# Well Reduction Plan

Monitoring requirements may be reduced, after review by the Department/Agency, on a case by case basis, if analytical results demonstrate that hazardous constituents are not present in the supplemental wells. The following procedure will be used to remove supplemental wells from the monitoring program:

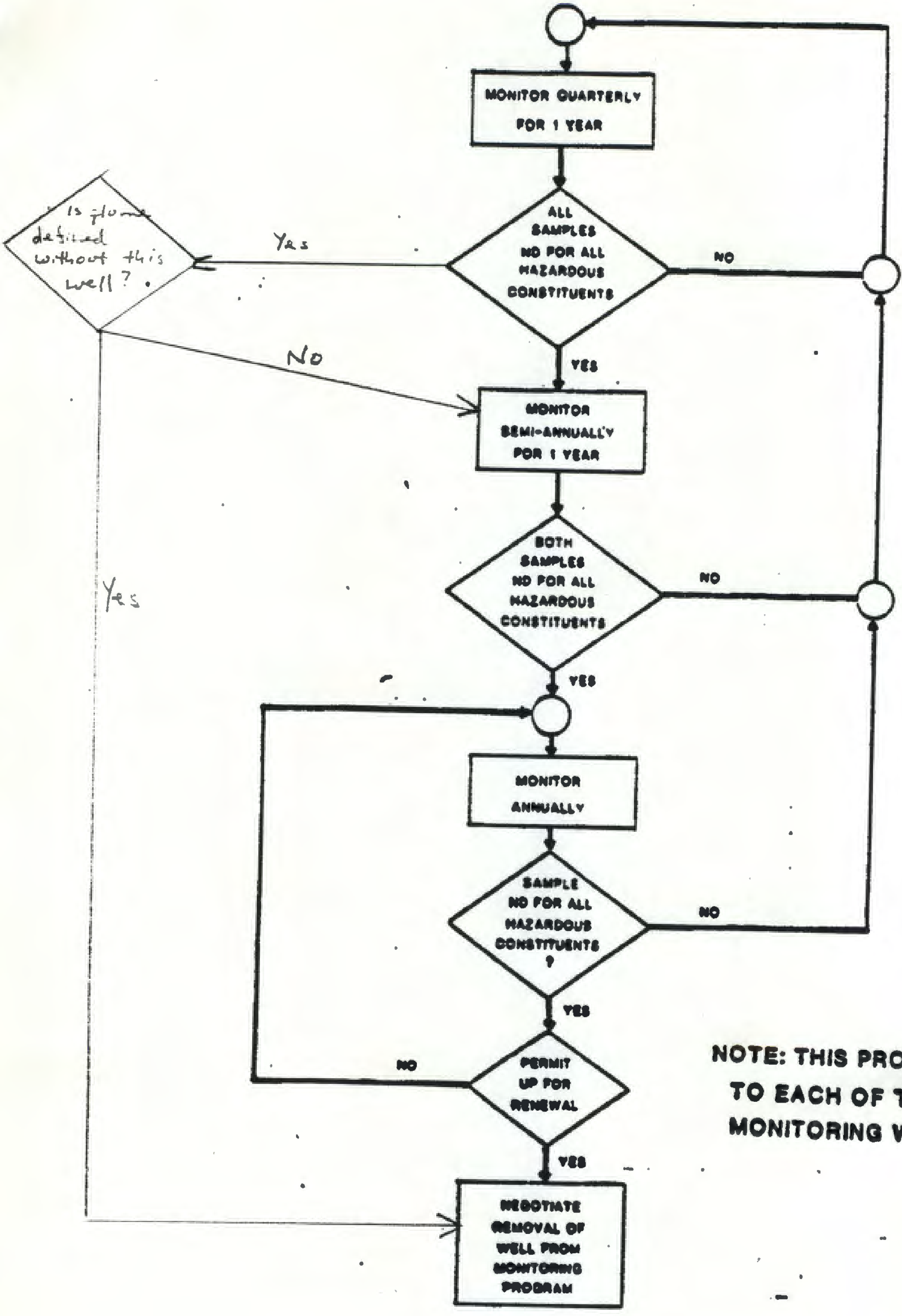
1. If hazardous constituents are not present in the well for one year (four quarters), the well will be monitored semi-annually the following year, or may be removed from the monitoring program if another clean well exists between the well under consideration and the plume of contamination.

2. If hazardous constituents are not present in either of the semi-annual samples, the well will be monitored annually thereafter.

3. If hazardous constituents are not present in the annual samples, Permittee may negotiate removal of the well when the Permit is up for renewal.

If at any time, the presence of one or more hazardous constituents are confirmed, above background, in a well in which quarterly monitoring requirements have been reduced, the well will again be subject to quarterly monitoring. The well removal procedure is outlined in Figure F-1.

Water level measurements must be obtained quarterly from all operable wells, even if the frequency of monitoring is reduced or a well is eliminated from the monitoring program.




NOTE: THIS PROCEDURE APPLIES TO EACH OF THE SUPPLEMENTAL MONITORING WELLS

PROCEDURE FOR REMOVING SUPPLEMENTAL WELLS FROM MONITORING PROGRAM

New York State Department of Environmental Conservation

**MEMORANDUM**

**TO:** James Reidy, RSHWE, White Plains
**FROM:** Steve Potter, SEG, New Paltz SP
**SUBJECT:** Review of RCRA Sludge lagoon, Post-Closure Plan for Texaco Research Center, Glenham, N.Y.
**DATE:** February 24, 1987

I have reviewed the above Post-Closure Plan and have the following comments.

1) Texaco has proposed to monitor only two wells, DL-6 and DL-8 and to sample semi-annually for three years to monitor the effects of lagoon remediation and groundwater clean-up. A report with conclusions and recommendations will be submitted after three years. They have also stated that in the event a well contains no detectable organics for two consecutive years, monitoring will be discontinued at that well. The Department has stated in the past that monitoring of one or two wells for post-closure care is not acceptable, nor is semi-annual sampling. The Department has maintained that Texaco must evaluate the extent of the contaminant plune and this can only be accomplished by additional monitoring.

2) Texaco maintains that groundwater flow and water quality at the base of the hill below the former lagoon area cannot be differentiated from the flow and water quality attributable to the adjacent CERCLA site. Texaco believes that monitoring any wells downgradient of the lagoon area beyond DL-8 to assess RCRA related issues is inappropriate due to the overlapping nature of the CERCLA groundwater with the RCRA related groundwater. Hydrologic and chemical aspects relating to the CERCLA sites are being addressed under Texaco's Post Remedial and Off-Site Monitoring Program. I am of the opinion that before we formally evaluate this plan we review the CERCLA Remedial Plan and see how best to evaluate the post-closure of the facility. A report dealing with CERCLA monitoring data is to be submitted sometime in March and after review of this and subsequent meetings with Remedial Investigation personnel we can formally respond to Texaco.

But CERCLA didn't monitor this side! left it up to us.

SP/jb

RECEIVED

FEB 26 1987

BUREAU OF HAZARDOUS WASTE TECHNOLOGY
DIVISION OF SOLID AND HAZARDOUS WASTE

GEOSCIENCE CORP.

5 NORTHWAY LANE NORTH •
LATHAM, NEW YORK 12110
(518) 783-8102

RECEIVED
FEB 03 1987
BUREAU OF
HAZARDOUS WASTE TECHNOLOGY
DIVISION OF SOLID AND
HAZARDOUS WASTE

# RCRA SLUDGE LAGOON
## Post-Closure Plan

Texaco Research Center Beacon
Glenham, New York
EPA ID No. NYD091894899

Prepared for:

Texaco Research Center Beacon
Glenham, New York

Prepared by:

DUNN GEOSCIENCE CORPORATION

Sander I. Bonvell

Sander I. Bonvell
Senior Chemist

Reviewed by:

James P. Behan Jr

James P. Behan, Jr., P.E.
Senior Engineer

January 23, 1987

DUNN GEOSCIENCE CORPORATION

## Table of Contents

## Figures



## Plates



## Appendices

## 1.0 INTRODUCTION

Texaco Research Center Beacon (TRCB) is a Texaco Inc. owned and operated facility located on approximately 50 acres of land in Glenham, New York. Texaco also owns an additional 90 acres of undeveloped land in close proximity to this facility. TRCB is an on-shore, non-production, non-transportation laboratory complex engaged in research, development and technical services related to petroleum products and energy. Petroleum and coal products, solvents and various chemical compounds are used at this plant in connection with the research functions.

In November 1980, TRCB submitted to Region II of the U.S. Environmental Protection Agency (EPA) Part A of a permit application for on-site treatment and storage of hazardous wastes. One of the units identified in the Part A application was a surface impoundment (lagoon) receiving sludges from a sanitary wastewater treatment system and from a laboratory wastewater treatment system. These sludges were considered hazardous wastes because they contained small amounts of chemicals listed in 40 CFR Part 261, Subpart D. Texaco decided to close the sludge lagoon, and accordingly submitted, on March 30, 1984, a closure and post-closure plan to New York State in accordance with federal and state hazardous waste regulations. A revised closure plan, which consisted of excavation and removal of lagoon materials to prescribed analytical limits was accepted by the New York State Department of Environmental Conservation (NYSDEC) and finalized on September 26, 1985. The NYSDEC approved the closure plan only and informed Texaco they would request a post-closure plan at a later date.

During November and December 1985, the closure plan was further modified by agreement between Texaco and NYSDEC. Implementation of the plan was initiated in February 1986 and the lagoon was closed by late March 1986 with final grading and seeding accomplished by late June. A "Report for Certification of the Closure of the Hazardous Waste Sludge Lagoon at the Texaco Research Center Beacon, New York (EPA ID NO. NYD091894899)" was submitted on July 23, 1986 and approved by NYSDEC on July 31, 1986 (See Appendix B).

Dunn Geoscience Corporation (DGC) was retained by TRCB to prepare a RCRA Post-Closure Plan for the closed sludge lagoon area. A proposal was accepted by TRCB and contract No. TRCB-MW-2310 was initiated on September 2, 1986.

## 2.0 PURPOSE

The purpose of this Post-Closure Plan is to provide a property care and use schedule in accordance with the New York State Department of Environmental Conservation regulation Title 6, NYCRR 373-3.7 and the requirements set forth in a letter from NYSDEC to Texaco dated April 3, 1986 (Appendix A). Such plan is to be submitted to NYSDEC no later than February 1, 1987.

## 3.0 SCOPE

This document serves as the TRCB sludge lagoon facility Post-Closure Plan. A copy of this plan and all revisions to it will be kept at the TRCB facility. This Post-Closure Plan identifies the activities which will be carried on after closure, and includes:

1. A description of the planned groundwater monitoring activities and frequencies at which they will be performed;

2. A description of the planned maintenance activities and frequencies at which they will be performed;

3. The name, address, and phone number of the person or office to contact about the former disposal facility during the post-closure care period. This person or office will keep an updated post-closure plan during the post-closure care period;

4. Financial Assurance for post-closure care.

The scope of work to investigate the influence of the former lagoon activities on groundwater is physically restricted by the presence of an adjacent CERCLA site. The confluence of the two downgradient water-bearing units provides a unique situation where the chemical natures of each site cannot be easily differentiated. A hydrogeologic assessment of the CERCLA site is presently being conducted by TEXACO and will be available shortly following submittal of this post-closure plan.

## 4.0 HISTORICAL PERSPECTIVE

### 4.1 Site History

The sludge lagoon was put into operation in 1963. The lagoon was constructed by forming a bowl five to six feet deep in natural, on-site materials consisting of brown glacial till. The down-hill, or east, side of the lagoon was formed by a short berm as were parts of the north and south sides. No liner material was used.

The lagoon was approximately 80 feet (north-south) x 90 feet (east-west) with bermed side walls. The material in the lagoon pond had the appearance of a dried sludge cake, with no standing water. Water entering the lagoon was generally direct precipitation and a small amount of surface runoff. The surrounding berms effectively prevented uphill surface runoff from entering the lagoon.

From 1963 through 1979 the lagoon received sludge from the TRCB laboratory waste water treatment system and sanitary waste water treatment system. Sludge was cleaned from the laboratory waste water treatment system on an annual basis. Approximately 75,000 gallons of sludge were placed in the lagoon each year through 1979.

From 1980 until June 19, 1981, the lagoon received only sludge from the sanitary waste water treatment system. The only organic solvent accepted in the sanitary waste stream was 1,2-dichlorobenzene. Approximately 30,000 to 40,000 gallons of sludge were placed in the lagoon during this one year period. The lagoon was removed from service in June, 1981 and formally closed on July 23, 1986.

## 4.2 Summary of Closure

Closure involved the removal of sludge and subsoil, backfilling with clean fill material, and grading to restore the area as close as possible to its original topography. The removal of the sludge and subsoil was carried out in a series of excavation lifts with each three foot lift covering the entire surface of the lagoon. All sludge residues and underlying and surrounding soil were removed to analytical and/or physical limitations.

The closure plan called for soil sampling and testing at the completion of each lift if field measured photoionization detector (PID) screening results showed no detection of volatile organics. If analytical limitations were not achieved, excavation continued until the physical limitations were reached. The physical limitations were established to define the maximum dimensions of the excavation.

The soil sampling and testing program at the completion of each lift involved taking both excavation bottom and wall soil samples and analyzing these for priority pollutant volatile organics and Extraction Procedure (EP) Toxicity for metals. Analytical methods for extraction and analysis were done in accordance with EPA Test Method Manual SW-846 approved procedures. These procedures were performed to obtain the lowest possible detection limits for all organics as dictated by the soil sample matrix. In addition to the individual samples, a composite bottom sample was analyzed for the parameters above as well as for priority pollutant base/neutral and acid extractable organics.

The excavation terminated when the individual priority pollutant volatile organics were not detected in any individual sample and none of the samples exceeded EP toxicity limits for metals. If the above criteria were not met, the excavation proceeded through additional lifts until the analytical and/or physical limitations were reached. The maximum depth of the excavation was the elevation of the historical low seasonal water table, approximately 12 feet below the natural grade.

The lateral extent of excavation went in all directions to two feet beyond the outermost limit of the surface impoundment berms.

Implementation of the closure plan began on February 4, 1986 and was completed on March 21, 1986. All contaminated (or source) material was excavated during closure; the excavation was completed when analytical criteria were acheived. Final grading and hydroseeding of the site were completed on June 23, 1986.

Appendix B contains copies of the TRCB closure certification report transmittal letter and the response of approval by NYSDEC.

Details concerning geologic, hydrologic and chemical assessments of the lagoon can be found in the following documents prepared for or by TRCB:

- Evaluation of the Geologic and Hydrologic Conditions at the Sludge Lagoon, Inactive Landfill Areas and Tank Farm.

  Prepared by: Dunn Geoscience Corporation
  August 19, 1981

- Sludge Lagoon Groundwater Quality Assessment

  Prepared by: Dunn Geoscience Corporation
  March 25, 1983

- Closure Plan for Hazardous Waste Sludge Lagoon
  Facility EPA ID NYD 091894899

  Prepared by: Texaco, Inc., Texaco Research Center Beacon, New York
  September 26, 1985
  (as amended by letter during November and December 1985)

- Report for Certification of Closure of the Hazardous Waste Sludge Lagoon at the Texaco Research Center - Beacon, New York
  Facility EPA ID NYD091894899

  Prepared by: John L. Leporati
  NYS PE license No. 47204
  July 15, 1986

## 5.0 SITE ASSESSMENT

### 5.1 Groundwater Monitoring

Pertinent monitoring data collected during the facility's interim status period are presented in Appendix C in accordance with a NYSDEC requirement pertaining to 6NYCRR 373-1.5(a)(3)(i). Plate 1 shows the location of the groundwater monitoring wells; Figure 1 shows the general direction of groundwater flow.

### 5.2 Geology and Hydrogeology

Soils encountered in test borings in the vicinity of the former lagoon consisted of brown glacial till to a depth of 12 feet to 16 feet overlying an unknown thickness of gray till. Numerous borings drilled in the valley below the former lagoon encountered the same types of till found in the vicinity of the lagoon. The depth to bedrock, where encountered, varied considerably in the borings in the valley. Borings DC-1 and DC-2 located in the valley downgradient of the former lagoon were drilled to depths of 15 feet (elevation 212 feet) and 30 feet (elevation 197 feet), respectively, without encountering bedrock. According to the log of boring DC-2 brown glacial till extends to a depth of approximately 17 feet (elevation 210 feet), where the gray glacial till is encountered. Field observations and the published literature for this area suggest that the drumlin east of the site is comprised of these same materials.

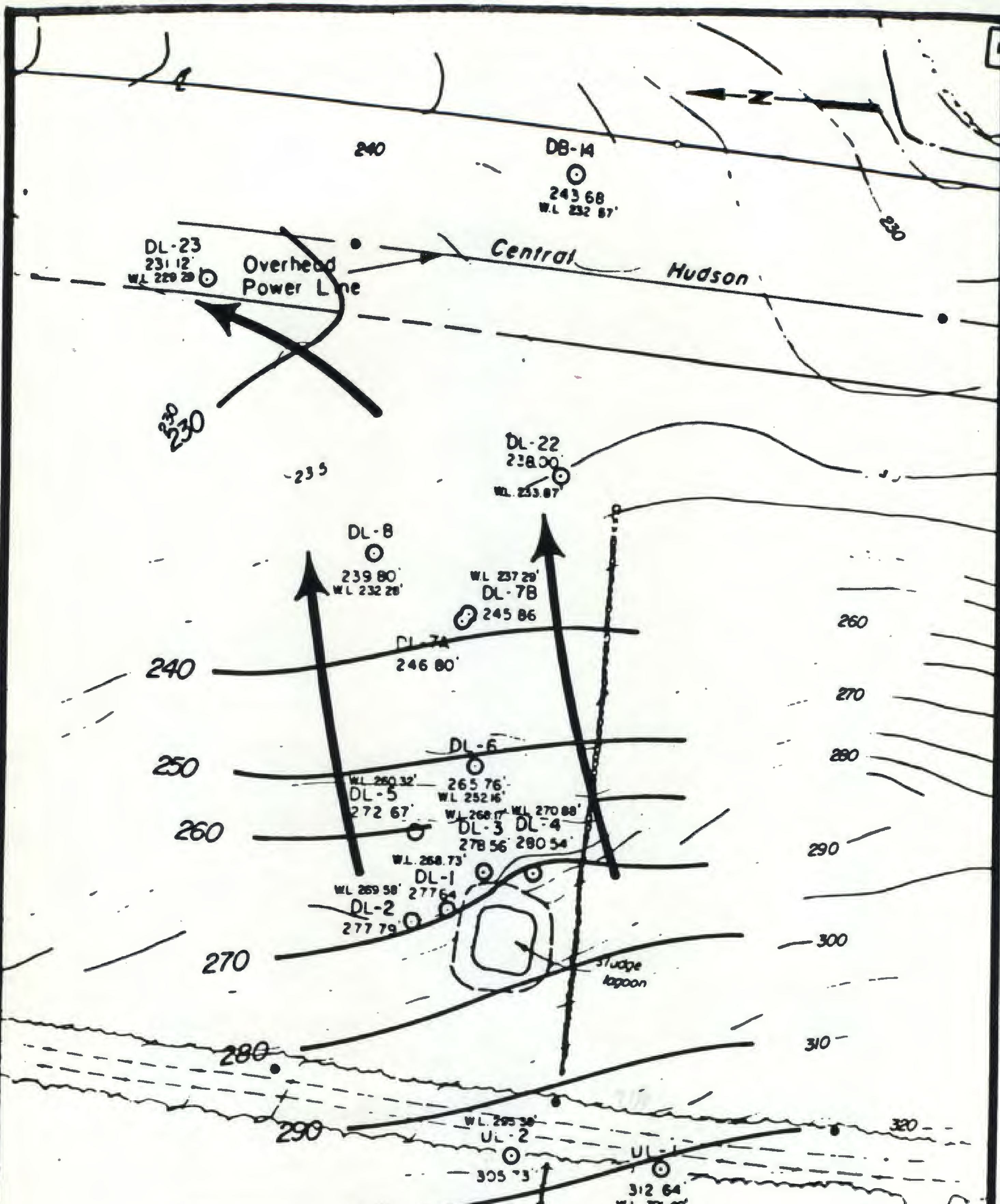



FIGURE 1 300

WATER TABLE CONTOUR MAP

TEXACO, INC.

from

July 2, 1982 Water Level Measurements

Scale: 1" = 100'

Sept. 1982

Note: Wells DL-22 and DL-23 were removed during August, 1985.

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Boring logs indicate the glacial till consists of a heterogeneous mixture of sand, gravel, silt and clay. Occasionally cobbles and small boulders are present. The composition of the till varies both vertically and horizontally due to local variations in depositional mode and to variation of materials in the ice mass at the time of deposition.

In general, sand and gravel comprise the majority of the soil and account for an average of about 70% of the soil's composition. Silt and clay comprise the remaining 30%.

Boring UL-1 drilled during the Dunn Geoscience Phase I study (1981) penetrated the glacial till to a depth of 81.5 feet (elevation 239 feet) without encountering bedrock. Bedrock was not encountered in other borings in the sludge lagoon area penetrating to a maximum depth of 25.5 feet (elevation 218 feet) (well DL-7a).

Groundwater at the former sludge lagoon area is derived from precipitation falling directly on the site and adjacent upland areas. The portion of precipitation which is not lost to evapotranspiration or surface runoff enters the groundwater reservoir as recharge. Groundwater occurs within the intergranular voids of the glacial till under essentially unconfined conditions. In such cases, the top of the zone of saturation, or water table, is free to fluctuate as the volume of groundwater in storage responds to recharge and discharge.

The former sludge lagoon area is underlain by sandy till with layers of clayey till. Due to the variable texture of the deposits, hydraulic conductivity values measured in the glacial till during previous site investigations ranged from moderate to very low. The vertical hydraulic conductivity of the sandy till calculated from field tests was about $10^{-2}$ cm/sec, whereas that of the clayey till was generally between $10^{-4}$ and $10^{-5}$ cm/sec. Laboratory testing of the clayey till suggested a lower hydraulic conductivity value on the order of $10^{-7}$ cm/sec. Horizontal hydraulic conductivity values were not determined, however, they may be as much as one to two orders of magnitude greater than corresponding vertical hydraulic conductivity values such as those given above.

Flow of contaminants into the bedrock flow system, which is probably fracture controlled, is not expected. The surficial materials are quite permeable and provide a more likely pathway; downward gradients are expected to be small due to the proximity to regional (Fishkill Creek) and local (tributary valley) groundwater discharge zones. This is supported by the observation that no groundwater quality problem exists in the grey, lower till monitored by well DL-7a, in an area downgradient of the lagoon and upgradient of the valley, but RCRA-related chemicals are found in well DL-7b in the saturated brown, upper till.

Water level contour maps show that the groundwater elevation reflects the topography, having a higher elevation beneath hills than beneath valleys. The water level elevation is about 300 feet above sea level upgradient of the former lagoon and decreases to about 230 feet above sea level in the valley floor below the former lagoon.

The direction of groundwater flow is perpendicular to the groundwater contours. Therefore, based on the groundwater elevation contour maps, the direction of flow downgradient from the site is east and northeast toward the small, north-south trending valley. Flow is in response to the measured hydraulic gradient of between 13 and 15 feet per 100 feet which is approximately the same as the slope of the topography.

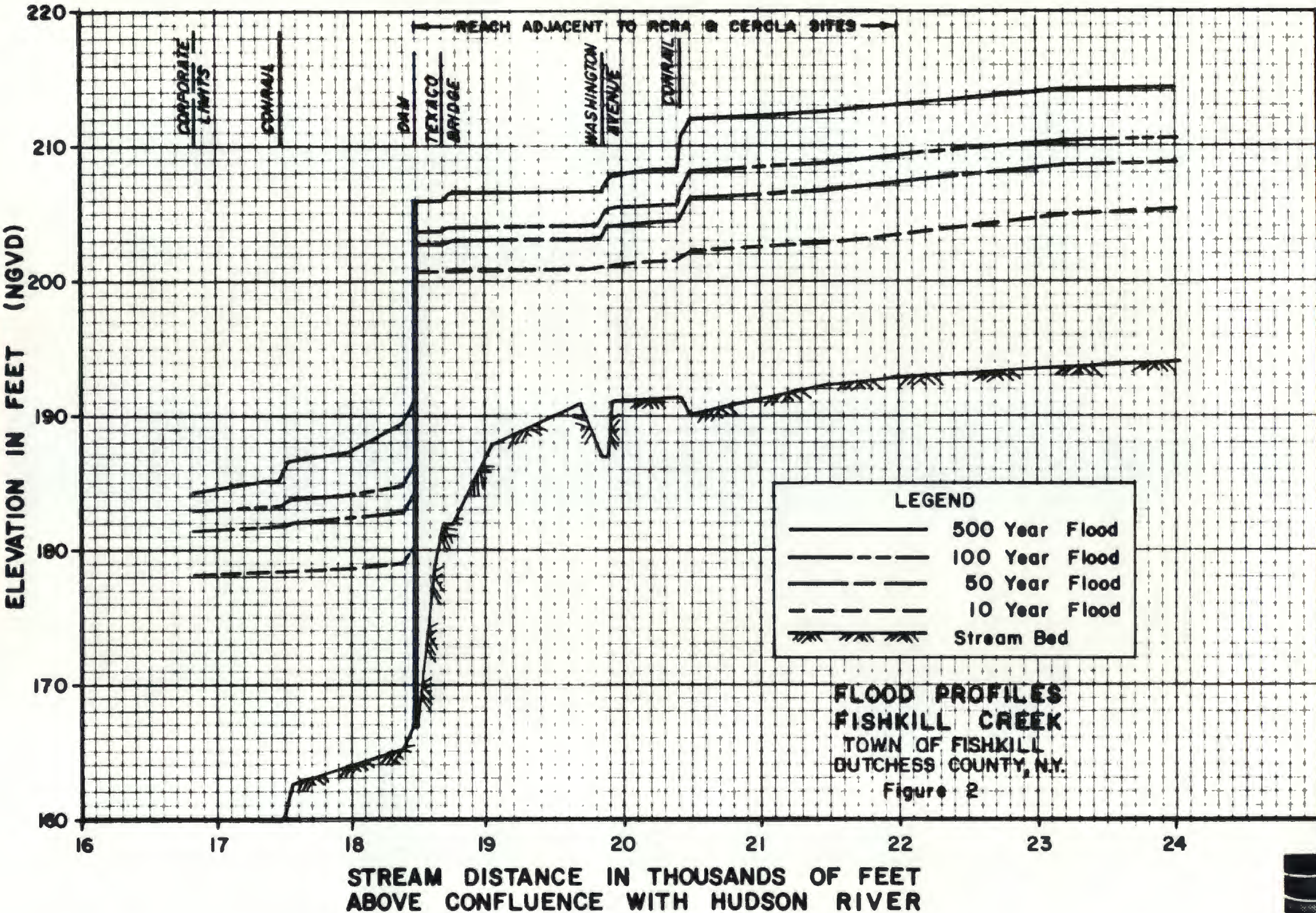
The rapid transport rate of groundwater moving down the steep slope of the hill would be expected to lead to rapid decrease of chemical residuals from the discontinued source as observed by the attenuation of organics in monitoring well DL-3.

The steep groundwater gradient and resultant high rate of groundwater flow limit the affected groundwater to a narrow plume isolated in the brown till before entering the south-north trending valley. This is supported by a two dimensional, analytical, solute transport model (Appendix D). The results of simulation of various site-specific hydrogeologic scenarios support observed and expected field conditions, i.e., the rapid groundwater transport rate produces greater distances of transport and more rapid groundwater restoration.

Groundwater flow and water quality at the base of the hill below the former lagoon area cannot be easily differentiated from the flow and water quality attributable to the adjacent CERCLA site. Monitoring of wells downgradient of the lagoon area beyond DL-8 to assess RCRA-related issues is inappropriate due to the overlapping nature of the CERCLA-related groundwater with the RCRA-related groundwater. Both hydrologic and chemical aspects of the valley below the former lagoon are more effectively understood when investigated from the view point of the CERCLA site. Hydrologic and chemical aspects relating to the CERCLA sites are being addressed under Texaco's Post Remedial and Off-Site Monitoring Program.

## 5.3 Flood Plain Information

Information on levels of flooding along Fishkill Creek were obtained from the Federal Emergency Management Agency (FEMA) Flood Insurance Study for the Town of Fishkill, New York, Dutchess County. The stretch of Fishkill Creek from the dam near the TRCB and upstream approximately 3500 feet lies near the Texaco RCRA and CERCLA sites. The 100 year flood boundary for this reach is between elevations 203.5 and 209.5 feet (NVGD). The 500 year boundary for the same reach is between elevations 206.0 and 213.0 feet (NVGD). The flood profiles from the FEMA report showing this reach of Fishkill Creek are presented in Figure 2 (Flood Profile 01P). The lowest ground surface in the vicinity of both the Texaco RCRA and CERCLA sites is approximately elevation 225 feet (MSL). Both sites, therefore, lie well above both the 100 and 500-year flood boundary levels of Fishkill Creek in this area.




FLOOD PROFILES
FISHKILL CREEK
TOWN OF FISHKILL
DUTCHESS COUNTY, N.Y.
Figure 2

From Federal Emergency Management Agency
Flood Insurance Study, Dec. 1, 1983.

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## 6.0 POST-CLOSURE CARE AND USE OF PROPERTY

Post-closure care commenced after the date of closure (July 23, 1986) and consists of groundwater monitoring and reporting and general land/soil maintenance to insure integrity of the site cover.

Since all lagoon contents were removed from the site and soil analysis showed no residual levels of chemicals of concern, there is no need for any maintenance of waste containment systems, such as dikes or freeboards usually associated with surface impoundments. As such there are no standing liquids, waste or waste residues, liners or underlying and surrounding contaminated soil not associated with groundwater.

General land/soil maintenance will include routine visual inspection of the site to insure that vegetative cover is intact and no erosion occurs along the slope of the hill.

Any technical questions regarding post-closure can be addressed directly to:

Michael P. Gallagher
Texaco Research Center
Old Glenham Road
Glenham, New York 12527

or

Texaco, Inc.
P.O. Box 509
Beacon, New York 12508

Phone: (914) 831-3400

All correspondence should be directed to:

Dr. D. F. Pollart
Director-Research and Environment Affairs Dept.
Texaco, Inc.
P.O. Box 509
Beacon, New York 12508

## 7.0 POST-CLOSURE GROUNDWATER MONITORING

All post-closure groundwater monitoring will be limited to those analyses defined by EPA Method 624 (purgeable organics).

Two groundwater wells, DL-6 and DL-8, will be sampled semi-annually for three years to monitor the effects of lagoon remediation and groundwater clean-up. A report with conclusions and recommendations will be submitted after three years.

In the event that a well contains no detectable organics for two consecutive years, monitoring can be discontinued at that well.

Prior to any groundwater collection, monitoring well groundwater levels will be measured to the nearest 0.1 foot with a chalked, steel tape or equivalent water level indicator device.

Water in monitoring wells will be exercized with dedicated tubing using a peristaltic pump. Groundwater will be sampled with a bottom-fill, check-valved Teflon bailer. If dedicated bailers are not used, decontamination of a bailer between wells will consist of distilled water rinses. Representative groundwater will be placed in glass vials with teflon-lined septums and plastic caps ensuring no trapped air. Immediately after collection, samples will be chilled by wet ice or pre-frozen ice paks and delivered to the laboratory by priority handling. Chains of custody will follow all samples. All appropriate quality assurance and control will be employed such as blanks, replicate analyses and spiked samples.

# 8.0 FINANCIAL ASSURANCE FOR POST-CLOSURE CARE

## 8.1 Post-Closure Cost Estimates

Post-closure activities will be performed by in-house Texaco personnel, including inspections, sampling and analysis. No post-closure costs apply. In the event that sampling and analysis only must be performed by contract personnel, the following yearly costs apply:

<u>Groundwater Sampling</u>

| | |
|---|---|
| One staff level scientist for one day @ $700 (includes travel time, mileage, expenses, equipment costs and a brief sampling event report) | $1400 |

<u>Laboratory Analyses</u>

| | |
|---|---|
| Two samples with all appropriate QA/QC protocols for EPA Method 624, purgeable organics by GC/MS @ $300 per analysis | 3600 |
| Total First Year Post-Closure Cost | $5000 |

## 8.2 Financial Assurance Mechanism

TRCB will use the financial test and corporate guarantee (6 NYCRR 373-3.8(f)(5)) to establish financial assurance for post-closure of the former sludge lagoon. Copies of correspondence relative to financial assurance are provided in Appendix E.

APPENDIX A

**New York State Department of Environmental Conservation**
**50 Wolf Road, Albany, New York 12233-0001**

Henry G. Williams
Commissioner

APR 03 1986

4/4 mBG

Mr. Dale F. Pollart
Director
Research, Environmental and Safety Department
Texaco Research Center
P.O. Box 509
Beacon, NY 12508

Copies sent to:
RLJ
DCMcG

Dear Mr. Pollart:

Re: 6 NYCRR Part 373 Post-Closure Plan
RCRA Lagoon
EPA I.D. No. NYD091894899

Pursuant to 6 NYCRR 373-3.7 for closure of disposal units under interim status, the facility is required to submit a post-closure plan as part of the closure plan. At the time approval was granted for Texaco's closure plan for the RCRA lagoon, it was believed that post-closure care would be addressed in a post-closure permit. However, based on when the unit stopped receiving waste, it has been determined that such a permit is not applicable in this case and a post-closure plan will now be necessary.

This letter constitutes an offical request for a Part 373 State post-closure plan for the above-referenced unit. Your plan must be submitted no later than February 1, 1987. The NYSDEC contact persons for this application are Ms. Leslie Stephenson of the Central Office, (518) 457-9696 and Ms. Mariana Dominquez of the Region 3 Office, (914) 761-6660.

Required information for a post-closure plan is established in 6 NYCRR 373-3.7. A listing of minimal requirements is provided in Attachment I. Additional information should be included if relevant to the post-closure care activities.

Please submit the original plan to:

Mr. Paul R. Counterman, P.E.
Chief
Bureau of Hazardous Waste Technology
Division of Solid and Hazardous Waste
NYS Dept. of Environmental Conservation
50 Wolf Rd. - Rm. 401
Albany, NY 12233

and one copy to each of the following:

Mr. James Reidy
Regional Hazardous Waste Engineer
NYS Dept. of Environmental Conservation
Region 3 Office
202 Mamaroneck Ave., 3rd Floor
White Plains, NY 10601

Mr. Andrew Bellina
Chief
New York State Permits Section
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, NY 10278

Sincerely,

Paul R. Counterman

Paul R. Counterman, P.E.
Chief
Bureau of Hazardous Waste Technology
Division of Solid and Hazardous Waste

Enclosure

cc: w/o enc. - A. Bellina, Region II
L. Stephenson
J. Reidy, Region 3
M. Dominquez, Region 3

## ATTACHMENT I

Current Regulatory Requirements (§373-1.5(a))

- A copy of the post-closure inspection schedule (§373-1.5(a)(2)(v))
- Floodplain information (§373-1.5(a)(2)(xi))
- A copy of the post-closure plan (§373-1.5(a)(2)(xiii))
- Documentation of the notice in deed or an appropriate alternative instrument (§373-1.5(a)(2)(xiv))
- Cost estimate for post-closure and post-closure financial mechanism (§373-1.5(a)(2)(xvi))
- Groundwater data and information demonstrating compliance with requirements for detection monitoring, compliance monitoring and corrective action, as applicable (§373-1.5(a)(3))

# APPENDIX B

M/G

Texaco Inc.
Research & Environmental
Affairs Department

July 23, 1986

New York State Department
of Environmental Conservation
50 Wolf Road
Albany, NY 12233-0001

Attention: Mr. Paul R. Counterman, P.E.
Chief, Bureau of Hazardous Waste Technology
Division of Solid and Hazardous Waste

Reference: Texaco Research Center Beacon (TRCB)
EPA ID NO. NYD091894899
Lagoon Closure Certification

Dear Mr. Counterman:

Enclosed you will find two originals of "Report for Certification of the Closure of the Hazardous Waste Sludge Lagoon at the Texaco Research Center Beacon, New York (EPA ID. NO. NYD091894899)" which we are submitting to you in accordance with 6NYCRR 373-3.7(f) and your letter to Dr. Dale F. Pollart dated April 7, 1986.

By this submittal, Texaco certifies that the lagoon was closed in accordance with the "Closure Plan For Hazardous Waste Sludge Lagoon" dated September 26, 1985, as approved by the NYSDEC.

TRCB is currently preparing a Post-Closure Plan for the closed facility in accordance with 6NYCRR 373-3.7(h) and your letter dated April 3, 1986, to be submitted on or before February 1, 1987.

If you have any questions on the Certification Report or the Post-Closure Plan preparation, please feel free to call Mr. Michael P. Gallagher, P.E., at (914)831-3400.

Very truly yours,

Harold J. Weiss

HAROLD J. WEISS

MPG:jep

CC: Mr. William Smith
USEPA, Region II

BCC: EEN - W/O Enclosure
RJT
REPi

Enclosure

**New York State Department of Environmental Conservation**
**50 Wolf Road, Albany, New York 12233-0001**

**Henry G. Williams**
**Commissioner**

JUL 3 1 1986

... AND ENVIRONMENTAL
... DEPARTMENT
AUG 4 1986

TJM
JMSV
RDM

8/5
MPG 8/11

Mr. Dale F. Pollart
Director
Research, Environmental and Safety Department
Texaco Research Center
P.O. Box 509
Beacon, NY 12508

Re: Texaco Research Center Beacon
Certification of Closure
Hazardous Waste Sludge Lagoon
EPA I.D. No. NYD091894899

Dear Mr. Pollart:

This letter confirms receipt by this office of both owner/operator and engineering certification of closure of the above-referenced unit. Upon review of our records, it is deemed that all applicable regulatory requirements in conjunction with closure of RCRA interim status portions of the referenced facility have been met.

This certification approval in no way precludes the work still required in this area as specified in the forthcoming post-closure plan and remedial investigation module of the RCRA Part B permit. This approval ceases liability for regulatory fees for a surface impoundment.

If you should have any questions, or comments regarding the above, please contact Ms. Leslie Stephenson at (518) 457-9696.

Sincerely,

Paul R. Counterman

Paul R. Counterman, P.E.
Chief
Bureau of Hazardous Waste Technology
Division of Solid and Hazardous Waste

cc: W. Smith

# APPENDIX C

Laboratories Used for Groundwater
Monitoring Program

Texaco Research Center Beacon
1981-1986

| Sampling Date | Laboratory |
|---|---|
| June 18, 1981 | H2M* |
| October 2, 1981 | TRCB** |
| February 10, 1982 | TRCB |
| March 10, 1982 | TRCB |
| May 3, 1982 | TRCB |
| June 3, 1982 | TRCB |
| August 2, 1982 | TRCB |
| November 1, 1982 | TRCB |
| January 17, 1983 | TRCB |
| February 24, 1983 | TRCB, ETC*** |
| June 18, 1984 | TRCB, OHM**** |
| August 21, 1984 | TRCB, CAMO***** |
| July 15, 1985 | TRCB, ETC |
| August 1, 1986 | TRCB |
| November 18, 1986 | TRCB |

* $H_2M$ - Holtzmacher, McLendon, and Murrell, P.C. (Melville, NY)

** TRCB - Texaco Research Center Beacon (Glenham, NY)

*** ETC - Environmental Testing and Certification (Edison, NJ)

**** OHM - O.H. Materials Laboratory (Findlay, Ohio)

***** CAMO - CAMO Laboratory (Poughkeepsie, NY)

Summary of Downgradient Groundwater Monitoring
Texaco Research Center Beacon
1981 - 1986

| | DL-1 | | | | DL-2 | | | |
|---|---|---|---|---|---|---|---|---|
| | F | MIN | Max (Date[a]) | MRAR (Date[b]) | F | MIN | Max (Date) | MRAR (Date[c]) |
| Benzene | 0/2 | ND | ND | ND | 0/8 | ND | ND | ND(d) |
| Bromomethane | 0/2 | ND | ND | ND | 1/7 | ND | 1(8-2-82) | ND |
| Chlorobenzene | 0/2 | ND | ND | ND | 2/8 | ND | 2(11-1-82) | ND(d) |
| Chloroethane | 2/2 | 11 | 125 | 11 | 3/7 | ND | 5(8-2-82) | ND |
| 2-Chloroethylvinyl ether | 0/2 | ND | ND | ND | 1/7 | ND | 2(11-1-82) | ND |
| Chloroform | 1/2 | ND | 2 | ND | 1/7 | ND | 1(11-1-82) | ND |
| 1,2-Dichlorobenzene | 0/2 | ND | ND | ND | 2/7 | ND | 1(8-2-82) | ND |
| 1,1-Dichloroethane | 2/2 | 21 | 31 | 31 | 5/7 | ND | 18(11-1-82) | ND |
| 1,2-Dichloroethane | 0/2 | ND | ND | ND | 1/7 | ND | 18(11-1-82) | ND |
| 1,1-Dichloroethene | 0/2 | ND | ND | ND | 1/7 | ND | 2(11-1-82) | ND |
| t-1,2-Dichloroethene | 2/2 | ND | 1 | ND | 2/7 | ND | 32(8-2-82) | ND |
| 1,2-Dichloropropane | 0/2 | ND | ND | ND | 1/7 | ND | 2(11-1-82) | ND |
| C-1,3-Dichloropropene | 0/2 | ND | ND | ND | 1/7 | ND | 2(11-1-82) | ND |
| t-1,3-Dichloropropene | 0/2 | ND | ND | ND | 0/7 | ND | ND | ND |
| Methylene Chloride | 1/2 | ND | 16 | ND | 3/7 | ND | 13(5-3-82) | ND |
| Tetrachloroethene | 0/2 | ND | ND | ND | 2/7 | ND | 7(8-2-82) | ND |
| 1,1,1-Trichloroethane | 1/2 | ND | 9 | ND | 7/7 | ND | 38(6-18-81) | ND |
| 1,1,2-Trichloroethane | 0/2 | ND | ND | ND | 0/7 | ND | ND | ND |
| Trichloroethylene | 1/2 | ND | 4 | ND | 3/7 | ND | 3(11-1-82) | ND |
| Trichlorofluoromethane | 2/2 | ND | 1 | ND | 2/7 | ND | 3(11-1-82) | ND |
| Vinyl Chloride | 0/2 | ND | ND | ND | 2/7 | ND | 2(11-1-82) | ND |

Summary of Downgradient Groundwater Monitoring
Texaco Research Center Beacon
1981 - 1986

| | DL-3 Before Closure | | | | DL-3 After Closure | |
|---|---|---|---|---|---|---|
| | F | MIN | Max (Date) | MRAR(Date[c]) | 8/1/86 | 11/18/86 |
| Benzene | 1/8 | ND | 6(8-21-84) | 6(d) | ND | ND |
| Bromomethane | 1/7 | ND | 12(8-2-82) | ND | ND | ND |
| Chlorobenzene | 3/8 | ND | 12(5-3-82) | 6(d) | ND | ND |
| Chloroethane | 6/7 | ND | 1684(11-1-82) | 287 | ND | ND |
| 2-Chloroethylvinyl ether | 0/7 | ND | ND | ND | ND | ND |
| Chloroform | 1/7 | ND | 3(5-3-82) | ND | ND | ND |
| 1,2-Dichlorobenzene | 1/7 | ND | 13(5-3-82) | 4(d) | ND | ND |
| 1,1-Dichloroethane | 7/7 | ND | 334(11-1-82) | 35 | 19 | 18 |
| 1,2-Dichloroethane | 4/7 | ND | 5(11-1-82) | 2 | ND | ND |
| 1,1-Dichloroethene | 2/7 | ND | 7(11-1-82) | 2 | ND | ND |
| t-1,2-Dichloroethene | 6/7 | ND | 163(11-1-82) | 6 | ND | ND |
| 1,2-Dichloropropane | 0/7 | ND | ND | ND | ND | ND |
| c-1,3-Dichloropropene | 0/7 | ND | ND | ND | ND | ND |
| t-1,3-Dichloropropene | 0/7 | ND | ND | ND | ND | ND |
| Methylene Chloride | 3/7 | ND | 49(5-3-82) | ND | ND | ND |
| Tetrachloroethene | 1/7 | ND | 3(5-3-82) | ND | ND | ND |
| 1,1,1-Trichloroethane | 8/7 | 7 | 89(10-2-81) | 7 | 9 | ND |
| 1,1,2-Trichloroethane | 1/7 | ND | 28(2-10-82) | ND | ND | ND |
| Trichloroethylene | 6/7 | ND | 123(11-1-82) | 12 | 20 | ND |
| Trichlorofluoromethane | 0/7 | ND | ND | ND | ND | ND |
| Vinyl Chloride | 2/7 | ND | 4(5-3-82) | ND | ND | ND |

Summary of Downgradient Groundwater Monitoring
Texaco Research Center Beacon
1981 - 1986

DL-4

| | F | MIN | MAX(Date) | MRAR(Date[c]) |
|---|---|---|---|---|
| Benzene | 1/8 | ND | 4(8-21-84) | 4(d) |
| Bromomethane | 2/7 | ND | 2(11-1-82) | ND |
| Chlorobenzene | 4/8 | ND | 13(8-21-84) | 13(d) |
| Chloroethane | 5/7 | ND | 859(11-1-82) | 17 |
| 2-Chloroethylvinyl ether | 0/7 | ND | ND | ND |
| Chloroform | 2/7 | ND | 13(5-3-82) | ND |
| 1,2-Dichlorobenzene | 6/8 | ND | 21(8-2-82) | 13(d) |
| 1,1-Dichloroethane | 4/7 | ND | 225(11-1-82) | 12 |
| 1,2-Dichloroethane | 1/7 | ND | 3(11-1-82) | ND |
| 1,1-Dichloroethene | 1/7 | ND | 12(11-1-82) | ND |
| t-1,2-Dichloroethene | 4/7 | ND | 21(11-1-82) | ND |
| 1,2-Dichloropropane | 0/7 | ND | ND | ND |
| C-1,3-Dichloropropene | 2/7 | ND | 2(11-1-82) | ND |
| t-1,3-Dichloropropene | 0/7 | ND | ND | ND |
| Methylene Chloride | 3/7 | ND | 16(5-3-82) | 7 |
| Tetrachloroethene | 1/7 | ND | 1(10-2-81) | ND |
| 1,1,1-Trichloroethane | 6/7 | ND | 54(10-2-82) | 5 |
| 1,1,2-Trichloroethane | 1/7 | ND | 3(2-10-82) | ND |
| Trichloroethylene | 3/7 | ND | 9(11-1-82) | 3 |
| Trichlorofluormethane | 1/7 | ND | 2(5-3-82) | ND |
| Vinyl Chloride | 1/7 | ND | 2(8-2-82) | ND |

Summary of Downgradient Groundwater Monitoring
Texaco Research Center Beacon
1981 - 1986

| | DL-5* | | | | DL-6 | | | |
|---|---|---|---|---|---|---|---|---|
| | F | MIN | MAX(Date) | MRAR (Date[b]) | F | MIN | MAX(Date) | MRAR (Date[b]) |
| Benzene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Bromomethane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chlorobenzene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chloroethane | 2/2 | ND | 3(3-10-82) | 2 | 1/2 | ND | 1(3-10-82) | ND |
| 2-Chloroethylvinyl ether | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chloroform | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,2-Dichlorobenzene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1-Dichloroethane | 2/2 | ND | 20(3-10-82) | 14 | 2/2 | 78 | 107(3-10-82) | 78 |
| 1,2-Dichloroethane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1-Dichloroethene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| t-1,2-Dichloroethene | 1/2 | ND | 4(10-2-81) | 2 | 1/2 | ND | 7(2-24-83) | 7 |
| 1,2-Dichloropropane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| C-1,3-Dichloropropene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| t-1,3-Dichloropropene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Methylene Chloride | 2/2 | ND | 3(3-10-82) | 2 | 2/2 | 2 | 2(2-24-83) | 2 |
| Tetrachloroethene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1,1-Trichloroethane | 2/2 | 9 | 14(2-24-83) | 9 | 2/2 | 39 | 72(3-10-82) | 39 |
| 1,1,2-Trichloroethane | 0/2 | ND | ND | ND | 1/2 | ND | 2(2-24-83) | 2 |
| Trichloroethylene | 2/2 | ND | 5(2-24-83) | 5 | 2/2 | 6 | 70(3-10-82) | 6 |
| Trichlorofluoromethane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Vinyl Chloride | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |

Summary of Downgradient Groundwater Monitoring
Texaco Research Center Beacon
1981 - 1986

| | DL-7A | | | | DL-7B | | | |
|---|---|---|---|---|---|---|---|---|
| | F | MIN | MAX(Date) | MRAR (Date[b]) | F | MIN | MAX(Date) | MRAR (Date |
| Benzene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Bromomethane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chlorobenzene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chloroethane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 2-Chloroethylvinyl ether | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chloroform | 0/2 | ND | ND | ND | 2/2 | 2 | 3(3-10-82) | 2 |
| 1,2-Dichlorobenzene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1-Dichloroethane | 2/2 | 2 | 2(2-24-83) | 2 | 2/2 | 65 | 106(2-24-83) | 106 |
| 1,2-Dichloroethane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1-Dichloroethene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| t-1,2-Dichloroethene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,2-Dichloropropane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| C-1,3-Dichloropropene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| t-1,3-Dichloropropene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Methylene Chloride | 2/2 | 2 | 154(2-24-83) | 154 | 2/2 | 6 | 169(2-24-83) | 169 |
| Tetrachloroethene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1,1-Trichloroethane | 2/2 | 2 | 6(2-24-83) | 6 | 1/2 | 70 | 218(2-24-83) | 218 |
| 1,1,2-Trichloroethane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Trichloroethylene | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Trichlorofluoromethane | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |
| Vinyl Chloride | 0/2 | ND | ND | ND | 0/2 | ND | ND | ND |

Summary of Downgradient Groundwater Monitoring
Texaco Research Center Beacon
1981 - 1986

| | DL-8 | | | | DL-22 | | | |
|---|---|---|---|---|---|---|---|---|
| | F | MIN | MAX(Date) | MRAR (Date[e]) | F | MIN | MAX(Date) | MRAR (Date[b]) |
| Benzene | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| Bromomethane | 0/4 | ND | ND | ND | 1/2 | ND | 1(6-3-82) | ND |
| Carbon Tetrachloride | 1/4 | ND | 111(7-15-85) | 111 | | | | |
| Chlorobenzene | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chloroethane | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| 2-Chloroethylvinyl ether | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chloroform | 1/4 | ND | 2(3-10-82) | ND | 0/2 | ND | ND | ND |
| 1,2-Dichlorobenzene | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1-Dichloroethane | 4/4 | 23 | 326(7-15-85) | 326 | 2/2 | 6 | 12(2-24-83) | 12 |
| 1,2-Dichloroethane | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1-Dichloroethene | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| t-1,2-Dichloroethene | 1/4 | ND | 2(2-24-83) | ND | 0/2 | ND | ND | ND |
| 1,2-Dichloropropane | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| C-1,3-Dichloropropene | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| t-1,3-Dichloropropene | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| Methylene Chloride | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| Tetrachloroethene | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| 1,1,1-Trichloroethane | 4/4 | 27 | 266(7-15-85) | 266 | 2/2 | 2 | 13(2-24-83) | 13 |
| 1,1,2-Trichloroethane | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| Trichloroethylene | 4/4 | ND | 13(7-15-85) | 13 | 0/2 | ND | ND | ND |
| Trichlorofluoromethane | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| Vinyl Chloride | 0/4 | ND | ND | ND | 0/2 | ND | ND | ND |
| Chloromethane | 0/4 | ND | ND | ND | 1/2 | ND | 2(6-3-82) | ND |

DUNN GEOSCIENCE CORPORATION

Footnotes
for
Summary of Downgradient Groundwater Monitoring

1. All analytical results are reported in micrograms per liter = part per billion.

2. ND = Not detected at or above the method detection limit.

3. F = Frequency that parameter was detected A times during B rounds of sampling.

4. Min = Minimum concentration detected during sampling.

5. Max (Date) = Maximum concentration detected during sampling and the date of sampling when it occurred.

6. MRAR = Most recent analytical results.

7. In rounds of sampling where duplicate/split samples were analyzed by two laboratories, the higher value is reported.

8. Monitoring well DL-23 was sampled on June 3, 1982, February 24, 1983 and July 15, 1985. All parameters on all three dates were ND except for 2 ug/L chloromethane on June 3, 1982.

a. March 10, 1982

b. February 24, 1983

c. February 24, 1983 except selected parameters as noted

d. August 21, 1984

e. July 15, 1985

* The sampling of well DL-5 on October 2, 1981 was from a dug well installed by Texaco and not the present DL-5 drilled well installed by Dunn Geoscience Corporation on December 22, 1981. Results in micrograms per liter for duplicate samples from this former dug well are listed below.

| | |
|---|---|
| 1,1,1-trichloroethane | 197/182 |
| chloroethane | 129/129 |
| t-1,2-dichloroethene | 4/3 |
| 1,2-dichlorobenzene | ND/1 |

All other EPA 601 parameters were ND.

# APPENDIX D

In order to complement existing groundwater information, and to better evaluate a potential need for additional monitoring, solute transport modeling was performed in order to determine: the width of the contaminant plume emanating from the source (now remediated); the potential downgradient extent of groundwater contamination problem; and, the rate at which reduction of contaminant concentrations may occur given that the source has been remediated.

The modeling was performed using a two-dimensional, analytical, solute transport model presented in Javandel et. al. (Groundwater Transport: Handbook of Mathematical Models American Geophysical Union, Washington, D.C., 1984). The model and associated computer program considers the following transport processes:

1. advection -- the flow of solute with groundwater;

2. dispersion -- the "dilution" or "spreading" of solute due to mechanical mixing and molecular diffusion;

3. retardation -- the "slowing" of solute movement relative to groundwater due to the adsorption of solute onto the soil materials and other processes;

4. decay -- the removal of solute from the system due to transformation (chemical or biological) to other species (either toxic or nontoxic).

No model, numerical or analytical, represents the natural system fully; simplifying assumptions are commonly involved. The assumptions of this method include the following:

1. the medium in which transport occurs in homogeneous and isotropic;

2. groundwater flow is unidirectional with constant pore water (or seepage) velocity;

3. the medium is initially free of the particular solute being modeled with zero concentration;

4. the source, hypothetical or real, can be modeled as a strip which is oriented perpendicular to the groundwater flow direction; and,

5. vertical mixing of the solute at the source is complete and instantaneous.

Furthermore, once introduced, the concentration of solute at the source is assumed to be constant. Alternately, the concentration of the source may decline following an exponential decay rate specified by the modeler.

For the purposes of the modeling presented herein, the solute was generally assumed to be a conservative species with no retardation and no solute decay. This assumption results in longer transport distances and/or shorter travel times relative to a nonconservative species. Several simulations were performed with retardation and decay as part of a sensitivity analysis as discussed below.

Additionally, no molecular diffusion was incorporated (i.e., the coefficient of molecular diffusion was zero). Thus, dispersion of solute was due to mechanical mixing alone and the longitudinal and transverse dispersion coefficients were determined using the pore water velocity and the longitudinal and transverse dispersivity of the medium, respectively. Due to the relatively high pore water velocities calculated for the site, molecular diffusion is negligible relative to dispersion due to mechanical mixing (hydrodynamic dispersion).

Water level measurements in various monitoring wells have been used to prepare groundwater contour maps of the site as previously reported. A representative groundwater hydraulic gradient of 0.14 feet/foot, was calculated for the area immediately downgradient of the site (Dunn Geoscience Corporation, 1983; Figures 8.1 and 8.2).

No horizontal hydraulic conductivity testing has been performed at the sludge lagoon site. However, vertical hydraulic conductivity testing was performed during drilling activities via falling head tests. The vertical hydraulic conductivity of the sandy till was reported as 28.3 ft/day ($10^{-2}$ cm/sec). The vertical hydraulic conductivity of the clayey till was reported as 0.283 to 0.0283 ft/day ($10^{-4}$ to $10^{-5}$ cm/sec). Examination of the boring logs for monitoring wells downgradient of the site indicates sandy material with "little" (defined as 10 to 20% using the Burmister Classification scheme) clayey silt and "little" medium to fine gravel. Thus, 2.83 ft/day ($10^{-3}$ cm/sec) is a reasonable estimate for the horizontal hydraulic conductivity of materials at the site.

Assuming an effective porosity of 0.20 (20%), the pore water velocity can be calculated using a modified form of Darcy's Law as follows:

$$v = Ki/n$$

where:

- $v$ = average pore water velocity (feet/day);
- $K$ = hydraulic conductivity (feet/day);
- $i$ = hydraulic gradient (feet/foot); and,
- $n$ = effective porosity (dimensionless).

Using the previously reported hydraulic gradient ($10^{-3}$ cm/sec), the pore water velocity is calculated to be 1.98 feet/day or approximately 725 feet/year.

Site specific data for the longitudinal and transverse dispersivity of the medium are not available. A value of 50 feet was estimated for longitudinal dispersivity and is within the range reported in published references for similar types of aquifer materials. If a longitudinal to transverse dispersivity ratio of 5 is assumed, the associated transverse dispersivity is 10 feet.

Dispersion of solute is mathematically controlled by the longitudinal and transverse dispersion coefficients given as:

$$D_L = v\,a_L + D^*$$

$$D_T = v\,a_T + D^*$$

where:

- $D_L$ = longitudinal dispersion coefficient ($ft^2$/day);
- $D_T$ = transverse dispersion coefficient ($ft^2$/day);
- $v$ = average pore water velocity (ft/day);
- $a_L$ = longitudinal dispersivity (ft);
- $a_T$ = transverse dispersivity (ft); and,
- $D^*$ = coefficient of molecular diffusion ($ft^2$/day).

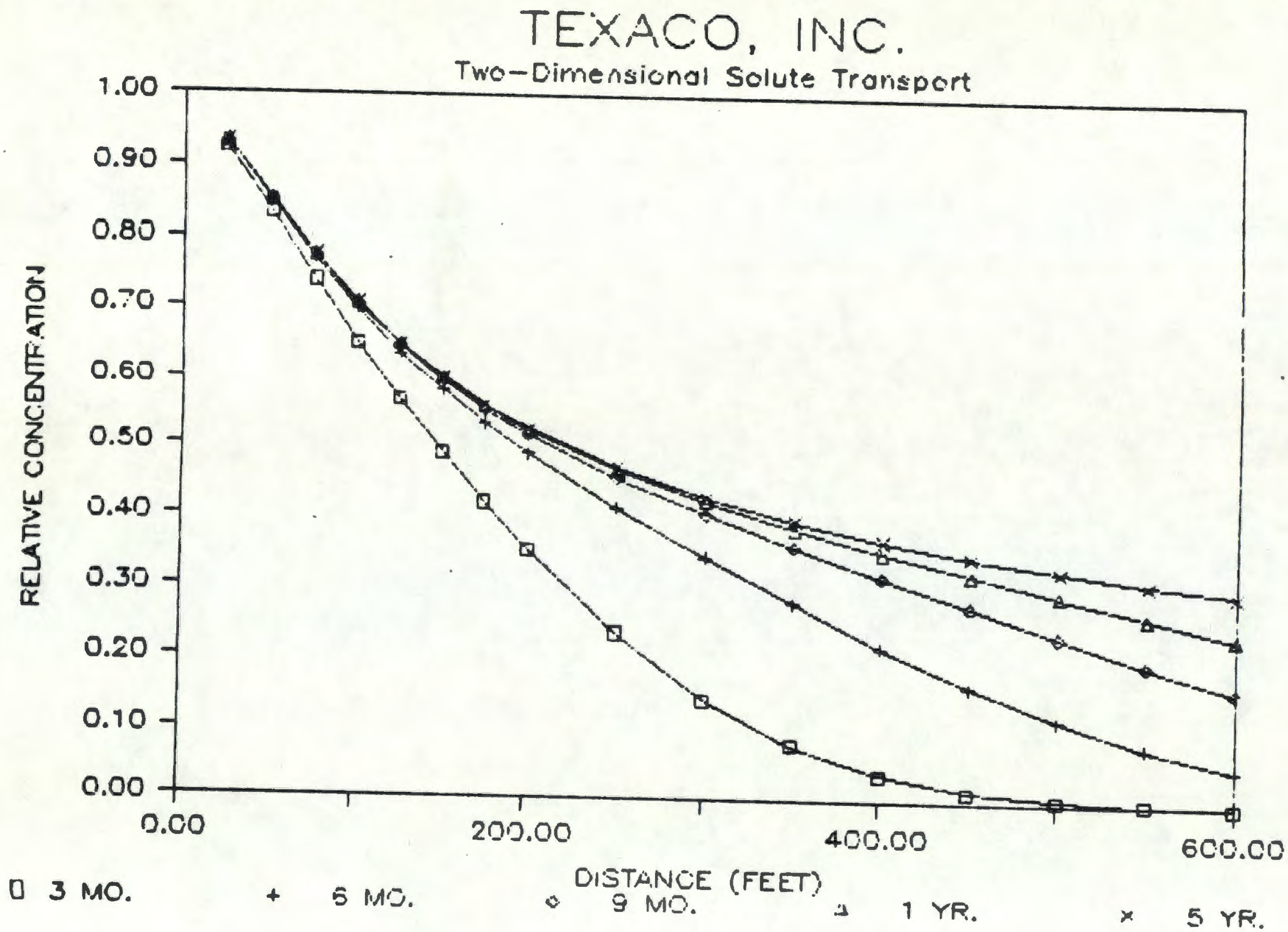
Neglecting molecular diffusion, the dispersion coefficient is simply the product of dispersivity and pore water velocity. Molecular diffusion is usually significant only when groundwater velocities are very low. Thus, for the modeling presented herein, values of longitudinal and transverse dispersion coefficients were approximately 100 and 20 $ft^2$/day, respectively.

For all simulations, the source was represented as a strip 80 feet in width. This is believed to be conservative; the actual width of the source may have been less.

Figure 1 represents the relative concentrations (concentration of the source is 1.0) after various times of transport (3 months, 6 months, 9 months, 1 year and 5 years) versus distance downgradient from the source. Consideration of dispersion leads to longer distances of travel in any given period of time. For example, by advection alone, groundwater and dissolved solutes would be expected to travel 1.98 feet/day or approximately 180 feet in 3 months. Figure 2, however, shows that detectable concentrations would be present more than 400 feet from the source.

Dispersion also leads to a "smearing out" of the plume front as shown by Figure 3 which illustrates relative concentration versus time of transport at various distances downgradient of the source (50 feet, 100 feet, 200 feet, 300 feet, and 400 feet).

Due to dispersion, the increase in concentration over time at a given point follows an "S" shape. Two important points are illustrated by Figure 3: while the time required to reach "steady state" concentrations increases with increasing distance from the source, "steady state" concentrations are generally




IGURE 1: Relationship between relative concentration and distance downgradient from the source for various transport times (3 months, 6 months, 9 months, 1 year and 5 years). Transport parameters as follows: retardation = 1.0; decay = 0.0; pore water velocity = 1.98 ft/day; longitudinal dispersivity = 50 feet; transverse dispersivity = 10 feet; coefficient of molecular diffusion = 0.0; and source width = 80 feet.

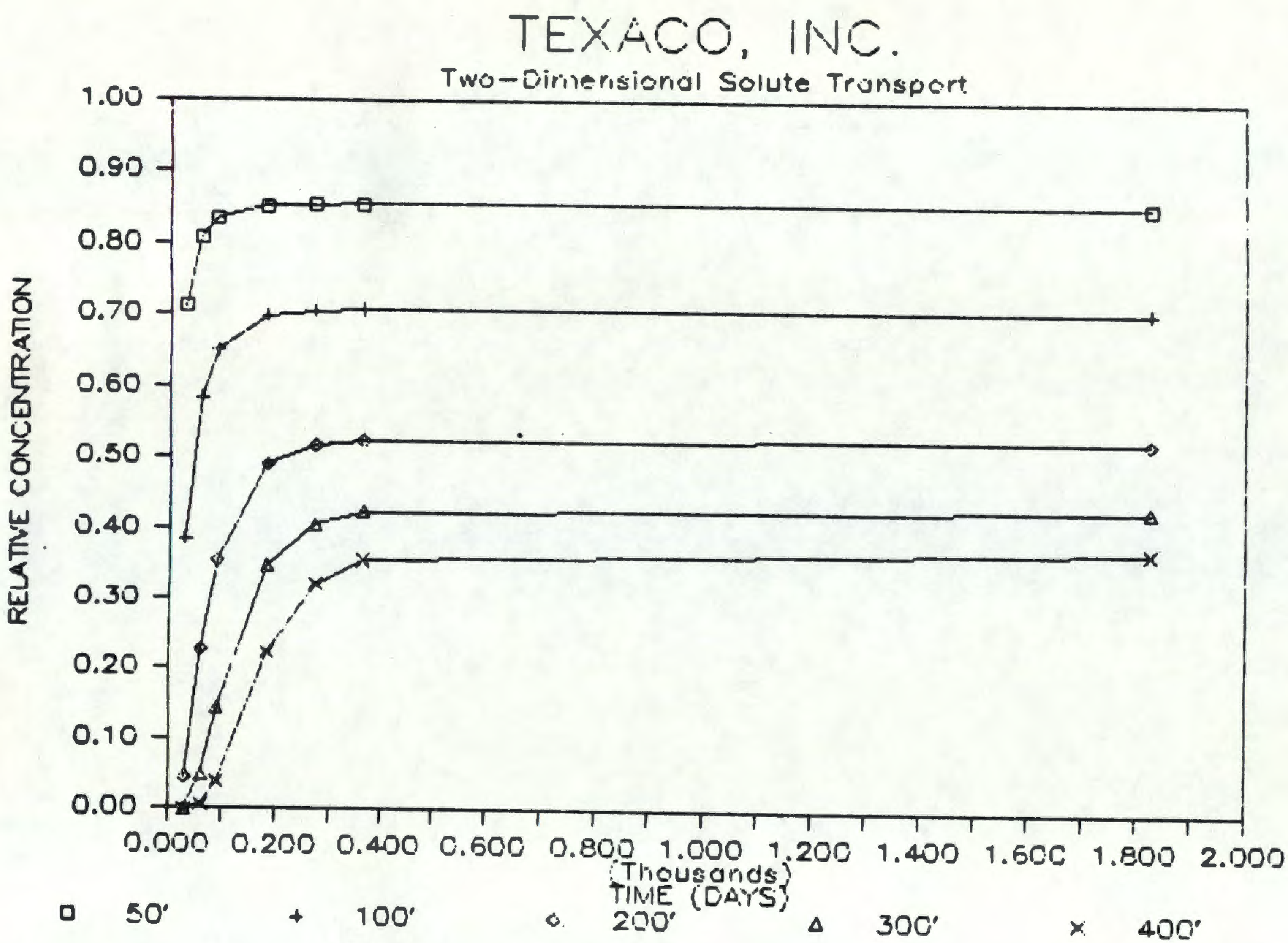



**FIGURE 2:** Relationship between relative concentration and time for various locations downgradient from the source (50 feet, 100 feet, 200 feet, 300 feet and 400 feet). Transport parameters as follows: retardation = 1.0; decay = 0.0; pore water velocity = 1.98 ft/day; longitudinal dispersivity = 50 feet; transverse dispersivity = 10 feet; coefficient of molecular diffusion = 0.0; and source width = 80 feet.

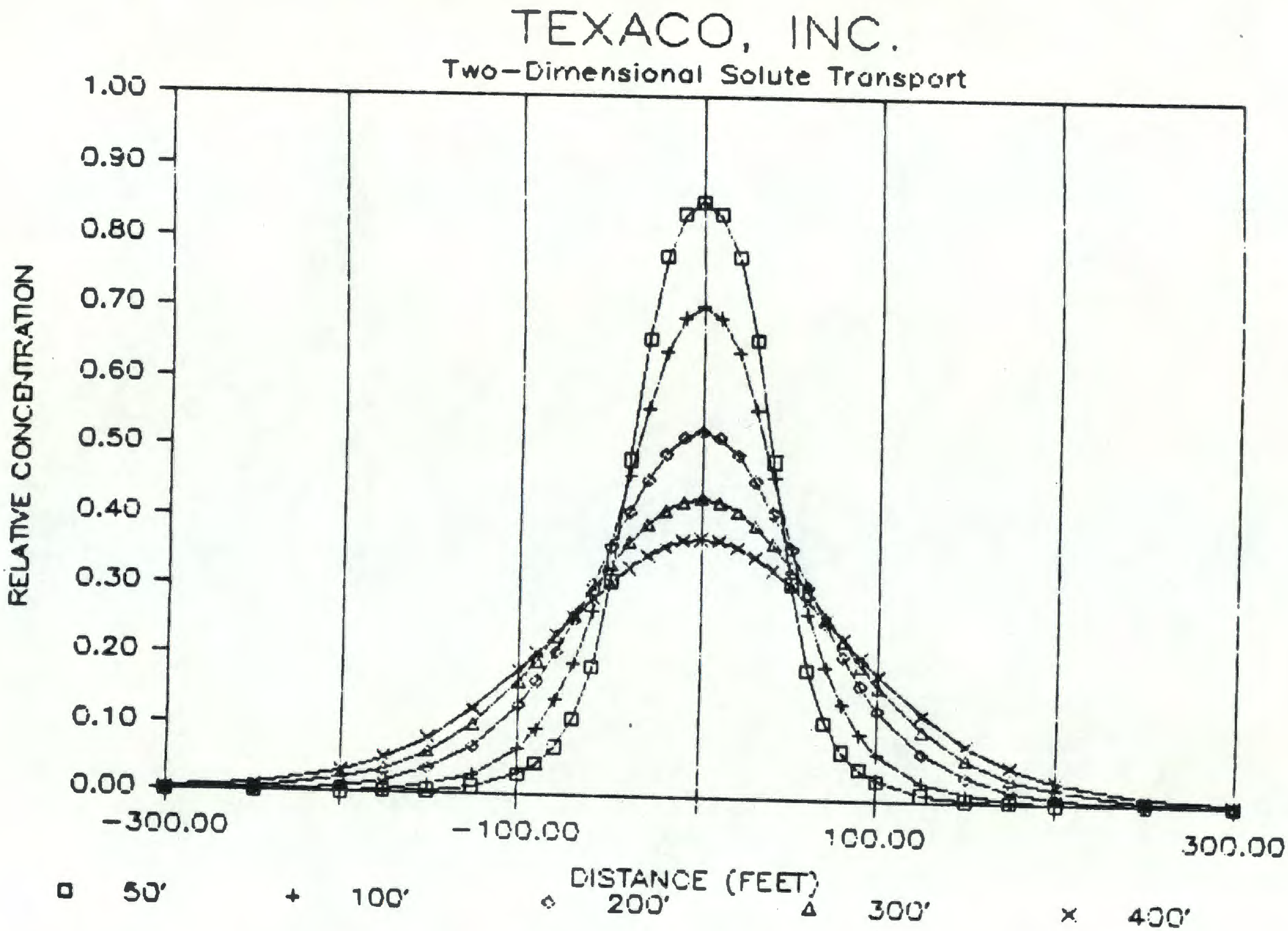


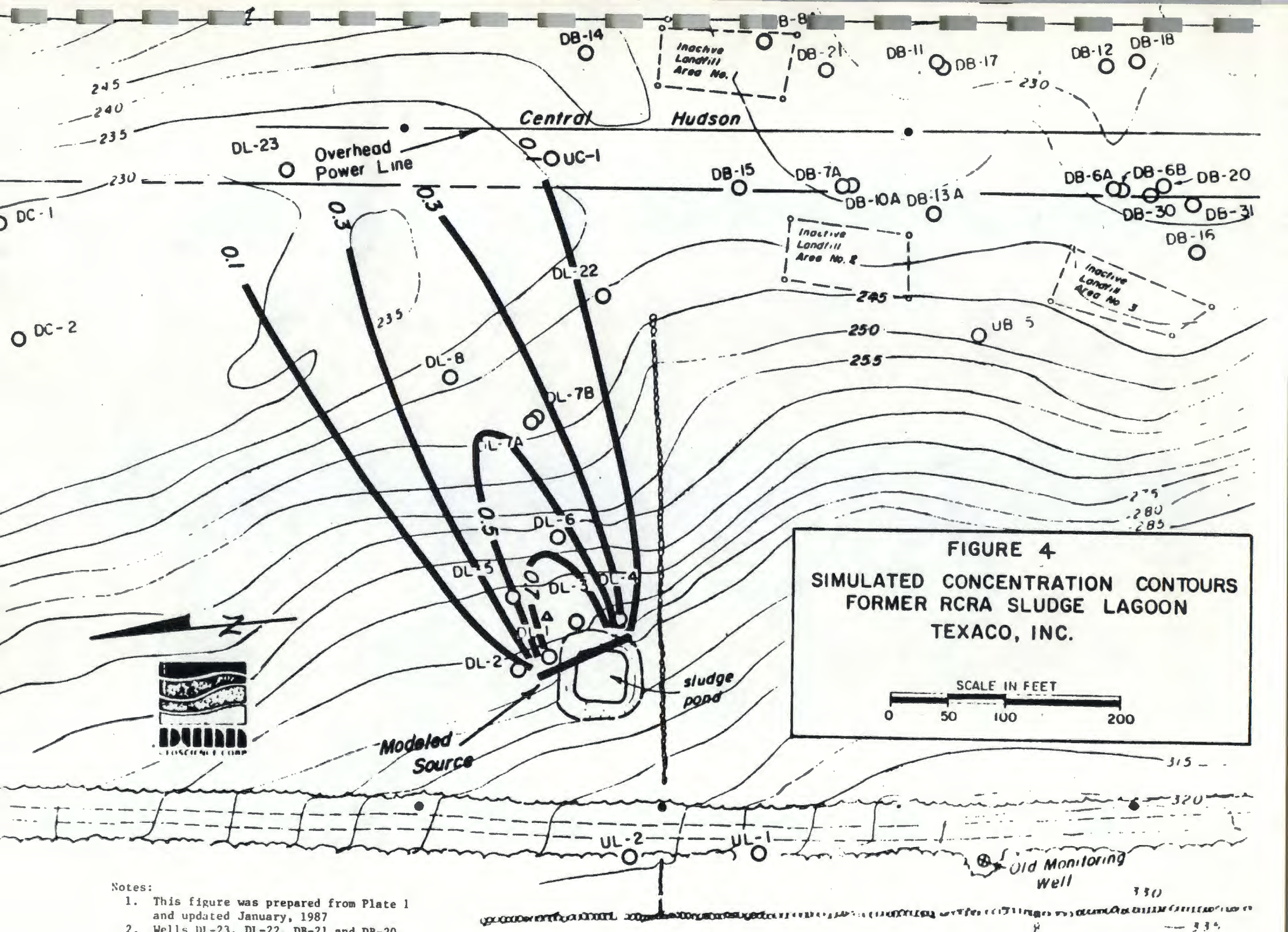

FIGURE 3: Cross-sectional profiles of relative concentration at various locations downgradient from the source (50 feet, 100 feet, 200 feet, 300 feet and 400 feet) after 1 year of transport. Transport parameters as follows: retardation = 1.0; decay = 0.0; pore water velocity = 1.98 feet/day; longitudinal dispersivity = 50 feet; transverse dispersivity = 10 feet; coefficient of molecular diffusion = 0.0; and source width = 80 feet.

achieved within 1 year for all distances under consideration; and, the "steady state" concentrations decrease with increasing distance from the source due to dispersion, both longitudinal and transverse.

Figure 3 illustrates concentration profiles across the centerline of the simulated plume at various locations downgradient from the source after 1 year of transport. A time of 1 year was selected because concentrations do not change significantly beyond this time for the distances of interest as illustrated by Figure 2. Figure 3 clearly illustrates that dispersion results in spreading out of the plume; with increasing distance from the source, the plume becomes broader and maximum concentrations decrease. If plume width is quantitatively defined by the 0.10 relative concentration boundaries, the width of the plume increases from approximately 140 feet at 50 feet from the source to 275 feet at 400 feet from the source. The simulated source itself is 80 feet in width.

The expected areal extent of the plume is shown on Figure 4, an isopleth map of the simulated plume. As illustrated, downgradient monitoring wells are located within the simulated plume with the exception of DL-22 which is located along the fringe. Monitoring well DL-22 has periodically shown organic contamination at relatively low levels.

The rapid transport rate, while leading to larger distances of transport, also leads to more rapid aquifer restoration. Several simulations were performed using a one-dimensional, analytical, solute transport model (Javandel et. al., 1984) which incorporates a discontinuous source. Results indicate that aquifer restoration is extremely rapid and should occur within a year for locations within 100 feet of the source,




Notes:

1. This figure was prepared from Plate 1 and updated January, 1987
2. Wells DL-23, DL-22, DB-21 and DB-20 were removed during August, 1985.

assuming the source has been completely removed. Monitoring well DL-3, located less than 50 feet downgradient from the source, has already shown marked concentration reductions since source remediation.

The following summarizes the most important findings of the analytical, solute transport modeling efforts:

1. Simulation of the plume immediately downgradient of the source (i.e., up to 400 feet) indicates that the existing monitoring wells (i.e., wells DL-1, DL-3, DL-4, DL-5, DL-6, DL-7A, DL-7B and DL-8) are adequately placed to monitor plume concentrations and effects of lagoon remediation given that the source has been removed.

2. The rapid groundwater flow and transport rates provide for rapid aquifer remediation via natural processes given that the source has been removed. Chemical concentrations in downgradient wells should show marked reductions in a relatively short time frame (i.e., less than one to two years) since the source has been remediated.

# APPENDIX E

Richard G Brinkman Texaco Inc

Commissioner
New York State Department of Environmental
Conservation
50 Wolf Road
Albany, New York 12233

Dear Sir or Madam:

I am the chief financial officer of Texaco Inc. with offices at 2000 Westchester Avenue, White Plains, New York 10650. This letter is in support of the use of the financial test to demonstrate financial responsibility for liability coverage and closure/or post-closure care as specified in Sections 373-2.8 and 373-3.8.

The owner or operator identified above is the owner or operator of the following facilities for which liability coverage is being demonstrated through the finacial test specified in Section 373-2.8 and 373-3.8:

NYD091894899
Texaco Research Center-Beacon
Old Glenham Road
Glenham, New York 12527

1. The owner or operator identified above operates the following facilities for which financial assurance for closure or post-closure care is demonstrated through the financial test specified in Sections 373-2.8 and 373-3.8. The current closure and/or post-closure cost estimates covered by the test are shown for each facility:

| | Closure | Post Closure |
|---|---|---|
| NYD091894899<br>Texaco Research Center-Beacon<br>Old Glenham Road<br>Glenham, New York 12527 | $ 87,344 | 0 |

2. The owner or operator identified above guarantees, through the corporate guarantee specified in Subpart H of 40 CFR Parts 264 and 265 or in states where EPA is not administering the financial requirements of Subpart H of Parts 264 and 265 through the use of a test equivalent or substantially equivalent to the financial test specified in Subpart H of Parts 264 and 265, the closure and post-closure care of the following facilities owned

or operated by subsidiaries of this firm. The current cost estimates for the closure or post-closure care so guaranteed are shown for each facility:

| | Closure | Post/Closure |
|---|---|---|
| WYD088677943<br>Casper Plant<br>P. O. Box 307<br>Evansville, Wyoming 82636 | 1,325,679 | 0 |
| WAD009276197<br>Puget Sound Plant<br>P. O. Box 622<br>Anacortes, Washington 98221 | 92,840 | 533,390 |
| TXD007378995<br>Amarillo Plant<br>315 S. Grand<br>Amarillo, Texas 79104 | $1,137,000 | $ 387,000 |
| TXD007399637<br>El Paso Plant<br>6500 Trowbridge<br>El Paso, Texas 79905 | 1,189,000 | 0 |
| TXD008097529<br>Port Arthur Plant<br>P. O. Box 712<br>Port Arthur, Texas 77640 | 1,769,700 | 1,177,482 |
| TXD980626022<br>Port Neches Plant<br>P. O. Box 787<br>Port Neches, Texas 77651 | 447,200 | 0 |
| TXD000820928<br>Port Arthur Chemical Plant<br>P. O. Box 712<br>Port Arthur, Texas 77640 | 3,000,000 | 0 |
| TXD00807653<br>Conroe Chemical Plant<br>P. O. Box 219<br>Jefferson Chemical Road<br>Conroe, Texas 77381 | 182,000 | 0 |
| TXD008076846<br>Neches Chemical Plant<br>Highway 366<br>At Hogaboom Road<br>Port Neches, Texas 77651 | 11,963 | 0 |

| | | |
|---|---|---|
| TXD041470980<br>Austin Research Laboratory<br>7114 North Lamar Blvd.<br>Austin, Texas 78752 | 161,940 | 0 |
| ILD042671248<br>Lawrenceville Plant<br>No. 1 Havoline Street<br>Lawrenceville, Illinois 62439 | 442,400 | 693,000 |
| ILD041518861<br>Lockport Plant<br>W. 2nd Street<br>Lockport, Illinois 60441 | 13,080,080 | 312,000 |
| LAD065485146<br>Louisiana Plant<br>P. O. Box 37<br>Convent, Louisiana 70723 | 655,720 | 82,420 |
| CAD000630830<br>Pacific Coast Pipe Lines'<br>Newhall Station<br>26187 Newhall Avenue<br>Newhall, California 91321 | 720 | 0 |
| CAB000631473<br>Pacific Coast Pipe Lines'<br>Fillmore Station<br>67 E. Telegraph Road<br>Fillmore, California 93015 | 9,840 | 0 |
| CAD099457087<br>Bakersfield Refinery<br>P. O. Box 1476<br>Bakersfield, California 93302 | 50,111 | 0 |
| CAD041520644<br>Los Angeles Plant<br>2101 E. Pacific Coast Highway<br>Wilmington, California 90744 | 552,000 | 0 |
| CAT000646331<br>Sulfur Recovery Plant<br>23208 S. Alameda Street<br>Carson, California 90744 | 288,000 | 0 |
| DED002329738<br>Delaware City Refinery<br>Delaware City, Delaware 19706 | 1,679,000 | 788,000 |

| | | |
|---|---|---|
| IND980271829 | 300,700 | 0 |

Texaco-Mount Vernon Terminal
West 2nd Street
Mount Vernon, Indiana 47620
(Mail) P. O. Box 311
Lawrenceville, Illinois 62439

The owner or operator is required to file a Form 10K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

The fiscal year of this owner or operator ends on December 31. The figures for the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed fiscal year, ended December 31, 1985 and represent the amounts as if Texaco Financial Services Inc. (a wholly owned finance subsidiary of Texaco Inc.) was consolidated with the firm's financial statements.

ALTERNATIVE I

| | | |
|---|---|---|
| 1. | Sum of current closure and post-closure cost estimates (total of all cost estimates shown in the paragraphs above) | $ 30,436,529 |
| 2. | Amount of aggregate liability coverage to be demonstrated | 3,000,000 |
| 3. | Sum of lines 1 and 2 | 33,436,529 |
| *4. | Total liabilities (if any portion of the closure or post-closure cost estimates is included in total liabilities, you may deduct that portion from this line and add that amount to lines 5 and 6) | $23,726,000,000 |
| *5. | Tangible net worth | $13,628,000,000 (Intangible assets are immaterial) |
| *6. | Net worth | $13,628,000,000 |
| *7. | Current assets | $10,674,000,000 |
| *8. | Current liabilities | $10,442,000,000 |
| 9. | Net working capital (line 7 minus line 8) | $ 232,000,000 |
| *10. | The sum of net income plus depreciation, depletion and amortization | $ 4,276,000,000 |

*11. Total assets in U.S. (required only if less than 90% of firms's assets are located in the U.S.) — $22,200,000,000 (U.S. petroleum, natural gas and petrochemical assets only)

| | YES | NO |
|---|---|---|
| 12. Is line 5 at least $10 million? | X | |
| 13. Is line 5 at least 6 times line 3? | X | |
| 14. Is line 9 at least 6 times line 3? | X | |
| *15. Are at least 90% of firms's assets located in the U.S.? If not, complete line 16. | | X |
| 16. Is line 11 at least 6 times line 3? | X | |
| 17. Is line 4 divided by line 6 less than 2.0? | X | |
| 18. Is line 10 divided by line 4 greater than 0.1? | X | |
| 19. Is line 7 divided by line 8 greater than 1.5? | | X |

ALTERNATIVE II

1. Sum of current closure and post-closure cost estimates (total of all cost estimates shown in the paragraphs above) ______
2. Amount of annual aggregate liability coverage to be demonstrated ______
3. Sum of lines 1 and 2 ______
4. Current bond rating of most recent issuance of this firm and name of rating service ______
5. Date of issuance of bond ______
6. Date of maturity of bond ______

*7. Tangible net worth (if any portion of the closure or post-closure cost estimates is included in "total liabilities" on your firm's financial statements you may add the amount of that portion to this line) ____________

*8. Total assets in U.S. (required only if less than 90% of firm's assets are located in the U.S.) ____________

| | YES | NO |
|---|---|---|
| 9. Is line 7 at least $10 million? | ____ | ____ |
| 10. Is line 7 at least 6 times line 3? | ____ | ____ |
| *11. Are at least 90% of firm's assets located in the U.S.? If not, complete line 12. | ____ | ____ |
| 12. Is line 8 at least 6 times line 3? | ____ | ____ |

I hereby certify that the wording of this letter is identical to the wording specified in paragraph 373-2.8(j)(9) (except that wording has been added to denote reference to both the federal and state RCRA regulations regarding the use of the corporate guarantee on page 1, article 2, and except for the explanation of the financial statements preceding the presentation of Alternative I) as such regulations were constituted on the date shown immediately below.

R. G. Brinkman
R. G. BRINKMAN
Senior Vice President
Texaco Inc.
March 28, 1986

Richard G Brinkman Texaco Inc

Regional Administrator, Region II
United States Environmental Protection Agency
26 Federal Plaza
New York, New York 10007

Regional Administrator, Region VIII
United States Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Texas Department of Water Resources
Solid Waste Branch
P. O. Box 13087
Capital Station
Austin, Texas 78711

California Department of Health Services
Hazardous Waste Management Branch
714 P Street
Sacramento, California 95814

Indiana State Board of Health
Division of Land Pollution Control
1330 West Michigan Street
P. O. Box 1964
Indianapolis, Indiana 46206

Dear Sir or Madam:

I am the chief financial officer of Texaco Inc. with offices at 2000 Westchester Avenue, White Plains, New York 10650. This letter is in support of the use of the financial test to demonstrate financial responsibility for liability coverage and closure and/or post-closure care as specified in Subpart H of 40 CFR Parts 264 and 265.

The owner or operator identified above is the owner or operator of the following facilities for which liability coverage is being demonstrated through the financial test specified in Subpart H of 40 CFR 264 and 265:

NY0091894899
Texaco Research Center-Beacon
Old Glenham Road
Glenham, New York 12527

1. The owner or operator identified above owns or operates the following facilities for which financial assurance for closure or post-closure care is demonstrated through the financial test specified in Subpart H of 40 CFR Parts 264 and 265. The current closure and/or post-closure cost estimates covered by the test are shown for each facility:

| | Closure | Post Closure |
|---|---|---|
| NYD091894899<br>Texaco Research Center-Beacon<br>Old Glenham Road<br>Glenham, New York 12527 | $ 87,344 | 0 |

2. The owner or operator identified above guarantees, through the corporate guarantee specified in Subpart H of 40 CFR Parts 264 and 265, the closure and post-closure care of the following facilities owned or operated by its subsidiaries. The current cost estimates for the closure or post-closure care so guaranteed are shown for each facility:

| | | |
|---|---|---|
| WYD088677943<br>Casper Plant<br>P. O. Box 307<br>Evansville, Wyoming 82636 | 1,325,679 | 0 |

[Facilities in number 3 below are guaranteed pursuant to applicable state regulations.]

3. In States where EPA is not administering the financial requirements of Subpart H of 40 CFR Parts 264 and 265, this owner or operator is demonstrating financial assurance for the closure or post-closure care of the following facilities through the use of a test equivalent or substantially equivalent to the financial test specified in Subpart H of 40 CFR Parts 264 and 265. The current closure and/or post-closure cost estimates covered by such a test are shown for each facility:

| | Closure | Post/Closure |
|---|---|---|
| WAD009276197<br>Puget Sound Plant<br>P. O. Box 622<br>Anacortes, Washington 98221 | 92,840 | 533,390 |
| TXD007378995<br>Amarillo Plant<br>315 S. Grand<br>Amarillo, Texas 79104 | $1,137,000 | $ 387,000 |

| | | |
|---|---|---|
| TXD007399637<br>El Paso Plant<br>6500 Trowbridge<br>El Paso, Texas 79905 | 1,189,000 | 0 |
| TXD008097529<br>Port Arthur Plant<br>P. O. Box 712<br>Port Arthur, Texas 77640 | 1,769,700 | 1,177,482 |
| TXD980626022<br>Port Neches Plant<br>P. O. Box 787<br>Port Neches, Texas 77651 | 447,200 | 0 |
| TXD000820928<br>Port Arthur Chemical Plant<br>P. O. Box 712<br>Port Arthur, Texas 77640 | 3,000,000 | 0 |
| TXD00807653<br>Conroe Chemical Plant<br>P. O. Box 219<br>Jefferson Chemical Road<br>Conroe, Texas 77381 | 182,000 | 0 |
| TXD008076846<br>Neches Chemical Plant<br>Highway 366<br>At Hogaboom Road<br>Port Neches, Texas 77651 | 11,963 | 0 |
| TXD041470980<br>Austin Research Laboratory<br>7114 North Lamar Blvd.<br>Austin, Texas 78752 | 161,940 | 0 |
| ILD042671248<br>Lawrenceville Plant<br>No. 1 Havoline Street<br>Lawrenceville, Illinois 62439 | 442,400 | 693,000 |
| ILD041518861<br>Lockport Plant<br>W. 2nd Street<br>Lockport, Illinois 60441 | 13,080,080 | 312,000 |
| LAD065485146<br>Louisiana Plant<br>P. O. Box 37<br>Convent, Louisiana 70723 | 655,720 | 82,420 |

| | | |
|---|---|---|
| 14. Is line 9 at least 6 times line 3? | X | |
| *15. Are at least 90% of assets located in the U.S.? If not, complete line 16. | | X |
| 16. Is line 11 at least 6 times line 3? | X | |
| 17. Is line 4 divided by line 6 less than 2.0? | X | |
| 18. Is line 10 divided by line 4 greater than 0.1? | X | |
| 19. Is line 7 divided by line 8 greater than 1.5? | | X |

I hereby certify that the wording of this letter is identical (except for the explanation of the financial statements preceding the presentation of Alternative I) to the wording specified in 40 CFR 264.151(g) as such regulations were constituted on the date shown immediately below.

R. G. BRINKMAN
Senior Vice President
Texaco Inc.
March 28, 1986

The fiscal year of this owner or operator ends on December 31. The figures for the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed fiscal year, ended December 31, 1985 and represent the amounts as if Texaco Financial Services Inc. (a wholly owned subsidiary of Texaco Inc.) was consolidated with the firm's financial statements.

ALTERNATIVE I

| | | |
|---|---|---|
| 1. | Sum of current closure and post-closure cost estimates (total of all cost estimates listed above) | $ 30,436,529 |
| 2. | Amount of annual aggregate liability coverage to be demonstrated | 3,000,000 |
| 3. | Sum of lines 1 and 2. | 33,436,529 |
| *4. | Total liabilities (if any portion of your closure or post-closure cost estimates is included in your total liabilities, you may deduct that portion from this line and add that amount to lines 3 and 4) | $23,726,000,000 |
| *5. | Tangible net worth | $13,628,000,000 (Intangible assets are immaterial) |
| *6. | Net worth | $13,628,000,000 |
| *7. | Current assets | $10,674,000,000 |
| *8. | Current liabilities | $10,442,000,000 |
| 9. | Net working capital (line 7 minus line 8) | $ 232,000,000 |
| *10. | The sum of net income plus depreciation, depletion and amortization | $ 4,276,000,000 |
| *11. | Total assets in U.S. (required only if less than 90% of assets are located in the U.S.) | $22,200,000,000 (U.S. petroleum, natural gas and petrochemical assets only) |

| | | YES | NO |
|---|---|---|---|
| 12. | Is line 5 at least $10 million? | X | |
| 13. | Is line 5 at least 6 times line 3? | X | |

| | | |
|---|---|---|
| CAD000630830<br>Pacific Coast Pipe Lines'<br>Newhall Station<br>26187 Newhall Avenue<br>Newhall, California 91321 | 720 | 0 |
| CAB000631473<br>Pacific Coast Pipe Lines'<br>Fillmore Station<br>67 E. Telegraph Road<br>Fillmore, California 93015 | 9,840 | 0 |
| CAD099457087<br>Bakersfield Refinery<br>P. O. Box 1476<br>Bakersfield, California 93302 | 50,111 | 0 |
| CAD041520644<br>Los Angeles Plant<br>2101 E. Pacific Coast Highway<br>Wilmington, California 90744 | 552,000 | 0 |
| CAT000646331<br>Sulfur Recovery Plant<br>23208 S. Alameda Street<br>Carson, California 90744 | 288,000 | 0 |
| DED002329738<br>Delaware City Refinery<br>Delaware City, Delaware 19706 | 1,679,000 | 788,000 |
| IND980271829<br>Texaco-Mount Vernon Terminal<br>West 2nd Street<br>Mount Vernon, Indiana 47620<br>(Mail) P. O. Box 311<br>Lawrenceville, Illinois 62439 | 300,700 | 0 |

4. The owner or operator identified above owns or operates the following hazardous waste management facilities for which financial assurance for closure or, if a disposal facility, post-closure care, is not demonstrated either to EPA or a State through the financial test or any other financial assurance mechanism specified in Subpart H of 40 CFR Parts 264 and 265 or equivalent or substantially equivalent State mechanisms. The current closure and/or post-closure cost estimates not covered by such financial assurance are shown for each facility:

NOT APPLICABLE

This owner or operator is required to file a Form 10K with the Securities and Exchange Commission (SEC) for the latest fiscal year.