

Union Carbide Chemicals and Plastics Co. Inc.

**Reich Farm Superfund Site
Dover Township, Ocean County, New Jersey**

Remedial Design/ Remedial Action

**Site Management Plan
for
Phase II Pre-Design**

May 1992

Prepared by:

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502642



**Reich Farm Superfund Site
Site Management Plan**

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1.0 INTRODUCTION

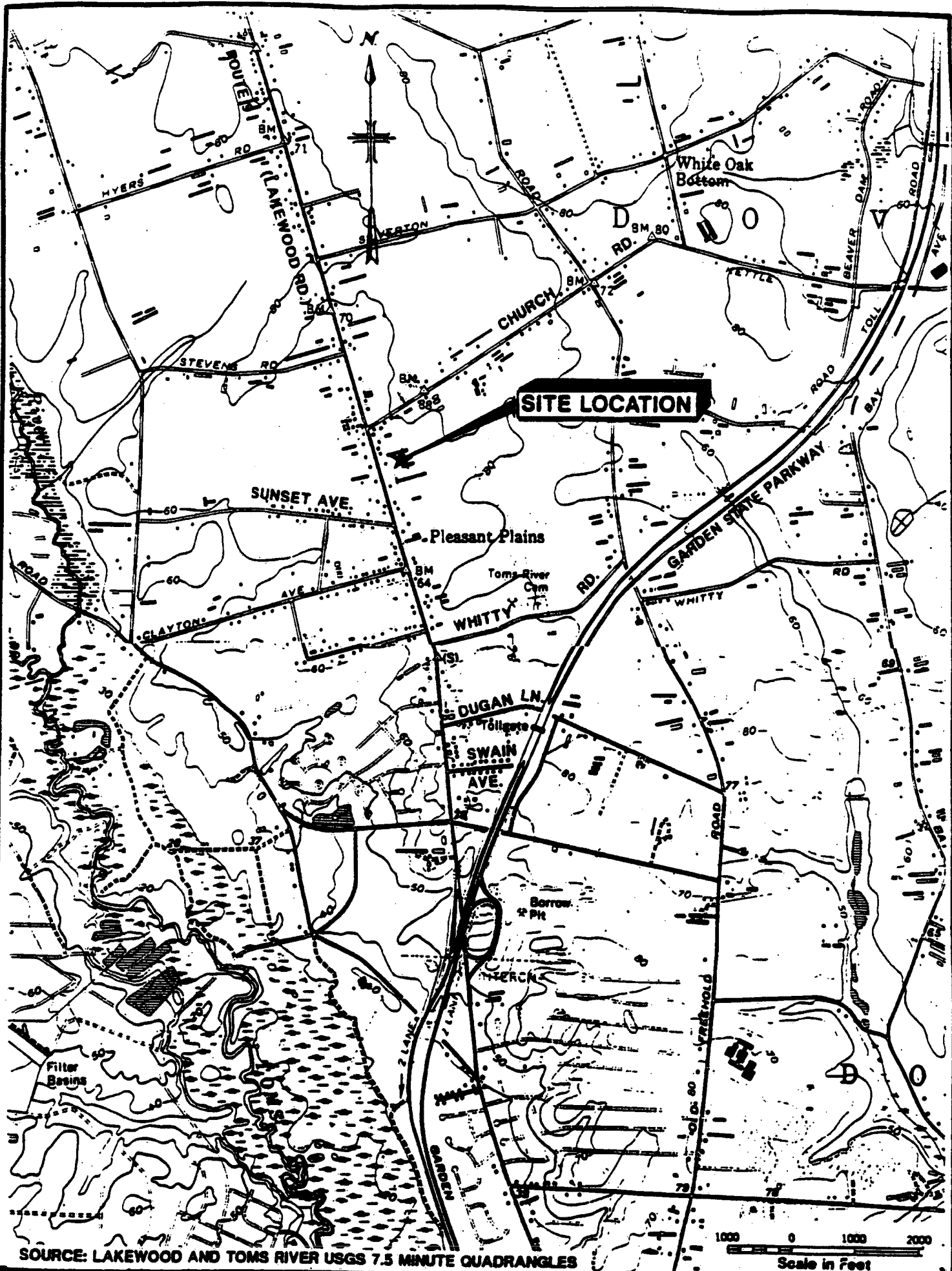
Reich Farm is located in the Pleasant Plains section of Dover Township, Ocean County New Jersey. Figure 1-1 shows the site and surrounding area.

relocate (The Kirkwood-Cohansey aquifer systems underlies the Reich Farm site. The average depth to ground water in the upper Cohansey aquifer in the area of the site is approximately thirty feet. The general direction of ground water flow in the Cohansey is to the south-southwest.)

In 1971, drummed wastes from Union Carbide Chemicals and Plastics (UCC&P's) Bound Brook, New Jersey plant were hauled to Reich Farm by a contract waste hauler. After learning of the unauthorized deposition of wastes at the Reich property, UCC&P removed all visible drums in early 1972. Additional buried drums were discovered and removed by UCC&P along with approximately 1100 cubic yards of contaminated soil in 1974. All site cleanup activities were performed under the supervision of the New Jersey Department of Environmental Protection and Energy.

In 1982, the United States Environmental Protection Agency (EPA) listed Reich Farm on the National Priority List, *is a list of sites requiring attention under the* Superfund Program. A Remedial Investigation/Feasibility Study was completed, and a Record of Decision (ROD) was issued for the site in 1988. Both ground water and soil remediation is specified in the ROD.

Union Carbide voluntarily entered into a Consent Decree with EPA in late 1989 to complete the Remedial Design and Remedial Action portion of the project. The Consent Decree specifies that pre-design work must first be completed to confirm and refine the basis for the remedial design. Phase I of the pre-design work consisted of a supplemental remedial investigation which included sampling of existing on-site ground water monitoring wells, delineation of the extent of soil contamination on-site, delineation of the extent of ground water contamination and preparation of reports for review and approval by EPA. A draft Remedial Design/Remedial Action report for Phase I Pre-Design was submitted to EPA in January 1992 and approved on May 5, 1992.



SOURCE: LAKEWOOD AND TOMS RIVER USGS 7.5 MINUTE QUADRANGLES

1000 0 1000 2000
Scale in Feet

**MALCOLM
PIRNIE**

REICH FARM SITE
PLEASANT PLAINS, NEW JERSEY
SITE LOCATION MAP

MALCOLM PIRNIE, INC.

FIGURE 1-1

Phase II of the Pre-Design work, which the Site Management Plan addresses, will consist of treatability studies to determine if the ~~EPA specified~~ soil treatment technology is applicable for remediating the site. Treatability studies will also be used to evaluate methods for the pretreatment of ground water for metals removal. Phase II pre-design work will consist of the following elements: soil treatment evaluation, ground water treatment evaluation and collector well installation and testing. This Site Management Plan covers only these Phase II pre-design activities.

*specified
in the ROD*

UCC&P selected Malcolm Pirnie Inc. (MPI) as the primary contractor to perform the pre-design and design work for the Reich Farm site. UCC&P will direct the work under the guidance of, and with direct approval of EPA. MPI will subcontract portions of the work requiring specific expertise. This Site Management Plan for the Phase II pre-design work establishes the management structure, details the key project personnel roles and their experience, provides the names and qualifications of selected subcontractors and establishes procedures for scheduling, recordkeeping, field management and changes in scope and personnel.

2.0 PROJECT MANAGEMENT

2.1 General Management Structure

The project management structure for the Reich Farm Phase II pre-design project is illustrated in Figure 2-1. The diagram shows the relationship of the various personnel and their affiliations. Overall coordination of the project with the primary contractor and subcontractors will be through Craig Wilger of Union Carbide Chemicals and Plastics (UCC&P). Mr. Wilger will be the primary contact for EPA on matters relating to work at the site.

The EPA Project Manager, Gary Adamkiewicz, will monitor the progress of the work and coordinate communication between EPA and UCC&P.

UCC&P's primary contractor for the Phase II investigations is Malcolm Pirnie, Inc. (MPI), Mahwah, New Jersey. MPI will coordinate all Phase II investigations through their project manager, Jennifer Bryson, who is responsible for coordination of all MPI and subcontractor activities for the treatability studies. Stephen Swope of MPI is responsible for all activities related to the collector well installation and testing. Additional details on the responsibilities of project personnel are given in the following sections.

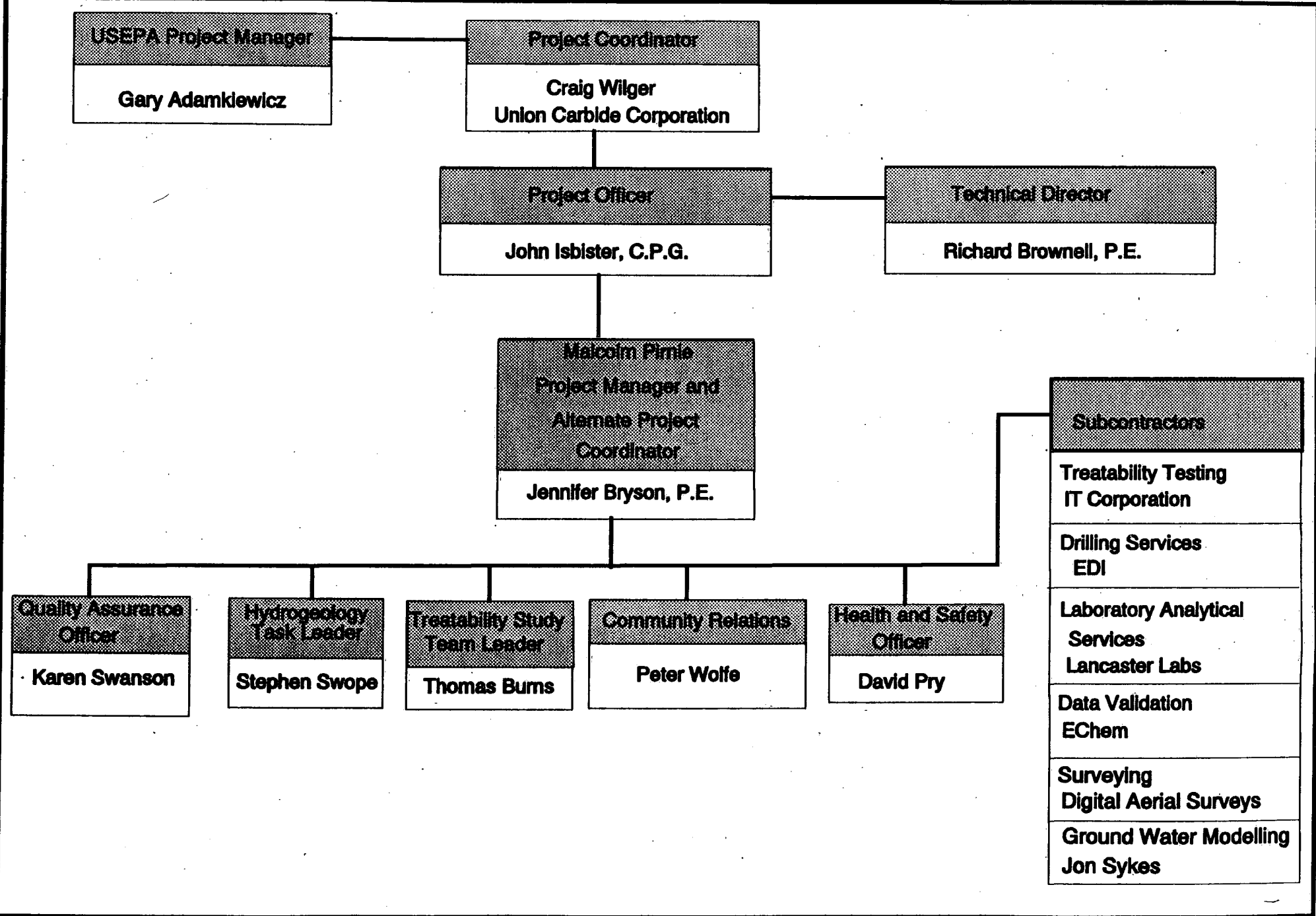
2.2 Lines of Communication and Responsibilities

The project management structure which defines the authority and lines of communication and areas of responsibility within MPI and between MPI, UCC&P and EPA are shown in Figure 2-1.

Project communication will be handled primarily through the project coordinator and the EPA Project Manager. Their roles in the project are summarized below:

Craig Wilger, Project Coordinator - Craig Wilger is the key contact for both the EPA and MPI, and is responsible for coordinating project activities. Overall, his project responsibilities include:

- assuring that all Reich Farm Consent Decree requirements are met



- communicating with EPA's project manager
- evaluating and providing technical input to project plans
- reviewing deliverables
- monitoring contractors activities
- coordinating UCC&P's resources
- maintaining project files
- coordinating community relations activities with MPI
- evaluating and approving change order requests and changes in project scope.

Gary Adamkiewicz, USEPA Project Manager - Gary Adamkiewicz is the key contact person at EPA for Reich Farm related activities. As part of this responsibility, he will:

- assure that the Reich Farm Consent Decree requirements are met
- review project documents
- assure that the documents and correspondence meet with full EPA approval
- coordinate interactions with Reich Farm owners
- coordinate document reviews with appropriate EPA personnel
- authorize field modifications
- coordinate NJDEPE activities
- approve deliverables
- assure that work is in compliance with the project work plan, quality assurance project plan, sampling plan and health and safety plan
- review and approve changes in project scope requested by UCC&P.

MPI, UCC&P's Primary Contractor, will conduct the Phase II studies at the Reich Farm site. The principal project team members assigned to this project and their respective management and technical roles are summarized below:

<u>Name</u>	<u>Title</u>	<u>Responsibility</u>
John Isbister	Project Officer	Project Direction and Oversight
Richard Brownell	Technical Director & Supervising P.E.	Project Review
Jennifer Bryson	Project Manager	Overall Project Coordination, Alternate Project Coordinator
Karen Swanson	Quality Assurance Officer	Project QA/QC
David Pry	Health and Safety Officer	Field Health and Safety
Stephen Swope	Task Leader	Hydrogeologic activities
Thomas Burns	Treatability Study Team Leader	Treatability testing activities
Peter Wolfe	Task Leader	Community Relations

In addition to these personnel, support for project activities will be coordinated from MPI's Mahwah, New Jersey office with assistance from the White Plains, New York office. The detailed responsibilities of the MPI project staff are summarized below:

John Isbister, Project Officer - is responsible for maintaining a clear definition of, and adherence to scope, schedule and budget. As part of this responsibility, he will:

- provide technical direction for preparation of work plans and tasks performed under this contract
- administer contracts with UCC&P and MPI subcontractors
- maintain budget and schedule surveillance
- approve plans and reports for release to UCC&P and EPA
- provide technical input to field activities and data evaluation.

Richard Brownell, Technical Director - is responsible for technical review of all project deliverables, including task work plans, sampling plans and reports. He will also act as the supervising engineer for the project.

Jennifer Bryson, Project Manager - will act as MPI's manager for Phase II activities. Her responsibilities will be to:

- coordinate the preparation of work plans for Phase II tasks
- provide a communication link between MPI and UCC&P
- perform as an alternate project coordinator with EPA
- assure that schedule and budget are adhered to
- assign staff and conduct tasks
- provide project progress reports to UCC&P
- conduct and oversee field activities
- prepare draft and final reports
- select and coordinate subcontractor activities
- coordinate quality assurance and health and safety activities

Stephen Swope, Hydrogeology Task Leader - is responsible for expediting and overseeing all hydrogeological investigation tasks at the site. This includes:

- recovery well design and installation
- pumping tests
- analysis and reporting of pumping test data
- monitoring well installation.

Karen Swanson, Quality Assurance Officer - shall oversee all field activities to assure adherence to the Quality Assurance Project Plan.

David Pry, Health and Safety Officer - is responsible for assuring that the Site Health and Safety Plan is adhered to during all site activities.

Thomas Burns, Treatability Study Team Leader - is responsible for coordinating soil treatability testing activities. These activities include:

- collection of soil to be tested by subcontractor
- oversight of subcontractor treatability testing
- evaluation of treatability test results.

2.3 Personnel Qualifications

The UCC&P project coordinator and the key MPI personnel are experienced in conducting their designated tasks. The resumes of these project personnel are provided in Appendix A.

2.4 Subcontractors

Subcontractors for the Phase II Pre-Design Tasks will be as follows. The subcontractors have been selected based on qualifications, bid quotes and past experiences. Their qualifications are provided in Appendix B. The following subcontractors have been selected:

<u>SUBCONTRACTOR</u>	<u>RESPONSIBILITY</u>
IT Corporation	Soil Treatability Testing and related analytical work.
EDI	Drilling
Lancaster Laboratories	Ground Water Sampling Analytical Services
EChem	Ground Water Sampling Data Validation
Digital Aerial Surveys	Surveying
Jon Sykes	Ground Water Modelling

2.5 Deliverables

Project deliverables during the Phase II Pre-Design activities shall be:

[1] **Phase II Pre-Design Work Plan**

This document will provide detailed descriptions of all activities to be performed during the Phase II work including soil treatability studies, ground water treatability studies, well installation, pump tests, and ground water sampling.

[2] **Monthly progress reports**

These reports will be submitted to EPA by the tenth day of each month and will contain at least the following: actions taken during the prior month, a description of any problems encountered and corrective actions taken in response to the problems, any validated analytical data, a description of activities for the next two months, an estimate of the percent of work completed and identification of any delays encountered or anticipated, and the effort made to mitigate the delays. In addition to these anticipated schedule delays, written notification to EPA will be provided in the event that schedule delays are identified between progress reporting time periods.

[3] **Phase II Pre-Design Investigative Report**

This report will present an analysis and interpretation of the soil and ground water treatability testing results. The results of all hydrogeologic activities will also be reported.

2.6 **Scheduling**

A detailed Phase II schedule will be developed as part of the work plan. In addition to the schedule produced for the work plan, monthly schedule updates will be provided with the progress reports. Schedule delays due to out of scope requests from EPA will be evaluated and their schedule impact assessed prior to the start of such work.

2.7 **Recordkeeping System**

The central file will be maintained at UCC&P under the direction of Craig Wilger. Duplicates of most of the file contents will be kept in MPI's Mahwah, New Jersey office. Records will be maintained by UCC&P for a period of at least 6 years after the termination of the Consent Decree. MPI shall retain their records for the duration of their contract with UCC&P. EPA shall, at their request, have access to and/or copies of records.

2.8 Field Management

Full-time supervision of Phase II field activities will be conducted by the MPI Task or Field Team Leaders. These personnel will assure that all work conducted in the Phase II investigations conforms with the approved plans and specifications.

The Task Leader will be responsible for notifying UCC&P, the EPA, the subcontractors and other MPI personnel of the start of field activities. The Field Team Leader will be responsible for obtaining field equipment and mobilizing to the site. Oversight of subcontractor activities and MPI field activities will be handled by the field Team Leader and/or the Task Leader.

The Quality Assurance Officer will review field activities to assure that the work is conducted in a manner that is consistent with the QAPjP. These reviews will be conducted at appropriate times during each phase of the field work.

2.9 Changes in Scope and Personnel

Any changes in scope or schedule from that stipulated in the approved work plans will require approval from EPA prior to their implementation. The EPA project manager will be notified in writing when changes or additions to the key personnel or subcontractors (as listed on Figure 2-1) are made. The notifications will include a reason for that change. It will require EPA approval prior to the installment of the new team member.

APPENDIX A
PROJECT PERSONNEL RESUMES

EDUCATION

BS (Civil Engineering) 1966; Rensselaer Polytechnic Institute
MS (Civil Engineering) 1967; Stanford University
MBA 1976; New York University

REGISTRATION

Professional Engineer
Diplomate, American Academy of Environmental Engineers
Member: Hazardous/Toxic Waste Management Committee

SOCIETIES

American Society of Civil Engineers
Water Pollution Control Federation
Member: Ground Water Committee

SUMMARY OF EXPERIENCE

As Vice President in charge of Malcolm Pirnie's industrial waste group, Mr. Brownell's involvement bridges problem identification and problem solving. He has directed projects on site evaluation, ground water pollution, remedial measures for hazardous waste problems, leachate, wastewater process design, odor and air emissions, and detailed design for hazardous and industrial wastewaters and landfill closure. All significant hazardous waste work performed by the firm is reviewed by Mr. Brownell.

DETAILED EXPERIENCE

1969 to Date Malcolm Pirnie, Inc.

As Vice President:

- Investigated inorganic and organic ground water and free phase contamination at sites for numerous industrial and public sector clients in the US. Directed an inorganic ground water investigation in Mexico.
- Developed remedial measures for Superfund and hazardous waste sites from New England (gas emissions from waste piles, metal fixation in soils, ground water contamination) to the southern US (extensive pesticide contamination of river sediments) to the Far West (volatile organic chemical (VOC) removal). Responsible for the design of stripping towers and granular activated carbon systems for VOC removal; also directed contaminated soils removal, landfill closures and leachate treatment system improvements at various sites. Project Officer on environmental evaluations for portions of the Upper Hudson River polychlorinated biphenyls (PCB) project and bench scale and pilot treatability studies on PCB wastes for the New York State Department of Environmental Conservation.

(continued)

DETAILED EXPERIENCE (Continued)

1969 to Date

Malcolm Pirnie, Inc. (continued)

- Directed hazardous waste management activities for Carpenter Technology Corp., Koppers, Texaco, Estee Lauder Inc., American Cyanamid Company, Scott Paper Company and The Upjohn Company. Activities included technical interpretations of the regulations and preparation of Part B permits, closure plans and ground water investigations. Directed multiplant, regional industrial/hazardous waste disposal evaluations for two major industrial corporations.
- Directed studies of new processes for treating various types of industrial wastes for numerous companies such as Olin Chemical Group, The Upjohn Company, Pfizer, Inc., Textron, Inc., Colgate-Palmolive, Scott Paper, and Gulf + Western. Evaluated ethylene glycol/urea collection and treatment systems for a major air freight carrier.
- Responsible for the design of various physical-chemical and biological treatment systems, including a 5-mgd granular activated carbon plant in the Midwest to remove tetrachloroethylene (TCE) from ground water, activated sludge treatment of 0.25 mgd of pharmaceutical wastewaters for Warner Lambert Co. in New Jersey and treatment of 0.05 mgd of plating wastewater for North and Judd in Connecticut.
- Directed property transfer audits, including nine multiplant environmental audits with an emphasis on underground storage tanks, solid waste management unit permit status, and liability costs. Directed ground water and/or site investigations for industrial clients where remedial measures considered included: relining lagoons, ground water, soil and sludge recovery, air stripping, vacuum extraction from soils, biotreatment, activated carbon treatment, landfill closure, slurry walls, surface water diversions.

As Project Manager:

- Managed a testing and feasibility study for disposal of alum sludges from Scott Paper Company and treatability, feasibility and engineering design reports for approximately 20 major corporations in the chemical processing, private utility, food, computer, and metal finishing industries.

As Project Engineer:

- Responsible for major pilot/prototype studies at Akron and Cleveland OH, and studies of high purity oxygen activated sludge for several corporations including American Cyanamid Company (Lederle Laboratories Division).

1967-1969

US Army Corps of Engineers
California and Republic of Korea

As Lieutenant: Deputy Post Engineer for 1,500-man organization; responsible for all facility planning; small project design and planning.

(continued)

RICHARD P. BROWNELL
Vice President

DETAILED EXPERIENCE (Continued)

1966

J. Kenneth Fraser and Associates

As Engineer: Comprehensive report for wastewater treatment facilities.

PUBLICATIONS AND PRESENTATIONS

Brownell, R.P., 1991. "Case Histories of Textile Wastewater Management in North America." Monterrey, Mexico. August, 1991.

Brownell, R.P., 1990. "Case History - Soil Cleanup Technologies at an NPL Site." University of North Carolina (Seminar), Chapel Hill, NC. March 1990.

Brownell, R.P., J. Z. Marcus, C. Ryden, 1989. "Environmental Liability Audits for Undeveloped Properties," Practising Law Institute, New York NY, December 1989.

Brownell, R.P., "Mechanics of an Environmental Liability Audit (Practising Law Institute), New York, NY. December 1988.

Brownell, R.P., 1986. "A Consultant's Viewpoint of Underground Storage Tanks," presented at New Jersey Chapter, WPCA Seminar, January 9.

Brownell, R.P., 1984. "A Report Card on the Waste of the 1970's - PCB's in the Environment," presented at the 14th American Chemical Society New England Regional Meeting, Fairfield CT, June.

Brownell, R.P., H. D. Stubing, and P.F. Kuniholm, 1982. "Comprehensive Approach to Landfill Leachate Treatment," New York Water Pollution Control Association, New York NY, January.

Brownell, R.P., 1980. "Real World Solutions to Hazardous Waste Problems," Columbus Industrial Association, Plant Engineers Council, Columbus OH, December.

Brownell, R.P., and C.R. Brunner, 1980. "Hazardous Waste Management," Seminar with D'Appolonia Consultants, Dallas TX, January.

Brownell, R.P., 1979. "Alternative Technology - Land Farming Suburface Disposal and Composting (Chemical Manufacturer's Association Seminars). Newark, NJ. November 1979.

Brownell, R.P., 1977. "Chemical Biological Treatment of Wastewater from the Batch Production of Organic Chemicals." Atlanta, GA. April 1977.

JENNIFER BRYSON
Senior Project Engineer

EDUCATION

BS (Environmental Engineering) 1982; Pennsylvania State University
MSE (Civil Engineering) 1988; University of Washington
Hazardous Waste Operation 40 CFR 1910.120

REGISTRATION

Professional Engineer

SUMMARY OF EXPERIENCE

Ms. Bryson has eight years of experience in managing environmental engineering projects related to hazardous waste, solid waste, and water resources. As a Project Manager for the US Environmental Protection Agency's (USEPA) REM II, TES III, and ARCS Programs, Ms. Bryson has directed remedial investigations, feasibility studies, risk assessments, and treatability studies, and provided technical oversight of remedial designs and remedial actions. She has been responsible for ensuring that numerous Superfund projects have been conducted in accordance with the requirements of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), the Superfund Amendment and Reauthorization Act (SARA), the National Contingency Plan (NCP), and the USEPA's guidance documents on remedial investigation/feasibility studies (RI/FSs). Ms. Bryson also has experience in solid waste planning, site selection, recycling programs, permitting, and water resources protection.

DETAILED EXPERIENCE

1990 to Date Malcolm Pirnie, Inc.

As Senior Project Engineer:

- Served as site manager for ARCS Design Oversight Team for Nascolite Corporation site, included oversight of preparation of plans and specifications for ground water/MMA extraction and treatment system.
- Served as Deputy Project Manager for the New York City Yard Waste Composting program, responsibilities included direction of site evaluations, market analysis, equipment evaluation, and permitting.
- Prepared sampling and analysis plan for design and construction of soils remediation at Reichhold Chemical site in Columbia MS.
- Developed linear programming model for landfill siting study in Luzerne County, Pennsylvania.
- Investigated mechanisms for transport via sedimentation of inorganic contaminants from a munitions facility.

(continued)

JENNIFER BRYSON
Senior Project Engineer

DETAILED EXPERIENCE (Continued)

1990 to Date Malcolm Pirnie, Inc.(continued)

- Prepared project plan for excavation of contaminated soils from drainage pit and septic tank.
- Directed permitting activities for discharge to POTW.

1989-1990 Gibbs and Hill, Inc.

As a Project Manager at Gibbs and Hill, Ms. Bryson was involved in numerous hazardous waste and solid waste consulting activities industry:

- Directed the remedial cleanup activities at a former Manhattan Printing Facility. This included preparing plans and specifications for an on-site aqueous waste treatment system and included ensuring that all off-site and disposal activities occurred according to the requirements of Resource Conservation and Recovery Act (RCRA), Toxic Substance Control Act (TSCA), and other applicable laws.
- Directed the preparation of a focused FS for an interim ground water pump and treat action as site manager for RI/FS at Chemsol site. The project includes ground water sampling, data validation and evaluation, risk assessment, treatability study, evaluation of discharge requirements, development of alternatives, preparation of FFS report and soils remediation. Also developed a computer model to evaluate alternative proposed composting sites. The program was able to select the site, or combination of sites that would minimize overall transportation, site development, equipment, and labor costs for the City.
- Directed preparation of the composting facility planning and permitting documents. Conducted an evaluation of expansion capacities, solid waste and recycling activities in Hudson County, New Jersey.

1986-1989 Camp Dresser and McKee, Inc.

As a Site Manager under the REM II and TES III contracts, Ms. Bryson directed many phases of hazardous waste site remediation activities. A partial listing of projects includes:

- Responsible for providing technical enforcement support at the Kin-Buc Landfill, Edison NJ. Included evaluation of project documents for validity and compliance with relevant requirements. This included reviewing project documents relating to the installation of a slurry wall and hydraulic barrier system, oil recovery and treatment system, surface water collection system and ground water recovery and treatment system. Also attended public meetings, met with consultants for responsible parties as technical support for USEPA, and prepared independent cost estimates for implementation of the remedial measures.

(continued)

JENNIFER BRYSON
Senior Project Engineer

DETAILED EXPERIENCE (Continued)

1986-1989

Camp Dresser and McKee, Inc. (continued)

- Acted as liaison between the USEPA and the oversight team at Ciba-Geigy, Toms River NJ. Assisted in the evaluation of ground water pump and treatment alternatives, including reinjection to ground water and surface water discharge points, evaluated treatment alternatives, and provided significant support during the community relations aspects of this assignment.
- Assisted in the preparation of the predesign project operations plan at Lipari Landfill, Pittman NJ. A significant aspect of this work was to coordinate preparation of the IFB for the treatability study to determine the design parameters for the full-scale wastewater treatment facility that has since been designed and is under construction.
- Responsible for investigating and selecting a vapor-phase granulated activated carbon unit to capture off-gases from a soils incinerator, for Metal Tec, Inc., Middlesex County NJ. Involved evaluating performance curves, contaminant competition impacts and determining flow rates and loading factors.
- Directed the evaluation of PRP activities for Chemsol, Piscataway NJ. This included a critical review of the regulatory history, and critique and analysis of 10 years of data collection efforts.
- Conducted oversight of excavation of PCB-contaminated soils for Renora Site, Edison NJ.
- Project Engineer for the RI/FS that was conducted at the Katonah municipal well, Katonah New York. Responsible for numerous activities, including: Preparation and award of bid documents including drilling and well installations; implementation of an air stripper pilot study and pump test; budgeting, scheduling, and staffing; and data analysis. Provided technical oversight of implementation of the selected remedy at the Katonah well, including the review and evaluation of design work plans, plans and specifications, and permitting documents for the installation of a volatile organic chemical (VOC) air stripper.
- Provided engineering services to the USEPA for a number of other hazardous waste sites in New Jersey. Among these were the Mannheim Avenue Site, Guloway Township, NJ and UOP, located at the Meadowlands, NJ. Also conducted numerous RCRA facility assessments and compliance investigations. Served as Director of linear and dynamic programming, trend analysis, and data base development.

1984 - 1986

University of Washington

As Instructor and Research Assistant, instructed engineering courses in computer programming, engineering dynamics, and pavement design. Conducted research on water resource planning and management including applying techniques of synthetic hydrology.

(continued)

JENNIFER BRYSON
Senior Project Engineer

DETAILED EXPERIENCE (Continued)

1983 - 1984

Washington State Department of Ecology

As Environmental Engineer:

- Responsible for allocating water on Olympic Peninsula Streams to protect the Fisheries Resources. Included evaluating Applications for Construction of Hydropower Facilities, modeling fisheries habitat as a function of instream flows, collecting stream flow data and developing stream flow hydrographs, preparing State Regulations for preservation of instream resources, and conducting public meetings for Olympic Peninsula Residents.

1981 - 1983

Pennsylvania State University

As Research Assistant:

- Participated in numerous research projects relating to water resources, fisheries, acid rain, and thermal pollution. Responsible for conducting numerous scale model demonstrations of alternative jetty design to minimize stream erosion, evaluating thermal pollution impacts on crocodiles, evaluating acid rain impacts on trout fecundity, and evaluating adsorption characteristics of amphibians.

EDUCATION

BS (Chemical Engineering) 1989; Rutgers University College of Engineering
MS (Chemical Engineering) 1991; Rutgers University

SUMMARY OF EXPERIENCE

Mr. Burns has experience in field investigations, ground water remediation, sampling, and process evaluation. His graduate research included investigating the adsorption/desorption of hydrocarbons into soils.

DETAILED EXPERIENCE

1991 to Date Malcolm Pirnie, Inc.

As Engineer:

- Coordinated an eight week sampling effort for compliance with a NJPDES permit. This included collecting surface water and sediment samples in compliance with USEPA Contract Lab Program (CLP) requirements.
- Developed sampling and analysis plans for delineation of the nature and extent of contamination.
- Conducted a detailed evaluation of alternative treatment systems for a Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA) site in New Jersey.
- Prepared cost estimates for groundwater treatment systems including air stripping, carbon adsorption, and UV disinfection processes.

1989 to 1991 Rutgers University
Department Chemical Engineering

As Graduate Researcher:

- Studied the adsorption of hydrocarbons onto soil and soil components.
- Determined project goals and schedule suitable time tables for necessary experimental work.
- Instructed, supervised and evaluated undergraduate students in the laboratories.
- Operated and maintained analytical equipment (GC and TOC machines).
- Wrote progress reports for submission to funding agencies.

JOHN ISBISTER
Vice President

EDUCATION

BS (Geology) 1956; Columbia University

REGISTRATION

Certified Professional Geologist

SOCIETIES

American Institute of Professional Geologists
National Water Well Association
American Water Works Association

SUMMARY OF EXPERIENCE

Mr. Isbister is an expert ground water geologist and hydrologist. He has worked with numerous Fortune 500 companies on contamination projects and is presently responsible for the organization, direction, and evaluation of complex ground water quality investigations and ground water development projects conducted for major industrial clients and large ground water developers. Mr. Isbister specializes in the investigation of contamination incidents and the development of cost-effective measures to control, contain, and abate ground water contamination. He has prepared documents for litigation and delivered expert testimony on the behalf of clients.

DETAILED EXPERIENCE

1987 to Date

Malcolm Pirnie, Inc.

As Vice President: Responsible for the administration and technical direction of corporate services in hydrogeology. Provides technical review and quality control of hydrogeological work performed in regional offices. Mr. Isbister has directed or provided technical review services for projects that include:

- Remedial design project for Reich Farm Superfund site (NJ). Project includes field investigations, soil and ground water modeling, risk assessment, remedial design, negotiations with USEPA, permitting assistance, and a public participation program.
- An Environmental Cleanup Responsibility Act (ECRA) investigation at an industrial site in southern New Jersey. Investigation involved soil sampling, soil borings, installation of monitoring wells, ground water sampling, design and execution of a controlled pumping test, some soil excavations, and data analysis. Final report was prepared and submitted to the regulatory agency.

(continued)

JOHN ISBISTER
Vice President

DETAILED EXPERIENCE (Continued)

1987 to Date

Malcolm Pirnie, Inc. (continued)

- A complex project at the Nassau County Fire Service Academy on Long Island. Conducted a Remedial Investigation/Feasibility Study (RI/FS) of contamination consisting of several areas of petroleum product, a highly concentrated solvent plume, and a more dilute downgradient plume. Investigated subsurface combustible gases. Project includes design and construction of remedial facilities.
- Investigation prior to property transfer to evaluate possible contamination of soil, ground water, and sediments at a sulphuric acid manufacturing plant in New Jersey. Site contains above ground storage tanks, neutralization pits, a sulphur pit, and leach fields receiving domestic septic tank effluent.
- Environmental assessment of three sulphuric acid terminals located in Ohio, Michigan, and Illinois. Assessments included soil gas surveys, soil and ground water sampling and analysis. Contaminants included polynuclear aromatic hydrocarbons, benzene, toluene, and xylenes. Remedial action plans were prepared for two of the three sites.
- A project designed to determine the source of contamination in monitoring wells adjacent to a landfill. Investigation involved soil borings, installation of monitoring wells, sampling and analysis. Data indicated that the source of the contamination was nearby road salting and not the landfill.
- The hydrogeological portion of a large project involving preparation of an environmental impact statement for a proposed resource recovery site at a location in north-central Long Island. Project involved analysis of data from a variety of sources, including a field testing program, US Geological Survey studies, and data from other consultants.
- Evaluation of remedial alternatives for VOC contamination of the Garden State Water Company's Phillipsburg Wellfield (NJ).
- Redevelopment of existing wells and drilling of new wells for two municipal water systems in northern New Jersey. Project included TV surveys of boreholes, redevelopment and controlled pump testing in existing well fields. New wells were located based on geological considerations and were rated on the basis of data collected from the drilling and controlled pump testing.
- Provided expert testimony to the New York Department of Environmental Conservation regarding the effects of increased drawdown on a community ground water supply located near an area of ground water contamination.

(continued)

JOHN ISBISTER
Vice President

DETAILED EXPERIENCE (Continued)

1987 to Date

Malcolm Pirnie, Inc. (continued)

- Environmental review of a developer's application and Draft Environmental Impact Statement for a 600-unit housing development on the waterfront in Hastings NY. Project included review of soil and ground water contamination issues.
- Hydrogeological evaluation of several projects involving landfill closure and, in some cases, design of supplemental cells for disposal of ash from resource recovery facilities. Work involved shallow soil sampling, soil borings, installation of monitoring wells, geophysical and other related surveys and ground water modeling.
- Projects involving assessment of contaminated ground water in a variety of geological environments. Work included identifying potential sources, determining direction of ground water movement and velocity, and assessment of contaminated ground water.

1984-1987

Lawler, Matusky & Skelly Engineers

As Director, Ground Water Section, Hazardous Waste and Ground Water Group and Chief Hydrogeologist:

- Responsible for facility closures for a major chemical company at an explosives plant. Conducted a hydrogeological investigation connected with the closure of a burning pit and waste pile at a plant that manufactures detonators and explosive caps. The project involved soil geologic assessment of ground water conditions sampling, test drilling, water quality analysis and negotiation of closure plan and field results with state regulatory agency.
- Responsible for the organization and management of ground water development projects and hazardous waste studies. Duties included management of projects involving hazardous waste contamination, ground water development, resources evaluation, and other types of hydrogeologic investigations.
- Manager of a project for a Superfund site located in Delaware. Evaluation of field studies, basic data, and reports prepared by US Environmental Protection Agency (USEPA) consultants; expert testimony services to an industrial client and attorneys representing the generators; attendance at technical meetings chaired by the USEPA; and successful negotiation of an alternative remediation scheme. Preparation of work plan for design testing phase will be followed by review of design testing data, specifications for construction, construction and preparation of Remedial Phase Monitoring Plan and long-term operation and maintenance monitoring.

(continued)

JOHN ISBISTER
Vice President

DETAILED EXPERIENCE (Continued)

1984-1987

Lawler, Matusky & Skelly Engineers (continued)

- Manager of a project to assess and clean up a large gasoline spill in Dutchess County NY. A test drilling program was designed and directed to define the limits of the spill and the conceptual design for cleanup was prepared.
- Represented a group of several generators in connection with the assessment and remediation of a Superfund site in Indiana. Reports and data provided by the USEPA were evaluated and alternative plans for additional investigation prepared.
- Provided expert services to a legal firm representing a group of generators in connection with remediation of an industrial landfill in Pennsylvania. Field inspection of the cleanup work was provided, and all testimony, data, and reports relating to site assessment reviewed; expert testimony will be provided as needed.
- Directed several projects involving the collection and interpretation of hydrogeologic data and design, and the installation of monitoring well programs at industrial sites where ground water and soil contamination was suspected or known, including a Superfund site in southern New Jersey.

1966-1984

Geraghty & Miller, Inc.

As Vice President and Senior Scientist:

- Directed several lagoon closure projects, including Monsanto's plant site involving PCB oils. Conducted closures for lagoons containing dissolved organic chemicals and tar for a major pharmaceutical company in New Jersey.
- Provided expert services to a major manufacturer of an industrial client in central Pennsylvania, that manufactures Resourcinal. Recommended remediation alternatives for ground water problems and closure of a waste lagoon. Provided expert services to an industrial waste treatment corporation for control and abatement of ground water contamination and remediation of several waste treatment lagoons containing metal and organic chemical waste.
- Responsible for the organization, direction, and evaluation of over 500 complex ground water quality investigations and ground water development projects in 20 states carried out for the firm's several major industrial clients and ground water developers. Specialized in the development of ground water supplies for municipalities and large industries, and in the investigation of incidents involving contamination and the development of cost-effective measures to control, contain, and abate ground water contamination. Prepared reports and presented expert testimony before state agencies in support of diversion applications. Prepared documents for litigation relating to the actions of the firm's industrial clients and delivered expert testimony on their behalf.

(continued)

JOHN ISBISTER
Vice President

DETAILED EXPERIENCE (Continued)

1966-1984

Geraghty & Miller, Inc. (continued)

Managed projects involving the evaluation, remediation, and closure of sites contaminated with coal tar. These included:

- Investigation of ground water contamination, recommendations for remediation and closure of two tar and acid waste lagoons for a chemical manufacturer in New Jersey.
- Technical oversight, regulatory assistance, and design of testing program for subsurface contamination at a former coke plant in New Jersey.
- Subsurface investigation and regulatory assistance for a major corporation's former coke manufacturing site in Minnesota contaminated with tar and organic chemicals.
- Evaluation and recommendations for closure of several large tar ponds for a confidential industrial client.
- Managed the development of "Procedures Manual for Ground-Water Monitoring at Solid Waste Disposal Facilities." The manual was designed to assist supervisory personnel of solid waste regulatory agencies complying with the management practices established by the Resource Conservation and Recovery Act (RCRA).
- Manager of a project for a major chemical company involving an assessment of the plant property to determine whether contamination of the ground water had taken place. The investigation revealed the presence of carbon tetrachloride at the bottom of the water table aquifer. The contaminant body was bounded and a well abatement system was designed and tested.
- Manager for a ground water assessment study at a site near Toms River NJ, involving clandestine dumping of hazardous wastes by a trucking firm contracted by a major chemical company for delivery to an acceptable landfill. Based on the results of the investigation, the chemical company cleaned the site and negotiated an agreement on plume management with the regulatory agency.
- Investigated ground water contamination for a major chemical and pharmaceutical firm. Extensive ground water contamination was found on the plant site as well as the revelation that movement of the contaminants was controlled by the operation of the plant supply wells and that the contamination had not spread beyond the plant boundaries. Also provided advice and recommendations on a major lagoon cleanup program and a monitoring well system designed to answer the requirements of the regulatory agency.

(continued)

JOHN ISBISTER
Vice President

DETAILED EXPERIENCE (Continued)

1966-1984

Geraghty & Miller, Inc. (continued)

- Manager of a project financed by several industrial firms to evaluate studies of USEPA contractors on the Price Landfill near Atlantic City NJ. The studies assessed ground water contamination and the need to relocate the nearby Atlantic City Municipal Utilities Authority (NJ) wellfield.
- Manager of a continuing project for a hazardous waste treatment facility in southern New Jersey. The investigation involved assessing ground water contamination and designing an abatement well system to contain and remove contamination from the ground water. Also provided advice and recommendations on ground water considerations of a major lagoon cleanup program.
- Manager of a large-scale investigation for a major chemical company in southern New Jersey which assessed the ground water impact of several waste disposal areas and made recommendations on cleanup/abatement measures.

1956-1966

US Geological Survey
Water Resources Division

As Project Manager: Ground water investigations related to availability of ground water supplies, saltwater intrusion, artificial recharge, long-term changes in water levels, aquifer properties, and contamination. Studies were carried out on Long Island and the Catskill Region of NY and in parts of Rhode Island.

PUBLICATIONS AND PRESENTATIONS

Isbister, J., 1977. "Westchester County 208," US Environmental Protection Agency Publication.

Isbister, J., 1976. "Procedures manual for monitoring solid waste disposal sites," USEPA Publications (principal author).

Isbister, J., 1975. "Study of ground water conditions on the Long Island Lighting Company tract," Jamesport, NY (principal author).

Isbister, J., 1970. "Ground water resources in Cape May County," (co-author).

Isbister, J., 1968. "The status of ground water resources, 1967, Nansemond County and Isle Wight County," (co-author).

(continued)

JOHN ISBISTER
Vice President

PUBLICATIONS AND PRESENTATIONS (Continued)

Isbister, J., 1965. "Geology and hydrology of northeastern Nassau County, Long Island, New York," US Geological Survey Water Supply Paper 1825.

Isbister, J., 1963. "Records of wells and related hydrologic data in northeast Nassau County, Long Island, New York," US Geological Survey Open-File Report.

Isbister, J., 1962. "Relation of fresh water to salt water at Centre Island, Nassau County, New York," US Geological Survey Professional Paper 450, Chapter E.

Isbister, J., 1959. "Ground water levels and related hydrologic data from selected observation wells in Nassau County, New York," New York State Water Power and Control Commission, Bulletin 41.

DETAILED EXPERIENCE (Continued)

1987 to 1989

Eckenfelder, Inc. (formerly AWARE, Inc.)

As Staff Hydrogeologist:

- Assistant Project Manager of hydrogeologic projects involving RCRA and CERCLA sites. Included management of drilling crews, mapping, surveying, writing technical reports, application of working knowledge of geophysical equipment, data entry/programming. Compiled and organized monitoring well database for Ciba-Geigy Corp., Toms River NJ and assisted in obtaining a New Jersey Discharge to Ground Water Permit for the facility. Involved locating, surveying, and organizing 30 years of water level data from over 400 wells.
- Installed monitoring wells to monitor contaminant plume migration and employed geophysical methods for plume delineation and locating a confining clay layer beneath a Ciba-Geigy Corporation (NJ) site. Methods included terrain conductivity using the Geonics EM-34 (2 hoop) system, and down hole logging with gamma, resistivity, and caliper probes.
- Designed and implemented ground water investigation to determine the presence of contamination on site for Rayles Realty, Sayerville NJ. Served as client contact and wrote final report.

1983 to 1987

International Playtex, Inc.

As Master Lab Technician: Conducted physical consumer product testing, including design and technical report writing.

1978 to 1982

Marine Geomechanics Lab
University of Rhode Island Bay Campus

As Research Associate: Involved in the study of deep sea sediments for burial of nuclear waste. Testing of sediments included: Atterberg Limits, specific gravity, grain size and triaxial compression tests.

PUBLICATIONS

Co-Author, "Enhancement of Volatile Organic Extraction in soil at an Industrial Site," presented at NGWA Focus Conference in 1991.

KAREN A. SWANSON
Project Hydrogeologist

EDUCATION

BS (Chemistry) 1976; Worcester Polytechnic Institute
MS (Geology) 1979; University of Pennsylvania
PhD (Geochemistry and Mineralogy) 1988; The Pennsylvania State University

SOCIETIES

American Chemical Society
Geological Society of America
National Water Well Association - Association of Ground Water Scientists and Engineers

SUMMARY OF EXPERIENCE

Dr. Swanson has participated in a variety of projects related to ground water and soil quality. She has designed and supervised sampling and analytical programs to determine the presence and extent of contamination in soils and ground water as well as design programs for the remediation of contaminated ground water. Her experience includes data evaluation, report and budget preparation, work plan development and interaction with state and federal regulatory agencies.

DETAILED EXPERIENCE

1990 to Date Malcolm Pirnie, Inc.

As Project Hydrogeologist:

Dr. Swanson provides geochemical support services, supervises data validation, assists with QA/data interpretation, interfaces with laboratories, and manages hydrogeologic projects.

- Quality Assurance officer for remedial design/remedial action work being conducted at the Reich Farm Superfund Site. Includes coordination of analytical work, coordination of data validation, laboratory interface, and data evaluation regarding the useability of the data.
- Project leader for hydrogeologic investigation for CIL, Sayerville NJ. Includes data evaluation and interfacing with the NJDEP.
- Assisting in development of Focus Feasibility Study (FFS) report for Chemsol Superfund site in NJ. Also involved in preparing the work plan for the RI/FS at the Chemsol Site.

(continued)

DETAILED EXPERIENCE (Continued)

1989-1990

Roux Associates, Inc.

As Senior Geochemist:

- Manager for the Anchor Chemical Superfund site (NY) remedial investigation. Responsibilities included providing technical assistance to client with the US Environmental Protection Agency (USEPA), development of work plan, quality assurance project plan (QAPP), health and safety plan (HASP), and sampling program for soil and ground water investigations.
- Project geochemist for the ground water and surface water investigation project (GSIP) at the Industri-Plex Superfund site (MA). Responsibilities included development of ground water and soil analytical program supervision of data validation team, and evaluation of experimental analytical techniques developed for the project.
- Performed audits of sampling and analytical protocols for compliance with the federal Good Laboratory Practices (GLP) requirements related to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).
- Developed data evaluation and data validation procedures for in-house use and conducted staff training seminars.
- Provided expert witness report for litigation concerning contamination of a private drinking water well. Report included a review of sampling and analytical data with recommendations concerning its acceptability.

1989-1990

Adelphi University

As Adjunct Professor of Earth Sciences:

- Taught graduate level courses in applied geochemistry and ground water management.

1985-1989

New Jersey Department of Environmental Protection

As Research Scientist and formerly Section Chief and Senior Geologist:

- Participated in the development of a ground water classification system a ground water management strategy and ground water quality standards for the State of New Jersey. Specific tasks included review of current technical literature and revision of regulations.

(continued)

KAREN A. SWANSON
Project Hydrogeologist

DETAILED EXPERIENCE (Continued)

1985-1989

New Jersey Department of Environmental Protection
(continued)

- Supervised geologists engaged in the review of technical reports on soil and ground water at industrial facilities under the New Jersey Environmental Cleanup Responsibility Act (ECRA). Technical review included the evaluation of hydrogeologic and chemical data to determine the extent of ground water contamination.
- Designed ground water monitoring programs and issued ground water discharge permit at over fifty industrial facilities under the New Jersey Pollutant Discharge Elimination System (NJPDES).
- Evaluated Resource Conservation and Recovery Act (RCRA) Part A and Part B permit applications and determined RCRA status of hazardous waste facilities.

EDUCATION

BA (Geology) 1985; Clermont McKenna College
MS (Hydrology) 1990; University of Idaho

SUMMARY OF EXPERIENCE

Mr. Swope's experience includes the design and analyses of aquifer tests, installation of piezometers and sampling of ground and surface water. He has installed monitoring wells and conducted slug tests on completed wells, assisted in geologic mapping efforts, performed magnetometer surveys and conducted soil sampling. Mr. Swope is also experienced in the use of hydrogeologic computer models including PLASM and Mod Flow.

DETAILED EXPERIENCE

1990 to Date

Malcolm Pirnie, Inc.

As Hydrogeologist:

- Conducted field investigations and evaluated data for the Reich Farm Superfund Site. Activities include slug tests, soil sampling, ground water sampling, well construction, water level mapping and contaminant tracking. Other activities include filing monthly progress reports, contractor supervision, and evaluation of chemical data.

Summer 1989

Golder Associates

As Staff Hydrogeologist:

- Administered drilling program for landfill site assessment, logged drill core, installed monitor wells, completed slug tests on completed wells.

1988

Havilah Mining Co.

As Geologist:

- Evaluated properties under consideration for acquisition, mapped existing mine workings, filed monthly mine progress reports to directors.

1987

Cascade Geotechnical

As Geotechnical Inspector:

- Monitored building pads for soil compaction and water content. Monitored retaining wall construction for conformity to building regulations. Filed daily reports on progress.

(continued)

STEPHEN P. SWOPE
Hydrogeologist

DETAILED EXPERIENCE (Continued)

Summer 1986

Coeur D'Alene Mining Co.

As Field Technician:

- Assisted in geologic mapping, located claim posts, logged drill core, conducted magnetometer surveys and soil sampling.

1985-1986

Fratteroli & Sons

As Surveying Chairman:

- Assisted in field and drafting duties.

Summer 1985

Marine Biological Laboratory

As Water Quality Technician:

- Sampled seawater for major ion content and correlated data with animal mortality. Filed monthly reports.

EDUCATION

BA (English/Philosophy) 1983; Providence College
MA (Communications) 1988; Fairfield University

SOCIETIES

International Association of Business Communicators

SUMMARY OF EXPERIENCE

Mr. Wolfe is responsible for creating and implementing overall corporate public affairs activities. Experienced in public policy formation, communication methods and public information practices, he has established firmwide public relations programs in various media. He has extensively promoted client-related projects in a variety of environmental fields, including the promotion of water, wastewater, hazardous, and solid waste management programs. An author of several technical articles, Mr. Wolfe is an active member with many academic, community and environmental groups in the metropolitan area.

DETAILED EXPERIENCE

1986 to Date

Malcolm Pirnie, Inc.

As Manager, Corporate Public Affairs:

- Manages a full array of public affairs services to include press relations, community-relation programming, promotional materials production and spokesperson training. Representative projects include a conservation slide presentation for Westchester County NY, an award-winning public participation campaign for the Waterbury CT recycling program, and a regional educational program for the Norwalk CT wastewater nutrient removal demonstration pilot project, the first of its kind on Long Island Sound. Additional educational campaigns have been developed for Southampton and Ulster County NY, Prince Georges County MD, and Arlington VA.
- Specializes in mandated citizen participation programming and right-to-know compliance under state and federal programs; community relations Projects Leader under multi-project Superfund program.
- Acts as company liaison with many environmental and community groups, including the Westchester Corporate Volunteer Council, Federal Conservationists of Westchester County, INFORM, Long Island Sound Taskforce, Chesapeake Bay Foundation, and various professional groups. He is currently on the Board of Directors for the Southern Connecticut Chapter of Big Brothers/Big Sisters of America.
- Coordinates professional education seminars on such topics as the "Safe Drinking Water Act Amendments, "Environmental Liability Auditing," and "Today's Solid Waste Management Solutions."

(continued)

DETAILED EXPERIENCE (Continued)

1986 to Date Malcolm Pirnie, Inc. (continued)

As Specialist, Corporate Communications:

- Responsible for implementing firmwide publicity on corporate activities, client projects, and the professional staff, including press coverage by *The New York Times* and *Gannett Westchester-Rockland Newspapers* and feature article placement in trade publications such as *American City and County*, *Public Works*, *Water/Engineering and Management*, *Waste Age*, *Engineering News Record*, *Resource Recovery Report*, *Biocycle*, and *City Currents*.
- As creator and instructor of internal communication/presentation skills training programs, has counseled technical staff, management and client spokespeople for public interface.

1984-1986 Knights of Columbus (International Headquarters)

As program consultant with the New Haven CT corporate offices, responsible for creating and directing community-based volunteer and recruitment programs in three countries. Developed promotional materials in all media, including print, film production and cable TV access promotional programming in New Haven CT and national market areas. Acted as public information coordinator for corporate activities, including liaison with the New Haven Visitors and Information Center, Yale University, Albertus Magnus College, Volunteer Action Center of New Haven, and various civic groups. As director of special projects, traveled extensively throughout North America as a consultant to community-based public participation programs.

PUBLICATIONS AND PRESENTATIONS

Wolfe, Peter L., 1990. "Communicating with the Public: Steps Toward a Successful Strategy," AWWA's National Conference, Cincinnati OH.

Wolfe, Peter L., 1989. "Efficient Management Vital to Large, Long-Term Engineering Projects," *Water Environment and Technology*.

Wolfe, Peter L., 1989. "Recycling Promotional Campaigns: How To Get Results," Westchester County Recycling Conference and Exposition, White Plains NY.

Wolfe, Peter L., 1989. "Publicizing Your Program: Choosing the Proper Audiences," Fourth Regional Tri-State Conference in Corporate Volunteerism, New York NY.

Wolfe, Peter L., 1988. Co-author, "Future Solid Waste Management Issues," ASME's 13th National Waste Processing Conference and Exhibit, Washington DC.

Wolfe, Peter L., 1987. Co-editor, *Dioxin and Resource Recovery*, ASCE publications, New York.

Wolfe, Peter L., 1987. "Poll Examines Future of Solid Waste Management," *City Currents*, U.S. Conference of Mayors, Washington DC.

(continued)

PETER L. WOLFE
Public Affairs Manager

PUBLICATIONS AND PRESENTATIONS (Continued)

Wolfe, Peter L., 1987. Co-author, "Contract Management: An Alternative to Treatment Facility Operations," *Public Works*.

APPENDIX B
SUBCONTRACTOR QUALIFICATIONS

STATEMENT OF QUALIFICATIONS

ENVIRONMENTAL DRILLING

A Division of Commercial Testing & Engineering Co.

**328 Stafford Forge Road
P.O. Box 323
West Creek, NJ 08092
(609) 294-1110
(609) 296-8970 FAX**

**2809 Boston Street
Suite 121
Baltimore, MD 21224
(410) 563-6018
(410) 563-9216 FAX**

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ENVIRONMENTAL DRILLING

Statement of Qualifications

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SECTION II: Technical Capabilities

SECTION III: Organization & Personnel

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ENVIRONMENTAL DRILLING

Statement of Qualifications

We have prepared this Statement of Qualifications to help you understand our capabilities and company mission. Environmental Drilling is dedicated to providing high quality drilling and related services for ground water investigation and remediation projects. All of our staff are thoroughly trained and are aware of the special needs of the hazardous waste industry.

A senior manager is personally involved with every project. Equipment and materials are selected by this individual to meet job specifications. We can also provide advice on technical or difficult aspects of drilling work. Our vice president of operations holds a degree in geology and has over 20 years ground water investigation and remediation experience. Our Baltimore, Maryland, manager holds a degree in engineering and has over 23 years project management experience. Our drilling superintendent has over 30 years field experience with all types of drilling equipment.

We are particularly qualified for this work. Since EDI's inception in 1985, we have preformed over 1,200 projects. Last year, we installed over 1,500 monitoring wells varying in depths from 10 to 360 feet and diameters of 2 inches to 18 inches. These wells were installed in many different consolidated and unconsolidated formations. We have collected thousands of soil and ground water samples utilizing equipment, such as, the moss continuous sampler and QED's HydroPunch system.

Environmental Drilling uses only high quality products, well maintained drilling equipment, and experienced field personnel. All of our drillers and helpers have in depth experience in the monitoring well industry and in the operation of our drilling equipment. All supervisors and field personnel are trained in accordance with OSHA CFR 1910.120 and most are licensed to install wells in many of the mid-Atlantic states. All field personnel have Level D and Level C personal protective equipment on each job. EDI has Level B equipment available should site conditions require its use.

Thank you for the opportunity to present our qualifications to you. We are proud of our accomplishments and encourage you to contact any of our references. We would be happy to provide additional information or discuss your specific drilling needs. Please call Arthur E. Becker at our home office in West Creek, New Jersey, or Peter Dow in Baltimore, Maryland.

Technical Capabilities

Environmental Drilling was founded in May 1985. Its primary goal is providing quality drilling and related services for hazardous waste sites and environmental remediation. Particular emphasis is placed on the installation of monitoring wells and ground water investigations. All of our equipment and personnel are selected and employed with this thought in mind.

Our administrative offices and shop facility are located in West Creek, New Jersey. On August 1, 1990, an office was opened in Baltimore, Maryland, to better serve the Maryland, Delaware, and Virginia markets. EDI will identify a senior manager to provide project management services for the work. He will be available on a daily basis to provide your field personnel with direct access to EDI management and home office resources without interrupting the field progress. This will minimize delays caused by field changes and reduce the risk of material shortages. In West Creek, we inventory all necessary well materials and related drilling products so that they are available to us on an immediate basis. Our project manager has access to this inventory or he can order from our local vendors.

EDI has on its staff a full-time mechanic who manages our maintenance shop and the preventive maintenance program for all drilling equipment. In the unlikely event of a breakdown on the job, our mechanic is equipped to mobilize immediately to make repairs in the field so that work can resume as quickly as possible. We are committed to purchase new and reliable equipment so that we can keep up with the state-of-the-art techniques, and limit mechanical problems and lost time on the job.

Our geographical operating and marketing area includes all of the mid-atlantic and some neighboring states. We hold licenses in Connecticut, Delaware, Florida, Maryland, Michigan, New Jersey, New York, and Pennsylvania.

We currently employ twenty field personnel and an office staff of eight. Our vice president holds a degree in geology and has over 20 years experience with subsurface investigations and ground water remediation. Our drilling superintendent has over 30 years field experience with all types of drilling equipment.

Technical Capabilities (continued)

Our Baltimore project manager holds a degree in engineering and has over 20 years project management and site development experience in the utility, transportation, mining, and port industries.

With our equipment and personnel, we can perform Hollow Stem Auger Drilling, Mud Rotary, Air Rotary/Hammer, and Core Drilling work. We have a large inventory of specialized drilling and sampling tools to complement our drilling fleet. We can easily accommodate jobs requiring large numbers of 2-inch and/or 3-inch diameter split spoons, as well as stainless steel split spoons.

Each drill rig comes equipped with its own 6500 watt generator and high pressure cold/hot water steam cleaner. We have a large assortment of centrifugal and submersible pumps for developing and purging of wells prior to sampling.

In addition to seven truck-mounted drill rigs, we have a barge-mounted drill which is utilized to install both wells and soil borings from the water. We also have a Mobile Drill Minuteman with folding tripod derrick and cathead which allows access on small, tight-quarter drill sites, both inside and outside buildings, and a trailer-mounted Mobile Drill B-24.

Additional support equipment includes two delivery vans which are used to move materials to the larger projects in volume quantities, two 1,000-gallon water trucks, an Ardco ATV water equipment carrier, and various pickup trucks.

Our firm has completed in excess of 1,200 projects since it was founded, varying in dollar volume from \$1,500 to \$500,000. We have done extensive work in the ECRA Market in New Jersey, and the Government Funded Superfund Market, as well as projects for the private industry sector.

EDI is fully insured and a references list is attached.

DRILLING EQUIPMENT CAPABILITIES

Equipment	Carrier	Approx. Weight (lbs.)	Mud Pump Type & Size	H. S. Auger	Mud Rotary	Air Rotary*	Coring	Hole Size (Max.)	Auger Depth (ft.)	Rotary Depth (ft.)
1985 B-61 HD Mobile Drill	GMC Diesel Truck Tandem Axle	47,000	4 x 3 Centrifugal	X	X	X	X	16"	200+	500+
1986 B-80-22 Mobile Drill	GMC Diesel Truck Tandem Axle	50,000	4 1/2 x 5 Piston Pump	X	X	X	X	16"	100	500+
1987 B-57 Mobile Drill	GMC Gas Truck Single Axle	27,000	—	X	—	—	X	12"	100	—
1987 B-53 Mobile Drill	ARDCO Model K Rubber-Tired Articulating ATV	21,000	4 1/2 x 5 Piston Pump	X	X	X	X	16"	100	300+
1988 B-80-22 Mobile Drill	GMC Diesel Truck Tandem Axle	50,000	4 1/2 x 5 Piston Pump	X	X	X	X	16"	100	500+
1990 B-80-22 Mobile Drill	Ford Diesel Truck Tandem Axle	48,000	4 1/2 x 5 Piston Pump	X	X	X	X	16"	100	500+
1988 B-24 Mobile Drill	Trailer-Mounted	2,000	—	X	X	—	X	6"	30	30
Barge-Mounted Drill Rig	—	7,000	—	—	X	—	—	4"	—	50
Mobile Drill Minuteman w/Tripod-Mounted Motorized Cathead	—	300	—	X	X	—	—	4"	20	—

*All Air Rotary Drilling is Performed Utilizing a 100% Oil-Free Food Grade Auxilliary Air Compressor or filtered 99.9 % oil free compressed air.

NOTE: A 1992 Mobile Drill B-80 with onboard air was delivered to Environmental Drilling on April 27, 1992. After undergoing inhouse testing and run in procedure it will be available for service on May 4, 1992.

EDI

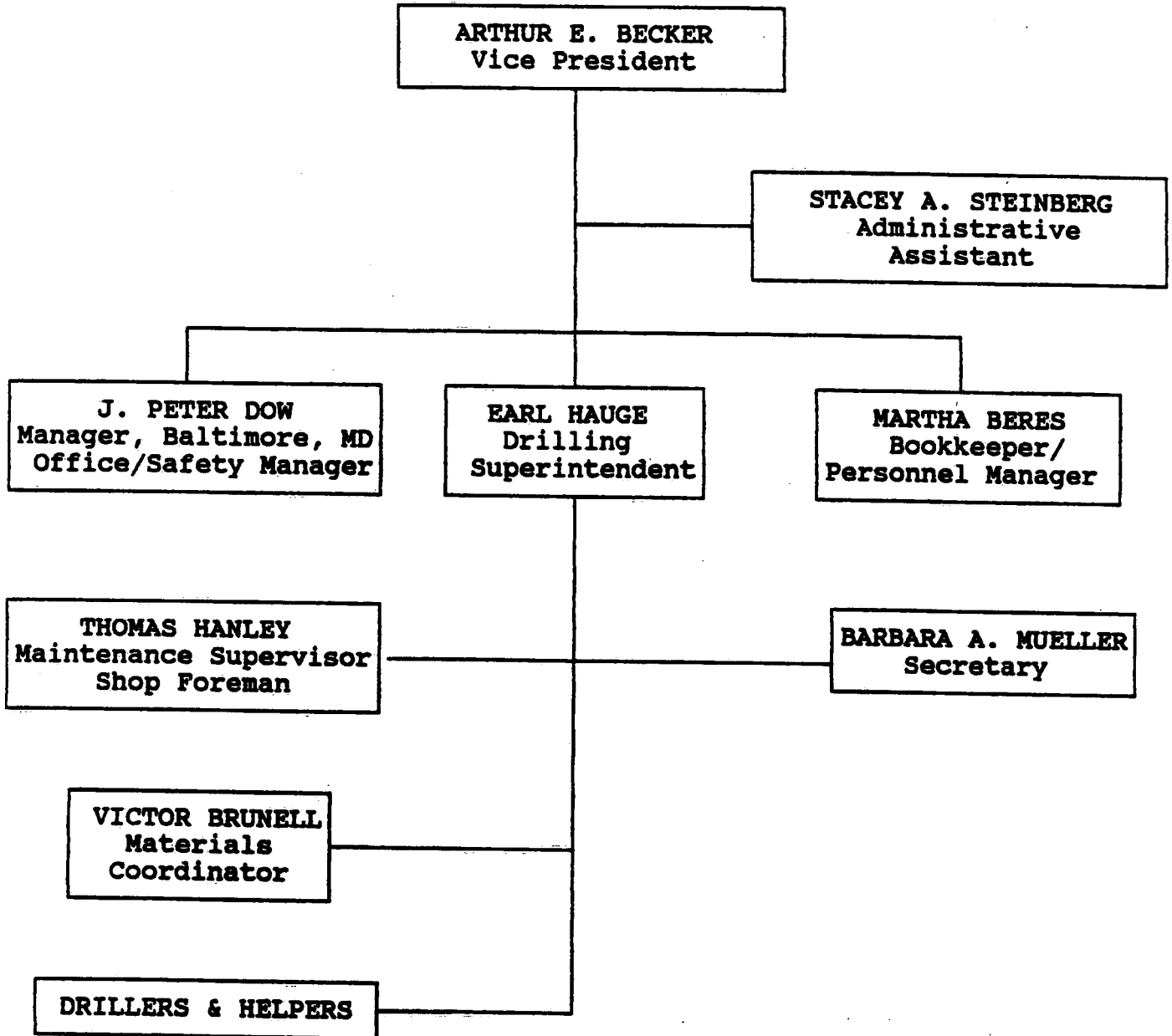
ENVIRONMENTAL DRILLING, INC.

609-294-1110
908-286-3232
Fax: 609-296-8970

P.O. Box 323, 328 Stafford Forge Road, West Creek, NJ 08092

ENVIRONMENTAL DRILLING

Organizational Chart



ENVIRONMENTAL DRILLING

Drilling Licenses

State	Name	License Number
CONNECTICUT	Arthur E. Becker	#335
DELAWARE	Environmental Drilling	#752
	Arthur E. Becker	#753
	Earl Hauge	#827
FLORIDA	Arthur E. Becker	#2427
MARYLAND	Arthur E. Becker	#MGD-001
	Scott Hauge	#JGD-002
MICHIGAN	Environmental Drilling	#1965
NEW JERSEY	Robert Atkinson	#J1478
	Arthur E. Becker	#M1143
	Kyle Beriont	#J1565
	Nicholas Fallucca	#J1526
	Thomas Hanley	#J1432
	Earl Hauge	#J1130
	Scott Hauge	#J1445
	Thomas Lynch	#J1499
	K. Michael Millican	#J1588
	Gregory Pijak	#J1560
	John Muller	#J1571
NEW YORK	Environmental Drilling	#1632
NORTH CAROLINA	Environmental Drilling	#1382
PENNSYLVANIA	Arthur E. Becker	#1752

ARTHUR E. BECKER

Vice President

Mr. Becker is a graduate of Rutgers University with a degree in Geology. A member of the National Water Well Association, Mr. Becker holds a Certified Well Driller's License from the Association. He also holds a Master Well Driller's License in both New Jersey and Maryland, and is licensed in numerous other states. Mr. Becker serves on the Board of Directors of the New Jersey Drilling Contractors Association and is vice president of this organization.

Mr. Becker's background and experience with contract drilling operations is extensive and varied. He has been employed as a consultant and has held the position of groundwater monitoring geologist in which he was responsible for managing the installation, sampling, and maintenance of groundwater monitoring well systems at several nuclear generating stations in upper New York State. He has served as project manager on highly technical and sophisticated drilling programs and monitoring systems at numerous locations, including Three Mile Island Generating Station, Terrapin Point, Niagara Falls State Park, and New Port News Shipbuilding and Dry Dock Company. Drilling contracts which he has been responsible for include uranium exploration in Northeast Pennsylvania, shallow gas wells in Western Pennsylvania, methane gas vent wells at various landfill refineries, and hazardous waste monitoring wells. His water well experience includes shallow and deep water wells in consolidated and unconsolidated formations.

Mr. Becker has an extensive knowledge of Air Rotary, Mud Rotary, Down-the-Hole Percussion, Cable Tool, Bucket, Auger, Reverse Rotary, and Test Drilling methods. His direct experience includes rotary holes to depths of 1,800 feet. This knowledge and diversity enables him to select and utilize the drilling methods and equipment appropriate for each job and its specific conditions and requirements.

ERLING I. HAUGE

Drilling Superintendent

Mr. Hauge has over 28 years of drilling and boring experience. He has drilled water supply wells, construction dewatering wells, monitoring wells, excavation and test holes to 5,000 feet, and numerous instrumentation holes. He is experienced in Air Rotary, Mud Rotary, Reverse Rotary, and Auger drilling methods.

During his 18 years with an international bridge and tunnel contractor, he was responsible for various drilling and test boring investigations. His experiences include barge-mounted and underground tunnel drilling. He has drilled deep borings for mineral exploration.

During the past 10 years, he was responsible for dewatering, geotechnical investigations, and foundation drilling for major construction projects including nuclear power plants, dams, buildings, and mass transit tunnels. Mr. Hauge has been with EDI since its inception in 1985. He has been responsible for all field operations and has experience with deep and shallow monitoring wells. He has installed heavy liquid piezometers, inclinometers, extensometers, porous stone piezometers, anodes, and settlement points.

He is familiar with well and pump systems, air stripping, and recharging systems. He has supervised the installation of high yield municipal wells and hundreds of monitoring wells for groundwater investigation and remediation.

J. PETER DOW

Branch Manager, Environmental Drilling, Baltimore, Maryland
Senior Project Manager

Mr. Dow graduated from the New Jersey Institute of Technology with a degree in mechanical engineering and is a licensed professional engineer in New Jersey. He has over 23 years engineering, construction, and plant operating experience. He has managed projects for the mining, utility, transportation, and chemical industries.

The first four years of his career were in the plant engineering and safety department for a process manufacturing company. He then became project engineer for equipment selection and installation of process plant equipment.

In 1975, Mr. Dow became project manager for an international firm specializing in the design, installation, and operation of large bulk materials handling facilities. During the next 13 years, he managed multi-million dollar engineering construction projects with extensive site development content. His experience includes geotechnical investigation, piling, and caisson installation, dock construction, foundations and dewatering, and installation of water treatment facilities.

Recently, Mr. Dow has managed subsurface investigation, monitoring well installations, and ground water remediation activities for a major manufacturing firm in New Jersey. He has a working knowledge of industrial chemicals, pumps, process equipment, and field construction techniques. He has supervised both technical and field personnel and has managed work for consultants, owners, and government agencies.

ROBERT ATKINSON
Driller

Bob Atkinson began working on an oil drilling rig in the Carribean and moved to the North Sea oil fields. He later worked on oil exploration borings in North Africa.

He joined EDI in 1987 and has installed numerous monitoring wells in New Jersey, Pennsylvania, New York, Delaware, Maryland, and Virginia. He has experience with Air and Mud Rotary and Hollow Stem Auger drilling equipment. He has performed drilling in Level B and Level C Health & Safety conditions.

He is thoroughly trained in the Health & Safety requirements of OSHA 1910.120 and is enrolled in a medical monitoring program meeting current OSHA regulations.

THOMAS LYNCH
Driller

Thomas Lynch began his drilling career as a driller's helper in 1979 for a Metro New York area drilling company. He became a driller in 1982 and has extensive experience with many different drilling rigs and methods.

Tom joined EDI in 1988 and has become the lead driller for rock coring and Air Rotary drilling. Due to his wide range of experience, he has executed some of the company's most difficult drilling projects.

He is thoroughly trained in the Health & Safety requirements of OSHA 1910.120 and is enrolled in a medical monitoring program meeting current OSHA regulations.

K. MICHAEL MILLICAN
Driller

Michael Millican began working in his family business in Texas at an early age. He spend ten years installing deep, high capacity municipal and industrial wells. He has experience with large rotary and reverse rotary drilling equipment, as well as hollow stem augers.

He worked with an environmental drilling firm in New Jersey for three years before joining EDI in 1991. He has installed numerous monitoring wells and soil borings. He has become an expert with HydroPunch sampling and is thoroughly familiar with the use of all terrain vehicles and other off road equipment.

He is thoroughly trained in the Health & Safety requirements of OSHA 1910.120 and is enrolled in a medical monitoring program meeting current OSHA regulations.

SCOTT HAUGE
Driller

Scott Hauge has over nine years of field drilling experience. He joined EDI in 1986 as a driller's helper and was promoted to driller in 1987. He currently has direct field responsibility for a Mobile Drill B-80 drill rig. He has installed numerous monitoring wells with Mud Rotary, Air Rotary, and Hollow Stem Auger drilling techniques. He has installed instrumentation; such as, piezometers, inclinometers, and has installed equipment for dewatering and ground water remediation.

He has knowledge of pumps, hydraulics, and other mechanical equipment normally found on drill rigs. He has developed both deep and shallow wells, and is familiar with well sealing requirements.

He is thoroughly trained in the Health & Safety requirements of OSHA 1910.120 and is enrolled in a medical monitoring program meeting current OSHA regulations.

GREGORY PIJAK
Driller

Greg Pijak had ten years of drilling and dewatering experience before joining EDI in 1988. He is thoroughly familiar with Bucket Auger, Rotary, and Hollow Stem Auger drilling techniques. He also installed many pumps and pumping systems for dewatering systems.

Greg also is familiar with heavy equipment operation. He has installed numerous monitoring wells in New Jersey, Maryland, Pennsylvania, and Delaware. He has performed drilling in both Level C and Level B safety conditions.

He is thoroughly trained in the Health & Safety requirements of OSHA 1910.120 and is enrolled in a medical monitoring program meeting current OSHA regulations.

THOMAS HANLEY
Maintenance Supervisor/Shop Foreman

Tom Hanley graduated from diesel mechanic school and began work in 1978 as a diesel mechanic. The company he worked with specialized in water well drilling and dewatering. He became supervisor of seven mechanics providing services for diesel powered drilling equipment.

He joined EDI in 1987 to maintain all the drilling equipment. Tom is a licensed well driller and supervises operations on numerous monitoring well sites. He has a thorough knowledge of all drilling equipment, including specialized tools and drive components, pumps and hydraulics. He also is licensed to seal wells in the State of New Jersey.

He is thoroughly trained in the Health & Safety requirements of OSHA 1910.120 and is enrolled in a medical monitoring program meeting current OSHA regulations.

Health & Safety and Medical Monitoring Program

The purpose of our safety plan and program is to make certain that on-site personnel are fully aware of hazards and understand proper safety procedures when working on contaminated or potentially contaminated sites. Mandatory procedures and practices have been developed to limit exposure and assist in dealing with contingencies that may arise while drilling operations are being conducted.

EDI will follow the Site Specific Health & Safety Plan developed by the consulting engineer when it meets or exceeds our safety practices and procedures.

Prior to commencement of the work, the owner or engineer is asked to provide a brief history of specific details regarding the type of contamination expected to be encountered at the site, and if a Site Specific Health & Safety Program has been developed. At that time, it will be determined who will be responsible for environmental monitoring while the drilling program is in progress. Threshold levels for air quality are established to determine safety level required.

All on-site personnel will have been instructed in proper care and use of canister-type respirators equipped with organic vapor cartridges. These personnel are familiar with and understand equipment and procedures used in safety Levels A, B, C, and D, and have completed a 40-hour course for Health & Safety. Sound personal hygiene practices and personal protective equipment are the most important defense in limiting exposure. No smoking or eating is allowed on site except at designated clean areas, after personal decontamination has been done.

Drilling tools and equipment are decontaminated prior to commencement of drilling operations and after completion of each borehole, or as directed by the consultant. Handling of drill spoils is done in such a manner as to limit spillage and spread of contaminants to other areas of the site.

Health & Safety (continued)

On-site personal safety equipment will consist of the following, at a minimum:

- Organic Vapor Cartridge Type Respirators
- Tyvek Suits
- Rubber Outer Gloves
- Rubber Inner Gloves (surgical type)
- Rubber Boots
- Hard Hat
- Safety Glasses
- Rain Gear
- Personal Decontamination Equipment
- Steel Toe Shoes

EDI has in its safety equipment inventory three ISI ARAP Escape pad "Level B" tethered airline respirators. The system is equipped with a six-bottle manifold and regulator setup and 600 feet of airline. Chemical resistant coveralls and full face shields can also be mobilized from shop inventory.

All drill rigs have on board first aid kits and fire extinguishers, located in the truck cab behind the driver's seat.

Medical monitoring of drill personnel is done on a yearly basis, and/or after completing a job where a high level of contaminants are known to exist in the drilling environment. Physical examinations include complete medical history, physical exam, blood serum chemistry analysis, X-rays, and any other additional tests recommended by the physician. A list of possible exposure to any contaminants is provided to the physician at follow-up examinations. All EDI managers and field personnel have been safety trained in accordance with OSHA 1910.120 regulations. In July 1990, EDI began drug testing in addition to the medical surveillance program required by OSHA. This program was instituted to comply with the Department of Transportation's commercial licensing requirements. All personnel required to drive vehicles in excess of 26,000 pounds GVW have current Commercial Drivers Licenses (CDLs).

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Lakehurst, New Jersey

DATE COMPLETED: 9/91

DURATION: (6) weeks, (2) rigs

TOTAL COST: \$180,000.

DESCRIPTION OF WORK: Drilling and installation of (66) boreholes; (228) HydroPunch samples. Drilled Mud Rotary method to depths of 100 feet.

GEOLOGY: Sands, clays, and silts.

CONSULTANT: Dames & Moore
12 Commerce Drive
Cranford, NJ 07016

PHONE: (908) 272-8300

CONTACT: Rob Spedding

OWNER: U.S. Navy
Naval Air Engineering Center
Lakehurst, New Jersey

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Maryland

DATE COMPLETED: 6/90

DURATION: (9) days

TOTAL COST: \$35,000.

DESCRIPTION OF WORK: Installation of instrumentation for excavation/soil movement monitoring.
Mud Rotary method of drilling.

GEOLOGY: Silts, sands, and clays.

CONSULTANT: Mueser Rutledge Consulting & Engineering
708 Third Street
New York, NY 10017

PHONE: (212) 490-7110

CONTACT: Peter Deming

OWNER: Confidential

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Lakehurst, New Jersey

DATE COMPLETED: 9/88

DURATION: (4) weeks

TOTAL COST: \$165,000.

DESCRIPTION OF WORK: Installation of (63) 4-inch diameter PVC monitoring wells utilizing the HSA and Mud Rotary methods of drilling. Depths vary from 25 to 120 feet. Three (3) rigs were employed to complete project.

GEOLOGY: Sands and clays.

CONSULTANT: Dames & Moore
12 Commerce Drive
Cranford, NJ 07016

PHONE: (908) 272-8300

CONTACT: Constantine Tsentas

OWNER: U.S. Navy

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: New Jersey

DATE COMPLETED: 4/90

DURATION: (3) months

TOTAL COST: \$140,000.

DESCRIPTION OF WORK: Coal tar investigation, and the installation of monitoring wells utilizing the HSA and Mud Rotary methods of drilling.

GEOLOGY: N/A

CONSULTANT: Dan Raviv Associates
57 East Willow Street
Millburn, NJ 07041

PHONE: (201) 564-6006

CONTACT: Dan Raviv, President

OWNER: Confidential

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Port Washington, New York

DATE COMPLETED: 3/88

DURATION: (2) weeks

TOTAL COST: \$83,000.

DESCRIPTION OF WORK: Installation of (21) gas probes in landfill material. Three (3) gas probes set at various levels per borehole; borehole depth of 70 feet; HSA drilling, Level B safety conditions.

GEOLOGY: Landfill materials - household refuse.

CONSULTANT: Camp, Dresser & McKee
40 Rector Street
New York, NY 10006

PHONE: (212) 693-0370

CONTACT: Winston Williams

OWNER: U.S. EPA (SuperFund Project)

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Cinnaminson, New Jersey

DATE COMPLETED: 5/88

DURATION: (4) months

TOTAL COST: \$185,000.

DESCRIPTION OF WORK: Installation of (22) shallow and deep monitoring wells; HSA and Mud Rotary methods of drilling; stainless steel casing and screen.

GEOLOGY: Sands, clays, and silts.

CONSULTANT: Geomatrix, Inc.
6810 Kenilworth Avenue, Suite 100
Riverdale, MD 20737

PHONE: (301) 779-5302

CONTACT: Donald Jackson

OWNER: U.S. EPA (SuperFund Project)

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Maryland

DATE COMPLETED: 9/91

DURATION: (3) months

TOTAL COST: \$180,000.

DESCRIPTION OF WORK: Installation of (30) 4-inch diameter monitoring wells to 110 feet through (2) confining zones. Many of the wells are double-cased and (1) well is triple-cased.

GEOLOGY: Silts, sands, clays, and river cobble.

CONSULTANT: EA Engineering, Science & Technology
15 Loveton Circle
Sparks, MD 21152

PHONE: (301) 771-4950

CONTACT: Frank Barranco

OWNER: Confidential

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Dover, Delaware

DATE COMPLETED: 6/91

DURATION: (2) months

TOTAL COST: \$63,000.

DESCRIPTION OF WORK: Installation of (10) shallow monitoring wells to 25 feet, and (110) soil borings to 15 to 20 feet.

GEOLOGY: Sands, clays, and silts.

CONSULTANT: Dames & Moore
7101 Wisconsin Avenue, Suite 700
Bethesda, MD 20814

PHONE: (301) 652-2215

CONTACT: John Osgood/Laurie Stenberg

OWNER: U.S. Air Force
Dover Air Force Base
Dover, Delaware

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Radford, Virginia

DATE COMPLETED: 11/91

DURATION: (3) months

TOTAL COST: \$290,000.

DESCRIPTION OF WORK: Installation of (36) 4-inch diameter overburden and rock monitoring wells to depths of 150 feet; (42) soil borings using moss continuous sampler.

GEOLOGY: Overburden - silts, clay & cobble;
Rock - Karst limestone.

CONSULTANT: Dames & Moore
Richmond, Virginia

PHONE: (804) 965-9000

CONTACT: Grace Wood/Anthony Duda

OWNER: U.S. Army
Radford Army Amunition Plant
Radford, Virginia

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Lodi and Maywood, New Jersey

DATE COMPLETED: 3/88

DURATION: (2) months

TOTAL COST: \$89,960.

DESCRIPTION OF WORK: Soil borings for radiological investigation. *

GEOLOGY: Natural soils.

CONSULTANT: Bechtel National
P.O. Box 350
Oakridge, TN 37831

PHONE: (716) 754-4442

CONTACT: Tom Leach

OWNER: U.S. Department of Energy
Manhattan Project Investigation

* This project was performed as part of a low level radioactive soil study.

ENVIRONMENTAL DRILLING

Representative Projects

LOCATION: Lodi, New Jersey

DATE COMPLETED: 10/87

DURATION: (2) days

TOTAL COST: \$2,300.

DESCRIPTION OF WORK: Soil borings drilled to approximately
10 feet.

GEOLOGY: Fill material and natural soils.

CONSULTANT: Martin Marietta
Oakridge, Tennessee

PHONE: (615) 576-5454

CONTACT: Ray Folley

OWNER: U.S. Department of Energy
Manhattan Project Investigation



International
Technology
Corporation

IT Corporation
Technology Development Laboratory
Knoxville, Tennessee

Thermal Separator Capabilities and Experience

Bench- and Pilot-Scale
Laboratory Treatability Studies

1.0 INTRODUCTION/TREATABILITY STUDY CAPABILITY

As a full-service environmental management organization, IT Corporation (IT) has established a network of test facilities and equipment to provide the complete range of testing capabilities for hazardous and mixed waste streams. This capability has been developed over a 15-year period and utilizes a large inventory of process equipment and test units. These units are available for testing on bench- and pilot-scale level to determine the technical and economic feasibility of proposed waste treatment processes. Table 1-1 presents the "off the shelf" capability of IT test facilities. Additional waste treatment process units can be readily assembled from a large inventory of vessels, reactors, separation columns, electrochemical systems, filtration units, thermal test equipment, and support and control systems.

Table 1-1

Treatability Testing Capability								
Bench Scale Units					Pilot Plant Units			
Technology	Media(1)	Contaminants(2)	Capacity	Location	Media(1)	Contaminants(2)	Capacity	Location
Activated Carbon on Exchange	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n	2 to 80 gal/min	TDL	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n	1 to 2 gal	ETDC
Other Adsorbents	a	h,i,j,k,m,n,o	20 to 160 gal/min	TDL	a	h,i,j,k,m,n,o	1 to 2 gal	ETDC
Activated Sludge	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 to 160 gal/min	TDL	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n,o	1 to 2 gal	ETDC
In-situ Biotreatment	a	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 l batch/cant.	TDL	a	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 gal batch/cant.	ETDC
Arabic Biotreatment	c,d,e	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 l batch/cant.	TDL	c,d,e	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 gal batch/cant.	ETDC
Peracetic Biotreatment	a	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 l batch/cant.	TDL	a	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 gal batch/cant.	ETDC
Catalysts	a	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 l batch/cant.	TDL	a	a,b,c,d,e,f,g,h,i,j,k,m,n,o	20 gal batch/cant.	ETDC
Chemical Oxidation	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Chlorination	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Ozonation	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Reduction	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Free Air Oxidation	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Mer (dechlorination)	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Liq-Liq Extraction	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	10 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	10 gal batch/cant.	ETDC
Neutralization	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Electrochemical Sep'n	a	a,b,c,d,e,f,g,h,i,j,k,m,n	2 l batch/cant.	TDL	a	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Coagulation/Filt.	a,b,c,d,e	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b,c,d,e	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Crystallization	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n	20 l batch/cant.	TDL	a,b	a,b,c,d,e,f,g,h,i,j,k,m,n	20 gal batch/cant.	ETDC
Reverse Osmosis	a	a,b,c,d,e,f,g,h,i,j,k,m,n	1 to 2 gal	ETDC	a	a,b,c,d,e,f,g,h,i,j,k,m,n	1 to 2 gal	ETDC
Solvent Recovery	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	10 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	10 gal batch/cant.	ETDC
Stripping (air/steam)	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	10 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	10 gal batch/cant.	ETDC
Chemical Extraction	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	10 l batch/cant.	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	10 gal batch/cant.	ETDC
Flotation	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	2 kg batch	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	2 kg batch	ETDC
Oil Washing	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	2 kg batch	TDL	a,b,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	2 kg batch	ETDC
Stabilization/Solidification	a,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	2 kg batch	TDL	a,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	100 lb batch	ETDC
Thermal Separation	a,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	2 kg batch	TDL	a,c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	150 lb/hr	ETDC
Vaporization	c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n	2 kg batch	TDL	c,d,e,f	a,b,c,d,e,f,g,h,i,j,k,m,n		ETDC

NOTES:

Media Codes: a = Aqueous, b = Organic Liquors, c = Solids, d = Sludges, e = Sediments, f = Other Solids

Contaminant Codes: a = Halogenated Volatiles, b = Non-Halogenated Volatiles, c = Non-Halogenated Non-Volatiles, d = Non-Halogenated Non-Volatiles, e = PCBs, f = Pesticides, g = Gases/Purges, h = Organic Cyanides, i = Organic Corrosives, j = Volatile Metals, k = Non-Volatile Metals, l = Acetates, m = Explosive Materials, n = Inorganic Corrosives, o = Inorganic Cyanides, p = Oxidizers, q = Solvents, r = Other

Location Codes: TDL = Technology Development Laboratory, Knoxville TN. Bench scale testing for physical, chemical, and biological systems. Complete on-site analytical support is provided within the facility. PERMIT STATUS: RCRA small quantity generator operating under a state non-enforcement policy with regards to treatability laboratory exemption.

ETDC = Environmental Technology Development Center, Oak Ridge TN. Bench and pilot scale testing for physical, chemical, and mixed waste systems. PERMIT STATUS: RCRA small quantity generator operating under a state non-enforcement policy with regards to treatability laboratory exemption. TSCA 803, and TN State air permit waivers on a project specific basis.

Mobile laboratories are available to perform on-site testing of all technologies.

2.0 THERMAL SEPARATION PROCESS DESCRIPTION

The thermal separation decontamination technology is based on the use of indirect heating to volatilize and separate volatile contaminants, such as waste oils, from a solid matrix. The materials are volatilized in an indirectly heated rotary calciner and are transferred in an inert gas stream to air pollution control equipment for removal. In the pilot-plant, the materials are recovered from the gas stream first by means of a hot cyclone separator for capture of particulate carryover and then a scrubber/condenser for collection of condensibles, followed in series by a refrigerated condenser, mist eliminator, high-efficiency particulate air (HEPA) filter, and two carbon adsorbers. Figure 2-1 is a block flow diagram of this thermal separation process. This treatment technique offers the potential for cost-effective on-site treatment and, therefore, is a competitive remedial alternative.

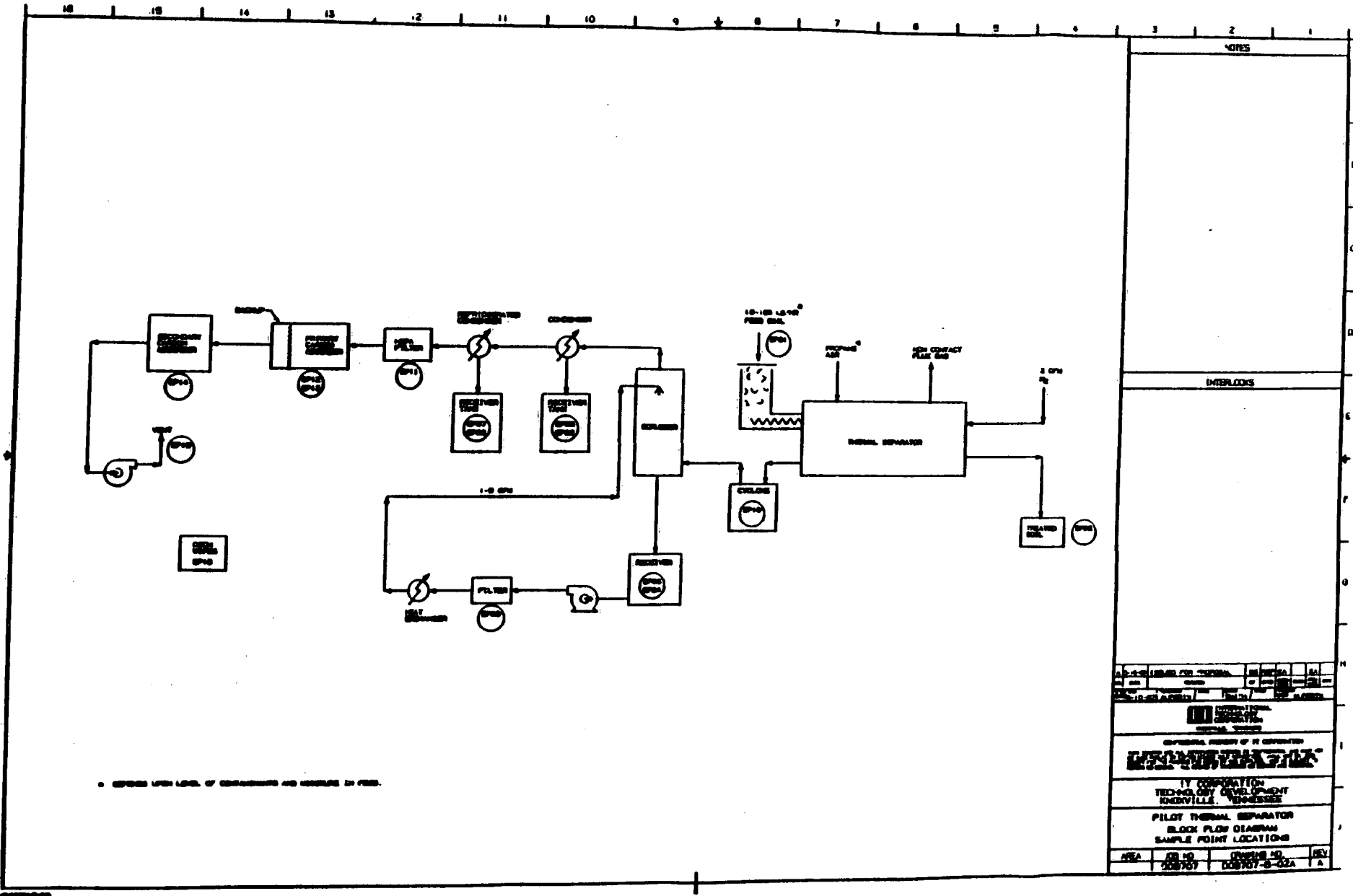
IT has done considerable research and has designed, constructed, and operated a pilot-scale thermal separator. This pilot-scale system, pictured in Figure 2-2, is assembled and ready for operation at IT's Environmental Technology Development Center (ETDC) in Oak Ridge, Tennessee. The pilot separator has been previously operated on several soils contaminated with PCBs, dioxin, PAHs, and low levels of mixed waste.

Soils, after preparation and sampling, are continuously fed to the thermal separator unit. After sufficient residence time at the proper operating temperature, the treated solids are discharged into a container. The volatilized moisture and organics (off-gas) are continuously discharged from the separator; a purge gas, such as air or nitrogen or another inert gas, may be passed through the separator.

The off-gas is cooled and scrubbed in a recirculating water scrubber. The cooled gas then passes through two heat exchangers, a HEPA filter, and two carbon adsorbers in series before being vented to the atmosphere. This air pollution control system ensures that no toxic organics from the processes are vented to the atmosphere.

Water from the scrubber is collected in a receiver that serves as a separator to allow the organic phase and any entrained solid particles to settle out. The receiver serves as a feed tank for the recirculating pumps. The water is recirculated to the scrubber through a bag filter to remove residual solids and through a heat exchanger to remove heat absorbed from the off-gas.

The thermal separation system is designed to prevent fugitive emissions from escaping the process by operating at a slight negative pressure of -1/4 inch to -1/2 inch of water column. The negative pressure is maintained by using a small blower to pull the gases through the separator, scrubber, condensers, HEPA, and carbon system. The pressure is electronically monitored at the solids discharge end of the separator and controlled by manually adjusting a valve upstream of the blower.



NOTES				
INTERLOCKS				
NO.	DESCRIPTION	DATE	BY	CHKD.
LOCKHEED MARTIN CORPORATION TECHNOLOGY DEVELOPMENT KENNEDYVILLE, VIRGINIA				
PILOT THERMAL SEPARATOR BLOCK FLOW DIAGRAM SAMPLE POINT LOCATIONS				
AREA	OR NO.	ISSUED NO.	ISSUED DATE	REV.

FIGURE 2-1

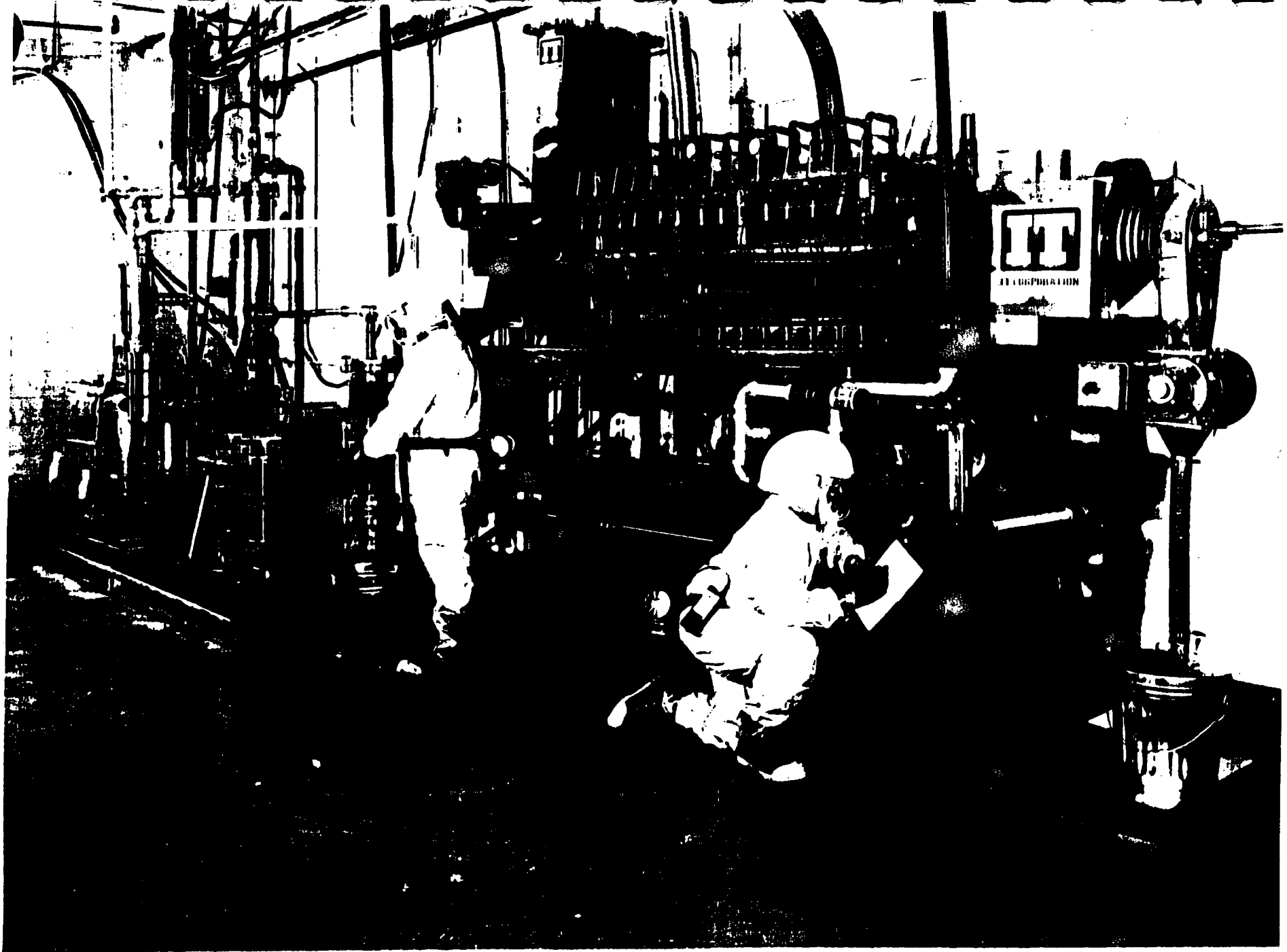


FIGURE 2-2

Thermal Separator Pilot Plant

The thermal separator itself consists of a continuously rotating tube (chamber), partially enclosed with a gas-fired, refractory-lined shell (furnace). This tube has a 6-1/2-inch internal diameter and is 14 feet 7/8 inches long. The heated part is 6 feet 8 inches long and has 14 equally spaced burners fired by natural gas or propane. The unheated, uninsulated portion of the tube at the solids discharge section is approximately 2 feet 10 inches long. The cooling in this zone is enhanced by the use of an air blower. Electrical heaters are placed on the off-gas plenum and the off-gas transfer pipe at the feed end to maintain a high temperature in these sections to prevent condensation. Baffles are placed at intervals within this tube to ensure better soil mixing. Soil material exiting the rotary tube drops through a gas plenum/transition section and a rotary (air lock) valve into a metal receiver can. A sight glass in the discharge section of the separator unit allows the soil flow to be visually monitored.

The thermal separator pilot system has a design capacity of 15 to 150 pounds per hour of solid feed and a residence time of 5 to 50 minutes. Operating capacity depends on the designated residence time for treatment at the designated test temperature and the amount of moisture present in the starting material. The residence time in the separator depends on the solid characteristics, the chamber inclination, and the rotation speed. The tube can be rotated at speeds from 1.16 to 1.5 rpm and also can be inclined to adjust the flow rate of solids. Typically, a 2 to 3 degree slope is used. The holdup also can be increased by attaching a "dam" or retainer ring at the discharge end.

The residence time of materials in the separator is measured by placing colored aquarium gravel into the feed hopper and visually observing its discharge from the separator. The soil processing rate is determined by continuously weighing the soil discharging from the separator while operating at a steady-state. This determination is made during a trial period before the actual test period.

Temperatures of solids in the separator unit are monitored by six type K thermocouples placed along the length of the heated separator chamber. Temperatures of the vapor in the separator are monitored at three locations using type K thermocouples. All thermocouples are connected to a multipoint recorder for data retention.

3.0 THERMAL SEPARATOR PROCESS EXPERIENCE

Thermal Separator Demonstration - PCB

Client: University of Minnesota

IT's thermal separation pilot plant was used to demonstrate on an engineering scale the decontamination of PCB-contaminated soils. The demonstration was conducted under a USEPA TSCA R&D Permit granted to IT Corporation on February 10, 1988. Thirteen experiments were conducted during the 18-day test period from April 4 to April 21, 1988. All of the soil types were successfully decontaminated to less than 2 ppm PCB within the planned experimental operating range. Starting soil concentrations ranged from 44,500 ppm PCBs for the sandy soil to 200 ppm PCBs for the fill material. The effects of separator temperature and residence time on decontamination performance were determined during the test program.

Three different soil matrices obtained from the University of Minnesota's Rosemount Research Center were successfully decontaminated during the demonstration program. PCB contamination levels were approximately 200 ppm for the fill material, 550 ppm for the organic soil, and 4% for the sandy soil. These contamination levels were reduced to less than 2 ppm using various treatment conditions. Experimental temperatures were varied from 375°C to 550°C, and total residence time in the thermal separator from 15 to 40 minutes. Conditions to successfully decontaminate a specific matrix depended on the matrix type and the initial level of contamination. Higher contamination levels required longer residence times at higher temperatures for successful treatment. Solid feed rates were varied from 40 to 70 pounds per hour for each soil type. Starting and treated soil samples from each run were analyzed for PCBs by the DCMA method as required by the permit.

Treated soils were also analyzed for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF), as well as total dioxins and furans. The test data indicated that 2,3,7,8-TCDF required higher temperatures for removal to below 1 ppb than for the removal of PCBs to <2 ppm.

Project Manager:	Edward S. Alperin
Other Key Staff:	K. Ferguson, R.D. Fox, T.J. Geisler, A. Groen
Performance Period:	February, 1988 - November, 1988
Client Contact:	Dr. Fay Thompson, Assistant Director Dept. of Health, Environment, & Safety W-140 Boynton Health Services 410 Church Street, S.E. Minneapolis, MN 55455

Thermal Treatment of Department of Energy Soil

Client: IT Internally Funded, Soil Samples from Paducah, KY, and Portsmouth, OH, Arranged by Martin Marietta Energy System

IT Corporation approached the Department of Energy (DOE) contractor with a novel concept for augmenting the capacity of their RCRA/RSCA/mixed waste thermal incineration facility at K-25 in Oak Ridge, TN. The unsolicited proposal sought a cooperative effort under the Oak Ridge Model Program to use thermal separation technology to significantly increase the capacity of the K-25 incinerator to process mixed waste soils.

IT engineering calculations revealed the soils processing capacity could be increased by running an indirectly fired thermal separator in parallel with the existing primary combustion chamber. The exhaust from the thermal treatment and air pollution control. The 20-fold increase in soils processing capacity would only reduce the capacity of the existing primary combustion chamber by 10% to 20%.

IT engineers prepared a complete test program for review by DOE and a DOE contractor committee. This review included Health and Safety, Experimental, and Regulatory Compliance plans and inspection of the test facility. Upon approval of the review committee, we modified the pilot-plant equipment to allow the safe treatment of soils contaminated with both radiological and PCB constituents. We obtained all required permits and licenses needed for demonstrating a mixed waste treatment process. These required coordination with the EPA's national TSCA organization, local air permits, and modification of the nuclear license at the test facility.

Project Manager: Edward Alperin
Other Key Staff: K. Ferguson, R.D. Fox, T.J. Geisler, A. Groen
Performance Period: May, 1988 - November, 1988
Client Contact: Mr. Mike Morris, (615) 574-0559
Special Projects Coordinator
Martin Marietta Energy Systems, Inc.
Waste Management Technology Center
Oak Ridge, TN

Thermal Treatment of Dioxin-Contaminated Solids

Client: U.S. Air Force Engineering Services Center,
Tyndall AFB

IT was subcontracted by EG&G to evaluate low-temperature thermal treatment of Herbicide Orange-contaminated surface soils at three Department of Defense sites used for storage of the herbicide. Laboratory and field testing was performed for the U.S. Air Force's Environmental Restoration Program to determine the effectiveness of a new decontamination process for soils containing 2,4-D/2,4,5,-T (constituents of Herbicide Orange) and traces of

dioxin. The process IT developed employed three primary operations: 1) thermal desorption to volatilize the contaminants; 2) condensation; and 3) adsorption of the contaminants in a solvent and photochemical decomposition of the contaminants. Bench-scale experiments established the relationship between desorption conditions (time and temperature) and treatment efficiency. Laboratory tests were made using a batch photochemical reactor to define the kinetics of 2,3,7,8-TCDD destruction. A pilot-scale system was designed and assembled to process up to 200 pounds of soil per hour.

Demonstration tests were conducted at two sites -- Gulfport, Mississippi, and Johnston Island in the Pacific Ocean -- to evaluate treatment performance and develop scale-up information. Soil was successfully decontaminated to less than 1 ppb 2,3,7,8-TCDD at temperatures above 460°C. The solvent containing the desorbed herbicide was processed through a thin film reactor until the appropriate degree of photochemical destruction of dioxin was achieved. Samples were taken periodically during the reaction to confirm kinetic rates. The solvent was treated to less than 1 ppb dioxin using the ultraviolet photolysis system.

An engineering and economic assessment was done to project the applicability of this remedial action process at several additional sites.

Project Manager: Edward S. Alperin
Other Key Staff: K. Ferguson, R.D. Fox, T.J. Geisler, V. Kalcevic
Performance Period: November, 1986 - February, 1987
Client Contact: Major Terry Stoddart, (904)283-2942
Engineering Services Labs.
HQAFESC/RDV
Tyndall AFB, FL 32402

Thermal Desorption Technology - MGP Soils

Client: Illinois Hazardous Waste Research and
Information Center (HWRIC) and Gas Research
Institute (GRI)

At some manufactured gas plant (MGP) sites, soils have become contaminated with waste materials including coal tar generated using former gas plant operations. The objective of this study was to demonstrate, on an engineering scale, the effectiveness of thermal desorption for decontamination of MGP site soils, to confirm the importance of primary treatment variables, and to evaluate the correlation between bench- and pilot-scale test systems. The study consisted of acquiring, preparing, and characterizing soil samples, conducting bench-scale baseline thermal desorption tests; operating a thermal desorption pilot plant for a series of treatment tests; analyzing treated soil samples; and evaluating the treatment results.

Two sites having known coal-tar-contaminated soils which could be provided for this project were identified through contact with utilities in Illinois. Also, a utility in California provided

MGP site soil for independent testing. Several drums of soils were shipped from each site to IT's ETDC, where the soil was prepared for testing. Preparation included air drying, blending, and removing very coarse material to provide a homogeneous soil batch which could be used in the bench-scale tests and be processed in the pilot plant. Physical, chemical, and thermal properties were measured for each prepared soil to provide a basis for evaluating the influence of soil type on treatment performance. Total measured PAHs were approximately 2,000 ppm for two soils and 400 ppm for the other soil. The soil properties were relatively consistent.

A series of nine bench-scale tests were conducted using a static tray test procedure which had been employed in many previous soil thermal desorption studies. The results of the static tray tests were used to confirm the planned pilot plant test conditions.

A total of eleven pilot tests were conducted in three phases. The test matrix consisted of tests of each soil at various temperatures and times. Treated soil was collected, sampled, and analyzed for residual PAH concentrations. The results of the pilot tests demonstrated that total quantified PAH levels were reduced to about 1 ppm at the longest residence time and highest temperature conditions. Less time and lower temperature generally had a significant effect on PAH treatment efficiencies, which ranged from 80% to greater than 99.9%. The three soils produced different results, particularly at the lower temperatures, but all were effectively treated.

This project confirmed thermal desorption to be an effective remediation technology for removal of PAHs from MGP site soils.

Project Manager: Edward S. Alperin
Other Key Staff: K. Ferguson, R.D. Fox, T.J. Geisler, A. Groen, V. Kalcevic
Performance Period: August, 1988 - November, 1989
Client Contact: Ms. Jacqueline M. Peden, Research Scientist
Hazardous Waste Research and Information Center
1808 Woodfield Drive
Savoy, IL 61874

4.0 TREATABILITY TESTING FACILITIES

IT has several facilities actively engaged in treatability studies for hazardous and mixed wastes. These facilities offer testing services associated with specific technologies or waste types. These facilities, their location, primary contact, and area of expertise follow:

- **Technology Development Laboratory**
304 Directors Drive
Knoxville, TN 37923
- **Contact: Richard Miller, Laboratory Director**
(615) 690-3211

Capability: Bench-scale testing of biological, chemical, and physical processes. Complete on-site analytical capability including GC, GC/MS/MS, HiRes GC/MS, GC/MS, IC, HPLC, metals, and wet chemistry. Special limited access laboratories for high hazard projects (dioxin, etc.).

- **Environmental Technology Development Center**
1570 Bear Creek Road
Oak Ridge, TN 37830
- **Contact: Thomas Geisler, Facility Manager**
(615) 482-6497

Capability: Pilot-scale testing of chemical and physical processes. On-site analytical support for demonstration projects. Geotechnical testing services to support contaminated soil treatment projects.

The Technology Development Laboratory (TDL) was constructed in 1975 for the evaluation of waste treatment processes and the development of new treatment technology. The laboratory was designed to allow bench- and pilot-scale testing of treatment processes with on-site analytical chemistry support. The facility was expanded in 1980 to include specialized limited access laboratories for the evaluation of high hazard processes and environmental contaminants. The facility currently is IT's primary laboratory for bench-scale testing of physical, chemical, and biological processes on hazardous and mixed waste samples. TDL is also the designated IT facility for handling and analyzing dioxin/furan contaminated samples. TDL is capable of managing several treatability projects simultaneously. Typically, 10 to 15 treatability projects are active during any given period.

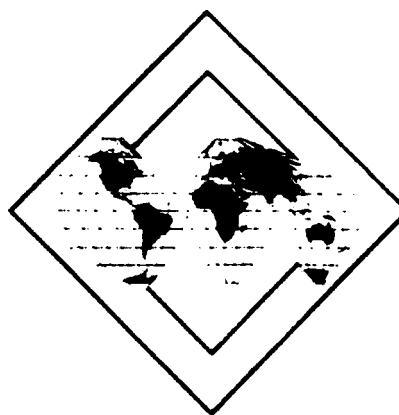
The ETDC complements the capabilities of the TDL by offering expanded capabilities for pilot-plant test demonstrations. This facility has completed several hazardous and mixed waste demonstration projects and is IT's primary test facility for geotechnical projects. This facility is also capable of supporting multiple treatability studies but at a reduced level due to the complexities associated with larger scale demonstration projects. The practical project capacity of the facility is one to three pilot demonstrations at a time.

In addition to the fixed base facilities, IT has mobile laboratories available to allow testing of treatment processes at Superfund sites. The ability to perform testing at fixed facilities and mobile laboratories provides a complete range of testing options to address project cost, testing support logistics, waste variability, and regulatory permit issues.

Technical

Associates

Program

**Edward S. Alperin****Physical/Chemical Treatment**Technical Associate
Knoxville, Tennessee

Professional Qualifications

Mr. Alperin is a chemical engineer with more than seventeen years of experience in the management, development, design, and demonstration of chemical engineering unit operations for solving hazardous waste and pollution control problems. Mr. Alperin is skilled in project/program management, cost estimating, budgeting, cost control, and subcontract administration. He is experienced in the design of treatability studies and in interfacing with regulatory agencies for permitting and compliance. He is accomplished in the design, fabrication, and assembly of bench- and pilot-scale systems for operation in the laboratory or in the field and is experienced in the development of design packages for implementation of full-scale processes.

Education

B.S., Chemical Engineering, Lowell Technological Institute, Lowell, Massachusetts; 1974

Continuing Education:

Supervision of Hazardous Waste Operation, OSHA, 29 CFR 1910.120; 1991
Technical Writing; 1990

Ground Water Technology; 1989

Health and Safety Hazardous Waste Operations, OSHA, 29 CFR 1910.120; 1988

Advanced Project Management, IT Corporation; 1988

Project Management Professional Development, IT Corporation; 1986

Edward S. Alperin

Technical Associate
Knoxville, Tennessee

Experience and Background

1988 - Present ***Treatability Operations Manager/Technical Associate, Technology Development Laboratory, IT Corporation, Knoxville, Tennessee.*** Manages the Treatability Testing Group for the development and implementation of processes for the minimization, recovery, or destruction of hazardous and toxic chemicals and mixed wastes. Technologies include air stripping, carbon adsorption, distillation, ion exchange, solid liquid separations, stabilization, and thermal treatment (incineration, pyrolysis, separation). Specific projects include:

- Evaluates treatment alternatives including air stripping, carbon adsorption, and biological treatment to remove mixed organics from contaminated groundwater.
- Demonstrates thermal separation technology on soils containing polychlorinated biphenyls (PCB) and radioactive constituents.
- Developed solidification processes for organic and inorganic contaminated sludges.

1986 - 1988 ***Senior Project Engineer, Technology Development Group, IT Corporation, Knoxville, Tennessee.*** Managed projects involving the development and design of laboratory-, pilot-, and full-scale field equipment for the treatment of matrices containing hazardous and toxic chemicals. Specific projects have included:

- Tested and scale-up of a thermal process to detoxify waste oil sludges including oil recovery.
- Modified IT's thermal desorption pilot plant to improve soil handling capabilities and to facilitate evaluation of sludge treatment.
- Modified, start-up testing, and demonstration of IT's process to treat PCB-contaminated mineral oil of dielectric fluids under a Toxic Substance Control Act (TSCA) demonstration permit.

Edward S. Alperin

Technical Associate
Knoxville, Tennessee

1985 - **Senior Project Engineer, Chemical Recovery and Treatment Systems Group, IT Corporation, Knoxville, Tennessee.** Managed projects involving development and/or application of chemical engineering unit operations for treatment of matrices containing toxic and hazardous chemicals. Supervised design, fabrication, and operation of prototype systems; evaluated data and developed process designs for full-scale systems. Specific projects have included:

- Designed construction start-up and testing of IT's proprietary thermal desorption technology for the treatment of dioxin-contaminated soils, including the destruction of the desorbed dioxin, using high-intensity ultraviolet (UV) light irradiation.
- Defined and assembled a process for treating contaminated groundwater to remediate the site of a leak in an underground transfer line. Treatment technologies included filtration, carbon adsorption, and heated air stripping.

1980 - **Research Engineer, Technology Development, IT Corporation, Knoxville, Tennessee.** Responsible for laboratory feasibility evaluation for application of chemical engineering processes. Has developed a broad background in the analysis of specific components in difficult-to-analyze matrices. Some specific projects included:

- Photolytic destruction of dioxin in contaminated soil.
- Measured time-temperature relationships for desorption of nonvolatile species such as PCB and dioxin from contaminated soil.
- Designed and assembled mobile analytical laboratory.
- Developed, designed, assembled, and tested a process for the decontamination of PCB transformers.
- Designed, fabricated, and start-up of several anaerobic biological oxidation pilot plants in support of a U. S. Environmental Protection Agency (U. S. EPA) project. Reactor designs evaluated were fluidized bed, packed bed, and upflow sludge blanket.

Edward S. Alperin

Technical Associate
Knoxville, Tennessee

- 1975 - **Chemical Engineer, Resource Recovery/Source Control, Hydrosience, Inc., Knoxville, Tennessee.** Was responsible for pollution control projects involving problem definition through sampling and analysis and pollution reduction through process modification involving state-of-the-art technology. Examples include design and evaluation of air sampling techniques for measuring organic emissions at low concentrations; use of electrodialysis for chemical separations and recovery; bench-scale evaluation of carbon adsorption with solvent and steam regeneration for chemical recovery; pilot-plant design, setup, and operation for phase separation, filtration, and carbon adsorption with solvent and steam regeneration; and development of bench-scale evaluation methodology for adsorption of trace organics.
- 1974 - **Chemical Engineer, Environmental Research Laboratory, Dow Chemical Company, Midland, Michigan.** Experienced in distillation operation, including developmental mini-plants and full-scale production equipment. Involved in the design, construction, and evaluation of extraction apparatus for chemical separation and recovery. Laboratory experience in activated carbon adsorption technology with recovery through nondestructive regeneration.

Professional Affiliations

American Chemical Society (ACS)
American Institute of Chemical Engineers (AIChE)
National Association of Hazardous Waste Generators

Publications

Fox, R. D., E. S. Alperin, H. Huls, 1991, "Thermal Treatment for the Removal of PCBs and other organics from Soil," *Pollution Engineering*.

Alperin, E. S., K. G. Sadler, and R. D. Fox, 1991, "Batch Steam Distillation/Metals Extraction Treatment Process for Contaminated Superfund Soils," presented at the 84th Annual Meeting of the Air and Waste Management Association, Vancouver, British Columbia.

Edward S. Alperin

Technical Associate
Knoxville, Tennessee

Alperin, E. S., A. Groen, and R. D. Fox, 1991, "Treatment of Mixed Waste Sludge," presented at the 84th Annual Meeting of the Air and Waste Management Association, Vancouver, British Columbia.

Morris, M., E. S. Alperin, and R. D. Fox, 1991, "Physical/Chemical Treatment of Mixed Waste Solids," presented at the 84th Annual Meeting of the Air and Waste Management Association, Vancouver, British Columbia.

Alperin, E. S., R. D. Fox, and H. H. Huls, 1990, "Thermal Treatment for the Removal of PCBs and Other Organics from Soil," presented at the Spring National Meeting: Hazardous Waste Elimination and Detoxification/Session #39e, American Institute of Chemical Engineers, Orlando, Florida.

Troxler, W. L., E. S. Alperin, and R. D. Fox, 1989, "Thermal Separation as an Innovative Technology for the Treatment of Hazardous and Mixed Wastes," presented at the 8th International Conference on Thermal Destruction of Hazardous, Radioactive, Infectious, and Mixed Wastes, Knoxville, Tennessee.

Alperin, E. S., R. D. Fox, H. H. Huls, and E. Thompson, 1989, "Innovative Treatment for the Removal of PCBs from Soil," presented at the Industrial and Engineering Chemistry Division Symposium of the American Chemical Society, Atlanta, Georgia.

Fox, R. D., E. S. Alperin, and R. W. Helsel, 1989, "Soil Decontamination by Low Temperature Thermal Separation," presented at the 5th International Conference on Solid Wastes, Sludges, and Residual Materials, Rome, Italy.

Alperin, E. S., R. D. Fox, W. L. Troxler, and M. I. Morris, 1989, "Innovative Treatment for the Removal of PCBs from Mixed Waste Soils," presented at WATtec 89, Knoxville, Tennessee.

Alperin, E., R. Miller, C. Pfrommer, R. Helsel et al., 1986, "Evaluation of On-Site Incineration for Cleanup of Dioxin Contaminated Materials," presented at the 1986 Hazardous Materials Spills Conference, St. Louis, Missouri.

Edward S. Alperin

Technical Associate
Knoxville, Tennessee

Helsel, R. W., H. Williams, E. S. Alperin, and T. Stoddart, 1986, "Technology Demonstration of a Thermal Desorption/UV Photolysis Process for Decontaminating Soils Containing Herbicide Orange," presented at the Spring American Chemical Society Conference, New York, New York.

Helsel, R. W., E. S. Alperin, R. A. Miller, A. Groen, D. Catalano, J. Fleming, D. Pitts, and F. Freestone, 1986, "Thermal Desorption and Heat Transfer Characteristics of Soil Contaminated with 2,3,7,8-Tetrachlorodibenzo-p-dioxin," presented at the Spring American Chemical Society Conference, New York, New York.

Exner, J. H., E. S. Alperin, A. Groen, C. E. Morren, V. Kalcevic, J. J. Cudahy, and D. M. Pitts, 1985, "Detoxication of Chlorinated Dioxins," *Chlorinated Dioxins and Dibenzofurans in the Total Environment II*, Butterworth Publishers.

Exner, J. H., E. S. Alperin, A. Groen, and C. E. Morren, 1984, "In-Place Detoxification of Dioxin-Contaminated Soil," *Hazardous Waste*, Vol. 1, No. 2.

Parmele, C. S., E. S. Alperin, J. H. Exner, and H. McLaughlin, November 1981, "Nondestructive Regeneration of Activated Carbon," presented at the American Institute of Chemical Engineers, New Orleans, Louisiana.

Fox, R. D., E. S. Alperin, C. S. Parmele, and J. H. Exner, 1979, "Carbon Adsorption as a Recovery Technology," presented at the Annual WPCF Conference, Houston, Texas.

Technical

Associates

Program



Stuart E. Shealy, P.E.

Chemical Treatment

Technical Associate
Knoxville, Tennessee

Professional Qualifications

Mr. Shealy is a chemical engineer with more than seventeen years of experience in the development, design, demonstration, and commercialization of chemical processes. His experience includes process optimization and waste minimization in operating plants. He is skilled in evaluating the comparative economics of various wastewater treatment options. He is experienced in the design, fabrication, and operation of bench- and pilot-scale systems for both laboratory and plant environments. He is also experienced in the development of design packages for implementation of full-scale processes and in initial system start-up.

Education

B.S., Chemical Engineering, Clemson University, Clemson, South Carolina; 1974

Registrations/Certifications

Professional Engineer, Chemical Engineering, California

Experience and Background

1991 - *Treatability Programs Manager, Technology Development Laboratory, IT Corporation, Knoxville, Tennessee.*
Present

- Manages treatability studies for mixed and hazardous wastes.

Stuart E. Shealy, P.E.

Technical Associate
Knoxville, Tennessee

- Project Manager for U. S. EPA merging technology program grant to treat mixed waste soil by thermal and physical separation processes.
- 1989 - **Project Manager, Pollution Prevention and Treatment Services Group, IT Corporation, Knoxville, Tennessee.** Managed projects involving application of chemical engineering unit operations to solve hazardous waste problems. Experience included:
- Developed waste minimization plan for a petroleum pipeline company and completed waste minimization survey at a southern California oil refinery.
 - Task Leader for waste minimization project. Project goal was to reduce the amount of wastewater requiring deep well injection. Project involves emulsion source identification, chemical de-emulsification, on-site pilot testing of oil water separation, and re-use of treated water as cooling tower make-up.
 - Project Manager for design of ventilation system for feed preparation building for Hybrid Thermal Treatment System[®] (HTTS[®]) incinerator. Managed conceptual through detailed design of system to treat air contaminated with volatile organic compounds (VOC) from waste preparation activities. Air was incinerated in either of the two HTTS units or in a backup fume incinerator. Design included combustible gas analyzers interlocked to alert operators to high levels of organics in the air and to divert high LEL air from the incinerator. This system was installed on two air-supported fabric structures at a Superfund site remediation.
 - Project Manager for process and engineering design of wastewater treatment system for remedial action design at a Superfund site. Treatment system included metals removal and biotreatment of saline wastewater. Assisted client in waste minimization efforts which led to study to reduce the amount of salts produced in plant. Excess salts were contributing to biotoxicity of plant effluent. Negotiated pretreatment requirements with the POTW.
- 1986 - **Senior Project Engineer, Chemical Recovery and Treatment Systems Group, IT Corporation, Knoxville, Tennessee.** Managed projects involving development and applications of chemical engineering unit operations of treatment of
- 1989

Stuart E. Shealy, P.E.

Technical Associate
Knoxville, Tennessee

groundwater or wastewater containing toxic or hazardous compounds. Supervised design, fabrication, and operation of pilot systems. Evaluated data, and developed process designs for full-scale systems. Specific projects included:

- Management of design and procurement of waste oil/sludge feed preparation system for HTTS incineration project at Superfund site. Scope included developing P&IDs from conceptual design and equipment specification and procurement.
- CERCLA feasibility studies for remediation of contaminated groundwater and waste sludges.
- Design of lead removal system for groundwater remediation at battery recycling site. Designed generic air stripping/catalytic fume incineration skids and carbon systems for California UST market.
- Vinehill Pond deinventory project. Developed conceptual designs and costs for alternative treatment processes for waste brines. Unit operations included solidification, evaporative concentration, UV-peroxidation, and carbon. Supervised on-site testing of UV-peroxidation and carbon adsorption.

1982 -
1986

Lead Research Engineer, Process Research and Engineering Groups, Ortho Research and Development, Agricultural Chemical Division, Chevron Chemical Company, Richmond, California. Was responsible for development, design, and economic evaluation of processes for production of agricultural chemicals. Was responsible for developing solutions to several wastewater treatment problems and process optimization for existing Richmond plants, including 100 mbh liquid waste incinerator. Supervised design, fabrication, and operation of pilot systems. Developed process designs for commercial systems, and provided process coverage for plant start-up. Some specific projects included:

- Development of computer program to allocate operating costs of liquid waste incinerator to plants according to the production rate and composition of the wastewater.
- Demonstration of bench-scale removal of pesticides and arsenic from contaminated pond muds by thermal stripping and vitrification. Developed

Stuart E. Shealy, P.E.

Technical Associate
Knoxville, Tennessee

and costed conceptual process design. Treated muds met California TPCA limits for arsenic and pesticides.

- Demonstration of process to remove arsenic, copper, and zinc from incinerator scrubber blowdown. Investigated use of chelating ion exchange resins and electrolytic cell. Supervised team that developed experimental cementation process and tested various precipitation techniques for removing metals from waste pond water and incinerator blowdown.

1975 - *Research Engineer, Process Research and Engineering Group, Chevron*
1982 *Chemical Company, Richmond, California.* Was responsible for:

- Daily process optimization for fungicide plant. Did quick turnaround development and design projects for increasing plant production and improving process yield. Work included several projects for minimizing production of wastewater and spent solvents as well as plant waste production survey. Filled in as chemical and control room operator during three-month strike.
- Developing ammonia scrubbing process for removing acid gases from incinerator stack gases and converting scrubber blowdown into saleable fertilizer solution. Did process design for commercial system.

1974 - *Research Engineer, Process Design Group, Chevron Research Company,*
1975 *Richmond, California.* Produced process design packages for refinery catalytic reformers and crude units. Experience in design and simulation of heat exchangers and distillation columns.

Publications

Shealy, S. E., S. Lyandres, J. A. Meardon, and J. R. Rees, 1989, "Evaluation of Alternative Processes for Final Treatment of Hazardous Waste Effluents," *Environmental Progress*, Vol. 8, No. 1. Also presented at AIChE Summer National Meeting, 1988, Denver, Colorado.

AREND GROEN, JR.

Professional Qualifications

Mr. Groen is a chemist with 10 years' experience in analytical chemistry and research and development. His experience includes formulation development in stabilization processes and agricultural chemicals as well as analytical methods development for industrial processes and chemical and physical detoxification processes. His recent experience includes work on dioxin and polychlorinated biphenyl (PCB) detoxification processes and removal of other priority pollutants from soils and sludges.

Education

B.S., Honors, Chemistry, University of Guelph, Guelph, Ontario, Canada; 1970
M.S., Physical Organic Chemistry, University of Guelph, Guelph, Ontario, Canada; 1972

Departmental Diploma in Chemical Engineering, University of Waterloo, Waterloo, Ontario, Canada; 1980

Experience and Background

1981 - Present Chemist, IT Corporation, Knoxville, Tennessee. Aids in development of processes for detoxification of hazardous wastes containing dioxins and PCBs. Experience includes:

- Evaluation of chemical reagents for insitu destruction of PCB-contaminated liquid wastes, specifically PCB-contaminated mineral oil from electrical transformers. Development of physical processes for the utilization of the above reagents.
- Evaluation of physical processes for the detoxification of hazardous wastes containing dioxins, including extraction processes with subsequent capture and destruction of the contaminants.
- Evaluation of physical processes for the removal of priority pollutants from soils and sludges.
- Evaluation of reagents and processes for the chemical stabilization of hazardous wastes. The wastes included heavy metal sludges and organic sludges containing cyanide or sulfide.
- Development and utilization of analytical methods to evaluate the destruction processes outlined above. Methods evaluated included gas chromatography with mass spectrometry (GC/MS), and liquid chromatography.

- 1979 Chemist Trainee, Hydrosience Canada, Sarnia, Ontario, Canada. Trainee at Hydrosience in Knoxville, Tennessee, in GC/MS and analytical methods for priority pollutant analysis.
- 1976 - Occasional Laborer, Guelph, Ontario, Canada. Worked as laborer for general contractor for housing construction.
- 1974 - Chemist, Uniroyal Chemical, Elmera, Ontario, Canada. Responsible for chemical formulation of agricultural chemicals including fungicides and herbicides.
- Evaluated existing chemical formulations for chemical and physical stability and updated formulations based on availability of raw materials and market requirements
 - Prepared formulations for new products to evaluate chemical and physical stability and to provide formulations to the agricultural research sections for testing of efficacy of new and updated formulations
 - Evaluated formulation produced with various grinding media for plant production to increase efficiency of existing process equipment.
- 1973 - Chemist, Chinook Chemical Corporation Limited, Sombra, Ontario, Canada. Responsible for analytical methods development and quality control of finished products and raw materials used in methyl amines manufacturing processes.
- Provided analytical data for development of mathematical model for methyl amines production process.
 - Provided chemical analyses and control methods for pollution control and monitoring in the production of methyl amines and related products.
 - Aided in setup and startup of a continuous process for the production of methyl ethyl ketone peroxide.
- 1970 - Technician and Teaching Assistant, University of Guelph, Guelph, Ontario, Canada. As a teaching assistant, provided tutoring and laboratory monitoring and grading for undergraduate chemistry programs. As a technician, prepared samples for research and set up and ran research equipment.

TRAY TEST APPARATUS

The tray test apparatus consists of a Lindberg Model 51848 muffle furnace with an electronic temperature controller and a 1600 watt heater. The oven has double-shell construction with interior surfaces made of Moldatherm², a molded aluminum-silicate insulation material. This oven is capable of operating at temperatures up to 1100°C and has a relatively fast heat-up rate due to its low mass. The interior space is approximately 3.9-in. wide x 4.3-in. high x 8.3-in. deep. A loose block (1/2 in. thick) of Moldatherm is placed on the bottom of the oven to provide additional separation between the tray and the hot interior surface of the oven.

A specially made tray is used to contain the waste sample within the oven. The tray which weighs approximately 430 grams, is 3.5-in. wide x 1.3-in. high x 7.6-in. long and is constructed of Incoloy to resist oxidation during high temperature tests.

During the test the oven will be continuously purged with nitrogen which is introduced through a 3/8 inch diameter Incoloy tube in the back wall of the oven. The purge gas is directed against the back wall to promote even heating and distribution. The purge gas flow rate is measured with a standard rotameter and maintained at approximately 90 cc per minute during the test.

Two thermocouples are used to measure temperature. One is an NBS traceable, type K sheathed thermocouple placed approximately three centimeters above the test material at the center of the oven. This is the thermocouple used to measure the "Test Temperature". The second thermocouple is used to measure the temperature within the test matrix. The thermocouples, and the oven temperature indicator are calibrated using a standard reference source. The purge gas rotameter is calibrated using a wet test meter. Temperatures are recorded using a multipoint recorder. Experimental test times are measured using a quartz digital chronometer.

ROTARY THERMAL APPARATUS

This custom designed and fabrication test unit which is designed to operate in the batch mode. The rotating tube portion of the system is 5 inches in diameter by 12 inches long and is fabricated from Incoloy to resist oxidation during high temperature tests. The cylinder rotates at five revolutions per minute and is externally heated with a custom-made 7000 watt Lindberg furnace. The chain driven tube is suspended on both ends by brass rollers and sealed by graphite packing rings at the inlet and outlet distribution boxes. The heat-up rate and operating temperature of the furnace are controlled with a Lindberg 59554-B temperature controller. Temperatures of the soil bed and the gas in the rotating cylinder are measured with two type K thermocouples calibrated against an NBS traceable standard. These temperatures, the temperature of the furnace, and the off-gas system are recorded on a multi-point recorder.

The off-gases (purge and product gas) exit from the cylinder through a three-foot long quartz tube into a scrubber system. The scrubber consists of heavy wall glass spray tower which is 2 inches in diameter and 16 inches tall. A caustic solution, typically 5 percent NaOH, is recirculated through the tower and cooled using a Haake laboratory chiller.

Uncondensed gases exit the spray tower and are pulled through a 6 inch-diameter by 14-inch deep carbon bed, by a diaphragm vacuum pump, before being discharged to a laboratory fume hood. Pressure in the RTA cylinder is maintained at minus 0.1 to 0.2 inches of water to prevent external leaks from the system. Rotameters are used to measure the purge gas rate into the system and the noncondensed fraction of the off-gas. Figure 2-3 is a cross sectional schematic representation of this apparatus. The off-gas treatment system is designed to meet the needs of laboratory operations and is not intended to produce scalable data for air pollution control design.

Qualifications Manual 1992



Lancaster Laboratories

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SECTION 1 INTRODUCTION

This manual provides a detailed picture of Lancaster Laboratories, Inc. with special emphasis on our personnel, physical facilities, instrumentation, and quality assurance programs. It allows the reader to appraise our ability to provide those technical services which we offer. The best way for a prospective client to judge our capabilities is by a personal visit. However, if limitations of time and geographical distance preclude such a visit, we hope this manual will prove an adequate substitute.

A. DESCRIPTION OF COMPANY

Lancaster Laboratories, Inc. is an independent company offering high quality technical services in the chemical and biological sciences with personal attention to client needs. These services include chemical analyses, microbiological testing, contract research and development, and consulting. Our firm is a privately held corporation and is not a subsidiary of another company. We are, therefore, an independent, technical service company and do not manufacture or distribute goods. Our "product" is accurate and timely technical information. As a for-profit, taxpaying organization, our continued existence depends on the quality of the services we offer and the efficiency with which we deliver them. Our operations are organized into the separate speciality areas of Environmental Sciences, Food Sciences, and Pharmaceutical Sciences.

B. COMPANY HISTORY

Our firm was founded in 1961 by Dr. Earl H. Hess (current CEO) in response to a perceived need for high quality technical services by the agricultural and industrial community in Southeastern Pennsylvania. Initial staff consisted of Dr. Hess, one technician, and Mrs. Hess as a part-time secretary and bookkeeper. Our organization reached its present size of over 450 people through continual growth, which has required nine expansions of the physical plant.

C. GEOGRAPHICAL AREA SERVED

Our clientele ranges over the entire conterminous United States and beyond, into South and Central America and Europe. Although the majority of our clients are in the Middle Atlantic states, the advent of overnight deliveries allows us to offer prompt service to the entire country. Our clients include private individuals, private business enterprises of all sizes, trade associations, universities and colleges, and federal, state, and local government organizations.

D. OWNERSHIP

The company is incorporated under the laws of the Commonwealth of Pennsylvania and is operated as a closed corporation. Earl H. Hess, founder, is the largest stockholder; all other stock is held by family members and key employees.

Lancaster Laboratories holds equity in two joint ventures with the ERM Group. One is Mountain States Analytical, Inc. in Salt Lake City, UT, in which the partners are ERM, Inc. and ERM-Rocky Mountain. The other is Gulf States Analytical, Inc. in Houston, TX, in which the partner is ERM-Southwest.

1. Board of Directors

The Board of Directors of the corporation consists of the following members:

Earl H. Hess, Ph.D., Chairman of the Board, CEO
J. Wilson Hershey, Ph.D., Executive Vice President, Laboratory Operations
Kenneth E. Hess, B.S., Executive Vice President, Finance & Data Processing, Treasurer
Carol D. Miller, M.B.A., Executive Vice President, Human Resources & Administration, Secretary
Christoph J. Grundmann, Ph.D., Board Member Emeritus
Ray F. Dawson, Ph.D., Board Member Emeritus

2. Consultants

The following are consultants retained by the corporation as Research Associates:

Christoph J. Grundmann, Ph.D.
Ray F. Dawson, Ph.D.

SECTION 2 ORGANIZATIONAL STRUCTURE

The organizational structure of the company is shown on the charts on pages 13 to 18. We have three business units: Environmental Sciences, Food Sciences, and Pharmaceutical Sciences. In addition, a Support Services Group handles the nontechnical work of the corporation. Here is a listing of the employees clients are likely to have contact with. Staff members' names appear with their regular work groups, but many workers are cross-trained and can perform the analytical work of various groups. Resumes of key technical personnel can be found in Appendix C.

A. CORPORATE SERVICES

Earl H. Hess, Ph.D., Chairman of the Board, President, and CEO

Gerry Hershey, Administrative Assistant

Anne Osborn, M.A., Assistant to the President

Esther Thompson, Executive Secretary

1. Quality Assurance

M. Louise Hess, B.S., Director, Quality Assurance

Monica Bretzin, M.S., Quality Assurance Specialist I

Kathy DiNunzio, B.S. Quality Assurance Specialist I

Kathleen Loewen, B.S., Quality Assurance Specialist II/Coordinator

Kimberly Oliver, B.S., Quality Assurance Specialist II

Lee Seats, M.B.A., Senior Quality Assurance Specialist

Susan Shorter, B.S., Quality Assurance Specialist I

B. BUSINESS UNITS

J. Wilson Hershey, Ph.D., Executive Vice President, Director, Laboratory Operations

Richard Burke, M.S., Director, Sales & Client Services

1. Environmental Sciences

a. Air Quality/Data Package

Martha Casstevens, B.S., Manager I

(1) Air Quality

Nadia Alfieri, IHIT, M.S., Air Quality Program Specialist III

Jack Follweiler, B.S., Industrial Hygienist II

Patrick Weidinger, B.S., Industrial Hygienist III/Coordinator

Additional Support Personnel in this Group: 5

(2) Data Package

Mary Ann Brubaker, M.S., Group Leader I

Sandy Patton, B.S., Data Package Specialist I

David Weiser, B.S., Data Package Specialist IV/Coordinator

Additional Support Personnel in this Group: 7

b. Applied Research & Development/Pesticide Residue Analysis

Nelson Risser, B.A., Manager I

(1) Applied Research & Development

Charles Neslund, B.S., Chemist IV

John Snyder, M.S., Senior Chemist

Bryan Winship, B.S., Chemist IV

(2) Pesticide Residue Analysis

Mary Dormer, B.S., Chemist I

Gregory France, B.A., Chemist I

Joseph Friel, B.S., Chemist I

Jenifer Hess, B.S., Chemist III/Coordinator

Donna Lewis, B.S., Associate Chemist

Dorothy Love, B.S., Data Review Specialist IV/Coordinator

Michele Mack, B.S., Associate Chemist

Nancy Saunders, B.S., Chemist II

Tamra Schumacher, B.S., Chemist III

John Styles, B.S., Chemist I

Additional Support Personnel in this Group: 14

c. Client Services

Susan Page, B.A., Group Leader I

Nancy Bornholm, B.S., Client Services Specialist II

Stephanie Bozym, B.S., Client Services Specialist I

Kathy Halkquist, Client Services Specialist II

Lynn Hebner, B.S., Client Services Specialist I

Jeannie Jacobson, B.S., Client Services Specialist II, Pharmaceutical Sciences

Rachel Kreamer, B.S., Client Services Specialist II

John MacKay, B.S., Client Services Specialist I, Food Sciences

Patrick Parmer, B.S., Client Services Specialist I, Air Quality

Kim Purdy, B.A., Client Services Specialist I, Food Sciences

Chris Ratcliff, B.S., Client Services Specialist II

Jill Sproat, B.S., Client Services Specialist II
Donald Wyand, B.S., Client Services Specialist I

Additional Support Personnel in this Group: 1

e. Equipment Maintenance & GC/MS Group

Timothy Oostdyk, B.A., Manager I

(1) Equipment Maintenance

Tim Arms, Instrument Administrator III
Fred Tolan, Instrument Specialist I

(2) Semivolatiles

Jon Kauffman, Ph.D., Group Leader I

Derek Berger, B.S., Chemist I
Phillip Esbenshade, Ph.D., Chemist I
Sharon Foight, B.S., Associate Chemist
Pamela Gulden, B.S., Associate Chemist
Joseph Hill, B.S., Chemist II
John Layman, B.A., Chemist I
George Main, B.S. Associate Chemist
Mark Ratcliff, B.A. Associate Chemist
James Rittenhouse, Ph.D., Chemist I
Brad Roadcap, B.S., Associate Chemist
Gerard Shero, B.S. Associate Chemist
Rick Shober, B.S., Chemist I
Andrew Strebel, Technical Specialist I
Lynn Wallace, B.S., Chemist I
Thomas Willig, B.S., Associate Chemist
Patricia Yatison, B.S., Associate Chemist

Additional Support Personnel in this Group: 11

(3) Volatiles

Robin Eaton, M.S., Group Leader I
Michele McClarin, B.A., Group Leader I

Charles Bourque, B.A., Chemist IV
Paul Cormier, B.S., Chemist II
Robin Couser, B.S., Associate Chemist
Susan Croyle, B.S., Chemist I
Kristen Curran, B.S., Associate Chemist
Mark Herrmann, B.S., Associate Chemist
Kathy Holley, B.S., Chemist I
Catherine Holt, B.S., Computer Specialist III
David Hoppman, Technical Specialist I
Duane Luckenbill, B.S., Associate Chemist

Robert Mellinger, B.S., Chemist I
John Morton, M.S., Chemist III
Tracey Neff, B.S., Data Package Administrator III
Melanie Rittenhouse, Ph.D., Chemist II
Richard Robino, B.A., Associate Chemist
Richard Rodgers, B.S., Chemist IV/Coordinator
Drew Shedwick, B.S., Associate Chemist
Robert Tapper, B.S., Associate Chemist
Lawrence Taylor, B.S., Associate Chemist
Barbara B. Weaver, B.S., Associate Chemist
Kevin Witman, B.S., Associate Chemist
Christiaan Wubbolt, Chemist I

Additional Support Personnel in this Group: 2

e. ExpressLAB/Water Quality

Arthur Pezzica, B.A., Manager I

(1) ExpressLAB

Delwyn Schumacher, B.S., Group Leader I

Matthew Barton, B.S., Associate Chemist
Mark Clark, B.S., Chemist II
Joseph Davis, Associate Chemist/Coordinator
Valerie St. Clair, B.S., Chemist I
Livonia Smith, B.S., Chemist I
Nancy Wagner, B.S., Associate Chemist
Elizabeth White, Client Services Specialist IV/Coordinator

Additional Support Personnel in this Group: 9

(2) Water Quality

Bethany Ebling, B.S., Group Leader I

Eric Eby, Senior Sampling Administrator III
Erik Frederiksen, B.S., Associate Chemist/Coordinator
Sherry Gittleman, Associate Chemist
Kendra Hartman, B.A., Associate Chemist/Coordinator
Robert Heisey, B.A., Chemist II/Coordinator
Terry Schuck, B.S., Chemist II/Coordinator

Additional Support Personnel in this Group: 16

f. Inorganic Analysis Group

Daniel Gerth, M.S., Manager I

(1) AAS Metals

Debora Gifford, B.S., Group Leader I

Eugene Abel, B.S., Chemist II/Coordinator

William Dahl, B.S., Associate Chemist

Kelly Jo Gamble, B.S., Associate Chemist

Michael Hintenach, B.S., Computer Systems Integration Specialist II

Beatrice Joseph, B.S., Chemist I

James Kushubar, Chemist I

Betsy Menefee, B.S., Chemist II/Coordinator

Craig O'Neil, B.S., Associate Chemist

Matthew Thomas, B.S., Associate Chemist

Timothy Trees, A.A.S., Chemist V/Coordinator

Additional Support Personnel in this Group: 13

(2) ICP Metals

Ramona Layman, B.S., Group Leader I

Eric Cuba, B.S., Chemist II/Coordinator

Jane Follweiler, B.S., Chemist V/Coordinator

Leah Ann Garbay, B.S., Associate Chemist

Mary Kendall, B.A., Data Validation Chemist I

Donna Sackett, Associate Chemist

Max Snavely, B.S., Chemist II

Additional Support Personnel in this Group: 5

(3) Instrumental Water Quality

Ramona Layman, B.S., Group Leader I

Myra Fink, Technical Associate

David Evans, B.S., Chemist V/Coordinator

Samuel Huber, B.S., Chemist V/Coordinator

Barry Townsend, Chemist I

Additional Support Personnel in this Group: 17

g. Marketing/Sales

Richard Burke, M.S., Assistant Division Director

Patricia Downing, B.S., Marketing Specialist III

Richard Entz, B.A., Senior Technical Specialist

Rick Griffith, Marketing Specialist II

Robert Large, B.S., Marketing Specialist IV

Julie O'Donnell, B.A., Marketing Specialist III

Additional Support Personnel in this Group: 1

h. Organic Analysis by GC & Organic Analysis Group

Judy Colello, A.S., Group Leader I

(1) Organic Analysis by GC

Karen Baney, B.S., Chemist I

Adam Hostetler, B.S., Associate Chemist

Scott Montague, B.S., Associate Chemist

Denise Null, B.S., Associate Chemist

Luke Peterschmidt, B.S., Associate Chemist

Jeff Schlegelmilch, B.S., Chemist I

Robert Stauffer, B.S., Integration Systems Specialist II

Christiane Sweigart, B.S., Chemist I

Tina Thoman, B.S., Associate Chemist

Dennis Urban, M.S., Chemist IV

David Wright, B.S., Chemist I

Melissa Yanchuck, B.S., Technical Specialist V/Coordinator

Stephen Zeiner, B.S., Chemist I

Additional Support Personnel in this Group: 4

(2) Organic Analysis Group

Stephanie Brodhecker, B.S., Associate Chemist

Mary Lou Eckels, B.A., Chemist I

Susan Kreider, Associate Chemist

Additional Support Personnel in this Group: 2

2. Food & Pharmaceutical Sciences

a. Food Sciences

Philip Oles, Ph.D., Manager II

(1) Food Chemistry

Sandy Bailey, B.S., Group Leader I, Nutritional Labelling
Gloria Gates, B.S., Group Leader I, Project Work

Gordon Beitzel, B.S., Systems Specialist II
Jean Brown, Technical Associate
Trudi Hensley, B.A., Chemist I
Deb Marcuson, B.A., Associate Chemist/Coordinator
Sharon McHenry, B.S., Associate Chemist
Victoria Pillion, B.S., Chemist I
Jeanine Schreiber, Technical Associate
Darla Schumacher, Technical Associate/Coordinator
David Schumacher, B.S., Senior Chemist
Tammy Showers, B.S., Chemist I/Coordinator
Arlene Silcox, B.A., Chemist I
Tami Spanitz, B.S., Associate Chemist
Jon Wenger, B.S., Associate Chemist
Jon Wright, B.S., Chemist II/Coordinator

Additional Support Personnel in this Group: 15

(2) Food Microbiology

James W. Wempe, M.S., Group Leader II

C. Robert Graham, B.S., Senior Microbiologist

Additional Support Personnel in this Group: 10

b. Pharmaceutical Sciences

Wesley Neumann, M.S., Manager I

(1) Pharmaceutical & Environmental Microbiology

Mark Kaiser, Group Leader III

Harolyn Clow, B.S., Microbiologist II
Earl Custer, B.S., Microbiologist III/Coordinator
Suzanne Gebhart, B.S., Associate Microbiologist
Mike Yunginger, B.S., Microbiologist IV/Coordinator

Additional Support Personnel in this Group: 9

(2) Pharmaceutical Chemistry

Brian Clow, B.S., Chemist I
Mark Heinbaugh, B.A., Chemist III, Coordinator
Cynthia Murphy, B.S., Chemist I
Jan Parker, B.A., Chemist III
Stacia Pfautz, A.A.S., Technical Associate
Joan Rebert, B.S., Associate Chemist
Tony San Martin, A.S., Chemist IV

Additional Support Personnel in this Group: 7

C. SUPPORT SERVICES

1. Administration

Carol Miller, M.B.A., Executive Vice President/Director/Corporate Secretary

Bonnie Lee, M.S., Corporate Projects Specialist II

Barbara J. Weaver, CIH, Corporate Technical Projects Specialist III

a. Human Resources

Laima Carlisle, Recruiting Specialist I

Beth DiPaolo, Training & Recruiting Coordinator II

Carol Marsh, B.S., Training Specialist II

Janice Mehnert, B.A., Employee Development Specialist I

Mary Munster, B.S., Safety Specialist I

Margaret Stoltzfus, Benefits & Safety Coordinator III

Additional Support Personnel in this Group: 3

b. Office Services/Billing & Reporting

Lorraine Heagy, Group Leader I, Office Support Services

Nancy Crouse, Office Services Coordinator II

Janet Hess, Billing & Reporting Administrator III, Coordinator

Sandra Weekes, B.S., Legal Specialist I

Additional Support Personnel in this Group: 12

c. Public Relations

Nancy Payne, B.S., Manager I

Lisa Bamford, B.S., Public Relations Specialist I

Lisa Shields, A.A., Public Relations Specialist I

Additional Support Personnel in this Group: 1

2. Corporate Marketing

George Mummert, M.Admin., Manager I

3. Finance & Data Processing

Kenneth Hess, B.S., Executive Vice President/Director/Corporate Treasurer

a. Accounting/Purchasing

Thomas Wolgemuth, M.B.A., Group Leader I, Accounting

Thomas Dull, A.A.S., Purchasing Administrator II

Marjorie Hollinger, Accounting Administrator III

Charles Kurtz, Purchasing Specialist I/Coordinator

Additional Support Personnel in this Group: 1

b. Computer Services

David Hooley, Ph.D., Group Leader II, Computer Services

Eugene Bowman, Computer Specialist III

David Jacobson, B.S., Computer Specialist II

Donna Kauffman, B.S., Computer Specialist II

David Leedom, B.S., Computer Specialist I

G. Scott Martin, A.A.S., Operations Specialist III

Deborah Stoltzfus, A.A.S., Computer Specialist II

Tom Wise, B.S., Computer Specialist II

Ed Zeigler, A.A., Computer Specialist II

Additional Support Personnel in this Group: 1

4. Maintenance & Security

Jay Fitze, Group Leader I

Jerry Clipper, Plant Engineer
Barry Gehman, Coordinator
Melvin Martin, 2nd Shift Coordinator
Harold Milton, Security Coordinator

Additional Support Personnel in this Group: 18

5. Sample Administration/Sample Support/Transportation

Richard Miller, B.A., Manager I

a. Sample Administration

Anneliese Hutchison, B.S., Group Leader I

(1) Environmental Sciences

Marianne Bragg, B.S., Specialist II
Deb Nace, Sample Administration Specialist II
Donald Nazario, B.S., Sample Administration Specialist I

(2) Food Sciences

Lynn Carruthers, B.S., Sample Administration Specialist I

Additional Support Personnel in this Group: 17

b. Sample Support

Cynthia Smith, B.S., Group Leader I

Brad Ayars, Sample Support Coordinator I

Additional Support Personnel in this Group: 8

c. Transportation

Steve Davies, B.S., Administrator III

Additional Support Personnel in this Group: 12

Earl H. Hess, Ph.D.
Chairman of the Board / CEO

Anne V. Osborn, M.A.
Assistant to President
Government Relations
LU Foundation

Carol D. Miller, M.B.A.
Executive V.P.
H.R. / Administration, Secretary

Kenneth E. Hess, B.S.
Executive V.P.
Finance / Data Processing, Treasurer

J. Wilson Hershey, Ph.D.
Executive V.P.
Laboratory Operations

Human Resources

Accounting

Environmental

Maintenance

Computer Services

Foods

Office Services /
Billing and Reporting

Corporate Marketing

Pharmaceuticals

Public Relations

Quality Assurance

Sales / Client Services

Sample Administration /
Sample Support /
Transportation

13

J. Wilson Hershey, Ph.D.
Executive Vice President
Laboratory Operations

**DATA PACKAGE & AIR
QUALITY**
Martha Casstevens, B.S.
Manager I

DATA PACKAGE
Mary Ann Brubaker
Group Leader I

GC/MS
Timothy Oostdyk, B.A.
Manager I

GC/MS Volatiles
Robin Eaton, M.S.
Group Leader I

GC/MS Volatiles
Michele McClarin, B.A.
Group Leader I

GC/MS Semivolatiles
Jon Kauffman, Ph.D.
Group Leader I

INORGANICS
Daniel Gerth, M.S.
Manager I

AAS METALS
Debora Gifford, B.S.
Group Leader I

**INSTRUMENTAL WATER
QUALITY/ICP METALS**
Ramona Layman, B.S.
Group Leader I

WATER QUALITY/EXPRESSLAB
Arthur Pezzica, B.S.
Manager I

WATER QUALITY
Bethany Ebling, B.S.
Group Leader I

EXPRESSLAB
Delwyn Schumacher, B.S.
Group Leader I

**PESTICIDE RESIDUE
ANALYSIS/APPLIED R&D**
Nelson Risser, B.A.
Manager I

**ORGANIC ANALYSIS BY GC &
ORGANIC ANALYSIS GROUP**
Judy Colello, A.S.
Group Leader I

J. Wilson Hershey, Ph.D.
Executive Vice President
Laboratory Operations

PHARMACEUTICALS
Wes Neumann, M.S.
Manager I

FOODS GROUP
Phillip Oles, Ph.D.
Manager II

PHARMACEUTICAL AND ENVIRONMENTAL MICROBIOLOGY
Mark Kaiser
Group Leader III

FOOD MICROBIOLOGY
James Wempe, M.S.
Group Leader II

FOOD SCIENCES
Sandy Bailey, B.S.
Group Leader I

FOOD SCIENCES
Gloria Gates, B.S.
Group Leader I

51

J. Wilson Hershey, Ph.D.
Executive Vice President
Laboratory Operations

SALES & CLIENT SERVICES
Richard Burke, M.S.
Director

**SAMPLE ADMINISTRATION/
SAMPLE SUPPORT/TRANSPORTATION**
Rick Miller, B.A.
Manager I

QUALITY ASSURANCE
M. Louise Hess, B.S.
Director

CLIENT SERVICES
Susan Page, B.A.
Group Leader I

SAMPLE ADMINISTRATION
Anneliese Hutchison, B.S.
Group Leader I

SAMPLE SUPPORT
Cynthia Smith, B.S.
Group Leader I

TRANSPORTATION
Steve Davies, B.S.
Administrator III

Kenneth E. Hess, B.S.
Executive Vice President
Finance/Data Processing

**ACCOUNTING/PURCHASING/
SHIPPING & RECEIVING**
Thomas Wolgemuth, M.B.A.
Group Leader I

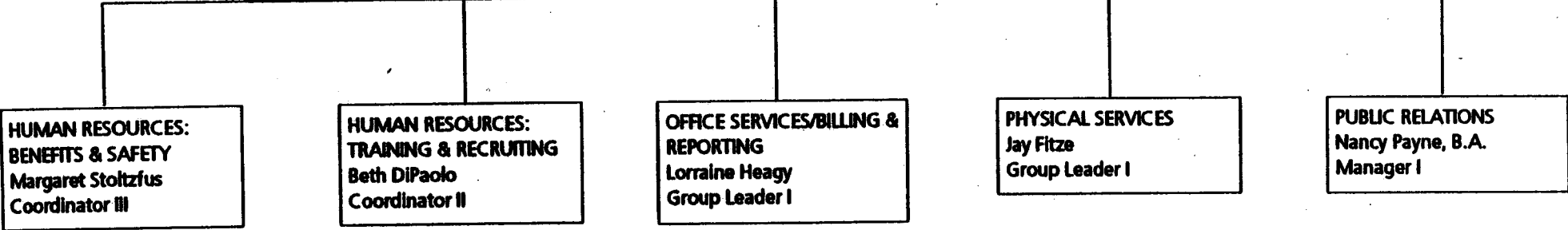
COMPUTER SERVICES
David Hooley, Ph.D.
Group Leader II

CORPORATE MARKETING
George Mummert, M.Admin.
Manager I

Carol D. Miller, M.B.A.
Executive Vice President
Human Resources/Administration

Barbara Weaver, CIH, B.S.
Technical Projects
Specialist III

Bonnie Lee, M.S.
Corporate Projects
Specialist II



**SECTION 3
PHYSICAL FACILITIES AND INSTRUMENTATION**

A. BUILDINGS

The physical facility is located on a four-acre lot on Pennsylvania Route 23 (2425 New Holland Pike) about five miles northeast of the City of Lancaster, PA. In addition to a major building complex, there are three auxiliary buildings housing a general maintenance shop, auto maintenance, and storage areas; solvent storage sheds located at some distance from the other buildings; and waste storage facilities.

The main building complex has a total area of 100,000 square feet including laboratories, offices, refrigerated and room-temperature sample storage areas, library, data processing center, employees' lunch room, conference rooms, and garage area. A class 100 clean room with a class 1000 gowning suite was added in 1990. The facility has undergone nine expansions to accommodate our growing staff.

The air-handling system for the main laboratory is specially designed to protect sensitive instruments from harmful vapors and to ensure that samples are not contaminated. In addition, sample preparations and instrumental analyses are performed in separate rooms.

The building is protected by a sophisticated security and fire alarm system. All outside doors, except the main entrance, are kept locked at all times to prevent unauthorized entry. Employees are issued cards which allow them to enter the building, and the main entrance is monitored by an attendant who registers visitors during normal business hours. During weekends and second and third shift operations, all doors are locked and personnel assigned to security are on duty to prevent unauthorized entry into the laboratory and to accept packages.

B. INSTRUMENTATION

<u>Instrument</u>	<u># of Units</u>	<u>Manufacturer/Model #</u>
<u>Gas Chromatography:</u>		
Gas Chromatograph/ Mass Spectrometers (GC/MS) (With: electron impact or chemical ionization, oscilloscope tuning, purge and trap concentrators, and 9-track tape drive)	2	Finnigan OWA 1020 with 1050 software upgrade
GC/MS (With: electron impact ionization and purge and trap concentrator)	1	Finnigan INCOS 50
GC/MS* (With: RTE-6VM or RTE-A operating system on HP-1000 computer, 9-track magnetic tape drive, and 7 with purge and trap concentrator)	16	Hewlett-Packard 5970B
GC/MS* (With: electron impact and PC MS/DOS based data system)	1	Hewlett-Packard 5971
Gas Chromatograph*+	11	Varian 3700
Gas Chromatograph*+	2	Varian 6000
Gas Chromatograph*+	15	Hewlett-Packard 5890
Gas Chromatograph+	7	Tracor 540
Gas Chromatograph*+	1	Shimadzu 15A
Gas Chromatograph*+	4	Varian 3400
Gas Chromatograph*+	2	Tracor 9000

<u>Instrument</u>	<u># of Units</u>	<u>Manufacturer/Model #</u>
<u>Auxiliary Equipment for Gas Chromatographs:</u>		
Automated Concentrator	1	Entech M 2000
Purge and Trap	22	Tekmar Various Models
Purge and Trap	1	O.I. Corp.
Headspace Sampler	1	Hewlett-Packard 19395A
Headspace Sampler	1	Dani 3950
Thermal Desorber for Tenax Tubes	1	Tekmar 5010

Detectors available for GC: Electron Capture, Flame Ionization, Photoionization, Hall Electrolytic Conductivity, Nitrogen/Phosphorus, Thermal Conductivity, and Flame Photometric

All of the chromatographs are attached to electronic integration systems. The largest system employed is an HP1000 computer with LAS software.

High Performance Liquid Chromatography:

High Performance Liquid Chromatograph*+	14	Shimadzu LC-6A or 6B
High Performance Liquid Chromatograph*+	1	Hewlett-Packard 1090
High Performance Liquid Chromatograph*	1	Shimadzu LC-600
High Performance Liquid Chromatograph*+	2	Hewlett-Packard 1050

Auxiliary Equipment for High Performance Liquid Chromatography:

Post Column Derivatization Unit	1	Kratos PCR 520 SF-980, SF-400
Post Column Reaction Unit	1	Pickering EC-500

Detectors available for HPLC: Diode Array Spectrophotometer, Refractive Index, Ultraviolet, and Fluorescence

<u>Instrument</u>	<u># of Units</u>	<u>Manufacturer/Model #</u>
<u>Gel Permeation Chromatography:</u>		
Gel Permeation Chromatograph	1	ABC Lab 601
Gel Permeation Chromatograph	1	ABC Lab 1002A
Gel Permeation Chromatograph	1	ABC Lab 1000
<u>Atomic Absorption/Emission Spectrophotometry:</u>		
Inductively Coupled Argon Plasma Spectrometer*+	1	Thermo Jarrell-Ash ICAP 61
Inductively Coupled Argon Plasma Spectrometer*+	1	Thermo Jarrell-Ash 1100
Atomic Absorption Spectrophotometer*	1	Perkin-Elmer 5000
Atomic Absorption Spectrophotometer	4	Varian 20
Atomic Absorption Spectrophotometer*	1	Varian SpectrAA10
Atomic Absorption Spectrophotometer+	3	Varian SpectrAA400 Zeeman
Atomic Absorption Spectrophotometer*	1	Perkin-Elmer 5100
Mercury Analyzer	1	Spectro Products Hg4
Graphite Furnace*	3	Varian GTA-96
Graphite Furnace*	1	Hitachi Z-9000
<u>Molecular Absorption/Emission Spectrophotometry:</u>		
Fourier Transform Infrared Spectrophotometer	1	Perkin-Elmer 1610
Fourier Transform Infrared Spectrophotometer	1	Perkin-Elmer 1620
Scanning UV/Visible Spectrophotometer	1	Bausch & Lomb Spectronic 2000
Diode Array UV/VIS Spectrophotometer	1	HP 8452
Scanning UV/Visible Spectrophotometer	1	Perkin-Elmer Lambda 3B

<u>Instrument</u>	<u># of Units</u>	<u>Manufacturer/Model #</u>
Scanning UV/Visible Spectrophotometer	1	Shimadzu UV160U
Visible Spectrophotometer	1	Hach DR2000
Scanning UV/Visible Spectrophotometer	1	Milton Roy 2001
Visible Spectrophotometer	2	Turner Instruments 330
Nephelometer	1	Monitek 21
Fluorometer	1	Turner Instruments 110
Spectrofluorophotometer*+	1	Shimadzu RF540
UV/Visible Spectrophotometer	1	Beckman - DB

Microscopes:

Petrographic Microscope with Phase Contrast, Polarized Light, and Photomicrographic Capability	1	Olympus BHTP BH2
Petrographic Microscope with Phase Contrast, Polarized Light, and Photomicrographic Capability	1	Olympus BHSP BH2
Phase Contrast Microscope	3	Olympus CH
Phase Contrast Microscope	1	Olympus BHTP BH2
Polarizing and Phase Contrast Microscope	1	American Optical 1135
Stereo Microscope	2	American Optical 570
Stereo Microscope with Fluorescent Antibody Attachment	1	American Optical 2071
Stereo Microscope	1	American Optical Spencer

<u>Instrument</u>	<u># of Units</u>	<u>Manufacturer/Model #</u>
<u>Miscellaneous Instrumentation:</u>		
Gas Sorption Analyzer	1	Coulter 360CX
Supercritical Fluid Extractor	1	Suprex SFE/50
Ion Chromatograph*+	1	Dionex 2010
Ion Chromatograph*+	1	Dionex DX-100
Total Organic Carbon Analyzer*	2	O.I. Corp. 700
Total Organic Halogen Analyzer	2	Mitsubishi TOX-10
Autoanalyzer*	2	Technicon AA-2
Autoanalyzer*+	3	Scientific Instrument AP-100, AS-140, AC-100, AF-100
Titration	1	Orion 960
Viscosimeter	1	Brookfield LVT
Viscosimeter	1	Brookfield DV-II
Refractometer	1	Bausch & Lomb
Closed Cup Flashpoint Apparatus, Pensky-Martin	1	Fisher Scientific TA6
High Purity Solvent Recycling System	2	B/R Instrument 8600
Bomb Calorimeter	1	Parr 1241
Ultrasonic Flowmeter	1	ISCO 3210
Submersible Pump (Upgraded for 300 foot depth)	1	Hajoca Corp. P050-2W
Flow Proportional Composite Water Sampler	5	ISCO 1580

<u>Instrument</u>	<u># of Units</u>	<u>Manufacturer/Model #</u>
Flow Proportional Composite Water Sampler	1	ISCO 1680
Flow Proportional Composite Water Sampler	2	ISCO 2710
Sterility Tester	1	Millipore Steri-test
Particle Counter	1	Coulter 320
Slit to Agar Biological Sampler	1	New Brunswick Scientific STA-203
Antibiotic Zone Reader	2	Fisher Scientific 126
Airborne Particulate Monitor	1	Met One, Inc. 206L
Digistrip	1	Kaye 3
Freeze Dryer	1	Virtis B3
Wellcutter for Antibiotic Assay	1	Purdue
Microwave Digester	1	Prolabo 8300
Fibertec E with Bath	1	Tecator 1023, 1024
Fibertec	1	Tecator TC-1020
Soxtec	1	Tecator 1043
Nitrogen Determinator	1	Leco FP-248
Zero Headspace Extractor	45	Various Models
Oxygen and Combustible Gas Meter	1	Bacharach Sniffer 202
Sound Level Meter	1	DuPont SCM-1
Hot Wire Anemometer	1	Datametrics 800VTP-2
Velometer	1	Alnor Series 6000
Oxygen Analyzer	1	Biomarine
Personal Sampling Pump	28	Various

<u>Instrument</u>	<u># of Units</u>	<u>Manufacturer/Model #</u>
High Volume Air Sampling Pump	20	Micro Trap, Inc. Micro-max I
Fibrous Aerosol Monitor	1	GCA FAM-1
Air Quality Monitor	1	Metrosonics AQ-501
MicroTIP	1	Photovac MP-100
Air Flow Calibration Device	1	Gilian Gillibrator
Negative Air Filtration Unit	1	Industrial Products AT 1000
Dissolution System (6 Spindle)	2	Van-Kel 600
Dissolution System (6 Spindle)	3	Hanson QC72RB
Disintegration Apparatus	1	Van-Kel 1113
Automatic Titrator	1	Mettler DL25K
Karl Fischer Titrator	1	Brinkman 701
Hardness Test Apparatus	1	Vector 2E
Friabilator/Counter	1	Van-Kel 10809
Thermometer Calibration System	1	Ertco TCS 100
Polarimeter	1	Perkin-Elmer 241
Laser Barcode Scanner	1	Intermec 12-MI620A

* Indicates autosampler capability

+ Indicates peripheral data handling equipment

The previous list shows our major instrumentation or instruments which demonstrate specific capabilities. In addition, we have numerous minor instruments (e.g., pH meters and analytical balances), and support equipment (e.g., ovens, centrifuges, incubators, autoclaves, muffle furnaces, stability chambers, etc.). We also have walk-in refrigerators for sample storage and a reverse osmosis, deionized water system, which is U.V. sterilized and continuously circulating to all laboratories. A 75 KVA electric generator is available on a standby basis to supply electrical power to selected areas of the laboratory in case of a power outage. To reduce spikes and spurious line voltage changes to instruments which can affect results or damage electronic equipment, "conditioned power" is fed to all sensitive instruments (e.g., GCs, HPLCs, GC/MSs). All essential computer hardware is on "uninterruptable power", a battery system, which provides continuous conditioned power in the event of a short power outage and is also backed up by an emergency generator.

An automated storage and retrieval system is housed in the largest walk-in refrigerator. The system combines robotic cranes, carousels, computers, and bar codes to allow samples to be tracked, stored, and retrieved efficiently without entering the refrigerated area.

C. COMPUTER EQUIPMENT

Our laboratories make extensive use of computers for business applications, technical operations (e.g., our sample management system), and QA program (see section on Quality Assurance). The following is a list of the major components of our computer system.

WANG VS 7310 Super Mini Computer System

- 40 MB Ram
- 140 Connected Terminals
- 4.0 GB On Line Disk
- 6250 Bit/Inch Tape Drive
- 10 Printers including two 26-Pages/Minute Lasers

WANG VS 65 Super Mini Computer System

- 2 MB Ram
- 400 MB of Disk

WANG VS 5000 Super Mini Computer System (for testing programs)

- 8 MB Ram
- 1.06 GB Disk

WANGNET Broadband Local Area Network

Ethernet 802.3 Network

MITEL SX 1002 Voice/Data PBX

- 80 Data ports in use

15 386 Network File Servers

100 386 SX Personal Computers

100 286 Personal Computers

30 IBM XT Compatible

10 KVA 3 Phase Uninterrupted Power System

- Dedicated to Computer Systems only

D. VEHICLE FLEET

Sample pick-up service is offered to all clients within reasonable driving distance of our laboratory. We currently offer this service to clients in the Lancaster, Harrisburg, York, Philadelphia, Reading, Allentown/Bethlehem/Easton, Pennsylvania areas; Baltimore, Maryland; New Castle County, Delaware; and Central and Northern New Jersey. We maintain a fleet of vehicles for sample pick-up service, field operations in industrial hygiene at clients' plants and other locations, wastewater sampling, and general use by our professional staff. Most of these vehicles are equipped for communication between mobile personnel and the main office. Our drivers are trained in proper sample handling and custody procedures, so that sample integrity is maintained during transport.

SECTION 4 QUALITY ASSURANCE PROGRAM

The major function of an independent laboratory in today's society is to generate technical information. In our case, the information consists of the results of chemical and microbiological analyses, along with whatever auxiliary information is necessary for proper interpretation, and research reports.

Our clients use this information for a variety of purposes. It may be used to demonstrate compliance with a government regulation; to evaluate a raw material for a manufacturer or food processor; to demonstrate value or quality of a finished product, as in nutritional analyses; to establish the basis for a patent; or to decide a legal dispute. This information has a high and intrinsic value over and above the cost of providing it to a client. Since this information is important to our clients, it is necessary to produce it under a program which will assure that it has the necessary "quality," i.e., that it has a degree of accuracy commensurate with its intended use. This section of the manual will describe the Quality Assurance Program under which we operate. Details relating to specific types of technical operations will be found in the sections dealing with the various technical groups.

A. OBJECTIVES OF THE QUALITY ASSURANCE PROGRAM

The objectives of our Quality Assurance Program, as directed by Corporate Management are:

- To establish quality control procedures which will ensure that data generated in the laboratory are within acceptable limits of precision and accuracy.
- To establish procedures to document that these quality control measures are, in fact, being carried out.
- To establish procedures to ensure the "accountability" of the data, i.e., that the results reported do apply to the sample as submitted.
- To establish procedures to ensure that any result reported to a client is traceable to:
 - The date the analysis was run
 - The analyst who performed the test
 - The raw data generated during the performance of the test
 - The condition of any instrument or equipment at the time it was used in the test
 - The status of the quality control system at the time of the test
- To establish procedures which minimize the possibility of loss, damage, or tampering with the data.

The administration of our Quality Assurance Program is the responsibility of the Quality Assurance Director in cooperation with all levels of management. The Quality Assurance Director reports directly to the Technical Director, thus ensuring that corrective actions can be taken immediately for any quality problems. The Quality Assurance Director does not have any direct supervisory responsibility for the generation of technical data to avoid any "conflict of interest" which could interfere with the Quality Assurance Program.

The formal structure of our Quality Assurance Program is described in a set of Standard Operating Procedures (SOPs). Copies of these SOPs are given to each Group Leader and they are available to all laboratory personnel. The following is a list of our current Quality Assurance (QA) SOPs, with a brief description of each:

QA-101 Sample Collection - In order for meaningful analytical data to be produced, the samples must be representative of the system from which they are drawn. Our samplers are trained and use written sampling procedures. Sample containers are chosen according to the analyses to be performed and are labeled to fully identify each sample. Where necessary, chemical preservatives and temperature adjusted storage during transport to the laboratory are employed.

QA-102 Sample Log-in - To ensure accountability of results, each sample is assigned a unique sample identification number as soon as possible after its receipt at the laboratory. Information corresponding to sample identity is logged with this sample number.

QA-103 Sample Storage and Disposal - Because sample integrity can be compromised by improper storage, samples are maintained in various locations to prevent deterioration. Locations are assigned in refrigerators, freezers, and at room temperature to assure that the chemical, physical, and biological properties of samples do not change prior to analysis. Sample locations are tracked by computer to prevent loss. After results are reported to clients, samples may be held for a period of time in case additional testing is required. Samples are then disposed of or returned to the client.

QA-104 Chain-of-Custody Documentation - Samples being tested for litigation or regulatory purposes may require locked storage and documentation of the laboratory personnel who used the sample as well as the times during which the sample was removed from locked storage. Chain-of-custody documentation minimizes the possibility of tampering with the samples, and is available upon request.

QA-105 Analytical Methods Manual - The method manuals, which are comprised of clear, complete written instructions for performing each standard test, are the basis for our analytical testing program. In addition to the actual procedure, each method includes safety and quality control information. Every standard method is assigned a unique identification number to ensure traceability. Copies of the methods are readily available to analysts in the lab.

QA-106 Validation and Authorization of Analytical Methods - Although our routine testing procedures are based on official or standard methods whenever possible, laboratory personnel must verify that acceptable precision and accuracy are obtainable before management will approve the use of any method. Validation studies may include the use of standard reference materials, fortified samples, or replicate analyses.

QA-107 Analytical Methods for Non-standard Analyses - Frequently, clients request analyses which are not regularly performed in our laboratory although we have the technical capabilities to do so. In these instances, methods may be supplied by the client, dictated by regulations, derived from scientific literature, or developed in the laboratory. In any case, special procedures must be followed to ensure that the method used is thoroughly documented. In addition, records of validation or quality control samples performed are maintained.

QA-108 Subcontracting - For the convenience of our clients, some analyses which we do not perform may be subcontracted to other laboratories. These laboratories must submit evidence of their qualifications to us. Wherever possible, laboratories certified by appropriate agencies will be used. Results produced by subcontracted laboratories will always be designated as such on our laboratory reports.

QA-109 Laboratory Notebooks and Documentation - All data which is manually acquired in the laboratory is entered into bound notebooks. Distribution of notebooks to personnel is controlled, with a master file kept of the recipient of the notebook, date issued, date returned, and place of storage of completed notebooks. Personnel are instructed in the proper method of data entry. All entries are made in ink, dated, and signed. Blank pages or substantial portions of pages are cancelled out. Periodic review and signing of notebooks by supervisors is also required. Requirements for documentation of computer generated data are also listed in this SOP.

QA-110 Reagents - Chemical and reagent quality will have a significant impact on our analytical results. Procedures for receiving, preparing, documenting, and storing reagents have been set forth to ensure that only supplies of adequate quality are used in our testing. Each analytical method contains specifications for the required materials.

QA-111 Instrument and Equipment Calibration - All instruments and other equipment are calibrated on a regular basis in accordance with written procedures, with frequency of calibration dependent on the type of instrument and its frequency of use. Acceptable limits of accuracy are also described in the procedures.

QA-112 Instrument and Equipment Maintenance - All maintenance work done on instruments and equipment is recorded in bound notebooks, with separate notebooks kept for each instrument. Routine, preventive maintenance is performed according to written procedures.

QA-113 Data Entry and Verification - In order to minimize errors, data reduction and transcription is computerized wherever possible. Analysts responsible for the generation of data also have the responsibility to log their results into the computer for reporting to clients. Results are then reviewed by a supervisor or the supervisor's designee before reporting to clients.

QA-114 Data Storage and Security - The data generated in our laboratories is a valuable commodity, purchased by our clients. In order to provide traceability, data is stored in an orderly fashion under controlled access so that loss, deterioration, or tampering is prevented. Copies of reports and all supporting raw data will be maintained for ten years.

QA-115 Quality Control Records - The term "quality control" is used to denote those laboratory procedures whose purpose is to ensure that the analytical system is in control within established limits of accuracy and precision. Quality control procedures for each analysis are documented in the written method. Results of quality control analyses are subjected to statistical evaluation to detect trends and outliers. Documentation of quality control samples includes a monthly report of the actual results obtained and the established acceptance limits.

QA-116 Investigation and Corrective Action - One of the most effective means for maintaining the production of high quality data is to respond immediately to indications of suspicious data or equipment malfunctions. Whenever results from quality control samples fall outside of established limits, the cause of the irregularity is investigated and corrected as soon as possible. Documentation of these activities is then used to prevent future occurrences of the problem.

QA-117 Personnel Training Records - Supervisors are required to maintain personnel training records of all personnel under their supervision. Training records for technicians indicate the date on which they were considered to be proficient in various laboratory techniques or in various analytical methods. Training records for professionals indicate special training or education received over and above their educational qualifications.

QA-118 Quality Assurance Audits - To ensure that laboratory personnel are adhering to the procedures set forth in our Quality Assurance Operations Manual, periodic checks of each group are made by the Quality Assurance Department. These audits may entail observation as procedures are carried out or a review of records to demonstrate traceability and compliance with all documented recordkeeping procedures. Reports of the findings of these audits are made to management.

QA-119 Proficiency Samples - The choice and frequency of quality control samples are specified in the analytical method and are often based upon the recommendations of regulatory agencies such as EPA. In addition, samples are obtained from various organizations that conduct collaborative studies or provide reference materials. Quality control samples are also submitted blind to analysts so that they may be analyzed without bias which may be introduced by known quality control samples.

QA-120 Documentation of Programming for the Sample Management System - The sample management system is used to perform calculations which convert raw data to the final result reported to our clients. Thus the computer code is part of the chain of documentation relating to each sample and must be recorded. All new or modified programming on this system is tested prior to use in the laboratory.

QA-121 Computer Validation - The design and development of software systems used to acquire and process data in the laboratories is a responsibility that is distributed among various groups within our laboratory. To maintain consistency of documentation and to ensure that all programs function correctly, guidelines for development, validation, and maintenance of quality computer software are provided. These guidelines are consistent with GLP requirements.

B. ACCOUNTABILITY OF RESULTS

The term "accountability" as applied to testing results refers to the procedures followed to assure that the data reported refers to the sample submitted. In other words, that there has been no sample mix-up and the sample has been properly handled in its transit through the laboratory to minimize changes in chemical composition or bacteriological quality.

At Lancaster Laboratories, Inc., we rely on our computerized Sample Management System to track and control movement of samples from the time of receipt until disposal. The system works as follows:

Samples are received at the laboratory in one of three ways: by personal delivery, by mail or common carrier, or by sample pick-up by laboratory personnel. All samples are received by personnel of the Sample Administration Group, who are responsible for sample log-in and tracking. The first step, after sample receipt, is entry into our Sample Management Program. All samples are logged into the computer along with pertinent information, e.g., the client's name, account number, client designation or description, and analyses requested. The computer assigns a unique number to the sample and requests information regarding necessary storage conditions, e.g., refrigeration, freezing, etc. The computer then assigns a storage location number which designates where the sample will be kept until analysis is begun and prints a label which is immediately attached to the sample container. The information contained on the label includes sample number, client designation, tests scheduled, and a bar code. The computer also assigns a storage time or disposal date which varies according to the nature of the sample or with specific instructions from the client.

The data base, which is thus automatically generated, is used in many ways. For example, each Group Leader receives a daily printout, which lists all samples and analyses waiting to be run in the laboratory. This is of inestimable value in planning and organizing the workload. The date of sample collection is also available through the computer to ensure that holding times are met, where applicable.

When a sample is to be analyzed, it is retrieved from the designated storage space by the analyst or by a member of the Sample Support Group if storage is in a controlled-access area. During analysis, raw data is recorded in ink in bound notebooks or on print-outs from instruments and then entered into the computer against sample number and analytical method number. Some instruments are connected directly to the Sample Management System, eliminating manual transcription. The computer performs many of the calculations to avoid a common source of error. When all analyses are completed and have been verified by a supervisor or designee, the computer generates a report. The client receives a copy of the face of the report containing the results of the analysis plus comments entered by the analyst where necessary. The back of the laboratory copy of the report contains the raw data plus the names of the analysts who made each entry. This copy is retained in our archives.

The following page is a copy of a simulated report. Note that opposite each reported result is a code number, which identifies the analytical method used. In addition, to avoid ambiguity in interpreting results, the reverse side of the client's copy of the report contains an explanation of all symbols and units used in reporting data. The report also contains the name of the person who reviewed the final report.

In the case of samples which are likely to be involved in litigation or a legal dispute, more stringent sample handling procedures are available upon request. Strict chain-of-custody procedures are followed. The delivery of the sample is documented, the sample is kept under locked storage, and photographs or videotapes may be used to document the condition of the sample or visual aspects of the test. After analysis, samples will be returned to the client or disposed of at his/her written request.



WLK1586 D 1 4

Smith Engineering, Inc.
1000 Any Street
Lancaster, PA 17601-5994
Water Sample from Monitoring Well #5
Collected on 12/8/90 at 1547 by MLH

LLI Sample No. WW 1335799

Date Reported 12/16/91
Date Submitted 12/08/91
Discard Date 01/16/92
Collected by MLH
P.O.
Rel.

ANALYSIS	RESULT AS RECEIVED	LIMIT OF QUANTITATION	LAB CODE
Total Coliform	< 2.2 /100ml	2.2	030301500
Nitrite Nitrogen	0.05 mg/l	0.02	021900800
Nitrate Nitrogen	11. mg/l	0.05	022000700
Ammonia Nitrogen	4.1 mg/l	0.1	022202600
Ortho-Phosphate as P	2.1 mg/l	0.05	022601100
Total Organic Carbon	8.5 mg/l	0.5	027302500
The Total Organic Carbon (TOC) result reported above was determined by measuring total carbon by a persulfate digestion/infrared detection method on an acidified sample which has been purged of inorganic carbon using nitrogen. It represents "nonpurgeable TOC."			
Pesticides/PCB's		attached	017819500
Lead	0.25 mg/l	0.05	025501200
Trichloroethene	12. ug/l	1.	041800500

1 COPY TO Smith Engineering, Inc. ATTN: John Smith

Questions? Contact Environmental
Client Services at (717) 656-2301
00649 10.00 2700

Respectfully Submitted
Lancaster Laboratories, Inc.
Reviewed and Approved by:

Bethany Ebling
Group Leader, Water Quality



Lancaster Laboratories, Inc.
2425 New Holland Pike
Lancaster, PA 17601-5994
717-656-2301



Explanation of Symbols and Abbreviations.

This section defines common symbols and abbreviations used in reporting technical data.

1. **DL** - The number following the sign is the limit of quantitation, the smallest amount of analyte reliably determined using this specific test.

2. **ND** - "Not Detected"

3. **Q** - "One detected"

4. **BL** - "Below Minimum Quantitation Level"

5. **NT** - "Too Numerous To Count"

6. **MPN** - "Most Probable Number". Used in reporting certain bacteriological results which are calculated from multiple data related to the bacterial count observed in a series of dilutions of the sample.

7. **U** - "Units". Used in reporting results on certain Vitamin assays.

8. **PCU** - "cobalt-chloroplatinate units". Used in reporting color of aqueous solutions.

9. **CMH** - "micromhos/cm". Used in reporting specific conductance of solutions.

10. **NTU** - "nephelometric turbidity units".

11. **F** - "Fibers greater than 5 microns in length, per ml".

12. **C** and **F** - degrees of temperature and refer to Celsius and Fahrenheit respectively.

13. **cal** - calories

14. **g** - grams

15. **mg** - milligrams. Abbreviation meaning 1/1000 of the equivalent weight of a substance

16. **gms** - grams. One gram is 1000 grams.

17. **kg** - kilograms. The unit weight used in the metric system. One gram equals about 1/30th of an ounce.

18. **µg** - micrograms. 1/1000 of a gram.

19. **cg** - centigrams. One-tenth of a gram.

20. **l** - liter. The volume used in the metric system.

21. **ml** - milliliter. 1/1000 of a liter.

22. **µl** - microliter. 1/1000 of a milliliter or one-millionth of a liter.

23. **ppm** - parts per million. Used as a concentration unit in all analyses.

24. **mg/kg** - milligrams per kilogram. Equivalent to one milligram per kilogram (mg/kg) or one gram per

thousand kilograms. This unit is usually taken to be equivalent to milligrams per liter (mg/l), because

one liter weighs very close to a kilogram. For gases or vapors, one ppm is equivalent to one

part per million of gas.

25. **µg/kg** - micrograms per kilogram. One µg is 1/1000 of a ppm and is equivalent to one microgram per kilogram.

26. **µg/l** - micrograms per liter. This unit is usually taken to be equivalent to micrograms per liter (µg/l).

27. **%** - percent or parts per hundred. This is usually followed by the designation "by weight" meaning grams per 100 grams. If followed by the designation "by volume" it refers to volume per unit volume, e.g. milliliters per 100 milliliters.

28. **DM** - means that results prior to under this heading have been adjusted for moisture content. The DM value concentration is a concentration that is present in a similar sample without moisture.

29. **As Analyzed** - means that results should be evaluated as they are. It is critical that a chemical or physical analysis of the sample, if the same analyzed is not representative of the sample, will be meaningless. If you have questions regarding the proper use of this heading, please do not hesitate to call. Lancaster Laboratories is held responsible for sample integrity, however, the customer is responsible for sample analysis.

30. **Accuracy** - In accepting analytical work, we warrant the accuracy of test results. We do not warrant any other warranties, express or implied, including a warranty of merchantability and warranty of workmanship. We accept no responsibility for the purpose for which the sample is used. The purchase order or other order for work shall be accepted by the company and shall constitute the entire agreement. Lancaster Laboratories performs work under the terms and conditions of our Standard Terms and Conditions. If Lancaster Laboratories performs work under a purchase order, our Standard Terms and Conditions are not part of the contract.

C. QUALITY CONTROL

1. Analysis of Blank, Spiked, Duplicate, Reference, and Control Samples

Each specific analytical method includes the particular quality control requirements performed to ensure that the data produced is of known quality. In addition to the necessary calibration standards, these quality control checks may consist of one or several different types of checks. Blanks, spikes, duplicates, reference materials, and control samples are employed, as appropriate for the analysis. The general criteria for the use of each of these types is outlined below.

Blanks are analyzed with most types of analyses to prevent reporting of false positives caused by factors in the laboratory system. Blanks are prepared and analyzed using the same reagents and equipment as the samples in the batch the blank represents. Acceptance criteria for blanks is based on the laboratory quantitation limit.

Spiked samples are samples fortified with a known amount of target analyte and subjected to the entire analytical procedure. The recovery of the method is calculated and indicates the appropriateness of the method for the matrix. Many of the gas chromatographic analyses in Environmental Sciences employ the special category of quality control samples known as matrix spike duplicates. This is the analysis of a pair of fortified samples from the same source. The use of matrix spike duplicates yields precision information as well as recovery. The acceptance criteria for percent recovery on spiked samples is based on EPA or other agency recommendation or past information generated in our laboratories.

Duplicate sample analysis is the analysis of the same sample twice in order to determine the precision of the analysis. The relative percent difference (RPD) between the two determinations is calculated and compared to values prescribed by EPA or determined by statistical analysis of past information generated in our laboratories.

Reference materials are samples which contain a known amount of target analyte. These are routinely analyzed to ensure accuracy of the analytical procedure. The reference materials may be from NIST or EPA, or they may be prepared in our own laboratories. Accuracy information determined from reference materials is valuable because variables specific to sample matrix are eliminated. The acceptance criteria for this type of quality control is either dictated by the agency from whom the material is obtained or by statistical analysis of past information generated in our laboratories.

Control samples are similar to reference materials except that the true value of the target analyte is not known with specific degrees of confidence. Acceptance criteria is developed by applying statistical techniques to repetitive determinations.

In addition, many of our chromatographic analyses employ surrogate and internal standards to evaluate analytical efficiency. The acceptance criteria for the recovery of these compounds is the same as that listed above for spiked samples.

The results of all quality control samples are entered into the computer in the same way as the results of client samples. The computer is programmed to compare the individual values with the acceptance limits and inform the analyst if the results of the quality control tests are in or out of specification. If the results are not within the acceptance criteria, corrective action suitable to the situation must be taken. This may include, but is not limited to, checking calculations, examining other quality control analyzed with the same batch of samples, qualifying results with a

comment stating the observed deviation, and reanalysis of the samples in the batch. Daily reports of quality control outliers are generated by the computerized system to keep management informed. The cause and solution to the problem is documented to prevent reoccurrence. In addition, computerized reports on the results for all quality control analyses including mean and standard deviation are generated monthly. These are used by the Quality Assurance Department to check for trends which may indicate method bias. Control charts are plotted via computer and may be accessed at any time by all analysts.

These programs have been found to be invaluable in monitoring our analytical procedures and detecting situations where a system was trending toward loss of control before the problem became serious enough to affect the integrity of the sample results.

2. Blind Samples

For many of the more common analyses performed in our laboratories, the Quality Assurance Department periodically submits blind samples to the laboratory using a pseudo-client name. These blind samples are similar to control samples, and results are reported directly to the Quality Assurance Department, for data evaluation. Summaries of the data are prepared periodically and reported to the Group Leaders and the Director of Laboratory Operations. The value of the blind sample system lies in the fact that the analysts are unaware that they are analyzing a quality control sample, thereby avoiding unconscious bias in performing the analysis.

3. Proficiency Sample Testing

Proficiency samples and check samples are samples submitted to the laboratory by an outside organization. The concentration of certain analytes is known to the outside organization but not to the laboratory. The laboratory is required to analyze the samples for the indicated analytes.

The proficiency sample testing programs are part of an accreditation process, and results of samples must be within limits defined as acceptable by the submitting organization, or the laboratory may lose its accreditation. In the case of check sample programs, participation is voluntary, and results are used to compare the laboratory's competence to other participating laboratories. The following is a list of proficiency testing and check sample programs in which Lancaster Laboratories, Inc. participates:

Organization	Sample Type	Analytes
U.S. Environmental Protection Agency	Potable water	Metals, organics, THMs, nitrate and fluoride, VOCs
U.S. Environmental Protection Agency	Wastewater	Various pollutants
National Institute for Standards & Technology (NVLAP)	Bulk building materials	Asbestos
American Industrial Hygiene Association	Filters and charcoal tubes	Metals, organics, and asbestos fibers

Organization**Sample Type****Analytes**U.S. Department
of Agriculture

Adipose tissue

Pesticides and PCBs

U.S. Department
of Agriculture

Meat (split samples)

Moisture, protein,
fat, and saltPA Department
of Agriculture

Dairy products

Bacterial contamination

American Association
of Feed Control
Operations

Animal feeds

Moisture, protein, fat,
fiber, ash, phosphorus,
calcium, and various
additives (nutritional and
veterinary drugs)

American Oil Chemists

Vegetable oils

Fatty acid profile

New York Department
of Health

Non-potable water

Various organic and
inorganic pollutantsAmerican Association of
Cereal Chemists

Cereal

Vitamins, minerals and
proximate, and micro-
biological contamination

SECTION 5 TECHNICAL OPERATIONS

A. OPERATIONAL PROCEDURES

1. Standard Testing

This category of work includes microbiological tests and chemical analyses using well-established methods, or methods which have been validated for the matrix being analyzed. Whenever possible, "official" or "standard" methods are used. "Official" methods are those required for compliance to government regulations, e.g., the methods mandated by the Environmental Protection Agency (EPA) for drinking water, wastewater, or solid waste or methods developed by the National Institute of Occupational Safety and Health (NIOSH) for industrial hygiene work. "Standard" methods are those established by standard-setting organizations, e.g., the American Society for Testing and Materials (ASTM), the Association of Official Analytical Chemists (AOAC), the American Oil Chemists Society (AOCS), or the United States Pharmacopeia (USP). These methods have been subjected to rigorous validation studies and interlaboratory collaborative testing, and are considered very reliable. Analysis summary sheets which list basic principles and method references for each standard test are available upon request. An example is given in Appendix B.

Occasionally a client will request that we test samples by a method furnished by the client, which is neither official nor standard. We will comply with the client's request with the provision that we cannot guarantee accuracy or reproducibility of results unless a validation study is authorized. In other cases, we develop our own in-house methods of analysis. In these cases, a validation study is always required before a method is authorized for use in standard testing. We have a formal documented procedure by which approval is granted to our laboratory personnel to use a new or modified method in this type of testing.

a. Work-Flow Routing

The computerized "Sample Management System", described in Section 4 B, has many benefits for our clients. Accuracy is improved since many of the calculations are done by the computer, eliminating transcription of data from one piece of paper to another. In addition, traceability of results is assured since each result indicates by code the analyst who entered the raw data and the method used. The Sample Management System has built-in levels of security to prevent unauthorized changes of data or verification status. Management receives a daily printout of the status of all samples in the lab, including a printout of those with priority status or those which have exceeded a preset turnaround time. This is an important aid to efficient work scheduling. In addition, a request for information on a client's samples can be immediately answered by instant referral to a computer terminal.

b. Reporting of Results

When all analyses are completed, the results are reviewed and approved by technical personnel. A copy of the report is mailed to the client. Each day's reports are reviewed by at least one member of Corporate Management before they are mailed.

We recognize that one of the most important aspects of the services we offer is "turnaround time," i.e., the time which elapses between the receipt of a sample at the laboratory and the report of the final results. This is one reason we operate on a three-shift, around-the-clock basis. Our normal turnaround time is about 7 to 14 days, but it can vary considerably depending on the workload in the various groups analyzing the sample and the nature of the analysis.

If faster turnaround time is required, clients should discuss their needs with a representative of our ExpressLAB. This laboratory, dedicated to helping clients with tight schedules, has its own three-shift staff of chemists and technicians. The scope of their operations is described in the next section.

One way of shortening turnaround time is personal delivery of samples to the laboratory or pick-up of samples by our personnel. Another method is to request that results be reported by telephone or fax. Such requests will always be honored and will be confirmed subsequently by mailed reports. The fastest means of getting hard copy results for routine samples will be via our Data Access System.

c. Data Access System

Clients who have need of fast turnaround time and who submit samples on a regular basis should investigate our computerized Data Access System. Under this system, a client can access our computer system by telephone and receive a printout in his/her own office or laboratory of all analytical results on samples which are completed and verified. The equipment required at the client's location is a teleprinter (or a computer terminal which can simulate a teleprinter) and an inexpensive telephone modem. For security purposes, clients are given access codes which limit access to their samples only. The codes are easily changed in case of a potential breach of security (e.g., loss of client key personnel).

Clients interested in our Data Access System should contact David Hooley, our Group Leader of Computer Services. There is no charge for this service.

d. Billing

Standard analyses are billed on a per sample, per analysis fee basis, as described in our Schedule of Services, a copy of which is available upon request. Discounts are available, as described in the Schedule of Services. A copy of our Standard Terms and Conditions may be found in Appendix A.

2. Specialized Testing

This type of work includes analyses for which standard methods are not available, or are available for substrates other than the samples being considered. This type of work is only attempted if we are convinced on the basis of our best professional judgment that our facilities and expertise are sufficient to assure a reasonable chance of success.

a. Work-Flow Routing

Management, in consultation with technical personnel, will make the decision whether or not to attempt the analyses. If the decision is made to proceed, the work flow will follow the general outline given under Standard Testing.

In cases involving litigation or the possibility of future litigation, special precautions are taken in sample handling and analysis, as described in Section 4.

b. Reporting

Results are reported in a manner similar to that described under Standard Testing. If the methods used are markedly different from those used in standard tests, a letter report disclosing the methods is prepared. Any difficulties and/or special techniques or precautions are also reported, as well as any interpretive information which may be necessary to understand the results.

c. Billing

Billing for specialized testing is on a per sample, per analysis fee basis, in accordance with our best estimate of the cost of doing the tests. This fee may be subject to later revision, either upward or downward, as we gain experience with the test method. The client will be informed of the fee or any fee revision prior to our beginning work.

Any method development or evaluation work which the client has agreed to finance is billed according to time records describing the level of effort of actual persons working on the project. Time charges are calculated based on the time spent on the project, multiplied by the worker's hourly rate, multiplied by a factor which covers overhead costs and profit. We reserve the right to determine the level of technical expertise required to solve a particular problem.

3. Contract Research and Development

Contract research and development has been an on-going activity at Lancaster Laboratories, Inc. since its inception in 1961. We have performed this service for many manufacturing companies, both large and small, for engineering firms, for government agencies, and for trade and industrial associations. Typical examples include: product formulation and evaluation for patent and marketing purposes; analytical method development; waste and by-product utilization studies; waste treatment studies; competitive product evaluation and "deformulation"; shelf-life and other stability studies; identification of unknown materials; "off-taste" and "off-odor" identification; and many other investigations in the fields of chemistry and microbiology. Special expertise is also available in analytical support for toxicology and environmental fate studies conducted under Good Laboratory Practice Regulations (GLPs).

Such projects usually begin with a client conference with a member of our Research and Development Group at no obligation to the client. The objectives of the project and possible technical approaches to achieving the objectives are discussed and, if possible, a rough estimate of the cost is given. After this meeting, assuming the client agrees, further discussions with technical staff are undertaken to refine the concept of the proper technical approach. A brief literature survey may be made to clarify technical questions and the feasibility of performing the work in view of staff expertise, instrumental and equipment capabilities, and workload is evaluated. The client usually is not charged for this phase of the investigation unless a more extensive literature search is necessary, which the client is asked to authorize.

At this point, assuming mutual agreement with the client, we prepare a detailed project proposal, including a cost estimate. This is done by breaking down the work into a series of tasks and estimating the number of work hours and level of technical expertise (professional, technician, quality assurance, secretarial, etc.) needed for each task. From this we can estimate the cost of

labor plus overhead to complete the project. Other related incidental expenses (e.g., the cost of special chemicals, travel costs, if necessary, and the like) are added to labor costs to arrive at a final project estimate.

The project cost quotation may contain a contingency factor, which represents our uncertainty in evaluating costs, or may be presented on a "not to exceed" basis, depending on the client's wishes. We require a written authorization from the client to proceed with the project prior to our beginning work.

Clients should realize that because of the exploratory nature of the work, it is frequently very difficult to arrive at highly accurate project costs. It is also impossible to guarantee success, i.e., results which are as expected beforehand by the client. (If this were possible, there would be no need to do the work.) We can guarantee that we will put forth our best technical effort in pursuing the work as agreed.

a. Reporting

Contract research and development projects will be reported to clients in the form of written reports. Reports are generated at the conclusion of the project or at intervals over the course of the project depending on the client's specifications. Reports include a description of the methods and materials used, experimental results, discussion of results, and conclusions based on the results. A Quality Assurance Statement as required by the GLPs will also be provided if the laboratory has been informed that those regulations apply to the project.

b. Billing

Contract research and development projects are billed at the conclusion of the project if completed within one month or on a monthly basis if not. When a client authorizes a project, a project number is assigned to that project, and employee time is logged against that number on a daily basis for all work done on the project. Project costs are calculated by multiplying the employee's time by his/her hourly rate and adding a factor to account for overhead and profit. Extraordinary costs not normally included as overhead are billed directly to the project as they are accrued. The monthly or final invoice sent to the client contains a list of itemized costs.

SECTION 6 BUSINESS UNITS

Technical personnel and equipment are organized into three business units: Environmental Sciences, Food Sciences, and Pharmaceutical Sciences, which reflect both the type of client served and the nature of the work done. The units are further divided into Groups on the basis of the same criteria.

This section will describe these various Groups with emphasis on special expertise available in the Group, and the quality assurance programs specific to that Group. For a discussion of our overall Quality Assurance Program, see Section 4 of this manual.

For the names of key personnel in each Group see Section 2, and for instrumentation available see Section 3.

ENVIRONMENTAL SCIENCES

A. ORGANIC ANALYSIS

The determination of trace volatile organic compounds is the forte of this group. Using gas chromatographs (GCs) with purge and trap concentrators, environmental samples are analyzed for contaminants at concentrations as small as the parts per billion (ppb) and even the parts per trillion (ppt) levels. In addition, capability is also available for identification and quantification of macro quantities of organics using infrared spectrophotometry.

Special expertise is available in the following areas:

- Analysis of potable water for trihalomethanes and volatile organic compounds for compliance with the Safe Drinking Water Act.
- Analysis of groundwater, wastewater, and solids for organic pollutants.
- Identification of solvents in unknown industrial wastes by capillary GC.
- Chemical characterization by a variety of techniques, e.g., infrared spectroscopy.

Quality Assurance

1. Instrument Calibration:

- **Gas Chromatographs:** Multiple levels of standard solutions are used to calibrate instruments each time a run is initiated. Instrument response is checked periodically to prevent detector drift. Where applicable, surrogate standards are used in samples. Quality control samples obtained from commercial sources are analyzed periodically.
- **Purge and Trap Concentrators:** Standard solutions are prepared and checked each time a batch of samples is analyzed, and surrogate standards are run with each sample.
- **Infrared Spectrophotometer:** A standard film of polystyrene is used to calibrate the instrument periodically. Such calibration is done quarterly or when there is reason to believe instrument response may have deteriorated.
- **UV/Visible Spectrophotometer:** Calibration is checked bimonthly with solutions of known absorbances and wavelength characteristics.

2. Standards: For analysis of volatile organic compounds by purge and trap GC, purgeable gases (e.g., chloromethane, bromomethane, vinyl chloride, and chloromethane) are purchased in solution from chemical supply houses. Purgeable halocarbons and aromatics are purchased neat, diluted as needed, and used for calibration and standardization.
3. Quality Control: Each batch of 20 samples analyzed by purge and trap techniques includes a blank, a matrix spike duplicate pair, and a calibration check sample.

B. PESTICIDE RESIDUE ANALYSIS

This group is responsible for the analysis of pesticides, polychlorinated biphenyls, herbicides, and similar compounds. Using gas and liquid chromatography, a wide variety of samples including water, soil, and foods are checked for trace residues. Automatic sample injectors, a variety of detectors, including ECD, NPD, FID, UV, and fluorescence, and microprocessor instrument control make the efficient analysis of many samples possible. HPLC analysis for polynuclear aromatic hydrocarbons is also available.

Special expertise includes:

- Analysis of potable water for pesticides and herbicides required for compliance with the Safe Drinking Water Act.
- Pesticide residue analyses on agricultural products, foods, animal feeds, soils, and water.
- PCB content of environmental samples, transformer oils, and other industrial fluids.
- Determination of pesticide contaminations according to Contract Laboratory Program (CLP) and Resource Conservation and Recovery Act (RCRA) methodology.
- Analytical support of pesticide registration data under FIFRA.

Quality Assurance

1. Instrument Calibration: Gas chromatograph standardization is accomplished as described under the Organic Analysis Group.
2. Standards: Purified pesticides and herbicides obtained from the Environmental Protection Agency or chemical supply houses which guarantee purity are used for preparing standard solutions for analysis of these compounds.
3. Quality Control: A blank and matrix spike/matrix spike duplicate are analyzed with each batch of 20 samples analyzed for Pesticides/PCBs. Surrogate standards are added to each sample, where applicable.

C. INORGANIC ANALYSIS

This Group has responsibility for the determination of trace metal concentrations by atomic absorption spectrophotometry (AAS) and inductively coupled plasma spectroscopy (ICP). Flame, furnace, hydride generation, and cold vapor techniques are employed as appropriate to sample and analyte.

Special expertise is available in this Group for:

- Analysis of sludge, leachates, soils, and water for inorganic contaminants.
- Analysis of potable water for compliance with EPA regulations for trace inorganic elements.
- Determination of inorganic compounds using methods employed in the EPA CLP.

Quality Assurance

1. Instrument Calibration: The AA spectrophotometers are calibrated with every run by analyzing 3 to 5 levels of standard solutions. The calibration curve is validated using a standard prepared from a source other than that used for preparation of the calibration standards. In addition, the calibration curve is verified throughout the run by periodic standard and blank check solutions. The ICAPs are calibrated according to the procedure prescribed by the EPA CLP.
2. Standards: Trace elements standards which have been checked against National Institute of Standards and Technology (NIST) Standard Reference Materials (SRM) are purchased from chemical supply houses for calibration of instruments. We maintain standards for each element for which we analyze. In addition, quality control samples obtained from commercial suppliers are analyzed periodically.
3. Quality Control: Each batch of 20 samples includes a blank, a laboratory control, a spike, and a duplicate.

D. GAS CHROMATOGRAPHY/MASS SPECTROMETRY

The combination of gas chromatography and mass spectrometry detector is a powerful tool for analysis of complex mixtures of organic compounds. It is possible not only to separate these compounds by chromatography, but to obtain definitive confirmation of identity by the mass spectrometer. The technique is widely used in analysis of groundwater, wastewater, and soils for industrial pollutants, and in special problems where the identity of trace contaminants must be determined.

Special expertise is available for:

- Determination of organic contaminants according to CLP and RCRA methodology.
- Priority pollutant determinations in waters and soils.
- Identification of unknown organic constituents.

Quality Assurance

1. Instrument Calibration: Calibration and tuning is performed according to EPA method requirements depending upon the analysis requested. Minimally, instruments are tuned and calibrated daily.
2. Standards: For GC/MS analysis of the volatile and semivolatile compounds in the EPA list of priority pollutants, pure liquids, or standard mixes received from chemical supply houses are used to prepare standard solutions. Quality control samples obtained from commercial suppliers are analyzed periodically as an independent check on the accuracy of our standards.

3. **Quality Control:** A blank, a matrix spike, and a matrix spike duplicate are analyzed with each batch of 20 samples. When required by the method, a laboratory control sample is also analyzed. Surrogate and internal standards are added to each sample or extract.

E. WATER QUALITY

This Group is responsible for wet chemistry analysis of potable water, wastewater, and soil samples. Examples would be: cyanide, phenols, phosphates, ammonia, turbidity, chemical oxygen demand, etc.

Analysis of wastes for hazardous components is also a responsibility of this Group with RCRA compliance and Pennsylvania Department of Environmental Resources (PA DER) Module #1 specialties.

Major instrumentation for these analyses includes total organic carbon (TOC) analyzers, total organic halogen (TOX) analyzers, an ion chromatograph, FT-IR Spectrophotometer, Technicon automatic analyzers, and a full complement of field sampling equipment.

Special expertise is available in this Group for:

- **Wastewater Sampling and Flow Measurement:** Equipment and personnel are available for field sampling of wastewater effluents, using either flow proportional or time proportional compositing techniques.
- **Groundwater Test Well Sampling and Monitoring:** Battery-powered field pumps teflon ballers are available.
- **Toxicity Characteristic Leaching Procedure (TCLP) and EPA Toxicity Testing:** Equipment and expertise are available for the EPA-mandated leaching and toxicity testing for hazardous waste.
- **Wastewater Treatment Studies:** Jar tests, activated sludge, dissolved air flotation, and sludge digestion tests can be run.
- **Biochemical Oxygen Demand (BOD):** BOD analyses are a specialty of this Group.
- **Trace Cation and Anion Analyses:** Ion chromatography is used for analysis of a variety of ions, both inorganic and organic.

Quality Assurance

1. Instrument Calibration:

- **Total Organic Carbon (TOC) Analyzer:** A calibration standard and five calibration check standards are run with each use of the instrument. An additional calibration check is run following every tenth sample.
- **Total Organic Halogen (TOX) Analyzer:** A calibration standard and absorption efficiency sample are run with each batch of samples, followed by three calibration check samples. Also, a calibration check sample is run after every ten samples..
- **Technicon Automatic Analyzers:** Five different levels of standard solutions are run with each group of samples. A calibration check standard is run after every ten samples.
- **Ion Chromatograph:** Standard solutions are run at five different concentrations with each batch of samples. A calibration check standard is run after every ten samples.
- **FT-IR Spectrophotometer:** A six-point calibration curve is run each day of use. A calibration check standard is run after every ten samples.

- Conductivity Meter: Cell constant is checked at each use with standard KCl solution.
 - Dissolved Oxygen Meter: The instrument is checked with each use against the Winkler iodometric titration procedure for dissolved oxygen.
 - BOD Incubators: The temperature is checked and recorded twice daily. The thermometer used is calibrated against a standard thermometer traceable to NBS.
 - Flowmeters for Wastewater Monitoring: These instruments are calibrated immediately before use.
2. Standards: Chemically pure standards are purchased from supply houses for use as calibration standards. Standard solutions with components typical of those found in wastewater, supplied by commercial suppliers, are analyzed periodically for a wide variety of analytes, and results are compared to certified values.
 3. Quality Control: Due to the wide variety of tests performed by this group, it is difficult to describe here the QC performed for each one. Generally, each batch of 20 samples includes a blank, a spike, a duplicate, and a reference material.

F. AIR QUALITY

The responsibility of this Group is the evaluation of health hazards resulting from indoor air pollution in workplaces, homes, and schools. Much of the work of this Group is conducted on-site at client facilities, supplemented by laboratory analysis of samples collected and evaluation of health hazard potential. Our laboratory is certified by the American Industrial Hygiene Association, and a Certified Industrial Hygienist is on staff.

Special expertise which is available includes:

- On-site personal or area air sampling for identification and quantitation of airborne contaminants. This may be done for evaluation for Occupational Safety and Health Administration (OSHA) compliance, for industrial hygiene purposes, or for industrial process control. NIOSH protocol is used in collection of air samples, where applicable.
- Air sampling for analysis of asbestos fibers in schools, office buildings, and elsewhere. Instantaneous airborne fiber concentrations can be determined using a Fibrous Aerosol Monitor (FAM).
- Monitoring of building contractors' adherence to specifications for asbestos removal projects.
- Identification and quantitation of asbestos in bulk materials, e.g., building materials and insulation.
- Surveys and inspections of buildings for compliance with Asbestos Hazard Emergency Response Act (AHERA).
- Use of battery-powered, portable personal monitoring pumps with collection devices to evaluate short-term or full, 8-hour workday exposure of employees to hazardous materials.
- Industrial hygiene surveys and consulting.
- Measurement of noise levels and noise exposure hazards.
- Evaluation of fume hoods and other protective ventilation devices by means of a hot-wire anemometer.
- Evaluation of indoor air for hazardous substances, e.g., carbon monoxide, carbon dioxide, formaldehyde, pesticides, and bioaerosols.

- Training courses are offered for EPA-AHERA and PA Act 194 certifications in asbestos-related occupations.

Quality Assurance

1. Instrument Calibration:

- **Area Ambient Air Samplers:** These devices are calibrated before and after use by flowmetering devices, e.g., rotameter; limited orifice, etc.
- **Personal Air Samplers:** These are calibrated by soapfilm flowmeter before and after sampling.
- **High Volume Area Air Samplers:** These are calibrated by using a soapfilm flowmeter before and after sampling.
- **AQ-501:** Calibrated from standards purchased from commercial suppliers (CO and CO₂) after each use and calibrated from the factory (humidity and temperature) on an annual basis.
- **MicroTIP:** Calibrated against standard gases purchased from commercial suppliers.
- **Sound Level Meter:** Calibrated to a standard sound level at a given frequency.

2. Standards:

- Standards are provided by NIST for evaluating personnel and methods for the quantitation of asbestos in bulk materials.
- Samples from the NIOSH Proficiency Analytical Testing (PAT) program are used to determine proficiency in counting asbestos fibers for airborne asbestos analysis.
- Chemically pure standards are purchased for use as calibration standards.

3. Quality Control:

The quality control follows the OSHA/NIOSH methods and includes submission of at least one blank per analysis group.

Other analyses of samples collected by this Group are carried out by the Inorganic and Organic Analysis Groups and are subject to the QA programs in those Groups.

G. EXPRESSLAB

This Group is a dedicated laboratory staffed and functioning for the sole purpose of delivering rapid turnaround time results that meet the same high-quality standards of the other environmental groups. The group includes its own Client Services personnel as well as laboratory personnel. The analytical work is performed using gas chromatographs, purge and trap concentrators, atomic absorption spectrophotometers, an infrared spectrophotometer, and an automated moisture analyzer. Some of the express analytical work is performed in the routine environmental laboratories, but the work is coordinated and reported through this group's administrative functions.

Rapid turnaround-time service is focused in the following areas:

- Key analyses for monitoring petroleum contamination.
- Priority pollutant list parameters.
- TCLP extraction and analysis for TCLP list parameters.

- Metals analysis by flame, cold vapor, and hydride atomic absorption.
- Standard GC and GC/MS volatiles, semivolatiles, and pesticide analyses.

Quality Assurance

Instrument Calibration, Standards, and Quality Control is parallel to these respective functions as performed in the routine departments.

FOOD SCIENCES

A. FOOD CHEMISTRY

This Group is responsible for chemical analyses of foods, animal feeds, and agricultural products, except for certain trace organic analyses which may be performed by the Organic Analysis Group in Environmental Sciences. In addition to standard tests, e.g., proximate analyses, special expertise is available in:

- Nutritional analysis, including sampling, labelling, and consultation on regulatory requirements.
- Vitamin analyses, including vitamins A, all B vitamins (B₁, B₂, B₃, B₄, B₅, B₁₂, and B complex), C, D, and E.
- Sugar analyses by High Performance Liquid Chromatography (HPLC) on foods and beverages, including screens for dextrose, fructose, maltose, lactose, and sucrose.
- Atomic absorption analysis for inorganic constituents in foods and animal feeds.
- Fatty acid profile analysis by GC. This technique is useful for identifying the sources of animal and vegetable fats and determining the amount of saturated fat.
- Analysis of laboratory animal feeds. Feeds used for laboratory animals in nutritional and toxicity testing must be carefully characterized for nutritional content and possible contamination.

Quality Assurance

1. Instrument Calibration:

- HPLC: Standard solutions are run with each batch of samples and instrument response is monitored periodically throughout the run. Control or reference materials are run when available.
- GC: Standards are run with each batch of samples and instrument response is monitored periodically throughout the run. Control or reference materials are run when available.
- pH Meters: These instruments are calibrated with standard buffer solutions (pH 4.0, 7.0, 11.0) each day used.
- AA: Trace elements standards which are traceable to NBS are purchased from chemical supply houses for calibration.
- Analytical Balances: Calibration is checked daily with various weights, and a complete overhaul and calibration is performed annually by a certified service company.
- Visible Spectrophotometer: A set of standard solutions is used for monthly calibration of absorbance and wavelength readings.

- **Fluorometer:** A standard solution is run with each batch of samples, and instrument response is checked.
2. **Standards:** A complete inventory of high purity samples is kept for all analyses for which standards are available. These are used for instrument and method calibration. In addition, control samples of dry cereal, pasta, NIST egg powder, and chocolate are used for Quality Control (QC) charting for our most frequently performed analyses (proximate analyses, vitamins, sugars, metals, and cholesterol).

B. FOOD MICROBIOLOGY

This Group is responsible for all microbiological testing of food, animal feeds, and industrial products. In addition to standard tests, e.g., plate counts and bacteriological identification, special expertise is available as follows:

- **Extraneous Matter:** Identification and quantitative estimation of the contamination of various foods and agricultural products by unwanted material, e.g, rodent hairs, insect fragments, synthetic fibers, and other materials.
- **Analysis for selected pathogens such as Salmonella and Listeria.**
- **Sanitary Inspection:** Our staff is experienced in inspection of food processing plants, equipment, and warehouses for sources of microbiological, rodent, and insect contamination, and can make recommendations for elimination of unsanitary practices.
- **Microbiological vitamin assays including B₆, B₁₂, biotin, folic, niacin, and pantothenic.**

Quality Assurance

1. Instrument and Equipment Calibration:

- **A-O Microscope:** Field diameter calibration is conducted every two years in conjunction with Milk Sanitation Certification by the Pennsylvania Department of Agriculture.
- **Incubators, Refrigerators, and Water Baths:** Temperatures are read and recorded twice daily. Thermometers are immersed in liquid.
- **Autoclaves:** A maximum registering thermometer is used weekly. Autoclave tape is used to indicate maximum temperatures in each run, and time and temperature are recorded continuously for each run.
- **pH Meters:** pH meters are calibrated every hour used, with commercial buffer solutions (pH 4.0, 7.0, and 10.0).
- **Thermometers (glass):** Glass thermometers are checked annually against a standard thermometer traceable to the NIST.
- **Thermometers (dial type):** These thermometers are checked semiannually against a standard thermometer traceable to the NIST.
- **Oven (for dry heat sterilization):** A thermometer record is kept showing date, time, and temperature of each cycle; test strips are run with each cycle.
- **UV Sterilizer:** This equipment is checked quarterly by the spread plate irradiation procedure.
- **Automatic Pipettor:** This is calibrated each day it is used.
- **Analytical Balance:** Accuracy is checked daily with various weights.

2. **Standards:** All chemicals and nutrients used in microbiological testing are purchased from supply houses which guarantee specifications to be equal or better than required by the Food and Drug Administration (FDA), United States Public Health Service (USPHS), etc. Stains used are "biological grade," i.e., certified by the Biological Stain Commission.

Standard cultures of microorganisms are obtained from the American Type Culture Collection (ATCC), government agencies, medical schools, or industry.

3. **Procedures:** Microbiological testing is less amenable to statistical techniques of quality control than is analytical chemistry. Many microbiological tests are qualitative, involving identification of microorganisms; while in other tests, meaningful standards are not available and substrates are perishable. For these reasons, microbiological quality control must rely on strict control of materials, test parameters, e.g., time and temperature, and individual analyst technique and training. The following are illustrative of quality control procedures used in our laboratory.
 - Sterility checks are run on each batch of dilution water.
 - Sterility and pH checks are run on each batch of broth used.
 - Airborne microbial density measurements are performed daily.
 - Spikes and duplicates are run regularly.
 - Records are kept of media batch sterilizations showing lot number, date, sterilization time, and temperature, and initial and final pH.
 - Media are dated when received and opened, and discarded if caked.
 - Laboratory pure water is checked annually for bactericidal properties and for heavy metal contamination.
 - Laboratory pure water is checked monthly for pH, chlorine residual, standard plate count, and low level ammonia. Conductance of the water is continually monitored, and recorded twice daily.
 - All new plastic caps for dilution bottles or agar bottles are boiled three times in deionized water, and the final water wash is checked for inhibitory substances prior to use.
 - Records are maintained of bacteriological suitability of detergents and procedures for their use.
 - Coliform media in tubes is discarded after one week of room temperature storage or three weeks of refrigerated storage.
 - Each canister of sterilized pipets is spot checked for pH.
 - Bacteria spikes are initiated regularly for E. coli, Pseudomonas, and Staphylococcus tests. All reagents and/or media used are recorded as well as corresponding preparation dates, expiration dates, and control numbers, as applicable.
 - A toxicity test is performed for each lot number of Brilliant Green Dye.
 - Positive and negative controls are initiated for the following: phosphatase tests, Staphylococcus coagulase reactions, and antibiotic tests.

PHARMACEUTICAL SCIENCES

A. PHARMACEUTICAL AND ENVIRONMENTAL MICROBIOLOGY

This Group has responsibility for microbiological analysis of finished pharmaceuticals, raw materials, and intermediates. This group is also responsible for potable water testing for coliforms. Special expertise is available in this group for:

- USP sterility testing of finished products using membrane filtration and direct inoculation procedures.
- Endotoxin testing of raw materials and finished products using the gel clot procedure. Testing is performed in compliance with the 1987 FDA Guideline on Validation of the Limulus Amebocyte Lysate Test.
- Antimicrobial preservative effectiveness testing using USP, BP, or client methods.
- USP microbial limit testing of raw materials, intermediates, and finished products.
- Testing in support of process and new facility validation, including analyses for pharmaceutical water systems, environmental monitoring, and spore strip incubation.
- Organism identification.

Quality Assurance

1. Instrument and Equipment Calibration and Maintenance:

- **Autoclave:** Temperature distribution studies are used to validate the autoclave. Sterilization cycles are validated for sterility testing media and apparatus. Preventative maintenance is performed quarterly by a certified service company. Sterilizer controls are calibrated on a routine basis.
- **Incubators, Refrigerators, and Water Baths:** The temperature is checked and recorded twice daily. The thermometers used are calibrated against a resistance thermal detector traceable to NIST.
- **Oven:** Heat distribution studies are used to validate the oven. Depyrogenation cycles are validated for endotoxin testing supplies. Oven controls are calibrated on a routine basis.
- **Clean Rooms and Laminar Flow Hood:** Each room and hood is certified every six months. Tests performed during certification include particle count, integrity testing of HEPA filters, and air velocity profile. Room pressurization is also measured for the clean rooms. Disinfection of critical and noncritical surfaces is performed routinely and includes rotation of disinfectants on a regular basis. Microbial monitoring of critical and noncritical surfaces is performed to evaluate the effectiveness of disinfection procedures. Organisms isolated from environmental monitoring are identified to genus and species when possible.
- **Airborne Particle Counter:** Calibration is performed once a year by a certified service company.
- **pH Meter:** These instruments are calibrated with standard buffer solutions (pH 4.0, 7.0, and 10.0) each day used.
- **Spectrophotometer:** A set of standard solutions is used for monthly calibration of absorbance and wavelength.
- **Balances:** Calibration is checked daily with various weights and a complete overhaul and calibration is performed annually by a certified service company.

2. Standards:

- USP reference standards are used for antibiotic where available.
- Laboratory cultures are obtained from the American Type Culture Collection (ATCC). Stock cultures are no more than five transfers from ATCC Freeze Dried Cultures.
- Control standard endotoxin and limulus amoebocyte lysate (LAL) reagent are obtained from licensed manufacturers.

3. Media Preparation:

- Batch records are kept of all media and reagent preparation which include sterilization records, pH checks, and sterility checks. Each batch of media is labelled with a unique control number, expiration date, and storage condition.
- Growth promotion is performed on each batch of media, if applicable, using the procedures outlined in the USP XXII.

4. Sterility Testing:

- Viable particle monitoring is performed during sterility testing using a slit-to-agar sampler.
- Nonviable particle monitoring is performed during sterility testing using a MET-ONE particle counter.
- Microbial monitoring of critical and noncritical surfaces is performed during sterility testing using contact plates and swabs and includes personal monitoring.
- Alert and action limits are pre-established for viable and nonviable particulate monitoring and surface monitoring. Organisms isolated during environmental monitoring are identified to genus and species whenever possible.
- A manipulative control is performed with each sterility testing batch.
- Bacteriostasis/Fungistasis testing is performed on new products submitted for sterility testing.
- Gowning training and qualification is performed for all analysts working in the sterility testing laboratory. Analysts are retrained and qualified annually.

5. Endotoxin Testing:

- Lysate label claim verification is performed on all lots of lysate used for testing as outlined in the 1987 FDA Guideline on LAL testing.
- Each analyst is qualified using procedures outlined in the 1987 FDA Guideline on LAL testing. Analysts are requalified annually.
- A 2 λ positive product control and negative control are analyzed with each endotoxin test.
- Inhibition and enhancement testing is performed on new products submitted for endotoxin testing.

6. Microbial Limits Testing:

- Positive and negative manipulative controls are performed with each batch of samples analyzed.
- Product validation is performed on new products submitted for microbial limit testing.
- Batch records are maintained of media, reagents, and apparatus used to analyze each sample.

B. PHARMACEUTICAL CHEMISTRY

This Group provides stability analyses, process validation, and analytical method validation to support the pharmaceutical industry. Stability studies can be housed in our stability chambers or sent to Lancaster Laboratories, Inc. after removal from a client's chambers. A computer tracking system is used to ensure studies are tested at the required intervals, and the stability chambers are checked for temperature control daily. Assistance with stability study design and analytical method validation protocol design are provided. Analytical method development service is also offered. Most chemical and physical testing requirements for our pharmaceutical customers can be met by this Group.

Quality Assurance

1. Instrument Calibration:

- **Stability Chambers:** Daily monitoring of temperature control within each chamber is documented. Calibration for temperature and humidity is completed using equipment referenced to NIST.
- **HPLC and GC:** Standard solutions are run with each batch of samples. Instrument response is monitored periodically through the run.
- **pH Meter:** These instruments are calibrated with standard buffer solutions (pH 4.0, 7.0, and 10.0) each day of use.
- **Analytical Balances:** Calibration is checked daily with various weights, and a complete overhaul and calibration is performed annually by a certified service company.
- **UV Spectrophotometer:** Standard solutions are run with each batch of samples to be quantitated. The instrument is self-calibrating. An external wave length check is performed annually.
- **Dissolution Bath:** Calibration is performed twice a year using salicylic acid and prednisone tablets as specified in the current USP.
- **Hardness Tester:** Calibration is performed once a year by a certified service company.
- **Viscometer:** The Brookfield Viscometer is calibrated yearly, using Brookfield standard solutions and according to Brookfield recommendations.
- **Refractometer:** Calibrated per manufacturer recommendations annually.
- **Polarimeter:** Calibrated per manufacturer recommendations annually.
- **Friabilator:** Calibrated per manufacturer recommendations annually.
- **Thermometers:** Calibrated against NIST reference standard thermometer annually.
- **Karl Fischer Titrator:** Calibrated at the time of use per manufacturer's recommendation.
- **Automatic Titrator:** Calibrated at the time of use per client requirements or manufacturer's recommendations.

2. Standards: USP Reference Standards or client-supplied reference standards are typically used.

SECOND AND THIRD SHIFTS

Our second shift operates from approximately 4:30 p.m. to 1:00 a.m., Monday through Friday, while our third shift works from 10:00 p.m. to 7:00 a.m., Sunday through Thursday. In addition, some groups require technical staff on Saturday and Sunday to maintain the operations. The operating hours of personnel on various shifts overlap to ensure good communications and continuity of operations.

Personnel of these two shifts at our Lancaster location are responsible for a variety of duties. In addition to performing certain standard analytical tests regularly, they are responsible for sample preparation steps such as sample digestion for trace element analyses. This shortens the time for turnaround on multiple, repetitive analyses, thus improving our efficiency. They are also responsible for glassware cleaning, glassware and instrument set-up for the day shift personnel, autoclaving, media preparation, and certain building maintenance services. Clients with emergency problems occurring in off-hours can be accommodated with certain services, e.g., sample receipt or early alerting of Group Leaders to the need for RUSH analyses.

SECTION 7 SUPPORT SERVICES

The following describes some of the Groups of personnel which supply support to our Business Units and whose operations are frequently vital to the efficient and reliable provision of the services we offer.

A. CLIENT SERVICES

Personnel of this Group are often the first to have contact with a prospective client since their responsibilities include receipt of incoming calls regarding the services we offer. They also assist clients by providing the following services:

- Giving status reports and verbal results via telephone before the analysis report is issued. Only results which have been verified by technical personnel are given by telephone.
- Coordinating high priority samples between the client and laboratory personnel.
- Answering common technical questions for clients.
- Coordination with technical staff regarding client inquiries such as status of sample analyses.

B. DATA PACKAGE

Members of this Group are responsible for the preparation of "data packages" for clients who request them. Our standard report format consists only of the final result generated in the laboratory. However, government regulations have made it necessary for many of our clients to retain copies of raw data as well as quality control information. The function of this Group is to collect and index methods, quality control, and raw data into a format that will be useful to our clients. The options and costs for this service are listed in our Schedule of Services.

C. FINANCE/DATA PROCESSING

This Group is responsible for all financial transactions of the company and the establishment and maintenance of all data processing programs.

All financial transactions, including accounting, billing, accounts receivable, accounts payable, purchasing, and payroll, are monitored and recorded by personnel of this Group.

Data processing includes, in addition to our computerized accounting system, all computerized aspects of our technical operations, e.g., our computerized Sample Management System, computer aspects of our QA program, and our Data Access System. Continued research and development into new and improved hardware and software are ongoing activities of this Group.

D. HUMAN RESOURCES

Human resource management includes coordination of all hiring, employee orientation, safety, monitoring, the employee evaluation program, and other personnel management functions. Secretarial services are also coordinated by this Group. Because of the technical nature of our business, a well-trained staff is critical to the production of quality data. Human Resources has oversight of the

employee training program which includes on-site training in basic subjects and training courses offered by outside organizations.

E. MAINTENANCE & SECURITY

Major functions of this Group include buildings and grounds maintenance. This Group also has certain responsibilities which impact directly on the quality and reliability of our technical services:

- It is responsible for maintenance of our deionized water system. Pure, sterilized water is a vital necessity for all of our laboratories. Continuous, in-line monitoring of conductivity is used to ensure that high quality water is produced.
- It is also responsible for maintenance of our Heating, Ventilating, and Air Conditioning (HVAC), and exhaust hood systems. This is particularly important in our instrumentation rooms and computer center where a controlled environment, positive pressure system is maintained to prevent contamination by dust or solvent vapor.
- Maintenance of the equipment used to generate and maintain conditioned electrical power is performed by this group.
- This Group also utilizes its carpentry and mechanical skills to develop and fabricate special pieces of equipment for laboratory or field use by our scientific staff.

F. SALES

This Group is responsible for sales, market development, and client services. These functions include:

- Coordination and preparation of proposals, in consultation with technical staff.
- Coordination of exhibits at technical meetings and conferences.
- Design and production of company literature including a Schedule of Services and various technical bulletins on the services we offer. Please inquire if you would like to receive copies of this literature or to be placed on our mailing list.

G. SAMPLE ADMINISTRATION

Sample Administration has overall responsibility for the receipt and log-in of all samples. Analyses requested, sample descriptions, analysis report recipients, invoicing information, and special laboratory instructions are included in the types of information entered into the sample management system by this group.

H. SAMPLE SUPPORT

Sample Support supplies environmental clients with sample bottles and mailing kits, performs preservation and homogenization on samples, maintains the central locked storage facility, and disposes of samples upon completion of the analytical work. The department maintains nearly 2500 square feet of refrigerated storage space.

I. TRANSPORTATION

The Transportation Group is responsible for pick-up of samples from clients. Sample pick-up service is available for all clients within a 150-mile radius of the laboratory. Regularly scheduled pick-up can be provided as well as special pick-ups. Drivers are trained (and certified in some cases) in the technical aspects of sampling, sample handling, and transportation and may also perform certain on-site tests, e.g., residual chlorine in swimming pools. Mobile phone communication with the laboratory is available in all vehicles. Maintenance of the company's fleet of vehicles is also the responsibility of this group.

SECTION 8 ACCREDITATIONS, CERTIFICATIONS, REGISTRATIONS, AND CONTRACTS

Accreditation of a laboratory has been defined as "the verification by a competent, disinterested third party that a laboratory possesses the capability to provide accurate test data and that it can be relied upon in its day-to-day operations to maintain high standards of performance." * The terms "certification," "registration," and others have been used in the past and are currently being used by some organizations, as synonyms for accreditation, but in recent years a consensus has been reached to restrict the term accreditation to laboratories and other organizations and to reserve certification to individuals, e.g., Certified Industrial Hygienist, Certified Public Accountant, or to products which conform to certain standards or specifications.

Accreditation is thus the one generally accepted method by which a laboratory such as ours can demonstrate its capability of generating acceptable, professional quality test results in those areas in which it claims competence. To this end, we have actively sought accreditation by organizations offering it in those areas relevant to our technical expertise.

Although organizations offering accreditation differ somewhat in the details of their programs, they generally evaluate laboratories in four basic areas: personnel (education, training, and experience), physical facilities, instrumentation/equipment, and quality assurance programs. The evaluation is performed by one or more of the following procedures: periodic on-site inspection of the laboratory by assessors experienced in technical operations and management, periodic testing of proficiency evaluation samples, and periodic updating of the laboratory's file to reflect changes in personnel, equipment, or services offered.

The following lists the accreditations, registrations, and contracts currently held by Lancaster Laboratories, Inc.:

- American Association for Laboratory Accreditation (A2LA): A2LA is a private sector, non-profit organization whose sole mission is accrediting laboratories in twelve fields of testing. Lancaster Laboratories, Inc. is accredited in the environmental field of testing. Certificate #0001-01.
- American Industrial Hygiene Association (AIHA): AIHA accredits laboratories for their ability to analyze collection media used in air pollution sampling for a broad variety of industrial workplace contaminants. Accreditation #237.
- EPA Contract Laboratory Program (CLP): This program is not truly an accreditation program, although many people consider it a de facto accreditation. In order to receive an EPA contract to perform laboratory work in support of Superfund investigations, a laboratory must successfully bid on a contract, obtain acceptable results on performance samples, and pass an on-site inspection by EPA officials. Lancaster Laboratories currently has an active Routine Analytical Services contract for Organics analysis and also performs Special Analytical Services (SAS) for the EPA-CLP. Contract #68-DO-0155.
- Food and Drug Administration (FDA): Because of our work for pharmaceutical companies, we are a registered FDA laboratory required to adhere to the Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP) regulations and subject to periodic, unannounced audits. This registration does not imply FDA approval. Registration #2513291.

From paper presented to the Annual Meeting of the Texas Council of Engineering Laboratories, by Earl H. Hess, Ph.D. (January 28, 1984)

- **State Environmental Authorities:** We are accredited in the following states, by the appropriate authorities, for the analysis of drinking water and, where applicable, for wastewater analyses:
 - Connecticut Department of Health Services (drinking and nonpotable water), Identification #PH-0746.
 - Kansas Department of Health and Environment (drinking water, nonpotable water, and hazardous/solid waste), Certificate #E-151 (water), Certificate #E-1130 (solid or hazardous waste).
 - Maryland Department of Health & Mental Hygiene (drinking water), Certification #100.
 - New Jersey Department of Environmental Protection (drinking and nonpotable water), Identification #77443.
 - New York Department of Health (nonpotable water), Identification #10670.
 - Pennsylvania Department of Environmental Resources (drinking water), Identification #36-037.
 - Utah Department of Health (nonpotable water and solid waste), Certificate #E-88.
 - Virginia Department of General Services (drinking water), Identification #00187.
 - West Virginia Department of Health & Human Resources (drinking water), Certification #R-16.
- **U.S. Department of Agriculture (USDA):** We are on the USDA list of recognized laboratories for Listeria, chlorinated hydrocarbon pesticide, and PCB residue analysis. Laboratory Code #4282.
- **U.S. Public Health Service (USPHS):** The Food Microbiology Group is an Approved Dairy Laboratory, subject to evaluation by USPHS through the Pennsylvania Department of Agriculture. FDA #42137.
- **National Voluntary Laboratory Accreditation Program (NVLAP):** NVLAP is an accreditation program administered by National Institute of Standards and Technology. Our laboratory is accredited by them for the analysis of asbestos in building materials. Laboratory Code #1084.

A. COMPANY MEMBERSHIPS

The following lists those business and technical organizations in which Lancaster Laboratories, Inc. holds membership:

- American Association for Laboratory Accreditation
- American Council of Independent Laboratories
- American Feed Industry Association
- Association of Official Analytical Chemists
- Better Business Bureau of Eastern Pennsylvania
- Chambers of Commerce:
 - United States Chamber of Commerce
 - Pennsylvania Chamber of Commerce
 - Lancaster (PA) Chamber of Commerce and Industry
- National Federation of Independent Businesses
- Pennsylvania Manufacturing Confectioners Association (Associate Member)
- Pennsylvania Association of Approved Environmental Laboratories

B. STAFF MEMBERSHIPS

The following organizations are those in which one or more members of our staff hold individual memberships:

- Air and Waste Management Association
- American Association of Candy Technologists
- American Association of Cereal Chemists
- American Association of Pharmaceutical Scientists
- American Board of Industrial Hygiene
- American Chemical Society
- American Industrial Hygiene Association
- American Management Association
- American Oil Chemists Society
- American Society for Microbiology
- American Society for Testing and Materials
- American Society for Training and Development
- American Society of Mass Spectrometry
- American Water Works Association
- Association of Official Analytical Chemists
- Delaware Valley Chromatography Forum
- Hazardous Materials Control Research Institute
- Institute of Food Technologists
- International Association of Business Communicators
- International Association of Milk, Food, and Environmental Sanitarians
- International Society for Pharmaceutical Engineering
- Lancaster County Industrial Safety Council
- National Asbestos Council
- New York Academy of Science
- Parenteral Drug Association
- Pennsylvania Dairy Laboratory Directors Association
- Pennsylvania Manufacturing Confectioners Association
- Public Relations Society of America
- Society for Human Resource Management
- Society of Quality Assurance
- Water Pollution Control Federation

**APPENDIX A
STANDARD TERMS AND CONDITIONS**

Standard Terms and Conditions

Unless otherwise agreed in a formal contract, services provided by Lancaster Laboratories, Inc., are expressly limited to the terms and conditions stated herein.

Confidentiality ... Strict confidentiality is maintained in all of our dealings with clients. Confidentiality agreements, therefore, are signed willingly. In any instance where information is subpoenaed by and must be released to a regulatory or legal body, the client is promptly notified. Likewise, the client agrees to respect all such relationships of trust. Client agrees it will not use Lancaster Laboratories' name and/or data in any manner which might cause harm to the company's reputation and/or business. Under no circumstances is the name of Lancaster Laboratories, Inc., (LLI) to be published - either alone or in association with that of any other party - without its approval in writing.

Payment Terms ... Payment in advance is required for all clients except those whose credit has been established with our company. For clients with LLI-approved credit, terms are net 30 days, after which time a 1-1/2% per month late charge is added to all unpaid balances. LLI has the right to ask for payment in advance, if the established payment terms are not adhered to. In the event of default in payment for services rendered, the client is responsible for reasonable collection/legal fees.

Billing ... All fees are charged or billed directly to the client. The billing of a third party will not be accepted without a statement, signed by the third party, which acknowledges and accepts payment responsibility. (Note: We will not be responsible for the re-collecting of samples whose holding times have been exceeded due to late or unauthorized requests for third-party billing.) It is necessary for us to assume that the paperwork submitted with a sample describes the testing protocol desired. Any changes to this protocol must be submitted to LLI in writing. However, if changes are made after the originally requested testing is initiated or has been completed, the client must accept payment responsibility. We cannot be responsible for holding times that are exceeded due to such changes. Please send all requests for changes marked: "Client Services - URGENT!" Our FAX number is (717) 656-2681.

Fee Discounts ... Economy-of-scale discounts are available and are determined by the number of samples and the nature and spectrum of the requested analyses. Quotations are provided free of charge. For established clients, discount rates are reevaluated annually, and a new rate is applied to future invoices based upon the previous year's volume of work, type of analyses, ease of scheduling, and work continuity. For clients with intermittent analytical needs, discounts may be extended based upon the quantity of work submitted at one time (\$1,000 - 4,999 = 5%, \$5,000+ = 10%). All discounts are contingent upon meeting payment terms. LLI reserves the right to drop discounts on late payments. No discounts apply to services provided by hourly rate.

Minimum Billing ... Minimum fee for service is \$10.

Rush Analyses ... A surcharge is added to the list fee if rapid reporting is requested; that is, if work must begin immediately upon receipt of the sample. The surcharge will be 50-200% of the list fee, depending upon the analysis to be performed. Rush analysis service is offered contingent upon prearrangement with our Client Services Group. However, any sample delivered after regular business hours (5 p.m.) will not be entered into our rush analyses handling system until the next business day.

Hazardous Wastes ... Unused portions of samples found or suspected to be hazardous according to state or federal guidelines are returned to the client upon completion of the analytical work. This includes samples known or suspected to contain hazardous materials as defined by state or federal regulatory agencies. The cost of returning the sample may be invoiced to the client. The sample and portions thereof remain the property of the client at all times.

Reports ... LLI prohibits use of its name in connection with any unauthorized conclusions based on its reports without its prior written consent.

Special Reports ... Additional charges may be necessary for customized reports which differ significantly from the LLI format. Additional charges will apply for specific QA/QC report formats, such as data packages or data on diskette. Please ask for a quotation. (NOTE: No reports or copies thereof will be sent to anyone other than the client unless the client formally requests us to do so in writing.)

Litigation ... All costs associated with compliance to any subpoena for documents, for testimony in a court of law, or for any other purpose relating to work performed by LLI, in connection with work performed for that client, shall be paid by the client. Such costs shall include, but are not limited to, hourly charge for persons involved in responding to subpoenas, travel and accommodations, mileage, attorney's preparation of testifier and advice of counsel in connection with response to subpoenas, and all other expenses deemed reasonable and associated with said litigation.

Warranty and Limits of Liability ... In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. The foregoing express warranty is exclusive and is given in lieu of all other warranties, expressed or implied. We disclaim any other warranties, expressed or implied, including a Warranty of Fitness for Particular Purpose and Warranty of Merchantability. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by the company which includes any conditions that vary from the above described Standard Terms and Conditions, and LLI hereby objects to any conflicting terms contained in any acceptance or order submitted by client.

Equal Opportunity/Affirmative Action Notice ... Lancaster Laboratories, Inc., is an equal opportunity/affirmative action employer and complies with all the regulations of executive order 11246 and the regulations promulgated thereunder.

Contracts ... All contracts are subject to review and approval by LLI's legal department, and must be signed by a corporate officer.

Retention of Samples ... After the analytical results have been reported, samples are routinely retained in our storage facilities according to the following schedule. Prior arrangements must be made if samples are to be held for periods longer than those indicated. LLI may charge a monthly fee for long-term storage.

Sample Type	Retention Time
Wastewater, sludge	7 days
Foods, perishables	7 days
All other samples	14 days

(Water tested for potability is discarded immediately after the analysis.)

Retention of Reports ... After analytical results have been reported to client, LLI shall retain copies of such analytical reports for a period of ten years, after which such reports will be destroyed. If client requests additional copies of such analytical reports during the retention period, an additional charge will apply for the preparation and printing of such reports.

Terms 10/1/91

APPENDIX B
EXAMPLE OF ANALYSIS SUMMARY SHEET
(Available Upon Request for all Standard Analyses)

LLI Analysis Summary 12/19/90

Analysis : 0203 Total Solids EPA 160.3
Quantitation limit : 5 mg/l
Sample type : waters
Minimum sample size to be submitted : 250 ml
Container type : glass/plasyov
Preservative : none
Department : 29 ENVIRON. WET CHEMISTRY
Holding time : 7 days
Storage conditions : cool, 4C

Special Instructions:

Basic Principles: A well-mixed sample is evaporated in a tared beaker and dried to a constant weight in an oven at 103-105C. The increase in weight is the total solids.

Reference: USEPA 600/4-79-020, Methods for Chemical Analysis of Water and Wastes, Office of R&D, USEPA-EMSL, Cincinnati, Ohio, (March 1983). Method 160.3.

Other Related Reference: Standard Methods for the Examination of Water and Wastewater, 15th ed., 1980, p. 92-93. Method 209A.

APPENDIX C
RESUMES OF KEY PERSONNEL

Earl H. Hess, Ph.D., Chairman of the Board, President, and CEO

Education:

B.S. Chemistry (cum laude) Franklin and Marshall College (1952)
Ph.D. Organic and Biochemistry, University of Illinois (1955)

Continuing Education:

Executive Quality College, Philip Crosby Associates (1989)
Quality Education System Instructor Training, Philip Crosby Associates (1989)

Post Doctoral Experience:

Chemistry Faculty, Franklin and Marshall College (1955 - 1957)
Research and Development Division, General Cigar Company (1957 - 1961)
Established Lancaster Laboratories, Inc. (1961)

Publications:

Various U.S. and foreign patents, scientific papers in basic and applied research (bibliography furnished on request).

Biographical Listings:

Who's Who in America
American Men and Women of Science
Men of Achievement
Who's Who in the East
Who's Who in Frontier Science and Technology
Who's Who in Technology Today

Awards, Citations, and Honorary Societies:

Honorary Societies - Phi Beta Kappa, Phi Lambda Upsilon, Sigma Xi
American Council of Independent Laboratories, Inc.,
Special Service Award (1979)
Roger W. Truesdail Award for Outstanding Service to Independent Laboratories (1983)
Distinguished Pennsylvanian (1982) (William Penn Committee)
Business Leader of the Year (1988) Pennsylvania Chamber of Business and Industry
Franklin & Marshall Alumni Citation (1988)
Lancaster Chamber of Commerce Exemplar Award (1988)
Sales and Marketing Executive of the Year Award (1989)
Small Business Award (Lancaster Chamber) (1989)

Professional, Trade, Civic, Memberships, and Offices:

American Council of Independent Laboratories (ACIL)
President (1985 - 1986)
ACIL Education Institute, Chairman of the Board (1992 -)
Lancaster Chamber of Commerce and Industry
Chairman of the Board (1985)
Pennsylvania Chamber of Commerce, Board of Directors
Vice Chairman (1984)
U.S. Chamber of Commerce, Board of Directors
Chairman, Eastern Region Vice; Chairman, Environmental Committee; Chairman, Accrediting Board
Chairman, Pennsylvania Delegation to 1986 White House Conference on Small Business
Issues Commissioner, Pennsylvania Governor's Conference on Small Business (1988)

Pennsylvania (Governor's) Commission on Families and Children (1991 -)
Pennsylvania (Governor's) Small Business Advisory Council (1989 -)
American Association for the Advancement of Science (AAAS)
American Association for Laboratory Accreditation (AZLA)
Chairman, Accreditation Council (1988 - 1991)
American Chemical Society (ACS)
American Public Health Association (APHA)
American Society for Testing and Materials (ASTM)
Committee on Laboratory Evaluation E-36
Business Executives for National Security (BENS)
Commonwealth Foundation, Board of Directors, Treasurer
Conestoga Valley Education Foundation, Board of Directors
Franklin & Marshall College, Trustee, Finance Committee
Meridian Bank, Susquehanna Valley Divisional Board
New York Academy of Sciences
Pennsylvania Council on Economic Education, Board of Directors

Other Affiliations:

Mountain States Analytical, Inc., Chairman of the Board
Gulf States Analytical, Inc., Board of Directors

J. Wilson Hershey, Ph.D., Executive Vice President/Director, Laboratory Operations

Education:

B.A. Chemistry, Millersville State College (1972)
M.S. Chemistry, Villanova University (1983)
Ph.D. Analytical Chemistry, Villanova University (1985)
M.B.A., Villanova University (1991)

Continuing Education:

Attended numerous technical meetings and seminars including short courses in gas chromatography and atomic spectroscopy.
Quality Management College, Philip Crosby Associates (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1972
Executive Vice President (1991)

Publications:

Seven scientific publications in analytical chemistry

Memberships:

American Association for Laboratory Accreditation Environmental Advisory Committee
American Chemical Society
Chromatography Forum of Delaware Valley
Committee on National Accreditation of Environmental Laboratories (Federal Advisory Committee)

Kenneth Hess, B.S., Executive Vice President, Finance and Data Processing

Education:

B.S. Chemistry, Juniata College (1975)

Continuing Education:

Various courses in accounting and computers.
Quality Management College, Philip Crosby Associates (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1975
Executive Vice President (1991)

Memberships:

Juniata College Trustee

Carol Miller, M.B.A., Executive Vice President, Human Resources and Administration

Education:

B.S. Applied Mathematics/Economics, Ursinus College (1982)
M.B.A. Administrative Management, Saint Joseph's University (1987)

Continuing Education:

Franklin and Marshall College, Interviewing and Selection Techniques (1983)
Franklin and Marshall College, Personnel Management (1983)
Managing Human Performance (1984)
Quality Management College, Philip Crosby Associates (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1981
Executive Vice President (1991)

Publications:

In Environmental Lab: "A Business Plan for Employee Retention Programs," October 1989
and "The Benefits of Human Resources," November 1989

Memberships and Appointments:

Leadership Lancaster, 1984 Graduate
American Society for Training & Development (1985)
Junior Achievement, Board of Directors (1985 - 1986)
Multiple Sclerosis Society, Board of Directors (1985 - 1988)
Human Resources Committee of the Pennsylvania Chamber of Commerce
Chairperson, Employee Benefits Subcommittee
Chairperson of the Steering Committee of the Environmental Laboratories Compensation Survey
Legislation Subcommittee for the Lancaster County Human Resource Management Association
Health and Employee Benefits Committee of the U.S. Chamber of Commerce
Chairperson of the Human Resources Committee for the American Council of Independent
Laboratories (ACIL)
Named Working Mother of the Year by Working Mother magazine (1990)
Lancaster Chamber of Commerce Board of Directors
Board of Trustees, Messiah College
ACIL Educational Institute Steering Committee

Eugene Abel, Jr., B.S., Chemist II/Coordinator, AAS Metals, Environmental Sciences

Education:

B.S. Science, Pennsylvania State University (1965)

Continuing Education:

Atomic Absorption Spectroscopy, Instrumentation Laboratories, Inc. (1975)
Computer School for Spectroscopic Applications, Angstrom, Inc. (1983)

Professional Experience:

Horsehead Resources Development Co., Inc./Zinc Corporation of America,
Chemist/Lab Supervisor (1965 - 1989)
With Lancaster Laboratories, Inc. since 1989
Coordinator (1990)

Nadia Alfieri, IHIT, Air Quality Program Specialist III, Air Quality, Environmental Sciences

Education:

B.S. Environmental Science, Rutgers University (1982)
M.S. Environmental Science, Rutgers University (1987)

Continuing Education:

Industrial Hygienist In Training (1990)
The Clean Air Act from A to Z, Executive Enterprises (1991)
AHERA Asbestos Inspector Refresher Course (1991)
AHERA Asbestos Management Planner Refresher Course (1991)
NJ Asbestos Safety Technician Refresher Course (1991)

Professional Experience:

Structure Probe, Inc., Research Chemist (1980 - 1984)
Johnson & Johnson Baby Products, Industrial Hygienist/Chemical Inventory Coordinator (1984 - 1985)
Rutgers University, Assistant Instructor (1983 - 1985)
Princeton Testing Laboratory, Assistant Manager, Industrial Hygiene (1985 - 1987)
Industrial Hygiene Forum for Scientific Excellence, Manager, Industrial Hygiene (1987 - 1989)
Alfieri Environmental, Inc., President (1989 - Present)
With Lancaster Laboratories, Inc. since 1991

Memberships:

Air & Waste Management Association
NJ & PA Sections of American Industrial Hygiene Association
PA Association of School Business Officials

Sandra Bailey, B.S., Group Leader I, Nutrition Labelling, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry (cum laude), University of Delaware (1987)

Continuing Education:

Scientific Instruments Auto Analyzer Training Course (1987)

Entry Level Management Development Program (1989)

Applied Statistics, Penn State Continuing Education (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987

Group Leader I (1991)

Memberships:

Institute of Food Technology

Karen Baney, B.S., Chemist I, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Medical Technology, Millersville University (1986)

Professional Experience:

St. Joseph Hospital, Medical Technologist (1986 - 1988)

With Lancaster Laboratories, Inc. since 1988

Chemist I (1991)

Gordon Beitzel, B.S., Systems Specialist II, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Electrical Engineering, Pennsylvania State University (1987)

Continuing Education:

Microsoft Developer's Tools Forum (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988

Systems Specialist II (1990)

Derek Berger, Chemist I, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Shippensburg University (1989)

Continuing Education:

M.S. Chemistry Coursework, Shippensburg University
Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist I (1991)

Nancy Bornholm, B.S., Client Services Specialist II, Environmental Sciences

Education:

B.S. Chemistry (magna cum laude), Muhlenberg College (1981)

Continuing Education:

Instrumental Analysis of Paints and Polymers, FBI Academy (1984)
Analytical Chemistry of Contaminants in Surface and Groundwater, ACS Short Course (1986)

Professional Experience:

University of Connecticut Health Center, Laboratory Technician (1977 - 1980)
Institute for Cancer Research, Research Technician (1981)
Baltimore City Crime Laboratory, Mobile Crime Unit Trainee (1981 - 1982)
Maryland State Police Crime Laboratory, Forensic Chemist III (1982 - 1985)
With Lancaster Laboratories, Inc. since 1985
Client Services Specialist II (1988)

Charles Bourque, B.A., Chemist IV, GC/MS Volatiles, Environmental Sciences

Education:

B.A. Chemistry/Mathematics, University of Maine (1981)

Continuing Education:

Gas Chromatography Training Course, Perkin Elmer Corp. (1984)
Hewlett Packard GC/MS Training Course (1984)
Management Training Course (1988)

Professional Experience:

Planning Research Corp., Chemist (1981 - 1982)
E.C. Jordan Consulting Engineers, Chemist (1983 - 1986)
With Lancaster Laboratories, Inc. since 1986

Stephanie Bozym, B.S., Client Services Specialist I, Environmental Sciences

Education:

B.S. Microbiology, Pennsylvania State University (1990)

Professional Experience:

ICI Pharmaceuticals, Pharmaceutical Sales Representative (1990 - 1991)
With Lancaster Laboratories, Inc. since 1991

Monica Bretzin, M.S., Quality Assurance Specialist I

Education:

B.A. Biochemistry (cum laude), Dartmouth College (1983)
M.S. Toxicology, Massachusetts Institute of Technology (1986)

Continuing Education:

Computer Validation Advanced Training, Society of Quality Assurance (1991)
Society of Quality Assurance Conference (1991)

Professional Experience:

University of Maryland, European Division, College Instructor (1986 - 1988)
Big Bend Community College, European Division, College and Secondary-Level Instructor (1986 - 1988)
Central Texas College, European Division, College Instructor (1986 - 1988)
With Lancaster Laboratories, Inc. since 1990
Quality Assurance Specialist I (1990)

Publications:

One scientific publication in biochemistry

Memberships:

Mid-Atlantic Region Society of Quality Assurance

Mary Ann Brubaker, M.S., Group Leader I, Data Package, Environmental Sciences

Education:

B.S. Chemistry, Marywood College (1971)
M.S. Chemistry, Xavier University (1973)

Continuing Education:

8 Graduate Credits in Polymeric and Inorganic Chemistry, University of Delaware (1975)

Professional Experience:

Armstrong World Industries R&D Center, Scientist (1976 - 1991)
With Lancaster Laboratories, Inc. since 1991

Publications:

"The Preparation and Characterization of the Compounds $N_3P_3(OC_6H_4-p-F)_6$, $N_3P_3(OC_6H_4-p-Cl)_6$, and $N_3P_3(OC_6H_4-p-Br)_6$ ", Inorg. Nucl. Chem. Letters, Vol. 11; 313-318 (1975)

Awards and Citations:

Granted U.S. Patent No. 4,595,626 "Conformable Tile" June 17, 1986

Richard Burke, M.S., Director, Sales & Client Services

Education:

B.S. Chemistry, LeMoyne College (1969)

M.S. Chemistry, State University of New York - College of Environmental Science and Forestry (1978)

Continuing Education

Quality Management College, Philip Crosby Associates (1989)

Professional Experience:

Donohue & Associates, Laboratory Project Manager (1978 - 1979)

Camp Dresser & McKee, Inc., Laboratory Services Manager (1979 - 1981)

Kemron Environmental Sciences, Field Services Manager (1981)

IT Corp., Laboratory Manager (1982 - 1987)

IT Corp., Regional Lab Director (1987 - 1988)

With Lancaster Laboratories, Inc. since 1988

Publications:

Arsenic in the Marine Environment (1978)

Memberships:

Air & Waste Management Association

American Chemical Society

American Society of Testing and Materials

PA Chamber of Commerce, Environmental Affairs Committee

Water Pollution Control Federation

Martha Casstevens, B.S., Manager I, Air Quality/Data Package

Education:

B.S. Business Administration (Management), Millersville University (1985)

Biology, 36 credits, Millersville University (1983)

Continuing Education:

Rapid Methods and Automation in Microbiology, Kansas State University (1986)

Immunology, Lebanon Valley College (1986)

Environmental Analytical Chemistry, ACS Short Course (1989)

Principles of Groundwater Monitoring, Geraghty & Miller (1989)

Professional Experience:

Hershey Chocolate Company, Microbiology Technician (1985 - 1986)
With Lancaster Laboratories, Inc. 1978 - 1984, 1986 - Present
Manager I (1991)

Mark Clark, B.S., Chemist II/Coordinator, ExpressLAB, Environmental Sciences

Education:

B.S. Biochemistry, Millersville University of Pennsylvania (1986)

Continuing Education:

Gas Chromatography, Chromatography Forum of the Delaware Valley (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1985
Chemist II (1990)

Brian R. Clow, B.S., Chemist I, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Chemist (ACS Accredited), Colorado State University (1988)

Continuing Education:

Certified OSHA 40-hour Hazardous Waste Training (Under 21 CFR 1910.120) (1990)
Certified 8-hour Training for EPA Level B Field Work (1990)
Chemistry of Hazardous Materials in Soils, Graduate Studies, University of Colorado (1990)
Advanced Organic Chemistry, Graduate Studies, University of Colorado (1990)
Certified OSHA Annual Refresher Training (Under 21 CFR 1910.120) (1991)

Professional Experience:

Colorado State University Department of Chemistry, Teaching Assistant (1988)
Cord Laboratories/Geneva Generics, Junior Chemist (1989)
Woodward-Clyde Federal Services, Staff Chemist (1989 - 1991)
With Lancaster Laboratories, Inc. since 1991

Memberships:

American Chemical Society

Harolyn Clow, B.S., Microbiologist II, Pharmaceutical Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Microbiology, Colorado State University (1986)

Certifications:

Registered Microbiologist in Consumer Products and Quality Assurance Microbiology, National Registry of Microbiologists of the American Academy of Microbiology

Continuing Education:

Laboratory Identification of Gram Positive Bacteria, Colorado Association for Continuing Medical Laboratory Education (1989)

Enterobacteriaceae, Colorado Association for Continuing Medical Laboratory Education (1990)

Laboratory Management: Quality Assurance/Quality Control, Colorado Association for Continuing Medical Laboratory Education (1990)

Professional Experience:

Benedict Nuclear Pharmaceuticals, Inc., Supervisor of Quality Control (1987 - 1990)

Cell Technology, Inc., Quality Assurance/Quality Control Analyst (1990 - 1991)

With Lancaster Laboratories, Inc. since 1991

Memberships:

American Society for Microbiology

American Society for Quality Control

National Registry of Microbiologists

Judy Colello, A.S., Group Leader I, Organic Analysis by GC & Organic Analysis Group, Environmental Sciences

Education:

A.S. Applied Science Medical Technology, Manor Junior College (1982)

Continuing Education:

Assertiveness Training, Lancaster YWCA (1987)

Managing Multiple Priorities, Dun and Bradstreet (1988)

Business Administration/Management Coursework at Millersville University (Graduating 8/92)

Geraghty and Miller, Fundamentals of Groundwater Contamination (1990 - 1991)

Professional Experience:

Lancaster Community Hospital, Laboratory Technician (1982 - 1984)

Struthers Medical Arts Clinic, Laboratory Supervisor (1984 - 1985)

With Lancaster Laboratories, Inc. since 1985

Group Leader I (1990)

Presentations:

"Women in the 1990's, Will They Reach the Top?", Midwest Business Association Conference (1991)

Biographical Listings:

Who's Who in American Junior Colleges

Memberships:

Chromatography Forum of Delaware Valley

Awards and Citations:

Spirit of LLI Award (1991)

Paul Cormier, B.S., Chemist II, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Microbiology, Virginia Tech (1984)
B.A. Chemistry, Virginia Tech (1984)

Continuing Education:

Hewlett Packard GC/MS Advance Operations/System Manager Course (1990)
Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experiences:

Environmental Testing & Certification (1985 - 1989)
Analytikem, Inc. (1989 - 1990)
With Lancaster Laboratories, Inc. since 1990

Memberships:

American Chemical Society

Susan Croyle, B.S., Chemist I, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Juniata College (1988)

Continuing Education:

Advanced Aquarius Report Training, Hewlett Packard (1989)
Social Styles Series, Wilson Learning Corporation (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist I (1990)

Memberships:

American Chemical Society

Eric Cuba, B.S., Chemist II/Coordinator, ICP Metals, Environmental Sciences

Education:

B.S. Chemistry, King's College (1985)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Chemist II/Coordinator (1991)

Earl Custer, B.S., Microbiologist III/Coordinator, Environmental Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Biology, University of Pittsburgh (1969)

Professional Experience:

With Lancaster Laboratories, Inc. since 1973
Microbiologist III/Coordinator (1989)

Kathy DiNunzio, B.S., Quality Assurance Specialist I

Education:

B.S. Business Administration, Elizabethtown College (1989)

Continuing Education:

Environmental Law and Policy (1991)
Applied Statistics, Penn State University (1991)
IAETL - Regulatory Process and Technical Aspects of the Environmental Laboratory (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1990
Quality Assurance Specialist I (1992)

Mary Dormer, B.S., Chemist I, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, Millersville University of Pennsylvania (1987)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Chemist I (1990)

Patricia Downing, B.S., Marketing Specialist III, Environmental Sciences

Education:

B.S. Chemistry, Spring Garden College (1982)

Continuing Education:

Sales Consultants, Sales Training (1989)

PAR Associates, Sales Training (1989)

OSHA 40-hour Training (1990)

How to Market Professional Services, ACIL Educational Seminars (1990)

Professional Experience:

Rollins Environmental Services, Inc., Chemist (1982 - 1986)

Century Labs, Client Services (1986 - 1988)

York Laboratories, Account Executive (1988 - 1990)

With Lancaster Laboratories, Inc. since 1990

Marketing Specialist III (1991)

Robin Young Eaton, M.S., Group Leader I, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Chemistry, Longwood College (1980)

M.S. Chemistry, Virginia Commonwealth University (1983)

Continuing Education:

Social Styles Series, Wilson Learning Corporation (1991)

Stress Management for Group Leaders (1991)

Mass Spectral Interpretation Course, Finnigan MAT (1991)

Professional Experience:

Instructor for the Pennsylvania State University at the York Campus and the Capital College locations teaching General Chemistry and Organic Chemistry courses (1984 - 1988)

With Lancaster Laboratories, Inc. since 1988

Group Leader I (1991)

Presentations and Publications:

Two scientific presentations on Catalysis at American Chemical Society meetings, and one scientific presentation on Catalysis at the Eighth North American Catalysis Meeting

Three scientific papers in the area of Catalysis for Synthesis Gas Conversion

Memberships:

American Association for the Advancement of Science

American Chemical Society

Bethany Ann Ebling, B.S., Group Leader I, Water Quality, Environmental Sciences

Education:

B.S. International Agriculture, Purdue University (1981)

Continuing Education:

Chrompack Inc. Basic HPLC course (1987)

Fundamentals of Groundwater Contamination, Geraghty & Miller, Inc. (1990)

Applied Statistics, Penn State Continuing Education (1990)

Professional Experience:

Purdue University, Laboratory Technician (1981 - 1982)

Princeton University, Laboratory Technician (1983 - 1985)

Carnegie Mellon University, Environmental Engineering Laboratory Manager (1986 - 1988)

Extrel Corporation, QA/QC Specialist (1988 - 1989)

With Lancaster Laboratories, Inc. since 1989

Group Leader I (1990)

Memberships:

American Chemical Society

Association of Official Analytical Chemists

Mary Lou Eckels, B.A., Chemist I, Organic Analysis Group, Environmental Sciences

Education:

B.A. Chemistry, Franklin & Marshall College (1986)

Continuing Education:

Gas Chromatography, Chromatography Forum of Delaware Valley (1990)

Applied Statistics, Penn State Continuing Education (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986

Chemist I (1989)

Awards and Citations:

Inter Collegiate Student Chemist Convention 1st place Analytical Chemistry (1986)

Richard Entz, B.A., Senior Technical Specialist, Environmental Sciences

Education:

B.A. Chemistry, Wabash College (1972)

Continuing Education:

Graduate Work in Analytical Chemistry, Kansas State University (1972 - 1977)

Basic Gas Chromatography, American Chemical Society (1978)

Advanced Gas Chromatography, American Chemical Society (1979)

Basic Liquid Chromatography, American Chemical Society (1980)
Toxicology for Chemists, American Chemical Society (1983)
Rational Decision Making, Kepner-Tregoe (1984)
Managing Multiple Priorities, Dun & Bradstreet (1987)
Procedures for Sampling and Analysis of Air Toxics, American Chemical Society (1990)
Environmental Regulations, Executive Enterprises (1991)

Professional Experience:

Teaching Assistant, Kansas State University (1972 - 1974)
U.S. Department of Agriculture, Research Assistant (1974 - 1977)
U.S. Food and Drug Administration, Division of Chemical Technology, Chemist (1977 - 1984)
With Lancaster Laboratories, Inc. since 1984
Senior Technical Specialist (1991)

Publications:

Four publications in areas of environmental analytical chemistry and volatile organic compounds.

Awards and Citations:

Undergraduate Chemistry Award, Wabash College (1972)
Phillips Petroleum Research Award (1976)
Phi Lambda Upsilon

Memberships:

Air and Waste Management Association
American Chemical Society

Phillip Esbenshade, Ph.D., Chemist I, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Biology, Pennsylvania State University (1978)
M.S. Plant Pathology, North Carolina State University (1980)
Ph.D. Plant Pathology, North Carolina State University (1986)

Professional Experience:

International Meloidogyne Project Department of Plant Pathology North Carolina State University,
Research Assistant (1980 - 1984)
Department of Genetics, North Carolina State University, Research Assistant (1985 - 1989)
With Lancaster Laboratories, Inc. since 1989
Chemist I (1991)

Publication:

9 scientific publications on plant pathology

Awards and Citations:

Phi Kappa Phi
Gamma Sigma Delta
Best Student Paper, Society of Nematologists (1984)
Sigma Xi

Memberships:

American Phytopathological Society, Committee on Nematology
Society of Nematologists

David Evans, B.S., Chemist I/Coordinator, Instrumental Water Quality, Environmental Sciences

Education:

B.S. Chemistry, Millersville University (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist I/Coordinator (1991)

Jack Follweiler, B.S., Industrial Hygienist II, Air Quality, Environmental Sciences

Education:

B.S. Analytical Chemistry, Juniata College (1982)

Continuing Education:

Industrial Hygiene Refresher Course (1985)
U.S. EPA: "Asbestos in Buildings - A Symposium" (1985)
U.S. EPA Course: "Asbestos Hazards, Evaluation and Abatement" (1987)
McCrone Research Institute: "Advanced Asbestos Identification" (1986)
U.S. EPA: "Symposium on Indoor Air" (1986)
U.S. EPA Course: "AHERA Building Inspector" (1987)
Quality Management College, Philip Crosby Associates (1989)
National Asbestos Council Professional Development Seminar: Project Design (1990)
National Asbestos Council Professional Development Seminar: Environmental Assessments (1990)
USEPA Course: "Asbestos Contractor/Supervisor Annual Refresher" (1991)
USEPA Course: "AHERA Building Inspector Annual Refresher" (1991)
USEPA Course: "AHERA Management Planner" (1991)
USEPA Course: "AHERA Project Designer" (1991)
PA-Certified Management Planner (1991)
PA-Certified Project Designer (1991)
Project Management/Cost Estimating Course, Pennsylvania State University (1991)

Professional Experience:

ICI Americas, Inc., Analytical Chemist/Industrial Hygienist (1982 - 1985)
With Lancaster Laboratories, Inc. since 1985

Memberships and Appointments:

Central Pennsylvania Section - American Industrial Hygiene Association (CPS-AIHA),
Co-Director, Professional Development (1987 - 1988)
EPA Technical Consultant for air sampling and analytical methodologies (EPA Region III)
PLM/PCM Subcommittee of the Sampling and Analytical Committee of the National Asbestos Council
Asbestos Subcommittee of the Environmental Section of the American Council of Independent
Laboratories, Inc.
Pennsylvania Chapter of the National Asbestos Council (PAC-NAC)
National Asbestos Council (NAC)

National Institute of Building Science (NIBS) Asbestos O&M Work Practices Committee
Pennsylvania Chamber of Business and Industry Asbestos Certification Work Group

Jane Follweiler, B.S. Chemist I/Coordinator, ICP Metals, Environmental Sciences

Education:

B.S. Biology, Juniata College (1982)

Continuing Education:

Society for Applied Spectroscopy Short Course: "Plasma Spectrochemical Analysis" (1990)
Inductively Coupled Plasma & Thermo Spec Software Training Course, Thermo Jarrell Ash (1991)

Professional Experience:

John Hopkins University (1982 - 1983)
University of Medicine and Dentistry of New Jersey (1983 - 1985)
M. S. Hershey Medical Center of Penn State University (1985 - 1990)
With Lancaster Laboratories, Inc. since 1990
Coordinator (1991)

Publications:

"Absence of α -Spectrin Synthesis in Lethal Hereditary Spherocytosis," C. F. Whitfield, J. B. Follweiler, and B. A. Miller, FASEB Journal 4:A1234 (1990)
"Deficiency of α -Spectrin Synthesis in BFU-Es in Lethal Hereditary Spherocytosis," C. F. Whitfield, J. B. Follweiler, L. Lopresti-Morrow, and B. A. Miller, submitted to Journal of Clinical Investigation (1990)

Memberships:

Society for Applied Spectroscopy

Greg France, B.A., Chemist I, Pesticide Residue Analysis, Environmental Sciences

Education:

B.A. Chemistry, Holy Cross College (1988)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist I (1991)

Joseph Friel, B.S., Chemist I, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, PMC, Widener University (1964)
20 graduate credits, Chemistry, State University of New York (1966 - 1971)

Professional Experience:

Ayerst Laboratories, ascending positions in all phases of quality control laboratory testing (1964 - 1982)
Ayerst Laboratories, Manager, Estrogen Labs (1982 - 1986)
Scott Paper Company, Chemical Services Technician (1986 - 1987)
With Lancaster Laboratories, Inc. since 1987

Gloria Gates, B.S., Group Leader I, Project Work, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, Bloomsburg State College (1983)

Continuing Education:

Maintaining and Troubleshooting Chromatographic Systems Workshop, ACS Short Course (1986)
Wide Bore GC Course, Chrompack Inc. (1988)
Capillary GC Course, J & W Scientific (1989)

Professional Experience:

Berkley Products, Analyst (1983)
Warner-Lambert, Parke Davis, Associate Chemist (1984 - 1985)
With Lancaster Laboratories, Inc. since 1985
Group Leader I (1991)

Publications:

"Determination of Cholesterol in a Variety of Foods," JAOAC (1990)

Daniel Gerth, M.S., Manager I, Inorganics, Environmental Sciences

Education:

B.S. Chemistry, Western Illinois University (1974)
M.S: Analytical Chemistry, Villanova University (1987)
Ph.D. Analytical Chemistry, Villanova University (Spring 1992)

Professional Experience:

Illinois Water Treatment Co., Chemist (1974 - 1979)
Barber Colman Co., Plant Chemist (1979 - 1981)
Betz Laboratories, Project Leader (1981 - 1990)
With Lancaster Laboratories, Inc. since 1991

Publications:

Two fundamental reviews on emission spectroscopy for analytical chemistry.
One paper on element specific detection for metal analysis.
One paper on an object-oriented data handling program for chromatography.

Biographical Listings:

Who's Who in American Junior Colleges

Memberships:

American Chemical Society
International Union of Pure and Applied Chemists
Society for Applied Spectroscopy

Debora Gifford, B.S., Group Leader I, AAS Metals, Environmental Sciences

Education:

B.S. Health and Physical Education, Ursinus College (1977)

Continuing Education:

General, Organic, and Analytical Chemistry Courses, Muhlenberg College (1979 - 1981)
Calculus I and II, Villanova University (1983)
Physics I and II, Ursinus College (1985)

Professional Experience:

Eastern PA Health Care Foundation, Special Projects Coordinator (1978 - 1981)
BCM Lab, Technical Supervisor (Instrumentation) (1981 - 1985)
With Lancaster Laboratories, Inc. since 1985
Group Leader I (1989)

Memberships:

Society for Applied Spectroscopy

C. Robert Graham, B.S., Senior Microbiologist, Food Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Dairy Science, Pennsylvania State University (1963)

Professional Experience:

With Lancaster Laboratories, Inc. since 1964
Senior Microbiologist (1985)

Publications:

"Effect of Supercritical Fluid Extraction on Microorganisms", IFT (1987)
"Microbiological Considerations of Processing Confectionery Rework", PMCA (1989)

Memberships and Appointments:

American Association of Candy Technologists (Philadelphia Section, Chairman)
American Society for Testing and Materials
AOAC Committee on Microbiology and Extraneous Materials
Approved Dairy Inspector, Pennsylvania Department of Agriculture
Associate Referee of AOAC for Extraneous Filth in Chocolate & Chocolate Products

Pennsylvania Dairy Laboratory Directors Association
Pennsylvania Manufacturing Confectioners Association (Program Committee)

Rick Griffith, Marketing Specialist II, Environmental Sciences

Education:

Assoc. Electronics, DeVry Technical Institute (1980)

Continuing Education:

Supervisory Management Certification, Franklin & Marshall College (1983)

Professional Experience:

RCA, Production Supervisor (1980 - 1986)
B+B Communications, Sales Representative (1987 - 1988)
With Lancaster Laboratories, Inc. since 1988
Marketing Specialist II (1991)

Kathy Hallquist, Client Services Specialist II, Environmental Sciences

Education:

Onondaga Community College
Community General Hospital Pharmacy Technician Certification Program (1976)

Continuing Education:

Pharmacology - Study of Drugs and Their Effects (1978)

Professional Experience:

Community General Hospital, Pharmacy Technician IV (1976 - 1980)
Evanston Hospital, Senior Technician IV (1980 - 1981)
Hazelton Environmental, Chemistry Lab Technician (1981)
Hazelton Laboratories of America, Sample Administrator of Radioimmunoassay Dept. (1981 - 1983)
St. Joseph's Hospital, Pharmacy Technician IV (1983 - 1985)
With Lancaster Laboratories, Inc. since 1985
Client Services Specialist II (1991)

Lynn Hebner, B.S., Client Services Specialist I, Environmental Sciences

Education:

B.S. Conservation and Resource Development, University of Maryland (1981)

Professional Experience:

University of Missouri, Senior Research Lab Technician (1982 - 1984)
GPU Nuclear Corporation, Data Analyst (1985 - 1989)
With Lancaster Laboratories, Inc. since 1989

Mark Heinbaugh, B.A., Chemist III/Coordinator, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, Shippensburg State College (1979)

Professional Experience:

Warner Lambert Company, Senior Analyst/Laboratory Supervisor (1980 - 1989)
With Lancaster Laboratories, Inc. since 1989

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

Robert Heisey, Jr., B.A., Chemist II/Coordinator, Water Quality, Environmental Sciences

Education:

B.A. Chemistry, Millersville State College (1972)

Professional Experience:

RCA Corp., Engineering Technician (1972 - 1987)
With Lancaster Laboratories, Inc. since 1988
Chemist II/Coordinator (1989)

Trudi Hensley, B.A., Chemist I, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Science, University of Maryland (1984)

Professional Experience:

Aberdeen Proving Grounds, Technician (1981 - 1983)
Lever Brothers, Inc., Chemist (1984 - 1985)
Center for Fire Research, Research Associate (1985 - 1986)
Barre National, Inc., Chemist II (1987 - 1990)
With Lancaster Laboratories, Inc. since 1990

Awards:

Barre National Quality Award

Jenifer Hess, B.S., Chemist III/Coordinator, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, University of Delaware (1984)

Continuing Education:

Currently enrolled in M.B.A. program, University of Delaware (15 credits)

Professional Experience:

J. M. Huber Corporation, Research Chemist (1984 - 1985)
With Lancaster Laboratories, Inc. since 1985
Chemist III/Coordinator (1990)

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

M. Louise Hess, B.S., Director, Quality Assurance

Education:

B.S. Chemistry (cum laude), Lebanon Valley College (1978)

Continuing Education:

Several short courses in atomic absorption and gas chromatography
Quality Assurance of Chemical Measurements, ACS (1985)
Quality Assurance in Microbiology, AOAC (1985)
Villanova University graduate work in analytical chemistry (1986)
Quality Management College, Philip Crosby Associates (1989)
Quality Education System Instructor Training, Philip Crosby Associates (1989)
Quality Work Group Instructor Training, Philip Crosby Associates (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1978
Director, Quality Assurance (1985)

Publications:

Two scientific papers on basic research in physical chemistry

Memberships:

Society of Quality Assurance

Joseph Hill, B.S., Chemist II, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Biology (magna cum laude), Fairleigh Dickinson University (1982)

Continuing Education:

Superincos Operation, Finnigan MAT Institute (1987)
Mass Spectral Interpretation Course, ACS Course (1988)
Currently enrolled at West Chester University progressing towards M.S. in Chemistry.
Mass Spectral Interpretation, Finnegan MAT Institute (1991)

Professional Experience:

ICI Americas, Inc., Senior Research Technician (1982 - 1984)
National Foam Inc., Senior Research Technician (1985 - 1986)
Roy F. Weston, Inc., Associate Project Scientist (1986 - 1989)
With Lancaster Laboratories, Inc. since 1989
Chemist II (1990)

Memberships:

American Chemical Society

Michael Hintenach, B.S., Computer Integration Specialist II, Inorganic Analysis, Environmental Sciences

Education:

B.S. Chemistry, Lebanon Valley College (1988)

Continuing Education:

Computer Organization & Design, Villanova (1989)
DECUS Symposium, RSX System Management (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Computer Integration Specialist II (1991)

Memberships:

DECUS

Kathleen Holley, B.S., Chemist I, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Biology/Chemistry, Beaver College (1987)

Continuing Education:

Mass Spectral Interpretation Course, Finnigan MAT Institute (1991)
Social Styles Series, Wilson Learning Corporation (1991)

Professional Experience:

E. I. DuPont Experimental Station, Analytical Chemist (1987 - 1988)
Roy F. Weston, Inc., Assistant Project Scientist (1988 - 1989)
With Lancaster Laboratories, Inc. since 1989

Catherine Holt, B.S., Computer Specialist III, GC/MS Volatiles, Environmental Sciences

Education:

B.A. Mathematics, Franklin & Marshall College (1984)
B.S. Computer Science, Millersville University (1987)

Continuing Education:

Novell Network Seminar (1989)
Clarion Database Management Seminar (1991)

Professional Experience:

R.R. Donnelley & Sons Company (1985 - 1987)
Shared Medical Systems (1987 - 1989)
With Lancaster Laboratories, Inc. since 1989

David Hooley, Ph.D., Group Leader II, Computer Services

Education:

B.A. Chemistry, Eastern Mennonite College (1973)
Ph.D. Chemistry, Virginia Polytechnic Institute (1981)

Continuing Education:

Effective Management of Chemical Analysis Laboratories (1984)
Masscomp MC5500 Hardware Maintenance (1986)
Attended numerous conferences on analytical chemistry, scientific computing and laboratory information management

Professional Experience:

WVPT-TV, Harrisonburg, VA, Operating Engineer (1972 - 1974)
Virginia Polytechnic Institute, Research Assistant (1974 - 1981)
Standard Oil Research & Development (1981 - 1987)
With Lancaster Laboratories, Inc. since 1987
Group Leader II (1991)

Publications and Presentations:

Five scientific publications on computer applications in analytical chemistry
Integrating LIMS and Business at Lancaster Laboratories, Inc.: Continuing Development given at 102nd AOAC Annual Meeting
An Architecture for Data Transfer from Instruments given at 103rd AOAC Annual Meeting

Memberships:

American Chemical Society
Forth Interest Group
Phi Lambda Upsilon

Samuel A. Huber, Chemist I/Coordinator, Instrumental Water Quality, Environmental Sciences

Education:

B.S. Biology, Lebanon Valley College (1988)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist I/Coordinator (1991)

Anneliese Hutchison, B.S., Group Leader I, Sample Administration

Education:

B.S. Molecular and Cell Biology, Pennsylvania State University (1986)

Continuing Education:

Currently enrolled in M.B.A. program at Pennsylvania State University

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Group Leader I (1992)

Jeannie Jacobson, B.S., Client Services Specialist II, Pharmaceutical Sciences

Education:

B.S. Biology (cum laude), Lambuth College (1986)

Continuing Education:

Limulus Amebocyte Lysate Testing Workshop (1988)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Client Services Specialist II (1990)

Biographical Listings:

Who's Who in American Colleges & Universities

Beatrice Joseph, B.S., Chemist I, AAS Metals, Environmental Sciences

Education:

B.S. Chemistry, College of Pharmacy and Chemistry, Iraq (1953)

Continuing Education:

Atomic Absorption Spectrometry

Professional Experience:

St. Joseph's Hospital, Research Institute, Laboratory Technician (1969 - 1976)
With Lancaster Laboratories, Inc. since 1976
Chemist I (1977)

Mark Kaiser, Group Leader III, Pharmaceutical and Environmental Microbiology, Food & Pharmaceutical Sciences

Education:

Elizabethtown College, Biology 120 credits (1983)

Continuing Education:

Fundamentals of D, Z, and F Valves, Parenteral Drug Association (1989)
Viable and Nonviable Environmental Monitoring, Parenteral Drug Association (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1983
Group Leader III (1991)

Memberships:

LAL User's Group
Parenteral Drug Association, Delaware Valley Chapter, Secretary Operating Committee
Parenteral Drug Association, Microbiological Subcommittee

Jon Kauffman, Ph.D., Group Leader I, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Millersville University (1985)
Ph.D. Physical Chemistry, University of Delaware (1989)

Continuing Education:

Basic Mass Spectral Interpretation, Finnigan MAT Institute (1990)

Professional Experience:

Chemistry Department, University of Delaware, Teaching Assistant Honors Chemistry (1985 - 1987)
Chemistry Department, University of Delaware, Nuclear Magnetic Resonance Graduate Assistant (1987 - 1988)
Center for Catalytic Science and Technology, University of Delaware, Research Assistant (1988 - 1989)
With Lancaster Laboratories, Inc. since 1989
Group Leader I (1991)

Publications:

J. S. Kauffman and C. Dybowski, "Determination of Transition Temperatures and Crystalline Content of Linear, High-molecular-weight Polyethylene by Proton NMR Spectroscopy", J. Polym. Sci., Part B, 27, 2203 (1989)

- V. Ramamurthy, J. V. Caspar, D. R. Corbin, D. F. Eaton, J.S. Kauffman, and C. Dybowski, "Modification of Photochemical Reactivity by Zeolites: Arrested Molecular Rotation of Polyenes by Inclusion in Zeolites", *J. Photochemistry and Photobiology*, 51, 259, (1990)
- R. Sprung, M. E. Davis, J.S. Kauffman, and C. Dybowski, "Pillaring of Magadiite with Silicate Species", *I&EC Research*, 29, 213, (1990)
- C. Tsiao, J. S. Kauffman, D. R. Corbin, L. Abrams, E. E. Carroll, Jr., and C. Dybowski, "Xenon in Zeolite rho. Adsorption and Xenon-129 NMR Spectroscopy", *J. Phys. Chem.*, 95, 5586, (1991)
-

Rachel Kreamer, B.S., Client Services Specialist II, Environmental Sciences

Education:

B.S. Biology, Eastern Mennonite College (1980)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Client Services Specialist II (1991)

James Kushubar, Chemist I, AAS Metals, Environmental Sciences

Education:

Chemistry Courses, Millersville University

Continuing Education:

Tutorial in Method Development and Analysis of Metals by Graphite Furnace, AAS, and ICP

Professional Experience:

Lancaster Laboratories, Inc. (1979 - 1985)
General Engineering Labs (1985 - 1986)
With Lancaster Laboratories since 1986
Chemist I (1990)

Robert Large, B.S., Marketing Specialist IV, Environmental Sciences

Education:

B.S. Zoology, Pennsylvania State University (1973)

Continuing Education:

M.B.A. Program, St. Joseph's University (1984 - 1987)
Foundations of Management, Gilbert Associates (1982)
Chromatography/Mass Spectral Interpretation, Finnigan MAT Institute (1981)

Professional Experience:

Gilbert Associates, Inc., Program Manager (1977 - 1984)
Spotts, Stevens, & McCoy, Director of Client Services (1984 - 1990)
With Lancaster Laboratories, Inc. since 1990

Memberships:

American Society for Testing and Materials

John Layman, B.A., Chemist I, GC/MS Semivolatiles, Environmental Sciences

Education:

B.A. Chemistry, Millersville University (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1981
Chemist I (1989)

Ramona Layman, B.S., Group Leader I, Instrumental Water Quality/ICP Metals, Environmental Sciences

Education:

B.S. Chemistry, Grove City College (1984)

Continuing Education:

Basic Ion Chromatography, Dionex (1988)

Professional Experience:

With Lancaster Laboratories, Inc. since 1979
Group Leader I (1989)

Kathleen Loewen, B.S., Quality Assurance Specialist II/Coordinator

Education:

B.S. Biology, West Virginia Wesleyan College (1969)

Continuing Education:

Environmental Analytical Quality, Hewlett Packard (1988)
Environmental Analytical Laboratory Services, NUS (1989)
USEPA Symposium on Waste Testing and Quality Assurance (1990)
USEPA RCRA Quality Assurance Workshop (1990)
USEPA Symposium on Waste Testing and Quality Assurance (1991)
USEPA Quality Assurance Workshop (1991)

Professional Experience:

Microbiological Associates, Biological Laboratory Technician (1969 - 1970)
Schuyler Laboratories, Laboratory Technician (1970 - 1971)
Victor F. Weaver, Inc., Labeling-Specifications Supervisor/Liason with USDA (1985 - 1988)
With Lancaster Laboratories, Inc. since 1988
Coordinator (1991)

**Dorothy Love, B.S., Data Review Specialist II/Coordinator, Pesticide Residue Analysis,
Environmental Sciences**

Education:

B.S. Environmental Health, Indiana University of Pennsylvania (1981)

Professional Experience:

Sun Transport, Inc., Safety Assistant (1980 - 1981)
Texas A & M University, Research Assistant (1982 - 1984)
Texas Water Commission, Chemist (1984 - 1986)
GHR Analytical, Chemist (1986 - 1987)
Clean Harbors, Inc., Senior Chemist (1987 - 1989)
With Lancaster Laboratories, Inc. since 1989

Duane Luckenbill, B.S., Chemist I, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Chemistry, Clarion University of PA (1989)

Professional Experience:

ATEC Associates, Inc., GC/MS Analyst (1989)
With Lancaster Laboratories, Inc. since 1989
Chemist I (1990)

Publications:

"Advanced in Mass Spectrometry", R. Minard, D. Luckenbill, P. Curry, and A. Ewing. Proceedings of the 11th International Mass Spectrometry Conference, Bordeaux, France (1989)

Awards:

Undergraduate Award in Analytical Chemistry, American Chemical Society (1988)
Department of Chemistry Competitive Award, Clarion University (1988 - 1989)
Outstanding Senior Chemistry Award, American Institute of Chemists Foundation (1989)
Senior College Award for Chemistry, Society for Analytical Chemists of Pittsburgh (1989)

Memberships:

American Chemical Society

John MacKay, B.S., Client Services Specialist I, Food Sciences

Education:

B.S. Biochemistry, Pennsylvania State University (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1991

Michele McClarin, B.A., Group Leader I, GC/MS Volatiles, Environmental Sciences

Education:

B.A. Chemistry, East Stroudsburg University (1987)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Group Leader I (1991)

Awards:

American Institute of Chemists Award (1987)

Memberships:

American Chemical Society
National Association of Female Executives

Robert Mellinger, B.S., Chemist I, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Chemical Engineering, Pennsylvania State University (1987)

Continuing Education:

Hewlett Packard Advanced RPN Programming course (1989)
Basic Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Chemist I (1989)

Betsy Menefee, B.S., Chemist III/Coordinator, AAS Metals, Environmental Sciences

Education:

B.S. Chemistry (cum laude), Salem College (Winston-Salem, NC) (1958)

Professional Experience:

Duke University, Research Assistant (1958 - 1959)
With Lancaster Laboratories, Inc. since 1979
Chemist III (1990)

Publications:

Two scientific publications in analytical chemistry

Richard Miller, B.A., Manager I, Sample Administration/Sample Support/Transportation

Education:

B.A. Journalism, Pennsylvania State University (1982)

Continuing Education:

Post graduate courses in marketing, accounting, and management
Quality Management College, Philip Crosby Associates (1989)
Currently enrolled in M.B.A. Program at St. Joseph's University

Professional Experience:

Video Mill, Inc., President (1982 - 1985)
With Lancaster Laboratories, Inc. since 1985
Manager I (1990)

John Morton, M.S., Chemist III, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Biochemistry, California Polytechnic State University (1974)
M.S. Chemistry, University of Delaware (1977)

Continuing Education:

Introduction to Data Processing and Algorithm Design in BASIC, Gwynedd-Mercy College (1983)
The LC Short Course, Waters Associates (1983)
The Series 1020/OWA Operator Course, Finnigan MAT Institute (1985)
Operation of the Superincos Data System, Finnigan MAT Institute (1986)
USEPA Symposium on Waste Testing and Quality Assurance, Washington D.C. (1988)
MS/PC DOS: The Disk Operating System, West Chester University (1989)
USEPA Symposium on Waste Testing and Quality Assurance, Washington D.C. (1991)

Professional Experience:

BCM, Inc., Analytical Chemist (1978 - 1980)
Envirosafe Services, Inc., Q.C. Supervisor (1980 - 1981)
Copper Range Company, Chief Chemist (1982)
Q.C. Inc., Analytical Chemist (1983 - 1988)
With Lancaster Laboratories, Inc. since 1988

Publications:

"Timed-Released Depot for Anticancer Agents II," Acta Pharm. Suec. (1978)
"Preparation of Steroid Esters of Hydroxypropyl Cellulose," J.Polymer Sci (1979)

Memberships:

American Chemical Society

George Mummert, M.Admin., Manager I, Corporate Marketing

Education:

B.A. Political Science, Allegheny College (1962)
M.Admin. Business Administration/Marketing, Pennsylvania State University (1974)

Professional Experience:

PACE Resources, Inc., Marketing Associate (1975 - 1978)
Friendly Ice Cream Corp., Division of Hershey Foods Corp., Manager Marketing Research and Planning (1978 - 1982)
Victor F. Weaver, Inc., Division of Holly Farms Corp., Marketing Manager (1982 - 1989)
With Lancaster Laboratories, Inc. since 1989

Memberships and Appointments:

American Marketing Association (Executive Member)

Mary Munster, B.S., Safety Specialist I/Chemical Hygiene Officer

Education:

B.S. Occupational Safety & Hygiene Management, Millersville University (1988)

Continuing Education:

Asbestos Abatement Workshop for the Worker/Supervisor, Temple University (1988) (Course recognized by the EPA)
A.H.E.R.A. Building Inspector Training Course, Temple University (1988) (Course recognized by the EPA)
Hazardous Materials Transportation Training Course, National Safety Council (1989)
OSHA Laboratory Standard Conference, PA Chamber of Business and Industry (1990)
Basics of Hazardous Materials Management, Padgett Thompson (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemical Hygiene Officer (1990)

Awards & Citations:

Scholarship presented by Central PA Chapter of the American Society of Safety Engineers (1987)

Memberships:

American Society of Safety Engineers
American Industrial Hygiene Association
Lancaster County Industrial Safety Council, Board of Directors (1991 - 1992)
National Safety Council

Cindy Murphy, B.S., Chemist I, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, Philadelphia College of Textiles and Science (1990)

Professional Experience:

SmithKline Beecham Animal Health Products, Lab Technician (1986 - 1990)

R. W. Johnson Pharmaceutical Research Institute, Chemist (1991)

With Lancaster Laboratories, Inc. since 1991

Publications:

"Ab Initio Molecular Orbital Study of Boron, Aluminum, Gallium, μ -Hydido-Bridge Hexahydrides",
C. W. Brock, M. Trachtman, C. Murphy, B. Mushart, G. J. Mains, J. Phys. Chem., 95, 2339-2344
(1991)

Charles Nestlund, B.S., Chemist IV, Applied Research & Development, Environmental Sciences

Education:

B.S. Chemistry, University of Pittsburgh (1982)

Organic Chemistry (1983)

Professional Experience:

Magee Women's Hospital, Pittsburgh, Laboratory Technician (1981 - 1984)

With Lancaster Laboratories, Inc. since 1984

Chemist IV (1991)

Memberships:

Chromatography Forum of Delaware Valley

Wesley Neumann, M.S., Manager I, Pharmaceutical Sciences, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, Syracuse University (1968)

M.S. Chemistry, Northeastern University (1971)

Continuing Education:

Pharmaceutical Quality Assurance Certification, New Jersey Quality Control Association (1985)

Innovative Teamwork Program, Synetics, Inc. (1986)

Dr. W. Edwards Deming's Methods for Management Productivity and Quality, George Washington University (1987)

Statistical Process Control, Phillips Quality Consultants (1988)

Problem Solving and Decision Making, Kepner-Tregor (1988)

Quality Assurance for the Analytical Laboratory, Center for Professional Advancement (1989)

Professional Experience:

Warner Lambert Research Institute (1973 - 1977)
Pharmacia (1977 - 1979)
Bristol-Myers Squibb (1979 - 1990)
With Lancaster Laboratories, Inc. since 1990

Memberships:

American Association of Pharmaceutical Scientists
American Chemical Society
International Society for Pharmaceutical Engineering

Julie O'Donnell, Marketing Specialist III, Food Sciences

Education:

B.A. Chemistry, Franklin & Marshall College (1979)

Continuing Education:

Carlisle-Hart Management Development Program (1984)
Villanova University Graduate Courses in Biochemistry (1984) and Analytical Chemistry (1986)
Financial Accounting & Managerial Accounting, Franklin & Marshall College (1988)
Introduction to DOS, Johnson County Community College (1990)
Seminar on Developing/Implementing a Marketing Plan, ACIL (1991)

Professional Experience:

Lancaster Laboratories, Inc., Food Chemistry Group Leader (1979 - 1989)
Kansas City Analytical Services, Quality Assurance Director (1989 - 1991)
With Lancaster Laboratories, Inc. since 1991

Memberships:

American Association of Pharmaceutical Scientists
Institute of Food Technologists
Society of Quality Assurance

Philip Oles, Ph.D., Manager II, Foods Group, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, University of Connecticut (1968)
Ph.D. Analytical Chemistry, University of Massachusetts (1974)

Continuing Education:

Hewlett Packard GC/MS Training Course (1986)
Process Design Optimization, Polaroid (1988)
Quality Management College, Philip Crosby Associates (1989)

Professional Experience:

Upjohn Company, (1974 - 1979)
Polaroid Corporation (1978 - 1989)
With Lancaster Laboratories, Inc. since 1989
Manager II (1991)

Publications:

- "Atomic Absorption Method for Determining Micromolar Quantities of Secondary Amines", P. J. Oles and S. Siggia, Analytical Chemistry 45, 2150 (1973)
- "Atomic Absorption Method for Determining Micromolar Quantities of Aldehydes", P.J. Oles and S. Siggia, Analytical Chemistry 46, 911 (1974)
- "Atomic Absorption Method for Determining Micromolar Quantities of 1,2 - Diols", P.J. Oles and S. Siggia, Analytical Chemistry 46, 2197 (1974)
- "Particle Analysis and Identification in the Pharmaceutical Industry", Philip J. Oles Presented at INTERMICRO - 77 in Cambridge, England, and published in Microscope, 26 (1978)
- "High Pressure Liquid Chromatographic Separation and Determination of Anomeric Forms of Streptozocin in a Powder Formulation", Philip J. Oles, Journal Pharm.Sci., 67, 4192 (1978)
- "The Scale-Up of Highly Exothermic Batch Processes in Which the Kinetics are Not Well Defined", N. Kaufman and P. J. Oles, presented at the 1983 meeting of the American Institute of Chemical Engineers, Washington, D.C.
- "Taguchi Design Experiments for Optimizing the Performance of a Gas Chromatograph and Mass Selective Detector", Philip J. Oles and Anne Yankovich, LC*GC, 7, 579 (1989)
- "Optimization of the Determination of Cholesterol in Various Food Matrixes", P.J. Oles et.al., IAOAC, 73, 5, 724 (1990)
- "Fatty Acid Determinations in a Variety of Food Matrices Using Capillary Column Chromatography", Philip Oles, Arlene Silcox, and Tammy Showers, presented at the 1991 Annual Meeting of the American Oil Chemists Society, May 15, 1991, Chicago, IL
- "Microwave Acid Digestion of Various Food Matrixes for Nutrient Determination by Atomic Absorption Spectrophotometry", Philip J. Oles and Wanda M. Graham, Journal of the Association of Official Analytical Chemists, 74, 5, 812-4 (1991)

Memberships:

American Chemical Society
American Oil Chemists Society
Institute of Food Technologists
International Association of Official Analytical Chemists

Kimberly Oliver, B.S., Quality Assurance Specialist II

Education:

B.S. Biology, Pennsylvania State University (1983)

Continuing Education:

Center for Professional Advancement, Good Laboratory Practices (1988)
Society of Quality Assurance Conference (1989)
Society of Quality Assurance Conference (1990)

Professional Experience:

Biospherics, Inc., Laboratory Technician (1983 - 1984)
Eastern Laboratory Service Associates, Laboratory Technician (1984 - 1985)
With Lancaster Laboratories, Inc. since 1985
Quality Assurance Specialist II (1990)

Memberships:

Society of Quality Assurance

Timothy Oostdyk, B.A., Manager I, GC/MS Group, Environmental Sciences

Education:

B.A. Chemistry (cum laude), Franklin and Marshall College (1985)

Continuing Education:

ICP Seminar (1985)
ASMS Interpretation of Mass Spectra (1989)
Ph.D. Coursework, Villanova University Graduate School

Professional Experience:

Nabisco Brands Technology Center, Technician (Summer 1983)
With Lancaster Laboratories, Inc. since 1985
Manager I (1990)

Publications:

One scientific publication in analytical chemistry

Awards and Citations:

Phi Beta Kappa, Franklin and Marshall College
Spirit of LLJ Award (1989)

Susan Page, B.A., Group Leader I, Client Services

Education:

B.A. Economics (magna cum laude), Millersville University (1974)

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Group Leader I (1990)

Jan Parker, B.A., Chemist III, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, University of Evansville (1981)

Professional Experience:

Energy Supply, Inc., Chemist (1981 - 1984)
Central Pharmaceuticals, Inc., Chemist (1984 - 1987)
Roxane Laboratories, Inc., Supervisor Method Development (1987 - 1991)
With Lancaster Laboratories, Inc. since 1991

Patrick Parmer, Client Services Specialist I, Air Quality

Education:

Professional Service Works, Harrisburg Area Community College (1991)

Professional Experience:

Lancaster Machinery Company, Customer Service (1985 - 1989)
With Lancaster Laboratories, Inc. since 1989
Client Services Specialist I (1991)

Awards:

Spirit of LJ Award (1990)

Arthur Pezzica, B.A., Manager I, ExpressLAB/Water Quality/Field Sampling, Environmental Sciences

Education:

B.A. Chemistry (cum laude), University of Maryland (1975)

Continuing Education:

Basic HPLC Short Course, Delaware Valley Chromatographic Forum (1981)
Practical Aspects of Liquid Chromatography, American Association of Clinical Chemists (1984)
2nd Annual International Symposium, Sample Preparation and Isolation using Bonded Silica's,
Analytichem (1985)
Advanced Solid Phase Extraction Seminar, Method Development and Troubleshooting Techniques,
Analytichem (1987)
Fundamentals of Groundwater Contamination, Geraghty & Miller (1990)

Professional Experience:

Office of the Chief Medical Examiners (1975 - 1980)
SmithKline Beecham Clinical Laboratories (1980 - 1989)
With Lancaster Laboratories, Inc. since 1990

Memberships:

Chromatographic Forum of Delaware Valley

Victoria Pillion, B.S., Chemist I, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Chemistry, Alvernia College (1983)

Continuing Education:

HPLC Course, The Chromatography Forum of Delaware Valley (1986)

Basic HPLC Course, Chrompack Inc. (1987)

Troubleshooting GC, Chrompack Inc. (1989)

A Short Course in Capillary Chromatography, Supelco, Inc. (1990)

Professional Experience:

Warner Lambert Co., Associate Analyst (1984 - 1987)

Royer Pharmaceutical Corp., Analytical Control Chemist (1987)

- AMP Inc., Chemist II (1988)

With Lancaster Laboratories, Inc. since 1988

Kimberly Purdy, B.A., Client Services Specialist I, Food Sciences

Education:

Smith College (1982 - 1984)

B.A. Biology, Bowdoin College (1986)

Professional Experience:

Tilton School (1986 - 1987)

Carney, Sandoe, & Associates, Educational Consultants (1987 - 1989)

With Lancaster Laboratories, Inc. since 1989

Christine Ratcliff, B.S., Client Services Specialist II, Environmental Sciences

Education:

B.S. Chemistry, Shippensburg University (1988)

Continuing Education:

Mass Spectral Interpretation, Finnigan MAT Institute (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988

Client Services Specialist II (1992)

Nelson Risser, B.A., Manager I, Applied Research & Development, Environmental Sciences

Education:

B.A. Chemistry, Shippensburg University (1977)

Continuing Education:

Chromatography Forum of Delaware Valley, Capillary GC (1981)
Dionex Ion Chromatography (1983)
Finnigan MAT 1020/OWA Operation (1983)
Finnigan MAT 1020/OWA Maintenance (1983)
Finnigan MAT Mass Spectra Interpretation and GC/MS (1984)
Finnigan MAT OWA/1050 Software (1986)
Hewlett Packard 5988/5966/5970 RTE Operator's Training Course (1987)
Quality Management College, Philip Crosby Associates (1989)
M.B.A. (12 credits) Coursework, Penn State

Professional Experience:

Frederick Cancer Center, Frederick MD, Analytical Chemist (1977 - 1979)
With Lancaster Laboratories, Inc. since 1979
Manager I (1990)

Publications:

Four scientific papers on chemical analysis of carcinogens

Biographical Listings:

Who's Who in Environmental Science

Memberships:

American Society for Mass Spectrometry
Chromatography Forum of Delaware Valley

James Rittenhouse, Ph.D., Chemist I, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Albright College (1950)
M.S. Chemistry, University of Pennsylvania (1955)
Ph.D. Chemistry, University of Pennsylvania (1957)

Continuing Education:

Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

Reading Batteries, Superintendent of Manufacturing (1950 - 1953)
Armstrong World Industries, Senior Research Scientist (1957 - 1988)
With Lancaster Laboratories, Inc. since 1991

Memberships:

American Chemical Society
Sigma Xi

Melanie Rittenhouse, Ph.D., Chemist II, GC/MS Volatiles, Environmental Sciences

Education:

B.A. Chemistry, Immaculata College (1967)
M.S. Chemistry, Villanova University (1987)
Ph.D. Analytical Chemistry, Villanova University (1989)

Continuing Education:

Basic Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

Armstrong World Industries (1967 - 1977)
Warner-Lambert Co. (1980 - 1986)
With Lancaster Laboratories, Inc since 1990

Awards and Citations:

Phi Kappa Phi
Sigma Xi

Richard Rodgers, B.S., Chemist IV, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Chemistry, Millersville University (1975)

Continuing Education:

Perkin-Elmer Atomic Absorption Workshop (1977)
5985 Gas Chromatograph/Mass Spectrometer Users (1980)
Analytical Methods for Priority Pollutants (1981)
Symposium on Advances in Analytical Methods for Monitoring Organic Chemicals in the Environment -
Water and Hazardous Wastes (1984)
GC/MS System Manager Training Course - User 1 (1986)
Interpretation of Mass Spectra - Short Course (1987)

Professional Experience:

Millersville State College, Department of Chemistry
Laboratory Assistant (1971 - 1972)
Chemistry Technician (1972 - 1975)
Ichthyological Associates, Inc., Analytical Chemist (1975 - 1977)
Radiation Management Corporation, GC/MS Operator, Manager (1978 - 1985)
With Lancaster Laboratories, Inc. since 1985
Chemist IV (1989)

Memberships:

American Chemical Society
American Society for Mass Spectrometry
Chromatography Forum of Delaware Valley

Valerie St. Clair, B.S., Chemist I, ExpressLAB, Environmental Sciences

Education:

B.S. Biology, James Madison University (1977)

Continuing Education:

Carlisle-Hart Management Development Program (1984)
MIF/AICM Listeria Workshop (1986)
AMI Listeria Workshop (1987)
Rapid Methods and Automation in Microbiology Workshop, Kansas State University (1987)
ASM Salmonella spp. and Campylobacter lyuni Workshop (1988)
Seafood Surveillance Program HACCP Workshop for Breaded Fish and Speciality Products (1988)
Applied Food Microbiology, graduate course at Pennsylvania State University (1988)
Food Microbiology for the '90's (1989)
Chilled Food Roundtable (1989)
ASM Quality Assurance and HACCP Workshop (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1977
Chemist I (1991)

Publications:

Co-author, "Performance of Three Methods for the Rapid Identification of Salmonella in Naturally Contaminated Foods and Feeds," Journal of Food Protection, Vol. 11, No. 53, November, 1990

Memberships and Appointments:

International Association of Milk, Food, and Environmental Sanitarians, Inc.

Tony San Martin, Chemist IV, Pharmaceutical Chemistry, Food & Pharmaceutical Sciences

Education:

Chemistry Courses, New Jersey Institute of Technology

Continuing Education:

LC Resources Inc., Computer-Aided HPLC Method Development
Center for Professional Advancement, Laboratory Interfacing with IBM PC

Professional Experience:

Bristol Myers (1963 - 1990)
With Lancaster Laboratories, Inc. since 1990

Nancy Saunders, B.S., Chemist II, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, Syracuse University (1985)

Continuing Education:

Analytical Gas Chromatography, J&W Scientific (1988)
HPLC Troubleshooting, Chrompac (1990)

Professional Experience:

Cayuga County Laboratory, Auburn, NY, Senior Technician (1967 - 1985)
With Lancaster Laboratories, Inc. since 1986
Chemist II (1990)

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

Jeffrey Schlegelmilch, B.S., Chemist I, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Chemistry, Pennsylvania State University (1988)

Continuing Education:

Applied Statistics, Penn State Continuing Education (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist I (1990)

Awards:

Weidner Scholarship, Pennsylvania State University (1988)

Memberships:

American Chemical Society
Nittany Chemical Society
Phi Lambda Upsilon National Honorary Chemical Society

Terry Schuck, B.S., Chemist II/Coordinator, Water Quality, Environmental Sciences

Education:

B.S. Environmental Resource Management, Pennsylvania State University (1984)

Continuing Education:

Groundwater Monitoring Seminar, Institute for Environmental Education (1986)
Water Quality Management, Penn State University (1990)
Water Pollution Control, Penn State University (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1984
Chemist II/Coordinator (1990)

David Schumacher, B.S., Senior Chemist, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Biochemistry (cum laude), Pennsylvania State University (1972)

Continuing Education:

Immunochemical Techniques for Chemists, American Chemical Society (1988)
Microsoft Developer's Tools Forum (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1972
Senior Chemist (1985)

Publications:

Five scientific publications in agricultural/environmental analytical chemistry

Memberships:

Association of Official Analytical Chemists
Chromatography Forum of Delaware Valley
Institute of Food Technologists

Delwyn Schumacher, B.S., Group Leader I, ExpressLAB, Environmental Sciences

Education:

B.S. Chemistry, Pennsylvania State University (1977)

Continuing Education:

Rubber Technology, American Chemical Society (1979)
Capillary Chromatography, West Chester State University (1980)
Environmental Analytical Chemistry: Air Toxics, American Chemical Society (1989)

Professional Experience:

Pennsylvania Department of Environmental Resources, Field Technician (1977)
Armstrong World Industries, Inc., Chemist (1977 - 1979)
With Lancaster Laboratories, Inc. since 1979
Group Leader I (1990)

Publications:

- Cosigned two records of invention involving assembly line furniture finishing for Armstrong World Industries (1977)
- Cosigned patent application for a polymerizing silicone masonry treatment for protection against weathering for Lancaster Laboratories' client (1984)

Memberships and Appointments:

Chromatography Forum of Delaware Valley

Tamra Schumacher, B.S., Chemist III, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry (cum laude), Millersville University (1985)

Continuing Education:

1 Year Graduate Work in Chemistry, Villanova University (1987)

Professional Experience:

With Lancaster Laboratories, Inc. since 1985
Chemist III (1992)

Memberships:

Chromatography Forum of Delaware Valley

Lee Seats, B.S., Senior Quality Assurance Specialist

Education:

B.S. Chemistry, Millersville University (1979)
M.B.A. General Administrative Management, St. Joseph's University (1991)

Continuing Education:

Three-day training course on Inductively Coupled Plasma Spectroscopy, Instrumentation Laboratories (1983)

Professional Experience:

With Lancaster Laboratories, Inc. since 1980
Senior Quality Assurance Specialist (1991)

Richard Shober, B.S., Chemist I, GC/MS Semivolatiles, Environmental Sciences

Education:

B.S. Chemistry, Muhlenberg College (1984)

Continuing Education:

Inductively Coupled Plasma Spectroscopy, Allied Analytical (1985)
ACS Short Course, Analytical Chemistry of Contaminants in Surface and Groundwater (1986)

Professional Experience:

With Lancaster Laboratories, Inc. since 1984
Chemist I (1991)

Publications:

Poster Paper at Pittsburgh Conference on Development of In-House Software For Use With ICP (1986)

Susan Shorter, B.S., Quality Assurance Specialist I

Education:

B.S. Chemistry/Mathematics, Cedar Crest College (1986)

Continuing Education:

Short Course in Plasma Spectrochemical Analysis (1990)
Inductively Coupled Plasma, Thermo Jarrel-Ash (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Quality Assurance Specialist I (1991)

Memberships:

Society for Applied Spectroscopy

Tammy Showers, B.S., Chemist I/Coordinator, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Albright College (1980)

Continuing Education:

Graduate Courses in Anatomy at Temple University (1981)
Basic HPLC Course, Chromatography Forum of Delaware Valley (1985)
Maintaining and Troubleshooting Chromatographic Systems - ACS Short Course (1986)
Advanced HPLC Course, Chrompack Inc. (1988)
Basic Capillary GC Course, Chrompack Inc. (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1984
Chemist I (1986)

Arlene Silcox, B.A., Chemist I, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.A. Chemistry, West Virginia Wesleyan College (1981)

Continuing Education:

Statistical Quality Control, Penn State Capitol Campus (1983)
HPLC Course, Center for Professional Education (1987)
Capillary GC Course, J&W Scientific (1989)
Troubleshooting GC, Chrompack Inc. (1989)

Professional Experience:

Warner Lambert Co., Analyst, Assistant Microbiologist (1982 - 1988)
With Lancaster Laboratories, Inc. since 1989

Memberships:

Chromatography Forum of Delaware Valley

Cynthia Anne Smith, B.S., Group Leader I, Sample Support

Education:

B.S. Chemistry, Shippensburg University (1987)

Continuing Education:

Telecation Associates CLP Training Course (1989)
Hitachi Z-9000 Operator's Training Course (1989)
Currently enrolled in M.B.A. program at Pennsylvania State University

Professional Experience:

With Lancaster Laboratories, Inc. since 1987
Group Leader I (1991)

Livonia Smith, B.S., Chemist I, ExpressLAB, Environmental Sciences

Education:

B.S. Chemistry, University of Rochester (1956)

Continuing Education:

Gas Chromatography, Chromatography Forum of Delaware Valley (1991)

Professional Experience:

American Viscose Corp., Chemist (1956 - 1962)
With Lancaster Laboratories, Inc. since 1979
Chemist I (1991)

Memberships:

Chromatography Forum of Delaware Valley

Max Snavely, B.S., Chemist II, ICP Metals, Environmental Sciences

Education:

B.S. Chemistry, Lebanon Valley College (1977)

Continuing Education:

Inductively Coupled Plasma Spectroscopy, Thermo Jarrell Ash (1991)

Professional Experience:

Sterling Drug, Inc., Quality Control Chemist (1977 - 1980)
Andrew S. McCreath & Sons, Inc., Analytical Chemist (1980 - 1987)
With Lancaster Laboratories, Inc. since 1987
Chemist II (1990)

John Snyder, M.S., Senior Chemist, Applied Research & Development, Environmental Sciences

Education:

B.A. Chemistry, Messiah College (1975)
Lancaster Theological Seminary (1979 - 1980)
M.S. Chemistry, Villanova University (1985); Currently doing research for Ph.D.

Professional Experience:

Teacher, Zimbabwe & Zambia (1975 - 1978)
National Hydron (1978 - 1979)
Charles Snyder (1981 - 1982)
With Lancaster Laboratories, Inc. since 1982
Senior Chemist (1989)

Publications:

Co-author, "Emission Spectroscopy Review" (1986)
Analytical Chemistry Paper, "TOX as an Analytical Tool," EPA Solid Waste Symposium (1987)
Co-author, "Emission Spectroscopy Review," Analytical Chemistry (1988)

Biographical Listings:

Who's Who in Environmental Laboratories

Memberships:

American Chemical Society
American Society of Mass Spectroscopy (ASMS)
Chromatography Forum of Delaware Valley

Jill Sproat, B.S., Client Services Specialist II, Environmental Sciences

Education:

B.S. Biology, Dickinson College (1979)

Professional Experience:

With Lancaster Laboratories, Inc. since 1984
Client Services Specialist II (1989)

Robert Stauffer, B.S., Integration Systems Specialist II, Environmental Sciences

Education:

B.S. Microbiology, Pennsylvania State University (1979)
B.S. Computer Science, Millersville University (1986)

Continuing Education:

Hewlett-Packard HP1000 System Manager Training (1988)
Hewlett-Packard HP1000 Laboratory Automation System Programming Training (1988)

Professional Experience:

Frederick Cancer Research Center, Microbiology Research Technician (1979 - 1981)
Victor F. Weaver, Inc., Quality Assurance Inspector (1982 - 1984)
Victor F. Weaver, Inc., Computer Programmer/Operator (1984 - 1987)
With Lancaster Laboratories, Inc. since 1988

Memberships:

INTEREX - International Association of Hewlett-Packard Computer Users

Andrew Strebel, Technical Specialist I, GC/MS Semivolatiles, Environmental Sciences

Education:

Advanced Aquarius Programmers Course, Hewlett Packard (1989)
Environmental Applications of GC/MS, Indiana University

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Technical Specialist I (1991)

John Styles, B.S., Chemist I, Pesticide Residue Analysis, Environmental Sciences

Education:

B.S. Chemistry, Bucknell University (1989)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Chemist I (1991)

Christiane Sweigart, B.S., Chemist I, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Chemistry/Medical Technology, Elizabethtown College (1985)

Professional Experience:

With Lancaster Laboratories, Inc. since 1985
Chemist I (1991)

Barry Townsend, Chemist I, Instrumental Water Quality, Environmental Sciences

Education:

International Ion Chromatography Symposium (1991)

Professional Experience:

Philadelphia Electric Company, Health Physics and Chemistry Technician (1982 - 1989)
With Lancaster Laboratories, Inc. since 1989
Chemist I (1991)

Timothy Trees, A.A.S., Chemist I/Coordinator, AAS Metals, Environmental Sciences

Education:

Certificate, Water/Wastewater Treatment Operations, Columbia Green Community College (1985)
A.A.S. Environmental Control of Hazardous Waste/Water Quality, Ulster Community College (1987)

Professional Experience:

York Wastewater Management (1985 - 1986)
Rider Engineering (1986 - 1988)
With Lancaster Laboratories, Inc. since 1988
Coordinator (1991)

Dennis Urban, M.S., Chemist IV, Organic Analysis by GC, Environmental Sciences

Education:

B.A. Chemistry, Millersville State University (1972)
M.S. Chemistry, St. Joseph's College (1976)

Continuing Education:

Seminars for various methods of instrumental analysis in the areas of gas chromatography, high performance liquid chromatography and infrared spectrometry

Professional Experience:

RCA, Associate Engineering Technician (1972 - 1977)
Wyeth Laboratories (Marietta, PA), Control Analyst (1977 - 1979)
Wyeth Laboratories (West Chester, PA), Chemist II (1979 - 1980)
RCA, Senior Engineering Technician (1980 - 1982)
Member, Technical Staff (1982 - 1987)
With Lancaster Laboratories, Inc. since 1987
Chemist IV (1991)

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

Irene Lynn Wallace, B.A., Chemist I, GC/MS Semivolatiles, Environmental Sciences

Education:

B.A. Chemistry, Washington & Jefferson College (1988)

Continuing Education:

Mass Spectral Interpretation Course (1991)
M.B.A. Coursework, Penn State University

Professional Experience:

Stauffer Chemical Company, Food Chemist (1987 - 1988)
With Lancaster Laboratories, Inc. since 1988
Chemist I (1991)

Memberships and Appointments:

National Society of Collegiate Journalists

Barbara Weaver, CIH, Corporate Technical Projects Specialist III

Education:

B.S. Chemistry, Elizabethtown College (1971)

Certifications:

American Board of Industrial Hygiene - Certified in the comprehensive practice of industrial hygiene, Certification #2719

Continuing Education:

Business Law, Elizabethtown College (1979)

NIOSH Course #553 "Industrial Hygiene Sampling, Decision Making, Monitoring and Record Keeping, Sampling Strategies" (1979)

"Workshop in Industrial Toxicology", Thomas Jefferson University (1980)

Special Topics: Environmental Analytical Chemistry, Graduate Work, Villanova University (1981)

"Analytical and Quantitative Microscopy", Northeastern Association of Microscopy (NEAM) (1981)

"Comprehensive Industrial Hygiene Review", University of Cincinnati, NIOSH Education Resource Center (1983)

Environmental Health, Graduate Work, West Chester University (1985)

"Chemical Hygiene, The OSHA Laboratory Standard", NEAIHA Conference PDC (1990)

Health and Safety Management for Hazardous Waste Professionals, AIHA PDC #11 (1990)

Industrial Ventilation, One Day Burton Workshop, CPS AIHA at Millersville University (1990)

Financial Accounting, Undergraduate Course, Penn State (1990)

NIOSH Course #582 "Sample and Analysis of Airborne Asbestos Fiber", NIOSH Education Resource Center, Cincinnati (1992)

Professional Experience:

Warner Lambert, Inc., Quality Control Chemist (1971 - 1973)

Hershey Medical Center, Junior Research Technician (1973 - 1974)

Elizabethtown College, Laboratory Instructor (1977 - 1978)

With Lancaster Laboratories, Inc. since 1978

Corporate Technical Projects Specialist III (1991)

Publications:

Albright, F.R., et al., "Fluorescent Dye Binding Technique for the Detection of Chrysotile Asbestos," Microscope (1983)

Biographical Listings:

Who's Who in the East, under Barbara J. Felty

Who's Who in the Safety Profession

Memberships and Appointments:

American Board of Industrial Hygiene

American Chemical Society

ACS, Chemical Health and Safety Section

American Industrial Hygiene Association and Central Pennsylvania Section - Offices at local section:

Treasurer (1981 - 1984), President-Elect (1985 - 1986), President (1986 - 1987), Membership Director (1988 - 1993)

Lancaster County Industrial Safety Council (Director 1988 - 1990)

Patrick Weidinger, B.S., Industrial Hygienist III/Coordinator, Air Quality, Environmental Sciences

Education:

B.S. Occupational Safety and Hygiene Management, Millersville University (1986)

Continuing Education:

Asbestos-Hazard Evaluation and Abatement, Drexel University (1987) (Course recognized by the EPA)
Asbestos Abatement for Inspectors, Tufts University (1987) (Course recognized by the EPA)
Asbestos Abatement Conference for Management Planners, Temple University (1988) (Course recognized by the EPA)
Assessing Bioaerosols in Indoor Environments, University of Michigan (1988)
Industrial Ventilation Workshop, Millersville University (1990)

Professional Experience:

High Industries, Inc., Safety and Health Intern (1986)
With Lancaster Laboratories, Inc. since 1986
Industrial Hygienist III/Coordinator (1991)

Awards and Citations:

Scholarship presented by Central PA Chapter of the American Society Engineers Occupational Safety and Hygiene Management

Memberships:

American Industrial Hygiene Association (AIHA)
American Society of Safety Engineers (ASSE)

David Weiser, B.S., Data Package Specialist II/Coordinator, Environmental Sciences

Education:

B.S. Education, Biology, Millersville University (1987)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Data Package Specialist II/Coordinator (1991)

James Wempe, M.S., Group Leader II, Food Microbiology, Food & Pharmaceutical Sciences

Education:

A.S. Biology/Chemistry, Jefferson Community College (1982)
B.S. Biology, Murray State University (1985)
M.S. Food Technology and Science, University of Tennessee (1991)

Continuing Education:

Current Concepts in Foodborne Pathogens and Rapid and Automated Methods in Food Microbiology, University of Wisconsin (1991)
Introduction to Windows, Lancaster Community College (1991)

Professional Experience:

Martin Marietta Energy Systems, Inc., Oak Ridge National Lab (1984 - 1985)
University of Tennessee, Food Technology and Science Department (1985 - 1991)
With Lancaster Laboratories, Inc. since 1991

Publications:

"Hydrophobic Grid Membrane Filter/MUG Method for Total Coliform and Escherichia coli Enumeration in Foods. Collaborative Study", J. Assoc. Off. Anal. Chem., 72:6 (936), (1989)
"Bacteriological Profile and Shelflife Studies of White Amur", J. W. Wempe and P. M. Davidson, J. of Food Sci. (1992)

Biographical Listings:

Who's Who in Junior Colleges

Awards and Honorary Societies:

Phi Theta Kappa Honor Society (1982)
Beta-Beta-Beta Biological Honor Society (1983)
Alpha Chi Honor Society (1983)
Gamma Sigma Delta Agricultural Honorary (1987)
Phi Kappa Phi Honor Society (1989)

Memberships:

American Society for Microbiology
Institute of Food Technologists
International Association of Milk, Food, and Environmental Sanitarians, Inc.

Elizabeth White, Client Services Specialist II/Coordinator, ExpressLAB, Environmental Sciences

Education:

Associate Degree, York Junior College, Chemistry Major (1946 - 1948)

Professional Experience:

York Junior College, Laboratory Assistant (1948 - 1950) Full-time (1950 - 1951)
Nina Dye Works, Laboratory Technician (1951 - 1953)
With Lancaster Laboratories, Inc. 1965 - 1967 and 1975 - Present
Client Services Specialist II/Coordinator (1989)

Bryan Winship, B.S., Chemist IV, Applied Research & Development, Environmental Sciences

Education:

B.S. Analytical Chemistry, Juniata College (1981)

Continuing Education:

"Liquid Chromatography Short Course", Chromatography Forum of Delaware Valley (1982)
Hewlett Packard 3350 Operator Training Course (1986)
Shimadzu HPLC and C-R3A Repairs Course (1986)

Professional Experience:

Department of Energy, Shale Research Project Assistant (1978 - 1980)
Juniata College, Laboratory Assistant (1980 - 1981)
With Lancaster Laboratories, Inc. since 1981
Chemist IV (1988)

Publications:

Poster paper at Fall AOAC Meeting concerning analysis of pharmaceuticals in cough lozenges (1984)

Memberships:

Association of Official Analytical Chemists
Chromatography Forum of Delaware Valley

David Wright, B.S., Chemist I, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Biology, Millersville University (1987)

Continuing Education:

Gas Chromatography, Chromatography Forum of Delaware Valley (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Chemist I (1991)

Jon Wright, B.S., Chemist II/Coordinator, Food Chemistry, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Albright College (1981)

Continuing Education:

Graduate-level toxicology courses, St. John's University (1985 - 1987)
Chrompack Course, "Troubleshooting GC" (1989)
Chrompack Course, "Capillary GC" (1990)

Professional Experience:

Bolar Pharmaceutical Co., Inc. (1984 - 1989)
With Lancaster Laboratories, Inc. since 1989
Coordinator (1991)

Memberships:

American Chemical Society
Chromatography Forum of Delaware Valley

Christiaan Wubbolt, B.S., Chemist I, GC/MS Volatiles, Environmental Sciences

Education:

B.S. Physics/Computer Engineering, Millersville University (1988)

Continuing Education:

Formaster Training Course
Basic Mass Spectral Interpretation, Finnigan MAT Institute (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988

Donald Wyand, B.S., Client Services Specialist I, Environmental Sciences

Education:

B.S. Chemistry, Lebanon Valley College (1989)

Continuing Education:

Advanced Analytical Chemistry, Villanova University (1990)

Professional Experience:

With Lancaster Laboratories, Inc. since 1989
Client Services Specialist I (1990)

Memberships:

Society of Applied Spectroscopy

Melissa Yanchuck, B.S., Technical Specialist I/Coordinator, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Biology, Millersville University (1984)

Professional Experience:

With Lancaster Laboratories, Inc. since 1988
Technical Specialist I/Coordinator (1991)

Michael Yunginger, B.S., Microbiologist II/Coordinator, Pharmaceutical Microbiology, Food & Pharmaceutical Sciences

Education:

B.S. Biology, Millersville University (1985)

Continuing Education:

LAL Technology Workshop (1991)

Professional Experience:

With Lancaster Laboratories, Inc. since 1986
Microbiologist II/Coordinator (1990)

Memberships:

LAL User's Group

Stephen Zeiner, B.S., Chemist I, Organic Analysis by GC, Environmental Sciences

Education:

B.S. Chemistry, Shippensburg University (1988)

Professional Experience:

With Lancaster Laboratories, Inc. since 1990

Memberships:

American Chemical Society

**ECHEM INCORPORATED
ENGINEERING CHEMISTRY CONSULTANTS**

P.O. Box 1510

#32 Route 35

Sebago Common

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ECHEM INCORPORATED ENGINEERING CHEMISTRY CONSULTANTS

**P.O. Box 1510
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Sebago Common
N. Windham, ME 04062**

INTRODUCTION

ECHEM Incorporated is an Engineering Chemistry Consulting firm, founded in 1989, providing services in chemistry and monitoring program design, laboratory support services, data validation and interpretation, quality assurance, hazardous waste management and minimization, regulatory compliance, health and safety support and other areas of applied environmental chemistry.

ECHEM INC. is a privately held company. Georgia L. Wallin is the Chairman of the Board, as well as the largest stockholder. She manages and directs corporate affairs. Robert A. Steeves, PE is Senior Chemical Engineering Professional and Quality Assurance Officer with over twenty years of experience in process design and waste treatment technology, regulatory support, industrial profile development, health and safety, site reconnaissance, and sampling and analysis program design as well as development of corporate-level Quality Assurance programs. Bruce K. Wallin, Ph.D. is Senior Chemistry Professional with over twenty years of experience in the chemistry and metabolism of man-made and naturally-occurring substances, waste treatment and pollution abatement, technology assessment, chemical behavior and effects, analytical laboratory management and industrial process chemistry.

ECHEM INC. is registered with the Federal Government (SBA) as a Woman-Owned Company and is part of the Procurement Automated Source System (PASS). ECHEM INC. is certified by the State of Maine Department of Transportation as a Disadvantaged/Women Business Enterprise (D/WBE), and has applied for certification with the State of New York.

**ECHEM INCORPORATED
ENGINEERING CHEMISTRY CONSULTANTS**

SCOPE OF SERVICES

ENVIRONMENTAL CHEMISTRY

HAZARDOUS WASTE MANAGEMENT AND MINIMIZATION

ANALYTICAL DATA EVALUATION AND INTERPRETATION

ANALYTICAL DATA VALIDATION

QUALITY ASSURANCE

LABORATORY SUPPORT SERVICES

ENVIRONMENTAL MONITORING PROGRAM DESIGN

SAMPLING PROTOCOL DEVELOPMENT

ANALYTICAL METHOD DEVELOPMENT

REGULATORY COMPLIANCE SUPPORT

HEALTH AND SAFETY SUPPORT

TECHNICAL PEER REVIEW

EXPERT TESTIMONY

ENVIRONMENTAL CHEMISTRY

The behavior of chemicals in the environment is subject to a number of complex factors and their interactions. Often chemicals released to the environment can be mobilized and transformed or degraded into related species by physical, chemical or biological forces. Investigation of suspected contamination may require analyses for these related species rather than the chemicals released to truly grasp the significance of a contamination incident. Appreciation of these transformation mechanisms is a minimum skill for environmental chemistry. ECHEM combines over 40 years of environmental chemistry experience in the evaluation of analytical data from site investigations. The combination of in-depth understanding of analytical protocols (and their limitations) with the probable fate and transport mechanisms anticipated for a site allows ECHEM to provide its clients with an understanding of the impact of analytical data on their projects.

HAZARDOUS WASTE MANAGEMENT AND MINIMIZATION

ECHEM develops and assists in the implementation of management strategies for industrial and municipal wastestreams. Appropriate management of most wastestreams has become mandatory and noncompliance can entail civil and criminal penalties. Thorough knowledge of both state and federal environmental statutes and regulations allows ECHEM to provide its clients with prompt, accurate recommendations for management of specific wastestreams. ECHEM also believes that waste minimization is a financially and environmentally sound goal for waste generators. Waste minimization reduces current expenditures and future liabilities while enhancing employee and public relations. ECHEM has participated in successful waste minimization projects for several industrial clients.

ANALYTICAL DATA EVALUATION AND INTERPRETATION

The data received from an analytical laboratory is of little use without an evaluation of its significance relative to the site setting. Evaluation of data differs from validation of data in that validation only addresses the analytical process and its adherence to protocol specifications while data evaluation takes into consideration the environment from which the analyzed sample was collected, the means of collection, field quality control data, the characteristics of data considered to be within the same data set and knowledge of the target analytes' behavior in the area of investigation. An interpretation of the data provides the client with a concise summary of the data's significance in relation to the objectives of the investigation.

ANALYTICAL DATA VALIDATION

Validation of analytical measurements is a systematic process of reviewing a body of data to provide an assessment of data quality and fitness for its intended use. The process includes:

- o auditing measurement system calibration and calibration verification
- o auditing quality control activity documentation
- o auditing field data records and chain of custody
- o checking intermediate calculations
- o adding data qualifiers to the data set
- o preparing a summary narrative of data quality
- o documenting the validation process

The level of data validation that may be accomplished is dependent upon the level of quality control deliverables accompanying the data set. If data validation is important to project objectives, the desired deliverables must be specified at the time of analytical request. ECHEM has a total of over 40 years experience, including over 40 Superfund sites, dealing with validation, from litigative quality validation for USEPA to spot checking data for process control.

QUALITY ASSURANCE

Quality assurance consists of the conscious development of policies and procedures which enhance the quality of services and products, and the follow-up review of staff, activities and products to assess the effectiveness of quality controls. Continual improvement of quality is a primary goal of quality assurance. Quality controls are the application of direct and positive influences on the conduct or performance of services. These controls include, for example, checking calculations, testing a product for fitness for use or providing a written standard procedure for performing an activity. ECHEM provides quality assurance consulting to industry, analytical laboratories, government and professional organizations. Activities have included design of quality assurance programs, preparation of quality assurance program and project plans, onsite audits of program implementation, development of quality controls and standard operating procedures, analytical data validation, and consultation regarding appropriate corrective actions for identified quality problems.

LABORATORY SUPPORT SERVICES

Coordination of sample analyses is becoming increasingly important as the regulations require many more and specific analytical protocols and schedules are often adversely impacted by compliance time tables. Laboratory support services include activities such as selecting a laboratory which possesses the necessary qualifications, experience and capacity for the intended analyses, assuring that appropriate analytical protocols are unambiguously requested, samples are uniquely identified, laboratory receipt of samples is verified, analytical requests and desired level of quality control deliverables are confirmed and data turnaround times are consistent with project objectives. Follow-up tracking of data until receipt and problem resolution are also considered laboratory support services. ECHEM's professional experience with dozens of analytical laboratories throughout the United States and major analytical programs entailing thousands of environmental samples provides a unique capability to enhance each client's response to analytical needs while reducing problems related to inaccurate communications.

ENVIRONMENTAL MONITORING PROGRAM DESIGN

Analysis of samples reveals only the concentration of target compounds in the sample. A well designed environmental monitoring program assures that samples are collected from appropriate locations and subsequently analyzed in accordance with data quality objectives (DQO). Occasionally, the routine analytical methods do not meet DQOs, e.g., a required parameter is not covered by currently approved methods or the method lacks sufficient sensitivity. In such cases, special methods must be developed. ECHEM scientists have directed the development of numerous special analytical methods for USEPA, state agencies and private industries. In addition, an appropriate monitoring program specifies the level of field and laboratory quality controls necessary to allow assessment of data quality. Environmental monitoring programs are often supported by Quality Assurance Project Plans (QAPP). ECHEM has participated in the preparation of over 100 QAPP and their associated monitoring programs.

SAMPLING PROTOCOL DEVELOPMENT

Data derived from the most sophisticated analytical techniques available are of limited value if the sample analyzed is not representative of the media being investigated. ECHEM has successfully developed a number of sampling protocols in various matrices which are as representative of the media of interest as is currently practicable. Recently, a particularly heterogeneous matrix required the collection of over 30,000 aliquots to accurately characterize chemical composition. ECHEM is also well acquainted with standard sampling techniques and can assist in selection of appropriate techniques for routine sampling events.

REGULATORY COMPLIANCE SUPPORT

Today's complex environmental regulations require a variety of interlocking environmental monitoring programs which must comply with often conflicting specifications. Each regulation has promulgated its own list of contaminants of concern and has differing levels of interest for each chemical identified. ECHEM's experience includes both development of municipal and industrial effluent discharge limitations under contract to USEPA and design of monitoring programs which fulfill all regulatory requirements and maximize data utility while minimizing total cost. Evaluation of analytical data for compliance with or relation to a regulatory action level also requires ECHEM's specialized experience in data interpretation, laboratory contaminants, typical "background" levels of chemicals in the environment and fate and transport mechanisms.

HEALTH AND SAFETY SUPPORT

Health and safety support services are focused on evaluation of personnel exposure risk, both in the analytical laboratory and in the field during environmental contamination investigations. Services include identification of chemical contaminants of concern, evaluation of routes of exposure, determination of action levels for upgrading dermal and respiratory protection, development of contaminant monitoring programs for workers and identified potential offsite receptors and preparation of site-specific health and safety plans.

TECHNICAL PEER REVIEW

The concept of peer review of technical documents prior to release is well entrenched in the scientific community and is becoming more widely accepted by the engineering profession. ECHEM's qualifications and experience in analytical and environmental chemistry regulatory compliance and chemical engineering can provide a thorough, in-depth external review of analytical program design, environmental monitoring program design, health and safety plans, quality assurance programs, sampling protocols, and analytical data assessments.

TRAINING

ECHEM provides services for standardized or specially developed training. Typical training topics include health and safety at hazardous waste sites, collection of environmental samples, selection and specification of analytical protocols for regulatory compliance and operation and maintenance of field analytical instruments. Specially developed training modules were recently prepared for calculation of mass balances in industrial processes, evaluating consultants and proposals and waste minimization.

Georgieann L. Wallin
6 George Street
Gorham, Maine
(207) 892-4073

EDUCATION

Waverly High School, Waverly, New York - Business Diploma (1961)
Ithaca College, Ithaca, New York - Business Management Courses (1967-1968)

PRIMARY EXPERTISE

Business management and administration, marketing, contract negotiation, procurement, and USEPA CLP Contract Compliance Screening.

PROFESSIONAL EXPERIENCE

ECHEM INCORPORATED, WINDHAM, MAINE

1989 to present President and Chief Executive Officer

As President, Chief Executive Officer and principal shareholder, Ms Wallin directs the operations and administration of the corporation. She functions as business manager, account executive, marketing director and contracts administrator and utilizes her extensive experience in business management to effectively negotiate and execute contracts while assuring cost-effective and efficient operation of the company.

Ms. Wallin also functions in a technical role, performing Contract Compliance Screening of USEPA Contract Laboratory Program data outputs. These efforts are performed in accordance with detailed USEPA Regional and state-specific guidelines and contract protocols.

GEORGIA WALLIN PLACEMENTS INCORPORATED, GORHAM, MAINE

1988 to present President

Ms Wallin owns and operates a professional placement service specializing in focused recruiting of technical professionals in the sciences and engineering disciplines. The primary focus of this service is locating and placing engineers, scientists analytical chemists and manufacturing engineers in careers mutually beneficial to the client and company.

Georgiann L. Wallin

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BRW SEARCH INCORPORATED, PORTLAND, MAINE

1984 to 1987 Recruiter

Ms Wallin recruited engineers and scientists for career advancement opportunities in the New England area. She assisted engineering firms, analytical laboratories and manufacturers in meeting their personnel acquisition needs.

VICTORY TEMPORARY SERVICES, PORTLAND, MAINE

1983 to 1984 Sales Executive

Ms Wallin was responsible for business development, marketing and account maintenance. Other duties included counseling, testing, interviewing and placement of individuals.

WELCH FOODS INCORPORATED, WESTFIELD, NEW YORK

1973 to 1978 Administrative Assistant

Ms Wallin was responsible to the manager of sales for contract administration, coordination of product delivery, production scheduling, government bids, quality control, and quotas for brokerage firms.

Bruce K. Wallin
6 George Street
Gorham, Maine
(207) 892-4073

EDUCATION - BA Chemistry, Mansfield State College, Mansfield, Pa. (1968)
PhD Biochemistry, Cornell University, Ithaca, New York (1973)

PRIMARY EXPERTISE

Principal investigator of applied chemistry, specializing in environmental assessment and industrial and biological processes.

PROFESSIONAL EXPERIENCE

ECHEM INCORPORATED, WINDHAM, MAINE

PRESENT Vice President

Dr. Wallin serves as Senior Chemistry Professional of the firm. Utilizing his background, spanning over two decades, as an experienced research and process scientist in behavior, metabolism and analysis of naturally occurring and synthetic chemicals and toxic substances, he is responsible for designing, implementing, supervising and evaluating laboratory procedures and operations involving isolation, purification and analysis of environmental, biological and industrial materials. He is also responsible for the company's environmental chemistry efforts involving laboratory start-up and support services, data validation, evaluation and interpretation, analytical program design and regulatory compliance support. These efforts include hazardous waste site SA/RI/FS, RCRA, CWA, SDWA and other Federally mandated environmental activities. Since it's inception, ECHEM has been involved in environmental chemistry support activities at five Superfund sites.

E.C. JORDAN COMPANY (now ABB ENVIRONMENTAL), PORTLAND, MAINE

1987 to 1989 Senior Chemistry Consultant and Manager, Engineering Chemistry Department

As Senior Consultant, Dr. Wallin was the information source for all technical matters associated with the firms analytical and R&D efforts. He was responsible for provision of information to the Environmental Services Division relative to innovative remedial action technology transfer and development; appropriate sampling and analytical techniques for regulatory compliance, data interpretation and utility considerations on an individual project basis. Of the above, environmental chemistry support activities have been performed at over 25 Superfund sites.

Bruce K. Wallin

Page 2

Dr. Wallin was also responsible for founding and managing the company's Engineering Chemistry Department consisting of senior chemists, certified safety professionals, chemists, statisticians, scientists, and technicians. The group's responsibilities included; chemical consultation, client interaction, development of work plans, health and safety plans, quality assurance plans and SI/RI-FS reports, CERCLA-SARA data validation, data review and interpretation, statistical treatment and acquisition of analytical input for all corporate projects.

1981 to 1987 Technical Director, Environmental Laboratory

As Technical Director, Dr. Wallin served as the information source for all technical matters associated with the firm's analytical and R&D efforts. Dr. Wallin provided direction and interpretation to environmental laboratory staff and was responsible for the development, maintenance and implementation of quality assurance philosophies and control procedures associated with the laboratory. He was responsible for all aspects of the laboratory's certification programs, which included external and internal performance evaluations and audits as well as record keeping practices, method application and data manipulation. He also provided information to the company's Earth Resources and Wastewater Divisions relative to appropriate sampling and analysis techniques, data interpretation and utility consideration on an individual project basis, and was involved with over 20 Superfund sites nationwide.

1978 to 1981 Laboratory Manager, and Senior Chemist

Dr. Wallin was responsible for direct supervision of all analytical work performed by the laboratory. He was directly responsible for the expansion of E.C. Jordan's analytical capacity and scope of services from conventional parameters only in 1978 to sales in excess of \$1 million involving atomic absorption and plasma emission spectroscopy, automated wet chemistries, gas chromatography with FID, PID, ELCD and ECD detection and state-of-the art GC/MS capabilities. Analytical work included conventional parameters such as metals, amphoterics, total organic carbon, chemical oxygen demand, biochemical oxygen demand, volatile and semi-volatile priority pollutants, pesticides and other toxic compounds. He was also responsible for interpretation of in-house and subcontracted analytical services for testing of water and wastewater samples resulting from the firms EPA contracted surveys of the nation's food and wood products industries. Included were conventional parameters and testing procedures to identify and quantify priority pollutants and toxicants within the industry.

He was also responsible for short and long range analytical program development and research relating to physical and chemical treatment technologies for water and wastewater purification.

Bruce K. Wallin

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WELCH FOODS CORPORATION, WESTFIELD, NEW YORK

1973 to 1978 Senior Chemist, Research Group Leader and Senior Research Scientist

Responsible for development of flavor profile methodologies to separate and identify by HRGC/MS volatile components of Concord and Niagara grapes. Derived information used for process improvements relating to essence recovery and manipulation. Researched color additives and by-product processing and utilization, including extensive testing programs required for the Food and Drug Administration and other federal agencies. Directed toxicology studies and membrane processes including ultrafiltration.

CORNELL UNIVERSITY, ITHACA, NEW YORK

1971 to 1973 Postdoctoral Research Associate - New York State Veterinary College

Researched the metabolism of various carbohydrates in mammals. Served as special consultant to the Equine Drug Testing Laboratory for analysis of toxic metabolites by GC/MS.

PROFESSIONAL ASSOCIATIONS

American Chemical Society

REFERENCES AND PUBLICATIONS

Available Upon Request

Robert Allen Steeves, PE
Box 996 RFD 1
Limerick, Maine
(207) 637-2183

EDUCATION Tufts University, Medford, MA - BS Chemical Engineering (1972)

PRIMARY EXPERTISE

Waste Management and Minimization, design and interpretation of Environmental Characterization and Monitoring programs, development of Quality Assurance programs and plans, and development of Health and Safety programs and plans.

PROFESSIONAL EXPERIENCE

ECHEM INCORPORATED, WINDHAM, MAINE

PRESENT Vice President

Mr. Steeves serves as Senior Chemical Engineering professional and Quality Assurance Officer of the firm. He is responsible for the design, implementation and coordination of projects and directly oversees the company's technical operations. As Quality Assurance Officer he is independently responsible for the assurance of highest professional standards and quality of the company's operations. Since the inception of ECHEM, Mr. Steeves has served as corporate Quality Assurance Officer for activities at five Superfund sites. Mr. Steeves is a registered Professional Engineer in Maine.

E.C. JORDAN COMPANY (now ABB ENVIRONMENTAL), PORTLAND, ME.

1987 to 1989 Senior Consultant, Quality Assurance

Reporting directly to the Vice President, Quality Assurance, Mr. Steeves created this position. He developed and implemented corporate quality assurance (QA) programs which defined program structure and documented policies for the corporation, and initiated the practice of preparing standard operating procedures. In addition, he created a computer-based, project auditing system which identified areas within corporate control that adversely impacted quality of service. Concurrently, he developed standard procedures for data acquisition, handling, manipulation, and presentation including co-authoring the design of a PC-based data management system for data acquired during investigation of chemically contaminated sites.

Robert A. Steeves

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1985 to 1987 Senior Chemical Engineering Consultant

In a specialized technical position, Mr. Steeves extended chemical data acquisition and interpretation expertise over all Environmental Services Division field investigations. He also served as Chairman, Personnel Health and Safety Committee, and Quality Assurance Coordinator, Environmental Services Division, including the Environmental Laboratory where he initiated a formal Quality Assurance Program. During this period, he prepared approximately 50 QA program and project plans for federal, regional, state and private party investigation of potentially hazardous wastes, including REM III, USAF-IRP, USN NACIP, USATHAMA, and programs in four USEPA regions, including over 25 Superfund sites.

1983 to 1985 Senior Chemical Engineer; Chairman, Personnel Health and Safety Committee; Quality Assurance Coordinator

Mr. Steeves developed and implemented corporate Health, Safety, and Respiratory Protection programs, developed an analytical laboratory quality controls, and prepared approximately 25 project QA plans. Project responsibilities included remedial investigations, lagoon closures, "Right to Know" compliance and initial site reconnaissance efforts.

1981 to 1983 Technical Project Director

During this period, Mr. Steeves directed the technical activities of Jordan's USEPA Effluent Guidelines Division (now Industrial Technology Division) regulatory support group, including nationwide industrial profile development, toxic pollutant sampling and analysis surveys, extensive computerized literature searches, data base development, treatment technology performance assessment, and cost analysis for over 10 industrial point source categories.

1979 to 1981 Senior Project Engineer

Mr. Steeves coordinated the technical activities of the USEPA support group for the Leather Tanning and Finishing, Adhesives and Sealants, Fruits and Vegetables, Soaps and Detergents, Dairy, Seafood, Red Meat and Corn Wet Milling industrial point source categories. He also evaluated sampling and analytical protocols, developed data base formats, directed field activities and prepared technical reviews of various issues in support of USEPA policy decisions.

Robert A. Steeves

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1976 to 1979 Project Engineer

In this position, Mr. Steeves prepared state-of-the-art treatment technology reviews (including bench-scale research), conducted industrial waste sampling surveys and sewer system evaluation surveys, and prepared "201" Facilities Plans.

CAMP, DRESSER AND MCKEE, INC., BOSTON, MASSACHUSETTS

1972 to 1976 Environmental Engineer

Mr. Steeves was responsible for the design and operation of pilot plants for the evaluation of ion exchange, chemical oxidation, and direct filtration water treatment processes, as well as bench-scale and pilot-scale wastewater treatability studies. He also conducted infiltration/inflow analyses, industrial waste surveys, eutrophication studies and wastewater treatment plant efficiency analyses throughout the continental U.S. and the U.S. Virgin Islands.

PROFESSIONAL ASSOCIATIONS

American Institute of Chemical Engineers
Professional Engineer, Maine

PUBLICATIONS AND REFERENCES

Available Upon Request

Michael Paul Rioux
RFD 2 Box 2506
Lisbon Falls, Maine
(207) 353-9614

EDUCATION Lowell Technological Institute, Lowell, Ma. - BS
Environmental Meteorology (1977)

PRIMARY EXPERTISE

Air Pollution Management, Pollution Prevention and Toxic Reduction Strategies, Environmental Permitting and Auditing, Hazardous Waste Management and Minimization, Environmental Training Programs, Noise Monitoring, Stormwater Permitting, SARA Title III Reporting, and Regulation Impact Analysis.

PROFESSIONAL EXPERIENCE

ECHEM INCORPORATED, WINDHAM, MAINE

PRESENT Environmental Consultant

Mr. Rioux serves as Manager of Air Quality Services as well as technical consultant to all environmental projects. His responsibilities for Air Quality Services include program management, marketing, program design, sampling and analysis protocol development, permitting and regulatory compliance. He is ECHEM's technical information source on air matters. Mr. Rioux is ECHEM's lead regulatory liaison and is responsible for obtaining and disseminating updates of State and Federal regulatory activities to ECHEM staff and clients.

BATH IRON WORKS, BATH, MAINE

1990 to 1992 Corporate Environmental Manager

Mr. Rioux was responsible for environmental compliance at four Bath Iron Works (BIW) facilities in Maine. He supervised and coordinated activities dealing with air, water, hazardous wastes, underground tanks, SARA Title III, toxics use reduction, environmental audits, contingency and emergency response plan development and implementation. As chair of BIW's Toxic Reduction Committee, he was instrumental in saving the company several million dollars during 1991 by identifying and implementing toxic chemical and solid waste reduction programs. Mr. Rioux provided technical assistance to EPA in developing Control Technique Guidelines for VOC emissions and Best Management Practice guidelines for NPDES permits for the shipbuilding industry. He also assisted the Maine DEP in developing air toxic emission inventories. He was considered BIW's Environmental expert and assessed the impact of all proposed environmental legislation and DEP regulations on the company's

Michael P. Rioux

Page 2

operations, while maintaining liaison with all environmental regulatory agencies. Mr. Rioux developed the company's first Environmental Awareness seminar which was used to educate all levels of management on environmental issues. During his tenure as Environmental Manager and Environmental Supervisor, BIW successfully participated in over 20 environmental regulatory inspections without assessment of any penalties.

BATH IRON WORKS, BATH, MAINE

1988 to 1990 Environmental Supervisor

Reporting directly to the Environmental Manager, Mr. Rioux assisted in overseeing environmental compliance at every facility. He supervised and assisted in SARA 312 & 313 reports for all facilities which included metal and pipe fabrication, metal and paint finishing, machine shops, and chemical departments. A significant portion of his efforts were targeted on hazardous and special waste management. Mr. Rioux designed and implemented weekly hazardous waste audits and authored the company's Hazardous Waste Training Program, conducted extensive noise monitoring programs and assisted in developing the Maine DEP's Noise Regulation. He was responsible for renewing all air and water permits and was heavily involved in overseeing air diffusion modeling and emission inventories.

BATH IRON WORKS, BATH, MAINE

1981 to 1988 Environmental Specialist

Mr. Rioux was responsible for all air, water, and hazardous waste monitoring and sampling. He assisted in air, water, and hazardous waste permitting and reporting. He developed the SARA Title III reporting protocol for every department within BIW and developed a protocol for auditing the company's disposal facilities. He also developed BIW's laboratory ICAP Spectrographic analysis and QC program and supervised the analysis of IH, environmental, and metallurgical samples. During this period, Mr. Rioux achieved certification as a Certified Hazardous Material Manager and an OSHA Registered Competent Person. Mr. Rioux was heavily involved in Industrial Hygiene monitoring of many industrial processes and supervised and monitored BIW's Hot Work program. He also assisted the Environmental Chemist in environmental monitoring and sampling.

Michael P. Rioux

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MAINE ENVIRONMENTAL SERVICES INC., LEWISTON, ME.

1979 to 1981 Partner

With 3 partners, Mr. Rioux formed an environmental consulting firm. He designed and maintained a 14 site ambient monitoring program under contract with the Maine DEP and conducted a wastewater sampling program for a large paper mill in Newfoundland. Mr. Rioux also developed computer programs which aided in the design of wastewater treatment systems.

MAINE DEPT. OF ENVIRONMENTAL PROTECTION, AUGUSTA, ME.

1976 to 1978 Environmental Consultant

Mr. Rioux was contracted by the Maine DEP to perform a meteorological investigation and statistical evaluation of air pollution data from Bangor, Maine, which was experiencing a long term air-pollution episode. He also designed and maintained air monitoring programs for open burning solid waste sites in Southern and Central Maine, in which he conducted monitoring for TSP, SO₂, NO_x, CO, ozone, wind speed and direction.

PROFESSIONAL ASSOCIATIONS

Air and Waste Management Association
Institute of Hazardous Material Management

REFERENCES

Available Upon Request

Penny K Wallin
6 George Street
Gorham, Maine
(207) 892-4073

EDUCATION:

University of Southern Maine, Portland, Maine - Certificates in the following (1990):

- o Lotus 1-2-3
- o Intermediate Lotus 1-2-3
- o dBase III+
- o Lotus 1-2-3 Macros

Curry College, Milton, Massachusetts - Fine Arts (1983-1984)

Old Orchard Beach High School, Old Orchard Beach, Maine - Business (1982)

PRIMARY EXPERTISE

Contract Compliance Screening and data management, utilizing computer software such as WordPerfect 5.0, LOTUS 1-2-3, dBase III +, Formworx, LOTUS Printgraph, and Sideways and coordination of file transfers via modem to client data bases.

PROFESSIONAL EXPERIENCE:

ECHEM INCORPORATED, WINDHAM, MAINE

1991 to Present - Technician I

Reporting directly to the data validation Supervisor, Ms Wallin logs in data validation packages and prepares the completeness, sample preparation and analysis data records. Ms Wallin also performs CLP Contract Compliance Screening in accordance with USEPA Analytical Program Statements of Work and performs data management resulting in tabulations of analytical data in standardized ECHEM formats utilizing Lotus 1-2-3 software.

Penny K Wallin

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ECHEM INCORPORATED, WINDHAM, MAINE

1989 to 1991 - Secretary-Receptionist

Ms Wallin was secretary to all corporate staff and received and screened clients and vendors. She processed all correspondence and reports, was responsible for magnetic and hardcopy file maintenance, and backup. Ms. Wallin was responsible for telefax machine operation, distribution of incoming transmissions, mail, supplies and performed photocopying of documents for distribution and recordkeeping.

HONEYCOMB SYSTEMS, BIDDEFORD, MAINE

1988 to 1989 - Administrative Assistant

Responsibilities included:

- o WANG Computer data input for mass mailings,
- o File maintenance, timekeeping, project tracking,
- o Data entry utilizing the Apple computer,
- o Ordering and distribution of office supplies for all departments,
- o Computer modem link with supplier, and
- o Switchboard operator and receptionist.

BRW SEARCH, PORTLAND, MAINE

1987 to 1988 - Secretary

Responsibilities included:

- o Distribution of unsolicited resumes,
- o Typing of correspondence for six people,
- o Phone call direction to appropriate consultants,
- o Utilize action of the Canon-SP VP2000 Word Processing System, and
- o Other office duties included filing, recordkeeping, mass mailings, and mail merging

Penny K Wallin
Page 3

CUMBERLAND COUNTY MENTAL HEALTH CONSORTIUM, PORTLAND, MAINE

1984 to 1985 - Executive Secretary

- o Trained on the IBM Memory typewriter and the Apple Computer,
- o Typing of weekly minutes and correspondence for four people, and
- o Other office duties included mass mailings, filing, recordkeeping, and other administrative duties.

CURRY COLLEGE - FINE ARTS DEPARTMENT, MILTON, MASSACHUSETTS

1983 to 1984 - Secretary

Responsibilities included:

- o Secretary to the Fine Arts Department, responsible for correspondence for six people,
- o Administration of examinations,
- o Assisting professors with grading and lecture preparations, and
- o Answering phones, recording, filing, and recordkeeping.

Stacey M. Douglas
Box 125A
West Baldwin, Maine
(207) 839-6659

EDUCATION

Associate Degree in Applied Computer Science, Andover College, Portland, ME (1990)
Lake Region High School, Naples, ME - Business (1987)

PRIMARY EXPERTISE

Office administration utilizing computer software such as WordPerfect 5.0, LOTUS 1-2-3, LOTUS Printgraph, Formworx, Norton Utilities, MemoMaker, Drawing Gallery, and Advance Link.

PROFESSIONAL EXPERIENCE

ECHEM INCORPORATED, WINDHAM, MAINE

1991 to Present - Secretary-Receptionist

Ms Douglas is secretary to all corporate staff and receives and screens clients and vendors. She processes all correspondence and reports, is responsible for magnetic and hardcopy file maintenance, and backup. Ms Douglas is responsible for telefax machine operation, distribution of incoming transmissions, mails and supplies and performs photocopying of documents for distribution and recordkeeping.

GTE PRODUCTS CORPORATION, STANDISH, MAINE

1988 to 1991 - Data Entry/Programmer Aide

Ms Douglas was responsible for entering and verifying data for Bill of Material structures, training new users, entering and/or correcting miscellaneous data on an as needed basis, distribution of reports such as payroll, vendor listings, purchase orders, accounting reports, and various other manufacturing reports to all departments. Ms Douglas also installed software on personal computers when needed, performed equipment maintenance, daily and weekly backups, and distributed and maintained personal computer supplies.

Stacey M. Douglas
Page 2

GTE PRODUCTS CORPORATION, STANDISH, MAINE

1987 to 1988 - Factory Assembly Worker

Ms Douglas was responsible for wiring telephone boxes that were placed on and in buildings.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSPORTATION BUILDING
STATE HOUSE STATION 16 AUGUSTA, MAINE

04033-0016

mdot

DANA F. CONNORS
Commissioner

January 28, 1991

ECHEM, Inc.
Georgia Wallin, President
#32 Route 35, Sebago Common
North Windham, Maine 04062

re: Initial D/WBE Certification

Dear Ms. Wallin:

We are pleased to notify you that your firm, ECHEM, Inc., has been certified as a Disadvantaged Business Enterprise by the Maine Department of Transportation and will be listed in our Disadvantaged/Women Business Enterprise Directory. We must be immediately advised of any changes in ownership, management or control of your business as such changes may affect your D/WBE status.

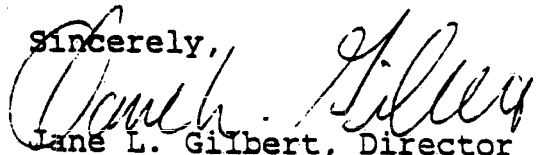
Your firm will be reexamined for continued eligibility on an annual basis. Prior to the anniversary date of your firm's certification, you will be required to complete the Renewal application, furnished by this office and return it along with the following information:

1. The latest financial statement of the firm;
2. The latest Corporate Tax Return of U.S. 1040, Schedule C;
3. The three largest contracts completed in the past twelve months; and
4. A notarized statement indicating any changes in the firm's legal structure, ownership or control.

Failure to comply with this re-examination requirement within 30 days of receipt of the notification will result in the deletion of your firm's name from the monthly Directory of D/WBEs.

As a disadvantaged owned firm, your participation in contracts may be counted toward the Department's Disadvantaged/Women Business Enterprise Commitments.

Sincerely,



Jane L. Gilbert, Director
Division of Equal Opportunity
and Employee Relations

JLG/jl
Enclosures

**EICHEM INC.
ENGINEERING CHEMISTRY CONSULTANTS**

Superfund sites that EICHEM staff have been involved with are tabulated below.

<u>SITE NAME</u>	<u>STATE</u>	<u>USEPA REGION</u>
Auburn Road	NH	I
Baird & McGuire	MA	I
Brunswick Naval Air Station	ME	I
Cannons Plymouth	MA	I
Cannons Bridgewater	MA	I
Charles George Landfill	MA	I
Haverhill Landfill	MA	I
Loring AFB	ME	I
Mass. Military Reservation	MA	I
McKin	ME	I
New Bedford Harbor	MA	I
NYANZA	MA	I
O'Connor Company	ME	I
Old Southington Landfill	CT	I
Picillo Farm	RI	I
Pine St. Canal	VT	I
Saco Tannery Pits	ME	I
Silresim	MA	I
Sullivan's Ledge	MA	I
W. R. Grace	MA	I
Western Sand & Gravel	RI	I
Winthrop Landfill	ME	I
Goose Farm	NJ	II
Love Canal	NY	II
Mamaroneck Compost	NY	II
Nassau Co. FTC	NY	II
Plattsburg AFB	NY	II
Solvent Savers	NY	II
Suffolk County	NY	II
Vineland Chemical	NJ	II
Dover AFB	DE	III
Tybouts Corner Landfill	DE	III
Anniston Army Depot	AL	IV
Cabot/Koppers	FL	IV
Acme Solvent	IL	V
Badger Army Ammo Plant	WI	V
Cemetery Dump	MI	V
Cross Brothers Pail	IL	V
Gratiot County Landfill	MI	V
Liquid Disposal Inc.	MI	V
Northernair Plating	MI	V
Rose Township	MI	V
Springfield Township Dump	MI	V

DIGITAL AERIAL SURVEYS

AGNES H. LEE
Executive Director

ROUTE 31 & ANDERSON ROAD
P.O. BOX 155
HAMPTON, N.J. 08827
908-537-4085
908-537-6862 FAX

BRIAN R. LEE
Vice President/Sales

ROBERT W. LEE, P.L.S.
President

RECEIVED
LARRY J. RUMPF
Vice President

RESUME

DIGITAL AERIAL SURVEYS, INC. is a photogrammetric mapping firm organized in New Jersey in 1973. Its primary function is the preparation of precise topographic mapping from aerial photography and related ground surveys. DIGITAL AERIAL SURVEYS, INC. is a Woman-Owned Business Enterprise (WBE).

DIGITAL AERIAL SURVEYS, INC. is associated with Robert W. Lee Associates, Inc. a land surveying and planning firm organized in 1963. Together, we provide a complete package of aerial surveying, land surveying, mapping, and geographic information systems (GIS) development, management, training, and support.

Aerial photography is especially helpful in the development of base maps to be used for tax mapping, geographic information systems, property acquisition, plant maps, drainage studies, sanitary and storm sewer construction, subdivisions, road design, land use, planning, zoning, transportation studies, and superfund landfill sites.

Surveying equipment utilized in obtaining horizontal and vertical ground control for our photogrammetric projects includes Topcon Total Stations and self-leveling levels. Calculations and data reductions are performed on one of our 10 in-house computers. Aerial triangulation is utilized on larger projects to reduce ground surveying requirements, and computations are carried out on our Zeiss C/120 Stereoplotter utilizing our DAT/EM software.

Photogrammetric measurements are performed on one of our three stereoplotters: a Zeiss C/120 Planicomp Analytical Stereoplotter with VideoMap; a Jena Stereometrograph Model-E of First-Order accuracy. Digital information from all stereoplotters is stored in either our PDP 11/73 or our Hewlett-Packard A900 computer.

Editing of the topographic information is accomplished on our Seiko 32 Color Graphics Terminal, and stored in our SMS 1000 computer. Pre-existing data can be digitized into our system via our Summagraphics 36" x 48" digitizing tablet. This information can then be plotted on our Zeiss Planitab T110 flatbed plotter or on one of our Data Tech Automatic Plotting Tables in either a manuscript form or as a final drafted sheet. Four colored inks are used for standard drafting: orange for index contours, green for foliage, blue for water, and black for all other details. All inks are custom-blended to assure quality reproduction.

Digital information can be translated into SIF files for the Intergraph System and into Autocad DXF or DWG files.

Autocad files may be integrated with DCA software for engineering applications. Autocad may also be married to Oracle through the use of GEO/SQL to form a powerful geographic information system. DIGITAL AERIAL SURVEYS, INC. is an authorized vendor for the Middle Eastern Region for Generation 5 Technology GEO/SQL software.

Information collected on all projects is stored permanently on 9-track magnetic tape or data cartridge, which can be retrieved at a later date. All or any part of a project can be plotted back at any desired scale to meet the needs of clients.

DIGITAL AERIAL SURVEYS, INC. and ROBERT W. LEE ASSOCIATES, Inc. combine to form a team of professionals who work together at one location to complete all phases of topographic mapping projects and GIS applications.

Our firm is located at the intersection of State Route # 31 and Anderson Road in Washington Township, Warren County. Our building is a two story building which houses both Digital Aerial Surveys, Inc. and Robert W. Lee Associates. The approximate square footage of our building is 7,000 feet of working space for our projects and employees. Company vehicles and field personnel are equipped with two-way radios.

PAD#7 "DASRES1"
3/18/92

DIGITAL AERIAL SURVEYS

AGNES H. LEE
Executive Director

ROBERT W. LEE, P.L.S.
President

ROUTE 31 & ANDERSON ROAD
P.O. BOX 155
HAMPTON, N.J. 08827
908-537-4085
908-537-6862 FAX

BRIAN R. LEE
Vice President/Sales

LARRY J. RUMPF
Vice President

LIST OF EQUIPMENT

- One Jena Stereometrograph-E Stereoplotting Instrument with a Data Tech Automatic Drafting Table.
- Two Silicon Valley 486/33mhz computers.
- One PDP 11/73 DEC computer (multi-user).
- Three DEC VT-220 terminals with keyboards.
- One 60 Meg tape drive - 9 track.
- One Summagraphics Digitizing Table -- 36" x 48".
- One Calcomp 9100 Digitizing Tablet -- 36" x 48".
- One Zeiss C/120 Planicomp Analytical Stereoplotter with Videomap software and a Zeiss Planitab precision tracing table.
- One Hewlett-Packard A900 computer with magnetic tape drive and HP cassette tape drive with a 2932A printer.
- Zeiss B/173 Cross Section Software and DAT/EM Software for Aerotriangulation.
- P-CAMS Software on a DEC PDP 11/73 utilizing a Seiko Graphics Terminal for off-line editing, using a Summagraphics Digitizing Tablet.
- GEO/SQL GIS software package.
- Oracle 5 system software manager.
- PFS word processing software.

7. Brief resume of key persons, specialists, and individual consultants anticipated for this project.

<p>a. Name & Title: ROBERT W. LEE, President</p>	<p>a. Name & Title: BRIAN R. LEE, Vice President</p>
<p>b. Project Assignment: Professional Land Surveyor</p>	<p>b. Project Assignment: Photogrammetrist/Field Technician</p>
<p>c. Name of Firm with which associated: DIGITAL AERIAL SURVEYS, INC. and ROBERT W. LEE ASSOCIATES</p>	<p>c. Name of Firm with which associated: DIGITAL AERIAL SURVEYS, INC.</p>
<p>d. Years experience: With This Firm <u>28</u> With Other Firms <u>14</u></p>	<p>d. Years experience: With This Firm <u>15</u> With Other Firms <u>0</u></p>
<p>e. Education: Degree(s) / Year / Specialization High School Graduate Courses at Rutgers University and International Correspondence School</p>	<p>e. Education: Degree(s) / Years / Specialization High School Graduate Graduate of the American School of Photogrammetry Two-year Business Degree Captain, New Jersey National Guard</p>
<p>f. Active Registration: Year First Registered/Discipline Licensed Land Surveyor, NJ 1961 Licensed Land Surveyor, Pa 1965 Licensed Professional Planner, NJ 1969</p>	<p>f. Active Registration: Year First Registered/Discipline</p>
<p>g. Other Experience and Qualifications relevant to the proposed project: 40 years' experience in all types of land surveys, from construction layout to geodetic surveying, to boundary surveys and control surveys, in New Jersey and Pennsylvania. ROBERT W. LEE ASSOCIATES started in 1963, continued to date. DIGITAL AERIAL SURVEYS, INC. started in 1973 continued to date. ROBINSON AERIAL SURVEYS, INC. purchased in January 1991.</p>	<p>g. Other Experience and Qualifications relevant to the proposed project: 15 years' experience in photogrammetry and related mapping.</p>

<p>1. Name & Title: LARRY J. RUMPF, Vice President</p>	<p>a. Name & Title: STEPHEN W. GAGE, Photogrammetrist</p>
<p>2. Project Assignment: Photogrammetrist</p>	<p>b. Project Assignment: Photogrammetrist Computer Specialist</p>
<p>3. Name of Firm with which associated: Digital Aerial Surveys, Inc.</p>	<p>c. Name of Firm with which associated: Digital Aerial Surveys, Inc.</p>
<p>4. Years experience: With This Firm <u>15</u> With Other Firms <u>0</u>.</p>	<p>d. Years experience: With This Firm <u>12</u> With Other Firms <u>0</u></p>
<p>5. Education: Degree(s) / Year / Specialization High School Graduate Graduate of the American School of Photogrammetry</p>	<p>e. Education: Degree(s) / Years / Specialization High School Graduate Graduate of the American School of Photogrammetry Graduate of the University of Maine - BS in Wildlife Management/Honors</p>
<p>6. Active Registration: Year First Registered/Discipline</p>	<p>f. Active Registration: Year First Registered/Discipline</p>
<p>7. Other Experience and Qualifications relevant to the proposed project: 15 years' experience in photogrammetry and related mapping.</p>	<p>g. Other Experience and Qualifications relevant to the proposed project: 12 years' experience in photogrammetry and related mapping.</p>

CURRICULUM VITAE**A. PERSONAL**

NAME: Jonathan Frederick Sykes

BIRTH DATE: July 15, 1948

PLACE OF BIRTH: Toronto, Ontario

HIGHEST DEGREE: Ph.D., October, 1975,
Department of Civil Engineering
University of Waterloo

DISSERTATION TITLE: Transport Phenomena in Variably Saturated Porous Media

ACCREDITATION: Member, Association of Professional Engineers of Ontario

EMPLOYMENT HISTORY:

Sept. 1975 - Assistant Professor, Department of Civil Engineering,
June 1981 University of Waterloo

Sept. 1981 - Senior Staff Consultant, INTERA Environmental Consultants
Aug. 1982 Inc., Houston Texas

July 1981 - Associate Professor, Department of Civil Engineering,
June 1986 University of Waterloo

July 1986 - Professor, Department of Civil Engineering,
present University of Waterloo

May 1987 - Associate Chairman Graduate Studies,
Dec. 1989 Department of Civil Engineering,
University of Waterloo

B. RESEARCH AND SCHOLARSHIP**AREAS OF INTEREST:**

Groundwater Flow and Contaminant Migration
Ice Mechanics
Image Analysis

PUBLICATIONS: (partial list)

Sleep, B.E. and J.F. Sykes, "Modelling the Transport of Volatile Organics in Variably Saturated Media", Water Resources Research, Vol. 25, No. 1, pp. 81-92, Jan. 1989.

Sykes, J.F. and N.R. Thomson, "Parameter Identification and Uncertainty Analysis for Variably Saturated Flow", Advances in Water Resources, pp. 185-191, Dec. 1988.

Thomson, N.R. and J.F. Sykes, "Route Selection Through a Dynamic Ice Field Using the Maximum Principle", Transportation Research Part B, Vol. 22B, No. 5, pp. 339-356, 1988.

Thomson, N.R., J.F. Sykes and R.F. McKenna, "Short-Term Ice Motion Modelling with Application to the Beaufort Sea", J. of Geophys. Res. 93(C6), pp. 6819-6836, 1988.

Osborne, M. and J.F. Sykes, "Numerical Modelling of Immiscible Organic Transport at the Hyde Park Landfill," Water Resources Research, Vol. 22, No. 1, Jan. 1986.

Sykes, J.F., J.L. Wilson, and B.W. Andrews, "Sensitivity Analysis for Steady State Groundwater Flow Using Adjoint Operators," Water Resources Research, Vol. 21, No. 3, pp. 359-371, 1985.

Thomson, N.R., J.F. Sykes, and W.C. Lennox, "A Lagrangian Porous Media Mass Transport Model," Vol. 20, No. 4, W.R.R. 1984.

Chan, H.T. and J.F. Sykes, "Ground Water Mounding Beneath a Large Leaching Bed," Groundwater, Vol. 22, No. 1, Jan 1984.

Farquhar, G.J. and J.F. Sykes, "Control of Leachate Organics in Soil," Conservation and Recycling, Vol. 5, No. 1, pp.55-68, 1982.

Farquhar, G.J. and J.F. Sykes, "Assessing the Impact of Waste Disposal on Groundwater Quality." In Industrial Waste Treatment and Utilization II, Pergamon Press, New York, pp. 503-524, 1982.

Sykes, J.F., S.B. Pabwa, R.B. Lantz, and D.S. Ward, "Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill," Water Resources Research, Vol. 18, No. 6, Dec. 1982.

Schmidtke, K.D., E.A. McBean, and J.F. Sykes, "Stochastic Estimation of States in Unconfined Aquifers Subject to Artificial Recharge," Water Resources Research, Vol. 18, No. 5, Pages 1519-1530, October 1982.

Sykes, J.F., R.B. Lantz, S.B. Pabwa, and D.S. Ward, "Numerical Simulation of Thermal Energy Storage Experiment Conducted by Auburn University," Groundwater, Vol. 20, No. 5, pp. 569-576, Sept. 1982.

- Sykes, J.F., S. Soyupak, and G.J. Farquhar, "Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills," *Water Resources Research*, Vol. 18, No. 1, Pages 135-145, Feb. 1982.
- Sykes, J.F. and A.J. Crutcher, "The Numerical Analysis of Contaminant Migration from Sanitary Landfill Sites." *Water Pollution Research in Canada*, pp. 233-255, 1977.
- Sykes, J.F., W.C. Lennox, and T.E. Unny, "Two-dimensional Heated Pipeline in Permafrost," *J. Geotech., Div., ASCE*, Vol. 100, pp. 1203-1214, November 1974.
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- McKenna, R.F., W.C. Lennox, and J.F. Sykes, "Interpolation of Near Shore Ice Motion," Presented at Canadian East Coast Workshop on Sea Ice, Halifax, N.S., Jan. 1986.
- Sykes, J.F. and J.D. Cushon, "The Modelling of Ice Motion Near Adams Island," Presented at Canadian East Coast Workshop on Sea Ice, Halifax, N.S., Jan. 1986.
- Scheier, N., J.F. Sykes, and W.C. Lennox, "Stochastic Temporal Influences on Contaminant Transport in Shallow, Phreatic Aquifers," ICHA, Indiana, Nov. 1985.
- Sykes, J.F. and M. Osborne, "Simulation of Immiscible Organic Transport at the Hyde Park Landfill," American Geophysical Union Spring Meeting, Washington, May 1985.
- Thomson, N.R., J.F. Sykes, and W.C. Lennox, "A Lagrangian Finite Element Mass Transport Model," Proc. of Ninth Canadian Congress of App. Mech., University of Saskatchewan, p. 715, June 1983.
- Sykes, J.F., "Adjoint Sensitivity Theory for Groundwater Flow," American Geophysical Union Fall Meeting, San Francisco, Dec. 1982.
- Sykes, J.F. and R.W. Andrews, "Application of Performance Assessment Models to Evaluate Uncertainty in Site Characterization," American Nuclear Society Meeting, Washington, Nov. 1982.
- Schmidtke, K., E.A. McBean, and J.F. Sykes, "Stochastic Estimation of States in Unconfined Aquifers Subject to Artificial Recharge," American Geophysical Union Fall Meeting, San Francisco, December 1980.

- Sykes, J.F. and H.T. Chan, "Numerical Modelling of Flyash Fills, Clarkson Flyash Park," American Geophysical Union Fall Meeting, San Francisco, December 1980.
- Sykes, J.F., "Modelling of Contaminant Migration from Sanitary Landfills," Workshop on Groundwater Contamination from Land Disposal Residues International Association of Water Pollution Research, Toronto, Ontario, June 1980.
- Sykes, J.F., "Modelling of Potassium Migration from the CFB Borden Landfill," Presented at the American Geophysical Union Spring Meeting, Toronto, Ontario, June 1980.
- Farquhar, G.J., S. Soyupak, and J.F. Sykes, "The Anaerobic Degradation of Land fill Leachate Organics in Soil," American Geophysical Union, Fall Meeting, San Francisco, December 1979.
- Sykes, J.F., S. Soyupak, and G.J. Farquhar, "The Modelling of Landfill Leachate Organic Degradation," American Geophysical Union, Fall Meeting, San Francisco, December 1979.
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- Lennox, W.C. and J.F. Sykes, "Application of the Finite Element Method to the Problem of First Passage for a Linear Oscillator," 16th Midwestern Mechanics Conference, Kansas State University, September 1979.
- Thompson, L.R. and J.F. Sykes, "Development and Implementation of an Urban-Rural Subcatchment Hydrologic Model (Sub Hyd)," SWMM Users Group Meeting, Montreal, Quebec, 41 pp., 1979.
- Sykes, J.F., "Waste Management: Alternatives," Invited paper presented at Seminar on Political Technical Tradeoffs in Municipal Water and Waste Management, Toronto, April 1979.
- Sykes, J.F., E.A. McBean, and D.J. Laviolette, "The Interdependence of Sanitary Landfill Gas and Leachate," Water Pollution Research in Canada Conference, Toronto, February 1979.
- Lennox, W.C. and J.F. Sykes, "First Passage Problem for a Linear Oscillator Using Finite Elements," Invited paper to U.S.-Japan Seminar on Interdisciplinary Finite Element Analysis. Cornell University, 19 pp., August 1978.
- Crutcher, A.J. and J.F. Sykes, "Modelling Sanitary Landfill Leachates Using a Chemical Mass Balance Technique," American Geophysical Union, Spring Meeting, Washington, D.C., May 1977.

Sykes, J.F., "Solute Transport in Variably Saturated Porous Media," American Geophysical Union, Spring Meeting, Washington, D.C., April 1976.

Leroux, W.C. and J.F. Sykes, "Random Excitation of a Nonlinear Oscillator," Canadian Congress of Applied Mechanics, Fredericton, N.B., pp. 339-340, May 1975.

C. PROFESSIONAL ACTIVITIES

TECHNICAL COMMITTEES:

Member of Canadian Advisory Committee on Remote Sensing - Ice Working Group, May 1986 - Dec. 1989.

Member of National Research Council, Associate Committee on Geotechnical Research, Snow and Ice Subcommittee, May 1984 - April 1989.

SEMINAR PRESENTATIONS AND SHORT COURSES:

Numerical Modelling Short Course. Presented to Nuclear Regulatory Commission and Sandia Laboratories, Washington, D.C., June 1980

"Modelling of Energy and Mass Transport in Porous Media" presented to AECL, Chalk River, March 1980

Numerical Modelling Short Course. Presented to Atomic Energy of Canada Ltd., Houston, Texas, February 1980

Numerical Modelling Short Course. Presented to Union Carbide Corporation Environmental Technology Centre, South Charleston, West Virginia, periodically 1985 to present.

Numerical Modelling Short Course. Presented to Ontario Hydro, 1987.

Numerical Modelling Short Course. Presented to ERM Southwest Inc., Houston, 1989.

CONSULTING AND TECHNOLOGY TRANSFER ACTIVITIES:

Client List:

Philips Planning and Engineering Ltd., Waterloo, 1977.

Marshall Macklin and Monaghan Ltd., Waterloo, 1978.

Ontario Hydro, Toronto, 1978 - present.

Intera Technologies Inc., Houston, 1979-1984.

Intera Technologies Ltd., Calgary, 1979-1984.

Acres International, Toronto, 1984-1985.

Union Carbide Corporation, South Charleston, W.VA, 1984 - present.

Conestoga Rovers and Associates, Waterloo, 1984-1988.

Piteau Associates, Vancouver, 1986.

O'Brien and Gere, 1989
 Morrison Beatty Limited, Mississauga, 1986 - present.
 M.M. Dillon, Toronto, 1986-1989.
 CH2M Hill, Waterloo, 1988 - present.

MODEL STUDIES:

Client	Site
Waterloo Research Inst.	Mississauga Landfill, Mississauga, Ontario
Ontario Hydro	Birchwood Park Landfill, Mississauga, Ontario
Waterloo Research Inst.	CFB Borden Landfill, Ontario
Intera	Paradox Basin, Utah (high level nuclear waste candidate site)
Intera	Permian Basin, Texas "
Intera	Richton Dome, Mississippi "
Intera	Vacherie Dome, Louisiana "
Piteau	AEGL Underground Research Lab, Manitoba
Morrison Beatty	EDC spill, Ft. Langley, British Columbia
Morrison Beatty	Pauze Landfill, Ontario
Conestoga Rovers	Proposed Durham Regional Landfill, Ontario
Conestoga Rovers	Hyde Park Landfill, Niagara Falls, NY
M.M. Dillon	FMC plant site, Middleport, NY
UCC	Maidstone Landfill, Windsor, Ontario
UCC	Ponce Plant Site, Puerto Rico
UCC	Plant Site, Bound Brook, New Jersey
UCC	Possumtown Landfill, Bound Brook, New Jersey
UCC	Taft Plant Site, Louisiana
UCC	Texas City OPDA, Texas
UCC	Texas City IPDA, Texas
UCC	Plant Site, Marietta, Ohio
UCC	Seadrift Plant Site, Texas
CH2M Hill	West Landfill, Seadrift, Texas
UCC	Uniroyal Plant Site, Elmira, Ontario
Ontario Hydro	Raich Farm, Toms River, New Jersey
	Nanticoke Thermal Generating Station

MEMORANDUM

To: Tom Burns, Malcolm Pirnie Inc.,
1 International Blvd.,
Mahwah, N.J. 07495

From: J.F. Sykes

Date: May 22, 1992

Re: Supplementary information to Curriculum Vitae

Further to our telephone conversation, I have put together some details regarding my experience.

Relevant Background

- PhD dissertation: Transport Phenomenon in Variably Saturated Porous Media
- modelling short courses on the use of SWIFT III have been developed and presented to the following groups: US DOE, US Nuclear Regulatory Commission, Atomic Energy Canada Limited, Ontario Hydro and Union Carbide Corporation
- relevant University graduate courses taught at the University of Waterloo: Civ E 673 - Mathematical Methods in Water Resources - topics include analytic solutions, finite element method, finite difference method, finite volume method, boundary integral equation method and the method of characteristics; Civ E 676 - Case Studies in Groundwater Management - topics include use of numerical models in the assessment of groundwater flow and contaminant migration, development of conceptual models, the use of sensitivity and uncertainty methods

Model Experience

- 12 years experience in three-dimensional modelling using SWIFT III
- 16 years experience in modelling variably saturated flow and contaminant transport using various models including GWPGM3, FEMWATER and FEMWASTE, FE3DGW
- experience with MODFLOW, FLOWPATH and MOC through both consulting and graduate teaching.
- multi-phase fluid flow codes include WSTIF
- 7 years experience in using Kriging; codes include AKRIP (from MIT), VKRIG (from U of Waterloo), and GEOPACK (from US EPA).
- surface water modelling experience includes EPA-SWMM and various basin models.

Relevant Model Application

- over 30 different sites have been modelled in the last 10 years
- deep sedimentary basins modelled include Paradox Basin in Utah, Permian Basin in

Texas, Richton dome area in Mississippi, Vacherie dome area in Louisiana
-fractured rock systems modelled include Lockport Dolomite at Niagara Falls NY,
Brunswick Shale at Possumtown and Bound Brook New Jersey, AECL Underground
Research Laboratory in Manitoba (for AECL and Ontario Hydro)
-modelling of dewatering systems: AECL URL (mine shaft), Union Carbide Napoleon
ville site (French drains), numerous unsaturated flow sites