-TP-48 S (2-3')	0.3	25600	448	0.99	31700	<.5	12	30.9	186	30500	2870	8260	411
88-TP-48 S (3-4')	0.4	33900	264	0.99	25100	<.5	18	43.6	32.6	32800	5030	12400	455
88-TP-49 N (1-2')	<.3	28500	369	0.86	29000	<.5	15	38	61.2	33400	4440	11100	611
88-TP-49 N (2-3')	<.3	31300	295	0.85	32100	<.5	14	37.7	50.9	33400	4830	12100	706
88-TP-49 N (3-4')	<.3	37700	238	1.02	24200	<.5	19	43.9	32.2	33200	5300	12900	427

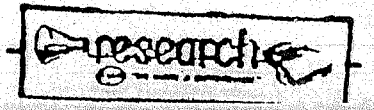
Sample ID	Mo	Na	Ni	P	Pb	Sr	Th	Tl	V	Zn	Zr
88-TP-42 (0-2')	30	450	33	490	53	99.6	<3	280	81.6	107	15
88-TP-42 (2-4')	<10	500	87	100	163	24.8	<3	72.3	97.6	37.7	3
88-TP-42 (2-4') dup	<10	470	127	80	148	22.7	<3	67.7	113	33.5	3
88-TP-42 (4-7')	20	2610	29	520	18	66.7	7	305	95.1	106	15
88-TP-44 (2-3')	50	1310	59	860	400	330	<3	375	42.2	90.8	9
88-TP-44 (6-8')	40	360	32	450	10	76.3	3	377	98.1	85.5	14
88-TP-45 0 (1-2')	50	970	53	620	450	167	<3	210	68	158	15
88-TP-45 0 (2-3')	50	670	48	560	290	144	<3	256	77.3	126	15
88-TP-45 0 (3-4')	40	390	34	510	105	106	<3	310	87.6	103	13
88-TP-45 2 (1-2')	30	570	56	600	600	172	<3	378	74.3	159	15
88-TP-45 2 (2-3')	40	810	55	560	540	162	<3	345	81	144	16
88-TP-45 2 (2-3') dup	40	660	52	560	520	154	<3	336	78.1	147	15
88-TP-45 2 (3-4')	50	760	54	610	700	167	<3	328	77.5	177	15
88-TP-45 4 (1-2')	30	1360	40	960	620	335	<3	362	69.4	128	14
88-TP-45 4 (2-3')	60	1490	152	930	410	356	<3	416	43.7	370	10
88-TP-45 4 (3-4')	50	740	33	880	500	177	3	439	86.1	98	14
88-TP-46 0 (2-3)	50	270	54	450	270	72.4	<3	287	65.8	78	12
88-TP-46 0 (4-5)	50	410	31	470	45	97.2	<3	232	94.5	84.1	13
88-TP-46 0 (4-5) dup	40	400	30	470	30	94.4	<3	204	90.7	82.9	12
88-TP-46 0 (6-7')	50	380	30	480	15	91.9	<3	204	89.7	84.8	11
88-TP-46 1 (2-3')	30	370	123	670	180	119	<3	407	75.6	85	11
88-TP-46 1 (4-5')	30	460	30	480	38	97.4	<3	255	93.6	88	14
88-TP-46 2 (2-3')	40	230	42	560	450	82.1	4	330	81.3	171	13
88-TP-46 2 (2-3') dup	30	190	41	520	480	84.8	<3	251	72.1	189	11
88-TP-46 2 (4-5')	40	280	28	480	23	91.3	<3	190	81.6	76.7	13
88-TP-47 (0-1.5')	10	310	4	230	40	106	15	495	10.5	44.2	28
88-TP-47 (1.5-3.0')	20	1910	33	2350	90	706	<3	469	37.2	181	19
88-TP-48 S (1-2')	20	740	142	600	630	159	<3	279	150	211	13
88-TP-48 S (2-3')	20	950	50	1420	108	238	<3	405	82	131	15
88-TP-48 S (3-4')	20	710	32	470	20	93.1	6	149	81.7	86.9	11
88-TP-49 N (1-2')	30	280	36	590	118	122	<3	160	74.9	91.4	14
88-TP-49 N (2-3')	<10	260	32	560	78	113	<3	248	78.4	87.6	15
88-TP-49 N (3-4')	<10	450	30	440	15	91.1	4	205	85.3	81.6	15

OLD T.E.L. PLANT

SOUTH T.E.L. SITE

research

CONTROL DATA													
Sample ID	Ag	Al	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn
BLANK 1	<.3	17.5	<.3	<.02	19.4	<.5	<3	0.8	<.4	18.2	<30	5.1	<.5
BLANK 2	<.3	3.3	<.3	<.02	<.5	<.5	<3	0.6	<.4	57.5	<30	<.5	<.5
BLANK 3	<.3	5.1	<.3	<.02	2.7	<.5	<3	0.7	<.4	15.1	<30	1.2	<.5
88-TP-30 (0-1')	<.3	42400	222	1.1	13700	1.3	18	47.2	33.9	34900	7650	11200	517
88-TP-30 (0-1') Barr. Dup.	<.3	44000	236	1.14	14200	1.4	17	51.6	37	35500	8320	11100	532
88-TP-34 S (2-3')	0.7	36600	266	0.96	31100	0.9	18	46.4	38.5	31700	6380	11900	573
88-TP-34 S (2-3') Barr. Dup	0.6	39400	253	0.86	27800	<.5	15	36.4	32.8	32100	5340	12100	554
88-TP-45 2 (3-4')	<.3	28200	365	0.93	43000	<.5	11	48.5	67.1	29900	4630	14300	481
88-TP-45 2 (3-4') Barr. Dup	0.3	24600	336	0.85	43400	<.5	12	42.8	63.6	29100	3960	14100	484



CONTROL DATA											
Sample ID	Mo	Na	Ni	P	Pb	Sr	Th	Tl	V	Zn	Zr
BLANK 1	<10	<30	<3	<30	<3	<.05	<3	<.3	0.7	0.7	<3
BLANK 2	<10	<30	<3	<30	<3	<.05	<3	<.3	<.3	<.5	<3
BLANK 3	<10	<30	<3	<30	<3	0.05	<3	<.3	<.3	0.6	<3
88-TP-30 (0-1')	<10	220	30	510	25	57.6	9	293	95.3	97.3	15
88-TP-30 (0-1') Barr. Dup.	20	210	30	520	25	60.6	8	382	104	101	12
88-TP-34 S (2-3')	<10	520	33	530	55	85.3	<3	237	90.4	101	12
88-TP-34 S (2-3') Barr. Dup	<10	470	28	480	50	78.9	<3	439	87.4	95.5	10
88-TP-45 2 (3-4')	50	760	54	610	700	167	<3	328	77.5	177	15
88-TP-45 2 (3-4') Barr. Dup	40	660	52	590	710	156	<3	197	65.9	166	13

Table 3

NORTH "OLD I.E.L" SITE.

FORMER IMPERIAL OIL REGINA REFINERY
SOIL LEACHATE ANALYSIS
CITY OF REGINA PROPERTY

Metal	Est. MDL	88-TP-32 2-3'	88-TP-34 (N) 2-3'	88-TP-34 (N) 2-3' anal dup	88-TP-34 (S) 4-5'	88-TP-35 (N) 2-3'	88-TP-35 (S) 4-5'	88-TP-42 2-4'	88-TP-45 (0) 2-3'	88-TP-45 (2) 1-2'	88-TP-45 (2) 2-3'	88-TP-45 (4) 2-3'	Env. Sask. Limits
Ag	0.05	NA	-	-	-	-	-	-	-	-	-	-	0.05
Al	0.15	NA	-	-	-	-	-	-	0.18	-	-	-	-
As	0.20	NA	-	-	-	-	-	-	-	-	-	-	0.05
B	2.00	NA	-	-	-	-	-	-	-	-	-	-	5.00
Ba	0.20	NA	0.93	0.78	0.21	1.76	0.33	-	0.39	0.23	0.24	0.27	1.00
Be	0.01	NA	-	-	-	-	-	-	-	-	-	-	-
Ca	0.05	NA	933	1144	955	1034	864	99.8	1184	1281	1381	1359	-
Cd	0.01	NA	-	-	-	-	-	-	-	-	-	-	0.01
Co	0.05	NA	-	-	-	-	-	-	-	-	-	-	-
Cr	0.05	NA	-	-	-	-	-	-	-	-	-	-	0.05
Cu	0.05	NA	-	-	-	-	-	-	-	-	-	-	1.00
Fe	0.05	NA	0.25	0.20	-	1.18	0.72	-	0.19	-	-	-	0.30
Ir	0.50	NA	-	-	-	-	-	-	-	-	-	-	-
K	1.00	NA	2.44	2.76	1.76	7.34	2.62	2.85	6.76	4.43	6.93	6.62	-
Mg	0.05	NA	151	146	188	132	187	20	126	89.9	112	120	-
Mn	0.05	NA	11.7	10.3	8.85	11.3	12.7	0.76	7.49	2.78	2.59	2.29	0.05
Mo	0.05	NA	-	-	-	-	-	-	-	-	-	-	-
Na	5.00	NA	25.5	25.9	29.2	16.8	28.4	9.61	11.0	-	10.2	11.0	-
Ni	0.10	NA	-	-	-	-	-	-	0.10	-	-	0.15	-
P	0.50	NA	-	-	-	-	-	-	-	-	-	-	-
Pb	0.20	NA	-	-	-	-	-	-	0.26	0.30	0.29	-	0.05
Pd	0.10	NA	-	-	-	-	-	-	-	-	-	-	-
Pt	1.00	NA	-	-	-	-	-	-	-	-	-	-	-
Sb	0.50	NA	-	-	-	-	-	-	-	-	-	-	-
Se	0.50	NA	-	-	-	-	-	-	-	-	-	-	-
Si	0.10	NA	4.63	3.86	6.95	4.49	5.97	1.90	8.33	8.82	11.4	9.36	0.01
Sn	0.50	NA	-	-	-	-	-	-	-	-	-	-	-
Ti	0.01	NA	-	-	-	-	-	-	-	-	-	-	-
Tl	0.50	NA	-	-	-	-	-	-	-	-	-	-	-
V	0.10	NA	-	-	-	-	-	-	-	-	-	-	-
Zn	0.05	NA	-	-	-	-	-	-	-	-	-	-	-
Phenols	5 ppb	21	NA	NA	NA	0.08	0.08	0.11	0.19	0.09	0.07	0.71	0.50
Fluoride	1	NA	-	-	-	NA	NA	-	NA	NA	6	NA	1
Chloride	1	NA	-	-	-	-	-	NA	NA	NA	NA	NA	-
Bromide	1	NA	-	-	-	-	-	NA	NA	NA	NA	NA	250
Nitrite	1	NA	-	-	-	-	-	NA	NA	NA	NA	NA	-
Nitrate	1	NA	-	-	-	-	-	NA	NA	NA	NA	NA	-
Phosphate	1	NA	-	-	-	-	-	NA	NA	NA	NA	NA	10
Sulphate	1	NA	20	20	90	20	130	NA	NA	NA	NA	NA	500

Note: " - " less than estimated Method Detection Limit
" MDL" Mehtod Detection Limit

EPC ENVIRONMENTAL RESEARCH

North Mold/Tar Site

South T.E.L Site

FORMER IMPERIAL OIL REGINA REFINERY
SOIL LEACHATE ANALYSIS
CITY OF REGINA PROPERTY

Metal	Est. MDL	88-TP-45 (2) 3-4'	88-TP-46 (0) 4-5'	88-TP-46 (0) 4-5' anal dup	88-TP-46 (1) 4-5'	88-TP-46 (2) 4-5'	88-TP-47 1.5-3.0'	88-TP-48 (S) 2-3'	88-TP-49 (N) 2-3'	Env. Sask. Limits
Ag	0.05	-	-	-	-	-	-	-	-	0.05
Al	0.15	-	-	-	-	-	-	-	-	-
As	0.20	-	-	-	-	-	-	-	-	0.05
B	2.00	-	-	-	-	-	-	-	-	5.00
Ba	0.20	0.39	1.15	1.15	0.56	1.31	0.38	0.27	1.67	1.00
Be	0.01	-	-	-	-	-	-	-	-	-
Ca	0.05	1205	878	936	873	987	1067	827	928	-
Cd	0.01	-	-	-	-	-	-	-	-	0.01
Co	0.05	-	0.05	0.08	0.06	0.07	-	-	-	-
Cr	0.05	-	-	-	-	-	-	-	-	0.05
Cu	0.05	-	-	-	-	-	-	-	-	1.00
Fe	0.05	-	1.64	5.74	1.48	1.02	-	-	1.27	0.30
Ir	0.50	-	-	-	-	-	-	-	-	-
K	1.00	5.62	2.67	2.02	2.68	1.67	3.80	2.41	3.23	-
Mg	0.05	118	159	169	187	160	48.1	44.5	42.3	-
Mn	0.05	2.96	11.7	12.9	12.3	13.0	3.39	0.47	7.09	0.05
Mo	0.05	-	-	-	-	-	-	-	-	-
Na	5.00	10.2	13.6	12.1	14.0	6.87	7.72	-	-	-
Ni	0.10	-	0.11	0.13	0.12	0.11	-	-	-	-
P	0.50	-	-	-	-	-	4.05	-	-	-
Pb	0.20	1.71	-	-	-	-	-	-	-	0.05
Pd	0.10	-	-	-	-	-	-	-	-	-
Pt	1.00	-	-	-	-	-	-	-	-	-
Sb	0.50	-	-	-	-	-	-	-	-	-
Se	0.50	-	-	-	-	-	-	-	-	0.01
Si	0.10	8.48	4.78	5.21	5.18	5.37	8.82	6.46	2.63	-
Sn	0.50	-	-	-	-	-	-	-	-	-
Ti	0.01	-	-	-	-	-	-	-	-	-
Tl	0.50	-	-	-	-	-	-	-	-	-
V	0.10	-	-	-	-	-	-	-	-	-
Zn	0.05	0.12	0.08	0.12	0.07	-	0.55	0.09	0.09	0.50
Phenols	5 ppb	NA	NA	NA	NA	NA	NA	NA	NA	1
Fluoride	1	NA	NA	NA	NA	NA	NA	NA	NA	-
Chloride	1	NA	NA	NA	NA	NA	NA	NA	NA	250
Bromide	1	NA	NA	NA	NA	NA	NA	NA	NA	-
Nitrite	1	NA	NA	NA	NA	NA	NA	NA	NA	-
Nitrate	1	NA	NA	NA	NA	NA	NA	NA	NA	10
Phosphate	1	NA	NA	NA	NA	NA	NA	NA	NA	-
Sulphate	1	NA	NA	NA	NA	NA	NA	NA	NA	500

Note: " - " less than estimated Method Detection Limit
" MDL" Mehtod Detection Limit

research
EPC ENVIRONMENTAL RESEARCH

Table 4

REGINA PHASE I SITE ASSESSMENT
POLYNUCLEAR AROMATIC HYDROCARBONS
results in ppm (ug/g)

Compound	MDL	88-TP-32 Ashphalt Oily Soil	88-TP-32 Duplicate	88-TP-42 "coke"	MENVIQ Criteria "C"
Naphthalene	0.3	3.1	2.8	29	50
Acenaphthylene	0.3	-	-	-	100
Acenaphthene	0.3	25	25	0.7	100
9H Fluorene	0.3	33	29	-	100
Phenanthrene	0.3	17	14	32	50
Anthracene	0.3	1.4	1.2	3.5	100
Fluoranthene	0.3	-	-	-	100
Pyrene	0.3	4.2	3.3	14	100
Chrysene	0.3	-	-	3.9	10
Benzo(a)anthracene	0.3	2.1	1.5	5.8	10
Benzo(b)fluoranthene	0.5	-	-	-	10
Benzo(k)fluoranthene	0.5	-	-	-	10
Benzo(a)pyrene	1.0	-	-	8.9	10
Perylene	1.0	-	-	-	-
Indeno(1,2,3-cd)pyrene	2.0	-	-	-	10
Dibenzo(ah)anthracene	3.0	-	-	-	10
Benzo(ghi)perylene	3.0	-	-	11	10

Note: " - " = Note detected at MDL

Why wasn't "benzene" tested for?

GN

REGINA OLD IOL REFINERY SITE
PHASE II SITE ASSESSMENT
Total Metals (mg/kg)

Analyte	MDL	Background		88-TP-50 1-East	88-TP-50 1-East	88-TP-50 1-East	88-TP-50 2-Mid	88-TP-50 2-Mid - Sand Duplicate		88-TP-50 2-Mid	MENVIQ Criteria	MOE Industrial
		1-2'	2-3'	3-4'	4-5'	7-8'	Pipe			0-3'	"C"	Criteria
Ag	2.5	-	-	-	-	-	-	-	-	-	40	50
Al	7.5	42200	41600	28425	27292	24362	33196	1695	1933	27996	-	-
As	10	NA	NA	-	-	-	-	-	-	-	50	50
Ba	100	261	368	284	265	248	252	-	-	365	2000	2000
Be	10	-	-	-	-	-	-	-	-	-	-	10
B	0.5	NA	NA	7.3	6.9	6.5	10.9	2.7	5.6	29.3	-	-
Ca	2.5	18500	23600	37270	27303	26076	19268	33936	35967	37975	-	-
Cd	0.5	1.1	0.9	-	-	-	-	-	-	-	20	8
Co	2.5	19.0	19.0	10.1	10.6	13.7	11.8	-	-	8.6	300	100
Cr	2.5	50.9	48.2	43.5	40.3	33.9	41.1	7.8	11.2	36.6	800	1000
Cu	2.5	63.0	31.0	45.2	31.0	31.3	27.5	4.5	3.7	62.0	500	300
Fe	2.5	36000	33900	32577	32999	33624	34424	7077	7841	31421	-	-
Ir	25	NA	NA	-	-	-	-	-	-	-	-	-
K	50	6830	6250	4389	4078	3664	6220	362	422	4319	-	-
Mg	2.5	11800	12700	12413	13079	12583	10494	6740	9122	11998	-	-
Mn	2.5	528	473	469	426	503	338	211	247	439	-	-
Mo	2.5	-	-	-	-	-	-	-	-	-	40	40
Na	250	330	560	325	259	258	405	-	-	643	-	-
Ni	5.0	33.0	30.0	43.6	34.5	37.0	33.6	6.9	11.2	46.4	500	200
Pb	25	75	10	130	29.3	25.3	72.0	-	-	265	600	1000
Pd	10	NA	NA	-	-	-	-	-	-	-	-	-
Pt	5.0	NA	NA	-	-	-	-	-	-	-	-	-
P	50	500	450	474	402	429	578	217	225	526	-	-
Sb	25	NA	NA	-	-	-	-	-	-	-	-	25
Se	25	NA	NA	-	-	-	-	-	-	-	10	10
Si	5.0	NA	NA	22.8	71.1	41.2	25.4	13.8	13.4	34.1	-	-
Sn	25	NA	NA	-	-	-	-	-	-	-	300	-
Ti	0.5	NA	NA	17.7	20.2	21.5	42.9	55.2	59.1	99.2	-	-
Tl	25	286	308	-	-	-	-	-	-	-	-	-
V	5.0	97.3	97.5	38.4	35.1	26.5	45.5	5.6	6.4	57.9	-	250
Zn	2.5	105	89.8	108	91.0	93.3	100	17.0	17.5	156	1500	800

Note: " - " less than estimated Method Detection Limit
" MDL" Method Detection Limit

Lot. of Missing Mercury Hg Tests

OLD T.E.L. SITE

REGINA OLD IOL REFINERY SITE
PHASE II SITE ASSESSMENT
Total Metals (mg/kg)

Analyte	MDL	88-TP-50 2-Mid 3-4' Duplicate		88-TP-50 2-Mid 4-5'	88-TP-50 2-Mid 5-6'	88-TP-50 2-Mid 6-7'	88-TP-50 2-Mid 7-8'	88-TP-51 2-West 2-4'	88-TP-51 2-West 6-8'	88-TP-51 2-West 9-11'	MENVIQ Criteria "C"	MOE Industrial Criteria
Ag	2.5	-	-	-	-	-	-	-	-	-	40	50
Al	7.5	25403	22900	21751	19827	16109	14361	27664	26748	16270	-	-
As	10	-	-	-	-	-	-	-	-	-	50	50
Ba	100	319	296	302	237	206	210	427	324	201	2000	2000
Be	10	-	-	-	-	-	-	-	-	-	-	10
B	0.5	19.2	11.0	-	-	-	-	11.5	-	-	-	-
Ca	2.5	42097	48230	30717	25996	26817	24017	29795	30720	24456	-	-
Cd	0.5	-	-	-	-	-	-	-	-	-	20	8
Co	2.5	8.8	8.5	10.8	11.0	11.5	10.2	9.8	10.5	9.3	300	100
Cr	2.5	36.1	32.4	30.7	31.8	25.2	21.9	32.1	35.7	24.5	800	1000
Cu	2.5	48.5	42.1	28.8	28.5	27.5	29.9	26.9	29.4	28.0	500	300
Fe	2.5	29388	31555	28781	29639	28006	25849	25132	30442	27005	-	-
Ir	25	-	-	-	-	-	-	-	-	-	-	-
K	50	4113	3263	3568	3481	2894	2638	4911	3998	2815	-	-
Mg	2.5	12220	12140	11734	11870	11000	10271	9018	11896	11182	-	-
Mn	2.5	440	468	454	421	384	465	434	520	461	-	-
Mo	2.5	-	-	-	-	-	-	-	-	-	40	40
Na	250	585	511	-	-	-	-	853	486	660	-	-
Ni	5.0	50.7	44.7	33.9	34.4	30.6	31.1	32.8	31.0	29.1	500	200
Pb	25	343	301	33.9	-	-	-	46.1	36.6	28.2	600	1000
Pd	10	-	-	-	-	-	-	-	-	-	-	-
Pt	5.0	-	-	-	-	-	-	-	-	-	-	-
P	50	485	435	432	404	379	386	772	379	377	-	-
Sb	25	-	-	-	-	-	-	-	-	-	-	25
Se	25	-	-	-	-	-	-	-	-	-	10	10
Si	5.0	71.1	103.4	55.0	68.2	48.1	72.7	49.3	89.0	86.3	-	-
Sn	25	-	-	-	-	-	-	-	-	-	300	-
Ti	0.5	81.3	48.8	17.4	12.2	14.0	16.8	65.4	19.6	18.7	-	-
Tl	25	-	-	-	-	-	-	-	-	-	-	-
V	5.0	50.4	42.0	25.8	22.9	16.9	14.5	45.3	33.7	15.7	-	250
Zn	2.5	145	133	82.5	81.7	77.7	86.1	98.8	90.8	87.0	1500	800

Note: " - " less than estimated Method Detection Limit

" MDL" Method Detection Limit

Table 5 (cont'd)

REGINA OLD IOL REFINERY SITE

PHASE II SITE ASSESSMENT

Total Metals (mg/kg)

Analyte	MDL	88-TP-52 1-Mid 2-4'	88-TP-52 1-Mid 6-8'	88-TP-52 1-Mid 10-12'	MENVIQ Criteria "C"	MOE Industrial Criteria
Ag	2.5	-	-	-	40	50
Al	7.5	32678	18812	15738	-	-
As	10	-	-	-	50	50
Ba	100	261	217	205	2000	2000
Be	10	-	-	-	-	10
B	0.5	-	-	-	-	-
Ca	2.5	26025	23805	23086	-	-
Cd	0.5	-	-	-	20	8
Co	2.5	11.6	12.3	10.8	300	100
Cr	2.5	38.7	29.2	27.0	800	1000
Cu	2.5	28.7	30.2	30.1	500	300
Fe	2.5	31463	29020	27508	-	-
Ir	25	-	-	-	-	-
K	50	5926	3063	2717	-	-
Mg	2.5	11162	11333	10879	-	-
Mn	2.5	499	455	436	-	-
Mo	2.5	-	-	-	40	40
Na	250	-	450	533	-	-
Ni	5.0	30.7	32.3	29.6	500	200
Pb	25	99.0	36.4	-	600	1000
Pd	10	-	-	-	-	-
Pt	5.0	-	-	-	-	-
P	50	479	389	367	-	-
Sb	25	-	-	-	-	25
Se	25	-	-	-	10	10
Si	5.0	118	86.6	97.7	-	-
Sn	25	-	-	-	300	-
Ti	0.5	36.8	18.4	16.7	-	-
Tl	25	-	-	-	-	-
V	5.0	43.1	19.4	15.9	-	250
Zn	2.5	96.9	98.7	80.3	1500	800

Note: " - " less than estimated Method Detection Limit

" MDL" Method Detection Limit

REGINA OLD IOL REFINERY

PHASE II SITE ASSESSMENT

Leachate Metals (mg/L)

nalyte	MDL	88-TP-50 1-East 3-4'	88-TP-50 1-East 4-5'	88-TP-50 1-East 7-8'	88-TP-50 2-Mid Pipe	88-TP-50 2-Mid Sand	88-TP-50 2-Mid 0-3'	88-TP-50 2-Mid 3-4'	88-TP-50 2-Mid 4-5'	Sask. Groundwater Guidlines	MENVIQ Criteria "C"	MOE Groundwater Guidelines
Ag	0.05	-	-	-	-	-	-	-	-	0.05	0.2	0.5
Al	0.15	-	-	-	-	-	-	-	-	-	-	-
As	0.2	-	-	-	-	-	-	-	-	0.05	0.1	0.5
Ba	2.0	-	-	-	-	-	-	-	-	5.0	2.0	10.0
Be	0.2	-	-	-	-	-	-	-	-	1.0	-	-
B	0.01	0.2	-	-	0.3	-	0.1	-	0.1	-	-	50.0
Ca	0.05	1158	905	870	673	215	1318	1523	990	-	-	-
Cd	0.01	-	-	-	-	-	-	-	-	0.01	0.02	0.05
Co	0.05	-	-	-	-	-	-	-	-	-	0.2	-
Cr	0.05	-	-	-	-	-	-	-	-	0.05	0.5	0.5
Cu	0.05	-	-	-	-	-	-	-	-	1.0	1.0	-
Fe	0.05	0.5	0.6	0.3	1.0	-	-	0.6	1.5	0.3	-	-
Ir	0.5	-	-	-	-	-	-	-	-	-	-	-
K	1.0	6.3	2.3	2.4	13.0	-	7.2	7.7	3.2	-	-	-
Mg	0.05	161	200	219	97.5	11.7	117	98.0	155	-	-	-
Mn	0.05	5.7	10.7	13.3	7.5	-	5.4	11.4	12.1	0.05	-	-
Mo	0.05	-	-	-	-	-	-	-	-	-	0.1	-
Na	5.0	10.2	6.9	5.9	12.0	-	10.5	7.0	6.2	-	-	-
Ni	0.1	-	-	-	-	-	-	0.2	0.1	-	1.0	-
Pb	0.5	-	-	-	-	-	-	0.6	-	0.05	0.1	0.5
Pd	0.2	-	-	-	-	-	-	-	-	-	-	-
Pt	0.1	-	-	-	-	-	-	-	-	-	-	-
P	1.0	-	-	-	-	-	-	-	-	-	-	-
Sb	0.5	-	-	-	-	-	-	-	-	-	-	-
Se	0.5	-	-	-	-	-	-	-	-	0.01	0.05	0.1
Si	0.1	6.9	5.5	6.6	5.4	1.2	9.0	7.3	4.9	-	-	-
Sn	0.5	-	-	-	-	-	-	-	-	-	0.15	-
Ti	0.01	-	-	-	-	-	-	-	-	-	-	-
Tl	0.5	-	-	-	-	-	-	-	-	-	-	-
V	0.1	-	-	-	-	-	-	-	-	-	-	-
Zn	0.05	0.1	-	-	-	-	0.1	0.4	0.1	0.50	10.0	-

ote: " - " less than estimated Method Detection Limit

" MDL" Method Detection Limit

Table 6 (cont'd)

REGINA OLD IOL REFINERY
PHASE II SITE ASSESSMENT
Leachate Metals (mg/L)

Analyte	MDL	88-TP-50 2-Mid 5-6'	88-TP-50 2-Mid 6-7'	88-TP-50 2-Mid 7-8'	88-TP-51 2-West 2-4'	88-TP-51 2-West 6-8'	88-TP-51 2-West 9-11'	88-TP-52 1-Mid 2-4'	88-TP-52 1-Mid 6-8'	Sask. Groundwater Guidlines	MENVIQ Criteria "C"	MOE Groundwater Guidelines
Ag	0.05	-	-	-	-	-	-	-	-	0.05	0.2	0.5
Al	0.15	-	-	-	-	-	-	-	-	-	-	-
As	0.2	-	-	-	-	-	-	-	-	0.05	0.1	0.5
Ba	2.0	-	-	-	-	-	-	-	-	5.0	2.0	10.0
Be	0.2	-	-	-	-	-	-	-	-	1.0	-	-
B	0.01	0.06	-	0.02	0.5	0.05	-	0.5	0.1	-	-	50.0
Ca	0.05	846	964	803	914	1265	845	1041	878	-	-	-
Cd	0.01	-	-	-	-	-	-	-	-	0.01	0.02	0.05
Co	0.05	-	-	-	-	-	-	-	-	-	0.2	-
Cr	0.05	-	-	-	-	-	-	-	-	0.05	0.5	0.5
Cu	0.05	-	-	-	-	-	-	-	-	1.0	1.0	-
Fe	0.05	1.2	0.4	0.1	1.0	3.4	0.5	0.8	4.6	0.3	-	-
Ir	0.5	-	-	-	-	-	-	-	-	-	-	-
K	1.0	1.6	1.8	2.6	12.1	4.0	3.2	9.1	4.3	-	-	-
Mg	0.05	186	176	180	105	227	237	132	244	-	-	-
Mn	0.05	11.0	8.8	9.1	9.7	16.9	12.4	11.0	13.2	0.05	-	-
Mo	0.05	-	-	-	-	-	-	-	-	-	0.1	-
Na	5.0	5.0	-	5.3	10.0	19.1	29.1	-	17.6	-	-	-
Ni	0.1	-	-	-	-	-	-	-	-	-	1.0	-
Pb	0.5	-	-	-	-	-	-	-	-	0.05	0.1	0.5
Pd	0.2	-	-	-	-	-	-	-	-	-	-	-
Pt	0.1	-	-	-	-	-	-	-	-	-	-	-
P	1.0	-	-	-	-	-	-	-	-	-	-	-
Sb	0.5	-	-	-	-	-	-	-	-	-	-	-
Se	0.5	-	-	-	-	-	-	-	-	0.01	0.05	0.1
Si	0.1	6.1	6.4	6.6	7.9	7.9	9.3	6.0	7.8	-	-	-
Sn	0.5	-	-	-	-	-	-	-	-	-	0.15	-
Ti	0.01	-	-	-	-	-	-	-	-	-	-	-
Tl	0.5	-	-	-	-	-	-	-	-	-	-	-
V	0.1	-	-	-	-	-	-	-	-	-	-	-
Zn	0.05	-	-	-	0.09	0.07	-	0.07	0.09	0.50	10.0	-

Note: " - " less than estimated Method Detection Limit
" MDL" Method Detection Limit

REGINA OLD IOL R.. INERY
PHASE II SITE ASSESSMENT
Leachate Metals (mg/L)

Analyte	MDL	88-TP-52 1-Mid 10-12'	Sask. Groundwater Guidlines	MENVIQ Criteria "C"	MOE Groundwater Guidelines
Ag	0.05	-	0.05	0.2	0.5
Al	0.15	-	-	-	-
As	0.2	-	0.05	0.1	0.5
Ba	2.0	-	5.0	2.0	10.0
Be	0.2	-	1.0	-	-
B	0.01	0.07	-	-	50.0
Ca	0.05	840	-	-	-
Cd	0.01	-	0.01	0.02	0.05
Co	0.05	-	-	0.2	-
Cr	0.05	-	0.05	0.5	0.5
Cu	0.05	-	1.0	1.0	-
Fe	0.05	0.5	0.3	-	-
Ir	0.5	-	-	-	-
K	1.0	4.2	-	-	-
Mg	0.05	236	-	-	-
Mn	0.05	11.4	0.05	-	-
Mo	0.05	-	-	0.1	-
Na	5.0	22.8	-	-	-
Ni	0.1	-	-	1.0	-
Pb	0.5	-	0.05	0.1	0.5
Pd	0.2	-	-	-	-
Pt	0.1	-	-	-	-
P	1.0	-	-	-	-
Sb	0.5	-	-	-	-
Se	0.5	-	0.01	0.05	0.1
Si	0.1	7.9	-	-	-
Sn	0.5	-	-	0.15	-
Ti	0.01	-	-	-	-
Tl	0.5	-	-	-	-
V	0.1	-	-	-	-
Zn	0.05	0.08	0.50	10.0	-

Note: " - " less than estimated Method Detection Limit
" MDL" Method Detection Limit

Table 7

REGINA OLD IOL REFINERY
PHASE II SITE ASSESSMENT
TOTAL, LEACHABLE AND ORGANIC LEAD COMPARISON

results in mg/kg

Sample	Total		Leachable	Organic					
	EPCR	Ortech	EPCR	Tetraethyl	Trimethyl	Triethyl	Diethyl	Monoethyl	Total
88-TP-50 1-E 3-4'	130	185	<10	<0.1	<0.1	<0.1	0.7	<0.1	0.7
2-Mid 3-4'	322	298	12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-Mid Pipe	72	46	<10	<0.1	<0.1	<0.1	1.4	<0.1	1.4
2-Mid Sand	<25	6.1	<10	<0.1	<0.1	0.2	<0.1	<0.1	0.2
88-TP-51 2-W 2-4'	46	30	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
88-TP-52 1-Mid 2-4'	99	82	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

? what does the mean → pipe" ?

Table 8

REGINA PHASE II SITE ASSESSMENT
VOLATILE ORGANIC HYDROCARBONS
results in ppb (ng/g)

Volatile Compound	MDL	88-TP-50 2-Mid 3-4'	88-TP-51 2-West 2-4'	88-TP-52 1-Mid 2-4'				MENVIQ Criteria "C"
Non-halogenated								
Benzene	0.3	1.5	1.4	tr	-	-	-	5000
Ethyl benzene	0.3	0.3	0.4	-	-	-	-	50000
Toluene	0.3	2.5	2.8	-	-	-	-	30000
p&m Xylene	0.3	15.4	15.4	tr	-	-	-	50000
o-Xylene	0.3	1.3	3.0	tr	-	-	-	-
Total C3 Benzenes	-	23.5	24.8	3.4	-	-	-	-
Total C4 Benzenes	-	3.2	4.4	3.6	-	-	-	-
Halogenated								
Dichlorodifluormethane	1.0	-	-	-	-	-	-	-
Chloromethane	1.0	-	-	-	-	-	-	-
Vinyl chloride	1.0	-	-	-	-	-	-	-
Bromomethane	1.0	-	-	-	-	-	-	-
Chloroethane	1.0	-	-	-	-	-	-	-
Trichlorofluoromethane	1.0	-	-	-	-	-	-	-
1,1-Dichloroethylene	0.5	-	-	-	-	-	-	-
)ichloromethane	0.5	-	-	-	-	-	-	-
T-1,2-Dichloroethylene	0.5	-	-	-	-	-	-	-
1,1-Dichloroethane	0.5	-	-	-	-	-	-	-
Chloroform	0.5	-	-	-	-	-	-	-
1,2-Dichloroethane	0.5	-	-	-	-	-	-	-
1,1,1-Trichloroethane	0.5	-	-	-	-	-	-	-
Carbon tetrachloride	0.5	-	-	-	-	-	-	-
1,2-Dichloropropane	0.5	-	-	-	-	-	-	-
Bromodichloromethane	0.5	-	-	-	-	-	-	-
Trichloroethylene	0.5	-	-	-	-	-	-	-
1,3-Dichloropropene(z)	0.5	-	-	-	-	-	-	-
1,3-Dichloropropene(e)	0.5	-	-	-	-	-	-	-
1,1,2-Trichloroethane	0.5	-	-	-	-	-	-	-
Dibromochloroethane	0.5	-	-	-	-	-	-	-
Tetrachloroethylene	0.5	-	-	-	-	-	-	-
Chlorobenzene	0.3	-	-	-	-	-	-	-
Bromoform	0.5	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	0.5	-	-	-	-	-	-	-
1,3-Dichlorobenzene	0.5	-	-	-	-	-	-	-
1,4-Dichlorobenzene	0.5	-	-	-	-	-	-	-
1,2-Dichlorobenzene	0.5	-	-	-	-	-	-	-
cis-1,2-Dichloroethylene	0.5	-	-	-	-	-	-	-
otal Hydrocarbons	-	30.8	54.4	8.3	-	-	-	10000

tr = trace amount detected
- = none detected

MDL = Method Dectection Limit

500000 ?

APPENDIX III

Industrial Site Decommissioning Criteria in mg/kg

Parameter	Jurisdiction	
	Ontario MOE	Quebec (MENVIQ) Level "C"
Ag	50	40
As	50	50
Ba	2000	2000
Be	10	-
Cd	8	20
Co	100	300
Cr	1000	800
Cu	300	500
Mo	40	40
Ni	200	500
Pb	1000	600
Sb	25	-
Se	10	10
Sn	-	300
V	250	-
Zn	800	1500
Oil	20 000	5000
Benzene	-	5
Ethyl Benzene	-	50
Toluene	-	30
Xylenes	-	50
Naphthalene	-	50
Acenaphthylene	-	100
Acenaphthene	-	100
9H Fluorene	-	100
Phenanthrene	-	50
Anthracene	-	100
Fluoranthene	-	100
Pyrene	-	100
Chrysene	-	10
Benzo(a) anthracene	-	10
Benzo(b) fluoranthene	-	10
Benzo(k) fluoranthene	-	10
Benzo(a) pyrene	-	10
Indeno(1,2,3-cd)pyrene	-	10
Dibenzo(ah) anthracene	-	10
Benzo(ghi) perylene	-	10

APPENDIX IV

Industrial Hygiene Exposure Survey

An Industrial Hygiene survey was carried out at the former IOL Refinery Site in Regina on August 19, 1988. The purpose of this survey was to assess the extent of personal exposure to tetra ethyl lead (TEL) while sampling at a TEL spill site. Personal monitoring was conducted by Esso Petroleum Canada Research with the assistance of Industrial Hygiene on 1 EPC employee and 1 contractor.

Soil monitoring was being conducted to determine the current condition of the former spill area. At the time of this survey trenches were dug at each site to take soil samples at various depths. Personnel did not have to enter the trenches to take the samples. As a precaution all 3 employees worn neoprene gloves, disposable coveralls (Tyvek) and dual organic cartridge respirators.

Air monitoring was conducted with the use of low flow Gillian pumps with XAD2 sorbant tube for TEL. Air monitoring results obtained during this survey are summarized below. All sample time weighted average concentrations to each component were all well within the Ontario and Saskatchewan regulated occupational exposure limits.

Based on the results of this survey, personal exposure to TEL was not an occupational exposure concern. Personal exposures are expected to vary during different excavation projects, therefore, caution should be applied when extrapolating this data to similar excavation projects.

Personal Exposures

Sample I.D.	Sample Time (min)	Location	Sample Time Weighted Ave. Conc. in mg/m^3 TEL
1-SM	109	Old TEL plant	< 0.01
2-SJ	236	Old TEL plant	< 0.01

Saskatchewan Workplace Contamination Limits

	8 Hours	15 Min
TEL	0.10 mg/m^3	0.3 mg/m^3

TEL EXPOSURE DURING EXCAVATION AT REGINA TERMINAL

NAME	SAMPLE TIME START HRS	START MIN	FIN. HRS	FIN. MIN	TOT MIN	FLOW RATES START CC/MIN	FIN. CC/MIN	AVG. CC/MIN	SAMPLE VOLUME (L)	SAMPLE TWA CONC. (MG/M3) TEL
S. MCGREGOR	8	47	10	36	109	136.0	128.0	132.0	14.4	< 0.01
S. JANKE	8	47	12	43	236	147.0	150.0	148.5	35.0	< 0.01

"<" - LESS THAN DETECTION LIMIT = 0.0002 MG/SAMPLE FOR TEL

ALL SAMPLES CORRECTED TO A BLANK (TRAVEL BLANK)

TWA = TIME WEIGHTED AVERAGE

MONITORING METHOD TEL = XAD2 TUBES (SKC-226-30-05)

ANALYTICAL METHOD TEL = SOP: IHASL.2.5.9 (HPLC)