



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6  
1445 ROSS AVENUE, SUITE 1200  
DALLAS, TEXAS 75202-2733

*AD FRK/you*

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MAY 14 1990  
EID DIRECTOR'S OFFICE

MAY 04 1990

MAY 15 1990

Mr. Richard Mitzelfelt  
Director  
Environmental Improvement Division  
New Mexico Health and Environment Department  
P.O. Box 968  
Santa Fe, New Mexico 87504-0968

Dear Mr. Mitzelfelt:

Enclosed is a copy of the Consent Decree recently executed between the Environmental Protection Agency (EPA) and Transwestern Pipeline Company (Transwestern). This decree covers four compressor stations in New Mexico which have been contaminated with PCBs and was negotiated under the authority of the Toxic Substances Control Act.

Also enclosed are reports of sample analyses from the pit areas at the four compressor stations: Corona, Mountaineer, Laguna, and Thoreau. The samples were collected by Condor Geotechnical Services, Inc. Transwestern intends to excavate the contaminated soils (to levels specified in the Consent Decree) and dispose of this material at a landfill operated by USPCI, Inc.

This information is provided for your review and any action which you feel is necessary under the State's authorized RCRA program.

If you have any questions, please call me, or your staff may call Court Fesmire at (214) 655-2192.

Sincerely yours,

*Allyn M. Davis*

Allyn M. Davis  
Director  
Hazardous Waste Management Division (6H)

Enclosures

UNITED STATES DISTRICT COURT  
DISTRICT OF NEW MEXICO

UNITED STATES OF AMERICA,

Plaintiff,

v.

TRANSWESTERN PIPELINE COMPANY,

Defendant.

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Civil Action No.

CONSENT DECREE

# CONSENT DECREE

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IN THE UNITED STATES DISTRICT COURT  
FOR THE DISTRICT OF NEW MEXICO

UNITED STATES OF AMERICA  
PLAINTIFF

vs.

TRANSWESTERN PIPELINE COMPANY  
DEFENDANT

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CONSENT DECREE

This Consent Decree is made and entered into by the United States of America ("the United States"), on behalf of the United States Environmental Protection Agency ("EPA"), and Transwestern Pipeline Company ("Transwestern").

WHEREAS, the United States, on behalf of the Administrator of EPA, has filed a Complaint in this Court against Transwestern Pipeline Company pursuant to the Toxic Substances Control Act ("TSCA"), 15 U.S.C. §§2601 et seq., alleging, inter alia, that polychlorinated biphenyls ("PCBs") have been stored, or are being stored, disposed of, or released into the environment at sites currently operated by Transwestern; and

WHEREAS, the objectives of the Parties are to provide for the protection of human health and the environment through the expeditious implementation of remedial actions set forth in this Consent Decree in accordance with the schedule agreed to by the Parties and to settle and compromise the civil claims of the United States in order to further the public interest by avoiding prolonged and complicated litigation; and

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WHEREAS, the Parties recognize that the states are not parties to this Consent Decree and have such rights as may be available under applicable law; and

WHEREAS, in consideration of and in exchange for the covenants contained herein, the parties have agreed to the entry of this Consent Decree; and

WHEREAS, the Parties agree to be bound by the terms and provisions of this Consent Decree;

NOW, THEREFORE, without adjudication of any issue of fact or law, it is ORDERED, ADJUDGED and DECREED as follows:

#### I. JURISDICTION

This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §1331 and §1345, and Section 17 of TSCA, 15 U.S.C. §2616, and over the Parties consenting hereto. The Complaint states a claim upon which relief could be granted. Venue is proper in this judicial district.

#### II. PARTIES-BOUND

This Consent Decree shall apply to, and be binding upon Transwestern, its officers, agents, employees, subsidiaries, successors and assigns, and upon the United States. Transwestern shall provide a copy of this Consent Decree to each contractor, laboratory or consultant retained to perform the work contemplated by this Consent Decree, and shall condition any contract for performance of work on compliance with the applicable terms and provisions of this Consent Decree. Any contractor retained by Transwestern shall be instructed by Transwestern to provide a copy hereof to any subcontractor retained to perform the work required by this Consent Decree.

### III. DEFINITIONS

The following definitions shall apply for purposes of this Consent Decree:

1. "Appendix" or "appendices" means those attachments listed below, which are incorporated herein and made a part of this Consent Decree by reference:

Appendix A - Implementation Plan for Transwestern Sites  
and Off-Site Locations

Appendix B - Scope of Work for Oversight Contractor

Appendix C - PCB Sampling Techniques and Analytical Methods for  
Site Characterization and Cleanup Verification

Appendix D - Site Descriptions

2. "Cleanup" or "work" includes all sampling, analyses, characterization, investigation, remedial activities and related tasks, conducted pursuant to this Consent Decree, as outlined in Appendix A.

3. "Consent Decree" means this Consent Decree, all appendices to this Consent Decree and all modifications agreed to by the Parties in writing or ordered by this Court. For convenience, all references to the Consent Decree in any Appendices hereto shall be understood to refer to this document.

4. "Off-site location" means any property that is not a Transwestern site but is the location of characterization and remediation activities.

5. "Parties" means the United States and Transwestern.

6. "PCBs" or "polychlorinated biphenyls" means any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees, or any combination of substances which contains such substances.

7. "Pit" means any backfilled or open earthen excavation which, during the normal operation of Transwestern's natural gas pipeline and compressor station sites, received pipeline liquids or compressor lubricating oil, either of which contained PCBs.

8. "Project Contact" and "Site Contact" are those persons or firms designated in accordance with the procedures set forth in Section X hereof.

9. "Transwestern sites" or the "sites" means those parcels of land owned or leased by Transwestern in New Mexico, including but not limited to compressor stations, pig receiver stations, blowdown and relief valves, maintenance facilities, and any other sources of PCB releases on or adjacent to the Transwestern pipeline beginning at Compressor Station Number 8 at or near Corona, New Mexico, and continuing westward (downstream) therefrom to the western border of New Mexico.

10. All time periods are based on calendar days. Should any deadline fall on a day that is not a working day, the deadline shall be continued to the next working day for all purposes of this Consent Decree.

11. All other terms, not otherwise defined herein, shall have their ordinary meaning unless defined in 15 U.S.C. §§2601 et seq., or 40 C.F.R. Part 761 et. seq.

#### IV. PENALTY

Within thirty (30) calendar days of the effective date of this Consent Decree, Transwestern shall pay a civil penalty to the United States in the amount of \$375,000. The penalty shall be paid by certified check, payable to the "Treasurer of the United States" and shall be submitted to the Office of the United States Attorney, District of New Mexico at:

500 Gold S.W.  
Rm. 12002  
Albuquerque, New Mexico 87102

Transwestern shall send notice of payment, including a copy of the check and transmittal letter, to the EPA Project Contact. Stipulated

penalties may be assessed under Section XIV.A.1 in the event that payment is not submitted as specified above.

#### V. IMPLEMENTATION OF WORK

A. Transwestern shall perform all work in compliance with all Consent Decree requirements as set forth in the approved Work Plan. Transwestern may retain one or more contractors to perform any of its obligations under this Consent Decree, but notwithstanding the retention of any contractor, Transwestern shall remain responsible for compliance with all Consent Decree requirements.

B. In the event of a discrepancy between the terms of an Appendix and this Consent Decree with respect to a technical issue concerning work to be performed pursuant to this Consent Decree, the more specific terms of the Appendix shall control.

#### VI. SCHEDULES

A. Transwestern shall initiate and complete all work in accordance with the schedules in this Consent Decree.

B. Except for groundwater monitoring at the Transwestern sites, Transwestern shall complete all work and shall certify completion of work at all of the sites and any adjacent off-site locations within eighteen (18) months after Transwestern commences remediation under this Consent Decree, subject to any extensions of time that are agreed to by the Parties or provided for herein. Stipulated penalties may be assessed under Section XIV.A.1 in the event that Transwestern fails to meet this deadline, as such deadline may be revised under this Consent Decree, including, without limitation, for Force Majeure.

## VII. REPORTING REQUIREMENTS

### A. Data Reports

1. Transwestern shall submit reports of data collected pursuant to this Consent Decree in accordance with the requirements and schedules provided in Appendix A.

2. Within thirty (30) days of receipt of a data report EPA shall notify the Transwestern Project Contact in writing of any deficiencies in the report. Within fifteen (15) days of receipt of such notice, Transwestern shall submit a revised data report addressing each deficiency.

3. If EPA fails to notify Transwestern of deficiencies in a data report within thirty (30) days of its receipt of a data report, or within fifteen (15) days of receipt of a revised data report, the report shall be deemed satisfactory.

### B. Quarterly Progress Reports

Transwestern shall provide written quarterly progress reports to EPA within 30 days of the end of the quarter as provided below for any work under the Consent Decree not yet certified by Transwestern as complete. The quarters to be reported shall be January 1 to March 31, April 1 to June 30, July 1 to September 30, and October 1 to December 31. At a minimum, progress reports (1) shall identify and describe the actions which Transwestern has taken pursuant to this Consent Decree during the subject quarter and the actions that it proposes to undertake during the following quarter; and (2) shall identify any event, including Force Majeure events, that Transwestern knows or reasonably should know will delay the completion of any future work and shall describe the efforts made and to be made to minimize the delay.

C. Work Plans

Transwestern shall submit proposed work plans to the EPA Project Contact for review in accordance with the requirements and schedules set forth in Appendix A.

VIII. OVERSIGHT CONTRACTOR

A. Transwestern shall employ an Oversight Contractor pursuant to procedures set forth in paragraph B below to observe and review the work performed under this Consent Decree. The Oversight Contractor shall not be employed by Transwestern to perform any sampling, characterization, or remediation tasks for Transwestern other than those specified in the Oversight Contract during the period of this Consent Decree without the approval of EPA or of this Court. EPA shall not be a party to the Oversight Contract.

B. Transwestern shall have ten calendar days from entry of this Consent Decree to select a qualified Oversight Contractor from the list of candidates identified by Transwestern. Transwestern shall immediately notify EPA of its selection. The proposed contract shall provide for the services specified in Appendix B, Scope of Work for Oversight Contractor. Within 14 days, EPA shall either approve the proposed contract or submit to Transwestern a statement of its objections. Upon approval of the proposed contract by EPA, Transwestern and the Oversight Contractor shall execute the contract (the "Oversight Contract"). Transwestern shall provide a copy of the executed Oversight Contract to EPA.

C. The Oversight Contract shall be executed 30 days prior to the inception of remedial activities at any and all Transwestern sites.

D. Transwestern shall be obligated for payment of the Oversight Contractor in accordance with the terms of the Contract.

E. The Oversight Contractor shall have no authority to control, direct, perform, modify, or suspend work being performed under the Consent Decree.

F. As specified in Appendix B, the Oversight Contractor shall review, observe, and report to EPA with respect to work performed under the Consent Decree, including sampling, chemical analysis of samples, and implementation of remediation measures. The Oversight Contractor shall confirm, observe and report to EPA that Transwestern follows the QA/QC procedures specified in the work plan under the Consent Decree, but is only authorized to collect and analyze split samples of up to 10% of field samples and 25% of certified composite verification samples taken by Transwestern.

G. The Oversight Contractor may make recommendations to EPA as to any further data or information that is needed to certify that a site is fully characterized or remediated.

H. By agreement of the Parties, the Oversight Contractor may be replaced at any time. Transwestern may terminate the employment of the Oversight Contractor with the approval of this Court. EPA may request the Court to terminate the contract. In the event that the Oversight Contractor's employment is terminated, the Parties agree to negotiate in good faith to arrange expeditiously for a replacement Oversight Contractor and to extend or modify the schedule accordingly. All work shall halt for a reasonable period of time until a replacement contractor is employed.

#### IX. DESIGNATED CONTACTS

A. EPA and Transwestern shall each designate a Project Contact and an

Alternate to monitor the progress of the work to be performed pursuant to the Consent Decree. The Alternate Project Contact shall act on behalf of the Project Contact in the event of the Project Contact's unavailability.

B. The EPA Project Contact, or his Alternate, shall have the authority on behalf of the United States to notify Transwestern of non-compliance with Consent Decree requirements and to notify Transwestern whether EPA believes that data reports, progress reports, work plans or other submittals comply with Consent Decree requirements or are deficient. The EPA Project Contact, or his Alternate, shall also have the authority on behalf of the United States to notify Transwestern of any required cessation of the performance of any work or activity at any site or off-site location that may present an imminent and unreasonable risk of serious or widespread injury or an imminent and substantial endangerment to health or the environment.

C. In the event the EPA Project Contact suspends any work or other activity due to an imminent and unreasonable risk of serious or widespread injury, or an imminent and substantial endangerment to health or the environment, the Parties agree to extend or modify the affected schedules under the Work Plan, to provide additional time to complete the work affected by such suspension. Transwestern shall not be subject to stipulated penalties for delay attributable to the suspension of work required by the EPA Project Contact pursuant to this Section unless the unreasonable risk or imminent and substantial endangerment was caused by an act or omission of Transwestern. Any order by the EPA Project Contact to suspend work and the reasons therefor shall be communicated immediately to the Transwestern Site Contact, and in writing to the Transwestern Project Contact within a reasonable time thereafter not to exceed fourteen (14) calendar days.

D. At least five (5) calendar days before the initiation of the earliest work conducted at a site or off-site location pursuant to this Consent Decree, Transwestern shall designate a Site Contact and an Alternate to monitor the progress of the work to be performed at such site or off-site location. Within fourteen (14) calendar days of the date that Transwestern executes the Oversight Contract, the EPA Project Contact will designate a Site Contact and an Alternate for each site or off-site location. EPA may designate the Oversight Contractor as the Site Contact. The EPA Site Contact shall monitor the progress of work to be performed at sites or off-site locations and shall coordinate communication between EPA and Transwestern. The EPA Site Contact shall not have authority to control, direct, perform, modify or suspend work at any site or off-site location.

E. Each Project Contact, Site Contact and their Alternates, shall be identified by name, title, address and telephone number. EPA and Transwestern have the right to change their respective Project Contacts and Site Contacts.

F. Transwestern shall provide site orientation for each EPA Site Contact.

G. The EPA Site Contact shall use best efforts to consult in a timely manner with the appropriate Transwestern Site Contact regarding possible non-compliance with Consent Decree requirements.

H. The EPA Site Contact, and all other EPA representatives shall comply with all reasonable requests and instructions made by Transwestern personnel or its contractors which relate to the safety of persons conducting work at the sites and/or natural gas transmission operations at the sites.

I. Transwestern may perform work at any site or off-site location without regard to the presence or absence of the EPA Site Contact or Alternate, provided

that Transwestern gives the EPA Site Contact reasonable written or telephone notice of departures from the schedules contained in work plans and quarterly progress reports.

#### X. SITE ACCESS

A. During the effective period of this Consent Decree EPA representatives and the Oversight Contractor shall have access during normal business hours and, upon reasonable notice to the Transwestern Site Contact, at reasonable non-business hours, to any Transwestern site and off-site location which is owned by Transwestern or to which Transwestern has obtained rights of access, and where characterization or remediation has been, is being, or will be conducted pursuant to this Consent Decree. Such access may be for the purpose of monitoring activities at the sites and off-site locations, verifying data submitted to EPA, conducting investigations, inspecting and copying records, logs or other documents which are not subject to a legally applicable privilege, or for any other purpose related to this Consent Decree. EPA representatives shall notify the Transwestern Site Contact, or other appropriate official if such Site Contact is unavailable, upon arrival at the site. Transwestern shall not object to EPA obtaining access to any property adjacent to Transwestern's sites.

B. To the extent that rights of access to any property not owned or controlled by Transwestern is required for the proper and complete performance of work, Transwestern shall make all reasonable efforts to obtain access rights from the owners of such property, and from any other necessary parties. Such access rights shall include reasonable access for Transwestern and its contractors and for EPA representatives and the Oversight Contractor. If Transwestern is unable to obtain access to property, it shall promptly notify the EPA Project Contact of the

lack of such access and the efforts made to obtain it. In such event, Transwestern may request that EPA assist Transwestern in obtaining necessary access.

C. Nothing herein shall limit or otherwise affect rights of entry available to the United States pursuant to any applicable statute, regulation or permit.

D. EPA representatives shall comply with all reasonable health and safety plans published by Transwestern and used by site personnel for the purposes of protecting property and the safety of site personnel, of which EPA has received prior reasonable notice from Transwestern.

#### XI. QUALITY ASSURANCE AND QUALITY CONTROL

A. Transwestern shall perform all sample collection and analyses required by this Consent Decree in accordance with the requirements of Appendices A and C.

B. In any contract with a laboratory for analysis conducted pursuant to this Consent Decree, Transwestern shall use its best efforts to insert a provision that permits EPA representatives access during normal business hours to the laboratory premises where analysis or testing is being done, for the purpose of interviewing laboratory personnel and examining records, equipment, procedures and other items necessary to audit the laboratory's performance and assure that its analyses and procedures are in compliance with the requirements of this Consent Decree.

C. Transwestern shall allow the Oversight Contractor to take splits of up to 10% of the field samples and 25% of certified composite verification samples taken by Transwestern pursuant to this Consent Decree. Transwestern agrees to provide at least twenty-four (24) hours notice to the EPA Project Contact prior

to the initiation of the sampling pursuant to the Work Plan or the re-initiation of sampling after an unscheduled suspension. The notice requirement may be waived or the time reduced by mutual consent of the parties' Site Contacts. At least sixty (60) calendar days before disposing of any sample, each Party shall notify the other Party's Site Contact and allow him the opportunity to take possession of such sample.

#### XII. ALTERNATE TECHNOLOGIES

A. Not later than 10 days after the effective date of this Consent Decree, Transwestern may submit in writing for EPA's review a proposal for alternate remediation technologies for the destruction, disposal, fixation in place or other remediation of PCBs at Transwestern sites which differ from the removal and off-site disposal of PCB contaminated soil required by this Consent Decree.

B. Transwestern's proposal shall address, but may not be limited to, (1) current availability of the proposed technology, (2) that use of such technology will not delay the cleanup completion deadlines established by this Consent Decree, (3) that such technology meets the requirements of all applicable EPA regulations and guidelines. EPA's consideration of the Transwestern proposal shall be in accordance with 40 CFR § 761.60(e).

#### XIII. RECORD PRESERVATION

A. For five (5) years after certification by EPA of the completion of the work required under this Consent Decree, Transwestern shall collect and maintain all records, documents, and information of whatever kind relating to the performance of the work conducted pursuant to this Consent

Decree at the Transwestern sites and off-site locations, including but not limited to: sample analyses; chain of custody records; manifests; contracts; trucking logs; bills of lading; receipts; records pertaining to traffic routing destination of PCBs; volume; correspondence; and other documents generated during the work. Prior to the destruction, Transwestern shall give EPA sixty (60) days advance notice of destruction and the opportunity to obtain copies of all such records.

B. Nothing herein shall require the disclosure of information subject to a legally applicable privilege or protected under the Freedom of Information Act or other applicable law. Nothing herein shall be construed to limit or otherwise affect either Party's right to gather information pursuant to any applicable statute.

#### XIV. STIPULATED PENALTIES

##### A. Penalty Amounts

1. Except with respect to any extensions agreed to by the Parties in writing, ordered by the Court or otherwise allowed by this Consent Decree, and except for a delay from events which constitute force majeure, Transwestern shall pay the following stipulated penalties:

<u>Period of Failure to Comply</u>	<u>Penalty Per Violation Per Day</u>
1st through 30th day	\$1,000
31st day and beyond	\$2,500

- a. For failure to pay the penalty within the period specified in Section IV;
- b. For failure to meet the deadlines specified in Section VI.B.; or
- c. For failure to notify EPA in the event of an imminent and unreasonable risk or an imminent and substantial endangerment in accordance with Section XVI.D.

2. Except with respect to any stipulated extensions agreed to by the Parties in writing, ordered by the Court, or otherwise allowed by this

Consent Decree, and except for delay from events which constitute force majeure, Transwestern shall pay the following stipulated penalties:

<u>Period of Failure to Comply</u>	<u>Penalty Per Violation Per Day</u>
1st through 30th day	\$ 500.00
31st day and beyond	\$1,000.00

- a. For failure to submit data reports in accordance with Section VII.A; or
- b. For failure to submit quarterly progress reports in accordance with Section VII.B.

3. Notwithstanding Subparagraphs A(1) and A(2) of this Section, deadlines contained in plans, reports, or this Consent Decree, other than deadlines for which stipulated penalties are expressly provided in Subparagraphs A(1) and A(2), shall be for information, program tracking and planning purposes only and Transwestern shall not be liable for stipulated penalties for its failure to meet any such deadline.

B. Stipulated penalties shall be paid by certified check, payable to the "Treasurer of the United States" and shall be submitted to the Office of the United States Attorney, District of New Mexico at:

500 Gold S.W.  
Room 12002  
Albuquerque  
New Mexico, 87102

Transwestern shall send notice of payment, including copies of the check and the transmittal letter, together with a brief description of the non-compliance, to the EPA Project Contact.

C. The stipulated penalties set forth above shall represent the sole remedy or sanction available to EPA by reason of Transwestern's failure to comply with the requirements of this Consent Decree, except that EPA may seek additional remedies or sanctions pursuant to this Court's contempt powers. The

Payment of stipulated penalties shall not relieve Transwestern of responsibility for full compliance with the requirements of this Consent Decree.

D. For purposes of determining whether a deadline has been met under this Section, and notwithstanding any other provision of this Consent Decree, a payment, report, or any other item required to be submitted to EPA by this Consent Decree shall be deemed submitted when it is postmarked, return receipt requested, or accepted for delivery by a commercial delivery service, or hand-delivered.

E. Stipulated penalties relating to requirements of this Consent Decree shall accrue from the first day of noncompliance. The stipulated penalties shall continue to accrue until the violation is corrected. Payment of all accrued penalties shall be made within thirty (30) calendar days of receipt of notice from EPA that stipulated penalties are being assessed following the last day of the month in which the penalty was incurred or in which notice was received, and if applicable, every thirty (30) calendar days thereafter. Nothing herein shall preclude the simultaneous accrual of separate penalties for separate violations of this Consent Decree.

#### XV. DISPUTE RESOLUTION

A. The dispute resolution procedure provided by this Section shall be available to resolve all disputes arising under this Consent Decree.

B. If the parties are unable to resolve a dispute arising under this Consent Decree, Transwestern shall implement EPA's decision unless Transwestern invokes the dispute resolution provisions of this Section XV. Dispute resolution shall be invoked by submitting written notice to the EPA Project Contact that dispute resolution is being invoked. The notice shall describe the nature of the dispute, and Transwestern's position with regard to such dispute. EPA shall acknowledge receipt of the notice and the Parties shall expeditiously schedule a meeting to

discuss the dispute informally in accordance with Paragraph C of this Section not later than seven (7) days after EPA receives the notice.

C. Disputes submitted to dispute resolution shall, in the first instance, be the subject of informal negotiation between the Parties. Such period of informal negotiation shall not extend beyond ten (10) calendar days from the date of first meeting between the EPA Project Contact or his representative and representatives of Transwestern, unless the Parties' representatives agree to extend this period.

D. In the event that the Parties are unable to reach agreement during the informal negotiation period, EPA shall provide Transwestern with a written summary of its position regarding the dispute within fifteen (15) calendar days after the end of the informal negotiation period. Transwestern shall implement EPA's decision unless within thirty (30) calendar days of Transwestern's receipt of the written summary of EPA's position, Transwestern files a motion to resolve such dispute with this Court. The United States shall have thirty (30) days to respond to Transwestern's motion. Each party shall bear its own costs of preparing and presenting its position in court.

E. In any dispute in which Transwestern prevails, affected schedules for completion of work under this Consent Decree shall be modified or extended to account for the delay in the work that occurred as a result of dispute resolution. Payment, but not accrual, of stipulated penalties with respect to a disputed issue shall be stayed pending resolution of the dispute. In the event Transwestern prevails in a dispute to which stipulated penalties attach, any stipulated penalties that would have accrued shall be discharged.

## XVI. FORCE MAJEURE

A. "Force Majeure" for purposes of this Consent Decree is defined as any event arising from causes beyond the reasonable control of Transwestern that delays or prevents the performance of any obligation under this Consent Decree despite the exercise of due diligence on the part of Transwestern. Force majeure shall not include increased costs or expenses of any of the work to be performed under this Consent Decree, nor the financial inability of Transwestern to perform such work nor delays attributable to approval or use of alternate disposal technology.

B. When Transwestern becomes aware of any circumstance that it knows, or reasonably should know, will delay or prevent the completion of any portion of the work to be performed pursuant to this Consent Decree, whether or not due to a force majeure event, Transwestern shall notify EPA in writing no later than fourteen (14) calendar days from the time it obtains such information. Such notice shall include, to the extent such information is available to Transwestern, a description of the reasons for the delay; the anticipated duration of the delay; the measures, if any, taken and to be taken to prevent or minimize the delay; and the time that Transwestern estimates will be required to implement such measures. Failure to notify EPA in accordance with this Section shall constitute a waiver by Transwestern of any claim of force majeure for such event, unless this Court orders otherwise for good cause shown.

C. If the non-compliance or delay was attributable to a force majeure event, the period for performance of the affected obligations under this Consent Decree will be extended or modified as warranted under the circumstances.

D. When Transwestern becomes aware of circumstances at the Transwestern

sites or off-site locations that Transwestern believes may present an imminent and unreasonable risk of serious or widespread injury or an imminent and substantial endangerment to health or the environment, whether or not due to a force majeure event, Transwestern shall make best efforts to notify the EPA Project Contact by telephone within twenty-four (24) hours, and shall notify EPA in writing no later than seven (7) calendar days from the time Transwestern obtains such information. Notification by Transwestern pursuant to this Paragraph shall not preclude Transwestern's responsibility, if any, to notify EPA pursuant to Paragraph B of this Section or under the authority of any other statutes. Failure to notify EPA in accordance with this Section shall render Transwestern liable for stipulated penalties under Section XIV.A.1.

#### XVII. PUBLIC NOTICE

Pursuant to the provisions of 28 C.F.R. §50.7, this Consent Decree shall be lodged with this Court for thirty (30) calendar days to allow for public comment prior to entry. Compliance with 28 C.F.R. §50.7 and the requirements for public notice shall be by publication in the Federal Register.

#### XVIII. INDEMNIFICATION

A. Transwestern agrees to indemnify, and save and hold harmless the United States, or its agencies, departments, agents, contractors, subcontractors, and employees from any and all claims or causes of action arising from or on account of the negligent acts, omissions, or willful misconduct of Transwestern, its officers, employees, receivers, trustees, agents, representatives, or assigns, in carrying out the activities pursuant to this Consent Decree.

B. Except as expressly provided above, this Section does not affect the

liability of the United States which may exist under federal law. The parties agree that each party shall be responsible to the extent provided by law for its own negligence and that of its agents, contractors, and employees, and that the acts or omissions of a party or its agents, departments, contractors, subcontractors, and employees in carrying out activities pursuant to this Consent Decree shall not in any manner, or for any purpose, be considered the acts or omissions of the other party or its agents, departments, contractors, subcontractors, and employees.

XIX. COVENANT NOT TO SUE

A. Subject to paragraphs B. and C. of this Section XIX, the United States hereby covenants not to take any administrative or civil action against Transwestern Pipeline Company for Covered Matters. Covered Matters are any and all administrative and civil liability to the United States for causes of action under the Toxic Substances Control Act relating to improper use, storage, and disposal of PCBs and recordkeeping violations concerning PCBs at Transwestern sites (defined in Section III of this Consent Decree) arising under Section 15 of the Toxic Substances Control Act prior to the date of lodging this Consent Decree.

B. Covered Matters shall not include any and all civil liability to the United States or any state for:

1. Claims related to groundwater protection or remediation;
2. Claims related to hazardous wastes, hazardous substances (except PCBs), or hazardous constituents; and
3. Claims based on the failure of Transwestern to fully comply with all requirements of this Consent Decree.

C. The covenant not to sue in paragraph A. above shall become effective upon the date of entry of this Consent Decree.

D. Transwestern covenants not to sue the United States including any and all departments, agencies, officers, administrators, and representatives thereof for any claim, counterclaim or cross-claim asserted, or that could have been asserted until the effective date of this Consent Decree, arising out of or relating to characterization and remediation at the Transwestern sites.

#### XX. RESERVATION OF RIGHTS

A. Notwithstanding any other provisions of this Consent Decree, to the extent that any hazardous wastes, hazardous substances (except PCBs), hazardous constituents, or other pollutants or contaminants remain at Transwestern sites during removal or after completion of the PCB removal and remedial activities required pursuant to this Consent Decree, the United States reserves the right to seek modification of this Decree, or to institute a new administrative or judicial action to seek additional removal or remedial measures at Transwestern sites. Transwestern waives the defense to such new action that, in proceeding to file the complaint in this action for matters addressed therein and in this Consent Decree, the United States may have split its claims and is thus barred by res judicata, collateral estoppel, and/or bar and merger from bringing such new action.

B. Nothing in this Consent Decree, nor the fact that it is entered into, shall constitute a compromise or waiver at law or in equity of the authority of the State of New Mexico or any other state to enforce its own laws and regulations (including those provisions of the Resource Conservation and Recovery Act, as amended, 42 U.S.C. §6901 et seq. and other environmental statutes which have been delegated to the states) as they may pertain to

Transwestern.

C. Nothing in this Consent Decree, nor the fact that it is entered into, shall constitute a compromise or waiver at law or in equity of the authority of the United States to enforce its own laws and regulations, including but not limited to the Resource Conservation and Recovery Act, as amended by the Hazardous and Solid Waste Amendments, 42 U.S.C. §6901 et seq., the Comprehensive Environmental Response, Compensation and Liability Act as amended by the Superfund Amendments and Reauthorization Act, 42 U.S.C. §9601 et seq. the Clean Water Act, 33 U.S.C. §1251 et seq., and any other federal or delegated or analagous State law or regulation as they may pertain to Transwestern.

D. Nothing in this Consent Decree, nor the fact that it is entered into, shall affect the ability of the United States or any state to bring or take action in response to an imminent and unreasonable risk or an imminent and substantial endangerment to health or the environment.

E. Nothing in this Consent Decree, nor the fact that it is entered into, shall constitute an admission of fact or liability on the part of Transwestern, its directors, officers, employees or agents.

#### XXI. COMPLIANCE WITH APPLICABLE LAWS

Nothing in this Consent Decree shall excuse Transwestern from complying with the requirements of all applicable federal, state or local laws and regulations.

#### XXII. MODIFICATION

This Consent Decree shall be modified only in writing, by application to this Court and subsequent approval by this Court. Either Party may without the agreement of the other Party, petition the Court to order modification of the deadlines and schedules provided under this Consent Decree for good cause shown. Any such modification shall have as its effective date the date of the approval by this Court of an agreement between the parties,

of interpretation, implementation, modification, enforcement and termination.

XXIII. HEADINGS

The section headings set forth in this Consent Decree are included for convenience of reference only and shall be disregarded in the construction and interpretation of any of the provisions of this Consent Decree.

XXIV. EFFECTIVE DATE

This Consent Decree is effective upon the date of its entry by this Court.

XXV. TERMINATION AND SATISFACTION

A. Within 30 days following completion of the remediation to be performed at each site and off-site location, pursuant to this Consent Decree, Transwestern shall submit to the EPA Project and Site Contact a written certification that the work at that site and all contiguous off-site locations has been completed in accordance with this Consent Decree. Within forty-five (45) calendar days of receipt of Transwestern's submission, EPA will provide Transwestern with a written certification that all work has been performed in accordance with this Consent Decree or, if EPA believes that Transwestern has not satisfied one or more requirements of this Consent Decree applicable to the site or off-site locations, a written statement specifying in sufficient detail why certification has not been granted. EPA will not unreasonably withhold certification.

B. This Consent Decree shall terminate upon (1) notice to Transwestern and the Court by the United States that all terms and conditions have been satisfied, or (2) upon petition by Transwestern subject to the Court's finding that all terms and conditions have been satisfied and, upon approval by the Court.

XXVI. FORM OF NOTICE

Unless otherwise expressly provided in this Consent Decree, all notices required to be given pursuant to this Consent Decree shall be in writing and

shall be deemed to have been made upon the date of deposit of a certified letter with the U.S. Postal Service or a commercial delivery service addressed to the appropriate recipient Party's Site Contact or Project Contact.

Unless otherwise specified herein, all notices to the United States shall be sent to the EPA Project Contact.

XXVII. NOTIFICATIONS

1. Notice of the existence of this Consent Decree shall be recorded with the local office having responsibility for the recording of deeds and other such instruments in every county in which any Transwestern site, as defined in Section III of this Consent Decree, is located.

2. Notice of the nature and extent of PCB contamination and the remedial actions undertaken by Transwestern pursuant to this Consent Decree shall be given to the owners of all lands, including Transwestern sites and offsite locations upon which remedial activities will be conducted. A copy of all such notifications to landowners shall be supplied to EPA.

XXVIII. RETENTION OF JURISDICTION

This Court shall retain jurisdiction over this Consent Decree for purposes of interpretation, implementation, modification, enforcement and termination.

XXIX. COSTS

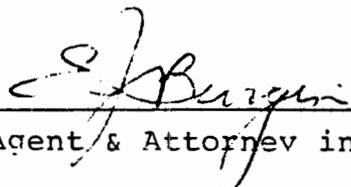
Each Party in this action shall bear its own costs.

UNITED STATES OF AMERICA  
Plaintiff

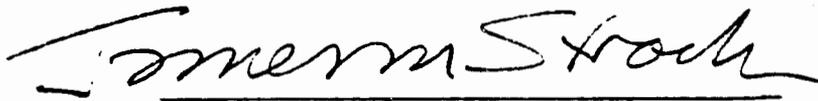
TRANSWESTERN PIPELINE COMPANY  
Defendant

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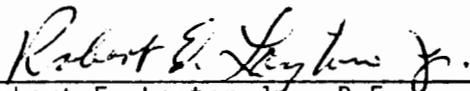
Donald A. Carr  
Acting Assistant Attorney General  
Land and Natural Resources Division  
United States Department of Justice  
Washington, D. C. 20530

  
Agent & Attorney in Fact RGM

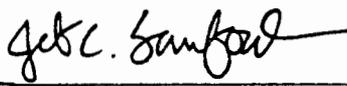
William L. Lutz  
U.S. Attorney District of New Mexico  
500 Gold S.W.  
Albuquerque, New Mexico 87102

 2/19/90  
Date

James M. Strock  
Assistant Administrator  
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Monitoring  
U.S. Environmental Protection Agency  
401 M Street, S.W.  
Washington, D.C. 20460

  
Robert E. Layton Jr., P.E.  
Regional Administrator  
U.S. Environmental Protection Agency  
Region 6  
1445 Ross Avenue  
Dallas, Texas 75202

Date

  
Jeb Sanford, Senior Attorney  
Environmental Enforcement Section  
Land and Natural Resources Division  
U.S. Department of Justice  
Washington, D.C. 20530

  
Pamela J. Travis  
Assistant Regional Counsel  
U.S. Environmental Protection Agency  
Region 6  
1445 Ross Avenue  
Dallas, Texas 75202

ADDENDUM

By agreement of the parties the following provisions are hereby made part of the foregoing Consent Decree between the United States and Transwestern Pipeline Company:

1. The following language is added to the end of Appendix A, VI.C(3):

For each site, within fifteen (15) days after excavation to the limit set forth in VI.C(3), Transwestern shall submit to EPA a report ("Excavation Report") which includes at a minimum, verification sampling, a characterization of contaminants present, the projected rate of horizontal and vertical contaminant migration, geological characterization data from a depth of twenty five (25) feet to the first aquifer, and hydrogeological data for each site. In the event that all required data (including but not limited to verification sampling data) are not available within 15 days, Transwestern shall submit all available data within such time and shall notify EPA of the date upon which any additional data will be available.

For any site at which Transwestern agrees to continue excavation beyond the limit set forth in VI.C(3), the parties shall stipulate in writing that excavation to a specified cleanup level shall be conducted by Transwestern. Transwestern may make such stipulation in lieu of the Excavation Report, within fifteen (15) days after excavation to the VI.C(3) limits. Transwestern shall continue excavation in accordance with the terms of the stipulation.

If upon review of all relevant information and guidance including but not limited to the Transwestern Excavation Report for that site, the EPA Project Contact determines that, in order to prevent unreasonable risk to human health and the environment, a particular site requires excavation to a depth greater than twenty five (25) feet or the historical pit bottom, the EPA Project Contact will make a written finding to support any conclusion that an excavation depth greater than twenty five (25) feet or the historical pit bottom, whichever is deeper, is necessary. Based upon the Project Contact's written findings, EPA may require excavation to a depth greater than twenty-five (25) feet below the ground surface or the historical pit bottom, whichever is deeper, at any site location. If Transwestern disagrees with the findings or conclusions of the EPA Project Contact, Transwestern may invoke dispute resolution in accordance with Section XV of this Consent Decree.

2. At page 13, Section XII, Alternate Technologies, paragraph B, final sentence, the regulatory citation is changed to read: "EPA's consideration of the Transwestern proposal shall be in accordance with 40 C.F.R. Part 761."

This Addendum is hereby made part of the foregoing Consent Decree between the United States and Transwestern Pipeline Company.

Date: 5 Feb 1990

  
\_\_\_\_\_  
Terence A. Thorn, President  
Transwestern Pipeline Company 26m

Date: 3/26/90

Richard B. Stewart  
Richard B. Stewart  
Assistant Attorney General  
Land and Natural Resources Division  
United States Department of Justice  
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Date: \_\_\_\_\_

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Regional Administrator  
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Date: 3/26/90

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APPENDIX A

IMPLEMENTATION PLAN

FOR TRANSWESTERN PIPELINE SITES AND OFF-SITE AREAS

## Appendix A

### Implementation Plan for Transwestern Sites and Off-site Areas

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VII. Source Control Program

EXHIBIT A: Potential Non-Pit Sources of PCB Contamination

EXHIBIT B: Operating Procedures

EXHIBIT C: Verification of PCB Spill Cleanup by Sampling  
and Analysis

EXHIBIT D: List of HSL Substances for Verification Sampling

EXHIBIT E: Federal, State and Local Contacts

EXHIBIT F: Monitoring Well Installation

## I. INTRODUCTION

### A. Purpose

The purpose of this Implementation Plan is to specifically address procedures for (1) characterizing the probable nature and extent of PCBs and other selected substances at and adjacent to Transwestern sites and at off-site equipment areas, (2) developing site-specific work plans specifying PCB remediation activities, and (3) verifying the PCB cleanup levels have been achieved.

### B. Data

Environmental Protection Agency (EPA) shall have access to all the data required to be developed and maintained by Transwestern pursuant to the Consent Decree and Transwestern shall provide EPA with a copy of specific data upon request.

Three copies of work plans, reports and data required by this Appendix shall be submitted to EPA Region 6. Additionally, one copy of each of these work plans, reports and data shall be submitted to the New Mexico Environmental Improvement Division. Whenever sample data are submitted in work plans and reports, the presentation shall include a narrative or tabular summary of the findings, a description of plot plan depiction of each sample location, a listing of the analytical results and a summary of Quality Assurance/Quality Control (QA/QC) data developed pursuant to Exhibit C.

The appropriate EPA Site Contact for receipt of the above submittals shall be identified by the EPA Project Contact.

## II. DEFINITIONS

The following definitions shall apply wherever these terms appear in the Consent Decree unless expressly provided to the contrary:

A. Impervious Surfaces - Impervious surfaces are defined as any solid surface, whether man-made or naturally occurring, that is non-porous and will not readily absorb liquids. Impervious surfaces include, but are not limited to, metals, glass, or enameled or laminated surfaces.

B. Man-Made Surfaces - Man-made surfaces are defined as impervious and non-impervious surfaces on equipment identified by Exhibit A and associated impervious and non-impervious surfaces which could be contaminated by releases of PCBs from equipment listed in Exhibit A such as concrete slabs under equipment.

C. Non-Impervious Surfaces - Non-impervious surfaces are defined as any solid surface, whether natural or man-made, that is porous and is likely to absorb PCB-containing liquids. Non-impervious surfaces include, but are not limited to, wood, concrete, and asphalt.

D. Restricted Access Area - For purposes of this Consent Decree, a restricted access area is defined as any area that lies at least 0.1 km from a residential/commercial area and that is limited by man-made barriers (e.g. fences and walls) or substantially limited by naturally occurring barriers such as mountains, cliffs, or rough terrain. For purposes of this Consent Decree, the term "residential/commercial area" means those areas where people live or work and includes any residence such as a house, apartment building, or mobile home and the yards, driveways, sidewalks, and parking lots adjacent to the residence; stores, office buildings, hospitals, schools, and other commercial or public structures and the adjacent property including parking lots, landscaping, and sidewalks; playgrounds; parks serving residential

areas; and campgrounds. The term "residential/commercial area" does not include the working areas of manufacturing, farming, or ranching industries where access of the public is limited. Nor does the term "residential/commercial area" include any areas on Transwestern sites, except for any areas which are used as a residence, a playground, or a campground, or where access to the public is not limited.

E. Sediments - Sediments are defined as material, whether dry or wet, that accumulates along the bottom of streams or other surface water bodies and drainage ditches.

F. Unrestricted Access Area - For purposes of this Consent Decree, an unrestricted access area is defined as any area that is not a restricted access area as defined in Section II.D, above.

G. Woodward - Clyde Report - The phrase Woodward Clyde Report includes the following documents:

1. "Polychlorinated Biphenyl Assessment Transwestern Pipeline Company Facilities in U.S. EPA New Mexico Region 6," dated April 1987.
2. "Health Risk Assessment, Laguna Compressor Station" dated July 1987.
3. "Health Risk Assessment, Corona Compressor Station," dated July 1987.
4. "Health Risk Assessment, Mountainair Compressor Station," dated July 1987.
5. "Health Risk Assessment, Thoreau Compressor Station," dated July 1987.
6. "Summary Sample Locations And Analytical Results", undated.

### III. SITE MAPS

Transwestern shall prepare site maps for all of the sites to be remediated. The base map shall include the site boundary, all fence lines, significant surface improvements, and the adjacent land within 0.2 kilometer of the site boundary. Base maps shall be, at a minimum, two (2) feet by three (3) feet in size. Significant surface improvements noted shall include all buildings; debris piles; tanks; drum storage areas; truck loading areas; discernible areas of past or present earth disturbance where the purpose of disturbance was not for construction of pipelines or pipeline equipment with an identification of the purposes of each disturbance; pits; pig receivers and launchers; sump tanks; case and starter vents; diffuser tanks and electrical substations. Base maps shall be drawn to scale, with legends and scales clearly indicated. Base maps for all sites shall, to the extent possible, be oriented in the same direction and drawn to the same scale. These maps shall be included on a site-specific basis as part of each of the Groundwater Assessment Plans (GAP) and Initial Groundwater Data Reports. The maps prepared shall include the following:

Potential Sources of Contamination -- Identification of all points at which pipeline liquids are known, believed, or suspected to have been emitted from the pipeline at each site in the past and all potential non-pit sources of contamination listed in Exhibit A.

Land Use Map Identification -- Location and delineation of all unrestricted areas, as that term is defined in Section II, and identification of all on-site and adjacent property land use.

Surface Water Map Overlay -- Location and identification of all surface water drainage ditches or streams, groundwater discharges (such as springs), and other surface water bodies within and around the site boundary.

#### IV. GROUNDWATER MONITORING

Groundwater sampling and monitoring at the Corona, Mountainair, Thoreau and Laguna Compressor Stations and any other sites so determined by the EPA Project Contact shall be conducted in accordance with the procedures in this section. The monitoring wells shall be installed in the uppermost aquifer and located for the purpose of detecting a release of contaminants from a pit. For the purposes of this section, an aquifer is defined as a groundwater formation capable of yielding significant quantities of water.

##### A. Waiver

Transwestern will not be required to conduct groundwater monitoring activities pursuant to this Consent Decree at the Corona, Mountainair, Laguna, and Thoreau compressor stations upon a written submission by Transwestern and approval by EPA, in accordance with the requirements contained in 40 C.F.R. Section 265.90(c), that groundwater monitoring should be waived.

##### B. Uppermost Aquifer Flow Gradients

Transwestern shall determine the uppermost aquifer horizontal flow gradients at each site, to assist in determining the locations of monitoring wells required by Section IV.C by installing a minimum of three (3) monitoring wells directly, in accordance with the drilling, logging and construction requirements specified in Exhibit F and the "RCRA Groundwater Monitoring Technical Enforcement Document" (hereafter, RCRA Document). Water level data shall be collected weekly for the first month after installation. Additional water level data shall be collected from wells installed pursuant to Section IV.C whenever those wells are sampled.

C. Groundwater Monitoring in the Uppermost Aquifer

Transwestern shall install and operate the groundwater monitoring well network in accordance with the requirements of this section.

1. Two (2) monitoring wells shall be placed downgradient and within seventy-five (75) feet of the historical pit boundary of each pit and one (1) monitoring well shall be placed upgradient of each pit. The upgradient monitoring well shall be located sufficiently upgradient to be unaffected by PCB concentrations in the pit. The wells installed under Section IV.B. may be used for these monitoring wells if they are located in proper relation to sources of contamination and groundwater gradient.

2. All monitoring wells shall be sampled for PCBs. All wells shall be sampled and analyzed in accordance with Appendix C.

3. All monitoring wells shall be sampled monthly during and until completion of the on-site remediation work.

4. Quantitation in the groundwater of PCBs, shall, at the discretion of Transwestern be confirmed prior to being subject to the notice requirements of Section IV.C.5 of Appendix A and initiation of additional actions under this Implementation Plan. If Transwestern chooses not to confirm its initial results, the initial results shall be deemed confirmed.

a. All wells indicating a presence of PCBs to be confirmed shall be resampled within fourteen (14) days after receipt of analytical results.

b. Results from analysis of both sampling events shall be evaluated by Transwestern and reported as described in Section IV.C.5. If Transwestern determines that contaminants have not been confirmed by the resampling, an explanation supporting such determination shall be included.

5. Transwestern shall notify the EPA Site Contact within three (3) working days after receipt of analytical results the first time a sample from any monitoring well installed pursuant to Section IV.C.1 is confirmed to contain PCBs, at concentrations greater than the quantitation limit of one part per billion (1 ug/l). Such notice shall be confirmed in writing to the EPA Site Contact and to appropriate EPA regional and state offices identified in Exhibit E within fifteen (15) days after notifying the EPA Site Contact. Such notice shall identify the monitoring well(s) affected and the concentrations of the confirmed constituents.

D. Groundwater Contamination Characterization

1. The first time any compound is confirmed pursuant to Section IV.C.4 through 5 in any downgradient pit monitoring well at greater than the quantitation limits, Transwestern shall install three (3) monitoring wells (hereafter referred to as "site boundary wells") within 30 days following the notification to the EPA Site Contact required in Section IV.C.5 at the downgradient site property boundary for the purpose of determining if contaminants have migrated to the site property boundary. The site boundary wells shall be screened in the same interval as the wells required under Section IV.C.

2. Within ninety (90) days following the notification to the EPA Site Contact required in Section IV.C.5, Transwestern shall submit to the EPA Site Contact a Groundwater Assessment Report (GAR) and schedule for review. The GAR shall characterize the rate, concentration, and extent of horizontal and vertical migration of contaminants, and describe the probable on-site source of the contamination. The GAR shall consist of the following:

a. A summary and compilation of the groundwater analytical and water level data collected at that site, including but not limited to all

analytical data showing the presence or absence of PCBs.

b. A description of the local hydrogeology. The description shall include geologic cross-sections with formational strike and dip information, as appropriate, and shall identify potential contamination pathways. A copy of the site map, as described in Section III, shall be included in the description. The description shall also identify existing on-site well locations and depths.

c. A description of the investigative approach which will be used to characterize the rate, concentration, and extent of horizontal and vertical migration of contaminants and describe the probable on-site source of the contamination. This discussion shall also include a description of investigatory phases. Quantification of the rate of contaminant migration through fractured rock shall not be accomplished if such quantification is technically impracticable.

d. A discussion of the number, location and depth of any wells that will initially be installed, and the strategy for installing more wells, if required, in subsequent phases.

e. A description and justification of well design and construction techniques, if different from the requirements of Exhibit F.

f. A description and justification of the sampling and analysis protocols and a definition of sampling frequency for each well if different from the requirements stated in Section IV.C.3.

g. An implementation schedule for the GAR.

3. Following completion of the groundwater monitoring program or the activities defined in the Groundwater Assessment Report, Transwestern shall

submit to the EPA Site Contact, for review in accordance with the data report requirements in Section VII.A. of the Consent Decree, a final report which shall include a conclusion as to whether the objectives of the GAR have been achieved and whether further groundwater assessment/monitoring is warranted.

#### V. ADDITIONAL SITE CHARACTERIZATION

Prior to excavation of PCB contaminated soil in a pit, one (1) composite soil sample to a minimum depth of twelve (12) inches from the historical top of each pit shall be analyzed using EPA Methods 8010 and 8020, and for glycol and methanol using approved EPA analytical methods.

Subsequent to excavation of each pit, but prior to backfilling, at least one (1) composite soil sample to a minimum of six inches shall be taken from the lowest exposed surface area where excavation occurs and analyzed using EPA Methods 8010, 8020, and for glycol and methanol using approved EPA analytical methods.

If the EPA Project Contact determines that additional sampling is needed in an area where removal is to be undertaken, then no additional sampling shall be done for site characterization.

If the EPA Project Contact determines that additional sampling is needed in an area where sampling has been done, but no soil removal is to be undertaken then Transwestern will either (a) meet and discuss the need for enhancement; (b) undertake the necessary work; or (c) exercise the dispute resolution process.

#### VI. SITE IMPLEMENTATION PLAN

##### A. Sampling of Man-Made Surfaces

Transwestern shall perform one wipe sample on the exterior surface of

each of the above ground items of equipment listed in Exhibit A. All samples shall be taken on the equipment surface area that shows visual signs of contamination or is most likely to have been contaminated.

B. On-Site Remediation Activities

1. Work Plans

Transwestern shall prepare a Site Remediation Work Plan within thirty (30) days of the execution of this Consent Decree delineating remediation activities for each site. Each Site Remediation Work Plan shall be submitted to the EPA Project Contact for review in accordance with Section VII.C. of the Consent Decree.

Each Site Remediation Work Plan shall contain fully documented information relevant to the determination of appropriate cleanup standards under the PCB Spill Cleanup Policy, including, at a minimum for each site:

- a. distance to the nearest nonrestricted access area/s, as defined in 40 C.F.R. Section 761.123;
- b. ownership and use of all property adjacent to each compressor station or other site;
- c. location of all surface water or drainage areas within 1/4 mile of each compressor station or other site;
- d. the following information on all water wells within a 1/2-mile radius of each compressor station or other site: location and depth, shortest distance to surface PCB contamination or pits, year of construction, and type of casing and construction; and
- e. reports from hydrogeological assessments performed at each compressor station.

2. Cleanup Standards

Cleanup standards contained in the PCB Spill Cleanup Policy (the "Policy")

40 C.F.R. Section 761.120 et seq., shall be attained at each Transwestern site subject to this Consent Decree. Following cleanup, PCB concentrations shall not exceed those levels required by the Policy, including without limitation, 10 ppm PCBs in soils of unrestricted access areas; 25 ppm in soils of restricted access areas; and 1 ppm in sediments of drainage ditches.

EPA reserves the right to require more stringent cleanup standards based on site-specific conditions, including but not limited to shallow depth to groundwater, proximity to grazing lands or vegetable gardens. If upon review of the Site Remediation Work Plan the EPA Project Contact determines that a particular site requires more stringent cleanup levels, the EPA Project Contact will make a written finding based upon the specific facts of the site, to support its conclusion that a more stringent cleanup level is necessary to prevent unreasonable risk. If Transwestern disagrees with the findings or conclusions of the EPA Project Contact, Transwestern may invoke dispute resolution in accordance with Section XV of this Consent Decree.

### 3. Excavation

Excavated pits shall be backfilled with clean fill. Surface areas shall be backfilled with clean fill to grade or with six (6) inches of clean fill, whichever is less. Surface areas which are not backfilled to grade shall be recontoured. Restoration or recontouring activities shall provide for adequate surface water drainage to prevent the ponding or collection of surface water. Excavated areas shall be stabilized or revegetated.

#### C. Excavation Limitations

Regardless of whether the applicable cleanup levels have been achieved, any excavation at a site shall cease when any of the following

conditions are encountered:

- (1) Bedrock which cannot be readily penetrated by a conventional backhoe bucket;
- (2) Groundwater which makes further excavation impracticable;
- (3) A depth of twenty-five (25) feet below the ground surface, (except that, subject to items C.(1) and C.(2) above, each pit shall be excavated to the historical pit bottom even if the historical pit bottom is greater than 25 feet below grade).

At sites where water tables are shallow, Transwestern shall avoid scheduling excavation during periods when the water table is expected to be at its highest. If Transwestern reschedules any activities for this purpose, the site-specific implementation schedule and any other affected schedules shall be extended or modified if necessary to account for the delay caused by the rescheduling.

#### D. Pits

Transwestern shall excavate all pits at all sites to the specific cleanup standards required under the "PCB Spill Cleanup Policy" definition of non-restricted access or restricted access areas unless EPA determines that a lower PCB cleanup level is applicable in accordance with procedures set forth in Section VI.B.2. In order to establish the starting point for pit excavation, Transwestern shall specify the historical pit boundary in the Site Remediation Work Plan. The historical pit boundary represents the approximate dimensions of the pit as originally constructed and shall be identified by Transwestern based on (a) site historical information; (b) observation of surface features in the area where the pit is known to have been located; (c) results of pit characterization data; and (d) any other available and relevant information. If during excavation it is determined that the historical pit boundary was not accurately identified in the Site Remediation Work Plan, Transwestern shall correctly locate the pit as it was

constructed and shall excavate the pit. Excavation shall continue horizontally beyond the pit as necessary to remove all adjacent soil with concentrations of PCBs greater than the specified cleanup standard. Excavation shall continue vertically below the historical pit bottom as necessary to remove soil with concentrations of PCBs greater than the specified cleanup standard, unless any of the three excavation limitations [VI.C. (1), (2), or (3)] is encountered. However, if PCBs have been found in concentrations greater than 1 ppm below the seasonal high groundwater line, excavation shall continue until soil containing PCBs at concentration greater than 1 ppm has been removed, unless any of the excavation limitations is encountered. The seasonal high groundwater line shall be defined in the Site Remediation Work Plan.

Remediation shall be verified by taking the number of samples and using the method of analysis as set forth in Exhibit C and Appendix C. In addition, Transwestern shall complete and provide EPA with post-remediation verification sampling analysis and results of those compounds and test methods listed in Exhibit D. Additionally, at the Corona landfill or any other site where Transwestern knows or should know that PCBs have been deposited and where open burning was practiced, all post-remediation verification samples shall be analyzed for the following compounds:

- Total tetrachlorodibenzodioxin (TCDD)
- Total tetrachlorodibenzofuran (TCDF)
- Total Pentachlorodibenzodioxin (PeCDD)
- Total Pentachlorodibenzofuran (PeCDF)
- Total Hexachlorodibenzodioxin (HxCDD)
- Total Hexachlorodibenzofuran (HxCDF)

At the Corona landfill if PCDDs and PCDFs are found in any post-remediation verification sample in excess of a 2, 3, 7, 8-TCDD equivalent concentration of 1 ppb (calculated in accordance with EPA 625/3-87/012, March 1987) the EPA Project Contact may require Transwestern to collect off-site soil samples and analyze them for PCDDs and PCDFs. Sample locations shall be

downsloped from the pit and shall be established at the discretion of the EPA Project Contact.

The sample and analytical data collected pursuant to Section V. and VI.D. shall be reported in the Site Verification Report.

E. On-Site Soils

On-site soils shall be remediated by excavation. When sample results indicate PCB concentrations which are greater than applicable cleanup levels of 25 ppm for on-site restricted access areas and 10 ppm for on-site unrestricted access areas or lower PCB concentrations required by EPA based on site-specific conditions, the excavation shall proceed until the verification samples are equal to or less than the applicable cleanup levels of 25 ppm or 10 ppm or other cleanup level, as appropriate under this Consent Decree.

F. Backfill

For the purposes of this Consent Decree, clean backfill is defined as backfill with a PCB concentration equal to less than that which can remain in accordance with the PCB Spill Cleanup Policy if the backfill originates from the site. Transwestern shall identify all on-site sources of backfill in the Site Remediation Work Plan. Off-site sources shall be identified in the Site Verification Report. Off-site backfill shall not contain PCBs in excess of one (1) ppm.

Prior to backfilling, Transwestern shall provide certified sample results to the Oversight Contractor and the EPA Project Contact. EPA shall have fifteen (15) working days upon receipt of the certified, valid sample results to determine whether the specific area in question has been cleaned to the appropriate cleanup level. Transwestern shall provide written notice to the EPA Project Contact not less than twenty four (24) hours in advance of transmittal that the certified sample results are being transmitted to the

EPA Project Contact, and upon request shall, within forty eight (48) hours of such request, provide to EPA all QA/QC and chain of custody information in connection with such certified sample results. Upon confirmation by the EPA Project Contact that the specific area is certified clean, Transwestern may proceed to backfill the area in compliance with this Consent Decree. In the event data is deemed questionable or not acceptable by EPA, the fifteen (15) working days required for EPA determination shall be extended as appropriate in order to facilitate a proper determination based on sampling and analysis.

G. Sampling and Decontamination of Man-Made Surfaces

1. Decontamination of On-Site Equipment

Transwestern shall decontaminate exterior surfaces of on-site pig receivers, vent stacks, and compressor cases to the levels specified in the PCB Spill Cleanup Policy. Verification sampling as set forth in the PCB Spill Cleanup Policy shall be performed on all decontaminated man-made surfaces to determine compliance with the cleanup levels.

Transwestern shall perform one wipe sample on the exterior surface of each of the above-ground items of equipment listed in Exhibit A. Sampling and analysis shall be performed in accordance with Appendix C. All samples shall be taken on the equipment surface area that shows visual signs of contamination or is most likely to have been contaminated. If any sample is found to contain PCBs at concentrations greater than the cleanup levels specified in the PCB Spill Cleanup Policy, the outside surfaces of the unit equipment where the sample was taken shall be decontaminated.

2. Wipe Sampling of Off-Site Equipment

The exterior surfaces of above-ground equipment shall be sampled at the gate valve settings which are equipped for draining, meter stations, and all pig receivers. These samples shall be collected at the off-site

equipment areas. Sampling and analysis shall be performed in accordance with Appendix C. All samples shall be taken on the equipment surface area that shows visual signs of contamination or is most likely to have been contaminated.

As part of the Site Verification Report, Transwestern shall submit the analytical results of the off-site wipe sampling program, an assessment of the results, and a plan and schedule for further sampling, if warranted.

If any wipe samples in an equipment grouping contain PCBs at levels greater than the cleanup levels specified in the PCB Spill Cleanup Policy, Transwestern shall submit a sampling plan to the EPA Site Contact for sampling untested equipment in that group. Transwestern may propose that subsets of untested locations be tested if justified by factors such as equipment design or geographic location.

Transwestern may present justification in the Site Verification Report that no further sampling is required within an equipment grouping.

#### H. Liquids

Transwestern shall dispose of all waste oils containing concentrations of 2 ppm PCB or greater and waste liquids in concentrations of 50 ppm or greater in accordance with the requirements of 40 C.F.R. Part 761 and 40 C.F.R. Section 268. Transwestern shall dispose of waste water in accordance with all applicable state and federal statutes and regulations.

### VII. SOURCE CONTROL PROGRAM

A. Within ninety (90) days of the effective date of the Consent Decree, Transwestern shall initiate and submit to the EPA Project Contact procedures ("Operating Procedures") for the use, handling, storage, and disposal of liquids contaminated with PCBs during pipeline operations identified in Exhibit B. These Operating Procedures shall be designed to reduce and

control the release of PCB containing liquids to the environment.

B. Within sixty (60) days of completion of EPA's review of the Operating Procedures, Transwestern shall complete implementation of the Operating Procedures at all sites.

C. At pigging facilities and all valve blowdown points, the vent connections and drain connections, if applicable, for each pig receiver barrel; the vent connections on each pig launcher barrel and the vent connections and drain connections for valve blowdown points shall be connected to a portable diffuser tank or a substantially equivalent separation system designed to reduce and control the release to the environment of pipeline liquids.

D. At compressor stations where PCB lubricants were used in the air compressor system, the condensate from the blowdown of air compressors shall be collected in appropriate storage containers.

EXHIBIT A

POTENTIAL NON-PIT SOURCES OF PCB CONTAMINATION

Blowdown vents

Vent stacks

Pig receivers and launchers

Sump tanks

Gas turbines/compressors

Electric motor drives/compressors

Reciprocating gas compressor drives

Air compressors

Diffuser/collector tanks

Storage tanks (which store or stored PCBs or PCB-contaminated liquids)

Drum storage areas (which store or stored PCBs or PCB-contaminated liquids)

Scrubbers

Filter separators

Strainers

Gate valves (equipped for draining)

Electrical transformers/capacitor substations owned by Transwestern (which use or used PCBs or PCB-contaminated liquids)

**EXHIBIT B**  
**OPERATING PROCEDURES**

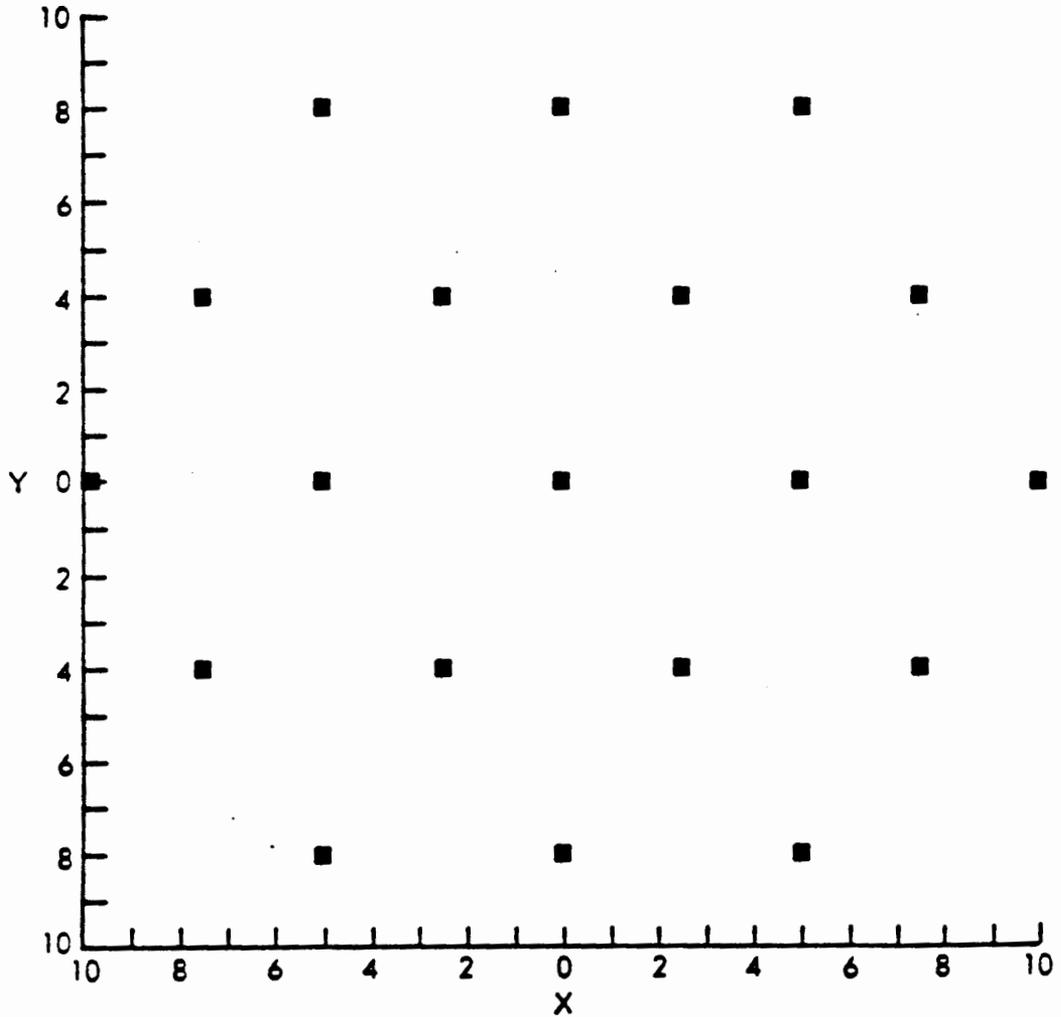
1. Operation of sumps and sump tanks
2. Handling of pig launchers and receivers
3. Operation of storage tanks and storage areas
4. Operation of tank loading areas
5. Scrubber/strainer operations
6. Waste pickup procedures
7. Cleanup and disposal of leaks and spills
8. Flushing and cleaning in-service valves

EXHIBIT C

Toxic Substances



# VERIFICATION OF PCB SPILL CLEANUP BY SAMPLING AND ANALYSIS



VERIFICATION OF PCB SPILL CLEANUP BY  
SAMPLING AND ANALYSIS

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WORK ASSIGNMENT 37

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No. F4138(8149)435

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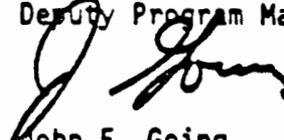
## PREFACE

This Interim Report was prepared for the Environmental Protection Agency under EPA Contract No. 68-02-3938, Work Assignment 37. The work assignment is being directed by Mitchell D. Erickson. This report was prepared by Dr. Erickson, Bruce A. Boomer, Gary L. Kelso, and Steve E. Swanson of Midwest Research Institute (MRI). The sampling design (Section IV.A) was written by David C. Cox and Bradley D. Schultz of the Washington Consulting Group, 1625 I Street, N.W., Washington, D.C. 20006, under subcontract to Battelle Columbus Laboratories, Subcontract No. F4138(8149)435, EPA Contract No. 68-01-6721 with the Design and Development Branch, Exposure Evaluation Division. The EPA Task Managers, Daniel T. Heggem, Richard A. Levy and John H. Smith, as well as Joseph J. Breen, Joseph S. Carra, and Martin P. Halper, of the Office of Toxic Substances, provided helpful guidance and technical information.

MIDWEST RESEARCH INSTITUTE

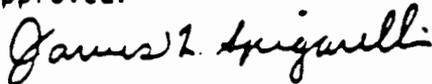


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## I. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) under the authority of the Toxic Substances Control Act (TSCA) Section 6(e) and 40 CFR Section 761.60(d), has determined that polychlorinated biphenyl (PCB) spills must be controlled and cleaned up. The Office of Toxic Substances (OTS) has been requested to provide written guidelines for cleaning up PCB spills, with particular emphasis on the sampling design and sampling and analysis methods to be used for the cleanup of PCB spills.

This work assignment is divided into two phases. The reports of Phase I are presented in Draft Interim Report No. 1, Revision No. 1, "Cleanup of PCB Spills from Capacitors and Transformers," by Gary L. Kelso, Mitchell D. Erickson, Bruce A. Boomer, Stephen E. Swanson, David C. Cox, and Bradley D. Schultz, submitted to EPA on January 9, 1985. Phase I consists of a review and technical evaluation of the available documentation on PCB spill cleanup, contacts with EPA Regional Offices and industry experts, and preparation of preliminary guidelines for the cleanup of PCB spills. The document was aimed at providing guidance in all aspects of spill cleanup for those organizations which do not already have working PCB spill cleanup programs.

Phase II, reported in this document, reviews the available sampling and analysis methodology for assessing the extent of spill cleanup by EPA enforcement officials. This report includes some of the information from the Phase I report, incorporates comments on the Phase I report and the general issue which were received at a working conference on February 26-27, 1985, and addresses the issue from the perspective of developing legally defensible data for enforcement purposes.

This report, intended primarily for EPA enforcement personnel, outlines specific sampling and analysis methods to determine compliance with EPA policy on the cleanup of PCB spills. The sampling and analysis methods can be used to determine the residual levels of PCBs at a spill site following the completion of cleanup activities. Although the methodologies outlined in this document are applicable to PCB spills in general, specific incidents may require special efforts beyond the scope of this report. Future changes in EPA policy may affect some of the information presented in this document.

Following a summary of the report (Section II), Section III presents an overview of PCB spills and cleanup activities. The guidelines on sampling and analysis (Section IV) includes discussion of sampling design, sampling techniques, analysis, and quality assurance.

## II. SUMMARY

This report presents the results of Phase II of this work assignment. Phase I consisted of a review and technical evaluation of the available documentation on PCB spill cleanup, contacts with EPA Regional Offices, and preparation of preliminary guidelines for the cleanup of PCB spills.

Phase II (this document) reviews the available sampling and analysis methodology for assessing the extent of spill cleanup by EPA enforcement officials. The report incorporates some of the information from the Phase I report and general issues received at a working conference on PCB spills.

The EPA has set reporting requirements for PCB spills and views PCB spills as improper disposal of PCBs. Cleanup activities have not been standardized since PCB spills are generally unique situations evaluated on a case-by-case basis by both the PCB owner (or his contractor) and the responsible EPA Regional Office. Components of the cleanup process may include protecting the health and safety of workers; reporting the spill; quick response/securing the site; determination of materials spilled; cleanup procedures; proper disposal of removed PCB materials; and sampling and analysis. The level of action required is dependent on the amount of spilled liquid, PCB concentration, spill area and dispersion potential, and potential human exposure.

A sampling design is proposed for use by EPA enforcement staff in detecting residual PCB contamination above a designated limit after a spill site has been cleaned. The proposed design involves sampling on a hexagonal grid which is centered on the cleanup area and extends just beyond its boundaries. Guidance is provided for centering the design on the spill site, for staking out the sampling locations, and for taking possible obstacles into account. Additional samples can be collected at the discretion of the sampling crew.

Compositing strategies, in which several samples are pooled and analyzed together, are recommended for each of the three proposed designs. Since an enforcement finding of noncompliance must be legally defensible, the sampling design emphasizes the control of the false positive rate, the probability of concluding that PCBs are present above the allowable limit when, in fact, they are not.

Sampling and analysis techniques are described for PCB-contaminated solids (soil, sediment, etc.), water, oils, surface wipes, and vegetation. A number of analytical methods are referenced; appropriate enforcement methods were selected based on reliability. Since GC/ECD is highly reliable, widely used, and is included in many standard methods, it is a primary recommended method for most samples. Secondary methods may be useful for confirmatory analyses or for special situations when the primary method is not applicable.

Quality assurance (QA) must be applied throughout the entire monitoring program. Quality control (QC) measures, including protocols, certification and performance checks, procedural QC, sample QC, and sample custody as appropriate, should be stipulated in a QA plan.

### III. OVERVIEW OF PCB SPILLS AND CLEANUP ACTIVITIES

#### A. Introduction to PCB Spills and Cleanup

The EPA has established requirements for reporting PCB spills based on the amount of material spilled and disposal requirements for the spilled PCBs and materials contaminated by the spill. Under TSCA regulations [40 CFR 761.30(a)(1)(iii) and 40 CFR 761.60d], PCB spills are viewed as improper disposal of PCBs. Although specific PCB cleanup requirements are not established in the TSCA regulations, each regional administrator is given authority by policy to enforce adequate clean-up of PCB spills to protect human health and the environment.

##### 1. Current Trends

Due to regional variations in PCB spill policy and the lack of a national PCB cleanup policy, PCB cleanup activities have not been standardized. Individual companies owning PCB equipment and contract cleanup companies have developed their own procedures and policies for PCB cleanup activities keyed to satisfying the requirements of the appropriate EPA Regional Office. In addition, the EPA Regional Offices typically have provided suggestions for companies unfamiliar with PCB cleanup.

PCB spills are generally viewed as unique situations to be evaluated on a case-by-case basis by both the PCB owner (or his contractor) and the EPA Regional Office. However, a general framework is often used to approach the problem. Most cleanup activities involve quick response, removal or cleaning of suspected contaminated material, and post-cleanup sampling to document adequate cleanup. Major considerations involved in the cleanup process include minimizing environmental dispersion, minimizing any present or future human exposure to PCBs, protecting the health and safety of the cleanup crew, and properly disposing contaminated materials.

In general, the involvement of EPA Regional Offices is limited to phone conversations often including a follow-up call to receive the analytical results of the post-cleanup sampling. If the EPA representative is not satisfied with the reported data, additional documentation, sampling and analysis, or cleanup (followed by further sampling and analysis) may be requested.

In cases of special concern (e.g., large spills), EPA Regional Offices may work more closely with the PCB owner or contractor in planning the cleanup, sampling and analysis activities, and on-site inspections.

##### 2. Limitations of This Overview

The general discussion in this chapter refers to the procedures, policy, and considerations that seem to be widely used at present by PCB owners and spill cleanup contractors in meeting the requirements of the EPA Regional Offices. The activities described do not involve EPA regulations or policy except where indicated, since the EPA has not established requirements on PCB cleanup procedures.

Table 1 categorizes PCB spills into approximate levels of action for PCB spill cleanup based on concern. Potential environmental problems increase with increases in PCB concentrations, amount of spilled liquid, spill area and dispersion potential, and potential human exposure. The three spill types presented in Table 1 are based on very rough estimates. "Severity" in one key item such as human exposure could raise a spill to a Type 3 (i. e., requiring special attention). On the other hand a spill of a large volume of liquid may be considered a Type 2 spill due to a relatively low concentration of PCBs. The three categories are only approximate and are intended to demonstrate the flexibility needed in responding to PCB spills. EPA Regional Offices should provide guidance on spill cleanup activities whenever questions develop.

The situations described in this chapter are limited to recent PCB spills of similar magnitude to the reported spills associated with PCB oil transformers and capacitors (i.e., Type 2 in Table 1). Unusually severe spill incidents (Type 3 in Table 1) involving large volumes of PCBs, a large spill area, a high probability of significant human exposure, and/or severe environmental or transportation scenarios may require special considerations, beyond the scope of this discussion.

All spills from regulated equipment are typically subject to the detail of effort outlined in this chapter. Although cleanup of smaller spills (Type 1 in Table 1) is required if the concentration of PCBs in the spilled material is 50 ppm or greater, the spill and the cleanup activities normally are not reported to EPA.

Future changes in EPA policy may invalidate some of the discussions appearing in this chapter. For example, if EPA adopts any type of formal categorization scheme for PCB spills, some of the assumptions made in this chapter may become inappropriate.

## B. Components of the Cleanup Process

### 1. Health and Safety

Protection of the health and safety of the clean-up crew during the PCB cleanup operation is an important concern. References discussing health and safety considerations relevant to some PCB spill incidents include NIOSH Criteria for A Recommended Standard for Exposure to Polychlorinated Biphenyls (PCBs) (1977c) and Health Hazards and Evaluation Report No. 80-85-745 (NIOSH 1980). The appropriate level of health and safety protection is dependent upon the specifics of the spill.

### 2. Reporting the Spill

If the regulatory limits are exceeded, the spill must be reported to Federal, State, and local authorities as applicable. Under EPA regulations [Fed. Reg. 50:13456-13475], spills over 10 lb must be reported to The National Response Center. The toll free phone number is (800) 424-8802.

Table 1. Approximate Levels of Action for PCB Spill Cleanup Based on Concern

	Categories of increasing concern		
	Type 1	Type 2	Type 3
Approximate gallons of spilled liquid	< 1	> 1	> 5
Area of spill (sq ft)	< 125	250 (avg.)	> 1,000
PCB concentration in spilled liquid (ppm)	< 500	≥ 50	Variable or high
Types of spilled liquid	Mineral oil (or variable)	Variable	Variable, Askarel
Exposure scenario	Various	Various	Special concern for high exposure situations

- Notes:
- Type 1 spill is usually not reported.
  - Type 2 spill is reported and discussed in this chapter.
  - Type 3 spill is not discussed in this chapter and may require special EPA assistance.
  - "Severity" in one key item may raise the spill to a higher risk category.

### 3. Quick Response/Securing the Site

Quick response is desirable to mitigate the dispersion of the spilled material and to secure the site. Federal regulations require that cleanup actions commence within 48 hr of discovery of a spill [40 CFR 761.30(a)(1) (iii)]. More rapid response is highly preferable.

A quick response allows removal or cleaning of the PCB-contaminated material before it is dispersed by wind, rain, seepage, and other natural causes or by humans or animals. In securing the site, the cleanup crew determines the spill boundaries, prevents unauthorized access to the spill site, and notifies all parties involved.

The methods used to secure the site will vary on a case-by-case basis, depending on the specific circumstances. The extent of the spill is usually determined by visual inspection with the addition of a buffer area that may include PCBs finely dispersed from splattering. Evaluating the extent of the spill involves considerable judgment, including consideration of the cause of the spill, weather conditions, and specifics of the site.

Field analysis kits may aid the crew in determining the extent of the spill in some instances. The field kits, when used properly, can serve as a screening tool. The need for quick response has limited the usefulness of the more accurate field analytical techniques such as field gas chromatography. Practical problems associated with availability of the equipment and trained staff, set-up time, and cost have limited the use of such techniques at this time.

### 4. Determination of Materials Spilled/Cleanup Plan

After securing the site, the response crew will either (a) immediately proceed with the cleanup operation, or (b) identify the materials spilled and formulate an appropriate cleanup plan. A suitable cleanup plan can be developed by identifying the type of PCB material (i.e., mineral oil, PCB oil, Askarel) and considering such factors as the volume spilled, area of the spill, and site characteristics.

Based on reasoning similar to Table 1, the crew leader can determine the necessary level of effort in accordance with the policy of the PCB owner and the EPA Regional Office. He can determine if additional guidance is needed, plan the sampling and analysis, and make other decisions related to the level of effort and procedures needed.

### 5. Cleanup Procedures

The cleanup procedure may include, but may not necessarily be limited to, the following activities:

- Removal or repair of failed/damaged PCB equipment,
- Physical removal of contaminated vegetation;

- Physical removal of contaminated soils, liquids, etc.,
- Decontamination or physical removal (as appropriate) of contaminated surfaces, and
- Decontamination or removal of all equipment potentially contaminated during the cleanup procedures.
- Encapsulation may be employed only with EPA approval.

The specific procedures used in a cleanup are selected by the PCB owner or the cleanup contractor. Key considerations include removal of PCBs from the site to achieve the standards required by the EPA region, company, or other applicable control authority; avoidance of unintentional cross contamination or dispersion of PCBs from workers' shoes, contaminated equipment, spilled cleaning solvents, rags, and other sources; and protection of workers' health.

The cleanup crew shall make every possible effort to keep the spilled PCBs out of sewers and waterways. If this has already occurred, the crew needs to contact the local authorities. Water is never used for cleaning equipment or the spill site.

A simple PCB spill cleanup may involve the removal of the leaking equipment, removal of contaminated sod and soil by shovel, cleaning pavement with an absorbant material and solvents, and decontamination or disposal of the workers' equipment (shovels, shoes, gloves, rags, plastic sheets, etc.). More complicated situations may include decontamination of cars, fences, buildings, trees and shrubs, electrical equipment, or water (in pools or bodies of water).

In some cases, adequate decontamination of surfaces (pavements, walls, etc.) may not be possible. An alternate to physical removal of the surface material is encapsulation of the contaminated area under a coating impervious to PCBs. (EPA approval would be required.)

#### 6. Proper Disposal of Removed PCB Materials

All PCB-contaminated materials removed from the spill site, must be shipped and disposed in accordance with relevant Federal, State, and local regulations. TSCA Regulations [40 CFR 761.60] outline the requirements for the disposal of PCBs, PCB articles, and PCB containers in an incinerator, high efficiency boiler, chemical waste landfill, or an approved alternative method. Facility requirements for incineration and chemical waste landfills are presented in 40 CFR 761.70 and 40 CFR 761.75, respectively. Applicable Department of Transportation regulations are listed in 49 CFR 172.101.

#### 7. Sampling and Analysis

Although sampling and analysis will be discussed in detail in Chapter IV, this discussion gives an overview of applicable considerations and current practice. Sampling and analysis may not always be needed (especially for the spills described as Type 1 in Table 1), but enforcement authorities or property owners may ask for proof that the spill site has been adequately

decontaminated. This can be accomplished by taking a number of samples representative of the area contaminated by the spill. Samples should represent the full extent of the spill, both horizontal and vertical, as well as the types of materials in the spill area (soil, surfaces, water, etc.).

Sampling design and technique as well as sample handling and preservation should incorporate acceptable procedures for each matrix to be sampled and concern for the adequacy and accuracy for the samples in the final analysis.

Analysis of the samples for PCB content should be performed by trained personnel using acceptable procedures with due consideration of quality assurance and quality control.

Further discussion of sampling and analysis (applicable to EPA enforcement activities) appears in Chapter IV.

#### 8. Remedial Action

If the analysis results indicate the cleanup was not in compliance with designated cleanup levels, additional cleanup is needed. Additional sampling can pinpoint the location of remaining contaminated areas if the original sampling plan was not designed to identify contaminated sub-areas within the spill site. If additional cleanup is needed, the cleanup crew will continue as before, removing more material or cleaning surfaces more thoroughly. Remedial action will be followed by additional sampling and analysis to verify the adequacy of the cleanup.

#### 9. Site Restoration

This is not addressed under TSCA and is a matter to be settled between the company responsible for the PCB spill and the property owner.

#### 10. Records

Although there are no TSCA requirements for records of PCB cleanup activities except for documentation of PCBs stored or transported for disposal [40 CFR 761.80(a)], the PCB owner should keep records of the spill cleanup in case of future questions or concern. Relevant information may include dates, a description of the activities, records of shipment and disposal of PCB-contaminated materials, and a report of collected samples and results of analysis.

#### 11. Miscellaneous Considerations

a. Expeditious and effective action are desired throughout the cleanup process to minimize the concern of the public, especially residents near the site or individuals with a special interest in the site. Likewise, speed and effectiveness in the cleanup may prevent any future concern or action related to the PCB spill.

b. Education and training of the spill response crews and responsible staff members is a constant concern. The employees need sufficient training to make proper judgements and to know when additional assistance or guidance is needed.

#### IV. GUIDELINES ON SAMPLING AND ANALYSIS

Reliable analytical measurements of environmental samples are an essential ingredient of sound decisions for safeguarding public health and improving the quality of the environment. Effective enforcement monitoring should follow the general operational model for conducting analytical measurements of environmental samples, including: planning, quality assurance/quality control, verification and validation, precision and accuracy, sampling, measurements, documentation, and reporting. Although many options are available when analyzing environmental samples, differing degrees of reliability, dictated by the objectives, time, and resources available, influence the protocol chosen for enforcement monitoring. The following section outlines the factors critically influencing the outcome and reliability of enforcement monitoring of PCB spill cleanup.

##### A. Sampling Design

This section presents a sampling scheme, for use by EPA enforcement staff, for detecting residual PCB contamination above a limit designated by EPA-OPTS after the site has been cleaned up. Two types of error traceable to sampling and analysis are possible. The first is false positive, i.e., concluding that PCBs are present at levels above the allowable limit when, in fact, they are not. The false positive rate for the present situation should be low, because an enforcement finding of noncompliance must be legally defensible; that is, a violator must not be able to claim that the sampling results could easily have been obtained by chance alone. Moreover, all sampling designs used must be documented or referenced.

The second type of error possible is a false negative, i.e., failure to detect the presence of PCB levels above the allowable limit. The false negative rate will depend on the size of the contaminated area and on the level of contamination. For large areas contaminated at levels well above the allowable limit, the false negative rate must, of course, be low to ensure that the site is brought into compliance. The false negative rate can increase as the area or level of contamination decrease.

##### 1. Proposed Sampling Design

In practice, the contaminated area from a spill will be irregular in shape. In order to standardize sample design and layout in the field, and to protect against underestimation of the spill area by the cleanup crew, sampling within a circular area surrounding the contaminated area is proposed. Guidance on choosing the center and radius of the circle, as well as the number of sample points to be used is provided in Section 2 below.

The detection problem was modeled as follows: try to detect a circular area of uniform residual contamination whose center is randomly placed within the sampling circle. Figure 1 illustrates the model. The figure depicts a sampling circle of 10 ft centered on a utility pole (site of the spill). After cleanup, a residually contaminated circle remains. However, in choosing locations at which to sample, the sampler has no knowledge of either the location of the circle or the level of contamination. This

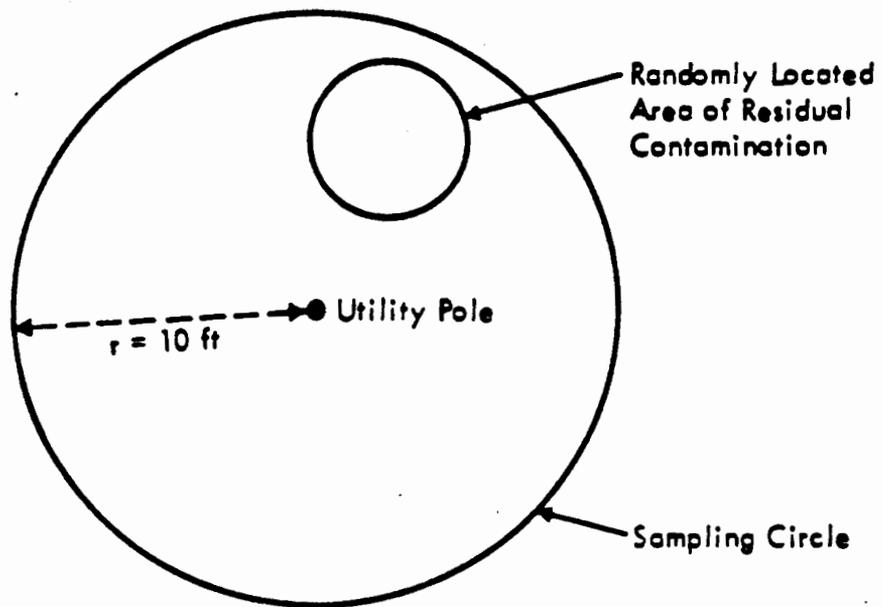


Figure 1. Randomly located area of residual contamination within the sampling circle.

lack of knowledge was modeled by treating the sampling locations as fixed and the center of the contaminated circle as a randomly located point in the circle of radius 10 ft. The implicit assumption that residual contamination is equally likely to be present anywhere within the sampling area is reasonable, at least as a first approximation (Lingle 1985). This is because more effort is likely to have been expended in cleaning up the areas which were obviously highly contaminated.

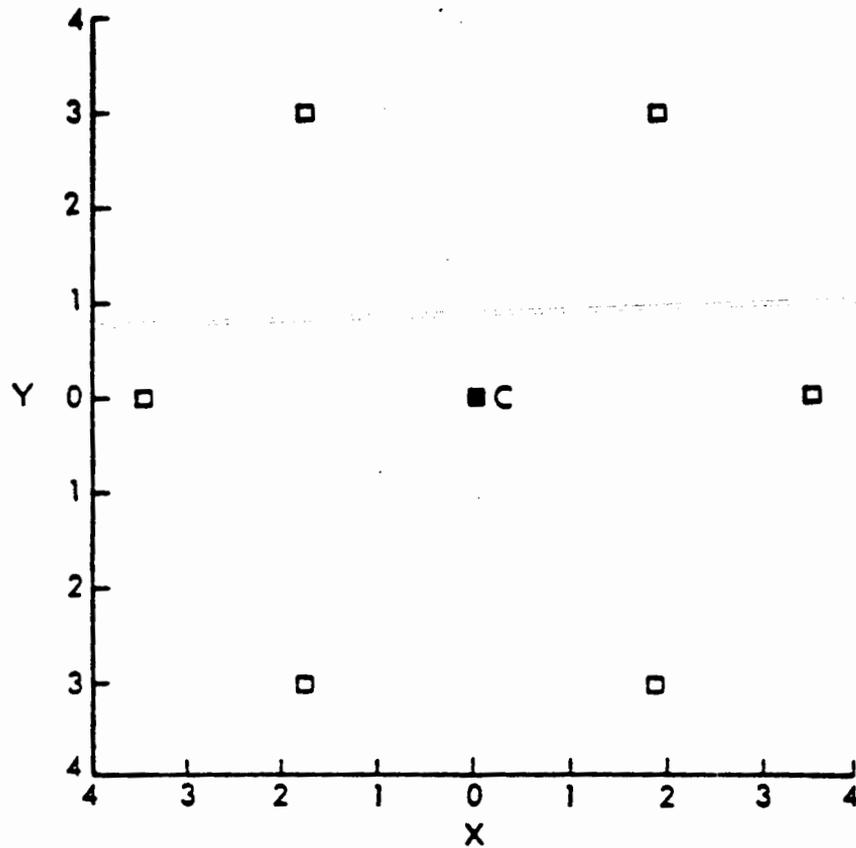
Two general types of design are possible for this detection problem: grid designs and random designs. Random designs have two disadvantages compared to grid designs for this application. First, random designs are more difficult to implement in the field, since the sampling crew must be trained to generate random locations onsite, and since the resulting pattern is irregular. Second, grid designs are more efficient for this type of problem than random designs. A grid design is certain to detect a sufficiently large contaminated area while some random designs are not. For example, the suggested design with a sample size of 19 has a 100% chance to detect a contaminated area of radius 2.8 ft within a sampling circle of radius 10 ft. By contrast, a design based on a simple random sample of 19 points has only a 79% chance of detecting such an area.

Therefore, a grid design is proposed. A hexagonal grid based on equilateral triangles has two advantages for this problem. First, such a grid minimizes the circular area certain to be detected (among all grids with the same number of points covering the same area). Second, some previous experience (Mason 1982; Matern 1960) suggests that the hexagonal grid performs well for certain soil sampling problems. The hexagonal grid may, at first sight, appear to be complicated to lay out in the field. Guidance is provided in Section 2 below and shows that the hexagonal grid is quite practical in the field and is not significantly more difficult to deploy than other types of grid.

The smallest hexagonal grid has 7 points, the next 19 points, the third 37 points as shown in Figures 2 through 4. In general, the grid has  $3n^2 + 3n + 1$  points. To completely specify a hexagonal grid, the distance between adjacent points,  $s$ , must be determined. The distance  $s$  was chosen to minimize, as far as possible, the size of the residual contaminated circle which is certain to be sampled. Values of  $s$  so chosen, together with number of sampling points and radius of smallest circle certain to be sampled are shown in Table 2. For example, the grid spacing for a circle of radius 20 ft for the 7-point design is  $s = (0.87)(20) = 17.4$  ft. For a given size circle, the more points on the grid, the smaller the residual contamination area which can be detected with a given probability.

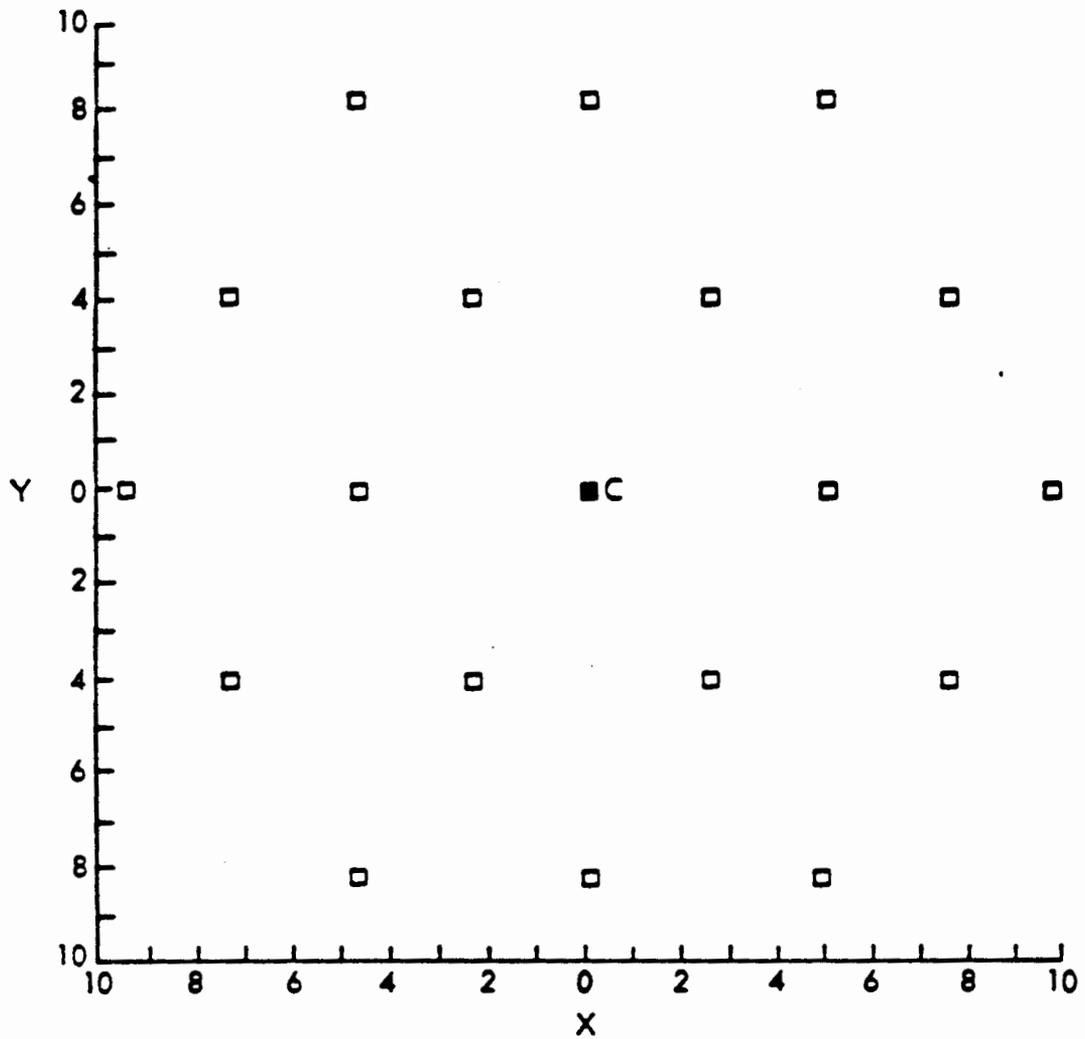
Table 2. Parameters of Hexagonal Sampling Designs for a Sampling Circle of Radius  $r$  Feet

No. of points	Distance between adjacent points, $s$ (ft)	Radius of smallest circle certain to be sampled
7	$0.87r$	$0.5r$
19	$0.48r$	$0.28r$
37	$0.3r$	$0.19r$



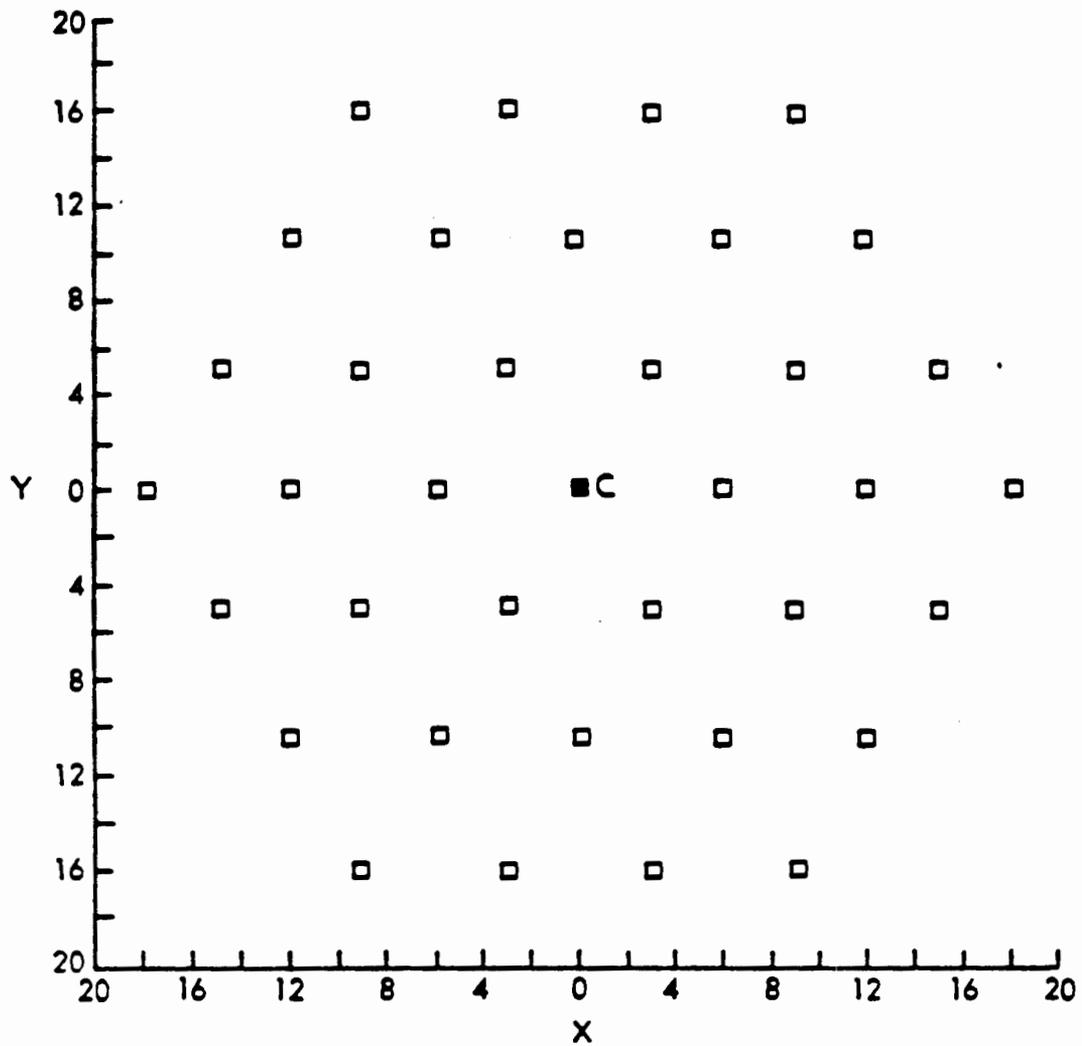
The outer boundary of the contaminated area is assumed to be 4 feet from the center (C) of the spill site.

Figure 2. Location of sampling points in a 7-point grid.



The outer boundary of the contaminated area is assumed to be 10 feet from the center (C) of the spill site.

Figure 3. Location of sampling points in a 19-point grid.



The outer boundary of the contaminated area is assumed to be 20 feet from the center (C) of the spill site.

Figure 4. Location of sampling points in a 37-point grid.

The first three hexagonal designs are shown in Figures 2 to 4, for a sampling circle radius of  $r = 10$  ft. The choice of sample size depends on the cost of analyzing each sample and the reliability of detection desired for various residually contaminated areas. Subsection 2 below provides some suggested sample sizes for different spill areas, based on the distribution of spill areas provided by the Utility Solid Waste Activities Group (USWAG 1984; Lingle 1985).

## 2. Sample Size and Design Layout in the Field

### a. Sample Size

The distribution of cleanup areas for PCB capacitor spill sites, based on data collected by USWAG (1984; Lingle 1985) is shown in Table 3. The smallest spill recorded in the USWAG database is  $5 \text{ ft}^2$ , the largest  $1,700 \text{ ft}^2$ . The median cleanup area is  $100 \text{ ft}^2$ , the mean  $249 \text{ ft}^2$ ; the wide discrepancy between the mean and the median reflects the presence of a small percentage of relatively large spills in the database.

Recommended sample sizes are given in Table 4. Several considerations were involved in arriving at these recommendations. First, the maximum number of samples recommended for the largest spills is 37, in recognition of practical constraints on the number of samples that can be taken. Even so, it is important to note that not all samples collected will need to be analyzed. The calculations in Section 5 below show that, even for the 37 sample case, no more than 8 analyses will usually be required to reach a decision. Since the cost of chemical analyses is a substantial component of sampling and analysis costs, even the 37-sample case should not, therefore, be prohibitively expensive. Second, the typical spill will require 19 samples. Small spills, with sampling radius no greater than 4 ft, will have 7 samples, while the largest spills, with sampling radius 11.3 ft and up, will require 37 samples. It should be noted that only capacitor spills are represented in Table 3. Transformer spills, however, would be expected to be generally smaller than capacitor spills because energetic releases are less likely from transformers. Thus, one would expect the smaller sample sizes to be relatively more likely for transformer spills than capacitor spills.

Table 3. Distribution of PCB Capacitor Spill Cleanup Areas Based on 80 Cases

Cleanup area (ft <sup>2</sup> )	Percent of cases
≤ 50	32.5
51-100	18.8
101-200	15.0
201-300	12.5
301-400	3.8
401-700	7.5
701-1,300	8.8
≥ 1,300	1.3

Source: Lingle 1985.

Table 4. Recommended Sample Sizes

Sampling area (ft <sup>2</sup> )	Radius of sampling circle (ft)	Percent of PCB capacitor spills	Sample size
≤ 50	≤ 4	32.5	7
51-400	4-11.3	50.0	19
> 400	> 11.3	17.5	37

The final consideration in recommending sample sizes was to achieve roughly comparable detection capability for different size spills. The radius of the smallest contaminated circle certain to be sampled at least once by the sampling scheme is used for comparative purposes (see Table 2). Table 5 presents some calculations of this quantity. The absolute detection capability of the sampling scheme is seen to be relatively constant for different spill sizes. This means that a given area of residual contamination is about as likely to be detected in any sized spill.

Table 5. Detection Capability of the Recommended Sampling Schemes

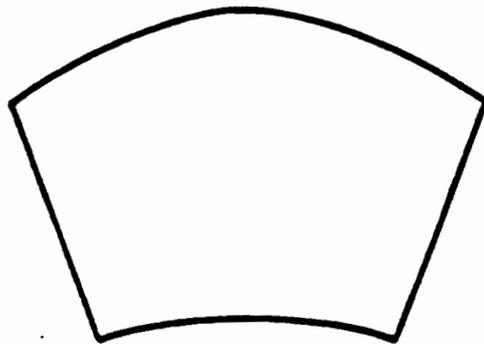
Sampling area (ft <sup>2</sup> )	Radius (ft)	Sample size	Radius of smallest circle to be sampled (ft)
50	4.0	7	2.0
150	6.9	19	1.9
400	11.3	19	3.2
875	16.7	37	3.2

#### b. Design Layout in the Field

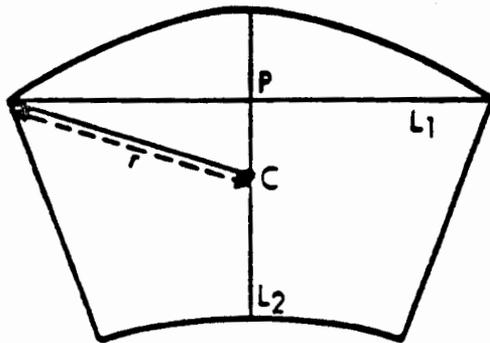
Figure 5 presents a typical illustration of design layout in the field. The first step is to determine the boundaries of the original cleanup area (from records of the cleanup). Next, find the center and radius of the sampling circle which is to be drawn surrounding the cleanup area. The following approach is recommended:

- (a) Draw the longest dimension,  $L_1$ , of the spill area.
- (b) Determine the midpoint,  $P$ , of  $L_1$ .
- (c) Draw a second dimension,  $L_2$ , through  $P$  perpendicular to  $L_1$ .
- (d) The midpoint,  $C$ , of  $L_2$  is the required center.
- (e) The distance from  $C$  to the extremes of  $L_1$  is the required radius,  $r$ .

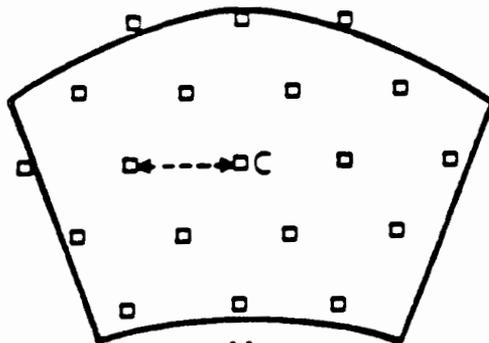
Figure 5 shows an example of the procedure; Figure 6 demonstrates how the center is determined for several spill shapes. Even if the center determined is slightly off, the sampling design will not be adversely affected.



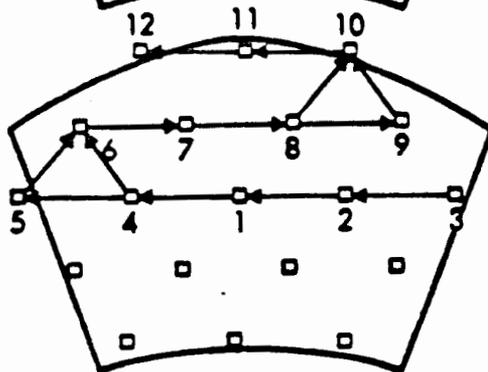
(a) Original cleanup area



(b) Locating the center of the sampling circle



(c) Centering the hexagonal grid



(d) Staking out the grid points

Figure 5

Once the sampling radius,  $r$ , has been found, the sample size can be selected based on Table 4.

Example: Suppose  $r = 5$  ft. From Table 4, a sample size of 19 should be used.

Having selected the sample size, the grid spacing can be calculated from Table 2.

Example (continued): For a 19-point design with radius  $r = 5$ , the grid spacing is  $s = 0.48r = (0.48)(5) = 2.4$  ft.

The procedure for laying out a 19 point design is as follows. The first sampling location is the center  $C$  of the sampling circle, as shown in Figure 5. Next, draw a diameter through  $C$  and stake out locations 2 through 5 on it as shown; adjacent locations are a distance  $s$  apart. The orientation of the diameter (for example east-west) used is not important; it may be chosen at random or for the convenience of the samplers. The next 4 locations, Nos. 6-9, are laid out parallel to the first row, again a distance  $s$  apart. The only difficulty is in locating the starting point, No. 6, for this row. To accomplish this the sampler needs two pieces of rope (or surveyor's chain, or equivalent measuring device) of length  $s$ . Attach one piece of rope to the stake at each location 4 and 5. Draw the ropes taut horizontally until they touch at location 6. Once the second row is laid out, the third and final row of 3 locations in the top half of the design is found similarly, starting with number 10. In the same way, the bottom half of the design is staked out. The 7-point or 37-point designs are laid out in an analogous fashion.

Once the sampling locations are staked out the actual samples can be collected. In the example in Figure 5, three of the sampling locations fall outside the original cleanup area. Samples should be taken at these points, to detect contamination beyond the original cleanup boundaries. This verifies that the original spill boundaries were accurately assessed.

In practice, various obstacles may be encountered in laying out the sampling grid. Many "obstacles" can be handled by taking a different type of sample, e.g., if a fire hydrant is located at a point in a sampling grid otherwise consisting of soil samples, then a wipe sample should be taken at the hydrant, rather than taking a sample of nearby soil. The obstacle most likely to be encountered is a vertical surface such as a wall. To determine the sampling location on such a surface, draw taut the ropes (chains) of length  $s$  attached to two nearby stakes and find the point on the vertical surface where their common ends touch. See Figure 7 for an illustration of the procedure. If more samples from the vertical surface are called for, the same principle may be applied, always using the last two points located to find the next one.

### 3. Judgemental Sampling

The inspector or sampling crew may use best judgement to collect samples wherever residual PCB contamination is suspected. These samples are

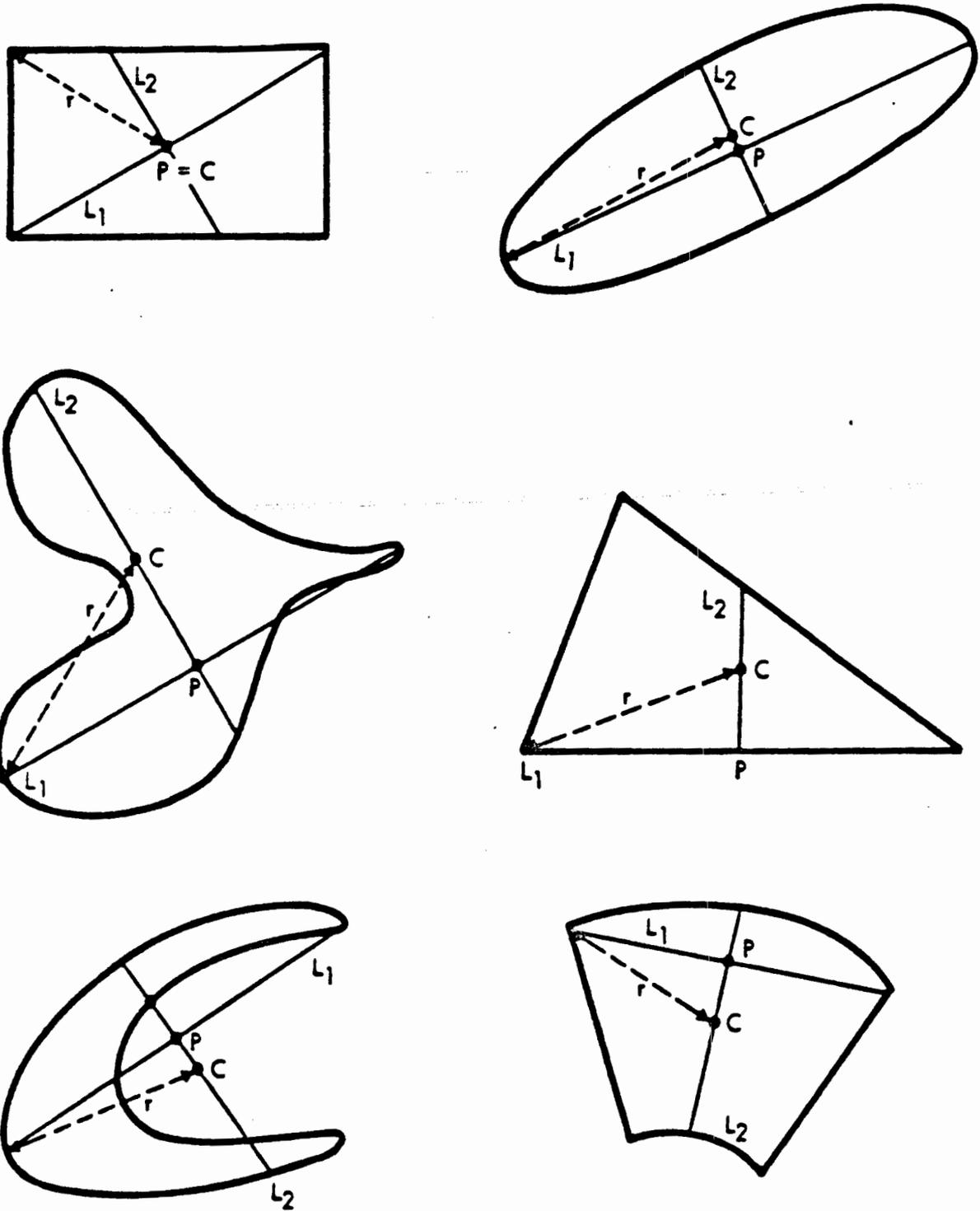


Figure 6. Locating the center and sampling circle radius of an irregularly shaped spill area.

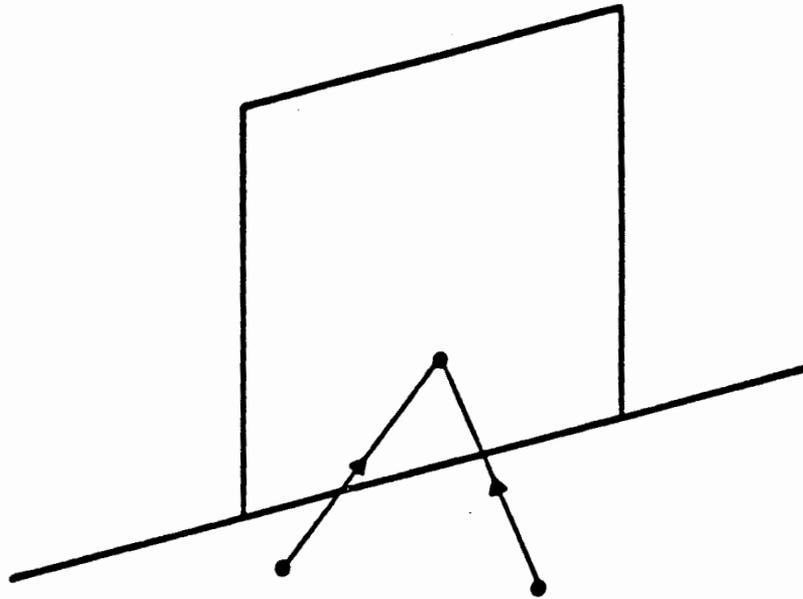


Figure 7. Location of a sampling point on a vertical surface.

in addition to those collected from the sampling grid. Examples of extra sampling points include suspicious stains outside the designated spill area, cracks or crevices, and any other area where the inspector suspects inadequate cleanup.

#### 4. Compositing Strategy for Analysis of Samples

Once the samples have been collected at a site, the goal of the analysis effort is to determine whether at least one sample has a PCB concentration above the allowable limit. This sampling plan assumes the entire spill area will be recleaned if a single sample contaminated above the limit is found. Thus, it is not important to determine precisely which samples are contaminated or even exactly how many. This means that the cost of analysis can be substantially reduced by employing compositing strategies, in which groups of samples are thoroughly mixed and evaluated in a single analysis. If the PCB level in the composite is sufficiently high, one can conclude that a contaminated sample is present; if the level is low enough, all individual samples are clean. For intermediate levels, the samples from which the composite was constructed must be analyzed individually to make a determination. Thus, the number of analyses needed is greatly reduced in the presence of very high levels of contamination in a few samples or in the presence of very low levels in most samples.

For purposes of this discussion, assume that the maximum allowable PCB concentration in a single soil sample is 10 ppm. The calculations can easily be adapted for a different level or for different types of samples. Based on review of the available precision and accuracy data (Erickson 1985), method performance of 80% accuracy and 30% relative standard deviation should be attainable for soil concentrations above 1 ppm.

To protect against false positive findings due to analytical error, the measured PCB level in a single sample must exceed some cutoff greater than 10 ppm for a finding of contamination. Assume that a 0.5% false positive rate for a single sample is desired. As will be shown later, this single sample false positive rate controls the overall false positive rate of the sampling schemes to acceptable levels. Then, using standard statistical techniques, the cutoff level for a single sample is

$$(0.8)(10) + (2.576)(0.3)(0.8)(10) = 14.2 \text{ ppm,}$$

where 0.8(80%) represents the accuracy of the analytical method, 10 ppm is the allowable limit for a single sample, 2.576 is a coefficient from the standard normal distribution, and 0.3(30%) is the relative standard deviation of the analytical method. Thus, if the measured level in a single sample is 14.2 ppm or greater, one can be 99.5% sure that the true level is 10 ppm or greater.

Now suppose that a composite of, say, 7 samples is analyzed. The true PCB level in the composite (assuming perfect mixing) is simply the average of the 7 levels of the individual samples. Let X ppm be the measured PCB level in the composite. If  $X \leq (14.2/7) = 2.0$ , then all 7 individual samples

are rated clean. If  $X > 14.2$ , then at least one individual sample must be above the 10 ppm limit. If  $2.0 < X \leq 14.2$ , no conclusion is possible based on analysis of the composite and the 7 samples must be analyzed individually to reach a decision. These results may be generalized to a composite of any arbitrary number of samples, subject to the limitations noted below.

The applicability of compositing is potentially limited by the size of the individual specimens and by the performance of the analytical method at low PCB levels. First, the individual specimens must be large enough so that the composite can be formed while leaving enough material for individual analyses if needed. For verification of PCB spill cleanup, adequacy of specimen sizes should not be a problem. The second limiting factor is the analytical method. Down to about 1 ppm, the performance of the stipulated analytical methods should not degrade markedly. Therefore, since the assumed permissible level is 10 ppm, no more than about 10 specimens should be composited at a time.

In compositing specimens, the location of the sampling points to be grouped should be taken into account. If a substantial residual area of contamination is present, then contaminated samples will be found close together. Thus, contiguous specimens should be composited, if feasible, in order to maximize the potential reduction in the number of analyses produced by the compositing strategy. Rather than describe a (very complicated) algorithm for choosing specimens to composite, we have graphically indicated some possible compositing strategies in Figures 8 Through 11. Based on the error probability calculations presented in Section 4 below, we recommend the compositing strategies indicated in Table 6. The recommended strategy for the 7-point design requires no explanation. The strategies for the 19- and 37-point cases are shown in Figures 9 and 11, respectively. The strategies shown in Figures 8 and 10 are used in Section 5 for comparison purposes. For details on the reduction in number of analyses expected to result (as compared to individual analyses), see the next Section, 5.

##### 5. Calculations of Average Number of Analyses, and Error Probabilities

Estimates of expected number of analyses and probabilities of false positives (incorrectly deciding the site is contaminated above the limit), and false negatives (failure to detect residual contamination) were obtained for various scenarios. The calculations were performed by Monte Carlo simulation using 5,000 trials for each combination of sample size, compositing strategy, level, and extent of residual contamination. The computations were based on the following assumptions:

a. Only soil samples are involved. In practice other types of samples will often be obtained and analyzed. Although the results of this section are not directly applicable to such cases, they do indicate in general terms the type of accuracy obtainable and the potential cost savings from compositing.

A 2 GROUP COMPOSITING PLAN FOR 7 SAMPLE POINTS

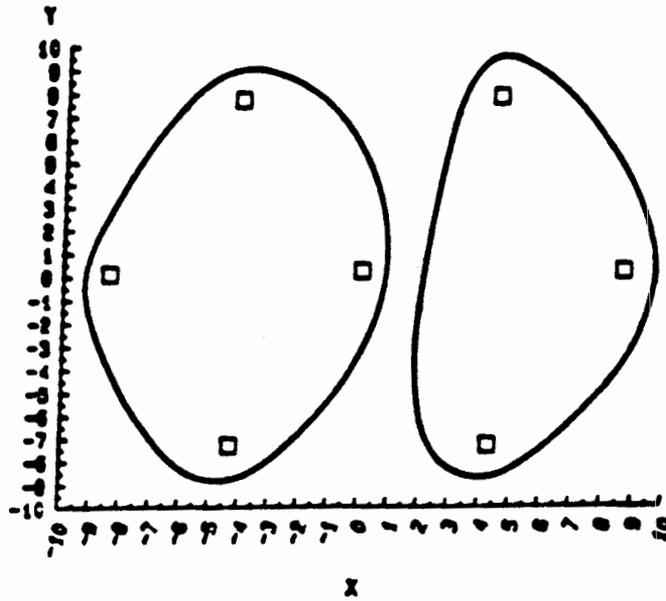


Figure 8

A 2 GROUP COMPOSITING PLAN FOR 19 SAMPLE POINTS

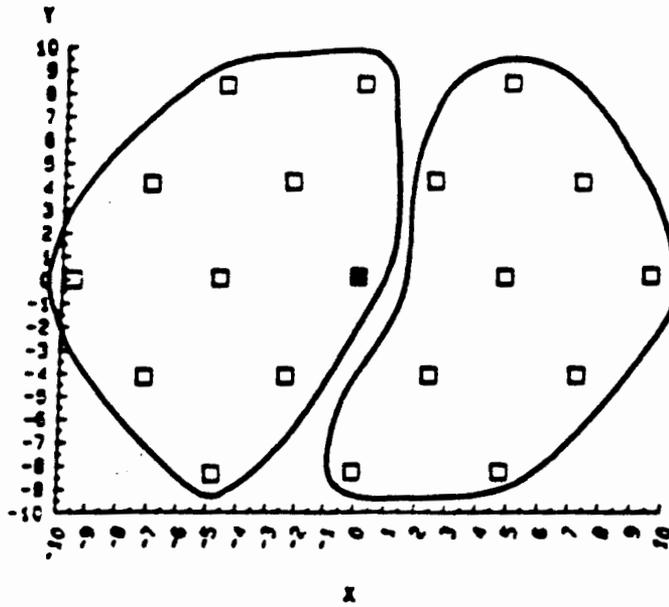


Figure 9

A 6 GROUP COMPOSITING PLAN FOR 19 SAMPLE POINTS

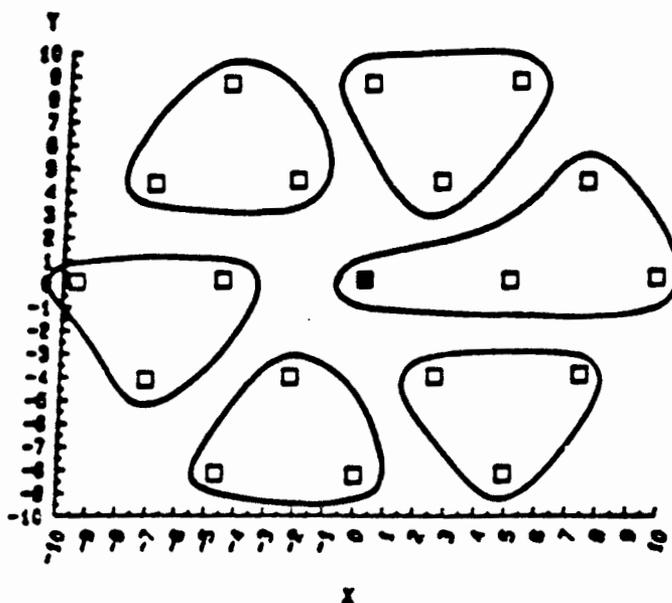


Figure 10. Location of sample points in a 19 sample point plan, with detail of a 2 group compositing design.

A 4 GROUP COMPOSITING PLAN FOR 37 SAMPLE POINTS

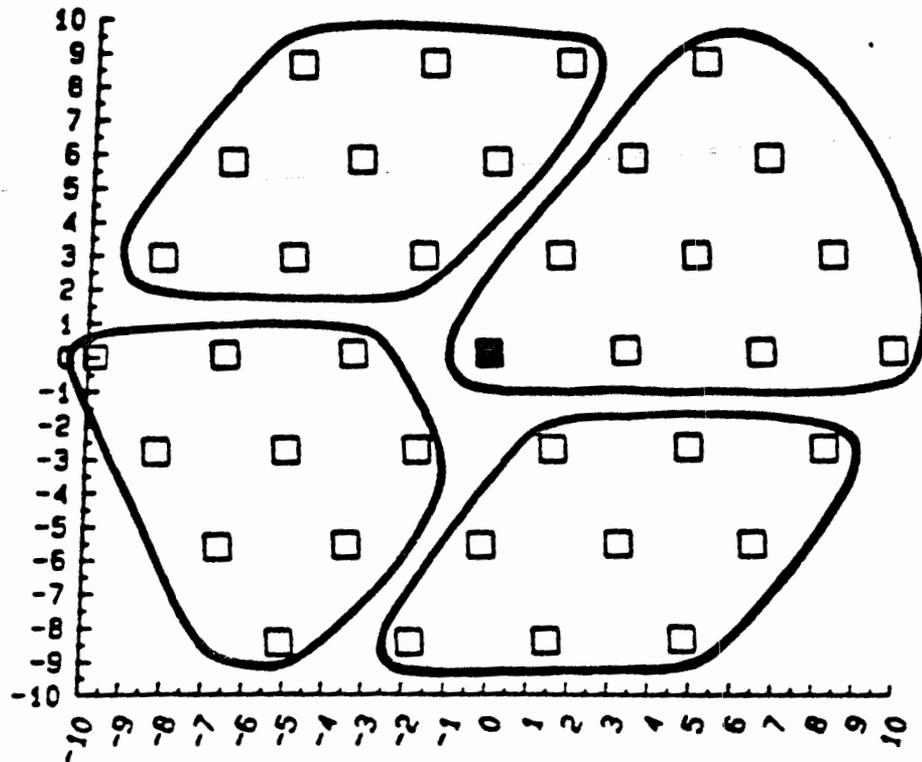


Figure 11. Location of sample points in 37 sample point plan, with detail of a 4 group compositing design.

Table 6. Recommended Compositing Strategies

No. of samples collected	Compositing strategy
7	One group of 7
19	One group of 10, one of 9
37	Three groups of 9, one of 10

b. If the true PCB level in a sample is  $C$ , then the measured value is a normally distributed random variable with mean  $0.8C$  and standard deviation  $(0.3)(0.8C) = 0.24C$ . Thus, it is assumed that the analytical method is 80% accurate, with 30% relative standard deviation.

c. The maximum allowable level in a single sample is 10 ppm. However, the measured level for a single sample must exceed 14.2 ppm for a finding of noncompliance. As previously discussed, this corresponds to a single-sample false positive rate of 0.5%.

d. The residual contamination present is modeled as a randomly placed circle of variable radius and contamination level. The PCB level is assumed to be uniform within the randomly-placed circle and zero outside it.

e. Analysis of samples is terminated as soon as a positive result is obtained on a single analysis. If a composite does not give a definitive result (positive or negative), the individual specimens from which the composite was formed are analyzed in sequence before any other composite.

f. The compositing strategies used are shown in Figures 8 and 11.

The results of the computations are shown in Tables 7 through 20. Tables 7 through 12 show the performance of the compositing strategies recommended in Section 3. For each strategy, there is a pair of tables. The first table shows the probability of reporting a violation of a 10 ppm cleanup standard, for different levels of residual contamination and percent of cleanup area contaminated. When the contamination level is 10 ppm or less, the number in the table is the probability of a false positive, i.e., a false finding of noncompliance. These probabilities are all very low, as they should be. When the level is above 10 ppm, the number in the table is the probability that a violation will be detected by the sampling design. For levels close to 10 ppm, and for small percentages of cleanup area residually contaminated, the detection probability is low. When the level is high and the percent of area contaminated is large, however, detection probability approaches 100%. For small areas with high contamination, detection capability is modest. This is because there is only a small chance that the contaminated area will be sampled. Similarly, detection capability is also modest for large areas contaminated near the 10 ppm limit. The reason for this is that, even though a number of contaminated samples will be found in such cases, the analytical method is not likely to give positive identification of levels near the 10 ppm cutoff. This is the price paid for reducing the single-sample false positive rate to 0.5%.

The second table for each compositing strategy shows the expected (average) number of analyses needed to reach a decision. For a fixed percent of area contaminated, the smallest number of analyses is needed if the level of contamination is very high or very low. For intermediate levels, more analyses are needed. The largest number of analyses are required with a large area contaminated at close to 10 ppm. In such a situation, the levels of the composite(s) will mostly lie in the intermediate range for which no conclusion is possible based on analysis of the composite. Thus, individual analyses will almost always be required, so that the advantage of compositing is lost.

Tables 13 through 20 compare the recommended compositing strategies for the 7-point and 19-point designs to alternative compositing strategies for these designs, for 4 different contaminated percentages (1%, 9%, 25%, and 49%). The comparison is based on the expected number of analyses required. Overall detection capabilities are comparable for the different strategies. The tables show that the recommended strategies are best, except for larger areas contaminated close to the 10 ppm level.

Table 7. Probability of Declaring a Violation of a 10 ppm Cleanup Standard, for the 7 Point, 1 Composite Design<sup>a</sup>

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	8	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	10	< 0.001	< 0.001	< 0.001	< 0.001	0.002	0.007
Noncompliant	11	< 0.001	< 0.001	< 0.001	< 0.001	0.009	0.032
	12	< 0.001	0.001	0.001	0.002	0.017	0.092
	13	0.001	0.005	0.005	0.009	0.045	0.184
	14	0.003	0.010	0.019	0.028	0.085	0.298
	15	0.006	0.016	0.039	0.065	0.134	0.396
	16	0.009	0.029	0.064	0.102	0.202	0.517
	18	0.019	0.074	0.137	0.218	0.344	0.655
	20	0.030	0.110	0.199	0.335	0.479	0.787
	25	0.048	0.186	0.342	0.554	0.736	0.905
	50	0.070	0.245	0.487	0.767	0.977	0.989
	75	0.071	0.245	0.496	0.787	0.992	0.995
	100	0.068	0.255	0.499	0.800	0.995	0.997
	150	0.070	0.246	0.481	0.796	0.998	0.999
	200	0.073	0.254	0.489	0.806	> 0.999	> 0.999
300	0.069	0.257	0.494	0.792	> 0.999	> 0.999	
500	0.070	0.242	0.492	0.811	> 0.999	> 0.999	

<sup>a</sup>Seven samples analyzed first as a composite, then individually if necessary to reach a decision.

Table 8. Expected Number of Analyses to Decide Compliance or Violation, for a 10 ppm Cleanup Standard, for the 7-Point, 1-Composite Design<sup>a</sup>

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	4	1.00	1.00	1.00	1.00	1.00	1.11
	6	1.00	1.00	1.00	1.00	1.06	2.31
	8	1.00	1.00	1.00	1.00	1.44	3.96
	10	1.00	1.01	1.02	1.03	1.75	4.96
Noncompliant	11	1.01	1.04	1.05	1.11	2.01	5.31
	12	1.04	1.08	1.17	1.32	2.21	5.39
	13	1.04	1.18	1.40	1.59	2.56	5.35
	14	1.10	1.32	1.63	2.02	2.86	5.18
	15	1.13	1.45	1.85	2.35	3.22	4.90
	16	1.15	1.52	2.03	2.67	3.50	4.71
	18	1.19	1.69	2.41	3.18	3.95	4.36
	20	1.24	1.85	2.57	3.59	4.19	4.04
	25	1.26	1.98	2.85	3.84	4.47	3.61
	50	1.28	1.96	2.93	3.99	4.45	2.96
	75	1.28	1.94	2.93	3.98	4.23	2.26
	100	1.21	1.79	2.53	3.45	3.54	1.87
	150	1.09	1.28	1.52	1.86	1.89	1.30
	200	1.03	1.11	1.15	1.34	1.33	1.13
	300	1.01	1.01	1.04	1.09	1.06	1.03
	500	1.00	1.00	1.01	1.02	1.02	1.01

<sup>a</sup>Seven samples analyzed first as a composite, then individually if necessary to reach a decision.

Table 9. Probability of Declaring a Violation of a 10 ppm Cleanup Standard, for the 19 Point, 2 Composite Design<sup>a</sup>

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	8	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	10	< 0.001	< 0.001	0.002	0.007	0.015	0.028
Noncompliant	11	< 0.001	< 0.001	0.007	0.034	0.058	0.017
	12	0.001	0.002	0.029	0.084	0.153	0.281
	13	0.003	0.007	0.062	0.179	0.304	0.497
	14	0.005	0.021	0.114	0.304	0.455	0.693
	15	0.012	0.052	0.178	0.407	0.606	0.832
	16	0.025	0.083	0.264	0.518	0.744	0.908
	18	0.046	0.167	0.421	0.698	0.883	0.978
	20	0.077	0.263	0.556	0.812	0.945	0.993
	25	0.125	0.461	0.784	0.923	0.990	0.999
	50	0.161	0.631	0.978	0.992	0.999	> 0.999
	75	0.171	0.651	0.993	0.997	> 0.999	> 0.999
	100	0.168	0.642	0.994	0.999	> 0.999	> 0.999
	150	0.166	0.657	0.998	0.999	> 0.999	> 0.999
200	0.175	0.648	0.999	0.999	> 0.999	> 0.999	
300	0.168	0.654	0.999	> 0.999	> 0.999	> 0.999	
500	0.180	0.661	0.999	> 0.999	> 0.999	> 0.999	

<sup>a</sup>Nineteen samples analyzed first as two composites, then individually if necessary to reach a decision.

Table 10. Expected Number of Analyses to Decide Compliance or Violation, for a 10 ppm Cleanup Standard, for the 19-Point, 2-Composite Design<sup>a</sup>

Level of residual PCB contamination (ppm)		Percent of cleanup area with residual PCB contamination					
		1	4	9	16	25	49
Compliant	4	2.00	2.00	2.00	2.18	3.30	7.49
	6	2.00	2.00	2.00	3.79	6.70	11.22
	8	2.00	2.00	3.01	6.15	9.20	13.18
	10	2.01	2.03	3.72	7.46	10.55	14.02
Noncompliant	11	2.03	2.14	4.07	7.90	10.74	13.81
	12	2.10	2.32	4.57	8.08	10.67	12.78
	13	2.21	2.74	4.84	7.94	9.95	11.00
	14	2.25	3.02	5.16	7.90	9.31	9.27
	15	2.37	3.40	5.50	7.65	8.42	7.80
	16	2.49	3.84	5.89	7.30	7.59	6.63
	18	2.60	4.36	6.11	6.57	6.29	5.02
	20	2.68	4.65	6.26	6.18	5.48	4.25
	25	2.82	5.02	6.20	5.45	4.57	3.36
	50	2.80	5.03	5.96	4.70	3.48	2.28
	75	2.80	5.05	5.69	3.68	2.63	1.84
	100	2.77	4.95	5.37	3.46	2.26	1.69
	150	2.53	3.94	3.99	2.59	1.80	1.46
	200	2.21	2.67	2.61	1.91	1.55	1.33
	300	1.99	1.89	1.70	1.50	1.34	1.19
500	1.92	1.69	1.48	1.39	1.30	1.16	

<sup>a</sup>Nineteen samples analyzed first as two composites, then individually if necessary to reach a decision.

Table 11. Probability of Declaring a Violation of a 10 ppm Cleanup Standard, for the 37 Point, 4 Composite Design<sup>a</sup>

Level of residual PCB contamination (ppm)	Percent of cleanup area with residual PCB contamination						
	1	4	9	16	25	49	
Compliant	8	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	10	< 0.001	0.002	0.010	0.022	0.031	0.060
Noncompliant	11	0.001	0.008	0.041	0.084	0.124	0.225
	12	0.001	0.024	0.103	0.217	0.305	0.488
	13	0.005	0.053	0.224	0.388	0.536	0.751
	14	0.012	0.094	0.360	0.575	0.726	0.908
	15	0.023	0.159	0.501	0.740	0.859	0.950
	16	0.039	0.242	0.621	0.831	0.936	0.991
	18	0.091	0.390	0.785	0.940	0.985	> 0.999
	20	0.147	0.542	0.884	0.981	0.996	> 0.999
	25	0.249	0.771	0.958	0.995	0.999	> 0.999
	50	0.340	0.976	0.997	0.999	0.999	> 0.999
	75	0.343	0.991	0.999	0.999	> 0.999	> 0.999
	100	0.353	0.993	0.999	> 0.999	> 0.999	> 0.999
	150	0.339	0.997	> 0.999	> 0.999	> 0.999	> 0.999
	200	0.357	0.996	> 0.999	> 0.999	> 0.999	> 0.999
300	0.344	0.997	> 0.999	> 0.999	> 0.999	> 0.999	
500	0.348	0.999	> 0.999	> 0.999	> 0.999	> 0.999	

<sup>a</sup>Thirty-seven samples analyzed first as four composites, then individually if necessary to reach a decision.

Table 12. Expected Number of Analyses to Decide Compliance or Violation, for a 10 ppm Cleanup Standard, for the 37-Point, 4-Composite Design<sup>a</sup>

Level of residual PCB contamination (ppm)	Percent of cleanup area with residual PCB contamination						
	1	4	9	16	25	49	
Compliant	4	4.00	4.01	4.41	6.72	9.85	15.69
	6	4.00	4.15	6.66	10.22	13.48	19.36
	8	4.00	4.77	9.01	12.76	15.98	22.08
	10	4.02	5.36	10.56	14.29	17.18	23.04
Noncompliant	11	4.07	5.69	10.87	14.29	16.93	21.28
	12	4.18	5.97	10.94	13.74	15.68	17.84
	13	4.35	6.28	10.56	12.74	13.44	13.54
	14	4.57	6.78	10.21	11.21	11.13	10.10
	15	4.73	7.04	9.60	9.71	9.33	7.78
	16	4.90	7.33	9.08	8.77	7.83	6.12
	18	5.09	7.59	8.02	7.05	6.16	4.71
	20	5.26	7.74	7.28	6.26	5.30	3.96
	25	5.34	7.55	6.53	5.28	4.37	3.08
	50	5.27	7.14	5.39	3.78	3.06	2.16
	75	5.23	6.84	4.31	3.04	2.55	1.90
	100	5.22	6.43	3.73	2.64	2.32	1.73
	150	4.55	4.89	3.02	2.37	2.07	1.57
	200	3.95	3.57	2.53	2.15	1.90	1.52
300	3.59	2.67	2.28	2.04	1.81	1.44	
500	3.49	2.48	2.22	1.99	1.79	1.44	

<sup>a</sup>Thirty-seven samples analyzed first as four composites, then individually if necessary to reach a decision.

Table 13. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 7-Point Design, When an Area 1% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		1 Composite	2 Composites	Individually
Compliant	4	1.00	2.00	7.00
	8	1.00	2.00	7.00
	10	1.00	2.00	7.00
Noncompliant	12	1.04	2.02	6.98
	14	1.10	2.05	6.96
	16	1.15	2.07	6.92
	20	1.24	2.10	6.88
	25	1.26	2.11	6.84
	50	1.28	2.09	6.80
	100	1.21	1.98	6.78
	200	1.03	1.96	6.80
	500	1.00	1.96	6.81

Table 14. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 7-Point Design, When an Area 9% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		1 Composite	2 Composites	Individually
Compliant	4	1.00	2.00	7.00
	8	1.00	2.00	7.00
	10	1.02	2.01	6.99
Noncompliant	12	1.17	2.09	6.91
	14	1.63	2.32	6.69
	16	2.03	2.50	6.49
	20	2.57	2.77	6.05
	25	2.85	2.79	5.65
	50	2.93	2.60	5.45
	100	2.53	1.85	5.46
	200	1.15	1.72	5.45
	500	1.01	1.17	5.45

Table 15. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 7-Point Design, When an Area 25% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		1 Composite	2 Composites	Individually
Compliant	4	1.00	2.00	7.00
	8	1.44	2.13	7.00
	10	1.71	2.24	6.98
Noncompliant	12	2.21	2.44	6.81
	14	2.86	2.84	6.29
	16	3.50	3.23	5.64
	20	4.19	3.54	4.68
	25	4.47	3.56	4.12
	50	4.45	2.97	3.58
	100	3.54	1.61	3.51
	200	1.33	1.38	3.50
	500	1.02	1.37	3.50

Table 16. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 7-Point Design, When an Area 49% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		1 Composite	2 Composites	Individually
Compliant	4	1.11	2.02	7.00
	8	3.96	2.99	7.00
	10	4.96	3.50	6.96
Noncompliant	12	5.39	3.81	6.61
	14	5.18	3.94	5.79
	16	4.71	3.86	4.82
	20	4.04	3.49	3.53
	25	3.61	3.03	2.87
	50	2.96	2.22	2.40
	100	1.87	1.36	2.40
	200	1.13	1.23	2.39
	500	1.01	1.20	2.39

Table 17. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 19-Point Design, When an Area 1% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		2 Composites	6 Composites	Individually
Compliant	4	2.00	6.00	19.00
	8	2.00	6.00	19.00
	10	2.01	6.00	19.00
Noncompliant	12	2.10	6.03	18.93
	14	2.25	6.07	18.74
	16	2.49	6.11	18.46
	20	2.68	6.07	18.06
	25	2.82	6.01	17.75
	50	2.80	5.80	17.49
	100	2.77	5.56	17.46
	200	2.21	5.53	17.46
	500	1.92	5.57	17.46

Table 18. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 19-Point Design, When an Area 9% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		2 Composites	6 Composites	Individually
Compliant	4	2.00	6.00	19.00
	8	3.01	6.19	19.00
	10	3.72	6.32	18.96
Noncompliant	12	4.57	6.54	18.40
	14	5.16	6.74	16.90
	16	5.89	6.83	14.86
	20	6.26	6.33	11.89
	25	6.20	5.74	10.22
	50	5.96	4.45	8.94
	100	5.37	3.34	8.64
	200	2.61	3.17	8.63
	500	1.48	3.17	8.62

Table 19. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 19-Point Design, When an Area 25% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		2 Composites	6 Composites	Individually
Compliant	4	3.30	6.07	19.00
	8	9.20	7.73	19.00
	10	10.55	8.44	18.83
Noncompliant	12	10.67	8.47	17.31
	14	9.31	7.67	13.72
	16	7.59	6.57	10.58
	20	5.48	5.09	6.25
	25	4.57	4.24	4.35
	50	3.48	3.22	3.34
	100	2.26	2.51	3.29
	200	1.55	2.41	3.26
	500	1.30	2.43	3.23

Table 20. Comparison of Expected Number of Analyses for Different Compositing Strategies for the 19-Point Design, When an Area 49% of the Size of the Cleanup Site Remains Contaminated

Level of residual PCB contamination (ppm)		2 Composites	6 Composites	Individually
Compliant	4	7.49	6.28	19.00
	8	13.18	9.85	19.00
	10	14.02	10.84	18.73
Noncompliant	12	12.78	10.10	16.15
	14	9.27	7.78	11.34
	16	6.63	5.87	7.14
	20	4.25	3.92	3.74
	25	3.36	3.23	2.61
	50	2.28	2.46	2.10
	100	1.69	1.85	2.06
	200	1.33	1.79	2.04
	500	1.16	1.78	2.02

The major conclusions that can be drawn from these results are as follows. First, the proposed cutoff on the measured PCB level for a finding of noncompliance for a single sample, 14.2 ppm, is successful in controlling the overall false positive rate of the sampling scheme. For example, when an area half the size of the entire site remains contaminated just at the allowable limit of 10 ppm, the false positive rate is 1% for the 7-point design, 3% for the 19-point design, and 6% for the 37-point design. Note, that the overall false-positive rate is highest for contamination just at the allowable limit. Second, the detection capabilities of the design appear satisfactory, bearing in mind the difficulty of detecting randomly-located contamination by any sampling scheme without exhaustive sampling. As an example, the proposed 19-point design can detect 50 ppm contamination present in 9% of the cleanup area with 98% probability. Similarly, the 19-point design can detect 20 ppm contamination present in 25% of the area with 95% probability. Third, the proposed compositing strategies are quite effective in reducing the number of analyses needed to reach a decision in all cases except those involving large areas contaminated near the cutoff of 10 ppm. For example, for contaminated levels of 25 ppm or greater, the expected number of analyses to reach a decision never exceeds 5 for the 7-point design, or 7 for the 19-point design, or 8 for the 37-point design. Larger number of analyses are needed in cases of contamination close to the allowable limit of 10 ppm, up to 23 for the 37-point design when 49% of the area is contaminated at 10 ppm.

## B. Sampling Techniques

The types of media to be sampled will include soil, water, vegetation and solid surfaces (concrete, asphalt, wood, etc.). General sampling methods are described below. Additional sampling guidance documents are available (Mason 1982, USWAG 1984).

### 1. Solids Sampling

When soil, sand, or sediment samples are to be taken, a surface scrape samples should be collected. Using a 10 cm x 10 cm (100 cm<sup>2</sup>) template to mark the area to be sampled, the surface should be scraped to a depth of 1 cm with a stainless steel trowel or similar implement. This should yield at least 100 g soil. If more sample is required, expand the area but do not sample deeper. Use a disposable template or thoroughly clean the template between samples to prevent contamination of subsequent samples. The sample should be scraped directly into a precleaned glass bottle. If it is free-flowing, the sample should be thoroughly homogenized by tumbling. If not, successive subdivision in a stainless steel bowl should be used to create a representative subsample.

In some cases, such as sod, scrape samples may not be appropriate. For these cases, core samples, not more than 5 cm deep, should be taken using a soil coring device. These core samples should be well-homogenized in a stainless steel bowl by successive subdivision. A portion of each sample should then be removed, weighed and analyzed.

Samples should be stored in the dark at 4°C in precleaned glass bottles. If samples are to be analyzed quickly, the storage requirements may be relaxed as long as sample integrity is maintained. Before collection of

verification samples, this equipment must be used to generate a field blank as described in Section IV.E.

## 2. Water Sampling

### a. Surface Sampling

If PCBs dissolved in a hydrocarbon oil were spilled, they will most likely be dispersed on the surface. Therefore, a surface water collection technique should be used. Surface water samples should be collected by grab techniques. Where appropriate, the precleaned glass sample bottle may be dipped directly into the body of water at the designated sample collection point. A sample is collected from the water surface by gently lowering a precleaned sample bottle horizontally into the water until water begins to run into it. The bottle is then slowly turned upright keeping the lip just under the surface so that the entire sample is collected from the surface.

### b. Subsurface Sampling

If the PCBs were in an Askarel or other heavier-than-water matrix, the PCBs will sink. In these cases water near the bottom should be collected. To collect subsurface water, the bottle should be lowered to the specified depth with the cap on. The cap is then removed, the bottle allowed to fill, and the bottle brought to the surface.

### c. Other Sampling Approaches

When the above approaches are not feasible, other dippers, tubes, siphons, pumps, etc., may be used to transfer the water to the sample bottle. The sampling system should be of stainless steel, Teflon, or other inert, impervious, and noncontaminating material. Before collection of samples, this equipment must be used to generate a field blank as described in Section IV.E.

### d. Sample Preservation

The bottle is then lifted out of the water, capped with a PTFE- or foil-lined lid, identified with a sample number, and stored at approximately 4°C (USEPA 1984a) until analysis to retard bacterial growth. If samples are to be analyzed quickly, the storage requirements may be relaxed as long as sample integrity is maintained.

## 3. Surface Sampling

### a. Wipe Samples

If the surface to be sampled is smooth and impervious (e.g., rain gutters, aluminum house siding), a wipe sample should indicate whether the cleanup has sufficiently removed the PCBs. These surfaces should be sampled by first applying an appropriate solvent (e.g., hexane) to a piece of 11 cm filter paper (e.g., Whatman 40 ashless, Whatman "50" smear tabs, or equivalent) or gauze pad. This moistened filter paper or gauze pad is held with a pair of stainless steel forceps and used to thoroughly swab a 100-cm<sup>2</sup> area as measured by a sampling template.

Care must be taken to assure proper use of a sampling template. Different templates may be used for the variously shaped areas which must be sampled. A 100 cm<sup>2</sup> area may be a 10 cm x 10 cm square, a rectangle (e.g., 1 cm x 100 cm or 5 cm x 20 cm), or any other shape. The use of a template assists the sampler in the collection of a 100 cm<sup>2</sup> sample and in the selection of representative sampling sites. When a template is used it must be thoroughly cleaned between samples to prevent contamination of subsequent samples by the template.

The wipe samples should be stored in precleaned glass jars at 4°C. Before collection of verification samples, the selected filter paper or gauze pad and solvent should be used to generate a field blank as described in Section IV.E.

#### b. Sampling Porous Surfaces

Wipe sampling is inappropriate for surfaces which are porous and would absorb PCBs. These include wood and asphalt. Where possible, a discrete object (e.g., a paving brick) may be removed. Otherwise, chisels, drills, saws, etc., may be used to remove a sufficient sample for analysis. Samples less than 1 cm deep on the surface most likely to be contaminated with PCBs should be collected.

#### 4. Vegetation Sampling

The sample design or visual inspection may indicate that samples of vegetation (such as leaves, bushes, and flowers) are required. In this case, samples may be taken with pruning shears, a saw, or other suitable tool and placed in a precleaned glass bottle.

#### C. Analytical Techniques

A number of analytical techniques have been used for analysis of PCBs in the types of samples which may be associated with PCB spills. Some of the candidate analytical methods are listed in Table 21. The analysis method(s) most appropriate for a given spill will depend upon a number of factors. These include sensitivity required, precision and accuracy required, potential interferences, ultimate use of the data, experience of the analyst, availability of laboratory equipment, and number of samples to be analyzed.

As shown in Table 21, many analytical methods are available. The general analytical techniques are discussed and then compared below.

##### 1. Gas Chromatography (GC)

As can be seen in Table 21, analysis of PCBs by gas chromatography is frequently the method of choice. PCBs are chromatographed using either packed or capillary columns and may be detected using either specific detectors or mass spectrometry. A comprehensive method for analysis of PCBs in transformer fluid and waste oils was developed by Bellar and Lichtenberg (1982). This method describes six different cleanup techniques, recommends three GC detectors, and suggests procedures for GC calibration and for measurement of precision and accuracy. This method also discusses several calculation methods.

Table 71 Standard Procedures of Analysis for PCBs

Procedure designation	Matrix	Extraction	Cleanup <sup>c</sup>	Determination method	Qualitative assessment	Quantitation method	LOD	QC discussed	Reference
D3534-80	Water	Hexane/CH <sub>2</sub> Cl <sub>2</sub>	Florisil (Silica Gel)	PGC/ECD <sup>d</sup>	No	Total area or Webb-McCall	0.1 µg/L	No	ASIM, 1981a
608	Water	CH <sub>2</sub> Cl <sub>2</sub>	Florisil (S removal)	PGC/ECD	No	Area	0.04-0.15 µg/L	Yes	EPA, 1984a; Longhollm and Lichtenberg, 1982
625	Water	CH <sub>2</sub> Cl <sub>2</sub>	None	PGC/EIMS (LGC)	Yes	Area	30-36 µg/L	Yes	EPA, 1984b; Longhollm and Lichtenberg, 1982
304h	Water	Hexane/CH <sub>2</sub> Cl <sub>2</sub> (85/15)	Florisil/silica gel (CH <sub>2</sub> Cl <sub>2</sub> ) (S removal)	PGC/ECD or HCD	Yes	Summed areas or Webb-McCall	NS	Yes	EPA, 1978
EPA (by-products)	Water	Several	Several	HRCG/EIMS	Yes	Ind. peaks	NS	Yes	Erickson et al., 1987, 1983d; EPA, 1984c
ANSI	Water	Hexane	(H <sub>2</sub> SO <sub>4</sub> ) (Saponification) Alumina	PGC/ECD	No	Single peak or summed peaks	2 ppb	Yes	ANSI, 1974
Monsanto	Water	Hexane	Alumina	PGC/ECD	No	Individual or total peak heights	2 ppb	No	Moeln, 1976
UK-DOE	Water	Hexane	Silica gel	PGC/ECD	No	NS	106 ng/L	No	UK-DOE, 1979; Devenish and Harling-Bowen, 1980
D3304-74	Air Water Soil, sediment	DI Hexane H <sub>2</sub> O/CH <sub>2</sub> Cl <sub>2</sub>	(H <sub>2</sub> SO <sub>4</sub> ) (Saponification) (Alumina)	PGC/ECD	No	Total area	NS	Yes	ASIM, 1981b
EPA (homolog)	Solids and liquids	Several	Several	HRCG/EIMS	Yes	Ind. peaks	NS	Yes	Erickson et al., 1985a
EPA 625-5	Sludge	CH <sub>2</sub> Cl <sub>2</sub>	Florisil, Silica gel, or GPC	HRCG/EIMS or PGC/EIMS	Yes	Area	NS	Yes	Walle and Lopez-Avila, 1984

Table 21 (Continued)

Procedure designation	Matrix	Extraction	Cleanup <sup>c</sup>	Determination method	Qualitative assessment	Quantitation method	LOD	QC discussed	Reference
EPA (Halocarbon)	Sludge	Hexane/ CH <sub>2</sub> Cl <sub>2</sub> / acetone (R3/15/2)	GPC S removal	PGC/ECD	Yes	Peak area or peak height	NS	Yes	Rodriguez et al., 1980
Priority Pollutant	Sludge	CH <sub>2</sub> Cl <sub>2</sub> (base/ neutral and acid fractions)	GPC	PGC/EIMS	Yes	NS	NS	Yes	EPA, 1979c
B100	Sludge	CH <sub>2</sub> Cl <sub>2</sub> (3 fractions)	GPC Silica gel	HRC/EIMS or PGC/EIMS	Yes	NS	NS	Yes	Ballinger, 1978
B080	Solid waste	CH <sub>2</sub> Cl <sub>2</sub>	(Florisil)	PGC/ECD	No	Area	1 µg/g	Yes	EPA, 1982e
B250	Solid waste	CH <sub>2</sub> Cl <sub>2</sub>	None	PGC/EIMS	No	NS	1 µg/g	Yes	EPA, 1982e
B270	Solid waste	CHCl <sub>3</sub>	None	EGC/EIMS	No	NS	1 µg/g	Yes	EPA, 1982e
EPA (spills)	Unspecified	Hexane/ acetone	(CH <sub>3</sub> CN) (Florisil) (Silica gel) (Mercury)	PGC/ECD	No	Total area or Webb-McCall	NS	No	Beard and Schaum, 1978
EPA	Soil and Sediment	Acetone/ Hexane	Florisil Silica gel (S removal)	PGC/ECD	No	Computer	NS	Yes	EPA, 1982d
Monsanto	Sediment	CH <sub>3</sub> CN	Saponification H <sub>2</sub> SO <sub>4</sub> Alumina	PGC/ECD	No	Individual or total peak heights	2 ppb	No	Moelin, 1976
ANSI	Sediment, soil	CH <sub>3</sub> CN	Saponification H <sub>2</sub> SO <sub>4</sub> Alumina	PGC/ECD	No	Single peak or summed peaks	2 ppm	Yes	ANSI, 1974
EPA (by- products)	Air collected on Florisil or XAD-2	Hexane	(H <sub>2</sub> SO <sub>4</sub> ) (Florisil)	HRC/EIMS	Yes	Ind. peaks	NS	Yes	Erickson et al., 1982, 1983d; Erickson, 1984b
EPA (ambient air)	Air near haz- ardous waste sites col- lected on PUF	Hexane/ ether	Alumina	PGC/ECD	No	Total area or peak height	10-50 ng/m <sup>3</sup>	No	Lewis, 1982

Table 21 (Continued)

Procedure designation	Matrix	Extraction	Cleanup <sup>c</sup>	Determination method	Qualitative assessment	Quantitation method	LOD	QC discussed	Reference
EPA (stack)	Incinerator emissions and ambient air collected on floristil	Hexane	(H <sub>2</sub> SO <sub>4</sub> )	Perchlorination PGC/ECD	No	Area	10 ng	No	Malle and Baladi, 1977; Beard and Schaum, 1978
EPA	Combustion sources collected on floristil	Pentane or CH <sub>2</sub> Cl <sub>2</sub>	(floristil/silica gel)	PGC/MS	Yes	Area/homolog	0.1 ng/lm <sup>3</sup>	No	Levins et al., 1979
EPA (incinerators)	Stack gas	Pentane/methanol		PGC/MS	Yes	Single peak	MS	Yes	Beard and Schaum, 1978
AMSI	Air (toluene impinger)		(H <sub>2</sub> SO <sub>4</sub> ) (Saponification) (Alumina)	PGC/ECD	No	Single peak	2 ppb	Yes	AMSI, 1974
NIOSH (PACOM 200)	Air collected on floristil	Hexane	None	PGC/ECD	No	Peak height or area from standard curve or Webb-McCall	0.01 ng/m <sup>3</sup>	No	NIOSH, 1977a
NIOSH (PACOM 753)	Air collected on floristil	Hexane	None	PGC/ECD Perchlorination	No	Peak height or area from standard curve	0.01 ng/m <sup>3</sup>	No	NIOSH, 1977b,c
EPA (gas)	Natural gas sampled with floristil	Hexane	H <sub>2</sub> SO <sub>4</sub>	PGC/ECD	No	Total area, peak height or Webb-McCall (Perchlorination)	0.1-2 µg/m <sup>3</sup>	No	Harris et al., 1981
EPA (5,A,(1))	Blood	Hexane	(floristil)	PGC/ECD	No	MS	MS	No	Watts, 1980
EPA (5,A,(1))	Adipose	Pet. ether/CH <sub>2</sub> Cl <sub>2</sub>	floristil	PGC/ECD	No	MS	MS	Yes	Watts, 1980
EPA (9,B)	Adipose	Pet. ether/CH <sub>2</sub> Cl <sub>2</sub>	Saponification floristil	IIC	No	Sealiquant.	10 ppm	No	Watts, 1980
EPA (9,B)	Milk	Acetone/hexane	CH <sub>2</sub> Cl <sub>2</sub> floristil Silica acid	PGC/ECD	Yes	Ind. peaks	50 ppb	Yes	Watts, 1980 Sherma, 1981



Table 21 (Continued)

Procedure designation	Matrix	Extraction	Cleanup <sup>c</sup>	Determination method	Qualitative assessment	Quantitation method	LOD	QC discussed	Reference
AOAC (29)	Food	CH <sub>2</sub> Cl <sub>2</sub> /Pet. ether	Florisil MgO/ Celite Saponification	PGC/ECD	No	Total area or Ind. peaks	NS <sup>a</sup>	No	AOAC, 1980a
Japan	Food	Pet. ether/ CH <sub>2</sub> Cl <sub>2</sub>	Silica gel Saponification (Florisil)	PGC/ECD	Yes	Summed areas perchlorination	NS	No	Ianobe, 1976
PMI	Food	Pet. ether/ CH <sub>2</sub> Cl <sub>2</sub>	Silicic acid (Saponification) (Oxidation) (Florisil)	PGC/ECD (PGC/MECD) (MP-TIC) (RP-TIC)	No	Area	NS	No	FDA, 1977
AOAC (29)	Paper and paperboard	Saponifica- tion	Florisil MgO/ Celite Saponification	PGC/ECD	No	Total area or Ind. peaks	NS <sup>a</sup>	No	AOAC, 1980b
D3303-74	Capacitor Asbestos	DI <sup>b</sup>	None	SCOT HRGC/FID	No	Total area	2.0 x 10 <sup>-6</sup> mol/L	No	ASTM, 1980a
D4059-83	Mineral oil	Dilute with hexane or isooctane	Florisil slurry (H <sub>2</sub> SO <sub>4</sub> ) (Florisil column)	PGC/ECD (PGC/MECD)	Yes	Ind. peaks or Webb-McCall	50 ppm	No	ASTM, 1983
EPA (oil)	Transformer fluids or waste oils	DI	(H <sub>2</sub> SO <sub>4</sub> ) (Florisil) (Alumina) (Silica gel) (GPC), (CH <sub>2</sub> Cl <sub>2</sub> )	PGC/MECD or /ECD or /EIMS (HRGC)	No	Total area or Webb-McCall	1 mg/kg	Yes	EPA, 1981 Dellar and Lichtenberg, 1981
EPA (by- products)	Products or wastes	Several	Several	HRGC/EIMS	Yes	Ind. peaks	NS	Yes	Erickson et al., 1982, 1983d; Erickson, 1984a
BCMA	3 pigment types	A. Hexane/ H <sub>2</sub> SO <sub>4</sub> B. CH <sub>2</sub> Cl <sub>2</sub>	None Florisil	PGC/ECD	No	10 isomers	< 1 ppm/homolog	Yes	BCMA, 1982
DOV	Chlorinated benzenes	DI	None	PGC/EIMS	Yes	Total peak height/homolog	NS	Yes	Dow, 1981
EPA (isomer groups)	Unspecified	Not addressed	Not addressed	HRGC/EIMS	Yes	Ind. peaks	NS	Yes	EPA, 1984d

Source: W. D. Erickson, The Analytical Chemistry of PCBs, Butterworths, Boston, MA, 1985, In press.

a No specific details.

b Direct injection or dilute and inject.

c Techniques in parentheses are described as optional in the procedure

d Or PGC with microcoulometric or electrolytic conductivity

a. Gas Chromatograph/Electron Capture Detection

Packed column gas chromatography with electron capture detection (GC/ECD) is generally the method of choice for analysis of spill site samples, transformer oils, and other similar matrices which must be analyzed for PCB content prior to disposal (Copland and Gohmann 1982). GC/ECD is very sensitive, highly selective against hydrocarbon background, and relatively inexpensive to operate. The technique is most appropriate when the PCB residue resembles an Aroclor® (Aroclor® is a registered trademark of Monsanto Company; the trademark designation is not used throughout this report) standard and other halogenated compounds do not interfere.

While it is considered a selective detector, ECD also detects non-PCB compounds such as halogenated pesticides, polychlorinated naphthalenes, chloroaromatics, phthalate and adipate esters, and other compounds. These compounds may be differentiated from PCBs only by chromatographic retention time. Elemental sulfur can interfere with PCB analysis in sediment and other samples which have been subjected to anaerobic degradation conditions. There are also common interferences which do not give discrete peaks. An example of a nonspecific interference is mineral oil (ASTM 1983). Mineral oil, a complex mixture of hydrocarbons, can cause a general suppression of ECD response. Mineral oils from transformers often contain PCBs as a result of cross-contamination of transformer oils.

A major disadvantage of ECD is the range of response factors which different PCB congeners exhibit. Zitko et al. (1971) and Hattori et al. (1981) published response factors ranges of about 540 and 9000, respectively. Boe and Egaas (1979), Onzuka et al. (1983) and Singer et al. (1983) have also published ECD response factors. The range of response factors seriously inhibits reliable quantitation of individual PCB congeners or non-Aroclor PCBs unless the composition of the sample and standard are the same.

When PCBs are analyzed by packed column gas chromatography, the PCBs are usually quantitated by total areas or individual peaks. In the total areas method, the areas of all peaks in a retention window are summed and this total compared with the corresponding response of an Aroclor standard. With the individual peak quantitation method, response factors are calculated for each peak in the packed column chromatogram. The most prominent individual peak quantitation method was originated by Webb and McCall (1973). These results may be reported as an Aroclor concentration or as total PCB. Packed column GC techniques are generally useful for quantitation of samples which resemble pure Aroclors but are prone to errors from interfering compounds or from PCB mixtures that do not resemble pure Aroclors (Albro 1979). For this reason analysts have been using capillary gas chromatography for the analysis of PCBs. Capillary gas chromatography offers the analyst the ability to separate most of the individual PCB isomers. Bush et al. (1982) has proposed a method of obtaining "total PCB" values by integration of all PCB peaks, using response factors generated from an Aroclor mixture. Zell and Ballschmiter (1980) have developed a simplified approach where only a selected few "diagnostic peaks" are quantitated. In a similar approach Tuinstra et al. (1983) have quantitated six specific, diagnostic congeners which appear to be useful for regulatory cutoff analyses.

#### b. GC/Hall Electrolytic Conductivity Detector

Electrolytic conductivity detectors have also been used with packed column gas chromatography to selectively detect PCBs (Webb and McCall 1973, Sawyer 1978). The Hall electrolytic conductivity detector (HECD) measures the change in conductivity of a solution containing HCl or HBr which is formed by pyrolysis of halogenated organic GC effluents. The HECD exhibits  $10^5$ - $10^6$  selectivity for halogenated compounds over other compounds. It also gives a linear response over at least a  $10^3$  range. HECD and ECD were compared for their use in detecting PCBs in waste oil, hydraulic fluid, capacitor fluid, and transformer oil (Sonchik et al. 1984). They found both detectors acceptable, but noted that the HECD gave higher results with less precision than the ECD. The method detection limits ranged from 3-12 ppm for HECD and 2-4 ppm for ECD. Greater than 100% recovery of spikes analyzed by HECD indicated a nonspecific response to non-PCB components, since extraneous peaks were not observed. Another comparison of HECD and ECD for the analysis of PCBs in oils at the 30-500 ppm levels found that the type of detector made no significant difference in the results (Levine et al. 1983). The authors noted that they had expected higher accuracy from the more specific HECD. They postulated that the cleanup procedures (Florisil, alumina, and sulfuric acid) all had effectively removed the non-PCB species which would have caused interferences in the ECD and reduced its accuracy.

#### c. GC/Mass Spectrometry

Highly specific identification of PCBs is performed by GC with mass spectrometric (GC/MS) detection. High resolution gas chromatography is generally used with mass spectrometry, so individual PCB isomers may be separated and identified. A GC/MS produces a chromatogram consisting of data points at about 1 second intervals, which are actually full mass spectra. The data are stored by a computer and may be retrieved in a variety of ways. The data file contains information on the amount of compound (signal intensity), molecular weight (parent ion), and chemical composition (fragmentation patterns and isotopic clusters).

GC/MS is particularly suited to detection of PCBs because of its intense molecular ion and the characteristic chlorine cluster. Chlorine has two naturally occurring isotopes,  $^{35}\text{Cl}$  and  $^{37}\text{Cl}$ , which occur in a ratio of 100:33. Thus, a molecule with one chlorine atom will have a parent ion, M, and an M+2 peak at 33% relative intensity. With two chlorine atoms, M+2 has an intensity of 66% and M+4, 11%.

Because of its expense, complexity of data, and lack of sensitivity, GC/MS has not been used as extensively as other GC methods (particularly GC/ECD), despite its inherently higher information content. As the above factors have been improved, GC/MS has become much more popular for analysis of PCBs, and will probably continue to increase in importance. Several factors including the introduction of routine instruments without costly accessories, decreasing data system costs, and mass-marketing, have combined to keep the costs of GC/MS down while prices of other instruments have risen steadily. With larger data systems and more versatile and "user-friendly"

software, the large amount of data is more easily handled. However, data reduction of a GC/MS chromatogram still requires substantially more time than for a GC/ECD chromatogram. In addition, the sensitivity of GC/MS has improved.

#### d. Field-Portable Gas Chromatography Instrumentation

Gas chromatography may be used for analysis of samples in the field. Gas chromatography is a well-established laboratory technique, and portable instruments with electron capture detectors are available (Spittler 1983, Colby et al. 1983, Picker and Colby 1984). A field-portable GC/ECD was used to obtain rapid measurements of PCBs in sediment and soil (Spittler 1983). The sample preparation consisted of a single solvent extraction. The PCBs were eluted from the GC within 9 min. In a 6-h period, 40 soils and 10 QC samples were analyzed, with concentrations ranging from 0.2 to 24,000 ppm. The use of field analysis permits real-time decisions in a cleanup operation and reduces the need for either return visits to a site.

Mobile mass spectrometers are also available. An atmospheric pressure chemical ionization mass spectrometer, marketed by SCIEX, has been mounted in a van and used for in situ analyses of soil and clay (Lovett et al. 1983). The instrument has apparently been used for field determination of PCBs in a variety of emergency response situations, including hazardous waste site cleanups. Other, more conventional mass spectrometers, should also be amenable to use in the field.

## 2. Thin-Layer Chromatography (TLC)

Thin-layer chromatography is a well-established analytical technique which has been used for the determination of PCBs for many years. Since the publication of a TLC method for PCBs by Mulhern (Mulhern 1968, Mulhern et al. 1971), several researchers have used TLC to measure PCBs in various matrices. Methods have been reported by Willis and Addison (1972) for the analysis of Aroclor mixtures, by Piechalak (1984) for the analysis of soils, and by Stahr (1984) for the analysis of PCB containing oils. Even with a densitometer to measure the intensity of the spots, TLC is not generally considered quantitative. Order-of-magnitude estimates of the concentration are certainly obtainable, but the precision and accuracy probably do not approach that of the gas chromatographic methods.

A spill site sample extract will probably need to be cleaned up before TLC analysis. Levine et al. (1983) have published a comparison of various cleanup procedures. Stahr (1984) has compared the Levine sulfuric acid cleanup to a SepPak® C<sub>18</sub> cleanup method.

Different TLC techniques have been used to improve the sensitivity and selectivity of the method. Several researchers have reported that the use of reverse-phase TLC (C<sub>18</sub>-bonded phase) achieves a better separation of PCBs from interferences (DeVos and Peet 1971, DeVos 1972, Stalling and Huckins 1973, Brinkman et al. 1976). Koch (1979) has reported an order of magnitude improvement in the PCB limit of detection through use of circular

TLC. The two most common methods of visualization are fluorescence (Kan et al. 1973, Ueta et al. 1974) and reaction with  $\text{AgNO}_3$ , followed by UV irradiation (DeVos and Peet 1971, DeVos 1972, Kawabata 1974, Stahr 1984).

No direct comparison of the performance of TLC with other techniques for analysis of samples from spill sites has been made. Two studies (Bush et al. 1975, Collins et al. 1972) compared TLC and GC/ECD. In both studies, the PCB values obtained were comparable. However, the study by Bush et al. indicated that the TLC results were generally lower than GC/ECD.

### 3. Total Organic Halide Analyses

Total organic halide analysis can be used to estimate PCB concentrations for guiding field work, but is not appropriate for verification or enforcement analyses. A total organic halide analysis indicates the presence of chlorine and sometimes the other halogens. Many of the techniques also detect inorganic chlorides such as sodium chloride. The reduction of organochlorine to free chloride ion with metallic sodium can be used for PCB analysis. The free chloride ions can be then detected colorimetrically (Chlor-N-Oil®) or by a chloride ion-specific electrode (McGraw-Edison). The performance of these kits has not been tested with any matrix other than mineral oil. X-ray fluorescence (XRF) has also been studied as a PCB screening technique (McQuade 1982, Schwalb and Marquez 1982).

#### D. Selection of Appropriate Methods

##### 1. Criteria for Selection

The primary criterion for an enforcement method is that the data be highly reliable (i.e., they are legally defensible). This does not necessarily imply that the most exotic, state-of-the-art methods be employed; rather that the methods have a sound scientific basis and validation data to support their use. Many other criteria also enter into selection of a method, including accuracy, precision, reproducibility, comparability, consistency across matrices, availability, and cost.

For PCB spills, it is assumed that the spills will be relatively fresh and therefore that PCB mixtures will generally resemble those in commercial products (i.e., Aroclor®). It is further assumed that, for most of the matrices likely to be encountered, the levels of interferences will be relatively low.

##### 2. Selection of Instrumental Techniques

Based upon the above criteria and assumptions, either GC/ECD or GC/MS should provide suitable data. Since GC/ECD is included in more standard methods and since the technique is more widely used, it appears to be the technique of choice. The primary methods recommended below are all based on GC/ECD instrumental analysis. Some of the secondary and confirmatory techniques are based on GC/EIMS.

### 3. Selection of Methods

Ideally, a standard method would be available for each matrix likely to be encountered in a PCB spill. The matrices of concern include solids (soil, sand, sediment, bricks, asphalt, wood, etc.), water, oil, surface wipes, and vegetation. The methods for these matrices are summarized in Table 22 and discussed in detail below. A primary recommended method is given and should be used in most spill instances. The secondary method may be useful for confirmatory analyses, or where the situation (e.g., high level of interferences) indicates that the primary method is not applicable. The methods used must be documented or referenced.

#### a. Solids (Soil, Sand, Sediment, Bricks, Asphalt, Wood, Etc.)

EPA Method 8080 from SW-846 (USEPA 1982e) is the primary recommended method. The secondary methods, Method 8250 and Method 8270, are GC/MS analogs. Method 8080 entails an acetone/hexane (1:1) extraction, a Florisil column chromatographic cleanup, and a GC/ECD instrumental determination. A total area quantitation versus Aroclor standards is specified. No qualitative criteria are supplied. A detection limit of 1 µg/g is prescribed. No validation data are available.

Bulk samples (bricks, asphalt, wood, etc.) should be readily extractable using a Soxhlet extractor according to EPA Method 8080 (USEPA 1982e). The sample must be crushed and subsampled to ensure proper solvent contact.

#### b. Water

EPA Method 608 (USEPA 1984e) is recommended as the primary method. This is one of the "priority pollutant" methods and involves extraction of water samples with dichloromethane. An optional Florisil column chromatographic cleanup and also an optional sulfur removal are given. Samples are analyzed by GC/ECD and quantitated against the total area of Aroclor standards. No qualitative criteria are given. This method has been extensively validated and complex recovery and precision equations are given in the method for seven Aroclor mixtures. The average recovery is about 86% and average overall precision about ± 26%. The average recovery and precision for the more common Aroclors (1242, 1254, and 1260) are about 78% and ± 26%, respectively. Detection limits are not given in the current version (USEPA 1984a), although they were listed as between 0.04 and 0.15 µg/L for the seven Aroclor mixtures listed as priority pollutants in the method validation study (Millar et al. 1984).

#### c. Oils

Spilled oil samples should be analyzed according to an EPA method (Bellar and Lichtenberg 1981). The method is written for transformer fluids and waste oils, but should also be applicable to other similar oils such as capacitor fluids. In this method, samples are diluted by an appropriate factor (e.g., 1:1000). Six optional cleanup techniques are given.

Table 22. Summary of Recommended Analytical Methods

Matrix	Primary method (GC/ECD)		Secondary method		
	Designation	Reference	Designation	GC detector	Reference
Solids	8080	USEPA 1982e	8250, 8270	MS	USEPA 1982e
Water	608	USEPA 1984a	625	MS	USEPA 1984b
Oil	"oil"	USEPA 1981a; Bellar and Lichtenberg, 1981	"oil"	MS	USEPA 1981a; Bellar and Lichtenberg, 1981
Surface wipes	Hexane extrac- tion/608	None	Hexane extrac- tion/625	MS	None
Vegetation	AOAC (29)	AOAC 1980a	None	None	None

The sample may be analyzed by GC/ECD as the primary method. Secondary instrumental choices, also presented in the method, are GC/HECD, GC/MS, and capillary GC/MS. PCBs are quantitated by either total areas or the Webb-McCall (1973) method. No qualitative criteria are given. QC criteria are given. A detection limit of 1 mg/kg is stated, although it is highly dependent on the amount of dilution required. An interlaboratory validation study (Sonchik and Ronan 1984) indicated 81 to 126% recoveries for different PCB mixtures, with an average of 97% for Aroclors 1242, 1254, and 1260, as measured by ECD. The overall method precision ranged from  $\pm 11$  to  $\pm 55\%$ , with an average of  $\pm 12\%$  for Aroclors 1242, 1254, and 1260. The method validation statistics were presented in more detail as regression equations.

#### d. Surface Wipes

No standard method is available for analysis of PCBs collected on surface wipes. However, since this matrix should be relatively clean and easily extractable, a simple hexane extraction should be sufficient. Samples should be analyzed according to EPA Method 608 (USEPA 1984a), except for Section 10.1 through 10.3. In lieu of these sections, the sample should be extracted three times with 25 to 50 mL of hexane. The sample can be extracted by shaking for at least 1 min per extraction in the wide-mouthed jar used for sample storage. Note that the rinses should be with hexane so that solvent exchange from methylene chloride to hexane (Section 10.7) is not necessary.

#### e. Vegetation

The AOAC (1980a) procedure for food is recommended for analysis of vegetation (leaves, vegetables, etc.). This method involves extraction of a macerated sample with acetonitrile. The acetonitrile is diluted with water and the PCBs extracted into petroleum ether. The concentrated extract is cleaned up by Florisil column chromatography by elution with a mixture of ethyl ether and petroleum ether. The sample is analyzed by GC/ECD with quantitation by total areas or individual peak heights as compared to Aroclor standards. No qualitative criteria are given. Validation studies with chicken fat and fish (Sawyer 1973) are not relevant to the types of matrices to be encountered in PCB spills.

### 4. Implementation of Methods

Each laboratory is responsible for generating reliable data. The first step is preparation of an in-house protocol. This detailed "cookbook" is based on methods cited above, but specifies which options must be followed and provides more detail in the conduct of the techniques. It is essential that a written protocol be prepared for auditing purposes.

Each laboratory is responsible for generating validation data to demonstrate the performance of the method in the laboratory. This can be done before processing of samples; however, it is often impractical. Validation of method performance (replicates, spikes, QC samples, etc.) while analyzing field samples is acceptable.

Changes in the above methods are acceptable, provided the changes are documented and also provided that they do not affect performance. Some minor changes (e.g., substitution of hexane for petroleum ether) do not generally require validation. More significant changes (e.g., substitution of a HECOD for ECD) will require documentation of equivalent performance.

#### E. Quality Assurance

Quality assurance must be applied throughout the entire monitoring program including the sample planning and collection phase, the laboratory analysis phase, and the data processing and interpretation phase.

Each participating EPA or EPA contract laboratory must develop a quality assurance plan (QAP) according to EPA guidelines (USEPA 1980). Additional guidance is also available (USEPA 1983). The quality assurance plan must be submitted to the regional QA officer or other appropriate QA official for approval prior to analysis of samples.

##### 1. Quality Assurance Plan

The elements of a QAP (U.S. EPA, 1980) include:

- Title page
- Table of contents
- Project description
- Project organization and responsibility
- QA objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability
- Sampling procedures
- Sample tracking and traceability
- Calibration procedures and frequency
- Analytical procedures
- Data reduction, validation and reporting
- Internal quality control checks
- Performance and system audits
- Preventive maintenance
- Specific routine procedures used to assess data precision, accuracy and completeness
- Corrective action
- Quality assurance reports to management

## 2. Quality Control

Each laboratory that uses this method must operate a formal quality control (QC) program. The minimum requirements of this program consist of an initial and continuing demonstration of acceptable laboratory performance by the analysis of check samples, spiked blanks, and field blanks. The laboratory must maintain performance records which define the quality of data that are generated.

The exact quality control measures will depend on the laboratory, type and number of samples, and client requirements. The QC measures should be stipulated in the QA Plan. The QC measures discussed below are given for example only. Laboratories must decide on which of the measures below, or additional measures, will be required for each situation.

### a. Protocols

Virtually all of the available PCB methods contain numerous options and general instructions. Effective implementation by a laboratory requires the preparation of a detailed analysis protocol which may be followed unambiguously in the laboratory. This document should contain working instructions for all steps of the analysis. This document also forms the basis for conducting an audit.

### b. Certification and Performance Checks

Prior to the analysis of samples, the laboratory must define its routine performance. At a minimum, this must include demonstration of acceptable response factor precision with at least three replicate analyses of a calibration solution; and analysis of a blind QC check sample (e.g., the response factor calibration solution at unknown concentration submitted by an independent QA officer). Acceptable criteria for the precision and the accuracy of the QC check sample analysis must be presented in the QA plan.

Ongoing performance checks should include periodic repetition of the initial demonstration or more elaborate measures. More elaborate measures may include control charts and analysis of QA check samples containing unknown PCBs, and possibly with matrix interferences.

### c. Procedural QC

The various steps of the analytical procedure should have quality control measures. These include, but are not limited to, the following:

Instrumental Performance: Instrumental performance criteria and a system for routinely monitoring the performance should be set out in the QA Plan. Corrective action for when performance does not meet the criteria should also be stipulated.

Qualitative Identification: Any questionable results should be confirmed by a second analytical method. A least 10% of the identifications, as well as any questionable results, should be confirmed by a second analyst.

Quantitation: At least 10% of all calculations must be checked. The results should be manually checked after any changes in computer quantitation routines.

d. Sample QC

Each sample and each sample set must have QC measures applied to it to establish the data quality for each analysis result. The following should be considered when preparing the QA plan:

Field Blanks: Field blanks are analyzed to demonstrate that the sample collection equipment has not been contaminated. A field blank may be generated by using the sampling equipment to collect a blank sample (e.g., using the water sampling equipment to sample laboratory reagent grade water) or by extracting the sampling equipment (e.g., extracting a sheet of filter paper from the lot used to collect wipe samples or rinsing the soil sampling apparatus into the sample jar). A field blank must be collected and analyzed for each type of sample collected.

Laboratory Reagent Blanks: These blanks are generated in the laboratory and are analyzed to assess contamination of glassware, reagents, etc., in the laboratory. Generally, a reagent blank is processed through the entire analysis process. Although in special circumstances, additional reagent blanks may be generated which are processed through only part of the procedure to isolate sources of contamination. At least one laboratory reagent blank must be generated and analyzed for each type of sample analyzed.

Check Samples: These samples contain known concentrations of PCBs in the sample matrix. They are analyzed along with field samples to demonstrate the method performance. The PCB concentrations may be known to the analyst.

Blind Check Samples: These samples are the same as the check samples discussed above, except the PCB concentration is not known to the analyst.

Replicate Samples: One sample from each batch of 20 or fewer will be analyzed in triplicate. The sample is divided into three replicate subsamples and all these subsamples carried through the analytical procedure, blind to the analyst. The results of these analyses must be comparable within the limits required for spiked samples.

Spiked Samples: The sensitivity and reproducibility must be demonstrated for any method used to report verification data. This can be done by analyzing spiked blanks near the required detection limit. To demonstrate the ability of the method to reproducibly detect the spiked sample, one or more spiked samples should be analyzed in at least triplicate for each group of 20 or fewer samples within each sample type collected. Samples will

be spiked with a PCB mixture similar to that spilled (e.g., Aroclor 1260). Example concentrations are:

<u>Matrix</u>	<u>Spike Level</u>
Soil, etc.	10 µg/g (10 ppm)
Water	100 µg/L (100 ppb)
Wipes	100 µg/wipe (100 µg/100 cm <sup>2</sup> )

Quantitative techniques must detect the spike level within ±30% for all spiked samples.

e. Sample Custody

As part of the Quality Assurance Plan, the chain-of-custody protocol must be described. A chain-of-custody provides defensible proof of the sample and data integrity. The less rigorous sample traceability documentation merely provides a record of when operations were performed and by whom. Sample traceability is not acceptable for enforcement activities.

Chain-of-custody is required for analyses which may result in legal proceedings and where the data may be subject to legal scrutiny. Chain-of-custody provides conclusive written proof that samples are taken, transferred, prepared, and analyzed in an unbroken line as a means to maintain sample integrity. A sample is in custody if:

- It is in the possession of an authorized individual;
- It is in the field of vision of an authorized individual;
- It is in a designated secure area; or
- It has been placed in a locked container by an authorized individual.

A typical chain-of-custody protocol contains the following elements:

1. Unique sample identification numbers.
2. Records of sample container preparation and integrity prior to sampling.
3. Records of the sample collection such as:
  - Specific location of sampling.

- Date of collection.
  - Exact time of collection.
  - Type of sample taken (e.g., air, water, soil).
  - Initialing each entry.
  - Entering pertinent information on chain-of-custody record.
  - Maintaining the samples in one's possession or under lock and key.
  - Transporting or shipping the samples to the analysis laboratory.
  - Filling out the chain-of-custody records.
  - The chain-of-custody records must accompany the samples.
4. Unbroken custody during shipping. Complete shipping records must be retained; samples must be shipped in locked or sealed (evidence tape) containers.
5. Laboratory chain-of-custody procedures consist of:
- Receiving the samples.
  - Checking each sample for tampering.
  - Checking each sample against the chain-of-custody records.
  - Checking each sample and noting its condition.
  - Assigning a sample custodian who will be responsible for maintaining chain-of-custody.
  - Maintaining the sign-offs for every transfer of each sample on the chain-of-custody record.
  - Ensuring that all manipulations of the sample are duly recorded in a laboratory notebook along with sample number and date. These manipulations will be verified by the program manager or a designee.

#### F. Documentation and Records

Each laboratory is responsible for maintaining complete records of the analysis. A detailed documentation plan should be prepared as part of

the QAP. Laboratory notebooks should be used for handwritten records. Digital or other GC/MS data must be archived on magnetic tape, disk, or a similar device. Hard copy printouts may also be kept if desired. Hard copy analog data from strip chart recorders must be archived. QA records should also be retained.

The documentation must completely describe how the analysis was performed. Any variances from a standard protocol must be noted and fully described. Where a procedure lists options (e.g., sample cleanup), the option used and specifics (solvent volumes, digestion times, etc.) must be stated.

The remaining samples and extracts should be archived for at least 2 months or until the analysis report is approved by the client organization (whichever is longer) and then disposed unless other arrangements are made. The magnetic disks or tapes, hard copy chromatograms, hard copy spectra, quantitation reports, work sheets, etc., must be archived for at least 3 years. All calculations used to determine final concentrations must be documented. An example of each type of calculation should be submitted with each verification spot.

#### G. Reporting Results

Results of analysis will normally be reported as follows:

<u>Matrix</u>	<u>Reporting Units</u>
Soil, etc.	µg PCB/g of sample (ppm)
Water	mg PCB/L of sample (ppm)
Surfaces (wipes)	µg PCB/wipe (µg PCB/100 cm <sup>2</sup> )

In some cases, the results are to be reported by homolog. In this case, 11 values are reported per sample: one each for the 10 homologs and one for the total. Some TSCA analyses require reporting the results in terms of resolvable gas chromatographic peak (U.S. EPA, 1982c, 1984e). In these cases, the number of results reported equals the number of peaks observed on the chromatogram. These analyses are generally associated with a regulatory cutoff (e.g., 2 µg/g per resolvable chromatographic peak (U.S. EPA, 1982c, 1984). In these cases it may be sufficient, depending on the client organization's request, to report only those peaks which are above the regulatory cutoff.

Even if an Aroclor is used as the quantitation standard, the results are never to be reported as "µg Aroclor/g sample." TSCA regulates all PCBs, not merely a specific commercial mixture.

## V. REFERENCES

Albro PW. 1979. Problems in analytic methodology: sample handling, extraction, and cleanup. *Ann NY Acad Sci* 320:19-27.

American National Standards Institute, Inc. 1974. American national standard guidelines for handling and disposal of capacitor- and transformer-grade askarels containing polychlorinated biphenyls. ANSI C107.1-1974. New York, NY.

American Society for Testing and Materials. 1980. Standard method for rapid gas chromatographic estimation of high boiling homologues of chlorinated biphenyls for capacitor askarels. ANSI/ASTM D 3303-74 (Reapproved 1979). In: Annual book of ASTM standards, Part 40. Philadelphia, Pennsylvania, pp. 870-876.

American Society for Testing and Materials. 1981a. Standard method for polychlorinated biphenyls (PCBs) in water. ANSI/ASTM D 3534-80. In: Annual book of ASTM standards, Part 31. Philadelphia, Pennsylvania, pp. 816-833.

American Society for Testing and Materials. 1981b. Standard method for analysis of environmental materials for polychlorinated biphenyls. ANSI/ASTM D 3304-77. In: Annual book of ASTM standards, Part 31. Philadelphia, Pennsylvania, pp. 877-885.

American Society for Testing and Materials. 1983. Standard method for analysis of polychlorinated biphenyls in mineral insulating oils by gas chromatography. ANSI/ASTM D 4059-83. In: Annual book of ASTM standards, Part 40. Philadelphia, Pennsylvania, pp. 542-550.

Association of Official Analytical Chemists. 1980a. General method for organochlorine and organophosphorus pesticides, Method 29.001. Official Methods of Analysis of the Association of Official Analytical Chemists, W. Horwitz, Ed. (13th ed., Washington, DC), pp. 466-474.

Association of Official Analytical Chemists. 1980b. PCB in paper and paperboard, Method 29.029. Official Methods of Analysis of the Association of Official Analytical Chemists, W. Horwitz, Ed. (13th ed., Washington, DC), p. 475-476.

Ballinger DG. 1978 (December 11). Test procedures for priority organics in municipal wastewater and sludges. U.S. Environmental Protection Agency, Cincinnati, Ohio.

Beard JH III, Schaum J. 1978 (February 10). Sampling methods and analytical procedures manual for PCB disposal: Interim Report, Revision 0. Office of Solid Waste, U.S. Environmental Protection Agency, Washington, DC.

Bellar TA, Lichtenberg JJ. 1982. The determination of polychlorinated biphenyls in transformer fluid and waste oils. Prepared for U.S. Environmental Protection Agency, EPA-600/ 4-81-045.

- Boe B, Egaas E. 1979. Qualitative and quantitative analyses of polychlorinated biphenyls by gas-liquid chromatography. *J Chromatogr* 180:127-132.
- Brinkman UATH, De Kok A, De Vries G, Reymer HGM. 1976. High-speed liquid and thin-layer chromatography of polychlorinated biphenyls. *J Chromatogr* 128:101-110.
- Bush B, Baker F, Dell'Acqua R, Houck CL, Lo F-C. 1975. Analytical response of polychlorinated biphenyl homologues and isomers in thin-layer and gas chromatography. *J Chromatogr* 109:287-295.
- Bush B, Connor S, Snow J. 1982. Glass capillary gas chromatography for sensitive, accurate polychlorinated biphenyl analysis. *J Assoc Off Anal Chem* 65(3):555-566.
- Colby BN, Burns EA, Lagus PL. 1983. The S-Cubed PCBA 101, an automated field analyzer for PCBs. Abstract No. 731, 1983 Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy.
- Collins GB, Holmes DC, Jackson FJ. 1972. The estimation of polychlorobiphenyls. *J Chromatogr* 71:443-449.
- Copland GB, Gohmann CS. 1982. Improved method for polychlorinated biphenyl determination in complex matrices. *Environ Sci Technol* 16:121-124.
- De Vos RH. 1972. Analytical techniques in relation to the contamination of the fauna. *TNO-nieuws* 27:615-622.
- De Vos RH, Peet EW. 1971. Thin-layer chromatography of polychlorinated biphenyls. *Bull Environ Contam Toxicol* 6(2):164-170.
- Devenish I, Harling-Bowen L. 1980. The examination and estimation of the performance characteristics of a standard method for organo-chlorine insecticides and PCB. In: *Hydrocarbons and Halogenated Hydrocarbons in the Aquatic Environment*, B. K. Afghan and D. Mackay, Eds. (New York: Plenum Press), pp. 231-253.
- Dow Chemical Company. 1981 (July 1). Determination of chlorinated biphenyls in the presence of chlorinated benzenes. Midland MI.
- Dry Color Manufacturers Association. 1981. An analytical procedure for the determination of polychlorinated biphenyls in dry phthalocyanine blue, phthalocyanine green, and diarylide yellow pigments. Arlington, VA.
- Erickson MD, Stanley JS, Turman K, Radolovich G, Bauer K, Onstot J, Rose D, Wickham M. 1982. Analytical methods for by-product PCBs--preliminary validation and interim methods. Interim Report No. 4, Office of Toxic Substances, U.S. Environmental Protection Agency, Washington, D. C., EPA-560/5-82-006, NTIS No. PB83 127 696, 243 pp.

Erickson MD, Stanley JS, Radolovich G, Blair RB. 1983 (August 15). Analytical method: the analysis of by-product chlorinated biphenyls in commercial products and product wastes. Revision 1, Prepared by Midwest Research Institute for Office of Toxic Substances, U.S. Environmental Protection Agency, Washington, DC, under Subcontract No. A-3044(8149)-271, Work Assignment No. 17 to Battelle, Washington, DC.

Erickson MD 1984a. Analytical method: The analysis of by-product chlorinated biphenyls in commercial products and product wastes, revision 2. U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, DC, EPA 560/5-85-010.

Erickson MD. 1984b. Analytical method: The analysis of by-product chlorinated biphenyls in water, revision 2. U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, DC, EPA 560/5-85-012.

Erickson MD. 1985. The analytical chemistry of PCBs. Butterworths, Boston, MA.

Erickson MD, Stanley JS, Turman JK, and Radolovich G. 1985a. Analytical method: The analysis of chlorinated biphenyls in liquids and solids. U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, DC, EPA-560/5-85-023.

Fisher DJ, Rouse TO, Lynn TR. 1984. Field determination of PCB in transformer oil "CLOR-N-OIL Kit." In: Proceedings: 1983 PCB Seminar, Addis G, and Komai RY, Eds. Report No. EPRI-EL-3581, Palo Alto, CA: Electric Power Research Institute.

Food and Drug Administration. Pesticide Analytical Manual. Vol. I, August 1, 1977.

Haile CL, Baladi E. 1977. Methods for determining the total polychlorinated biphenyl emissions from incineration and capacitor and transformer filling plants. U. S. Environmental Protection Agency, EPA-600/4-77-048, NTIS No. PB-276 745/7G1.

Haile CL, Lopez-Avila V. 1984. Development of analytical test procedures for the measurement of organic priority pollutants--project summary. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, EPA-600/S4-84-001; (Full Report available as NTIS No. PB 84-129 048).

Harris RW, Grainger CF, Mitchell WJ. 1981. Validation of a method for measuring polychlorinated biphenyls in natural gas pipelines. EPA 600/4-81-048; NTIS No. PB82-207556.

Hattori Y, Kuge Y, Nakamoto M. 1981. The correlation between the electron-capture detector response and the chemical structure for polychlorinated biphenyls. Bull Chem Soc Jpn 54(9):2807-2810; Chem Abstr 96:34427s (1981).

- Kan T, Kamata K, Ueta T, Yamazoe R, Totani T. 1973. Fluorescence reactions of organohalogen compounds. I. Fluorometry of polychlorinated biphenyls (PCB) with diphenylamine on thin-layer chromatograms. Tokyo Toritsu Eisei Kenkyusho Kenky Nempo 24:137-145; Chem Abst 80:115771w (1974).
- Kawabata J. 1974. Simple method for the determination of PCBs [polychlorinated biphenyls] by a combination of thin-layer chromatography and UV absorption. Kogai To Taisaku 10(10):1112-1116; Chem Abst 83:201652b (1975).
- Koch R. 1979. Circular thin-layer chromatography as a rapid method for a qualitative detection of organochlorine compounds. Acta Hydrochim Hydrobiol 7(3):355-356; Chem Abst 91:101574z (1979).
- Levine SP, Homsher MT, Sullivan JA. 1983. Comparison of methods of analysis of polychlorinated biphenyls in oils. J Chromatogr 257:255-266.
- Levins PL, Rechsteiner CE, Stauffer JL. 1979. Measurement of PCB emissions from combustion sources. U.S. Environmental Protection Agency, Report No. EPA-600/7-79-047.
- Lewis RG. 1982 (March). Procedures for sampling and analysis of polychlorinated biphenyls in the vicinities of hazardous waste disposal sites. U.S. Environmental Protection Agency, Research Triangle Park, NC, 14 pp.
- Lingle JW. Wisconsin Electric Power Company, P.O. Box 2046, Milwaukee, WI 53201. May 24, 1985. Personal communication.
- Longbottom JE, Lichtenberg JJ, Eds. 1982 (July). Methods for organic chemical analysis of municipal and industrial wastewater. U.S. Environmental Protection Agency, Report No. EPA-600/4-82-057.
- Lovett AM, Nacson S, Hijazi NH, Chan R. 1983. Real time ambient air measurements for toxic chemical. In: Proceedings: a specialty conference on: measurement and monitoring of non-criteria (toxic) contaminants in air, Frederick ER, Ed., The Air Pollution Control Association, Pittsburgh, PA, 113-125 pp.
- Mason BJ. 1982 (October). Preparation of soil sampling protocol: techniques and strategies. ETHURA, McLean, VA, under subcontract to Environmental Research Center, University of Nevada, for U.S. Environmental Protection Agency, Las Vegas.
- Matern B. 1960. Spacial variation. Medd. fr. Statens Skogsforsknings Institut. 49:1-144.
- McQuade JM. 1982. PCB analysis by X-ray fluorescence. In: Proceedings: 1981 PCB Seminar, Addis G, Marks J, Eds., Report No. EPRI-EL-2572, Palo Alto, CA: Electric Power Research Institute, pp. 2-9.
- Millar JD, Thomas RE, Schattenberg HJ. 1984 (June). EPA Method Study 18, Method 608--organochlorine pesticides and PCB's. Quality Assurance Branch, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. Report No. EPA-600/4-84-061, NTIS No. PB84 211358, 197 pages.

- Moein GJ. 1976. Study of the distribution and fate of polychlorinated biphenyls and benzenes after spill of transformer fluid. Report No. EPA 904/9-76-014, NTIS No. PB288484.
- Mulhern BM. 1968. An improved method for the separation and removal of organochlorine insecticides from thin-layer plates. J Chromatogr 34:556-558.
- Mulhern BM, Cromartie E, Reichel WL, Belisle A. 1971. Semiquantitative determination of polychlorinated biphenyls in tissue samples by thin layer chromatography. J Assoc Offic Anal Chem 54(3):548-550.
- National Institute for Occupational Safety and Health. 1977a (April). NIOSH Manual of Analytical Methods, Second Edition, Part I, NIOSH Monitoring Methods, Vol. 1, "Polychlorinated Biphenyls (PCB) in Air, Analytical Method P&CAM 244," U.S. Department of Health, Education, and Welfare, Cincinnati, Ohio.
- National Institute for Occupational Safety and Health. 1977b (April). NIOSH Manual of Analytical Methods, Second Edition, Part I, NIOSH Monitoring Methods, Vol. 1, "Polychlorinated Biphenyls (PCB) in Air, Analytical Method P&CAM 253," U.S. Department of Health, Education, and Welfare, Cincinnati, Ohio.
- NIOSH. 1977c (September). National Institute for Occupational Safety and Health. Criteria for a recommended standard...occupational exposure to polychlorinated biphenyls (PCBs). U.S. Department of Health, Education, and Welfare (Public Health Service, Center for Disease Control, and National Institute for Occupational Safety and Health), DHEW (NIOSH) Publication No. 7-225, 224 pp.
- NIOSH. 1980 (September). National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services. Health Hazard Evaluation Report No. 80-85-745. Oakland, CA: Pacific Gas and Electric Company.
- Onsuka FI, Komisar RJ, Terry KA. 1983. Identification and determination of polychlorinated biphenyls by high-resolution gas chromatography. J Chromatogr 279:111-118.
- Picker JE, Colby BN. 1984. Field determination of Aroclors using an automated electron capture detector gas chromatograph. In: Proceedings: 1983 PCB Seminar, Addis G, Komai RY, Eds., Report No. EPRI-EL-3581. Palo Alto, CA: Electric Power Research Institute.
- Piechalak B. 1984. The semiquantitative detection of polychlorinated biphenyls (PCBs) in contaminated soils by thin-layer chromatography. In: Proceedings: 1983 PCB Seminar, Addis G, Komai RY, Eds., Report No. EPRI-EL-3581. Palo Alto, CA: Electric Power Research Institute.
- Rodriguez CF, McMahon WA, Thomas RE. 1980 (March). Method development for determination of polychlorinated hydrocarbons in municipal sludge. Final Report, Contract No. 68-03-2606, Environmental Protection Agency, EPA-600/2-80-029; NTIS No. PB 82-234 071.

- Sawyer LD. 1973. Collaborative study of the recovery and gas chromatographic quantitation of polychlorinated biphenyls in chicken fat and polychlorinated biphenyl-DDT combinations in fish. *J Assoc Offic Anal Chem* 56(4):1015-1023.
- Sawyer LD. 1978. Quantitation of polychlorinated biphenyl residues by electron capture gas-liquid chromatography: reference material characterization and preliminary study. *J Assoc Offic Anal Chem* 61(2):272-281.
- Schwalb AL, Marquez A. 1982. Salt River Project's experience with the Horiba Sulfur/Chlorine-in-Oil Analyzer. In: *Proceedings: 1981 PCB Seminar*, Addis G, Marks J, Eds., Report No. EPRI-EL-2572. Palo Alto, CA: Electric Power Research Institute, pp. 2-23.
- Sherma, J. Manual of Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples, EPA-600/2-81-059; NTIS No. PB81-222721 (April 1981).
- Singer E, Jarv T, Sage M. 1983. Survey of polychlorinated biphenyls in ambient air across the province of Ontario. Chapter 19 in *Physical Behavior of PCBs in the Great Lakes*, Mackay D, Paterson S, Eisenreich SJ, Simmons MS, Eds. Ann Arbor, MI: Ann Arbor Science Publishers, Inc., pp 367-383.
- Sonchik S, Madeleine D, Macek P, Longbottom J. 1984. Evaluation of sample preparation techniques for the analysis of PCBs in oil. *J Chromatogr Sci* 22:265-271.
- Spittler TM. 1983. Field measurement of PCB's in soil and sediment using a portable gas chromatograph. *Natl Conf Manage Uncontrolled Hazard Waste Sites* 105-107; *Chem Abst* 100:220890p (1984).
- Stalling DL, Huckins JN. 1973. Reverse phase thin layer chromatography of some Aroclors, halowaxes, and pesticides. *J Assoc Offic Anal Chem* 56(2): 367-372.
- Stahr HM. 1984. Analysis of PCBs by thin layer chromatography. *J Liq Chrom* 7(7):1393-1402.
- Tahiliani VH. 1984. CLOR-N-OIL field test program. In: *Proceedings: 1983 PCB Seminar*, Addis G, Komai RY, Eds., Report No. EPRI-EL-3581. Palo Alto, CA: Electric Power Research Institute.
- Tanabe H. 1976. PCB microanalysis. In *PCB Poisoning and Pollution*, K. Higuchi, Ed. (Tokyo: Kodansha, Ltd; New York: Academic Press), pp. 127-145.
- Tuinstra LGMTh, Driessen JJM, Keukens HJ, Van Munsteren TJ, Roos AH, Traag WA. 1983. Quantitative determination of specified chlorobiphenyls in fish with capillary gas chromatography and its use for monitoring and tolerance purposes. *Intern J Environ Anal Chem* 14:147-157.

Ueta T, Kamata K, Kan T, Kazama M, Totani T. 1974. Fluorescence reactions for organic halogen compounds. II. In situ fluorometry of polychlorinated biphenyls and their isomers on thin-layer chromatograms using diphenylamine. Tokyo Toritsu Eisei Kenkyusho Kenkyu Nempo 25:111-118; Chem Abst 83:21991c (1975).

United Kingdom Department of the Environment. 1979. Organochlorine Insecticides and Polychlorinated Biphenyls in Waters 1978; Tentative Method. Methods for the Examination of Waters and Associated Materials. Organochlorine Insectic. Polychlorinated Biphenyls Waters 28 pp.

USEPA. 1978 (September). U.S. Environmental Protection Agency. Methods for benzidine, chlorinated organic compounds, pentachlorophenol and pesticides in water and wastewater. Interim Report, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

USEPA. 1979a (December 3). U.S. Environmental Protection Agency. Organochlorine pesticides and PCBs--Method 608. 44 FR 69501-69509.

USEPA. 1979b (December 3). U.S. Environmental Protection Agency. Base/ neutrals, acids, and pesticides--Method 625. 44 FR 69540-69552.

USEPA. 1979c (September). U.S. Environmental Protection Agency. Analytical protocol for screening publicly owned treatment works (POTW) sludges for organic priority pollutants. Environmental Monitoring and Support Laboratory, Cincinnati, OH.

USEPA. 1980. U.S. Environmental Protection Agency. Guidelines and specifications for preparing quality assurance project plans. Office of Monitoring Systems and Quality Assurance, QAMS-005/80.

USEPA. 1981a (February). U.S. Environmental Protection Agency. The analysis of polychlorinated biphenyls in transformer fluid and waste oils. Office of Research and Development, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

USEPA. 1981b. U.S. Environmental Protection Agency. PCB disposal by thermal destruction. Solid Waste Branch, Air and Hazardous Materials Division, Region 6, Dallas, TX, EPA-200/9-81-001; NTIS No. PB82 241 860, 606 pp.

USEPA. 1981c (March). U.S. Environmental Protection Agency. TSCA Inspection Manual.

USEPA. 1982a (November 4). U.S. Environmental Protection Agency. Analysis of pesticides, phthalates, and polychlorinated biphenyls in soils and bottom sediments. HWI Sample Management Office, Alexandria, VA, unpublished method, 12 pp.

USEPA. 1982b (July). U.S. Environmental Protection Agency. Test methods for evaluating solid waste, physical/chemical methods, SW-846, 2nd ed. Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1982c (October 21). 40 CFR Part 761, Polychlorinated Biphenyls (PCBs); Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions; Use in Closed and Controlled Waste Manufacturing Processes. Fed. Reg. 47:46980-46986.

USEPA. 1982d (November 4). Analysis of Pesticides, Phthalates, and Polychlorinated Biphenyls in Soils and Bottom Sediments. HWI Sample Management Office, Alexandria, VA, unpublished method, 12 pp.

USEPA. 1982e (July). Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, SW-846, 2nd Edition. Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1983. U.S. Environmental Protection Agency. Quality assurance program plan for the Office of Toxic Substances, Office of Pesticides and Toxic Substances, Washington, D.C.

USEPA. 1984a (October 20). Organochlorine Pesticides and PCBs--Method 608. Fed. Reg. 49(209):89-104.

USEPA. 1984b (October 26). Base/Neutrals, Acids, and Pesticides--Method 625. Fed. Reg. 49(209):153-174.

USEPA. 1984c (October 11). 40 CFR Part 761, Polychlorinated Biphenyls (PCBs); Manufacture, Processing, Distribution in Commerce and Use Prohibitions; Use in Electrical Transformers. Fed. Reg. 49:39966-39989.

USEPA. 1984d (October). Mass Spectrometric Identification and Measurement of Polychlorinated Biphenyls as Isomer Groups. Draft Report by Physical and Chemical Methods Branch, Office of Research and Development, Cincinnati, OH.

USEPA. 1984e (July 10). 40 CFR Part 761, Polychlorinated Biphenyls (PCBs); Manufacturing, Processing, Distribution in Commerce and Use Prohibitions; Response to Individual and Class Petitions for Exemptions, Exclusions, and Use Authorization, Final Rule. Fed. Reg. 49:28154-28209.

USWAG. 1984 (October 15). The Utility Solid Waste Activities Group. Proposed spill cleanup policy and supporting studies. U.S. Environmental Protection Agency.

Watts RR (Ed.). 1980 (June). Analysis of Pesticide Residues in Human and Environmental Samples, A Compilation of Methods Selected for Use in Pesticide Monitoring Programs, U.S. Environmental Protection Agency, Research Triangle Park, NC, EPA-600/8-80-038.

Webb RG, McCall AC. 1973. Quantitative PCB standards for electron capture gas chromatography. *J Chromatogr Sci* 11:366-373.

Willis DE, Addison RF. 1972. Identification and estimation of the major components of a commercial polychlorinated biphenyl mixture, Aroclor 1221. *J Fish Res Board Can* 29(5):592-595.

Zell M, Ballschmiter K. 1980. Baseline study of the global pollution. III. Trace analysis of polychlorinated biphenyls (PCB) by ECD glass capillary gas chromatography in environmental samples of different trophic levels. Fresenius' Z Anal Chem 304:337-349.

Zitko V, Hutzinger O, Safe S. 1971. Retention times and electron-capture detector responses of some individual chlorobiphenyls. Bull Environ Contam Toxicol 6(2):160-163.

EXHIBIT D  
VERIFICATION SAMPLING

EPA Method 8010

EPA Method 8020

Glycol and Methanol using EPA Methods

EXHIBIT E

LIST OF FEDERAL AND STATE CONTACTS

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## EXHIBIT F

### MONITORING WELL INSTALLATION

#### 1.0 SITE LOCATION AND CLEARANCE

Prior to the commencement of well installation, the precise locations for the monitoring wells shall be staked by Transwestern. All staked locations shall be utility-cleared by Transwestern prior to drilling.

#### 2.0 MONITORING WELL INSTALLATION

##### 2.1 Hollow-Stem Auger Drilling

In areas where the groundwater is anticipated to be present in the unconsolidated material, monitoring wells shall be installed utilizing hollow-stem augers. Soil samples shall be collected continuously from the surface to the total depth in one representative well boring associated with each pit; at other boring locations, samples shall be taken at five (5) foot intervals. Depending upon the type of soils encountered, split-spoon, split-barrel or Shelby tube samplers shall be used. Samples from each continuously sampled well boring shall be collected and retained on-site for EPA inspection. Transwestern's onsite geologist shall record field boring log information consistent with Table A-B.

Once the uppermost aquifer is reached with the augers, the well screen and riser pipe shall be placed inside the augers. All screened monitoring wells shall be constructed of not less than 4-inch diameter Schedule 5, No. 304 threaded joint or butt-welded stainless steel casing and 0.010 inch slotted well screen.

For water-bearing units less than fifteen (15) feet thick, the entire zone shall be screened with a minimum of two (2) feet of the screen above the water table as determined at the time of well installation. For water-bearing units in excess of fifteen (15) feet thick, a maximum of fifteen (15) feet of screen shall be installed with a minimum of two (2) feet of the screen above the water table as determined at the time of monitoring well installation. The intent is that the top of the uppermost aquifer (saturated zone), including any floating layer, lie within the screened interval.

As the augers are gradually removed from the borehole, the annular space around the screen shall be filled with a clean uniform sand pack to a height of approximately one (1) to two (2) feet above the top of the screen. When plumbing of the hole indicates that the sand pack is at the desired level, a 2-foot thick layer of bentonite pellets or bentonite slurry shall be placed on the sand pack. After the bentonite seal is placed, the remaining annular space shall be sealed by grouting to the ground surface. The grout mixture shall consist of bentonite and Portland cement mixed with enough water to yield a pumpable mixture, which shall produce a seal to isolate the screened interval. The wells shall be sealed by pumping the grout mixture through a tremie pipe to the top of the bentonite seal. A 5-foot long, 6-inch or greater ID outer protective steel casing with a lockable hinged cap shall then be installed approximately three feet into the grout seal at each well. A cement pad shall be installed around the base of the protective casing. The well shall be permanently engraved or marked with the well number.

Upon completion of drilling, all drill cuttings shall be collected into 55-gallon drums, or other suitable containers, and left onsite in the custody of Transwestern for proper disposition.

## 2.2 Mud Rotary Drilling

In areas where the water-bearing zone of interest is located at depths beyond the practical limit of an auger rig or the stratigraphy is not conducive to the use of hollow-stem auger techniques, mud rotary drilling techniques may be used.

The use of commercial drilling fluids during the drilling process shall be kept to a minimum by using potable water and natural formation materials initially on all holes until it is determined that a drilling fluid is required. Chemical analysis of the drilling fluid to be used shall be obtained from the manufacturer, if available, and submitted to the EPA Site Contact. If possible, the boring shall be flushed prior to the installation of the well casing. Wells installed with drilling fluids in the borehole shall be flushed through the well screen with potable water until the drilling fluid is removed

The annular space around the screen shall be filled with a clean uniform sand pack to a height of approximately one (1) to two (2) feet above the top of the screen. A two (2) foot thick layer of bentonite pellets or bentonite slurry shall then be installed above the sand pack. The remaining annular space shall be sealed by grouting to ground surface. The grout mixture shall consist of bentonite and Portland cement mixed with enough water to yield a pumpable mixture, which shall produce a seal to isolate the screened interval. The wells shall be sealed by pumping the grout mixture through a tremie pipe lowered to the top of the bentonite seal. Alternatively, if boring obstructions preclude use of a tremie pipe, pressure grouting techniques may be used. A 5-foot long, 6-inch or greater ID outer protective steel casing with a lockable hinged cap shall then be installed three feet into the grout seal of each well. A cement pad

shall be installed around the base of the protective casing. The well shall be permanently engraved or marked with the well number.

Upon the completion of drilling, all drilling fluids and cuttings shall be collected in 55-gallon drums or other suitable containers and left onsite in the custody of Transwestern for proper disposition.

### 2.3 Air Rotary Drilling

Monitoring wells constructed in bedrock shall be installed utilizing air rotary or percussion techniques. The air from the compressor on the rig shall be filtered to ensure that oil from the compressor is not introduced into the groundwater. Foam or joint compounds for the drill rods shall not be used to eliminate the introduction of potential contaminants into the well. Shrouds, canopies, or directional pipes shall be used to contain and direct the drill cuttings and fluids into a containment lined with synthetic impermeable liner, then as soon as practical into lined 55-gallon drums or other suitable containers. Borehole cuttings shall be collected to physically characterize the overburden and lithology and then shall be discarded into 55-gallon drums, or other suitable containers, and left onsite in the custody of Transwestern for proper disposition. Transwestern's onsite geologist shall record field boring log information consistent with Table A-B.

Air rotary or percussion techniques shall be used to drill through the unconsolidated sediments (overburden) to at least five (5) feet into bedrock. A 6-inch or greater diameter low carbon steel well casing shall be installed from the base of the borehole to ground surface. After the casing is placed, the annular space around the casing shall be sealed by pumping the grout mixture described in Section 2.1 through a tremie pipe to the base of the borehole. Alternatively,

if boring obstructions preclude use of a tremie pipe, pressure grouting techniques may be used. The grout seal shall be extended to ground surface.

After allowing an appropriate time interval for the grout to set (at least twelve (12) hours) following grout emplacement, to produce a seal to isolate the screened interval, a nominal 4-inch diameter or larger open borehole shall be drilled below the base of the casing, and each well shall be completed as either an open hole construction or a screened well. Drilling shall advance the borehole to the uppermost aquifer. Drilling shall proceed in such a manner that the presence of the uppermost aquifer can be detected by the Transwestern onsite geologist. At one monitoring well associated with each pit location, a continuous rock core shall be taken and the core retained onsite for EPA inspection. If 15-feet of saturated thickness has been obtained, drilling shall terminate and well installation and/or development shall proceed. If such a saturated thickness has not been attained, then the borehole shall be extended to a depth to which at least fifteen (15) feet of saturated thickness is anticipated.

If during drilling of the borehole, the on-site Transwestern geologist observes that the borehole is unstable, a centralized screen casing and gravel pack shall be inserted into the borehole to stabilize this condition. This well shall then be constructed as described in Section 2.1.

The upper two feet of the carbon steel casing shall remain above ground surface and shall be fitted with a lockable, hinged cap. A cement well pad shall be constructed. The well shall be permanently engraved or marked with a well number.

### 3.0 WELL DEVELOPMENT

All monitoring wells shall be developed with either manual bailing, air purging, or a submersible or surface pump to ensure that they shall provide representative aquifer samples. Development of the wells shall continue until the water discharged from each well is as clear and free of sand as practical. The submersible pump or pump base shall initially be set at the bottom of the well, then later moved toward the top of the screen or borehole to ensure water is drawn through all portions of the saturated thickness. Development fluids shall be collected in 55-gallon drums or other suitable containers and left onsite in the custody of Transwestern for proper disposition.

### 4.0 DECONTAMINATION PROCEDURES

The drilling rig and materials shall arrive onsite in clean condition. Prior to the start of the drilling, all drill rods, augers, tools, drill bits, sample devices, well casings, and screens shall be decontaminated in accordance with Sections II.B and III.B of Appendix C at an area onsite prepared for this purpose. These materials shall be inspected to ensure that all residue such as machine oils have been removed. Similar decontamination procedures shall be implemented prior to each successive drilling operation to prevent cross-contamination. Liquids and solid waste generated during the initial decontamination process need not be collected; however, liquids and solids generated during decontamination between boreholes and prior to leaving the site shall be collected in lined 55-gallon drums or other suitable containers and left in the custody of Transwestern for proper disposition.

## 5.0 SURVEYING AND PERIODIC INSPECTION

The elevation of each well shall be surveyed at a point on the top of the well riser pipe. This point shall be scribed for future measuring activities. Each well shall be inspected during each sampling event to determine if any maintenance for the protective casing is necessary.

## 6.0 WAIVER OF MONITORING WELL INSTALLATION REQUIREMENTS

Transwestern may, at its option, submit data on construction of groundwater monitoring wells, if applicable, that may already be present at the sites. The construction and use of these groundwater monitoring wells are subject to approval by the EPA Project Contact. Upon submission of the above data, EPA will have thirty (30) days in which to approve/disapprove of the data. If EPA disapproves with the monitoring well construction, written notification shall be sent to Transwestern within ten (10) days after the review has been completed. This approval will be subject to the dispute resolution process.

**TABLE A-B  
FIELD BORING LOG INFORMATION<sup>a</sup>**

**General**

- |                             |                            |   |
|-----------------------------|----------------------------|---|
| o Project name              | o Name of Drilling Firm    | o Petrologic lithologic classification schemes, if used (e.g. Wentworth unified soil classification system) |
| o Hole name/number          | o Hole location sketch map | o Static water level at completion  |
| o Sheet number              | o Precipitation (yes/no)   |   |
| o Date started and finished | o Rig type, bit/auger size |   |
| o Geologist's name          |                            |   |

**Sample Information**

- o Depth
- o Sample location/number
- o Sample recovery, if split spoon or rock core samples are taken

**Narrative Description**

o **Geologic Observations (including depth)**

- |                         |   |  |
|-------------------------|---|--|
| - soil/rock type        | - presence of carbonate*  | - bedding, discontinuities, and fossils (if soil or rock core samples are taken) |
| - color and stain       | - fractures or solution cavities (unless air rotary is used in unsaturated bedrock) | - depositional structures*   |
| - friability*           | - visible organic content   | - water bearing zones  |
| - moisture content*     |   |  |
| - degree of weathering* |   |  |

o **Drilling Observations**

- |   |   |   |
|---|---|---|
| - blow counts and advance rate (if split spoons are used) | - rig chatter*                            | - estimated water yield or loss (during drilling at different depths) |
| - loss of circulation                                     | - drilling difficulties*                  | - types of liquids used   |
| - advance rates*  | - changes in drilling method or equipment | - running sands   |
|   | - detection equipment readings (if any)   | - caving or hole instability  |

o **Other Remarks**

- |                       |                  |  |
|-----------------------|------------------|--|
| - equipment failures* | - odor, if noted | - visible presence of non-natural materials (describe) |
|-----------------------|------------------|--|

**Note:** Log notations made only for positive observations (i.e. absence of above data shall not be noted in the boring log). Asterisked items are optional, at the discretion of the onsite geologist.

APPENDIX B  
SCOPE OF WORK FOR TRANSWESTERN  
OVERSIGHT CONTRACTOR

I. INTRODUCTION

The designated Oversight Contractor has responsibility to review, observe and report to EPA concerning Transwestern's compliance with all all aspects of the Consent Decree.

The designated Oversight Contractor is fully accountable to the EPA throughout every stage of these oversight activities. It is to maintain independent oversight of Transwestern's activities. Thus, it is essential that the Oversight Contractor provide a strong management team to deal independently with the wide variety of technical issues that will arise before meeting regularly with EPA's Site Contact. The purpose of these contacts will be to report on Transwestern's progress, to obtain assistance resolving problems at any stage of the below-described activities, and to obtain EPA approvals at key points in the compliance process.

The contractor will provide direct oversight of all activities required of Transwestern pursuant to the Consent Decree. The contractor will attempt to resolve informally any disputes between its representatives and personnel of Transwestern arising from the implementation, remediation, verification of PCB contamination, source control plans, and quarterly reports and their own invoice submissions. The contractor will notify the Agency of all disputes which it has informally resolved by providing a brief description of each party's position, the rationale which served as the basis for that position, and the ultimate decision resolving the dispute, including the manner of resolution, or whether the matter is to be referred to dispute resolution pursuant to Section XV of this Consent Decree. If the dispute

involves on-scene contractor representatives, their manager, the Site Contact, will notify EPA by telephone of any unresolved dispute. All other dispute notifications will be made to the Agency in writing by the Site Contact.

In order to provide adequate oversight responsibility, the contractor selected must have a wide variety of expertise available in field sampling, multimedia chemical analysis of PCBs and other hazardous substances, quality assurance practices and procedures, statistical sampling and data analysis, hydrogeology, and various engineering capabilities to oversee such activities as soil excavation, well drilling, and pipeline equipment modifications. In addition to these areas of technical expertise, the contractor must provide a sound management structure for overseeing the activities of the many groups involved, as well as a management information system staffed by a team experienced in tracking such activities.

## II. SCOPE OF WORK

The designated Oversight Contractor shall perform the following tasks:

1. Review all data and information generated by Transwestern, its contractor(s), EPA, the State of New Mexico and any other source of information on the Transwestern sites originating at Corona, New Mexico and all inclusive of the sites downstream westward from the Corona site to the New Mexico/Arizona border. The contractor will collect and analyze samples according to the QA/QC procedures set forth in Appendix C.
2. Review the site-specific work plans to advise EPA on whether the cleanup plan is capable of achieving the cleanup standard.
3. Be present on-site during and observe all cleanup activities and verification sampling. Observe excavation and verification sampling of soil

proposed for backfill. Report to EPA any deviations from the requirements of the Consent Decree or site-specific workplan, or problems which arise needing resolution by EPA.

4. Observe sample collection and handling procedures, including chain-of-custody forms and sampling equipment.

5. Observe the QA/QC procedures followed for field and composite verification sampling.

6. Review and tabulate all data submitted by Transwestern for verification purposes, including QA/QC data.

7. Review all source control design proposals submitted and/or implemented by Transwestern pursuant to the Consent Decree. Report to EPA regarding any source control design proposals or implemented controls.

8. Observe the installation of all source control equipment pursuant to the Consent Decree. Observe the operation of each unit of installed source control equipment and verify that the equipment is operating at the level of efficiency specified in the Consent Decree. Notify the EPA of any deviation from the Consent Decree.

9. Observe the removal of 50% of the equipment replaced in accordance with the source control requirements of the Consent Decree. Review the disposal records of all pipeline equipment replaced pursuant to the source control requirements of the Consent Decree. Notify EPA of any deviations from the Consent Decree.

10. Report by phone at least twice per week to the EPA Project Contact.

11. Serve as the Records Officer and maintain a complete indexed file of all documents issued pursuant to the Decree or which pertain to State or Federal compliance activities. Documents would include but would not be limited to field logs maintained by on-site personnel; weekly summaries to be E-mailed to the EPA Project Contact and NMEID; quarterly reports; final

reports on each site cleanup; photodocumentation of all phases of the project; and all disposal and manifesting records.

12. Review of cleanup contractor's safety plan. Adequate review should be provided to ensure that work practices are in accord with OSHA Standards 1910.20. The intent is not to have the Oversight Contractor bear liability for health and safety matters, but to ensure that OSHA concerns are addressed. Review of the safety plan shall be completed prior to initiation of onsite work.

13. Advise EPA immediately of any conditions at any site that may pose an imminent and unreasonable risk or an imminent and substantial endangerment to health or the environment.

14. Advise the EPA Project Contact whether enhancement of existing sampling must be conducted to determine the extent of PCB contamination.

If the recommendation to conduct additional sampling is supported by reasons for believing that sampling must be done where no sampling has been done in the past, then Transwestern will undertake the necessary work.

### III. AREAS OF EXPERTISE REQUIRED FOR OVERSIGHT OF TRANSWESTERN CLEANUP

#### Groundwater Monitoring

Hydrogeological characterization  
Installation of first wells  
Chemical analysis of samples  
Location of further wells if contamination identified  
Quality Assurance for all aspects of groundwater monitoring

#### Remediation Activities

Overall evaluation of workplan to make sure that it is environmentally sound.

Excavation oversight

Disposal oversight  
Landfill  
Incineration

Quality Control and Assurance Oversight

Verification of Remediation

Oversight to make sure samples are taken according to the Consent Decree

Oversight to make sure locations are reasonable

Oversight to make sure samples are taken with proper equipment and handling procedures

Oversight of chain-of-custody

Oversight of proper PCB and other hazardous substances analyses

Oversight of Off-Site Equipment Area and Man-Made Surface Sampling

Decontamination of Man-Made Surfaces Program

Reviewing cleanup procedures to assure that existing regulations are followed, etc.

Quality Assurance at all Stages of a Remediation Program, Including Active Identification of Potential Problems

Knowledge of 40 C.F.R. Part 761, 40 C.F.R. Part 260 et seq.; CERCLA; OSHA Requirements for Hazardous Waste Site Activity

APPENDIX C

PCB SAMPLING TECHNIQUES AND ANALYTICAL METHODS  
FOR SITE CHARACTERIZATION AND CLEANUP VERIFICATION

PCB SAMPLING TECHNIQUES AND ANALYTICAL METHODS  
FOR SITE CHARACTERIZATION AND CLEANUP VERIFICATION  
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## I. INTRODUCTION

### A. Purpose

The purpose of this Appendix C is to describe acceptable PCB sampling techniques and analytical methods for characterization and cleanup verification at the Transwestern sites. This Appendix C shall be used by Transwestern as a guidance document for the preparation of an overall Quality Assurance Project Plan (QAPP), and the quality assurance section of the remediation work plan.

### B. Sampling and Analytical Quality Assurance Project Plan

Quality assurance (QA) shall be applied throughout the entire sampling program including (1) sample program design, (2) sample collection, handling, and preservation, (3) laboratory analysis and (4) data processing and interpretation. A QAPP shall be developed according to References 1, 2 and 5. The QAPP shall be submitted to the EPA Project Contact for review in accordance with Section VII.C of the Consent Decree not later than thirty (30) days after the effective date of the Consent Decree, and the review shall be completed prior to sampling conducted pursuant to the Consent Decree.

The elements of the QAPP include:

- Project description
- Project organization and responsibility
- Sample collection
- Sample custody
- Calibration
- Sample analysis
- Recordkeeping/documentation
- Data management
- Internal quality control checks

External quality control checks  
Preventive maintenance (for laboratory  
equipment)  
Specific routine procedures for assessing  
data quality  
Feedback and corrective action  
Quality assurance reports to management

All field-sampling and laboratory personnel shall understand and conform with all elements of the QAPP related to their activities.

The quality assurance section of the remediation work plans shall incorporate the QAPP, by reference, and shall include, appropriate site-specific QA elements (such as types of laboratory facilities and equipment to be used for the work at that site).

C. Quality Control Program

Transwestern shall operate a formal quality control (QC) program. The minimum requirements of this program are described herein. Additional quality control measures shall be described in the QAPP.

## II. PRESAMPLING REQUIREMENTS

### A. Glassware Preparation

New sampling glassware and equipment shall be used whenever practical. Before using sampling glassware (new or cleaned), the glassware shall be verified as being below detection for PCBs. The verification process shall follow any cleaning process. The cleaning process shall include one of the following methods: (1) washing with soap and water, triple rinsing with deionized (DI) water, rinsing with isooctane, wiping with a disposable wipe and drying at 350 degrees C for one hour or (2) washing with Alconox and water; rinsing in sequence with potable water, methanol, hexane, methanol and DI water, then air drying. The verification procedure shall include:

1. Statistical sampling of:
  - (a) no less than 1% of new sampling glassware from each lot, and
  - (b) no less than 5% of sampling glassware which has been used in this project (or any other PCB sampling and analysis project) and has been cleaned for reuse in this project.

2. Triple rinsing of the selected sampling glassware with isooctane, or with the methanol-hexane-DI water sequence:

- (a) equal to ten percent of the volume of the sampling glassware, and
- (b) providing a complete coating of all surfaces for each rinse.

3. The final rinse shall be collected and concentrated to the same volume used in preparation of a final extract for field samples and then analyzed for PCBs. Only when all of the verification samples of a new or cleaned lot of glassware are below the quantitation limit for PCBs shall the glassware be used.

In lieu of the Section II.A.1 through 3 procedures, use of new sample bottles which have been certified as clean by the supplier is allowed.

4. Analytical glassware shall be verified free of PCBs through the use of reagent (method) blanks, as described in Section VI.B.

#### B. Sampling Equipment Cleaning

Prior to being used for any sampling event, sampling equipment, other than disposable sampling equipment, shall be cleaned using the cleaning processes described in Section II. A., with the exceptions presented in subsequent sections.

Commercial distilled water may be substituted for DI water for sampling equipment cleaning when field conditions dictate. The verification procedures for glassware are not applicable for sampling equipment. Sampling equipment required to be cleaned is any equipment or protective gear that may come into contact with the sample matrix.

### III. FIELD SAMPLING TECHNIQUES

#### A. Surface Soil Sampling (Soil Core Sampling)

Surface soil samples (also called soil core samples) shall be collected using a piston corer, King-tube sampler, bucket auger, stainless steel scoop, or similar device. Prior to obtaining a sample, surface debris, loose material, and ground cover shall be removed from the area to be sampled. Samples shall be collected to a depth of six inches. One or more cores or scoops shall be taken at each sample location. If more than one core or scoop is obtained, they shall be taken a few inches apart at each sampling location and they shall be placed into a stainless steel, tempered glass, or aluminum container and thoroughly mixed. At Transwestern's option, these samples may also be sieved through a 1/4 or 3/8 inch sieve in the field or at the laboratory prior to analysis. The sieving is for the purpose (1) removing non-soil debris (rocks, sticks), (2) size reduction, and (3) to promote sample homogeneity. Random portions of the sample in the container shall be used to fill one or more glass bottles and the bottle shall be capped.

All samples shall be stored and shipped at 4 degrees C.

#### B. Soil Boring Sampling

Soil boring samples shall be taken at the sampling location using an auger with a split spoon sampler, split barrel sampler or similar device. The soil from the first interval (typically 2 feet) shall be removed from the sampling device and placed into a stainless steel, tempered glass, or aluminum container and mixed to obtain a homogeneous sample. Soil boring samples may also be sieved to promote sample homogeneity. Random portions of the sample in the container shall be used to fill one or more glass sample bottles and the sample bottles shall be capped. The hole shall then be opened with an auger to the next sampling depth. The next sample interval shall be collected in the same manner. This procedure shall be repeated until the maximum prescribed depth is reached. In situations where a five-foot split barrel sampler is used, the procedure shall be the same as described above, except for 5-foot intervals. Five-foot split barrel samples may be removed from the barrel in smaller (e.g. 2 or 3 feet) increments and analyzed separately. All samples shall be stored and shipped at 4 degrees C.

The auger shall be cleaned between each boring location to prevent cross contamination. The sampling equipment shall be cleaned between each sampling event. This cleaning shall be consistent with the procedures described in Section II.B except that augers, split spoons, split barrels and other similar soil boring and sampling devices may be washed with soap and water and steam-cleaned (i.e.,

with high pressure hot water).

Excess soil shall be drummed and held on-site pending a decision by Trans-western regarding disposition. The excess soil shall be segregated in so far as practical to separate potentially contaminated and uncontaminated soils.

#### C. Composite Soil Samples

Samples from the same type matrix may be composited for analysis if specifically allowed in Appendix A. Compositing shall be done either by equal volume or equal weight.

Unless specifically excepted in Appendix A, the number of individual samples which can be composited is limited by the characterization or cleanup level and the analytical quantitation limit. All samples making up a composite shall be considered to be less than or equal to the characterization or cleanup level if the measured concentration of PCBs in the composite is less than the value obtained by dividing the characterization or cleanup level by the number of individual samples comprising the composite.

#### D. Surface Water Sampling

PCB spills on water may result in a surface film (particularly when the PCBs are dissolved in hydrocarbon oils) or may sink to the bottom (particularly when the PCBs are in Askarel or other heavier-than-water matrix). When a surface film is suspected (or visible), the water surface shall be sampled. Otherwise, a water sample shall be taken near the bottom of the body of water. Duplicate samples, where required, shall be collected immediately after the initial sample.

## 1. Surface Sampling

Surface samples shall be collected by lowering an open, glass sample bottle horizontally into the water with the mouth of the bottle directed upstream. As the sample container fills, the bottle shall be slowly turned upright, keeping the lip just under the water surface. The bottle shall be capped and the exterior surface wiped with a disposable wiping cloth. All samples shall be stored and shipped at 4 degrees C.

## 2. Subsurface Sampling

Water near the bottom of the body of water shall be sampled by lowering a sealed sample bottle to the required depth (but without disturbing the sediment), removing the bottle cap, allowing the bottle to fill, removing the bottle from the water, and recapping. The exterior of the bottle shall be wiped with a disposable wiping cloth. All samples shall be stored and shipped at 4 degrees C.

If the above water collection procedures are not practical, other equipment such as siphons, pumps, dippers or tubes may be used to collect a water sample and transfer it to a glass sample bottle. The sampling system shall be constructed of glass, stainless steel, and/or Teflon.

## E. Sediment Sampling

A sediment sample shall consist of a field homogenization of three discrete subsamples collected from equidistant points along a transect of the stream. This homogenized sample shall be treated as a discrete sample. At Transwestern's option, the three discrete subsamples may be analyzed separately. All subsamples shall be collected from a 0 to 6 inch depth in the same manner as surface soil samples (Section III.A) and shall be thoroughly mixed in a stainless steel, tempered

glass, or aluminum container. If discrete subsamples cannot be collected, one representative sample shall be taken where the sediment tends to collect (e.g., quiescent pools). The sample shall be collected at the bottom of each body of water with a stainless steel scoop, Ponar dredge or similar device, placed into a glass sample bottle, and capped with a Teflon-lined cap. All sediment samples shall be stored and shipped at 4 degrees C.

#### F. Groundwater Sampling

Prior to any well sampling, each well shall be checked to determine whether an oily phase is present on the top of the groundwater. If an oily phase is present in a sufficient quantity for a sample to be obtained, it shall be sampled using a bailer made of Teflon, stainless steel, or other approved material.

If no oily phase is present, the well shall be pumped or bailed until the well is flushed of standing water and contains fresh water from the aquifer. A minimum of 3 to 5 well casing volumes shall be removed. A sample shall be collected (1) using a bailer made of Teflon, stainless steel, or other approved material, (2) by inserting a Teflon or stainless steel pump into the well casing, or (3) by using a dedicated (permanently mounted) Teflon or stainless steel pump. The bailed or pumped sample shall be collected in one or more glass sample bottles. A pumped sample shall be collected from the saturated zone to assure a representative sample of the aquifer. All pump tubing shall be Teflon, stainless steel, or other approved material. Sample containers shall be glass bottles with Teflon-lined caps. The samples shall be stored and shipped at 4 degrees C. Replicate samples, where required, shall be collected immediately after the initial sampling.

## G. Hard Surface Sampling

Samples of hard surfaces may be taken by two methods: (a) wipe sampling and (b) destructive sampling. Wipe samples shall be taken of any smooth surface which is relatively nonporous (such as metal equipment surfaces). Destructive samples shall be taken of hard porous surfaces (such as concrete, brick, asphalt, and wood). Both wipe and destructive samples may be taken if it is not known whether the surface is porous or nonporous.

### 1. Wipe Sampling

Wipe samples shall be taken by first applying a suitable solvent (such as hexane or isooctane) to a piece of filter paper (e.g., Whatman 40 ashless or Whatman 50 smear tabs) or a gauze pad. The moistened filter paper or gauze pad shall then be held with a pair of stainless steel forceps or rubber gloves and rubbed thoroughly over a 100 cm<sup>2</sup> area (delineated by a template) of the sample surface. The filter or pad shall be placed in a glass sample bottle, and the bottle shall be capped. All samples shall be stored and shipped at 4 degrees C. The outer gloves worn when taking wipe samples and any wiping cloth shall be discarded into a plastic bag and handled as potentially PCB-contaminated material. The wipe sample results shall be used to define whether the discarded material is contaminated.

### 2. Destructive Sampling

Wipe sampling is not appropriate on porous surfaces, such as wood, asphalt, concrete, and brick, which may absorb PCBs. In some cases, these surfaces can be sampled by taking a discrete sample such as a piece of wood or a paving brick. Otherwise, chisels, drills, hole saws, or similar tools shall be used to remove sufficient sample for analysis. Samples less than 2 cm deep shall be taken and placed in a glass sample bottle or double wrapped in solvent-rinsed aluminum foil.

#### H. Split Samples

EPA may obtain split samples of any sample collected by Transwestern. Splitting protocol shall be as follows:

EPA shall notify Transwestern 48 hours in advance of when split samples are to be obtained.

EPA shall provide all sample containers for collecting and transporting their split samples.

An EPA representative shall be present when split samples are obtained.

EPA split sample results shall not invalidate Transwestern results when the quality control criteria described herein are achieved by Transwestern.

Analytical results from EPA split samples shall be made available to Transwestern for Transwestern's information.

For soil samples, the split sample shall be taken from the same mixture in the same container as the Transwestern sample is taken.

For groundwater samples, the split sample bottle shall be filled as nearly coincident as practical with the Transwestern sample bottle.

#### I. Field Blanks and Background Samples

Surface soil background samples shall be collected in the field (off-site where feasible) using the soil sampling equipment. These samples shall be collected upgradient in a direction not impacted by site surface drainage. Two background soil samples shall be collected and analyzed at each site.

A field blank of each source of deionized or distilled water, or other rinse material used at each site shall be collected and analyzed.

Field blanks for wipe samples shall be obtained in the field by wetting

clean wiping material with a solvent and placing the wiping material in a sample bottle. One glass sample bottle filled with solvent, per site, shall also be obtained and analyzed.

All background samples and field blanks shall be stored and shipped at 4 degrees C.

#### J. Disposition of Sampling Wastes

All sampling wastes including excess sample materials, disposable items (e.g., rubber gloves, disposable wipes), and decontamination solutions, shall be containerized and labeled, pending a Transwestern decision regarding disposition. These materials may be segregated and held on-site pending availability of analytical data prior to ultimate disposal according to waste classification.

### IV. FIELD QUALITY ASSURANCE PROCEDURES

#### A. Sample Custody

The chain-of-custody protocol shall follow NEIC procedures described in the document "NEIC Policies and Procedures," Revised June 1985 (Reference 4). A single form is permissible for both chain-of-custody and sample analysis request purposes.

#### B. Documentation of Field Sampling

In order to assure that the field sampling effort has been adequately documented, the documents described in paragraphs 1 through 5, below, shall be prepared.

### 1. Documentation and Records

Transwestern is responsible for preparing and maintaining complete records of the field sampling activities. A documentation plan shall be prepared as a part of the QAPP and shall be adhered to by field personnel. The following written records shall be maintained for each sampling program:

- Sample codes
- Field log book (including equipment preparation logging)
- Annotated maps (to show sample locations)
- Chain-of-custody forms (can be combined with sample analysis request)
- Sample analysis request forms

### 2. Sample Codes

Each sample when collected shall be assigned a unique sample code and the sample container labeled accordingly. The sample code shall contain information traceable to the site and location at which the sample was collected. This code shall be used for all reference to that particular sample.

### 3. Field Log Book

Transwestern shall maintain a field log book or books which contain all information pertinent to the field sampling program and the equipment preparation each site. The log books shall be bound and entries made in ink. The field team leaders shall review field log entries daily and shall indicate so by initialing each page of entries.

At a minimum, each log book shall include the following entries:

Location of site  
Date(s) of sample collection  
Time(s) of sample collection  
Type(s) of samples taken and sample identification numbers  
Number of samples taken  
Description of sampling methodology (referencing the QAPP)  
Field observations  
Summary of equipment preparation procedures  
Name and affiliation of field team leader  
Cross-reference of sample identification numbers to grid sample points (shown on annotated maps)

#### 4. Sample Location Record

The site maps prepared pursuant to Appendix A shall be used to record key site conditions and to show approximate (scaled, not surveyed) pit, surface soil, sediment and monitoring well sampling points.

#### 5. Sample Analysis Request Forms

A sample analysis request (chain of custody) form shall accompany all samples delivered to the laboratory. The following information shall be included on the form:

Project site  
Name of sample collector  
Sample identification numbers  
Sample type and description (pit, surface soil, soil boring, sediment, surface or groundwater)  
Analyses requested  
Special handling and storage requirements

The laboratory personnel receiving the samples shall enter the following information on the form:

Name of person receiving the samples  
Laboratory sample numbers  
Date of sample receipt

## V. PCB ANALYTICAL TECHNIQUES

The chemical analysis, quality assurance/quality control (QA/QC), and sample handling procedures documented in Reference 5 shall be used as guidance. The Reference 5 guidelines shall apply except where they directly conflict with NEIC Policies and Procedures or where there is conflict with the Consent Decree. The QAPP, and the quality assurance section of the remediation work plans, shall provide specific detail as to chemical analysis, QA/QC, and sample handling procedures.

Transwestern shall have the responsibility for achieving the appropriate quantitation limits and meeting the quality control criteria. In order to achieve these quantitation limits and meet these quality control criteria, standard analytical techniques (such as the use of column chromatographic cleanup, sulfuric acid cleanup or alumina column cleanup) may be required that may not be explicitly associated with PCB methods in Reference 5. Since the goal of these analyses is the quantitation of the actual amount of PCBs in the samples, it shall be necessary for Transwestern to follow the procedures outlined in this section and to take the quality control measures described in Section VI in order to achieve and document this goal.

### A. Quantitation

Quantitation of PCBs shall be by comparison to Aroclor standards. The relevant standard upon which quantitation shall be based is the Aroclor having the most similar chromatographic response to the chromatographic response of the PCBs present in the field samples. The identity of this Aroclor shall be reported.

If the presence of overlaps in chromatographic responses or severely weathered Aroclor patterns preclude accurate identification and quantitation by comparison to Aroclor standards, then the quantitation method described by Webb and McCall in Reference 6 shall be used.

For soil or water samples with measured PCB concentrations less than the quantitation limits, analytical results shall be reported as "less than the appropriate quantitation limit". For soil samples with measured PCB concentrations less than 1 ppm, analytical results shall be reported as "less than 1 ppm" if the quantitation limit is also less than 1 ppm; however, if the quantitation limit is greater than 1 ppm, analytical results shall be reported as "less than the quantitation limit."

For a soil sample for which the initial analysis yields an analytical result greater than 25 ppm and outside the calibration range, only those sample dilutions need be performed that are required to produce an interpretable chromatogram and following that an approximate PCB concentration may be reported.

#### B. PCB Analytical Methods

PCB analytical methods, such as Method 8080 in Reference 5 or similar EPA approved methods, which meet the performance criteria described herein are acceptable. PCB analytical methods used by Transwestern shall be defined in the QAPP.

For each alternative analytical method proposed by Transwestern, Transwestern shall either (1) include in the QAPP existing performance data to validate such method or (2) perform method validation prior to use of such proposed method. In the latter instance, the method validation procedure shall be described in the QAPP.

Typically, the method validation shall include analyzing a standard matrix (soil) fortified with the analyte of interest at concentrations ranging from the target quantitation limit to a defined upper limit concentration. Samples shall be analyzed in triplicate at selected concentrations to permit calculation of method precision and accuracy. For instances where the field sample matrix is expected to be substantially different from the standard matrix (e.g., presence of interferences), then a representative number and type of field samples shall be collected and analyzed (in triplicate) as part of the method validation.

#### C. Surface Wipes

No standard method is available for analysis of PCB surface wipe samples. Surface wipe samples may be prepared using a solvent extraction technique with subsequent concentration of the extract as needed prior to analysis. The PCB analytical method for wipe samples shall be specified in the QAPP.

#### D. Destructive Samples

No standard method is available for analysis of PCB samples collected by destructive techniques. The sample preparation shall be by grinding or other size reduction technique followed by analysis with one of the PCB analytical methods described in the QAPP.

#### E. Oil, Pipeline Liquids and Oily Phase Samples

Oil, pipeline liquids, and oily phase groundwater samples collected pursuant to Appendix A shall be analyzed for PCBs per Reference 9.

## VI. ANALYTICAL QUALITY CONTROL

### A. Surrogate Compound

Candidate surrogate compounds shall be evaluated and, if applicable, a surrogate compound shall be selected and defined in the QAPP. Recommended recovery criteria for the candidate surrogate shall be defined in the QAPP. If a suitable surrogate compound is identified, each sample (including QA/QC samples) shall be fortified with the surrogate compound. The concentration of the surrogate measured in the sample shall then be used to calculate surrogate recovery in that sample.

### B. Quality Control Samples

Specific quality control procedures for each matrix shall be described in the QAPP. The samples shall be grouped and analyzed as follows:

Sample batches shall be segregated by site and matrix. Each field sample shall be part of a sample batch. Each batch of twenty or fewer field samples shall include the following quality control samples:

- o Two fortified (matrix spike) samples which have been spiked at approximately:

- twice the concentration of the PCBs in the sample or 50 ppm (for samples having a characterization or cleanup level of 25 ppm)

- 30 ppm for samples having a characterization or cleanup level of 10 ppm

- 5 to 10 ppm for samples having a characterization level of 1 ppm

#### 4. Documentation

Documentation for each analysis shall include a laboratory chronicle, data summaries, and QC summaries. All raw data, including chromatograms and standards data shall be retained by Transwestern and shall be made available to EPA at the place of retention upon request.

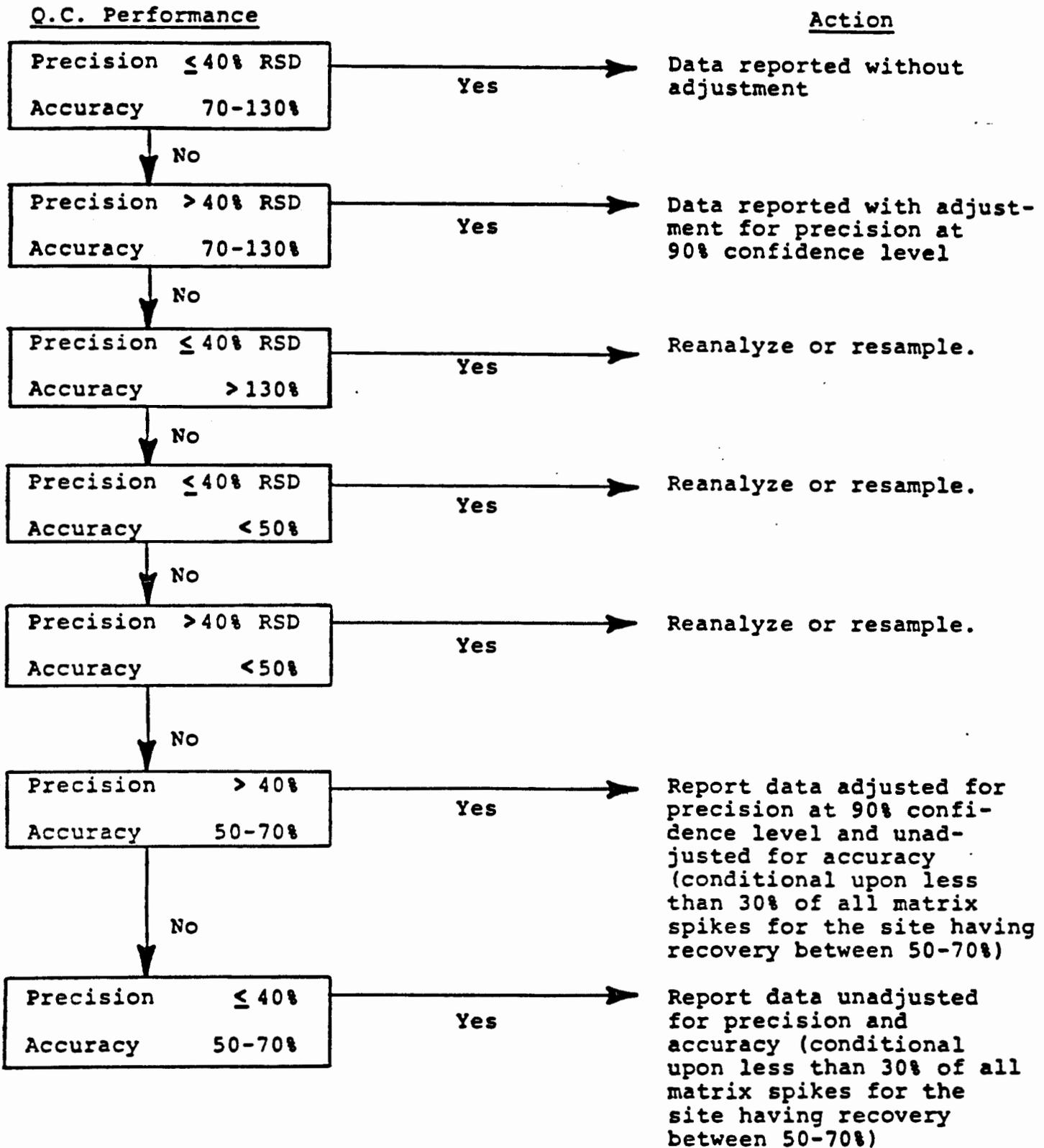
TABLE B-1

Quality Control Criteria and  
Corrective Action  
for  
Water, Soil and Sediment Samples

<u>Matrix</u>	<u>Confidence Level</u>	<u>Precision</u>	<u>Accuracy</u>	<u>Action</u>
Water	90%	≤ 30% RSD	≥ 70%	If QC criteria are met, data are reported; if QC criteria are not met, reanalyze or resample.
Soil or Sediment ( > 25 ppm PCBs)	N/A	N/A	N/A	Data shall be reported and accepted without adjustment.
Soil or Sediment (1 to 25 ppm PCBs)	N/A	-- refer to Figure B-1 --		

Figure B-1

QC Decision Chart  
for  
Soil or Sediment Samples with Measured  
PCB Concentration between  
1 and 25 mg/kg (ppm)



## REFERENCES

1. USEPA. 1980. U.S. Environmental Protection Agency. Guidelines and specifications for Preparing Quality Assurance Project Plans. Office of Monitoring Systems and Quality Assurance, QAMS-005/80
2. USEPA. 1987. U.S. Environmental Protection Agency OTS Guidance Document for the Preparation of Quality Assurance Project Plans.
3. USEPA. 1984. Sampling Guidance Manual for the National Dioxin Study, Final Draft Report, July 1984.
4. USEPA. 1985. U.S. Environmental Protection Agency. "NEIC Policies and Procedures," EPA-330/9-78-110-R
5. USEPA. 1986. U.S. Environmental Protection Agency. "Test Methods for Evaluating Solid Waste," SW-846.
6. Webb, R.G. and McCall, A.C., J. Chrom. Sci., 11, 1973, 336-373. Quantitative PCB Standards for Electron Capture Gas Chromatography.
7. USHHS. 1986, Pesticide Analytical Manual, Vol. 1. Food and Drug Administration
8. USEPA. 1980. U.S. Environmental Protection Agency. EPA-600/4-81-055.
9. USEPA. 1982. U.S. Environmental Protection Agency. The Determination of PCBs in Transformer Fluids and Waste Oil. EPA-600/4-81-045.

**ENRON**  
**Transwestern Pipeline Company**

P. O. Box 1188 Houston, Texas 77251-1188 (713) 853-6161

April 11, 1990  
EDB: E25-90

RECEIVED

APR 12 1990

TOXICS SECTION

Ms. Donna Mullins  
USEPA Region VI  
1445 Ross Avenue, Suite 1200  
Dallas, Texas 75202

Subject: SOIL SAMPLE ANALYSES: EPA METHODS 8010 AND 8020  
AND GLYCOL AND METHANOL

Enclosed are the reports of the 8010/8020, methanol/glycol, pit soil sample analyses for the compressor station sites at Corona, Mountainaire, Laguna, and Thoreau. The samples were taken by Condor Geotechnical Services, Inc., and their sampling plan and procedure, and the log of their activities, are also enclosed.

As you are aware, excavation will commence at Corona and Mountainaire shortly. Work is not scheduled to commence at Thoreau until the latter part of May, and at Laguna not until September. Therefore, I suggest that at this time we concentrate our efforts on the Corona and Mountainaire sites. USPCI is currently moving into the Corona location, and will be moving into Mountainaire on April 23 or 24. Excavation and cleanup will proceed in accordance with the terms and conditions of the Consent Decree. However, no excavation will occur in the pit areas until you have had an opportunity to review, and we have discussed, the enclosed test results.

The 8010/8020, methanol/glycol test results were positive for some constituents. We know the origin of some of these constituents, but we do not know the source of others. For example, pipeline liquids (or condensate) are hydrocarbons naturally produced with natural gas, and these hydrocarbons liquefy as the natural gas cools as it moves away from the compressor stations. If these liquids were stored in earthen impoundments, we would expect to find xylenes, benzene and toluene in the soil. One or more of these constituents were found in soils at three stations. Methanol must be injected into the pipeline to prevent freeze-offs and to ensure the safe operation of the pipelines. Therefore, some methanol may be entrained in the pipeline liquids and was detected in soil samples at Thoreau. We cannot determine the source of the other constituents with any certainty, but at the extremely low levels detected, the source may have been solvents used at the stations. For your information, the use of all solvents containing potentially hazardous constituents has been discontinued.

Donna Mullins  
April 11, 1990

Page 2

Although the soils in the pit areas contain de minimus levels of constituents not regulated under TSCA, we plan to dispose of the PCB contaminated soil in a secure chemical waste landfill operated by USPCI, Inc. in accordance with the federal regulations at 40. C.F.R. 4. § 761.75 (1989). We seek your authorization to proceed with this manner of disposal.

Only two weeks ago, EPA observed in its final rule on its toxicity characteristic revisions that if PCB wastes were to be regulated now under RCRA as well as under TSCA, serious legal, practical and administrative complications could result. In the context of discussing how dielectric fluid and PCB contaminated equipment may now exhibit the toxicity characteristic, the agency observed that the existing TSCA disposal regulations, including the recent PCB manifesting rules are adequate to protect human health and the environment with respect to the disposal of these wastes. The agency stated that it plans to evaluate the integration of the TSCA PCB regulations with the hazardous waste regulations for other PCB-containing wastes which are identified or listed as hazardous. 55 Fed Reg. 11798, at 11841. (March 29, 1990).

If you have any questions regarding the enclosures, or wish to discuss any of these matters, please call me.



E. D. Berdine  
Vice President  
Environmental Affairs and Administration  
Agent and Attorney-in-Fact  
Transwestern Pipeline Company

EDB/jc

Attachments:

cc: B. Janacek      w/o attachments  
    R. Meyer        "            "  
    G. Wassell     "            "

July 22, 1989

Mr. Gordon Wassell  
Enron Pipeline Group  
2223 Dodge Street  
Omaha, Nebraska 68102

Additional Site Characterization at New Mexico Stations

Dear Mr. Wassell:

The following is Condor's methodology for collecting samples from pits at various Compressor Stations on the Transwestern Pipeline in New Mexico. We have reviewed the Consent Decree with regard to sampling requirements, sampling procedures and sample tool decontamination.

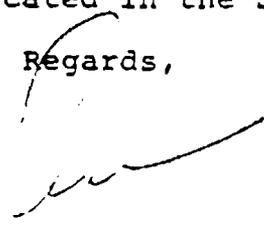
The details of the Sampling Plan, the Sampling Techniques and Procedures and Sample Tool Decontamination begin on the next page.

You will observe that at several places in the sampling plan we are asking questions about whether something needs to be sampled. These are in CAPITAL letters.

We mobilized on Friday, July 21, 1989 for this work and will begin at Corona on Saturday, go to Mountainair on Monday. Mountainair will require drilling through a concrete cap and we are prepared to do that.

Give me a call concerning the questions that I have indicated in the Sampling Plan.

Regards,



## SAMPLING PLAN

We will sample the following pits:

1. Station 8
  - a. three pits located southeast of the Station Shop and along the east property boundary. Pits are shown on diagram.
2. Station 7
  - a. three pits, one located northeast of the receiver site and the other two west of the shop yard near the western property boundary
3. Station 6
  - a. the waste oil pit approximately 200 feet west of the east property fence north northwest of the receiver. NOT CLEAR ON WHETHER THE LONG NORTE-SOUTH PITS ON THE EAST NEED TO SAMPLED.
4. Station 5
  - a. four pits per Langston/Walker memo of December 31, 1984. One pit is located in the southeast area of the property north of the receiver, another is located west of the shop area along the west boundary of the property. WE ARE NOT SURE WHERE THE REMAINING PITS DESCRIBED IN THE MEMO ARE LOCATED.

According to the requirements outlined on page 38 of the consent decree, Condor will sample to a minimum depth of 12 inches beneath the historical top of each pit. Samples will be collected for analysis using EPA Methods 8010 and 8020 and for glycol and methanol.

## PROCEDURE

Condor will sample according to the following procedure:

1. Dedicated, clean, 7 oz glass jars, provided by Rocky Mountain Analytical Labs, will be used for sample containers. These jars will be cleansed according to the "Presample Requirements", p. 5 of the section in the Consent Decree titled "PCB Sampling Techniques and Analytical Methods for Site Characterization and Cleanup Verification."

2. The sample tool will be a 2 inch seamless 304 stainless tube driven into the ground using percussion. Sampling will commence from the historical top of the pit. The sample point will be determined by Condor Geologists. Criteria will be a change in sample matrix from back fill material to material clearly consisting of waste oil.

3. The sampling tube will contain enough material to fill two 7 oz sampling jars. Samples will be extruded from the sampling tube using a stainless steel 303 solid rod. Before the jars are filled, the entire 12 inch sample will be mixed in a stainless steel container so that each sample jar contains a composite split of the 12 inch interval. Each jar will be filled to the top with zero space left.

A field blank consisting of deionized water which has been used to rinse the sampling tool and mixing bowl will be collected at each site.

4. The sampling tube will be used only once to sample. Upon completion of the sampling, the sample tube will be retired and a new, clean tool will be used for the next sample.

5. Two background soil samples as prescribed on page 13 of the section entitled "PCB Sampling Techniques and Analytical Methods For Site Characterization and Cleanup Verification" will be collected at each station location.

5. All jars will be labeled with date, time, sample numbers and a PCB label. The jars will be sealed, kept out of direct sunlight, wrapped in aluminum foil and placed on blue ice in a cooler.

6. Samples will be taken directly to the Federal Express Office in Albuquerque which is authorized to handle hazardous materials.

7. A chain of custody form, part of the Sample Request Form, will be enclosed with the samples.

8. The sample site will be clearly marked and surveyed in by Condor crews presently surveying Station Sites. A copy of the site map will be incorporated into the record to show the sample site and numbers.

9. Notes will be taken regarding the following per page 15 of the Procedures document of the Consent Decree.:

1. Field log book
  - a. document sample equipment preparation
  - b. Site location
  - c. Date, time of sample collection
  - d. Type of sample collected
  - e. Sample identification
  - f. Number of samples taken
  - g. Description of method
  - h. Names of samplers and their affiliation
  - i. Cross reference to grid
  - j. Field weather conditions and observations

10. Sample Analysis request forms will be provided by Rocky Mountain Analytical. It will also be a chain of custody form. Information on the form will be:

1. Project Site (Station 8)
2. Name of Collector
3. Sample Identification Numbers
4. Sample Type (ie Pit, etc)
5. Analysis requested
6. Special handling and storage requirements

11. Samples will be taken by qualified personnel; all personal protective clothing will be properly disposed of on site in concert with the local Transwestern plant management.

12. Sampling wastes will be containerized, labelled and left on site in containers provided by Transwestern.

## WASTE PIT SITE CHARACTERIZATION SAMPLING

Condor Geotechnical Services, Inc. was retained by Transwestern Pipeline Company to sample pits at four (4) compressor stations. The pits sampled were identified in correspondence from Transwestern Pipeline, and included only pits which contain waste oil contaminated soils. Active pits (currently in use) and pits in which there has been no determination of waste oil contamination were not sampled.

Two background samples were collected at each station. In general, the location of these samples was determined in the up-gradient, up-wind direction from the stations or areas of known contamination. A single field blank of the deionized rinse material was collected by running the water through the sampling device.

The sampling program was initiated by preparing a Sampling Plan QA/QC Program. This program is attached to this report as Appendix A, and was followed diligently during the sampling program. The samples collected are to be analyzed by Rocky Mountain Analytical Laboratory using EPA Protocols 8010 and 8020, as well as for glycol (ethylene), and methanol.

The samples were placed in coolers and shipped to Rocky Mountain Analytical Laboratory by Federal Express, under chain-of-custody.

Sample numbers were devised as follows: SPC stands for Site Pit Characterization, # stands for which compressor station the work was done, alpha character refers to the pit letter and 00X is the sample number from its associated pit.

### STATION 8, CORONA, NEW MEXICO

The three samples were taken from measured centers of three pits documented on drawings and/or correspondence provided for the sampling effort.

Sample SCP8A-001 was taken on 7/21/89 at 3:25 PM. Sample was of clayey soil, sample taken from surface to 12 inches in depth and composited and placed in sterile jars for shipment to laboratory.

Sample SCP8B-001 was taken on 7/21/89 at 5:21 PM. Sample was sandy clay and was taken from a natural drainage about three feet below the present surface. The sample would represent a 36 inch to 48 inch interval below surface composite sample. Sample was placed in sterile jars for shipment to laboratory.

Sample SCP8C-001 was taken on 7/21/89 at 4:15 PM inside the present containment area for the 500 barrel tank. It was determined that this was the location of a waste oil pit. Sample was taken from 12 inches to 24 inches and had a definite oily smell and appearance. The sample was composited and placed in sterile jars for shipment to the laboratory.

Background samples SCP8-FLD-BLK-001 and 002 were taken on the west (up-wind) side of the station.

#### STATION 7, MOUNTAINAIR, NEW MEXICO

Sampling was started on 7/25/89 and was completed on 7/26/89. Two pits were identified for sampling: the first (sample number SCP7-A-001) from a pit to the north and west of the blue storage tank in the south east portion of the station; the second (sample number SCP7-B-001) from a pit located southwest of the pig receiver in the southeastern portion of the station.

SCP7-A-001: Sample taken at 4:28 PM on 7/25/89 from pit covered with black plastic, now partially torn. Sample tube was driven through torn portion of cover, and the "historic top of the pit" was determined by noting change in character of sample from reddish clayey soil to black oily clayey soil. This interface was determined to be at 36 inches. The sample tool was driven 12 inches past this "historic top" and the sample was composited and placed in sterile containers for shipment to the laboratory.

SCP7-B-001: Sample taken at 4:20 PM on 7/26/89 from pit located southwest of pig receiver in the southeast portion of the station. The sample tube was driven three feet into the pit. The upper two feet consisted of sever inches of light reddish-tan sandy soil, followed by darker reddish tan more clayey soil. The "historic top" of the pit was determined to be the sharp interface between this reddish tan soil and very dark oil (



to be at 24 inches. Sample was composited and placed in sterile jars for shipment to the laboratory.

Sample number SCP6B-001 was taken on 8/1/89 at 12:33 PM from a location surveyed in approximately 50 feet north of the existing covered pit sampled above. This site was sampled because of correspondence which indicated that the existing covered pit was a second one located in this vicinity. The original pit was located approximately 50 feet north and was abandoned when the present pit was constructed. The sample tool was driven into the soil. Sample from surface to 12 inches below the surface consisted of reddish tan sandy clay. From 12 inches to 24 inches there was an increase in hydrocarbon smell and appearance. Sample taken from 24 inches to 36 inches and consisted of streaks of darker material, with hydrocarbon odor. So-called "historic top" was determined to be at 24 inches. Sample tool left in the hole.

Sample SCTR6-001 was taken on 8/1/89 at 1:41 PM. Condor was instructed to sample the existing trash pit located on the east side of the property approximately 500 feet northeast of the radio tower. The "historic top" was determined to be the top as it exists now. A sample was taken from this historic top down 12 inches. The sample consisted of light reddish sandy clay, there were some dark carbonaceous (?) streaks, but no hydrocarbon odor. The sample was composited and placed in sterile containers for shipment to the laboratory.

Two background samples were taken, the first, located off the southwest corner of the property and the second west of the west fence. Both sample sites were chosen in up wind and up drainage direction. The sample numbers are SCP6-BGND-001 and SCP6-BGND-002.

#### STATION 5, THOREAU, NEW MEXICO

Sample SCP5A-001 was taken on 7/29/89 at 1:13 PM from a pit which station personnel indicated had been excavated then put back into the pit. Thus, no so-called "historic top" would have been preserved. A composite sample was made from the uniform material from the top of the surface down to 24 inches from the top. This composite sample was put into sterilized containers for shipment to the laboratory. Sample tool was left in the hole and foam sealed to keep the integrity of the plastic liner.

A second pit located on the west side of the station has been evacuated of fluids and the sampling team was instructed not to sample that pit.

Two background samples were taken, one (numbered SCP6-BGND-001) approximately 200 feet north of the northwest corner of the station fence, the second, number SCP5-BGND-002, was located approximately 250 feet west of the residence entrance into the station on the north side of the road. Both samples are in up wind and up drainage direction.

TRANSWESTERN PIPELINE COMPANY

CORONA COMPRESSOR STATION #8

SOIL SAMPLE ANALYSES

EPA Analysis Methods 8010, 8020  
and for glycol and methanol

SAMPLE DESCRIPTION INFORMATION  
for  
Enron

Lab ID	Client ID	Matrix	Sampled Date	Time	Received Date
005867-0001-SA	SCP8-BLK	AQUEOUS	22 JUL 89	14:30	25 JUL 89
005867-0002-SA	SCP8A-001	SOIL	22 JUL 89	15:25	25 JUL 89
005867-0003-SA	SCP8B-001	SOIL	22 JUL 89	17:21	25 JUL 89
005867-0004-SA	SCP8C-001	SOIL	22 JUL 89	16:15	25 JUL 89

ANALYTICAL TEST REQUESTS  
for  
Enron

Lab ID: 005867	Group Code	Analysis Description	Custom Test?
0001	A	Aromatic Volatile Organics Halogenated Volatile Organics Water Miscible Solvents	N N Y
0002 - 0004	B	Aromatic Volatile Organics Halogenated Volatile Organics Water Miscible Solvents	N N Y

## Halogenated Volatile Organics

### Method 601

Client Name: Enron	Enseco ID: 1045946	Received: 25 JUL 89
Client ID: SCP8-BLK	Sampled: 22 JUL 89	Analyzed: 04 AUG 89
Lab ID: 005867-0001-SA	Prepared: NA	
Matrix: AQUEOUS		
Authorized: 25 JUL 89		

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	ug/L	5.0
Bromomethane	ND	ug/L	5.0
Vinyl chloride	ND	ug/L	1.0
Chloroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	0.50
1,1-Dichloroethane	ND	ug/L	0.50
1,2-Dichloroethene (cis/trans)	ND	ug/L	0.50
Chloroform	ND	ug/L	0.50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/L	1.0
1,2-Dichloroethane	ND	ug/L	1.0
1,1,1-Trichloroethane	ND	ug/L	0.50
Carbon tetrachloride	ND	ug/L	0.50
Bromodichloromethane	ND	ug/L	1.0
1,2-Dichloropropane	ND	ug/L	1.0
trans-1,3-Dichloropropene	ND	ug/L	1.0
Trichloroethene	ND	ug/L	0.50
Chlorodibromomethane	ND	ug/L	1.0
cis-1,3-Dichloropropene	ND	ug/L	2.0
1,1,2-Trichloroethane	ND	ug/L	1.0
EDB (1,2-Dibromoethane)	ND	ug/L	2.0
Bromoform	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	1.0
Tetrachloroethene	ND	ug/L	0.50
Chlorobenzene	ND	ug/L	2.0

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

## Halogenated Volatile Organics

### Method 8010

Client Name: Enron	Enseco ID: 1045947	Received: 25 JUL 89
Client ID: SCP8A-001	Sampled: 22 JUL 89	Analyzed: 04 AUG 89
Lab ID: 005867-0002-SA	Prepared: NA	
Matrix: SOIL		
Authorized: 25 JUL 89		

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	71	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP88-001  
 Lab ID: 005867-0003-SA  
 Matrix: SOIL  
 Authorized: 25 JUL 89

Enseco ID: 1045948  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 25 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

## Halogenated Volatile Organics

### Method 8010

Client Name: Enron  
 Client ID: SCP8C-001  
 Lab ID: 005867-0004-SA  
 Matrix: SOIL  
 Authorized: 25 JUL 89

Enseco ID: 1045949  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 25 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	92	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Aromatic Volatile Organics

Method 602

Client Name: Enron  
 Client ID: SCP8-BLK  
 Lab ID: 005867-0001-SA  
 Matrix: AQUEOUS  
 Authorized: 25 JUL 89

Enseco ID: 1045946  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 25 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Chlorobenzene	ND	ug/L	0.50
Ethyl benzene	ND	ug/L	0.50
Total xylenes	ND	ug/L	1.0
1,3-Dichlorobenzene	ND	ug/L	0.50
1,4-Dichlorobenzene	ND	ug/L	0.50
1,2-Dichlorobenzene	ND	ug/L	0.50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP8A-001  
 Lab ID: 005867-0002-SA  
 Matrix: SOIL  
 Authorized: 25 JUL 89

Enseco ID: 1045947  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 25 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	170	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. - Not Detected  
 N.A. - Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Client Name: Enron  
Client ID: SCP88-001  
Lab ID: 005867-0003-SA  
Matrix: SOIL  
Authorized: 25 JUL 89

Enseco ID: 1045948  
Sampled: 22 JUL 89  
Prepared: NA

Received: 25 JUL 89  
Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	160	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. - Not Detected  
N.A. - Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
Client ID: SCP8C-001  
Lab ID: 005867-0004-SA  
Matrix: SOIL  
Authorized: 25 JUL 89

Enseco ID: 1045949  
Sampled: 22 JUL 89  
Prepared: NA

Received: 25 JUL 89  
Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	180	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP8-BLK  
Lab ID: 005867-0001-SA  
Matrix: AQUEOUS  
Authorized: 25 JUL 89

Enseco ID: 1045946  
Sampled: 22 JUL 89  
Prepared: NA

Received: 25 JUL 89  
Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/L	1
Ethylene glycol	ND	mg/L	5

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP8A-001  
Lab ID: 005867-0002-SA  
Matrix: SOIL  
Authorized: 25 JUL 89

Enseco ID: 1045947  
Sampled: 22 JUL 89  
Prepared: NA

Received: 25 JUL 89  
Analyzed: 16 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	5.0

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP88-001  
Lab ID: 005867-0003-SA  
Matrix: SOIL  
Authorized: 25 JUL 89

Enseco ID: 1045948  
Sampled: 22 JUL 89  
Prepared: NA

Received: 25 JUL 89  
Analyzed: 16 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	5.0

N.D. - Not Detected  
N.A. - Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP8C-001  
Lab ID: 005867-0004-SA  
Matrix: SOIL  
Authorized: 25 JUL 89

Enseco ID: 1045949  
Sampled: 22 JUL 89  
Prepared: NA

Received: 25 JUL 89  
Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	5.0

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP8-BLK-001  
 Lab ID: 005903-0005-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046370  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. - Not Detected  
 N.A. - Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP8-BLK-002  
 Lab ID: 005903-0006-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046371  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP8-BLK-001  
 Lab ID: 005903-0005-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046370  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP8-BLK-002  
 Lab ID: 005903-0006-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046371  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP8-BLK-001  
Lab ID: 005903-0005-SA  
Matrix: SOIL  
Authorized: 27 JUL 89

Enseco ID: 1046370  
Sampled: 22 JUL 89  
Prepared: NA

Received: 27 JUL 89  
Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
 Client ID: SCP8-BLK-002  
 Lab ID: 005903-0006-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046371  
 Sampled: 22 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. - Not Detected  
 N.A. - Not Applicable

Reported By: Leslie Dalla

*Corona*

Approved By: Leslie Dalla

TRANSWESTERN PIPELINE COMPANY

LAGUNA COMPRESSOR STATION #6

SOIL SAMPLE ANALYSES

EPA Analysis Methods 8010, 8020  
and for glycol and methanol

SAMPLE DESCRIPTION INFORMATION  
for  
Enron

Lab ID	Client ID	Matrix	Sampled Date	Time	Received Date
005989-0001-SA	SCP6B-001	SOIL	01 AUG 89	12:33	03 AUG 89
005989-0002-SA	SCTR6-001	SOIL	01 AUG 89	13:41	03 AUG 89



ANALYTICAL TEST REQUESTS  
for  
Enron

Lab ID: 005989	Group Code	Analysis Description	Custom Test?
0001 - 0002	A	Halogenated Volatile Organics Aromatic Volatile Organics Water Miscible Solvents	N N Y

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP6B-001  
 Lab ID: 005989-0001-SA  
 Matrix: SOIL  
 Authorized: 03 AUG 89

Enseco ID: 1046918  
 Sampled: 01 AUG 89  
 Prepared: NA

Received: 03 AUG 89  
 Analyzed: 11 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. - Not Detected  
 N.A. - Not Applicable

Reported By: Nathaniel Biah

Approved By: Kim Zilis

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCTR6-001  
 Lab ID: 005989-0002-SA  
 Matrix: SOIL  
 Authorized: 03 AUG 89

Enseco ID: 1046919  
 Sampled: 01 AUG 89  
 Prepared: NA

Received: 03 AUG 89  
 Analyzed: 11 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Kim Zilis

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP6B-001  
 Lab ID: 005989-0001-SA  
 Matrix: SOIL  
 Authorized: 03 AUG 89  
 Enseco ID: 1046918  
 Sampled: 01 AUG 89  
 Prepared: NA  
 Received: 03 AUG 89  
 Analyzed: 11 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCTR6-001  
 Lab ID: 005989-0002-SA  
 Matrix: SOIL  
 Authorized: 03 AUG 89

Enseco ID: 1046919  
 Sampled: 01 AUG 89  
 Prepared: NA

Received: 03 AUG 89  
 Analyzed: 11 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP6B-001  
Lab ID: 005989-0001-SA  
Matrix: SOIL  
Authorized: 03 AUG 89

Enseco ID: 1046918  
Sampled: 01 AUG 89  
Prepared: NA

Received: 03 AUG 89  
Analyzed: 22 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

## Water Miscible Solvents

## DAI/GC/FID

Client Name: Enron  
Client ID: SCTR6-001  
Lab ID: 005989-0002-SA  
Matrix: SOIL  
Authorized: 03 AUG 89

Enseco ID: 1046919  
Sampled: 01 AUG 89  
Prepared: NA

Received: 03 AUG 89  
Analyzed: 22 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

## Halogenated Volatile Organics

### Method 8010

Client Name: Enron	Enseco ID: 1046520	Received: 28 JUL 89
Client ID: SCP6A-001	Sampled: 27 JUL 89	Analyzed: 04 AUG 89
Lab ID: 005914-0002-SA	Prepared: NA	
Matrix: SOIL		
Authorized: 28 JUL 89		

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	1200
Bromomethane	ND	ug/kg	1200
Vinyl chloride	ND	ug/kg	250
Chloroethane	ND	ug/kg	1200
Methylene chloride	ND	ug/kg	1200
1,1-Dichloroethene	ND	ug/kg	120
1,1-Dichloroethane	ND	ug/kg	120
1,2-Dichloroethene	ND	ug/kg	120
(cis/trans)	ND	ug/kg	120
Chloroform	ND	ug/kg	120
1,1,2-Trichloro-2,2, 1-trifluoroethane	290	ug/kg	250
1,2-Dichloroethane	ND	ug/kg	250
1,1,1-Trichloroethane	6800	ug/kg	120
Carbon tetrachloride	ND	ug/kg	120
Bromodichloromethane	ND	ug/kg	250
1,2-Dichloropropane	ND	ug/kg	250
trans-1,3-Dichloropropene	ND	ug/kg	250
Trichloroethene	ND	ug/kg	120
Chlorodibromomethane	ND	ug/kg	250
cis-1,3-Dichloropropene	ND	ug/kg	500
1,1,2-Trichloroethane	ND	ug/kg	250
EDB (1,2-Dibromoethane)	ND	ug/kg	500
Bromoform	ND	ug/kg	1200
1,1,2,2-Tetrachloroethane	ND	ug/kg	250
Tetrachloroethene	ND	ug/kg	120
Chlorobenzene	ND	ug/kg	500

Sample taken from over the old condensate pit, from approx. 1 foot below traditional level of contents.

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP6-BGND-001  
 Lab ID: 005914-0003-SA  
 Matrix: SOIL  
 Authorized: 28 JUL 89

Enseco ID: 1046521  
 Sampled: 27 JUL 89  
 Prepared: NA

Received: 28 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

## Halogenated Volatile Organics

### Method 8010

Client Name: Enron  
 Client ID: SCP6-BGND-001  
 Lab ID: 005914-0004-SA  
 Matrix: SOIL  
 Authorized: 28 JUL 89

Enseco ID: 1046522  
 Sampled: 27 JUL 89  
 Prepared: NA

Received: 28 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Halogenated Volatile Organics

Method 601

Client Name: Enron  
 Client ID: SCP6-BLK  
 Lab ID: 005914-0005-SA  
 Matrix: AQUEOUS  
 Authorized: 28 JUL 89

Enseco ID: 1046523  
 Sampled: 27 JUL 89  
 Prepared: NA

Received: 28 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	ug/L	5.0
Bromomethane	ND	ug/L	5.0
Vinyl chloride	ND	ug/L	1.0
Chloroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	0.50
1,1-Dichloroethane	ND	ug/L	0.50
1,2-Dichloroethene (cis/trans)	ND	ug/L	0.50
Chloroform	ND	ug/L	0.50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/L	1.0
1,2-Dichloroethane	ND	ug/L	1.0
1,1,1-Trichloroethane	ND	ug/L	0.50
Carbon tetrachloride	ND	ug/L	0.50
Bromodichloromethane	ND	ug/L	1.0
1,2-Dichloropropane	ND	ug/L	1.0
trans-1,3-Dichloropropene	ND	ug/L	1.0
Trichloroethene	ND	ug/L	0.50
Chlorodibromomethane	ND	ug/L	1.0
cis-1,3-Dichloropropene	ND	ug/L	2.0
1,1,2-Trichloroethane	ND	ug/L	1.0
EDB (1,2-Dibromoethane)	ND	ug/L	2.0
Bromoform	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	1.0
Tetrachloroethene	ND	ug/L	0.50
Chlorobenzene	ND	ug/L	2.0

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP6A-001  
 Lab ID: 005914-0002-SA  
 Matrix: SOIL  
 Authorized: 28 JUL 89  
 Enseco ID: 1046520  
 Sampled: 27 JUL 89  
 Prepared: NA  
 Received: 28 JUL 89  
 Analyzed: 08 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	120
Toluene	ND	ug/kg	120
Chlorobenzene	ND	ug/kg	120
Ethyl benzene	ND	ug/kg	120
Total xylenes	ND	ug/kg	250
1,3-Dichlorobenzene	ND	ug/kg	120
1,4-Dichlorobenzene	ND	ug/kg	120
1,2-Dichlorobenzene	ND	ug/kg	120

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
Client ID: SCP6-BGND-001  
Lab ID: 005914-0003-SA  
Matrix: SOIL  
Authorized: 28 JUL 89

Enseco ID: 1046521  
Sampled: 27 JUL 89  
Prepared: NA

Received: 28 JUL 89  
Analyzed: 08 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron	Enseco ID: 1046522	Received: 28 JUL 89
Client ID: SCP6-BGND-001	Sampled: 27 JUL 89	Analyzed: 04 AUG 89
Lab ID: 005914-0004-SA	Prepared: NA	
Matrix: SOIL		
Authorized: 28 JUL 89		

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 602

Client Name: Enron  
Client ID: SCP6-BLK  
Lab ID: 005914-0005-SA  
Matrix: AQUEOUS  
Authorized: 28 JUL 89

Enseco ID: 1046523  
Sampled: 27 JUL 89  
Prepared: NA

Received: 28 JUL 89  
Analyzed: 04 AUG 89

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Chlorobenzene	ND	ug/L	0.50
Ethyl benzene	ND	ug/L	0.50
Total xylenes	ND	ug/L	1.0
1,3-Dichlorobenzene	ND	ug/L	0.50
1,4-Dichlorobenzene	ND	ug/L	0.50
1,2-Dichlorobenzene	ND	ug/L	0.50

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP6A-001  
Lab ID: 005914-0002-SA  
Matrix: SOIL  
Authorized: 28 JUL 89

Enseco ID: 1046520  
Sampled: 27 JUL 89  
Prepared: NA

Received: 28 JUL 89  
Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
 Client ID: SCP6-BGND-001  
 Lab ID: 005914-0003-SA  
 Matrix: SOIL  
 Authorized: 28 JUL 89

Enseco ID: 1046521  
 Sampled: 27 JUL 89  
 Prepared: NA

Received: 28 JUL 89  
 Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
 Client ID: SCP6-BGND-001  
 Lab ID: 005914-0004-SA  
 Matrix: SOIL  
 Authorized: 28 JUL 89

Enseco ID: 1046522  
 Sampled: 27 JUL 89  
 Prepared: NA

Received: 28 JUL 89  
 Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Leslie Dalla

*Leguwa.*

Approved By: Leslie Dalla

ter Miscible Solvents

DAI/GC/FID

Client Name: Enron  
 Client ID: SCP6-BLK  
 Lab ID: 005914-0005-SA  
 Matrix: AQUEOUS  
 Authorized: 28 JUL 89

Enseco ID: 1046523  
 Sampled: 27 JUL 89  
 Prepared: NA

Received: 28 JUL 89  
 Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/L	5
Ethylene glycol	ND	mg/L	25

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

TRANSWESTERN PIPELINE COMPANY

THOREAU COMPRESSOR STATION #5

SOIL SAMPLE ANALYSES

EPA Analysis Methods 8010, 8020  
and for glycol and methanol

SAMPLE DESCRIPTION INFORMATION  
for  
Enron

Lab ID	Client ID	Matrix	Sampled		Received
			Date	Time	Date
005939-0001-SA	SCP5-BLK	AQUEOUS	29 JUL 89	12:30	01 AUG 89
005939-0002-SA	SCP5A-001	SOIL	29 JUL 89	13:12	01 AUG 89
005939-0003-SA	SCP5-BGND-001	SOIL	29 JUL 89	13:50	01 AUG 89
005939-0004-SA	SCP5-BGND-002	SOIL	29 JUL 89	14:14	01 AUG 89

*background*

*Thoreau*

ANALYTICAL TEST REQUESTS  
for  
Enron

Lab ID: 005939	Group Code	Analysis Description	Custom Test?
0001	A	Halogenated Volatile Organics Aromatic Volatile Organics Water Miscible Solvents	N N Y
0002 - 0004	B	Halogenated Volatile Organics Aromatic Volatile Organics Water Miscible Solvents	N N Y

Halogenated Volatile Organics

Method 601

Client Name: Enron  
 Client ID: SCP5-BLK  
 Lab ID: 005939-0001-SA  
 Matrix: AQUEOUS  
 Authorized: 01 AUG 89

Enseco ID: 1046721  
 Sampled: 29 JUL 89  
 Prepared: NA

Received: 01 AUG 89  
 Analyzed: 04 AUG 89

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	ug/L	5.0
Bromomethane	ND	ug/L	5.0
Vinyl chloride	ND	ug/L	1.0
Chloroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	0.50
1,1-Dichloroethane	ND	ug/L	0.50
1,2-Dichloroethene (cis/trans)	ND	ug/L	0.50
Chloroform	ND	ug/L	0.50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/L	1.0
1,2-Dichloroethane	ND	ug/L	1.0
1,1,1-Trichloroethane	ND	ug/L	0.50
Carbon tetrachloride	ND	ug/L	0.50
Bromodichloromethane	ND	ug/L	1.0
1,2-Dichloropropane	ND	ug/L	1.0
trans-1,3-Dichloropropene	ND	ug/L	1.0
Trichloroethene	ND	ug/L	0.50
Chlorodibromomethane	ND	ug/L	1.0
cis-1,3-Dichloropropene	ND	ug/L	2.0
1,1,2-Trichloroethane	ND	ug/L	1.0
EDB (1,2-Dibromoethane)	ND	ug/L	2.0
Bromoform	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	1.0
Tetrachloroethene	ND	ug/L	0.50
Chlorobenzene	ND	ug/L	2.0

*Sample prepared in lab - liquid out of soil*

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP5A-001  
 Lab ID: 005939-0002-SA  
 Matrix: SOIL  
 Authorized: 01 AUG 89

Enseco ID: 1046722  
 Sampled: 29 JUL 89  
 Prepared: NA

Received: 01 AUG 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP5-BGND-001  
 Lab ID: 005939-0003-SA  
 Matrix: SOIL  
 Authorized: 01 AUG 89

Enseco ID: 1046723  
 Sampled: 29 JUL 89  
 Prepared: NA

Received: 01 AUG 89  
 Analyzed: 05 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethane	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethane (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP5-BGND-002  
 Lab ID: 005939-0004-SA  
 Matrix: SOIL  
 Authorized: 01 AUG 89

Enseco ID: 1046724  
 Sampled: 29 JUL 89  
 Prepared: NA

Received: 01 AUG 89  
 Analyzed: 05 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 602

Client Name: Enron  
 Client ID: SCP5-BLK  
 Lab ID: 005939-0001-SA  
 Matrix: AQUEOUS  
 Authorized: 01 AUG 89  
 Enseco ID: 1046721  
 Sampled: 29 JUL 89  
 Prepared: NA  
 Received: 01 AUG 89  
 Analyzed: 04 AUG 89

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Chlorobenzene	ND	ug/L	0.50
Ethyl benzene	ND	ug/L	0.50
Total xylenes	ND	ug/L	1.0
1,3-Dichlorobenzene	ND	ug/L	0.50
1,4-Dichlorobenzene	ND	ug/L	0.50
1,2-Dichlorobenzene	ND	ug/L	0.50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron	Enseco ID: 1046722	Received: 01 AUG 89
Client ID: SCP5A-001	Sampled: 29 JUL 89	Analyzed: 04 AUG 89
Lab ID: 005939-0002-SA	Prepared: NA	
Matrix: SOIL		
Authorized: 01 AUG 89		

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP5-BGND-001  
 Lab ID: 005939-0003-SA  
 Matrix: SOIL  
 Authorized: 01 AUG 89

Enseco ID: 1046723  
 Sampled: 29 JUL 89  
 Prepared: NA

Received: 01 AUG 89  
 Analyzed: 05 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP5-BGND-002  
 Lab ID: 005939-0004-SA  
 Matrix: SOIL  
 Authorized: 01 AUG 89

Enseco ID: 1046724  
 Sampled: 29 JUL 89  
 Prepared: NA

Received: 01 AUG 89  
 Analyzed: 05 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP5-BLK  
Lab ID: 005939-0001-SA  
Matrix: AQUEOUS  
Authorized: 01 AUG 89

Enseco ID: 1046721  
Sampled: 29 JUL 89  
Prepared: NA

Received: 01 AUG 89  
Analyzed: 07 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/L	2
Ethylene glycol	ND	mg/L	25

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP5A-001  
Lab ID: 005939-0002-SA  
Matrix: SOIL  
Authorized: 01 AUG 89

Enseco ID: 1046722  
Sampled: 29 JUL 89  
Prepared: NA

Received: 01 AUG 89  
Analyzed: 07 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	12	mg/kg ppm	1.3
Ethylene glycol	ND	mg/kg	32

*Per Ship  
Sample taken from over  
the old condensate just*

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP5-BGND-001  
Lab ID: 005939-0003-SA  
Matrix: SOIL  
Authorized: 01 AUG 89

Enseco ID: 1046723  
Sampled: 29 JUL 89  
Prepared: NA

Received: 01 AUG 89  
Analyzed: 07 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	8.7	mg/kg	1.2
Ethylene glycol	ND	mg/kg	30

*Leslie*  
Background sample taken from  
NW corner of property.

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP5-BGND-002  
Lab ID: 005939-0004-SA  
Matrix: SOIL  
Authorized: 01 AUG 89

Enseco ID: 1046724  
Sampled: 29 JUL 89  
Prepared: NA

Received: 01 AUG 89  
Analyzed: 07 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	11	mg/kg	1.2
Ethylene glycol	ND	mg/kg	30

*Per Ship*  
*Background sample taken from NW corner of property.*

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

*Thoreza*

Approved By: Leslie Dalla

TRANSWESTERN PIPELINE COMPANY

MOUNTAINAIRE COMPRESSOR STATION #7

SOIL SAMPLE ANALYSES

EPA Analysis Methods 8010, 8020  
and for glycol and methanol

SAMPLE DESCRIPTION INFORMATION  
for  
Enron

Lab ID	Client ID	Matrix	Sampled		Received
			Date	Time	Date
005903-0001-SA	SCP7-BLK	AQUEOUS	25 JUL 89	14:10	27 JUL 89
005903-0002-SA	SCP7-BGND-001	SOIL	25 JUL 89	13:26	27 JUL 89
005903-0003-SA	SCP7-BGND-002	SOIL	25 JUL 89	15:35	27 JUL 89
005903-0004-SA	SCP7A-001	SOIL	25 JUL 89	16:28	27 JUL 89
005903-0005-SA	SCP8-BLK-001	SOIL	22 JUL 89	11:30	27 JUL 89
005903-0006-SA	SCP8-BLK-002	SOIL	22 JUL 89	11:40	27 JUL 89

SAMPLE DESCRIPTION INFORMATION  
for  
Enron

Lab ID	Client ID	Matrix	Sampled Date	Time	Received Date
005914-0001-SA	SCP7B-001	SOIL	26 JUL 89	16:20	28 JUL 89
<del>005914-0002-SA</del>	<del>SCP6A-001</del>	<del>SOIL</del>	<del>27 JUL 89</del>	<del>11:30</del>	<del>28 JUL 89</del>
<del>005914-0003-SA</del>	<del>SCP6-BGND-001</del>	<del>SOIL</del>	<del>27 JUL 89</del>	<del>12:23</del>	<del>28 JUL 89</del>
<del>005914-0004-SA</del>	<del>SCP6-BGND-001</del>	<del>SOIL</del>	<del>27 JUL 89</del>	<del>13:04</del>	<del>28 JUL 89</del>
<del>005914-0005-SA</del>	<del>SCP6-BLK</del>	<del>AQUEOUS</del>	<del>27 JUL 89</del>	<del>11:00</del>	<del>28 JUL 89</del>

ANALYTICAL TEST REQUESTS  
for  
Enron

Lab ID: 005903	Group Code	Analysis Description	Custom Test?
0001	A	Halogenated Volatile Organics Aromatic Volatile Organics Water Miscible Solvents	N N Y
0002 - 0006	B	Halogenated Volatile Organics Aromatic Volatile Organics Water Miscible Solvents	N N Y

ANALYTICAL TEST REQUESTS  
for  
Enron

Lab ID: 005914	Group Code	Analysis Description	Custom Test?
0001 - 0004	A	Halogenated Volatile Organics	N
		Aromatic Volatile Organics	N
		Water Miscible Solvents	Y
0005	B	Halogenated Volatile Organics	N
		Aromatic Volatile Organics	N
		Water Miscible Solvents	Y

## Halogenated Volatile Organics

### Method 601

Client Name: Enron	Enseco ID: 1046366	Received: 27 JUL 89
Client ID: SCP7-BLK	Sampled: 25 JUL 89	Analyzed: 04 AUG 89
Lab ID: 005903-0001-SA	Prepared: NA	
Matrix: AQUEOUS		
Authorized: 27 JUL 89		

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	ug/L	5.0
Bromomethane	ND	ug/L	5.0
Vinyl chloride	ND	ug/L	1.0
Chloroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	0.50
1,1-Dichloroethane	ND	ug/L	0.50
1,2-Dichloroethene (cis/trans)	ND	ug/L	0.50
Chloroform	ND	ug/L	0.50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/L	1.0
1,2-Dichloroethane	ND	ug/L	1.0
1,1,1-Trichloroethane	ND	ug/L	0.50
Carbon tetrachloride	ND	ug/L	0.50
Bromodichloromethane	ND	ug/L	1.0
1,2-Dichloropropane	ND	ug/L	1.0
trans-1,3-Dichloropropene	ND	ug/L	1.0
Trichloroethene	ND	ug/L	0.50
Chlorodibromomethane	ND	ug/L	1.0
cis-1,3-Dichloropropene	ND	ug/L	2.0
1,1,2-Trichloroethane	ND	ug/L	1.0
EDB (1,2-Dibromoethane)	ND	ug/L	2.0
Bromoform	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	1.0
Tetrachloroethene	ND	ug/L	0.50
Chlorobenzene	ND	ug/L	2.0

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP7-BGND-001  
 Lab ID: 005903-0002-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046367  
 Sampled: 25 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

## Halogenated Volatile Organics

### Method 8010

Client Name: Enron  
 Client ID: SCP7-BGND-002  
 Lab ID: 005903-0003-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046368  
 Sampled: 25 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2,1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. - Not Detected  
 N.A. - Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Halogenated Volatile Organics

Method 8010

Client Name: Enron  
 Client ID: SCP7A-001  
 Lab ID: 005903-0004-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046369  
 Sampled: 25 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Chloromethane	ND	ug/kg	500
Bromomethane	ND	ug/kg	500
Vinyl chloride	ND	ug/kg	100
Chloroethane	ND	ug/kg	500
Methylene chloride	ND	ug/kg	500
1,1-Dichloroethene	ND	ug/kg	50
1,1-Dichloroethane	ND	ug/kg	50
1,2-Dichloroethene (cis/trans)	ND	ug/kg	50
Chloroform	ND	ug/kg	50
1,1,2-Trichloro-2,2, 1-trifluoroethane	ND	ug/kg	100
1,2-Dichloroethane	ND	ug/kg	100
1,1,1-Trichloroethane	ND	ug/kg	50
Carbon tetrachloride	ND	ug/kg	50
Bromodichloromethane	ND	ug/kg	100
1,2-Dichloropropane	ND	ug/kg	100
trans-1,3-Dichloropropene	ND	ug/kg	100
Trichloroethene	ND	ug/kg	50
Chlorodibromomethane	ND	ug/kg	100
cis-1,3-Dichloropropene	ND	ug/kg	200
1,1,2-Trichloroethane	ND	ug/kg	100
EDB (1,2-Dibromoethane)	ND	ug/kg	200
Bromoform	ND	ug/kg	500
1,1,2,2-Tetrachloroethane	ND	ug/kg	100
Tetrachloroethene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	200

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 602

Client Name: Enron  
 Client ID: SCP7-BLK  
 Lab ID: 005903-0001-SA  
 Matrix: AQUEOUS  
 Authorized: 27 JUL 89

Enseco ID: 1046366  
 Sampled: 25 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Chlorobenzene	ND	ug/L	0.50
Ethyl benzene	ND	ug/L	0.50
Total xylenes	ND	ug/L	1.0
1,3-Dichlorobenzene	ND	ug/L	0.50
1,4-Dichlorobenzene	ND	ug/L	0.50
1,2-Dichlorobenzene	ND	ug/L	0.50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP7-BGND-001  
 Lab ID: 005903-0002-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046367  
 Sampled: 25 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	200	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

**Aromatic Volatile Organics**

**Method 8020**

Client Name: Enron  
 Client ID: SCP7-BGND-002  
 Lab ID: 005903-0003-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89

Enseco ID: 1046368  
 Sampled: 25 JUL 89  
 Prepared: NA

Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Aromatic Volatile Organics

Method 8020

Client Name: Enron  
 Client ID: SCP7A-001  
 Lab ID: 005903-0004-SA  
 Matrix: SOIL  
 Authorized: 27 JUL 89  
 Enseco ID: 1046369  
 Sampled: 25 JUL 89  
 Prepared: NA  
 Received: 27 JUL 89  
 Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Chlorobenzene	ND	ug/kg	50
Ethyl benzene	ND	ug/kg	50
Total xylenes	ND	ug/kg	100
1,3-Dichlorobenzene	ND	ug/kg	50
1,4-Dichlorobenzene	ND	ug/kg	50
1,2-Dichlorobenzene	ND	ug/kg	50

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP7-BLK  
Lab ID: 005903-0001-SA  
Matrix: AQUEOUS  
Authorized: 27 JUL 89

Enseco ID: 1046366  
Sampled: 25 JUL 89  
Prepared: NA

Received: 27 JUL 89  
Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/L	5
Ethylene glycol	ND	mg/L	25

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
Client ID: SCP7-BGND-002  
Lab ID: 005903-0003-SA  
Matrix: SOIL  
Authorized: 27 JUL 89

Enseco ID: 1046368  
Sampled: 25 JUL 89  
Prepared: NA

Received: 27 JUL 89  
Analyzed: 17 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Leslie Dalla

Approved By: Leslie Dalla

## Aromatic Volatile Organics

## Method 8020

Client Name: Enron  
Client ID: SCP7B-001  
Lab ID: 005914-0001-SA  
Matrix: SOIL  
Authorized: 28 JUL 89

Enseco ID: 1046519  
Sampled: 26 JUL 89  
Prepared: NA

Received: 28 JUL 89  
Analyzed: 04 AUG 89

Parameter	Result	Wet wt. Units	Reporting Limit
Benzene	3800	ug/kg	1000
Toluene	19000	ug/kg	1000
Chlorobenzene	2700	ug/kg	1000
Ethyl benzene	4100	ug/kg	1000
Total xylenes	27000	ug/kg	2000
1,3-Dichlorobenzene	ND	ug/kg	1000
1,4-Dichlorobenzene	3400	ug/kg	1000
1,2-Dichlorobenzene	ND	ug/kg	1000

N.D. = Not Detected  
N.A. = Not Applicable

Reported By: Nathaniel Biah

Approved By: Lauren Skinner

Water Miscible Solvents

DAI/GC/FID

Client Name: Enron  
 Client ID: SCP7B-001  
 Lab ID: 005914-0001-SA  
 Matrix: SOIL  
 Authorized: 28 JUL 89

Enseco ID: 1046519  
 Sampled: 26 JUL 89  
 Prepared: NA

Received: 28 JUL 89  
 Analyzed: 18 AUG 89

Parameter	Result	Units	Reporting Limit
Methanol	ND	mg/kg	1.0
Ethylene glycol	ND	mg/kg	25

N.D. = Not Detected  
 N.A. = Not Applicable

Reported By: Leslie Dalla

*Mountainview*

Approved By: Leslie Dalla