

J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

ADDRESS ALL CORRESPONDENCE TO:

14 Burns Road
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File No: 8054-9

March 31, 1995

DIAND, Action on Waste Program
#345 - 300 Main Street
Whitehorse, Yukon
Y1A 2B5

Attention: Mr. Brett Hartshorn

Dear Sir:

**Re: Haines Junction Refinery
Remediation Assessment**

Please find enclosed our report with respect to the above noted project.

In brief, this report presents the results of the environmental assessment conducted at the abandoned oil refinery in Haines Junction. The report details the extent of soil and groundwater contamination encountered at the study area and presents recommendations for remediation.

Thank you for the privilege of providing this service to your organization . We will be pleased to meet with you to review the contents of this report at your convenience.

Sincerely,

YUKON

WILBUR C. KOFOED

Wilbur C. Kofoed, P. Eng.

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MEB/ml



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J. R. Paine & Associates Ltd.

**HAINES JUNCTION REFINERY
REMEDIATION ASSESSMENT**

EXECUTIVE SUMMARY

J.R. Paine & Associates Ltd. was retained by the Department of Indian Affairs and Northern Development, Action On Waste program, to determine the extent of soil and groundwater contamination present at the abandoned oil refinery site in Haines Junction, Yukon.

The results of the study indicates that low concentrations of hydrocarbon impurities have entered the subsurface in four areas throughout the site. In order to determine the extent of remediation which should be employed, we conducted a risk assessment study that consisted of a numerical comparison approach and a site sensitivity approach. Details of this study are presented in the Interpretations chapter of this report.

In summary, the site was found to have a low sensitivity to impact resulting from contamination at the study area. This evaluation was based on the relatively immobile nature of the impurity in the subsurface and the low probability of exposure to humans or animals. Further, the level of contamination is relatively low and is acceptable for a moderate sensitivity land use.

Three different remediation options have been presented in the Recommendations chapter of this report, each of which addresses a specific objective for remediation. Option A describes a surface remediation program for the removal of tar in various locations within the refinery infrastructure and a monitoring program for perched groundwater considerations. This approach would be acceptable to develop the site for an industrial land use, as intended. Option B details an isolation and containment approach which would ensure that the impurity occurring within the gravel stratum does not migrate along the perched water table.

The final remediation option, C illustrates the measures which should be taken to remediate the site to the highest levels. This would involve removing the surficial silt material from the site and engaging in a groundwater pumping program.

Once the objectives for remediation have been identified by the client, a detailed remediation program can be designed and implemented as desired.

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1.0 INTRODUCTION

The following report details the results of the environmental assessment which our firm has conducted at the abandoned site of the Haines Junction Oil Refinery. The site is located on Hume Street approximately 1.2 kilometres east of the Alaska Highway in Haines Junction, Yukon.

Prior to initiating this study, information regarding this refinery site was as follows. The refinery inception occurred in the late 1950's with the intention of producing pitch (tar) and heating fuel from a crude source originating from the Haines - Fairbanks pipeline. Apparently, the facility did not operate successfully with production ending shortly after start-up. A second attempt of unknown duration was made during the late 1960's. Known environmental hazards arising from this facility consisted primarily of visually detectable near surface tar.

Upon initiating this study, it was the intention of the Department of Indian Affairs and Northern Development (DIAND), Action On Waste Program, to determine if contamination of the subsurface had occurred at this site. Specifically, the objective was to assess the extent of soil and groundwater contamination at the site and to obtain recommendations for remediation of the contamination found.

J.R. Paine & Associates Ltd. was retained for this study with authorization to proceed granted by Ms. Judy Robbins of DIAND, Contracting Services, on October 28, 1994.

This report contains a description of the methodology which our firm employed to satisfy the required objectives, a summary of our results, discussions and engineering interpretations, and recommendations for remediation. It was our intention to provide the majority of relevant information in one illustration, enclosed as Drawing No. 1, so that it may be removed and viewed while reading the report.

2.0 METHODOLOGY

Our project approach generally involved a review of existing data, a multi-phase field work program, and a detailed laboratory program. A thorough description of each facet of our methodology is provided below.

2.1 Review of Existing Data

Our data research was initially intended to familiarize ourselves with the site conditions prior to initiating the field program. Later, in order to develop recommendations, further data review was necessary to determine the site sensitivity. Each component of the data search is described below.

- a) **Geotechnical Review:** We conducted a review of geotechnical information obtained from previous studies which our firm conducted near the site. This essentially consisted of reviewing information from the Hume Street Improvements (1984-1986), Willow Acres (1987), and Lift Station (1984).
- b) **Well Records review:** In order to determine the groundwater characteristics of the study area, we contacted Fredelana Enterprises Limited who has drilled several water wells in Haines Junction. This provided us with typical aquifer elevations and soil stratigraphy information.
- c) **Aerial Photo Review:** We obtained 1:10000 scale aerial photos from YTG, Lands Branch in order to familiarize ourselves with the general topographic and surface water conditions of the area.
- d) **Archival Search:** Information regarding oil development or refinement which related to the Haines Junction facility was reviewed at the Yukon Archives.
- e) **Land Use Review:** Information regarding land use and zoning was obtained from the Community Plan for the Village Of Haines Junction, made available by YTG, Lands Branch. Consultation

with the Champagne Aishihik First Nations was then initiated to confirm future zoning plans.

- f) **Interviews:** Our firm conducted several interviews in order to obtain specific information regarding site history, land and water use in the study area, and oil refinement.

We interviewed Mr. Lou Kirpen who possessed copies of the original design drawings of the facility and who was familiar with regular operations of the facility. The original design team, H.G. Acres International Limited and Fluor Corporation (from Niagara Falls, Ontario and Niagara Falls, New York, respectively), were also contacted to gain further information of the facility.

We also contacted personnel from the refinery industry with Imperial Oil and Petro Canada in order to obtain detailed information regarding refinement byproducts and hazards.

For land use considerations we interviewed Mr. Paul Birkell and Mr. Lawrence Joe of the Champagne Aishihik First Nations. This was purposed to clearly define the land and water use within the area to the west of the site.

The water use within the Village of Haines Junction was reviewed with Mr. Martin Jones, Town Foreman with Public Works Canada.

2.2 Field Work Program

Following initial searches, the field work program was necessary to determine the soil and groundwater conditions and the extent of contamination at the site. Each component of the field work is detailed below. Note that the dates of field work performed are presented on Drawing No. 1, enclosed.

a) Site Surveys

Upon contract award, our firm mobilized to the refinery site in order to establish a 10 metre by 10 metre grid throughout the study area. This grid is shown on Figure 1 of Drawing No. 1 with A to L as north - south coordinates and with 1 to 13 as east-

west coordinates. This grid encompasses the refinery infrastructure and surrounding area which was utilized for normal operations. This was determined in reviewing aerial photographs to identify practical boundaries such as topography and clues of historical use such as vegetative cover. The location of the grid is provided relative to an established bench mark located 3 metres north, 1 metre east of A4. This bench mark consisted of a vertical pipe cast in a concrete base and was referred to in the original design drawings.

Our firm also conducted an environmental survey of the study area for the purpose of identifying existing conditions which may be related to environmental considerations at this site. This essentially involved taking notes of contaminant sources or other site features which may have caused contamination. The survey was conducted in general accordance with the "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process", American Society for Testing and Materials, 1993.

b) Geophysical Analysis

Once the required grid was established, Mr. Mark Bowman, P. Geoph. of AMCL in Calgary, Alberta mobilized to the refinery site and conducted a "Total Field Magnetometer Survey". The purpose of this survey was to identify buried metallic objects within the study area that may be related to environmental considerations. Details of the methodology used in this analysis are provided in the AMCL report located in Appendix "A".

c) Surface Sampling

At the time of the geophysical survey, our firm conducted an initial surface sampling program. Given that frost had penetrated the subsurface, a portable coring machine with a 100 millimetre diameter hollow stem core barrel was required to obtain samples to a depth of approximately 200 millimetres. The sample locations were chosen according to previously identified soil stained areas and prominent site features which were perceived to be related to environmental considerations at this site. At the time of this coring program, hydrocarbon vapour readings were taken using a GasTech Tracetehtor vapour extraction unit.

d) Test Pit Program

The test pit program was designed following the initial surveys which identified possible contaminant sources. Once the environmental survey, geophysical study, and surface sampling program were completed, all data was collated and a letter report was prepared for Action On Waste personnel outlining the locations of the proposed subsurface probes. The details of the information presented in the said letter report are provided in Appendix "A". Note that Figure 4 displays the locations of the proposed test pits which were identified for subsurface probes. The test pit locations were chosen according to the results of the initial environmental surveys conducted at the site. Examples of the rationale used in determining the test pit locations are shown in Table One and Table Two. Two further pits were located in areas where possible buried metal was identified from the geophysical survey. These areas are shown as "1. Source not evident at surface" on the contour map within the AMCL report in Appendix "A". Finally, the design drawings indicated two underground storage tanks located south of the Boiler Building and thus two excavations were performed in this area.

The test pits were excavated utilizing a 215 Caterpillar backhoe on contract with Tana Contracting of Haines Junction. While excavating, a continuous visual log was kept of the soil stratigraphy. Spill piles were kept at regular intervals so that soil samples could be retrieved for laboratory analysis. Soil or water with hydrocarbon presence was also noted on each test pit log with the apparent vertical zone of impurity recorded.

The maximum depth of excavation was determined by several factors, namely:

- i) whether contamination was encountered and, if so,
- ii) at the termination of the impurity, or,
- iii) once an aqueous zone was realized.

It was assumed at the time of the test pit program that hydrocarbons encountered in the subsurface would be composed of Light Non-Aqueous Phase Liquids (LNAPL) given that the heavier end hydrocarbons produced at this facility (tar) would not be susceptible to vertical migration due to its high viscosity. The light end hydrocarbons such as diesel are restrained by saturated zones and thus the test pits did not progress beyond this point.

e) Drilling Program

Upon completion of the test pit program and associated laboratory analyses, there were contaminant zones identified which necessitated further study. Specifically, an extensive drilling program was proposed in order to identify the lateral and vertical extent of contamination. Soil stratigraphy and groundwater conditions at greater depths also had to be identified so as to intimate migration patterns.

The drilling program was initiated at identified contaminant zones and progressed outward using an 'inside-out' drilling technique until the spatial orientation of the plume was determined. This aggressive drilling technique was employed once the contaminant source was identified as diesel, an LNAPL, where the risk of creating a preferential pathway vertically beyond the aquifer was limited.

The test holes were advanced using a CME 75 drill rig mounted on an all terrain Nodwell vehicle. Solid stem augers were utilized with soil samples retrieved at regular intervals from auger cuttings. Hollow stem augers were employed in establishing test wells where soil conditions necessitated this approach (i.e.: loose gravel within saturated zones).

Where obvious contaminant zones were encountered, the augers were cleaned between test holes to prevent cross contamination. Further, hydrated bentonite was injected in test holes which extended beyond the gravel stratum into the underlying clayey silt stratum.

All samples were kept at, or below, 4°C so as to prevent the volatilization of hydrocarbons prior to testing. Selected samples were sent to ASL Laboratories for chemical analyses.

f) Hydraulic Testing and Water Sampling

In order to ascertain the groundwater vector, hydraulic conductivity, and hydraulic gradient conditions, our forces mobilized to the site for further testing.

The groundwater elevations in wells, both those installed by J.R. Paine & Associates Ltd. and those existing, were determined using a level and electronic water level meter. The distance between each well was measured using a hip chain. This

information was used in the calculation of the vector and gradient.

Hydraulic conductivity data is also important for contaminant migration considerations. Although the impurity occurred primarily in the sandy gravel stratum, the hydraulic conductivity, K , could only be obtained using a multi-well drawdown testing technique. That provision was not made for such extensive testing, approximate K values were assumed from grainsize information.

The hydraulic conductivity was determined for the clayey silt material which predominated in the north portion of the site. This information was necessary to estimate migration potential arising from the impurity encountered at the feed tank area. The K value was determined using a falling head, single borehole testing technique. The slug injection falling head test was pioneered by Hvorslev (1951) and is one of the more common methods employed in field hydraulic testing programs. The test involves adding water (slug) instantaneously to the test well, thereby raising the level of the water above the existing static level a distance h_0 measured at time $t=0$. The change in head is noted over time, where h_t is designated as the height of the slug at any given time, t . The data is then collated and the hydraulic conductivity is estimated.

Water samples were retrieved from the test wells installed at TH#2-95 and TH#14-95. A third water sample was retrieved at the existing well (without house) located near B8. Prior to sampling, the wells were purged of standing water with an electric pump to ensure a representative, sediment-free sample could be retrieved from the aquifer. The samples were retrieved using a PVC bailer which was cleaned and rinsed thoroughly between sampling locations. All water samples were stored in air tight containers with little or no headspace and maintained at, or below, 4°C .

Following hydraulic testing and sampling, a level run was then conducted to determine the elevation of each test hole and of relevant test pit locations. This information was necessary to produce hydrogeologic cross sectional drawings and to make interpolations of soil strata between test holes.

2.3 Laboratory Program

The laboratory program was a significant component of this evaluation and consisted of both Physical and Chemical analyses.

a) Physical Laboratory Program

In order to confirm the visual logs taken during the field work program, a detailed laboratory analysis was conducted on selected samples.

All samples retrieved were tested for moisture content (ASTM D2216) and for grain size analysis (ASTM D422). For fine grained soils, the hydrometer analysis was applied to selected samples in order to determine the relative quantity of sand, silt, and clay occurring in the soil.

The laboratory results are necessary to provide information on the physical characteristics of the soil so as to intimate probable migration routes, porosity, hydraulic conductivity, and like considerations.

b) Chemical Laboratory Program

Prior to initiating the chemical testing program, screening tests were performed at our laboratory in Whitehorse. For hydrocarbon considerations, portions of the soil samples were heated and analyzed using a GasTech Tracetehtor vapour extraction unit. For PCB testing, the Envirogard PCB test kit was used to analyze soil samples for a sensitivity range of 5 ppm. The kit uses an enzyme immunoassay technique for the detection of a range of polychlorinated biphenyls in soil. Details of the methodology used in this screening test are provided in Appendix "D".

Once screening tests were completed, selected samples were sent to ASL Laboratories in Vancouver for chemical analyses. The primary objectives of the laboratory program were to confirm type and concentration of the impurities which were identified from screening tests and to satisfy the testing requirements as outlined in the proposal call. The methodology employed in each of the various chemical analysis are provided in the ASL Laboratories report submission.

That this study involves the evaluation of an abandoned oil refinery, the laboratory

program was biased toward hydrocarbon analyses. Examples include actual hydrocarbon indicator tests such as total extractable hydrocarbons (TEH) and oil and grease, as well as tests for hydrocarbon components such as volatile organic compounds (BTEX) and polycyclic aromatic hydrocarbons (PAH).

Prior to initiating testing, consideration was given to the type of analysis which would be most suited to the type of impurity which was present in soil or water. Each specific chemical test is successful in identifying carbon constituents within a certain range. The two most relevant tests for the type of hydrocarbons encountered at this site were chosen to be: 1) the TEH analysis for mid range products (C_7 to C_{30}) such as diesel and 2) the oil and grease analysis for heavier end hydrocarbons ($>C_{18}$). Following the test pit program, it was evident that the impurities were characteristic of mid-range products. Therefore, the laboratory analyses employed following the drilling program focussed on the TEH test.

3.0 RESULTS OF STUDY

This chapter will present the information obtained from the work program described above. Briefly, a description of the refinery facility and site conditions will be provided along with details of the subsurface soil and groundwater trends. Finally, all relevant data with respect to contamination encountered at the study area will be presented.

3.1 Description of Refinery Facility

In order to estimate probable contaminant source locations, a review of the refinery facility operations was deemed necessary. The refinery components are displayed on Figure 1 on Drawing No.1, enclosed. Also provided is a panoramic view of the refinery infrastructure displayed as Photo 1 in Appendix "A".

As mentioned, the refinery was designed primarily to produce pitch which was to be used in paving the Alaska Highway. The other main hydrocarbon product was to be diesel fuel. The design plans also show a holding tank for bunker, a low grade fuel used for marine vessels.

The crude oil source is unknown although it is believed that it originated outside of Yukon and was delivered to the site via trucks. It has been suggested that the oil originated from the Haines-Fairbanks pipeline, however, this pipeline transported refined products such as aviation fuel and diesel. The canol pipeline and associated Whitehorse refinery were operational only during the war effort and were decommissioned well before the Haines Junction facility was established.

Once the crude oil arrived via truck, it was weighed at the scale located at 'P'. It was then pumped to the Feed Tank at 'A' via the load rack area shown as 'O'. The movement of hydrocarbons throughout the facility was accomplished using a network of above ground pipes which joined all aspects of the infrastructure. In order to maintain an adequate temperature of the hydrocarbons, each pipe was adjacent to, and insulated with, a pipe containing hot water. The water was extracted from the well located at B8 and transported underground along 8 to eventually reach the boiler building for heating purposes. The movement of all hydrocarbons and water was powered by the pumphouse at 'I'.

The refinement process itself involved heating the crude oil in the heater building at 'M' until volatilization of desired components was realized. The distillation of the various hydrocarbon forms occurred in the Separator Column at 'L' where it was then placed through the Condenser Unit and Cooling Fans at K, and J, respectively. The final product was then moved to its respective holding tank as shown on Figure 1. It is believed that the disposal pit located west of the infrastructure was used to place refuse oil products via an underground pipe leading from the pumphouse.

The underground storage tanks which were shown on the original design drawings were not encountered during the test pit programs. Two large excavations were made in the area of the suspected buried tanks, however, neither tanks nor signs of disturbed soil were noted.

3.2 Site Conditions

The site conditions were determined following the initial surveys made at the study area. Namely, the aerial photo review provided initial evidence of topography, surface water, and vegetative cover in the surrounding area of the site. Also, the environmental survey conducted at the refinery site provided details of conditions which may be related to environmental considerations.

The site is located on Hume Street approximately 1.2 kilometres east of the Alaska Highway in the Village of Haines Junction. The relative location of the site is shown on Figure Five in Appendix "A". This illustration consists of the aerial photo and depicts several features of the study area. Following a review of the photos, the general depositional character of the area consists of three main zones. The Dezadeash River is within a fluvial, channelled deposit which extends north to the limit of the most recent floodplain, as shown. North of this area is an inactive colluvium deposit which occurs up to the limit of the historic floodplain. North of this area, there is a pronounced raise in elevation where a subdued morainal deposit predominates. From this review, it appears that the refinery site falls within the colluvium deposit area and is historically linked with the floodplain of the Dezadeash River.

The site itself is relatively flat with a slight incline to the north. Several cutbanks have been made in the north portion of the site to facilitate placement of

infrastructure components. Drainage is to the south toward Hume Street. Vegetation consisted of immature poplar and willow within the refinery area itself and mature spruce and poplar along the northern periphery.

The refinery infrastructure remained relatively intact at the time of the initial environmental survey. The various buildings had suffered vandalism with much of the equipment damaged or removed. The overhead piping had been severed in a few locations throughout the network. Three of the nine original tanks (shown as 'E' on Figure 1) had been previously removed. The remaining six tanks were empty and open at the main flange connection (diameter of opening approximately 0.8-1.0 metres).

There were two underground pipes utilized at the facility. These were identified either from our review of the design plans or during the test pit program. The pipe leading from the pumphouse to the disposal pit is exposed at the entrance to the pit and is open at the ground surface. The second underground pipe enters the subsurface at 2 metres north, 2 metres east of E8. In uncovering this pipe, it is evident that it leads south toward the existing wells located near B8. The well (without house) was noticed near B8 upon closer inspection of the area.

Several notes which were taken as part of the environmental survey component of the work program are provided in Table One in Appendix A. An example includes tar staining around the south pitch tank and near TP#3-94. Also, several 45 gallon drums were encountered in various locations throughout the study area. One of the drums had a DOW Chemical insignia with warning label printed on the side. Upon contacting DOW, they could not provide details with respect to its previous contents. Based on the information contained on the drum label, they did speculate that it may have been a glycol formulation. Both soil and water samples retrieved from this area were tested for glycols, however, no such impurities were present at detectable levels.

3.3 Subsurface Soil Conditions

The soil conditions throughout the study area were determined following the detailed test pit and drilling programs. The locations of all test pits and test holes are shown on Figure 1 on Drawing No.1, enclosed. Details of soil conditions for each test pit

and test hole are shown on the individual logs provided in Appendix B and Appendix C, respectively.

Each soil log contains the following information:

- i) soil description for each stratum encountered with Unified Soils Classification,
- ii) depths at which changes in soil stratigraphy occurs,
- iii) the depth at which samples were retrieved,
- iv) physical laboratory results,
- v) chemical test results and notes of impurities,
- vi) approximate static water level, and
- vii) well installation information

The test pit and test hole data was collated and the following trends in soil stratigraphy were noted. The study area seemed to be relatively consistent in its soil composition with a surficial layer of organic rich silt and gravel to approximately 0.2 metres. This was underlain by a dense till material which varied from a sandy silt to a silty sand and occurred to an average depth of approximately 3.0 metres. There was a distinctive change to a sandy gravel material which was clean, loose, and water bearing. The thickness of the gravel stratum was largest in the south and west portions of the study area and decreased steadily toward the northeast. For example, the gravel stratum was approximately 2 metres thick at TH#4-95 and not present within a 6.0 metre depth at TP#10-94.

Below the gravel material there occurred a dense sandy silt, some clay stratum. This material was stiff, plastic, and did not appear to be water bearing. This material occurred to the maximum depth of 12 metres which TH#18-95 advanced.

Refer to the hydrogeologic cross-sections provided on Drawing No.1 for a typical profile illustration of the subsurface soil stratigraphy.

In order to confirm the soil classifications made during the field work, physical tests were conducted on selected soil samples. Grain size analysis results are provided in the Appendix following the soils log in which that particular sample derived. In order to determine the relative quantity of silt and clay which represented total fines content, hydrometer analysis were performed on certain samples. This test was

performed to define the characteristics of the silt stratum underlying the gravel stratum so as to intimate vertical migration of impurities into this layer. The material has a very high fines content with approximately 20 to 25 percent clay as determined from the hydrometer analysis. The falling head slug injection test was conducted within this stratum to estimate hydraulic conductivity. The hydraulic conductivity was determined to be approximately 2×10^{-6} cm/sec to 9×10^{-6} cm/sec. From grain size data and hydraulic conductivity data, it appears that the deep sandy silt and clay stratum will serve as an impermeable boundary through which contamination would be restrained. Further discussions regarding contaminant presence will be discussed in following sections.

3.4 Groundwater Conditions

Free water was noted in the loose sandy gravel stratum throughout the study area. The approximate static water level in each test pit and test hole is shown on the individual soils logs. The average depth to the static water level was approximately 3.2 metres below ground surface. As mentioned, the underlying dense sandy silt and clay material was not perceived to be water bearing. It is believed that water occurring within the gravel stratum is perched and does not represent the actual groundwater table. With the silt and clay layer beginning at an average depth of 4.8 metres, the perched aquifer appears to be approximately 1.6 metres in thickness. However, the aquifer occurs in the south portion of the site where the gravel stratum was encountered.

The groundwater vector was determined to have a bearing of 226° from north. The vector was calculated using the existing well (without house) and the installed wells at TH#14-95 and TH#2-95. This groundwater direction is specific to the area specified since perched conditions can have localized directions.

The hydraulic gradient was determined to be 4.7×10^{-3} , again using the water elevations taken at the above mentioned wells. This information is again specific to the location and date at which the water levels were taken as the rate of change of hydraulic head can vary both spatially and temporally. The gradient can be used to intimate the velocity of flow for the aquifer. With assumed values for hydraulic conductivity and effective porosity, the volumetric flow rate is estimated at a range of between 2×10^{-5} m/sec to 5×10^{-6} m/sec.

From the above review of groundwater considerations, it appears that the aquifer is perched, has a bearing of 226° from north, and is relatively slow moving with a volumetric flow rate of approximately 1×10^{-6} m/sec.

3.5 Contamination Considerations

The previous discussions have been focused on the actual soil and groundwater conditions encountered at the study area. This section will consider the extent of contamination which was encountered during the work program. Specifically, it was the objective of the environmental evaluation to make the following determinations with respect to contamination:

- i) type of impurity and concentration,
- ii) spatial and vertical orientation in the subsurface,
- iii) source of the impurity,
- iv) history of migration, and
- v) possible future migration.

Following initial surveys, there were several locations identified with visible impurities on the surface. This included thick, viscous tar which, due to its fluid-mechanical properties, remained at the surface and did not migrate into the relatively impermeable glacial till soil. These tar covered areas were concentrated near the south portion of the pitch tank, extending along the surface to the E8 area. These surface impurities were not located on Figure 1 simply because they are visually detectable and not extensive.

There were four areas where contaminants were encountered in the subsurface following the extensive test pit and drilling programs. Each of the four areas are depicted as shaded areas on the plan map in Figure 1. These areas have been interpolated between test pit and test hole data and therefore are not considered exact. Hydrogeologic cross-sections have been provided for two specific areas where impurities have been encountered and are shown in Figure 2 and 3. It should be understood that the areas shown for contaminant presence are considered conservative in that the outward boundaries of impurities was given. Further, the impurity occurs at the concentration shown and does not represent pure phase hydrocarbons. Rather, hydrocarbons exist for the most part in small quantities in emulsion within water, or in isolated pore spaces.

The chemical laboratory program was necessary to verify the concentration of impurities within soil and water samples. It was also useful in determining the type of impurity since different types of hydrocarbons were produced at this refinery. The total extractable hydrocarbon analysis is provided with a 'Hydrocarbon Distribution Report' (HDR) which displays the range of carbon constituents that are present in the impurity. With this information, one can intimate the type of impurity based on known carbon range data from different hydrocarbons. For instance, diesel fuel typically is composed of carbon constituents ranging from C₉ to C₁₈ (refer to the HDR for diesel fuel in ASL report in Appendix "B" or Figure 5 on page D1 in Appendix "D"). The majority of the soil and water samples analyzed for TEH had carbon constituents in this range and thus the impurity was characterized as a diesel fuel in such cases.

In order to give each of the four identified areas individual attention with respect to the contaminant characteristics, they are presented separately below.

a) Disposal Pit Area

As mentioned, the disposal pit area was utilized to dump refuse products from the refinery facility. As such, a variety of hydrocarbons could have been placed here. The source or entry point of contaminants is deemed to be the outlet pipe near F5 (as shown on Photo #5). The orientation of the impurity is shown on the hydrogeologic cross section shown on Figure Two. It is believed that the impurity occurs in the gravel stratum primarily. The overlying silt layer appears to be contaminated in the immediate area of the outlet pipe.

In reviewing the HDR's for the samples retained at or near the disposal pit, it appears that the impurity resembles a diesel fuel. The concentrations of the impurity are greatest near the outlet pipe and decrease with distance from the pipe.

The lateral orientation of the plume is depicted on Figure 1. The impurity has travelled a distance of approximately 40 metres over its 25 to 35 year history in the subsurface. The direction of travel appears to be similar to that of groundwater flow, suggesting that the migration is controlled by the perched aquifer. From the estimates of the volumetric flow rate described in Section 3.4, water would flow through the aquifer a distance of 40 metres in approximately 30 to 100 days. This is

markedly faster than the rate at which the contaminant has migrated.

The slow rate of contaminant migration may be explained by the concept of relative permeability which occurs in multi-fluid systems of this nature. There is a reduction in the intrinsic permeability when two or more liquids are present in the system. The intrinsic permeability is based, among other things, on the relative saturation of each fluid. The diesel was not present in large quantities with no pure phase oil table encountered during the test pit program. With TP#16-94 left open for two hours, only a slight film of hydrocarbons was noted on the water surface. For a coarse grained gravel with little displacement pressure necessary for hydrocarbons to flow into the open test pit, it can be surmised that no appreciable oil table was present. Therefore, there is most likely two or three phase flow with diesel, water, and air occupying the available pour space. At finite saturations, the relative permeability of the non-wetting fluid (diesel) will approach zero. That is, some quantity of diesel fluid in the pore system cannot move below some saturation threshold, known as residual saturation. In the case of the plume occurring near the disposal pit, the concentration of diesel appears to be at residual saturation where it is not capable of flow because at the low levels of saturation, the fluid is not connected across the network of pores. This theory is confirmed by the small area of contaminant presence which has resulted within the gravel stratum despite its 35 year history.

The above discussions relate to the lateral extent of the impurity within the subsurface. For vertical migration considerations, it appears that further movement is unlikely. The impurity is composed of an LNAPL which is restricted vertically by aqueous zones. Although presence was encountered below the apparent static water level, this could be attributed to a fluctuating water table (seasonally or from drawdown during refinery operation) which would cause the impurity to move accordingly. Another possibility is that the impurity could have travelled into the aquifer from the disturbance caused by drilling. Regardless, the dense clay and silt stratum occurring below the gravel layer will restrict further vertical migration. As a check, samples were taken from this silt layer and following chemical testing, it appears that no impurity has migrated into this material.

Future migration of the contaminant plume found near the disposal pit will likely be

restricted to the gravel stratum and in the direction of groundwater flow. However, lateral movement is not envisioned to be extensive due to the low relative saturation level of the diesel. Vertical migration into the lower silt and clay stratum is unlikely. Considering that diesel does not readily partition to the vapour phase, migration into the upper fine sand and silt stratum is also not probable.

b) Feed Tank Area

As discussed, there was a release of hydrocarbons at the flange opening on the feed tank located near J10. As an above ground release, the concentration is greatest near the surface adjacent to the tank and decreases with depth.

There were two Test Pits, #10A-94 and #10B-94, which were excavated in such a way as to map out the lateral extent of impurity in the subsurface. The soil which contains the impurity is within an area radiating 5.0 metres outward from the tank opening. The maximum depth of excavation was 6.0 metres and although the impurity was still present, it was at a relatively low level.

The soil in this area was composed of a dense sandy silt and clay material with no sign of the gravel stratum which was located on the south portion of the site. Further, it is assumed there was no water bearing zone within a 6.0 m depth with an ingress of water into the test pit excavation remaining imperceptible over a two hour period.

The HDR indicates a large range of carbon constituents present in the impurity similar to that of a crude oil. Although appearing bi-nodal in character, it is not believed that two different hydrocarbons had caused the contamination.

The fine grained soil has effectively restrained contaminant migration and thus further migration is not anticipated.

c) Pipe Area

The pipe area refers to the vertical pipe leading into the ground approximately 2 metres north, 3 metres east of E8. The Test Pit #3-94 revealed contamination of the subsurface beginning at approximately 1 metre below the ground and leading into the permeable gravel stratum. The contaminant appears to have migrated approximately

15 metres, again in the general direction of groundwater flow.

As with the plume in the disposal pit area, the migration pattern is groundwater controlled and the impurity is believed to be diesel. The concentrations are lower than those encountered at the disposal pit area and thus the restrictions to lateral movement are again limited as residual saturation occurs.

Vertical migration into the lower dense silt and clay layer has not occurred and is not envisioned in the upper sandy silt and clay stratum.

d) Existing Well (without house) Area

The presence of hydrocarbons in the existing well (without a house) located near B8 necessitated the excavation of Test Pit #5-94. In this test pit, there were hydrocarbons noted at the gravel stratum near the static water level only, with a relatively low concentration.

The drilling program included placing Test Holes at #1-95 and #7-95 to determine if the hydrocarbon present at the pipe area and well area were linked. No hydrocarbons were found in these locations. Also, TH #8-95 was placed to determine whether the impurity had migrated further than where TP #5-94 was located. From these supplementary probes, it appears that extensive lateral migration has not occurred.

The chemical laboratory results indicate that the impurity does not appear to originate from the refinery facility. As shown in the HDR for Sample W12, the carbon constituents range from C_{20} to C_{28} . From Figure 5, the closest similar product appears to be a lubricating oil. It may be feasible for a small amount of oil to have leaked into the well from the pumping machinery or as an accident.

The impurity appears to be present in the immediate area of the well location, and as with the disposal area and pipe area, further migration is not anticipated to be extensive.

The above discussions were centred on the four areas where hydrocarbon contaminants were encountered and where laboratory analyses were performed with

a hydrocarbon bias. The other chemical testing required, namely heavy metals (in water only), persistent pesticides, and PCB's, were also incorporated into the laboratory program. Our initial data search did not reveal any specific source of these substances at the site which may have caused contamination. However, selected samples were analyzed as required.

The PCB screening tests were conducted at our laboratory in Whitehorse. Several samples from the pumphouse and disposal pit areas were analyzed for positive or negative PCB presence at a 5 ppm range. Table Six located on Page D7 in Appendix "D" depicts the samples which were analyzed along with the results. As a summary, negative PCB presence occurred with each sample. Selected samples were analyzed at the chemical laboratory for PCB and other chlorinated hydrocarbons or solvents as part of the VOC scan. The only impurity at detectable levels was found to be 1,1,1,2 tetrachloroethane at a concentration of 8 parts per billion. Specific criteria for this particular compound was not available but typical drinking water levels are at 5 parts per billion for chlorinated solvents of this nature. The low level of the impurity and its isolated occurrence is not evidence in itself for remediation considerations. However, this compound should be incorporated in future groundwater quality monitoring activities.

Both Organochloride pesticide and Organophosphate pesticide scans were conducted on selected soil and water samples. Results indicate that pesticides were not present at detectable levels.

As required, heavy metals occurring in water were also analyzed. A few metals were detected, however, the levels were well below specified drinking water criteria.

4.0 INTERPRETATIONS

In order to develop recommendations, the site conditions must be evaluated according to the environmental risks associated with contaminated soil and groundwater. There are generally two approaches in assessing a contaminated site, either a) by comparing numerical contamination levels with bench marks provided in various environmental criteria, or b) by developing a site specific risk assessment for the site.

Numerical analysis alone is somewhat problematic in that it is insensitive to differences in exposure potential and environmental transport of contaminants. As such, we will provide both the site sensitivity assessment and numerical comparison approaches in evaluating the refinery site.

a) Numerical Comparison Approach

The numerical comparison approach involves contrasting the chemical testing results obtained from this study with established criteria from various sources. There are various Environmental Quality Criteria available and each has its deficiencies with respect to criteria parameters. In order to have a complete data set with which our laboratory results could be compared, we have adopted the following documents in our study (full references available in Chapter 8):

- Canadian Council of Ministers of the Environment, 1991
- Alberta Environmental Protection, 1994
- B.C. Ministry of Environment, 1989
- Phyber, Ibbotson, 1994

The criteria are typically presented for each impurity at varying levels, A, B, or C. These levels refer to various site sensitivity assignments. The most stringent, level A, refers to a residential or recreational land use where the site sensitivity may be quite high. Alternately, level C refers to an industrial or commercial land use and with low sensitivity to exposure.

For convenience, all laboratory results have been collated and presented in Table Three and Table Four in Appendix "D" for the test pit and test hole programs, respectively. Where the laboratory analyses revealed contaminant levels above detection limits, the criteria for those specific impurities were extracted from the

above mentioned sources, as available, and summarized in Table Five on Page D4 in Appendix "D". The values obtained in the laboratory program were then compared with the available criteria from Table Five.

Following this exercise, it appears that the contamination at this site meets the Level A criteria for all impurities other than hydrocarbons. In the case of hydrocarbons, two of the four areas do not meet Level A criteria (disposal pit and feed tank). Laboratory results indicate that only a portion of the soil surrounding the entry point area itself is contaminated at concentrations above Level A. For the case of oil and grease and total petroleum hydrocarbon parameters, it appears that the site generally meets the Level B criteria for hydrocarbon consideration. Exception to this would include the pure phase tar contamination existing near surface at various locations throughout the site. From this, it appears that surface remediation of the near surface tar would be necessary if 'moderate sensitivity' represents the risk assessment evaluation of the refinery site. If it is the intention of the client to remediate the site to the Level A criterion, the soil in the immediate area of the entry points at each contaminant zone will have to be removed.

b) Site Sensitivity Approach

In order to determine which criteria level is most appropriate for this site, a site sensitivity analysis was conducted. This approach involves considering the i) contaminant characteristics, ii) exposure pathways, and iii) receptors, as each relates to contamination at the study area.

i) contaminant characteristics

For the most part, the impurity encountered at this site resembles a diesel fuel. Diesel is composed of many hydrocarbons ranging from C_9 to C_{20} which boil at temperatures from 160°C to 370°C . With a relatively high boiling range, diesel will not readily partition to the vapour phase. The boiling range of diesel also accounts for the relative lack of toxic compounds. For instance, benzene, toluene, ethylbenzene, and xylene (BTEX) are toxic compounds found in gasoline but since they have boiling points below 150°C , they are not found in diesel in appreciable quantities. This was confirmed in the laboratory program where contaminated soil and water samples did not contain BTEX at detectable levels. Further, the TEH analyses for each sample indicates that less than one per cent of hydrocarbons were

present within the $<C_{10}$ range where BTEX compounds are typically found. Similarly, polycyclic aromatic hydrocarbons (PAH's) may occur in diesel in low levels (0 to 0.5%) but those that pose health concerns have boiling temperatures above $370^{\circ}C$ and are thus not present in diesel fuel. The diesel was encountered at the perched aquifer and thus solubility is relatively important. With a very low solubility, the diesel may occur in trace levels which would contribute to taste or smell in water, making it unpalatable.

Other contaminants encountered at this site include a crude oil source near the feed tank, and a tar layer found on the surface near the south pitch tank. The crude oil impurity is composed of a large range of carbon constituents which indicates that BTEX and PAH constituents may occur in such contaminated areas. However, the source at this site occurred at a low concentration and was "weathered" with the majority of lighter end hydrocarbons having volatilized away. Sample P28 was retrieved near surface and adjacent to the feed tank opening and had the highest concentration of hydrocarbons from those samples taken in this area. However, no PAH's occurred in this sample and only 0.1% of hydrocarbons were present in the $<C_{10}$ range, indicating the relative absence of volatiles. As such, it appears that the impurity encountered at the feed tank was at a low concentration and with little evidence of BTEX or PAH presence.

The tar encountered at the surface is composed of heavier end hydrocarbons which indicates a high level of PAH presence. However, the fluid-mechanical properties of this material restrict it from migration into the subsurface and thus it does not pose a threat to soil or groundwater quality.

ii) exposure pathways

Each of the contaminants mentioned above must be considered with respect to the exposure pathways, or to the possibility that the contaminants could migrate where exposure could occur.

The near surface tar is immobile and poses little threat to migration. The near surface presence indicates exposure to the air and to surface water runoff.

The crude source encountered near the pitch tank is not considered to be

susceptible to further migration due to the retention properties of the fine grained soils encountered there. Further, there are no permeable gravel stratum or groundwater presence within the depth where the impurity was encountered. Exposure would be limited to vapour presence and only if the subsurface soil was disturbed.

The diesel presence (and, to a lesser extent, the impurity encountered at the existing well) occurs within the permeable gravel stratum approximately 3 metres below the ground surface. The concentrations are small enough that further migration along the perched water table is unlikely. However, trace levels may travel in emulsion within the water and migrate throughout the subsurface in a direction estimated at 226° from north. The diesel will remain in this gravel stratum with vertical migration into the underlying and overlying silt layers very unlikely.

iii) receptors

Potential receptors for contaminant intake is related to future land use of this area. Following consultation with Champagne Aishihik First Nations, it appears that future development will be toward light industrial use and not residential or parkland. This land use typically limits the receptor potential.

Vapour inhalation would be only possible if future building developments occur where the near surface impurities are located. This may be avoided by removing the near surface contaminated soil located directly adjacent to the feed tank opening, to the pipe leading into the ground near E8, and to the outlet pipe in the disposal pit.

Receptors to groundwater contamination do not include humans as there is no current or perceived future use of this perched aquifer. Following our initial data search and interview program, water use in the Village of Haines Junction is dominated by the municipal water system. The source originates from a deep artesian aquifer which is located approximately 140 metres below the ground surface as measured from the Dezadeash floodplain elevation (similar to the study area). Also, wells drilled in the Haines Junction area by Fredelana Enterprises tap into groundwater which occurs at a minimum depth of 98 metres. Therefore the impurity located within the gravel stratum will not affect the water source of the Village of Haines Junction.

The water occurring within this gravel stratum could be linked with the Dezadeash River. However, danger to fish and other animals is unlikely due to the low levels present on site and to the relatively non-toxic nature of the impurity. Migration potential to a surface water source is considered low due to the slow rate of transport which has occurred to date.

From the numerical comparison and site sensitivity approaches to evaluating this site, the following conclusions can be made:

- 1) The contaminant presence at this site generally meets the Level B Criteria (exception being the surficial tar deposits) which is acceptable for a site with moderate sensitivity.
- 2) The site is perceived to be of low sensitivity with respect to probable impact of the contaminants.

5.0 RECOMMENDATIONS

As concluded from the previous chapter, the contamination encountered at this site is not considered extensive. However, there were impurities encountered in the subsurface and thus certain considerations should be made with respect to remediation. The following chapter will outline remediation options which may be initiated according to the desired objectives of the client. Possible scenarios for remediation have been identified as follows:

- A) Remediate the site for a moderate to low sensitivity land use (commercial/industrial)
- B) Remediate the site to restrict possible further migration.
- C) Remediate the site to Level A or to meet aesthetic guidelines.

Each of the remediation options are described in detail below.

A. Remediate To Meet Intended Land Use

As intimated earlier, this site does not appear to have large quantities of impurities in the subsurface and the site sensitivity is low with respect to probable impact. In order to develop the study area for future commercial or industrial land use, the following minimum remedial measures should be taken:

- A.1 As per the numerical comparison approach, the impurity which does not meet criteria is the near surface tar occurring in various areas throughout the site. This material has not migrated into the subsurface because of its viscous nature and thus it is visually detectable. The material should be removed from the refinery site if future development is considered.
- A.2 The tar could be placed in a municipal landfill facility following removal from the site. However, if this is not possible, it may be practical to dispose of the material on the north portion of the property where the gravel stratum does not occur in the subsurface soil profile. The tar material should be placed under a cap using the sandy silt and clay till material which is ubiquitous in this area. This will avoid the occurrence of impurities in surface runoff originating from the disposal area.

- A.3 In those areas where an impurity had entered the subsurface, hydrocarbon odours may be noticed if the near surface soil is disturbed. Future buildings which include provision for a crawl space or basement (as apposed to a slab-on-grade) should not be placed in these areas. The specific areas include i) at the vertical pipe near E8, and ii) at the feed tank opening near J8. If this possibility is of concern, recommendation C.1 should be implemented.
- A.4 It may be prudent to establish permanent groundwater monitoring wells in strategic locations throughout this study area. For legal purposes, it is advised to establish these wells at the southwest corners of Lots 38 and 39 which comprise the study area. This will provide current baseline water quality data and also facilitate future groundwater monitoring. This information may be required to repudiate possible future claims that groundwater contamination encountered at adjacent properties had originated at this site.

Note that the more extensive remediation options described below also include the recommendations presented in option A.

B. Remediate To Restrict Future Migration

There were hydrocarbons resembling diesel fuel located within the gravel stratum at the disposal pit area and at the vertical pipe area E8. Following our analysis, it appears that the impurity occurs at or below residual concentrations where migration potential is limited. However, trace levels may travel in emulsion within the aquifer, thereby increasing the area with diesel presence. This may render the water unpalatable with a slight hydrocarbon odour present. If it is the objective of the client to ensure that trace levels of hydrocarbons do not migrate further, the following remedial measures could be taken in the adoption of a containment and isolation approach.

- B.1 In order to isolate the impurity within the subsurface, an engineered wall could be emplaced around the known plume area. This would consist of a low permeability barrier designed to

confine the impurity from groundwater flow. This containment method is easily adaptable to the site conditions because of the existing low permeability sandy silt and clay layer occurring both above and below the gravel stratum. The addition of an engineered wall would effectively confine the impurity in all directions. Further, the gravel stratum is near surface allowing for relatively easy placement of the wall.

- B.2 The wall would surround the known plume area with a distance of 5 metres from the periphery of the impurity. A trench would be prepared with a minimum width of 0.5 metres and a depth which would provide a 0.5 metre extension into the underlying sandy silt and clay stratum.
- B.3 Once the trench has been prepared, the low permeability barrier would be emplaced utilizing either a bentonite slurry alone or in conjunction with a native material taken from a borrow source on site. The hydrometer and grain size analyses performed on the near surface sandy silt and clay material indicates that low permeability characteristics could be expected from this material.
- B.4 Placement of the native material above the static water level would coincide with some compaction effort to ensure that the low permeability nature of the material and the overall integrity of the wall are maintained.
- B.5 A two-pass approach should be considered in the trench excavation process. This would initially include excavating all overlying silt material up to the depth of the gravel stratum. The second pass for the excavation would involve removing the gravel material as required. In this way, the overlying silt layer removed in the initial excavation pass could be isolated and re-used in the top portion of the wall construction.

The advantages of this containment approach is that the subsurface soil conditions favour the placement and the overall success of such a system. This approach will also restrict the possibility of further migration which could otherwise create more difficult conditions for remediation in the future, if such measures were considered.

C. Remediate To Aesthetic Guidelines

The above remediation options do not include the removal of the diesel impurity which has travelled within the permeable gravel stratum at the disposal pit and vertical pipe areas. Further, they do not include provision for the removal of soil with hydrocarbon odours present as with the feed tank area. It may be the objective of the client to remove impurities which pose aesthetic concerns such as a hydrocarbon sheen or odour occurring on soil or groundwater within contaminant areas. In order to satisfy such remediation objectives, both an excavation program and a pumping program would have to be initiated. The remediation program would involve removing all near surface soil with hydrocarbon presence in the three contaminant areas described above. This would consist primarily of the fine grained soils located above the gravel stratum which retained much of the impurities. The pumping program would involve placing wells at various locations throughout the plume areas to facilitate pumping the hydrocarbons and water from the perched aquifer. Details of these programs are provided below.

- C.1 The excavation program would require the removal of the soil with contamination at three areas throughout the site. A summary of the location and the quantity of contaminated soil is described in Table Seven in Appendix "D". The disposal of this soil could be performed as per the recommendation A.2 described previously. In conducting this recommendation, the site would effectively meet a Level A criteria.
- C.2 The pumping program would involve placing several wells throughout the plume areas and pumping the water and hydrocarbons from the gravel stratum. The orientation of the wells would be chosen according to several factors, including the depth of the aquifer, the hydraulic conductivity of the gravel stratum, the direction of groundwater flow, and the shape of the plume. Although a two-well, two-pump system may often be applied for LNAPL product recovery, such a procedure is not deemed necessary due to the lack of a pure phase oil table. Rather,

necessary due to the lack of a pure phase oil table. Rather, small concentrations of diesel occur in isolated pore spaces or in emulsion within the aquifer. The gravel stratum should have little displacement pressure which is necessary for successful LNAPL removal. Further, diesel does not readily absorb to sand or gravel particles. As such, this pumping technique may be successful in removing a portion of the impurity.

- C.3 The liquid pumped from the ground could be placed in one of the large storage tanks on site. Natural separation of the two phases may occur within the tank, allowing for LNAPL recovery utilizing an absorbent material.
- C.4 Following water quality testing to ensure that sufficient aesthetic guidelines have been achieved, the water could be placed in the subsurface.

The pumping program described above is provided for illustrative purposes and requires further design prior to initialization. This system, however, may not provide sufficient LNAPL recovery given the low concentrations present and the difficulty in achieving aesthetic criteria. With the low sensitivity of this site, cost-benefit considerations should be made prior to pursuing this remediation option.

6.0 CONCLUSIONS

J.R. Paine & Associates Ltd. has been successful in satisfying the required objectives of the subject project. The detailed work program involved performing initial surveys, conducting a test pit and a drilling program, and performing hydraulic tests. Both soil and groundwater samples were analyzed for physical and chemical properties to determine the characteristics of the soil stratigraphy and of the contaminants.

It appears from the work program that there are four areas where impurities have entered the subsurface. The extent of contaminant migration has been characterized by the presence or absence of the gravel stratum. This gravel layer has permitted some lateral migration throughout the subsurface due to the conductive nature of the material and to the presence of a perched aquifer. Where the gravel does not occur, the high retention capabilities of the fine grained soil has effectively confined the impurity.

In order to develop recommendations for remediation, our firm analyzed the data according to both a numerical comparison approach and a site sensitivity approach. The impurities occur at low concentrations which would be acceptable for a moderate sensitivity land use development. The site was identified as having a low sensitivity with respect to probable impact.

From this assessment, it appears that little remediation effort is required prior to development based on current environmental criteria. However, three different remediation options have been provided according to which objective for remediation the client wishes to pursue.

Remediation Option A includes the measures which should be taken if the site is developed according to a commercial or industrial land use. This appears to be the intended future land use of the study area and therefore this option seems to be the most appropriate.

The impurity which has occurred within the gravel stratum may be subject to migration along the perched aquifer. However, our analysis indicates that further

movement of the diesel is unlikely. This is based on the slow rate of migration which has occurred over its 35 year history in the subsurface. Further, the impurity occurs at low concentrations where residual saturation exists and where additional migration is not probable. It appears that migration beyond the existing area would be limited to trace levels of diesel travelling in emulsion within the aquifer. If the client wishes to limit the possibility of such migration, Remediation Option B should be considered.

The impurity which occurs within the gravel stratum is present at low concentrations which may render the water unpalatable. If the client wishes to clean the soil and water to aesthetic guidelines, Remediation Option C was described for illustrative purposes. That this aquifer has no present or perceived future use, and that diesel is relatively non-toxic as compared to other hydrocarbons, this option should be considered only after cost-benefit considerations have been made.

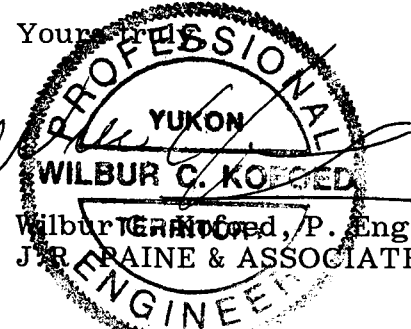
7.0 CLOSURE

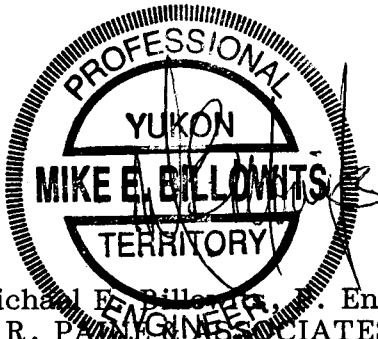
This report has been prepared for the exclusive and confidential use of the Department of Indian Affairs and Northern Development, Action On Waste Program. It applies only to the environmental assessment performed on the study area described above.

The subsurface soil and groundwater conditions are known at the test pit and test hole locations only. Further, contaminant presence is known only in those test pit and test hole locations where qualitative observations have been made and where laboratory verification has been conducted. All stratigraphic and hydrogeologic sections have been interpolated from test pit and test hole logs. As such, actual stratigraphy and hydrogeology between test pit and test hole locations may vary from that shown on these drawings. Variations in both geologic conditions and contaminant migration are inherent and thus J.R. Paine & Associates Ltd. does not represent the conditions illustrated as exact.

The recommendations provided herein are based on the subsurface soil conditions encountered during the field work programs, current investigative techniques, and generally accepted engineering practices. Recommendations for remediation are based, in part, on current environmental criteria which may change in time. Specific to the Alberta Environmental Protection, 1994 document, conditional requirements have been established as per the inclusion provided on Page D8 in Appendix "D". It is envisioned that future remediation activities on this site will be undertaken in concert with this conditional requirement. Should other information pertinent to this study become available, the recommendations may be altered or modified in writing by the undersigned.

Yours truly,


Wilbur C. Koop, P. Eng.
J.R. PAINE & ASSOCIATES LTD.
MEB/mf


Mike E. Billonits, P. Eng.
J.R. PAINE & ASSOCIATES LTD.

8.0 REFERENCES

The following references were used in the preparation of this report:

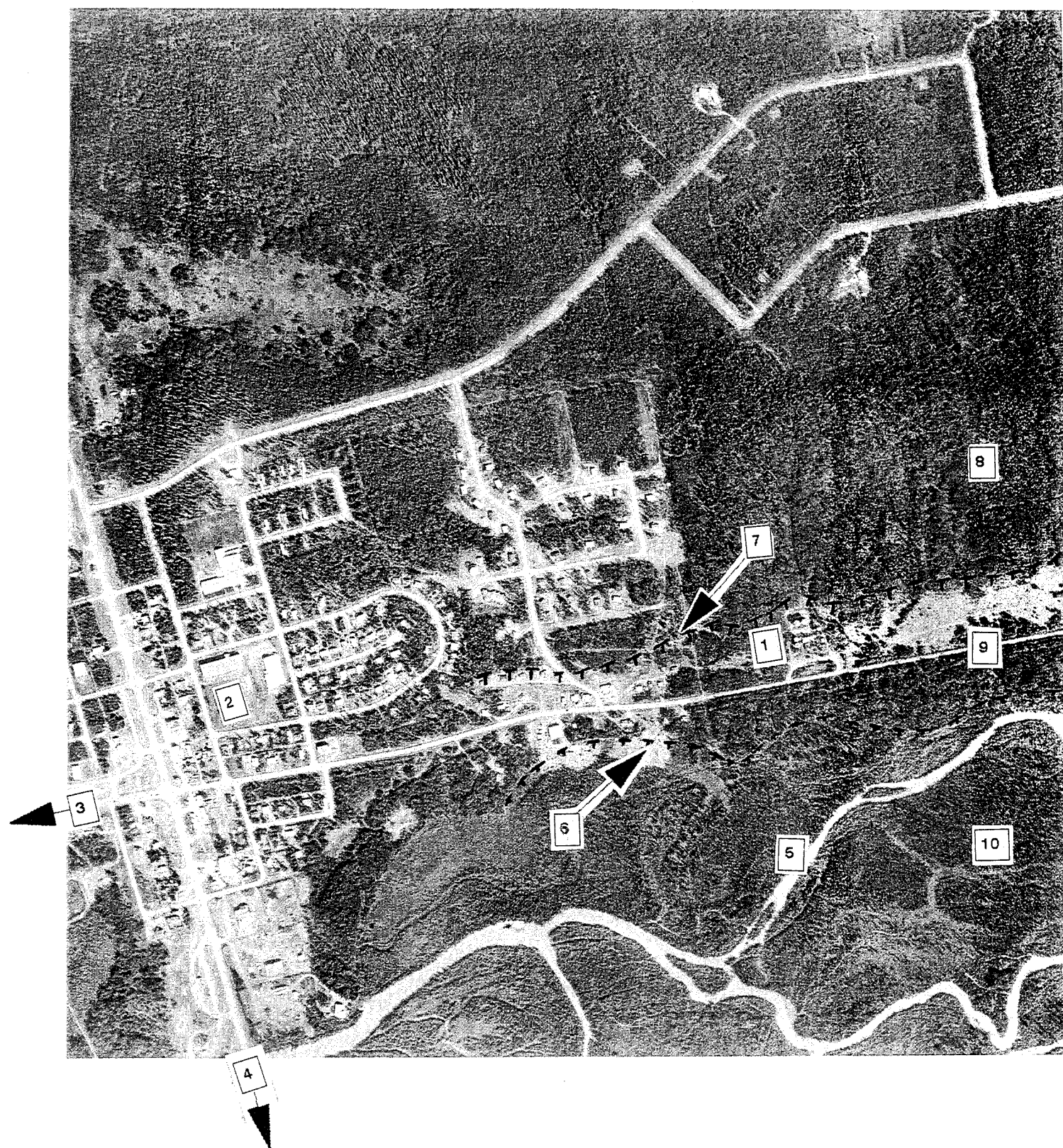
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APPENDIX "A"

Results of Initial Surveys and Data Review

FIGURE FIVE

AERIAL PHOTO DEPICTING FEATURES OF
STUDY AREA



Number	Feature
1	Location of Study Area
2	Village of Haines Junction
3	to Fairbanks, Ak
4	to Haines, Ak
5	Dezadeash River channel
6	Limit of Most Recent Active Floodplain
7	Limit of Historic Floodplain Embankment
8	Subdued Morrainal Deposit (Mm)
9	Inactive Colluvium Deposit (Ci)
10	Fluvial, Channelled Deposit (F-E)

 J. R. Paine & Associates Ltd. CONSULTING AND TESTING ENGINEERS	
HAINES JUNCTION OIL REFINERY ASSESSMENT	
Dwn. By MEB	Date 1995/03/03
Scale 1:10000	Plate No. 1 of 1

PHOTO SHEET SUMMARY

Photo No.	Description
#1	•Panoramic view of site; looking south from atop of tank at K10
#2	•Retrieving surface sample from load rack area at D9
#3	•Typical near surface tar layer located at TP#3-94
#4	•Well without house uncovered at TP#5-94
#5	•TP#16-94 located near F5, note outlet pipe leading into disposal pit (ends at surface)
#6	•TP#3-94 located adjacent to pipe leading into ground; at 1.2 metre depth, pipe begins to lead south



Photo #1



Photo #2



Photo #3



Photo #4



Photo #5

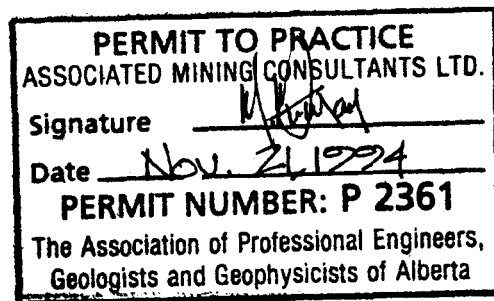


Photo #6

**TOTAL FIELD MAGNETOMETER SURVEY
HAINES JUNCTION REFINERY
Haines Junction, Yukon**

Submitted to:

J.R. PAINE & ASSOCIATES LTD.
Whitehorse, Yukon





1401, 910 - 7 Avenue S.W.; Calgary, Alberta, Canada T2P 3N8
Tel: (403) 264-9496 Fax: (403) 269-7640



File: PG30
November 21, 1994

J.R. PAINE & ASSOCIATES LTD.
14 Burns Road
Whitehorse, Yukon
Y1A 4Y9

Attention: Michael Billowits, P.Eng.

Dear Mr. Billowits

Associated Mining Consultants Ltd. (AMCL) is pleased to submit its report entitled:

*Total Field Magnetometer Survey
Haines Junction Refinery
Haines Junction, Yukon*

We wish to express our thanks to J.R. Paine & Associates Ltd. for the opportunity to provide our services in relation to this project, and we hope that we may have further opportunities to be of service in the future.

Respectfully submitted,

ASSOCIATED MINING CONSULTANTS LTD.

A handwritten signature in black ink, appearing to read 'Mark Bowman'.

Mark Bowman, P.Geoph.
Project Geophysicist

MB/mlh
attachment

1.0 INTRODUCTION

This report presents the results of a total field magnetometer survey undertaken at the Haines Junction Refinery in Haines Junction, Yukon.

The objective of the survey was to map variations in magnetic response to ascertain the presence of underground storage tanks, pipelines and scrap metal at the site.

2.0 METHODOLOGY

Magnetometers measure the intensity of the geomagnetic field. The geomagnetic field is comprised of two main parts:

- The earth's magnetic field. The origin of this field is apparently a system of electric currents originating in the earth's fluid conductive core. The resulting magnetic field resembles that of a large bar magnet.
- Local magnetic anomalies in the relatively near surface. These consist of variations caused by geologic features such as magnetic rocks and by man-made magnetic objects.

Over relatively small areas, magnetic geological features contribute minimally to the geomagnetic field and local magnetic anomalies are generally entirely due to above surface magnetic/electromagnetic sources and to buried metallic objects.

A 10 metre by 10 meter survey grid was established at the site by J.R. Paine & Associates Ltd. personnel. Total magnetic field measurements were recorded at 2.5 metre intervals along lines 5 metres apart. A base station, located adjacent to the survey grid, was repeatedly surveyed at small time intervals to compensate for time dependant diurnal variations in the earth's magnetic field.

The existing refinery infrastructure precluded data acquisition over a significant portion of the survey area.

3.0 RESULTS

Magnetic interference due to existing refinery infrastructure dominates the magnetic response over a significant portion of the survey area. This response was isolated and subtracted from the data, enabling identification of localized magnetic anomalies. The resulting total field magnetometer survey data are presented as a colour contour map illustrating lateral variations in magnetic intensity (Figure 1).

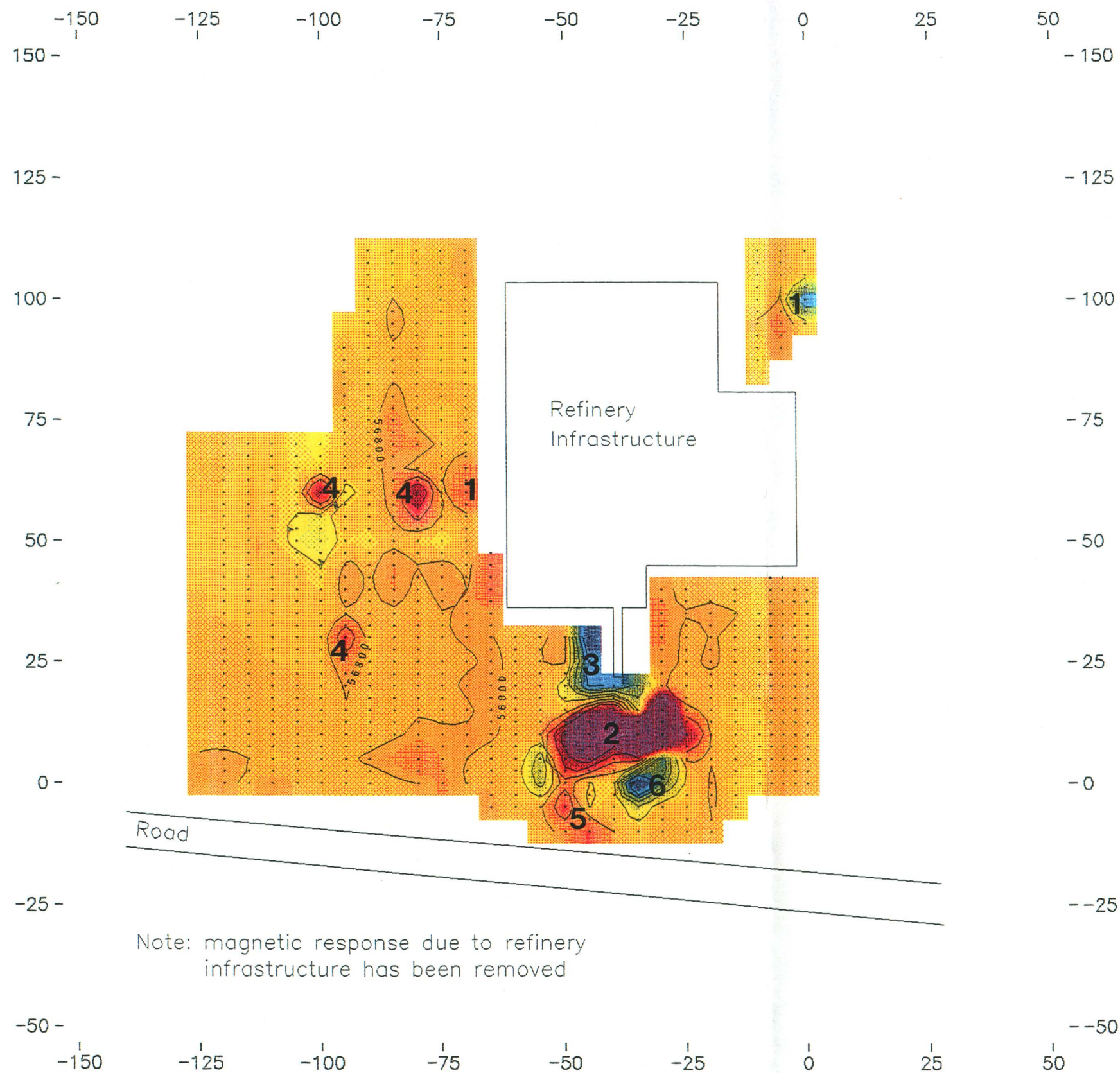
Survey results identify several regions of anomalous magnetic response, most of which may be attributed to features visible at surface as identified in Figure 1.

Two regions of anomalous magnetic response are identified as magnetic anomaly response **Type 1**. It is likely that these responses are due to the proximity of the refinery infrastructure.

Due to the relatively large response to above ground infrastructure in the vicinity of the existing disposal pit, the magnetic survey is inconclusive in the identification of underground pipes extending from existing tanks to the pit.

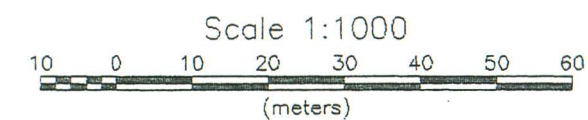
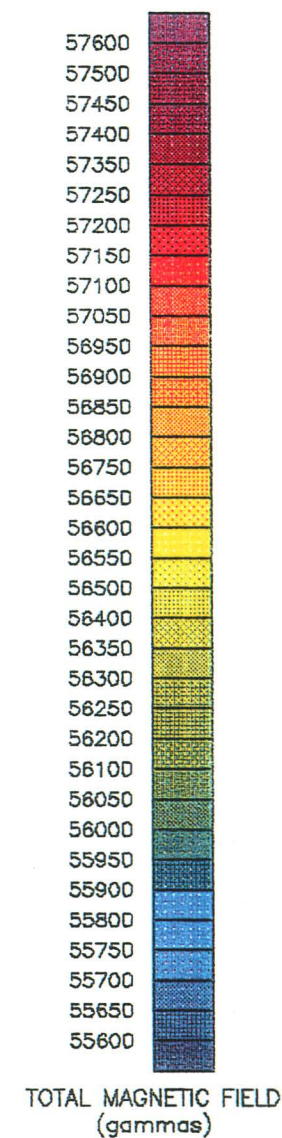
4.0 CONCLUSIONS

All magnetic anomalies identified at the Haines Junction Refinery site may likely be attributed to scrap metal on surface, and to existing refinery infrastructure. No magnetic response due to large underground metallic sources other than those identified in Figure 1 are evident. However, due to the significant magnetic influence of the existing refinery infrastructure, smaller buried metallic objects may remain undetected. Undetected objects may include relatively small diameter underground pipes at depth, and metal drums buried immediately adjacent to above ground metal structures.



MAGNETIC ANOMALIES:

- 1** Source not evident at surface
- 2** Underground scale
- 3** Overhead pipes
- 4** 45 gallon drums on surface
- 5** Scrap metal on surface
- 6** Metal within adjacent building



J R PAINE & ASSOCIATES LTD.

HAINES JUNCTION REFINERY
HAINES JUNCTION, YUKON

TOTAL FIELD MAGNETOMETER SURVEY
MAGNETIC INTENSITY MAP - Figure 1
November, 1994

ASSOCIATED MINING CONSULTANTS LTD. PG-30

TABLE ONE
SUMMARY OF NOTES TAKEN OF ENVIRONMENTAL CONDITIONS
RELATED TO THE SITE 1994/11/09

NO.	DESCRIPTION	SUBSURFACE P R O B E INTENDED (SEE FIG. 1)
1	•200mm O.D. vertical pipe out of ground approximately 900mm, 3m north of A4	XI
2	•Berm running west along Line A starting at Line 4	
3	•Concrete blocks 1m north of Line A, 4m east of Line 2	
4	•3, 45 gal drums and 1 small 5 gal. container gathered near G5. One drum with DOW Chemical insignia with warning	VIII
5	•2m east of G5 are 6, 45 gal drums with oil stains on drums	VIII
6	•2, 45 gal drums located 4m south, 3m east of G4 with oil stains on drums	VIII
7	•6, 45 gal drums 2m west of G3	VIII
8	•Various debris (engine block, sheet metal, 1 - 45 gal drum) located within pit area (F3, F4)	X, IX
9	•2, 45 gal drums at E8	
10	•pipes leading into ground 2m north, 2m east of E8	XVI
11	•Tar staining around south east portion of south pitch tank	XII
12	•Several open pipes near south west corner of pump house	XIII

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13	•3, 45 gal drums with oil stains near H8	VI
14	•Some damaged pipes near H-11	V
15	•45 gal drum at K9	
16	•Cutback into slope approximately 20m east of G13 with refuse (drums in pit)	I
17	•Pit excavated and backfilled -suspected on-site sewage disposal (privy)	III

TABLE TWO
DETAILS OF SURFACE SAMPLING PROGRAM

SAMPLE NO.	LOCATION	SAMPLE DESCRIP.	INSITU VAPOUR READING (PPM)	LABORATORY RESULT (PPM) (TOTAL EXTRACTABLE HYDROCARBONS)	SUB-SURFACE PROBE INTENDED
S1	Along 9 5m north of C	•sandy gravel, GW(possibly fill) •fuel odour	12		XIV
S2	Along 9 5m north of F	•SILTY SANDY GRAVEL •slight fuel odour •thick black pitch in sample	10		XIII
S3	Along 8 6m north of F	•Pea gravel fill material	0		XII
S4	Along F 6m west of 11	•sandy gravel, some silt •see grain size analysis	44	194	
S5	Along F 5m east of 11	•silty sandy •see grain size analysis	13		
S6	3m east of H12	•gravelly sand, coarse graded sand	14		
S7	6m east, 2m north of H10	•gravelly sand, coarse grained sand •slight smell	20		V

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S8	5m west 4m south of of I10	•sandy gravel, loose dry, slight hydro- carbon odour	18		
S9	2m west of J8	•sandy gravel, oil rich •resembles asphalt with oil solid- ifying the soil	26	14100	IV
S10	3m west, 1m south of F5	•sandy silt, dense, moist, frozen •hydrocarbon presence -see grain size analysis	14	1710	IX
S11	2m east of F3	•sandy silt, dense, frozen			X

service

laboratories

ltd.



CHEMICAL ANALYSIS REPORT

Date: November 22, 1994

ASL File No. E5598

Report On: Soil Analysis (SAMPLING PROGRAM)

Report To: **J. R. Paine and Associates Ltd.**
14 Burns Road
Whitehorse, YT
V1A 4Y9

Attention: **Mr. Michael Billowitz**

Received: November 15, 1994

ASL ANALYTICAL SERVICE LABORATORIES LTD.

per:

A handwritten signature in dark ink, appearing to read 'Dawn Gilbert'.

Dawn Gilbert
Supervisor, Trace Organics Lab

A handwritten signature in dark ink, appearing to read 'Joanne Patrick'.

Joanne Patrick, B.Sc.
Project Chemist





RESULTS OF ANALYSIS - Sediment/Soil

File No. E5598

S4

S9

S10

Physical Tests

Moisture %	4.35	1.14	23.0
------------	------	------	------

Extractables

Total Extr Hydrocarbons (C9-40)	194	14100	1710
Total Extr Hydrocarbons (C10-30)	113	11800	1370

Results are expressed as milligrams per dry kilogram except where noted.
< = Less than the detection limit indicated.



METHODOLOGY

File No. E5598

Samples were analyzed by methods acceptable to the appropriate regulatory agency. Outlines of the methodologies utilized are as follows:

Moisture

This analysis is carried out gravimetrically by drying the sample to constant weight at 103 C.

Total Extractable Hydrocarbons in Sediment/Soil

This analysis is carried out in accordance with U.S. EPA Method 3500/8015 (Publ. # SW-846 3rd ed., Washington, DC 20460). This procedure involves hexane/acetone extraction followed by analysis of the extract by capillary column gas chromatography with flame ionization detection.

End of Report

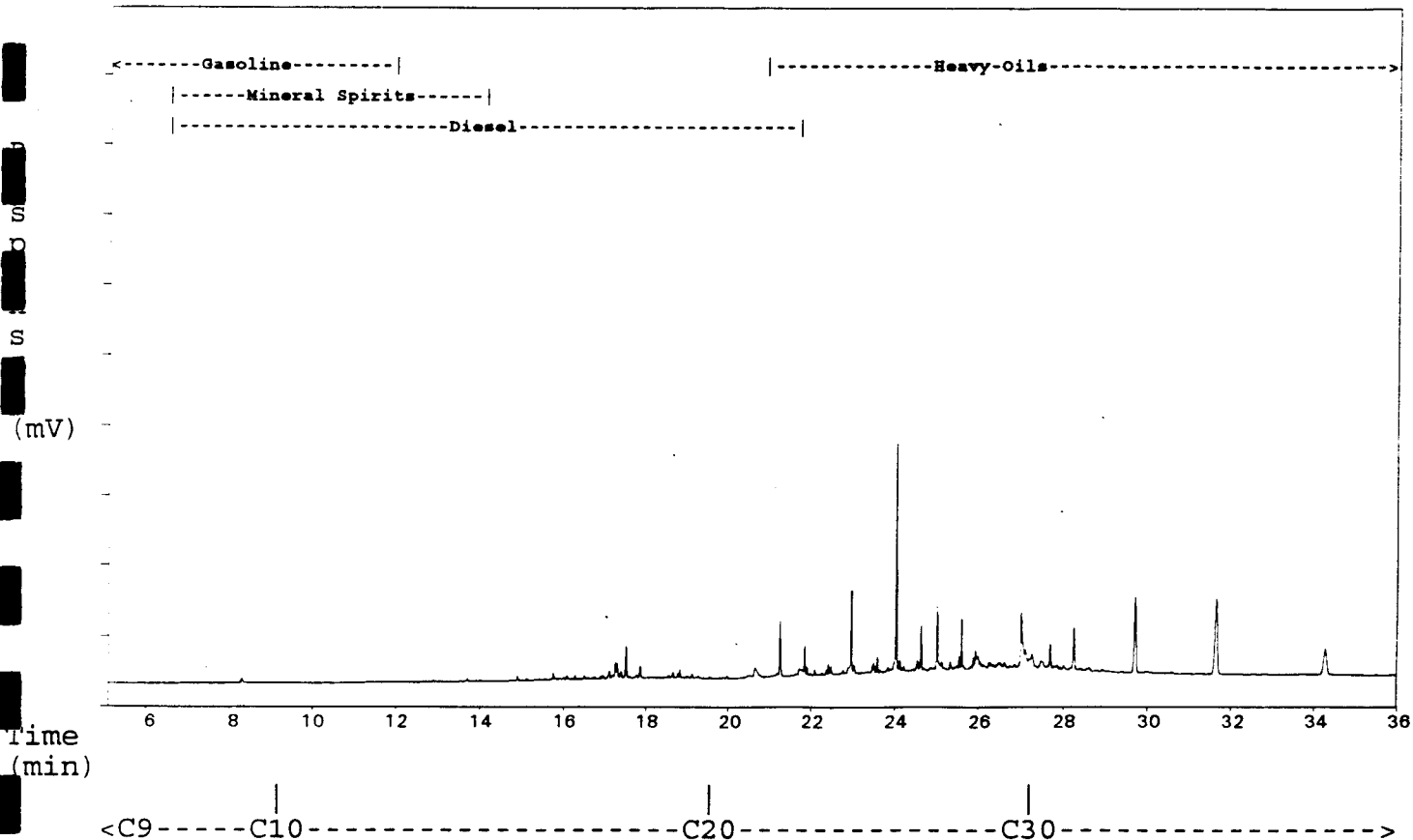
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E5598 1 S4

Sample acquired: NOV 17, 1994 00:37:55

File Name: c:\TEH\TEHNOV16.38R , Sample Name: E5598 1

Sequence file: TEHNOV16



HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.3
Carbon 10 to Carbon 20 (C10-C20)	13.5
Carbon 20 to Carbon 30 (C20-C30)	42.5
Greater than Carbon 30 (>C30)	43.9

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

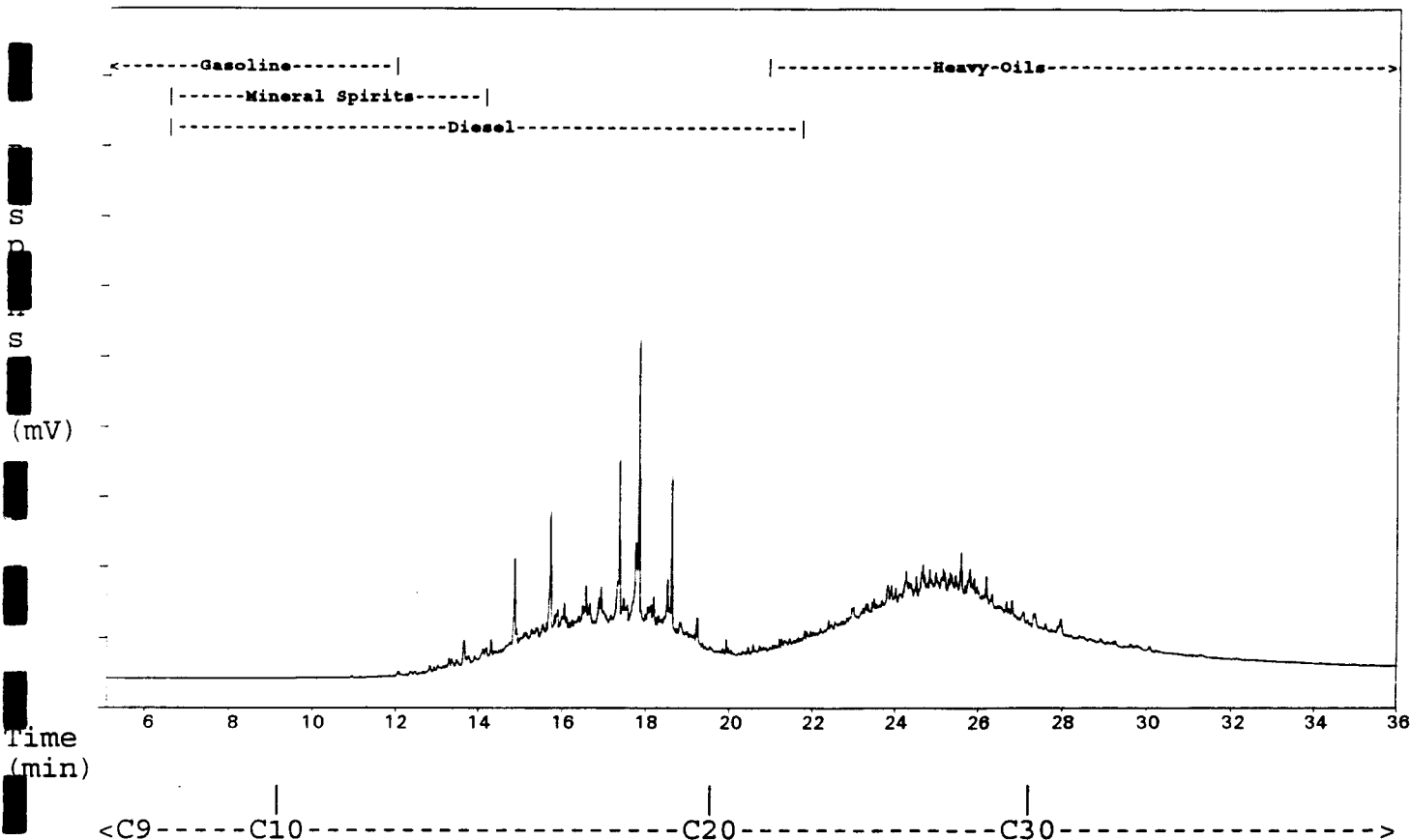
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E5598 2 S9

Sample acquired: NOV 17, 1994 01:24:55

File Name: c:\TEH\TEHNOV16.39R , Sample Name: E5598 2

Sequence file: TEHNOV16



HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.0
Carbon 10 to Carbon 20 (C10-C20)	38.5
Carbon 20 to Carbon 30 (C20-C30)	39.2
Greater than Carbon 30 (>C30)	22.2

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

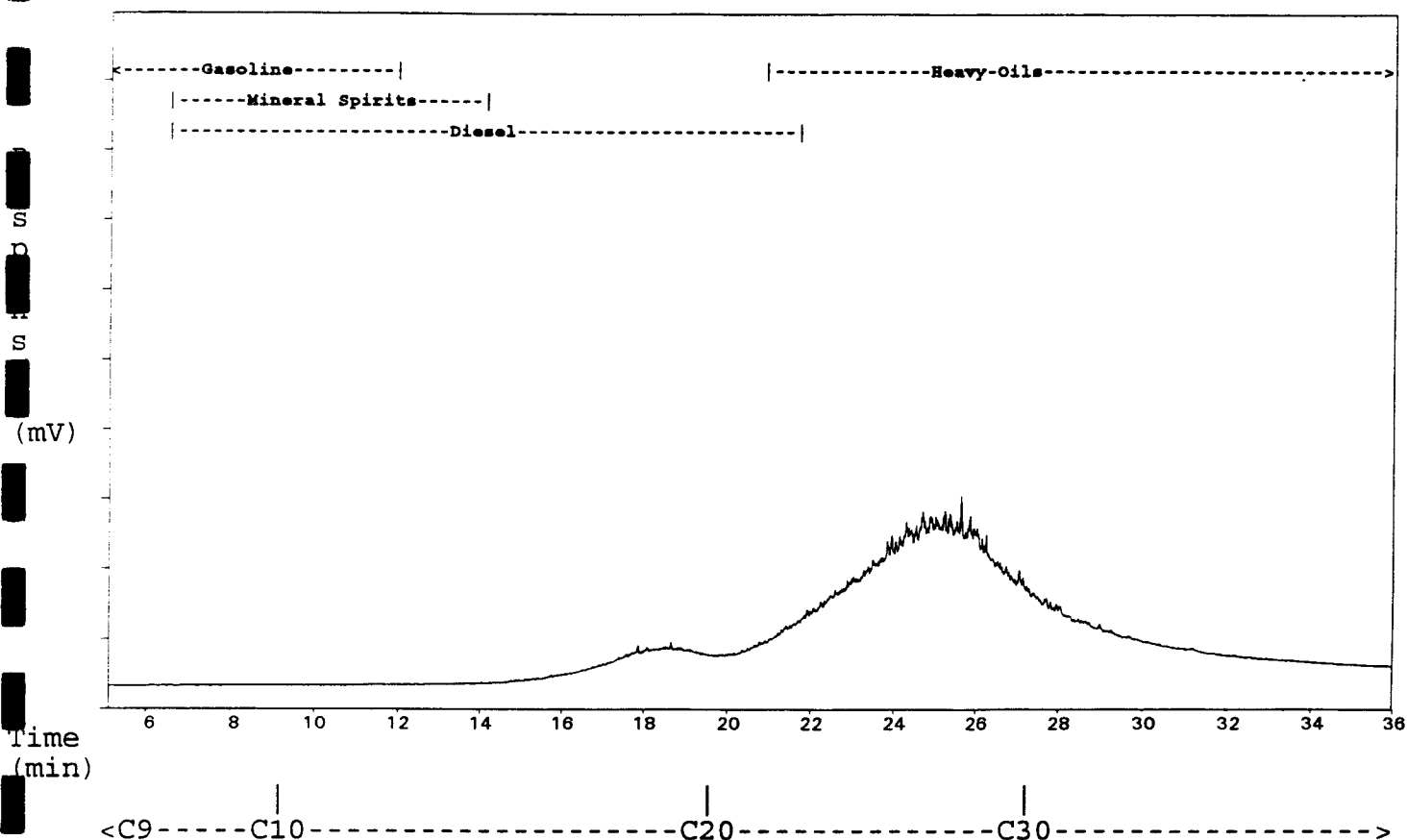
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E5598 3 S10

Sample acquired: NOV 17, 1994 01:24:55

File Name: c:\TEH\TEHNOV16.40R , Sample Name: E5598 3

Sequence file: TEHNOV16



HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)		0.0
Carbon 10 to Carbon 20 (C10-C20)		9.5
Carbon 20 to Carbon 30 (C20-C30)		56.8
Greater than Carbon 30 (>C30)		33.7

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

APPENDIX "B"

Results of Test Pit Program and associated Laboratory Analyses

NOTES ON SOIL CLASSIFICATION

The soil is named after its principal component, and modified by other components as follows:

Presence of Component

greater than 15%
11% to 15%
5% to 10%

Modifier

XXX-ey
some XXX
trace of XXX

Examples

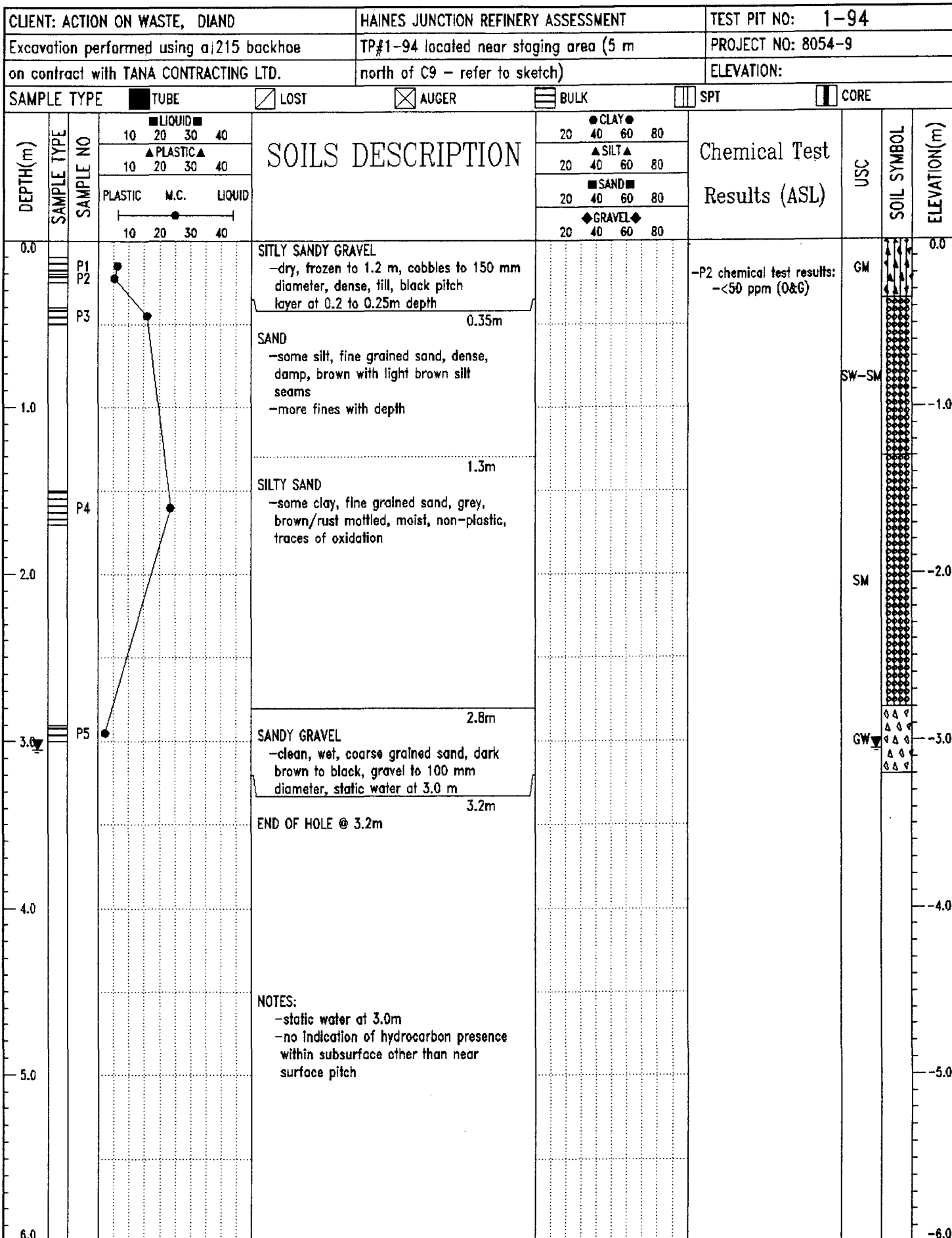
<u>CLAY</u>	<u>SILT</u>	<u>SAND</u>	<u>GRAVEL</u>	
65%	15%	10%	10%	CLAY, some silt, trace of sand, trace of gravel
5%	10%	45%	40%	GRAVELLY SAND, trace of silt, trace of clay
10%	65%	25%	---	SANDY SILT, trace of clay

Also, the USC Classification System is used.

Table 1.1 Unified Soil Classification System (adapted from U.S. Army Corps of Engineers, 1953)

Major division			Group symbol	Typical name	Field identification procedure	Laboratory classification procedure (see Fig. 1.13)				
Coarse-grained soils, more than half of material larger than no. 200 sieve size	Gravels, more than half of coarse fraction larger than no. 4 sieve size	Clean gravels (little or no fines)	GW	Well-graded, gravel-sand mixtures, little or no fines	Wide range in grain sizes and substantial amounts of intermediate particle sizes	Determine percentages of gravel and sand from grain-size curve; depending on percentage of fines (fraction smaller than no. 200 sieve size) coarse-grained soils are classified as follows: Less than 5% = GW, GP, SW, SP More than 12% = GM, GC, SM, SC 5-12% = borderline cases requiring use of dual symbols	$C_u = D_{60}/D_{10} > 4$ $C_c = 1 < D_{30}^2/D_{10} D_{60} < 3$			
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines	Predominantly one size or a range of sizes with some intermediate sizes missing		Not meeting all gradation requirements for GW			
		Gravels with fines (appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Nonplastic fines or fines with low plasticity (for identification procedures see ML)		Atterberg limits below A line or $PI < 4$	Above A line with $4 < PI < 7$ are borderline cases requiring use of dual symbols		
			GC	Clayey gravels, gravel-sand-clay mixtures	Plastic fines (for identification procedures see CL)		Atterberg limits above A line with $PI > 7$			
	Sands, more than half of coarse fraction smaller than no. 4 sieve size	Clean sands (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	Wide range in grain size and substantial amounts of all intermediate particle sizes		$C_u = D_{60}/D_{10} > 6$ $C_c = 1 < D_{30}^2/D_{10} D_{60} < 3$			
			SP	Poorly-graded sands or gravelly sands, little or no fines	Predominantly one size or a range of sizes with some intermediate sizes missing		Not meeting all gradation requirements for SW			
		Sands with fines (appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Nonplastic fines or fines with low plasticity (for identification procedures see ML)		Atterberg limits below A line or $PI < 4$	Above A line with $4 < PI < 7$ are borderline cases requiring use of dual symbols		
			SC	Clayey sands, sand-clay mixtures	Plastic fines (for identification procedures see CL)		Atterberg limits above A line with $PI > 7$			
Fine-grained soils, more than half of material smaller than no. 200 sieve size					Identification procedures on fraction smaller than no. 40 sieve size					
					Dry strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near PL)			
	Silts and clays, liquid limit < 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	None to slight	Quick to slow	None				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium to high	None to very slow	Medium				
		OL	Organic silts and organic silty clays of low plasticity	Slight to medium	Slow	Slight				
	Silts and clays, liquid limit > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Slight to medium	Slow to none	Slight to medium				
		CH	Inorganic clays of high plasticity, fat clays	High to very high	None	None				
		OH	Organic clays of medium to high plasticity, organic silts	Medium to high	None to very slow	Slight to medium				
	Highly organic soils			Pt	Peat and other highly organic soils	Readily identified by color, odor, spongy feel, and frequently by fibrous texture				

(see notes on p. 28)



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 Whitehorse, Yukon

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 REVIEWED BY: WCK
 Fig. No:

COMPLETION DEPTH: *.
 COMPLETE: 94/11/27

Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 2-94	
Excavation performed using a 215 backhoe		TP#2-94 located near opening to south		PROJECT NO: 8054-9	
on contract with TANA CONTRACTING LTD.		pitch tank (refer to sketch)		ELEVATION:	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	LIQUID PLASTIC 10 20 30 40 M.C. 10 20 30 40			SOILS DESCRIPTION				CLAY SILT SAND GRAVEL 20 40 60 80				Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0		P6				GRAVEL											
		P7				-fill material existing below the large pitch tank, pitch layer (75 mm thick) occurring in gravel											
							0.2m										
						SILTY SANDY GRAVEL											
						-dense, frozen to 1.4 m, damp, fine grained sand, brown, traces of oxidation, some clay											
							0.4m										
1.0		P8				SANDY SILT											
						-some clay, damp, grey/light brown mottled soil, fine to medium grained sand, dense, non-plastic											
2.0																	
3.0																	
4.0		P9				SANDY GRAVEL											
						-clean, wet, dark brown to black, medium dense (slight sloughing of pit walls), coarse grained sand, traces of oxidation											
							3.3m										
							3.5m										
						END OF HOLE @ 3.5 m											
5.0						NOTES:											
						-static water at 3.3m											
						-no indication of hydrocarbon presence within subsurface other than near surface pitch											
6.0																	

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 3-94	
Excavation performed using a 215 backhoe		TP#3-94 located at vertical damaged pipe		PROJECT NO: 8054-9	
on contract with TANA CONTRACTING LTD.		2m N, 3m E of E8 (refer to sketch)		ELEVATION: 101.007 (m)	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	LIQUID			PLASTIC			M.C.	LIQUID	SOILS DESCRIPTION				Chemical Test Results (ASL)				USC	SOIL SYMBOL	ELEVATION(m)		
			10	20	30	40	10	20			30	40	20	40	60	80	20	40				60	80
0.0		P10									SILTY SANDY GRAVEL -moist, frozen to 1.3 m, dense, near surface pitch layer continuous from source located at TP#2-94, fine grained										101.0		
0.6																							
1.0											SILTY SAND -some clay, damp, mottled colours - grey and brown, fine grained sand, dense, (suspected fill material around pipe)										100.0		
1.2		P11									-becomes GRAVELLY SILTY SAND												
2.0		P12									-chemical analysis performed on sample P12 -grainsize distribution performed on sample P12				-P12 chemical test results: -1040 ppm (TEH)						99.0		
3.0		P13									SANDY GRAVEL -trace silt, moist, medium grained sand, dense, hydrocarbon (diesel) odour starts, free water at approximately 3.3 m										98.0		
3.4											END OF HOLE @ 3.4 m										97.0		
4.0																					96.0		
5.0																							
6.0																							

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		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 5-94					
Excavation performed using a 215 backhoe		TP#5-94 located adjacent to abandoned		PROJECT NO: 8054-9					
on contract with TANA CONTRACTING LTD.		water well 3m E of B8 (refer to sketch)		ELEVATION:					
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE									
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	☒ LIQUID ☒ PLASTIC PLASTICM.C.LIQUID 10203040 ☐ CLAY ☐ SILT ☒ SAND ☒ GRAVEL		20 40 60 80 20 40 60 80 20 40 60 80 20 40 60 80 Chemical Test Results (ASL)		USC	SOIL SYMBOL	ELEVATION(m)
0.0		P17	SILTY SANDY GRAVEL -traces of organics, dense, moist, frozen, fine grained sands 0.2m				GM		0.0
1.0		P18	SILTY SAND -moist, frozen, mottled brown/grey, fine grained sand, dense, 1.2m				SM		-1.0
2.0		P19	SILTY SANDY GRAVEL -damp, dense, fine to medium grained sand sizes, brown, 2.3m				GM		-2.0
3.0		P20	SANDY GRAVEL -clean, coarse grained sand, wet, medium dense, slight hydrocarbon odour, -chemical analysis on P20 2.4m		-P20 chemical test results: -350ppm (O&G)		GW		-3.0
4.0			END OF HOLE @ 2.4 m						-4.0
5.0			NOTES: -static water encountered at 2.3 metres -slight hydrocarbon odour exists near static water level -absorbent cloth lowered into existing abandoned well and hydrocarbons						-5.0
6.0									-6.0

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CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST PIT NO: 6-94		
Excavation performed using a 215 backhoe			TP#6-94 south of boiler bldg. for search			PROJECT NO: 8054-9		
on contract with TANA CONTRACTING LTD.			of suspected UST (refer to sketch)			ELEVATION:		
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE								

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOILS DESCRIPTION										Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)				
			☒ LIQUID ☐ ☒ PLASTIC ☐							☐ CLAY ☐ ☐ SILT ☐										
			PLASTIC M.C. LIQUID							☒ SAND ☐ ☒ GRAVEL ☐										
			10	20	30	40	10	20	30	40	20	40					60	80	20	40
0.0		P21																PT	0.0	
																		GM		
1.0		P22																SM	-1.0	
2.0																			-2.0	
3.0																			-3.0	
4.0																			-4.0	
5.0																			-5.0	
6.0																			-6.0	
			ORGANICS -thin layer of organic rich soil 0.1m																	
			SILTY SANDY GRAVEL -dense, damp, frozen, fine to medium grained sand sizes, rootlets, traces of oxidation 0.4m																	
			SILTY GRAVELLY SAND -dense, damp, well graded, appears to be native, traces of oxidation, 1.4m																	
			END OF HOLE @ 1.4 m																	
			NOTES: -no Underground Storage Tanks (UST) or hydrocarbons encountered																	

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		REVIEWED BY: WCK	COMPLETE: 94/11/27
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 7-94						
Excavation performed using a 215 backhoe		TP#7-94 south of TP#6-94 in search		PROJECT NO: 8054-9						
on contract with TANA CONTRACTING LTD.		of suspected UST (refer to sketch)		ELEVATION:						
SAMPLE TYPE ☒ TUBE ☒ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE										
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOILS DESCRIPTION				Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
☒ LIQUID ☐ PLASTIC 10 20 30 40 10 20 30 40 ☐ CLAY ☐ SILT ☐ SAND ☐ GRAVEL 20 40 60 80 20 40 60 80 20 40 60 80 20 40 60 80										
PLASTIC M.C. LIQUID 10 20 30 40										
0.0			ORGANICS -thin layer of organic rich soil 0.1m						0.0	
			SILTY SANDY GRAVEL -dense, damp, frozen, fine to medium grained sand sizes, rootlets, traces of oxidation 0.4m							
1.0			SILTY GRAVELLY SAND -dense, damp, well graded, appears to be native, traces of oxidation, coarse grained sand 2.2m							
2.0			END OF HOLE @ 2.2 m							
3.0										
4.0										
5.0										
6.0										
			NOTES: -no Underground Storage Tanks (UST) or hydrocarbons encountered							
J.R. Paine & Associates Ltd. Whitehorse, Yukon			LOGGED BY: MEB		COMPLETION DEPTH: 2.2 m					
			REVIEWED BY: WCK		COMPLETE: 94/11/27					
			Fig. No:		Page 1 of 1					

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST PIT NO: 8-94		
Excavation performed using a 215 backhoe			TP#8-94 located in excavated area 20m E			PROJECT NO: 8054-9		
on contract with TANA CONTRACTING LTD.			of G13 (refer to sketch)			ELEVATION:		
SAMPLE TYPE ☒ TUBE ☒ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE								

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOILS DESCRIPTION												Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)	
			LIQUID PLASTIC PLASTIC M.C. LIQUID			CLAY SILT SAND GRAVEL													
			10	20	30	40	20	40	60	80	20	40	60	80					
			10	20	30	40	20	40	60	80	20	40	60	80					
0.0			SILTY SAND -damp, becomes moist with depth, brown and grey mottled soil, native soil, dense, fine grained sand, traces of oxidation													SM		0.0	
1.0																			
		P23	1.3m																
			END OF HOLE @ 1.3m																
2.0																			
3.0																			
4.0																			
5.0																			
6.0																			

NOTES:
 -several refuse items located on surface (stained drums, pipe, wooden pallets) indicates past use as disposal area
 -subsurface probe indicates that the soil was not previously disturbed and buried material not likely

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		REVIEWED BY: WCK	COMPLETE: 94/11/27
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 9-94					
Excavation performed using a 215 backhoe		TP#9-94 located in near A4		PROJECT NO: 8054-9					
on contract with TANA CONTRACTING LTD.		(refer to sketch)		ELEVATION:					
SAMPLE TYPE ☒ TUBE ☒ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE									
DEPTH(m)	SAMPLE TYPE	SOILS DESCRIPTION		Chemical Test Results (ASL)		USC	SOIL SYMBOL	ELEVATION(m)	
	SAMPLE NO								
	■ LIQUID ■ 10 20 30 40 ▲ PLASTIC ▲ 10 20 30 40 PLASTIC M.C. LIQUID								
	● CLAY ● 20 40 60 80 ▲ SILT ▲ 20 40 60 80 ■ SAND ■ 20 40 60 80 ◆ GRAVEL ◆ 20 40 60 80								
0.0	P24	SILTY SAND -damp, dense, medium to fine grained sands, light brown,				SM		0.0	
1.0	P25							1.3m	-1.0
2.0	SANDY GRAVEL -some silt, medium dense, gravel to 150mm diameter, damp							GW	
3.0			P26	2.7m	-3.0				
4.0	SANDY GRAVEL -clean, wet, dark brown, medium dense, traces of oxidation		GW-GW		-4.0				
5.0					END OF HOLE @3.0 m	-5.0			
6.0	NOTES: -static water encountered at 2.8 m -no hydrocarbon odour noted				-6.0				

-P26 chemical test results:
-<50 ppm (O&G)

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Whitehorse, Yukon

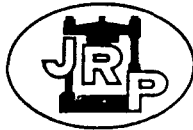
LOGGED BY: MEB
REVIEWED BY: WCK
Fig. No:

COMPLETION DEPTH: 3.0 m
COMPLETE: 94/11/27

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 10-94	
Excavation performed using a 215 backhoe		TP#10a-94 located at opening to 'feed'		PROJECT NO: 8054-9	
on contract with TANA CONTRACTING LTD.		tank, near J8 (refer to sketch)		ELEVATION:	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	☒ LIQUID ☒ PLASTIC PLASTIC M.C. LIQUID ☐ CLAY ☐ SILT ☐ SAND ☐ GRAVEL			SOILS DESCRIPTION	Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)	
			10	20	30						40
			10	20	30						40
			10	20	30						40
0.0		P27				SANDY GRAVEL -suspected fill below feed tank, dry, frozen, slight hydrocarbon odour 0.3m			0.0		
		P28									
1.0						SANDY SILT -fine grained sand, trace of gravel, damp, obvious hydrocarbon odour, dark brown, very dense, medium plasticity, some clay present -higher sand content begins at 2.6 m			-1.0		
		P29									
2.0									-2.0		
3.0		P30							-3.0		
4.0		P31				-hydrocarbon odour persists, cobbles to 150 mm diameter embedded in sandy silt matrix -hydrocarbon odour disappears at 5.5 m			-4.0		
5.0									-5.0		
6.0		P32				END OF HOLE @ 6.0m NOTES: -hydrocarbon presence within sandy silt material to a depth of approximately 5.5 m -no free water or water bearing stratum encountered throughout test pit depth			-6.0		
7.0									-7.0		
8.0									-8.0		

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 3.0 m
		REVIEWED BY: WCK	COMPLETE: 94/11/27
		Fig. No:	Page 1 of 1



J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

GRAIN SIZE ANALYSIS

SAMPLE: P28	CLIENT: ACTION ON WASTE,
DEPTH: 0.4M	DIAND
LOCATION TP#10-94	PROJECT: HAINES JUNCTION
DATE: 95/01/24	REFINERY ASSESMENT
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

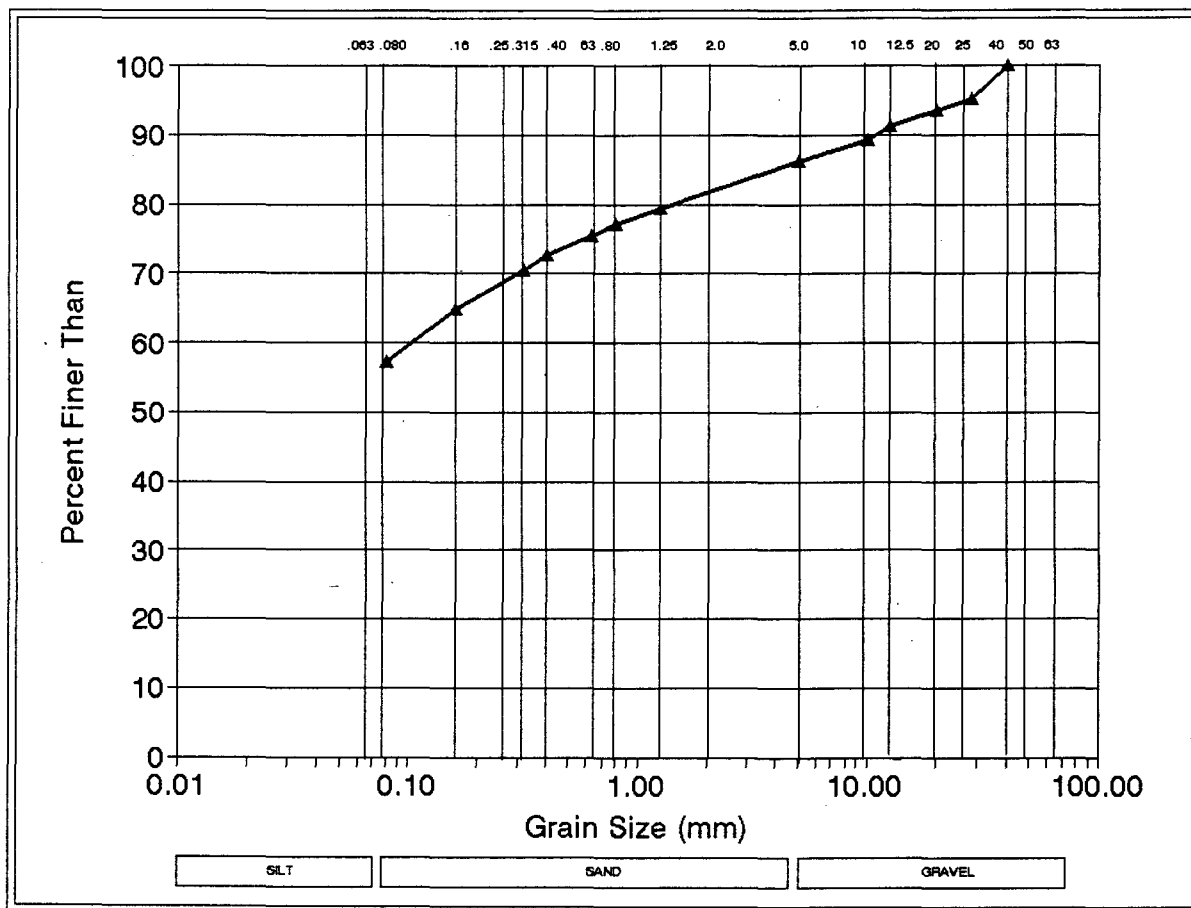
MOIST. CONT.:	12.4	CRUSH COUNT:	
% GRAVEL:	13.7	% FRAC. FACES:	
% SAND:	29.3	LIQUID LIMIT:	
% SILT:	57.0	PLASTIC LIMIT:	

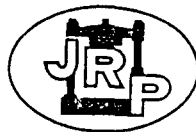
DESCRIPTION OF SAMPLE: REMARKS:

SANDY SILT, SOME GRAVEL

ML

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	100.0
28000	28.0	95.2
20000	20.0	93.5
14000	14.0	
12500	12.5	91.1
10000	10.0	89.3
5000	5.0	86.3
2000	2.0	81.8
1250	1.250	79.2
800	0.800	77.2
630	0.630	75.4
315	0.315	70.4
250	0.250	
160	0.160	64.8
80	0.080	57.0





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CONSULTING AND TESTING ENGINEERS
EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

GRAIN SIZE ANALYSIS

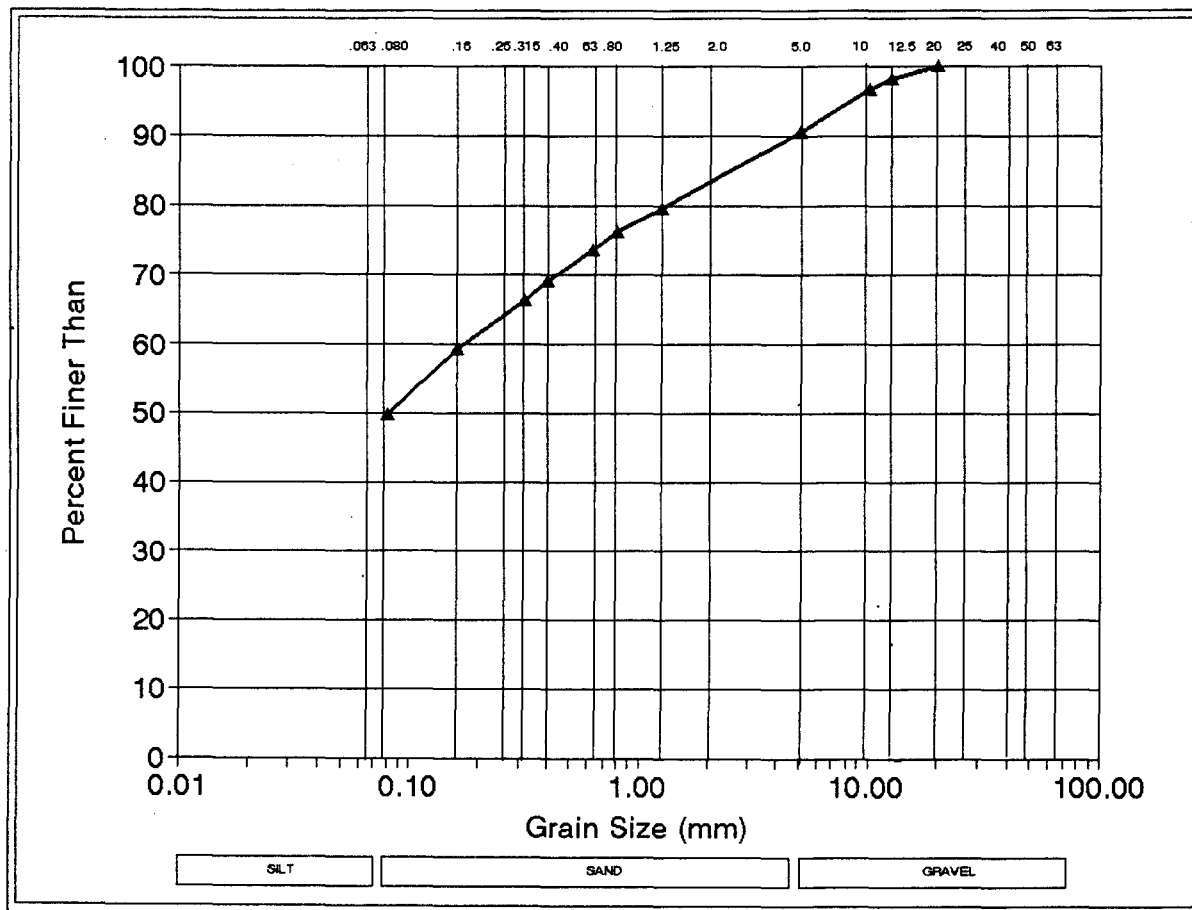
SAMPLE: P32	CLIENT: ACTION ON WASTE,
DEPTH: 6.0M	DIAND
LOCATION TP#10A-94	PROJECT: HAINES JUNCTION
DATE: 95/01/24	REFINERY ASSESMENT
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 11.0	CRUSH COUNT:
% GRAVEL: 9.5	% FRAC. FACES:
% SAND: 40.7	LIQUID LIMIT:
% SILT: 49.8	PLASTIC LIMIT:

DESCRIPTION OF SAMPLE:	REMARKS:
SANDY SILT, TRACE OF	
GRAVEL,	
ML	

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	100.0
14000	14.0	
12500	12.5	98.1
10000	10.0	96.5
5000	5.0	90.5
2000	2.0	83.5
1250	1.250	79.5
800	0.800	76.0
630	0.630	73.5
315	0.315	66.3
250	0.250	
160	0.160	59.2
80	0.080	49.8



[illegible]

CLIENT: ACTION ON WASTE, DIAND						HAINES JUNCTION REFINERY ASSESSMENT						TEST PIT NO: 11-94					
Excavation performed using a 215 backhoe						TP#11-94 located at opening to north						PROJECT NO: 8054-9					
on contract with TANA CONTRACTING LTD.						pitch tank (refer to sketch)						ELEVATION:					
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE																	
DEPTH(m)		SAMPLE TYPE	SAMPLE NO	SOILS DESCRIPTION			Chemical Test Results (ASL)			USC	SOIL SYMBOL	ELEVATION(m)					
				LIQUID 10 20 30 40 PLASTIC 10 20 30 40 PLASTIC M.C. LIQUID 10 20 30 40 CLAY 20 40 60 80 SILT 20 40 60 80 SAND 20 40 60 80 GRAVEL 20 40 60 80													
0.0		P40		GRAVEL	-poorly graded, black oil staining, loose, dry, frozen, fill under large pitch storage tank					GP		0.0					
0.3m		P41		SANDY SILT	-trace gravel, some clay, brown, frozen to 400mm, dense, no odour present -chemical analysis on sample P41			-P41 chemical test results: -<50 ppm (O&G)		ML		-1.0					
1.8m		P42		SILTY SAND	-moist, some clay, fine grained sand, material appears to be decayed organics black in colour					SM		-2.0					
2.1m				SANDY SILT	-damp, some clay, dense, non-plastic, fine grained sand sizes, grey/brown striations, traces of oxidation					ML		-3.0					
4.0m		P43		END OF HOLE @ 4.0m								-4.0					
				NOTES:													
				-no free water encountered -no hydrocarbon odour noted													
6.0																	

J.R. Paine & Associates Ltd.
Whitehorse, Yukon

LOGGED BY: MEB
REVIEWED BY: WCK
Fla. No:

COMPLETION DEPTH: 4.0 m
COMPLETE: 94/11/28

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CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 12-94	
Excavation performed using a 215 backhoe		TP#12-94 located at opening to large		PROJECT NO: 8054-9	
on contract with TANA CONTRACTING LTD.		diesel tank (refer to sketch)		ELEVATION:	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	☒ LIQUID ☒ PLASTIC PLASTIC M.C. LIQUID ☒ CLAY ☒ SILT ☒ SAND ☒ GRAVEL			SOILS DESCRIPTION	Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)	
			10	20	30						40
			10	20	30						40
			10	20	30						40
0.0					GRAVEL -poorly graded, fill under large tank, loose, dry, frozen,			GP	▲▲▲▲	0.0	
		P44			0.2m						
		P45			SILTY SAND -trace gravel, dense, brown, frozen to 400mm, no odour present, fine to medium grained sand			SM	■ ■ ■ ■		
					0.6m						
1.0					SILT and CLAY -some sand, moist, grey with dark layer of decayed organics, dense, firm, fine grained sand sizes			ML		-1.0	
					0.9m						
2.0					SANDY SILT -some clay, trace gravel, dense, damp, grey/brown striations, traces of oxidation, fine grained sand -becomes dry with depth			ML		-2.0	
3.0										-3.0	
4.0		P46			END OF HOLE @ 4.0m					-4.0	
5.0										-5.0	
6.0										-6.0	

NOTES:

- no free water encountered
- no hydrocarbon odour noted

LOGGED BY: MEB	COMPLETION DEPTH: 4.0 m
REVIEWED BY: WCK	COMPLETE: 94/11/28
Fig. No:	Page 1 of 1

J.R. Paine & Associates Ltd.

Whitehorse, Yukon

CLIENT: ACTION ON WASTE, DIAND						HAINES JUNCTION REFINERY ASSESSMENT						TEST PIT NO: 13-94					
Excavation performed using a 215 backhoe						TP#13-94 located at abandoned excavation						PROJECT NO: 8054-9					
on contract with TANA CONTRACTING LTD.						near L5 (refer to sketch)						ELEVATION:					
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE																	
DEPTH(m)		SAMPLE TYPE	SAMPLE NO	SOILS DESCRIPTION			Chemical Test Results (ASL)			USC	SOIL SYMBOL	ELEVATION(m)					
				☒ LIQUID ☐ ☐ PLASTIC ☒ PLASTIC M.C. LIQUID	☐ CLAY ☐ ☐ SILT ☐ ☒ SAND ☐ ☐ GRAVEL ☐												
0.0				SILTY SAND -dense, dry, poorly graded, fine grained sand sizes, no contaminant source encountered, light brown,							0.0						
1.0											-1.0						
2.0				END OF HOLE @ 1.5 m	1.5m						-2.0						
3.0											-3.0						
4.0											-4.0						
5.0											-5.0						
6.0				NOTES: -no static water encountered -no sign of contamination or of a contaminant source							-6.0						

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Whitehorse Yukon

LOGGED BY: MEB
 REVIEWED BY: WCK
 Fla. No:

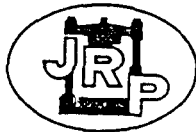
COMPLETION DEPTH: 1.5 m
 COMPLETE: 94/11/28

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CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 14-94	
Excavation performed using a 215 backhoe		TP#14-94 located adjacent to stained		PROJECT NO: 8054-9	
on contract with TANA CONTRACTING LTD.		druums near G4 (refer to sketch)		ELEVATION:	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	LIQUID		PLASTIC		M.C.	SOILS DESCRIPTION	CLAY				SILT				SAND				GRAVEL				Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
			10	20	30	40			10	20	30	40	20	40	60	80	20	40	60	80	20	40	60	80				
0.0		P47							SILT -some sand, moist, dense, frozen to 400mm, grey and brown															ML		0.0		
0.4																												
1.0									SILTY SAND -light brown, dry, dense, fine grained sand, traces of oxidation -grainsize analysis and chemical analysis performed on P49																			
2.0		P49																						SM		-2.0		
3.0																												
4.0		P50							GRAVEL -some sand, wet, coarse grained sand, loose, clean, slight hydrocarbon odour -chemical analysis on P50															GW		-4.0		
4.0																												
5.0									END OF HOLE @ 4.0m																			
6.0									NOTES: -static water encountered at 3.9 m -slight hydrocarbon odour encountered within gravel stratum -water sample W3 retrieved																			

J.R. Paine & Associates Ltd.		LOGGED BY: MEB		COMPLETION DEPTH: 4.0 m	
Whitehorse, Yukon		REVIEWED BY: WCK		COMPLETE: 94/11/28	
		Fig. No:		Page 1 of 1	



J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS
EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

GRAIN SIZE ANALYSIS

SAMPLE: P49	CLIENT: ACTION ON WASTE,
DEPTH: 2.0M	DIAND
LOCATION TP#14-94	PROJECT: HAINES JUNCTION
DATE: 95/01/24	REFINERY ASSESMENT
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 4.2	CRUSH COUNT:
% GRAVEL: 0.0	% FRAC. FACES:
% SAND: 70.2	LIQUID LIMIT:
% SILT: 29.8	PLASTIC LIMIT:

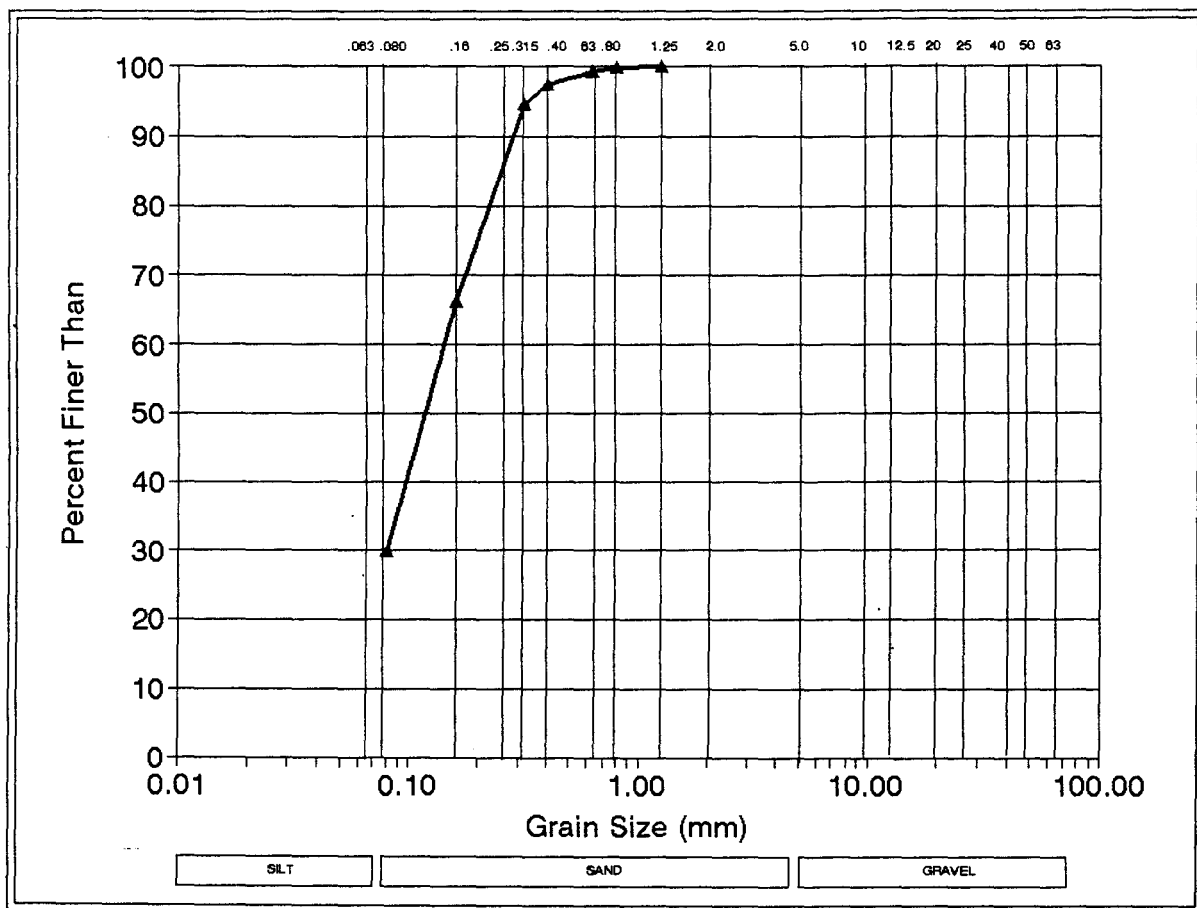
DESCRIPTION OF SAMPLE:

SILTY SAND

SM

REMARKS:

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	
14000	14.0	
12500	12.5	
10000	10.0	
5000	5.0	
2000	2.0	100.0
1250	1.250	99.9
800	0.800	99.7
630	0.630	99.3
315	0.315	94.6
250	0.250	
160	0.160	66.0
80	0.080	29.8



CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 15-94	
Excavation performed using a 215 backhoe		TP#15-94 within disposal pit, west side,		PROJECT NO: 8054-9	
on contract with TANA CONTRACTING LTD.		near F3 (refer to sketch)		ELEVATION:	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					

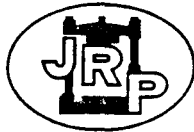
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	LIQUID			SOILS DESCRIPTION	CLAY			SILT	SAND	GRAVEL	Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)												
			10	20	30		40	20	40								60	80										
			PLASTIC				M.C.										20			40			60			80		
			10	20	30		40	20	40								60	80	20	40	60	80						
0.0		P51					SANDY SILT								ML	0.0												
		P52					-frozen, dense, light brown, non-plastic rootlets, fine grained sand, moist								SM													
		P53					SILTY GRAVELLY SAND																					
							-medium dense, dry, brown, gravel to 100 mm diameter, medium grained																					
1.0							SANDY GRAVEL								GP	-1.0												
		P54					-wet, clean, oxidation, loose, coarse grained sand, gravel seams of uniform diameter, sloughing of pit walls, more gravel with depth																					
							-grainsize distribution on P53																					
							-grainsize distribution on P54																					
2.0							END OF HOLE @ 1.5m									-2.0												
3.0																-3.0												
4.0																-4.0												
5.0																-5.0												
6.0																-6.0												

NOTES:

- static water encountered at 1.5m
- hydrocarbon odour noted at depths of 0.7 metres and greater

-P53 chemical test results: -86 ppm (O&G)

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 1.6 m
		REVIEWED BY: WCK	COMPLETE: 94/11/28
Fig. No:		Page 1 of 1	



J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS
EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

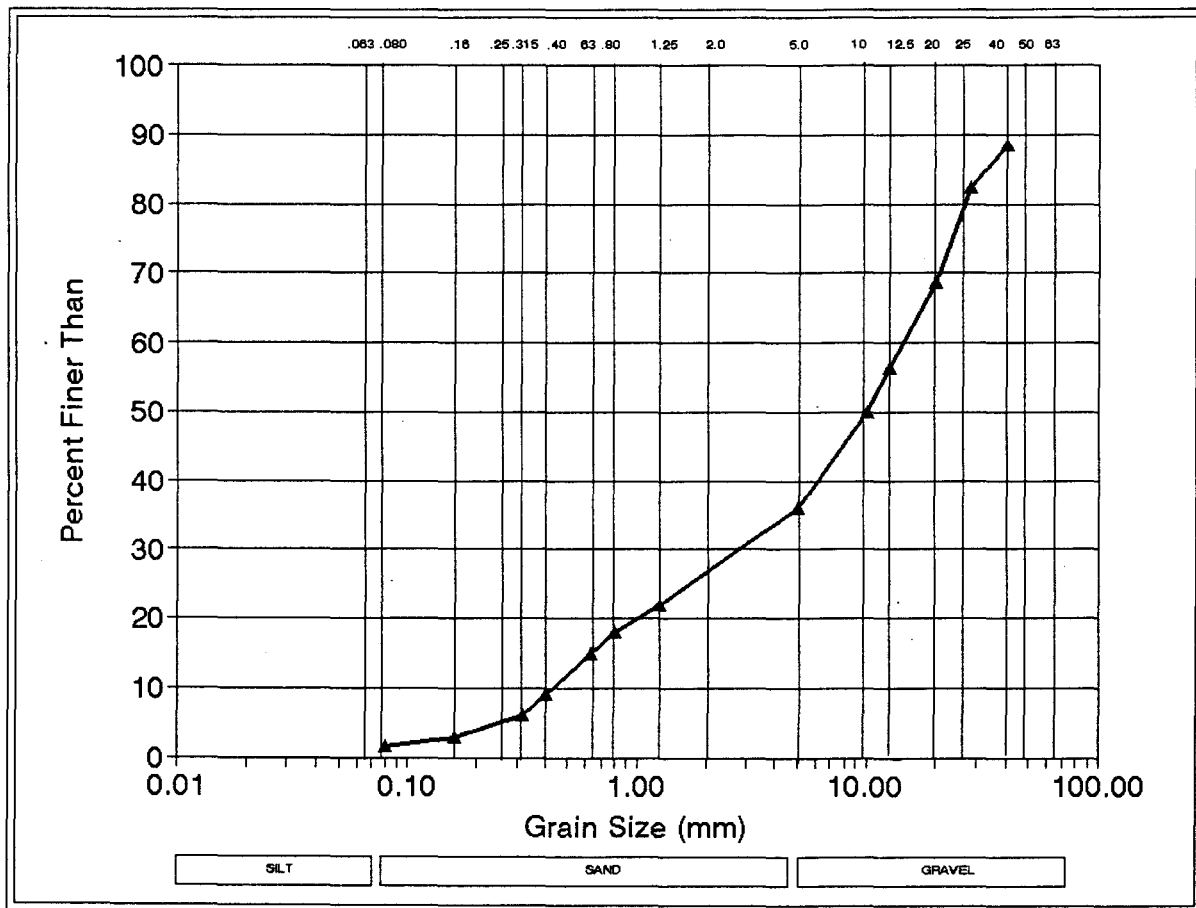
GRAIN SIZE ANALYSIS

SAMPLE: P53	CLIENT: ACTION ON WASTE,
DEPTH: 0.7M	DIAND
LOCATION TP#15-94	PROJECT: HAINES JUNCTION
DATE: 95/01/24	REFINERY ASSESMENT
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 1.5	CRUSH COUNT:
% GRAVEL: 64.2	% FRAC. FACES:
% SAND: 34.4	LIQUID LIMIT:
% SILT: 1.5	PLASTIC LIMIT:
DESCRIPTION OF SAMPLE:	REMARKS:
SANDY GRAVEL	
GP	

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	88.5
28000	28.0	82.1
20000	20.0	68.5
14000	14.0	
12500	12.5	56.1
10000	10.0	50.0
5000	5.0	35.8
2000	2.0	26.2
1250	1.250	21.8
800	0.800	17.7
630	0.630	14.6
315	0.315	6.1
250	0.250	
160	0.160	2.7
80	0.080	1.5





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS
EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

GRAIN SIZE ANALYSIS

SAMPLE: P54	CLIENT: ACTION ON WASTE,
DEPTH: 1.5M	DIAND
LOCATION TP#15-94	PROJECT: HAINES JUNCTION
DATE: 95/01/24	REFINERY ASSESMEN
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

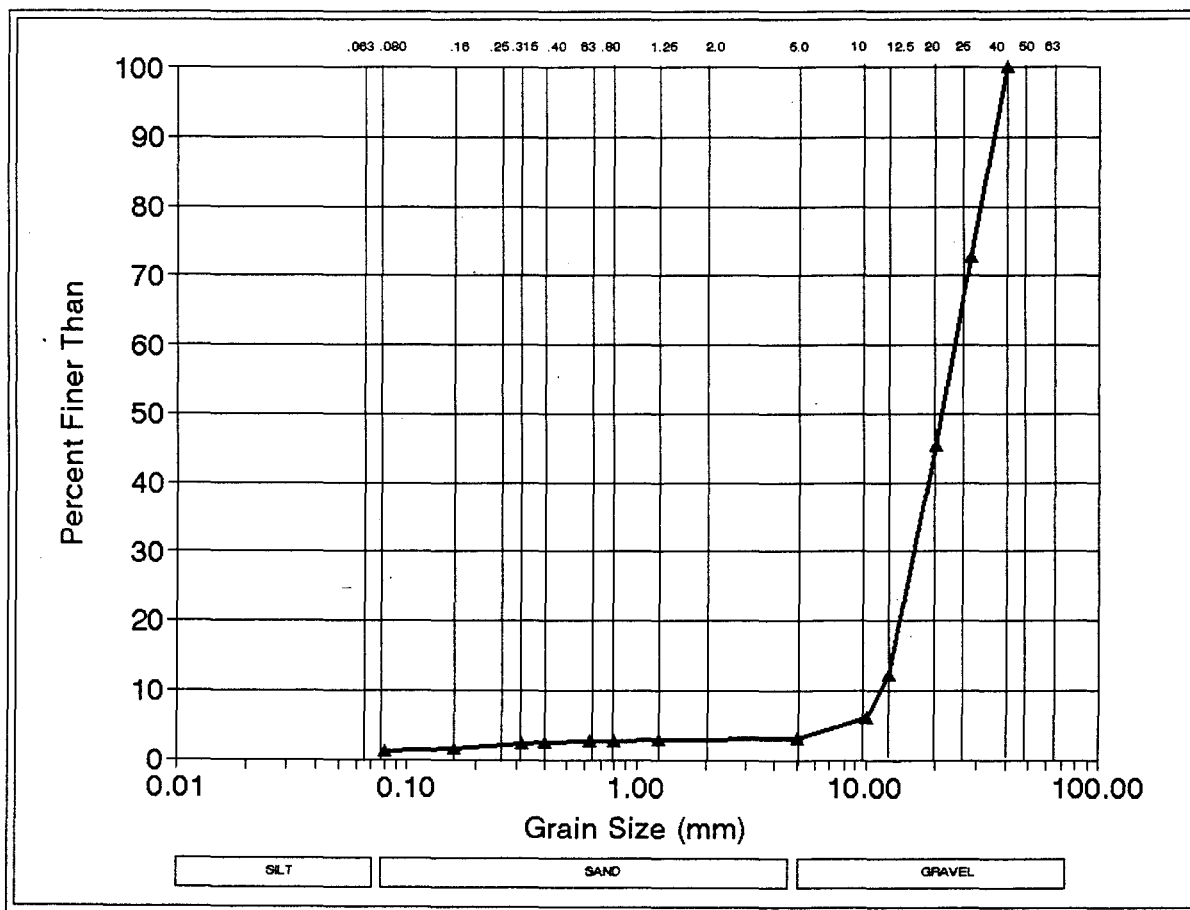
MOIST. CONT.: 0.8	CRUSH COUNT:
% GRAVEL: 97.0	% FRAC. FACES:
% SAND: 1.9	LIQUID LIMIT:
% SILT: 1.1	PLASTIC LIMIT:

DESCRIPTION OF SAMPLE: REMARKS:

GRAVEL

GP

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	100.0
28000	28.0	72.5
20000	20.0	45.2
14000	14.0	
12500	12.5	12.0
10000	10.0	5.9
5000	5.0	3.0
2000	2.0	2.8
1250	1.250	2.7
800	0.800	2.6
630	0.630	2.5
315	0.315	2.2
250	0.250	
160	0.160	1.5
80	0.080	1.1

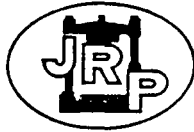


CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 16-94						
Excavation performed using a 215 backhoe		TP#16-94 within disposal pit, east side,		PROJECT NO: 8054-9						
on contract with TANA CONTRACTING LTD.		5m east of F4 (refer to sketch)		ELEVATION: 98.792 (m)						
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE										
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	LIQUID 10 20 30 40 PLASTIC 10 20 30 40 M.C. 10 20 30 40		CLAY 20 40 60 80 SILT 20 40 60 80 SAND 20 40 60 80 GRAVEL 20 40 60 80		Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0		P55	SANDY SILT -moist, frozen, dense, rootlets, 30 mm tar layer of surface, fine grained sand 0.2m					ML		98.0
		P56								
		P57	GRAVELLY SAND -some silt, dense, damp, well graded, 0.7m				-P57 chemical test results: -656 ppm (oil & grease)	SM		
1.0			SANDY GRAVEL -clean, coarse grained sand, black with oil stains, gravel to 150 mm diameter, medium dense, moist, hydrocarbon odour begins -chemical analysis on P57 -silty sand lense occurs at 1.4 m with approximately 15 cm thickness -chemical analysis on P59 -grainsize analysis on P60 1.6m				-P59 chemical test results: -2200 ppm (TEH) -<1.0 ppm (PAH)	GW		97.0
		P58								
2.0		P60	END OF HOLE @ 1.6m					SM		
								GW		
3.0										96.0
4.0										95.0
5.0										94.0
6.0										93.0
NOTES:			-static water at 1.45 meters of 0.7m and greater -hydrocarbons encountered at depths -sample P58 from near surface tar, chemical analysis performed		-refer to hydrocarbon dist. report for typical distribution of near surface pitch sample					

J.R. Paine & Associates Ltd.

Whitehorse, Yukon

LOGGED BY: MEB	COMPLETION DEPTH: 1.6 m
REVIEWED BY: WCK	COMPLETE: 94/11/28
Fig. No:	Page 1 of 1



J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

GRAIN SIZE ANALYSIS

SAMPLE: P60	CLIENT: ACTION ON WASTE,
DEPTH: 1.4M	DIAND
LOCATION TP#16-94	PROJECT: HAINES JUNCTION
DATE: 95/01/24	REFINERY ASSESMEN
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

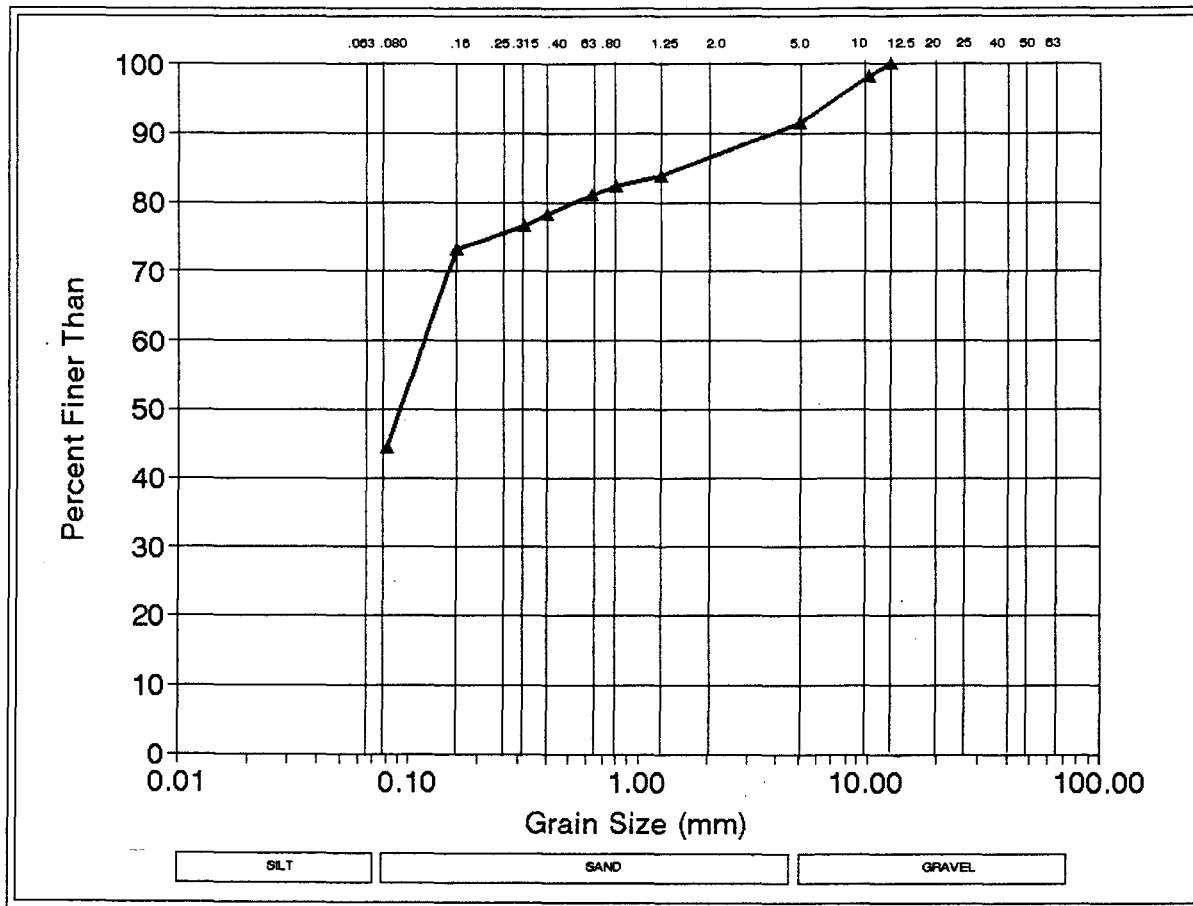
MOIST. CONT.: 21.3	CRUSH COUNT:
% GRAVEL: 8.7	% FRAC. FACES:
% SAND: 46.9	LIQUID LIMIT:
% SILT: 44.4	PLASTIC LIMIT:

DESCRIPTION OF SAMPLE: REMARKS:

SILTY SAND, TRACE GRAVEL

SM

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	
14000	14.0	
12500	12.5	100.0
10000	10.0	98.2
5000	5.0	91.3
2000	2.0	86.0
1250	1.250	83.8
800	0.800	82.2
630	0.630	81.0
315	0.315	76.6
250	0.250	
160	0.160	73.0
80	0.080	44.4



CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 17-94	
Excavation performed using a 215 backhoe		TP#17-94 at suspected buried metal		PROJECT NO: 8054-9	
on contract with TANA CONTRACTING LTD.		location, 5 m E of H6 (refer to sketch)		ELEVATION:	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	☒ LIQUID ☒ PLASTIC PLASTIC M.C. LIQUID ☐ CLAY ☐ SILT ☐ SAND ☐ GRAVEL			SOILS DESCRIPTION	Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0				GRAVEL FILL -located adjacent to pitch tank 0.2m					0.0	
				GRAVELLY SAND -some silt, dense, damp, brown, grey/brown in colour, fine grained sand possibly fill 0.4m						
1.0				SANDY SILT -decayed organic layer of 5cm thickness located at 0.4 m, some clay, grey/brown silt striations, trace gravel embedded within silt matrix, damp, dense 0.4m						
2.0										
3.0										
4.0		P64		SAND -clean, medium grained, loose, damp, oxidation, 3.9m						
4.4		P65		SANDY GRAVEL -clean, gravel to 75 mm diameter, loose, wet, possibly hydrocarbon odour, -chemical analysis on sample P65 4.4m						
4.6				END OF HOLE @ 4.6m						
5.0				NOTES: -static water level at 4.4 m						
6.0										

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 94/11/28
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST PIT NO: 18-94		
Excavation performed using a 215 backhoe			TP#18-94 at abandoned pit, 18 m east,			PROJECT NO: 8054-9		
on contract with TANA CONTRACTING LTD.			5 m north of H13 (refer to sketch)			ELEVATION:		
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE								

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	☒ LIQUID ☐ PLASTIC ☐ M.C. ☐ LIQUID			SOILS DESCRIPTION				20 ● CLAY ● 40 60 80 20 ▲ SILT ▲ 40 60 80 20 ■ SAND ■ 40 60 80 20 ◆ GRAVEL ◆ 40 60 80				Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
			10	20	30												
			10	20	30	40											
			10	20	30	40											
0.0						SANDY SILT -dry, fine grained sand, organics present near surface, light brown, no sign of contaminant										0.0	
1.0																-1.0	
2.0						END OF HOLE @ 2.0 m										-2.0	
3.0																-3.0	
4.0																-4.0	
5.0																-5.0	
6.0																-6.0	

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 2.0 m
		REVIEWED BY: WCK	COMPLETE: 94/11/28
Fig. No:		Page 1 of 1	

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST PIT NO: 19-94	
Excavation performed using a 215 backhoe		TP#19-94 at opening to bunker tank, 4 m		PROJECT NO: 8054-9	
on contract with TANA CONTRACTING LTD.		west, 4 m north of H13 (refer to sketch)		ELEVATION:	
SAMPLE TYPE ☒ TUBE ☒ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	LIQUID PLASTIC 10 20 30 40 10 20 30 40		
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PLASTIC

M.C.

LIQUID

10

20

30

40

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST PIT NO: 20-94		
Excavation performed using a 215 backhoe			TP#20-94 at suspected buried metal			PROJECT NO: 8054-9		
on contract with TANA CONTRACTING LTD.			location, at K13 (refer to sketch)			ELEVATION:		
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE								

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOILS DESCRIPTION				Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0			10 20 30 40 10 20 30 40 10 20 30 40							
			SANDY SILT -dry, fine grained sand, organics present near surface, light brown, no sign of buried metal							
1.0										
2.0			END OF HOLE @ 2.0 m							
3.0										
4.0										
5.0										
6.0										

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 2.0 m
		REVIEWED BY: WCK	COMPLETE: 94/11/28
		Flg. No:	Page 1 of 1



CHEMICAL ANALYSIS REPORT

Date: December 22, 1994

ASL File No. E6113

Report On: Soil and Water Analysis (TEST PIT PROGRAM)

Report To: **J. R. Paine and Associates Ltd.**
14 Burns Road
Whitehorse, YT
V1A 4Y9

Attention: **Mr. Michael Billowitz**

Received: December 5, 1994

ASL ANALYTICAL SERVICE LABORATORIES LTD.

per:

A handwritten signature in dark ink, appearing to read 'Dawn Gilbert', written over a horizontal line.

Dawn Gilbert
Supervisor, Trace Organics Lab

A handwritten signature in dark ink, appearing to read 'Cameron McLean', written over a horizontal line.

Cameron McLean, B.Sc
Project Chemist





REMARKS

File No. E6113

A Sample identified as P58 was submitted for characterization by gas chromatography with flame ionization detection (GC/FID). The Hydrocarbon Distribution Reports for this sample and several reference standard have been appended to this report to assist you in your investigation. The scale at the top of the chromatographic traces represents the hydrocarbon range and the scale at the bottom represents retention time, in minutes.

RESULTS OF ANALYSIS - Sediment/Soil¹

File No. E6113

P7

(TP 2-94)

Halogenated Volatiles

Bromodichloromethane	<0.010
Bromoform	<0.010
Carbon Tetrachloride	<0.010
Chlorobenzene	<0.010
Chloroethane	<0.010
Chloroform	<0.010
Chloromethane	<0.010
Dibromochloromethane	<0.010
1,2-Dichlorobenzene	<0.010
1,3-Dichlorobenzene	<0.010
1,4-Dichlorobenzene	<0.010
1,1-Dichloroethane	<0.010
1,2-Dichloroethane	<0.010
cis-1,2-Dichloroethylene	<0.010
trans-1,2-Dichloroethylene	<0.010
1,1-Dichloroethylene	<0.010
Dichloromethane	<0.050
1,2-Dichloropropane	<0.010
cis-1,3-Dichloropropylene	<0.010
trans-1,3-Dichloropropylene	<0.010
1,1,1,2-Tetrachloroethane	<0.010
1,1,2,2-Tetrachloroethane	<0.010
Tetrachloroethylene	<0.010
1,1,1-Trichloroethane	<0.010
1,1,2-Trichloroethane	<0.010
Trichloroethylene	<0.010
Trichlorofluoromethane	<0.010
Vinyl Chloride	<0.010

Non-halogenated Volatiles

Benzene	<0.010
Ethylbenzene	<0.010
Styrene	<0.010
Toluene	<0.010
meta- & para-Xylene	<0.010
ortho-Xylene	<0.010

Remarks regarding the analyses appear at the beginning of this report.

< = Less than the detection limit indicated.

¹Results are expressed as milligrams per dry kilogram except where noted.

RESULTS OF ANALYSIS - Sediment/Soil¹

File No. E6113

	P26	P36	P41	P2	P20
				(TP 1-94)	(TP 5-94)
<u>Physical Tests</u>					
Moisture	3.5	10.4	19.4	13.9	5.9
<u>Extractables</u>					
Oil and Grease	<50	930	<50	<50	350
Sample IO's					
	P7	P39	P32	P53	P50
<u>Physical Tests</u>					
Moisture	9.4	10.6	11.2	2.0	3.8
<u>Extractables</u>					
Oil and Grease	5230	<50	466	86	<50

Remarks regarding the analyses appear at the beginning of this report.

< = Less than the detection limit indicated.

¹Results are expressed as milligrams per dry kilogram except where noted.

RESULTS OF ANALYSIS - Sediment/Soil¹

File No. E6113

	P57	P65	P49	P28	P12
<u>Moisture</u>	2.7	8.8	6.1	12.9	10.6
<u>Water Soluble Volatiles</u>					
Diethylene Glycol	-	-	<10	-	-
Ethylene Glycol	-	-	<10	-	-
Propylene Glycol	-	-	<10	-	-
<u>Polyaromatic Hydrocarbons</u>					
Acenaphthene	-	-	-	<0.050	-
Acenaphthylene	-	-	-	<0.020	-
Anthracene	-	-	-	<0.020	-
Benz(a)anthracene	-	-	-	<0.020	-
Benzo(a)pyrene	-	-	-	<0.050	-
Benzo(b)fluoranthene	-	-	-	<0.020	-
Benzo(ghi)perylene	-	-	-	<0.020	-
Benzo(k)fluoranthene	-	-	-	<0.020	-
Chrysene	-	-	-	<0.060	-
Dibenz(a,h)anthracene	-	-	-	<0.020	-
Fluoranthene	-	-	-	<0.020	-
Fluorene	-	-	-	<0.020	-
Indeno(1,2,3-cd)pyrene	-	-	-	<0.020	-
Naphthalene	-	-	-	<0.020	-
Phenanthrene	-	-	-	<0.020	-
Pyrene	-	-	-	<0.020	-
<u>Extractables</u>					
Oil and Grease	656	<50	<50	-	-
Total Extr Hydrocarbons (C9-40)	-	-	-	2920	1040
Total Extr Hydrocarbons (C10-30)	-	-	-	2730	1030

Remarks regarding the analyses appear at the beginning of this report.

< = Less than the detection limit indicated.

¹Results are expressed as milligrams per dry kilogram except where noted.

RESULTS OF ANALYSIS - Sediment/Soil¹

File No. E6113

P59

P58

Moisture

22.1

-

Polyaromatic Hydrocarbons

Acenaphthene	<0.050	-
Acenaphthylene	<0.050	-
Anthracene	0.020	-
Benz(a)anthracene	<0.020	-
Benzo(a)pyrene	<0.020	-

Benzo(b)fluoranthene	<0.020	-
Benzo(ghi)perylene	<0.020	-
Benzo(k)fluoranthene	<0.020	-
Chrysene	0.020	-
Dibenz(a,h)anthracene	<0.020	-

Fluoranthene	<0.020	-
Fluorene	0.126	-
Indeno(1,2,3-cd)pyrene	<0.020	-
Naphthalene	<0.100	-
Phenanthrene	0.093	-

Pyrene	0.022	-
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Extractables

GC Scan	-	see below
Total Extr Hydrocarbons (C9-40)	2200	-
Total Extr Hydrocarbons (C10-30)	2120	-

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
¹Results are expressed as milligrams per dry kilogram except where noted.

RESULTS OF ANALYSIS - Water¹

File No. E6113

	W3	W4	W5
<u>Water Soluble Volatiles</u>			
Diethylene Glycol	<10	-	-
Ethylene Glycol	<10	-	-
Propylene Glycol	<10	-	-
<u>Extractables</u>			
Oil and Grease	-	-	<10
Total Extr Hydrocarbons (C9-40)	-	18.0	-
Total Extr Hydrocarbons (C10-30)	-	16.2	-

Remarks regarding the analyses appear at the beginning of this report.

< = Less than the detection limit indicated.

¹Results are expressed as milligrams per litre except where noted.



METHODOLOGY

File No. E6113

Samples were analyzed by methods acceptable to the appropriate regulatory agency. Outlines of the methodologies utilized are as follows:

Moisture

This analysis is carried out gravimetrically by drying the sample to constant weight at 103 C.

Volatile Organic Compounds in Sediment/Soil

This analysis was carried out in accordance with U.S. Environmental Protection Agency Method 8240 (Publ. # SW-846, 3rd Ed., Washington, DC 20460). This method involves a purge and trap extraction of the volatile compounds and subsequent analysis by capillary column gas chromatography with mass selective detection.

Oil and Grease in Sediment/Soil

This analysis is carried out by extracting the sample with hexane. The extract thus produced is evaporated to dryness and the residue weighed to determine gravimetric oil and grease.

Water Soluble Organic Compounds in Sediment and Soil

These analyses are carried out in accordance with EPA Method 8000 (Publ. #SW-846, 3rd Ed., Washington, DC 20460). Sediment/Soil samples are extracted with agitation for one hour at room temperature using reagent quality water. The aqueous phase is then analysed by direct injection into a gas chromatograph with Flame Ionization Detection. Quantification is by external calibration with due consideration of the response of an internal standard.

Polynuclear Aromatic Hydrocarbons in Sediment/Soil

This analysis is carried out using a procedure adapted by ASL from U.S. EPA Methods 3540, 3630, and 8270 (Publ. # SW-846 3rd ed., Washington, DC 20460). The procedure involves a triple solvent extraction with dichloromethane and clean-up using silica gel column chromatography. This clean-up procedure has been found to effectively remove aliphatic and heterocyclic hydrocarbons which could potentially interfere with the analysis. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection.



METHODOLOGY (cont'd)

File No. E6113

Total Extractable Hydrocarbons in Sediment/Soil

This analysis is carried out in accordance with U.S. EPA Method 3500/8015 (Publ. # SW-846 3rd ed., Washington, DC 20460). This procedure involves hexane/acetone extraction followed by analysis of the extract by capillary column gas chromatography with flame ionization detection.

Product Characterization By Gas Chromatography

This analysis is carried out in accordance with U.S. EPA Method 8015 (Publ. #SW-846 3rd ed., Washington, DC 20460). The sample is diluted with methylene chloride followed by analysis using capillary column gas chromatography with flame ionization detection. The chromatogram is then compared to known petroleum blends for identification.

Water Soluble Organic Compounds

These analyses are carried out in accordance with EPA Method 8000 (Publ. #SW-846, 3rd Ed., Washington, DC 20460). Water samples are analysed as received, or diluted, by direct injection into a gas chromatograph with Flame Ionization Detector. Quantification is by external calibration with due consideration of the response of an internal standard.

Oil and Grease in Water (Gravimetric)

This analysis is carried out in accordance to procedures described in "A Laboratory Manual for the Chemical Analysis of Waters, Wastewaters, Sediments, and Biological Tissues" 2nd Edition, published by B.C. Ministry of Environment, 1976 and in "Standard Methods for the Examination of Water and Wastewater" 18th Ed. published by the American Public Health Association, 1992. Further details are available upon request.

Total Extractable Hydrocarbons in Water

This analysis is carried out in accordance with U.S. EPA Method 3510/8015 (Publ. #SW-846, 3rd Ed., Washington, DC 20460). The procedure involves extraction with methylene chloride. The extract is then reduced in volume and analysed by capillary column gas chromatography with flame ionization detection.

End of Report

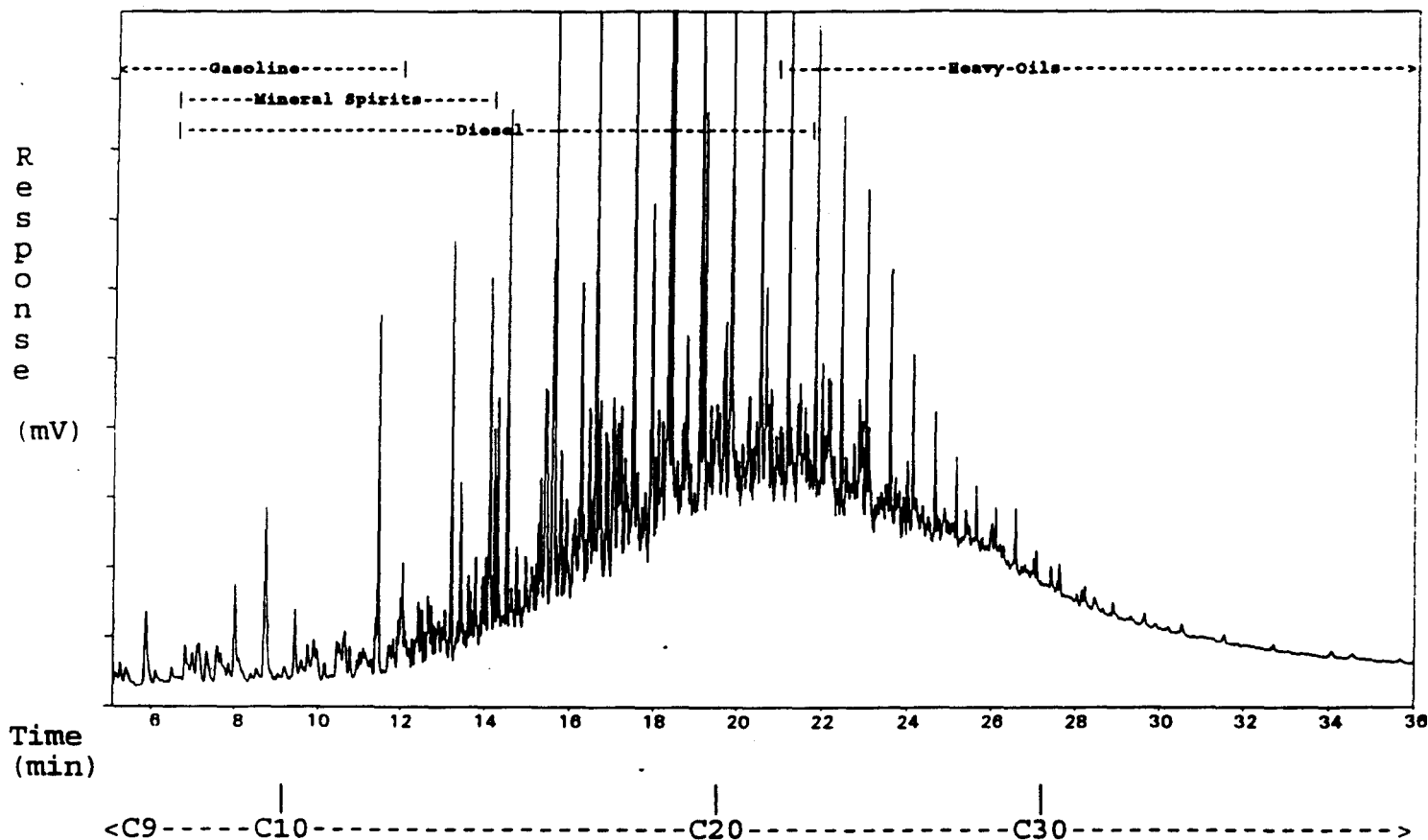
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: BUNKER FUEL

Sample acquired: DEC 29, 1993 22:55:30

File Name: E:\TEH\TEHDEC29.28R , Sample Name: BUNKER FUEL

Sequence file: TEHDEC29



HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	1.9
Carbon 10 to Carbon 20 (C10-C20)	47.4
Carbon 20 to Carbon 30 (C20-C30)	37.8
Greater than Carbon 30 (>C30)	12.9

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

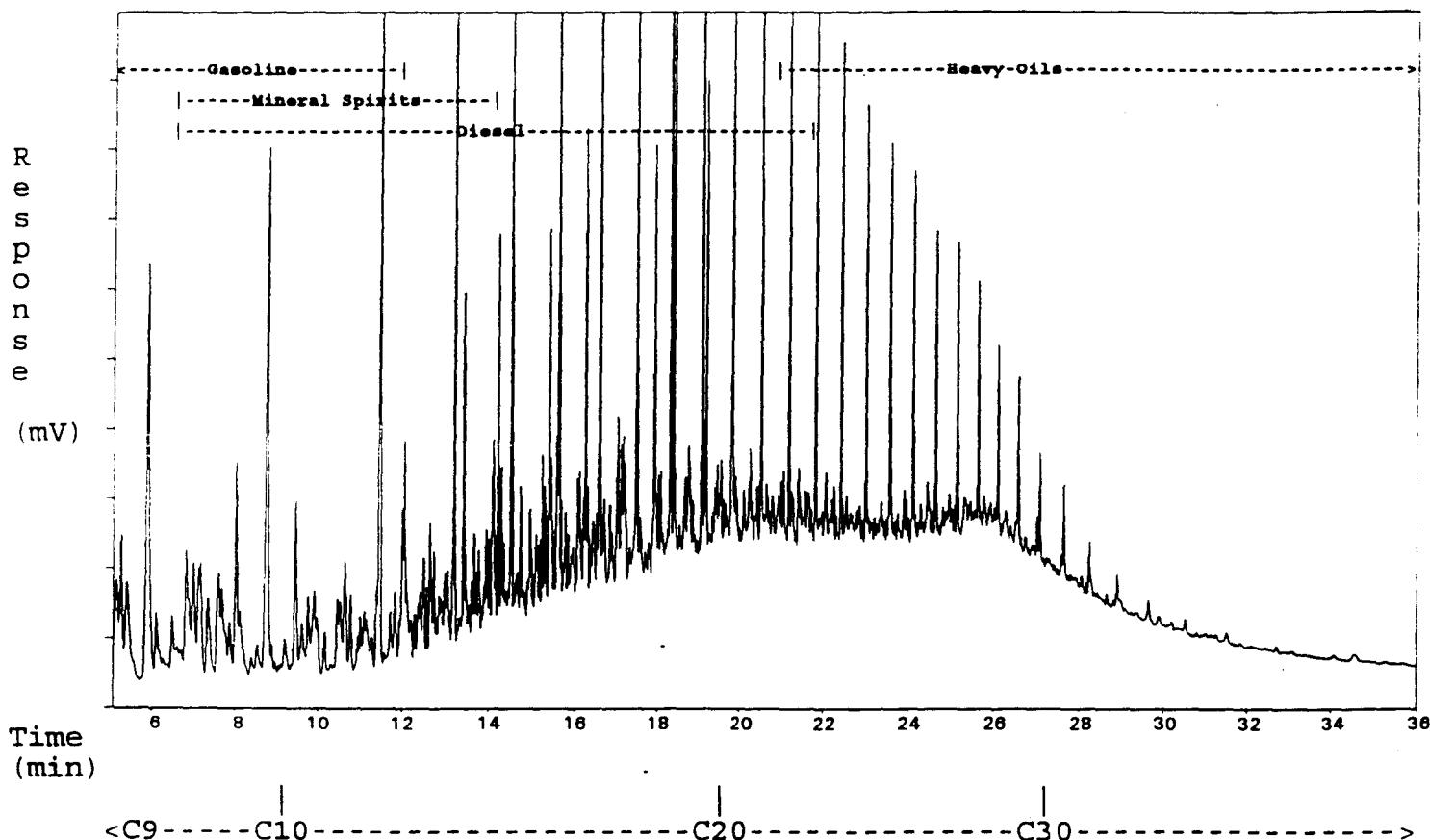
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: CRUDE OIL

Sample acquired: DEC 29, 1993 22:05:26

File Name: E:\TEH\TEHDEC29.26R , Sample Name: CRUDE OIL

Sequence file: TEHDEC29



HYDROCARBON RANGE (C#)

RELATIVE AMOUNT (%)

Less than Carbon 10 (<C10)	8.3
Carbon 10 to Carbon 20 (C10-C20)	45.9
Carbon 20 to Carbon 30 (C20-C30)	31.1
Greater than Carbon 30 (>C30)	14.5

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

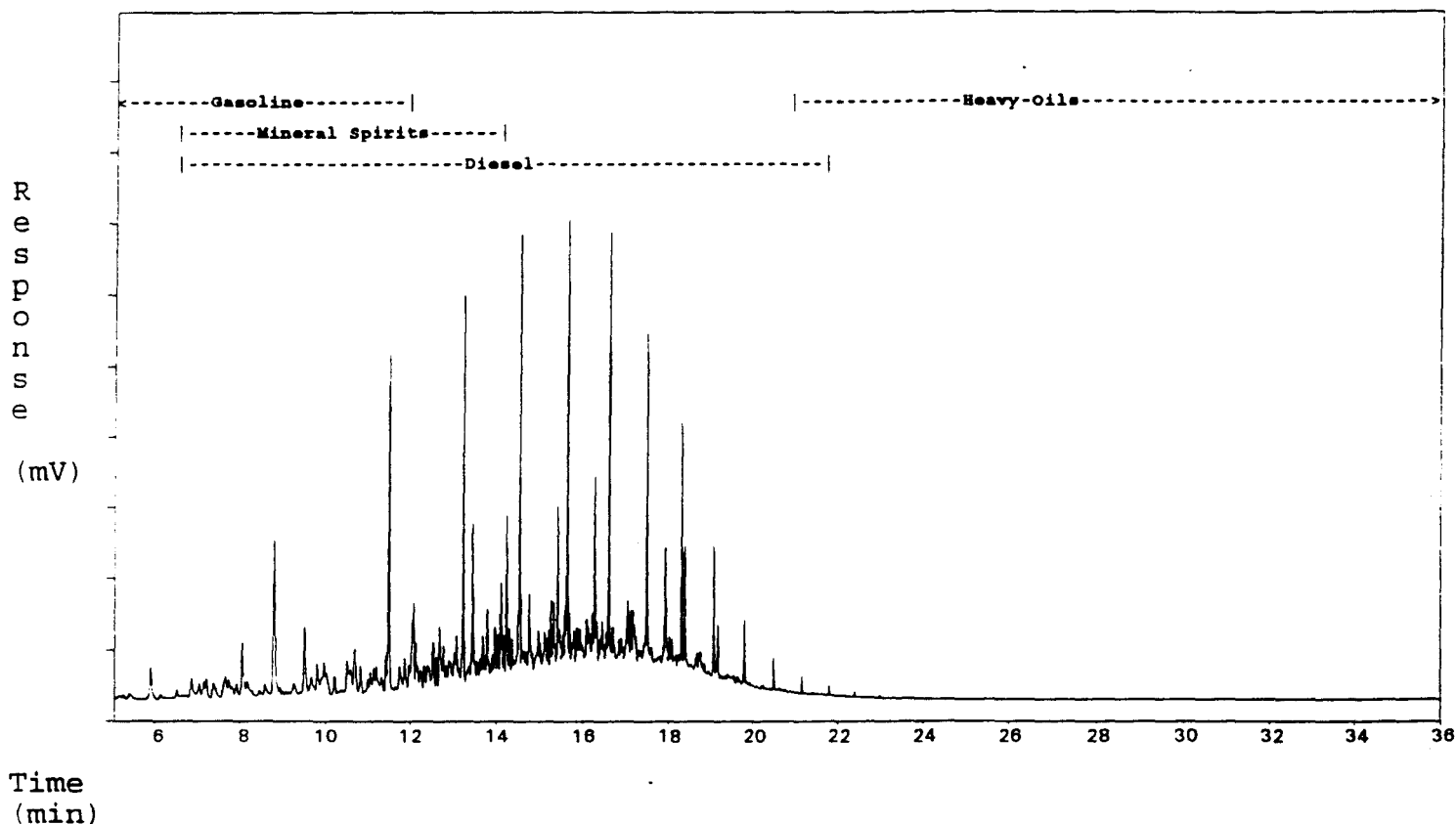
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: DIESEL

Sample acquired: JAN 3, 1994 21:13:54

File Name: C:\TEH\TEHJAN04.13R Sample Name: DIESEL

Sequence file: TEHJAN04



HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)		5.2
Carbon 10 to Carbon 20 (C10-C20)		92.2
Carbon 20 to Carbon 30 (C20-C30)		2.5
Greater than Carbon 30 (>C30)		0.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

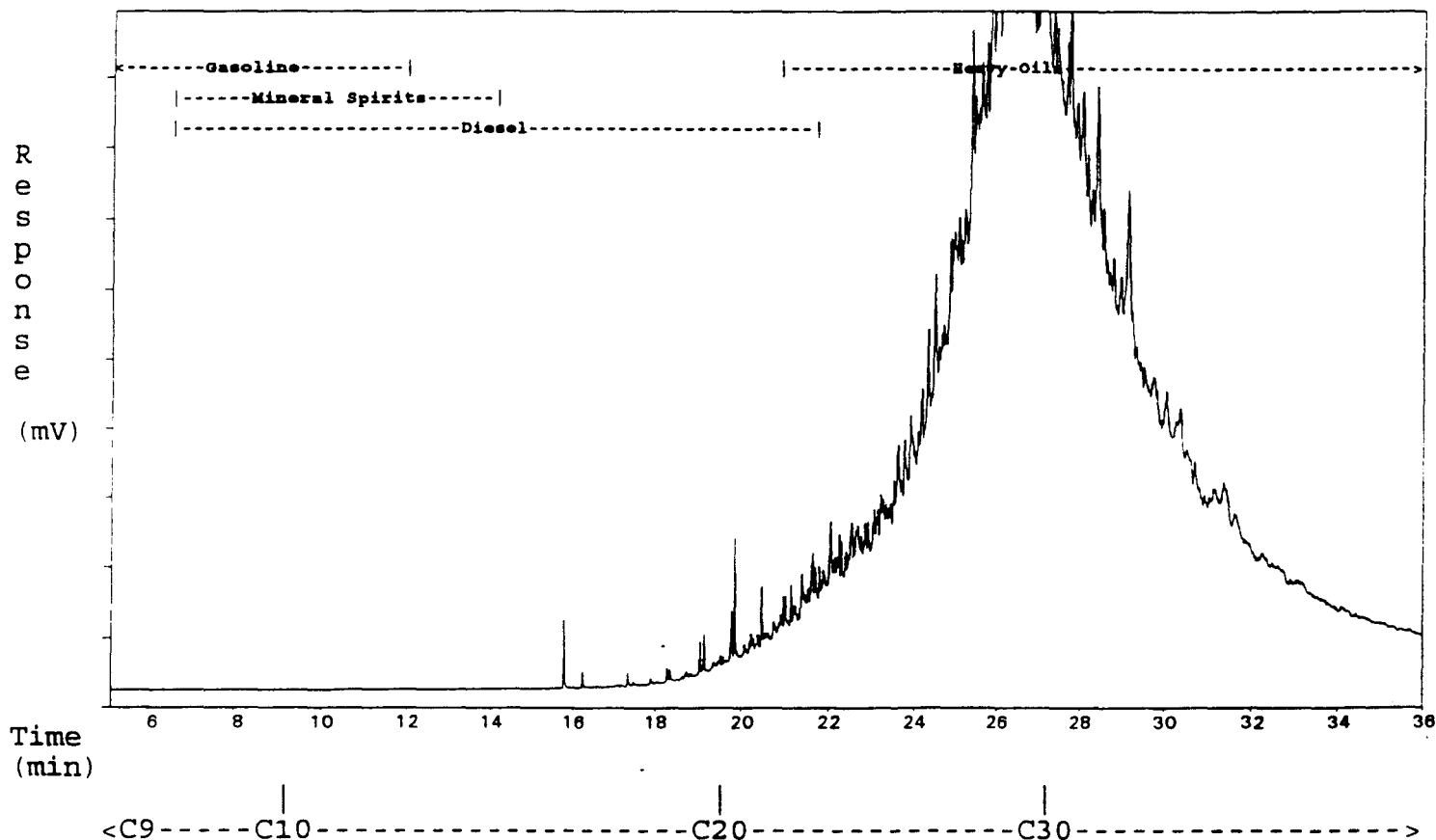
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: PUMP OIL

Sample acquired: DEC 29, 1993 19:38:40

File Name: C:\HCLIBRAR\TEHDEC29.20R , Sample Name: PUMP OIL

Sequence file: TEHDEC29



HYDROCARBON RANGE (C#)		RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)		0.0
Carbon 10 to Carbon 20 (C10-C20)		1.1
Carbon 20 to Carbon 30 (C20-C30)		33.8
Greater than Carbon 30 (>C30)		65.2

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

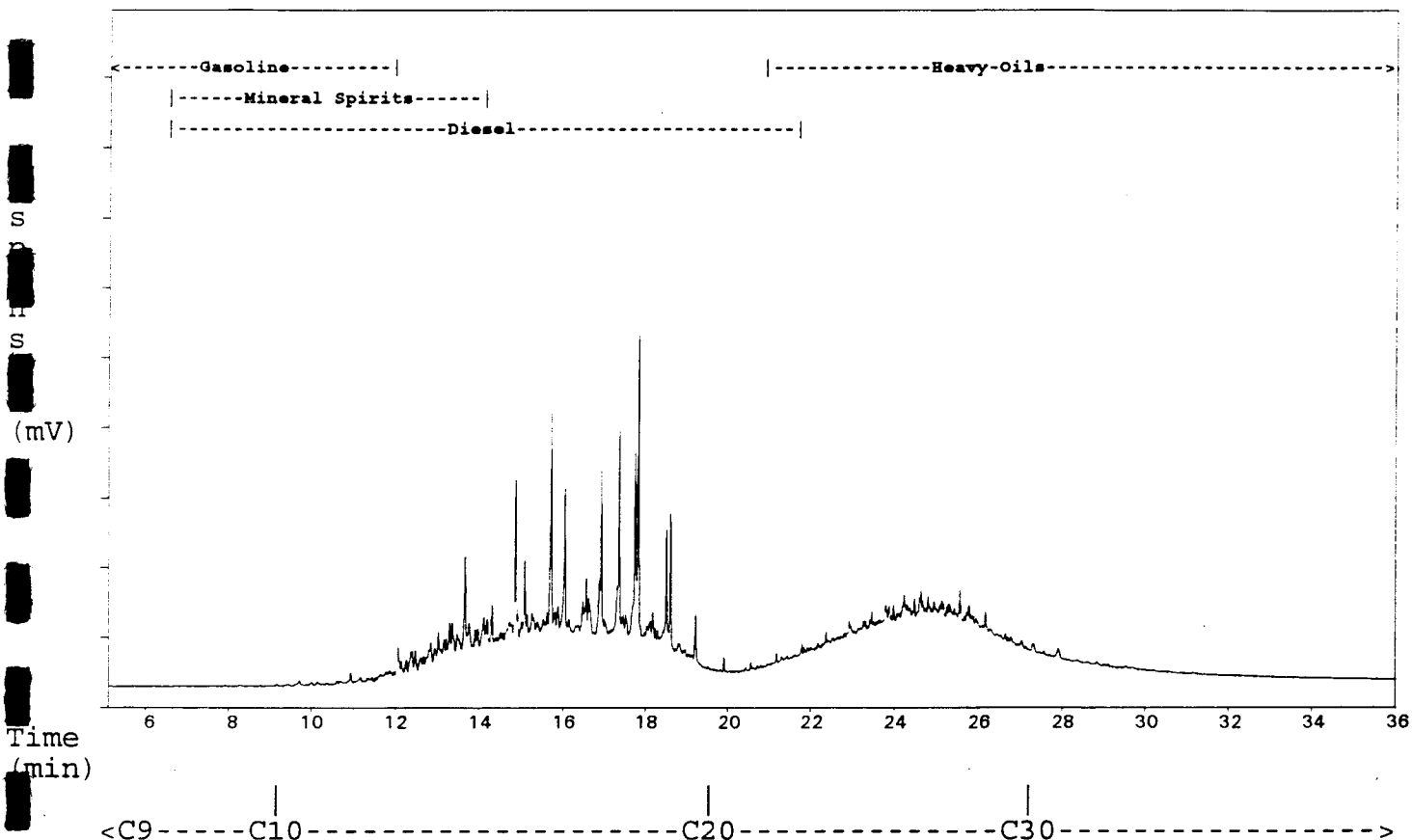
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E6113 18 P28

Sample acquired: DEC 6, 1994 19:09:13

File Name: c:\TEH\TEHDEC06.18R , Sample Name: E6113 18

Sequence file: TEHDEC06



ASL Sample ID: E6113 18* 16.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.1
Carbon 10 to Carbon 20 (C10-C20)	52.9
Carbon 20 to Carbon 30 (C20-C30)	34.0
Greater than Carbon 30 (>C30)	13.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

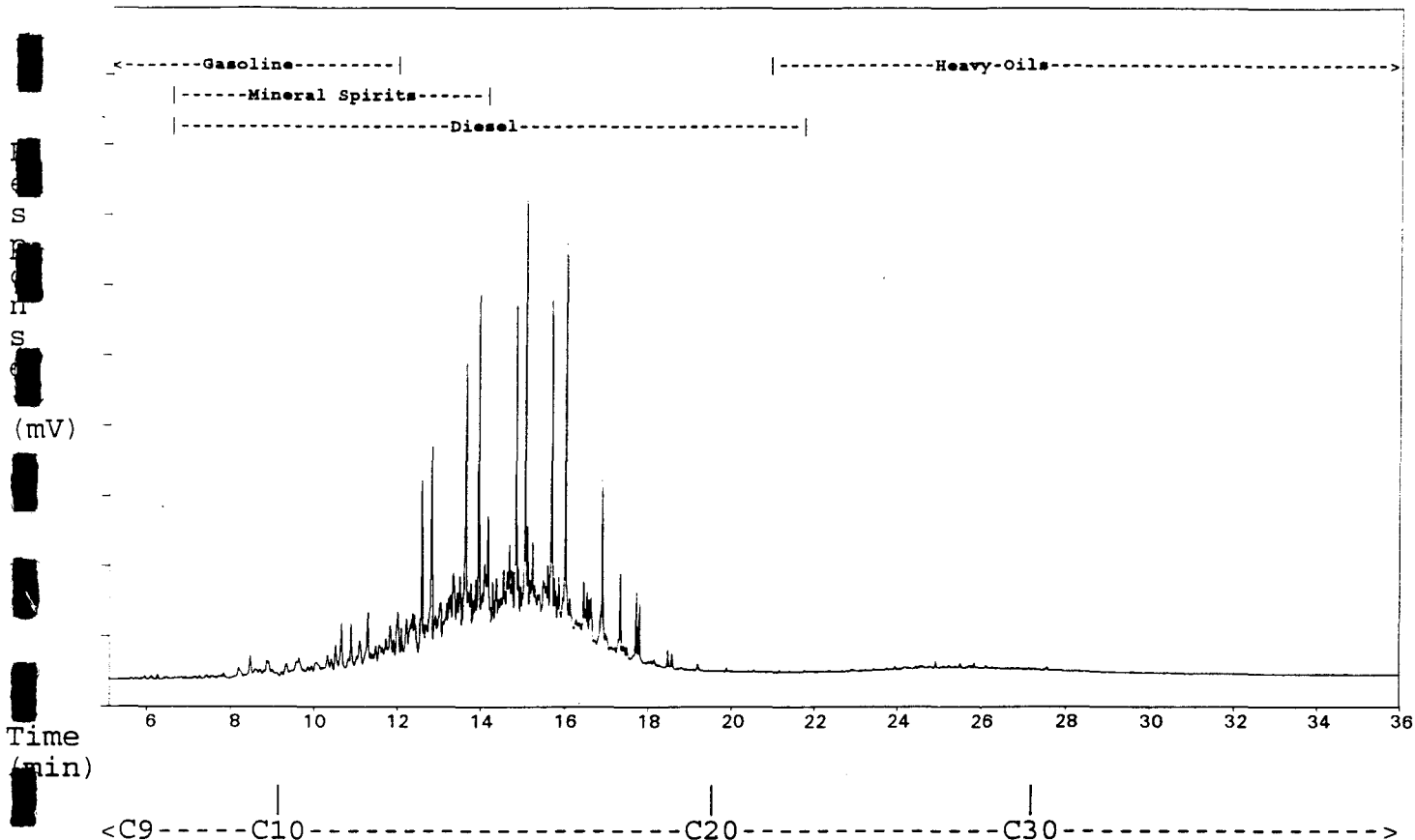
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E6113 19 P12

Sample acquired: DEC 6, 1994 19:59:02

File Name: c:\TEH\TEHDEC06.19R , Sample Name: E6113 19

Sequence file: TEHDEC06



ASL Sample ID: E6113 19* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	1.4
Carbon 10 to Carbon 20 (C10-C20)	90.8
Carbon 20 to Carbon 30 (C20-C30)	5.1
Greater than Carbon 30 (>C30)	2.7

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

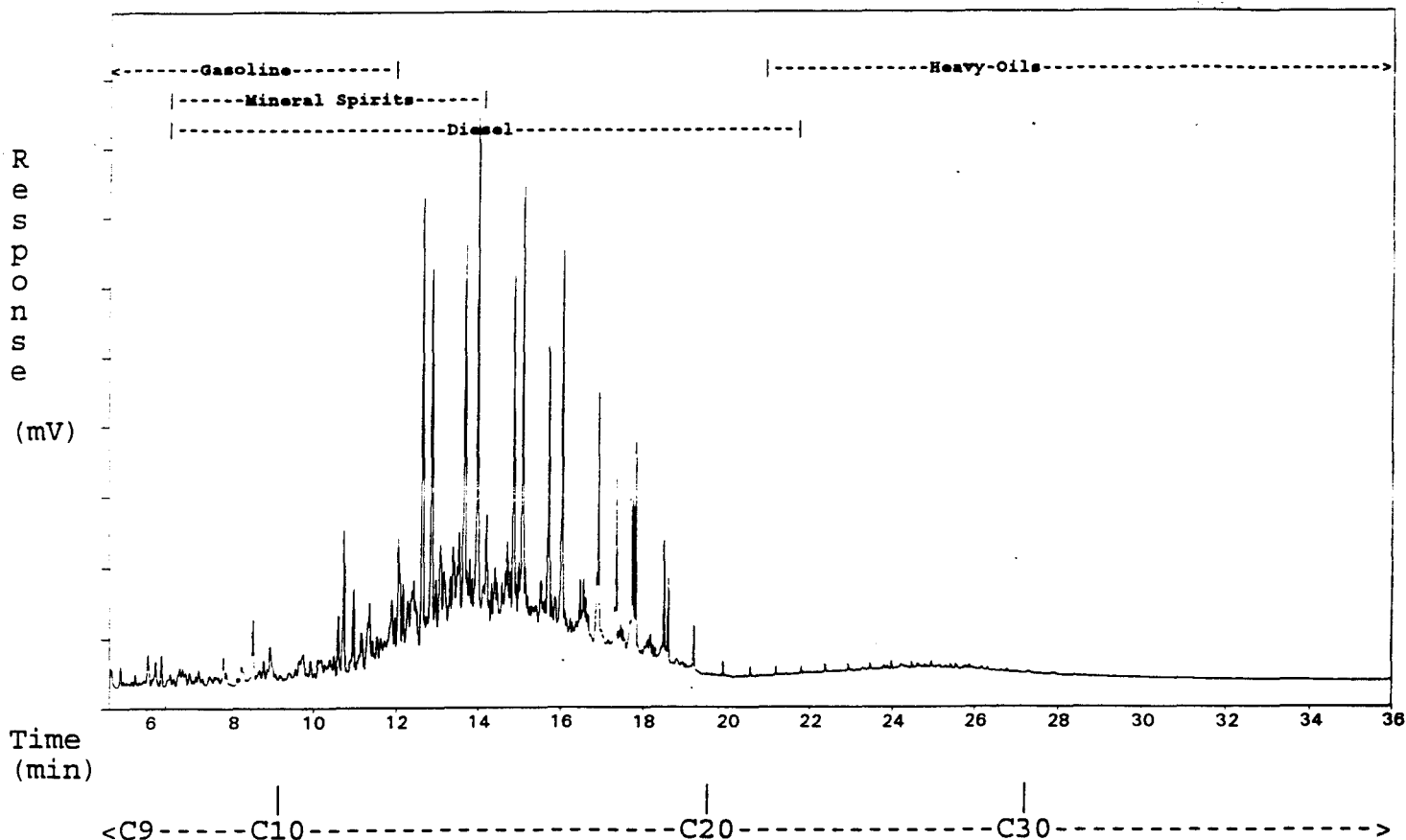
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E6113 20 P59

Sample acquired: DEC 6, 1994 19:59:02

File Name: c:\TEH\TEHDEC06.20R , Sample Name: E6113 20

Sequence file: TEHDEC06



ASL Sample ID: E6113 20* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	4.0
Carbon 10 to Carbon 20 (C10-C20)	85.5
Carbon 20 to Carbon 30 (C20-C30)	7.8
Greater than Carbon 30 (>C30)	2.7

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

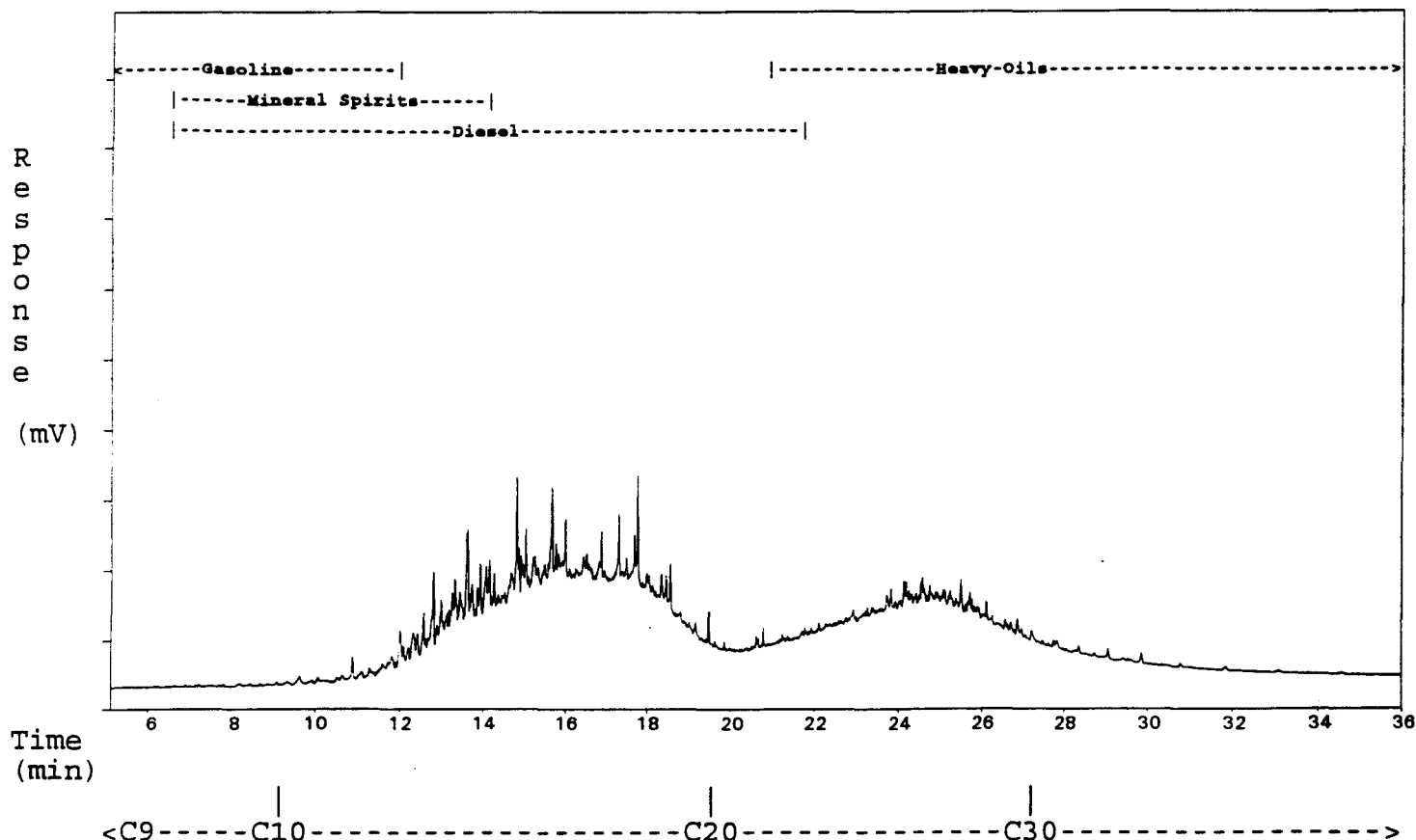
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E6113 22 04

Sample acquired: DEC 13, 1994 08:39:36

File Name: C:\TEH\TEHDEC12.58R , Sample Name: E6113 22

Sequence file: TEHDEC12



ASL Sample ID: E6113 22* 1.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.2
Carbon 10 to Carbon 20 (C10-C20)	58.2
Carbon 20 to Carbon 30 (C20-C30)	28.8
Greater than Carbon 30 (>C30)	12.9

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

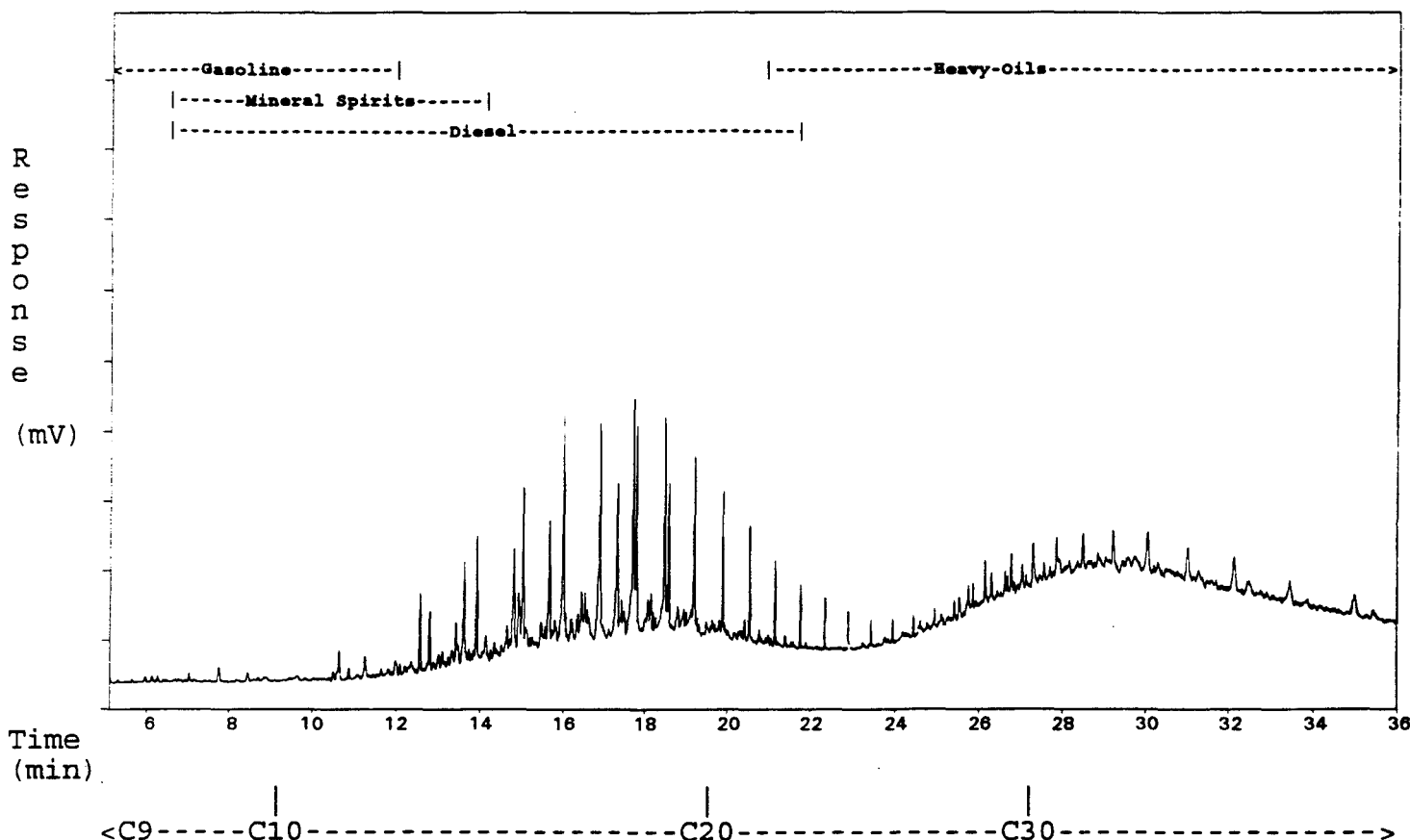
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E6113 21 P58 GC Scan

Sample acquired: DEC 13, 1994 08:39:36

File Name: C:\TEH\TEHDEC12.57R , Sample Name: E6113 21

Sequence file: TEHDEC12



ASL Sample ID: E6113 21* 1.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.7
Carbon 10 to Carbon 20 (C10-C20)	34.3
Carbon 20 to Carbon 30 (C20-C30)	7.8
Greater than Carbon 30 (>C30)	56.7

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

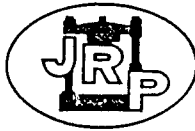
APPENDIX "C"

Results of Drilling Program and associated Laboratory Analyses

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 1-95		
Test hole drilled using a CME 75 rig			Test Hole #1-95 located 3.5 m S, 4.5 m E			PROJECT NO: 8054-9		
with solid stem augers			of E8 (refer to sketch)			ELEVATION: 100.31 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☒ GROUT	☒ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0	☒	H1		ORGANICS	0.1m					100.0
1.0	☒	H2		SANDY SILT -trace gravel, damp, dense, fine to medium grained sand, traces of oxidation, brown, some clay						99.0
2.0				SILTY GRAVELLY SAND -dense, damp, fine to medium grained, brown, till, traces of oxidation	1.8m					98.0
3.0	☒	H3								97.0
4.0				SANDY GRAVEL -clean, wet, coarse grained sand, gravel to 30 mm diameter retrieved, oxidation, free water begins at 3.4 meters	3.4m					96.0
5.0	☒	H4		END OF HOLE @ 4.6 m	4.6m					95.0
6.0				NOTES: -free water at approximately 3.4 metres -no evidence of hydrocarbons						94.0
7.0										93.0
8.0										

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Fig. No:	Page 1 of 1



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EDMONTON - GRANDE PRAIRIE - WHITEHORSE - PEACE RIVER

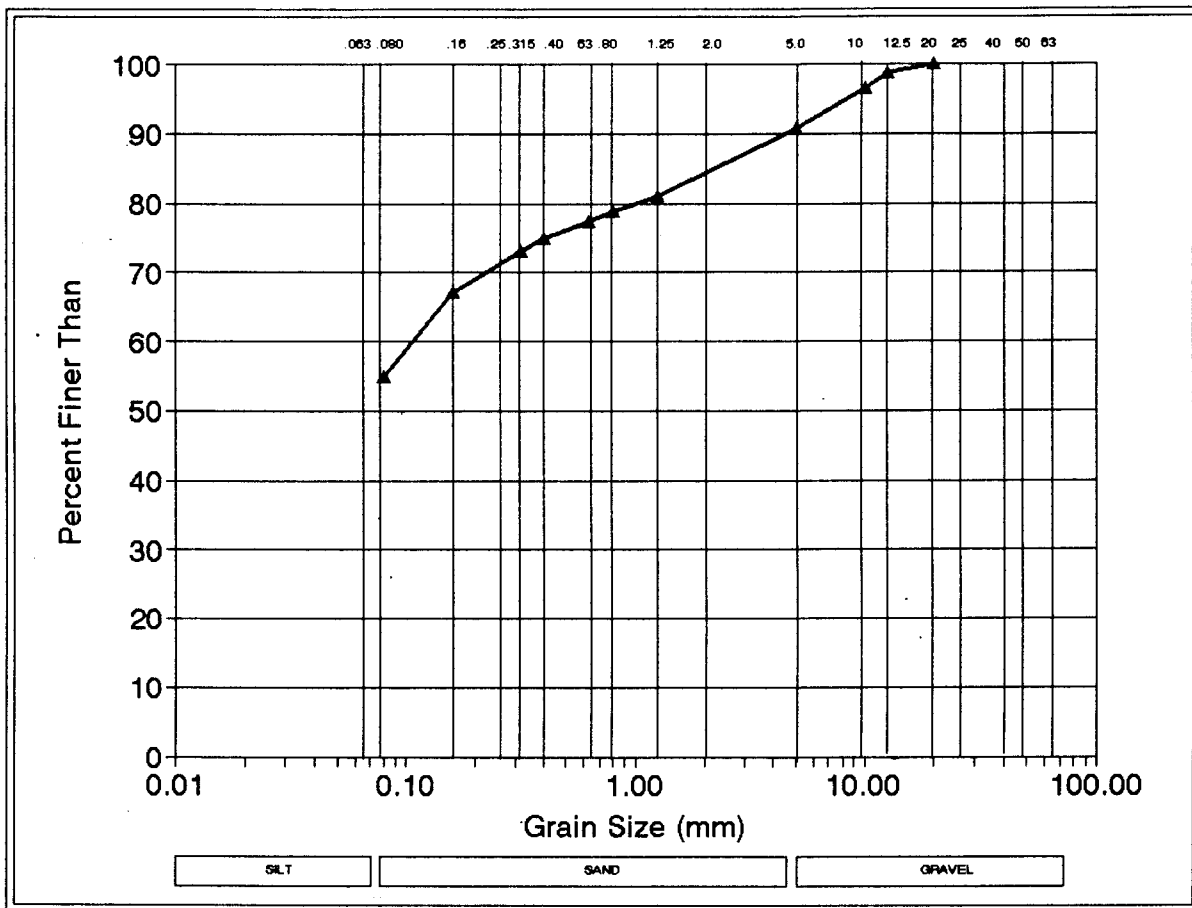
GRAIN SIZE ANALYSIS

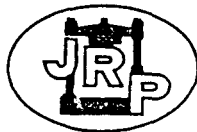
SAMPLE: H1	CLIENT: ACTION ON WASTE,
DEPTH: 0.15-0.30M	DIAND
LOCATION TH#1-95	PROJECT: HAINES JUNCTION
DATE: 95/02/03	REFINERY
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 8.9	CRUSH COUNT:
% GRAVEL: 9.4	% FRAC. FACES:
% SAND: 36.0	LIQUID LIMIT:
% SILT: 54.6	PLASTIC LIMIT:
DESCRIPTION OF SAMPLE:	REMARKS:
SANDY SILT, TRACE	
OF GRAVEL, ML	

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	100.0
14000	14.0	
12500	12.5	98.6
10000	10.0	96.4
5000	5.0	90.6
2000	2.0	83.9
1250	1.250	81.0
800	0.800	78.6
630	0.630	77.3
315	0.315	72.8
250	0.250	
160	0.160	67.1
80	0.080	54.6





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GRAIN SIZE ANALYSIS

SAMPLE: H8	CLIENT: ACTION ON WASTE,
DEPTH: 3.05-3.35M	DIAND
LOCATION TH#2-95	PROJECT: HAINES JUNCTION
DATE: 95/02/03	REFINERY
MADE BY: RL	CHECKED:

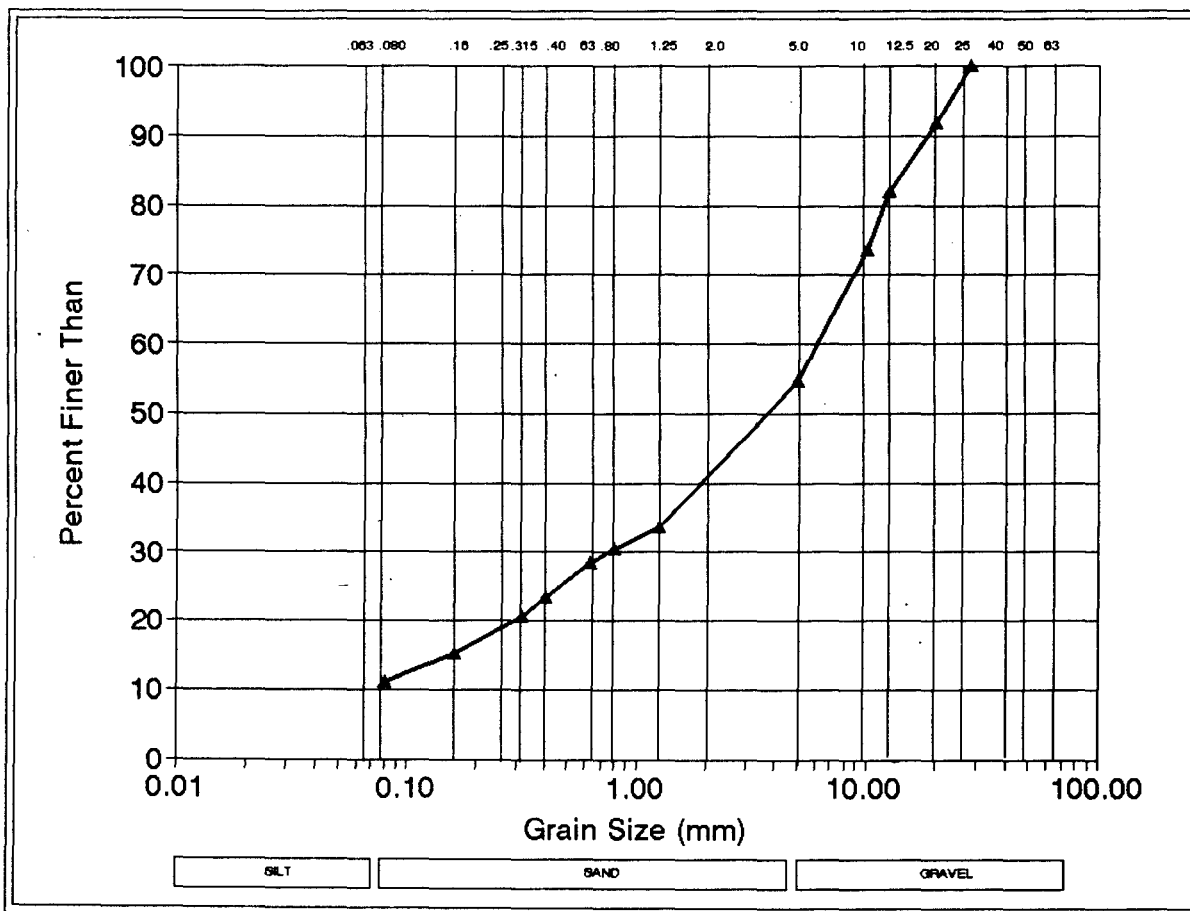
CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 3.8	CRUSH COUNT:
% GRAVEL: 45.4	% FRAC. FACES:
% SAND: 43.5	LIQUID LIMIT:
% SILT: 11.0	PLASTIC LIMIT:

DESCRIPTION OF SAMPLE: REMARKS:

SANDY GRAVEL, SOME SILT
GW-GM

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	100.0
20000	20.0	91.8
14000	14.0	
12500	12.5	81.9
10000	10.0	73.6
5000	5.0	54.6
2000	2.0	38.0
1250	1.250	33.5
800	0.800	30.5
630	0.630	28.3
315	0.315	20.4
250	0.250	
160	0.160	15.1
80	0.080	11.0



CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 2-95		
Test hole drilled using a CME 75 rig			Test Hole #2-95 located 1.0 m East			PROJECT NO: 8054-9		
with solid stem augers			of E8 (refer to sketch)			ELEVATION: 100.727 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	PLASTIC M.C. LIQUID			SOILS DESCRIPTION				Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				10	20	30	40	20	40	60				
0.0								ORGANICS						
								SILTY SAND	0.1m					
								-some gravel, damp, dense, frozen, brown						
								SANDY SILT	0.6m					
								-damp, poorly graded, fine grained sand, brown/grey colour striations, traces of oxidation						
1.0														
2.0								SILTY GRAVELLY SAND	1.8m					
								-dense, brown, damp, oxidation throughout, fill, no hydrocarbon odour						
3.0								SANDY GRAVEL	2.7m					
								-some silt, coarse grained sand, wet, medium dense, hydrocarbon odour begins at 2.7 metres						
								-grainsize analysis performed on sample H8						
4.0														
5.0														
6.0														
7.0														
8.0														

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
Fig. No:		Page 1 of 1	

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 3-95		
Test hole drilled using a CME 75 rig			Test Hole #3-95 located 3.5 m East			PROJECT NO: 8054-9		
with solid stem augers			of E8 (refer to sketch)			ELEVATION: 100.302 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0				ORGANICS	0.1m		-H10 chemical test results: -11600ppm (O&G) (pure phase pitch within sample)	PT		100.0
				SILTY GRAVELLY SAND -traces of clay, dense, frozen, fine to medium grained sand, possibly fill -chemical analysis on H10	0.6m			SM		
1.0				SANDY SILT -some clay, brown/grey, dense, low plasticity, stiff, fine grained sand, oxidation throughout				ML		99.0
2.0										98.0
3.0				SANDY GRAVEL -trace silt, coarse grained sand, wet, hydrocarbon odour present, loose, -chemical analysis on H12	2.7m		-H12 chemical test results: -<40 ppm (TEH)			97.0
									GW	
4.0										96.0
5.0				END OF HOLE @ 4.6m	4.6m					95.0
6.0				NOTES: -static water at approximately 3.4 m -hydrocarbon odour noted once gravel stratum penetrated						94.0
7.0										93.0
8.0										

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 4-95		
Test hole drilled using a CME 75 rig			Test Hole #4-95 located 4.0 m East, 5 m			PROJECT NO: 8054-9		
with solid stem augers			south of E7 (refer to sketch)			ELEVATION: 100.355 (m)		
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE								
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND								

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				PLASTIC	M.C.	LIQUID				
0.0				ORGANICS	0.1m					100.0
0.1				SANDY SILT						
				-dense, grey/brown, frozen to 1.3 m, moist, fine grained sand						
1.0										
1.5	X	H14								
2.0	X	H15								
2.1				SILTY GRAVELLY SAND	2.1m					
				-dense, damp, well graded, fine to medium grained sand, traces of oxidation						
2.7				SANDY GRAVEL	2.7m					
				-trace silt, coarse grained sand, moist, well graded, traces of oxidation, brown,						
3.0	X	H16								
3.7				-hydrocarbon and free water starts at 3.7 m						
4.0	X	H17		-chemical analysis on sample H17						
4.3				-hydrocarbons less prominent at 4.3 m						
4.5	X	H18								
4.9				SANDY SILT	4.9m					
				-trace gravel, very dense, moist, no evidence of hydrocarbons, medium plasticity, traces of oxidation						
				fines consist of silt and clay						
				-chemical analysis on sample H20						
5.0	X	H19								
6.0	X	H20								
6.0				END OF HOLE @ 6.0 m	6.0m					
6.0				NOTES: -hydrocarbons and free water begin at approximately 3.7 metres						
7.0										
8.0										

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 6.0 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST HOLE NO: 5-95	
Test hole drilled using a CME 75 rig		Test Hole #5-95 located 3.5 m East		PROJECT NO: 8054-9	
with solid stem augers		of D7 (refer to sketch)		ELEVATION: 100.265 (m)	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☒ DRILL CUTTINGS ☐ SAND					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION		Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				LIQUID	PLASTIC				
				10 20 30 40	10 20 30 40				
0.0	☒	H21		ORGANICS	0.1m				100.0
0.6				SANDY SILT	0.6m				
1.0	☒	H22		-some gravel, dense, fine grained sand, grey/brown, frozen to 1.2 m, moist					
2.0				SAND	1.8m				
2.4	☒	H23		-trace silt, medium grained, uniform in composition, damp					
2.9				SANDY GRAVEL	2.4m				
3.0	☒	H24		-trace silt, moist, medium dense, coarse brown, oxidation					
3.4				SAND	2.9m				
4.0	☒	H25		-some silt, fine grained sand, wet, no hydrocarbon odour encountered					
4.4				SANDY GRAVEL	3.4m				
4.6				-coarse, wet, clean, loose, oxidation, no hydrocarbons present					
5.0				SILT	4.4m				
5.0				-some clay and sand, dense, stiff, moist grey, low plasticity, oxidation present					
5.0				END OF HOLE @ 4.6m	4.6m				95.0
6.0				NOTES:					
6.0				-free water noted at 3.4 metres					
6.0				-no hydrocarbons noted					
7.0									94.0
8.0									93.0

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 6-95		
Test hole drilled using a CME 75 rig			Test Hole #6-95 located 5.2 m East, 1.0			PROJECT NO: 8054-9		
with solid stem augers			m north of E6 (refer to sketch)			ELEVATION: 100.432 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				LIQUID	PLASTIC	M.C.				
0.0	☒	H21								100.0
0.6										
1.0	☒	H22								99.0
2.0										
2.4	☒	H23								98.0
3.0	☒	H24								97.0
4.0	☒	H25								96.0
4.6										95.0
5.0										94.0
6.0										93.0
7.0										
8.0										

J.R. Paine & Associates Ltd.		LOGGED BY: MEB	COMPLETION DEPTH: 3.0 m
Whitehorse, Yukon		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Flg. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 7-95		
Test hole drilled using a CME 75 rig			Test Hole #7-95 located 5.5 m north, 6.0			PROJECT NO: 8054-9		
with solid stem augers			m west of B9 (refer to sketch)			ELEVATION: 100.004 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				LIQUID	PLASTIC	M.C.				
0.0	☒	H28								100.0
0.1				ORGANICS						
0.1				GRAVELLY SILTY SAND -damp, fine grained sand, very dense, auger action indicates possible cobble presence, traces of oxidation						
2.4				-gravel content increases, less fines						
3.4	☒	H29		GRAVEL -some sand, coarse grained sand, wet, oxidation noted, loose, no hydrocarbon presence						
4.6	☒	H30		END OF HOLE @ 4.6 m						
				NOTES: -free water occurs at 3.4 meters -no hydrocarbons present						

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 3.0 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 8-95		
Test hole drilled using a CME 75 rig			Test Hole #8-95 located 2.0 m west, 2.0			PROJECT NO: 8054-9		
with solid stem augers			m south of B8 (refer to sketch)			ELEVATION: 100.087 (m)		
SAMPLE TYPE			☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					
BACKFILL TYPE			☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0				ORGANICS	0.1m					100.0
1.0	X	H31		SILTY GRAVELLY SAND -damp and frozen to 1.2m, dense, difficult drilling - possibly cobbles,						99.0
2.0				SANDY GRAVEL -some silt, brown, moist, well graded, traces of oxidation, medium dense,	1.5m					98.0
3.0	X	H32		GRAVEL -some sand, coarse sand, brown, wet (free water), traces of oxidation, loose	2.4m					97.0
4.0										96.0
5.0										95.0
6.0	X	H33		SANDY SILT -some clay, medium plasticity, trace gravel, moist, dense, brown	5.2m					94.0
7.0				END OF HOLE @ 6.1 m	6.1m					93.0
8.0				NOTES: -free water encountered at 2.7 metres -no contamination encountered here						

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 6.1 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Flg. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 9-95		
Test hole drilled using a CME 75 rig			Test Hole #9-95 located 1.5 m west, 2.0			PROJECT NO: 8054-9		
with solid stem augers			m south of E5 (refer to sketch)			ELEVATION: 100.405 (m)		
SAMPLE TYPE		☒ TUBE	☒ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS	☐ SAND	

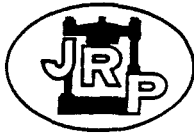
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0				ORGANICS	0.1m					100.0
0.3				SILTY SANDY GRAVEL -damp, dense, frozen to 1.2m, fine grained sands, brown	0.3m					99.0
1.0	X	H34		SILTY SAND -some clay, some gravel, light brown, dry, frozen, dense, fine grained sand -more gravel with depth						98.0
2.0										
2.5	X	H35								
3.0	X	H36		SANDY GRAVEL -clean, coarse grained sand, wet, loose, traces of oxidation	3.0m					97.0
4.0										
4.5	X	H37		SANDY SILT -some clay, dense, low plasticity, moist, firm, brown	4.1m					96.0
4.6				END OF HOLE @ 4.6 m	4.6m					95.0
5.0										94.0
6.0										93.0
7.0										
8.0										

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 10-95		
Test hole drilled using a CME 75 rig			Test Hole #10-95 located 1.5 m west of			PROJECT NO: 8054-9		
with solid stem augers			E3 (refer to sketch)			ELEVATION: 100.707 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☒ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	PLASTIC M.C. LIQUID			SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				10	20	30	40	20	40				
0.0													
0.1	X	H38							ORGANICS				
1.0									SANDY SILT -trace gravel, very dense, damp, fine grained sand, brown, no odour, frozen to 1.0 m, some clay				
2.0													
3.0	X	H39							SILTY GRAVELLY SAND -dense, fine to medium grained sand, brown, damp, slight hydrocarbon odour, traces of oxidation surrounding gravel				
3.4													
4.0	X	H40							SANDY GRAVEL -wet, coarse grained sand, trace of silt hydrocarbon presence, loose, well graded, oxidation -chemical analysis on sample H40				
5.0													
5.2	X	H41							SANDY SILT -some clay, medium plasticity, stiff, grey, moist, slight odour -chemical analysis on sample H42 to confirm absense -hydrometer analysis on H42				
6.0	X	H42											
6.1									END OF HOLE @ 6.1 m				
7.0									NOTES: -free water occurs at 3.4 m -hydrocarbon odour begins at 2.7 m and ends at approximately 5.5 metres				
8.0													

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 6.1 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Fig. No:	Page 1 of 1



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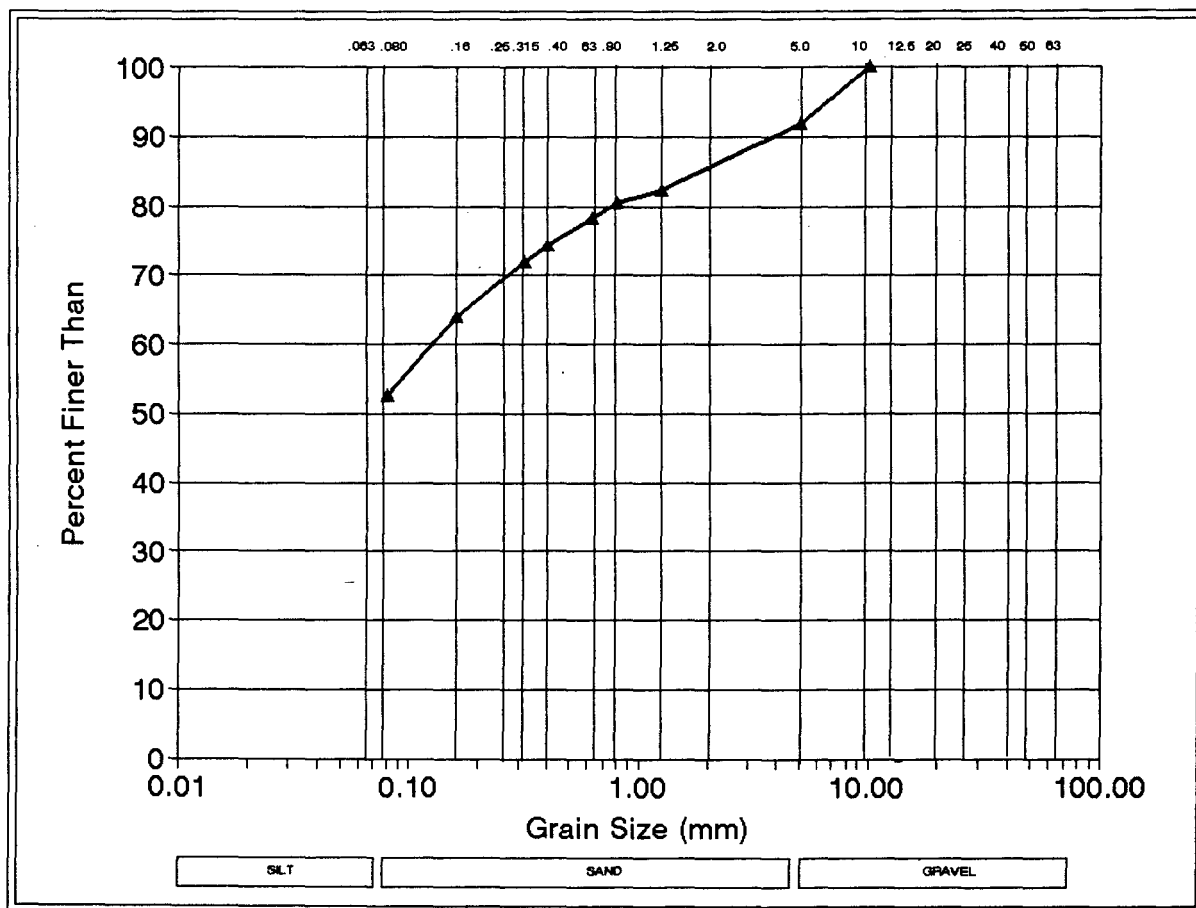
GRAIN SIZE ANALYSIS

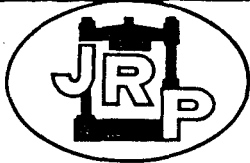
SAMPLE: H42	CLIENT: ACTION ON WASTE,
DEPTH: 5.8M	DIAND
LOCATION TH#10-95	PROJECT: HAINES JUNCTION
DATE: 95/02/06	REFINERY ASSESMENT
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 11.4	CRUSH COUNT:
% GRAVEL: 8.1	% FRAC. FACES:
% SAND: 39.4	LIQUID LIMIT:
% SILT: 52.5	PLASTIC LIMIT:
DESCRIPTION OF SAMPLE:	REMARKS:
SANDY SILT, SOME CLAY	
TRACE GRAVEL, ML	REFER TO HYDROMETER ANALYSIS FOR
	CLASSIFICATION OF FINE GRAINED SOILS

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	
14000	14.0	
12500	12.5	
10000	10.0	100.0
5000	5.0	91.9
2000	2.0	
1250	1.250	82.3
800	0.800	80.5
630	0.630	78.1
315	0.315	71.8
250	0.250	66.8
160	0.160	63.9
80	0.080	52.5





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

PROJECT HAINES JUNCTION REFINERY ASSESSMENT			CLIENT Action On Waste		DATE RECORDED 1995/02/16
STA.	SAMPLE TYPE	DEPTH 5.8m	HOLE NO. #10A-95	FIELD NO.	LAB NO. H 42

GRAIN SIZE ANALYSIS

SIEVE SIZE	% FINER BY WEIGHT	SIEVE SIZE	% FINER BY WEIGHT	DIA. mm	% FINER BY WEIGHT	DIA. mm	% FINER BY WEIGHT
				0.063	56	0.004	30
				0.045	53	0.003	27
				0.032	52	0.002	23
				0.022	48	0.001	19
				0.016	46		
				0.012	42		
				0.008	38		
				0.006	34		

PETROGRAPHIC ANALYSIS

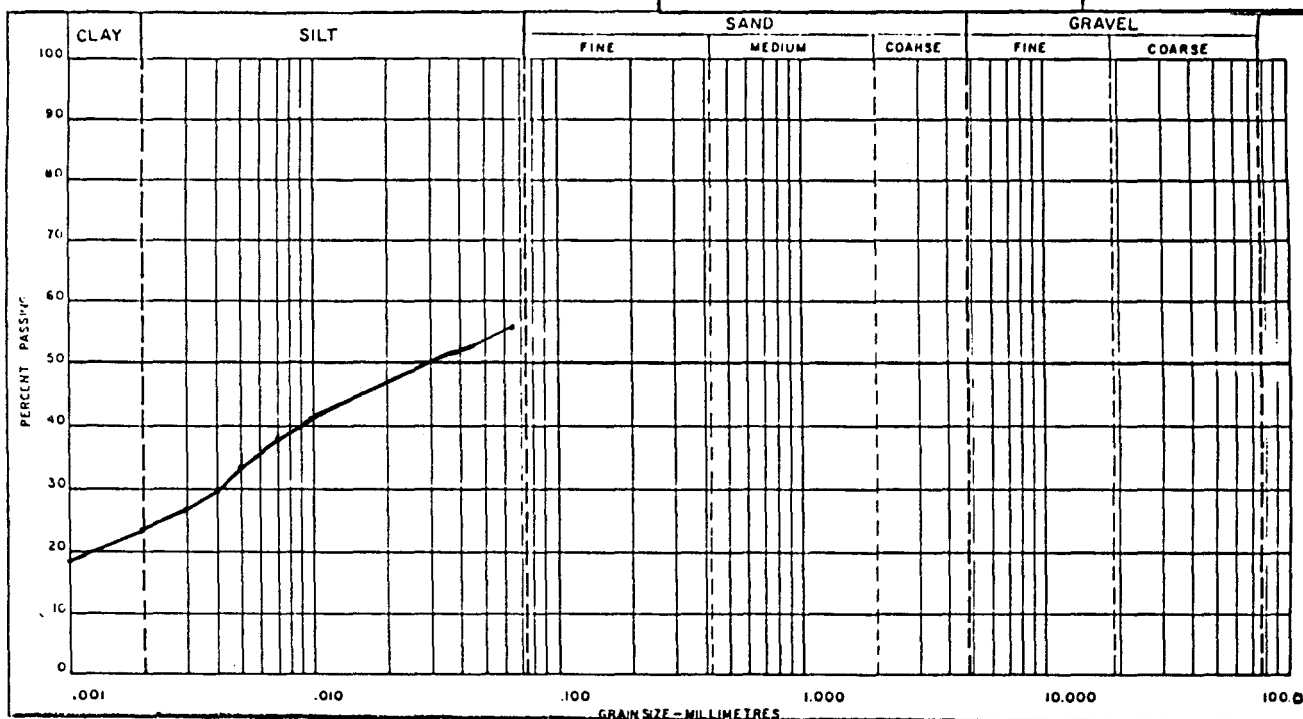
MATERIAL TYPE	% OF TOTAL SAMPLE

SAMPLE NO.	UNIFIED CLASSIFICATION	LL	PL	PI	NATURAL % H ₂ O	SS

PARTICLE SHAPE ANALYSIS

ROUND	
SUB-ROUND	
ANGULAR	
SUB-ANGULAR	
FLATS	
NEEDLES	

CRUSH COUNT _____ %



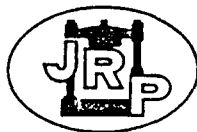
LABORATORY'S REMARKS _____
Clayey Silt, ML

DATE SAMPLED _____
 DATE RECEIVED _____
 TECHNICIAN(S) _____
 CHECKED BY _____

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 11-95		
Test hole drilled using a CME 75 rig			Test Hole #11-95 located 2.5 m west of			PROJECT NO: 8054-9		
with solid stem augers			D2 (refer to sketch)			ELEVATION: 100.397 (m)		
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE								
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND								

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	PLASTIC M.C. LIQUID			SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				10	20	30	40	20	40				
0.0								ORGANICS					
								SANDY SILT -light brown, dry, frozen to 1.2 m, medium dense, traces of oxidation, non plastic, no hydrocarbon presence					
1.0													
2.0													
2.1								SILTY GRAVELLY SAND -dry, well graded, medium grained sand, medium dense, traces of oxidation, no hydrocarbon presence					
3.0													
3.0								SANDY GRAVEL -clean, wet, loose, well graded, coarse grained sand, traces of oxidation, hydrocarbons encountered throughout gravel stratum -chemical analysis on H45					
4.0													
4.6								END OF HOLE @ 4.6m					
5.0													
6.0													
7.0													
8.0													

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/20
		Fig. No:	Page 1 of 1



J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS
EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

GRAIN SIZE ANALYSIS

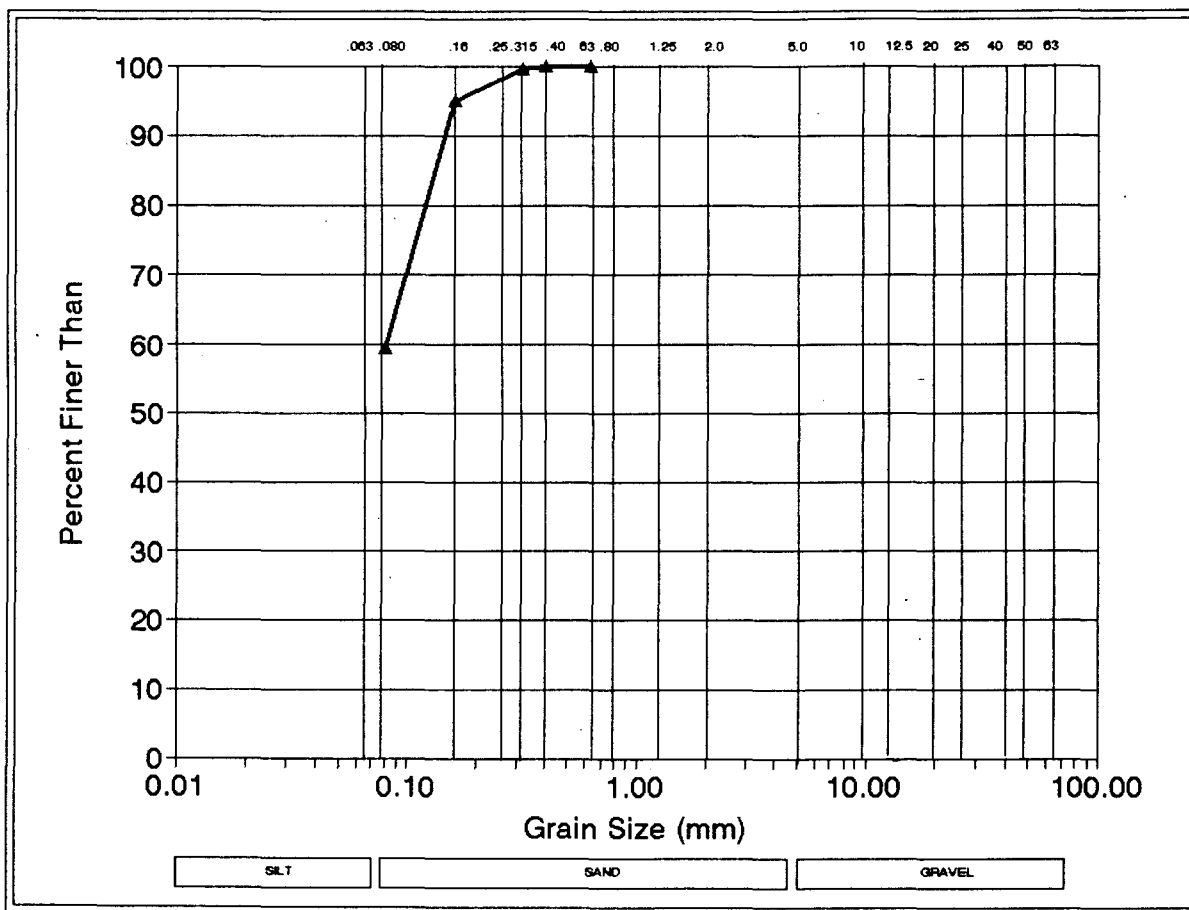
SAMPLE: H43	CLIENT: ACTION ON WASTE,
DEPTH: 1.22-1.50M	DIAND
LOCATION TH#11-95	PROJECT: HAINES JUNCTION
DATE: 95/02/03	REFINERY
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 5.5	CRUSH COUNT:
% GRAVEL: 0.0	% FRAC. FACES:
% SAND: 40.6	LIQUID LIMIT:
% SILT: 59.4	PLASTIC LIMIT:

DESCRIPTION OF SAMPLE:	REMARKS:
SANDY SILT, ML	

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	
14000	14.0	
12500	12.5	
10000	10.0	
5000	5.0	
2000	2.0	
1250	1.250	
800	0.800	
630	0.630	100.0
315	0.315	99.6
250	0.250	
160	0.160	95.0
80	0.080	59.4



CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 12-95		
Test hole drilled using a CME 75 rig			Test Hole #12-95 located 2.5 m west, 4.0			PROJECT NO: 8054-9		
with solid stem augers			m north of C1 (refer to sketch)			ELEVATION: 100.427 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☒ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
0.0				ORGANICS	0.1m					100.0
1.0				SANDY SILT -dry, light brown, frozen to 1.2 m, non-plastic, dense, traces of oxidation						99.0
2.0				SILTY SANDY GRAVEL -medium grained sand, well graded, damp, dense, traces of oxidation	2.0m					98.0
3.0				SANDY GRAVEL -clean, wet, very slight hydrocarbon odour, loose, traces of oxidation, dark brown	2.9m					97.0
4.0				-chemical analysis on sample H47						96.0
5.0				END OF HOLE @ 4.6m	4.6m					95.0
6.0				NOTES: -free water encountered at 2.9 m -very slight hydrocarbon odour noted however, H47 results indicates absence						94.0
7.0										93.0
8.0										

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/21
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 13-95		
Test hole drilled using a CME 75 rig			Test Hole #13-95 located at C3			PROJECT NO: 8054-9		
with solid stem augers			(refer to sketch)			ELEVATION: 100.327 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☒ DRILL CUTTINGS	☐ SAND	

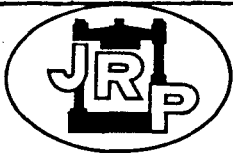
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION		Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				● LIQUID ● 20 40 60 80 ▲ PLASTIC ▲ 20 40 60 80 ■ SAND ■ 20 40 60 80 ◆ GRAVEL ◆ 20 40 60 80	PLASTIC M.C. LIQUID 10 20 30 40				
0.0				ORGANICS	0.1m				100.0
1.0				SANDY SILT -dry, light brown, frozen to 1.2 m, non-plastic, dense, traces of oxidation					99.0
2.0		H48		SANDY GRAVEL -trace silt, dark brown, no hydrocarbon odour, loose, traces of oxidation, dark brown, wet	1.8m				98.0
3.0				END OF HOLE @ 3.0m	3.0m				97.0
4.0									96.0
5.0									95.0
6.0									94.0
7.0									93.0
8.0									

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 3.0 m
		REVIEWED BY: WCK	COMPLETE: 95/01/21
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 14-95		
Test hole drilled using a CME 75 rig			Test Hole #14-95 located 3 m east, 5 m			PROJECT NO: 8054-9		
with solid stem augers			north of E1 (refer to sketch)			ELEVATION: 100.892 (m)		
SAMPLE TYPE		☒ TUBE	☒ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	PLASTIC M.C. LIQUID			SOILS DESCRIPTION				Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				10	20	30	40	CLAY	SILT	SAND				
0.0														
0.1								ORGANICS						
0.1m								SANDY CLAYEY SILT -light brown, frozen to 1.2 m medium plasticity, dense, traces of oxidation, fine grained sand						
1.0														
2.0														
2.1														
2.2														
2.3														
2.4														
2.5														
2.6														
2.7														
2.8														
2.9														
3.0														
3.1														
3.2														
3.3														
3.4														
3.5														
3.6														
3.7														
3.8														
3.9														
4.0														
4.1														
4.2														
4.3														
4.4														
4.5														
4.6														
4.7														
4.8														
4.9														
5.0														
5.1														
5.2														
5.3														
5.4														
5.5														
5.6														
5.7														
5.8														
5.9														
6.0														
6.1														
6.2														
6.3														
6.4														
6.5														
6.6														
6.7														
6.8														
6.9														
7.0														
7.1														
7.2														
7.3														
7.4														
7.5														
7.6														
7.7														
7.8														
7.9														
8.0														

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/21
Fig. No:		Page 1 of 1	



J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

EDMONTON - GRANDE PRAIRIE - WHITEHORSE - PEACE RIVER

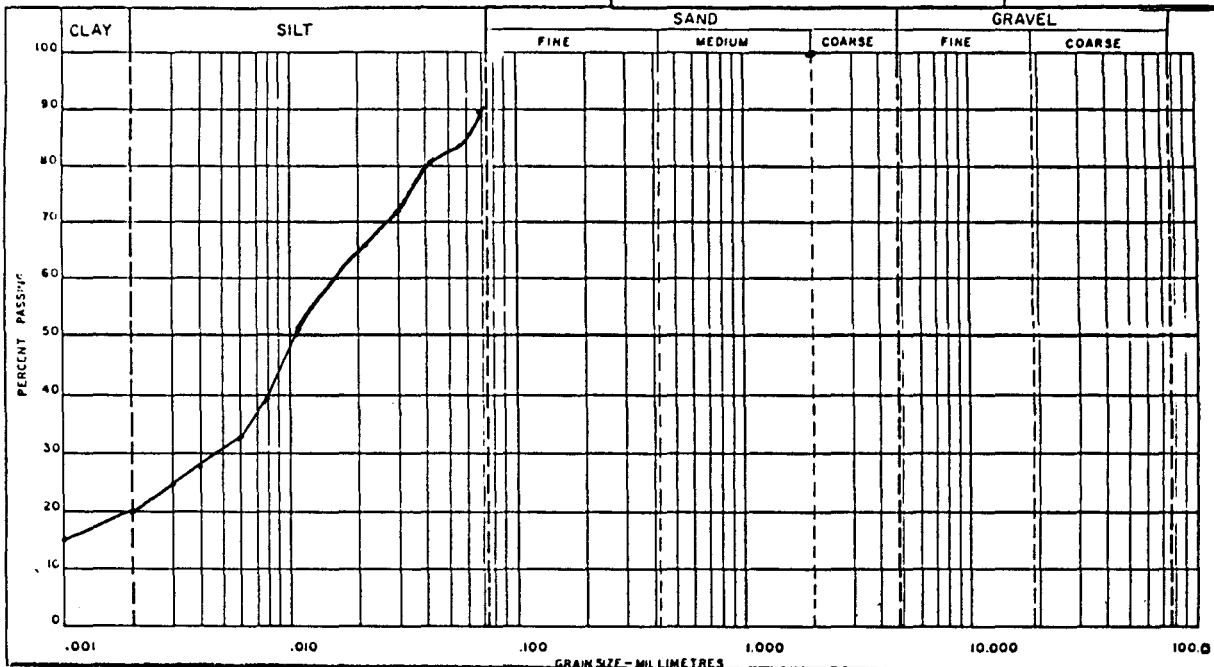
PROJECT HAINES JUNCTION REFINERY ASSESSMENT			CLIENT Action On Waste		DATE RECORDED 1995/02/16
STA.	SAMPLE TYPE	DEPTH 2.1m	HOLE NO. #14-95	FIELD NO.	LAB NO. H49

GRAIN SIZE ANALYSIS						PETROGRAPHIC ANALYSIS	
SIEVE SIZE	% FINER BY WEIGHT	SIEVE SIZE	% FINER BY WEIGHT	DIA. mm	% FINER BY WEIGHT	DIA. mm	% FINER BY WEIGHT
				0.059	84	0.004	28
				0.041	80	0.003	26
				0.030	71	0.002	20
				0.022	66	0.001	16
				0.015	59		
				0.011	52		
				0.008	40		
				0.006	37		
		0.063	89.8				

SAMPLE NO.	UNIFIED CLASSIFICATION	LL	PL	PI	NATURAL % H ₂ O	SG.

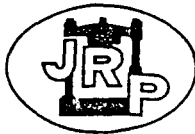
PARTICLE SHAPE ANALYSIS	
ROUND	
SUB-ROUND	
ANGULAR	
SUB-ANGULAR	
FLATS	
NEEDLES	

CRUSH COUNT _____ %



LABORATORY'S REMARKS
Clayey Silt, ML

DATE SAMPLED _____
 DATE RECEIVED _____
 TECHNICIAN(S) _____
 CHECKED BY _____



J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

EDMONTON - GRANDE PRAIRIE - WHITEHORSE - PEACE RIVER

GRAIN SIZE ANALYSIS

SAMPLE: H50	CLIENT: ACTION ON WASTE,
DEPTH: 3.96M	DIAND
LOCATION TH#14-95	PROJECT: HAINES JUNCTION
DATE: 95/02/03	REFINERY
MADE BY: RL	CHECKED:

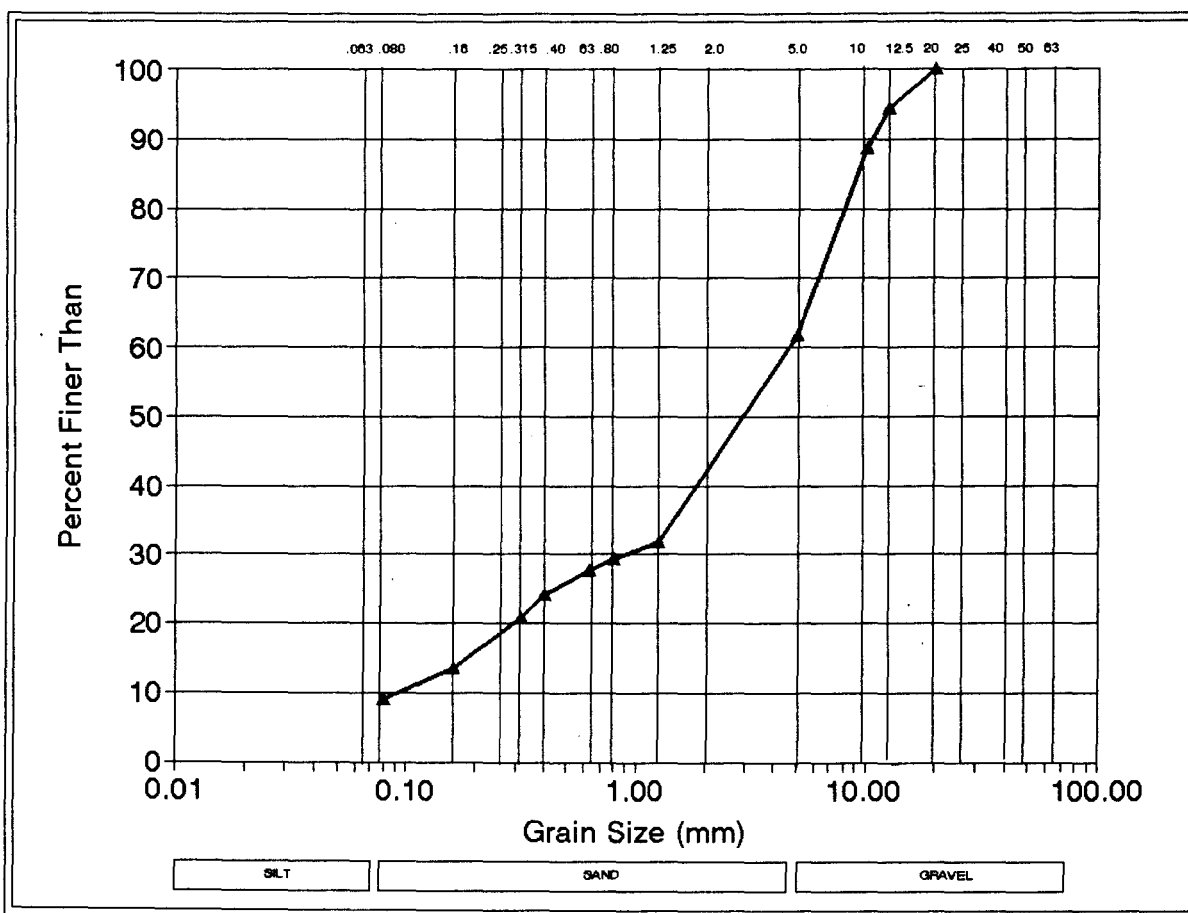
CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 3.6	CRUSH COUNT:
% GRAVEL: 38.3	% FRAC. FACES:
% SAND: 52.8	LIQUID LIMIT:
% SILT: 8.9	PLASTIC LIMIT:

DESCRIPTION OF SAMPLE: REMARKS:

GRAVELLY SAND, TRACE
OF SILT, SW-SM

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	100.0
14000	14.0	
12500	12.5	94.3
10000	10.0	88.7
5000	5.0	61.7
2000	2.0	35.1
1250	1.250	31.6
800	0.800	29.2
630	0.630	27.7
315	0.315	20.6
250	0.250	
160	0.160	13.4
80	0.080	8.9



CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 15-95		
Test hole drilled using a CME 75 rig			Test Hole #15-95 located 10 m west, 3 m			PROJECT NO: 8054-9		
with solid stem augers			south of F1(refer to sketch)			ELEVATION: 101.287 (m)		
SAMPLE TYPE		☒ TUBE	☐ LOST	☒ AUGER	☐ BULK	☐ SPT	☐ CORE	
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS	☐ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	PLASTIC M.C. LIQUID			SOILS DESCRIPTION			Chemical Test Results (ASL)			USC	SOIL SYMBOL	ELEVATION(m)
				10	20	30	40	20	40	60	80	20			
0.0								ORGANICS					PT		101.0
								SANDY SILT -trace gravel, dense, frozen to 1.2m damp, fine grained sand, low plasticity					ML		100.0
1.0															
2.0															
3.0								GRAVELLY SILTY SAND -dense, moist, gravel to 30 mm diam, dark brown					SM		99.0
4.0								SANDY GRAVEL -clean, loose, wet, well graded, medium to coarse grained sand					GW		98.0
5.0															97.0
6.0															96.0
7.0															95.0
8.0															94.0

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/21
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 16-95		
Test hole drilled using a CME 75 rig			Test Hole #16-95 located 3.5m east, 2.5m			PROJECT NO: 8054-9		
with solid stem augers			south of G2 (refer to sketch)			ELEVATION: 101.167 (m)		
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE								
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☒ GROUT ☒ DRILL CUTTINGS ☐ SAND								

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION			Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				PLASTIC	M.C.	LIQUID				
0.0										101.0
0.1										
1.0										
2.0	X	H53								
3.0										
4.0	X	H54								
4.3	X	H55								
5.0										
6.0										
7.0										
8.0										

ORGANICS

0.1m

SANDY SILT
-some clay, dry, light brown, dense, low plasticity, fine grained sand

-gravelly with depth

3.7m

SANDY GRAVEL
-clean, wet, loose, well graded, coarse grained sand, possibly hydrocarbons,

4.3m

SANDY SILT
-some clay, fine grained sand, trace gravel, oxidation around gravel,

4.6m

END OF HOLE @ 4.6 m

NOTES:
-free water at 4.0 metres
-very slight hydrocarbon odour noted in sample H54, however, chemical analysis indicates absence

Chemical Test Results (ASL)

-H54 chemical test results:
-<40 ppm (TEH)

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 4.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/21
		Fig. No:	Page 1 of 1

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST HOLE NO: 17-95	
Test hole drilled using a CME 75 rig		Test Hole #17-95 located 3.0m south of		PROJECT NO: 8054-9	
with solid stem augers		J7 (refer to sketch)		ELEVATION: 102.618 (m)	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

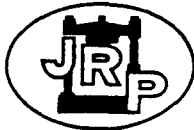
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	PLASTIC M.C. LIQUID		SOILS DESCRIPTION		CLAY SILT SAND GRAVEL		Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				10 20 30 40	10 20 30 40	20 40 60 80	20 40 60 80	20 40 60 80	20 40 60 80				
0.0						ORGANICS							102.0
1.0		H56				SANDY SILT -some clay, some gravel, dense, firm, dry, traces of oxidation, fine grained sand, brown, no hydrocarbon presence							101.0
2.0						-becomes trace gravel							100.0
3.0													99.0
4.0													98.0
5.0						-becomes moist and less firm							97.0
6.0						-becomes clayey, medium plasticity							96.0
7.0		H57				-40 mm thick coarse sand lens occurs							95.0
8.0													

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 10.6 m
		REVIEWED BY: WCK	COMPLETE: 95/01/21
		Fig. No:	Page 1 of 2

CLIENT: ACTION ON WASTE, DIAND		HAINES JUNCTION REFINERY ASSESSMENT		TEST HOLE NO: 17-95	
Test hole drilled using a CME 75 rig		Test Hole #17-95 located 3.0m south of		PROJECT NO: 8054-9	
with solid stem augers		J7 (refer to sketch)		ELEVATION: 102.618 (m)	
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	SOILS DESCRIPTION		Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				■ LIQUID ■ ▲ PLASTIC ▲ 10 20 30 40 10 20 30 40 PLASTIC M.C. LIQUID 10 20 30 40	● CLAY ● ▲ SILT ▲ ■ SAND ■ ◆ GRAVEL ◆ 20 40 60 80 20 40 60 80 20 40 60 80 20 40 60 80				
8.0									94.0
9.0	X	H58		-grainsize and hydrometer analysis performed on H58					93.0
10.0									92.0
11.0				END OF HOLE @ 10.6m					91.0
12.0				NOTES: -slotted well placed in this hole (advanced with solid stem augers) -static water level at 5.0 m noted when collecting water samples 95/1/31 -falling head slug injection test performed 95/1/31					90.0
13.0									89.0
14.0									88.0
15.0									87.0
16.0									

J.R. Paine & Associates Ltd.		LOGGED BY: MEB	COMPLETION DEPTH: 10.6 m
Whitehorse, Yukon		REVIEWED BY: WCK	COMPLETE: 95/01/21
		Fig. No:	Page 2 of 2



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CONSULTING AND TESTING ENGINEERS

EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

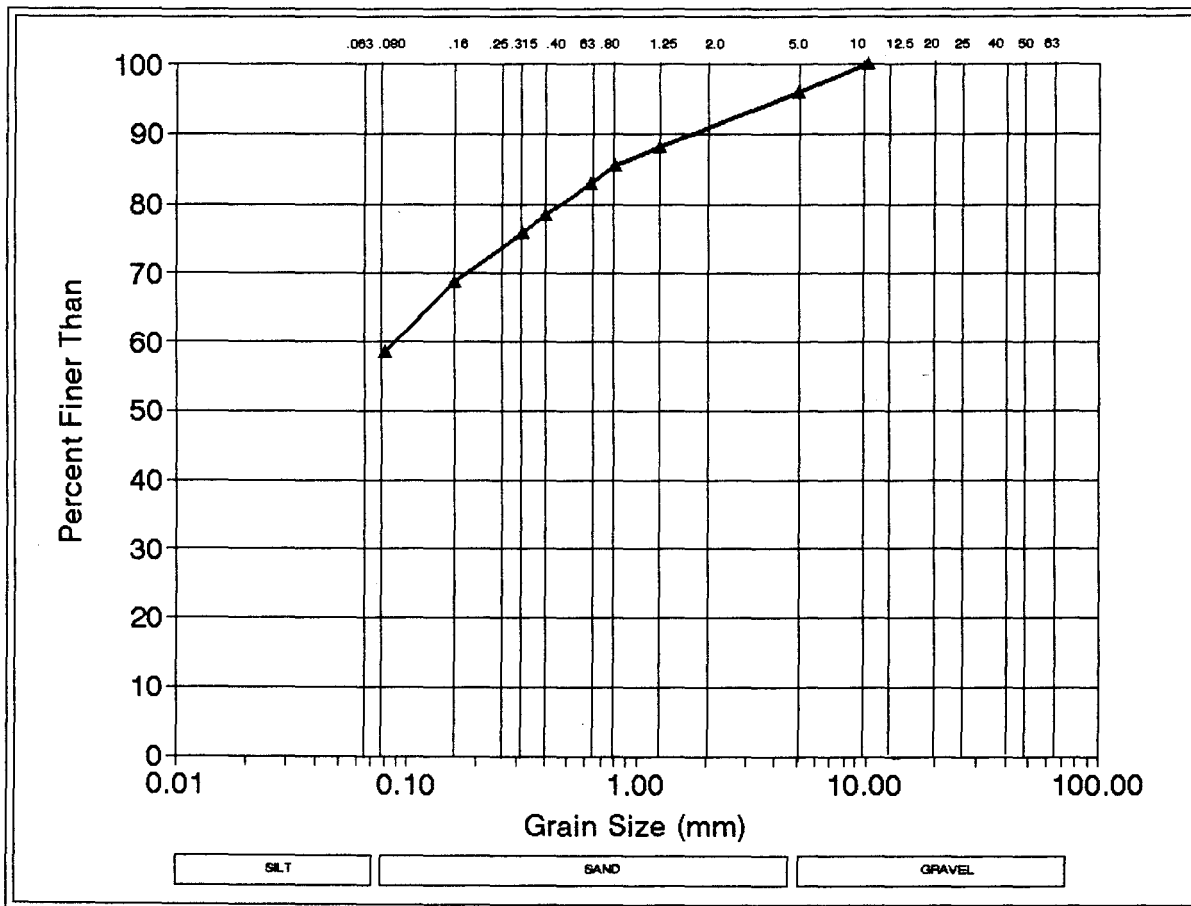
GRAIN SIZE ANALYSIS

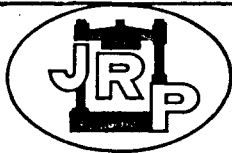
SAMPLE: H58	CLIENT: ACTION ON WASTE,
DEPTH: 8.84-9.14M	DIAND
LOCATION TH#17-95	PROJECT: HAINES JUNCTION
DATE: 95/02/06	REFINERY ASSESMEN
MADE BY: RL	CHECKED:

CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 10.7	CRUSH COUNT:
% GRAVEL: 4.2	% FRAC. FACES:
% SAND: 37.3	LIQUID LIMIT:
% SILT: 58.5	PLASTIC LIMIT:
DESCRIPTION OF SAMPLE:	REMARKS:
SANDY SILT, SOME CLAY	
ML	REFER TO HYDROMETER ANALYSIS FOR
	CLASSIFICATION OF FINE GRAINED SOILS

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	
14000	14.0	
12500	12.5	
10000	10.0	100.0
5000	5.0	95.8
2000	2.0	90.7
1250	1.250	88.0
800	0.800	85.5
630	0.630	82.9
315	0.315	75.6
250	0.250	
160	0.160	68.7
80	0.080	58.5





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CONSULTING AND TESTING ENGINEERS

EDMONTON - GRANDE PRAIRIE - WHITEHORSE - PEACE RIVER

PROJECT HAINES JUNCTION REFINERY ASSESSMENT			CLIENT Action On Waste		DATE RECORDED 1995/02/16
STA.	SAMPLE TYPE	DEPTH 8.8m	HOLE NO. #17-95	FIELD NO.	LAB NO. H 58

GRAIN SIZE ANALYSIS

SIEVE SIZE	% FINER BY WEIGHT	SIEVE SIZE	% FINER BY WEIGHT	DIA. mm	% FINER BY WEIGHT	DIA. mm	% FINER BY WEIGHT
				0.063	58	0.004	30
				0.045	55	0.003	27
				0.032	50	0.002	23
				0.023	47	0.001	20
				0.016	45		
				0.012	41		
				0.008	36		
				0.006	34		

PETROGRAPHIC ANALYSIS

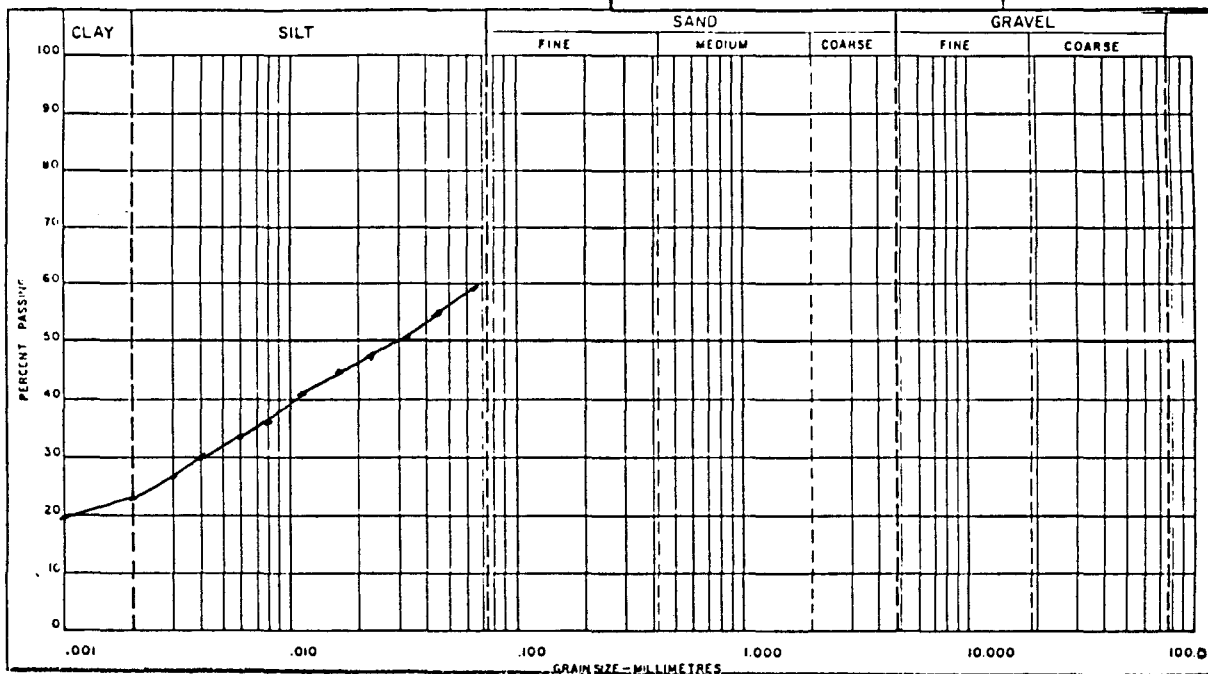
MATERIAL TYPE	% OF TOTAL SAMPLE

SAMPLE NO.	UNIFIED CLASSIFICATION	LL	PL	PI	NATURAL % H ₂ O	SG

PARTICLE SHAPE ANALYSIS

ROUND	
SUB-ROUND	
ANGULAR	
SUB-ANGULAR	
FLATS	
NEEDLES	

CRUSH COUNT _____ %



LABORATORY'S REMARKS
Clayey Silt, ML

DATE SAMPLED _____
 DATE RECEIVED _____
 TECHNICIAN(S) _____
 CHECKED BY _____

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 18-95		
Test hole drilled using a CME 75 rig			Test Hole #18-95 located 3 m west			PROJECT NO: 8054-9		
with solid stem augers			of C8 (refer to sketch)			ELEVATION: 100.10 (m)		
SAMPLE TYPE		☒ TUBE	☒ LOST	☒ AUGER	☒ BULK	☒ SPT	☒ CORE	
BACKFILL TYPE		☒ BENTONITE	☒ PEA GRAVEL	☒ SLOUGH	☒ GROUT	☒ DRILL CUTTINGS	☒ SAND	

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	SOILS DESCRIPTION		Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				■ LIQUID ■ ▲ PLASTIC ▲ 10 20 30 40 10 20 30 40 PLASTIC M.C. LIQUID 10 20 30 40	● CLAY ● ▲ SILT ▲ 20 40 60 80 20 40 60 80 ■ SAND ■ ◆ GRAVEL ◆ 20 40 60 80 20 40 60 80				
0.0				ORGANICS 0.1m					100.0
1.0				SILTY GRAVELLY SAND -damp and frozen to 1.2m, dense, difficult drilling - possibly cobbles,					99.0
2.0				SANDY GRAVEL -some silt, brown, moist, well graded, traces of oxidation, medium dense,					98.0
3.0				GRAVEL -some sand, coarse sand, brown, wet (free water), traces of oxidation, loose					97.0
4.0									96.0
5.0									95.0
6.0				SANDY SILT -some clay, medium plasticity, trace gravel, moist, dense, brown					94.0
7.0									93.0
8.0									

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 12.2 m
		REVIEWED BY: WCK	COMPLETE: 95/01/21
		Flg. No:	Page 1 of 2

CLIENT: ACTION ON WASTE, DIAND			HAINES JUNCTION REFINERY ASSESSMENT			TEST HOLE NO: 18-95		
Test hole drilled using a CME 75 rig			Test Hole #18-95 located 3 m west			PROJECT NO: 8054-9		
with solid stem augers			of C8 (refer to sketch)			ELEVATION: 100.10 (m)		
SAMPLE TYPE ☒ TUBE ☐ LOST ☒ AUGER ☐ BULK ☐ SPT ☐ CORE								
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND								

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	INSTRUMENTATION DATA	PLASTICITY INDEX		LIQUID LIMIT		SOILS DESCRIPTION				Chemical Test Results (ASL)	USC	SOIL SYMBOL	ELEVATION(m)
				10	20	30	40	10	20	30	40				
8.0															92.0
9.0															91.0
10.0															90.0
11.0															89.0
12.0	☒	H59		●						●●	▲				88.0
				SANDY SILT -some clay, medium plasticity, moist, stiff, brown, dense											
				END OF HOLE @ 12.2 m											
13.0															87.0
14.0															86.0
15.0															85.0
16.0															

J.R. Paine & Associates Ltd. Whitehorse, Yukon		LOGGED BY: MEB	COMPLETION DEPTH: 12.2 m
		REVIEWED BY: WCK	COMPLETE: 95/01/21
		Fig. No:	Page 2 of 2



J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS
EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

GRAIN SIZE ANALYSIS

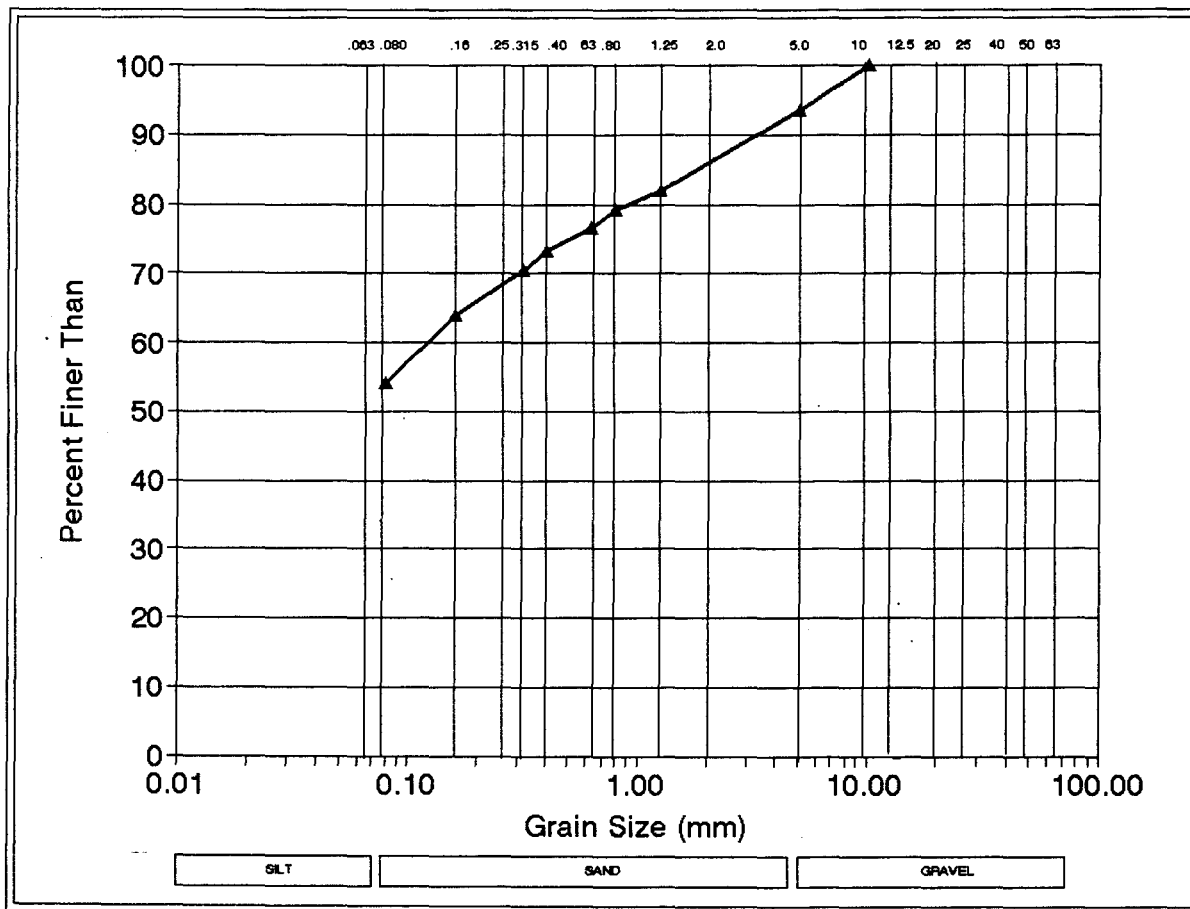
SAMPLE: H59	CLIENT: ACTION ON WASTE,
DEPTH: 11.89-12.19M	DIAND
LOCATION TH#18-95	PROJECT: HAINES JUNCTION
DATE: 95/02/06	REFINERY ASSESMEN
MADE BY: RL	CHECKED:

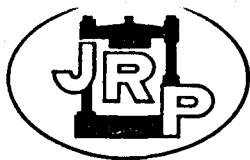
CHARACTERISTICS OF SAMPLE:

MOIST. CONT.: 13.0	CRUSH COUNT:
% GRAVEL: 6.5	% FRAC. FACES:
% SAND: 39.5	LIQUID LIMIT:
% SILT: 54.0	PLASTIC LIMIT:

DESCRIPTION OF SAMPLE:	REMARKS:
SANDY SILT, SOME CLAY,	
TRACE GRAVEL,	REFER TO HYDROMETER ANALYSIS FOR
ML	CLASSIFICATION OF FINE GRAINED SOILS

Sieve No.	Size of Opening (mm)	% Finer Than Basis Orig. Sample
63000	63.0	
40000	40.0	
28000	28.0	
20000	20.0	
14000	14.0	
12500	12.5	
10000	10.0	100.0
5000	5.0	93.5
2000	2.0	84.9
1250	1.250	81.8
800	0.800	79.0
630	0.630	76.6
315	0.315	70.4
250	0.250	
160	0.160	63.7
80	0.080	54.0





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

EDMONTON - GRANDE PRAIRIE - WHITEHORSE - PEACE RIVER

PROJECT HAINES JUNCTION REFINERY ASSESSMENT			CLIENT Action On Waste		DATE RECORDED 1995/02/16
STA.	SAMPLE TYPE	DEPTH 11.9m	HOLE NO. #18-95	FIELD NO.	LAB NO. H 59

GRAIN SIZE ANALYSIS

SIEVE SIZE	% FINER BY WEIGHT	SIEVE SIZE	% FINER BY WEIGHT	DIA. mm	% FINER BY WEIGHT	DIA. mm	% FINER BY WEIGHT
				0.063	60	0.004	30
				0.045	56	0.003	26
				0.032	51	0.002	23
				0.030	50	0.001	20
				0.016	43		
				0.012	38		
				0.008	36		
				0.006	33		

SAMPLE NO.	UNIFIED CLASSIFICATION	LL	P.L	P.I.	NATURAL % H ₂ O	SG.

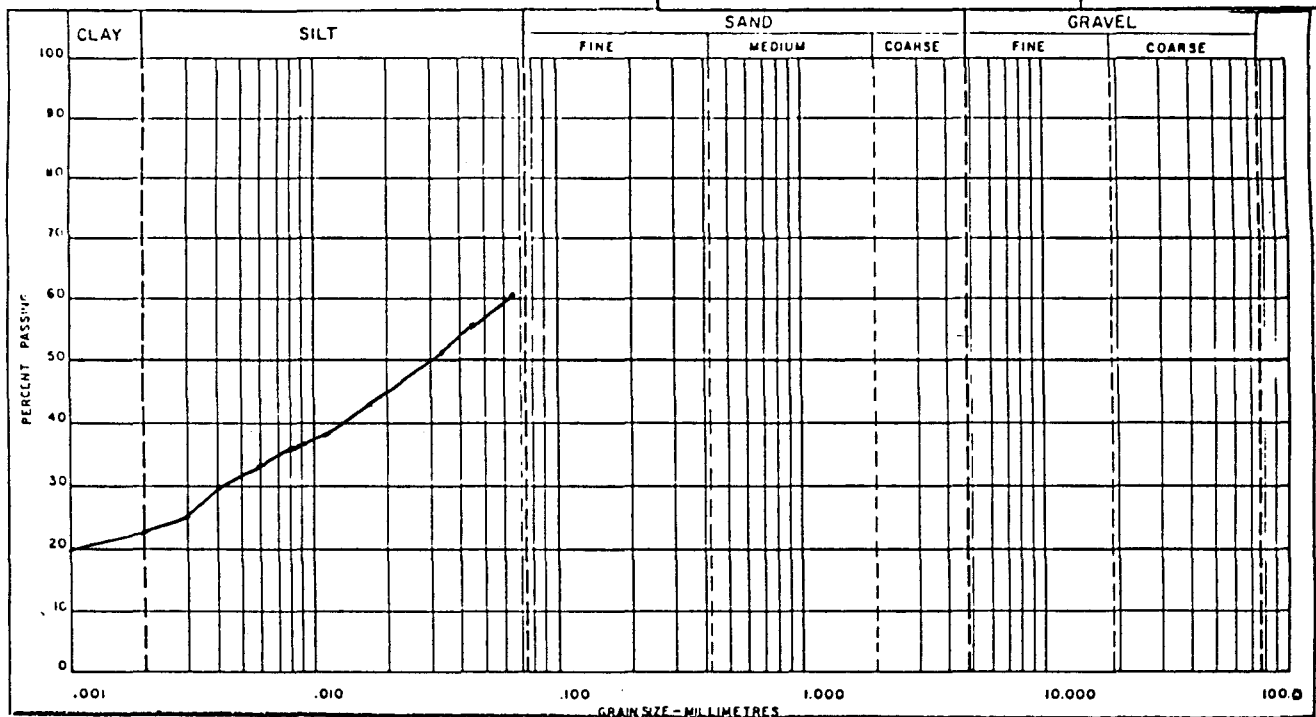
PETROGRAPHIC ANALYSIS

MATERIAL TYPE	% OF TOTAL SAMPLE

PARTICLE SHAPE ANALYSIS

ROUND	
SUB-ROUND	
ANGULAR	
SUB-ANGULAR	
FLATS	
NEEDLES	

CRUSH COUNT _____ %



LABORATORY'S REMARKS
Clayey Silt, ML

DATE SAMPLED _____
DATE RECEIVED _____
TECHNICIAN(S) _____
CHECKED BY _____

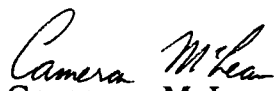


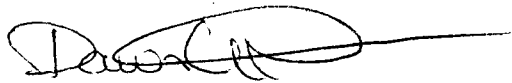
CHEMICAL ANALYSIS REPORT

Date: February 15, 1995
ASL File No. E7335
Report On: Soil Analysis
Report To: **J. R. Paine and Associates Ltd.**
14 Burns Road
Whitehorse, YT
V1A 4Y9
Attention: **Mr. Michael Billowitz**
Received: February 7, 1995

ASL ANALYTICAL SERVICE LABORATORIES LTD.

per:


Cameron McLean, B.Sc
Project Chemist


Dawn Gilbert
Supervisor, Trace Organics Lab



RESULTS OF ANALYSIS - Sediment/Soil

File No. E7335

	H9	H10	H12	H17	H20
	95 02 06	95 02 06	95 02 06	95 02 06	95 02 06
<u>Physical Tests</u>					
Moisture %	7.0	9.7	5.1	6.0	11.1
<u>Organochloride Pesticides</u>					
Aldrin	-	<0.001	-	-	-
alpha-BHC	-	<0.001	-	-	-
beta-BHC	-	<0.002	-	-	-
gamma-BHC (Lindane)	-	<0.001	-	-	-
delta-BHC	-	<0.001	-	-	-
cis-Chlordane (alpha)	-	<0.001	-	-	-
trans-Chlordane (gamma)	-	<0.001	-	-	-
2,4'-DDD	-	<0.001	-	-	-
4,4'-DDD	-	<0.001	-	-	-
2,4'-DDE	-	<0.002	-	-	-
4,4'-DDE	-	<0.001	-	-	-
2,4'-DDT	-	<0.001	-	-	-
4,4'-DDT	-	<0.002	-	-	-
Dieldrin	-	<0.001	-	-	-
Endosulfan I	-	<0.001	-	-	-
Endosulfan II	-	<0.001	-	-	-
Endosulfan Sulfate	-	<0.001	-	-	-
Endrin	-	<0.005	-	-	-
Endrin Aldehyde	-	<0.001	-	-	-
Heptachlor	-	<0.002	-	-	-
Heptachlor Epoxide	-	<0.001	-	-	-
Methoxychlor	-	<0.005	-	-	-
Mirex	-	<0.001	-	-	-
cis-Nonachlor	-	<0.001	-	-	-
trans-Nonachlor	-	<0.001	-	-	-
Oxychlordane	-	<0.001	-	-	-
Toxaphene	-	<0.030	-	-	-
<u>Extractables</u>					
Oil and Grease	-	11600	-	-	-
Total Extr Hydrocarbons (C9-40)	618	-	<40	213	<40
Total Extr Hydrocarbons (C10-30)	606	-	<40	213	<40

Results are expressed as milligrams per dry kilogram except where noted.
< = Less than the detection limit indicated.



RESULTS OF ANALYSIS - Sediment/Soil

File No. E7335

	H40	H42	H45	H47	H50
	95 02 06	95 02 06	95 02 06	95 02 06	95 02 06
<u>Physical Tests</u>					
Moisture %	8.6	14.1	9.9	5.6	6.2
<u>Extractables</u>					
Oil and Grease	-	-	-	-	-
Total Extr Hydrocarbons (C9-40)	851	<40	554	<40	158
Total Extr Hydrocarbons (C10-30)	840	<40	553	<40	158

Results are expressed as milligrams per dry kilogram except where noted.
< = Less than the detection limit indicated.



RESULTS OF ANALYSIS - Sediment/Soil

File No. E7335

H54

95 02 06

Physical Tests

Moisture	%	6.5
----------	---	-----

Extractables

Oil and Grease	-
Total Extr Hydrocarbons (C9-40)	<40
Total Extr Hydrocarbons (C10-30)	<40

Results are expressed as milligrams per dry kilogram except where noted.
< = Less than the detection limit indicated.



Appendix 1 - METHODOLOGY

File No. E7335

Samples were analyzed by methods acceptable to the appropriate regulatory agency. Outlines of the methodologies utilized are as follows:

Moisture

This analysis is carried out gravimetrically by drying the sample to constant weight at 103 C.

Organochloride Pesticides in Sediment/Soil

This analysis is carried out in accordance with U.S. EPA Method 8080 (Publ. # SW-846 3rd ed., Washington, DC 20460). The procedure involves a solvent extraction with acetonitrile. The extract is then solvent exchanged to hexane followed by an alumina column clean-up. The final extract is analysed by dual capillary column gas chromatography with electron capture detection.

Oil and Grease in Sediment/Soil

This analysis is carried out by extracting the sample with hexane. The extract thus produced is evaporated to dryness and the residue weighed to determine gravimetric oil and grease.

Total Extractable Hydrocarbons in Sediment/Soil

This analysis is carried out in accordance with U.S. EPA Method 3500/8015 (Publ. # SW-846 3rd ed., Washington, DC 20460). This procedure involves hexane/acetone extraction followed by analysis of the extract by capillary column gas chromatography with flame ionization detection.



APPENDIX 2

**HYDROCARBON
DISTRIBUTION
REPORTS**

HYDROCARBON DISTRIBUTION REPORT

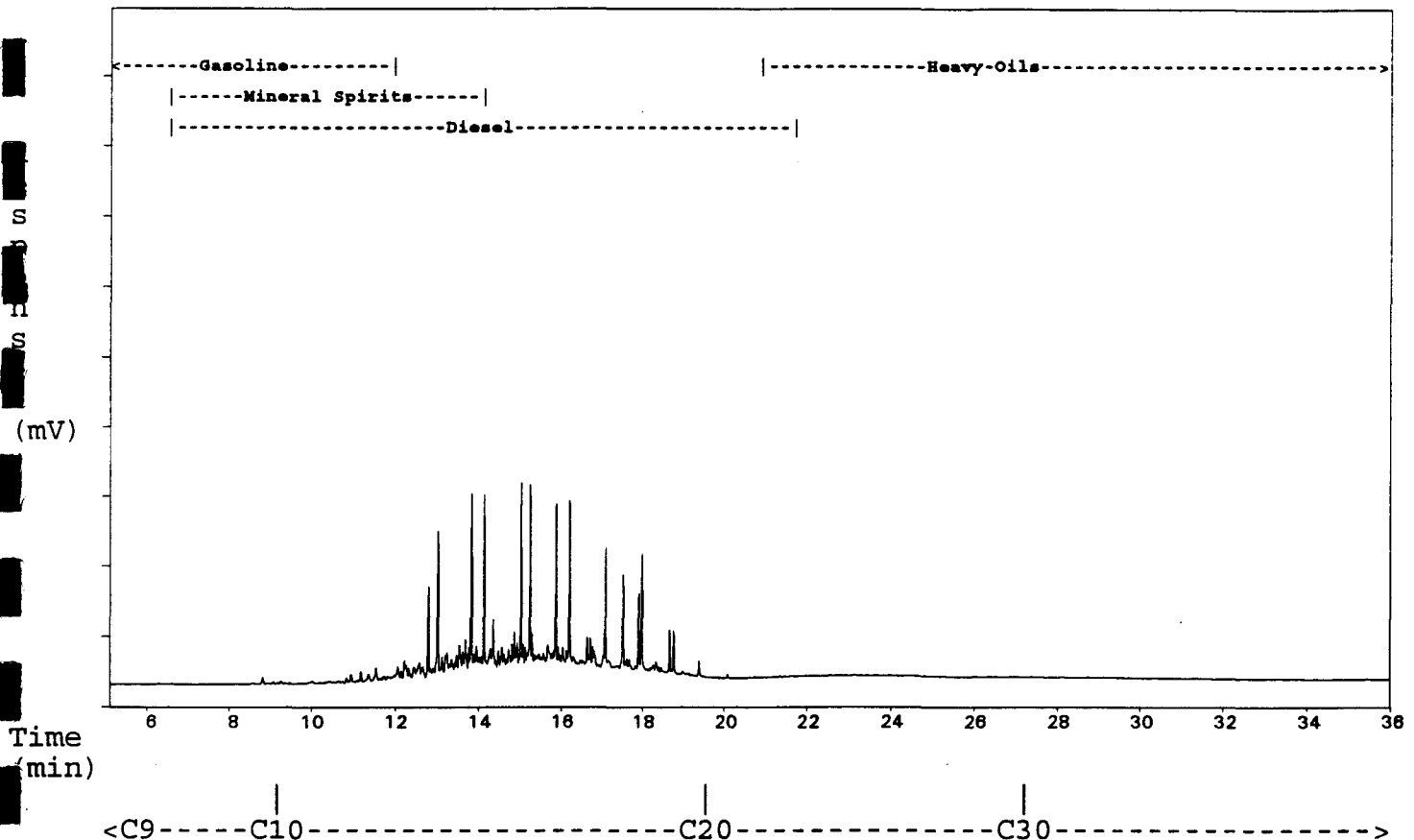
SAMPLE NAME: E7335 1

H9

Sample acquired: FEB 13, 1995 12:59:45

File Name: c:\TEH\TEHFEB13.12R , Sample Name: E7335 1

Sequence file: TEHFEB13



ASL Sample ID: E7335 1* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.4
Carbon 10 to Carbon 20 (C10-C20)	86.9
Carbon 20 to Carbon 30 (C20-C30)	8.7
Greater than Carbon 30 (>C30)	4.1

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

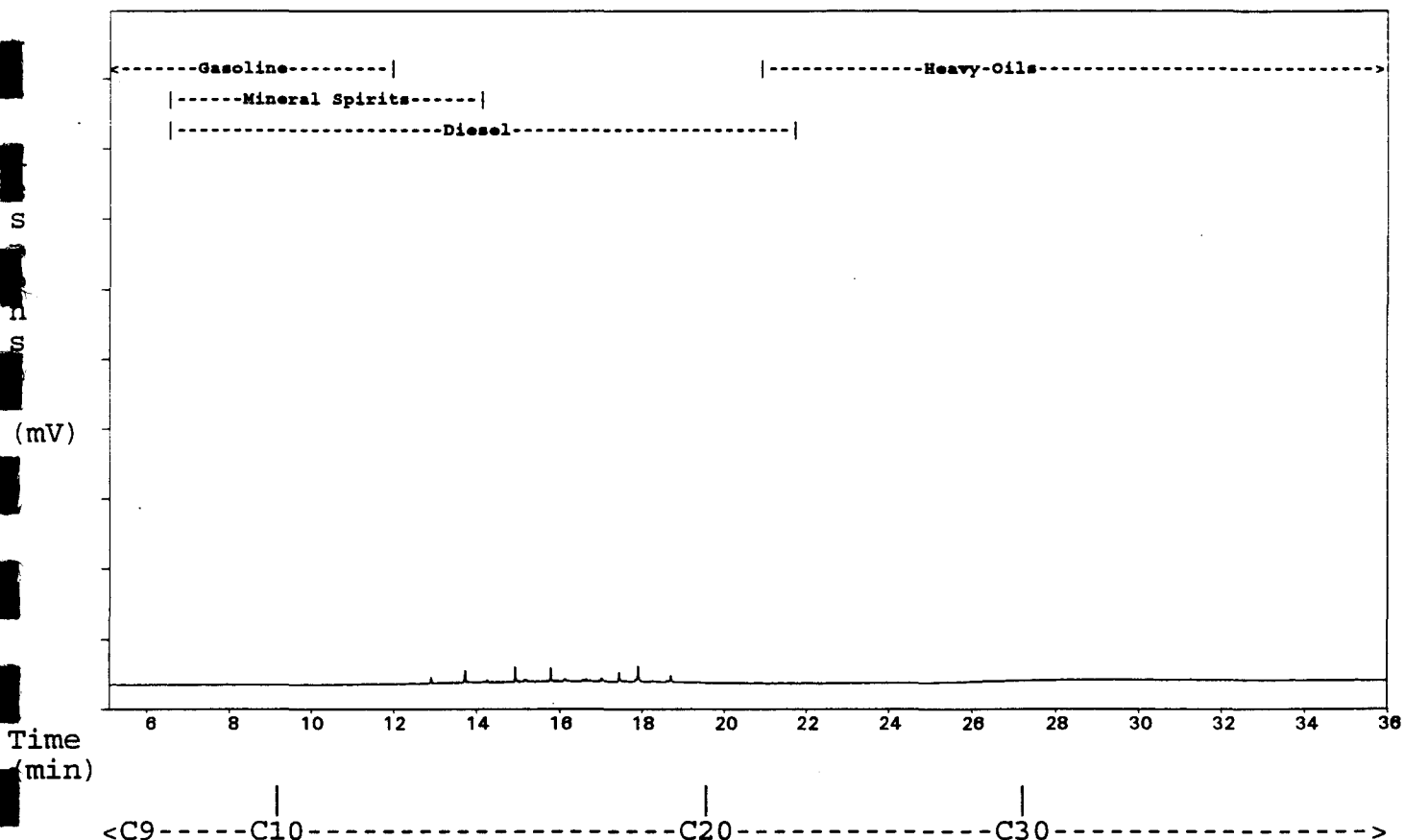
HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E7335 3 **H12**

Sample acquired: FEB 10, 1995 05:02:51

File Name: c:\TEH\TEHFEB09.39R , Sample Name: E7335 1

Sequence file: TEHFEB09



ASL Sample ID: E7335 3* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.3
Carbon 10 to Carbon 20 (C10-C20)	67.1
Carbon 20 to Carbon 30 (C20-C30)	3.0
Greater than Carbon 30 (>C30)	29.8

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

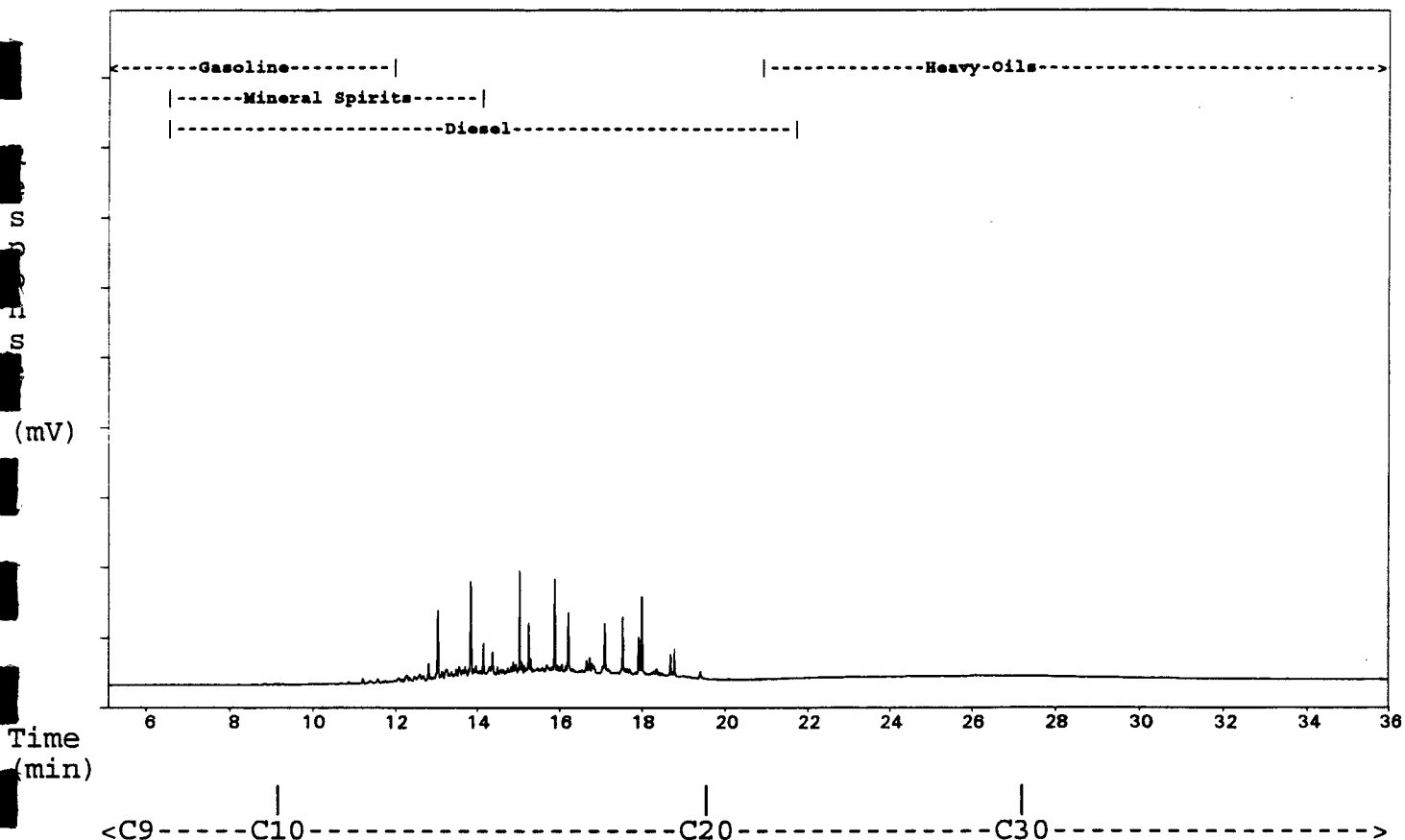
SAMPLE NAME: E7335 *A*

H17

Sample acquired: FEB 10, 1995 05:49:47

File Name: c:\TEH\TEHFEB09.42R , Sample Name: E7335 5

Sequence file: TEHFEB09



ASL Sample ID: E7335 *A* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.2
Carbon 10 to Carbon 20 (C10-C20)	96.2
Carbon 20 to Carbon 30 (C20-C30)	3.3
Greater than Carbon 30 (>C30)	0.5

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

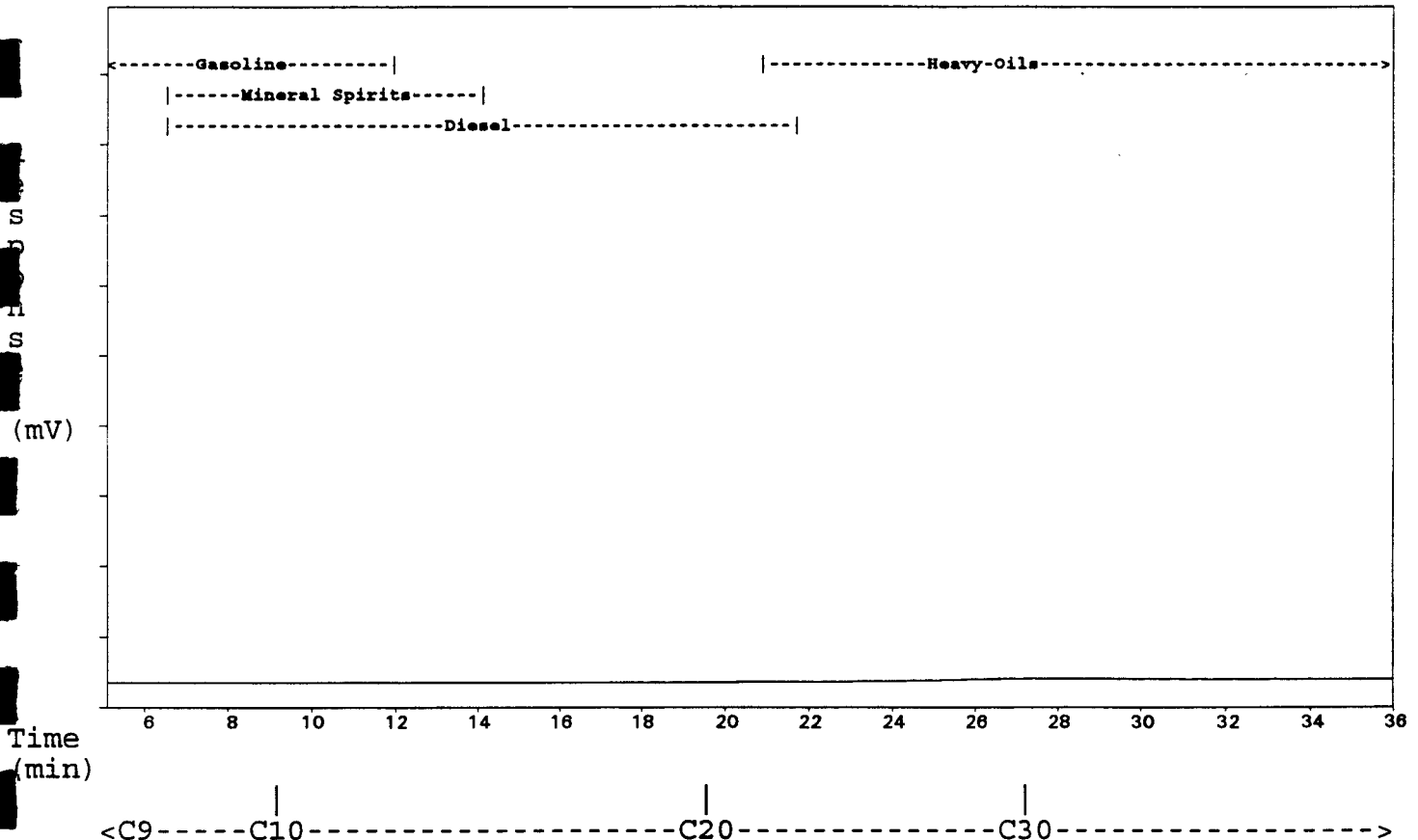
SAMPLE NAME: E7335 5

H20

Sample acquired: FEB 10, 1995 05:49:47

File Name: c:\TEH\TEHFEB09.41R , Sample Name: E7335 4

Sequence file: TEHFEB09



ASL Sample ID: E7335 5* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.0
Carbon 10 to Carbon 20 (C10-C20)	0.0
Carbon 20 to Carbon 30 (C20-C30)	32.7
Greater than Carbon 30 (>C30)	67.3

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

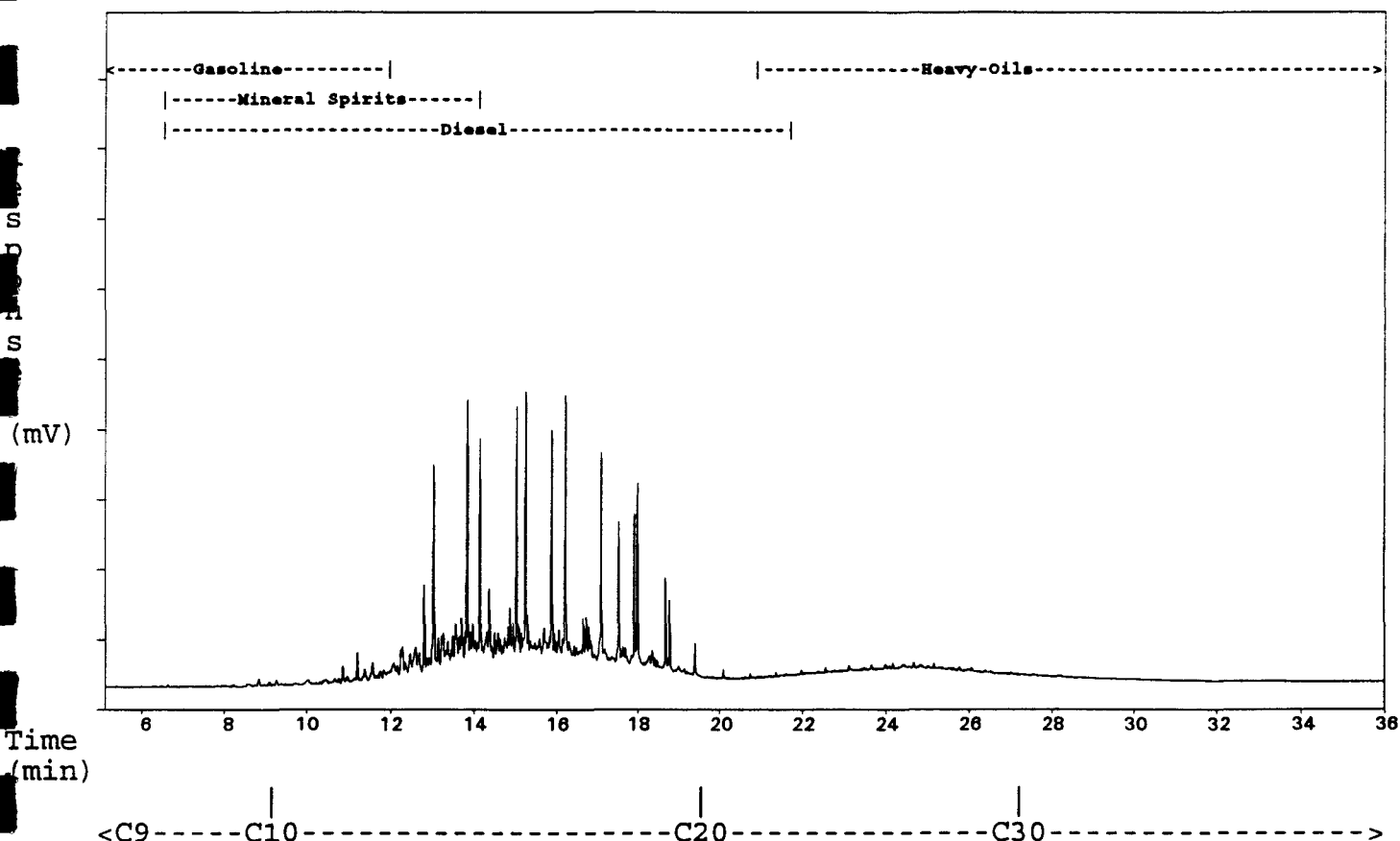
SAMPLE NAME: E7335 6.

H40

Sample acquired: FEB 10, 1995 06:36:35

File Name: c:\TEH\TEHFEB09.44R , Sample Name: E7335 7

Sequence file: TEHFEB09



ASL Sample ID: E7335 6* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.3
Carbon 10 to Carbon 20 (C10-C20)	81.5
Carbon 20 to Carbon 30 (C20-C30)	14.7
Greater than Carbon 30 (>C30)	3.5

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

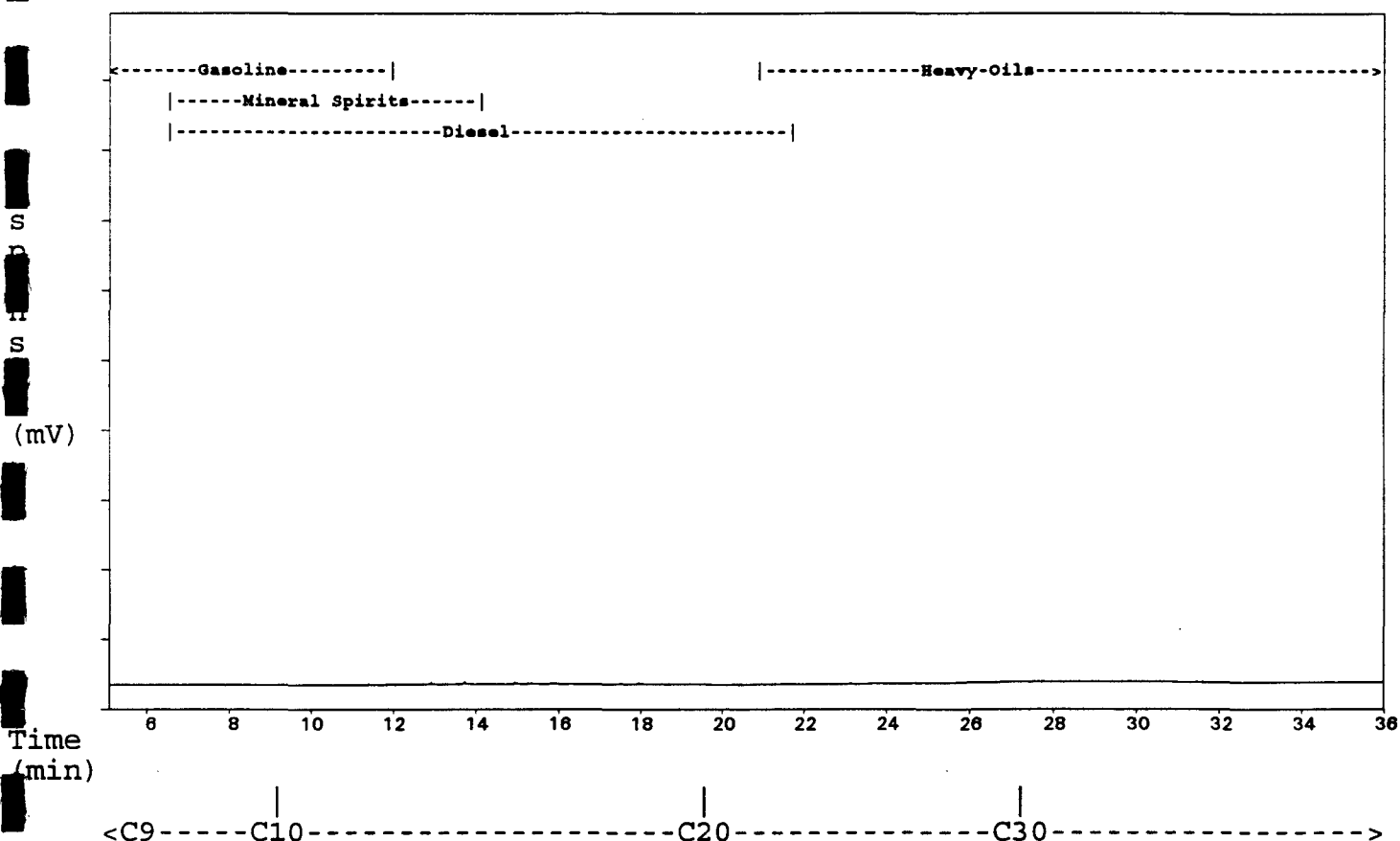
SAMPLE NAME: E7335 7

H42

Sample acquired: FEB 10, 1995 06:36:35

File Name: c:\TEH\TEHFEB09.43R , Sample Name: E7335 6

Sequence file: TEHFEB09



ASL Sample ID: E7335 7* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.0
Carbon 10 to Carbon 20 (C10-C20)	96.6
Carbon 20 to Carbon 30 (C20-C30)	2.2
Greater than Carbon 30 (>C30)	5.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

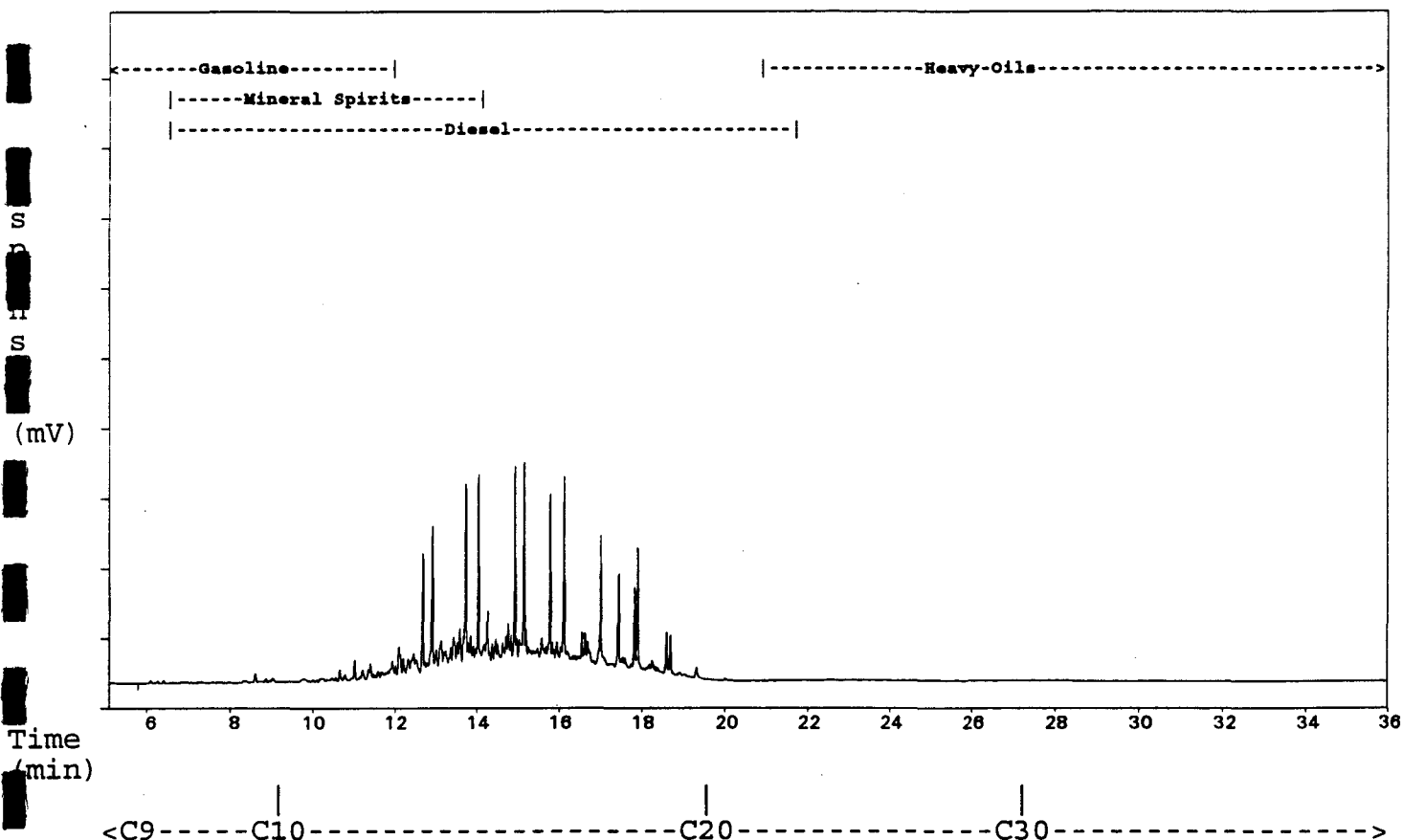
SAMPLE NAME: E7335 8

H45

Sample acquired: FEB 13, 1995 11:23:51

File Name: c:\TEH\TEHFEB13.07R , Sample Name: E7335 8

Sequence file: TEHFEB13



ASL Sample ID: E7335 8* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.8
Carbon 10 to Carbon 20 (C10-C20)	98.4
Carbon 20 to Carbon 30 (C20-C30)	0.8
Greater than Carbon 30 (>C30)	0.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

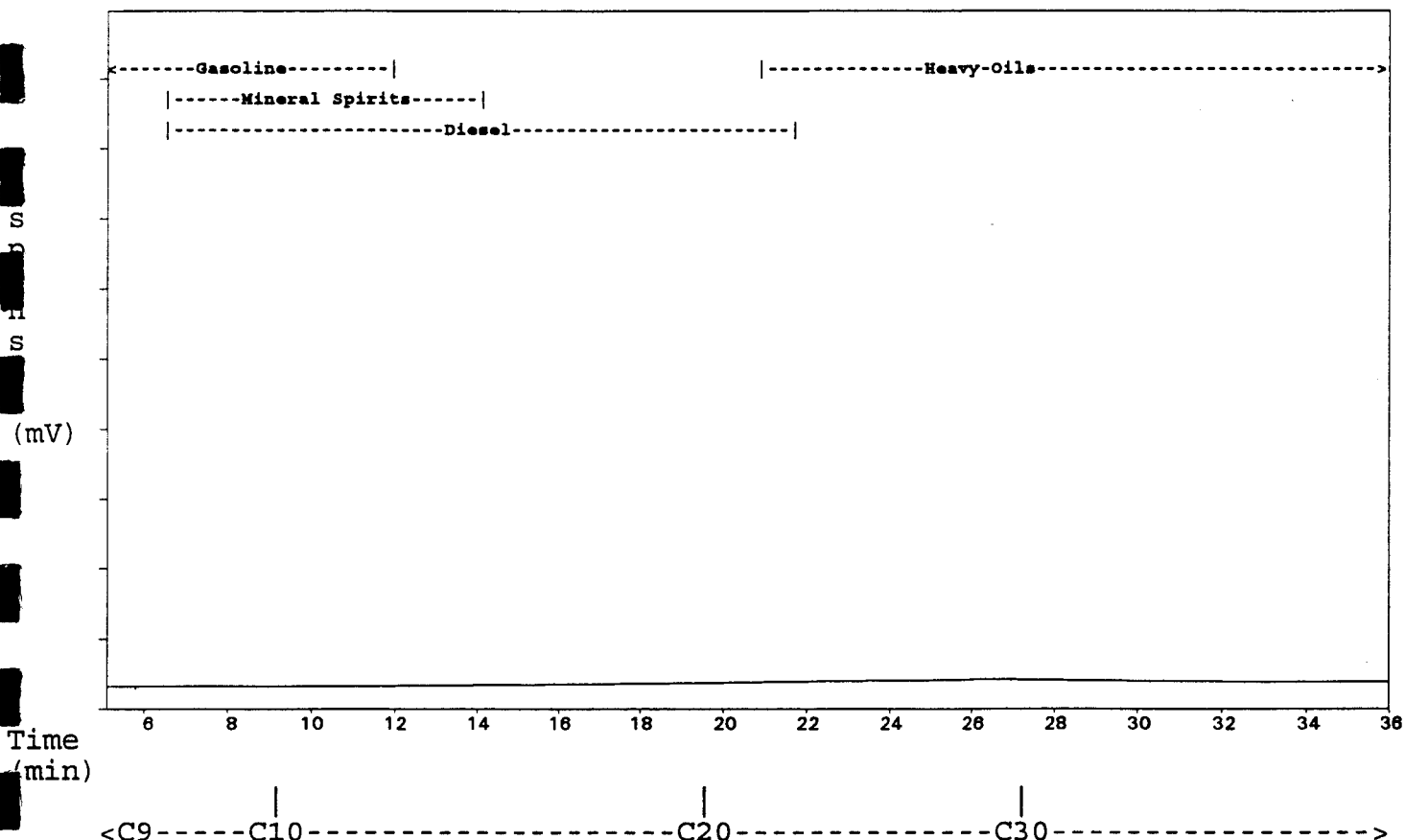
SAMPLE NAME: E7335 9

H47

Sample acquired: FEB 13, 1995 11:23:51

File Name: c:\TEH\TEHFEB13.08R , Sample Name: E7335 9

Sequence file: TEHFEB13



ASL Sample ID: E7335 9* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	44.7
Carbon 10 to Carbon 20 (C10-C20)	0.0
Carbon 20 to Carbon 30 (C20-C30)	56.1
Greater than Carbon 30 (>C30)	0.0

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

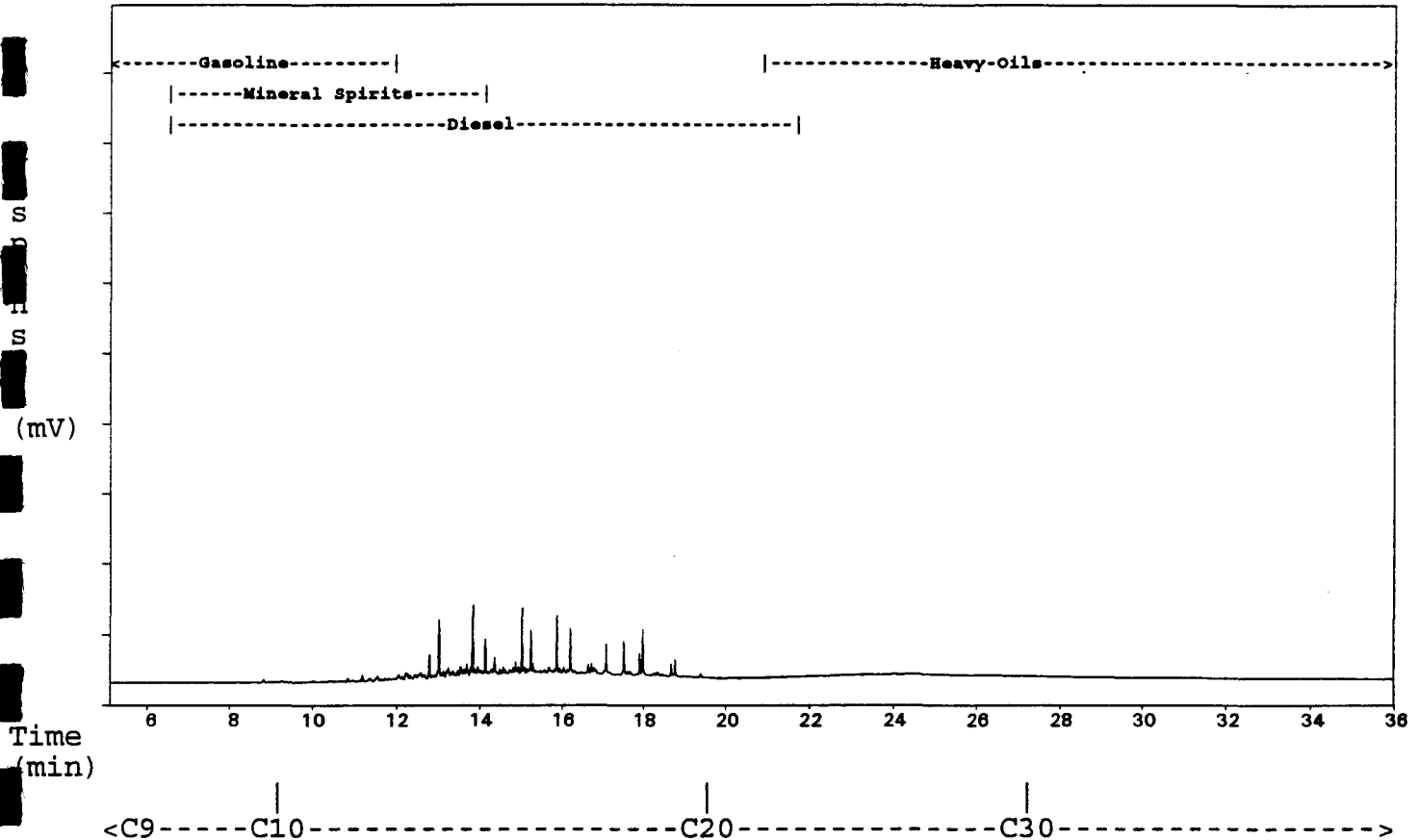
SAMPLE NAME: E7335 10

H50

Sample acquired: FEB 13, 1995 12:12:17

File Name: c:\TEH\TEHFEB13.10R , Sample Name: E7335 10

Sequence file: TEHFEB13



ASL Sample ID: E7335 10* 8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.8
Carbon 10 to Carbon 20 (C10-C20)	87.9
Carbon 20 to Carbon 30 (C20-C30)	11.1
Greater than Carbon 30 (>C30)	0.4

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME:

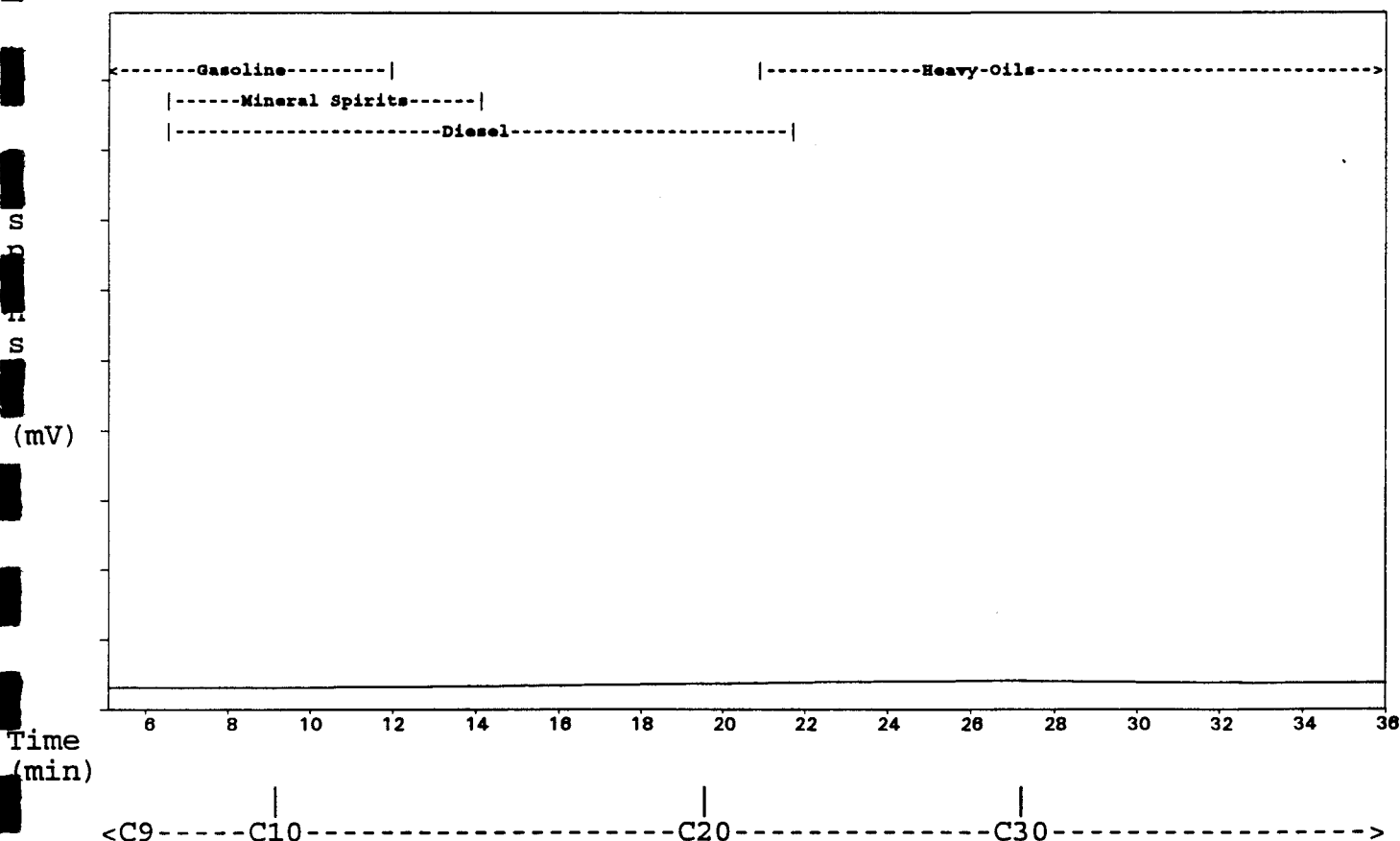
H54

E7335-11

Sample acquired: FEB 10, 1995 08:59:26

File Name: c:\TEH\TEHFEB09.50R , Sample Name: E7341b Gasol

Sequence file: TEHFEB09



ASL Sample ID: ~~E7341b Gasol~~
7335-11

8.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.0
Carbon 10 to Carbon 20 (C10-C20)	18.7
Carbon 20 to Carbon 30 (C20-C30)	102.9
Greater than Carbon 30 (>C30)	2.7

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.



CHEMICAL ANALYSIS REPORT

Date: February 15, 1995

ASL File No. E7334

Report On: Water Analysis

Report To: **J. R. Paine and Associates Ltd.**
14 Burns Road
Whitehorse, YT
V1A 4Y9

Attention: **Mr. Michael Billowitz**

Received: February 7, 1995

ASL ANALYTICAL SERVICE LABORATORIES LTD.

per:

Cameron McLean
Cameron McLean, B.Sc
Project Chemist

Dawn Gilbert
Dawn Gilbert
Supervisor, Trace Organics Lab



RESULTS OF ANALYSIS - Water

File No. E7334

W12

95 02 06

Total Metals

Arsenic	T-As	0.0019
Barium	T-Ba	0.027
Cadmium	T-Cd	<0.0002
Chromium	T-Cr	<0.015
Cobalt	T-Co	<0.015
Copper	T-Cu	<0.010
Lead	T-Pb	0.003
Mercury	T-Hg	<0.00005
Molybdenum	T-Mo	<0.030
Nickel	T-Ni	<0.020
Selenium	T-Se	<0.0005
Silver	T-Ag	<0.015
Tin	T-Sn	<0.30
Zinc	T-Zn	0.014

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.



RESULTS OF ANALYSIS - Water

File No. E7334

W10

95 02 06

Halogenated Volatiles

Bromodichloromethane	<0.001
Bromoform	<0.001
Carbon Tetrachloride	<0.001
Chlorobenzene	<0.001
Chloroethane	<0.001
Chloroform	<0.001
Chloromethane	<0.001
Dibromochloromethane	<0.001
1,2-Dichlorobenzene	<0.001
1,3-Dichlorobenzene	<0.001
1,4-Dichlorobenzene	<0.001
1,1-Dichloroethane	<0.001
1,2-Dichloroethane	<0.001
cis-1,2-Dichloroethylene	<0.001
trans-1,2-Dichloroethylene	<0.001
1,1-Dichloroethylene	<0.001
Dichloromethane	<0.005
1,2-Dichloropropane	<0.001
cis-1,3-Dichloropropylene	<0.001
trans-1,3-Dichloropropylene	<0.001
1,1,1,2-Tetrachloroethane	0.008
1,1,2,2-Tetrachloroethane	<0.001
Tetrachloroethylene	<0.001
1,1,1-Trichloroethane	<0.001
1,1,2-Trichloroethane	<0.001
Trichloroethylene	<0.001
Trichlorofluoromethane	<0.001
Vinyl Chloride	<0.001

Non-halogenated Volatiles

Benzene	<0.0005
Ethylbenzene	<0.0005
Styrene	<0.0005
Toluene	<0.0005
meta- & para-Xylene	<0.0005
ortho-Xylene	<0.0005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.



RESULTS OF ANALYSIS - Water

File No. E7334

W11

95 02 06

Polvaromatic Hydrocarbons

Acenaphthene	<0.0005
Acenaphthylene	<0.0005
Anthracene	<0.0002
Benz(a)anthracene	0.00003
Benzo(a)pyrene	<0.00001
Benzo(b)fluoranthene	<0.00001
Benzo(ghi)perylene	<0.0001
Benzo(k)fluoranthene	<0.00001
Chrysene	<0.0001
Dibenz(a,h)anthracene	<0.00001
7,12-Dimethylbenz(a)anthracene	<0.0001
Fluoranthene	<0.0001
Fluorene	<0.0001
Indeno(1,2,3-cd)pyrene	<0.00001
3-Methylcholanthrene	<0.0001
Naphthalene	<0.0002
Phenanthrene	<0.0002
Pyrene	<0.0002

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.



RESULTS OF ANALYSIS - Water

File No. E7334

	W12	W10	W11
	95 02 06	95 02 06	95 02 06
<u>Organochloride Pesticides</u>			
Aldrin	-	<0.001	-
alpha-BHC	-	<0.001	-
beta-BHC	-	<0.001	-
gamma-BHC (Lindane)	-	<0.001	-
delta-BHC	-	<0.001	-
cis-Chlordane (alpha)	-	<0.001	-
trans-Chlordane (gamma)	-	<0.001	-
2,4'-DDD	-	<0.001	-
4,4'-DDD	-	<0.001	-
2,4'-DDE	-	<0.001	-
4,4'-DDE	-	<0.001	-
2,4'-DDT	-	<0.001	-
4,4'-DDT	-	<0.001	-
Dieldrin	-	<0.001	-
Endosulfan I	-	<0.002	-
Endosulfan II	-	<0.0005	-
Endosulfan Sulfate	-	<0.010	-
Endrin	-	<0.001	-
Endrin Aldehyde	-	<0.001	-
Heptachlor	-	<0.0005	-
Heptachlor Epoxide	-	<0.010	-
Methoxychlor	-	<0.010	-
Mirex	-	<0.010	-
cis-Nonachlor	-	<0.010	-
trans-Nonachlor	-	<0.010	-
Oxychlordane	-	<0.010	-
Toxaphene	-	<0.030	-
<u>Extractables</u>			
Total Extr Hydrocarbons (C9-40)	1.6	3.3	3.5
Total Extr Hydrocarbons (C10-30)	1.4	3.3	3.5

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.



RESULTS OF ANALYSIS - Water

File No. E7334

W10

95 02 06

Organophosphate Pesticides

Azinphos methyl	<0.001
Carbophenothion	<0.001
Diazinon	<0.001
Dimethoate	<0.001
Fenitrothion	<0.001
Fensulfothion	<0.001
Fenthion	<0.001
Fonofos	<0.001
Malathion	<0.001
Methamidophos	<0.005
Mevinphos	<0.001
Parathion	<0.001
Parathion Methyl	<0.001
Phosmet	<0.001

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.



Appendix 1 - METHODOLOGY

File No. E7334

Samples were analyzed by methods acceptable to the appropriate regulatory agency. Outlines of the methodologies utilized are as follows:

Metals in Water

These analyses are carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 18th Edition published by the American Public Health Association, 1992. The procedures involve a variety of instrumental analyses including atomic emission spectrophotometry (ICP) and atomic absorption spectrophotometry (AA) to obtain the required detection limit for each element. Specific details are available on request.

Volatile Organic Priority Pollutants in Water

This analysis is carried out in accordance with U.S. EPA Method 624 and 524. These procedures involve purge and trap extraction of the sample and subsequent analysis of the volatile components by capillary column gas chromatography with mass spectrometric detection.

Polynuclear Aromatic Hydrocarbons in Water

This analysis is carried out in accordance with U.S. EPA Method 3510/8270. (publ. #SW-846, 3rd Ed., Washington, DC 20460). This method involves the extraction of the sample with methylene chloride followed by silica column chromatography cleanup. The resulting extract was analysed by capillary column gas chromatography with mass spectrometric detection.

Organochloride Pesticides in Water

This analysis is carried out in accordance with U.S. EPA Method 3510/8080 (Publ. #SW-846 3rd ed., Washington, DC 20460). The procedure involves a solvent extraction using dichloromethane. The extract is then solvent exchanged to hexane followed by an alumina column clean-up. The final extract is analysed by dual capillary column gas chromatography with electron capture detection.

Total Extractable Hydrocarbons in Water

This analysis is carried out in accordance with U.S. EPA Method 3510/8015 (Publ. #SW-846, 3rd Ed., Washington, DC 20460). The procedure involves extraction with methylene chloride. The extract is then reduced in volume and analysed by capillary column gas chromatography with flame ionization detection.



Appendix 1 - METHODOLOGY (cont'd)

File No. E7334

Organophosphate Pesticides in Water

This analysis is carried out in accordance with U.S. EPA Method 8140 (Publ. # SW-846 3rd ed., Washington, DC 20460). The procedure involves a solvent extraction of the sample followed by analysis by capillary column gas chromatography with thermionic detection.



File No. E7334

APPENDIX 2
FIGURES

HYDROCARBON DISTRIBUTION REPORT

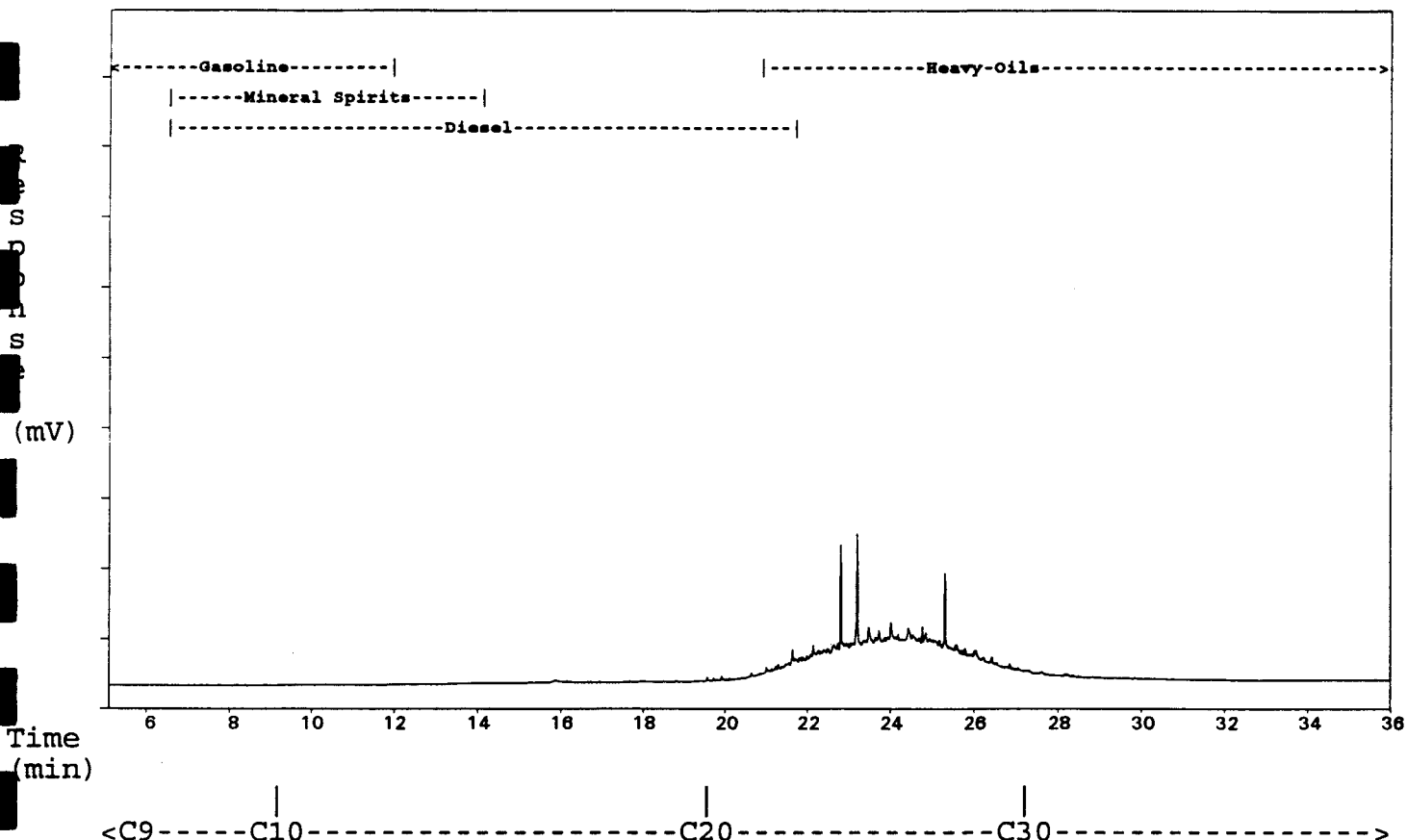
SAMPLE NAME: E7334 1

W12

Sample acquired: FEB 9, 1995 01:20:29

File Name: c:\TEH\TEHFEB08.30R , Sample Name: E7334 1

Sequence file: TEHFEB08



ASL Sample ID: E7334 1* 1.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.1
Carbon 10 to Carbon 20 (C10-C20)	2.9
Carbon 20 to Carbon 30 (C20-C30)	82.2
Greater than Carbon 30 (>C30)	14.9

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

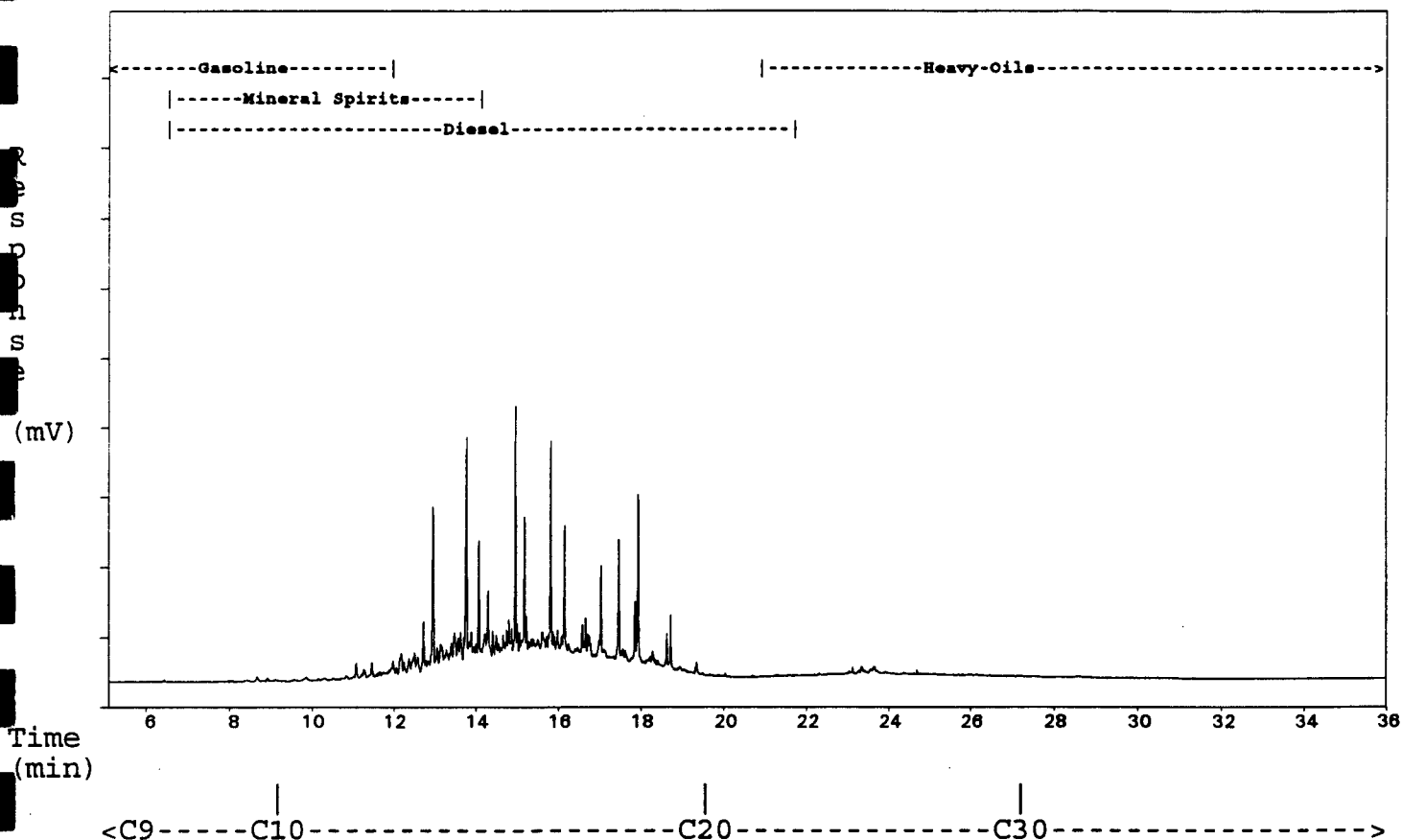
SAMPLE NAME: E7334 2

W10

Sample acquired: FEB 9, 1995 02:07:27

File Name: c:\TEH\TEHFEB08.31R , Sample Name: E7334 2

Sequence file: TEHFEB08



ASL Sample ID: E7334 2* 1.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.4
Carbon 10 to Carbon 20 (C10-C20)	88.7
Carbon 20 to Carbon 30 (C20-C30)	8.6
Greater than Carbon 30 (>C30)	2.4

The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

HYDROCARBON DISTRIBUTION REPORT

SAMPLE NAME: E7334 3

W11

Sample acquired: FEB 9, 1995 02:07:27

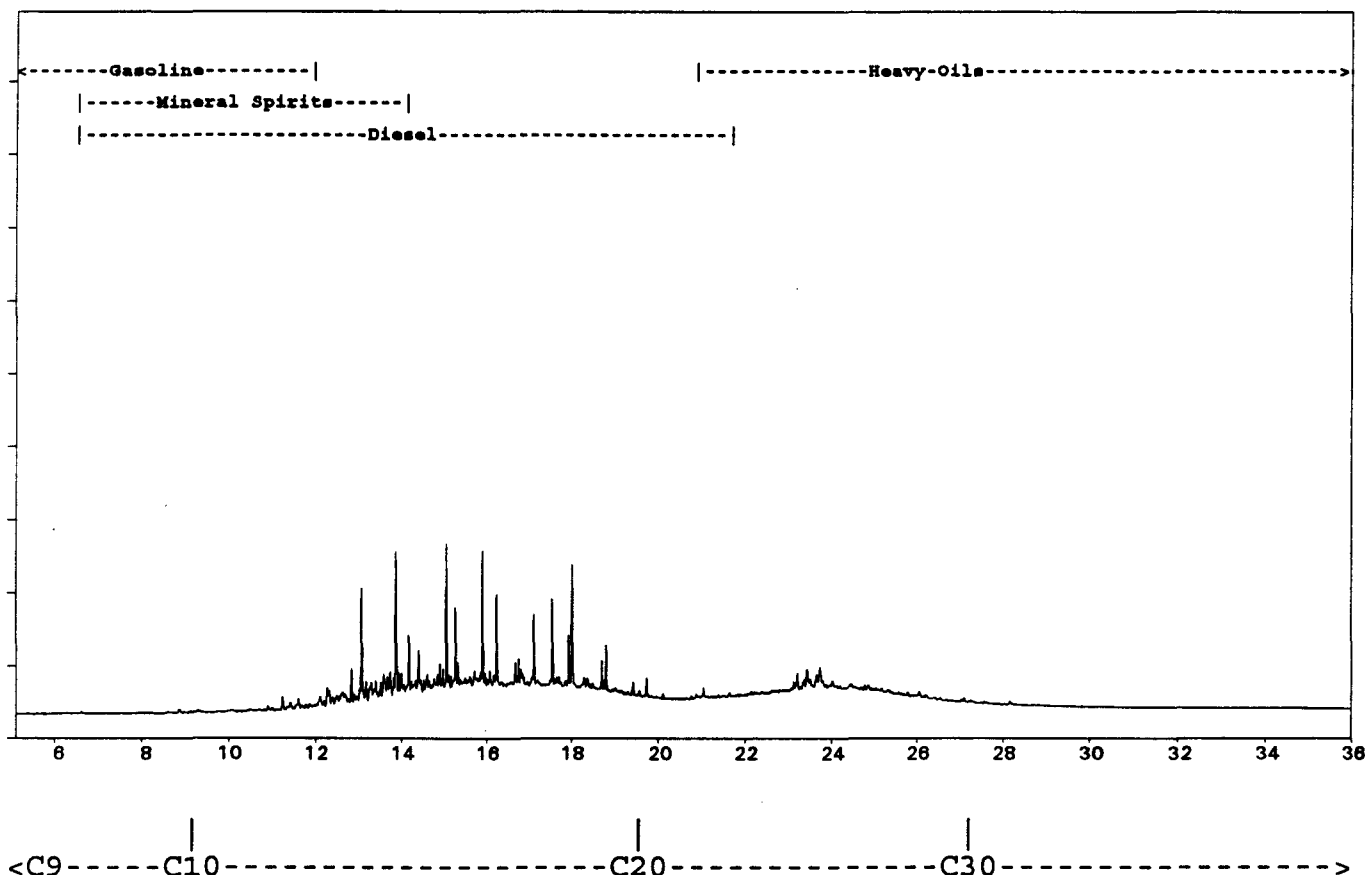
File Name: c:\TEH\TEHFEB08.32R , Sample Name: E7334 3

Sequence file: TEHFEB08

Resonance

(mV)

Time (min)



ASL Sample ID: E7334 3* 1.0Dilution

HYDROCARBON RANGE (C#)	RELATIVE AMOUNT (%)
Less than Carbon 10 (<C10)	0.4
Carbon 10 to Carbon 20 (C10-C20)	66.2
Carbon 20 to Carbon 30 (C20-C30)	28.4
Greater than Carbon 30 (>C30)	5.1

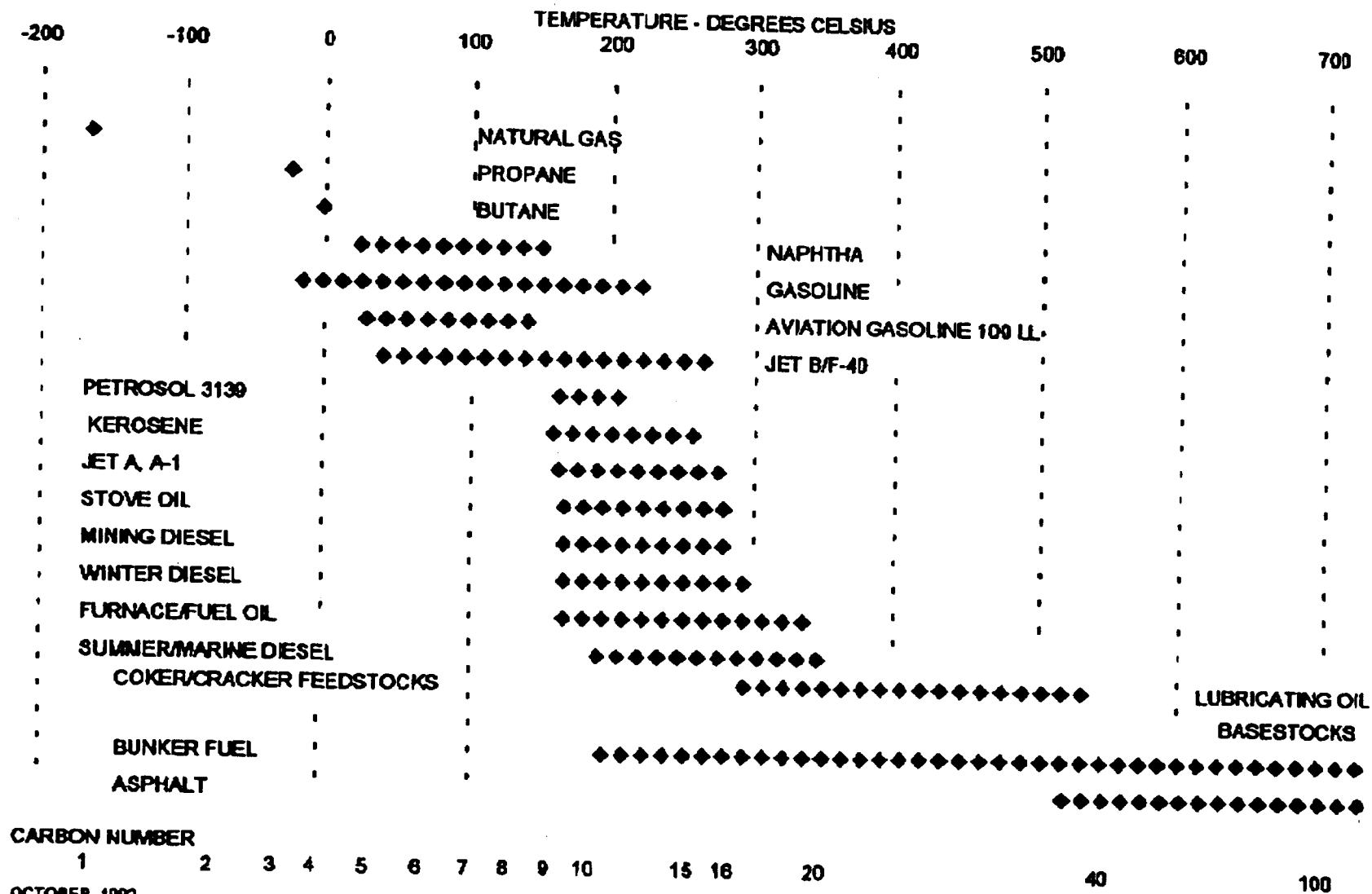
The Hydrocarbon Distribution Report is intended to assist you in characterizing the hydrocarbon product present in a given sample. The scale at the top of the chromatographic trace represents the hydrocarbon range of common petroleum products. Comparison of this report with those of reference standards may also assist you in the identification of the hydrocarbon product detected in your sample. The second part of the report is a table that expresses the relative amount of hydrocarbon product present in the ranges specified.

APPENDIX "D"

Various Information Related to Chemical Analyses and Interpretations

FIGURE 6

TYPICAL PETROLEUM PRODUCT BOILING RANGES



OCTOBER, 1992
Doc. BOILING

TABLE THREE
SUMMARY OF CHEMICAL TEST RESULTS - TEST PIT PROGRAM

SAMPLE NO.	LOCATION	CONTAMINANT AREA	TYPE OF ANALYSIS	CONCENTRATION (mg/Kg) - UON	TYPE OF IMPURITY	SOIL TYPE (fine or co
P7	TP 2-94		halog. volatiles oil & grease	< det 5230	tar	fine
P2	TP 1-94		oil & grease	<50		coarse
P12	TP 3-94	pipe	teh	1040	diesel	coarse
P20	TP 5-94	existing well	oil & grease	350	oil	coarse
P26	TP 9-94		oil & grease	<50		coarse
P28	TP 10-94	feed tank	teh	2920	crude	fine
			PAH	<det		
P32	TP 10-94	feed tank	oil & grease	466	crude	fine
P36	TP 10B-94	feed tank	oil & grease	930	crude	fine
P39	TP 10B-94	feed tank	oil & grease	<50		fine
P49	TP 14-94	disposal pit	oil & grease glycols scan	<50 <10		coarse
P50	TP 14-94	disposal pit	oil & grease	<50		coarse
P53	TP 15-94	disposal pit	oil & grease	86	diesel	coarse
P57	TP 16-94	disposal pit	oil & grease	656	diesel	coarse
P59	TP 16-94	disposal pit	teh PAH	2200 0.02 0.02 0.126 0.093 0.022	diesel anthracene chrysene fluorene phenanthre pyrene	fine
P65	TP 17-94		oil & grease	<50		coarse
W4 (water)	TP16-94	disposal pit	teh	18 mg/L		

NOTES: teh = total extractable hydrocarbons
 coarse grained soil refers to D50 value greater than 75 microns
 fine grained soil refers to D50 value less than 75 microns

TABLE FOUR
SUMMARY OF CHEMICAL TEST RESULTS - DRILLING PROGRAM

SAMPLE NO.	LOCATION	CONTAMINANT AREA	TYPE OF ANALYSIS	CONCENTRATION (mg/Kg) - UON	TYPE OF IMPURITY	SOIL TYPE (fine or coarse grained)
H9	TH 2-95	pipe	teh	618	diesel	coarse
H10	TH 3-95	pipe	oil & grease pest. scan	11 600 <det	tar	coarse
H12	TH 3-95	pipe	teh	<40		coarse
H17	TH 4-95	pipe	teh	213	diesel	coarse
H20	TH 4-95	pipe	teh	<40		coarse
H40	TH 10-95	disposal pit	teh	851	diesel	coarse
H42	TH 10-95	disposal pit	teh	<40		fine
H45	TH 11-95	disposal pit	teh	554	diesel	coarse
H47	TH 12-95	disposal pit	teh	<40		coarse
H50	TH 14-95	disposal pit	teh	158	diesel	coarse
H54	TH 16-95	disposal pit	teh	<40		coarse
W10 (water)	TH 2-95	pipe	teh halog. volatiles non-halog. vol. organo pest. organo phos. pest.	3.3 mg/L 0.008 mg/L <0.0005 mg/L <det. <det.	diesel 1,1,1,2 tetrachloroethane	coarse
W11 (water)	TH 14-95	disposal pit	teh pah	3.5 mg/L .00003 mg/L	diesel benz(a)anthracene	coarse
W12 (water)	existing well (without house)	well	teh total metals	1.6 mg/L 0.0019 mg/L .027 mg/L .003 mg/L .014 mg/L	oil arsenic barium lead zinc	coarse

NOTES: teh = total extractable hydrocarbons
 coarse grained soil refers to D50 value greater than 75 microns
 fine grained soil refers to D50 value less than 75 microns

TABLE FIVE
ENVIRONMENTAL QUALITY CRITERIA FOR CONTAMINATED SITES
(VARIOUS SOURCES)

	CONTAMINATION IN SOIL (mg/kg of dry matter, or ppm)			CONTAMINATION IN GROUNDWATER (mg/L)		
	A	B	C	A	B(dw)	B(ds)
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)						
benzo(a)anthracene	0.1	1	10	1E-05	1E-04	1E-05
benanthrene	0.1	5	50	2E-04	2E-03	
anthracene	0.1	10	100	2E-04		
chrysene	0.1	1	10	1E-04		
fluorene	0.1	10	100	1E-04		
pyrene	0.1	10	100			
PAH (summation)	1	20	200	2E-04		
HALOGENATED VOLATILES						
1,1,1,2 tetrachloroethane	0.3	5	50			
HEAVY METALS						
arsenic	5	30	50	0.005	0.05	0.05
barium	200	500	2000	0.05	1	1
lead	50	500	1000	0.01	0.05	0.05
zinc	80	500	1500	0.05	5	0.2
HYDROCARBONS						
oil & grease	100	1000	5000	0.1		
total petroleum hydrocarbons (*)	1000	2000	5000			
total petroleum hydrocarbons (**)	2000	4000	5000			

NOTES:

* refers to coarse grained soils

** refers to fine grained soils

-all criteria, except TPH* and TPH**, are taken from B.C. (1989) document (see REFERENCES)

-TPH* and TPH** taken from Alberta (1994) document (see REFERENCES)

-for SOIL: A =recreation, residential, agriculture (investigation criterion)

B =rec., residential, agric. (remediation criteria)

C =industrial, commercial (remediation criterion)

-for GROUNDWATER:

A= concentrations at or less than this level considered uncontaminated

B(dw)= drinking water criteria - if greater than this level, remediation required
if intended for human consumptionB(ds)= de minimus criterion to protect aquatic life - if greater than this level
further work required to assess probable impact

TABLE SIX
Results of PCB Screening Test

Sample No.	Location	Range (ppm)	Result*
S5	near pumphouse	5	negative
S2	near pumphouse	5	negative
S4	near pumphouse	5	negative
P7	TP#2-94	5	negative
P9	TP#2-94	5	negative
P55	TP#16-94	5	negative
P56	TP#16-94	5	negative
P57	TP#16-94	5	negative
P47	TP#14-94	5	negative
P49	TP#14-94	5	negative

*Note: Negative indicates PCB not present in sample.

MILLIPORE

EnviroGard™ PCB Test Kit

ENVR 000 09 (with PCB calibrators)
ENVR 0NC 09 (without PCB calibrators)

Read this instruction manual thoroughly before attempting to use this product.

Intended Use

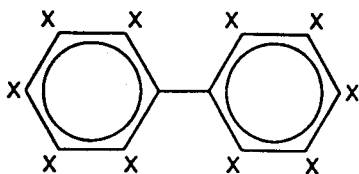
The Millipore EnviroGard PCB Test Kit is an enzyme immunoassay for the detection of a range of polychlorinated biphenyls (PCB) in soil, to include Aroclors 1016, 1242, 1248, 1254, and 1260. The EnviroGard PCB Test Kit allows for reliable and rapid screening for PCB in soils at specified action levels within the following sensitivity ranges:

- 5, 10, 50 part per million (ppm) (standard range)
- 1, 5, 10 ppm (high sensitivity range)

NOTE: If you use the EnviroGard PCB test kit without calibrators (ENVR 0NC 09), modify the directions according to the calibrator or standards in use.

Test Summary and Explanation

PCBs are a family of compounds with the following general structure.



where X = Hydrogen (H) or Chlorine (Cl)

There are 209 individual forms (or congeners) containing from 1–10 chlorine atoms on the biphenyl structure shown. PCBs were originally sold in the U.S.A. under the trade name Aroclor. Each Aroclor is composed of many congeners. Many congeners may occur in more than one Aroclor. Aroclors are differentiated on the basis of average chlorine content (percent chlorine by weight). For Aroclor nomenclature, the last two digits of the four digit label indicate this percentage. For example, Aroclor 1248 is approximately 48% chlorine by weight. The sole exception to this rule, Aroclor 1016, is similar in total chlorine content to Aroclor 1242, but contains a different congener distribution.

NOTE: Refer to the section "Results Interpretation" and "Specificity" for more information on Aroclors.

The EnviroGard PCB Test Kit employs an antibody against PCB that is coated onto 12 X 75 millimeter (mm) polystyrene test tubes. The method is based on the principles of competitive immunoassay, where the absorbance signal (optical density) of the final reaction mixture is inversely proportional to the concentration of analyte (PCB) present in the original sample. A soil sample that generates a signal greater than the signal of the PCB assay calibrator (e.g., 50 ppm) has a 99% probability of containing less PCB than the specified assay calibrator (e.g., < 50 ppm).

Test Principles

PCBs present in soil extracts and assay calibrators are bound during the first incubation by the anti-PCB antibodies, which have been adsorbed onto the test tubes. After you decant the sample and wash test tubes, you add a peroxidase-PCB conjugate.

NOTE: The amount of conjugate bound (by unoccupied anti-PCB antibody binding sites in the test tube) is inversely proportional to the amount of PCB originally present in the sample.

After a 5 minute incubation, you decant unbound conjugate and wash the test tubes again. Finally, you add a solution that contains a chromogenic peroxidase substrate to the test tubes.

NOTE: Color development is directly proportional to enzyme concentration and inversely proportional to PCB concentration in the original sample in the test tubes.

PCB levels in unknown samples are interpreted relative to standard assay calibrator levels (e.g., 1, 5, 10, 50 ppm) or Aroclor standards, using visual comparison or reading by a spectrophotometer.

TABLE SEVENDetails Of Contaminated Soil Presence
Throughout Study Area

Location	Lateral Orientation Of Impurity *	Vertical Orientation Of Impurity *	Approximate Volume of Soil
1) Disposal Pit Area, 3m west of F5 (at out- let pipe)	10m west, 5m north & south of outlet pipe	1.6m below existing ground surface	160 m ³
2) Feed Tank Area, near J10 (at opening to tank)	5 metres south, east, & west of opening to tank	6.0 metres below existing ground surface	300 m ³
3) Vertical Pipe Area,	Circle around vertical pipe with 3m radius	2.5 metres below existing ground surface	70 m ³

*NOTE: Extent of contaminated soil estimated via extrapolations between test pit/test hole data. Verification will be required during excavation program.

PREFACE

The "Remediation Guidelines for Petroleum Storage Tank Sites - 1994" provides a remediation process specifically for soil and groundwater contamination originating from existing or former petroleum storage facilities. The information presented in this document is in draft form pending the completion of a public review and consultation process.

The Canadian Petroleum Products Institute (CPPI) member companies have requested that they be allowed to use these draft guidelines during the public review and consultation process. Alberta Environmental Protection has agreed to the CPPI request and makes the same offer to all parties subject to the following condition:

The person responsible for site remediation may use these draft guidelines on the condition that if the draft guidelines are changed as a result of the public review and consultation process, the person responsible must upgrade the remediation to meet the criteria contained in the final guidelines.

The person responsible for site remediation must provide written acceptance of this condition prior to undertaking any remediation activities. If this condition is not acceptable, the person responsible must use the remediation criteria presented in "Subsurface Remediation Guidelines for Underground Storage Tank Sites" (1991 draft).