

Port of Seattle
Terminal 115
LUST # 5011

Environmental Science & Engineering, Inc.



A CILCORP Company

RECEIVED
DEC 14 1994
DEPT. OF ECOLOGY

GROUNDWATER ASSESSMENT
PORT OF SEATTLE
TERMINAL 115
WEST MARGINAL WAY
SEATTLE, WASHINGTON, 98134

SUBMITTED TO:

Ms. Kathy Bahnick
Port of Seattle
P.O. Box 1209
Seattle, Washington 98111

DEPARTMENT OF ECOLOGY	
NWRO/TCP TANK UNIT	
<i>1/12/95</i> <i>CM</i> <i>INC # 504</i>	
INTERIM CLEANUP REPORT	<input checked="" type="checkbox"/>
SITE CHARACTERIZATION	<input checked="" type="checkbox"/>
FINAL CLEANUP REPORT	<input type="checkbox"/>
OTHER _____	<input type="checkbox"/>
AFFECTED MEDIA: SOIL	<input checked="" type="checkbox"/>
OTHER _____ GW	<input checked="" type="checkbox"/>
INSPECTOR (INIT.) <i>RN</i>	DATE <i>8/23/95</i>

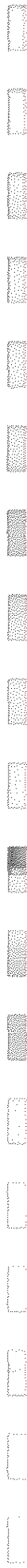
SUBMITTED BY:

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
15444 N.E. 95TH STREET, SUITE 224
REDMOND, WASHINGTON 98052
(206) 869-8220

August 4, 1994

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
INTRODUCTION	1
Background Summary	1
Objectives	2
SITE ASSESSMENT	2
Field Activities	2
Laboratory Analyses	4
FINDINGS	5
Cleanup Level Determination	5
Physical Results	5
Lab-Reported Analyses	6
CONCLUSIONS	7
STANDARD LIMITATIONS	8
CLOSURE	9



EXECUTIVE SUMMARY

In April 1993, Nordic Construction, a subcontractor to CD Construction removed an underground storage tank (UST), and associated dispensers and/or piping from the southern portion of Terminal 115. The UST had a capacity of approximately 6,000 gallons and contained diesel fuel. Soil samples collected by REAL, Inc., the site assessor for the UST removal, indicated concentrations of petroleum hydrocarbons in the diesel range above the State of Washington Model Toxics Control Act (MTCA) Cleanup Levels - Soil (Method A) [Soil Cleanup Level] of 200 parts per million (ppm).

In May 1993, Coastal Tank Cleaning, Inc. (CTC) returned to the site to perform soil excavation activities near the location of the former UST. Soil was excavated until field screening indicated concentrations of petroleum hydrocarbons were below Soil Cleanup Levels. The analytical results of soil samples collected after completion of overexcavation indicated concentrations of petroleum hydrocarbons above Soil Cleanup Levels had been removed. However, a water sample collected from groundwater that entered the bottom of the excavation, at a depth of approximately 13 feet below ground surface (bgs), was analyzed for diesel range petroleum hydrocarbons in water. The laboratory reported a concentration of 8 ppm in the water sample, which exceeds the MTCA Cleanup Level - Ground Water (Method A) [Groundwater Cleanup Level] of 1 ppm.

The Port requested that Environmental Science & Engineering, Inc. (ESE) conduct a soil and shallow groundwater assessment in the vicinity of the diesel UST. On April 7, 1994, ESE installed a total of three monitoring wells, two in the vicinity of the diesel UST (MW5 and MW6) and one approximately 50 feet east of the diesel UST (MW7), in the direction of the Duwamish waterway

Soil samples collected for field screening during well installation did not contain visual or olfactory indications of concentrations of petroleum hydrocarbons. One sample was collected from each well and analyzed for by the Washington State Method for Total Petroleum Hydrocarbons in the diesel range (WTPH-D) and by WTPH-D Extended, which detects heavier organic compounds in the motor oil range. Laboratory-reported results indicated none of the soil samples contained diesel range petroleum hydrocarbons above Soil Cleanup Levels. Only the soil sample collected from five feet bgs in Well MW5 contained concentrations of motor oil range compounds above Soil Cleanup Levels.

During monitoring well installation, groundwater was encountered between nine and 13 feet bgs. After the wells were completed and developed, depth to groundwater measurements were collected. Groundwater surface elevations ranged between 8.32 bgs and 7.87 bgs. Based on these measurements, shallow groundwater flowed toward the east, with a calculated gradient of approximately .006.

Because of the proximity of the site to the Duwamish waterway and Elliott Bay, ESE believed there was a potential for local tidal fluctuations to affect the daily elevation of shallow groundwater. To obtain a rough estimate of the tidal effect, groundwater measurements of depth to groundwater were conducted at high and low tide during a single cycle. Based on a comparison between the two sets of measurements, there did not appear to be a significant tidal effect in the area where the wells are located.

Groundwater samples were collected from each well and analyzed by WTPH-D and WTPH-D Extended. Based on lab-reported analytical results, none of the water samples contained concentrations of diesel or motor oil range compounds above Groundwater Cleanup Level. One water sample was also collected and analyzed by a method that provides a qualitative assessment of the presence of petroleum hydrocarbons in the gasoline, diesel, and motor oil range. The laboratory-reported results from this sample indicated no concentrations of petroleum hydrocarbons constituents were present above laboratory detection limits for this analysis.

INTRODUCTION

This report documents soil boring, monitoring well installation and groundwater sampling activities at the Port of Seattle (Port) Terminal 115 facility in Seattle, Washington (Figure 1). The narrative on the field activities and analytical results conducted prior to ESE's involvement at this site is based on information supplied to ESE by the Port.

Background Summary

In April 1993, Nordic Construction, a subcontractor to CD Construction removed an underground storage tank (UST), and associated dispensers and/or piping from the southern portion of Terminal 115. The UST had a capacity of approximately 6,000 gallons and contained diesel fuel. REAL, Inc. acted as the site assessor for the UST removal, under contract to Nordic Construction. REAL, Inc. collected soil samples from the sidewalls and floor of the excavation. Laboratory results from the soil analyses indicated concentrations of petroleum hydrocarbons in the diesel range above the State of Washington Model Toxics Control Act Cleanup Levels - Soil (Method A) [Soil Cleanup Levels] of 200 parts per million (ppm).

In May 1993, Coastal Tank Cleaning, Inc. (CTC) returned to the site to perform soil excavation activities near the location of the former UST. Soil excavation limits were evaluated using Thin Layer Chromatography (TLC). When TLC results indicated concentrations of petroleum hydrocarbons were below the Cleanup Level for soil, discrete soil samples were collected and analyzed for petroleum compounds in the diesel range by Washington State method for Total Petroleum Hydrocarbons - Diesel (WTPH-D). The analytical results, as reported by the laboratory, indicated concentrations of petroleum hydrocarbons above Soil Cleanup Levels had been removed. The final dimensions of the excavation were approximately 28 feet from east to west, 23 feet from north to south, and approximately 13 feet deep. Approximately 220 tons of soil were removed and disposed through Rabanco Disposal Company.

During excavation activities, water began to enter the bottom of the excavation, at a depth of approximately 13 feet below ground surface (bgs). Based on information from the Port, the water was pumped out of the excavation and disposed. Within 24 hours, water again seeped back into the excavation, indicating the top of the shallow water table had been encountered. A groundwater sample was collected from the base of the excavation, at approximately 13 feet bgs. The groundwater sample was analyzed by Method 3510, for diesel range petroleum hydrocarbons in water. The laboratory reported a concentration of 8 ppm in the water sample, which exceeds the State of Washington Model Toxics Control Act Cleanup Level - Ground Water (Method A) of 1 ppm or 1,000 parts per billion (Groundwater Cleanup Level).

Following receipt of soil analytical results, a new diesel UST, along with new product piping and a new dispenser island, was installed in the same location. However, because analytical results of the groundwater sample, the Port determined additional assessment of the groundwater in the vicinity of this diesel UST was necessary.

Objectives

Pursuant to the Port's request, ESE prepared a proposal (398-PORT.PRO) and work plan to perform additional site assessment at the site. The objectives of the additional site assessment were:

- To evaluate the lateral extent of petroleum hydrocarbon constituents in the diesel range in groundwater and determine groundwater flow direction and gradient, and
- To obtain a rough estimate of the influence of local tides on groundwater below the site.

SITE ASSESSMENT

Field Activities

Terminal 115 is an operating facility for the loading and unloading of cargo ships. The facility is located on the west bank of the Duwamish Waterway, which eventually flows into Elliott Bay (Figure 1). Terminal 115 is basically flat and covered by buildings, asphalt or concrete (Figure 2). West Marginal Way borders the terminal on the east side, and industrial facilities border the terminal on the north and south sides. Based on soil samples collected during well installation, the underlying material appears to be composed of alluvial deposits of fine to medium grained sands.

On April 7, 1994, Tacoma Pump and Drilling, Inc (TPD) of Graham, Washington, under the observation of ESE personnel, drilled three soil borings. TPD collected soil samples from each boring at 5 and 10 feet bgs. The samples were tested for field indications of petroleum hydrocarbons by headspace analysis, using a Photoionization Detector. The deepest soil sample deemed suitable for analysis was selected from each boring and submitted to the laboratory. ESE personnel selected soil samples from 5 feet bgs from two borings (MW5-5 and MW6-5), and at ten feet bgs in the third boring (MW7-10). The samples collected at ten feet bgs in MW5 and MW6 were saturated and not suitable for laboratory analysis.

The borings were completed to approximately 25 to 27 feet bgs, depending on the depth to saturated soil conditions. The ESE representative on site documented field conditions and prepared a geologic log for each soil boring. Drilling and soil sampling procedures are described in Appendix A. Copies of the soil boring logs are included in Appendix B.

TPD collected the drill cuttings generated from the borings and placed the soil in Department of Transportation (DOT) -approved 55-gallon drums. The flights of auger used to drill the wells were steamcleaned between monitoring wells and TPD place the water generated by steamcleaning into DOT drums. One soil sample was collected from a drum containing soil and one water sample was collected from a drum containing water. All drums of soil and water generated during onsite activities were stored on site, pending lab-reported analytical results.

Following the drilling of each boring, TPD installed groundwater monitoring wells, which ESE identified as MW5, MW6, and MW7, as requested by the Port. The wells were constructed of 2-inch Schedule 40 PVC, and were installed according to Washington State Department of Ecology standards for well construction (WAC Chapter 173-160). All three wells were completed according to "Groundwater Monitoring Well Head Completion Specifications - Flush Mounted Application" (Rev2Feb94), supplied to ESE by the Port.

Monitoring wells MW5 and MW6 were installed south and north of the new diesel UST, respectively. Well MW7 was installed approximately 50 east of the UST, in the direction of the Duwamish waterway. The locations of the three monitoring wells are shown on Figure 2. A description of well construction procedures are included in Appendix A. The well specifications are included on soil boring logs in Appendix B.

On April 8, 1994, TPD personnel developed the monitoring wells using a portable development trailer with an air lift pump. Development of each well stopped when the extracted water was relatively clear. This required the removal of approximately 45 to 55 gallons of water from each well. The water extracted from each well was stored onsite in DOT drums. After development, ESE personnel collected groundwater samples for laboratory analysis.

The holding time for the water sample collected from MW5 lapsed while in the custody of the laboratory. To ensure lab-reported results of water samples from MW5 were valid, ESE returned to the site on April 26, 1994, then purged and resampled MW5. A detailed description of groundwater well sampling procedures is included in Appendix A.

After the wells were installed, CTS Engineers (CTS) surveyed the three wells, under contract to ESE. CTS determined the horizontal locations of the ground water monitoring wells according to the Seattle Tide Lands Grid, and the elevations according to the Mean Low Low Water vertical grid, as specified by the Port. CTS personnel surveyed in each well for the Mean Low Low Water vertical grid elevations from the top

of casing (TOC) of each well. The report supplied to ESE by CTS is included in Appendix C.

ESE believed groundwater could be influenced by local tidal fluctuations due to the proximity of the diesel UST to the Duwamish waterway (approximately 250 feet west of the diesel UST). On April 13, 1994, ESE personnel measured the groundwater surface elevations at two separate times; at high tide (approximately 6:23 a.m., Pacific Standard Time [PST]) and low tide, (approximately 1:14 p.m. PST). According to tidal charts for April 13, 1994, the tide dropped approximately 10 feet over that time period. Well casing elevations and depth to groundwater measurements are summarized in Table 1. Procedures used during groundwater depth measurements are included in Appendix A.

Because the change in groundwater surface elevations was minimal between high and low tides, ESE arbitrarily selected the elevations measured at 1:14 p.m. PST measurements to construct a groundwater surface elevation contour map (Figure 3). The contour map shows the estimated direction of shallow groundwater flow beneath the site at the time of measurement was to the east.

Laboratory Analyses

Chemical analyses of soil and groundwater samples were performed by ETC Northwest Laboratories (ETC), a Washington State-certified analytical laboratory located in Redmond, Washington. Samples collected for analysis were placed in a cooler with ice and transported to ETC under chain of custody documentation.

The soil samples collected from the borings (MW5-5, MW6-5 and MW7-10) and the sample collected from the drums containing soil (DS-1) were analyzed by WTPH-D which detects organic compounds in the n-C12 to n-C24 range. The samples were also analyzed by WTPH-D Extended, which detects heavier organic compounds in the n-C24 to n-C40 range.

The water samples collected from MW5, MW6, and MW7 and the sample collected from the drums containing water (DRUM) were analyzed by ETC for WTPH-D and WTPH-D Extended. A field duplicate was collected from MW7 (MW7D) for quality control purposes and analyzed for WTPH-D and WTPH-D Extended.

A water sample was also collected from MW5 and submitted for a qualitative analysis of compounds that may be present in water in the gasoline (< n-C12), diesel and motor oil ranges, similar to the Washington State Hydrocarbon Identification (HCID) method for soil. This qualitative analysis provided information on compounds that could be present in the gasoline or motor oil ranges that would not be identified in the WTPH-D analysis.

FINDINGS

Cleanup Level Determination

Washington Administrative Code (WAC 173-340-700 through -760) establishes cleanup standards that apply to releases of hazardous substances into the environment. At this site, the Soil Cleanup Level was assumed to be at levels consistent with the Model Toxics Control Act Cleanup Levels - Soil (Method A) [WAC 173-340-740(2)]. The Groundwater Cleanup Level was assumed to be consistent with the Model Toxics Control Act Cleanup Level - Ground Water (Method A) [WAC 173-340-720(2)].

Physical Results

The sediments encountered beneath the site in MW5 through MW7 consisted predominantly of sand to a total boring depth of 25 to 27 feet bgs. The sand observed during drilling was gray to brown, medium to fine grained, and cohesive. Just above the beginning of the saturated zone which began nine to twelve feet bgs, a thin (three- to four-inch) layer of dark grey silt was encountered. There were no olfactory or visual indications of petroleum hydrocarbons in any of the drill cuttings or the soil samples collected. A complete description of the soil types observed in each boring during drilling is included in Appendix B.

Groundwater was found during drilling in MW5 at approximately 10 feet bgs, in MW6 at approximately 9 feet bgs, and in MW7 at approximately 13 feet bgs. The static groundwater levels in the wells immediately after installation were 11.62 feet below TOC in MW5, 11.79 feet below TOC in MW6, and 12.40 below TOC in MW7.

Groundwater surface elevation measurements showed no more than .04 feet difference between the high and low tide cycles. There was no measured difference in MW7, which is closest to the waterway; the largest difference was measured in MW6, which is the farthest of the three wells from the waterway. This difference probably indicates a minimal tidal influence in the vicinity of the diesel UST. The groundwater gradient at 6:23 a.m. measured .005; at 1:14 p.m. the gradient increased very slightly to .006. At both times, the direction of groundwater flow beneath the site appears to be toward the east (Figure 3). Actual measurements made by ESE personnel are shown in Table 1.

Table 1. Groundwater Elevations Measured on April 13, 1994 (in feet)

Well Number	Well Elevation ¹	Measured Depth to Groundwater ² (6:23 A.M.)	Calculated Groundwater Elevation ¹ (6:23 A.M.)	Measured Depth to Groundwater ² (1:14 P.M.)	Calculated Groundwater Elevation ¹ (1:14 P.M.)
MW5	19.60	11.47	8.13	11.45	8.15
MW6	19.80	11.48	8.32	11.44	8.36
MW7	19.53	11.66	7.87	11.66	7.87

¹ In feet above Mean Low Low Water

² Measured from TOC

Lab-Reported Analyses

The lab-reported results on groundwater samples collected from the three groundwater monitoring wells, MW5 through MW7, are summarized in Table 2. Copies of the laboratory reports and chain-of-custody documents are also provided in Appendix D.

Based on the lab-reported results, only the soil sample collected at 5 feet bgs in MW6 (MW6-5) contained concentrations of petroleum hydrocarbons above Soil Cleanup Levels at 510 ppm in the motor oil range. None of the other soil samples contained concentrations of petroleum hydrocarbons above the Soil Cleanup Level of 200 ppm for diesel or other heavy petroleum hydrocarbons in soil.

The lab-reported analytical results for the water samples collected from the wells indicated concentrations of dissolved petroleum hydrocarbon constituents were below the Groundwater Cleanup Level of 1,000 parts per billion (ug/l).

The lab-reported results of the water sample and soil sample collected from the drums generated during drilling activities indicated concentrations of petroleum hydrocarbons in the soil and water were below Soil and Groundwater Cleanup Levels. After the analytical results of the samples collected from the drums became available, the Port accepted responsibility for disposal of all of the material in the drums.

Table 2. Laboratory-reported Results of Soil and Groundwater Samples Collected during Field Activities at Terminal 115

Sample I.D.	WTPH Method	
	Diesel	Diesel Extended
SOIL (mg/Kg)		
MW5-5	<13	<40
MW6-5	<130	510
MW7-10	<13	<40
DS-1	17	<40
Soil Cleanup Levels	200 mg/Kg	200 mg/Kg
GROUNDWATER (ug/L)		
MW5	310	310
MW6	220	<300
MW7	150	<150
MW7D ¹	160	<150
DRUM	240	360
Groundwater Cleanup Levels	1,000 ug/L	1,000 ug/L

mg/Kg: Milligrams per kilogram or approximately parts per million.
 ug/L: Micrograms per liter or approximately parts per billion.
 MW7D¹: Groundwater sample MW7D is a field duplicate of sample MW7.

CONCLUSIONS

The following conclusions are based on our interpretation of information currently available to ESE. The lab-reported analytical results received during this investigation for MW5 through MW7 indicated shallow groundwater in the vicinity of the diesel UST did not contain petroleum hydrocarbon constituents at concentrations above Groundwater Cleanup Levels. Concentrations of diesel and heavier compounds were present in the samples from the three wells, but below Groundwater Cleanup Levels.

One soil sample, collected at 5 feet bgs during the installation of MW6, contained concentrations of motor oil range petroleum hydrocarbons above Soil Cleanup Levels. Because the concentration of diesel range compounds in that same soil sample were below Soil Cleanup Levels, the source of petroleum hydrocarbons found in this sample is not likely to be the old diesel UST. Due to the highly industrial nature of the terminal, the specific source of the motor oil range compounds in this soil sample cannot be positively identified. The concentrations of heavier range petroleum compounds that were detected in soil do not appear to have increased concentrations of similar range compounds in shallow groundwater in the vicinity of the MW6.

STANDARD LIMITATIONS

The findings and conclusions documented in this report have been prepared for specific application to this project and have been developed in a manner consistent with that level of care and skill normally exercised by members of the environmental science and engineering profession currently practicing under similar conditions in this area, and in accordance with the terms and conditions set forth in our authorized proposal dated February 25, 1994. All conclusions, expectations, and recommendations are ESE's professional opinions based on ESE's interpretation of information currently available to ESE, and made within the operative constraints of the scope, budget and schedule for this project. No warranty, expressed or implied, is made.

This report is for the exclusive use of the Port of Seattle and their representatives. Use or interpretations of this report by others is not recommended.

The conclusions in this report are based on lab-reported analyses of samples from widely scattered borings and monitoring wells. A potential always remains for possible surface or subsurface contamination, or other adverse subsurface conditions, that are presently unknown, unidentified, unexpected, or unforeseen. Further evidence against such possible site contamination or adverse conditions would require appropriate exploration, testing, and interpretation.

If new information is discovered or developed in future work (which may include excavations, borings, other studies, or new regulations), ESE should be requested to reevaluate the conclusions of this report, and to provide amendments if required.

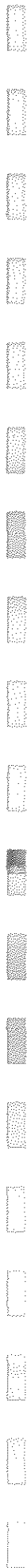
CLOSURE

We appreciate the opportunity to be of service on this project. Please contact ESE if you have any questions regarding our scope, methods, findings, conclusions or recommendations.

Sincerely,
Environmental Science & Engineering, Inc.

Sue Swan
Senior Project Scientist

Gregory Burgess, R.G.
Senior Project Geologist
Geosciences Department Manager



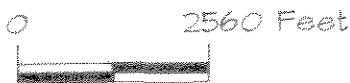
FIGURES



SEATTLE



SOURCE: THOMAS BROS. MAPS, 1990
 STATE: WASHINGTON
 COUNTY: KING
 PAGE: 26
 SECTION: B-4

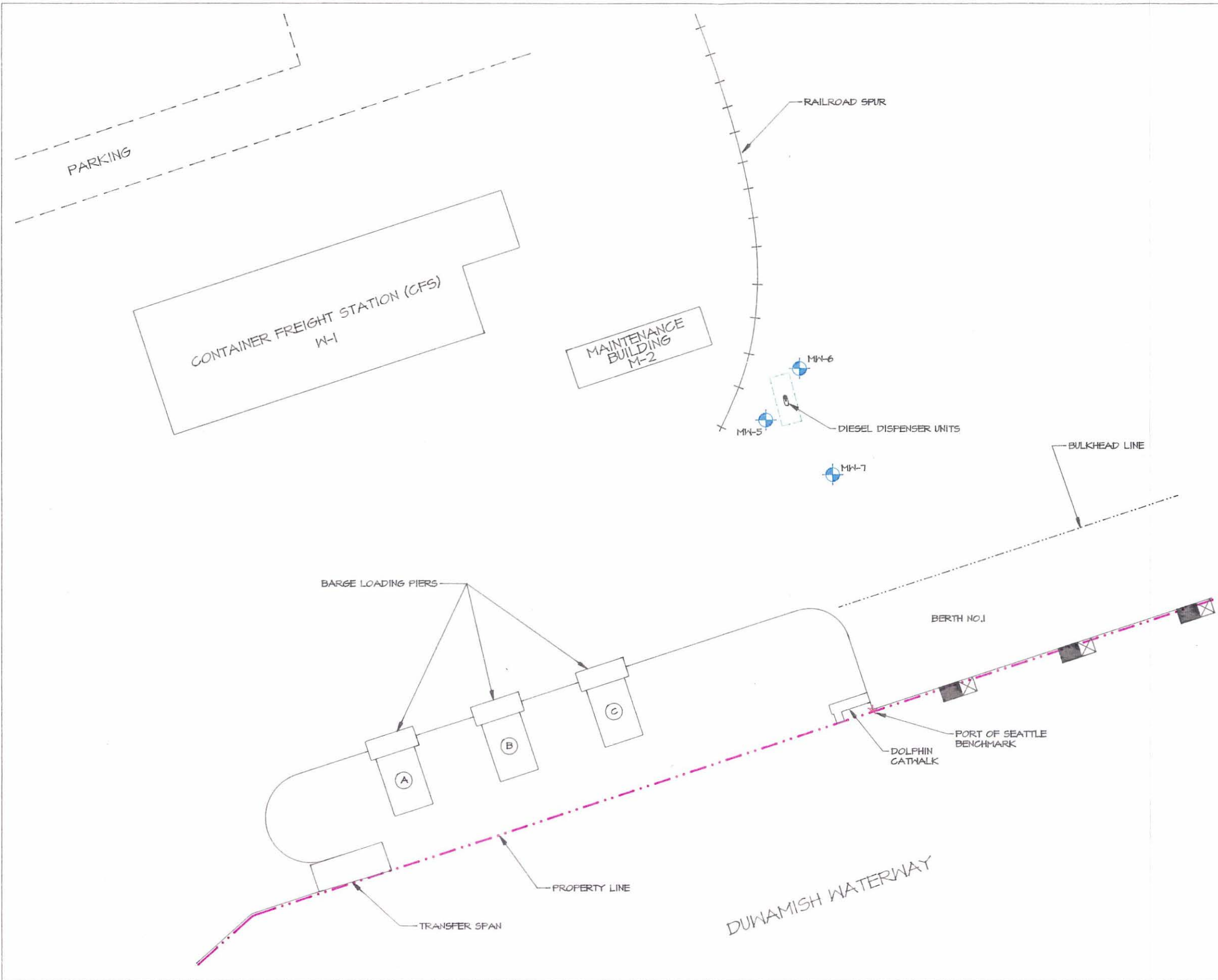


PORT OF SEATTLE
 TERMINAL 115
 SEATTLE, WASH.

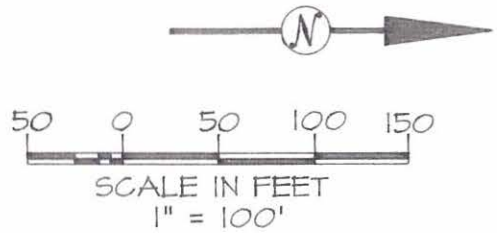
LOCATION MAP

DATE:	PROJECT NO.	FIG#
6-01-94	6-94-7301-0007	1
SCALE:	DWG No.:	SIZE:
1"=2560'	7301LM	A
DRAWN BY:	APPROVED BY:	REV:
M. ARMSTRONG	S. SWAN	-

Reproduced with permission granted by Thomas Bros. Maps. This map is copyrighted by Thomas Bros. Maps. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.



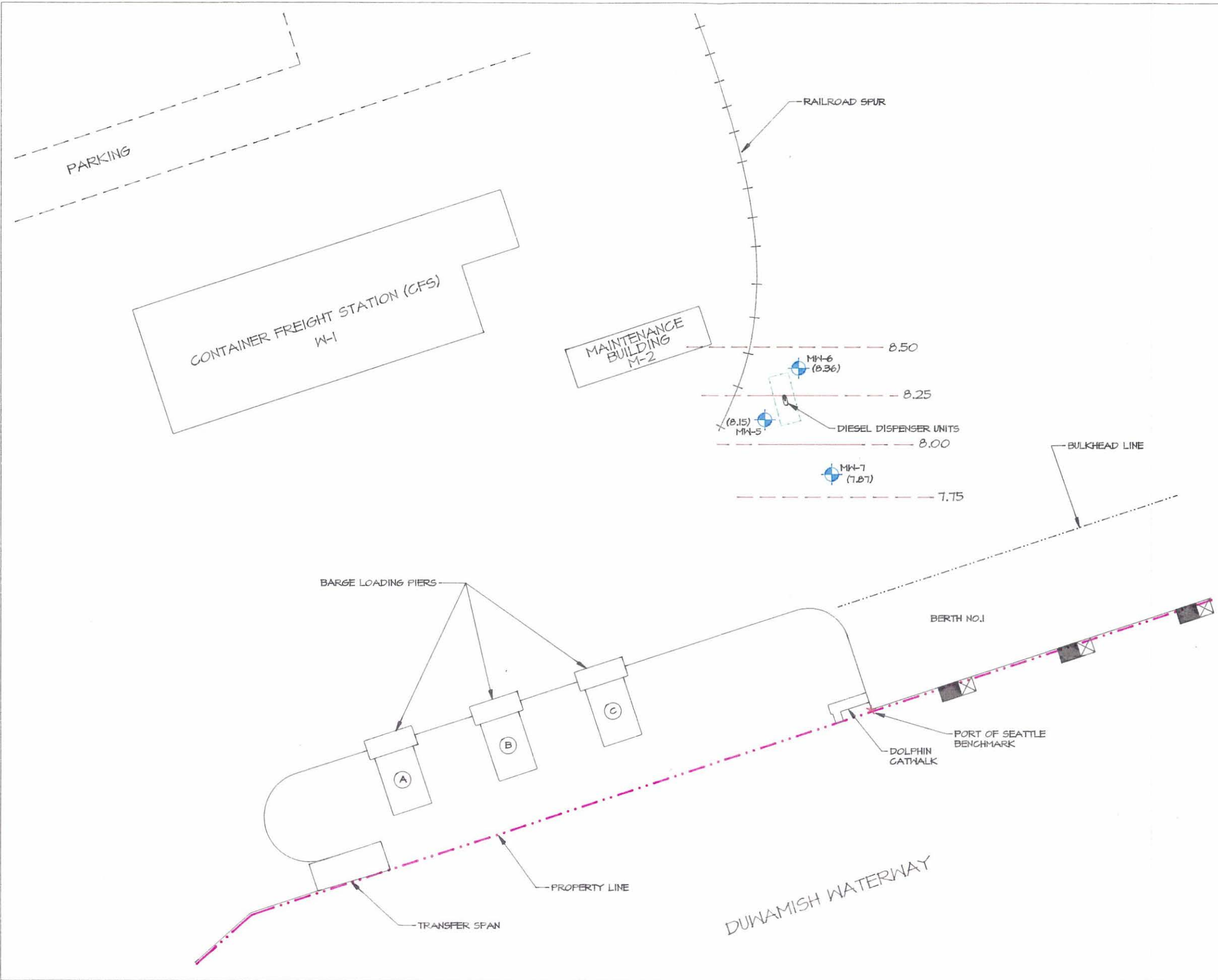
LEGEND	
SYMBOL:	EXPLANATION:
	GROUNDWATER MONITORING WELL LOCATION WITH IDENTIFICATION.
	APPROXIMATE LOCATION OF DIESEL UNDERGROUND STORAGE TANK.



	PORT OF SEATTLE TERMINAL 115 SEATTLE, WASH	
--	--	--

SITE MAP

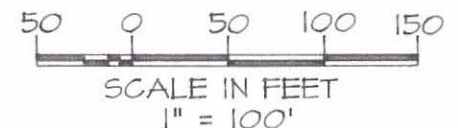
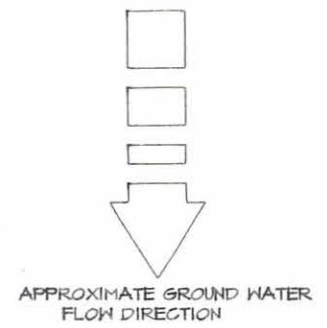
DATE: 6-01-94	PROJECT NO. 6-94-7301-0007	FIG# 2
SCALE: 1"=100'	DWG NO.: 7301SM	SIZE: B
DRAWN BY: M. ARMSTRONG	APPROVED BY: S. SWAN	REV: -



LEGEND

SYMBOL:	EXPLANATION:
	GROUNDWATER MONITORING WELL LOCATION WITH IDENTIFICATION.
	APPROXIMATE LOCATION OF DIESEL UNDERGROUND STORAGE TANK.
	8.25 GROUNDWATER SURFACE ELEVATION CONTOUR LINE WITH IDENTIFICATION, DASHED WHERE INFERRED.
	GROUNDWATER SURFACE ELEVATION MEASURED IN FEET ABOVE MEAN SEA LEVEL (MSL).

NOTE:
 1.) DATA COLLECTED ON APRIL 13, 1994 AT APPROX 1:14 PST.
 2.) CONTOUR INTERVAL = 0.25 FEET



	PORT OF SEATTLE TERMINAL 115 SEATTLE, WASH	
--	--	--

GROUNDWATER SURFACE ELEVATION CONTOUR MAP		
DATE: 6-01-94	PROJECT NO. 6-94-7301-0007	FIG# 3
SCALE: 1"=100'	DWG NO.: 7301SM	SIZE: B
DRAWN BY: M. ARMSTRONG	APPROVED BY: S. SWAN	REV: -

APPENDIX A
FIELD INVESTIGATION METHODOLOGY



Drilling Procedures

A truck-mounted hollow-stem auger drilling rig was used to drill and install wells MW5 through MW7. The auger flights were in 5-foot lengths with an inside diameter (ID) of approximately four inches and an outside diameter (OD), including the drill bit, of approximately six inches.

Soil Sampling Procedures

During the drilling process, relatively undisturbed soil samples were collected from the borings for organic vapor monitoring and visual description using a split spoon sampler. Soil sample collection was attempted at 5 and 10 foot depths from each boring.

The split spoon sampler consisted of an outer sampler barrel with a sand catcher in the tip. The sampler was attached to the end of a 140 pound slide hammer, lowered through the hollow-stem auger flights and driven 12 to 18-inches by driving the sampler with the slide hammer. A soil sample for description and volatile headspace analysis was collected inside the sampler barrel.

Before the split spoon sampler was assembled and placed in the boring, it was cleaned to avoid cross-contamination of samples. The equipment was washed with Liqui-Nox detergent solution, rinsed with tap water and then allowed to air dry. The auger flights were steam cleaned prior to arrival at the site and between each boring.

After the sampler was driven to the desired depth, it was removed from the boring. The soil in the sampler was examined in the field for olfactory indications of petroleum hydrocarbons and used for lithologic description and a vapor headspace analysis. The grain size, color, odor, moisture, and other pertinent Unified Soil Classification System properties were described on field boring logs by an individual from Environmental Science & Engineering, Inc.

Soil cuttings generated during the drilling process were contained in 55-gallon Department of Transportation (DOT)-approved drums and stored on site pending the results of chemical analyses.

Organic Vapor Monitoring

An organic vapor headspace test was performed on each soil sample in the field using a Photoionization Detector (PID). In performing the test, soil extracted from the boring was placed in an 8-ounce glass jar until the jar was approximately 50% full. The jar was sealed with aluminum foil and fitted with an air-tight lid. The sample in the jar was exposed to direct sunlight for at least 15 minutes. After the 15 minutes had expired, the lid was removed and the organic vapor concentration of the soil was monitored by inserting the PID probe through the foil and into the vapor head space. The organic vapor readings were recorded in the field on the soil boring logs.

Groundwater Monitoring Well Installation

The groundwater monitoring wells were constructed of 2-inch diameter Schedule 40 slotted and blank PVC casing. The slotted casing, with openings of 0.010-inch, was fitted with a flush threaded cap and positioned at the bottom of each well. The blank casing was connected by flush threads to the slotted casing, no glues or solvents were used in the connection of the PVC casings or caps. Specific well installation data are included on the soil boring logs.

The annulus of each well was filled with a graded, clean silica sand pack (Colorado Silica Sand (CSS), 10/20) to approximately one foot above the top of the perforated pipe (see boring logs). A 1.5 to 2.5 foot layer of compressed bentonite pellets was placed above the sand pack and hydrated to form an impermeable barrier in the annulus. The remainder of the annular space to approximately three feet bgs was filled with cement and concrete. The well was completed according to "Groundwater Monitoring Well Head Completion Specifications - Flush Mounted Application" (Rev2Feb94), supplied to ESE by the Port. The PVC casing was fitted with water tight, lockable caps and secured.

Depth to Groundwater Measurements

Depth to groundwater surface measurements were recorded for each groundwater monitoring well by ESE personnel. The groundwater surface measurements were made by lowering an electronic water level probe into each well. The tape on the instrument, graduated in .02-foot increments, was lowered into the well until the electronic sounder was triggered. The depth to the groundwater surface was then recorded relative to the top of the PVC casing. Prior to being lowered into each well, the equipment was washed with a Liqui-Nox detergent solution, rinsed with tap water and then allowed to air dry.

Groundwater Monitoring Well Sampling

Groundwater samples were collected from each well, once groundwater levels in the wells had recovered, using a disposable Teflon bailer attached to a nylon cord. The groundwater samples were transferred from the bailer to one liter amber with Teflon-lined lids, labeled, and placed in an ice chest for cold storage and transport. To prevent cross contamination of the groundwater samples, the Teflon bailer and cord were disposed of following sample collection in each well.

APPENDIX B

SOIL BORING LOGS AND WELL CONSTRUCTION SPECIFICATIONS





LOG OF EXPLORATORY
BORING WITH WELL
INSTALLATION DATA

PROJECT NO. 6-94-7301
CLIENT: Port of Seattle
LOCATION: Terminal I15
LOGGED BY: S. Swan

WELL NO. MW-5
DATE: 4/7/94
DRILLER: Tacoma Pump & Drilling
PAGE: 1 of 1

FIELD LOCATION:
BENCHMARK ELEVATION:
WELL CASING ELEVATION: 19.60'
WELL CASING TYPE: 2" PVC Sch 40
SCREEN PERFORATION: 0.010"

WELL COMPLETION DEPTH: 27'
TOTAL DEPTH: 27'
BORING DIAMETER: 4.25"
WELL DIAMETER: 2"
FILTER PACK TYPE: 10-20 CSS

SEAL TYPE: Bentonite
WATER DEPTH FIRST: 10'
WATER DEPTH COMPLETED: 11.62'
WATER DEPTH 24HRS: NA

DEPTH	VAPOR CONC. (PPM)	BLOW/FT	SAMPLE TYPE	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTION	WELL DIAGRAM
0						ASPHALT.	
5	0	39	Ring	sm		SAND, fine-grained, dark gray, dry, cohesive, no odor.	
10	--	107/9"	No Sample	↓		SAND, fine-grained, dark brown with white, black grains, moist, cohesive, no odor. SILT, very fine-grained, dark gray, saturated, cohesive, no odor.	
15						SAND, fine-grained, dark gray, saturated, cohesive, no odor.	
20							
25							
30						Total Depth: 27'	
35							
40							





LOG OF EXPLORATORY
BORING WITH WELL
INSTALLATION DATA

PROJECT NO. 6-94-7301
CLIENT: Port of Seattle
LOCATION: Terminal 115
LOGGED BY: S. Swan

WELL NO. MW-6
DATE: 4/7/94
DRILLER: Tacoma Pump & Drilling
PAGE: 1 of 1

FIELD LOCATION:	WELL COMPLETION DEPTH: 27'	SEAL TYPE: Bentonite
BENCHMARK ELEVATION:	TOTAL DEPTH: 27'	WATER DEPTH FIRST: 9'
WELL CASING ELEVATION: 19.80'	BORING DIAMETER: 4.25"	WATER DEPTH COMPLETED: 11.79
WELL CASING TYPE: 2" PVC Sch 40	WELL DIAMETER: 2"	WATER DEPTH 24HRS: NA
SCREEN PERFORATION: 0.010"/0.020"	FILTER PACK TYPE: 10-20 CSS	

DEPTH	VAPOR CONC. (PPM)	BLOW/FT	SAMPLE TYPE	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTION	WELL DIAGRAM
0						ASPHALT	
5	0	50	Ring	sm		SAND, medium-grained, dark brown with white, black grains, dry, cohesive, no odor.	
10	--	18	No Sample	ml sm		SILT, very fine-grained, blue-black, saturated, cohesive, no odor.	
15				▼		SAND, medium-grained, dark brown with white, black grains, saturated, cohesive, no odor.	
20							
25							
30						Total Depth: 27'	
35							
40							





LOG OF EXPLORATORY
BORING WITH WELL
INSTALLATION DATA

PROJECT NO. 6-94-7301
CLIENT: Port of Seattle
LOCATION: Terminal 115
LOGGED BY: S. Swan

WELL NO. MW-7
DATE: 4/7/94
DRILLER: Tacoma Pump & Drilling
PAGE: 1 of 1

FIELD LOCATION:
BENCHMARK ELEVATION:
WELL CASING ELEVATION: 19.53'
WELL CASING TYPE: 2" PVC Sch 40
SCREEN PERFORATION: 0.010"

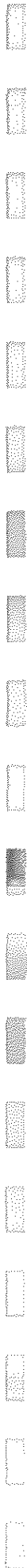
WELL COMPLETION DEPTH: 25'
TOTAL DEPTH: 25'
BORING DIAMETER: 4.25"
WELL DIAMETER: 2"
FILTER PACK TYPE: 10-20 CSS

SEAL TYPE: Bentonite
WATER DEPTH FIRST: 13'
WATER DEPTH COMPLETED: 12.4'
WATER DEPTH 24HRS: NA

DEPTH	VAPOR CONC. (PPM)	BLOW/FT	SAMPLE TYPE	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTION	WELL DIAGRAM
0						ASPHALT.	
5	0	36	Ring	sm		SAND, fine-grained, dark brown with white and black grains, dry, cohesive, no odor.	
10	9	13	Ring	sm		SAND, medium-grained, dark brown, dry, cohesive, no odor.	
15				ml sm		SILT, very fine-grained, blue-black, saturated, cohesive, no odor.	
15						SAND, medium grained, dark brown, saturated, no odor.	
						Total Depth: 27'	
30							
35							
40							



APPENDIX C
CTS ENGINEERS SURVEY REPORT



cts

ENGINEERS, INC.

April 13, 1994

Ms. Sue Swan
Senior Project Scientist
Environmental Science & Engineering, Inc.
15444 NE 95th Street
Suite 244
Redmond, WA 98052

RENATA G. PROCHASKA, P.E.
President
PAUL PROCHASKA, P.E.
Vice President
CIVIL
TRANSPORTATION
STRUCTURAL

Dear Ms. Swan:

Enclosed are the coordinates and elevations based on field survey completed April 12, 1994.

Beginning at the monument at the intersection of Erie Ave. (4th Ave. SW) and Michigan Ave. (SW Michigan St.), using SW Michigan St. as the Basis of Bearing, we traversed and located the monitoring wells; which were shown to us by an employee of Environmental Science and Engineering Inc. The coordinate computed were based on the coordinate system as indicated on the 1992 drawing "Duwamish Waterway through Commercial Waterway District No. 1" and referenced to tide lands meridian.

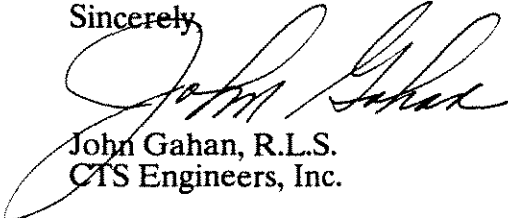
Elevations are based on Port of Seattle datum (MLLW). Brass plug stamped "Port of Seattle elevation 21.03 feet."

Location	Coordinates		Elevation (MLLW)
Monitoring well	N2262.0	E31155.0	19.53
	N2298.5	E31110.7	19.60
	N2332.7	E31216.3	19.80

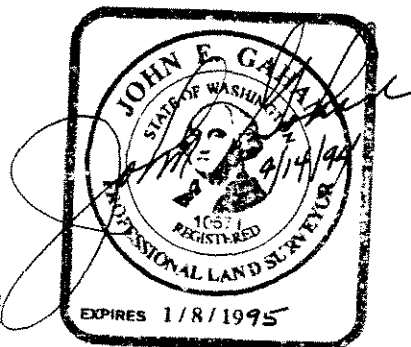
Elevations are on the chiseled mark on the top of the 2-inch round PVC pipe.

If you have any questions please call.

Sincerely,


John Gahan, R.L.S.
CTS Engineers, Inc.

cc: File





APPENDIX D

LABORATORY REPORTS AND CHAIN-OF-CUSTODY DOCUMENTS



An ETC Laboratory

6645 185th
Avenue NE

Suite 100

Redmond, WA
98052

Telephone
(206) 885-0083

Facsimile
(206) 883-8528



May 4, 1994

MAY 11 1994

Susan Swan
Environmental Science and Engineering Inc.
15444 NE 95th ST, Suite 244
Redmond, WA 98052

Subject: Project Port of Seattle
ETC/NW SDG T115/POS/MW4, Batch 5395

Enclosed are the results for the samples collected on April 26 and received by ETC/Northwest on April 27, 1994.

A brief discussion of the analytical methodologies employed is presented, as well as a summary of quality control data generated as part of the analyses. The following narrative is considered an integral part of this report. Reproduction of reports is encouraged to be in whole, not in part. Results apply only to the samples analyzed.

Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

If you require any additional information, please feel free to contact one of our Project Managers.

Respectfully submitted,

David A. Wundlich
Director, Laboratory Services
Enclosures

NARRATIVE FOR ETC/Northwest SDG T115/POS/MW4, Batch 5395

The samples for this project were received and assigned a corresponding ETC/Northwest identification number as follows:

<u>ETC/NW ID</u>	<u>CLIENT ID</u>
5395-01	MW-5

Listed below are anomalies and narratives associated with the receipt and/or analysis of these samples. This narrative is an integral portion of this data package and should not be separated from the following pages.

Sample Receiving

There were no anomalies associated with the receipt of these samples.

***Total Petroleum
Hydrocarbons as Diesel
and Other Extractable
Products by GC***

Gas Chromatographic Analysis by WTPH-D, April 1992 update,
Appendix L, Guidance for Remediation of Releases from
Underground Storage Tanks, July 1991.

There were no anomalies associated with the analysis of these samples and their associated QC.

DATA REPORTING QUALIFIERS

Some of these qualifiers may appear in this analytical data report. Soil samples are analyzed and reported on a dry weight basis unless otherwise noted.

Organics Data Qualifiers

- A - This flag indicates that a TIC is a suspected aldol-condensation product.
- B - Indicates compound was found in the associated blank as well as in the sample.
- C - This flag applies to pesticide results where the identification has been confirmed by GC/MS.
- D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.
- E - This flag identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.
- J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed, or when the mass spectral data indicate the presence of a target compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero.
- L - Compound detected in leachate blank.
- M - Indicates value is taken from a medium level analysis.
- N - Indicates that the identity of the compound is based upon a mass spectral library search (applies to tentatively identified compounds only).
- ND- Not detected. Detection limit shown in parentheses.
- NQ- Not quantitated as...
- U - Indicates compound was analyzed for but not detected at the given detection limit. The sample quantitation limit was corrected for dilution and for percent moisture, when applicable.
- X - Other specific flags and footnotes may be required to properly define the results. If more than two qualifiers are required for a sample result, the "X" flag combines several flags, as needed. For instance, the "X" flag might combine the "A," "B," and "D" flags for some sample.
- Z - Spike compound diluted out, recovery value could not be determined.

Inorganics Data Qualifiers

- NA- Relative percent difference calculation is not applicable to analytes when not detected.
- NC- Not calculated when analyte is not detected.
- NS- Not calculated when sample concentration of analyte exceeds spike level by a factor of four or more.
- U - Indicates that analyte was analyzed for but not detected. The number is the minimum attainable detection limit for the sample.
- B - Indicates that the reported value is less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).
- E - The reported value is estimated because of the presence of interference. An explanatory note must be included under Comments on the Cover Page (if the problem applies to all samples) or on the specific FORM-I (if it is an isolated problem).
- M - Duplicate injection precision not met.
- N - Spike sample recovery not within control limits.
- S - The reported value was determined by the Method of Standard Additions (MSA).
- W - Post-digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance. (See Exhibit E.)
- * - Duplicate analysis not within control limits.
- + - Correlation coefficient for the MSA is less than 0.995.

Inorganics Method Qualifiers

- CV- Manual Cold Vapor AA
- F - FURNACE AA
- P - ICP

ETC/Northwest

Petroleum Hydrocarbons by GC

Method WTPHD

930902:WHD

Client Sample ID	METHOD BLANK	MW-5
ETC/NW Sample ID	5395-MBW	5395-01
Matrix	WATER	WATER
Date Sampled	N/A	04/26/94
Date Received	N/A	04/27/94
Date Extracted	04/27/94	04/27/94
Date Analyzed	04/28/94	04/28/94
Dilution Factor	1	1
Units of Measure	UG/L	UG/L

Compound

TEPH Quantitated as

Diesel	50 U	310
n-C12 to n-C24		
Motor Oil	150 U	310
n-C24 to n-C40		

ETC/Northwest

Petroleum Hydrocarbons by GC

Method WTPHD

930902:WHD

SURROGATE RECOVERY

% O-Terphenyl

5395-MBW	84
5395-O1	96
5395-LCSW	92

Recovery Limits 50-150

ETC/Northwest

Petroleum Hydrocarbons by GC

Method WTPHD

930902:WHD

LCS/LCSD

Client Sample ID METHOD BLANK
 ETC/NW Sample ID 5395-LCSW
 Matrix WATER
 Date Sampled N/A
 Date Received N/A
 Date Extracted 04/27/94
 Date Analyzed 04/28/94
 Percent Solids N/A
 Dilution Factor 1
 Units of Measure UG/L

LCS (Blank Spike)

Compound	Spike Added	Sample Conc.	LCS Conc.	LCS % Recovery
Diesel	2000	50 U	1500	75.0

CompoundWater QC Limits.....	Soil QC Limits.....	
	RPD	Rec.	RPD	Rec.
Diesel	</= 20	60-120	</= 20	60-120

2000

ETC/Northwest

chrom

DATA PACKAGE

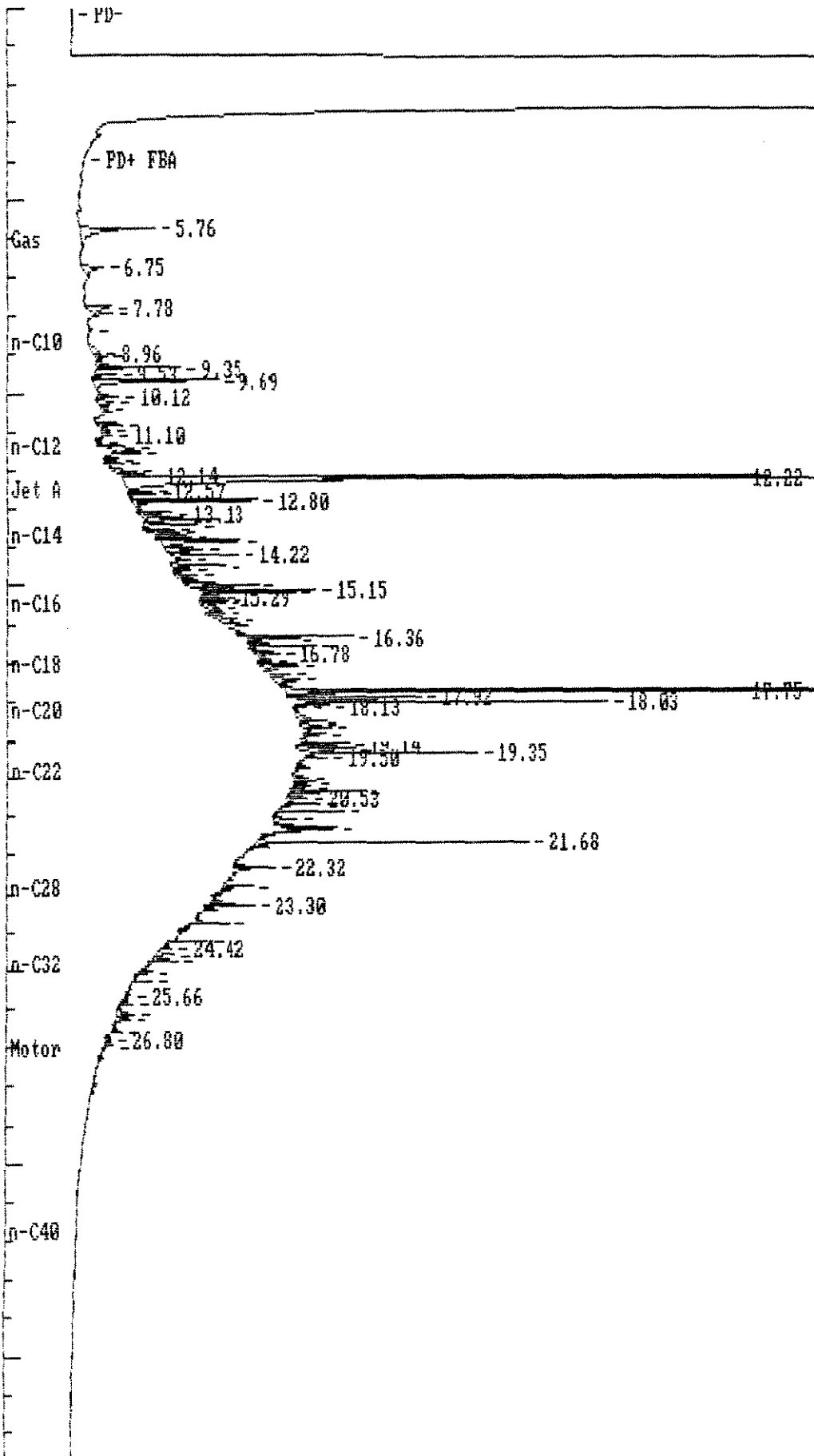
SDG: T115/POS/MW4; Batch: 5395

*Total Petroleum
Hydrocarbons as Diesel
and Other Extractable
Products by GC*

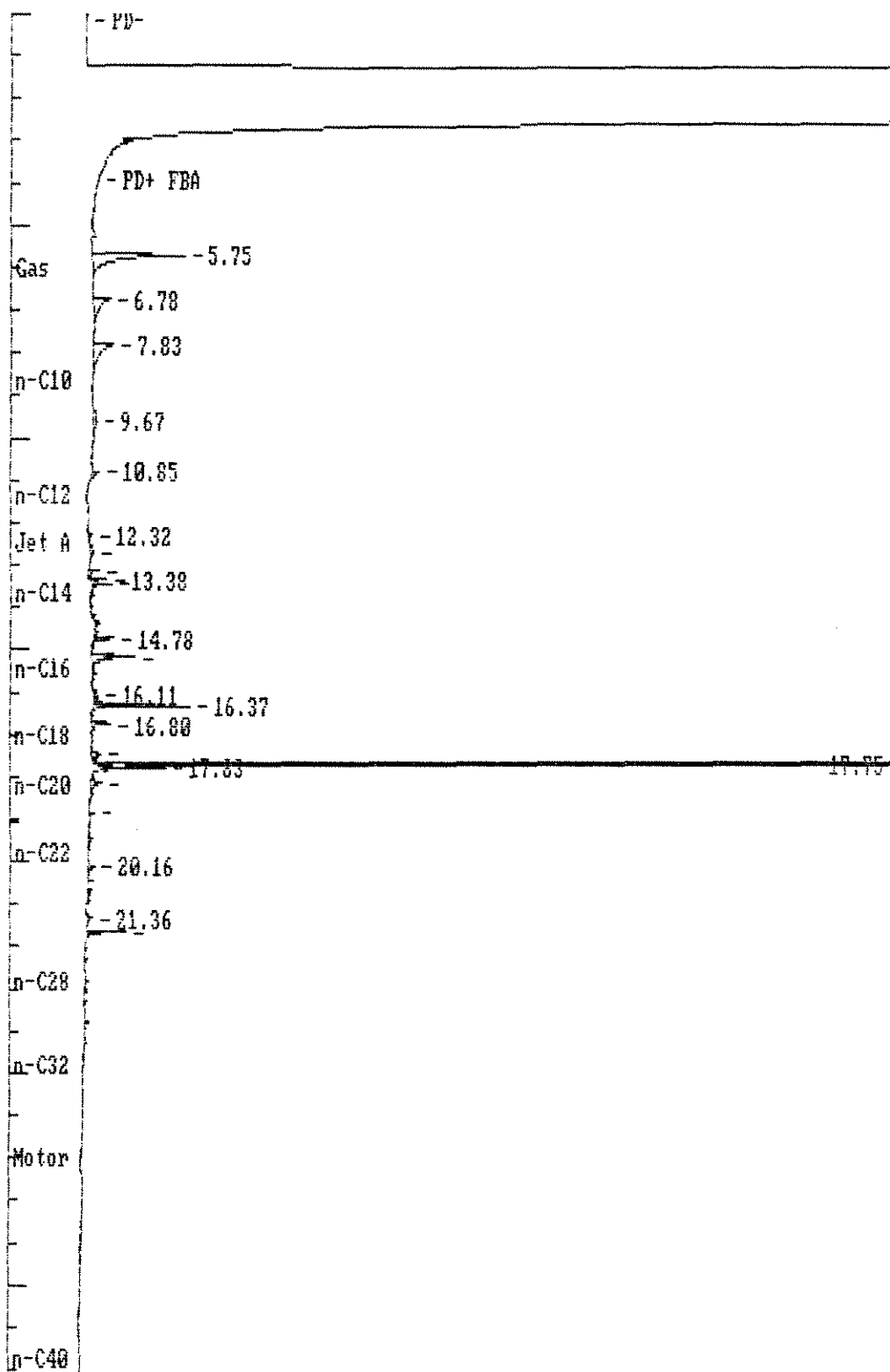
Gas Chromatographic Analysis by WTPH-D, April 1992 update,
Appendix L, Guidance for Remediation of Releases from
Underground Storage Tanks, July 1991.

CHROMATOGRAMS

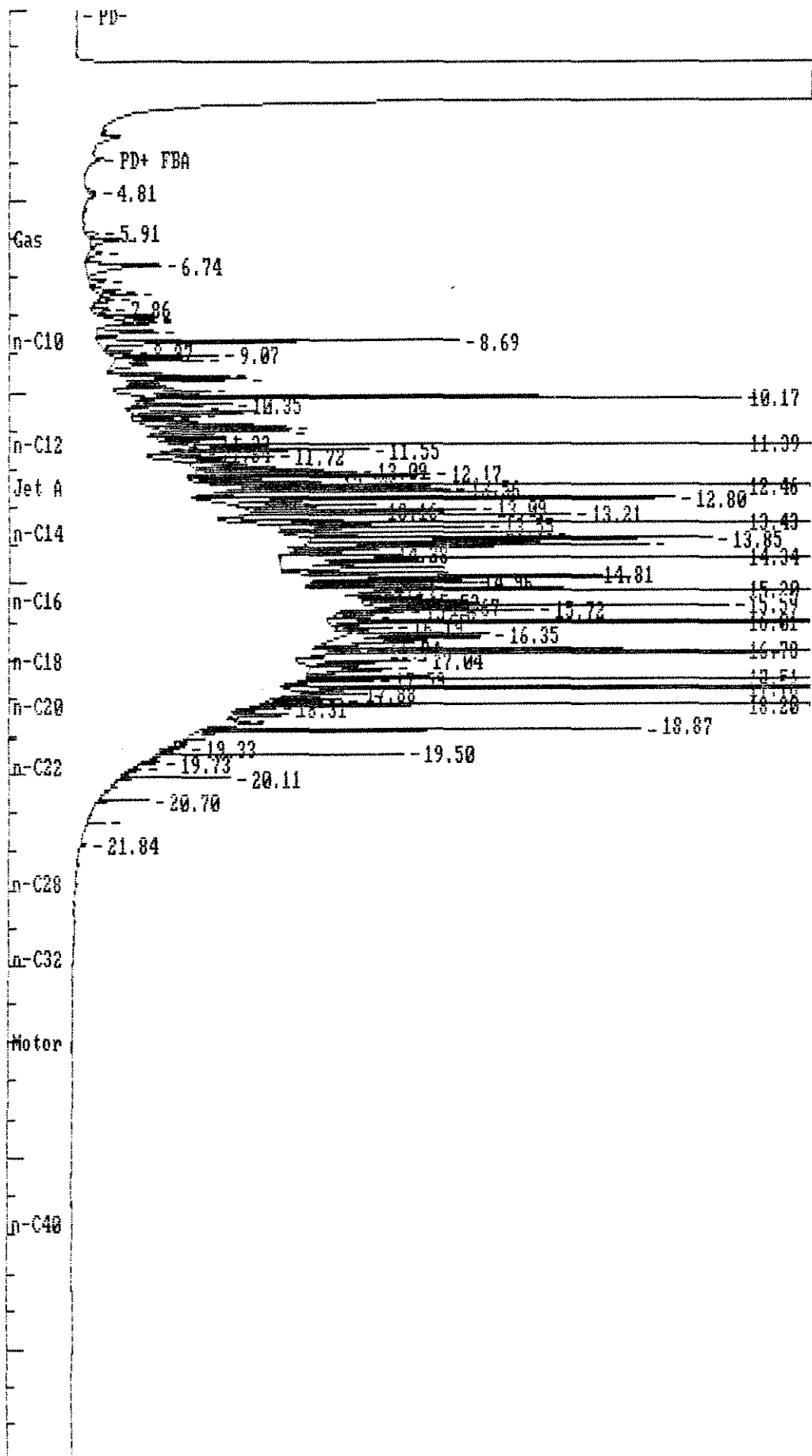
SAMPLE NAME: 5395-01 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-28-1994 21:36:5 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A118-10.PTS



SAMPLE NAME: 5395-MBW COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: 04-28-1994 19:45:02 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A118-8.PTS

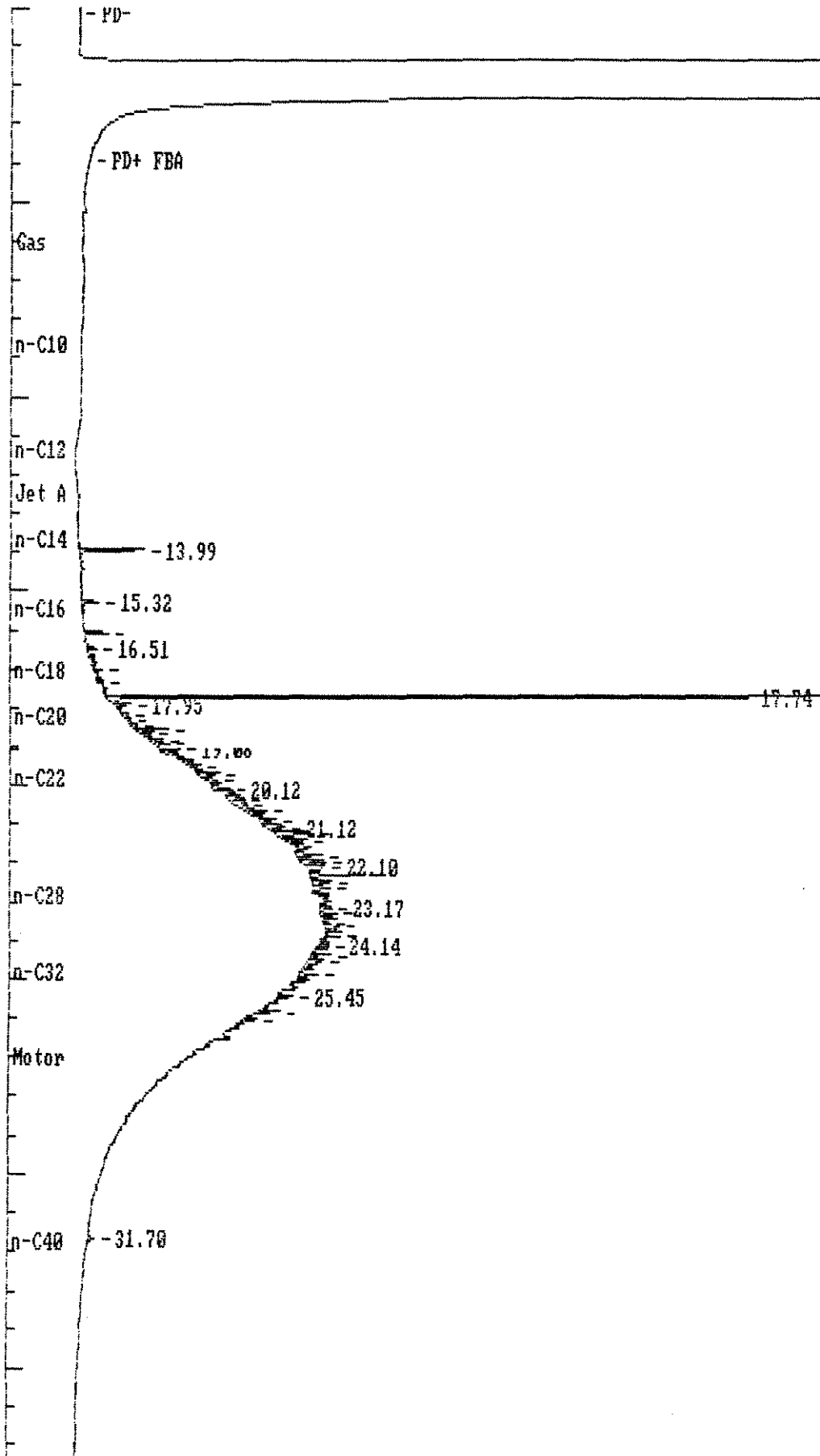


SAMPLE NAME: Diesel/o-Terphenyl 500/100 021 COLUMN: 15m x 0.32mm DB-5 : FID
 DATE AND TIME INJECTED: 04-28-1994 17:53:02 INSTRUMENT I.D.: GCQA5890
 VOLUME INJECTED: 2 uL
 Full Range: 50 millivolts Data File = Q:A118-6.PTS



C010

SAMPLE NAME: Motor Oil 750 011494-207 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: 04-28-1994 18:49:11 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A118-7.PTS





An ETC Laboratory

6645 185th
Avenue NE

Suite 100

Redmond, WA
98052

Telephone
(206) 885-0083

Facsimile
(206) 883-8528



April 29, 1994

Susan Swan
Environmental Science and Engineering Inc.
15444 NE 95th ST., Suite 244
Redmond, WA 98052

Subject: Project Port of Seattle
ETC/NW Batch 5360

Enclosed are the results for the samples collected on April 7, 8, and received by ETC/Northwest on April 11, 1994.

A brief discussion of the analytical methodologies employed is presented, as well as a summary of quality control data generated as part of the analyses. The following narrative is considered an integral part of this report. Reproduction of reports is encouraged to be in whole, not in part. Results apply only to the samples analyzed.

Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

If you require any additional information, please feel free to contact one of our Project Managers.

Respectfully submitted,

David A. Wendelich
Director, Laboratory Services
Enclosures

NARRATIVE FOR ETC/Northwest 5360

The samples for this project were received and assigned a corresponding ETC/Northwest identification number as follows:

<u>ETC/NW ID</u>	<u>CLIENT ID</u>	<u>ETC/NW ID</u>	<u>CLIENT ID</u>
5360-01	T115/POS/DRUM	5360-06	T115/POS/DS-1
5360-02	T115/POS/MW5	5360-07	T115/POS/MW5-5
5360-03	T115/POS/MW7	5360-08	T115/POS/MW7-10
5360-04	T115/POS/MW7D	5360-09	T115/POS/MW6-5
5360-05	T115/POS/MW6		

Listed below are anomalies and narratives associated with the receipt and/or analysis of these samples. This narrative is an integral portion of this data package and should not be separated from the following pages.

Sample Receiving

The following anomaly was associated with the receipt of the Port of Seattle samples received on 4/11/94;

The sample identification limitation is 15 characters. An example of the sample identification truncation is as follows; "Terminal115/POS/MW4" was truncated to "T115/POS/MW4." All characters following the "T" are represented as listed on the chain.

The sample identified as "Terminal115/POS/MW4" was collected at three different times; 1525, 1524 and 1526. As per conversation with the client, the sample will be identified as the same sample for all processing and reporting purposes.

The client was notified verbally of the above sample receiving anomalies.

***Total Petroleum
Hydrocarbons as Diesel
and Other Extractable
Products by GC*** Gas Chromatographic Analysis by WTPH-D, April 1992 update,
Appendix L, Guidance for Remediation of Releases from
Underground Storage Tanks, July 1991.

Sample 5360-02 (T115/POS/MW5) was not extracted within the hold time for WTPHD. Arrangements have been made with the client for the re-collection and analysis of this sample.

The reported concentrations in sample 5360-09 are based on the analysis of a dilution.

***Hydrocarbon Product
Identification by GC*** Gas Chromatographic Analysis by WTPH-HCID, April 1992 update,
Appendix L, Guidance for Remediation of Releases from
Underground Storage Tanks, July 1991.

There were no anomalies associated with the analysis of these samples and their associated QC.

The method was modified for the analysis of water samples.



2000 100TH AVENUE NE SUITE 100
 Redmond Washington 98052
 206/885-0083
 206/883-8528 FAX

CHAIN-OF-CUSTODY / REQUEST FOR ANALYSIS

Laboratory Contact Sally Gough

Send Lab Report To Sue Swan / ESE, Inc
15444 NE 95th St.

Redmond WA 98052

Date Report Required 4/25/94 (FAX)

Client Contact Kathy Bahatch Sue Swan

Client Contact Phone 869-8220

Client Name E.S.E. / Port of Seattle

Client Number _____

Bill To E.S.E., Inc. c/o Sue Swan
15444 NE 95th Street
Redmond WA 98052

PO No. W5379

Carrier No. _____

Analysis and Container

Sample Number	Sample Location and Description	Date Collected	Time Collected	Sample Matrix	Number of Containers	Analysis and Container				Comments	
1	Terminal 115/Pos/DRUM	4/8/94	1545	W	1	X					
2	" " / " / MW5 (S)	4/8/94	1525	W	2		X				
3	" " / " / MW7 (S)	4/8/94	1506	W	1	X					
4	" " / " / MW7D (S)	4/8/94	1505	W	1	X					
5	" " / " / MW6 (S)	4/8/94	1524	W	1	X					
6	" " / " / MW6 (S)	4/8/94	1450	W	1	X					
7	" " / " / DS-1	4/8/94	1515	S	2	X					
8	" " / " / MW5-S (S)	4/8/94	1705	S	1	X					
9	" " / " / MW7-10 (S)	4/8/94	0912	S	1	X					
10	" " / " / MW6-S (S)	4/8/94	1515	S	1	X					

W/PH-D
 8015 ml

Special Instructions Please correct well ID #'s as noted Sue Swan 4/21/94 Possible Hazards _____

Was Preservative Used? No Yes What Kind? _____ What Analysis? _____

- Relinquished By Daniel de Souza Date 4/11/94 Time 9:08am Received By Sue Swan Date 4/11/94 Time 9:08am
- Relinquished By Sue Swan Date 4/11/94 Time 1342 Received By Bradley C. de Rosa Date 4/11/94 Time 1342
- Relinquished By _____ Date _____ Time _____ Received By _____ Date _____ Time _____
- Relinquished By _____ Date _____ Time _____ Received By _____ Date _____ Time _____

0003

Method WTPHD

930902:WHD

LCS/LCSD

Client Sample ID METHOD BLANK
 ETC/NW Sample ID A5338-LCSS
 Matrix SOIL
 Date Sampled N/A
 Date Received N/A
 Date Extracted 04/12/94
 Date Analyzed 04/13/94
 Percent Solids 100
 Dilution Factor 1
 Units of Measure MG/KG

LCS (Blank Spike)

Compound	Spike Added	Sample Conc.	LCS Conc.	LCS % Recovery
Diesel	100	12 U	91.5	91.5

CompoundWater QC Limits.....	Soil QC Limits.....	
	RPD	Rec.	RPD	Rec.
Diesel	</= 20	60-120	</= 20	60-120



DATA REPORTING QUALIFIERS

Some of these qualifiers may appear in this analytical data report. Soil samples are analyzed and reported on a dry weight basis unless otherwise noted.

Organics Data Qualifiers

- A - This flag indicates that a TIC is a suspected aldol-condensation product.
- B - Indicates compound was found in the associated blank as well as in the sample.
- C - This flag applies to pesticide results where the identification has been confirmed by GC/MS.
- D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.
- E - This flag identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.
- J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed, or when the mass spectral data indicate the presence of a target compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero.
- L - Compound detected in leachate blank.
- M - Indicates value is taken from a medium level analysis.
- N - Indicates that the identity of the compound is based upon a mass spectral library search (applies to tentatively identified compounds only).
- ND- Not detected. Detection limit shown in parentheses.
- NQ- Not quantitated as...
- U - Indicates compound was analyzed for but not detected at the given detection limit. The sample quantitation limit was corrected for dilution and for percent moisture, when applicable.
- X - Other specific flags and footnotes may be required to properly define the results. If more than two qualifiers are required for a sample result, the "X" flag combines several flags, as needed. For instance, the "X" flag might combine the "A," "B," and "D" flags for some sample.
- Z - Spike compound diluted out, recovery value could not be determined.

Inorganics Data Qualifiers

- NA- Relative percent difference calculation is not applicable to analytes when not detected.
- NC- Not calculated when analyte is not detected.
- NS- Not calculated when sample concentration of analyte exceeds spike level by a factor of four or more.
- U - Indicates that analyte was analyzed for but not detected. The number is the minimum attainable detection limit for the sample.
- B - Indicates that the reported value is less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).
- E - The reported value is estimated because of the presence of interference. An explanatory note must be included under Comments on the Cover Page (if the problem applies to all samples) or on the specific FORM-I (if it is an isolated problem).
- M - Duplicate injection precision not met.
- N - Spike sample recovery not within control limits.
- S - The reported value was determined by the Method of Standard Additions (MSA).
- W - Post-digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance. (See Exhibit E.)
- * - Duplicate analysis not within control limits.
- + - Correlation coefficient for the MSA is less than 0.995.

Inorganics Method Qualifiers

- CV- Manual Cold Vapor AA
- F - FURNACE AA
- P - ICP

Method WTPHD

930902:WHD

Client Sample ID	METHOD BLANK	METHOD BLANK	T115/POS/DRUM	T115/POS/MW7
ETC/NW Sample ID	A5338-MBS	5360-MBW	5360-01	5360-03
Matrix	SOIL	WATER	WATER	WATER
Date Sampled	N/A	N/A	04/08/94	04/08/94
Date Received	N/A	N/A	04/11/94	04/11/94
Date Extracted	04/12/94	04/14/94	04/14/94	04/14/94
Date Analyzed	04/13/94	04/15/94	04/15/94	04/15/94
Percent Solids	100	N/A	N/A	N/A
Dilution Factor	1	1	1	1
Units of Measure	MG/KG	UG/L	UG/L	UG/L

Compound

TEPH Quantitated as

Diesel n-C12 to n-C24	12 U	50 U	240	150
Motor Oil n-C24 to n-C40	38 U	150 U	360	150 U

ETC/Northwest

Petroleum Hydrocarbons by GC

Method WTPHD

Client Sample ID	T115/POS/MW7D	T115/POS/MW6	T115/POS/MW6	T115/POS/DS-1
ETC/NW Sample ID	5360-04	5360-05	5360-05Dup	5360-06
Matrix	WATER	WATER	WATER	SOIL
Date Sampled	04/08/94	04/08/94	04/08/94	04/07/94
Date Received	04/11/94	04/11/94	04/11/94	04/11/94
Date Extracted	04/14/94	04/14/94	04/14/94	04/12/94
Date Analyzed	04/15/94	04/15/94	04/15/94	04/13/94
Percent Solids	N/A	N/A	N/A	94.4
Dilution Factor	1	1	1	1
Units of Measure	UG/L	UG/L	UG/L	MG/KG

Compound

TEPH Quantitated as

Diesel n-C12 to n-C24	160	220	200	17
Motor Oil n-C24 to n-C40	150 U	300 U	300 U	40 U

Method WTPHD

Client Sample ID	T115/POS/MW5-5	T115/POS/MW7-10	T115/POS/MW6-5
ETC/NW Sample ID	5360-07	5360-08	5360-09
Matrix	SOIL	SOIL	SOIL
Date Sampled	04/07/94	04/07/94	04/07/94
Date Received	04/11/94	04/11/94	04/11/94
Date Extracted	04/12/94	04/12/94	04/12/94
Date Analyzed	04/13/94	04/15/94	04/15/94
Percent Solids	94.1	94.7	96.7
Dilution Factor	1	1	10
Units of Measure	MG/KG	MG/KG	MG/KG

Compound

TEPH Quantitated as

Diesel n-C12 to n-C24	13 U	13 U	130 U
Motor Oil n-C24 to n-C40	40 U	40 U	510

ETC/Northwest

Petroleum Hydrocarbons by GC

Method WTPHD

930902:WHD

SURROGATE RECOVERY

	<u>% O-Terphenyl</u>
A5338-MBS	106
5360-MBW	79
5360-01	95
5360-03	95
5360-04	99
5360-05	91
5360-05Dup	80
5360-06	102
5360-07	88
5360-08	87
5360-09	123
A5338-LCSS	103
5360-LCSW	100

Recovery Limits 50-150

Method WTPHD

LCS/LCSD

Client Sample ID METHOD BLANK
 ETC/NW Sample ID 5360-LCSW
 Matrix WATER
 Date Sampled N/A
 Date Received N/A
 Date Extracted 04/14/94
 Date Analyzed 04/15/94
 Percent Solids N/A
 Dilution Factor 1
 Units of Measure UG/L

LCS (Blank Spike)

Compound	Spike Added	Sample Conc.	LCS Conc.	LCS % Recovery
Diesel	2000	25 U	1460	73.0

CompoundWater QC Limits.....	Soil QC Limits.....	
	RPD	Rec.	RPD	Rec.
Diesel	</= 20	60-120	</= 20	60-120

WA DOE Method WTPH-HCID

930923:HCID

Client Sample ID	METHOD BLANK	T115/POS/MW4
ETC/NW Sample ID	53 60-MBW	5360-02
Matrix	WATER	WATER
Date Sampled	N/A	04/08/94
Date Received	N/A	04/11/94
Date Extracted	04 /12/94	04/12/94
Date Analyzed	04 /12/94	04/12/94
Percent Solids	N/A	N/A
Units of Measure	MG/L	MG/L

 Compound

Gasoline	< 2	< 2
Solvent Front to n-C12		
Diesel	< 5	< 5
n-C12 to n-C24		
Motor Oil	< 40	< 40
n-C24 to n-C40		

ETC/Northwest

Petroleum Hydrocarbons by GC

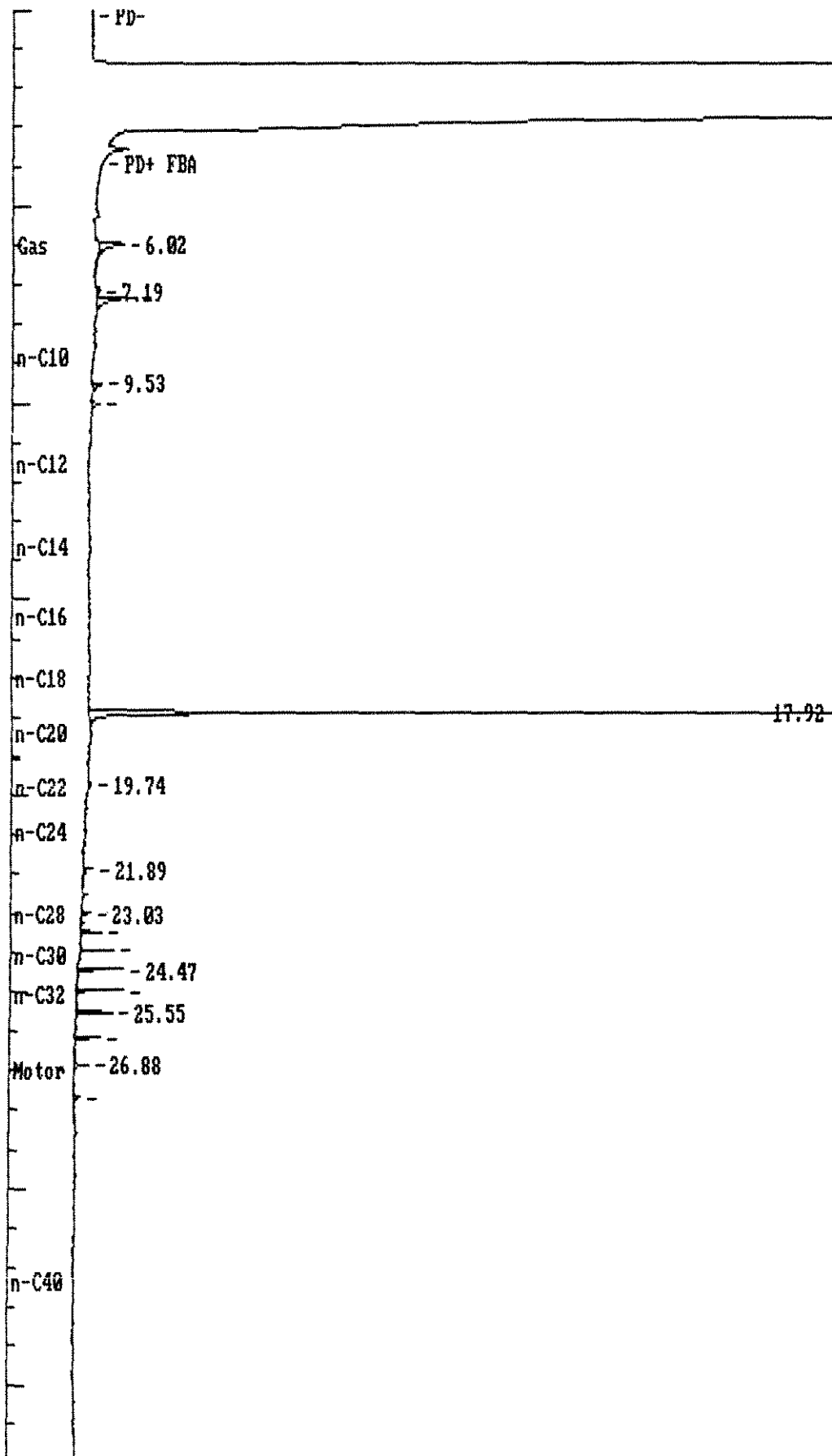
WA DOE Method WTPH-HCID

930923:HCID

SURROGATE RECOVERY

	<u>%Bromofluorobenzene</u>	<u>% O-Terphenyl</u>
5360-MBW	116	107
5360-02	114	108
Recovery Limits	50-150	50-150

SAMPLE NAME: 5338-MBS COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-13-1994 06:22:3 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A101-40.PTS



0013

DATA PACKAGE

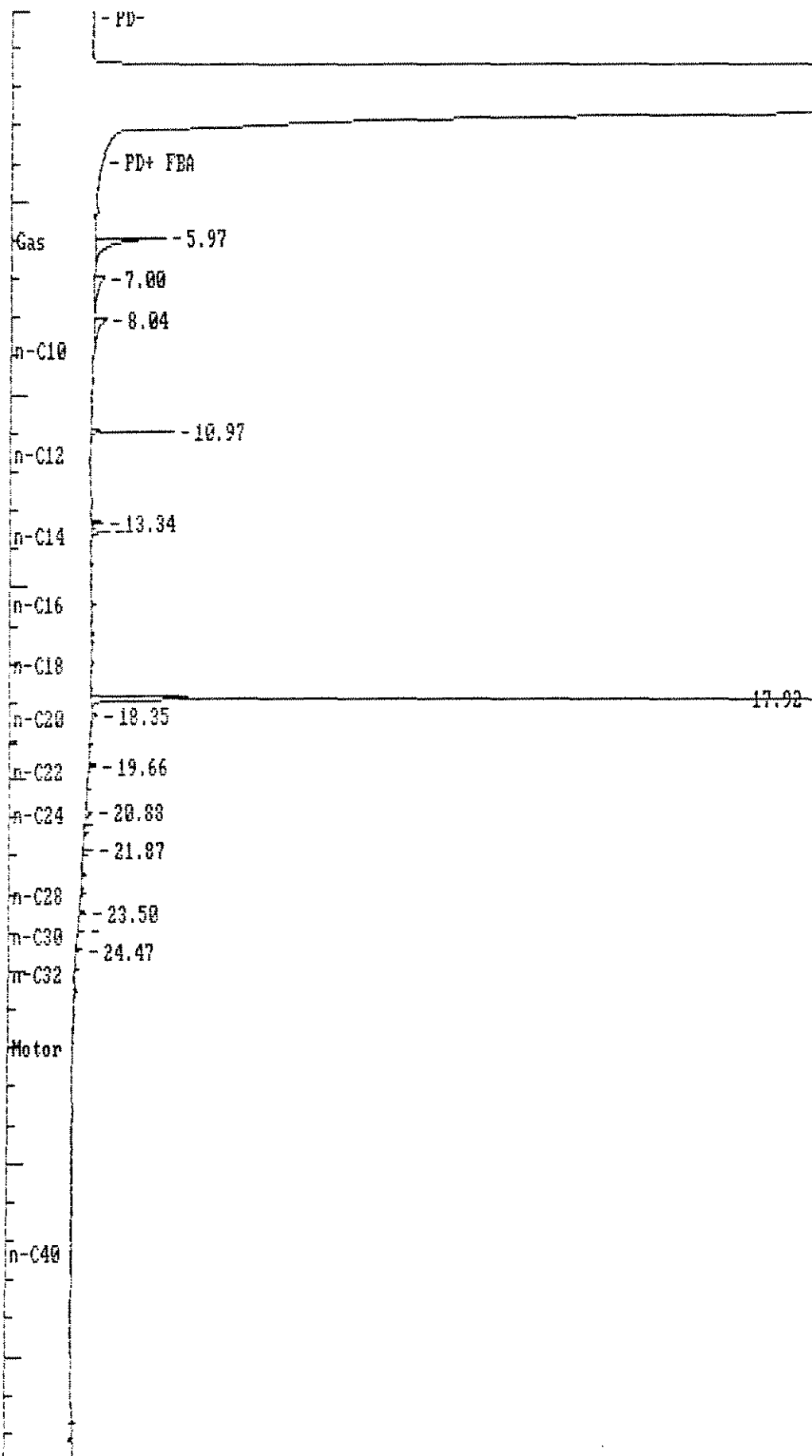
Batch: 5360

*Total Petroleum
Hydrocarbons as Diesel
and Other Extractable
Products by GC*

Gas Chromatographic Analysis by WTPH-D, April 1992 update,
Appendix L, Guidance for Remediation of Releases from
Underground Storage Tanks, July 1991.

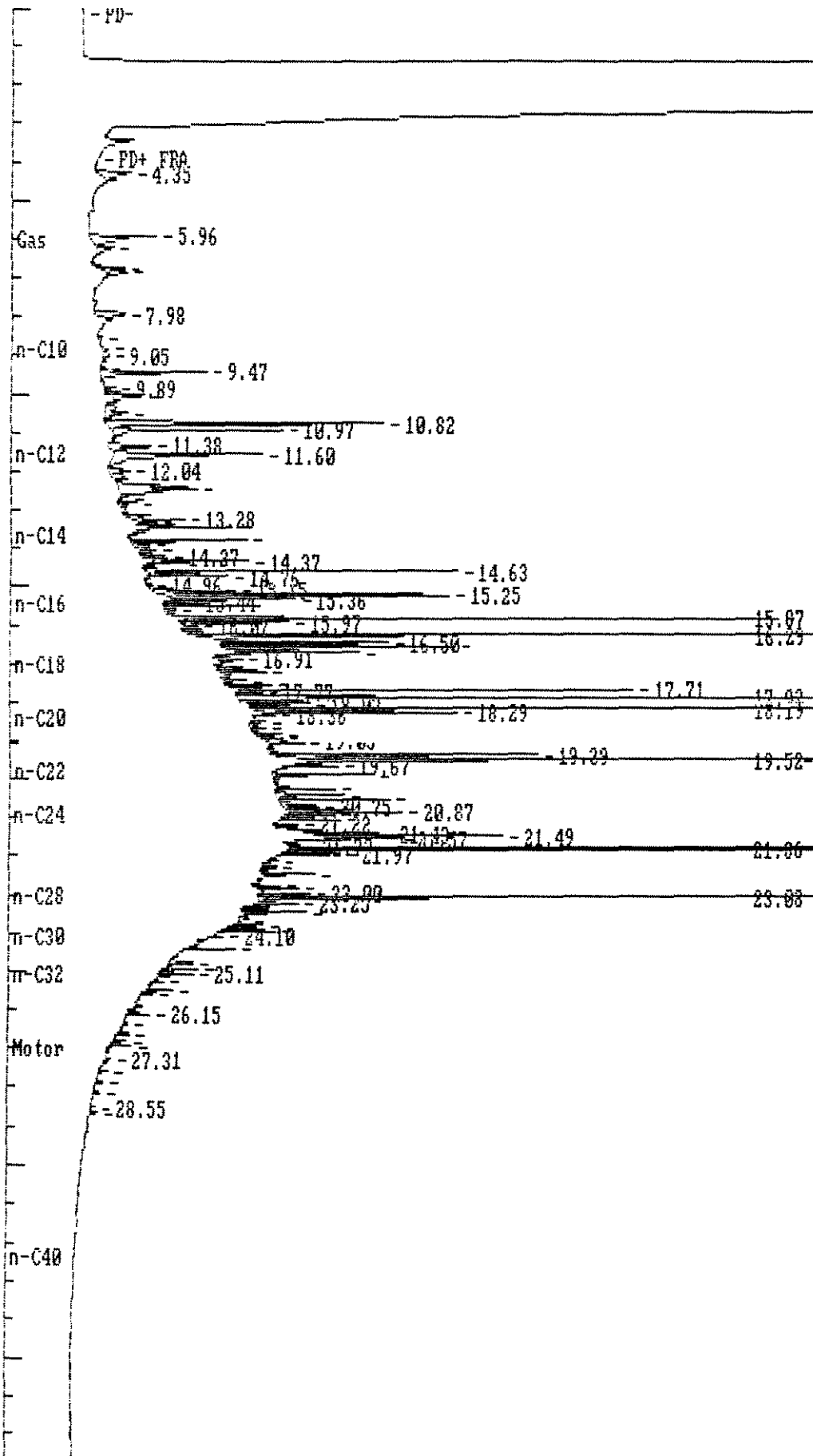
CHROMATOGRAMS

SAMPLE NAME: 5360-MBW COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-15-1994 14:53:3 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A104-24.PTS



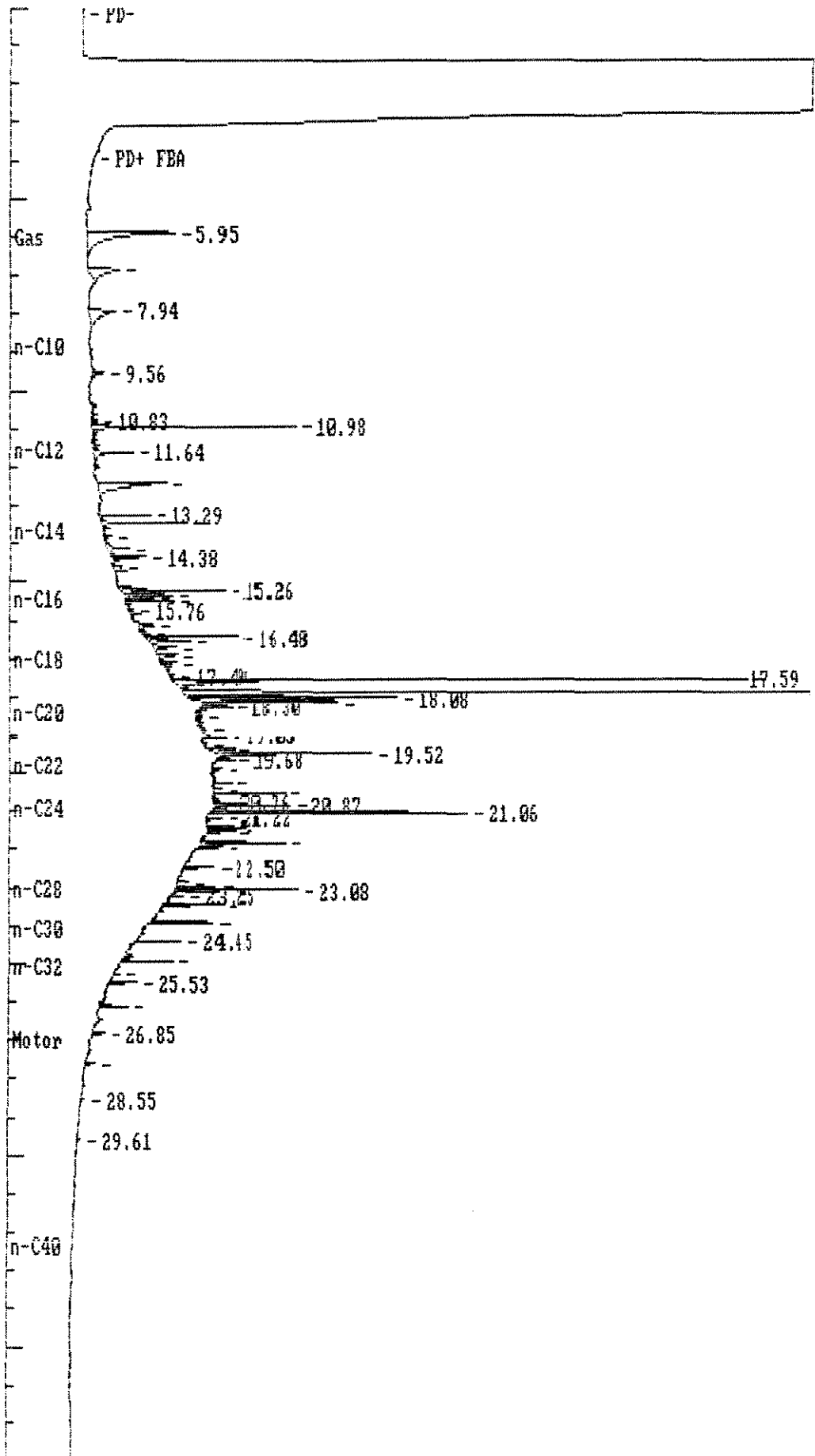
C014

SAMPLE NAME: 5360-01 COLUMN: 15m x 0.32mm DB-5 : FID
 DATE AND TIME INJECTED: "04-15-1994 16:44:5 INSTRUMENT I.D.: GCQA5890
 VOLUME INJECTED: 2 uL
 Full Range: 50 millivolts Data File = Q:A104-26.PTS



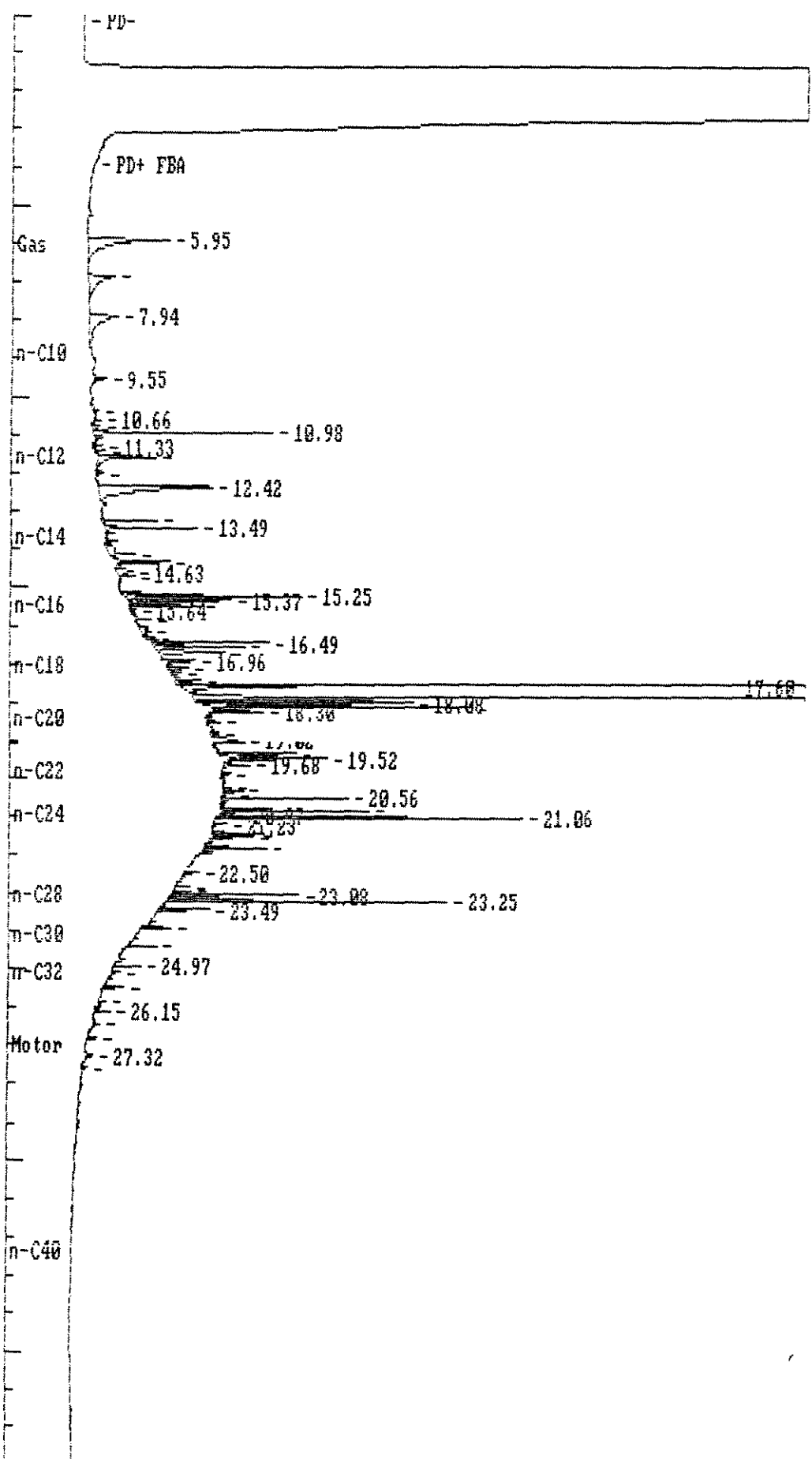
C015

SAMPLE NAME: 5360-03 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-15-1994 17:39:5 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A104-27.PTS



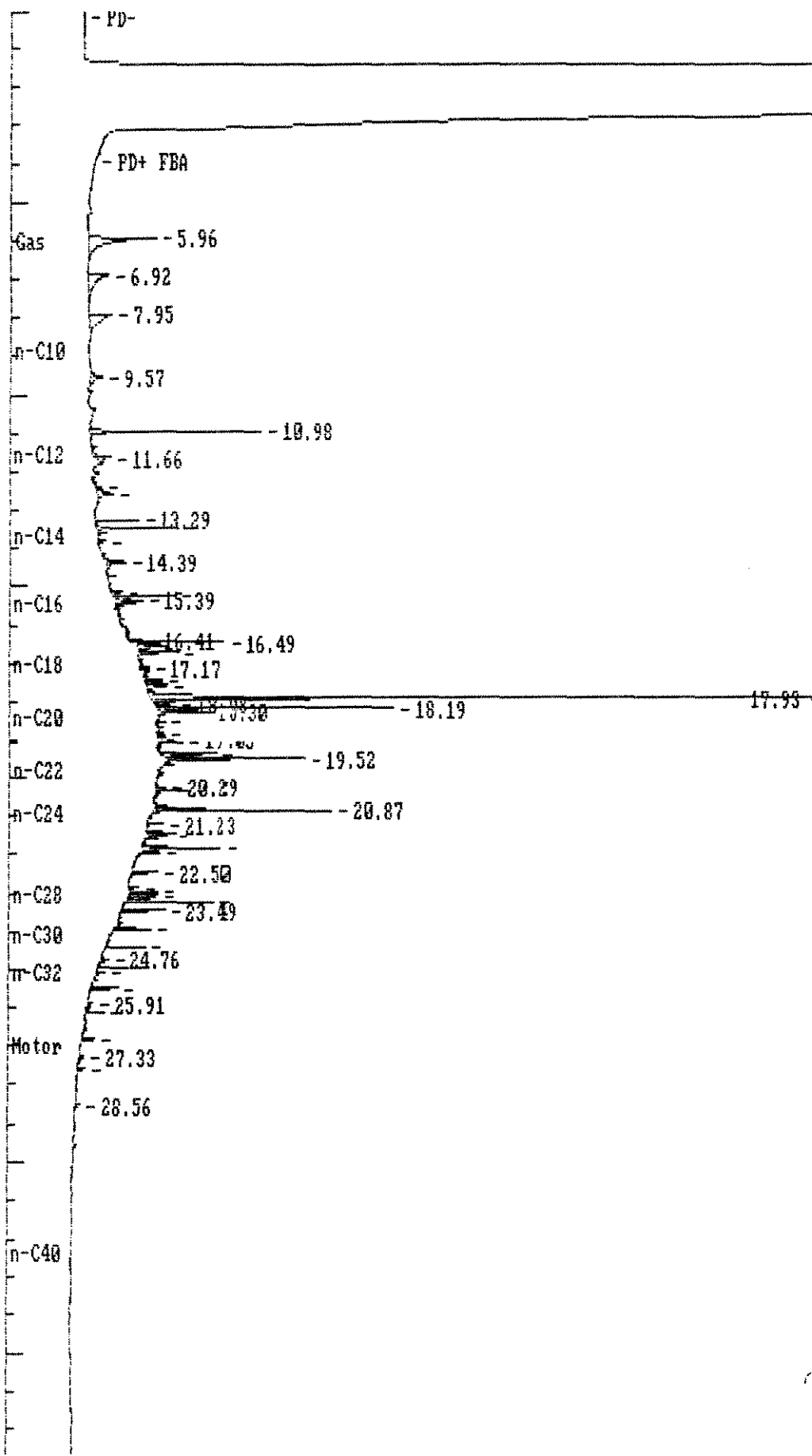
C016

SAMPLE NAME: 5360-04 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-15-1994 18:35:0 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A104-28.PTS

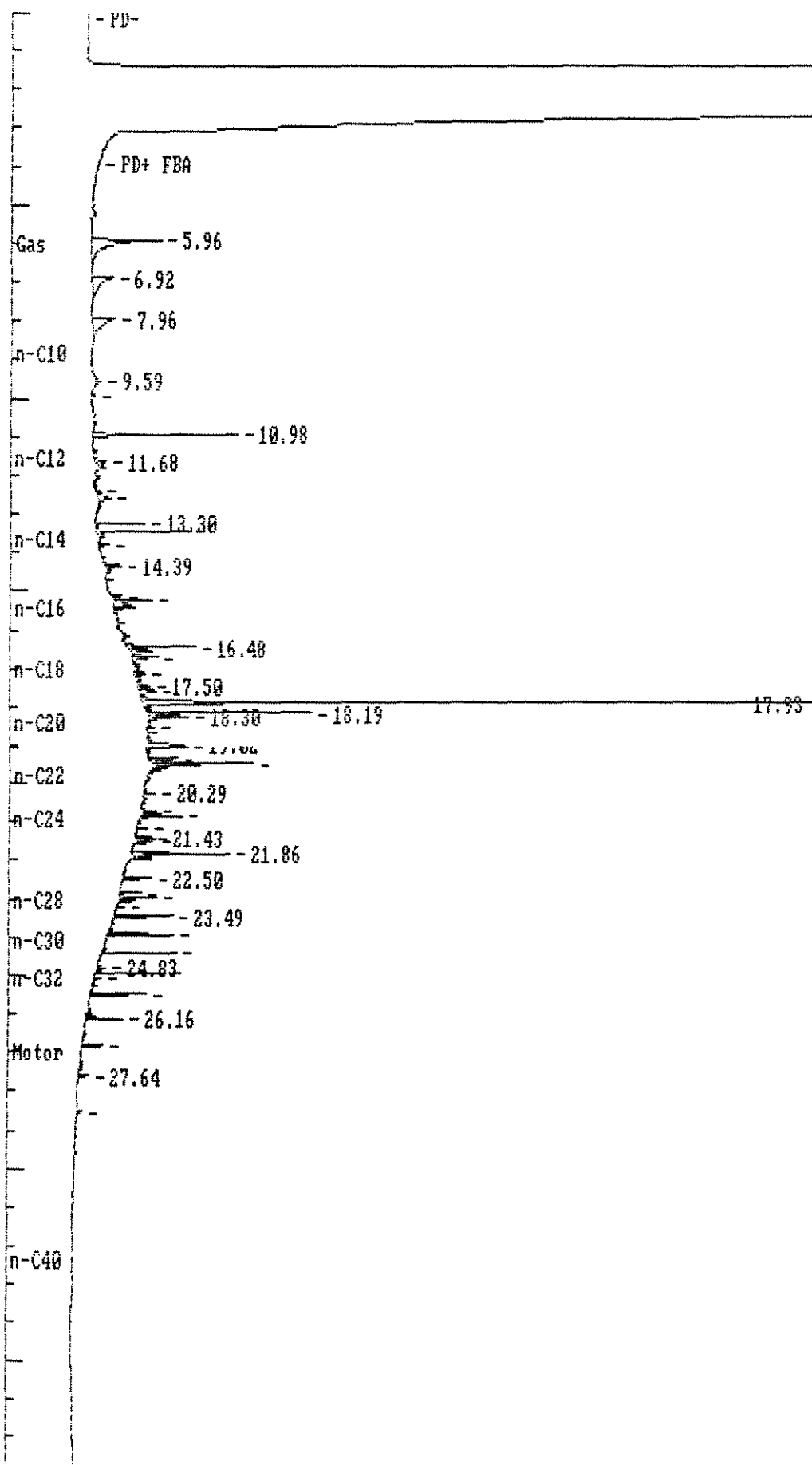


C017

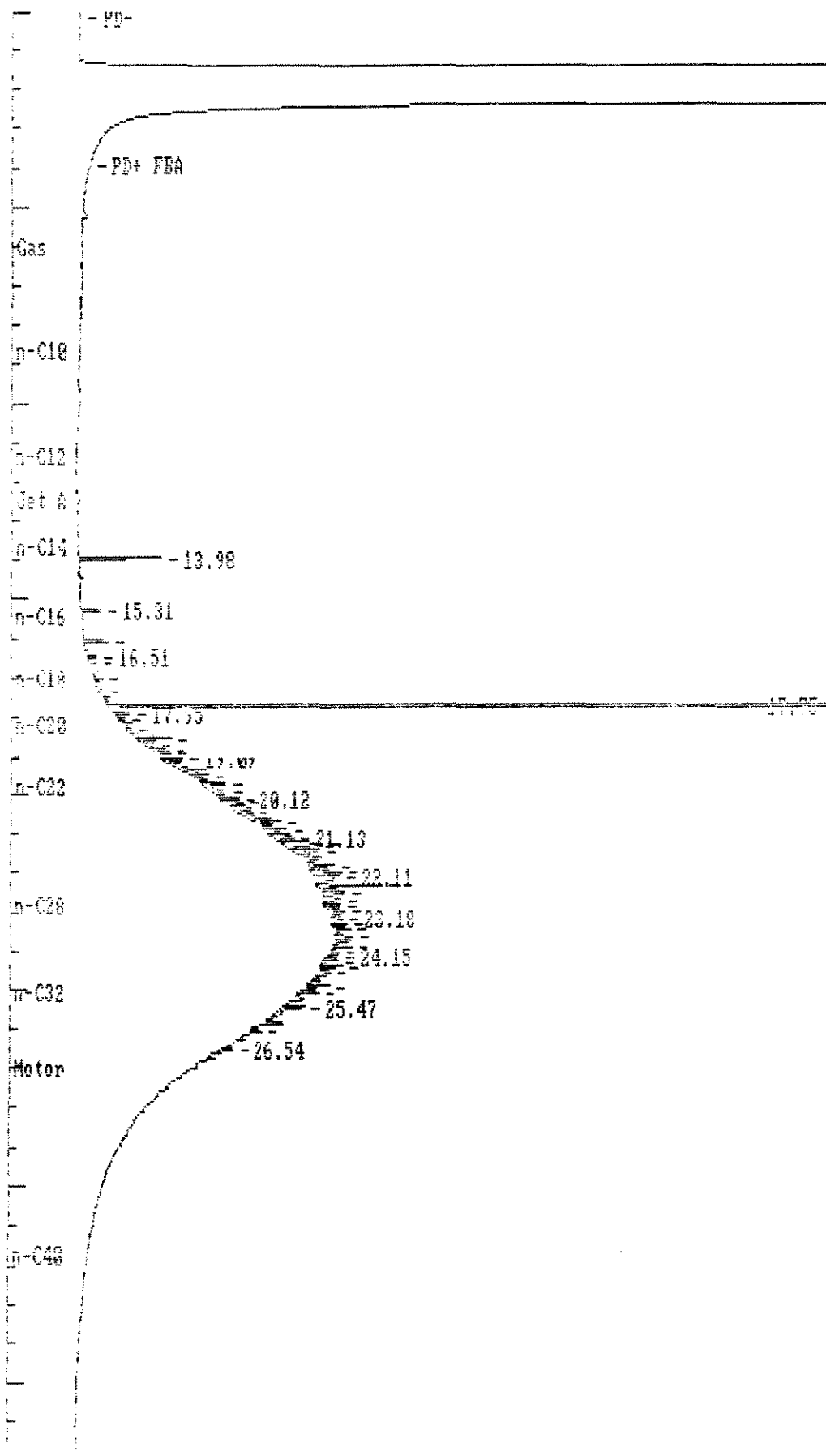
SAMPLE NAME: 5360-05 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-15-1994 19:30:2 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A104-29.PTS



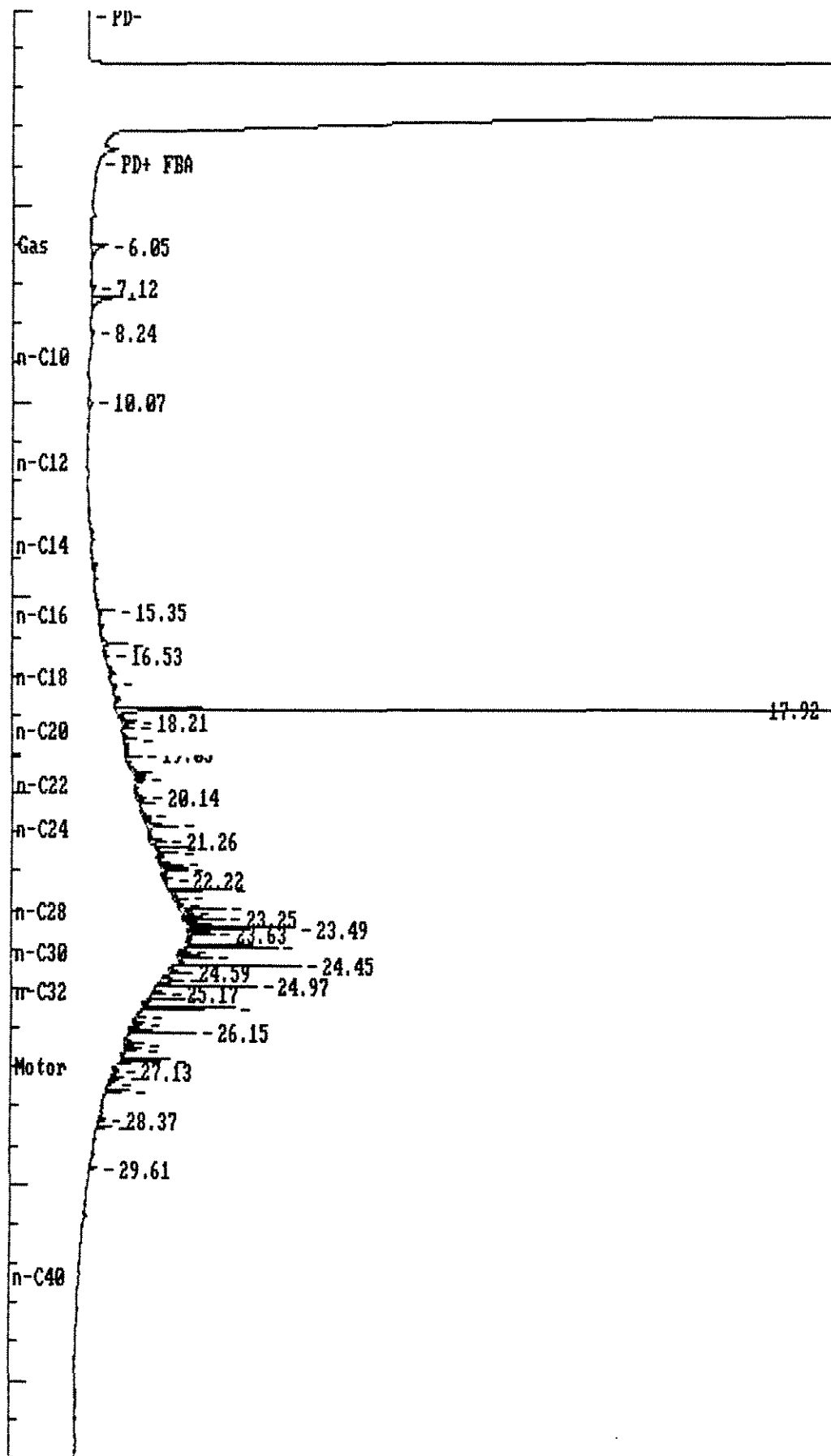
SAMPLE NAME: 5360-05Dup COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-15-1994 20:25:2 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A104-30.PTS



SAMPLE NAME: Motor Oil 750 011494-207 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-21-1994 00:36:1 INSTRUMENT I.D.: GCQA5290
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A110-14.PTS

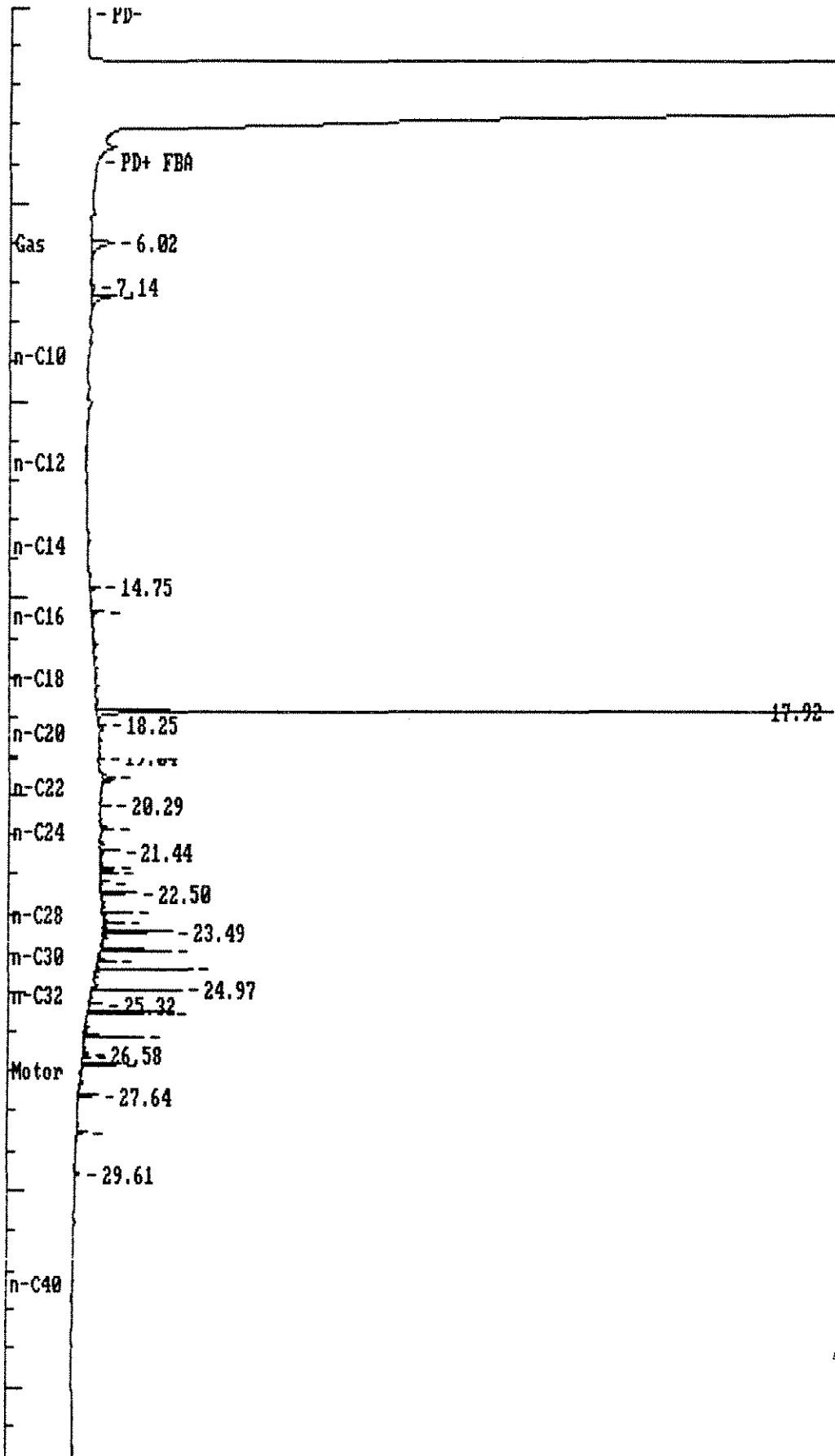


SAMPLE NAME: 5360-06 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-13-1994 13:49:2 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A101-48.PTS

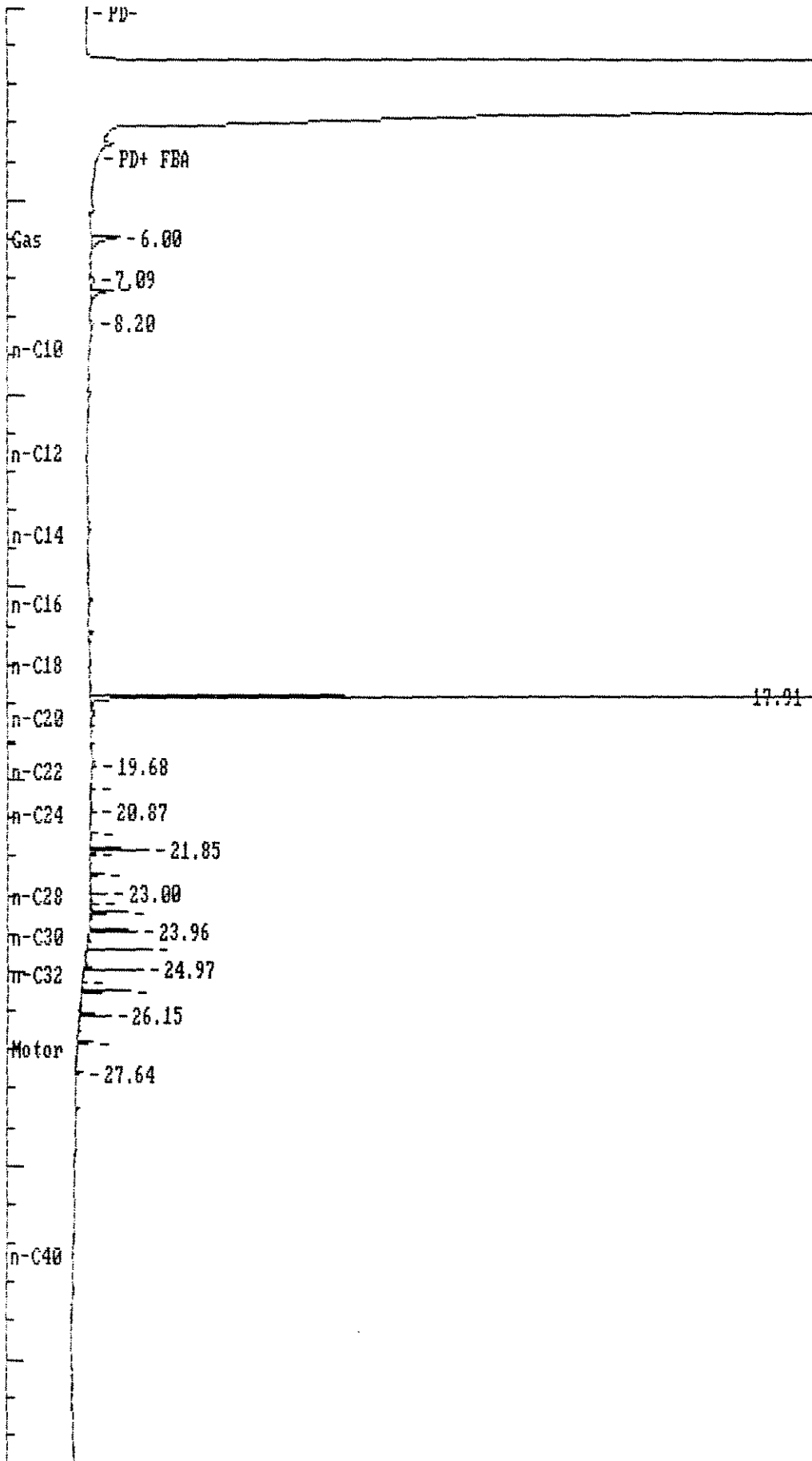


C020

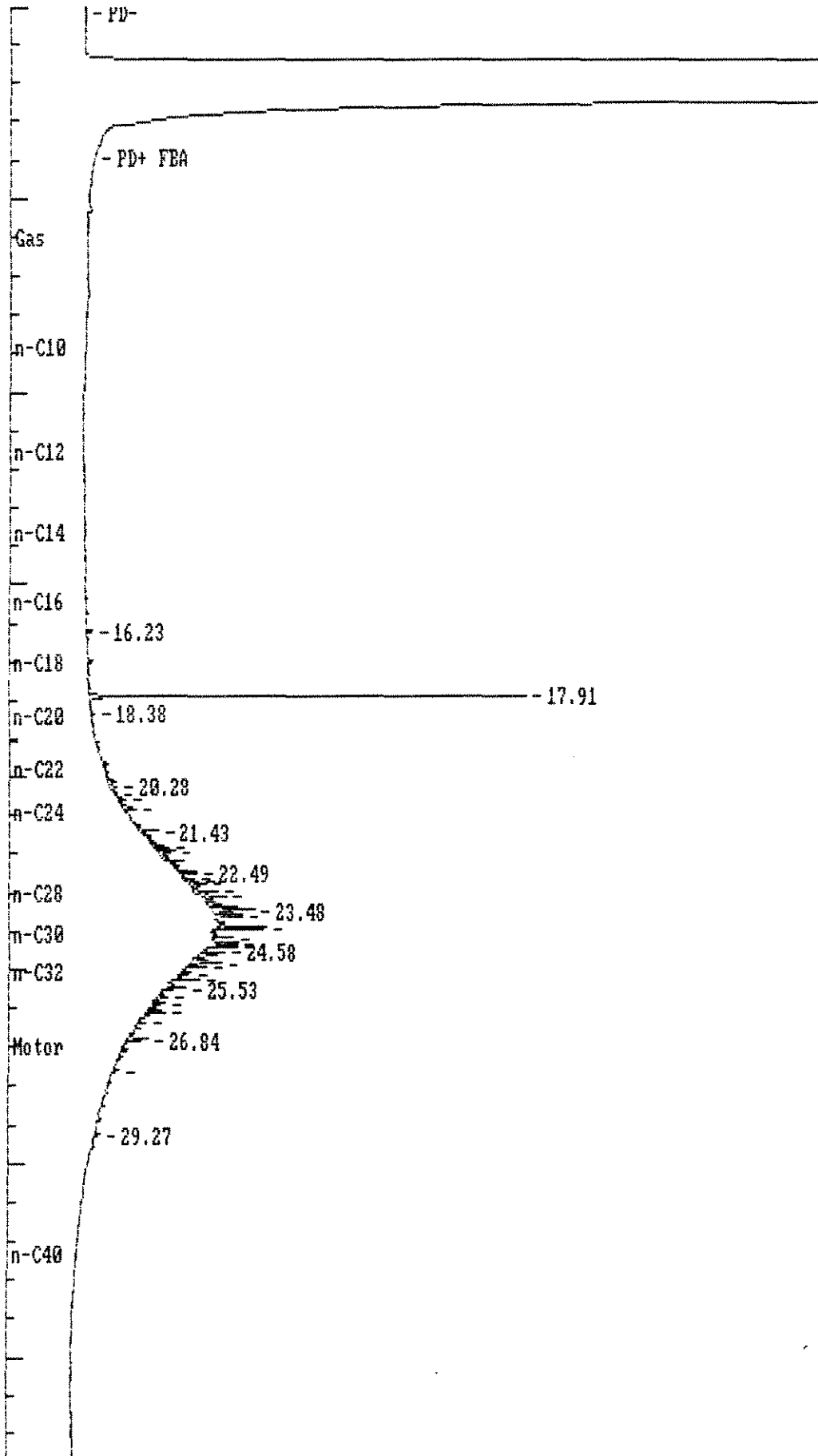
SAMPLE NAME: 5360-07 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-13-1994 14:45:1 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A101-49.PTS



SAMPLE NAME: 5360-08 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-15-1994 11:10:1 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A104-20.PTS

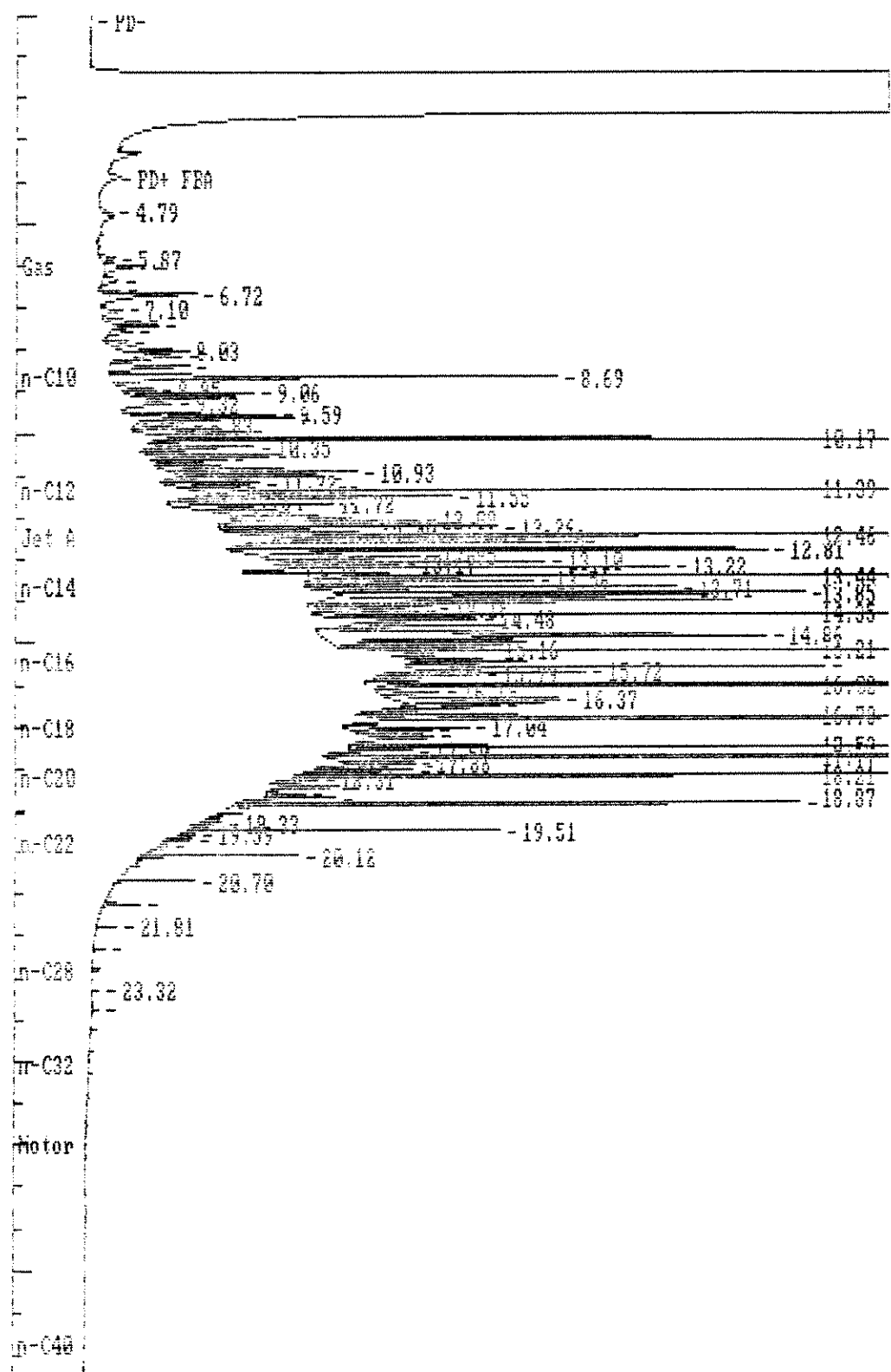


SAMPLE NAME: 5360-09 1/10 COLUMN: 15m x 0.32mm DB-5 : FID
DATE AND TIME INJECTED: "04-15-1994 12:06:4 INSTRUMENT I.D.: GCQA5890
VOLUME INJECTED: 2 uL
Full Range: 50 millivolts Data File = Q:A104-21.PTS



C023

SAMPLE NAME: Diesel/o-Terphenyl 500/100 021 COLUMN: 15m x 0.32mm DB-5 : FID
 DATE AND TIME INJECTED: 04-20-1994 23:40:12 INSTRUMENT I.D.: GCQ05090
 VOLUME INJECTED: 2 µL
 Gain Range: 50 millivolts Data File = Q:\A110-16.PTS



DATA PACKAGE

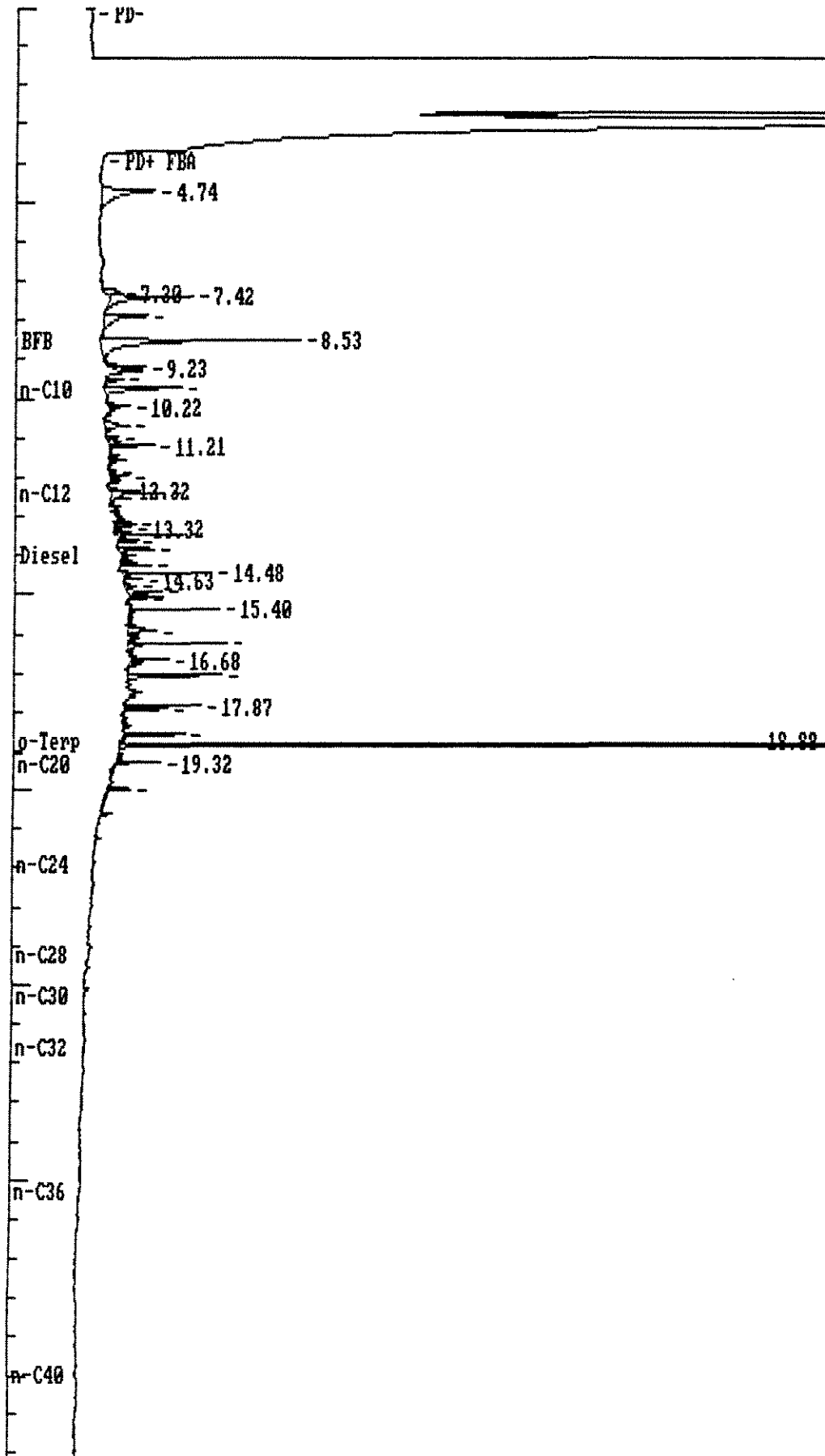
Batch: 5360

*Hydrocarbon Product
Identification by GC*

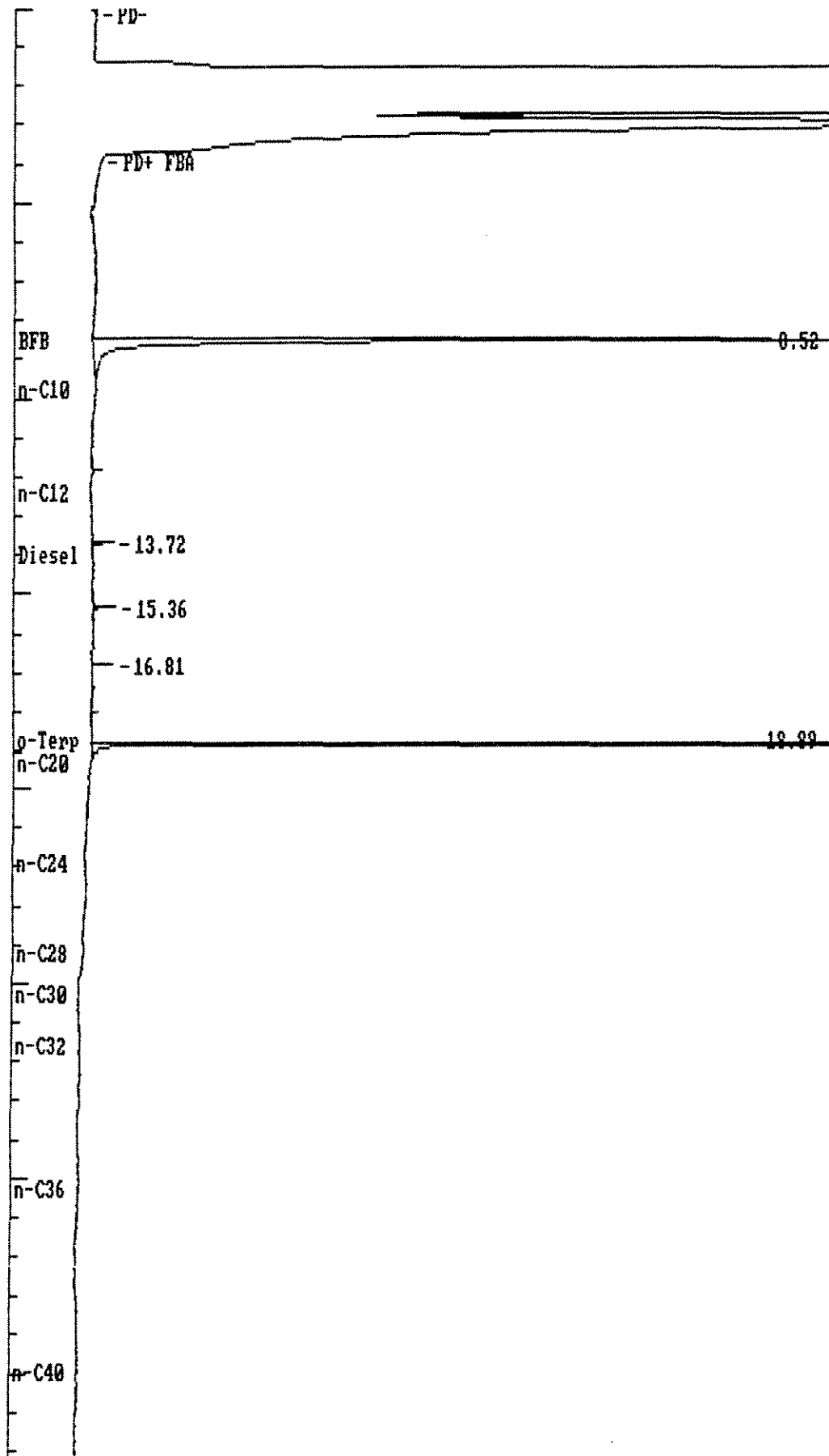
Gas Chromatographic Analysis by WTPH-HCID, April 1992 update,
Appendix L, Guidance for Remediation of Releases from
Underground Storage Tanks, July 1991.

CHROMATOGRAMS

SAMPLE NAME: HCID Std 1 032994-218 COLUMN: 15m x 0.25mm DB-5.625 : FID
DATE AND TIME INJECTED: "04-12-1994 17:02:4 INSTRUMENT I.D.: GCPB5890
VOLUME INJECTED: 2 uL
Full Range: 25 millivolts Data File = P:B101-29.PTS

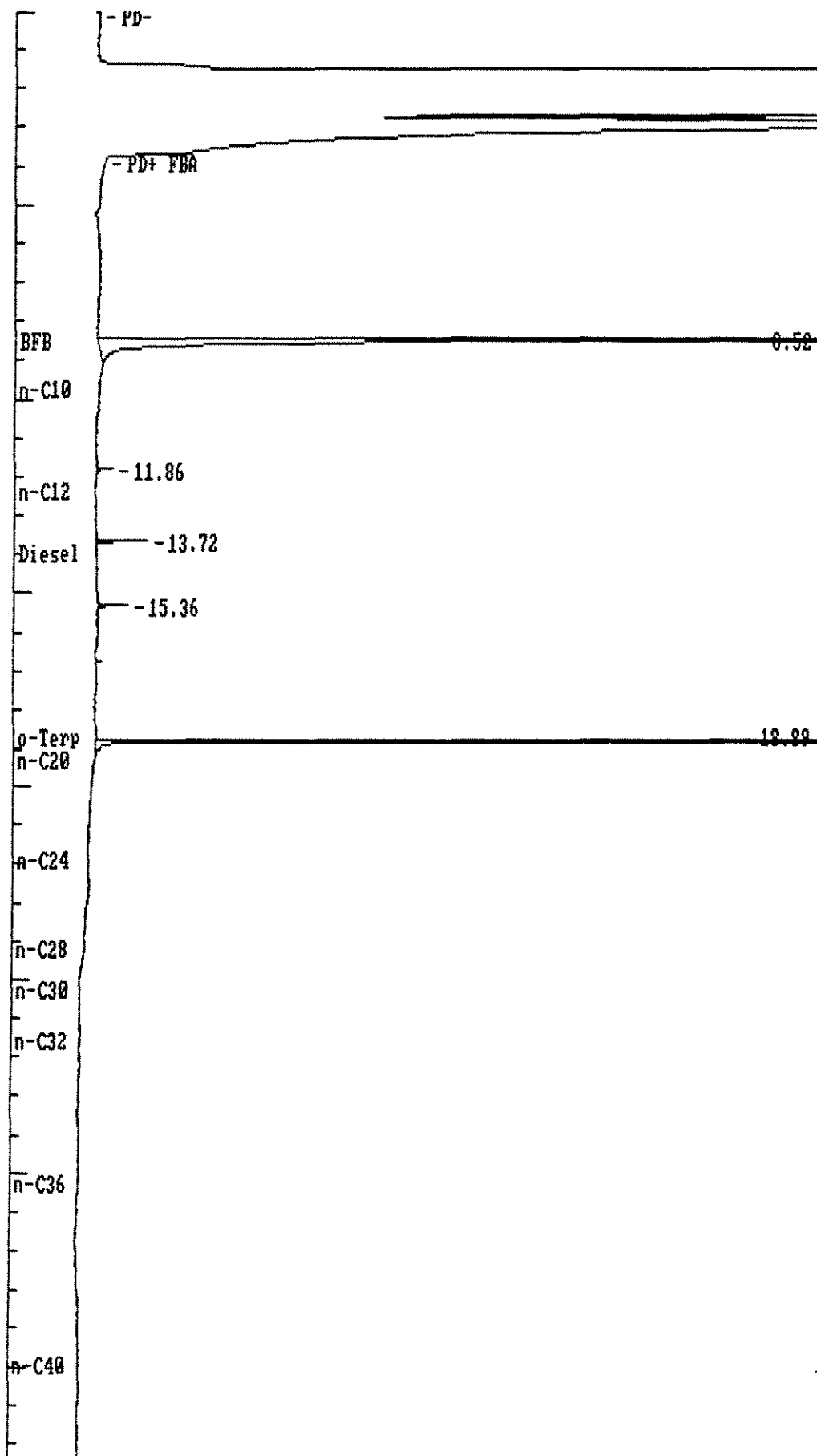


SAMPLE NAME: 5360-MBW COLUMN: 15m x 0.25mm DB-5.625 : FID
DATE AND TIME INJECTED: "04-12-1994 18:49:4 INSTRUMENT I.D.: GCPB5890
VOLUME INJECTED: 2 uL
Full Range: 25 millivolts Data File = P:B101-31.PTS



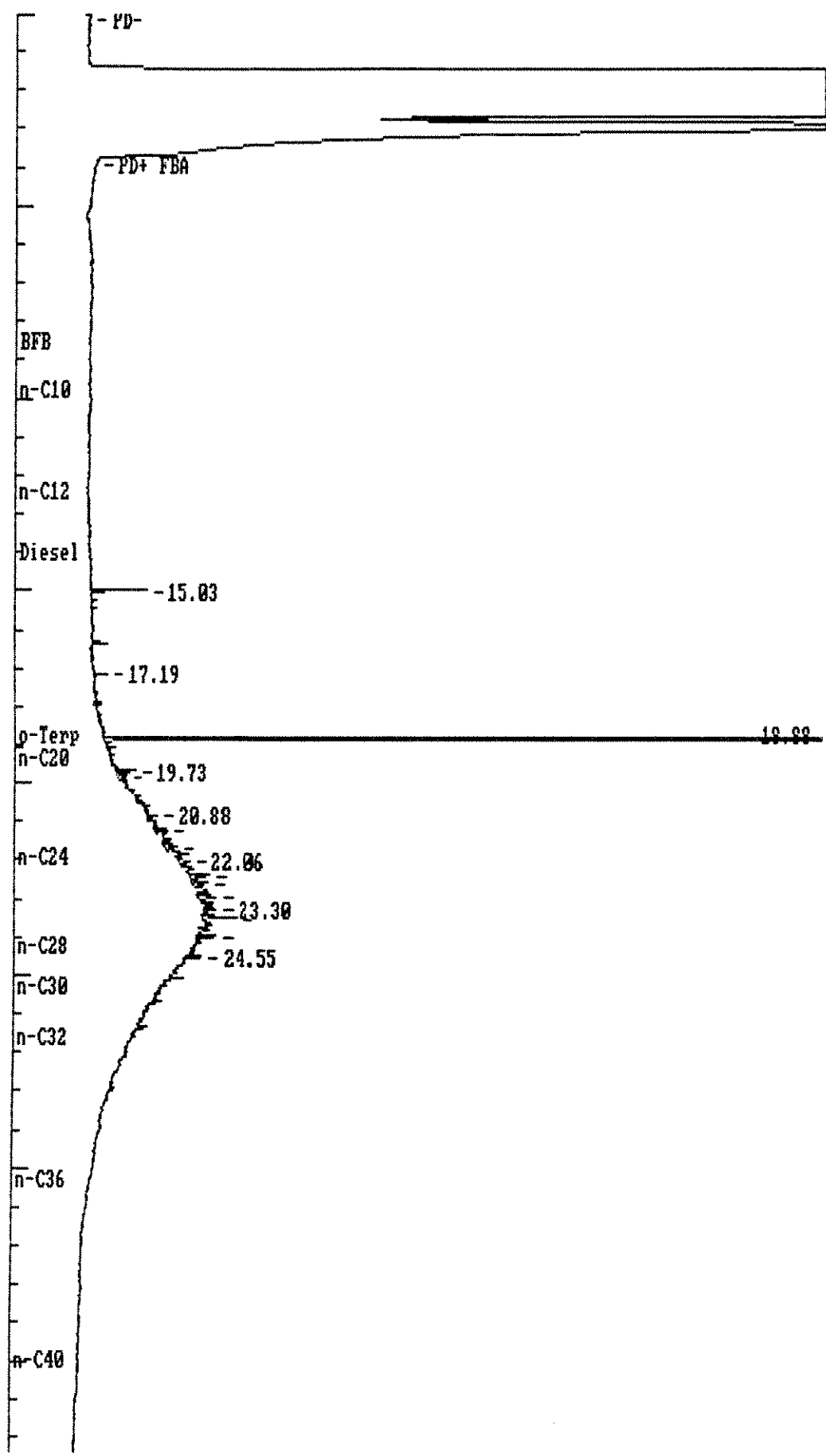
0026

SAMPLE NAME: 5360-02 COLUMN: 15m x 0.25mm DB-5.625 : FID
DATE AND TIME INJECTED: "04-12-1994 19:42:5 INSTRUMENT I.D.: GCPB5890
VOLUME INJECTED: 2 uL
Full Range: 25 millivolts Data File = P:B101-32.PTS



0027

SAMPLE NAME: HCID Std 2 010494-195 COLUMN: 15m x 0.25mm DB-5.625 : FID
DATE AND TIME INJECTED: "04-12-1994 17:56:1 INSTRUMENT I.D.: GCPB5890
VOLUME INJECTED: 2 uL
Full Range: 25 millivolts Data File = P:B101-30.PTS



DISTRIBUTION

GROUNDWATER ASSESSMENT
PORT OF SEATTLE TERMINAL 115
WEST MARGINAL WAY, SEATTLE WASHINGTON 98134
ESE PROJECT # 6-94-7301

COPY NO. _____

Copy No.

1 original	Kathy Bahnick	1
3 copies	Port of Seattle	2-4
	P.O. 1209	
	Seattle, WA 98111	
1 master	ESE Unbound Master File	5
1 copies	ESE Bound Report File	6

QUALITY CONTROL REVIEWER

Assembler _____

Name
Title

