US EPA RECORDS CENTER REGION 5
515439

545 Indian Mound
Wayzata, Minnesota 55391
(612) 473-4224

January 18, 1980

Mr. Edwin H. Ross
Supervisor Ground Water Quality Control
Minnesota Department of Health
717 Delaware Street S.E.
Minneapolis, Minnesota 55440

Re: Qualifications and Experience to Provide Professional Hydrologic and Engineering Services

Dear Mr. Ross:

E. A. Hickok and Associates is pleased to submit this formal proposal to provide professional hydrologic and engineering services to study, evaluate and prepare a cost analysis and plan for the remedy of groundwater contamination resulting from discharge of industrial chemicals at the site of the former creosote works in St. Louis Park, Hennepin County, Minnesota.

For your project we have associated with nationally recognized consulting groundwater geologists and hydrologist, Geraghty and Miller, Inc. of Syosset, New York and the national consulting engineering firm of Henningson, Durham and Richardson, Inc. This combination of professional expertise provides a local staff located in the Twin City area of more than 120 personnel with an additional 900 professionals available at other offices. The associated firms have extensive background in groundwater pollution investigations, groundwater resources management and planning, chemical and hazardous waste analysis and research, hydrology and groundwater analysis, and facility planning for water treatment and wastewater systems for both industrial and municipal facilities.

We believe this team offers the Minnesota Department of Health the strongest possible combination of consultant capabilities for the project. The project will be managed locally by E. A. Hickok and Associates and will have access as required to a wide spectrum of specialized expertise. This combination will be of significant benefit to the Minnesota Department of Health and the project.

This consultant team brings not only the highest level of technical expertise but a new professional dimension to bear on this very significant groundwater problem. Hickok and Associates has had nearly 20 years of groundwater experience in the Twin City area and has performed a number of metropolitan-wide and regional groundwater projects. The firm's experience with groundwater contamination by toxic chemicals includes a major project in Charles City, Iowa involving aquifer contamination with a variety of toxic organics and arsenic. Hickok and Associates has worked successfully with the other consulting team members on a variety of projects for nearly 20 years, with projects ranging from groundwater investigations in southwestern Minnesota and Honduras with Henningson, Durham and Richardson to a report for the U. S. Congress with Geraghty and Miller.

In accordance with the Request for Proposal we are also submitting for your inspection copies of our reports entitled "Waste Characteristics, La Bounty Site" prepared for the Iowa Department of Environmental Quality, and "Urban Runoff Treatment Methods, Volume I - Non-Structural Wetland Treatment" published by the U.S. Environmental Protection Agency. The Iowa report is a file copy which we would appreciate your returning.

We appreciate this opportunity to offer our services to the Minnesota Department of Health and want to stress our interest and desire to be your consultant for the project. E. A. Hickok and Associates and our consultant team are available at your convience to discuss the proposal or for a more in-depth interview.

Respectfully submitted,

EUGENE A. HICKOK AND ASSOCIATES

E. A. Hickok

E. A. Hickok, P.E.
President

EAH:lf

EPA COPY

Analysis and Plan

STUDY OF GROUNDWATER CONTAMINATION ST. LOUIS PARK

MINNESOTA

[illegible]

[illegible]

[illegible]

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Table of Contents

		Page No.
A.	Introduction	A-1
B.	Statement of Understanding	B-1 - B-2
C.	Capabilities	C-1 - C-2
D.	Personnel	D-1 - D-3
E.	Experience	E-1
F.	Response	F-1
	1. Technical Approach	F-1 - F-13
	2. Estimated Expenses	F-14
	3. Coordination	F-14
	4. State Work and Typical Invoice	F-14
	5. References	F-14

List of Tables

		Page No.
1	Estimated Hours and Total Expenses	F-15
2	Composite Hourly Rates	F-16
3	Expenses and Assumptions	F-17

List of Figures

		Page No.
1	Organizational Chart of Key Technical Personnel	D-2
2	Project Schedule	F-2
3	Project Task Flow Chart	F-3

List of Exhibits

		Page No.
1	Draft Outline	F-13
2	Previous and Present State of Minnesota Projects	F-18
3	Henningson, Durham, Richardson, Inc. State Work	F-19
4	Typical Invoice	F-20
5	References	F-21

A. INTRODUCTION

The City of St. Louis Park, Minnesota Department of Health, Minnesota Pollution Control Agency, Minnesota Geological Survey and United States Geological Survey have conducted a number of studies regarding long term discharge of coal-tar distillates, creosote and possibly other wood-treating products which may in time contaminate the major groundwater aquifers of the Twin City metropolitan area. Although the Cities of Minneapolis and St. Paul are presently served primarily by the Mississippi River as a water supply, they may in future periods of low flow increase their dependence on groundwater.

In addition to past studies, currently the U.S. Geogical Survey is performing an extensive study to define more clearly the extent of the problem. The U.S.G.S. prepared a preliminary report in November, 1979 which contains results to date in several significant areas including: a) compilation of all available information, b) location of all public and private wells, c) maps and tables showing areal distribution, thickness and geologic structure of aquifers and confining beds, d) analyses of soil and fluid samples for characterization of organic compounds, e) soil and fluid sample analyses for specific organic compounds and f) column experiments on soil and soil combinations representative of site conditions. In addition the U.S.G.S. is developing a three-dimensional diffusion-dispersion chemical transport groundwater model to test variables affecting contaminant movement in the soil of the St. Louis Park area.

Although a great deal of work has been performed on this problem there remain significant questions and concerns, in particular relating to remedial measures. Consequently, the Minnesota Department of Health has requested proposals for study, evaluation, and preparation of a cost analysis and plan for remedy of the groundwater contamination.

E. A. Hickok and Associates, in association with Geraghty and Miller, Inc. and Henningson, Durham and Richardson, Inc., is submitting this proposal in response to the above request.

000924

B. Statement of Understanding

Our analysis of the request for proposal which was received from the Minnesota Department of Health on December 12, 1979 and contained in the document entitled, "Request for Proposals" dated November 20, 1979 indicates that the purpose of the proposed project is to provide the technical and economic information necessary to design and implement a remedial program to eliminate the chemical contamination of the groundwater in the area of St. Louis Park as much as possible.

It is understood from our analysis of the Request for Proposals that this project will, at a minimum, include:

a. Study and evaluation of the cost effectiveness of a gradient control well system, evaluation of methods for excavation of heavily contaminated soil and programs for treatment and disposal of the water discharged from the gradient control wells and the contaminated soil. Various combinations of gradient control wells will be evaluated to determine which will best control water movement in all contaminated aquifers and aquifers subject to contamination. The evaluation will include, but not be limited to, the ten specific points outlined in the Request for Proposals.

b Participation in the refinement of the diffusion-dispersion model being developed by the U.S. Geological Survey. This model will be available for use to predict the effectivess of the proposed design for removal of contaminated water.

c. Definition and evaluation of a system to treat the water pumped by the gradient control wells. This evaluation will include, at the minimum, the three points listed in the Request for Proposal.

d. Evaluation of the volume of contaminated material and procedures for possible excavation. This evaluation will be based upon available data regarding distribution of soil contaminants and the geology and hydrology of the site and adjacent area. Methods of treatment and disposal of the excavated material will be investigated, including landfill, incineration, land spreading, etc. This major task will include, but will not be limited to the three specific tasks indicated in the Request for Proposal.

e. Review and evaluation of all existing data concerning the site. Review of this information will provide a basis for investigative work and recommending preliminary remedial actions.

f. Literature review to assist the Minnesota Department of Health in setting guidelines for acceptable levels of contamination of soil and water.

g. Estimation of the relative effectiveness of various combinations of barrier wells, treatment systems, and excavation programs. These estimates will be used to evaluate the cost effectiveness of each alternative, indicating the most appropriate plan of action which can be taken to protect the drinking water supply of the area and to reduce the extent and intensity of the contamination as much as possible.

h. Preparation of a detailed work plan including a schedule of activities.

i. Development of a schedule of dates at which times the consultant will report to the Minnesota Department of Health concerning the progress of the study.

j. Evaluation of existing information, outlining the adequacy of information and any additional information that may be required to supplement data gathering efforts.

k. Thorough coordination and close interaction with the Minnesota Department of Health staff and others involved with the problem. This may include participation in public meetings and testimony at public and legislative hearings.

l. Preparation of a final project documentation report to be submitted by June 30, 1981. The report is to address all aspects of the project.

000926

C. Capabilities

The overall capabilities of the project team are addressed in this section. The project team comprises [illegible] A. Hickok and Associates in association with Geraghty and Miller, Inc. and Henningson, Durham and Richardson, Inc. The general capabilities of each firm, specific capabilities in areas to be utilized for this project, history of the firm, location of offices and facilities, organizational structure and summary of total staff capabilities will be provided in this section.

We believe our project team is the best one for this job because it possesses the following unique capabilities:

a. E. A. Hickok and Associates' locally based experience and knowledge in groundwater hydrology and engineering.

b. Geraghty and Miller's nationally recognized expertise in groundwater hydrology with broad experience in problems similar to that in St. Louis Park.

c. Henningson, Durham and Richardson's highly experienced environmental engineering capabilities.

The firm of E. A. Hickok and Associates is a highly experienced and competent team of professional hydrologists and engineers. The firm has performed a number of projects similiar to the St. Louis Park project. The firm has expertise and experience in the areas of modeling including groundwater models, river system models and lake models. The firm has capabilities in groundwater hydrology, analysis and evaluation for both groundwater supply and groundwater contamination and remedial action. Outstanding capabilities and experience in the areas of hydrology and water quality have been key factors in successful performance of past projects of similiar complexity and importance.

The firm of Geraghty and Miller, Inc. has worked on a wide variety of projects in various geologic settings and has conducted groundwater investigations in more than 40 states and 30 foreign countries. The firm provides groundwater pollution investigations and monitoring programs, groundwater exploration and development, and expert testimony. Geraghty and Miller has performed a number of projects for the United States Congress and the United States Environmental Protection Agency. The firm has expert groundwater modeling capabilities; for example, the areal and temporal effects of various pumping rates and pumping patterns on groundwater availability and quality to support the phased development of major chemical works and power plants have been simulated. The firm prepared an environmental impact statement on EPA's proposed underground injection control regulations and has completed a detailed study of current deep well disposal practices.

000927

The firm of Henningson, Durham and Richardson has more than 800 employees, with corporate heaquarters located in Omaha, Nebraska and major facilities in Minneapolis. The firm has been involved in the design of environmental facilities since the founding of the company in 1917 and has designed a large number of water treatment and wastewater treatment plants throughout the nation. The firm is experienced in advanced treatment systems and specialized design. Henningson, Durham and Richardson has a qualified staff of personnel familiar with industrial wastes and has performed a number of toxic waste treatment and handling projects. The firm also has solid expertise in hydrogeology, which will ensure close interfacing of the project team.

The following pages present detailed documentation on the capabilities of each of the firms. Standard Forms 254 for each of the associated firms are included. Subsequent sections of the proposal will present resumes of key technical personnel, applicable work experience of each firm and our proposed work plan response.

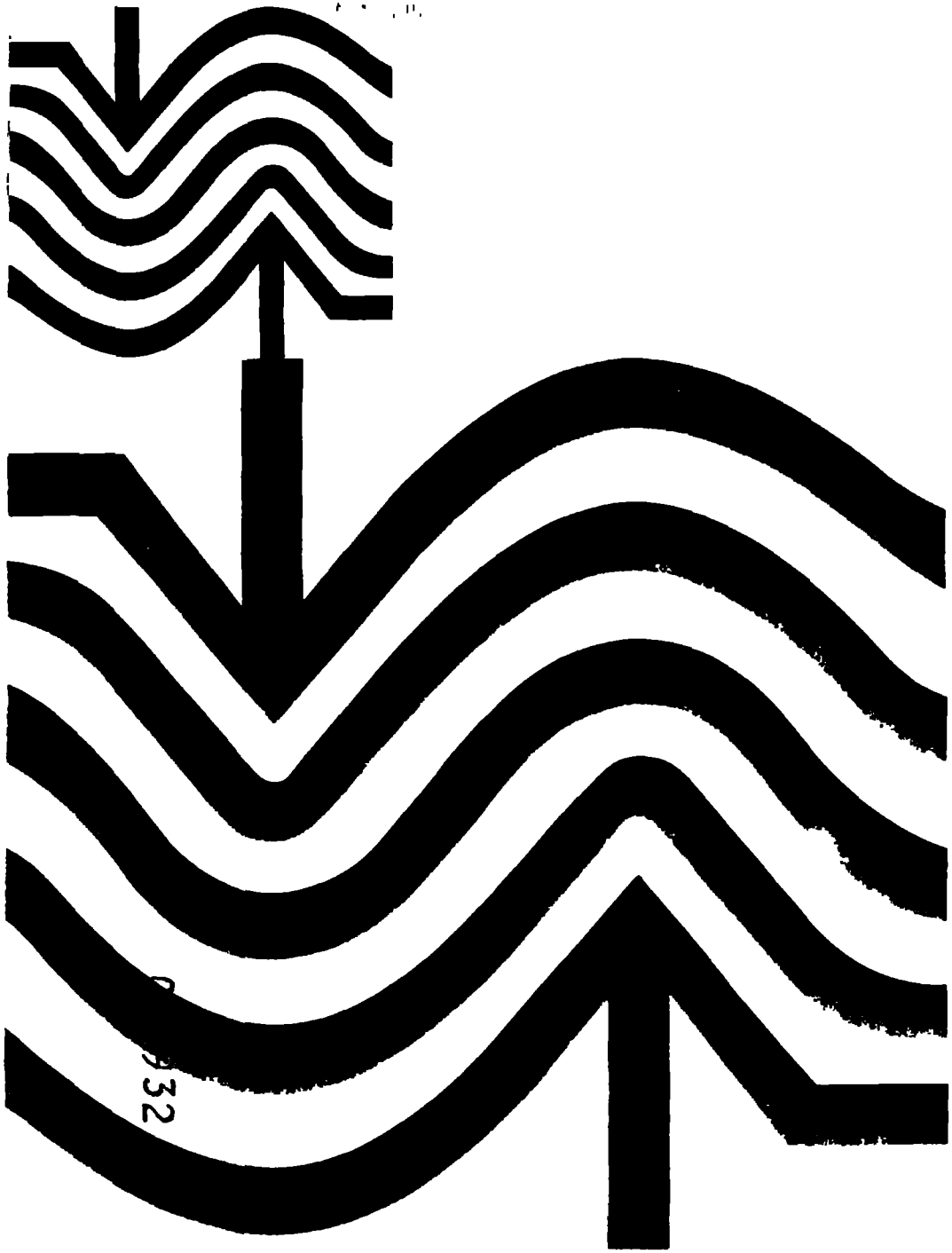
E. A. Hickok and Associates

Capabilities

Eugene A. Hickok AND ASSOCIATES
Consulting Hydrologists-Engineers
545 Indian Mound, Wayzata, Minnesota 55391

000930

PROFESSIONAL INVESTIGATIONS,
RESEARCH AND REPORTS



EUGENE A HICKOK AND ASSOCIATES is a consulting engineering firm with particular expertise in the exploration, planning, development and management of water resources. The firm also is experienced in site planning and engineering and natural resource development.

It's professional staff includes experts in geological, civil and mining engineering and also in limnology With this broad array of talent, the firm is in an excellent position to supply the technical experience and competency required to resolve the most critical problems of water resource management and development.

The list of public agencies and industrial clients it has served since the company was founded in 1961 is the best evidence we can offer of its broad, in-depth experience in the field of water resources A partial list of these clients may be found elsewhere in this brochure

Among the many special services available to our clients are research and consultation prior to the preparation of recommendations for the solution of specific problems

Field studies, combined with geophysical investigations, also are conducted to provide information which will aid water resource managers in their decision making. And, in addition, the company operates a comprehensive biological, bacteriological and chemical laboratory to provide expert analysis of soil and water samples

Principals of the firm have authored numerous ground-water and geologic reports which have been published by government agencies and professional journals This, we think, is an excellent indication of professional competence And this competence, combined with an impressive record of performance for a long list of clients, eminently qualifies it to serve as consultant, either on a specific aspect of a complex hydrological engineering problem, or as prime consultant for the planning, research, costing and construction of projects involving numerous technical disciplines

TECHNICAL EXPERTISE AND EXPERIENCE

OF

E. A. HICKOK AND ASSOCIATES

General Description

The firm of E. A. Hickok and Associates is a leading firm of consultants on water and waste problems in the Midwest. The firm has a broad interdisciplinary staff of professionals in such fields as hydrology, geology, civil and sanitary engineering and computer applications. The company also operates a comprehensive biological, bacteriological and chemical laboratory to provide expert analysis of soil and water samples.

Principals of the firm have authored numerous water resources reports which have been published by government agencies and professional journals. The company has received various awards for its work in water resources. In 1971 for example, it won state and national awards from the Consulting Engineers Council of the United States for the Overall Plan for the Minnehaha Creek Watershed District. The District is the largest in the Twin Cities Metropolitan Area, and includes 27 municipalities and 184 square miles.

The company has provided professional services on water quality to the World Health Organization, the Pan American Health Organization, and many federal and state agencies and local governments. The company has also provided hydrologic services, including wastewater treatment recommendations, to many clients in the following industries: paper, power, mining, food processing, chemical manufacturing, heavy equipment manufacturing, oil, textile and brewing.

The company is a leader in the application of computers to water management. The firm has also furnished expert testimony in several states in litigation involving water issues.

SCOPE OF WORK

Water Quality Monitoring Programs have been established for many governmental clients in order to measure various chemicals and biological factors, evaluate water quality and determine the input and impact from pollutional sources.

Limnological Studies have been conducted to quantify the nutrient balance for lake systems. In this connection, management guidelines have been prepared to assist governing bodies in improving the quality of their water resources and in helping to restore the ecological balance.

Water Treatment Systems have been designed by the firm for the removal of turbidity, iron and manganese and for softening, chlorination, fluoridation and de-ionization of water supplies of both municipalities and private industries. Investigations to increase the efficiency of water treatment facilities have also produced savings for many clients and helped to conserve water resources.

Water Systems providing ultra-pure water for special applications such as plating, etching and cleaning processes have been designed for numerous industrial clients. The re-use of cooling water and other methods of water conservation recommended by the company have resulted in reduced water costs.

Solid Waste Disposal Plans have been prepared to provide environmentally acceptable solutions for the ultimate disposal of solid wastes. Careful consideration is given in these studies to runoff factors, leaching effects, geologic formations and groundwater.

Artificial Recharging of Aquifers has been evaluated for municipalities and industries whose existing groundwater supplies have become inadequate. The firm has investigated the merits of storing treated fresh water or de-mineralized brackish water in natural, underground reservoirs.

Contamination of Groundwater Supplies is an increasingly critical problem in both urban and industrial areas. The firm has conducted investigations to determine the sources of such contamination, along with patterns of movement and rates of flow, and this has resulted in appropriate abatement facilities and practices.

Regional Sewer and Water Planning is another environmental service in which the company is engaged. Water and waste system plans are integrated on an area-wide basis to accommodate projected urban growth patterns.

Comprehensive Water Quality Management Plans are extensive programs that involve safeguarding all aspects of water resources. Coordinated studies are undertaken of stormwater, groundwater, lakes and streams, limnology, waste treatment and rural as well as urban land use effects.

A Testing Laboratory is operated by the firm to provide complete analysis of water, wastewater, air soils and minerals. The technical significance of chemical and biological determinations is evaluated and reported in this laboratory. The detection and identification of iron bacteria and sulfate-reducing bacteria is one of the many special services which are made possible through maintenance of this facility.

Environmental Impact Studies have been prepared to evaluate the effect of projects or plans on the total environment. These studies involve quantification of the positive as well as the negative impact of a proposed project as well as the cost benefit analysis.

Flood Plain Studies have been performed to identify the flood plains and flood hazard zones of several rivers and streams for planning and management purposes.

Land Allocation Studies have been performed on eight river segments in the State of Minnesota. A mathematical computer model has been developed and used to solve the complex problem involved with multiple waste loads discharged to a stream or river.

Stormwater Treatment Facilities for major shopping centers, airports and other point sources have been designed to comply with the requirements of regulatory agencies. Control and management of stormwater runoff is becoming an increasingly important environmental aspect and must be considered during the initial planning process for any new facility or development.

Wastewater Treatment Systems have been designed by the firm including several with high industrial loads. In addition to conventional treatment processes, systems utilizing land application techniques have been designed and are operating. The recycling aspect of land application as well as increased crop production have made this technique an attractive alternative.

Research and Demonstration Studies have been performed under EPA Grant No. S-802535 to evaluate various methods of stormwater treatment. The evaluation of urban stormwater quality, the effectiveness of marshes and the effectiveness of high rate filtration and organic soil filtration were determined.

OMB Approval No. 29-R0224

STANDARD FORM (SF) **254**

Architect-Engineer and Related Services Questionnaire

1 Firm Name / Business Address

Eugene A. Hickok and Associates, Inc.
1545 Indian Mound
Wayzata, Minnesota 55391

1a Submittal is for ☐ Parent Company ☐ Branch Office

2 Year Present Firm Established: 1961

3 Date Prepared: Nov. 1, 1979

4 Type of Ownership

4a Minority Owned ☐ yes ☒ no

5 Name of Parent Company, if any: N/A

5a Former Firm Name(s), if any, and Years Established: N/A

6 Names of not more than Two Principals to Contact Title / Telephone

Eugene A. Hickok, President (612) 473-4224
John R. MacLennan, Executive Vice-President 612) 473-4224

7 Present Offices City / State / Telephone / No Personnel Each Office

7a Total Personnel 39

Wayzata, Minnesota (612) 473-2660

8 Personnel by Discipline.

4 Administrative	___ Electrical Engineers	___ Oceanographers	1 Agricultural Engineer
___ Architects	___ Estimators	1 Planners Urban/Regional	1 Chemist
___ Chemical Engineers	4 Geologists ✓	3 Sanitary Engineers ✓ (Environmental)	2 Microbiologists
8 Civil Engineers ✓	2 Hydrologists ✓	___ Soils Engineers	1 Geological Engineer
___ Construction Inspectors	___ Interior Designers	___ Specification Writers	1 Mathematician
1 Draftsmen	2 Landscape Architects	___ Structural Engineers	1 Hydraulic Engineer
1 Ecologists	___ Mechanical Engineers	5 Surveyors	
___ Economists	1 Mining Engineers ✓	___ Transportation Engineers	

9 Summary of Professional Services Fees Received (insert index number)

Last 5 Years (most recent year first)

	19 78	19 77	19 76	19 75	19 74
Direct Federal contract work, including overseas	1	1	1	1	1
All other domestic work	4	4	4	4	4
All other foreign work*	1	1	1	1	1

*[illegible] work but without such experience, check here ☐

Ranges of Professional Services Fees

1 Less than $100 000
2 $100 000 to $250 000
3 $250,000 to $500 000
4 $500 000 to $1 million
5 $1 million to $2 million
6 $2 million to $5 million
7 $5 million to $10 million
8. $10 million or greater

000936

10. Profile of Firm's Project Experience, Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)
096	8	180	11) 028	3	80	21) 097	9	120
114	11	564	12) 046	5	80	22) 099	5	102
106	22	1,630	13) 056	8	70	23) 102	7	470
102	7	470	14) 059	4	35	24) 104	9	90
114	11	564	15) 065	4	40	25) 104	9	90
079	3	135	16) 078	5	170	26) 106	22	1,630
079	3	135	17) 079	3	135	27) 114	11	564
009	3	110	18) 096	8	180	28) 114	11	564
114	11	564	19) 114	11	564	29) 114	11	564
020	3	150	20) 097	9	120	30) 115	8	156

11. Project Examples, Last 5 Years

Profile Code	"P", "C", "JV", or "IE"	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion Date (Actual or Estimated)
096	P	1 Stream Load Allocations for Eight (8) Rivers in Minnesota (Stream Surveys, Cross-Sections & Hydraulic Models)	MN Pollution Control Agency 1935 W. Co. Rd. B-2 Roseville, MN	80	1974
114	P	2 Toxic Waste Disposal Methods Study, Charles City, IA (Ground-water Contamination)	Iowa Dept. of Environmental Quality 900 E. Grand Des Moines, IA	94	1978
[illegible]	P	3 National Runway Friction Measurement Program, 48 states (Data collection, analysis, management)	Federal Aviation Administration 800 Independence Avenue S.W. Washington, DC	1,464	1980
[illegible]	P	4 Flood Insurance Studies, 18 communities in southern Minnesota	Department of Housing & Urban Development 451 - 7th Street S.W. Washington, DC	420	1980
114	P	5 Mississippi River Wet and Dry Weather Sampling, Saint Paul, Minnesota	Metropolitan Waste Control Commission 350 Metro Square Building Saint Paul, Minnesota	14	1978
[illegible]	C	6 Southwest Service Area 201 Facilities Plan, Twin Cities Metro Area, Minnesota	Metropolitan Waste Control Commission - 350 Metro Square Bldg. Saint Paul, MN	72	1980
[illegible]	C	8 Service Area Six 201 Facilities Plan - Twin Cities Metro Area, Minnesota	Metropolitan Waste Control Commission - 350 Metro Square Bldg. Saint Paul, MN	55	1980

000937

209	P	[illegible] Instrumentation system [illegible] third river road, Cass Lake, MN (Surveying & Instrumentation)	U.S. Dept. of Agriculture Forest Service-Chippewa National Forest Cass Lake, MN [illegible]6633	80	1979
114	P	[illegible] Lake Minnetonka Control Structure; Recreational Facilities (Flood Control & Organizational Coordination)	Minnehaha Creek Watershed Dist. P.O. Box 387 Wayzata, MN 55391	70	1979
220	P	[illegible] Overall Plan for Water Quality Management, Washington, Ramsey & Anoka, County, MN (Flood Control & Floodplain Studies)	Rice Creek Watershed District 3585 North Lexington Arden Hills, MN 55112	30	[illegible]
228	P	[illegible] Ecological Evaluation of the Meadowbrook Marsh, St. Louis Park, MN (Floodplain Area)	Minnehaha Creek Watershed Dist. P.O. Box 387 Wayzata, MN 55391	8	1975
246	P	[illegible] Interstate 35W Northeast Diagonal, Minneapolis, MN (Drainage Design)	Minnesota Highway Department St. Paul, MN	40	1976
256	P	[illegible] Irrigation of Leased Farmland with Industrial and Municipal Treated Wastewater, Storm Lake, Iowa (Irrigation & Soil Systems)	City of Storm Lake Storm Lake, Iowa	40	1975
259	P	[illegible] Meadowbrook Marsh Improvement Project, St. Louis Park, MN (Floodplain Studies)	Minnehaha Creek Watershed Dist. P.O. Box 387 Wayzata, MN 55391	12	1975
265	P	[illegible] Microclimatology of MN Wetlands, Wayzata, MN (Hydrologic Effects of Climatic Conditions)	Minnehaha Creek Watershed Dist. P.O. Box 387	15	1976
278	P	[illegible] Iowa Water Quality Management Plan for the Western Iowa Basin and the Northeastern Iowa Basin (Hydrologic & Hydraulic Analysis)	Iowa Department of Environmental Quality Des Moines, Iowa	70	1975
[illegible]	P	[illegible] Hickory Ridge Residential Subdivision (Flood Control Structures)	Mendota, Inc. Minneapolis, MN	[illegible]	1976
294	P	[illegible] Wastewater Treatment Facility Richland Center, Wisconsin (Final Design of Facilities)	City of Richland Center Wisconsin	200	1974
114	P	[illegible] Chain of Lakes Research and Demonstration Project, Minneapolis MN (Lake Restoration)	City of Minneapolis Minneapolis, MN	186	1980

000938

397	P	Geological Foundation Investigation for the Mile Post 7 Disposal Site, Beaver Bay, MN (Field Surveys & Hydrology)	Reserve Mining Company, Silver Bay, MN	1	1976
[illegible]	P	Geophysical Survey and Groundwater Investigation, Worthington MN Field Work & Design of Hydraulic Facilities to Increase Recharge)	City of Worthington, Minnesota	10	1976
[illegible]	P	Locoshonas Sanitary Landfill Rochester, MN (Hydrological Evaluation)	City of Rochester Rochester, MN	15	1975
[illegible]	P	Special Flood Hazard Report Minnesota River, Mankato, MN (Floodplain Study)	U. S. Army Corps of Engineers St. Paul District	18	1974
[illegible]	P	Ridgedale Regional Shopping Center - Stormwater Treatment Facilities, Minnetonka, MN (Open Channel, Reservoir & Flood Control System)	Dayton-Hudson Development Corp. Minneapolis, Minnesota	30	1975
[illegible]	P.	Evaluation of Stormwater Treatment Methods-EPA Grant No. S-802535, Wayzata, MN (Mechanisms to Improve Drainage)	U. S. Environmental Protection Agency Edison, NJ	294	1976
[illegible]	P	Preoperational Monitoring, Minnesota Spruce Road Project Ely, MN (Evaluation of Hydrology & Drainage)	The International Nickel Co. New York City, NY	80	1976
[illegible]	P	Groundwater Investigation Mile Post 7 Disposal Site, Beaver Bay, MN (Hydrologic Balance & Open Channel Flood Routing)	Reserve Mining Company Silver Bay, MN	125	1975
[illegible]	P	Overall Plan for Water Quality Management, Twin Cities, MN (Floodplain Studies)	Rice Creek Watershed District 3585 North Lexington Arden Hills, MN 55112	30	1975
[illegible]	P	Management Plan for Water Quality, Iowa Great Lakes Northwestern Iowa (Drainage Control, & Lake Improvement)	Iowa Great Lakes Protective Assoc. Spirit Lake, Iowa	36	1974
[illegible]	P	Water Treatment Facilities, Elmhurst, Pennsylvania (Hydraulic Design of Watershed Reservoirs, Treatment & Distribution System)	Pennsylvania Gas & Water Co. 39 Public Square Wilkes-Barre, PA	70	1975

*2 The foregoing is a statement of facts

Signature

Typed Name and Title E. A. Hickok, President

Date November 1, 1979

000939

Geraghty & Miller, Inc.

Capabilities

Description of Geraghty & Miller Services
and Work History

WORK HISTORY

Geraghty & Miller, Inc. is the largest firm in the United States specializing in the development, management, and protection of ground water. The diversity of challenging assignments completed by staff specialists on behalf of Federal, state, and local government agencies and industrial clients is demonstrated in this selected Work History. Over the years, the firm has earned a reputation for developing innovative solutions to difficult problems, and for technical excellence and reliability. Geraghty & Miller, Inc. has demonstrated its ability to design and complete multi-faceted research projects, many of which have required an intensive effort and precise adherence to task deadlines in order to meet timetables predetermined by laws and regulations.

The firm has been continuously involved with research related to the Resource Conservation and Recovery Act (RCRA) since passage of that law in 1976. Prior to that time, Geraghty & Miller, Inc. completed a Report to Congress on Waste Disposal Practices and Their Effects on Ground Water for the U.S. Environmental Protection Agency. Information from this study, which was required by the Safe Drinking Water Act, has been widely used by the Agency as background to justification to proposed ground water protective negotiations.

Since 1974, Geraghty & Miller, Inc. has also been involved in 14 major projects on behalf of the U. S. Environmental Protection Agency, as a consultant responsible for the fulfillment of agency projects or for performance of assignments funded by the Federal government. These projects include Section 208 Areawide Planning studies, a major contribution to development of master water supply plan for the entire State of New Jersey, landfill contamination evaluations in Westchester County, New York, New Jersey, Connecticut, and for the Delaware River Valley Planning Commission. At present, Geraghty & Miller, Inc. is evaluating the status of landfills serving New York City with respect to compliance with RCRA.

Performance of these regulatory-related technical groundwater investigations has considerably broadened the firm's ability to be of assistance to its private clients. Geraghty & Miller, Inc.'s professional staff has access to a regularly updated in-house regulatory reference library.

In addition, senior members of the firm are called upon to testify at public hearings and legal proceedings on behalf of clients seeking approval of their site operations, groundwater management, or adjudication of cases involving groundwater contamination. At the Federal level, the firm was retained by the American Petroleum Institute in connection with the Insititute's preparation of formal comments on the Envi-

ronmental Protection Agencies proposed regulations for Sections 3001 and 3004 of RCRA.

The firm maintains offices in Hartford, Connecticut; Syosset, Long Island, New York; Tampa and West Palm Beach, Florida; and Annapolis, Maryland. Staff members are assigned to projects based on their expertise rather than resident location within the organization. The backgrounds of professional staff members include hydrogeology, hydrology, ground-water modeling, well design, geophysics, chemistry, soils, engineering, waste disposal, and regulatory analysis.

AN INTRODUCTION TO GERAGHTY & MILLER, INC.

Geraghty & Miller, Inc. provides consulting services relating to the development, management and protection of ground-water resources and the formulation of workable and cost effective solutions to environmental problems related to ground water.

Geraghty & Miller, Inc.'s staff has worked in a wide variety of geologic settings and has conducted ground-water investigations in 40 states and 30 foreign countries. The firm's work includes all major aspects of ground-water management:

Ground-Water Pollution Investigations and Monitoring Programs
Ground-Water Exploration and Development
Ground-Water Resource Management and Planning
Environmental Impact Assessments
Deep Well Disposal Programs and Facilities Design
Ground-Water Modeling Studies
Expert Testimony
Mine Related Investigations

GROUND WATER POLLUTION INVESTIGATIONS AND MONITORING PROGRAMS FOR INDUSTRY

Geraghty & Miller, Inc. is often called on to assist its clients and their legal counsel in establishing the nature and probable extent of violations of Federal and state law arising from materials handling, storage, and disposal practices that may affect ground water quality.

Geraghty & Miller, Inc. provides a number of diverse services to meet the specific needs of its industrial clients:

Investigation of the origin, areal extent and persistence of ground water contamination attributable to the discharge of industrial chemicals and wastes.

Investigation of the migration of ground water contamination from industrial sites.

Investigation and identification of sources of chemical contamination in ground water.

Development of ground-water monitoring systems at industrial waste treatment and disposal sites.

Identification and evaluation of the hydrological factors incident to the siting and operation of industrial facilities, power generating stations and waste storage and disposal facilities to comply with Federal and state regulatory requirements designed to protect ground-water quality.

Design and evaluation of abatement strategies related to the chemical contamination of ground water from various sources.

SERVICES TO GOVERNMENT

Geraghty & Miller, Inc. conducted the first national program to monitor ground water quality and establish a data base relating to hazardous substances in ground water supplies for the U.S. Environmental Protection Agency.

The firm prepared a Report to Congress on waste disposal practices and their effects on ground water. The study was sponsored by the EPA as part of its mandated responsibilities under the Safe Drinking Water Act.

Geraghty & Miller, Inc. evaluated the requirements for site location and water quality protection at hazardous waste disposal facilities to assist EPA in establishing regulatory and performance standards.

Geraghty & Miller, Inc. evaluated the nature and extent of the impact of surface impoundments on ground water quality. This study was prepared for the EPA and was used in the development of a system to determine the vulnerability of various hydrogeologic environments to contamination from waste storage impoundments.

Geraghty & Miller, Inc. prepared three regional studies for the EPA which detail ground water pollution problems in the northeastern, southeastern, and northwestern United States.

The firm prepared a national evaluation of injection well practices that will be regulated under the Safe Drinking Water Act, including an assessment of the probable effects for proposed EPA regulations.

Geraghty & Miller, Inc. prepared guidance documents for the U.S. Environmental Protection Agency on the land disposal of solid and residual wastes.

EXPERT TESTIMONY

Geraghty & Miller, Inc. provides expert testimony on behalf of industrial and governmental clients in cases regarding water rights, the environmental impact of ground water development, and conflicts arising from ground water contamination incidents. The firm has developed significant expertise in establishing the nature and probable extent of violation of Federal and state law, administrative regulations, and/or permitted activities caused, or resulting from, its clients' commissive and/or omissive errors.

The firm's expert testimony has included:

Presentations on behalf of the State of New York relating to the potential damage to ground-water supplies from highway construction.

Presentations on behalf of the State of Connecticut concerning pollution of ground water by landfill leachate.

Presentation relating to the impact of a proposed east coast nuclear power plant on ground water resources.

Testimony before the New Jersey Water Policy and Supply Council relating to proposed ground water diversions in designated critical areas.

Presentations and the defense of actions taken by the firm's industrial clients to contain and abate ground water contamination caused by their performance and compliance failures, accidents, or their lack of adequate knowledge of current regulations and failure of the government to provide adequate and timely guidance.

GROUND WATER EXPLORATION AND DEVELOPMENT

Geraghty & Miller, Inc. has been responsible for the planning, supervision, and overall management of major ground water exploration and development projects. As part of this work, the firm conducts detailed site evaluations, prepares well drilling specifications, directs drilling operations, and manages complex data-collection and data-evaluation programs.

Geraghty & Miller, Inc.'s ground water exploration and development work includes the assessment of ground water resources incident to the construction and operation of major industrial facilities, the development of methods for the conjunctive use of surface and ground water, and the siting and design of high capacity municipal and industrial production wells. The firm has conducted a number of major planning studies for its industrial clients, including the evaluation of ground water availability necessary to support the construction and operation of electric generating facilities and chemical complexes.

Geraghty & Miller, Inc.'s staff has developed a systematic approach to geophysical and hydrological evaluation which enables the firm to define and evaluate hydrologic and geologic conditions at a single site or throughout an entire region in an efficient and cost-effective manner.

GROUND WATER RESOURCE MANAGEMENT AND PLANNING

Geraghty & Miller, Inc. has participated in a number of complex ground water planning and management projects in the United States.

Geraghty & Miller, Inc. was retained by the Nassau-Suffolk Regional Planning Board, Long Island, New York, to develop the ground-water policy aspects of its 208 study. The firm participated in other 208 planning projects conducted by the Middlesex County Planning Board, New Jersey; the Delaware River Valley Regional Planning Commission, New Jersey; and the Westchester County Planning Board, New York.

In 1965, Geraghty & Miller, Inc. developed a management plan for surface and ground water use in a 300-square mile region of central Connecticut. The firm developed the ground water policy components of the State of New Jersey Water Supply Master Plan, and is a major participant in the Suffolk County, New York, streamflow augmentation project designed to evaluate the effects of large scale sewering on ground water levels and streamflow.

The firm developed an environmentally sound management plan to meet the long-term water supply needs of the Tampa/St. Petersburg region in Florida which would stabilize falling ground water levels and conserve the region's streams and ponds.

The U.S. Corps of Engineers engaged Geraghty & Miller, Inc. to design a resource management plan to ensure the most efficient conjunctive use of surface and ground waters in a large area of west-central Florida.

ENVIRONMENTAL IMPACT ASSESSMENTS

Since the passage of the National Environmental Policy Act (NEPA) in 1969, the 1972 amendments to the Federal Water Pollution Control Act, and the USEPA's Hazardous Waste Guidelines and Regulations (RCRA, P.L. 94-580), Geraghty & Miller, Inc. has been retained to evaluate the impact of current and proposed laws and regulations on the availability, development, and quality of ground water and has assisted the Federal government and its industrial clients in preparing guidelines and plans to control industrial waste discharges that may impact ground water quality.

The firm assisted the U.S. Environmental Protection Agency in developing strategies to enable the Agency to meet its statutory requirements under the Safe Drinking Water Act and, in addition, Geraghty & Miller, Inc. assessed the probable effects of implementing EPA proposed regulations to assure compliance with the ground-water quality requirements of the Act. Geraghty & Miller, Inc. prepared a Report to Congress which identified the probable effects of national waste disposal practices on ground water quality.

Geraghty & Miller, Inc. conducted a nationwide study for the National Commission on Water Quality to determine the possible ground water quality consequences of the land disposal of sludge.

The firm has prepared a number of other environmental assessments of major projects including:

- The environmental effects from construction and operation of an oil pipeline in Nassau and Suffolk Counties in New York.
- The regional impacts of large-scale housing developments in Florida.
- The anticipated environmental impacts from land development in undeveloped areas in Arizona.

GROUND WATER MODELING STUDIES

Geraghty & Miller, Inc. has conducted ground water modeling studies to support the development of ground water resource management programs. These studies have simulated the aerial and temporal effects of various pumping rates and pumping patterns on ground water availability and quality to support the phased development of major chemical works, power plants, and public supply systems.

Geraghty & Miller, Inc. operates an in-house computer facility in its Syosset, New York, office and, in addition, maintains time sharing arrangements with private and university computing centers.

DEEP WELL DISPOSAL STUDIES

Geraghty & Miller, Inc. has conducted studies to determine the feasibility of injecting industrial and municipal wastes into deep geologic formations and has developed the design criteria for various types of disposal wells.

The firm is presently completing work on a deep-well disposal system as part of a regional water pollution control facility at West Palm Beach, Florida. This facility will dispose of 44 mgd of treated effluent through five, 24-inch wells drilled to 3,600 feet.

Geraghty & Miller, Inc. has completed a feasibility study for a proposed disposal well near Orlando, Florida. The test well for this project was drilled to 6,000 feet.

Other deep well projects conducted by Geraghty & Miller, Inc. include the development of cost and technical data relating to the use of deep wells to dispose of waste water at various industrial sites and the design of programs to monitor injected waste water at various industrial sites in Ohio, Florida, Louisiana, Texas, Tennessee and Alabama.

Geraghty & Miller, Inc. has prepared several reports for the U.S. Environmental Protection Agency relating to injection well regulations and practices, including an environmental

impact statement on the EPA's proposed underground injection control regulations. The firm has completed a detailed study of current deep well disposal practices, developed guidelines for deep well construction and testing, and has evaluated injection well operations associated with mining activities.

MINE-RELATED INVESTIGATIONS

Geraghty & Miller, Inc. has conducted investigations related to the availability of process water, dewatering, and the protection of ground water quality incident to mining operations. These studies include:

Mathematical simulation of the effects of mine dewatering.

Design and supervision of the installation of ground-water quality monitoring and protection systems.

Supervision and preparation of environmental impact analysis for phosphate mining in Florida and North Carolina and coal mining in Pennsylvania.

Preparation of operating, closure and post-closure plans to protect ground-water quality.

Preparation of an environmental assessment for the Nuclear Regulatory Commission on in situ leach mining of uranium, and the development of guidelines to regulate the underground injection of solvents.

STAFF

Geraghty & Miller, Inc. has a staff of 70 professionals representing the following scientific and technical disciplines:

- Geology
- Ground and Surface Water Hydrology
- Chemistry
- Geophysics
- Soil Chemistry
- Well Design
- Mathematical Modeling
- Information Transfer
- Computer Programming

WATER INFORMATION CENTER, INC.
(A Geraghty & Miller, Inc. subsidiary firm)

The Water Information Center, Inc. (WIC) acquires and publishes material relating to ground water resources. It provides a clearing house for technical information from published reports, books, newspapers, and journals. The company publishes reference materials, text books, special reports, atlases, and two semi-monthly reports, the "Water Newsletter" and the "Ground Water Newsletter."

WIC's specialized data gathering capabilities, and its files, library, and publications provide Geraghty & Miller, Inc. with up-to-date information relating to virtually all aspects of the firm's work.

Partial List of Geraghty & Miller, Inc. Clients

UTILITIES & INDUSTRIES

Allied Chemical Corp.
Alumina Partners of Jamaica
AMAX Specialty Metals Co., Inc.
American Can Company
American Cyanamid Co.
American Petroleum Institute
American Standard, In
American Telephone & Telegraph Co.
Armstrong Cork Co.
BASF Systems
Bethlehem Steel Corp.
Biocraft Laboratories Inc.
Borwning-Ferris Industries
Buckeye Cellulose Corp.
Campbell Soup Co.
Caterpillar Tractor Co.
Central Illinois Public Service Co.
Cincinnati Gas & Electric Co.
Cities Service Co.
Colgate-Palmolive Co.
Columbia Carbon Corp.
Columbia LNG Corp.
Connecticut Light & Power Co.
Connecticut Water Co.
Consolidated Cigar Corp.
Container Corporation of America
Crown Zellerbach Corp.
Culligan, Inc.
Dayton Power and Light Co.
EI DuPont DeNemours & Co.
Esso Production Research Co.
Fedders Corp.
Florida Power Co.
FMC Corp.
GAC Utilities, Inc.
General Development Utilities
General Electric Co.
B.F. Goodrich Chemical Co.
W.R. Grace & Co.
Great Bear Spring Co.
Grumman Aerospace Corp.
Heli-Coil Corp.
Hooker Chemical & Plastics Corp.
IBM Corp.
ICI-United States, Inc.
ITT Community Development Corp.
Kimberly-Clark Corp.
Levitt & Sons, Inc.
Lilly Industrial Coatings, Inc.
Lily-Tulip Co.
Thomas J. Lipton, Inc.
Long Island Lighting Co.
Masonite Corp.
Mobil Chemical Co.
Monsanto Co.
National Gypsum Co.
National Starch & Chemical Corp.
Northville Dock & Pipe Line Corp.
Pennsalt Chemicals Corp.
Pepsico, Inc.
Pfizer International, Inc.
Phillips Petroleum Co.
PPG Industries, Inc.
Pratt & Whitney, Inc.
Proctor & Gamble Co.
Pureland Water Co.
Rockresorts, Inc.
Rollins Environmental Services
St. Regis Paper Co.
Schering Corp.
Schlitz International, Inc.
P.J. Schweitzer - Division of Kimberly-Clark Corp.
Sears Roebuck & Co.
Shell Oil Company
The Sherwin-Williams Company
Singer Company
Sohio Natural Resources Co.
Sperry Rand Corp.
Stauffer Chemical Corporation
Sun Oil Company
Syntex Corp.
Texaco, Inc.
Toyota Motor Distributors, Inc.
Transcontinental Gas Pipeline Corp.
Union-Camp Corp.
UniRoyal, Inc.
The United States Time Corp.
Velsicol Chemical Corp.
R.D. Wood & Co.
Worthington Corp.
Xerox Corp.

CONSULTING FIRMS

Anderson-Nichols & Company
Bechtel Corporation
Sidney B. Bowne & Son
Camp, Dresser, & McKee, Inc.
Catalytic, Inc.
Connell Associates, Inc.
William F. Cosulich Associates
Daniel Construction Co.
The DeLeuw, Cather Organization
Ford, Bacon & Davis Engineers
Gannett Fleming Corddry & Carpenter, Inc.
General Electric - TEMPO
Havens & Emerson, Ltd.
Hazen & Sawyer, Inc.
Hudson Institute
Hydrotechnic Corporation
INTECSA
King & Gavaris Consulting Engineers, Inc.
Charles Luckman Associates
Madigan-Praeger, Inc.
CE Maguire & Associates, Inc.
Metcalf & Eddy
The Mitre Corporation
Parsons Brinckerhoff Quade & Douglas
Malcolm Pirnie, Inc.
Robert and Company Associates
Ross, Saarin, Bolton & Wilder
Roushey Smith & Miller
Sasaki, Dawson & DeMay Associates
Smith & Gillespie Engineers, Inc.
Stone & Webster Engineering Corp.
United Engineers & Contractors Inc.
VTN Inc.
Wehran Engineering
Weston & Sampson
Roy F. Weston Inc.
Wilsey & Ham
Woodward-Clyde Consultants

PUBLIC AGENCIES, PRIVATE ORGANIZATIONS AND MUNICIPALITIES

Agency for International Development
Amherst, Massachusetts
Anastasia Sanitary District, St. Augustine, Florida
Cape May County, New Jersey
The City of New York
Clearwater, Florida
Columbia University
Connecticut Board of Fisheries & Game
Connecticut Water Resources Commission
County of Westchester, New York
Darien, Connecticut
Delaware Geological Survey
Dover, Massachusetts
East Orange, New Jersey
Fort Walton Beach, Florida
Hartford, Connecticut
Jackson, Mississippi
Johns Hopkins University, Laurel, Maryland
Miami Conservancy District of Ohio
Nansemond County, Virginia
Nassau-Suffolk Regional Planning Board, New York
National Audubon Society
Newark, Delaware
New Jersey Department of Environmental Protection
New York State Department of Environmental Conservation
Pima County, Arizona
Puerto Rico Water Resources Authorit
Rhode Island Water Resources Board
St. Lucie Board of County Commissioners, Florida
Sarasota, Florida
Servicio Geologico de Obras Publicas (Spain)
Southwest Florida Water Management District
Springfield, Massachusetts
State of New York Department of Law
The United Nations
U.S. Corps of Engineers
U.S. Environmental Protection Agency
U.S. Nuclear Regulatory Commission

PUBLIC AGENCIES, PRIVATE ORGANIZATIONS AND MUNICIPALITIES

University of Louisville, Kentucky
Vero Beach, Florida
Vigo County, Indiana
West Coast Regional Water Supply
Authority
West Palm Beach, Florida
Westfield, Illinois

Geraghty & Miller, Inc

PRINCIPAL OFFICES

SYOSSET, NEW YORK

6800 Jericho Turnpike
Syosset, New York 1179

Mr. David W. Miller (516) 921-6060

ANNAPOLIS, MARYLAND

703 Giddings Avenue
Suite M-5
Annapolis, Maryland 21401

Mr. James J. Geraghty (301) 268-7730

TAMPA, FLORIDA

13902 North Dale Mabry Highway
Post Office Box 271173
Tampa, Florida 33688

Mr. Peter J. Schreuder (813) 961-1921

WEST PALM BEACH, FLORIDA

1675 Palm Beach Lakes Boulevard
Suite 404
West Palm Beach, Florida 33401

Mr. Vincent P. Amy (305) 683-3033

HARTFORD, CONNECTICUT

36 Woodland Street
Hartford, Connecticut 06105

Mr. William Bois (203) 522-5999

SUBSIDIARY ORGANIZATION

Water Information Center, Inc.
6800 Jericho Turnpike
Syosset, New York 11791

Mr. Fred Troise (516) 921-7690

OMB Approval No. 29-R0234

STANDARD FORM (SF) 254
Architect-Engineer and Related Services Questionnaire

1. Firm Name / Business Address:
GERAGHTY & MILLER, INC.
North Shore Atrium
6800 Jericho Turnpike
Syosset, New York 11791

1a. Submittal is for ☐ Parent Company ☒ Branch Office

2. Year Present Firm Established: 1957

3. Date Prepared: December 17, 1979

4. Type of Ownership:

4a Minority Owned ☐ yes ☒ no

5. Name of Parent Company, if any:

As above

5a. Former Firm Name(s), if any, and Year(s) Established:

N/A

6. Names of not more than Two Principals to Contact: Title / Telephone

1) James J. Geraghty, President, (301) 268-7730
2) David W. Miller, Secretary-Treasurer, (516) 921-6060

7. Present Offices: City / State / Telephone / No. Personnel Each Office

7a. Total Personnel 70

Office	Telephone	No. of Personnel
Annapolis, MD	(301) 268-7730	7
Syosset, NY	(516) 921-6060	38
Tampa, FL	(813) 961-1921	14
West Palm Beach, FL	(305) 683-3033	10
Hartford, CT	(203) 522-5999	1
		70

8. Personnel by Discipline:

15 Administrative
___ Architects
___ Chemical Engineers
1 Civil Engineers
___ Construction Inspectors
6 Draftsmen
___ Ecologists
1 Economists
___ Electrical Engineers
___ Estimators
27 Geologists
20 Hydrologists
___ Interior Designers
___ Landscape Architects
___ Mechanical Engineers
___ Mining Engineers
___ Oceanographers
___ Planners: Urban/Regional
___ Sanitary Engineers
___ Soils Engineers
___ Specification Writers
___ Structural Engineers
___ Surveyors
___ Transportation Engineers
1 Soils Chemist
3 Computer Modelers
1 Well Drilling Specialist
1 Water Resource Admin.
1 Hydrologic Technician
2 Geophysicists

9. Summary of Professional Services Fees Received: (insert index number)

Last 5 Years (most recent year first)

	1978	1977	1976	1975	1974
Direct Federal contract work, including overseas	4	4	4	2	1
All other domestic work	6	5	5	4	4
All other foreign work*	1	1	1	1	1

*Firms interested in foreign work, but without such experience, check here ☐.

Ranges of Professional Services Fees

INDEX
1. Less than $100,000
2. $100,000 to $250,000
3. $250,000 to $500,000
4. $500,000 to $1 million
5. $1 million to $2 million
6. $2 million to $5 million
7. $5 million to $10 million
8. $10 million or greater

000964

Profile Firm Project Experience Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)
1) 020	4	$484	11)			21)		
2) 099	3	$480	12)			22)		
3) 114	10	$809	13)			23)		
4) 096	4	$2.3 million	14)			24)		
5) 054	1	$260	15)			25)		
6) 033	2	$104	16)			26)		
7) 026	1	$ 55	17)			27)		
8) 067	2	$315	18)			28)		
9) 115	2	$ 85	19)			29)		
10)			20)			30)		

11. Project Examples, Last 5 Years

Profile Code	"P", "C", "JV", or "IE"	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion Date (Actual or Estimated)
020	P	1 Availability of ground water in the Southereastern Virginia Ground Water Management Area	Eugene A. Sindla, Virginia State Water Control Board, 287 Pembroke 11, Virginia Beach, VA 23462	$75	1979
020	P	2 Four River Basins Area Water Resources Management Study, West Central Florida	George Mansch, Dept. of the Army, Corps of Engineers, Jacksonville District, Jacksonville, Florida 32201	$108	1977
099	P	3 Waste Disposal Practices and their effects on ground-water (national). Report to Congress of the United States	Thomas Belk, U.S. Environmental Protection Agency, Office of Drinking Water, 401 M St., S.W., Washington, D.C.20460	$250	1976
099	P	4 Ground-water/surface-water protection requirements for hazardous waste management facilities (nationwide)	Lawrence Weiner, U.S. Environmental Protection Agency, Office of Drinking Water, 401 M St., S.W., Washington,D.C. 20460	$222	1978
114	P	5 Hydrogeologic investigations and modeling of aquifer responses, Jamesport, N.Y.	J. P. Camey, Long Island Lighting Co., Jamesport Nuclear Power Station, 175 E. Old Country Road, Hicksville, NY 11801	$85	1977
020	P	6 Ground-water Problems in the Northwestern, Southwestern and Northeastern United States (27 states)	Marion R. Scalf, U.S. Environmental Protection Agency, Robert S. Kerr Water Resources Research Center, Ada, OK 14820	$218	1976
096	C	7 Feasibility of deep-well disposal of advanced treated waste water, Orange County, Florida	Richard Shanklin, Jr., VTN Inc., 712 West Gore Street, Orlando, Florida 32805	$300	1976

096	C	Feasibility of deep well disposal of power-plant wastes, Jam[illegible]ille, FL	William T. Shef[illegible]k, [illegible] McDonnell, 460 [illegible] 63rd St., Kansas City, MO 64101	$800	1978
114	P	Connecticut Water Co. Development of Public Water Supplies	Connecticut Water Company P.O. Box 511 Clinton, Connecticut 06413	$100	On Going
114	P	Technical support & evaluation of injection well practices (nationwide)	Thomas E. Belk, Office of Water Supply, U. S. Environmental Protection Agency, Washington, D.C. 20460	$100	1978
114	P	Ground-water Exploration & Development Ringuskid , Ireland and San Paulo, Brazil	Pfizer International, Inc. 235 East 42nd St. New York, NY 10017	$56	1972
020	C	Ground-water Environmental Assessment Proposed East Coast Refinery Site	Shell Oil Co. 95 Commercial St. Plainview, New York 11803	$50	1972
114	C	Polluted Ground Water: Some causes, effects, controls, and monitoring (nationwide study)	R. N. Tinlen General Electric TEMPO, General Accounting Drawer 22, Santa Barbara, Cal 93102	$83	1973
114	C	Ground-Water Evaluations for proposed XEROX & AMAY industrial sites, Greenwich, Conn.	Charles Luckman Associates 521 Fifth Ave., New York, NY 10017	$56	1972
054	P	Great Neck & Port Washington Sewer District, Ground-water Study, Nassau County, N.Y.	Wm. S. Cosulich Associates 100 Crossways Park West, Plaza Bldg. Woodbury, New York 11797	$20	1972
033	P	Investigation of the impact and use of surface impoundments for waste disposal in the U.S.	Thomas E. Belk, Office of Water Supply, U.S. Environmental Protection Agency, Washington, D.C. 20460	$260	1978
026	C	Environmental Impact Statement for EPA's Underground Injection Regulations (nationwide)	E. L. Hockman, U.S. Environmental Protection Agency, Office of Drinking Water, 401 M St., S.W., Washington, DC 20460	$85	1976
033	C	Installation of brine well for desalination plant in Virginia Beach, Virginia	Fred Swats, Wiley & Wilson, Inc., 2310 Langhorne Road, Lynchburg, VA 24501	$55	1979
		Environmental Impact of Phosphate Mining in Central Florida	William Underwood, Texas Instruments, Inc P. O. Box 5621, MS 949, Dallas, TX	$49	1978

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67	P	20 Ground -water elements of in-situ leach mining of uranium [illegible]ationwide,	Glenn Terry, U.S. Nuclear Regulatory Commission (NMS[illegible] Washington, DC 20555	$112	1978
67	P	21 Ground-water pollution from eastern underground coal mines, Eastern U.S.	Edward Bates, U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Cincinnati, OH	$203	1979
96	C	22 Feasibility of deep-well disposal of power-plant wastes, Gainesville, FL	William T. Shefchik, Burns and McDonnell 460 East 63rd Street, Kansas City, MO 64141	$800	1978
96	C	23 Injection of treated sewage, City of West Palm Beach, Florida.	J. H. Weaver, Robert & Company Assoc., 2250 Palm Beach Lakes Blvd., West Palm Beach, Florida 33401	$400	1978
99	P	24 Hydrogeologic investigation of the St. Lucie County Sanitary Landfill, St. Lucie, Florida	Andrew Helseth, Board of County Commissioners, P.O. Box 700, Ft. Pierce, FL 33450	$ 8	1977
114	P	25 Evaluation of ground-water conditions at Delmarva Power & Light Company's Vienna, Maryland, site	J. J. Lentz, Applied Physics Laboratory, John's Hopkins University, Johns Hopkins Rd., Laurel, MD 20810	$ 55	1979
114	P	26 Ground-water exploration and development, Aquirre and Macana Power Generating Stations, Puerto Rico	Puerto Rico Resources Authority P.O. Box 4267 San Juan, Puerto Rico	$237	1973
114	P	27 Ground-water exploration and testing, Verna well field, Sarasota, Florida	John Colyer, Smith & Gillespie Eng.,Inc. P.O. Box 1048 Jacksonville, FL 32201	$ 50	1974
115	C	28 Regional water supply sources and post 1980 needs study, West-central Florida	Ross, Saarinen, Bolton & Wilder, Inc. 1321 U.S. Hwy. 19 South, Suite 503 Clearwater, FL 33516	$ 70	1977
115	P	29 Public water supply, Norwood, Massachusetts	Townhall Norwood, MA 02072	$ 15	1978
		30			

2. The foregoing is a statement of facts

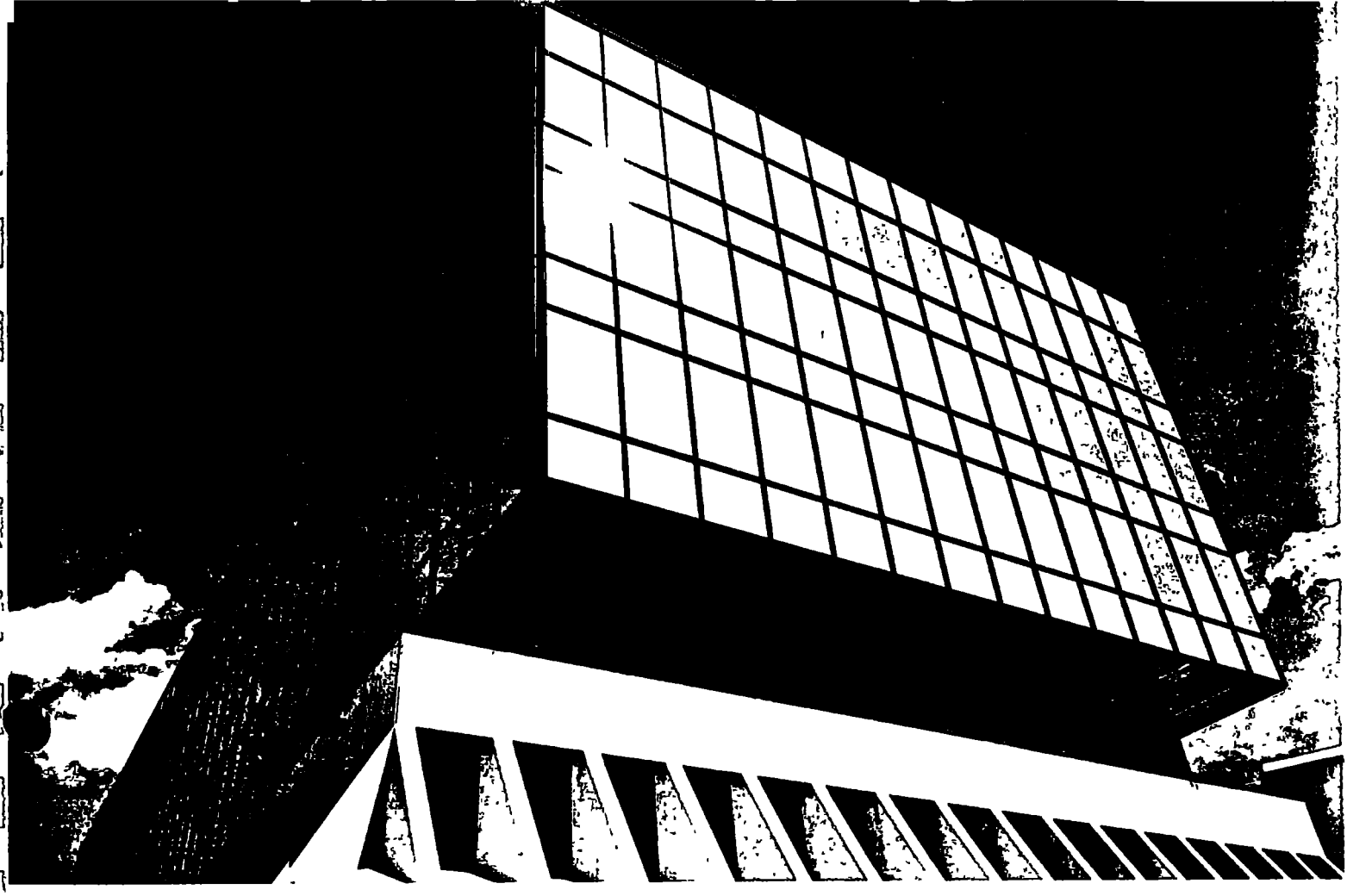
Signature: [signature] Typed Name and Title: William J.Seevers, Vice President

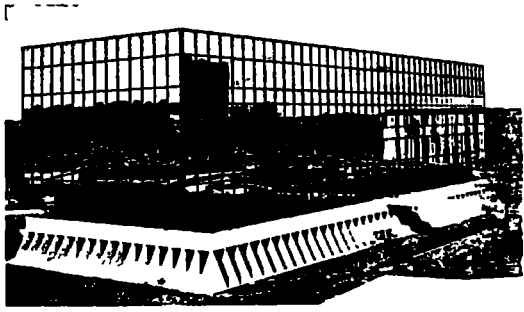
Date: 12/17/79

Standard Form 254 July 1975
Prescribed By GSA Fed Proc Reg (41 CFR) 1 1[illegible]

Henningson, Durham & Richardson, Inc.

Capabilities

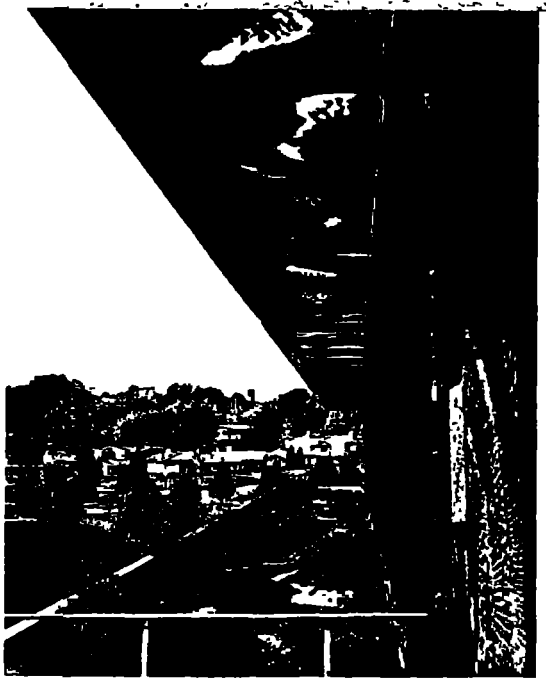




HDR

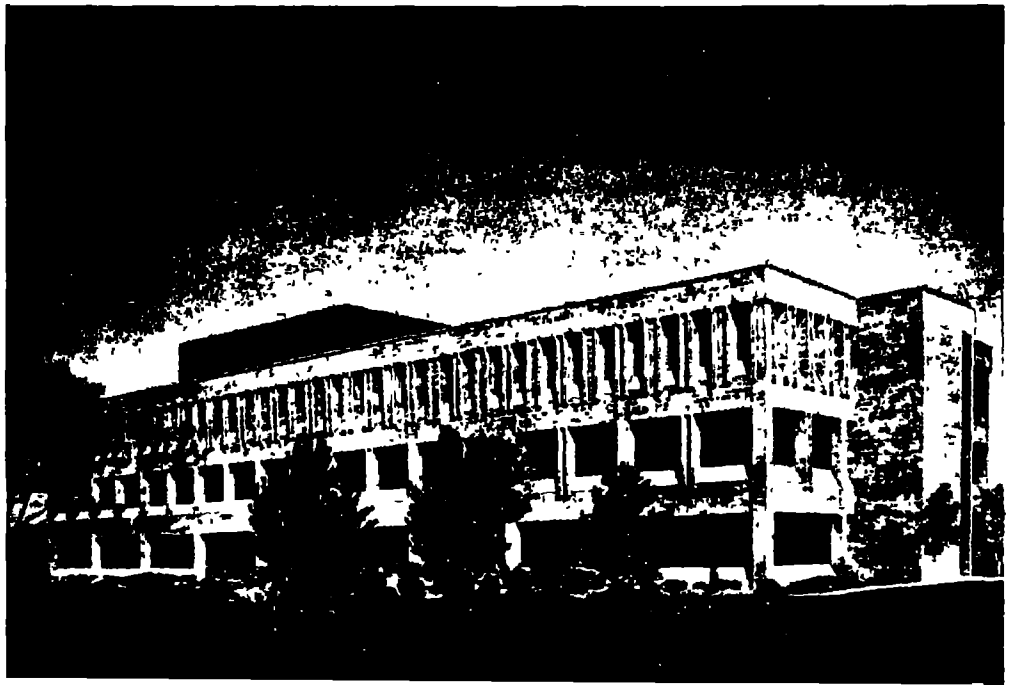
Omaha, Nebraska

The headquarters building of Henningson, Durham & Richardson houses more than 400 persons who provide clients with total in-house services in architecture, engineering, systems, planning, and science research The building's three basic materials, earth, concrete and glass, were used to establish the design principles as a natural expression of its sloping site The interior of the office contains approximately 80,000 square feet on six floors and incorporates some of the most modern office facilities available today



HDR Place

HDR's home office is a modern facility designed specifically to enable the firm's architects, engineers and support personnel to provide efficient and creative professional services. Professionals have instant access to computer terminals with a complete on-line battery of design programs, as well as conveniences including nationwide WATS lines, telecopiers, total in-house graphic design and printing capabilities, and a fleet of corporate aircraft that enable them to maintain accurate and instant communication with each of the firm's offices and any project site



Pfeifer and Shultz/HDR

300 Parkdale Building
5401 Gamble Drive
Minneapolis, Minnesota 55416

Under the leadership of Phil Fuller, P.E., P&S/HDR provides total engineering and support services for the generation, transmission, distribution and end use of energy by applying both conventional methods and such innovative techniques as the use of wood, wood products and other refuse derived fuels to generate both steam and electrical power.

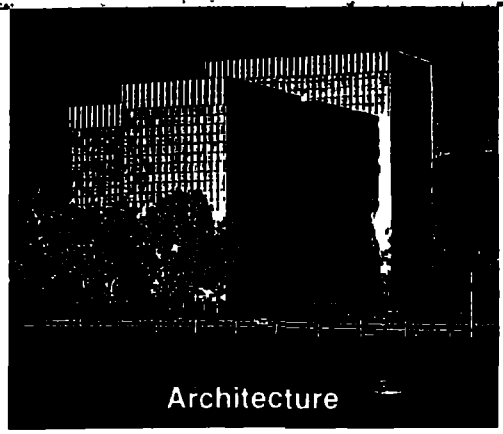
With more than 34-years of both power and general engineering experience at their command, the professionals at P&S/HDR also offer complete services in architecture; environmental, civil, industrial and transportation engineering; resource recovery; planning; systems; and ecosciences.

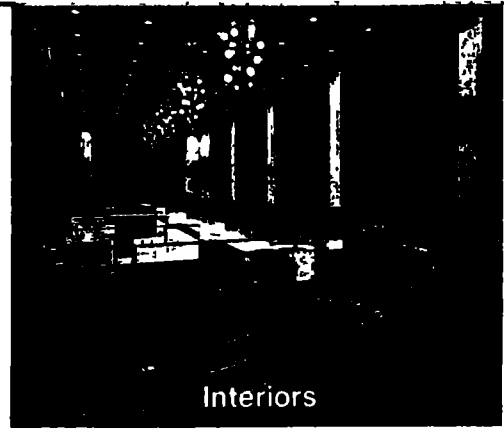
P&S/HDR, Inc.

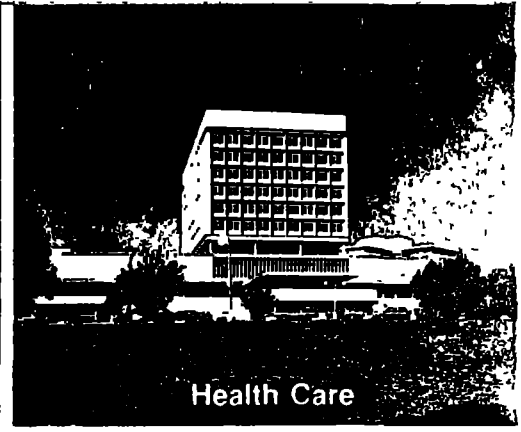
Minneapolis, Minnesota

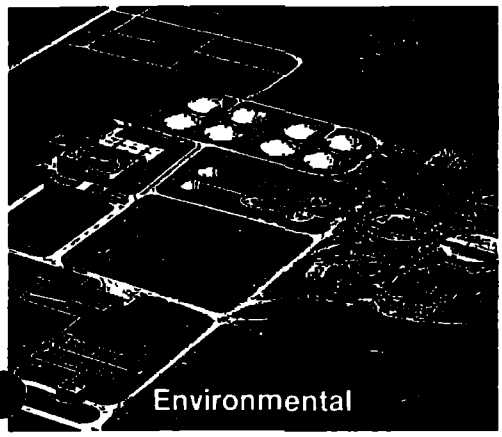
Capabilities have been developed over the years to enable P&S/HDR to assist industrial, institutional and steam/electric utility clients in all phases of their energy projects, from feasibility and planning studies, site selection and alternate fuels analyses, through complete engineering design, construction and operation.

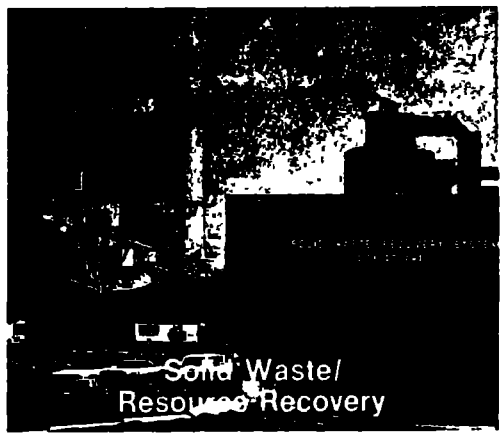
P&S/HDR's extensive experience in cogeneration and coal and waste burning steam generators combines with their pollution control engineering expertise to meet clients' needs for the planning and design of environmentally and economically sound energy generation, transmission and distribution systems.

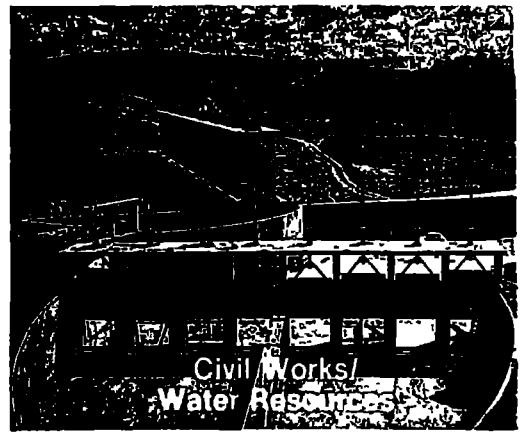


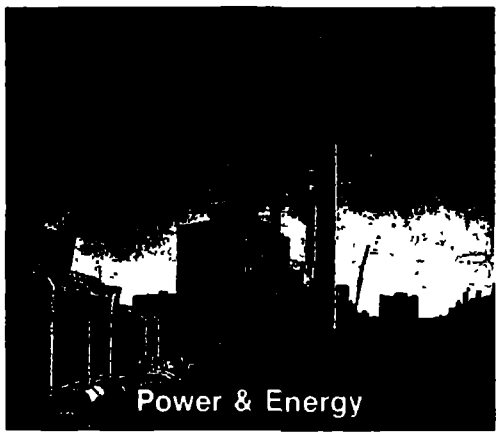


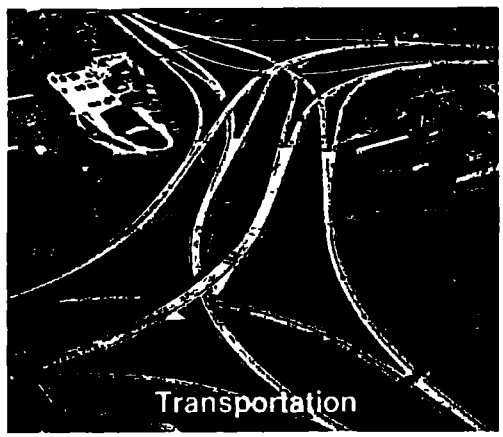


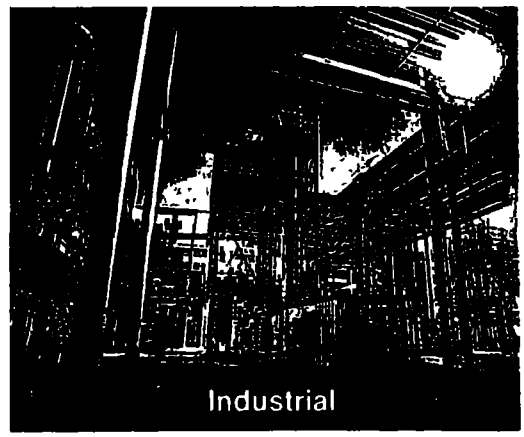


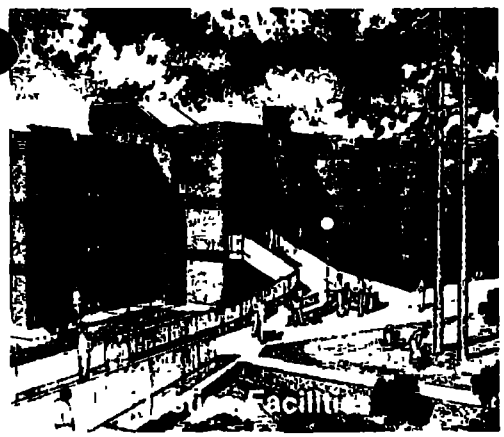


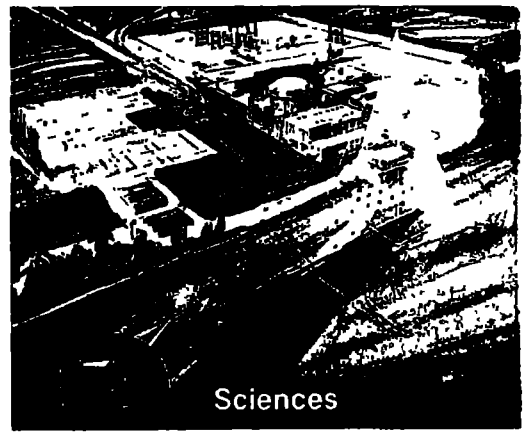












HDR
Henningson, Durham & Richardson

HDR has twelve specialized fields of service, as listed above These areas are complementary of each other, giving clients on any project access to specialists in all of these fields

Each specialized area employs professionals and technical personnel capable of accomplishing all aspects of a project including project management, planning, design and construction services Each client working with HDR thus has the advantage of the firm's complete in-house services, organized to serve the client on a close, personal basis anywhere in the nation

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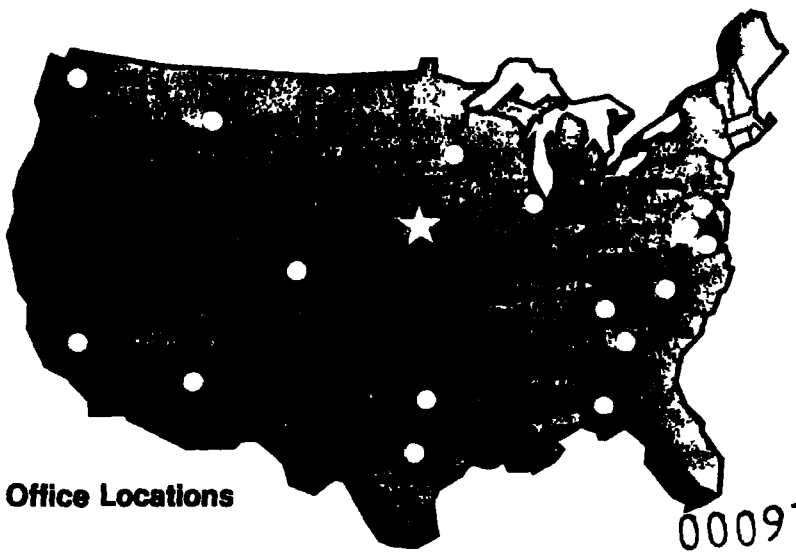
(XXX)14 1179

Architecture	Architectural programming, physical/functional evaluation, master planning, interior design/space planning, equipment/materials handling, landscaping, value engineering, life-cycle costing, energy	conservation and complete architecture and engineering design services for commercial, industrial, educational, health care and justice facilities
Health Care	Complete architectural/engineering planning and design services for replacement, additions and renovations of acute, general and primary care hospitals,	geriatric care, psychiatric care and chemical dependency units, ambulatoriums, physicians' office buildings and parking garages
Justice Facilities	Statewide planning studies, institutional master planning, facilities programming, design of correctional and detention	facilities, county jails, county and city police facilities, court and judicial administration complexes
Industrial	Manufacturing plants, warehouses, offices, power plants, wastewater treatment	plants, air quality studies, site engineering and process support engineering
Interiors	Complete interior design, space planning, color selection, selection and design of furniture and furnishings for health care	facilities, offices, schools, banks, clubs and restaurants
Environmental	Master planning municipal and industrial water and wastewater systems, design of water treatment plants, pumping stations, storage reservoirs, water	mains, water rates, wastewater treatment facilities and sanitary sewers, construction management, operation manuals, operator training and plant start-up
Civil Works/ Water Resources	Urban drainage, dams and water control projects, hydrologic, hydraulic and flood studies, regional water resources	planning, irrigation, ports and harbor facilities
Transportation	Transportation planning, traffic engineering, parking studies, transit studies, highway corridor and functional studies, land development, flood control, design of	rapid transit systems, highways, airports, bridges, municipal street improvements, railroads
Power & Energy	Power supply planning and systems studies, feasibility and rates analyses, site and right-of-way selection, power plant, transmission line and substation design including gas turbine and diesel installations, alternate fuels analysis including fossil fuels,	solid waste and wood, fuel handling, waste storage and transportation, energy management/conservation, air and water pollution control systems, regulatory agency permits
Solid Waste/ Resource Recovery	Solid waste and hazardous waste studies, facility procurement by conventional A/E and full service RFQ-	RFP, energy management and alternate energy source studies, retrofit and design, sanitary landfill design
Sciences	Environmental baseline studies, impact analyses and reports, siting studies, environmental monitoring, 316 (a) and (b) demonstrations, socioeconomic studies,	computer simulation, special technical studies, local and regional land use planning, research and new technology studies
Systems	Computer systems analysis, design and implementation, hardware evaluations,	business, scientific, engineering, geoprocessing and graphics applications



Office Locations

10. Profile of Firm's Project Experience, Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)
1) 006	18	1,000	11) 050	5	500	21) 087	25	3,500
2) 011	75	3,350	12) 052	100	7,000	22) 090	60	4,000
3) 019	200	2,750	13) 054	30	1,500	23) 092	25	2,000
4) 029	25	2,500	14) 055	120	1,500	24) 096	200	25,000
5) 032	25	350	15) 057	5	500	25) 098	23	500
6) 033	22	6,000	16) 058	30	3,000	26) 099	25	600
7) 039	7	1,500	17) 072	25	2,500	27) 102	41	1,500
8) 042	10	1,500	18) 079	30	1,280	28) 107	125	3,500
9) 046	130	7,500	19) 083	375	4,500	29) 114	18	1,500
10) 048	75	30,000	20) 084	24	1,800	30) 115	180	5,000

11. Project Examples, Last 5 Years

Profile Code	"P", "C", "JV", or "IE"	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion Date (Actual or Estimated)
006	P	1 Riverton Airport Expansion-Phase I Riverton, Wyoming	City of Riverton Riverton, Wyoming	2,500	1979
011	P	2 Sloway, Clark Fork River Twin Bridge Structures, Design Superior, Montana	Montana State Highway Commission Helena, Montana	3,000	1978
019	C	3 Land Use Data & Storm Water Runoff Management System, Pinellas County, FL	Pinellas County Clearwater, Florida	46,000	1979
029	P	4 College of Health Sciences, King Abdulaziz University Jeddah, Saudi Arabia	King Abdulaziz University Jeddah, Saudi Arabia	1,900,000	1984
032	P	5 Pacific Science Center, Phase I Conservation, Research, Development & Demonstration Program	Seattle City Light Seattle, Washington	500	1978
033	P	6 City of Los Angeles Wastewater Facilities Plan, Environmental Impact Report and Environmental Impact Statement	City of Los Angeles Los Angeles, California	855	1977
039	P	7 Nebraska State Office Building Parking Garage Lincoln, Nebraska	City of Lincoln Lincoln, Nebraska	2,100	1977

Standard Form 254 July 1975

OMB Approval No. 29-R0234

STANDARD FORM (SF) 254
Architect-Engineer and Related Services Questionnaire

1 Firm Name / Business Address

Henningson, Durham & Richardson, Inc. & Affiliates
8404 Indian Hills Drive
Omaha, Nebraska 68114...Phone: (402) 399-1000

1a. Submittal is for ☐ Parent Company ☐ Branch Office x Entire Corporation

2. Year Present Firm Established: 1951

3 Date Prepared 4/1/79

4. Type of Ownership: Corporation

4a. Minority Owned ☐ yes ☒ no

5. Name of Parent Company, if any:

HDR, Inc.

5a. Former Firm Name(s), if any, and Year(s) Established:

Henningson Engineering Company 1917-1930
Henningson Engineering Company, Inc. 1930-1951
Henningson, Durham & Richardson, Inc. 1951-Present

6. Names of not more than Two Principals to Contact: Title / Telephone

1) Larry N. Hawthorne, Vice President...Architecture...(402) 399-1215
2) William B. Preston, Vise President...Engineering...(402) 399-1214

7. Present Offices: City / State / Telephone / No. Personnel Each Office

7a. Total Personnel 887

Alexandria, VA...(703) 683-3400 / 22
Atlanta, GA...(404) 892-0772 / 6
Charlotte, NC...(704) 364-1800 / 36
Chicago, IL...(312) 297-1708 / 3
Dallas, TX...(214) 748-6351 / 32
Denver, CO...(303) 861-1300 / 44
Helena, MT...(406) 442-7400 / 6
Minneapolis, MN...(612) 544-7741 / 62
New Orleans, LA...(504) 525-1444 / 22
Norfolk, VA...(804) 461-6351 / 1
Omaha, NE...(402) 399-1000 / 403
Pensacola, FL...(904) 432-2481 / 40
Phoenix, AZ...(602) 264-0731 / 33
Santa Barbara, CA...(805) 965-5214 / 95
Seattle, WA...(206) 682-9000 / 42
Washington, DC/Chevy Chase, MD...(301) 657-1780 / 40

8. Personnel by Discipline:

188 Administrative
120 Architects
1 Chemical Engineers
95 Civil Engineers
27 Construction Inspectors
103 Draftsmen
20 Ecologists
5 Economists
11 Biologists
34 Electrical Engineers
___ Estimators
1 Geologists
10 Hydrologists
8 Interior Designers
2 Landscape Architects
56 Mechanical Engineers
___ Mining Engineers
2 Sociologists
2 Oceanographers
6 Planners: Urban/Regional
62 Sanitary Engineers
1 Soils Engineers
4 Specification Writers
38 Structural Engineers
13 Surveyors
15 Transportation Engineers
5 Equipment Specialists
5 Accountants
6 Computer Operators
2 Industrial Engineer
1 Lawyer
27 Systems Analysts
16 Artists / Writers
1 Physician

9. Summary of Professional Services Fees Received: (insert index number)

Last 5 Years (most recent year first)

	1978	1977	1976	1975	1974
Direct Federal contract work, including overseas	6	6	4	3	4
All other domestic work	8	8	8	8	8
All other foreign work*	4	4	1	1	1

*Firms interested in foreign work, but without such experience, check here: ☐.

Ranges of Professional Services Fees
INDEX
1 Less than $100,000
2. $100,000 to $250,000
3. $250,000 to $500,000
4. $500 000 to $1 million
5 $1 million to $2 million
6 $2 million to $5 million
7 $5 million to $10 million
8 $10 million or greater

042	P	6	800' Pier & R/O Ramp, redesign Wilmington, North Carolina	North Carolina Ports Authority Wilmington, North Carolina	7,000	1980
046	P		I-90 Freeway Design Seattle, Washington	Washington State Department of Transportation Olympic, Washington	175,000	1980
048	P	1	Design of 176-bed addition & remodeling, psychiatric facility Abbott-Northwestern Hospital Minneapolis, Minnesota	Abbott-Northwestern Hospital Corp. Minneapolis, Minnesota	23,300	1980
050	P	11	Multifamily Housing Project Bremerton, Washington	Dept. of the Navy, Naval Facilities Engineering Command, Western Division San Bruno, California	7,800	1976
052	P	12	Air Products, Inc. PVC Plant Expansion Pensacola, Florida	Air Products, Inc. Pensacola, Florida	10,000	1976
054	P	13	Wastewater Abatement Program Design & Construction Supervision Omaha, Nebraska	Allied Chemical, Inc. Agricultural Division Omaha, Nebraska	2,000	1978
055	P	14	Guarantee Mutual Insurance Executive Offices, Interior Design, Omaha, Nebraska	Guarantee Mutual Insurance Company, Omaha, Nebraska	Confidential	1978
057	JV	15	Pensacola County Judicial Center Pensacola, Florida	Escambia County Board of Comm. Escambia County Courthouse Annex Pensacola, Florida	3,500	1978
058	JV	16	Ambulatory Care & Research Facility Design Bethesda, Maryland	National Institutes of Health Bethesda, Maryland	120,000	1980
072	P	17	Finance & Accounting Center Lowry Air Force Base Denver, Colorado	Omaha District Corps of Engineers Omaha, Nebraska	20,350	1976
079	JV	18	Trident Support Site Master Plan Bangor, Washington	OICC-Trident, Naval Facilities Engineering Command, Dept. of the Navy, Washington, D.C.	2,500 (study)	1974
083	P	19	60 MW Plant Addition, Retrofit, Turbine, Substation Design and Supervision. Rochester, Minnesota	Public Utilities Commission Rochester, Minnesota	16,083	1976

Standard Form 254 July 1975

084	P	20	North Carolina Medium-Security Institutions, Design, Salisbury, North Carolina	North Carolina Department of Corrections Raleigh, North Carolina	13,518	1978
087	P	21	Rapid Transit Facilities Section D-8, Design Washington, D.C.	Washington Metropolitan Area Transit Authority Washington, D.C.	34,000	1978
090	P	22	Design of 2,000 ton/day Solid Waste Processing Plant, 50MW Steam Power Plant & 5 transfer stations, Norfolk, Virginia	Southeastern Public Service Authority of Virginia Norfolk, Virginia	130,000	1983
092	P	23	Flood Control Plan, Phase II Timber Creek Lewisville, Texas	City of Lewisville Lewsiville, Texas	1,750	1976
096	P	24	Wastewater Treatment Plant Design and Supervision Papio Creek, Omaha, Nebraska	City of Omaha Omaha, Nebraska	47,500	1976
098	P	25	Hydronic Solar Heating System Municipal Complex Wheatridge, Colorado	City of Wheatridge Wheatridge, Colorado	1,600	1978
099	P	26	State of Michigan 1978 State Solid Waste Management Plan State of Michigan	State of Michigan Dept. of Natural Resources Lansing, Michigan	351 (study)	1978
102	P	27	Residential Subdivision, Water, Sewer, Land Planning, Platting, Grading, Design of 7,000 acres. Sun City & Sun West, Arizona	Del Webb Development Corp. Phoenix, Arizona	48,000	Ongoing
107	P	28	North-Northwest Expressway, I-580, Location Corridor Study. Omaha, Nebraska	Nebraska Department of Roads Lincoln, Nebraska	500 (study)	1976
114	P	29	Study of Freshwater Needs of Fish & Wildlife Resources in the Nueces-Corpus Christi Bay Area, Texas	U. S. Department of Interior Fish & Wildlife Service Austin, Texas	350 (study)	1980
115	P	30	Water Treatment Plant & High-service Pumping Station, Design & Supervision. Thornton, Colorado	City of Thornton Thornton, Colorado	5,000	1975

12. The foregoing is a statement of facts

Signature: Robert L. Reins Typed Name and Title: Robert L. Reins, Executive Vice President

Date: 4/1/79

Standard Form 254 July 1975
Prescribed By GSA Fed. Prop. Reg. (41 CFR) 1-16.903

D. Personnel

We propose a multi-disciplinary team approach for this project. At the outset of the work, we will assemble all of the necessary skills so that we can make use of the best talents available. Our combined professional staff includes personnel skilled in all facets of groundwater evaluations and water and waste disposal practices and techniques. Figure 1 is an organization chart of key technical personnel proposed to be used on this project. The following paragraphs briefly describe key members of the team. Following these introductory remarks are divisions containing the resumes of all technical personnel.

Mr. Eugene A. Hickok, P.E., President of Eugene A. Hickok and Associates, will be Principal-in-Charge and will be the project manager for all facets of the project. Mr. Hickok is a recognized authority on the evaluation and assessment of impacts of various actions and proposed actions on ground and surface water resources. He has provided expert testimony in a number of landmark cases in Illinois, Wisconsin, Iowa, North Dakota, South Dakota, as well as Minnesota.

The Senior Advisory Staff will include Mr. James J. Geraghty, President of Geraghty and Miller, Inc. Mr. Geraghty is a widely recognized authority in the field of groundwater resources and has devoted his professional career to the analysis and solution of problems related to large-scale groundwater developments. Mr. Robert D. Catton, P.E., of Henningson, Durham and Richardson, Inc., has more than 25 years of experience in preparing designs and reports for water works and sewage treatment systems. His experience has included both industrial and municipal projects. Mr. John R. MacLennan, P.E., of E. A. Hickok and Associates, has worked on a variety of water management programs throughout the country. In addition, he has developed computer models to evaluate hydrologic balances, groundwater models and models to predict urban runoff quality and quantity.

The Senior Advisory Staff will have responsibility for monitoring the analytical approach to each of the assignments as well as to ensure that the work plan and final outputs of each task are of the highest professional quality. These persons are in responsible charge so that they may provide the necessary technical expertise in whatever areas are required.

The Project Leader will be in responsible charge of all technical activities on the project and will coordinate activities of the three associated firms. Mr. John B. Erdmann of E. A. Hickok and Associates will function as the Project Leader. Mr. Erdmann is an Environmental Engineer experienced in water quality management projects, including groundwater modeling for a proposed hazardous waste facility and primary responsibility for investigating surface and groundwater impacts of, and remedial measures for, a toxic chemical dump located in Iowa. Mr. Erdmann will be the focal point for all technical evaluations, literature reviews and data interpretation, and will be supported as required by highly skilled professional personnel from the three associated firms.

000079

M A K R A M T. S U I D A N, Ph.D.
Assistant Professor of Civil Engineering
Georgia Institute of Technology
Atlanta, Georgia

Dr. Suidan completed his doctorate in Environmental Engineering at the University of Illinois in 1975. After a Visiting Assistant Professorship at Illinois, Dr. Suidan has been Assistant Professor from 1976 to the present at Georgia Institute of Technology.

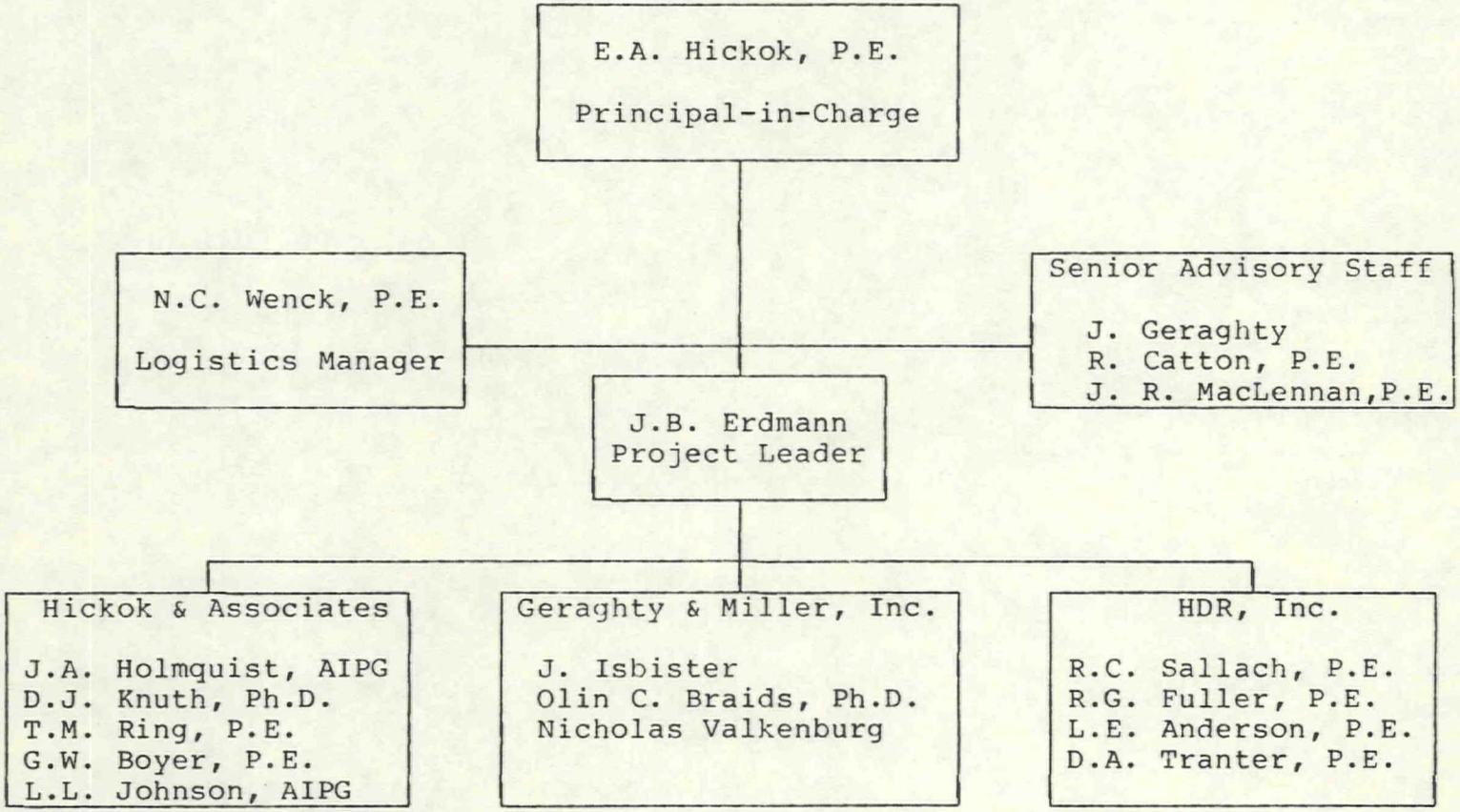
Dr. Suidan is expert in advanced treatment technologies, including physical, chemical and biological methods. The six courses he teaches include Physical Principles in Sanitary Engineering and Advanced Water and Wastewater Treatment Technology.

Dr. Suidan currently is performing, and for several years has been involved in, research on treatment of phenolic and related chemicals by advanced techniques. He supervises six graduate students in this area of research and has available a thorough, up-to-date literature review on all treatment methods for phenolic and related chemicals.

Dr. Suidan has spoken at some twenty conferences and invited seminars, including a recent seminar at the University of Minnesota, and has authored numerous papers and research reports.

Figure 1

ORGANIZATION CHART OF KEY TECHNICAL PERSONNEL



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A senior management person from the firm of E. A. Hickok and Associates will serve as Logistics Manager with primary responsibility for timeliness of completion and cost control. Mr. Norman C. Wenck, P.E., will be the Logistics Manager for this project. In addition to ensuring that schedules and budgets are met, he will ensure that all work outputs meet the requirements of the Minnesota Department of Health and the highest professional standards.

The following pages present detailed resumes of all the key technical personnel proposed to be assigned to this project.

000982

E. A. Hickok and Associates

Personnel

EUGENE A. HICKOK

BIOGRAPHICAL DATA

Degrees

Master of Science in Geological Engineering, Princeton University, 1954
Bachelor of Science in Geological Engineering (5 years), University of Minnesota, 1951
Registered Professional Engineer, States of Minnesota, Wisconsin, Iowa, Illinois, North Dakota, South Dakota, Montana, Pennsylvania and Missouri
Geological Engineer, State of Minnesota
Registered Geologist, State of California
Engineering Geologist, State of California
Certified Professional Geologist, American Institute of Professional Geologists

Military Record

United States Marine Corps Reserve, Korea, 1951-1953, Grade - Captain

Experience

Consulting Hydrologist, 545 Indian Mound, Wayzata, Minnesota, to date
Staff Hydrologist, International Development Services, Inc., Guatemala, 1959-1961
Partner, Geraghty, Miller and Hickok, Consulting Hydrologists, New York, 1957-1959
Groundwater Hydrologist, Leggette, Brashears and Graham, Consulting Groundwater Geologists, New York, 1954-1957

Professional Societies and Organizations

Executive Committee, Princeton Engineering Association, 1958-1960
President, Tech Board, University of Minnesota, 1950-1951
Charter Member, Water Resources Committee of Technical Association Pulp and Paper Manufacturers
T.A.P.P.I. Representative, Joint Committee on Uniformity Methods of Water Examination, 1957-1959
Member, NWWA, AIME, AWWA, International Association of Hydrologists, Minnesota Society of Professional Engineers, Twin City Geologists, Minneapolis Chamber of Commerce, American Institute of Professional Geologists
Vice-Chairman, Natural Resources Committee, Minneapolis Chamber of Commerce

Professional Societies and Organizations (continued)

Member, Task Committee on Underground Liquid Waste Disposal, American Society of Civil Engineers, Hydraulics Division
Member, Watershed Management Committee, American Society of Civil Engineers, Hydraulics Committee
Member, Water Resources Committee, Minneapolis Capital Long Range Improvements Committee
Member, Watershed Management Committee, American Society of Civil Engineers, Irrigation and Drainage Division
Member, Board of Directors, Alumni Association, University of Minnesota Institute of Technology

Publications and Professional Papers

"Groundwater Geology, Princeton Area, New Jersey", Master's Thesis
"Seismic Refraction Method in Groundwater Exploration", Journal of AIME
"Geophysical Investigations in the Piedmont and Coastal Plain of New Jersey and Pennsylvania" (For Publication in the GSA Bulletin)
"Case Histories of the Use of the Refraction Seismograph for Shallow, Subsurface Investigations" - American Institute of Mining Engineers
"Water Supply Problems in Guatemala, Central America", Minneapolis Chamber of Commerce
"Groundwater Control on an Urban Interstate Highway Project", Proceedings of 18th Annual Conference on Soil Mechanics and Foundation Engineering, University of Minnesota
"Application of the Seismograph in Water-Supply Development", Journal of New England Water Works Association
"Seismic Testing Applied to Highway and Engineer Problems", Proceedings of 10th Annual Conference on Soil Mechanics and Foundation Engineering, University of Minnesota and Northwestern Section, American Society of Civil Engineers
"Geophysical Surveys for Groundwater", University of Minnesota Waterworks School
"Well Water Supplies", North Central Section, American Water Works Association
"Water Resources Twin City Metropolitan Area", Water Research Foundation Forum
"Water Resources Education", Seminar Water Resources Education, Water Research Center, University of Minnesota
"Groundwater Investigations", National Water Well Association, Des Moines, Iowa
"Urban Runoff Treatment Methods Volume I - Non-structural Wetland Treatment", U.S. Environmental Protection Agency
"Wetlands and Organic Soils for the Control of Urban Stormwater National Lake Restoration Conference, 1978 , EPA

Publications and Professional Papers (continued)

"The Troubled Waters of Minnetonka", Water Research Foundation

"Life Span of a Lake", Minnesota Municipalities, November, 1971

"Big Yield From Glacial Drift", Johnson National Drillers Journal, March-April, 1966

"Flood-Control Plan for Minnesota Watershed", Civil Engineering-ASCE, April, 1973

"A Primer on Phosphorus and Nitrogen", Water Research Foundation

"Overall Plan for Water Management, Minnehaha Creek Watershed District, Minnesota", Consulting Engineering, May, 1971

"A Deionized Water System for Light Industry", Commercial Water/Wastewater, October, 1970

"Radial Collector Well Solves Water Supply Problem", Consulting Engineering, February, 1973

"Lake Restoration and Maintenance Techniques", Water Research Foundation

"Watershed Planning and Management", Water Research Foundation

"Environmental Impact Assessment of Water Resources", Water Research Foundation

"Stormwater: A Potential Groundwater Contaminant", Proceedings: 8th Annual Water Resources Seminar, Water Resources Research Center, University of Minnesota

"Non-Point Source Pollution", Water Research Foundation

"Evaluation of Stormwater Treatment Methods, Minnehaha Creek Watershed District", 49th Annual Conference of the Water Pollution Control Federation

"The Report to Congress - Waste Disposal Practices and Their Effects on Ground Water", United States Environmental Protection Agency, January, 1977

"Urban Erosion & Sediment Control: Institutions & Technology", University of Minnesota, October, 1979

Committees

Consulting Council - University of Minnesota Water Research Center
Minnesota Governor's Water Law Review Committee
Minneapolis City Council - Water and Sewerage Coordinating Committee
Minnesota Association of Consulting Engineers Natural Resources Committee
Minnesota Society of Professional Engineers - Water Review Coordinating Committee

Countries Where Water Supply Investigations of Projects Have Been Untertaken

Guatemala
Honduras
British Honduras
Costa Rica
Nicaragua
Panama
El Salvador
Trinidad
Tobago
Antigua

N O R M A N C. W E N C K, P. E.

SANITARY ENGINEER

EXPERIENCE:

Vice President (1978-Present) E. A. Hickok and Associates, Wayzata, Minnesota. Responsible for corporate management and marketing functions as well as management of sanitary engineer, water resources, airports, and pavement evaluation projects.

Project Manager (1970-1978) E. A. Hickok and Associates, Wayzata, Minnesota. In responsible charge of sanitary engineering and water resources projects, including water quality and planning.

Project Engineer (1968-1970) Autocon Industries, Inc. St. Paul, Minnesota. Chief engineer of water treatment division including research and development.

Public Works Officer (1967-1968) U.S. Navy, Naval Air Station, Minneapolis, Minnesota. In responsible charge of the base engineering and maintenance organization. Annual budget of $700,000 with an annual construction budget of $1.5 million.

Construction Officer (1965-1967) U.S. Navy, Udorn, Thailand. In responsible charge of the construction of Thai and U.S. Air Force facilities and a large self-contained U.S. Army Camp. Annual contract volume of $5 million.

Construction Officer (1963-1965) U.S. Navy, Naval Air Station, Patuxent River, Maryland. Annual contract volume of $2 million for airfield and personnel facilities.

Junior Engineer (1962) Buck, Seifer and Jost, Englewood Cliffs, New Jersey. Directed layout and inspection of sewage facilities at Trenton, New Jersey.

DEGREES:

B.S., 1962, M.S., 1963 in Civil Engineering, Iowa State University. Registered Professional Engineer, Minnesota Wisconsin, Iowa and Pennsylvania.

PROFESSIONAL ORGANIZATIONS:

Member, American Society of Civil Engineers.
Member, A.S.C.E., Northwest Section Sanitary Engineering Education Committee.
Member, American Society of Agricultural Engineers.
Member, Minnesota Geotechnic Society.
Member, American Institute of Chemical Engineers.
Chairman, Consulting Engineers Council, Minnesota Pollution Control Agency, Environmental Protection Agency, Federal Housing Administration, Liaison Committee

PUBLICATIONS:

"Evaluation of Granular Filters for Contact Water Softening", Master's Thesis, Iowa State University, 1963.

"A Deionized Water System for Light Industry", Commercial Water/Wastewater, Vol. 1, No. 1, October, 1970, pp. 99 to 104.

"Field Evaluation of an Asphalt Stabilized Sand Pavement Designed using the Elastic Layered System", Proceedings Association of Asphalt Paving Technologists, 1974.

'A Primer on Phosphorus and Nitrogen", Water Research Foundation, Publication No. 2. 1975.

"Irrigation of Leased Farmland with Treated Wastewater", 1975 Winter Meeting, American Society of Agricultural Engineers.

"Geophysical Implants Check Design Criteria, Behavior and New Methods in Minnesota Road Tests", Civil Engineering, 1976.

"Environmental Impact Assessments of Water Resources", Water Research Foundation, Publication No. 3. 1976.

"Irrigation of Leased Farmland with Treated Wastewater", Third National Conference of Complete WateReuse, American Institute of Chemical Engineers. 1976.

"Evaluation of Stormwater Treatment Methods", 49th Water Pollution Control Federation Conference, Water Pollution Control Federation. 1976.

"Use of Wetlands for Non-Structural Methods of Stormwater Treatment" 10th Annual Water Resources Seminar. 1977.

J O H N B. E R D M A N N

ENVIRONMENTAL ENGINEER

EXPERIENCE:

Environmental Engineer (1977-Present) E. A. Hickok and Associates, Wayzata, Minnesota. Projects include the following:

Groundwater Contamination - Prepared eight major reports on hazardous chemical waste disposal, environmental contamination and prevention methods concerning Salsbury Laboratories in Charles City, Iowa (Client: Iowa Department of Environmental Quality).

Hazardous Wastes - Research, selection and testing of groundwater computer model for Twin Cities hazardous waste landfill; and research on agricultural land use for Twin Cities hazardous waste landfill project (Client: Pfeifer and Schultz - Henningson, Durham and Richardson, Inc. for Metropolitan Waste Control Commission).

Hydrology - Analyzed and reported on climatological, hydrologic and cost data for water supply for future mining operation in northern Minnesota (Client: Amax Mining).

Applied Mathematics - Assisted in testing and development of urban watershed hydrologic model (Client: Rice Creek Watershed District).

Water Quality - Principal investigator for Minneapolis Chain of Lakes restoration project (Client: City of Minneapolis).

Assistant Sanitary Engineer (1973-1977), Commonwealth of Massachuetts, Division of Water Pollution Control, Water Qualtiy and Research Section - Developed and authored Charles River Basin Plan under Section 303 (e) of Public Law 92-500, corrected and revised steady state stream model (FORTRAN IV), planned, coordinated and participated in water quality, time of travel and wastewater discharge surveys of streams, lakes and coastal waters.

Research Associate (1972-1973) - New England Aquarium (Boston), Research Department, Systems Group - Co-developer and co-programmer of water quality information storage/retrieval system (PL/1).

DEGREES:

Bachelor's degree Cum Laude in Engineering and Applied Physics, Harvard College. Has taken Professional Engineer examination and expects to be registered in February 1980.

PROFESSIONAL ORGANIZATIONS:

Member, Water Pollution Control Federation.

PUBLICATIONS:

"Determining Photosynthetic Productivity in Streams," Programmer, Vol. 9 No. 1, Wang Laboratories, Tewksbury, Mass., pp. 7-12 (March 1975).

"Charles River Basin 1976 Water Quality Management Plan," Massachusetts Division Water Pollution Control, Westborough, Massachusetts (March 1976).

"Charles River 1973-1976 Part C, Water Quality Analysis," Masachusetts Division of Water Pollution Control, Westborough, Masachusetts (May 1977).

"Simplified Diurnal Curve Analysis," Journal Environmental Engineering Division, ASCE (December 1979).

D A N I E L J. K N U T H

PRINCIPAL HYDROLOGIST

EXPERIENCE:

Principal Hydrologist (1978-Present) E. A. Hickok and Associates - Design and conduct hydrologic and water quality studies; evaluation of water quality and other environmental impacts on proposed projects through the use of mathematical models, statistical methods and other technical procedures.

Principal Hydrologist/Water Appropriation Permits Coordinator (1977-1978) Minnesota Department of Natural Resources, St. Paul, Minnesota - Developed rules and policy and procedural recommendations for administration of statewide permit program for appropriation and use of state waters; monitored program effectiveness; supervised preparationof water appropriation permits.

Research Scientist II/Copper-Nickel Coordinator (1977) Minnesota Pollution Control Agency

Senior Hydrologist (1975-1977) Minnesota Pollution Control Agency

Hydrologist II (1972-1973; part-time 1974-1975) Minnesota Pollution Control Agency

Visiting Assistant Professor (1973-1975) Macalaster College, Geography Department, St. Paul, Minnesota

DEGREES:

B.A., 1967 in Geography - Mankato State College
M.A., 1970 in Physical Geography - Indiana University
Ph.D, 1975 in Physical Geography - Indiana University (minors in Geology, Cartography), Dissertation on "Karst Hydrology in Urban Planning: Bloomington, Indiana"

MEMBERSHIPS:

American Water Resources Association
Sigma Xi, Scientific Research Society of North America
Minnesota Association of Environmental Professionals

COMMITTEES:

Water Interest Advisory Committee, Minnesota Water Planning Board, St. Paul, Minnesota

Planning Commission, City of New Brighton, Minnesota

Engineering and Envrionmental Citizens Advisory Committee, Ramsey County, Minneosta

Water Quality Advisory Committee, City of New Brighton, Minnesota - Vice Chairman (former member)

Surveillance Subcommittee, Great Lakes Water Quality Board, International Joint Commission, Windsor, Ontario, Canada (former member)

PUBLICATIONS:

Knuth, Daniel J., "Institutional and Legal Problems in Implementing Instream Flow Management," Proceedings Symposium of Instream Flow Management-State of the Art, Upper Mississippi River Basin Commission, Twin Cities, Minnesota (In Press).

Knuth, Daniel J., "Water Quantity and Quality: Instream and In-Lake Use Protection in Minnesota," Proceedings Conference on Planning and Research: Keys to Minnesota Water Resources Decisions, Minnesota Water Planning Board, St. Paul, Minnesota

Knuth, Daniel J., "Wastewater Management: A Waste Load Allocation for the Mississippi River Below Minneapolis/St. Paul," Information Circular No. 158, Water Resources Research Center, University of Minnesota, 1977.

Knuth, Daniel J., "Water Quality Indicators in Minnesota," Information Circular No. 157, Water Resources Research Center, University of Minnesota, 1976.

LEGAL TESTIMONY:

In the matter of the Application of the City of Crookston, Minnesota for Permits for New Municipal Wells, 1977.

Affidavit, in the United States District Court for the District of Columbia, National Audubon Society, Inc., V. Cecil D. Andrus, et al, and State of North Dakota; Garrison Diversion Conservancy District, 1977.

In the matter of the Application by Northern States Power Company for a Certificate of Site Compatibility for a Large Electric Generating Plant, 1975.

In the matter of the Proposed Revisions to WPC 18 - Effluent Standards for Disposal Systems Discharging to the Mississippi River from the Junction of the Rum River to Lock and Dam No. 2 Near Hastings, 1975.

In the matter of the Adoption of Effluent Limitations for Dischargers of Water to the Vermillion River based on a Waste Load Allocation Study 1975.

John R. MacLennan

Executive Vice President, E. A. Hickok and Associates, Wayzata, Mr. MacLennan is a University of Minnesota graduate with a Bachelor of Science degree in Mining Engineering and a minor in Business Administration. He is a Registered Professional Engineer in Minnesota and Pennsylvania.

Mr. MacLennan has worked on a variety of water management programs throughout the country. He has developd computer programs to determine the hydrologic balance of developing watersheds, predict urban runoff quantities, predict dissolved oxygen, pollutant levels and flow in streams and to route storm flows through detention basins.

Prior to his association with E, A. Hickok and Associates, Mr. MacLennan was with Honeywell as senior staff engineer, Director of Engineering, and Product Manager. He also was with the Chief Consolidated Mining Company in Utah and the E. J. Longyear Company in Pennsylvania.

Among other activities, Mr. MacLennan has engaged in the construction of well irrigation systems in Florida and development of mineral resources in Central America. While located in Los Angeles, he was a member of the West Basin Water Council and Vice President for Industrial Development of the Gardena Chamber of Commerce. He serves as a Director of the Water Research Foundation, a member of the Board of Managers for the Nine Mile Creek Watershed District, and was a founding Director of the Minnesota Association of Watershed Districts.

He has authored papers on Control of Urban Erosion, Waste Load Allocations and Stormwater Treatment.

John A. Holmquist

John A. Holmquist has had broad experience in engineering and mineral geophysics in the United States and Central America. He has conducted geophysical research and exploration for the Phelps-Dodge Corporation in Montana, South Dakota and Wyoming, and has been in charge of geological engineering investigations and geological studies for the Materials and Research Section of the Minnesota Highway Department; the Bureau of Engineering, Minnesota Department of Conservation; and the City of Minneapolis.

Mr. Holmquist received his degree in Geological Engineering at the University of Minnesota and has been a member of the staff of Eugene A. Hickok and Associates since 1966. He is active in the American Institute of Mining Engineers and is a Registered Professional Geologist.

Mr. Holmquist is an experienced manager of watersheds and water quality and is an expert in dealing with regulatory agencies.

Timothy M. Ring

Timothy M. Ring is a graduate of the University of Minnesota with a Bachelor of Civil Engineering and a Master of Science degree in Civil Engineering. He is a Registered Professional Engineer in Minnesota.

Mr. Ring's professional experience includes deep tunnel hydraulic research at Saint Anthony Falls Hydraulic Laboratory and teaching fluid mechanics research at the University of Minnesota. He has performed flood plain studies using the HEC-2 model and is project manager for 18 flood insurance studies for the National Flood Insurance Program.

Mr. Ring has experience with groundwater hydrology and geophysical investigations throughout the Upper Midwest, including projects in New Ulm, Fargo, Osceola and Iron County, Michigan.

Mr. Ring is expert in applied mathematical techniques including computer modeling and statistical analysis. In addition to using the HEC-2 model, he is experienced with the TR-20 model. He has also developed a finite-difference groundwater model.

George W. Boyer

Vice President, Mr. Boyer graduated from the University of North Dakota with a Bachelor of Science and a Master of Science degrees in Civil Engineering. He taught at the University of North Dakota and was resident engineer on an Idaho missle base before heading the civil engineering department for a major consulting engineering firm. Mr. Boyer designed more than thirty major projects, including water and wastewater treatment plants. Mr. Boyer is a Registered Professional Engineer in Minnesota, Pennsylvania, Iowa and Wisconsin and a member of several professional organizations.

Mr. Boyer is an experienced designer of water supply, water treatment, waste treatment and general civil and municipal projects. He is an experienced specifications writer and construction contract administrator. Mr. Boyer has extensive experience estimating construction costs and developing practical solutions to difficult problems.

Larry L. Johnson

Larry L. Johnson was graduated from Kansas State University with a Bachelor of Science degree in Geology and from the University of Alaska with a Master of Science degree in Science Management. Mr. Johnson has diverse experience including teaching meteorology, performing clay mineral research, highway and building construction inspection, materials testing and geological drafting. Mr. Johnson is an experienced geophysical specialist, having planned and directed seismic field work, interpreted seismic surveys, performed geological, geophysical and bathymetrical mapping. Mr. Johnson spent several years with an oil company performing geophysical studies in Alaska. He is experienced with the water resources and environmental aspects of projects since there has been close coordination of these factors required for these sensitive projects. With E. A. Hickok and Associates, Mr. Johnson's water resources experience has included Mississippi River sampling and various water pollution and water supply pollution.

Geraghty & Miller, Inc.

Personnel

Personnel Who May Be Assigned

To This Project

JAMES J. GERAGHTY

Principal

Geraghty & Miller, Inc.

Professional Qualifications

James J. Geraghty is a widely recognized authority in the field of ground-water resources, who has spent his entire professional career in the analysis and solution of problems relating to large-scale ground-water developments. In this connection, he has worked extensively throughout the United States and in more than 30 other countries, for major corporations, state and local governmental bodies, other consulting firms, and national and international agencies. Prior to entering the consulting field in 1957, he had spent seven years on field investigations of ground-water resources with the Water Resources Division of the U. S. Geological Survey. He holds a B.S. degree in Geology from the City College of New York, an M.S. degree in Geology from New York University, and has completed additional post-graduate studies at New York University.

In the course of his professional activities, Mr. Geraghty has served on numerous technical committees and panels, has provided expert testimony on regulatory and litigation matters, has made presentations to private and public bodies, and has written a wide variety of reports and papers on water-related subjects. He is the principal author of Water Atlas of the United States and shared the responsibility for compiling material for the United Nations publication entitled Ground-Water Storage and Artificial Recharge.

In addition, he has taught courses in ground water and geology at several universities, is a Fellow of the American Association for the Advancement of Science, a former Director of the Technical Division of the National Water Well Association, and a member of the International Association of Hydrogeologists, the International Water Resources Association, the American Water Works Association, the American Society of Civil Engineers, the American Geophysical Union, the American Institute of Professional Geologists, the American Association of Petroleum Geologists, the New York Academy of Sciences, and the Geological Society of America. He has been certified as a Professional Geological Scientist by the Association of Professional Geological Scientists and is a Registered Geologist in several states where such registration is required.

Professional Activities

The United Nations (New York, N. Y.) - Served from 1962 to 1977 as Technical Advisor on Ground Water to the Resources and Transport Division of the U. N. and as Special Consultant to the U. N. Development Programme. In this connection, Mr. Geraghty completed many planning and advisory missions to developing nations in Africa, Asia, Latin America, and the Middle East.

Hudson Institute (Croton-on-Hudson, N. Y.) - Has served as a Fellow Member since December 1967. The Institute is a non-profit policy research center that undertakes broad studies relating to economic development and international affairs. Mr. Geraghty is also a consultant to the Institute, and has been involved in basic planning for a number of its water-resource research projects, including the proposed Choco Valley Interoceanic Canal in Colombia and the scheme for creating a Mediterranean-size lake on the Amazon River in Brazil.

Columbia University (New York, N. Y.) - Member of the University Seminar on Problems in Water Resources between 1968 and 1973.

Ground Water Resources Institute (Chicago, Ill.) - Served during 1968 as a member of the Institute's Technical Advisory Board. The Institute is dedicated to promoting public awareness of ground-water resources.

American Water Resources Association - Appointed as a member of the Executive Committee and as Chairman of the Local Arrangements Committee, responsible for planning the 1968 national convention in New York City.

American Geophysical Union - Served as a member of the Ground Water Committee, Section of Hydrology, from 1965 to 1968.

Geological Society of America - Served during 1969-1970 as Chairman of the Society's Hydrogeology Division.

North Atlantic Treaty Organization - Served as the U. S. representative on ground-water matters for NATO's Committee on the Challenges of Modern Society, responsible for conducting an international study on drinking water problems, 1977-1979.

National Academy of Sciences/National Research Council - Served as a member of the U. S. National Committee for the International Hydrological Decade Program, 1970-1976.

National Science Foundation - Served on a panel of American Scientists for the planning of a documentary film on water to be shown on international educational TV stations, 1978-1979.

National Academy of Sciences/National Research Council - Served during 1978-1979 as a member of the Council's Panel on Phosphate, Committee on Surface Mining and Reclamation, to assist the Council of Environmental Quality in connection with the Surface Mining Control and Reclamation Act of 1977.

Halcomb Research Institute (Indianapolis, Ind.) - Served during 1978-1979 as a member of the Institute's Ground-Water Modeling Policy Committee, organized under the auspices of the U. S. Environmental Protection Agency to establish national policy guidelines with respect to ground-water modeling.

Selected Publications

Geraghty, J. J., and others, "Water Levels and Artesian Pressures in Observation Wells in the United States - Northeastern States, 1951, 1952, 1954," U. S. Geological Survey Water-Supply Papers 1191, 1221, and 1321.

Lusczynski, N. J., J. J. Geraghty, E. S. Asselstine, and I. G. Grossman, 1956, "Saline Waters in New York State," Water Resources Commission of the State of New York, Bulletin GW-36.

Geraghty, J. J., 1959, "Ground-Water Problems in the New York City Area," Annals of the New York Academy of Sciences, Vol. 80, pp. 1047-1170.

Perlmutte, N. M., J. J. Geraghty, and J. E. Upson, 1959, "The Relation Between Fresh and Salty Ground Water in Southern Nassau and Southeastern Queens Counties, Long Island, New York," Econ. Geology, Vol. 54, No. 3, pp. 416-435.

Geraghty, J. J., 1962, "Movement of Contaminants Through Geologic Formations," Journal of the National Water Well Association, October.

Perlmutter, N. M., and J. J. Geraghty, 1963, "Geology and Ground-Water Conditions in Southern Nassau and Southeastern Queens Counties, Long Island, New York," U. S. Geological Survey Water-Supply Paper 1613-A.

Geraghty, J. J., 1965, "Changing Patterns of Water Development," Highlights of the First International Water Quality Symposium, Water Conditioning Association International.

Geraghty, J. J., 1965, "Evaluation and Selection of Water Sources - Ground Water," Inter-Regional Seminar on the Economic Application of Water Desalination, Department of Economic and Social Affairs of the United Nations.

Geraghty, J. J., 1966, "Appraisal of Fresh Ground-Water Reserves Based on Hydrogeological Studies," United Nations Inter-Regional Seminar on Integrated Utilization of Water Resources, Fergana, Uzbekistan, USSR.

Geraghty, J. J., 1966, "Large-Scale International Ground-Water Programs," Water Well Journal, October.

Geraghty, J. J., 1967, "Ground Water--A Neglected Resource," Journal of the American Water Works Association, Vol. 59, pp. 820-828.

Geraghty, J. J., and others, 1973, "Water Atlas of the United States," published by Water Information Center, Huntington, New York.

Geraghty, J. J., 1975, "Ground-Water Development and Use," Proceedings of the International Seminar on Water Resources Administration in New Delhi, India, United Nations Document DP/UN/INT-70-371.

Chow, Ven Te, and J. J. Geraghty, (compilers of the material), 1975, "Ground-Water Storage and Artificial Recharge," United Nations, Natural Resources/Water Series No. 2.

Geraghty, J. J., and D. W. Miller, 1978, "Status of Ground-Water Contamination in the United States," Journal of the American Water Works Association, Vol. 70, pp. 162-167.

Geraghty, J. J., 1977, "Considerations in Planning for the Disposal of Wastes in Desert Environments," Proceedings of the United Nations Conference on Alternative Strategies for Desert Development and Management, Sacramento, California.

JOHN ISBISTER

Vice President & Senior Scientist

Geraghty & Miller, Inc.

Professional Qualifications

Mr. Isbister is responsible for the organization, direction, and evaluation of complex ground-water quality investigations and ground-water development projects carried out for the firm's 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. Mr. Isbister has prepared documents for litigation and appeal purposes relating to the actions of the firm's industria clients, and he has delivered expert testimony on their behalf.

Mr. Isbister is an expert ground-water geologist and hydro ogist. He holds a geology degree from Columbia University and has comp eted advanced graduate courses in geology at New York University. In addition, he has attended special training courses sponsored by the U.S. Geological Survey. Mr. Isbister is responsible for admini .tering the firm's internal training and quality assurance program.

From 1956 to 1966 Mr. Isbister was employed by the U.S. Geological Survey as a ground-water geologist in the Water Resources Division. He was project manager for ground-water investigations related to salt-water intrusion, artificial recharge, long-term changes in water levels, aquifer properties, and contamination.

Mr. Isbister has been employed by Geraghty & Miller, Inc. in a senior capacity since 1966. He has managed projects representing every aspect of the firm's consulting work. The following selected examples of Mr. Isbister's work experience indicate the diverse nature of his skills, experience, and management capability.

Selected Geraghty & Miller, Inc. Work Experience

Project manager of a study for a major industrial firm whose plant site was formerly owned by another company. Test drilling indicated that the ground water was contaminated by hydrocarbons, and the State took legal action against the firm. Mr. Isbister's investigation revealed that the contamination was in transit beneath the firm's property and was not caused by their fault or negligence. The State dropped its case after the project report was submitted.

Project manager for a ground-water contamination abatement program for a major chemical company. The study required detailed test drilling, chemical analysis, and evaluation of complex ground-water flow patterns in order to develop procedures to abate the contamination of aquifer impacted by leaking storage lagoons and accidental spills.

Project manager for site location studies on behalf of a major oil company seeking new plant site in the northeast. The project involved proposed sites in southern Delaware and southern New Jersey.

Managed Geraghty & Miller, Inc.'s participation in 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 in complying with the management practices established by the Resource conservation and Recovery Act.

Project manager for a study on behalf of a client engaged in the development of a large industrial park. The investigation required an evaluation of the aquifer beneath the property in terms of the impact on the ground-water system which could be anticipated as an outcome of various pumping patterns and the withdrawal of various amounts of ground water. Detailed test drilling and pumping were required over a long period. Mr. Isbister provided expert testimony on the client's behalf at a permit hearing.

Project manager of a multi-phase ground-water study incident to the granting of a permit to the Long Island Lighting Company to construct a nuclear power plant. The first phase dealt with the long-term effects of developing a 1,000 gpm ground-water supply for the plant. Phase two determined the impact of construction dewatering.

Project manager for the Suffolk County, Long Island, New York, Flow Augmentation Needs Study which will determine the water table impacts of major sewer construction and the feasibility of augmenting streamflow with ground water pumped from the upper glacial aquifer or Magothy Formation.

Affiliations

National Water Well Association
Association of Professional Geological Scientists
Geological Society of America
Registered professional geologists in the States of Idaho, Delaware, and Maine

OLIN C. BRAIDS, Ph.D.

Senior Scientist

Geraghty & Miller, Inc.

Professional Qualifications

Dr. Braids is responsible for the evaluation of complex ground-water quality problems relating to the chemical contamination of ground water and soil. He plays a major role in the firm's investigation of ground-water contamination incidents and is often required to provide detailed technical memoranda to Geraghty & Miller staff, the firm's industrial clients, and their legal counsel relating to the probable source, extent, and ground-water quality implications of materials introduced into the ground-water regeime through spills, storage, and disposal activities. Dr. Braids has prepared documents for litigation and appeal purposes and provides expert testimony on behalf of the firm's clients.

Dr. Braids holds a M.S. in soil chemistry from the University of New Hampshire and a Ph.D. in soil chemistry from The Ohio State University. Dr. Braids worked as Assistant Professor in the Department of Agronomy at the University of Illinois, Urbana, and has conducted independent research in a number of environmental areas including the agricultural utilization of municipal sludges, the chemistry of lead in soils and plants, and the organic chemistry of soil.
Dr. Braids has taught graduate seminars and courses in soil chemistry and has consulted to Bechtel Corporation and Amoco Chemicals Corporation.

Dr. Braids worked on the staff of the U.S. Geological Survey, Mineola, New York, where he conducted a number of ground-water contamination studies related to solid waste disposal. He joined Geraghty & Miller, Inc. in 1975 as a Senior Scientist and has participated in every aspect of the firm's work relating to ground-water contamination. The following selected examples of Dr. Braids's work experience indicate the diverse nature of his skills, experience, and management capability.

Selected Geraghty & Miller, Inc. Work Experience

Prepared reports on the ground-water contamination potential of the land disposal of residuals for the National Commission on Water Quality and the U.S. Environmental Protection Agency.

Contributed to reports on residuals management and ground-water contamination, ground-water monitoring at solid waste disposal sites, and "Report to Congress--Waste Disposal Practices and Their Effects on Ground Water" for the U.S. Environmental Protection Agency.

Responsible for the evaluation of ground-water quality impacts from contamination incidents at industrial plant sites.

Selected Publications

Isbister, J., 1959, Ground-Water Levels and Related Hydrologic Data from Selected Observation Wells in Nassau County, Long Island, New York, New York State Water Power and Control Commission, Bulletin 41.

Isbister, J., 1962, Relation of Fresh Water to Salt Water at Centre Island, Nassau County, New York, U.S.G.S. Professional Paper 450, Chapter E.

Isbister, J., 1963, Records of Wells and Related Hydrologic Data in Northeast Nassau County, Long Island, New York, U.S.G.S. Open File Report.

Isbister, J., 1966, Geology and Hydrology of Northeastern Nassau County, Long Island, New York, U.S.G.S. Water Supply Paper 1825.

Co-Author, Ground Water Resources in Cape May County, 1970.

Co-Author, The Status of Ground Water Resources, 1967, Nansemond County, and Isle Wight County.

Principal Author - Study of Ground Water Conditions on the Long Island Lighting Company Tract, Jamesport, New York.

U.S. Environmental Protection Agency Publications

Principal Author - Procedures Manual for Monitoring Solid Waste Disposal Sites, 1976.

Westchester County 208 - 1977.

Most of Mr. Isbister's work is of a confidential nature and/or is part of current litigation and cannot be divulged.

Managed a 26-month study of ground-water contamination at hazardous waste-disposal sites. Fifty sites in 11 states were investigated and documented. A second phase of the study required the preparation of a report detailing monitoring techniques at hazardous waste-disposal sites.

Contributed to 208 planning studies in Westchester County and on Long Island, New York, as they related to organics contamination of ground water.

Presented paper on ground-water contamination resulting from waste disposal at national meetings of the American Chemical Society and the Association of Official Analytical Chemists.

Consulted with the U.S. Environmental Protection Agency to develop regulations for ground-water monitoring at hazardous waste management facilities.

Affiliations

Abstractor for Chemical Abstracts Service
American Chemical Society (Chairman-elect of the Nassau-Suffolk Subsection, New York Section)
American Society of Agronomy/Soil Science Society of America
Sigma XI (research honoray)
Alpha Chi Sigma (professional chemistry)

Bibliography

Braids, O. C., 1966, "A Study of the Components of the Lipid Fraction of Rifle Peat," Ph.D. Thesis, The Ohio State University.

Braids, O. C., F. L. Himes, and G. W. Volk, 1967, "The Occurrence of Carbazole in a Peat Soil," Soil Science Society America Proc. 31:435-436

Hinesly, T. D., O. C. Braids, R. I. Dick, J. A. E. Molina, et al., 1968, "Disposal of Digested Sludge on Farm Land," Solid Waste Reasearch and Development II, Engineering Foundation Research Conference, Beaver Dam, Wisconsin, D-7

Stevenson, F. J., and O. C. Braids, 1968, "Variation in the Relative Distribution of Amino Sugars with Depth in Some Profiles," Soil Science Society America Proc. 32:598-600.

Braids, O. C., M. Sobhan-Ardakani, and J. A. E. Molina, 1970, "Liquid Digested Sewage Sludge Gives Field Crops Necessary Nutrients," Illinois Research, 12(3):6-7.

Hinesly, T. D., O. C. Braids, and J. A. E. Molina, 1971, "Agricultural Benefits and Environmental Changes Resulting from the Use of Digested Sewage Sludge on Field Crops," An Interim Report on a Solid Waste Demonstration Project, EPA Publication No. WP-30, U.S. Government Printing Office.

Molina, J. A. E., O. C. Braids, T. D Hinesly, and J. B. Cropper, 1971, "Aeration-Induced Changes in Liquid Digested Sewage Sludge," Soil Science Society America Proc. 35:60-63.

Braids, O. C., 1972, "Trace Metals in Soils," Pages 163-174 in Chemistry and Biology of Trace Metals in the Environment, University of Illinois Environmental Sciences Program.

Molina, J. A. E., O. C. Braids, and T. D. Hinesly, 1972, "Observations on Bactericidal Properties of Digested Sewage Sludge," Environmental Science Technology 6:448-450.

Braids, O. C., 1972, "Air-Soil-Water-Plant Continuum," Pages 164-183 and 227-233 in Environmental Pollution by Lead and Other Metals, Progress Report May 1, 1971, to April 30, 1972, Environmental Studies Program, University of Illinois, Urbana.

Kimmel, G. E., and O. C. Braids, 1974, Leachate Plumes in a Highly Permeable Aquifer," Ground Water, 12(6):388-392.

Braids, O. C., and R. H. Miller, 1975, "Fats, Waxes, and Resins in Soil," Pages 343-368 in John E. Gieseking, ed., Soil Components Volume I, Organic Components, Springer-Verlag, New York.

Braids, O. C., and S. E. Ragone, 1975, "Nitrogen in Long Island Ground Water," Pages 64-91 in R. E. Burge, ed., Conference Proceedings of Nitrogen in Long Island Water Systems, Environmental Improvement Committee, American Chemical Society, Nassau-Suffolk Subsection.

Kimmel, G. E., and O. C. Braids, 1975, "Preliminary Findings of a Leachate Study on Two Landfills in Suffolk County, New York," Journal Research, U.S. Geological Survey, 3(3):273-280.

Braids, O. C., G. R. Wilson, and D. W. Miller, 1977, "Effects of Industrial Waste Disposal on the Ground-Water Resources," Pages 179-207 in Robert P. Pojasek, ed., Drinking Water Quality Enhancement Through Source Protection, Ann Arbor Science, Ann Arbor, Michigan.

Fenn, D., E. Cocozza, John Isbister, O. C. Braids, and Paul Roux, 1977, "Procedures Manual for Ground-Water Monitoring at Solid Waste Disposal Facilities," EPA Publication No. EPA/530/SW-611, Cincinnati, Ohio, 269 pp.

Kimmel, G. E., and O. C. Braids, 1977, "Leachate Plumes in Ground Water from Babylon and Islip Landfills, Long Island, New York," U.S. Geological Survey Open-File Report 77-583.

A large part of Dr. Braids's work is of a confidential nature and/or is part of current litigation and cannot be divulged.

NICHOLAS VALKENBURG

Senior Hydrogeologist

Geraghty & Miller, Inc.

Professional Qualifications

Mr. Valkenburg specializes in the investigation and evaluation of ground-water contamination incidents. He is responsible for site evaluations and the sequencing and ordering of work tasks necessary to complete field investigations. Mr. Valkenburg is an expert hydrologist and is responsible for the field supervision of well drilling, sampling, and testing activities. He has considerable experience in survey methods, including earth resistivity, seismic, and magnetic techniques.

Mr. Valkenburg holds a B.S. degree in geology from the State University of New York at Stony Brook and a M.S. degree in geology from the University of Toledo.

Mr. Valkenburg was employed by the Geological Survey of Alabama as principal investigator in an Office of Water Resources Technology project related to iron bacteria. Mr. Valkenburg worked as an environmental scientist for Ebasco Services, Inc. where he analyzed data on geology and ground-water hydrology for power plant sites and prepared environmental impact assessments. He joined Geraghty & Miller, Inc. in 1976.

Geraghty & Miller, Inc., Work Experience

Contributed to the assessment of the impact upon ground-water quality due to septic tanks, industrial storage areas and disposal sites, and municipal landfills as part of the Section 208 Areawide Waste Management Planning Study for Middlesex County, New Jersey.

Supervised hydrogeological field services required to determine the impact of dewatering on ground-water resources at a large industrial site.

Supervised hydrogeological field services required for the construction and testing of two large capacity production wells and completed a water-quality survey, including field analyses of water-quality samples at an industrial site in Missouri.

Assessed impact of the disposal of municipal waste on surface and ground water associated with property owned by a private club in Massachusetts.

Assessed the impact upon ground-water levels which would result from the installation of a municipal sewer system on Cape Cod, Massachusetts, where ground water is the only source of supply. Tasks included the use of computer programs to simulate various hydrological alternatives.

Investigation of contamination of an industrial production well by organic compounds, including recommendations for remedial action.

Hydrogeologic field services associated with investigation of ground-water contamination by organic compounds in West Virginia.

Supervised hydrogeologic field services to determine the magnitude and extent of ground-water contamination caused by the subsurface infiltration of leachate from waste disposal ponds at an industrial site in West Virginia.

Participated in ground-water investigation in Jamaica, West Indies, involving contamination by caustic soda.

Prepared environmental report concerning the reactivation of an abandoned well in the Town of Norwood, Massachusetts.

Assisted with the planning and hydrological field services associated with test drilling to determine the most advantageous site for a production well for a New Jersey industrial plant.

Affiliations

National Water Well Association
American Association for the Advancement of Science
Association of Professional Geological Scientists (Associate Member)
Geological Society of America

Bibliography

Valkenburg, N., 1973. Water Quality and Mineral Solubilities in Surface and Ground Water, Oak Openings Community, Lucas County, Ohio. National Technical Information Service No. PB-224014/1GT.

Shade, J. W. and Valkenburg, N., 1975. Comparison of Base Flow and Ground-Water Chemistry, Oak Openings Sand, Lucas County, Ohio. Ohio Journal of Science, Vol. 75, No. 3, pp. 138-146.

Valkenburg, N.; Green, M.; and Christian, R., 1975. Iron Bacteria in Ground-Water Supplies of Alabama. Geological Survey of Alabama, Circular 96, 108 p.

Henningson, Durham & Richardson, Inc.

Personnel

Robert D. Catton, P.E.

Project Role Senior Advisor

Education Bachelor of Science in Civil Engineering, South Dakota State College, 1955.

Registration Professional Engineer, 1963

Experience Mr. Catton is experienced in preparing reports and designs for water works and sewerage treatment systems. He has been responsible for planning, directing and supervision of the design as well as construction of environmental facilities including preparation of plans, specifications, contracts, project costs and project acquisition. In preparing water reports, Mr. Catton has been responsible for investigation of present and future land use as well as for both water availability and quality. Selected projects include:

Allied Chemical Corporation, Omaha, Nebraska. Water plant waste handling facilities design. Project Manager.

Allied Chemical Corporation, Omaha, Nebraska. Industrial waste handling facilities design including ammonia stripping, oil removal, energy recovery systems, solar ponds, recycling and other environmental systems. Project Manager.

City of Council Bluffs, Iowa. Water treatment plant and waste handling report. Project Manager.

Texarkana, Texas. Water treatment plant and waste handling report. Project Manager.

Dubuque, Iowa. Water treatment plant and waste handling report. Project Manager.

Ottumwa, Iowa. Water treatment plant and waste handling report. Project Manager.

Thornton, Colorado. Water treatment plant. Project Manager.

Lewisville, Texas. Water treatment plant. Project Engineer.

Longview, Texas. Water treatment plant. Project Engineer.

Dubuque, Iowa. Water treatment plant. Project Manager.

Garland, Texas. Storage facility. Project Engineer.

Missoula, Montana. Storage facility. Project Engineer.

Omaha, Nebraska. 25 mg storage facility and 40 mgd pumping station.

The following is a listing of master plans for which Mr. Catton was project manager:

York, Dubuque, Mecklenburg County, Forsyth County, Montana Conservancy District, Omaha MUD, Council Bluffs, Missoula, Suffolk.

The following is a listing of water rate studies for which Mr. Catton was project manager or rate analyst:

Red Oak, Dubuque, Shenandoah, Carroll and Council Bluffs in Iowa; LaVista, Syracuse and Ralston in Nebraska; Forsyth County in North Carolina; Missoula, Montana; and Yuma, Arizona.

Professional Endeavors

1959-Present
Henningson, Durham & Richardson, Inc., Omaha, Nebraska. Environmental Engineer, Assistant Vice President, Environmental Engineering Division and Water Systems Section Leader. Plans, directs, surveys, researches, investigates and determines procedures in the design and writing of environmental engineering reports for water works and sewerage systems. Also supervises construction of environmental engineering projects and related tasks such as the preparation of plans, specifications and contracts, project costs and acceptance of projects.

1956-1959
United States Air Force. Pilot.

1955-1956
City of Milwaukee, Wisconsin. Engineer.

1950-1954
Minnesota Highway Department. Inspector and Engineering Aide.

Professional Activities National Society of Professional Engineers; National Director, American Water Works Association; Water Pollution Control Federation; American Academy of Environmental Engineers

Honors AWWA Fuller Award, 1975

Robert C. Sallach, P.E.

Project Role Team Leader

Education Bachelor of Science in Civil Engineering, University of Nebraska, Lincoln, Nebraska, 1973; Master of Science in Civil Engineering, University of Nebraska, 1979

Registration Professional Engineer, 1978

Experience Mr. Sallach has experience in storm drainage and wastewater treatment and collection systems including municipal facilities planning, treatment process evaluation, nonpoint source pollution investigation and modeling, as well as waste treatment plant design. Water works projects cover such aspects as water supply and treatment evaluation, distribution system hydraulics modeling, rate studies and water storage and treatment facility design. Representative projects are:

Wastewater Collection and Treatment

Indianapolis, Indiana. Indiana Heartland Coordinating 208 Study. Project Engineer.

Sioux Falls, South Dakota. Sioux Falls 201 facility plan. Project Engineer.

Hastings, Nebraska. 201 facility plan. Project Engineer.

Omaha, Nebraska. 50 mgd Papillion Creek Wastewater Treatment Plant, field inspection engineer during construction phase.

Aurora, Nebraska. 201 facility plan. Project Engineer.

Carroll, Iowa. 201 facility plan. Project Engineer.

Glenwood, Iowa. 1.4 mgd wastewater treatment plant. Design Engineer.

Carroll, Iowa. Sewer rate study. Project Engineer.

Minneapolis, Minnesota, MWCC Service Area #6 201 facility plan study. Project Engineer.

Water Supply and Treatment

Metropolitan Omaha, Nebraska, and Council Bluffs, Iowa, Army Corps of Engineers, regional water supply study. Project Engineer.

Omaha, Nebraska. Metropolitan Utilities District, water supply system master plan update. Project Engineer.

Carroll, Iowa. Water supply and treatment study. Project Engineer.

Omaha, Nebraska. Metropolitan Utilities District, twenty-five million gallon ground storage reservoir. Design Engineer.

Suffolk, Virginia. Water supply and treatment study.

Carroll, Iowa. Water rate study. Project Engineer.

Suffolk, Virginia. 3.0 mgd water treatment facility. Process and Design Engineer.

Bloomington, Minnesota. Hennepin County Lime Sludge Disposal Study. Project Engineer.

Asheville, North Carolina. Water supply and distribution study. Project Engineer.

Professional Endeavors 1974-Present
Henningson, Durham & Richardson, Inc., Omaha, Nebraska. Environmental Engineer.

Professional Activities American Water Works Association
Water Pollution Control Federation

Publications Masters Thesis -- "Urban Stormwater Runoff Characterization Study", University of Nebraska, 1979.

R. Gary Fuller, P.E.

Project Role Water Plant Alternatives

Education Bachelor of Science in Civil Engineering, Iowa State University, Ames, Iowa, 1974

Registration Professional Engineer, 1978

Experience Mr. Fuller is an environmental engineer with considerable experience in both water and wastewater projects. Water projects include water treatment facilities, storage, distribution systems, water supply and water rate studies, as well as water works improvements. Wastewater projects cover 201 facility plans, sewer rate studies, sewer and treatment plant modifications and construction supervision. Proficient in data collection and analysis, population projections, systems analysis, supply/demand projection, report writing, as well as rate determinations and recommendations based on current standards for the water works industry. Also adept in the evaluation of current labor forces, land use, financial programs, of the most practical alternatives for collection systems and treatment facilities, as well as at projecting growth and development. In addition, Mr. Fuller has handled design criteria and process selection, layout design, preparation and review of specifications and contract documents, construction coordination and client liaison. Selected project experience includes:

Water Supply and Treatment

City of Longview, Texas. Sabine River water supply and treatment facilities. 8 mgd capacity. Design Engineer.

City of Council Bluffs, Iowa. Water treatment and distribution system improvements and 2.0 mg storage reservoir. Project Engineer.

City of Missouri Valley, Iowa. Water distribution system improvements. Design Engineer.

Regional Water Supply Study, Metropolitan Omaha, Nebraska/Council Bluffs, Iowa, for Omaha District Corps of Engineers.

City of Council Bluffs, Iowa. Water rate studies.

City of Missouri Valley, Iowa. Water works report update.

Montana Power Company. Water rate studies for Missoula, Montana; and Superior, Montana.

City of Yuma, Arizona. Water rate study.

City of Suffolk, Virginia. Water supply and treatment facilities. 3 mgd capacity. Project Engineer.

City of Yuma, Arizona. Water treatment facilities. 8 mgd expansion. Project Engineer.

Wastewater Collection and Treatment

City of Missouri Valley, Iowa. "201" Facilities Plan.

City of Springfield, Nebraska. Construction engineer for outfall sewer and activated sludge treatment plant.

City of Estherville, Iowa. Sewer rate study.

City of Carroll, Iowa. Outfall sewer and wastewater treatment plant modifications.

Professional Endeavors 1974-Present
Henningson, Durham & Richardson, Inc., Omaha, Nebraska.
Water and Wastewater Systems Designer.

Professional Activities American Water Works Association

City of Litchfield, Minnesota. Report on municipal water utility, supply, storage and distribution; plans, specifications, construction administration of water mains; specifications and construction administration of municipal water wells, pumps and pumphouse.

City of Waseca, Minnesota. Design, plans, specifications, construction administration of municipal water well, pump, pumphouse.

City of Rochester, Minnesota. Design, specifications, construction administration of municipal water well, pumps, pumphouse.

City of Emmetsburg, Iowa. Construction administration of municipal iron removal water filtration plant.

Professional Endeavors

1978-Present
Henningson, Durham & Richardson, Inc., Environmental Division, Minneapolis, Minnesota. Project Engineer. Responsible for design, administration and inspection of water and wastewater facility projects.

1976-1978
Pfeifer and Shultz/HDR, Inc., Minneapolis, Minnesota. Project Engineer.

1973-1976
Pfeifer and Shultz, Inc., Minneapolis, Minnesota. Project Engineer.

1970-1974
Minnesota Pollution Control Agency, Division of Water Quality, Industrial Waste Section, Minneapolis, Minnesota. Graduate Engineer II.

Professional Activities

Water Pollution Control Federation
Central States Water Pollution Control Association
National Water Well Association

Lawrence E. Anderson, P.E.

Project Role Cost Estimating

Education Michigan Technological University, 1970

Registration Professional Engineer

Experience Mr. Anderson is a project engineer with responsibilities of design, administration and inspection on water and wastewater facility projects. His representative projects include:

Wastewater Treatment Facilities

City of Comfrey, Minnesota. 201 wastewater treatment facility plan.

City of Luverne, Minnesota. Plans, specifications and construction administration of sanitary sewer; report on comprehensive wastewater monitoring program; report on rotating biological media pilot plant study.

City of Two Harbors, Minnesota. Preparation of operation and maintenance manual for wastewater treatment facilities; construction administration of 1.2 tertiary wastewater treatment facility; report, plans and specifications for 11.5 wastewater lift station.

City of River Falls, Wisconsin. 201 wastewater treatment facilities plan; plans and specifications for 1.8 secondary wastewater treatment facilities.

City of Springfield, Minnesota. Report on wastewater treatment facilities.

Village of Hammond, Wisconsin. Report on wastewater treatment facilities.

Village of Pepin, Wisconsin. Plans and specifications, construction of wastewater treatment laboratory.

Water Treatment Facilities

City of Luverne, Minnesota. Report on municipal water utility supply, treatment, storage and distribution and water rates; plans, specifications and construction administration of water mains; specifications and construction administration of municipal water wells, pump and pumphouse.

DALE A. TRANTER, P. E.

project role	Disposal Alternatives
education	Bachelor of Science in Civil Engineering, University of Minnesota, 1969; Master of Environmental Planning, University of Washington, 1973
experience	Mr. Tranter has a broad background in both environmental planning and engineering including water quality planning, stream studies and solid waste management studies. In addition to serving as project manager for various 201 and 208 plans, he has supervised plants and outdoor construction crews. Serving as liaison for citizen groups and governmental agencies also reflects his capabilities. He has additional experience in plan implementation, HUD 701 Plans, zoning regulations, subdivision applications and road design. Mr. Tranter's selected project experience includes:

MWCC (Metropolitan Waste Control Commission), Minneapolis-St. Paul, Minnesota. Study includes rapidly urbanizing population of two counties plus associated major industrial discharges to nearly 8 mgd. Eight municipal and four wastewater treatment facilities are included. Various levels of treatment must be considered. A unique feature of the study area includes the discharge of two municipal treatment facilities to a U.S. Department of Interior designated "Wild and Scenic Stream". Project Manager.

201 Facilities Plan, City of Sioux Falls, South Dakota. 13.5 mgd advanced wastewater treatment plant. Project Engineer.

201 Facilities Plan, City of Walnut, Iowa. Project Engineer.

Environmental Protection Agency 201 Facility Plan for wastewater collection and treatment for the City of Winona, Minnesota, to treat domestic waste for a population of 33,000 plus assorted wet-process industries. Project Manager.

201 Facilities Plan, Woodbine, Iowa. Project Engineer.

208 Areawide Waste Treatment Management Plan, Indiana Heartland Coordinating Commission, Indianapolis, Indiana. Study area included eight counties with a projected population of 1.7 million by the year 2000. Investigation included point source and nonpoint source pollution. Project Engineer.

Grand Rapids, Michigan. 208 Plan. Project management and point source evaluation for point source as well as work program development.

MACOG (Michigan Area Council of Governments) 208 Plan Point Source Evaluation. Aided in development of both work and computer modeling programs.

professional endeavors

1978-Present.
Henningson, Durham & Richardson, Inc., Minneapolis, Minnesota. Project Manager. Responsible for environmental engineering projects including numerous 201 and 208 studies plus various water works projects.

1974-1978.
Henningson, Durham & Richardson, Inc., Omaha, Nebraska. Environmental Engineer.

1974.
Western Lake Superior Sanitary District, Duluth, Minnesota. Engineer/Planner.

1973-1974.
Hennepin County Sheriff's Department, Minneapolis, Minnesota. Consulting Engineer.

1972-1973.
Kenai Peninsula Borough Planning Department, Soldatna, Alaska. Project Engineer/Planner.

1971.
Fridley City Public Works Department, Fridley, Minnesota. Associate Planner.

1970-1971.
Bellevue City Planning Department, Bellevue, Washington. Planning Intern.

professional activities

Water Pollution Control Federation;
American Public Works Association;
American Water Works Association.

E. Experience

The Project Team presented in this proposal provides the broadest base of experience and technical expertise available to bear on this very complex problem. In this section, the previously cited experience in evaluating groundwater hydrology and contamination problems will be defined, along with experience in treatment of discharge waters.

The firm of E. A. Hickok and Associates performed an intensive investigation and evaluation of groundwater contamination at a toxic waste site in Iowa containing arsenical and organic compounds, including phenols and associated materials. This investigation resulted in fourteen volumes of documents evaluating alternatives and data and presenting criteria and recommendations.

An important groundwater aquifer located in Wisconsin was polluted with sulfide liquor and the firm of E. A. Hickok and Associates investigated this situation, designed and implemented a groundwater protection system to protect the aquifer from further degradation. This barrier well system is satisfactorily operating more than 10 years after implementation.

An intense site selection for a hazardous waste disposal site for the Twin City area was conducted by the firm. A computer groundwater model was used to investigate the effects of various catastrophic events on such a site.

The firm designed and implemented a monitoring system to detect the presence of phenolic compounds escaping from a waste wood pile in a northern Minnesota community. A system of control of the leachate and runoff from the waste pile was implemented.

The firm of E. A. Hickok and Associates is familiar with the St. Louis Park problem, having collected numerous water samples in the mid and late 1960's to determine the presence of phenolic compounds in the municipal wells. This early work in the identification of the problem was key to the stimulation of further investigation.

Geraghty and Miller, Inc. has performed numerous groundwater contamination assessments and abatement procedures investigations. Such projects include cases of hazardous industrial waste contamination, municipal landfill leachate plumes, cooling tower blowdown disposal by shallow well injection, major hydrocarbon spill at an airport and spray irrigation of industrial wastes.

Henningson, Durham and Richardson's experience in environmental facilities design extends from 1917 to the present. In the areas of water and wastewater treatment and conveyance, the firm has designed many facilities throughout the Midwest and the nation. HDR has experience with innovative treatment technologies, as exemplified by its work at Shreveport, Louisiana on ozone-enhanced biological activated carbon systems.

In the following pages are examples of previous projects for each of the associated firms. Cost information is given for some projects listed, and note that additional project cost data appear in the Standard Form 254 included in Section C - Capabilities.

E. A. Hickok and Associates

Experience

Experience

The firm of E. A. Hickok and Associates is a consulting engineering and hydrology firm with extensive background in the design, evaluation and monitoring of sanitary landfills, hazardous waste sites, groundwater pollution potential and the devlopment of environmental impact documentation. The firm has performed numerous sanitary landfill studies and environmental assessment and impact statements, both within the metropolitan area and throughout the upper midwest. The firm has prepared numerous environmental information documentation, including an Environmental Impact report for the Washington County Sanitary Landfill No. 2 in December, 1973, followed by three environmental information documents for the Metropolitan Airports Commission, several for lake restoration projects, a wetland research and demonstration project for the Environmental Protection Agency and evaluation of several hazardous waste or material projects. These and other projects are detailed in the following paragraphs.

Client: Washington County
Name and Type of Project: Solid Waste Feasibility Study
Estimated/Actual Cost: $16,000/$16,000
Firm's Role: Prime Contractor

The firm performed a solid waste feasibility study for a metropolitan county in 1977. The report evaluated the feasibility of developing three separate sites and the use of alternative methods, including conventional land filling, shredding and land filling and bailing and land filling, as well as transfer stations. The cost of the various alternatives in addition to the energy requirements and the material recovery opportunities were evaluated.

Client: Washington County
Name and Type of Project: Sanitary Landfill Monitoring Plan
Estimated/Actual Cost: $5,000/$5,000
Firm's Role: Prime Contractor

A monitoring plan was developed and implemented for a closed sanitary landfill within the metropolitan area. Due to the proximity of the landfill to several water resources, a monitoring system capable of detecting both gaseous decomposition products as well as any potential leachate was required.

Client: Metropolitan Waste Control Commission
Name and Type of Project: Hazardous Waste Site Selection and Evaluation
Estimated/Actual Cost: $90,000/$67,500
Firm's Role: Sub-contractor

The firm provided input to the Minnesota Hazardous Waste Project on a sub-contract basis for environmental considerations for the siting of groundwater evaluational potential sites, including the use of a sophisticated groundwater model and performed geophysical evaluation of various potential sites.

Client: Metropolitan Waste Control Commission
Name and Type of Project: Environmental Inventory
Estimated/Actual Cost: $97,000/$97,000
Firm's Role: Prime Contractor

The firm, together with the study team proposed for this project, prepared a document entitled, "Baseline Environmental Inventory - Twin Cities Metropolitan Area," for the Metropolitan Waste Control Commission in 1977. This document is being used for the massive facility planning effort presently underway by the Metropolitan Waste Control Commission and covers the entire metropolitan area, with all of the basic environmental information.

Client: Minnesota Pollution Control Agency
Name and Type of Project: Wastewater Pond Seepage Evaluation
Estimated/Actual Cost: $44,970/$44,970
Firm's Role: Prime Contractor

The firm performed a study for the Minnesota Pollution Control Agency to determine the effects of wastewater stabilization pond seepage on groundwater quality. The information developed in that study will be most useful in evaluating the impact of the Loretto wastewater treatment facilities on the local water resources of the project area.

Client: Iowa Department of Environmental Quality
Name and Type of Project: Environmental and Water Quality Assessmen
Estimated/Actual Cost: $108,000/$106,000
Firm's Role: Prime Contractor

A project performed for the Iowa Department of Environmental Quality to define the extent of an industrial waste disposal site which was used for potentially hazardous and toxic chemicals for over 25 years was performed. The evaluation of a regional aquifer system, together with field borings, laboratory analysis for heavy metals and organic compounds were performed, including mass balance of various hazardous materials. Fourteen comprehensive reports were prepared on a very rigid time schedule in a five-month period.

Client: Haltz Krause Sanitary Landfill
Name and Type of Project: Evaluation of Impacts on Groundwater and Surface Water
Estimated/Actual Cost: $8,000/$8,000
Firm's Role: Sub-contractor

An environmental assessment of a combination county and industrial sanitary landfill was performed for a community in central Wisconsin. This landfill is located in a low lying area next to a major natural resource and the possibility of leachate contaminating this river was a major concern. A major effort to evaluate the impact on this water resource was performed in a very similiar circumstance of that found at the Woodlake sanitary landfill.

Client: Materials Service Corporation
Name and Type of Project: Sanitary Landfill Evaluation
Estimated/Actual Cost: $6,000/$6,000
Firm's Role: Prime Contractor

An environmental evaluation of a proposed sanitary landfill in the Chicago, Illinois area was performed, including the evaluation of the impacts on groundwater, the potential for leachate generation and movement of leachate. The required permit applications for the local and state regulatory agencies were prepared.

Client: Metropolitan Airports Commission
Name and Type of Project: Environmental Impact Assessment
Estimated/Actual Cost: $26,000/$12,000
Firm's Role: Prime Contractor

An environmental impact assessment report was prepared for the Metropolitan Airports Commission Retention Basin No. 1, which is a stormwater retention pond to control stormwater runoff from part of the Minneapolis-St. Paul International Airport. This environmental assessment included a complete inventory of terrestrial vegetation, terrestrial wildlife and aquatic biology in a wetland used as an integral part of the treatment system.

Client: Metropolitan Airports Commission
Name and Type of Project: Environmental Impact Assessment
Estimated/Actual Cost: $30,000/$29,000
Firm's Role: Prime Contractor

An environmental impact assessment report and an environmental information document was prepared for the Metropolitan Airports Commission Retention Basin No. 2, which is located in the Fort Snelling State Park. This document was then used by the Federal Aviation Administration as the environmental impact statement. These documents include a complete inventory of the existing environment, including all aspects of the terrestrial and aquatic elements and required a comprehensive evaluation of the seepage potential for the retention basin, as well as the normal groundwater seepage into the recreation lake.

Client: Metropolitan Airports Commission
Name and Type of Project: Environmental Impact Assessment
Estimated/Actual Cost: $55,000/$43,000
Firm's Role: Prime Contractor

An environmental impact assessment report was prepared for the Metropolitan Airports Commission Retention Basin No. 3. This document again included an extensive inventory of the existing environment and in addition, required extensive coordination with various state and federal agencies, including the Veteran's Administration, General Services Administration, Federal Aviation Administration, U.S. Corps of Engineers, U.S. Fish and Wildlife Service, Minnesota Department of Transportation, the Minnesota Pollution Control Agency, the Minnesota Department of Natural Resources and the Metropolitan Council. The effort required coordinating this project with these various agencies is viewed as a similar task to the establishment and use of the Consultant's Task Force for the proposed project.

Groundwater Projects Performed by
E. A. Hickok and Associates

Project	Client
Groundwater Pollution Investigation	Eagle Picher Industries
Groundwater Supply Investigation	Pennsylvania Gas and Water Company
Lime Sludge Disposal Site Evaluation	Pennsylvania Gas and Water Company
Minnesota Chemical Landfill Groundwater Investigation and Prediction Model	Metropolitan Waste Control Commission
Tailings Disposal Site Groundwater Investigation	Reserve Mining Company
Sanitary Landfill Groundwater Monitoring System	Washington County, Minnesota
Impact of Arsenical and Organic Wastes on Major Iowa Aquifer	Iowa Department of Environmental Quality
Predicted Impact on Groundwater of Copper Nickel Mining	The International Nickel Company
Water Resources Investigation	AMAX Exploratory, Inc.
Impacts of Stabilization Pond Seepage on Shallow Groundwater	Minnesota Pollution Control Agency
Soil Renovation of Wastewater and Impacts on Groundwater	City of Balsam Lake, Wisconsin
Wastewater Pond Seepage Evaluation	Minnesota Department of Natural Resources
Impacts of Irrigation Project on Groundwater	Buford-Trenton Irrigation District
Groundwater Pollution Investigation	Aneroda-Hess Oil Company
Groundwater Pollution Investigation	Wausau Paper Mills
Groundwater Pollution Investigation	Northern States Power
Groundwater Pollution Investigation	John Deere and Company
Groundwater Pollution Investigation	Green Giant Company

Groundwater Projects Performed by
E. A. Hickok and Associates (continued)

Project	Client
Groundwater Pollution Investigation	Kraft Foods
Groundwater Pollution Investigation	More than 50 Municipalities and Agencies
Impact of Sanitary Landfill on Groundwater	Holtz-Krause Landfill, Wausau, Wisconsin
Johnson Street Sanitary Landfill	Minnesota Department of Transportation
Phenol Pollution of Groundwater	St. Louis Park, Minnesota

TYPICAL PROJECTS

Surface Water Quality Monitoring Program

Client: Metropolitan Council of the Twin Cities

A comprehensive survey of surface water quality was undertaken with special emphasis on defining the impact of stormwater and thermal discharges.

A monitoring program was established throughout a metropolitan area of 3,000 square miles, consisting of 148 sub-watersheds. Water samples were collected and analyzed from selected sub-watershed locations and from 52 lakes found within the area. Factors influencing water quality were identified. Through the use of a computer program, correlations were developed between water quality and land use classifications, soil types, slope and population densities.

River Pollution Monitoring Programs

Client: Twin City Metropolitan Airports Commission

A water quality monitoring program was established to measure the pollutional effects of fuel spills. The water sampling network for this program extended approximately 30 miles down the Mississippi River from the airport facility.

When 150,000 gallons of aviation fuel were accidentally spilled into the Minnesota River from the airport, E. A. Hickok and Associates coordinated the cleanup activities.

Lake Monitoring Program

Client: Minnesota Pollution Control Agency

Perhaps the most intensive lake sampling program ever accomplished anywhere was undertaken on Lake Minnetonka, the number one recreational lake in Minnesota. Approximately 5,000 water quality samples were collected and analyzed during one year from a network of sampling stations covering the lake.

Groundwater Pollution Investigation

Client: Eagle-Picher Industries, Inc.

In order to determine the presence of absence of groundwater pollution from old mines, a groundwater quality monitoring program was established. The firm also conducted field investigations of all wells in the area and all mine shafts. The firm researched and evaluated historical data, determined historical groundwater tables and estimated historical water quality.

Comprehensive Water Quality Management Plan

Client: Dickinson County, Iowa

Under an Environmental Protection Agency grant to investigate pollution into the major chain of lakes in Iowa, E. A. Hickok and Associates directed a comprehensive regional investigation by 25 government agencies and three private associations of all factors affecting water quality. This $154,930 program encompassed extensive water quality monitoring, groundwater studies, ecological evaluations, evaluations of historical data, hydrologic calculations, identificaiton of pollution sources, quantification of waste inputs, studies of lake bottom sediments, recreational water uses, computer applications, existing and projected land uses, projected lake conditions, agricultural runoff, lakeshore property values, administrative policies and organization and a program of recommended improvement facilities.

Computer Model of a Watershed

Client: Minnehaha Creek Watershed District

On the basis of data collected from a network of hydrologic instruments established throughout the watershed, as well as from historical data, E. A. Hickok and Associates developed a digital computer mathematical model for Minnehaha Creek, which is the major tributary to the Mississippi River within the Twin Cities Metropolitan Area. The model has nine sub-systems, and 315 variable parameters that represent soil characteristics, areas, evaporation rates, evapo-transpiration rates, seepage, etc. In response to input of daily precipitation data from ten sample years, the model will determine correlative lake levels and stream flows throughout the District.

Water Resources Inventory Program

Client: Minnesota State Planning Agency

Assemblage of all hydrologic data for the entire state, including the Upper Mississippi River Basin for reproduction in a report of the State Planning Agency.

Environmental Impact Statement, Sanitary Landfill

Client: Washington County, Minnesota

A comprehensive analysis of the impact of a proposed landfill to serve a substantial portion of Ramsey and Washington Counties. The analysis included the groundwater, hydrology, geology, pollution potential, monitoring requirements and future land use.

Load Allocation Studies

Client: Minnesota Pollution Control Agency

Load allocations for point sources were determined for eight river segments in the State of Minnesota. The studies included

comprehensive stream surveys, including biological assessment, water quality and physical assessment of the streams. Hydrologic analyses of the basins were performed to determine the critical flows. Detailed documentation of the data and mathematical computer model are included in the final reports.

Basin Water Quality Management Plan

Client: Iowa Department of Environmental Quality

A comprehensive inventory and analysis of all municipal, industrial, semi-public, agricultural and non-point sources was prepared. Treatment needs were determined relative to water quality standards, load allocations and costs and priority of the needs were assessed. The analysis included the geology, hydrology, groundwater, growth projections and water quality.

Evaluation of Stormwater Treatment Methods

Client: Minnehaha Creek Watershed District

An Environmental Protection Agency research and demonstration project to evaluate various techniques of controlling, managing and treating urban stormwater runoff was performed by the firm. Techniques evaluated include porous roughing filters, filtration by natural marshes, high rate pressure filtration and organic soil filtration. The hydrologic, nutrient and microbiological aspects of the various techniques were evaluated. Recommended methods of treatment and design criteria have resulted from the project.

Assessment of Water Needs

Client: Pennsylvania Gas and Water Company

A comprehensive investigation of the existing and projected water needs for more than 450,000 residents of the metropolitan Wilkes-Barre-Scranton, Pennsylvania area was performed. This assessment was used to formulate a long range water supply plan. The environmental impact of withdrawing 110 million gallons per day from the Susquehanna River was assessed as well as various methods of securing additional water sources.

Land Application of Treated Wastewater

Client: City of Storm Lake, Iowa

A comprehensive investigation was conducted in order to determine the feasibility of land application of treated wastewater in the Storm Lake area. The project was unique in that the wastewater application treatment was designed for maximum crop production and resource utilization. The application treatment was based on the results of a statistical analysis of plant available soil moisture data.

Tailings Disposal Site Selection

Client: Reserve Mining Company

In order to assist the Reserve Mining Company in the selection of an environmentally acceptable tailings disposal site, a comprehensive geo-hydrologic investigation was conducted in northeastern Minnesota. The analysis included water balance determinations, surface and subsurface geology, surface and subsurface hydrology and also an assessment of potential environmental impacts.

Stormwater Treatment Facility

Client: Dayton-Hydson Properties, Inc.

This project received a Grand Award for engineering excellence from the Minnesota Association of Consulting Engineers in February, 1976. The project was designed to maintain the ecological balance of a lake receiving runoff from a new major regional shopping center in a suburban setting. The facility was designed to meet the stringent requirements of a NPDES permit, one of the few issued to heretofore sources considered to be non-point. The facilities, consisting of multiple baffled grit and floating debris removal units, holding ponds, oil removal units and outlet controls, are capable of handling a 100-year return frequency storm.

Municipal Stormwater Treatment Needs

Client: Minnesota Pollution Control Agency

The municipal stormwater treatment needs for the entire State of Minnesota were developed by the firm. The variables considered include city type, land use, precipitation, topography, soil type, population area, existing development patterns, pollutants generated, effluent standards and receiving water standards. The overall needs for both stormwater collection or separation and treatment for more than 440 cities were determined with populations from 505 to more than 430,000. Typical treatment facilities were described as well as construction and operational procedures and expenses.

Special Flood Hazard Study

Client: U. S. Army Corps of Engineers

A special flood hazard study was performed on the Minnesota River in the vicinity of Mankato, Minnesota. This study defined the limits of the standard project flood and the intermediate regional flood with and without a flood control project. The report defined certain responsibilities of the local units of government which were necessary to successfully implement the entire project.

Pre-operational Water Quality Monitoring

Client: International Nickel Company

An intensive water quality and limnological investigation was designed, performed and completed over an eighteen month period to define background conditions in northeastern Minnesota prior to commencement of the construction of a copper-nickel mine. In addition to the standard water quality parameters, trace metal analysis to parts per billion and parts per trillion sensitivity were performed. Hydrologic analysis, groundwater evaluation, analysis of stream and lake sediments, installation of a remote gaging station and evaluation of bottom organisms were other specific work items in the investigation. The most advanced sampling, sampling handling and analytical techniques including flameless atomic spectrophotometry were routinely used.

Flood Plain Delineation

Clients: Minnehaha Creek Watershed District
Rice Creek Watershed District

The 100-year flood plain limits along selected portions of both of these metropolitan streams have been defined as a tool in the implementation of certain water management strategies. Both of these Districts are experiencing rapid urban development and increased incidences and awareness of the flooding potential. The flood plain delineation has been an important factor in the control, management and acquisition of land which are of utmost importance to each District.

Land and Water Management Improvements

Client: Minnehaha Creek Watershed District

A comprehensive and multi-faceted program consisting of thirteen separate recreationally oriented projects have been developed and designed for six cooperating units of government within the Minnehaha Creek Watershed District. The projects include a dam site recreation area, canoe landings, pedestrian trails and facilities, creek bed maintenance, kiosks, nature areas and landscaping of sensitive areas. The improvements were successfully tailored to match and meet the diverse requirements of the various government units and the concerned citizens. The public participation, coordination and support from the inception to the completion of this project has been a highlight.

Minnesota Chemical Landfill Project

Client: Metropolitan Waste Control Commission

This five year project funded by the United States Environmental Protection Agency is estimated to cost more than five million dollars over the project period. The project is designed to demonstrate land disposal techniques for potentially hazardous

chemical wastes. The project is designed to demonstrate land disposal techniques for potentialy hazardous chemical wastes. The project emphasizes a high degree of citizen participation in the decision-making process and a high level of industrial awareness. The site selection process and preliminary design of the facilities determined the public acceptance and support of the project.

Surface Water Management Plan

Client: City of Orono

A comprehensive surface water management plan for the entire city was developed through field surveys and computer simulation to preserve and enhance the natural drainage and treatment systems. The plan included specific recommendations for 110 marsh/wetland areas within 21 drainage basins to preserve water quality and prevent flood damages.

Water Resources Investigation

Client: AMAX Exploration, Inc.

This investigation assessed the complex hydrological systems of northeastern Minnesota relative to providing a dependable makeup water supply for a major mining facility. The study included evaluation of several alternatives and combination of supplies, compatibility with tailings disposal facilities, other water users, regulatory requirements and anticipated environmental impacts. A complete review and analysis of existing data was performed in the area of climatology, geology, groundwater, soils, stream flow, runoff water use, other disposal facilities, and capital, operation and maintenance costs. Statistical techniques were used to develop correlations and projections of "wet" and "dry" year conditions. The conclusions drawn from this study are used to plan the ultimate facilities with a projected useful life of at least forty years.

Stabilization Pond Seepage Impacts

Client: Minnesota Pollution Control Agency

The study evaluated the impact of seepage from wastewater stabilization pond systems on groundwater and surface water quality. Existing systems, which characterized the general geomorphic regions of the state were evaluated. The effectiveness of the seal, the effects of the bottom deposits and the significance of the underlying soils were determined and evaluated. Complete water and nutrient balances were developed for each system. Intensive groundwater sampling and level monitoring programs were implemented, climatological data was collected and bacteriological and chemical water quality monitoring programs were estblished to define the variables of each system.

Lake Restoration

Clients: Rice Creek Watershed District
Minnehaha Creek Watershed District
Minneapolis Park and Recreation Board
Clearwater River Watershed District

A number of feasibility studies for lake restoration projects have been performed. These projects include water quality sampling, analyses and evaluation, dtermination of pollutant sources, determination of alternative corrective actions, cost effective analysis of the alternatives and environmental assessment of the alternatives. Application for grant funds have been prepared and follow-up correspondence processed.

A project developed for the Long Lake Chain of Lakes at an estimated cost of 2.6 million dollars was awarded an Environmental Protection Agency lake restoration grant. This three year restorative project inludes sediment control and removal, flood storage and routing, wetland treatment and erosion and nutrient control measures.

A lake restoration system for Wirth Lake in the City of Minneapolis was designed and constructed, which included aeration and biological activated soil filtration.

Soil Renovation of Wastewater

Client: City of Balsam Lake, Wisconsin

This comprehensive hydrological evaluation of a proposed wastewater adsorption system considered a variety of factors including groundwater flow, quality and fluctuations, permeability and adsorptive capacity of the soils systems, impact of wetlands on effluent quality and groundwater quality and effects of soils on the nitrogen, phosphorus and heavy metals concentrations. This evaluation permitted approval of a system based on several recommended design modifications.

Stormwater Treatment System

Client: Twin Cities Metropolitan Airports Commission

A complex drainage network serving an international airport requires stormwater treatment and control facilities to comply with the conditions of the National Pollutant Discharge Elimination System permits. The drainage is contributed by lands under the jurisdiction of a variety of agencies and lands on which to construct facilities are also controlled by outside sources. The coordination of the concerns of the many agencies involved, coupled with the technical complexities of problems make implementation of these projects extremely sensitive. The projects include water quality monitoring, flow measurement, preliminary design, permit acquisition, final design and construction of the required facilities.

Groundwater Model

Client: Metropolitan Waste Control Commission

A comprehensive review and evaluation of available computer groundwater models was performed. The model was applied to a planned hazardous waste site for the environmental and field evaluation studies. The model can be used to predict the direction and rate of movement of leachate which might escape a chemical landfill and to evaluate various remedial actions. Two models were tested and verified and the recommended model was revised for the specific project and tests on a hypothetical site were performed. A sensitivity analysis was performed to determine the level of field data that is required for the desired results. Factors such as solute transport, density and dispersion effects, complete anisotrophy, heterogeneity, recharge rate, vertical and horizontal hydraulic conductivity, porosity, geomorphology and leachate quality were evaluated.

Recreational Facilities

Client: Okabena-Ocheta Watershed District
Worthington, Minnesota

A recreational facility was designed for water oriented facilities including boating, camping, picnicking, fishing and hiking. This rustic facility was designed to complement an artificial lake created to improve the water resources of this water deficient region. These facilities were designed with an expandability feature to ensure adequate facilities as the use and demand increases. Coordination with state, regional and local agencies was required to ensure compliance with the objectives of each agency.

Evaluation of Hazardous Wasste Disposal

Client: Iowa Department of Environmental Quality

The project defined the extent of an industrial waste disposal site which was used for potentially hazardous and toxic chemical for over twenty five years. A regional aquifer system is potentially threatened by the waste site and alternative actions to protect the environment were evaluated. Field borings, laboratory analyses for heavy metals and organic compounds were performed and mass balances developed for the four sites investigated. Fourteen comprehensive reports wre prepared on a very rigid time schedule during a five-month period. Outputs include recommendation for safe disposal, recommended monitoring procedures and systems, recommended land disposal evaluation criteria, literature reviews as well as various interim reports.

Lake Phalen Restoration Evaluation

Client: Ramsey County, Minnesota

In order to determine the most effective restoration measure that should be implemented, this evaluation considered detention

ponding, reuse of urban runoff, seepage ponds, first flush diversion systems, biologically activated soil filtration units and lake level management technique. The evaluation included a detailed investigation of the lake's interconnection with the groundwater system and the role of the lake's sediments as a nutrient load. Several multipurpose measures are recommended based on projected improvements on the water quality of the intensively used urban lake. These measures include providing for recreational activities improved habitat areas, a stabilized lake level in addition to an improved aesthetic quality.

Small Boat Harbor

Client: Corps of Engineers, St. Paul District

Configuration channel and dredging alternatives were evaluated for the Warroad small boat harbor in Lake of the Woods. This project evaluated the sediment deposition patterns in the harbor, considered various channel configurations, considered construction alternatives to provide a channel and evaluated the maintenance requirements for the various configurations. A unique solution was developed which minimizes the channel maintenance requirements.

Environmental Baseline Inventory

Client: Metropolitan Waste Control Commission

The firm was the prime consultant in an intensive effort to develop a detailed inventory and assessment of the ecological, social, cultural and physical and aesthetic characteristics on the seven county metropolitan area. The purpose of the project was to provide a baseline data source for the Metropolitan Waste Control Commission's on-going 201 Facilities Plan. The work involved research compilation and consolidation of existing data, updating when possible and providing additional sources of information. In addition to overall project management, Hickok and Associates performed detailed analyses in the discipline of climatology, topography, geology, geomorphology, soils hydrology, wetlands, water use, water quality, land-water interfaces, agriculture, land quality and environmental constraints. The documentation was designed to be used as a tool for the on-going planning projects for the Commission and other agencies in the Metropolitan Area.

Environmental Impact Assessment Report

Client: Metropolitan Airports Commission

An environmental impact assessment report was prepared for a facilitiy proposed to be constructed in an extremely sensitive habitat within the Minnesota River Valley and several alternatives and mitigative measures were required to obtain approval of this facility. A comprehensive and detailed inventory of the vegetation in the upland, the wetlands and the wildlife in the uplands, the pond and the weltands was performed. The interaction between these factors and the park's objectives, the disturbances that would take place during construction and the operating conditions were assessed and quantified.

Flood Insurance Studies

Client: The Federal Insurance Administration (Housing and Urban Development)

Flood Insurance Studies are being performed for 18 communities within the State of Minnesota. These studies include reconnaissance, survey of the communities, hydrology of the study area, use of the HEC-2 model to determine the flood plain area, preparation of floodway maps and final flood insurance maps. These studies include a complete evaluation of the flood-prone areas within the community or county under study, and the results are reconciled with other on-going studies in surrounding communities.

National Runway Friction Measurement Program

Client: Federal Aviation Administration

The runways at more than 270 of the major airports throughout the United States are being evaluated for the pavement conditions and the friction characteristics. This 24-month project includes the design, procurement and operation of six sophisticated friction measurement vehicles. The techniques includes the use of the Mu-Meter and a qualitative and quantitative evaluation of such pavement characteristics as texture, construction method, rubber accumulation, surface contaminants on the pavement, structural condition, joint condition and other miscellaneous parameters. A sophisticated data base management computer program has been developed and all data is input from the field, to an on-line computer system. The objectives of this massive data collection system are to increase the effectiveness of the funding program and to enhance safety by reducing hydroplaning and improving runway friction characteristics.

Wastewater Pond Seepage Evaluation

Client: Minnesota Department of Natural Resources

The wastewater treatment facility for Itasca State Park was evaluated to determine the impact of seepage from the pond system on the water resources of the Mississippi headwaters area. This study evaluated the groundwater and surface water quality by performing water and nutrient balances for the system. Intensive groundwater and sampling and level monitoring programs were used along with climatological data, bacteriological and chemical water quality information to define the operating regimes in the system.

Evaluation of Hyland Lake Restoration Project

Client: Hennepin County

An intensive water quality monitoring program is being implemented to evaluate the results of a lake restoration project performed

on an urban lake in Hennepin County. Evaluation is to determine the effectiveness of the lake restorative techniques employed on the lake and include water quality sampling of the lake as well as the influent streams and drainage systems. The report will be prepared detailing the findings and wil be used presumably by the Federal government to evaluate the techniques used on the restoration nof Highland Lake.

Regional water studies

client:

MINNEHAHA CREEK WATERSHED DISTRICT

problem:

To develop an overall plan for the purpose of implementing a land, soil and water management program in a district comprising 174 square miles and including both urban and rural areas. Present and future population densities and land-use requirements were major factors which had to be considered in the development of this plan.

solution:

There are 33 units of government within the Watershed District: 27 municipalities, 4 townships and 2 counties. Development of the plan included a comprehensive investigation of local regulations, the philosophy of the citizens and the natural and historical characteristics of the communities. The natural characteristics of the watershed, its historical significance, population and economic growth patterns and the quality of its water resources were major areas of investigation. Problems were defined and plans and recommendations presented to the Board of Managers of the Watershed District. Water and land management regulations and policies also were proposed. The overall plan has now been approved by the Minnesota Water Resources Board and is being used as the management guideline for future investigations and projects within the district.

The overall plan received an engineering excellence award from the Minnesota Association of Consulting Engineers and the Consulting Engineers Council of the United States.

001041

PROFESSIONAL STAFF

JOHN A. HOLMQUIST has had broad experience in engineering and mineral geophysics in the United States and Central America. He has conducted geophysical research and exploration for the Phelps-Dodge Corp. in Montana, South Dakota and Wyoming. And he has been in charge of geological engineering investigations and geological engineering studies for the Materials and Research Section of the Minnesota Highway Department; the Bureau of Engineering, Minnesota Department of Conservation; and the City of Minneapolis. Mr. Holmquist received his degree in Geological Engineering at the University of Minnesota and has been a member of the staff of Eugene A. Hickok and Associates since 1966.

WILLIAM M. CAMPBELL is a registered engineer with extensive experience in Canada, Central America and South America. He has been in charge of many successful mineral development projects and also was Chief Engineer of the AID Mission in Guatemala for seven years. In the latter capacity, he was responsible for planning and supervising a wide variety of public works and heavy construction projects. Mr. Campbell obtained his degree in mining engineering at the University of Minnesota in 1950.

MARCUS C. HANNAMAN has conducted numerous ground-water and geophysical field investigations in Minnesota, Wisconsin, Illinois and Iowa He also has supervised exploratory drilling on large-scale ground-water development projects and has been a soils scientist in the Soils Laboratory of the City of Minneapolis. A University of Minnesota graduate, Mr. Hannaman joined Eugene A. Hickok and Associates as an assistant hydrologist in 1967.

EDMUND C. CONTOSKI has been the Planner, Planning & Research Manager, and Project Administrator with Pemtom, Inc. Previously he held the position of Senior Planner with a major planning consultant Mr. Contoski is experienced in comprehensive planning for cities and counties, including economic and demographic studies, land use, transportation, natural resources and park system planning. Mr. Contoski is a graduate of the University of Minnesota and a certified planner-in-charge in the State of Minnesota.

ROBERT D. TAFELSKI has been a hydrologist with the Peace Corps in the Dominican Republic and staff and consulting hydrologist for the Dominican government. He has done research concerning ground-water problems associated with solid waste disposal for the City of Madison, Wisconsin, and conducted geochemical and geophysical surveys in Guatemala and various parts of the United States. Mr. Tafelski holds a Master of Science degree in Water Resources from the University of Wisconsin

WALTHER P. VAN DER BORGHT has over twenty years of professional experience in civil engineering and project management, including design and construction supervision for water, sewer and power projects. He has been site development engineer for U S. Air Force Minuteman missile complexes, and Assistant City Engineer of Casper, Wyoming. He is experienced in project administration in the United States, Africa, Europe, and Central America, and is responsible for overseas engineering projects. He obtained degrees from the University of Vienna, Lycée de l'État and the University of California He is a member of the Society of American Military Engineers

FRANK A. VILLELA has held the position of Coordinating Engineer responsible for the location, design and construction of public facilities and utilities for the Rural Development Program in Guatemala. He is a Registered Engineer in California, Nova Scotia, and Guatemala. He served as a structural engineer with the Nova Scotia Department of Highways, and has been responsible for mineral development projects in Central America and municipal utility projects in California.

NORMAN C. WENCK has been in charge of a wide range of water supply, transmission, storage and water treatment projects as a U.S. Navy construction officer in Thailand and the United States. He also has done research and development work in the water treatment field. And he has had extensive experience in storm and sanitary sewer design, site development, engineering and feasibility studies and site engineering and drainage. Mr. Wenck obtained a Master of Science degree in Civil Engineering at Iowa State University and is a Registered Engineer in Minnesota and Wisconsin.

001042

Site investigations / typical project

client:

JONATHAN

problem:

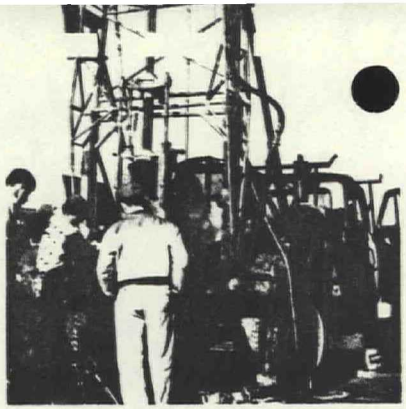
Development of a recreational lake for a planned NEW TOWN of 50,000 population at Chaska, Minnesota.

solution:

A hydrological investigation was made to determine the characteristics of an existing stream. Test drilling was conducted to determine subsurface conditions From this data, the boundaries of the lake were planned and the site for the dam was selected. The resulting 70-acre lake provides the focal point for the planned community

001043

Millions of people throughout the world are dependent upon ground-water resources for their daily water supplies. And the problem of matching the demands of our growing population with available water is one that calls for considerable expertise both in ground-water exploration and in the management of existing water facilities. Eugene A. Hickok and Associates has supplied the necessary expertise for the development of scores of public and private water supply systems. And whether the problem is one of locating a new water supply, drilling and testing a new well or finding ways in which to increase the production of existing wells, the firm is always happy to be of service.



Municipal water supply

client:

CITY OF WORTHINGTON, MINNESOTA

problem:

To find and develop sources of ground-water for a city whose future growth was threatened by an inadequate water supply. As a part of the immediate problem, the construction of a large food processing plant was being delayed until a reliable water supply could be assured.

solution:

Electrical resistivity studies were made of large areas in and around the city. Quantitative hydrologic tests provided a dependable source of water 7 miles from the city. Subsequently, production wells were drilled, a pipeline constructed and treatment facilities provided. The availability of an adequate water supply has been an important factor in the continued growth of the community.

001044

Some of the Clients the Firm Has Served . . .

INDUSTRIAL

Apple River Chemical Company
Dairyland Power Cooperative
John Deere & Company
Eagle-Picher Industries
Glenwood-Inglewood Co.
Green Giant Company
Honeymead Company
International Nickel Company
International Minerals and Chemical Company
Kimberly-Clark Corporation
Kraft Foods
3M Company
Munsingwear
Northern States Power Company
Oliver Iron Mining Company
E. J. Longyear Company
Northwestern Malt & Grain Company
Wausau Paper Mills Company
Morton Salt Company

MUNICIPALITIES

Chisholm, Minn.
Deephaven, Minn.
Eau Claire, Wisc.
East Troy, Wisc.
Glenwood, Minn.
Hibbing, Minn.
Jackson, Minn.
Luverne, Minn.
Mankato, Minn.
Marshall, Minn.
Neilsville, Wisc.
New Ulm, Minn.
Olivia, Minn.
Renville, Minn.
St. Anthony Village, Minn.
St. Louis Park, Minn.
Sauk Centre, Minn.
Sleepy Eye, Minn.
South St. Paul, Minn.
Stevens Point, Wisc.
Wayzata, Minn.
Weyerhauser, Wisc.
White Bear Lake, Minn
Willmar, Minn.
Worthington, Minn.

OTHER PUBLIC AGENCIES

Metropolitan Council
Minnehaha Creek Watershed District
Minnesota Department of Conservation
Minnesota Highway Department
Minnesota State Planning Agency
Pan American Health Organization
United States Customs Department
World Health Organization
Buford-Trenton Irrigation District

MISCELLANEOUS

Minnegasco
Jonathan Development Corp.
Miller Well & Pump Co.
Minneapolis Athletic Club
Brookview Country Club
Minnetonka Country Club
Orrin Thompson Homes
Water Research Foundation
Buck Hill Ski Area

001045

A. Testing for ground-water pollution

B. Sampling lake bottom sediments

C. Testing water quality

D. Exploring for copper and silver in Central America

E. Spillway construction at dam site

F. Soils testing for artificial lake construction

G. Water treatment installation

H. Probing drill-hole with electric logger

I. Test drilling for village water supply in Central America

Other activities

WATER SYSTEMS providing ultra-pure water for special applications such as plating, etching and cleaning processes have been designed for numerous industrial clients The re-use of cooling water and other methods of water conservation recommended by the company have resulted in reduced water costs Investigations to increase the efficiency of treatment facilities, or to modify existing equipment to increase its capacity, also have produced substantial savings for clients

CONTAMINATION OF GROUND-WATER SUPPLIES is an increasingly critical problem in both urban and industrial areas. The firm has conducted investigations to determine the sources of such contamination, along with patterns of movement and rates of flow, and this has resulted in appropriate abatement facilities and practices.

WATER TREATMENT SYSTEMS have been designed by the firm for the removal of turbidity, iron and manganese and for softening, chlorination, fluoridation and deionization of water supplies of both municipalities and private industries

GEOPHYSICAL SURVEYS are conducted to economically locate sources of ground-water or delineate mineral deposits The firm conducts electrical resistivity, seismic, electro-magnetic, gravity, magnetic-susceptibility and induced-potential surveys

NATURAL RESOURCE DEVELOPMENT and management programs for several areas in Central America have been successfully accomplished These projects involved planning, financing, staffing, construction and operational management of major base-metal properties

ARTIFICIAL RECHARGING OF AQUIFERS has been evaluated for municipalities and industries whose existing ground-water supplies have become inadequate. The firm has investigated the merits of storing treated fresh water or demineralized brackish water in natural, underground reservoirs.

LIMNOLOGICAL STUDIES have been conducted to quantify the nutrient balance for lake systems. In this connection, management guidelines have been prepared to assist governing bodies in improving the quality of their water resources and in helping to restore the ecological balance.

A TESTING LABORATORY is operated by the firm to provide complete analysis of water, waste-water, air, soils and minerals. The technical significance of chemical and biological determinations is evaluated and reported in this laboratory And the detection and identification of iron bacteria and sulfate-reducing bacteria is one of the many special services which are made possible through maintenance of this facility

001046

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Geraghty & Miller, Inc.

Experience

SELECTED PROJECTS FOR PRIVATE INDUSTRIAL CLIENTS AND PUBLIC AGENCIES

The Geraghty & Miller, Inc. projects listed in this Work History have been selected to demonstrate the scope of the firm's capabilities and specific skills involved in a wide variety of projects. The brief project descriptions are keyed to a skills table to assist the reader with evaluation of the firm's experience, services, and technical flexibility.

The principal skills involved for each project are "keyed" as follows:

A) Hydrogeological Investigation
B) Contamination Assessment
C) Design of Monitoring Facilities
D) Hydrogeologic Field Services Pertaining to Well Drilling
E) Knowledge of Regulations
F) Ability to Assist with Development of Local Regulatory Requirements
H) Environmental Impact Assessment
I) Procedures for Abatement of Ground-Water Contamination
J) Presentation of Testimony at Hearings and Other Legal Proceedings
K) Participation in Joint Ventures with Other Environmental Specialists
L) Integrating Waste Disposal and Water Programs
M) Sanitary Landfill Siting, Design, and Monitoring
N) Communication, Management, Planning, etc.

Industrial Projects

The following list of projects undertaken on behalf of industrial clients are located by state without reference to specific location in the interests of client-contractor ethical considerations and confidentiality agreements.

Project Description	State	Principal Skills
Investigation of ground-water potential to supply 3 million gpd for a new planned community	Connecticut	A,D
Investigation of ground-water conditions at a major industrial site	do	A,B,D,H
Investigation of the extent of ground-water contamination attributable to the discharge of industrial wastes	do	A,B,C,D, F,H,I,M
Investigation of the extent of a leachate plume originating from a town landfill, and its position relative to ground water beneath property owned by a club in order to prepare a legal testimony	Massachusetts	A,B,C,D,F, I,J,M,N
Investigation of migration of heavy metals at an industrial waste disposal site resulting from the disposal of sludge containing hazardous wastes	Vermont	A,B,C,F, H,I
Investigation of sources of contamination of an industrial well	New Jersey	A,B,C,D, H
Field investigation of oil pollution of ground water to determine whether contaminants from an industrial site are discharging to adjacent properties	do	A,B,C
Assessment of ground-water contamination due to discharges from an industrial plant, and implementation of corrective measures	do	A,B,C,D, F,I

Project Description	State	Principal Skills
Investigation of nitrate contamination of ground water	New Jersey	A,B
Development of a ground-water monitoring system at a commercial hazardous waste disposal facility	do	A,C,D
Consulting services in connection with application to the PSC for a power plant license	New York	A,C,D,F,H, J,K,L,N
Review of ground-water and recharge conditions on a 432-acre site proposed for development and presentation of expert testimony at hearing	do	A,C,F,J
Formulation of program to control ground-water contamination at site owned by industrial firm discharging hazardous wastes	do	A,B,C,D, F,H,I,M
Investigations and reports for a major manufacturing company seeking solid waste disposal permit	Pennsylvania	A,B,C,F, H
Siting of lagoons at steel plant to comply with state regulatory requirements pertaining to ground water	do	A,B,C,F
Presentation of a seminar on regulatory aspects of ground-water contamination to executives of a major industrial company	do	F,N
Determination of the extent of chloride contamination of a shallow artesian aquifer at industrial plant site	Delaware	A,B,C,D
Investigation of benzene contamination	West Virginia	A,B,H
Hydrogeologic evaluation of potential landfill sites in the vicinity of an industrial plant	Virginia	A,M

Project Description	State	Principal Skills
Feasibility study of disposal of cooling-tower blowdown water from a power plant into shallow injection wells	Florida	A,B,C
Investigation and removal of a large hydrocarbon spill from subsurface storage at airport	do	A,B,C,D, I,N
Development of ground-water supplies and preparation of permit applications for a large new development, including appearance at hearings	do	A,D,F,H, J,I
Consulting services to assist golf club ameloriate problems of excessive chlorides in irrigation wells. Assistance with obtaining permit for water use	do	A,B,I,F, J
Investigation associated with develment of a phosphate mine	do	A,F,H
Investigation to determine the impact of borrow pit excavation on ground-water quality in preparation for a zoning application	do	A,B,F,H
Design of a monitoring program for ground-water protection at a chemical plant	Georgia	A,C,F
Assessment of ground-water pollution potential from disposal of heavy metal process materials and wastes from battery production	North Carolina	A,B
Investigation of disposal site for hazardous wastes to ensure compliance with state and local requirements	do	A,B,C,F, M
Investigation of landfill disposal practices at plant sites disposing of hazardous materials	do	A,B,C,F

Project Description	State	Principal Skills
Investigation of potential for ground-water contamination arising from spray irrigation of industrial wastes	Illinois	A,B,C,D, I
Abatement of leakage of PCB-contaminated oil at a regulatory facility in the midwest	do	A,B,C,D, I,J
Evaluation of the pollution potential of a landfill receiving industrial wastes	do	A,B,M
Investigation of suspected ground-water contamination arising from disposal of heavy metal wastes	Indiana	A,B
Investigation of possible effects of proposed industrial development on local ground-water system	Ohio	A,H
Study of availability of ground water at a large industrial site	do	A
Design and installation of ground-water monitor well system for five impoundments at chemical plant	Michigan	A,B,C

Selected Projects Involving Public Agencies or Municipalities

Job Description and Location	Contact/Client	Skills
Hydrogeologic evaluation of a proposed 32.7-acre municipal landfill site, Darien, Connecticut	M. Albertson Albertson, Sharp & Backus, Inc. Norwalk, Connecticut	A,D,M
Investigation of the effect of landfill leachate on ground water, Weston, Connecticut	D. Strassler Selectman's Office Weston, Connecticut	A,B,J
Feasibility study of land disposal of sewage plant effluent through sand filtration, Bourne, Massachusetts	Roy Long Anderson & Nichols Co., Inc. Boston, Massachusetts	A,D,K,L
Development of solid waste management plan, Southborough, Massachusetts	do	A,K,L
Assessment of land disposal of wastes involving hydrogeologic investigation of 20 sites to determine the impact of landfills on ground-water quality, Gloucester and Camden Counties, New Jersey	T. Goodrich U. S. EPA Office of Solid Waste Management Programs Washington, D. C.	A,B,C,D,H
Evaluation of the potential hydrogeologic impact of development on a 35-acre tract to assist with zoning decision, Millburn, New Jersey	J. Helbe Millburn Engineering Department Millburn, New Jersey	A,H,N
Investigation of a 7,000-gallon PCB discharge in Old Bridge, New Jersey, near the well field serving Perth Amboy. PCB concentrations in the soil, and rates of movement into deep soils and ground water are being measured in order to evaluate abatement procedures	Karl Birns New Jersey DEP Office of Hazardous Substances Control Trenton, New Jersey	A,B,D,J
Consulting services in connection with escape of hazardous wastes at Kin Buc landfill, Middlesex County, New Jersey	do	A,B,D,I

001054

Selected Projects Involving Public Agencies or Municipalities (Cont'd.)

Job Description and Location	Contact/Client	Skills
Evaluation of ground-water conditions. Design and installation of monitoring well system for sanitary landfill, Port Washington, New York	Felix Andrews, Commissioner Department of Public Works Town of North Hempstead Manhasset, New York	A,B,D,M
Ground-water contamination study and monitoring at Croton Point landfill to comply with landfill closure order, Croton, New York	Peter Eschweiler Director of Planning Westchester County White Plains, New York	A,B,C,D, H,I,K,M
Ground-water aspects associated with the development of a comprehensive quality management plan for the lower and central Susquehanna River Basin, Pennsylvania	Carlyle Westlund, Chief Ground Water Section Pennsylvania DER Harrisburg, Pennsylvania	A,N
Review of proposed water injection system for seasonal storage of surplus water in Norfolk, Virginia	Lawrence Benader Gannett Fleming Corddry & Carpenter, Inc. Harrisburg, Pennsylvania	A,E
Study of availability and quality of ground water to serve the City of Virginia Beach, Virginia	R. L. Green, P.E. Wiley & Wilson, Inc. Lynchburg, Virginia	A,N
Hydrogeologic tasks associated with the development of a municipal landfill for Bowie, Maryland	R. Leach EMCON Corp. San Jose, California	A,D,M
Development of a deep well injection system to receive treated municipal wastes, including design of test well and construction of system of permanent wells, City of West Palm Beach, Florida	J. H. Weaver Robert & Company Associates West Palm Beach, Florida	A,C,D,E, F,L,N
Investigation of four potential new landfill sites including monitoring systems. Two sites selected for development, St. Lucie County, Florida	Andrew Helseth County Engineer St. Lucie County Ft. Pierce, Florida	A,F,M

Selected Projects Involving Public Agencies or Municipalities (Cont'd.)

Job Description and Location	Contact/Client	Skills
Assessment of the effects of sand mining and assistance with the development of sand mining permit requirements, St. Lucie County, Florida	St. Lucie County Board of Water Commissioners Ft. Pierce, Florida	A,H,N
Investigation of a landfill which had received large quantities of PCB-contaminated wastes, in order to determine steps required to prevent the contaminants from degrading ground-water quality and the waters of a nearby stream	Charles Stratton Environmental Science and Engineering, Inc. Gainesville, Florida	A,B,K,M

001056

NATIONAL STUDIES

Report to Congress - Waste Disposal Practices and Their Effects on Ground Water (EPA-570/9-77-001)

In 1976, Geraghty & Miller, Inc. completed a two-year study of the impact of waste disposal practices on ground water in the United States. This investigation, on behalf of the U. S. Environmental Protection Agency, fulfilled the requirement of Section 1442(a)(4) of the Safe Drinking Water Act which directed the Administrator of EPA to conduct a survey of (a) "disposal of waste (including residential waste) which may endanger underground water which supplies, or can reasonably be expected to supply, any public water systems," and (b) "means of control of such waste disposal."

Completion of the 531-page report required a thorough understanding of national hydrologic conditions; industrial, agricultural, and community waste management practices; and technological options available for protection of ground water from the adverse affect of man's activities on land. Of particular importance was the firm's ability to design and manage the study by drawing upon the talents of experts within the Geraghty & Miller, Inc. staff, together with contributions from individuals known to the firm whose skills were considered valuable to successful completion of the investigation. Sections of the report reviewed existing Federal

legislation and state and local alternatives for ground-water quality protection.

Client: U. S. Environmental Protection Agency
Office of Solid Waste Management
Washington, D. C. 20460

Development of a Data Base for Determining the Prevalence of Migration of Hazardous Chemical Substances into the Ground Water at Industrial Land Disposal Sites

The fundamental objective of this investigation was to establish whether or not industrial hazardous wastes contained in land disposal sites are contaminating ground water. To meet the project site selection criteria, 727 facilities were inventoried in 41 states, and regulatory agency files were examined in 23 states. From this data base, 122 sites were selected for field inspection, the purpose of which was to determine geologic and hydrologic conditions, facility design and operation, and availability of monitoring wells. This project was subjected to particularly rigorous criteria in order to document cases of previously unsuspected contamination, obtain representative water samples from affected aquifers and to document migration of the contaminated ground water. Successful completion of the project was heavily dependent upon the firm's ability to work with local and state regulatory departments in order to select sites and gain access to private property, and to protect the confiden-

tial nature of much of the information obtained.

The firm was responsible for interpretation of results of analytical tests for 30 constituents run on a total of 172 ground-water samples taken from representative sites. It was necessary to carry out site selection and hydrogeologic field services at 19 sites. The original contract specified that 75 industrial waste land-disposal sites would be investigated. Due to enactment of the Resource Conservation and Recovery Act of 1976 (PL 94-580), the contract was amended to limit the number of sites to 50 in order to allow the consultant to develop support documents for monitoring regulations required by this Act.

The second section of the study explains techniques for monitoring ground water at hazardous waste management facilities, and reviews state laws and regulations providing for hazardous waste monitoring programs. Hazardous waste management plans being developed in 10 selected states, which have progressive policies relative to ground-water protection, were analyzed. These states represent the broad range of geologic and hydrologic environments in the United States.

Client: U. S. Environmental Protection Agency
Hazardous Waste Management Division
Washington, D. C. 20460

Site Location and Water Quality Protective Requirements for Hazardous Waste Management Facilities

This study by Geraghty & Miller, Inc., was undertaken to assist EPA in evaluating alternative regulatory methods for establishing performance standards for hazardous waste management facilities, at both on-site and off-site locations. Essentially, the objectives of the study were to (1) compile a list of potential technical regulatory alternatives, and (2) assess the effectiveness and applicability of these alternatives in terms of water-quality protection, implementation requirements, manpower requirements, effects on existing regulatory programs, and cost. The three areas of regulatory alternatives examined in most detail were site location criteria, water-quality criteria, and process methodology.

An in-depth evaluation of existing Federal, state, and foreign laws, regulations, and guidelines was undertaken by the consultant as a prerequisite for the development of a set of regulatory alternatives for facilities. Early in the investigation it became apparent that the states were having particular difficulty in aligning their existing requirements with those of the Resource Conservation and Recovery Act. This was because at least 25 states already had laws, regulations or other requirements for hazardous waste manage-

ment facilities.

Performance of this contract was heavily dependent upon the consultant's understanding of the relationships between the Resource Conservation and Recovery Act and other Federal and state legislation, and the ability to interpret these requirements as they would affect ground-water management from the point of view of both developing the resource and protecting its quality.

Client: U. S. Environmental Protection Agency
Hazardous Waste Management Division
Washington, D. C. 20460

Study to Determine the Nature and Extent of the Impact of Industrial and Municipal Surface Impoundments on Underground Drinking Water Sources

Geraghty & Miller, Inc. has completed an investigation of the occurrence of surface impoundments and their impact upon ground water, to fulfill the requirement of Section 1443(a)(8) of the Safe Drinking Water Act which instructed the Administrator of EPA to "...carry out a study of the nature and extent of the impact on underground water of... (c) ponds, pools, lagoons, pits, or other surface disposal of contaminants in underground water recharge areas..."

This project involved the inventorying of a total of 100,000 sites containing one or more surface impoundments.

Industrial facilities surveyed were classified according to approximately 25 selected major Standard Industrial Classification groups, and the municipal facilities according to population ranges. The impoundments are described by characteristics such as natural (sinkholes) or man-made, presence or absence of linings, and by use. It was also necessary to describe the inorganic and organic substances and the kinds of pathogenic and non-pathogenic organisms being disposed of in surface impoundments.

The data were used to determine the impact on ground-water quality; to develop a rating system to show relative vulnerability of the hydrogeologic environments to threats of contamination from impoundments in each of the states; and to develop a parallel rating system to show to what extent ground-water systems are being contaminated. In addition, the consultant was required to determine to what extent surface impoundments presently are subject to control in each state, a task which required visits to a number of key states whose regulatory control of the facilities is considered to include outstanding features. Finally, a number of alternatives were developed to ameliorate the impact upon ground water attributable to the facilities surveyed.

Client: U. S. Environmental Protection Agency
Office of Water Supply
Washington, D. C. 20460

REGIONAL STUDIES

Ground-Water Contamination in the Northeast States (EPA-660/2-74-056)

This study evaluated the principal sources of ground-water contamination in 11 northeast states: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The findings of the study have been used to determine priorities for research into ways of correcting existing sources of contamination, and to point out deficiencies in present control methods for protection against further degradation of ground-water quality. The project included determination of the present and future use of ground water in the study region, and detailed description of the hydrogeology of each state studied, together with evaluation of existing water quality and contraints upon future uses.

Client: U. S. Environmental Protection Agency
Office of Research and Development
Washington, D. C. 20460

Ground-Water Pollution Problems in the Northwestern United States (EPA-660/3-75-018)

Geraghty & Miller, Inc. surveyed and documented contamination problems in the six states in the northwest: Colorado, Idaho, Montana, Oregon, Washington, and Wyoming. The

project included descriptions of the hydrogeologic environments in each state, as well as determination of baseline ground-water quality conditions and investigation of sources of ground-water contamination. Specific needs for ground-water management were assessed, and research and control priorities were assigned to the various sources of ground-water contamination.

Client: U. S. Environmental Protection Agency
National Environmental Research Center
Office of Research and Development
Corvallis, Oregon 97330

Ground-Water Pollution Problems in the Southeastern United States (EPA-600/3-77-012)

Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Virginia were the states studied by Geraghty & Miller, Inc. in this investigation. Basically, this investigation followed the outline already established for the other two regional studies completed by the firm. In this region ground water supplies 46 percent of the total water supply. At least 90 percent of the population of Florida and Mississippi is dependent upon ground water for drinking water supplies.

Client: U. S. Environmental Protection Agency
Office of Research and Development
Ada, Oklahoma 74820

Preliminary Evaluation of Injection Well Practices

Over a 10-week period, Geraghty & Miller, Inc. undertook an intensive study of 22 injection-well practices in the United States that will be regulated to one degree or another through Subparts C and E of the Safe Drinking Water Act. The objectives of the study were to describe each of the practices, identify state and Federal regulations governing the practices, and to point out how regulations proposed by EPA would or would not create administrative and technical problems.

Client: U. S. Environmental Protection Agency
Office of Water Supply
Washington, D. C. 20460

Ground-Water Management Study of the Pinellas-Anclote and Northwest Hillsborough River Basins for the Southwest Florida Water Management District

Geraghty & Miller, Inc. has completed an investigation to quantify all of the geologic and hydrologic elements that constitute the water resources system of two large river basins in west-central Florida. The results of the study provided the Southwest Florida Water Management District with guidelines on how to manage ground water within the region to best comply with economic, social, and political constraints. The study included a complete technical description of the two basins and an assessment of the effects of

various water management options on both the ground-water system and the vegetative communities. A principal objective of the investigation was to describe the interrelationship between ground water and surface water, and to identify water management techniques required to protect a complex hydrologic system.

Client: Southwest Florida Water Management District
P. O. Box 457
Brooksville, Florida 33512

Ground-Water Aspects of the New Jersey Water Plan

Geraghty & Miller, Inc. is presently participating with other consulting organizations in the development of a water supply master plan for New Jersey. The prime objective of this firm's activities is to formulate the ground-water management aspects of such a plan, taking into account the impact on surface-water sources and the constraints imposed by social, economic, technological, legal, and institutional considerations.

Particular attention is being paid to existing management alternatives and conservation plans in the state so that, wherever possible, minimal changes would be necessary in adopting new guidelines. This would include state designated critical aquifers and areas; the well and diversion permit systems; and controls on potentially polluting indus-

tries, landfills, and other sources of ground-water contamination.

Client: New Jersey Statewide Water Supply Master Plan
Havens and Emerson, Limited
Brook-Mayhill Building
299 Market Street
Saddle Brook, New Jersey 07662

Section 208 Areawide Waste Treatment Planning Studies

Geraghty & Miller, Inc. has been involved in four Federally funded 208 waste treatment management studies; two in New York State (Westchester County and Nassau-Suffolk Counties) and two in New Jersey (Middlesex County and Mercer, Camden, Burlington, and Gloucester Counties). Each of these studies has been tailored to fit the needs of the area under investigation.

Geraghty & Miller, Inc.'s input into the Nassau-Suffolk 208 project was to achieve a detailed understanding of Long Island's water resources and to identify ground-water quality and quantity constraints. The program emphasized an evaluation of waste-water management options under consideration by the 208 Technical Advisory Committee. This evaluation involved indentification of significant ground-water pollution sources and considered their relationships to the overall hydrogeologic regime. The investigation summarized significant management concepts presently implemented, or

proposed, with emphasis on the relationship between hydrogeology and land use.

Client: Nassau-Suffolk Regional Planning Board
H. Lee Dennison Building
Veterans Memorial Highway
Hauppauge, New York 11787

MANUALS

Planners' Handbook for Residual Waste Management

Geraghty & Miller, Inc. was a major contributor to this manual, prepared by the U. S. Environmental Protection Agency, designed to assist planners in developing programs for the effective and environmentally sound management of residual wastes, principally sludges from municipal, industrial, and agricultural waste treatment practices. The handbook is a compilation of state-of-the-art knowledge and techniques for available Best Management Practices (BMP). BMP addressed by Geraghty & Miller, Inc. include ground water related aspects of landfilling, landspreading, surface impoundments, and monitoring practices.

Client: PEDCo-Environmental (on behalf of the U. S. Environmental Protection Agency)
Atkinson Square - Suite 13
Cincinnati, Ohio 45246

Procedures Manual for Ground-Water Monitoring at Solid Waste Disposal Facilities

This manual, prepared for the U. S. Environmental Protection Agency by Wehran Engineering Corp. and Geraghty & Miller, Inc., brings together in one volume information which will assist solid waste regulatory agencies in adjusting solid waste management practices to the requirements of

the Resource Conservation and Recovery Act of 1976. Although the publication was completed prior to passage of the law, its contents will assist the user in: (1) establishing the need for monitoring; (2) assigning priorities for facilities to be monitored; and (3) implementing and directing cost-effective, on-going monitoring programs responsive to the purposes and data needs established.

Client: U. S. Environmental Protection Agency
Office of Solid Waste
Washington, D. C. 20460

Impact of Land Disposal of Waste Water Residuals on Ground-Water Quality

This evaluation was prepared by Geraghty & Miller, Inc. for incorporation into a report to the National Water Commission entitled "Environmental Impact of the Disposal of Waste Water Residuals." The firm's contribution defined the potential effects of land disposal of sludge and effluent based upon considerations of geology, hydrology, site and waste characteristics, and waste disposal practices.

Client: Environmental Quality Systems, Inc. (on behalf of the National Commission on Water Quality)
6110 Executive Blvd.
Rockville, Maryland 20852

Henningson, Durham & Richardson, Inc.

Experience

STATEMENT OF EXPERIENCE

General

Henningson, Durham and Richardson has been involved in the planning for and the design of environmental facilities since the founding of the company in 1917. Prior to the late 1960's, most of the environmental work involved the design of facilities for the collection, treatment, storage and distribution of water or the collection and treatment of wastewater. This activity remains a major area of HDR work. The firm now offers a total in-house capability with more than 800 personnel including transportation and transit planners and engineers; architects; civil, structural, mechanical, electrical and environmental engineers; energy management specialists; ecological and safety scientists, system analysts; interior designers; estimators; equipment specialists and other support personnel. The firm's in-depth engineering capability, assisted by its design programs can effectively analyze alternate systems to provide the most value for the construction dollar.

HDR is an international engineering firm, headquartered in Omaha with twenty-two regional offices throughout the nation. Our Minneapolis office is located in the immediate study area in St. Louis Park. This office has a staff of 70 personnel with a depth of experience in municipal engineering, supported by specialists in our Omaha office. In addition, HDR has made a strong commitment to the Minnesota region by transferring experienced and capable environmental engineers to the Minneapolis office.

Technical Competence

Henningson, Durham and Richardson has been studying, designing and providing construction review for water system projects for many years. We maintain a current awareness in the state-of-the-art for all aspects of design relative to the proposed facilities. Our engineers can readily become intimately familiar with the work that has been completed by your staff and others and continue on with expeditious and exacting solutions to water system problems.

A. Hydrogeological Evaluations. HDR has completed many hydrological and geological evaluations of potential water supply sources including aquifers along the Platte and Missouri Rivers in Nebraska, Bitterroot and Clarks Fork Rivers in Montana, Mississippi and Nishnabotna Rivers in Iowa and deep well aquifers in Iowa, Maryland and Minnesota. Major hydrology studies in connection with these studies included evaluations of the Platte, Missouri, Mississippi, Patuxent, Potomac, Sabine, Yadkin, Catawba, Blackwater, Nottoway, North Platte and Big Wind Rivers. We have an outstanding capability for evaluation and design of wells.

B. Water Treatment Plants. Water treatment plants have been designed by HDR engineers in twenty-six communities since the design of the Omaha Platte River Treatment Plant in 1965. These plants range in size from 1.0 mgd to 60 mgd with varied treatment processes. Water treatability studies were satisfactorily accomplished in connection with each of the designs.

SIMILAR PROJECTS

A list of water related projects and project photographs is included in this section of the submittal; however, we wish to call special attention to a few of the more appropriate projects with expertise requirements similar to those of this project.

1. Shreveport, Louisiana -- Activated Carbon Pilot Plant

Henningson, Durham and Richardson has demonstrated its capabilities to explore and develop innovative and advanced technologies and design applications. HDR, in conjunction with the Institute of Applied Sciences at North Texas State University, has designed one of the first pilot scale water treatment plants incorporating ozone enhanced biological activated carbon systems as a part of an EPA program at Shreveport, Louisiana's, Amiss Water Treatment Plant, demonstrating treatment methods for the removal of trihalomethane precursors from drinking water. Carbon treatment is currently being proposed as a required treatment method under the National Interim Primary Drinking Water Regulations and is a possible treatment alternative for this project.

2. Omaha Metropolitan Utilities District -- Platte River Plant

HDR prides itself on its' large number of repeat clients. The Omaha Metropolitan Utilities District is one of our major clients. Work for this client began in 1954 with construction review of a 25 mg reservoir. In 1963 we completed a report entitled "Development of a New Water Supply". Work was completed on this 60 mgd Platte River Water Supply and Treatment Plant in 1968.

The treatment process at the Platte River Plant provides split treatment or calcium selective softening and includes lime to remove iron and magnanese and soften the water, potassium permangante and chlorine to assist in the removal of iron and maganese and a polyerolyte and polyphosphate to aid in removing solids and filtering the water. The plant consists of upflow basins, filters, clearwell, high service pumps and drives. Heat recovery systems on gas engine exhausts generate steam used in the plant heating and dehumidifying equipment. The control panel permits one man to operate the plant, but at least two men are on duty at all times for safety and security.

A Water System Master Plan was completed in 1972, which developed a water supply and distribution system plan to meet all probable demands for water system over a period of twenty-five years. The planned system is functional, dependable, meets with customer satisfaction and its cost was minimized. The report provides a description of the proposed system, a schedule showing the priority of improvements and cost of plan implementation.

Since completion of the report, many miles of water distribution system piping have been constructed in accordance with the master plan by MUD staff and others. HDR has designed a roof structure and lining of a 20 mg reservoir and a 40 mgd booster pump station. We have also designed and construction is complete of a 25 mg buried concrete ground storage reservoir. HDR was responsible for the total project effort for their projects including preliminary report, predesign report, design and construction administration.

3. Westminster, Colorado -- Semper Plant

HDR has done virtually all water works engineering for the City of Westminster for the past fifteen years. Westminster is a rapidly growing city on the northwest side of Denver with a current population of approximately 30,000.

HDR has been responsible as the prime consultant to Westminster for all planning, detailed design and construction administration/inspection for the 20 mgd Semper Water Treatment Plant. The facility provides treatment to a surface water supply from Clear Creek. The original plant was constructed in 1969 with a capacity of 6 mgd and then in 1973 it was expanded to 12 mgd. Additional improvements were constructed to increase the hydraulic capacity and finally they are in the final steps of construction that brings the capacity to 20 mgd. In this most recent project, the sedimentation basins were converted to high rate shallow depth sedimentation utilizing tube settlers, the basins were covered and a solar heat installation was included to heat the building.

4. HDR Minneapolis Water Plant Design

HDR purchased the Minneapolis based firm of Pfeifer and Shultz, Inc., in 1976. Pfeifer and Shultz had been providing Minnesota communities with environmental engineering services since its founding in 1944. The firm has in recent years designed eight water treatment plants having capacities of from 1 mgd to 3 mgd and having both gravity and pressure filter systems. Some of the cities served by these plants are Worthington, Marshall, Windom, Tracy and Luverne. Key people who were involved in these projects are available for this project.

5. Wastewater Disposal

The consultant for this project must have experience in evaluating wastewater disposal alternatives. HDR has a proven record of performance in the planning and design of over 275 wastewater treatment facilities in nearly twenty states, and work in wastewater for more than twenty-five Minnesota municipalities. All of these projects have required determination of disposal for liquid and solid wastes.

HDR also has experience in projects for the Metropolitan Waste Control Commission. An ongoing Segment II Study, initiated during 1978 and scheduled for completion during 1980, is to determine wastewater management alternatives and solutions for those parts of Washington and Dakota Counties which comprise MWCC designated Service Area 6. The Metropolitan Council projects a Year 2000 population of 305,150 for the study area. Included within the planning area are currently eight MWCC owned and operated treatment facilities. HDR has been selected to implement recommendations to upgrade the MWCC treatment facility located at Hastings.

1974
Westminster, Colorado -- 12 mgd (expandable to 24 mgd) water treatment plant expansion.

1974
Georgetown, South Carolina -- 6 mgd (expandable to 24 mgd) water treatment plant, design and supervision.

1975
Norman, Oklahoma -- 14 mgd water treatment plant enlargement.

1975
Dubuque, Iowa -- 12 mgd (expandable to 24 mgd) water treatment plant design.

1975
Lewisville, Texas -- 6 mgd (expandable to 12 mgd) plant and raw water pump design and supervision.

1977
Longview, Texas -- 8 mgd water treatment plant.

1978
Douglas, Wyoming -- 2.5 mgd water treatment plant.

1978
Riverton, Wyoming -- 4 mgd water treatment plant.

1978 Suffolk, Virginia -- 3 mgd water treatment plant.

1979
Yuma, Arizona -- 8 mgd water treatment plant expansion.

1979
Lewisville, Texas -- 6 mgd water treatment plant expansion (under design).

WATER TREATMENT PLANTS

1958

Nebraska City, Nebraska -- 3 mgd water treatment plant, design and supervision.

1964

Sulphur Springs, Texas -- 3 mgd water treatment plant, design and supervision.

1964

Blanding, Utah -- 1.25 mgd (expandable to 3 mgd) water treatment plant.

1967

Rio de Janeiro, Brazil -- 210 mgd Guanabara Water Project (reviewed design for Inter-American Development Bank).

1968

Omaha, Nebraska -- 60 mgd (80 mgd hydraulically) water treatment plant.

1968

Borger, Texas -- 5 mgd water treatment plant, design and supervision.

1969

Taegue, Korea -- 24 mgd (expandable to 48 mgd) water treatment plant, design and supervision.

1969

Grand Junction, Colorado -- 16 mgd (expandable to 24 mgd) water treatment plant; report, design and supervision.

1970

Westminster, Colorado -- 6 mgd water treatment plant; report, design and supervision.

1971

Texarkana, Texas -- 12 mgd water treatment plant, design and supervision.

1971

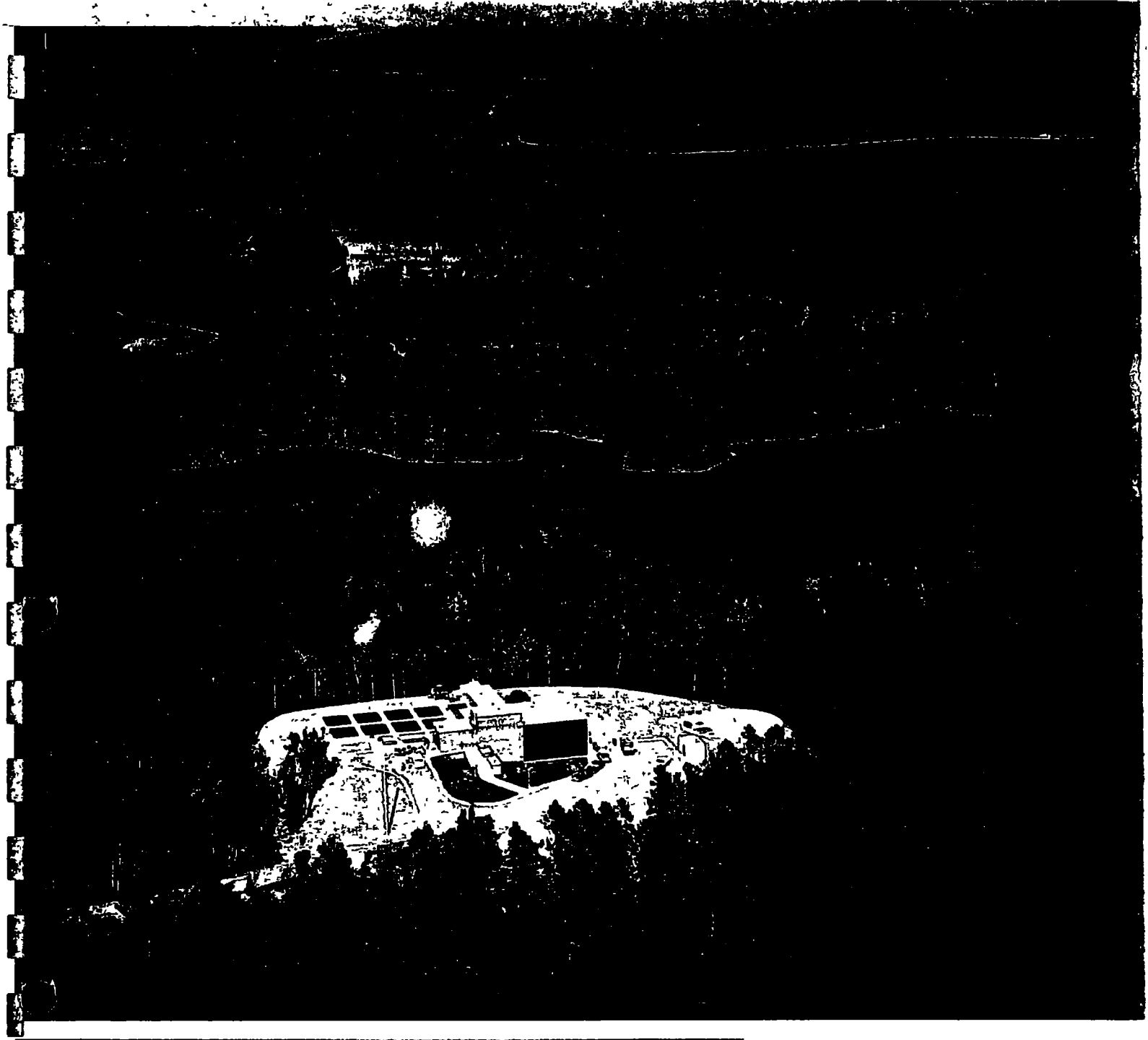
Anson County, North Carolina -- 4 mgd water treatment plant, design and supervision.

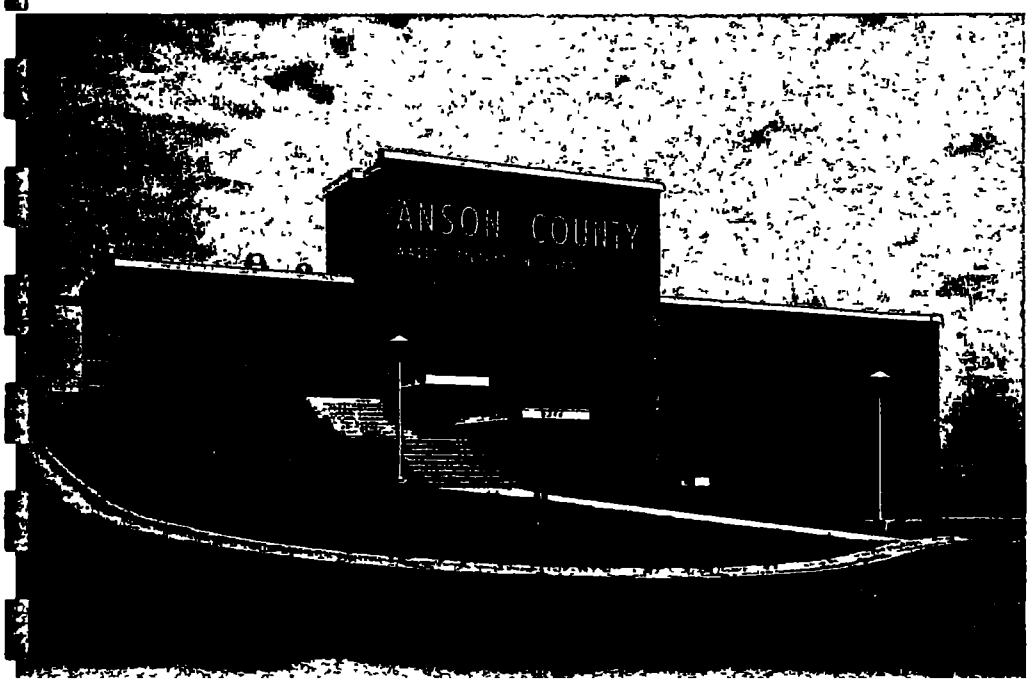
1971

Nebraska City, Nebraska -- 3 mgd water treatment plant expansion, design and supervision.

1974

Thornton, Colorado -- 20 mgd (expandable to 60 mgd) water treatment plant, design and supervision.



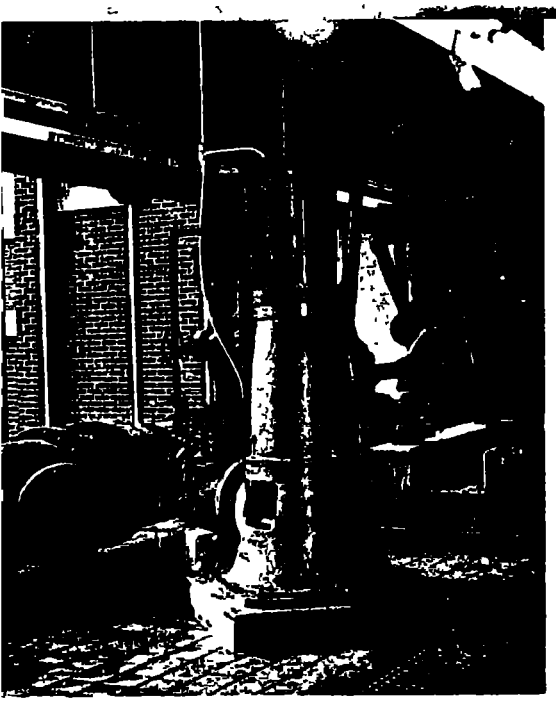


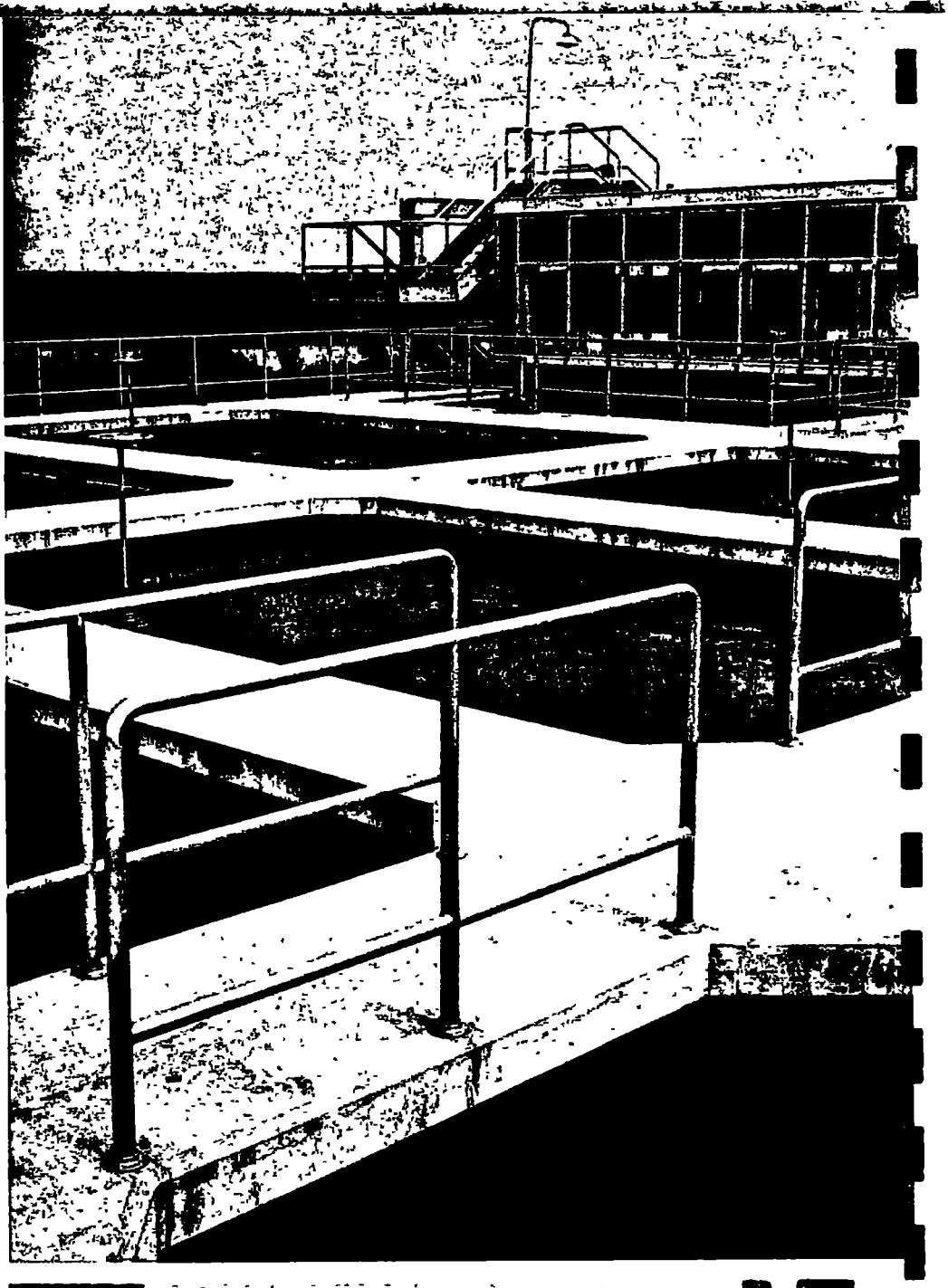
Water Treatment Plant

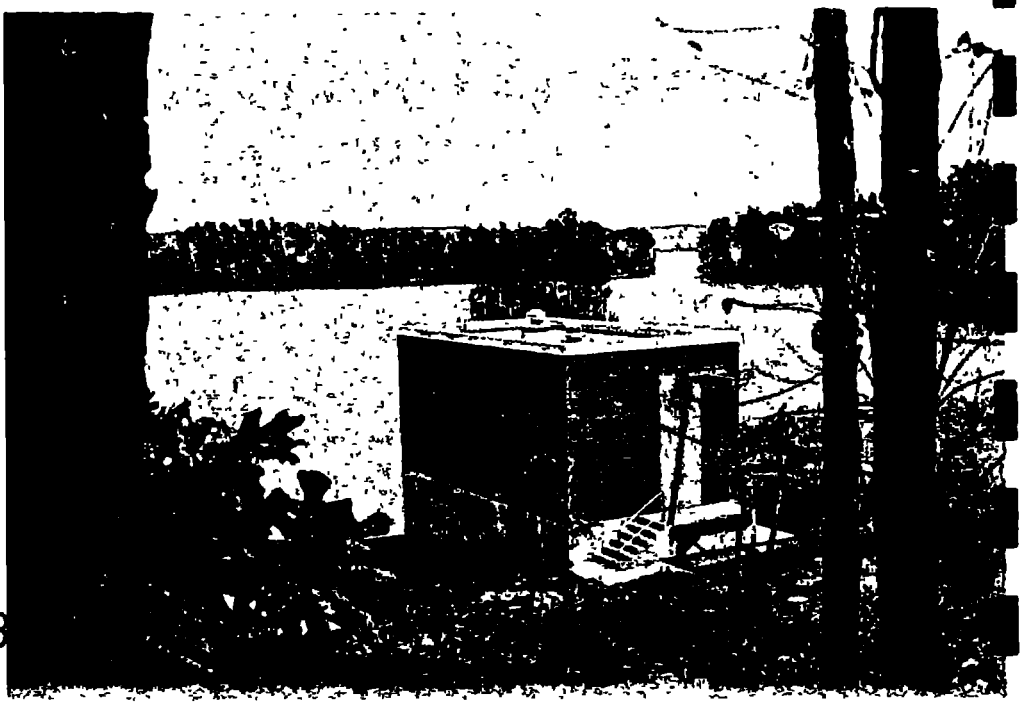
Anson County, North Carolina

A preliminary design report for Anson County, North Carolina, led to the final design and construction of the water treatment plant. With the plant's completion, Anson County became the first county government in the Carolinas to go into the water business on a county-wide basis.

001077



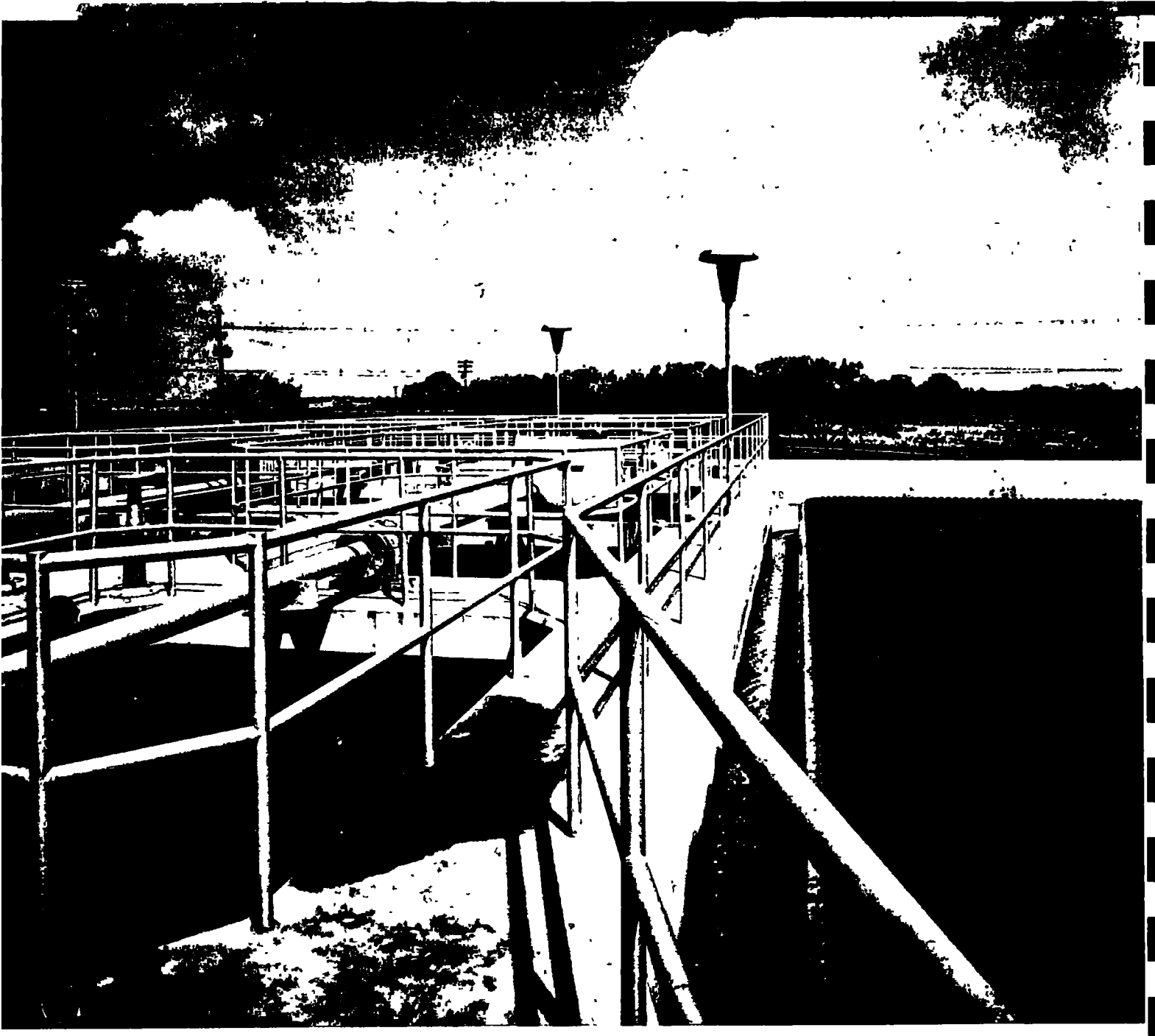




Water Treatment Plant

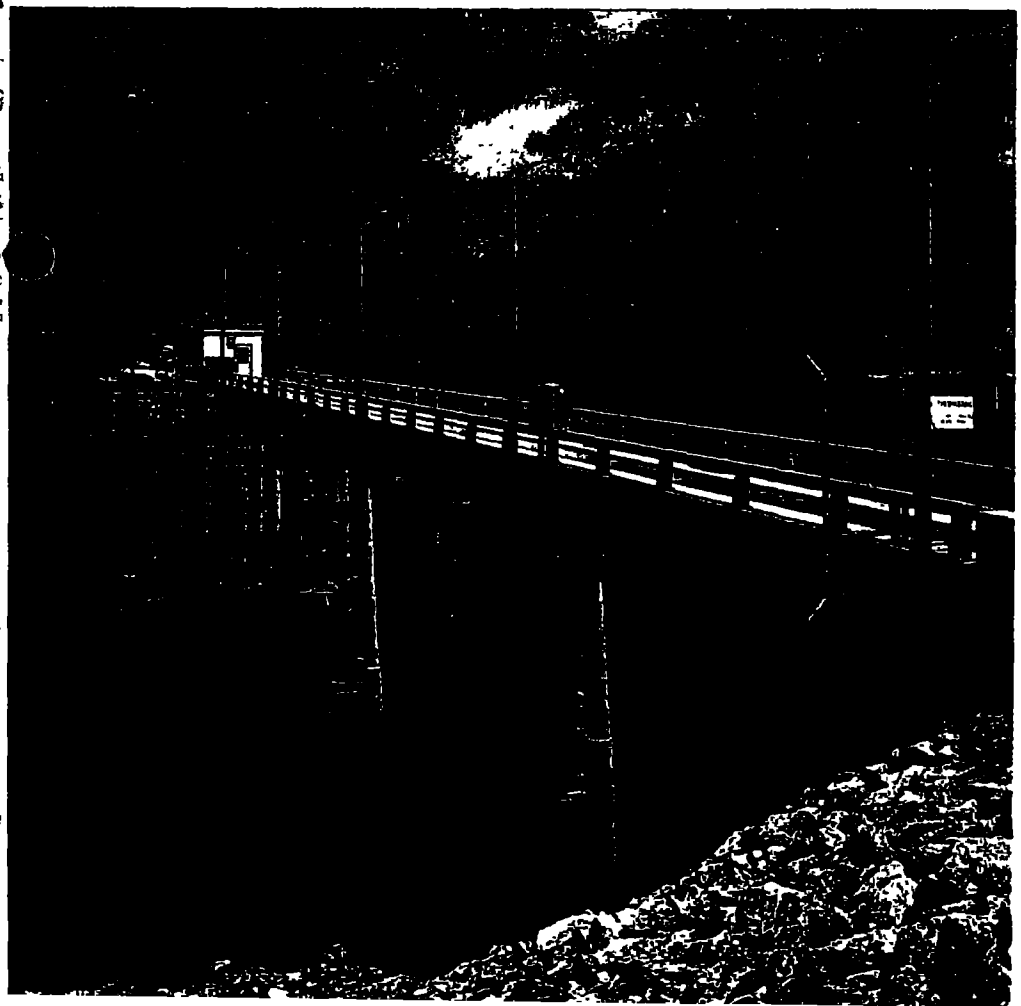
The facility includes a filter control gallery, a sedimentation tank with filters, a raw water intake pump station, high service pumps and a standby engine. Capacity of the new plant is 4,000,000 gallons per day. A distribution system to serve communities throughout the county also was built. It includes 70 miles of 8-inch through 24-inch water lines.

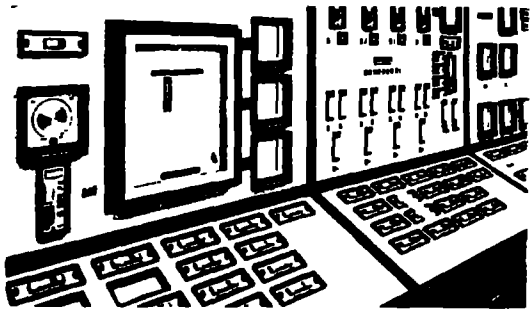
001078



Water Treatment Plant

Studies performed indicated that it would be more feasible for the city to own and operate its own water system than to build the many miles of pipeline necessary to tie into other existing systems. Of primary concern was a new source of raw water to replace the existing deep well systems Lake Lewisville lies adjacent to the city but the water rights are owned by the city of Dallas. The two cities entered into a contract which allows the city of Lewisville to purchase raw water from the lake. With present ground water levels receding, the dependable supply will enable Lewisville to serve major industry as well as the adjacent city of Highland Village.





Water Treatment Plant

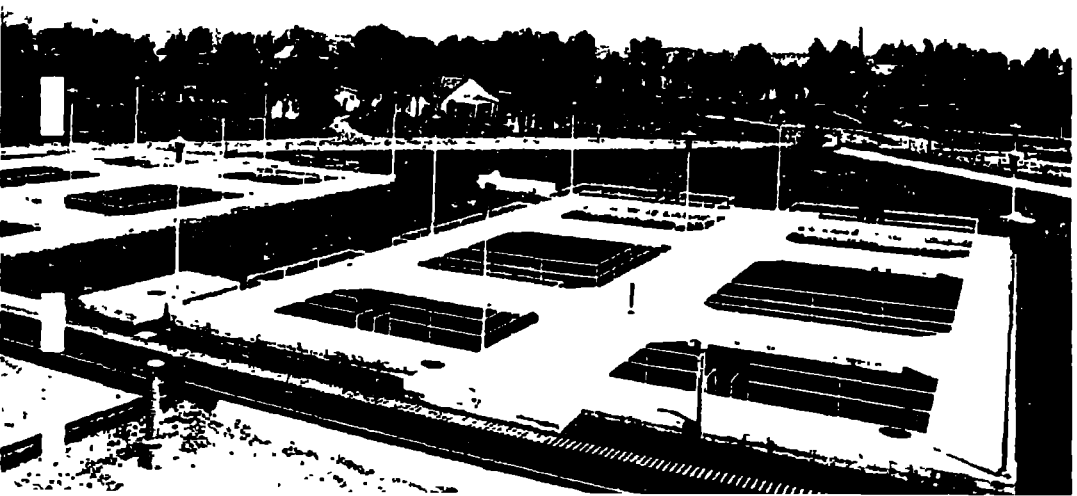
Lewisville, Texas

The City of Lewisville's first water treatment plant on Lake Lewisville provides the area with its first raw surface water supply Its planned capacity is six million gallons per day In addition to the plant, the facility includes a raw water intake structure and pumping station, two ground storage tanks and high service pumping facilities Also incorporated are raw water intake transmission mains and treated water transmission mains for distribution to various parts of the city.

(115)7 479

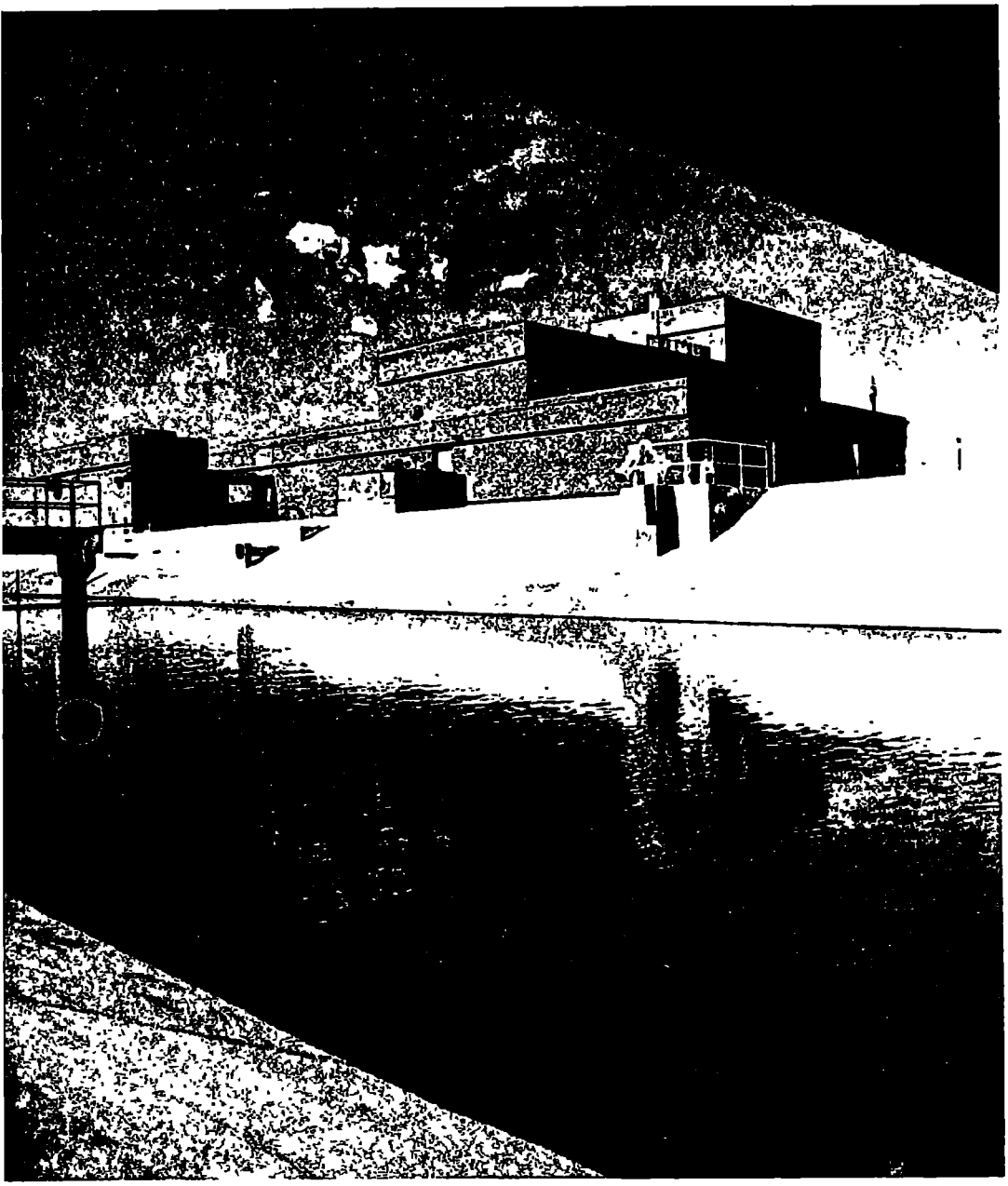
Water Treatment Plant

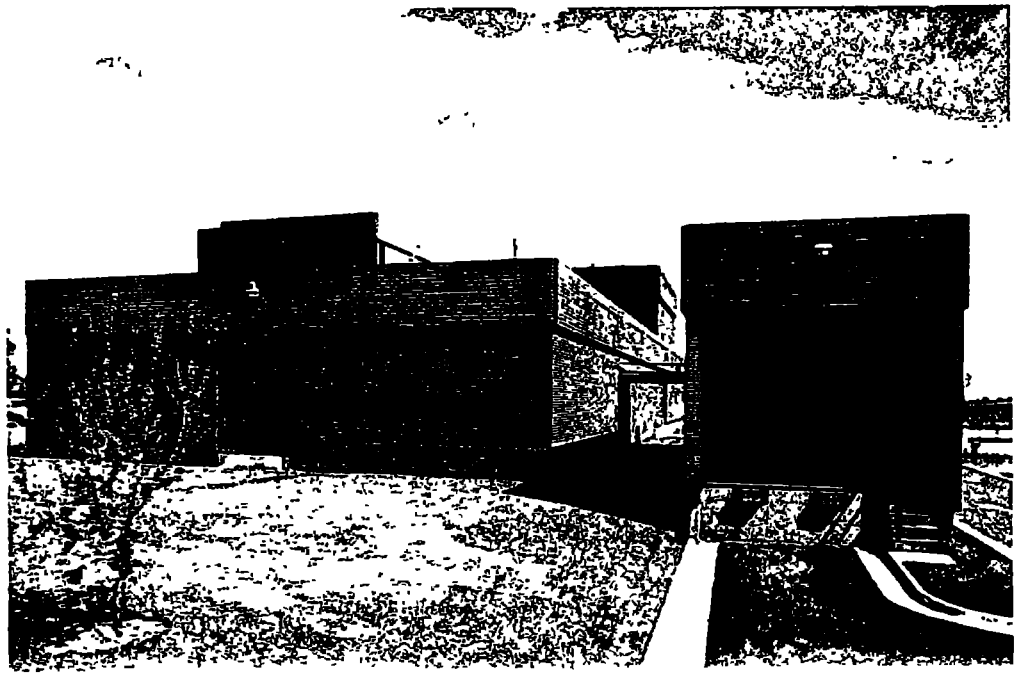
Westminster, Colorado



With a capacity of 12 mgd, the facility includes micro-screening of raw water, chemical treatment, flash mixing, sedimentation, gravity filters and high service pumping. The design includes provisions for expansion to 24 mgd with 150 per cent hydraulic capacity.

We originally designed the plant as a 6 mgd facility while planning the expansion for the growing community.



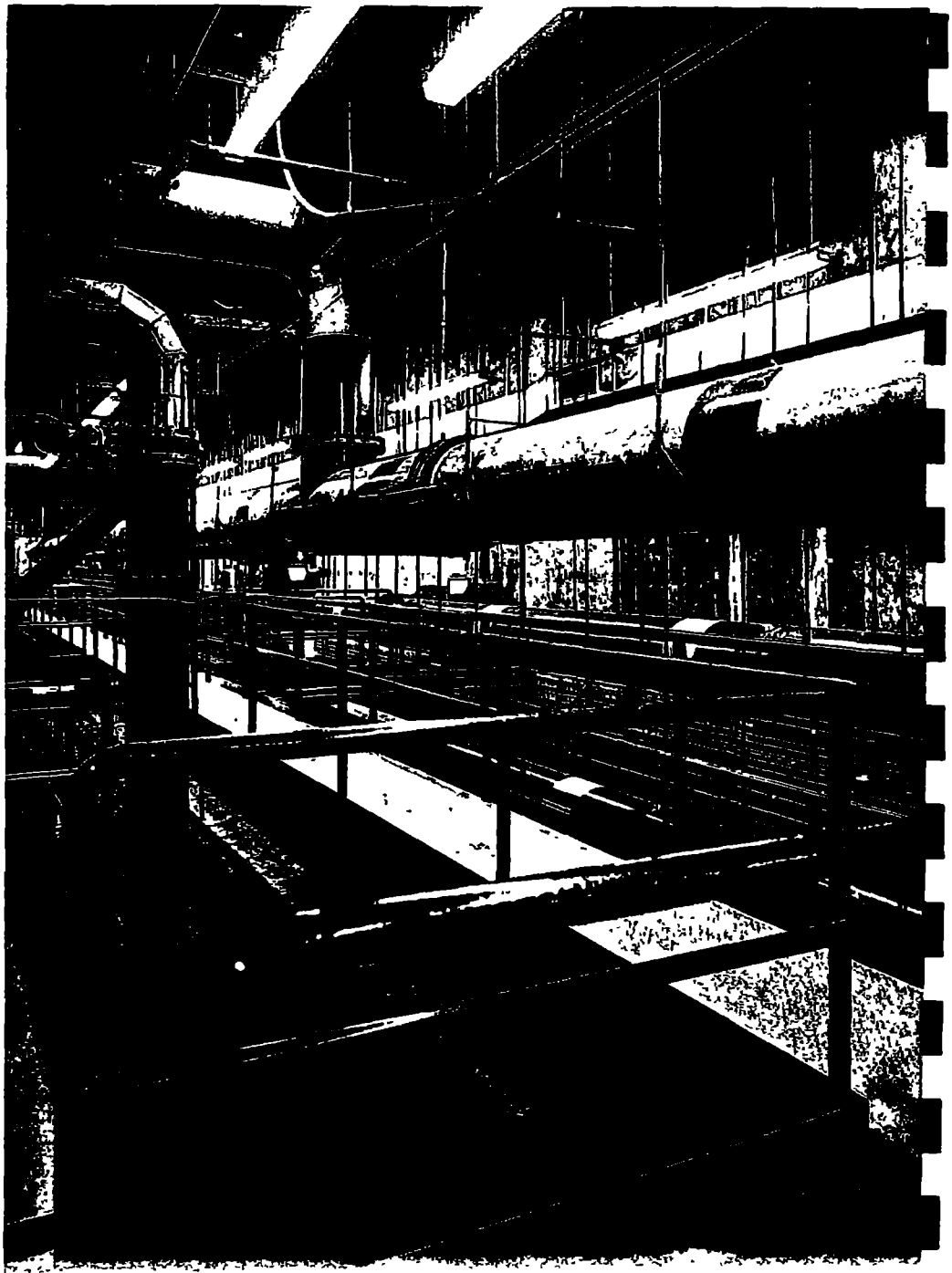


Water Treatment Plant

Westminster, Colorado

Lagoons provide for reclamation and recycling of waste backwash water from the filters. Dual sand-anthracite high-rate filters were used. Laboratory facilities for chemical and bacteriological analysis are used to maintain waste quality control.

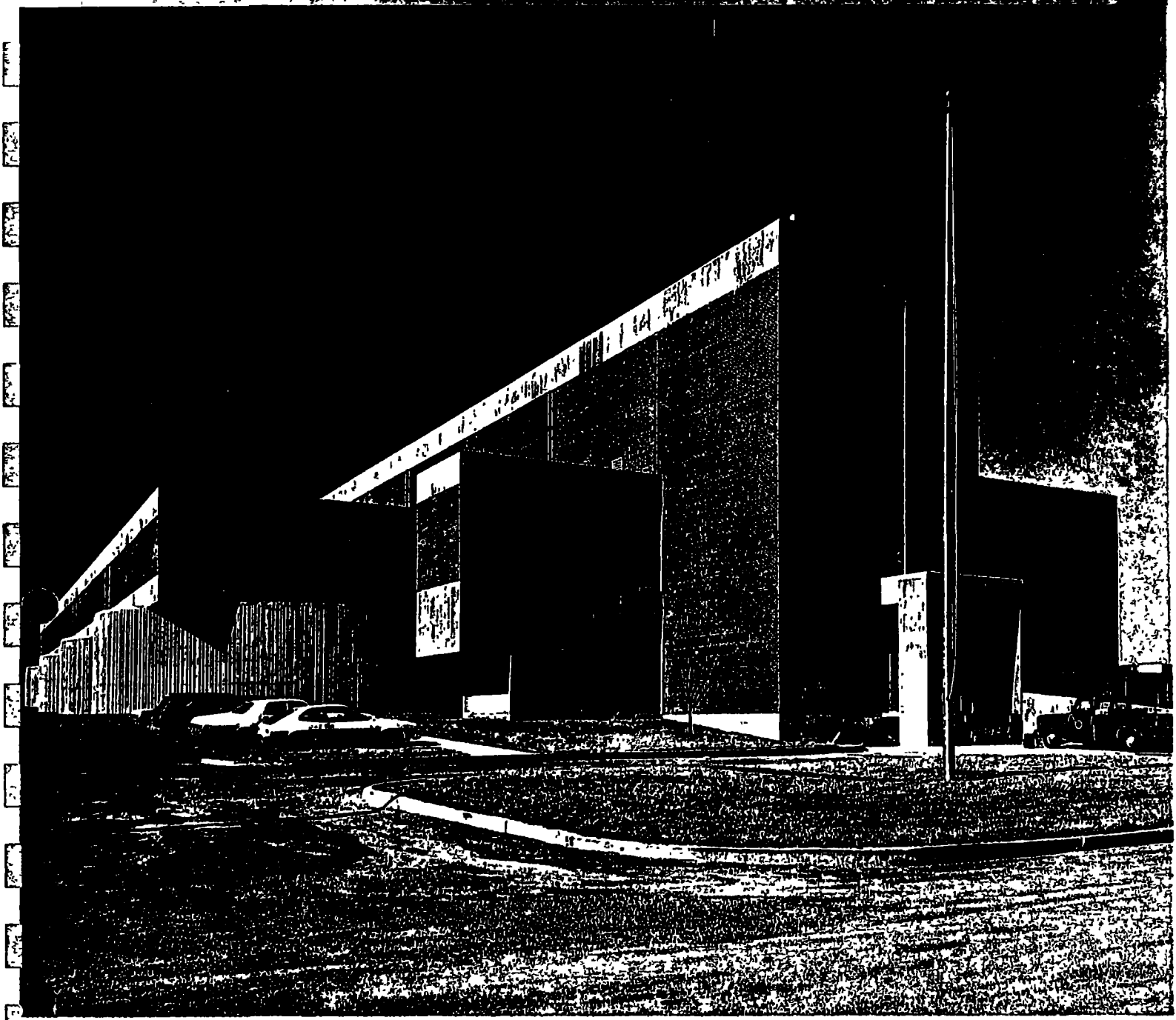
001082

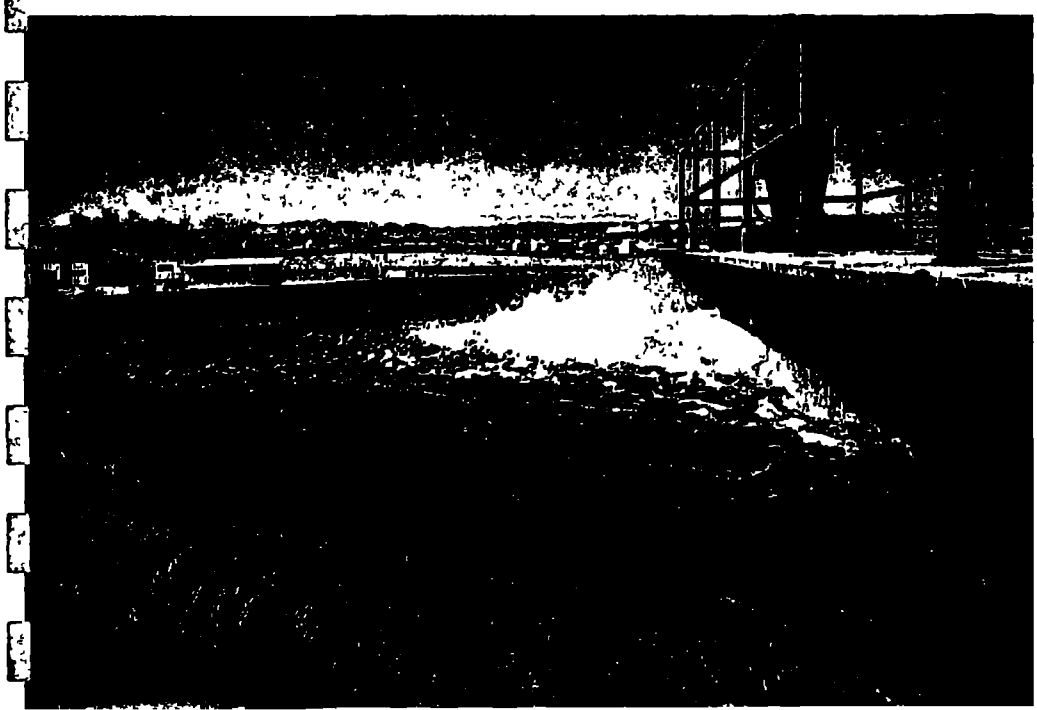


Water Treatment Plant

A raw water pumping station with four high service pumps and water mains were also elements of the overall project. The facility's water analysis laboratory continuously monitors and controls water quality

Spent chemical sludge and backwash water are piped to two lagoons on the site where solids settle out The water is then drawn off and returned to the premix basin for reclamation. Accumulated sludge is periodically removed for disposal.





Water Treatment Plant

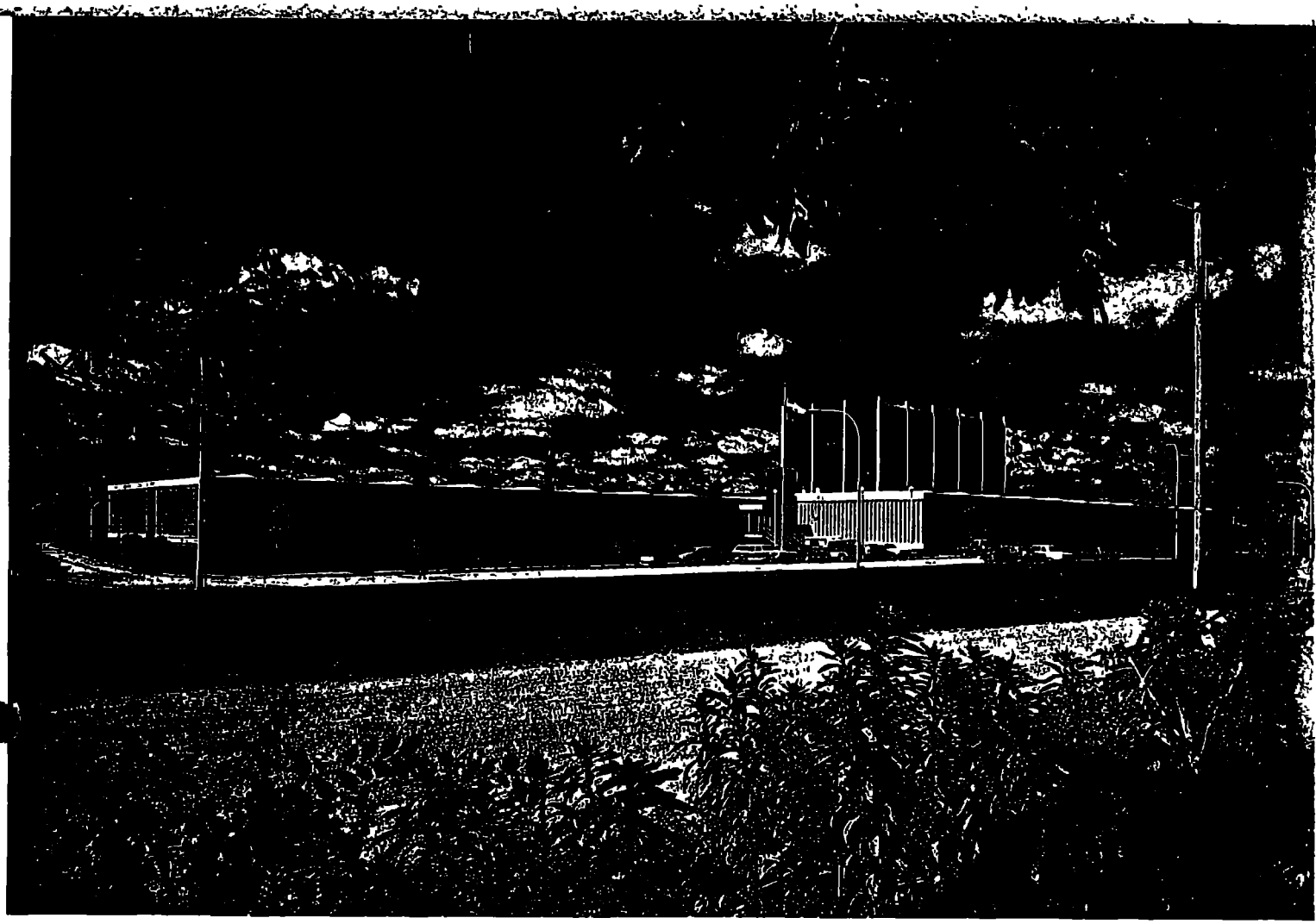
Thornton, Colorado

001084

The Columbine Water Treatment Plant is one of the few lime-soda softening plants in the Rocky Mountain area The 20 mgd plant treats both surface water and hard ground water from wells. Plant design incorporated provisions for future expansion to double treatment capacity

The plant's layout is modular in that each of the four upflow clarifiers and its accompanying pair of gravity filters constitute a complete treatment unit Operation can be reduced to one unit to maintain an efficient rate of flow during periods of low plant demand or routine maintenance and repair

(115)4 1179

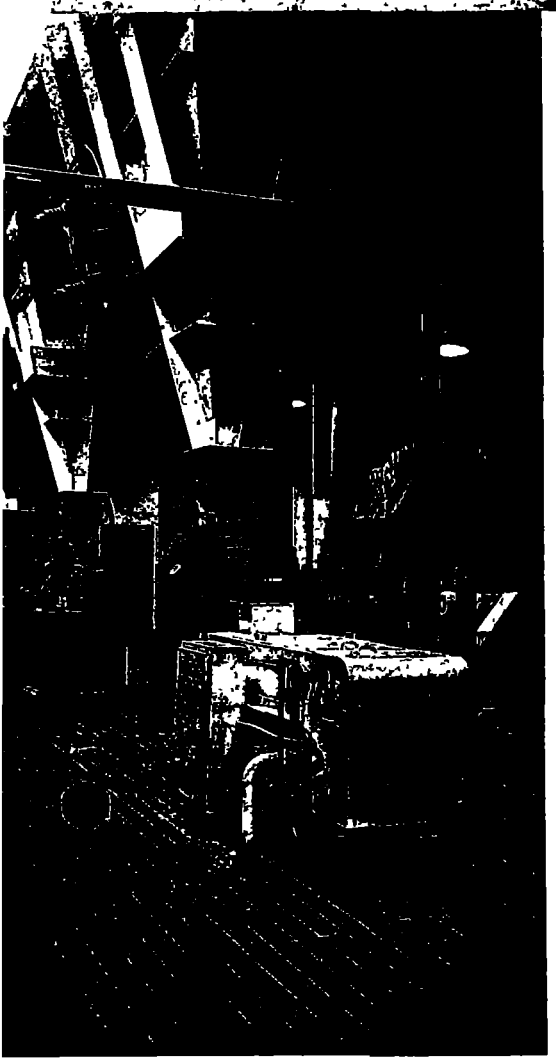


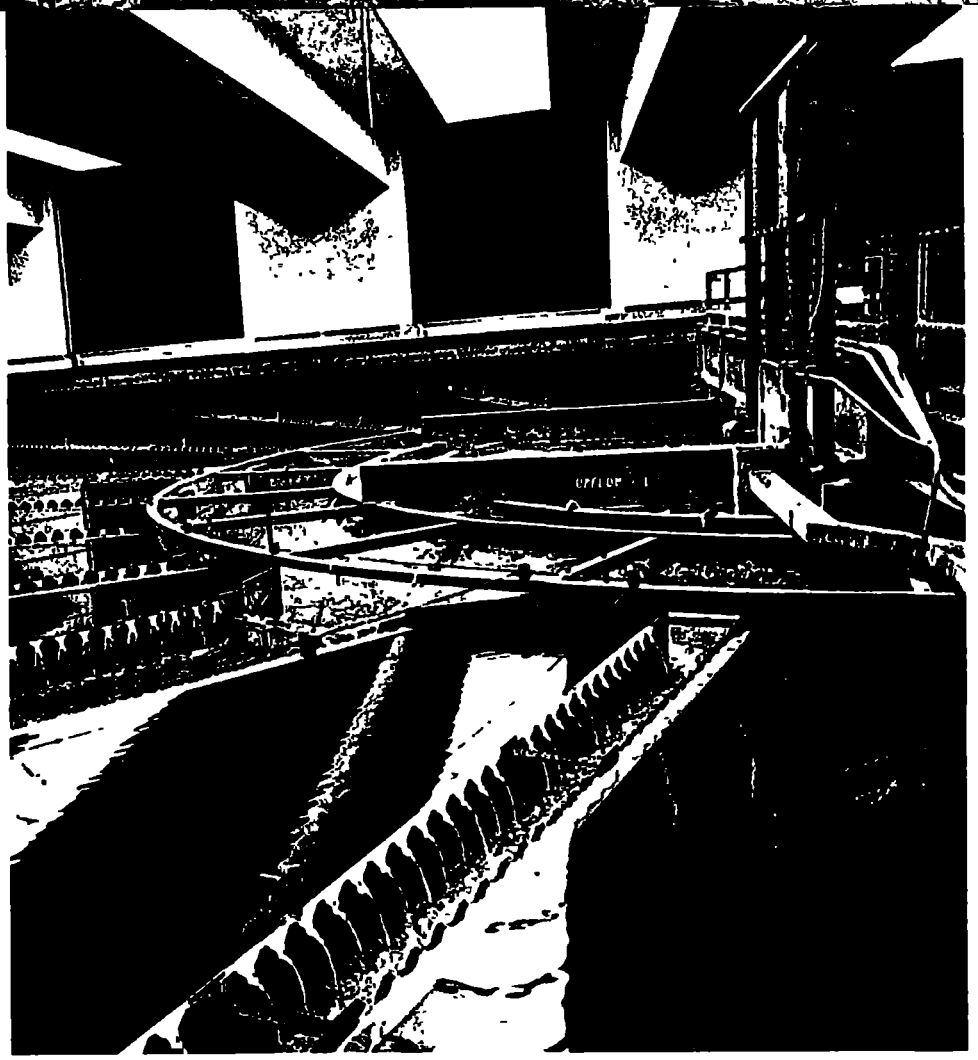
Water Treatment Plant

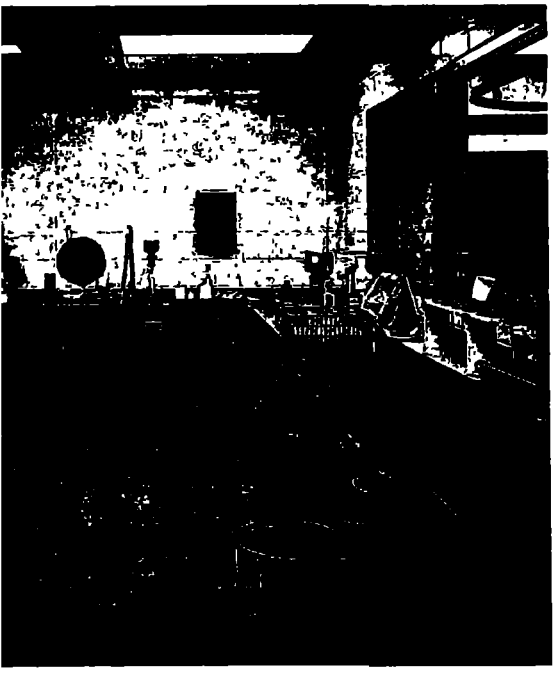
Metropolitan Utilities District
Omaha, Nebraska

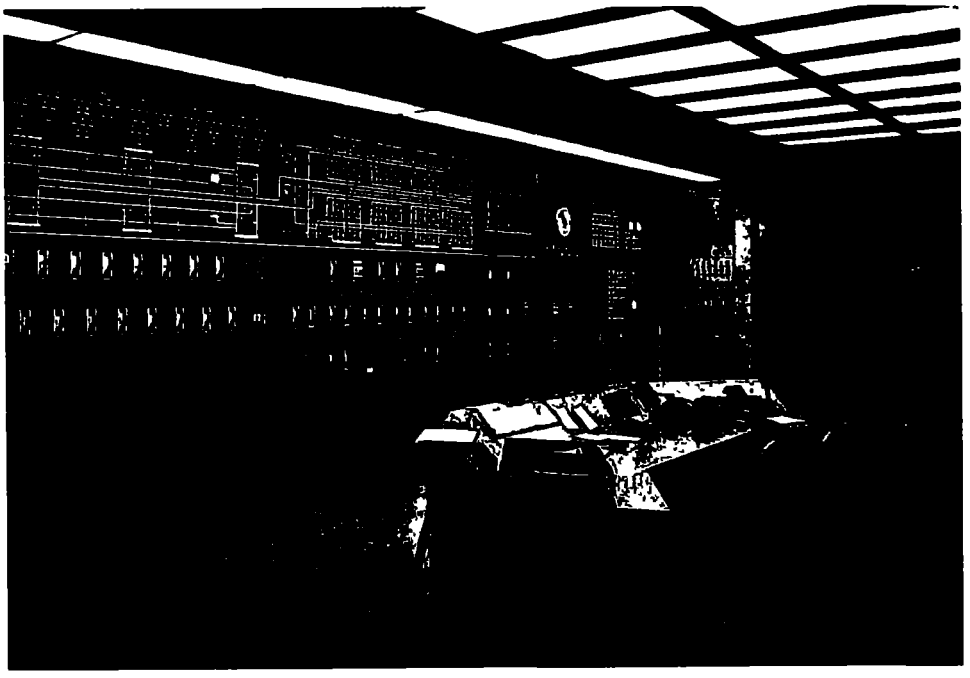
The 60 mgd Platte River Water Treatment Plant provides the City of Omaha with its second source of potable water, the first source being the Missouri River The water treatment plant is composed of six solids contact upflow units, chemical feeding equipment and storage bins, eight high-rate sand filters, a six-million-gallon clearwell, and a high service pump station with four 15 million gallon per day capacity pumps The raw water pumps, various stages of the purification process and pumping of potable water into the distribution systems are controlled and monitored automatically

(115)3 479









Water Treatment Plant

Raw water is supplied by 37 well houses which vary in capacity from 1,500 gallons per minute to 3,500 gallons per minute. Certain chemical characteristics of the underground water are altered to insure its compatibility with water from the river In addition to the well houses, development of the well field involved the necessary collection piping, electrical wiring and controls, access roads and bridges.

F. Response

This section of the proposal will provide the work plan as presently developed and the estimated cost of performing this project, together with a project schedule, a project flow chart and other requested information. Included in this last category are cost of administration, travel and other direct charges, assumptions made in estimating the cost, a brief outline of the draft report and explanation of how the firm will interface with the Minnesota Department of Health and others involved with the program.

1. Technical Approach

Effective project management is the key to the successful and prompt completion of any project of this type. The definition of work to be performed in the Request for Proposal is clear, relatively precise and, in fact, establishes much of the required technical approach. Obviously, procedures may be modified slightly as work progresses and as the Department of Health and the Contractor establish a working relationship. Final refinement of the work program is envisioned to be accomplished during development of the detailed work plan and in contract negotiations. The approach described here has been developed as a result of careful review of the entire Request for Proposal by members of our proposed Project Team. Work, as defined in the Request for Proposal, has been organized into six major tasks as follows:

Task 1000 - Evaluation of Existing Information
Task 2000 - Evaluation of Gradient Well System
Task 3000 - Participation in Refinement of Model
Task 4000 - Evaluation of Treatment of Gradient Well Discharge
Task 5000 - Evaluation of Excavation
Task 6000 - Final Project Documentation

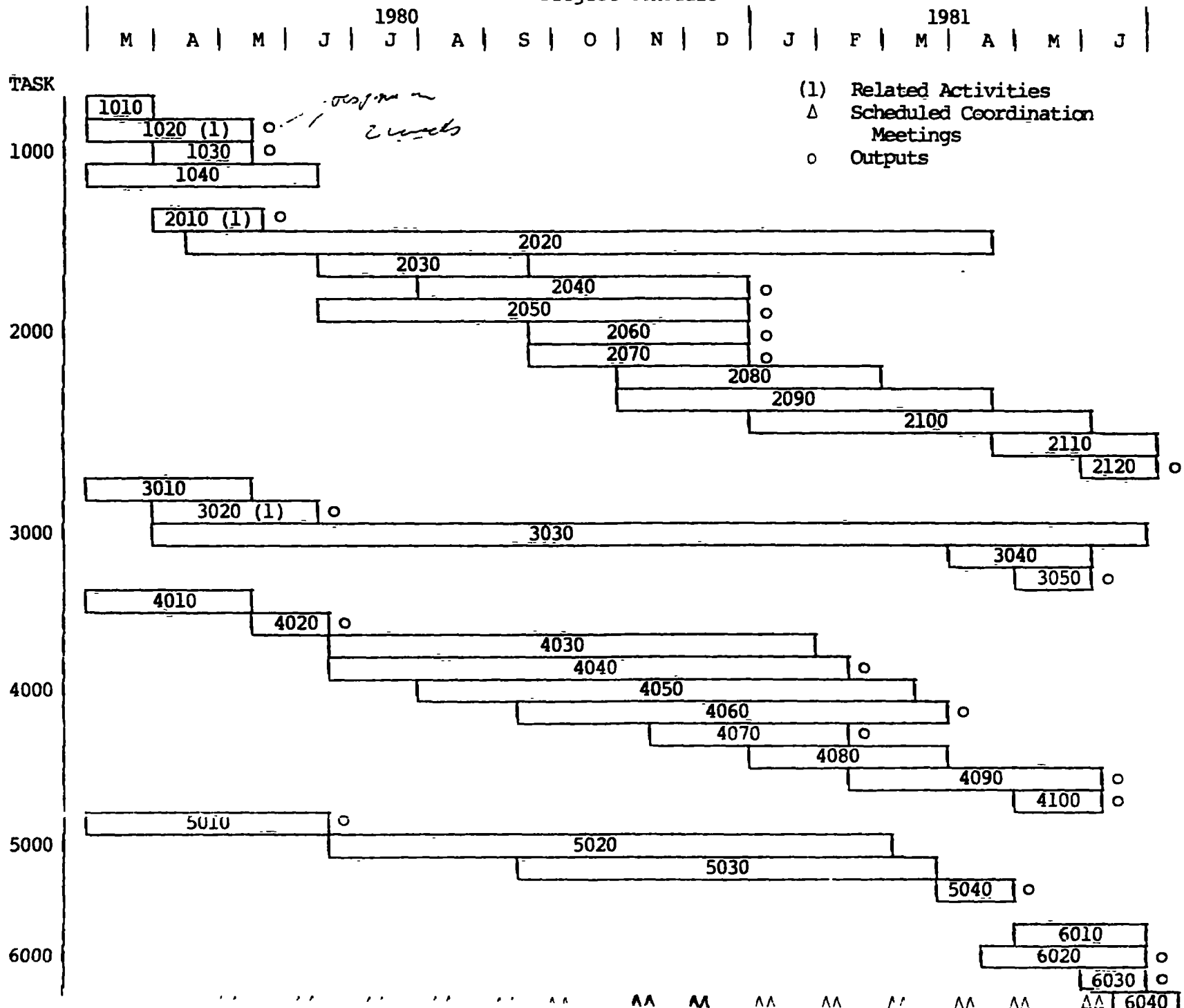
pilot water treatment not desired

These six major tasks have been organized into 39 work tasks, described below. Figure 2 is the project schedule, which shows the scheduling of the 39 specific tasks, while Figure 3 is a project task flow chart showing major work outputs and the interrelationship of the various work tasks.

Special note is made here of Task 3030, which falls under the model refinement category. As further described below, this task includes periodic meetings with the Department of Health and U.S.G.S. These meetings would occur on an estimated two-week frequency and would be aimed not only at model refinement, but also overall coordination with the participating agencies. These meetings are indicated at the bottom of Figure 2.

In the following paragraphs, each of the work tasks will be briefly defined. It should be understood that the tasks will be more precisely defined during the development of the final work plan.

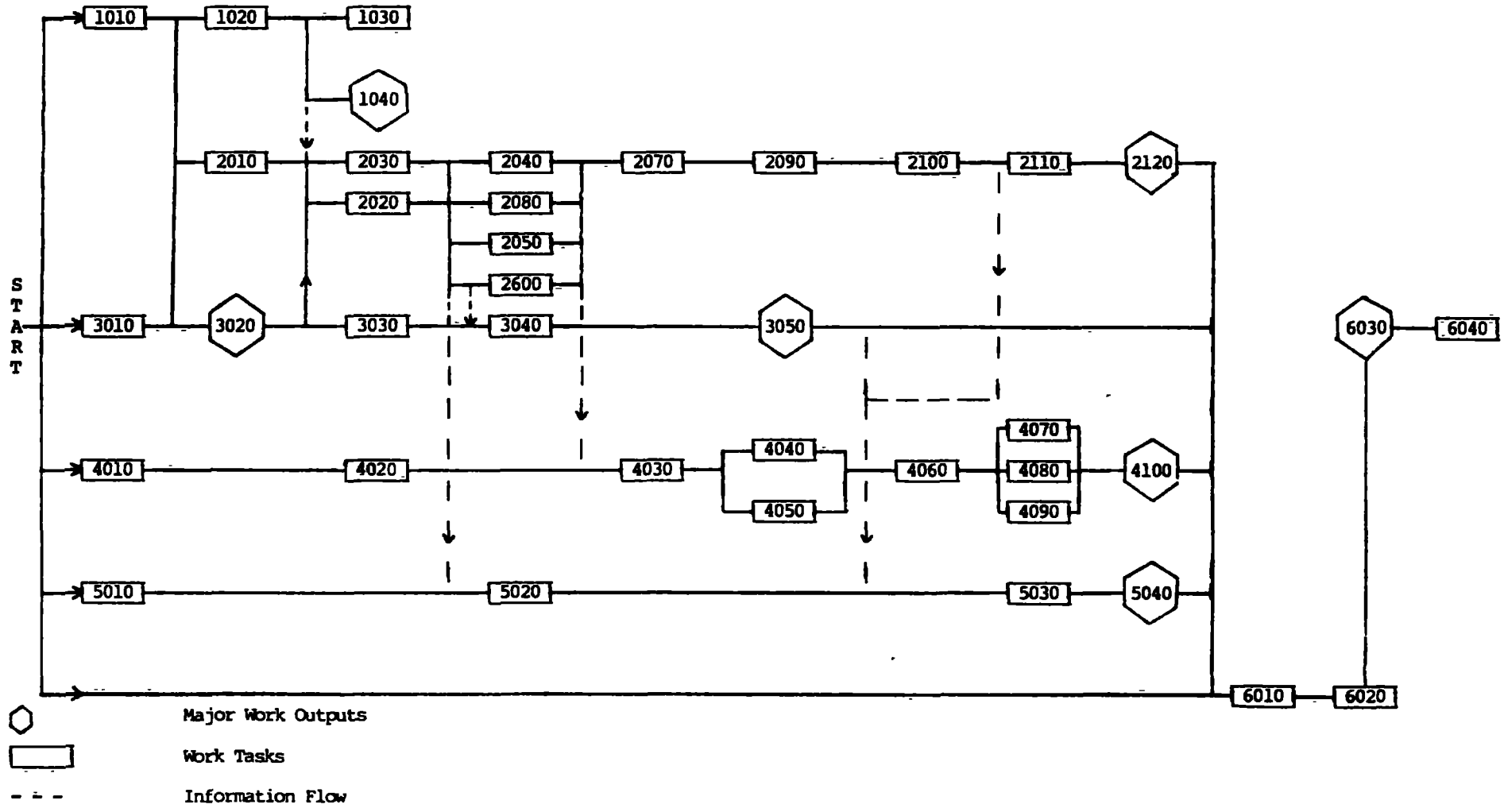
Figure 2
St. Louis Park Groundwater Contamination Project
Project Schedule



001088

Figure 3

PROJECT TASK FLOW CHART



001089

Task 1000 - Evaluation of Existing Information

Task 1010 - Data Assembly

This task will be initiated by the assembling of all the existing data. This will include data from the Minnesota Department of Health, the Minnesota Pollution Control Agency, the Minnesota Geologic Survey, the U.S. Geologic Survey, other consultants who have worked on this project and results found in literature on similar situations. Although it is expected that much of the data is readily available, an effort will be made to glean additional data from various sources.

Task 1020 - Review and Evaluation of Data

All the data assembled will be reviewed and evaluated. It is expected that this information will provide the basis for investigative work and preliminary remedial actions. In addition, the output from this effort will provide input into Task 2020, the definition of the required hydrogeological field studies. This task will have as an output, a technical memorandum listing all of the documentation with summarized conclusions and recommendations or findings of each document, where each may be found and other comments.

Task 1030 - Refine the Detailed Work Plan

After all of the available information has been assessed, the work plan and the remainder of this proposal will then be re-examined and refined as necessary. Not only will the tasks be refined but the timing for each of the tasks and associated costs will be identified. Once this detailed work plan is approved, it will be displayed in a Critical Path Method format. This technique will then be used throughout the project to monitor progress, key work items and fiscal progress of the project.

Task 1040 - Literature Review for Acceptable Contaminant Levels

All available literature will be reviewed in order to assist the Minnesota Department of Health in setting guidelines for acceptable levels of contamination for soil and water. The output of this task will consist of an annotated bibliography of all literature reviewed, proposed criteria and justification for the recommended levels of contamination.

001090

Task 2000 - Evaluation of Gradient Well Systems

Task 2010 - Conceptual Analysis

The initial task in this work item will consist of a conceptual analysis of the gradient well system. This will consist of the identification and evaluation of alternatives, evaluation of the success potential and preliminary evaluation of risk associated with each of the alternatives, preliminary cost analysis, and finally, identification of the most promising alternatives. This task will be performed concurrently with Task 3020, in which information deficiencies will be identified. This analysis will be completely documented and it is planned that concurrence with the conclusions and recommendations of this analysis will be necessary from the Minnesota Department of Health before proceeding on Task 2030.

Task 2020 - Hydrogeological Field Investigations

From the data deficiencies identified in Tasks 1020 and 3020, hydrogeological field investigations required to increase the success potential of a gradient well system will be identified. It is the intent that a sensitivity analysis of the various parameters and information be performed and that the data most sensitive for a successful implementation of a remedial control system will be identified. The major emphasis of field work will be determined in this manner.

Task 2030 - Location and Description of Gradient Control Wells

This task will consider location, depth, method of construction, discharge rate, extent of effective control and a total estimated cost for each proposed barrier well. It is the intent that part of the effectiveness of the barrier control wells can be determined with the model and specifically, under Task 3040.

Task 2040 - Cost Effectiveness Analysis for Escaped Water Interception

It is the intent of this task to perform an analysis of the cost effectiveness of intercepting contaminated water which has left the site. Methods which have been identified in Task 2010 will be evaluated as to their cost and effectiveness in intercepting the contaminated water.

Task 2050 - Estimation of Well Discharge Water Quality

This task is very important for the performance of Task 4030. The estimates of water quality will be made using available data and modeling techniques, possibly use of the U.S.G.S. model. However, other methods will also be investigated and used if applicable.

Task 2060 - Analysis of Well Discharge Quantity

This task is closely related to Task 2050 and will be performed concurrently using many of the same techniques used for that task.

Task 2070 - Operating Cost Estimates

Upon the conclusion of Task 2060, identifying the quantities of water to be removed, the operating cost of the system or alternative systems will be developed. It is anticipated that a series of operating modes will be evaluated and the cost will be identified for each of these modes.

Task 2080 - Analysis of Subsidence and Land Use Effects

This task includes the analysis of the effects of the barrier well system on land use and the assessment of any subsidence problems which may occur due to a long-term dewatering or gradient control system.

Task 2090 - Analysis of Supplemental Control Activities

Other water use controls will be identified and a determination will be made as to which of these other water controls may improve the success potential for the system. Any water use controls which may be mandatory to allow the final design system to perform will be identified during this task. During this task again the usefulness of the model in Task 3040 will become very important.

Task 2100 - Analysis of Risk and Required Monitoring

This task will provide an estimate of the confidence which the Consultant has that the final design will provide the desired degree of control. The risk associated with this system will be a combination of statistics and engineering judgment concerning past systems which have been successful. Part of the output from this task will be the required monitoring systems that will be necessary to evaluate what the success of the recommended and implemented system will be.

Task 2110 - Analysis of Effects of Excavation on the Proposed Barrier Well System

This task, of course, is related to the output of Task 5000 and will identify any environmental or hydrological effects that the variety of excavation techniques may have on the recommended barrier well system.

001092

Task 2120 - Documentation

A major technical memorandum is anticipated to be prepared at the conclusion of Task 2000, pulling together all of the interim reports that were submitted in Tasks 2010, 2020, 2040, 2050, 2060 and 2070. It is hoped that the Department will have been able to respond to these interim reports so that those clarifications that may be required, as well as total documentation for this task, can be provided at this time. Further review of the output from this task can then proceed before the final project documentation report is prepared under Task 6030.

001093

Task 3000 - Participation in Refinement of Model

Task 3010 - Assess Status of Model

The initial task will be to assess the present status of the model being developed by the U.S.G.S. This will be facilitated by the meetings held with U.S.G.S. under Task 3030 below.

Task 3020 - Identify Information Deficiencies

Upon the familiarization of our Team with the model, certain important data parameters will be identified. It is considered that sensitivity of the various types of information will be determined with the aid of the model. It is the intent of this task to identify data deficiencies to which the proposed gradient control system is sensitive. The output from this task is seen as an important element in the performance of Task 2020, hydrogeological field investigation.

Task 3030 - Participate in Further Model Development

This task is viewed as a project-long effort, consisting of a number of working meetings with members of the U.S.G.S. staff. It is the intent to have coordination meetings with the Department of Health and U.S.G.S. personnel on a two week frequency. It is considered that during this time, major participation in the refinement of the model can take place.

Task 3040 - Evaluation of Proposed Gradient Well System Design

This very important task will be used to evaluate the selected or several alternative barrier well system designs. It will be used to verify estimated water quality, estimated water quantity, extent of effective control, as well as location and depth of each proposed barrier well.

Task 3050 - Documentation

The documentation is viewed as a major effort throughout this project. This task will consist of the documentation of the Consultant's participation in refinement of the model and may be a very important link to the future public and legislative hearings.

Task 4000 - Evaluation of Treatment of Gradient Well Discharge

Task 4010 - Review Existing Data and Literature

The Consultant will conduct a review of existing data as well as conduct a review of appropriate literature relevant to treatment evaluations. No attempt will be made as part of any effort of Task 4000 to determine public health considerations and/or consequences.

Task 4020 - Establish Supplemental Testing Program

Following review of existing data, the Consultant will recommend to the Minnesota Department of Health the implementation of any supplemental testing program deemed necessary to develop information required to complete this task. It is anticipated that the Minnesota Department of Health and/or the City of St. Louis Park will collect samples, perform stipulated analyses and report the findings to the Consultant. Costs for sample collection or analyses are not included by the Consultant.

Task 4030 - Document Raw Water Quantities/Quality Characteristics

Utilizing material prepared in Task 2000, the Consultant will document expected raw water quantities and associated qualities for differing gradient well system pumping rates. The parameters will be verified by the model being refined in Task 2000, and will be approved by the U.S.G.S. prior to proceeding further.

Task 4040 - Determine Ultimate Water Disposal Alternatives

Utilizing all material prepared previously, the Consultant will determine possible alternatives for the ultimate disposal of treated waters. An integral part of this element will be Minnesota Pollution Control Agency collaboration on the determination of a single set of maximum parameter concentrations allowable for discharge to surface waters. For alternatives utilizing possible discharge to the sanitary sewer system, the Metropolitan Waste Control Commission will be relied upon to establish maximum permissible rates. Analyses of in-stream water quality and/or sanitary sewer system considerations are not included.

Task 4050 - Identify Collection/Treatment Alternatives

The Consultant will identify and determine feasible collection and treatment alternatives for the raw water quantities documented in Task 4030. It is antiticipated that this task will identify various combinations of treatment plants and associated collector systems. Treatment alternatives must be capable of meeting the recommended levels provided in Task 1040.

Task 4060 - Identify and Describe Treatment Possibilities

Utilizing literature data and all information collected to date, the Consultant will identify and delineate no more than the three most apparently feasible treatment possibilities for raw water quantities and characteristics documented in Task 4030. Each of the delineated treatment possibilities will be described. Because this information has significant impact to the overall assessment, lack of specific data will result in a broad conceptualization of possible treatment facilities.

Task 4070 - Bench Scale Laboratory Testing

will this be implemented?

If deemed necessary, the Consultant will design and propose a limited Bench Scale Laboratory testing program to help identify the characteristics of the expected raw water qualities for final preliminary design recommendations, pilot plant suggestions and cost estimating. It is expected that State Board of Health and/or City of St. Louis Park personnel will assist in the bench scale testing as appropriate.

Task 4080 - Cost Estimates

The Consultant will utilize all information gathered to date for the apparently feasible treatment possibilities delineated in Task 4060 and further refined in Task 4070 to prepare cost estimates for preliminary design purposes. The Consultant will identify different preliminary costs that are dependent on various required levels of final treatment as identified in Task 4040.

Task 4090 - Pilot Plant Program

Based upon the work completed to this point, the Consultant will identify and define a suggested pilot plant study program to verify and finalize preliminary design considerations and cost estimates. The implementation of the actual pilot plant program is not included within this scope of services.

Task 4100 - Final Report

The Consultant will prepare a final report setting forth all findings and recommendations of this task. As part of this element, further pilot recommendations developed in Task 4090 will also be set forth, as will a listing of assumptions made throughout this study. The report will also identify and recommend areas where further information is seen as necessary by the Consultant prior to implementation of recommendations.

001096

Task 5000 - Evaluation of Excavation

This task will involve the review of the available data regarding levels and distribution of soil contaminants and the geology and hydrogeology of the site and adjacent area. The major task will be to estimate the volume of contaminated material and prescribe procedures for excavation. The methods of treatment of the excavated material will be identified.

Task 5010 - Identification of Treatment and Disposal Alternatives

The alternative methods for treatment to various levels of contamination and/or excavation and disposal of contaminated soils will be evaluated. The results of this task will conform to the recommendations provided in Task 1040. Consideration will be given to effects on roadways and structures on and near the site, which may limit excavation. Where this is the case, in situ methods of treatment will be investigated thoroughly. These may include various methods of soil solidification and chemical injection resulting in relatively impermeable soil barriers. Up to three overall schemes of excavation and treatment will be recommended.

Task 5020 - Evaluate Environmental Effects of Alternatives

An analysis of all environmental consequences of each of the alternative methods will be performed. These analyses will include any effects of off-site treatment on other treatment or disposal sites, impact on land use, transportation, underground and above-ground utilities in the excavated area, need for an environmental impact statement and any permit requirements for implementing the recommended alternatives.

Task 5030 - Cost Estimates

The estimated costs associated with each of the alternative methods will be identified. These costs will include the cost of excavation, storage, transportation and in situ treatment, as well as the ultimate disposal costs. The costs of the recommended alternatives will be compared with their respective environmental impacts. This will provide a basis for selecting among the recommended alternatives.

Task 5040 - Documentation

The documention of this task will be extensive, including the evaluation of the alternative methods, documentation of data sources, estimated confidence level of the data used, cost estimates and recommendations. Past experience with this very type of documentation has shown that it may be the most sensitive area of all the tasks in the project.

001097

Task 6000 - Final Project Documentation

Task 6010 - Refine Previous Outputs

It is anticipated that major work outputs will be submitted to the Minnesota Department of Health in Tasks 1040, 2120, 3020, 3050, 4100 and 5040. It is proposed that the Department of Health review these major work outputs and supply the Consultant team with their comments and suggestions for other evaluations or analyses. These work outputs would then be refined to an acceptable level during this task.

Task 6020 - Develop Conclusions and Recommendations

Upon receipt of all comments from the Department of Health, the Minnesota Pollution Control Agency and the U.S.G.S., the conclusions and recommendations of the entire project would be drawn together. It is anticipated that a great deal of coordination with all parties involved will be required for the successful performance of this task.

Task 6030 - Prepare Final Report

The actual preparation of the final report will be the subject of this task. It is the intent that all of the previous technical memorandums and major work outputs would be prepared on word processing equipment and that all changes could be easily made. It is the intent that a draft of this final report will be available to all agencies and that any changes that are deemed necessary can be quickly made and the final document prepared. A brief preliminary outline of the draft report is shown as Exhibit 1.

Task 6040 - Presentation of Findings

This task includes a presentation of findings to the Department of Health and other agencies as required. Estimated costs for this presentation are included in this proposal. As a follow-on to this task, it may be necessary to participate in public meetings and provide testimony at public and legislative meetings. Consultant costs for the latter are not included in this proposal.

001098

Exhibit 1

DRAFT OUTLINE

Final Documentation-Report of Findings,
Cost Analysis and Plan for the Remedy of Groundwater Contamination
Resulting from Discharge of Industrial Chemicals at Site of a
Former Creosote Works, St. Louis Park

I. Executive Summary

II. Introduction and Purpose

III. Background
- A. History
- B. Previous Evaluations
- C. Continuing Investigations

IV. Literature Review
- A. Limits of Contamination
- B. Remedial Actions & Technology

V. Study Methodology

VI. Evaluation of Gradient Well System
- A. Test Well Requirements
- B. Barrier Well System Design
- C. Cost Effectiveness of Interception
- D. Barrier System Water Quality
- E. Barrier System Water Quantity
- F. Barrier System Costs
- G. Barrier System Effects
- H. Other Water Use Controls
- I. Level of Confidence
- J. Effects of Excavation

VII. Dispersion - Diffusion Model Refinement

VIII. Evaluation of Treatment of Gradient Well Discharge
- A. Potential Methods
- B. Estimated Costs
- C. Estimated Performance
- D. Estimated Cost Related to Performance Level

IX. Evaluation of Excavation Alternatives
- A. Alternative Methods
- B. Estimated Cost
- C. Environmental Assessment

X. Conclusions

XI. Recommendations
- A. Present
- B. Additional Data Needs

XII. Meetings and Contacts

XIII. References

Appendices

001099

2. Estimated Expenses

The estimated expenses of performing this project are shown by task and Consultant in the enclosed Table 1. In addition, Tables 2 and 3 show the composite hourly rates, the estimated cost of travel and other direct charges, as well as the assumptions made in preparing Table 1. The time frame for providing the required services is shown on Figure 2, with the entire project to be complete by June, 1981.

3. Coordination

As indicated on Figure 2, it is anticipated that a coordination meeting with the Department of Health and other agencies will occur on a two week frequency. It is our consideration that very close coordination is required since many activities are proceeding at the same time and that only through an intimate coordinative effort can assurance be given that all data and information will be used to the optimum level.

4. State Work and Typical Invoice

Work for the State of Minnesota is summarized in Exhibit 2 for E. A. Hickok and Associates and in Exhibit 3 for Henningson, Durham and Richardson. A typical invoice by E. A. Hickok and Associates for State of Minnesota work appears as Exhibit 4.

5. References

References for E. A. Hickok and Associates, Geraghty and Miller, Inc., and Henningson, Durham and Richardson, Inc. are presented in Exhibit 5.

001100

Table 1

ESTIMATED HOURS AND TOTAL EXPENSES

	E. A. Hickok & Associates Hours					Geraghty & Miller Hours			Henningson, Durham & Richardson Hours					
Task	Senior Advisor	Team Leader	Engineer	Tech-nician	Clerical	Senior Advisor	Team Leader	Engineer	Senior Advisor	Team Leader	Engineer	Tech-nician	Clerical	Total Dollars By Task*
1000	12	40	24	16	16	4	-	32	4	8	-	-	-	$ 5,530
2000	72	120	180	60	60	56	344	464	4	32	8	-	-	$ 51,901
3000	24	120	40	16	16	8	40	16	4	4	8	-	-	$ 10,435
4000	8	16	16	8	8	4	8	-	32	336	224	40	40	$ 27,869
5000	24	160	200	40	40	4	16	-	4	8	-	-	-	$ 14,853
6000	24	80	8	40	40	16	-	-	16	-	-	-	-	$ 9,312
Total Dollars By Consultant *			$47,756				$42,249				$29,895			$119,900

*Note: Dollar totals include expenses as well as salary

001101

Table 2

COMPOSITE HOURLY RATES
(Fully Burdened)

	E. A. Hickok & Associates	Geraghty & Miller	Henningson, Durham & Richardson
Senior Advisor	$56.00	$55.55	$54.32
Team Leader (Senior Chemist)	$32.00	$42.79	$38.08
Engineer (Senior Scientist)	$25.00	$33.75	$30.24
Technician	$22.00	-	$24.64
Clerical	$12.00	-	$16.24
Overhead Factor	1.376	1.45	1.4197
Profit	12%	10%	12%

001102

Table 3

EXPENSES AND ASSUMPTIONS

	E. A. Hickok and Associates		Geraghty and Miller		Henningson, Durham and Richardson	
	Expenses	Assumptions	Expenses	Assumptions	Expenses	Assumptions
Travel	$1,200	Mileage for 16 months at 15/mo. at 25 miles each	$1,500	5 trips at $300/trip (New York-Mpls.-New York)	$ 750	5 trips at $150/trip (Omaha-Mpls.-Omaha)
Subsistence	-		$ 900	15 days at $60/day	$ 900	15 days at $60/day
Printing	$1,600	50 copies at 100 pages plus 10 copies at 500 pages	-		$1,100	50 copies at 100 pages
Long Distance Telephone	$ 800	16 months at 10/month at $5 each	-		-	
Totals	$3,600		$2,400		$2,750	

001103

Exhibit 2

PREVIOUS AND PRESENT
STATE OF MINNESOTA PROJECTS
BY E. A. HICKOK AND ASSOCIATES

Agency	Project
Minnesota Pollution Control Agency	Load Allocation Studies
Minnesota Pollution Control Agency	Stormwater Treatment Needs
Minnesota Pollution Control Agency	Effects of Wastewater Stabilization Pond Seepage on Groundwater Quality
Minnesota Department of Economic Development	Feasibility Study - Cement Production
Minnesota Department of Natural Resources	Itasca Pond Study (current project)

001104

Exhibit 3

HENNINGSON, DURHAM & RICHARDSON STATE WORK

HISTORY OF STATE OF MINNESOTA

PROJECT WORK SINCE JULY 1, 1975 TO PRESENT

I. Pfeifer and Shultz/HDR, Inc. is currently involved as the design engineer for a project at the Stillwater State Prison. The project is for the elimination of fly ash re-injection in two boilers.

Our work on this project involves a study and equipment specifications, review of bids and installation inspection. The approximate fee for our services is $20,000; the installation is currently underway.

II. In August, 1976, Pfeifer and Shultz/HDR, Inc. completed a study for the University of Minnesota Engineering and Construction Division. The study was entitled, "Crookston Technical College Heating Plant Study" and addressed the following items: Compliance with Minnesota Pollution Control Agency particulate emission regulations; an evaluation of existing stoker equipment; and an analysis of steam heating loads, present capabilities and future requirements.

The approximate fee for our services associated with this study was $5,000.

III. In January, 1977, Pfeifer and Shultz/HDR, Inc., in association with Bruch Consultants, Inc. completed a design development for the University of Minnesota. The project involved the addition of air conditioning to Coffman Memorial Union and an analysis of the energy quality of the Building. The estimated cost of construction was $1,200,000 and the design development fee was $27,000.

IV. Currently, Pfeifer and Shultz/HDR, Inc. is conducting a study for the Minnesota Energy Agency to investigate the condition of approximately 20 Municipal District Heating Systems. The results of this study will be presented in a draft report to the MEA for submission to the Legislature for their consideration. The approximate fee for this Study and Draft Report is $12,300.00.

V. Pfeifer and Shultz/HDR, Inc. is currently providing engineering design services for the remodeling work at the Stillwater Prison Boiler Plant. The estimated construction cost of this project is about $1,000,000 with a stated fee of 7%.

VI. In June, 1978, Pfeifer and Shultz/HDR, Inc. was selected by the University of Minnesota Engineering and Construction Division to design an ash handling and storage system and associated heating plant improvements for a future 25,000 lb/hr lignite fired boiler at the Crookston Campus. The first phase has been authorized at about $270,000.00.

Exhibit 4

TYPICAL INVOICE

45 Indian Mound
Wayzata Minnesota 55391
(612) 473 4224

May 10 1977

Mr. Perry Beaton
Minnesota Pollution Control Agency
1935 County Road B 2
Roseville, Minnesota 55113

STATEMENT

Re: Study of Effects of Wastewater Stabilization Pond
Seepage on Ground and Surface Water Quality
Your Requisition Number 03564

6.5 Hrs. @ $42.00/hr. =	$ 273.00	
2.0 Hrs. @ $36.00/hr. =	$ 72.00	
17.5 Hrs. @ $30.00/hr. =	$ 525.00	
101.0 Hrs. @ $27.00/hr. =	$2,727.00	
18.0 Hrs. @ $20.00/hr. =	$ 360.00	
160.5 Hrs. @ $16.00/hr. =	$2,568.00	
26.5 Hrs. @ $12.00/hr. =	$ 318.00	
		$6,843.00

EXPENSES

Reproductions	$ 4.20	
Mileage	545.55	
Per Diem	37.65	
Equipment	91.03	
		$ 678.43

Stevens Well Drilling Company, Inc. 15,000.00

TOTAL ---------- $22,521.43

001106

Exhibit 5

REFERENCES

References for E. A. Hickok and Associates

Mr. Gordon Meyer (296-7391)
Minnesota Pollution Control Agency

Mr. Lanny Peissig (296-7397)
Minnesota Pollution Control Agency

Mr. Tom Morrow, P.E. (202/426-3826)
Federal Aviation Administration
800 Independence Avenue S.W.
Washington, D.C. 20591

Mr. George V. Dimke (612/784-7669)
Rice Creek Watershed District
Suite 177 Arden Plaza
3585 Lexington Avenue North
Arden Hills, Minnesota 55112

Mr. David H. Cochran (612/733-2177)
Minnehaha Creek Watershed District
4640 Linwood Circle
Excelsior, Minnesota 55331

Mr. William B. Olson (612/926-5782)
Metropolitan Airports Commission
6040-28th Avenue South
Minneapolis, Minnesota 55450

001107

Exhibit 5 (continued)

References for Geraghty & Miller, Inc.

Mr. Jerry Kotas (202/426-2747)
U.S. Environmental Protection Agency
Water Planning Division (WH-554)
401 M Street S.W.
Washington, D.C. 20460

Mr. Leslie G. McMillion (702/736-2969)
U.S. Environmental Protection Agency
944 East Harmon
Las Vegas, Nevada 89109

Mr. Jack W. Keeley, Chief (405/332-8800)
Ground Water Research Branch
Robert S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, Oklahoma 74820

Mr. Marion R. Scalf (405/332-8800)
Sanitary Engineer
Ground Water Research Branch
Robert S. Kerr Environmental Research Lab
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P.O. Box 1198
Ada, Oklahoma 74820

Mr. Richard Sobel (201/455-2807)
Director, Environmental Services
Allied Chemical Corporation
P.O. Box 1087R
Morristown, New Jersey 07960

Mr. Burnell Vincent (202/755-9116)
Environmental Specialist
Office of Solid Waste (WH-564), Room 2514
U.S. Environmental Protection Agency
Washington, D.C. 20460

Mr. Rino L. Pellissier (215/299-6575)
Environmental Engineer
FMC Corporation
Chemical Group Headquarters
2000 Market Street
Philadelphia, Pennsylvania 19103

Mr. James A. Kinsey (612/636-5740)
Hazardous Waste Management Section
Division of Solid Waste
Minnesota Pollution Control Agency
1935 West County Road B-2
Roseville, Minnesota 55113

00108

Exhibit 5 (continued)

References for Henningson, Durham & Richardson, Inc.

Mr. Luther Nelson (612/935-3381)
Manager, Department of Environment and
Energy - Hennepin County
Hopkins, Minnesota

Mr. Bernard J. Harrington (612/222-8423)
Director of Engineering
Metropolitan Waste Control Commission
St. Paul, Minnesota

Mr. William Lloyd (612/881-5811)
Director of Utilities
City of Bloomington, Minnesota

Mr. Frances Brennan (507/285-8961)
Director of the Water Division
Rochester, Minnesota

Mr. Robert Bollant (507/452-8550)
Director of Utilities
Winona, Minnesota

Mr. Duane Brase (507/835-3890)
Superintendent of Utilities
Waseca, Minnesota

Mr. Dallas Nelson (612/693-3277)
Superintendent of Utilities
Litchfield, Minnesota

Mr. Craig Osvog (507/283-2388)
City Administrator
Luverne, Minnesota

Mr. William Brinker (605/339-7088)
Manager of Water Reclamation Division
Sioux Falls, South Dakota

001109

City had copy
10/13/78
City Atty Had Copy 11/16/78

~~JPM~~ 4
~~RDA~~
~~MRH~~
~~JCC~~
~~GOP~~
~~GAE~~

GROUND-WATER INVESTIGATION PROGRAM

AT

ST. LOUIS PARK, MINNESOTA

PROGRESS REPORT I

Addresses phenols
only
found them 1½ mile
from plant

SEPTEMBER 1969

EUGENE A. HICKOK & ASSOCIATES
HYDROLOGISTS - ENGINEERS
MINNEAPOLIS, MINNESOTA

001110

INDEX

	Page No.
Illustrations	
Introduction	1
Ground-Water Quality	3
Glacial Drift	9
St. Peter Formation	13
Shakopee Formation	14
Jordan Formation	15
Hinckley Formation	16
Conclusions	17
Recommendations	19

ILLUSTRATIONS

List of Figures

Figure 1	Location Map
Figure 2	Geologic Cross-section A A'
Figure 3	Geologic Cross-section B B'
Figure 4	Graphic Log of Soil Borings - Section C C'
Figure 4A	Graphic Log of Soil Borings - Section D D'
Figure 5	Water Quality, September 1969

List of Tables

Table 1	Water Analysis of St. Louis Park, Sept. 1969
Table 1A	Well Index, St. Louis Park, Sept. 1969
Table 2	Well Water Analysis 1946-1968, St. Louis Park

INTRODUCTION

An investigation was undertaken during September 1969 to determine the extent of phenolic compounds in the major aquifers in the vicinity of the Republic Creosoting Company plant located at 7200 Walker Street, St. Louis Park, Minnesota. See Figure 1, Location Map.

In conjunction with this study seven borings were made to obtain soil samples for analysis of phenolic compounds in the unsaturated soil zone and to determine the extent of migration of the compounds in the shallow sand and gravel deposits in the area. The analysis of water and soil samples made during the study are included in the report, as well as a tabulation of water analyses of selected deep wells for the years 1946 - 1968.

7 soil borings

In 1932 complaints were ~~made to the Village~~ of St. Louis Park that a municipal well contained water with a tarry taste. This well (No. 8A) was subsequently abandoned. At the same time a group of shallow private wells were also abandoned due to taste and odor problems.

1932 complaints lead to abandonment of wells

During 1936 the McCarthy Well Company investigated reports of ground-water contamination, and concluded that they had not found any source of material that could be responsible for these tastes other than wastes discharged from the Republic Creosoting Company.

1936 investigation

Recently the City of St. Louis Park has been confronted with problems due to the surface existence of creosote. It is believed by the utility personnel that the creosote has an adverse affect on buried water mains. In addition, there have been reports of

effect on buried water mains

city personnel who have had severe skin reactions due to handling creosote bearing soil during utility line construction.

anyone by contact with soil

001114

GROUND WATER QUALITY

Phenol is a colorless substance which is highly soluable in water. It poses a potential health hazard. The U.S. Public Health Service has set an upper limit of concentration of 0.001 ppm for drinking water (Anon., "Drinking Water Standards," Title 42 - Public Health; Chapter 1 - Public Health Service, Department of Health, Education and Welfare, Part 72 - Interstate Quarantine Federal Register 2152 (Mar. 6, 1962.)

1962 Dw standard = .001 ppm

During the recent survey water samples were collected from 14 city wells and selected commercial wells in the area. Two locations on Minnehaha Creek were sampled and one sample was obtained from a ditch originating on the property of Republic Creosoting Company. Samples were analyzed in the laboratories of E.A. Hickok & Associates. See Table 1, Tabulation of Water Analysis, Sept. 1969.

For comparison purposes the results of available chemical analysis of well water from 1946 to 1968 have been tabulated. See Table 2.

The general direction of flow of ground water in the artesian aquifers in the area of St. Louis Park is toward the East. Superimposed on the artesian water surface are cones of depression caused by pumping from both municipal and industrial wells.

When water is withdrawn from a well, the water level in the ground-water reservoir is drawn down in the vicinity of the well forming a cone of depression in the ground-water surface. The drawdown is greatest at the well and diminishes as the

distance from the well increases. As a result, the pumping causes ground water to move radially through the underground reservoir toward the well. With continuous pumping, the cone of depression is steadily enlarged until the reservoir is exhausted or until the cone of depression reaches a source of recharge large enough to sustain the yield of the well and thus stop further water level declines.

The rate of growth and lateral extent of the cone of depression are independent of the rate of pumping. However, the rate of pumping causes a proportional variation in the depth of the cone of depression. Twice the pumping rate would produce a cone of depression twice as deep at any point.

The gradient of the upper flow systems is modified where liquid wastes are discharged onto the surface. This downward percolating liquid creates a ground-water high or mound from which the water moves away in all directions. The discharge of liquid wastes as at the Republic Creosoting plant would be expected to cause such a condition.

001116

TABLE I

WATER ANALYSIS OF

ST. LOUIS PARK, MINNESOTA

September, 1969

Well No	Geologic Formation	Phenols in ppm
1	St. Peter	0.014
2	St. Peter	0.008
3	St. Peter	0.012
--	Jordan	0.014
5	Jordan	0.014
6	Jordan	0.023
7	Jordan	0.013
8	Jordan	0.0.8
8A	Jordan	0.012
9	Jordan	0.013
10	Jordan	0.014
11	Hinckley	Trace
12 (Before Iron treatment)	Hinckley	0.018
12 (After Iron treatment)	Hinckley	0.018
13 (Before Iron treatment)	Hinckley	0.018
13 (After Iron treatment)	Hinckley	0.018
14	Jordan	0.009
19	------	0.028
23	St. Peter	0.023
33	------	0.02
Mhahe. Cr. Sample #1		0.02
Mhahe. Cr. Sample #2		0.021
Drainage Ditch (7200 Walker St.)		Excess of 2.0 ppm

Analysis by E.A. Hickok & Associates

001117

TABLE 1A

WELL INDEX
ST. LOUIS PARK, MINNESOTA
SEPTEMBER 1969

Well No.	Owner	Location	Well Log Avail	Static Water Level	Pumping Water Level
1	City Well	2936 Idaho Ave.	X	56'	[illegible]
2	City Well	2956 Idaho Ave.	X	56'	69'
3	City Well	2924 Idaho Ave.	X	54'4"	[illegible]
4	City Well	W.41st. & Natchez	X	---	----
5	City Well	Wyo. & 34th St.	X	119'9"	[illegible]
6	City Well	42nd St. & Zarthan	X	123'6"	[illegible]
7	City Well	2500 Louisiana Ave.	X	91'1"	[illegible]
8	City Well	36th & Alabama	X	149'7"	----
9	City Well			91'	[illegible]
10	City Well	29th & Jersey Ave.	X	---	----
11	City Well	29th & Idaho	X	386'4"	[illegible]
12	City Well	42nd St. & Zarthan	X	----	----
13	City Well	Cedar Lk.Rd. & Ala.	X	----	----
14	City Well	Cedar Lk.Rd. & Ala.		116'6"	125'6
15	Hamm Industries	Lake St. & Taft		----	----
24	McCourtney Plastics	27th W. of Louisiana	X	----	----
53	S-K Products	36th & Brunswick	X	----	----

TABLE 2

WELL WATER ANALYSIS 1946-1968

PHENOL CONCENTRATIONS - PPM

ST. LOUIS PARK, MINNESOTA

[illegible]	WELL NUMBER								
	3	4	5	6	11	12	13	14	33
[illegible]/46		0.100							
[illegible]/46		0.115	0.02						
[illegible]/46									
10/16/47				0.007					
10/[illegible]/47			0.02						
[illegible]/48				0.015					
[illegible]/48				0.015					
[illegible]/48		.005							
[illegible]/48		0.010							
[illegible]/48		0.005							
[illegible]/48		0.070							
[illegible]/48		0.015							
[illegible]/48		0.070							
2/6/68									0.000
3/7/68	0.002	0.008		0.0025	0.000	0.000	0.000	0.000	

All wells to left of this line for whose the figures [illegible] for both 1946

well #4 seems to have gotten better since then

001119

GLACIAL DRIFT

The glacial drift consists largely of till with some sand and gravel deposits. The till is composed mainly of clay with sand, pebbles, cobbles and boulders intermixed.

Seven shallow borings were made within a 4,000 ft. radius of the Republic Creosoting plant. Depths of these wells range from 13 - 18 ft. Soil samples were obtained every 5 feet. Logs of each boring are shown in Figure 4 and 4A.

The following procedure was established to analyze the phenol content of the soil samples.

1. A representative 100 gram soil sample was obtained from each 5 ft. interval.
2. The 100 gram sample was then placed in a 1000 ml beaker and 500 ml of distilled water added. This was stirred for 15 minutes.
3. The sample was then filtered through a vacuum filter and a standard phenol test was performed on the liquid portion. Results were interpreted from a standard phenol curve.

The laboratory procedure is believed to establish the amount of phenol material that can readily be leached from the soil by percolating water. It should be noted that results of this procedure will give a somewhat lower phenol content than actually exists, as all of the phenol in the sample is not leached in a 15 minute period.

Figure 4 is a comparison of phenol concentrations with relative elevation. There is apparently no consistent relationship between phenol concentration and depth. High concentrations

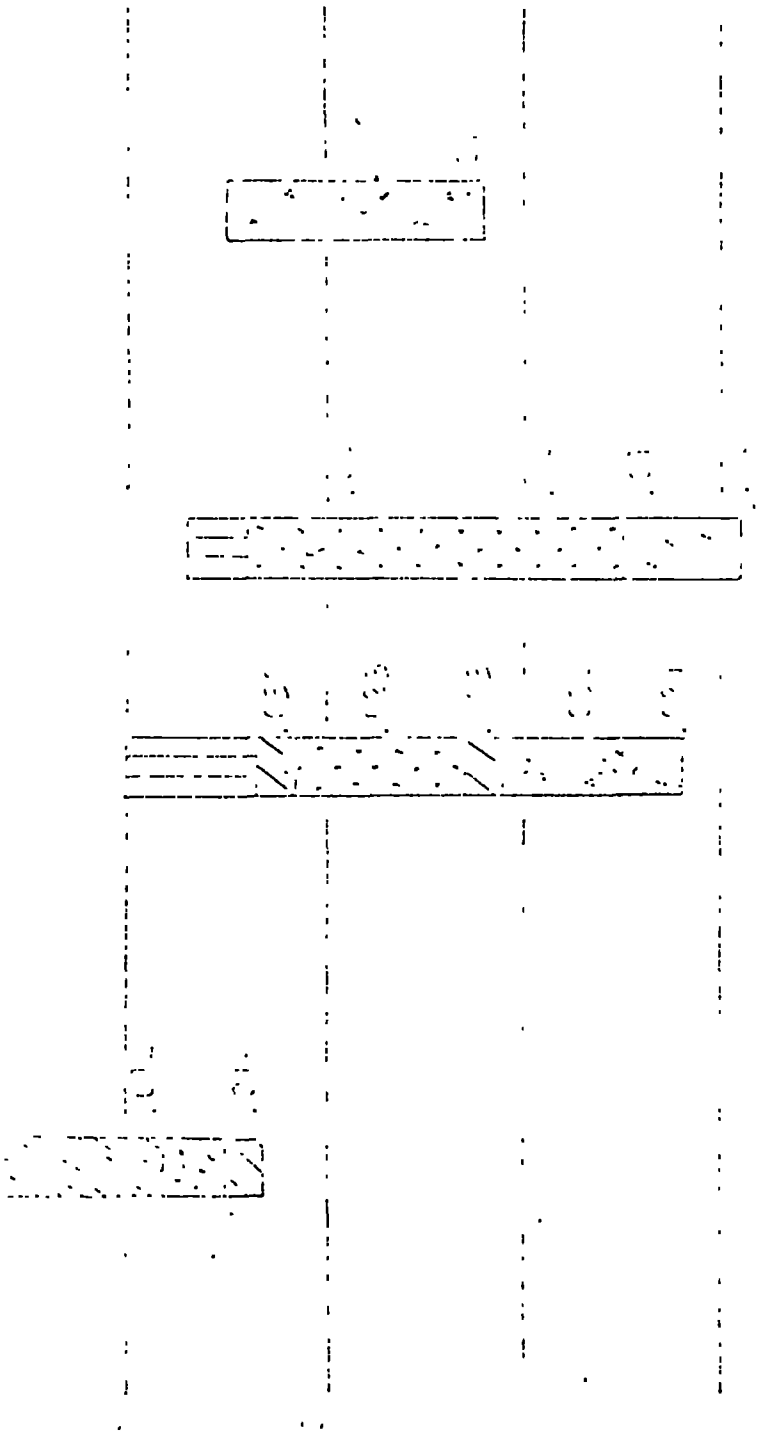
[illegible] coarse sand.

The phenol concentrations seem to decrease with distance from the Republic Creosoting plant. The results of samples taken from 13 ft. depths below ground surface at each soil boring have been plotted and are shown on Figure 5. Boring SL-1 located on the north edge of Republic Creosoting approximately 1,000 ft. from the source of phenols shows a phenol content of 0.030 ppm.

To make a detailed analysis of the effect of distance and depth on phenol concentration will require more intensive geologic and hydrologic information than is now available. To provide the data necessary for a more complete analysis a minimum of 10 soil borings ranging to 50 ft. in depth in addition to several additional deep test wells will be required.

Further analysis required

001121



ST. PETER FORMATION

The St. Peter formation consists of a white to yellow, medium to fine-grained sandstone. It varies from 100 - 165 ft. in thickness in the St. Louis Park area and contains beds of shale in the lower part of the formation.

The highest concentrations of phenols are found in wells open to the St. Peter formation, near the Republic Creosoting plant and down gradient in the direction of the regional water level slope. Well No. 19 shows the highest phenol concentration at 0.028 ppm. This well is located approximately 1,200 ft. south of the creosoting plant property line and less than 500 ft. from the low swampy area which receives water from the company's effluent ditch. Well No. 33 located down gradient but at a greater distance has a phenol concentration of 0.020 ppm or a decrease of .008 ppm in a horizontal distance of 6,000 ft.

Municipal wells 1, 2, and 3 located to the north of the plant also have phenol but due to increased distance and their location in respect to the regional water level gradient, contain lower concentrations. These wells contain an average of 0.011 ppm of phenol.

A possible explanation for even small amounts of phenol up-gradient lies in the fact that wells 1, 2 and 3 pump an average of approximately 2 to 3 million gallons per day (mgd). This is believed to produce a cone of depression around the wells and correspondingly a local reversal in the direction of ground water flow. This pumpage could cause movement of water from the area of the creosoting plant toward wells 1, 2, and 3.

SHAKOPEE FORMATION

Most of the Shakopee formation is a massive, gray to buff, dolomitic limestone with cavities filled with white calcite. Some private wells are constructed in the Shakopee but the St. Louis Park municipal wells do not utilize this formation for its water supply.

limestone

JORDAN FORMATION

The Jordan formation is a loosely cemented medium to coarse grained, white sandstone. Average thickness in the St. Louis Park area is 80 - 100 ft. The coarseness of grain and uniformity of grain size make the Jordan formation an excellent aquifer.

To some extent the horizontal migration of phenols in the Jordan resembles that in the St. Peter geologic formation. Phenol concentrations decrease with distance from the source and also up gradient. The high phenol content of municipal well No. 6 is believed due to its location with reference to the low lying land surrounding Minnehaha Creek. Surface water containing phenolic compounds draining from the vicinity of Highway 7 towards Minnehaha Creek could have caused a source of phenols to be located near well No. 6. Therefore, subsurface travel time has been decreased and the phenol concentrations observed are higher than would otherwise be anticipated.

The general pattern of vertical and horizontal migration of phenol compounds is complicated by the existence of numerous fissures and solution cavities in the Shakopee formation overlying the Jordan Sandstone. Numerous wells which penetrate the geologic formations above the Jordan, including the Shakopee formation, if improperly constructed could serve as conduits for vertical migration of phenols.

Evidence of contamination at depth is shown in the area near 29th Street and Idaho Avenue. In this area the results indicate that the St. Peter and Jordan formations contain concentrations of phenols in near equal amounts.

HINCKLEY FORMATION

The Hinckley formation is a coarse to fine, yellowish to pink sandstone. Average thickness in the St. Louis Park area is 120 ft. sandstone

A trace of phenols was found to be present in municipal well No. 11 which penetrates the Hinckley formation. Due to location, less than 100 ft. from municipal wells 1, 2, and 3 which are open to the St. Peter formation, it is believed that leakage could be responsible for the presence of this trace of phenols. A sample from well No. 12 also contained a trace of phenols. Municipal well No. 6 located 200 ft. distant, may be responsible for the phenol due to vertical leakage.

It is recommended that further investigations be made to determine the source of these phenols.

CONCLUSIONS

1. The chemical process wastes such as those discharged by the Republic Creosoting Company contain phenols.
2. Phenolic compounds have penetrated to the glacial drift, St. Peter, Shakopee and Jordan geologic formations in the vicinity of St. Louis Park.
3. The city wells sampled have phenol concentrations above the upper limits set by the U.S. Public Health Service. Ground water contaminated by phenolic compounds is objectionable and potentially a health hazard. Concentrations of phenol in excess of 0.001 mg/l can be undesirable to the taste and may be harmful to health. (Anon., "Drinking Water Standards," Title 42 - Public Health; Chapt. 1 - Public Health Service, Department of Health, Education and Welfare, Part 72 - Interstate Quarantine Federal Register 2152 (March 6, 1962).
4. Phenols have been identified in municipal and commercial wells at distances of 8,000 ft. from the creosote plant. = 1½ miles away!
5. The glacial drift is primarily utilized for domestic wells in the St. Louis Park area. The majority of the shallow private wells in the glacial drift in the vicinity of the creosote plant have been abandoned.
6. The St. Peter, Jordan and Hinckley formations are the principal aquifers for St. Louis Park municipal and commercial wells.
7. The observed movement of ground water in the vicinity of St. Louis Park is in the same Easterly direction as regional ground-water movement. In some areas the movement is controlled by local pumping wells.

001128

8. The biodegredation of phenols under anaerobic conditions is not fully understood. Research of public documents to date has not proven helpful in providing an evaluation of analysis techniques or in estimation of the biodegredation features of phenolic compounds.

9. The ground-water control program initiated should be considered one of continuing investigation. Geologic and hydrologic subsurface information is lacking in many locations in St. Louis Park. This information is needed to document travel of ground-water contaminants.

RECOMMENDATIONS

1. The further disposal of untreated phenolic liquid waste should be prohibited.
2. A comprehensive investigative program to more exactly delineate the extent of ground-water contamination and to prevent further migration of phenolic compounds in the aquifers of the area should be initiated.
3. The following studies should start immediately.
   (a) Water quality sampling should be conducted on a regular basis.
      1. Selected wells should be sampled on a monthly basis to determine if there are seasonal changes in water quality or phenol content.
      2. Water levels should be recorded on a monthly basis from all aquifers.
      3. Stream and storm sewer monitoring at selected sites should be initiated to determine if phenol waste from Republic Creosoting is entering the surface waters of the area.
4. Shallow soil borings which penetrate the static water level of the upper flow systems should be constructed.
   (a) Soil samples should be taken and analyzed to determine phenol content.
5. Observation wells which would penetrate to the Jordan formation should be drilled to provide better control where subsurface information is lacking.
   (a) See Appendix A for construction details
   (b) These wells should be monitored as described above

6. A quantitative pumping test should be conducted in the immediate vicinity of the Republic Creosoting Company plant to determine aquifer characteristics of the glacial drift material.

7. A program of removal of water containing high phenol concentrations in the glacial drift immediately surrounding the Republic Creosoting plant should be initiated. The program should be based upon the results of the test outlined in No. 6 above. = "bailing wells" ??

8. An investigation should be made of all possible means of removal and disposal of the shallow, heavily saturated soils in the vicinity of the creosote plant. The best program should be selected and implemented at the earliest possible date. = excavation

9. Based on the data obtained from deep drilling a specific program to either remove the contaminated ground water from these aquifers or to control its further migration should be implemented.

10. Using pump test data construct removal wells (5) to pump contaminated water out of the ground within the area of highest concentration before it has an opportunity to migrate.

Respectfully submitted,

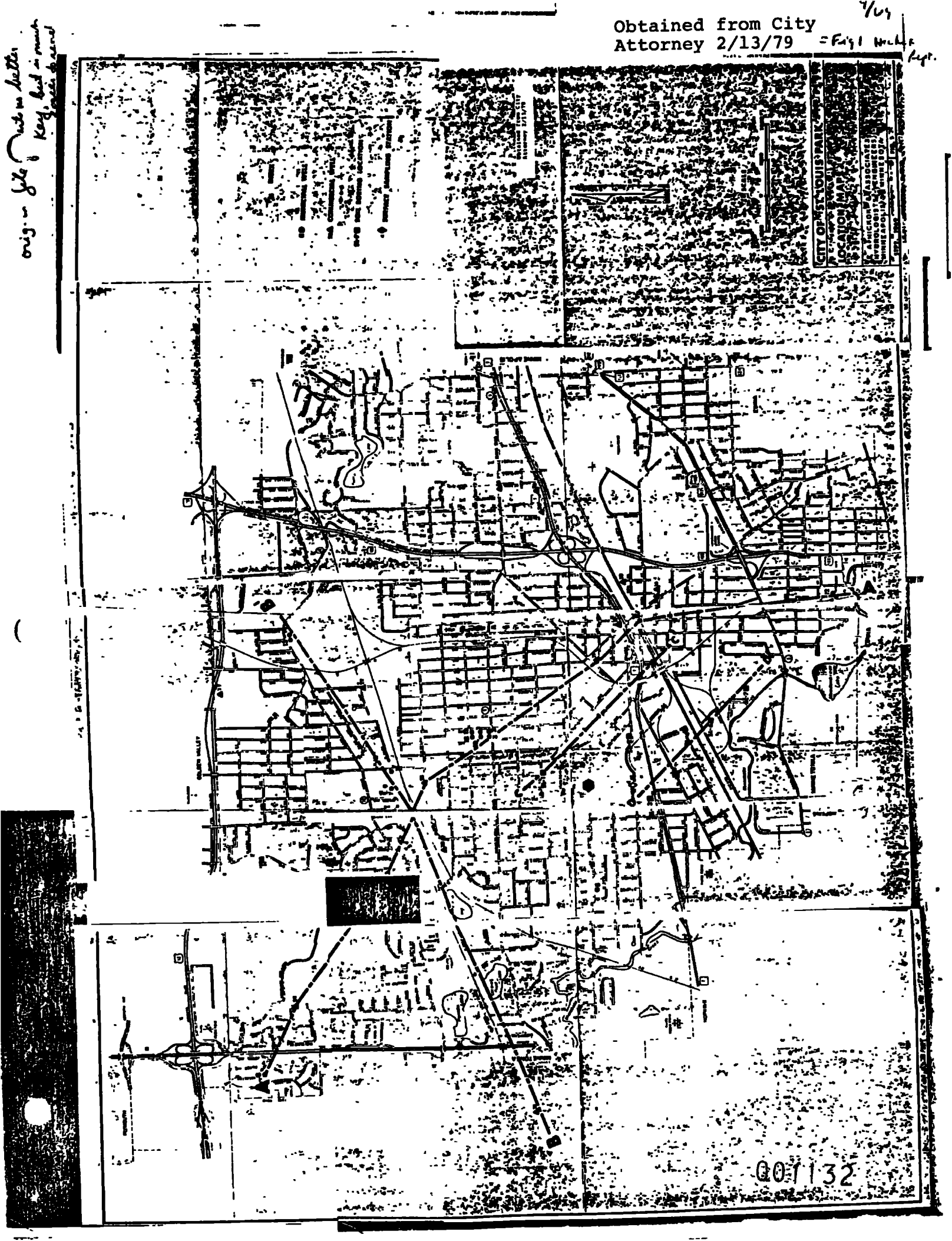
EUGENE A. HICKOK & ASSOCIATES

E.A. Hickok, P.E.

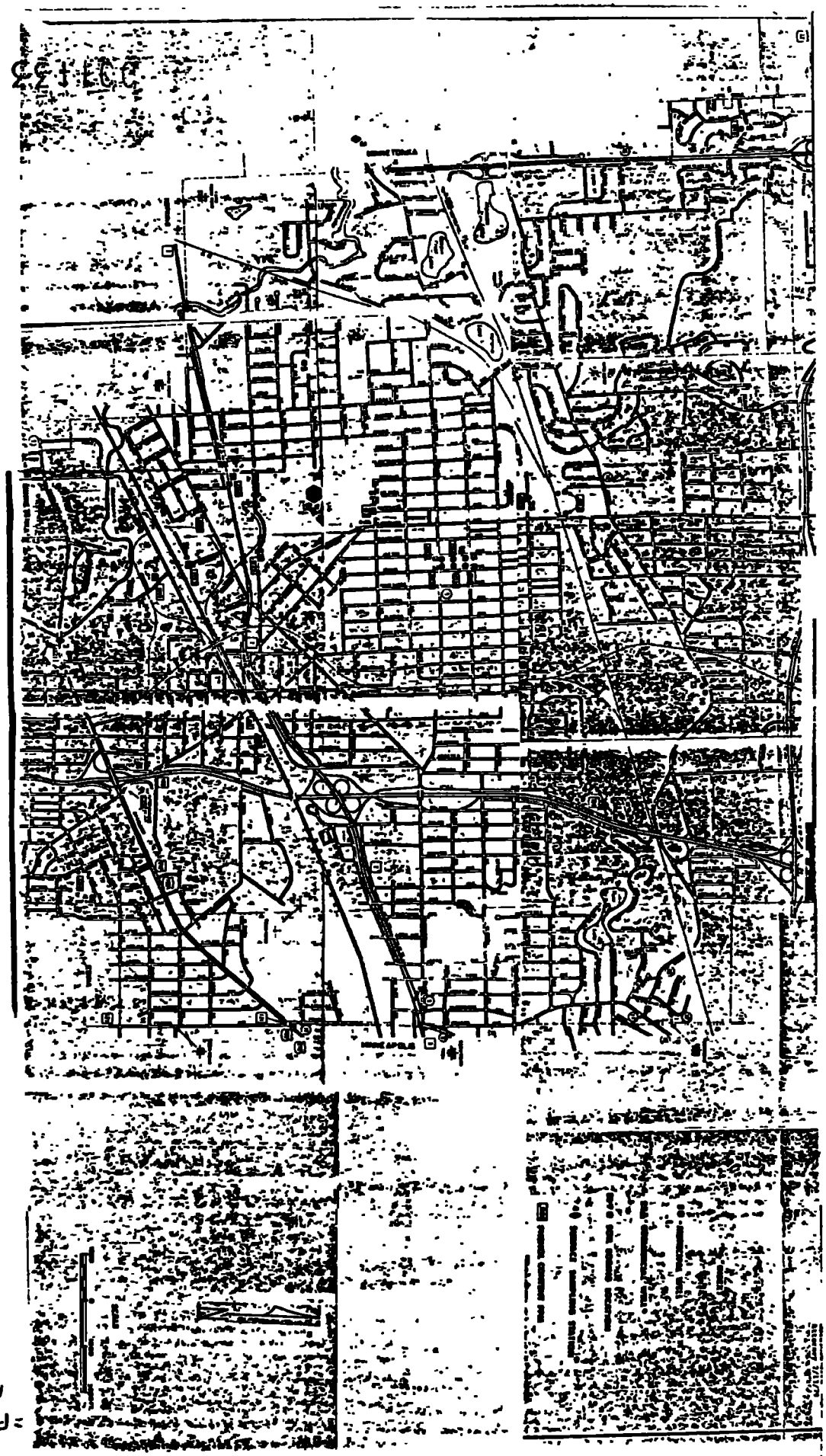
September 26, 1969

EAH:rc

Obtained from City Attorney 2/13/79



Obtained from City
Attorney 2/13/79



ST. LOUIS PARK PILOT STUDY

Run. No. 1 Date 9-25 & 9-26 80

PAC Concentration 15 mg/l GAC Flow Rate 4 GPM/Ft²

FLOW DATA

Well No. 11 Recorder	Well No. 11 Totalizer	Time	Well No. 15 Recorder	Well No. 15 Totalizer
1060	202459	8:48 a.m	980	1804
1060	202583	9:00 "	980	1922
1050	203235	10:00 "	950	2512
1040	203866	11:00 "	950	3091
1030	204472	NOON	940	3646
1020	205092	1:00 Pm	980A	4240
1020	205701	2:00 "	980	4832
1000	207023	4:10 "	970	6120
1000	208021	5:50 "	970	7081
990	201345	8:00 "	990A	8369
980	216031	7:30 a m.	960	14941

GAC Column Pressure

Time	No.	M	So.	Time Δt
8:30 a.m.	8.5	7.0	5.5	0
9:00	"	"	"	2
10:00	"	"	"	6
11:00	"	"	"	12
NOON	"	"	"	18
2:00 P	"	"	"	24
4:00	"	"	"	
8:00	"	"	"	
7:30 am	8.0	7.0	5.0	

Samples: (✓ indicates sample taken)

Time	#11 Raw	#15 Raw	Comb.	PAC	GAC
8:30 a.m.	✓	✓	✓		
9:00				✓	✓
10:00		✓		✓	✓
11:00		✓		✓	✓
NOON					
2:00 P		✓		✓	✓

A - Adjusted Flow

9605153

Run. No. 1 Date 4-29 & 4-30 80

PAC Concentration 11 mg/l GAC Flow Rate 8 GPM/Ft²

FLOW DATA

Well No. 11 Recorder	Well No. 11 Totalizer	Time	Well No. 15 Recorder	Well No. 15 Totalizer
1020	21,50[illegible]	8:30 a.m	980	16050
1030	21982[illegible]	9:00	960A	16350
1000	22041[illegible]	10:00	980	16932
990	22051	11:04	970	17566
980A	22162[illegible]	12:04 Pm	960A	18130
1000	22286	1:10 "	1000	18788
990	22278[illegible]	2:00 "	1000	19287
990	22397[illegible]	4:00 "	990	20492
990	-	6:45 "	990	-
990	22,861	8 00 "	990	22868
990	22,654	8 30 "	990	23161
990	23,441	7:45 a.m.	990	29619

GAC Column Pressure

Samples: (✓ indicates sample taken)

Time	No.	M	So.	Time Δt	#11 Raw	#15 Raw	Comb.	PAC	GAC
8:30 a.m	12.0	10.5	4.0	0		✓	✓		
10:00 a	"	"	"	2					
Noon	"	"	"	6				✓	✓
2:00 P	"	"	"	12		✓		✓	✓
4:00	"	"	"	18					
6:00	"	"	"	24		✓		✓	✓
8:00	"	"	"						
7:30 a.m.	10	8	6						

A - Adjusted flow

9605154

ST. LOUIS PARK PILOT STUDY

Run. No. 6 Date 2-26 & 2-27

~~PAC~~ Concentration H_2O_2 - 2 mg/l GAC Flow Rate

FLOW DATA

Well No. 11 Recorder	Well No. 11 Totalizer	Time	Well No. 15 Recorder	Well No. 15 Totalizer
		9:10am (2-27)	1000	81481
		9:00am (2-28)	"	95756

GAC Column Pressure

Time	No.	M	So.

Samples: (✓ indicates sample taken)

Time Δt	#11 Raw	#15 Raw	Comb.	PAC	GAC	H_2O_2
0						
2						✓
6						
12		✓				✓
18						
24		✓				✓

9605155

ST. LOUIS PARK PILOT STUDY

Run. No. 5 Date 2-25 & 2-26 81

~~PAC~~ Concentration H_2O_2 - 6mg/l ~~GAC~~ Flow Rate

FLOW DATA

Well No. 11 Recorder	Well No. 11 Totalizer	Time	Well No. 15 Recorder	Well No. 15 Totalizer
		8:45 a.m (2-26)	1000	66689
		9:10 a.m (2-27)	"	81330

GAC Column Pressure

Time	No.	M	So.

Samples: (✓ indicates sample taken)

Time Δt	#11 Raw	#15 Raw	Comb.	PAC	GAC	H_2O_2
0		✓				
2						✓
6		✓				✓
12		✓				✓
18						
24						✓

9605156

3.1

288

301.00
13.50
287.50

ST. LOUIS PARK PILOT STUDY

Run. No. 7 Date 10-24 & 10-30 80

PAC Concentration 5.5 mg/l GAC Flow Rate 16 GPm/Ft²

FLOW DATA

Well No. 11 Recorder	Well No. 11 Totalizer	Time	Well No. 15 Recorder	Well No. 15 Totalizer
990	342291	10:00 a.m	1000	52848
1040	342587	10:30 "	980	53135
1010	344741	1:45 Pm	960	55155
1010	344871	1:58 "	1000A	55278
1000	348099	7:30 "	1000	58451
1000	34 34 c2	8:00 "	1000	58757
980	35 58 55	8:30 a.m	1020	66235
1000	35 6149	9:00 a.m	1020	66533

GAC Column Pressure

Samples: (✓ indicates sample taken)

Time	No.	M	So.	Time Δt	#11 Raw	#15 Raw	Comb.	PAC	GAC
9:00 a.m	18	14	9	0					
10:00 "	16	12	6	2		✓	✓		
1:45 Pm	16	11	4	6				✓	✓
2:10 "	14	10	4	12			✓	✓	✓
7:30 "	14	10	4	18					
8:00 a.m	14	10	5	24			✓	✓	✓

A - Adjusted flow

9605157

ST. LOUIS PARK PILOT STUDY

Run. No. 3 Date 10-23 & 10.24 80

PAC Concentration 65mg/l GAC Flow Rate 12 GPM/FT^2

FLOW DATA

Well No. 11 Recorder	Well No. 11 Totalizer	Time	Well No. 15 Recorder	Well No. 15 Totalizer
1000	289594	8:00 a.m	1000	37231
1060	290208	9:00 "	970	37788
1060	292900	10:00 "	960	38402
1020A	291343	10:40 "	990A	38793
1020	293398	2:00 pm	980	40736
1000	295248	5:00 "	1000	42485
1000	295888	6:00 "	1000	43108
1000	297104	8:00 "	1000	44291
1020	301160	7:25 a.m	960	50947

GAC Column Pressure

Time	No.	M	So.	Time Δt	#11 Raw	#15 Raw	Comb.	PAC	GAC
9:00 am.	14	11	8	0					
10:00 "	15	12.5	10	2		✓	✓		
11:00 "	15	12	10	6				✓	✓
2:00 pm	15	12	10	12			✓	✓	✓
5:00 "	15	12	9.5	18					
6:00 "	15	12	9.5	24			✓	✓	✓
8:00 "	15	12	9.5						
7:30 a.m.	16	12	10						

Samples: (✓ indicates sample taken)

A - Adjusted flow

9605158

UNITED STATES GOVERNMENT

memorandum

DATE: June 10, 1981

REPLY TO ATTN OF: Chief, Central Laboratory, WRD, Denver, CO

SUBJECT: REPORTS AND STATISTICS - Water Quality: Results of the St. Louis Park water samples

TO: District Chief, WRD, Minneapolis MN
Attn: Marc Hult, WRD, St. Paul, MN

The custom analysis on six water samples from the St. Louis Park area have been completed.

The methods, procedures, and results for polynuclear aromatic hydrocarbons (PNA) by liquid chromatography are described in Chemist's Report I and by gas chromatography/mass spectrometry (GC/MS) in Chemist's Report II. Other organic compounds tentatively identified by GC/MS are reported in Chemist's Report II.

CHEMIST'S REPORT I

Six water samples (SLP #4, SLP #15, W-117, Flame Ind., W-13, and P-14) from Minnesota were each extracted with three - 40 mL portions of high performance liquid chromatographic (HPLC)-grade methylene chloride. The sample and the bottle were weighed before and after extraction. The methylene chloride extract was dried over sodium sulfate in a dark, explosion-proof refrigerator, for 2 hours or longer. (Previously, the sodium sulfate had been burned at 350°C for approximately 12 hours.) One-half milliliter HPLC-grade acetonitrile was added to the organic extract which was reduced to approximately 4 mL in a Kuderna-Danish (K-D) concentrator.

Special treatment was required with sample W-13. The interface between the methylene chloride and the aqueous layer on W-13 was not clearly discernable. A maximum amount of methylene chloride was removed from the separatory funnel without collecting any of the emulsified aqueous portion. Since some methylene chloride remained emulsified with the discarded aqueous layer, a portion of some constituents were lost. Therefore the reported values on W-13 are considered "minimum" values.

Sample P-14 was not concentrated after the K-D concentration step. The other samples were concentrated below 4 mL using an evaporative concentrator with dry, inert nitrogen flowing over the surface. After concentrating to 500 µL., 250 µL. were transferred to a micro-insert vial in the autoinjector and 100 µL. were injected into the high performance liquid chromatograph.

The instrument, column, and gradient conditions are as follows:

Instrument: Waters Associates - Model 440 (uv) detector at 254 nm. and 313 nm.

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5010-112

Accessories: "Wisp" 710B auto-injector and the Model 720 System Controller with Data Module.

Column: Reversed phase, Beckman "Ultrasphere" - ODS - (C_{18}) - 5 micron - 25 cm. x 4.6 mm. I.D.

Conditions: 40-100% CH_3CN/H_2O - 55 min. run - 1.0 mL/min. flow rate; Chartspeed: 1.0 cm./min.

Fourteen polynuclear aromatic hydrocarbon (PNA) stock standards were prepared individually from pure standard material in methylene chloride. Three working solutions (0.2-11.0 ng/μL concentration) were prepared in acetonitrile by diluting appropriate amounts of the stock solutions. The working solutions were injected preceding and following the six sample analysis run.

The fourteen PNA's prepared were:

1) Naphthalene
2) Acenaphthylene
3) Fluorene
4) Acenaphthene
5) Phenanthrene
6) Anthracene
7) Fluoranthene
8) Pyrene
9) Chrysene
10) 1,2-Benzanthracene
11) Benzo(a)pyrene
12) 1,2:5,6-Dibenzanthracene
13) Indeno (1,2,3-c,d) pyrene
14) Benzo [g,h,i] perylene

Each PNA has a characteristic absorbance peak response ratio between 254 nm. and 313 nm. This ratio, in addition to the retention times, was used to identify the PNA. The results on the six water samples showing their corresponding PNA concentrations were tabulated using integrated area counts or peak-height measurements. The results are shown on the attached table.

The reported concentrations for some PNA's are higher from the analyses performed by HPLC than those performed by GC/MS. The values reported from the HPLC analyses are probably high due to two or more compounds being present under one peak.

W. R. White

W. R. White
Chemist

9605160

PNA Concentrations of Minnesota (St. Louis Park) samples

(μg/L)

Sample	Naphthalene	Acenaphthylene	Fluorene	Acenaphthene	Phenanthrene	Anthracene	Fluoranthene
W-13	*220,000	**<5,250	*110,000	*D-I (interference)	*630,000	66,000	*420,000
P-14	*270	<2.0	*6.3	*20	*1.8	0.10	<0.30
Flame Ind.	**<0.019	<0.02	**<0.002	**<0.036	*0.01	<0.001	0.04
W-117	**<0.018	<0.02	<0.002	*4.9	<0.001	<0.001	<0.007
SLP #15	0.07	**<0.02	*0.73	**<0.035	*0.11	0.07	0.07
SLP #4 (GC/MS did not analyze this sample)	<0.018	<0.02	<0.002	<0.036	<0.001	<0.001	<0.007

* Detected by GC/MS and by LC
** Detected by GC/MS, not by LC
< Less than minimum detectable limit. Dilution factors are included where applicable.

9605161

PNA Concentrations of Minnesota (St. Louis Park) samples (con.)
(µg/L)

Sample	Pyrene	Chrysene	1,2 Benzanthracene	Benzo(a) pyrene	1,2:5,6 Di-benzanthracene	Indeno-(1,2,3-c,d) pyrene	Benzo [g,h,i,] Perylene
W-13	*500,000	**<360	*300,000	*160,000	16,000	27,000	*92,000
P-14	0.85	<0.14	<0.12	<0.18	<0.27	<0.09	<0.29
Flame Ind.	<0.006	<0.001	<0.003	<0.005	<0.012	<0.002	<0.007
W-117	<0.006	<0.001	<0.003	<0.004	<0.012	<0.002	<0.007
SLP #15	<0.006	<0.001	<0.003	<0.005	<0.012	<0.002	<0.007
SLP #4	<0.006	<0.001	<0.003	<0.005	<0.012	<0.002	<0.007

* Detected by GC/MS and by LC
** Detected by GC/MS, not by LC
< Less than minimum detectable limit. Dilution factors are included where applicable.

9605163

CHEMIST'S REPORT II

Six samples were received from the Minnesota District for acid/base-neutral extractables and volatiles analyses (one sample, SLP #4, for acid/base-neutral extractables was received broken). The samples for acid/base-neutral extractables were adjusted to pH 11 and extracted with three 50 mL portions of methylene chloride (extracts for each sample were composited). The samples were then adjusted to pH 2, saturated with 50 mL di-ethyl ether, and extracted as above with three 50 mL portions of methylene chloride. (NOTE: Sample W-13 contained a visible organic layer which was emulsified and co-extracted with the water phase. Due to the dark coloration of this sample, the interface between the extraction solvent and the water phase was difficult to determine. Consequently, the extracts containing the base-neutral components were conservatively withdrawn leaving an ambiguous emulsion. The emulsion was withdrawn into a separate flask to avoid contamination during the acid component extractions. This emulsion was not composited with the base-neutral extracts, but is believed to contain a great deal of the base-neutral components. Therefore, estimated concentration figures listed should be presumed to be minimum values.)

The composited extracts were reduced using a Kuderna-Danish concentrator and further reduced to approximately 0.5 mL using a nitrogen evaporator. Sample nos. P-14 and W-13 were known to be heavily contaminated and were diluted 1:10 and 1:2000 respectively for base-neutral analyses and 1:10 and 1:20 respectively for acid analyses. The extracts were submitted for gas chromatography/ mass spectrometric analysis.

10 µg of the internal standard, d_{10}-biphenyl, were added to each extract (or 0.5 mL aliquot of the diluted extract). Approximately 1 µL of the extract was injected onto a 25m x 0.25mm i.d. SE-54 coated fused silica capillary column using the Grob (splitless) injection technique. The gas chromatograph was temperature programmed as follows: Initial temperature 50°C hold for 5 min., program to 300°C at 6°C/min., hold 300°C for 15 min. The mass spectrometer was scanned from 35 to 450 amu at 1 sec/scan. Peaks of interest were determined using the Biemann-Biller search routine. Spectra were tentatively identified using a computer assisted search of the National Bureau of Standards (NBS) mass spectral library. Those spectra meeting specified "Purity" and "Fit" criteria are given tentative identification in the accompanying tables. "Purity"and "Fit" are indicators of how closely the unknown spectrum resembles the library spectrum with the best possible value for each beins "1000". Concentrations were estimated by comparing the base peak of the internal standard (m/e 164) with the base peak of the identified spectrum, assuming a relative response factor of 1.0. The concentration estimates may be considered to be accurate to the nearest order of magnitude. The detection limit for this method is on the order of 1 µg/L for all compounds except for diluted samples P-14

and W-13, for which the detection limits for the base-neutral analyses would be 10 µg/L and 2000 µg/L respectively and for the acid analyses would be 10 µg/L and 20 µg/L respectively.

Samples for volatiles analyses were analyzed per "Determination of Selected Volatile Organic Priority Pollutants in Water by Computerized Gas Chromatography-Quadrapole Mass Spectrometry" by W. Pereira and B. Hughes as published in the Journal of the American Water Works Association, April, 1980. The samples were analyzed quantitatively for the following compounds and qualitatively for all others reported: (— on the volatiles tables indicates no quantitation was done.)

Methylene Chloride
Cyclohexane
Benzene
Trichloroethene
Toluene
Ethylbenzene

The detection limit for volatile compounds is on the order of 1 µg/L for all samples analyzed.

Michael Brooks

Michael Brooks
Chemist

There is no cost for these analyses in accordance with the agreement made by our previous laboratory chief. Rolly Grabbe had recommended that we request samples from you to test our new PNA method on waters containing detectable quantities of PNA's and to test our GC/MS method, used for oil shale retort waters, on the coal tar waste waters.

If you have questions, please call Rolly Grabbe at FTS 234-4992.

Howard E. Taylor
Chief, Denver Central Laboratory

rw

Attachments

cc: H. Feltz, WRD, Reston, VA
Analytical Services Coordinator, Reston, VA
Chief, Atlanta Central Laboratory
Regional Hydrologist, NE, Reston, VA
Regional Hydrologist, CR, Denver, CO

Table 1.

SLP #15

Scan #	Tentative Identification	Purity	Fit	Est. Conc. (µg/L)
Base-Neutral:				
629	2,3 dihydro-1H-indene	922	992	1
841	4-methyl-2,3-dihydro-1H-indene	920	950	<1
1203	biphenyl	885	898	<1
1259	dimethylnaphthalene	913	926	<1
1300	acenaphthylene	931	954	1
1349	acenaphthene	978	989	1
1390	dibenzofuran	943	980	1
1477	fluorene	915	955	1
1715	phenanthrene	664	858	<1
Acid:				
541	phenol	922	962	4
Volatiles:				
59	methylene chloride	975	993	9
154	pentane	939	958	--
220	benzene	457	985	1
220	trichloroethene	490	996	2

Table 2

Flame Ind.

Scan #	Tentative Identification	Purity	Fit	Est. Conc. (µg/L)
Base-Neutral:				
639	2,3-dihydro-1H-indene	824	954	<1
901	naphthalene	976	996	1
917	1-(2-butoxy ethoxy)ethanol	855	984	15
1350	acenaphthene	910	924	<1
1479	fluorene	881	915	<1
1716	phenanthrene	709	818	<1
Acid:				
534	phenol	940	982	1
Volatiles:				
58	methylene chloride	800	976	5
169	1,1,1-trichloroethane	498	743	--
219	benzene	669	986	1
219	trichloroethene	---	---	<1
304	tetrachloroethene	396	794	<1

Table 3

W-117

Scan #	Tentative Identification	Purity	Fit	Est. Conc. (µg/L)
Base-Neutral:				
224	tetrachloroethene	974	998	25
360	xylene	942	992	2
423	(1-methylethyl)benzene	919	970	<1
532	ethylmethylbenzene	915	985	1
640	2,3-dihydro-1H-indene	910	994	30
722	dihydrobenzofuran	815	896	<1
734	methyl-2,3-dihydro-1H-indene	867	994	3
756	7-methylbenzofuran	906	978	2
763	3-phenyl-2-propenal	915	994	1
772	2-methylbenzofuran	871	967	1
845	methyl-2,3-dihydro-1H-indene	813	955	2
854	1,2,3,4 tetrahydro-1,4-methano-naphthalen-9-one	868	933	1
902	naphthalene	920	973	<1
910	dimethyl-2,3-dihydro-1H-indene	851	895	<1
927	dimethyl-2,3-dihydro-1H-indene	869	925	<1
1018	2,3-dihydro-benzo/B/thiophene	917	996	2
1059	2,3 dihydro-1H-indene-1-one	847	992	<1
1068	methylbenzo/B/thiophene	919	984	1
1102	methylbenzo/B/thiophene	888	966	<1
1157	diethylphenol	807	916	1
1164	dimethyl(methylethyl)benzene	785	953	<1
1184	2-(2 methyl-2-propenyl)phenol	804	929	<1
1254	pentamethylbenzene	840	928	<1
1350	acenaphthene	942	992	2
1688	3-methyl-2(1H)-quinolinone	813	906	<1
1755	4-methyl-2(1H)-quinolinone	803	876	<1
Acid:				
529	phenol	926	981	1

Table 3 (con.)

W-117

Volatiles:

59	methylene chloride	821	981	9
87	dichloroethene (3 isomers)	784	990	--
124	dichloroethene	971	997	--
134	dichloroethene	978	997	--
154	pentane	787	907	--
169	cyclohexane	854	961	2
219	benzene	---	---	10
220	trichloroethene	922	995	500
305	tetrachloroethene	976	995	280
316	toluene	882	956	<1
363	ethylbenzene	834	969	<1

Table 4

P-14

Scan #	Tentative Identification	Purity	Fit	Est. Conc. (µg/L)
Base-Neutral:				
259	cyclohexanone	867	890	<10
291	ethylbenzene	944	998	500
305	xylene	922	987	400
319	dimethylthiophene	893	961	<10
351	xylene	922	983	250
415	(1-methylethyl)benzene	941	997	30
438	methyl cyclohexanol	848	972	<10
459	2-propenylbenzene	907	947	<10
491	ethylmethylbenzene	899	997	100
505	trimethylbenzene	920	996	50
525	aniline	929	998	10
527	ethylmethylbenzene	849	925	30
539	benzonitrile	835	996	30
555	ethylmethylbenzene	905	975	300
562	benzo furan	863	958	400
612	trimethylbenzene	893	994	50
639	2,3-dihydro-1H-indene	910	994	300
659	1H-indene	914	981	700
680	2-methylphenol	931	997	150
723	3-methylphenol	894	983	300
744	trimethyl-2-cyclopenten-1-one	794	967	<10
756	methylbenzofuran	902	978	50
766	3-phenyl-2-propenal	926	994	100
775	dimethylphenol	873	997	300
828	1-methyl-2,3-dihydro-1H-indene	795	823	20
830	ethylphenol	686	950	100
836	ethylphenol	933	995	100
846	3-methylindene	904	959	50
854	dimethylphenol	891	993	350
858	1,2,3,4-tetrahydro-1,4-methano-naphthalen-9-one	845	864	50
866	dimethylphenol	830	935	500
894	ethylphenol	848	947	250
911	naththalene	852	923	850
915	dimethylphenol	831	937	150
937	1,6-dimethyl-2,3-dihydro-1H-indene	720	773	<10

Table 4 (con.)

P-14

Base-Neutral:

948	trimethylphenol	881	988	200
963	dimethylbenzo furan	825	921	<10
983	ethylmethylphenol	853	989	150
988	trimethylphenol	866	982	200
1001	ethylmethylphenol	890	998	350
1007	ethylmethylphenol	844	985	250
1039	ethylmethylphenol	835	997	350
1047	trimethylphenol	893	996	150
1054	trimethylphenol	878	994	200
1063	diethylphenol	720	919	<1
1071	2,3-dihydro-1H-indene-1-one	929	997	50
1087	2-methylnaphthalene	868	997	500
1112	2-methylnaphthalene	873	978	400
1155	dimethylbenzaldehyde	797	993	200
1209	biphenyl	914	989	100
1214	p-(2 methylallyl)phenol	811	948	20
1220	pentamethyl benzene	806	956	50
1229	2-ethylnaphthalene	808	972	30
1244	dimethylnaphthalene	803	948	20
1265	dimethylnaphthalene	637	951	30
1270	dimethylnaphthalene	813	864	20
1292	dimethylnaphthalene	835	967	10
1313	dimethylnaphthalene	870	979	10
1321	hexamethylbenzene	780	921	20
1356	acenaphthene	934	990	20
1368	triethylbenzene	696	944	10
1388	2-naphthalenol	795	984	50
1395	1,1'-biphenyl-2-ol	774	936	30
1397	dibenzofuran	808	876	100
1399	1-naphthalenol	868	980	100
1429	fluorene	896	974	40
1456	2-methylnaphthalenol	865	967	10
1477	1-methylnaphthalenol	618	910	10
1503	4-methylnaphthalenol	665	911	<10
1657	phenanthrene	933	970	100
1721	9-H-carbazole	885	989	30
1759	dibenzo/B,E/1,4/dioxin	804	891	<10

Table 4 (con.)

P-14

Acid:

536	phenol	958	976	10
675	methylphenol	927	993	40
719	methylphenol	892	979	150
766	dimethylphenol	870	991	<10
824	2-ethylphenol	951	995	20
843	dimethylphenol	898	992	100
884	dimethylphenol	887	987	150
916	dimethylphenol	913	995	100
925	3-chlorophenol	921	998	30
991	ethylmethylphenol	740	951	10
1025	ethylmethylphenol	866	987	40
1050	benzene acetic acid	900	968	30
1089	3-methylbenzoic acid	872	985	20
1095	4-methylbenzoic acid	699	776	<10
1246	dimethylbenzoic acid	608	917	<10
1411	methylpropylphenol	705	883	10
1604	2-naphthalencarboxylic acid	841	970	<10
1621	1-naphthalencarboxylic acid	845	927	30

Volatiles:

58	methylenechloride	885	992	8
169	cyclohexane	691	908	<1
182	thiophene	840	985	--
195	cyclohexene	928	975	--
219	benzene	948	972	110
220	trichloroethene	---	---	1
242	cycloheptene	891	907	--
259	methylcyclohexane	777	981	--
268	tetrahydro-2-methyl thiophene	754	983	--
278	3-methyl thiophene	868	975	--
305	tetrachloroethene	573	957	<1
315	toluene	928	994	56
332	ethylthiophene	833	980	--
362	ethylbenzene	865	949	160
367	dimethylthiophene	603	870	--
373	dimethylthiophene	874	960	--

Table 5

W-13

Scan #	Tentative Identification	Purity	Fit	Est. Conc. (µg/L)
Base-Neutral:				
314	ethylbenzene	954	996	2,000
328	xylene	937	995	6,000
370	xylene	938	983	2,000
502	ethylmethylbenzene	907	994	2,000
514	trimethylbenzene	931	991	2,000
536	ethylmethylbenzene	886	907	2,000
562	trimethylbenzene	921	991	4,000
567	benzofuran	852	919	4,000
576	hydrocarbon			*
616	trimethylbenzene	938	993	2,000
624	2-propenylbenzene	893	920	<2,000
640	2,3-dihydro-1H-indene	915	988	20,000
656	1-H-indene	947	987	20,000
681	methylphenol	924	982	<2,000
685	isopropylmethyl benzene	912	977	<2,000
720	methylphenol	767	978	2,000
754	7-methylbenzofuran	930	970	<2,000
760	hydrocarbon			*
763	3-phenylpropenal	946	993	2,000
786	tetramethylbenzene	937	967	<2,000
825	4-methyl-2,3-dihydro-1H-indene	897	996	2,000
845	5-methyl-2,3-dihydro-1H-indene	699	948	4,000
847	dimethylphenol	881	950	2,000
853	methylindene	897	955	2,000
885	dimethylphenol	875	986	2,000
907	naphthalene	896	993	230,000
930	hydrocarbon	---	---	*
933	5,6-dimethyl-1H-benzeneimidazole	842	911	<2,000
952	hydrocarbon	---	---	*
954	4,7-dimethylbenzofuran	856	949	<2,000
964	hydrocarbon	---	---	*
992	ethylmethylphenol	775	940	<2,000
1008	1,3-dimethyl-2,3-dihydro-1H-indene	869	938	<2,000
1031	4,7-dimethyl-2,3-dihydro-1H-indene	625	846	<2,000
1046	hydrocarbon	---	---	*

Table 5 (con.)

W-13

Base-Neutral:

1067	5-methyl-benzo/B/thiophene	943	984	2,000
1080	2-methylnaphthalene	914	997	120,000
1085	hydrocarbon	---	---	*
1091	6-methyl-benzo/B/thiophene	897	944	2,000
1105	1-methylnaphthalene	898	977	4,000
1204	biphenyl	927	988	20,000
1224	2-ethylnaphthalene	856	972	10,000
1230	hydrocarbon	---	---	*
1239	dimethylnaphthalene	924	994	20,000
1250	3,6-dimethylbenzo/B/thiophene	720	900	<2,000
1261	dimethylnaphthalene	915	995	10,000
1265	dimethylnaphthalene	924	994	10,000
1287	dimethylnaphthalene	918	993	6,000
1300	acenaphthylene	912	982	4,000
1308	dimethylnaphthalene	878	966	4,000
1316	hydrocarbon	---	---	*
1352	acenaphthene	931	988	8,000
1366	hydrocarbon	---	---	*
1395	dibenzofuran	913	990	60,000
1410	trimethylnaphthalene	819	944	4,000
1483	fluorene	884	964	40,000
1494	hydrocarbon	---	---	*
1503	1-(2-propenyl)naphthalene	849	932	2,000
1526	methyldibenzofuran	837	963	8,000
1543	methyldibenzofuran	902	978	10,000
1554	hydrocarbon	---	---	*
1596	dehydrophenanthrane	912	974	6,000
1611	dihydrophenanthrene	815	973	2,000
1615	hydrocarbon	---	---	*
1620	methylfluorene	890	982	6,000
1622	hydrocarbon	---	---	*
1629	methylfluorene	684	916	4,000
1642	methylfluorene	697	959	2,000
1668	hydrocarbon	---	---	*
1678	hydrocarbon	---	---	*
1685	dibenzothiophene	780	966	10,000
1722	phenanthrene	939	984	110,000
1731	hydrocarbon	---	---	*
1733	anthracene	899	957	2,000
1741	hydrocarbon	---	---	*

Table 5 (con.)

W-13

Base-Neutral:

1781	9-H-carbazole	813	973	10,000
1804	1-phenylnaphthalene	754	905	2,000
1820	methyldibenzothiophene	734	940	2,000
1840	hydrocarbon	---	---	*
1845	methylphenanthrene	908	974	8,000
1852	methylphenanthrene	895	980	8,000
1877	methylphenanthrene	722	879	6,000
1926	2-phenylnaphthalene	869	967	4,000
1946	hydrocarbon	---	---	*
1962	dimethylphenanthrene	766	926	<2,000
1972	dimethylphenanthrene	715	946	<2,000
1991	dimethylphenanthrene	771	959	2,000
2025	fluoranthene	956	994	4,000
2046	hydrocarbon	---	---	*
2077	pyrene	944	985	2,000
2168	methylpyrene	844	964	4,000
2185	methylpyrene	890	943	2,000
2190	methylpyrene	605	857	2,000
2212	methylpyrene	808	955	<2,000
2220	methylpyrene	797	933	<2,000
2235	hydrocarbon	---	---	*
2279	1,1':2',1" terphenyl	713	860	<2,000
2321	benzo/B/naphtho/2,1-D/thiophene	858	938	<2,000
2332	benzo/C/phenanthrene	783	851	<2,000
2383	benz/A/anthracene	917	981	4,000
2393	chrysene	856	952	4,000
2644	benzo/K/fluoranthene	848	883	<2,000
2701	perylene	879	891	<2,000
3017	benzo/g,h,i/perylene	752	813	<2,000

*"hydrocarbon" refer to a series of alkanes which cannot be distinguished by mass spectrometry - Total estimated concentration 70,000 µg/L.

Table 5 (con.)

W-13

Acid:

539	phenol	958	991	50
679	methylphenol	911	992	60
720	methylphenol	895	981	300
846	dimethylphenol	602	992	20
884	dimethylphenol	895	984	100
921	dimethylphenol	651	852	<20
1028	ethylmethylphenol	756	915	<20
1030	benzeneacetic acid	876	960	20
1036	methylbenzoic acid	694	923	40
1096	methylbenzoic acid	762	911	100
1604	2-naphthalene carboxylic acid	771	987	20

Volatile:

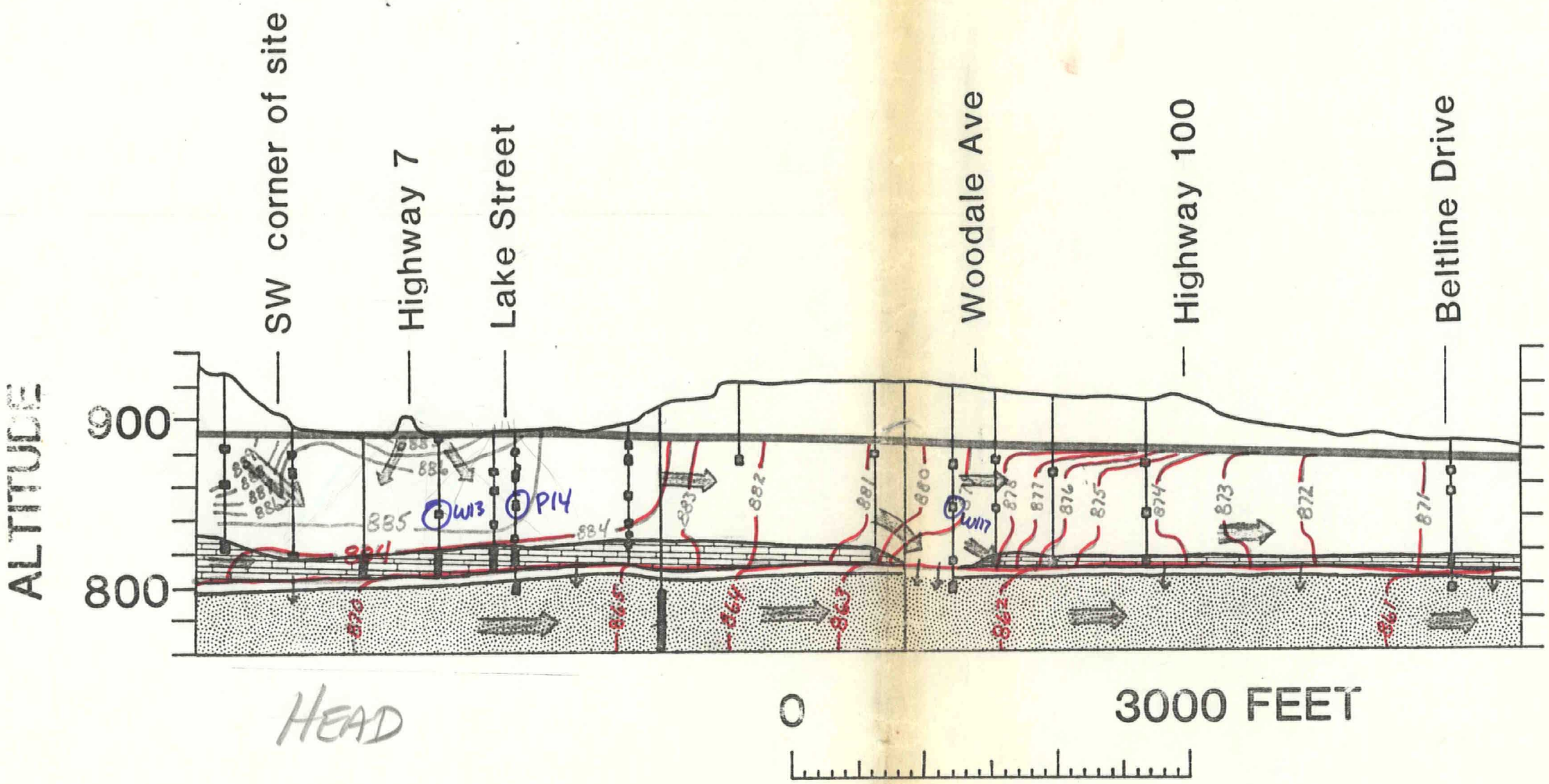
58	methylene chloride	758	976	5
154	pentane	945	960	--
170	cyclohexane	917	972	8
182	thiophene	831	938	--
215	methylcyclopentene	820	859	--
218	benzene	921	950	240
242	cyclo heptene	838	885	--
259	methylcyclohexane	892	994	--
268	tetrahydro-2-methyl-thiophene	794	879	--
278	methylthiophene	837	962	--
312	toluene	866	980	270
332	dimethylcyclohexane	754	923	--
359	trimethylcyclohexane	532	963	--
361	ethylbenzene	788	912	370
365	dimethylthiophene	708	823	--
367	methylheptane	897	979	--
372	dimethylthiophene	694	954	--
394	dimethylheptane	925	992	--

Table 6

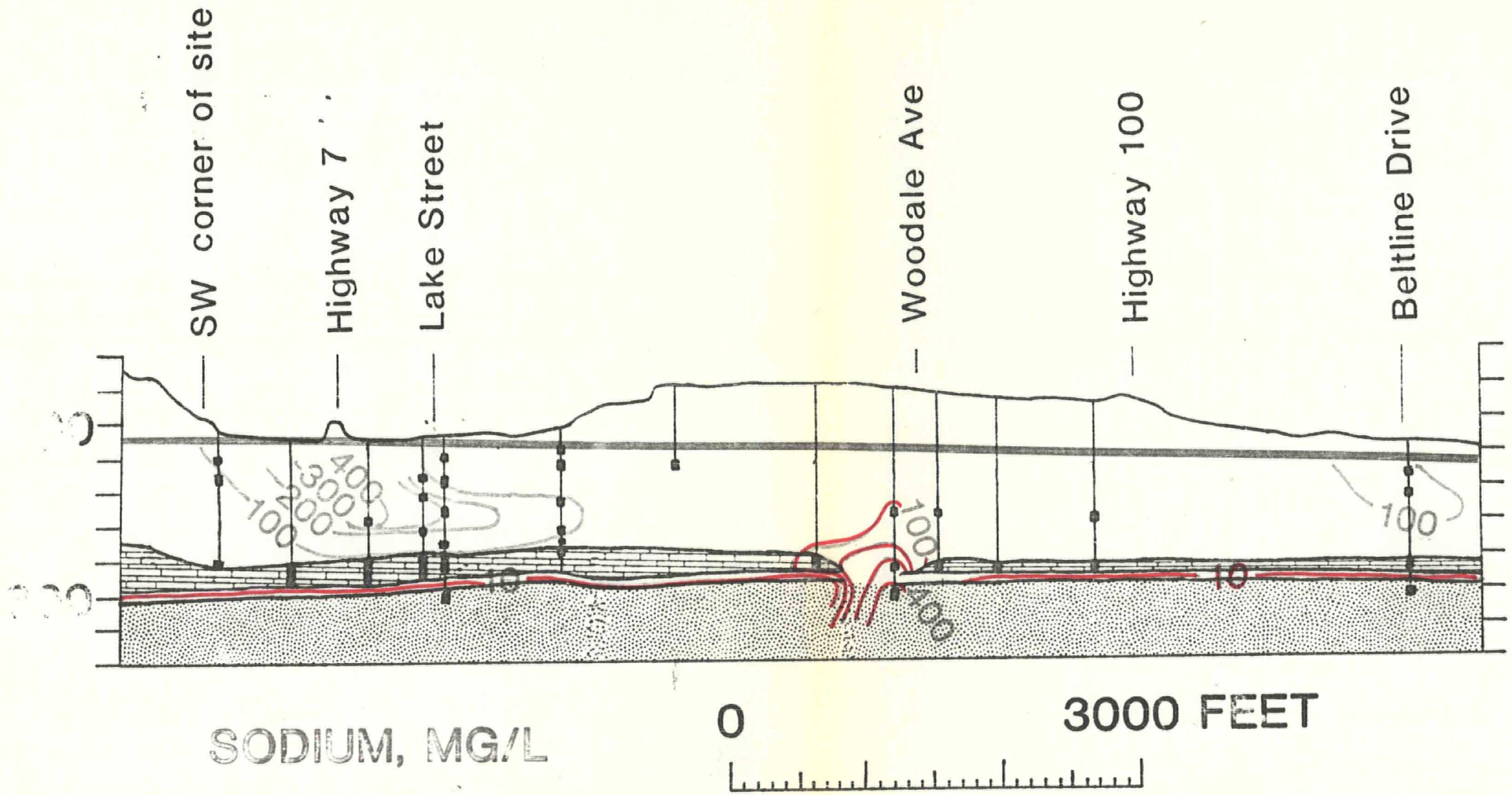
SLP #4

Scan #	Tentative Identification	Purity	Fit	Est. Conc. (µg/L)
Volatiles:				
58	methylene chloride	890	995	12
153	pentane	911	949	--
219	benzene	742	987	1
220	trichloroethene	---	---	<1
304	tetrachloroethene	265	818	<1
325	trimethylbenzene	837	965	--
395	trimethylbenzene	883	993	--
397	trimethylbenzene	820	994	--

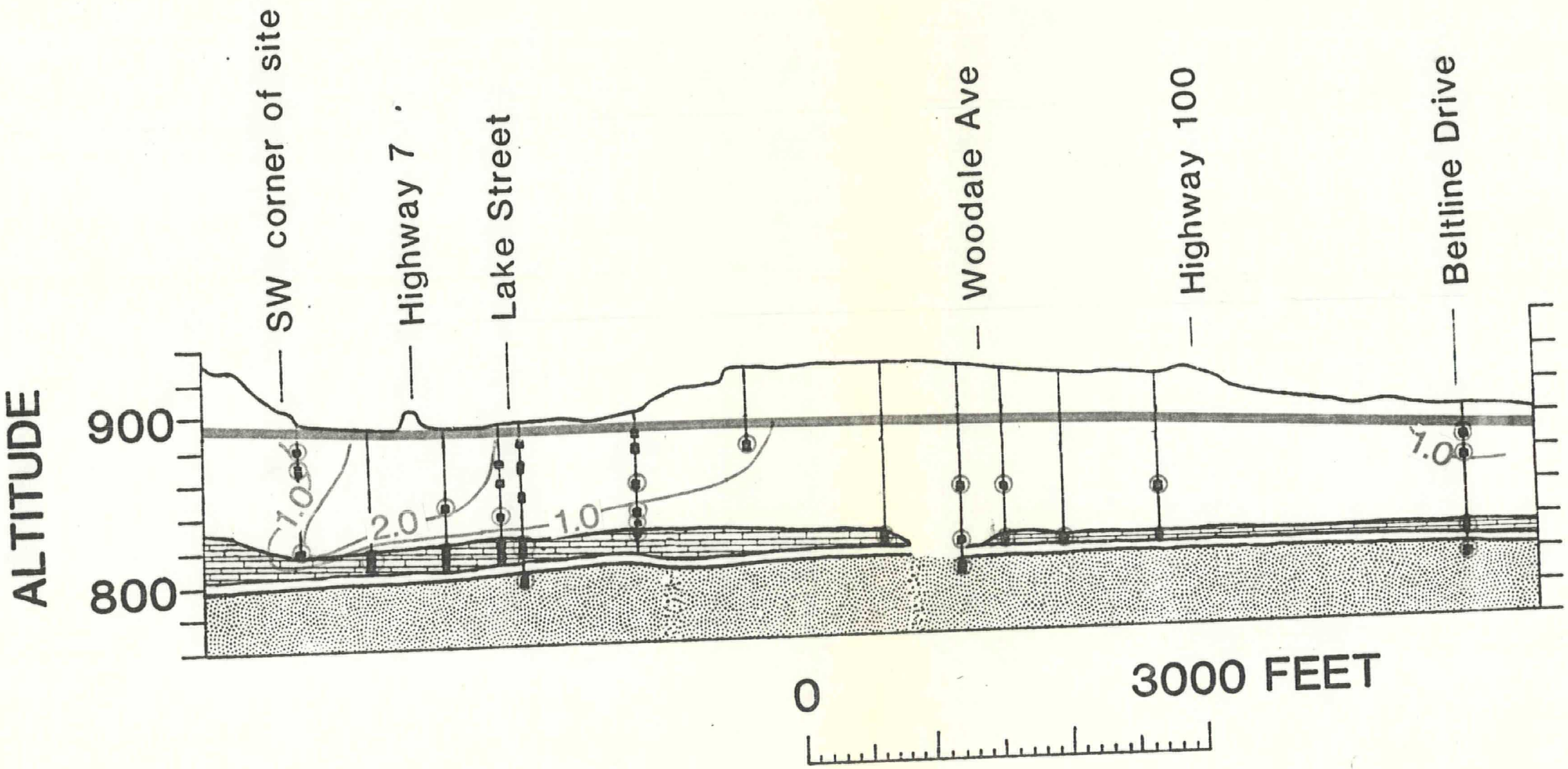
Acid/Base-neutral (sample received broken).


SW corner of site
Highway 7
Lake Street
Woodale Ave
Highway 100
Beltline Drive
ALTITUDE
900
800
885
884
W13
P14
W17
HEAD
0
3000 FEET

9605178

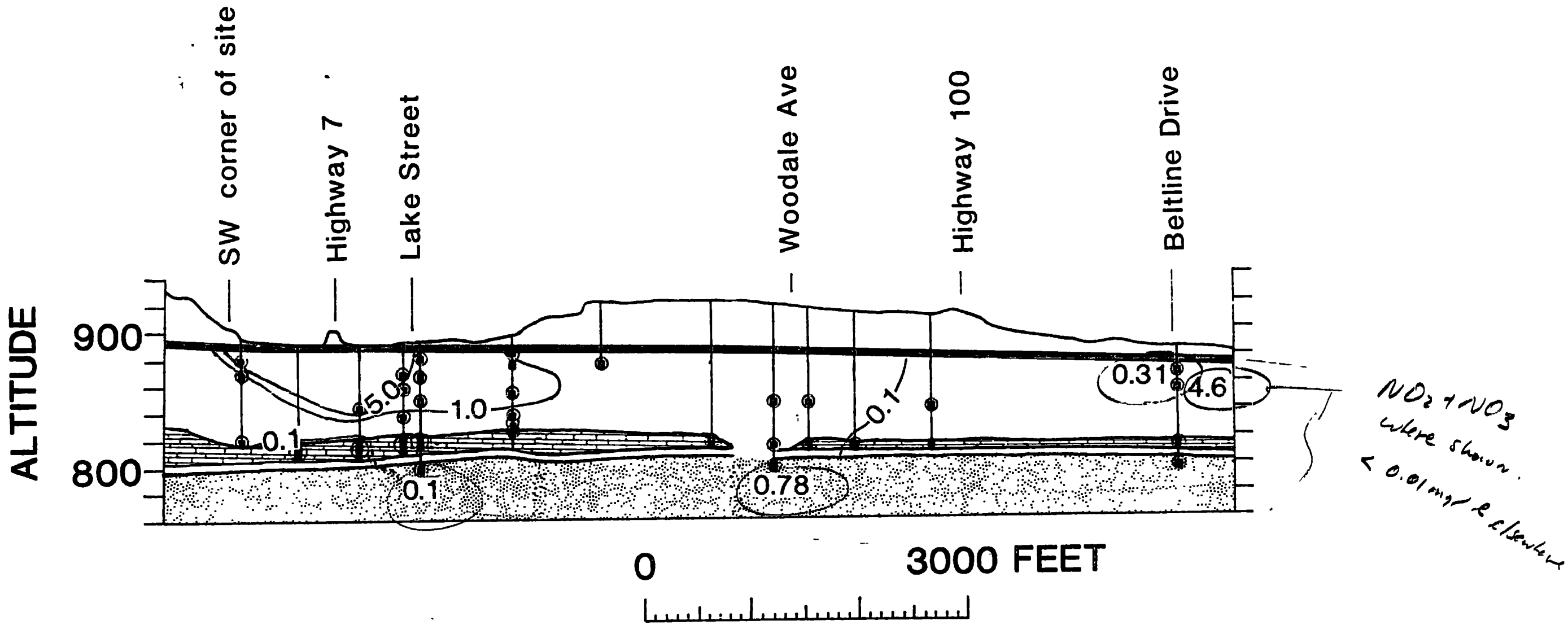

SW corner of site
Highway 7
Lake Street
Woodale Ave
Highway 100
Beltline Drive
400
300
200
100
10
100
400
10
100
SODIUM, MG/L
0
3000 FEET

9605179

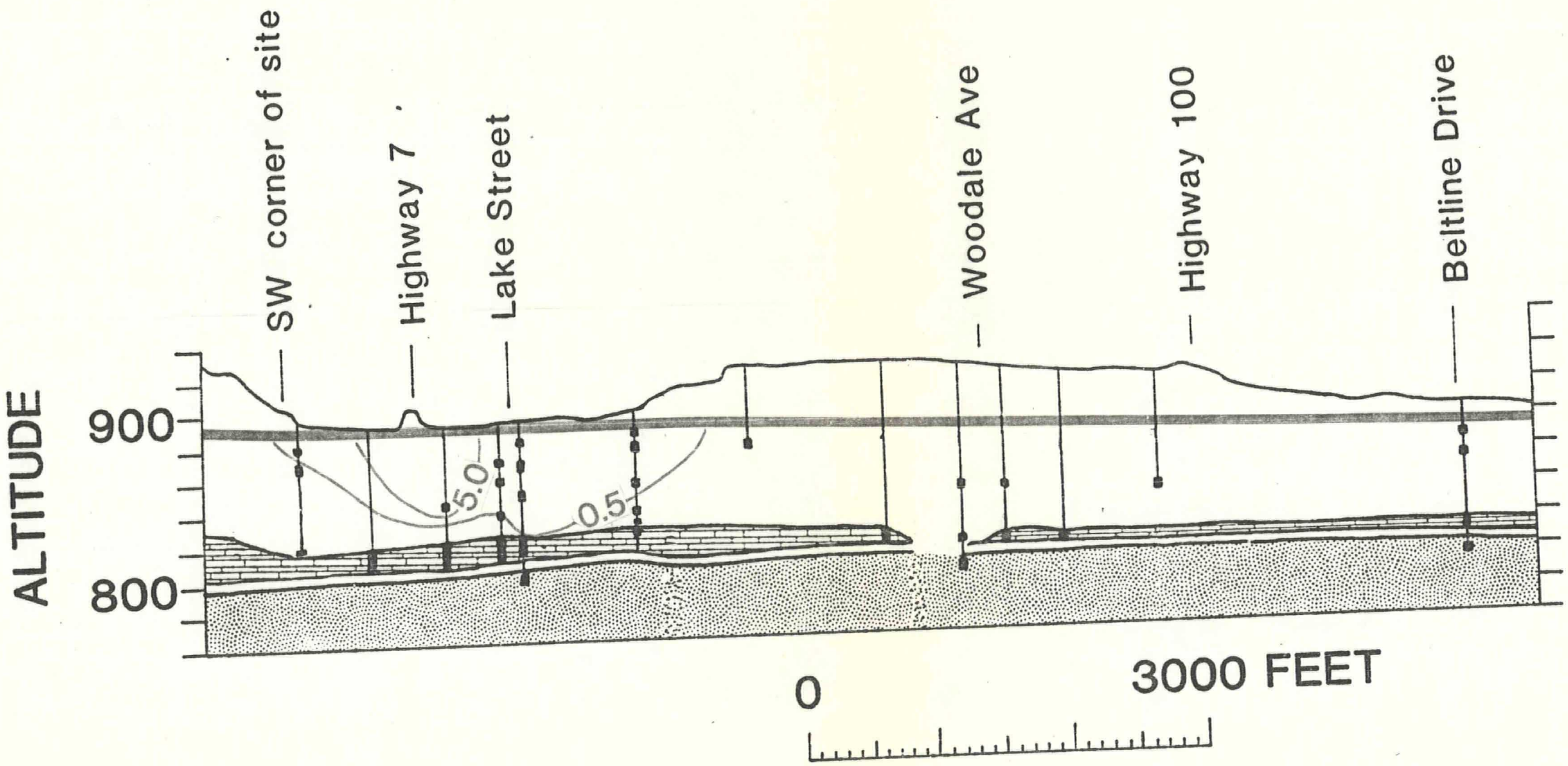


MOLAR RATIO OF SODIUM TO CHLORIDE

9605180

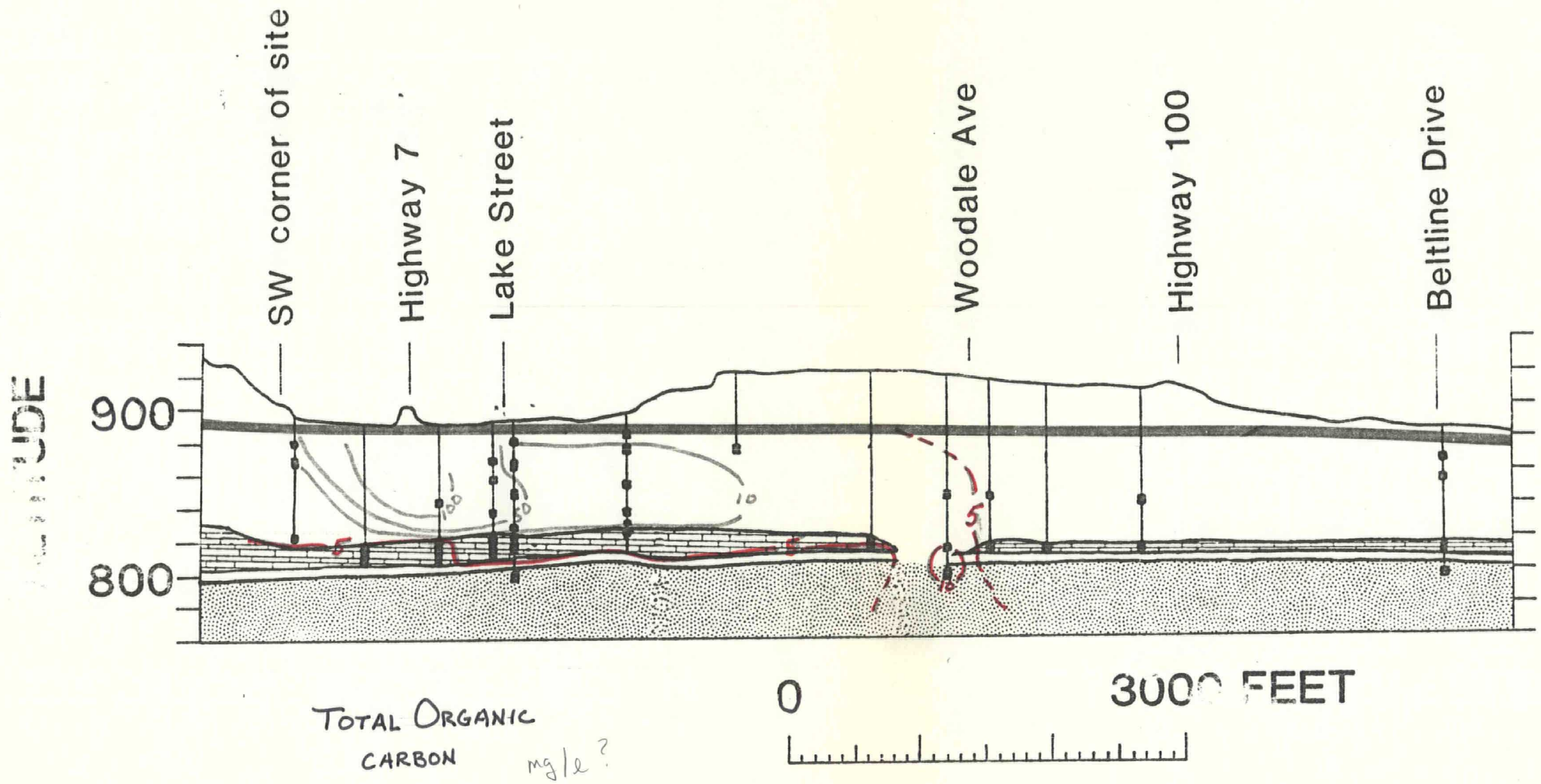

SW corner of site
Highway 7
Lake Street
Woodale Ave
Highway 100
Beltline Drive
ALTITUDE
900
800
5.0
1.0
0.1
0.1
0.1
0.78
0.31
4.6
0
3000 FEET
AMMONIA, MG/L
NO2+NO3
NO2+NO3 where shown.
< 0.01 mg/l elsewhere

9605181

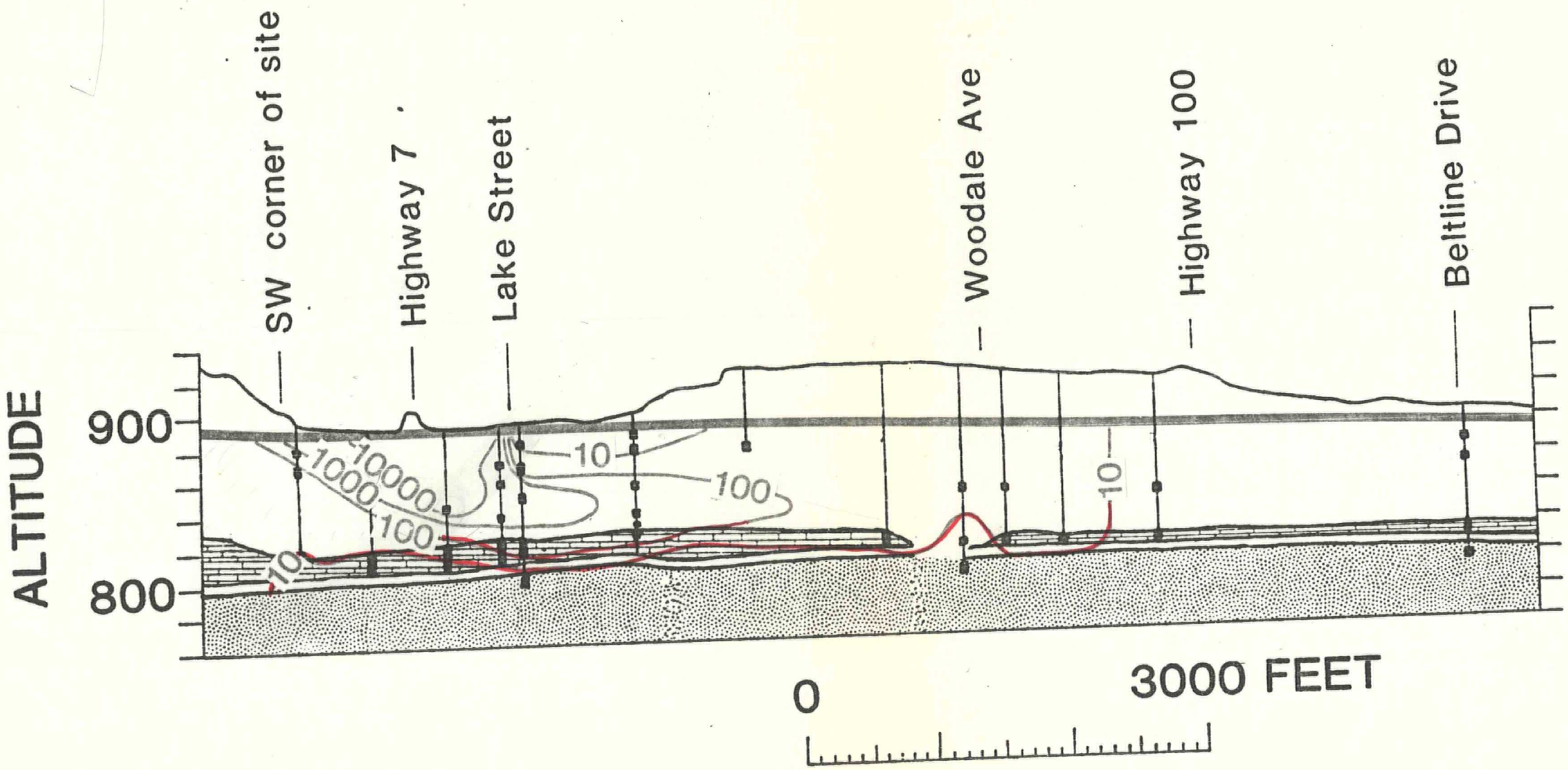


CHROMIUM, UG/L

9605182

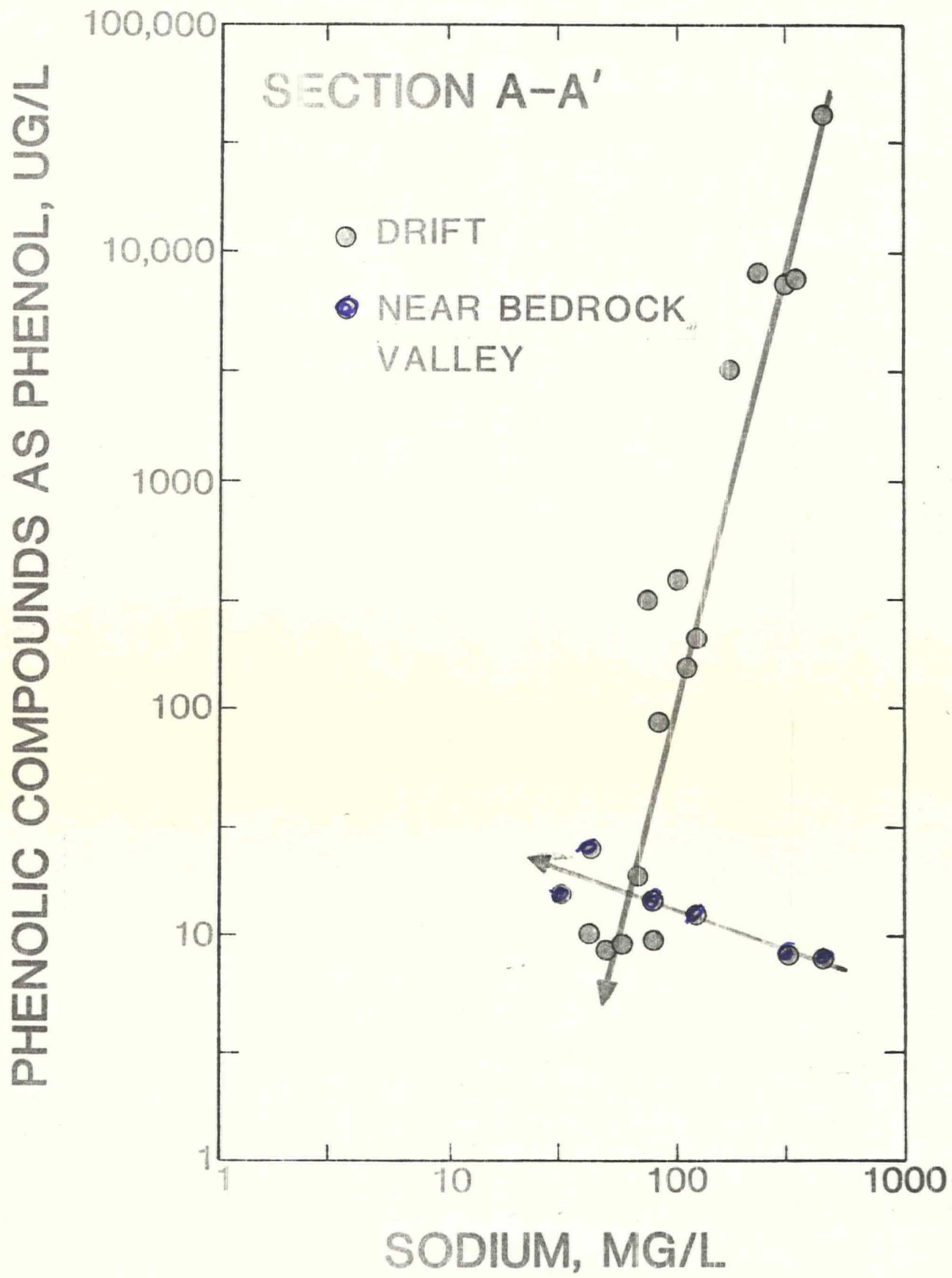

SW corner of site
Highway 7
Lake Street
Woodale Ave
Highway 100
Beltline Drive
900
800
100
50
10
5
0
3000 FEET
TOTAL ORGANIC
CARBON
mg/l ?

9605183

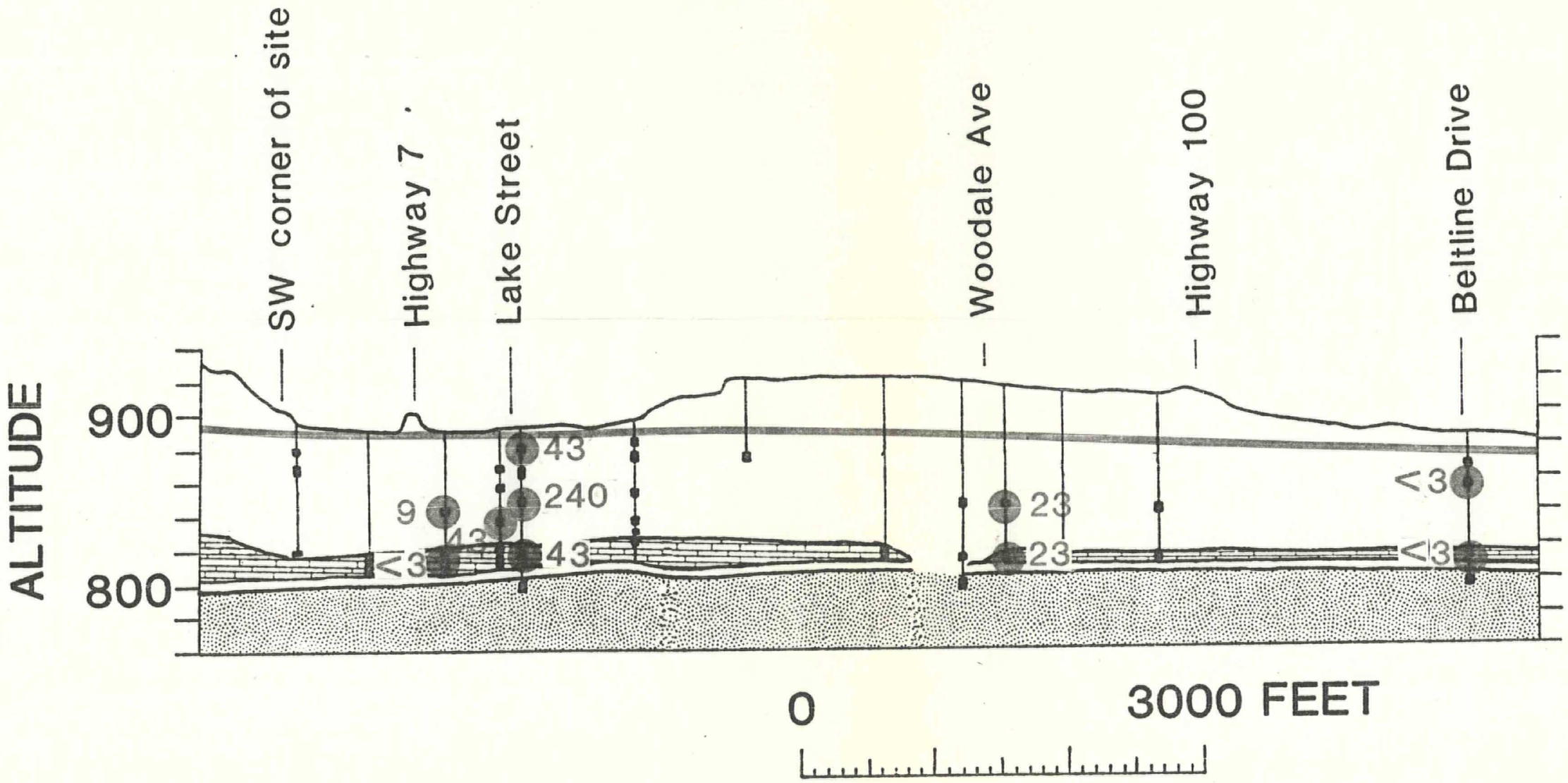


PHENOLIC COMPOUNDS, UG/L

9605184

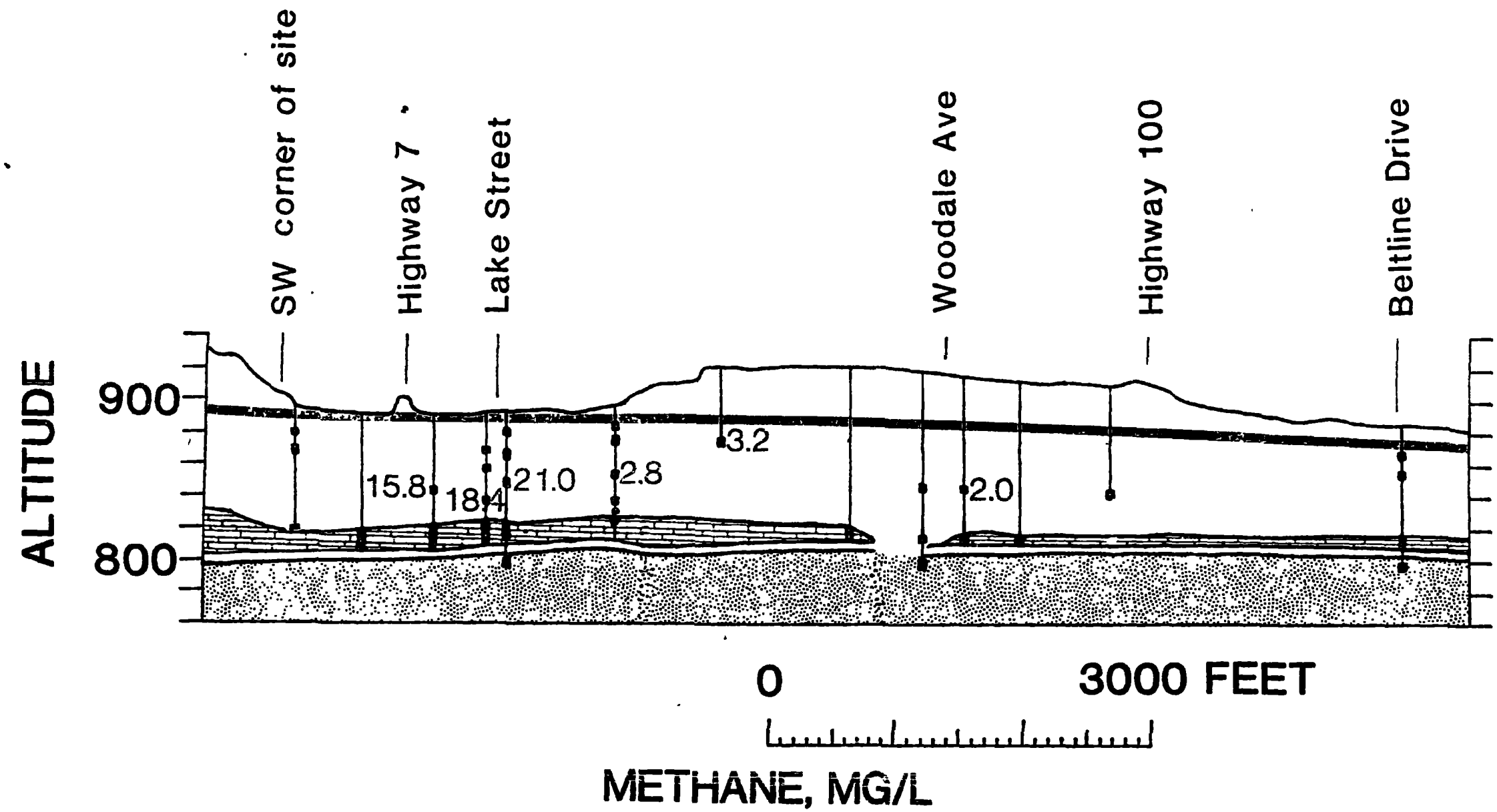

SECTION A-A'
DRIFT
NEAR BEDROCK VALLEY
PHENOLIC COMPOUNDS AS PHENOL, UG/L
100,000
10,000
1000
100
10
1
1
10
100
1000
SODIUM, MG/L

9605185

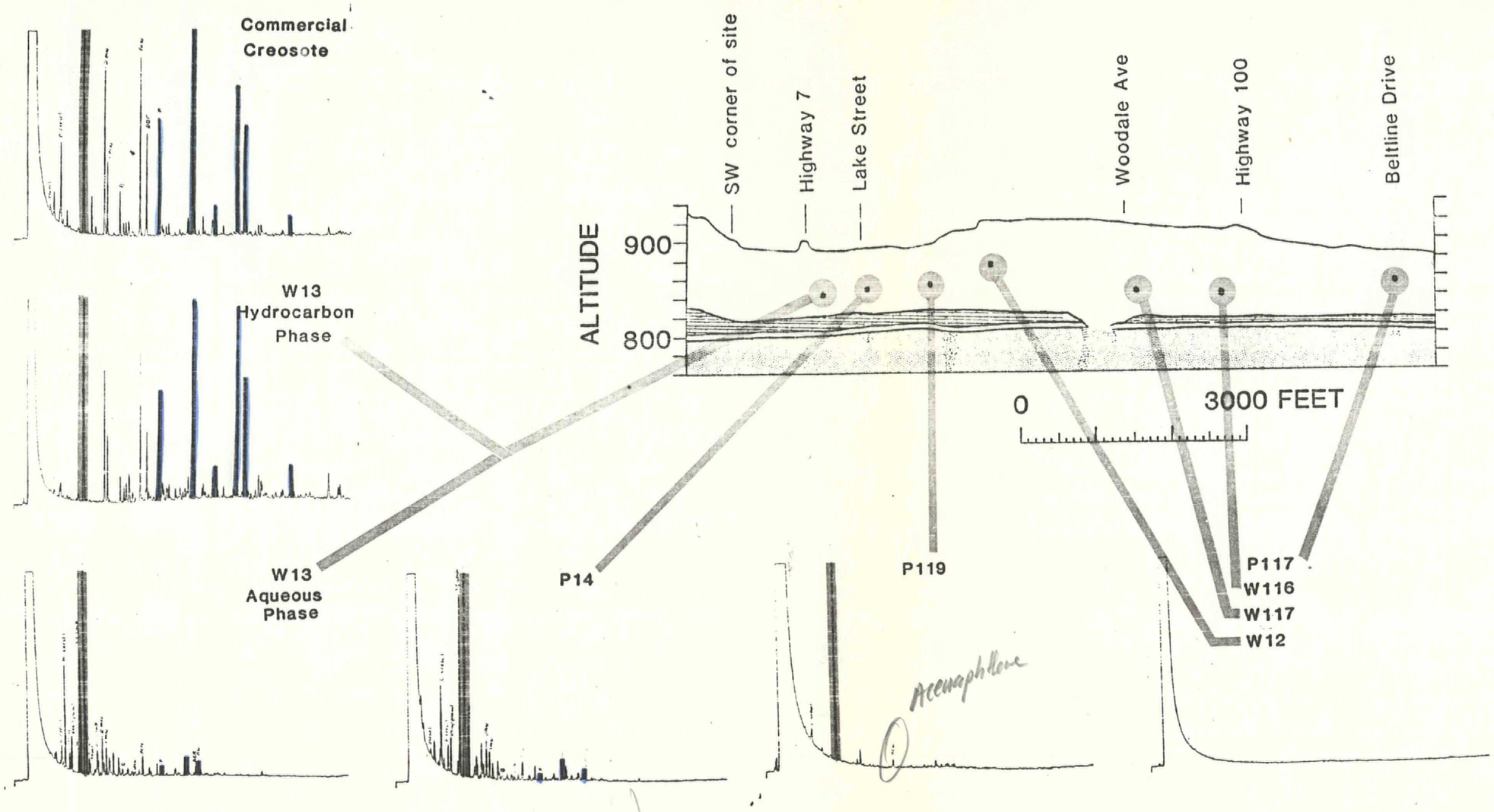


METHANE BACTERIA/100 ML

9605186


SW corner of site
Highway 7
Lake Street
Woodale Ave
Highway 100
Beltline Drive
ALTITUDE
900
800
15.8
18.4
21.0
2.8
3.2
2.0
0
3000 FEET
METHANE, MG/L

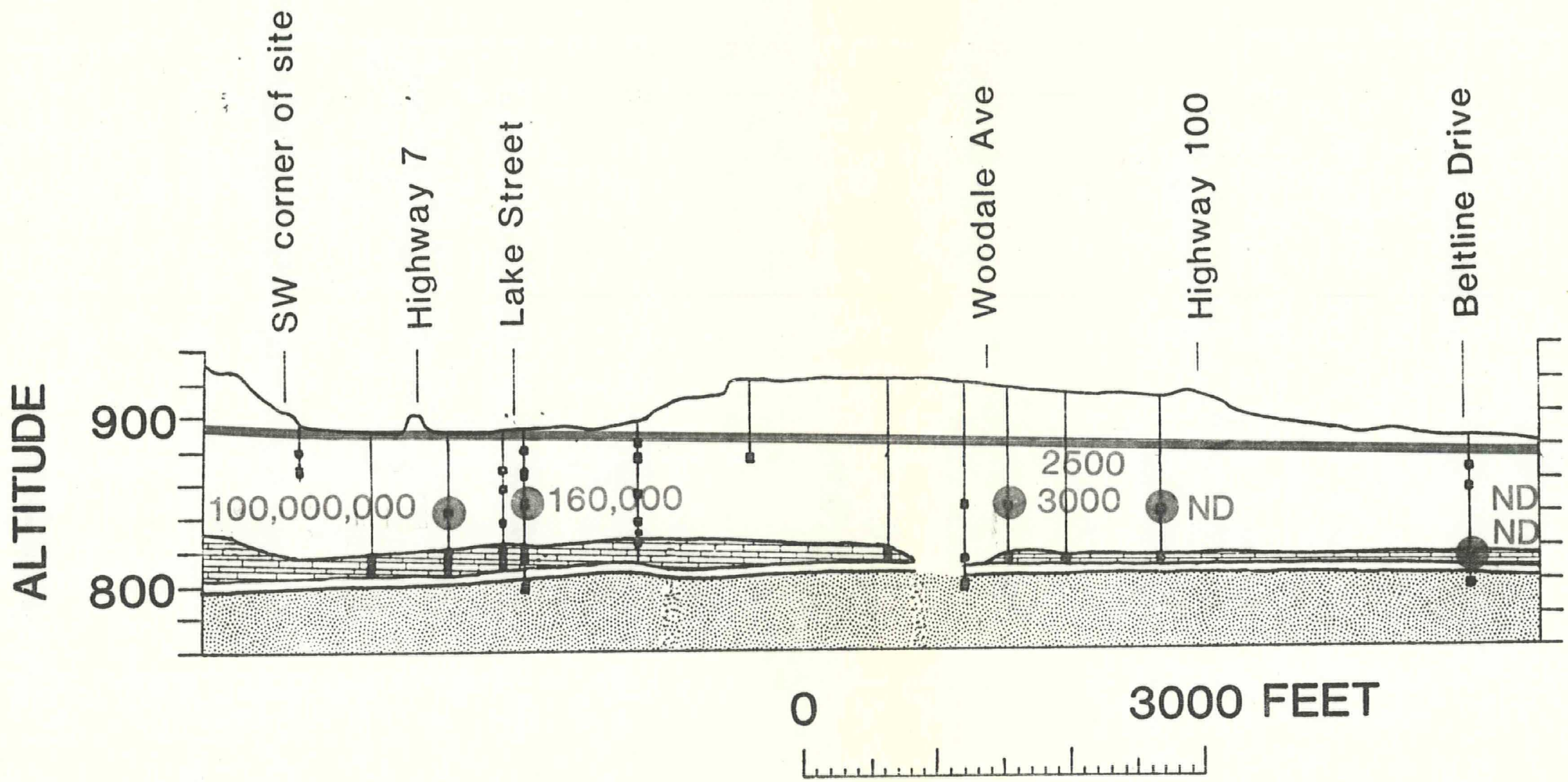
9605187



CONCENTRATION OF NAPHTHALENE RELATIVE TO OTHER COMPOUNDS

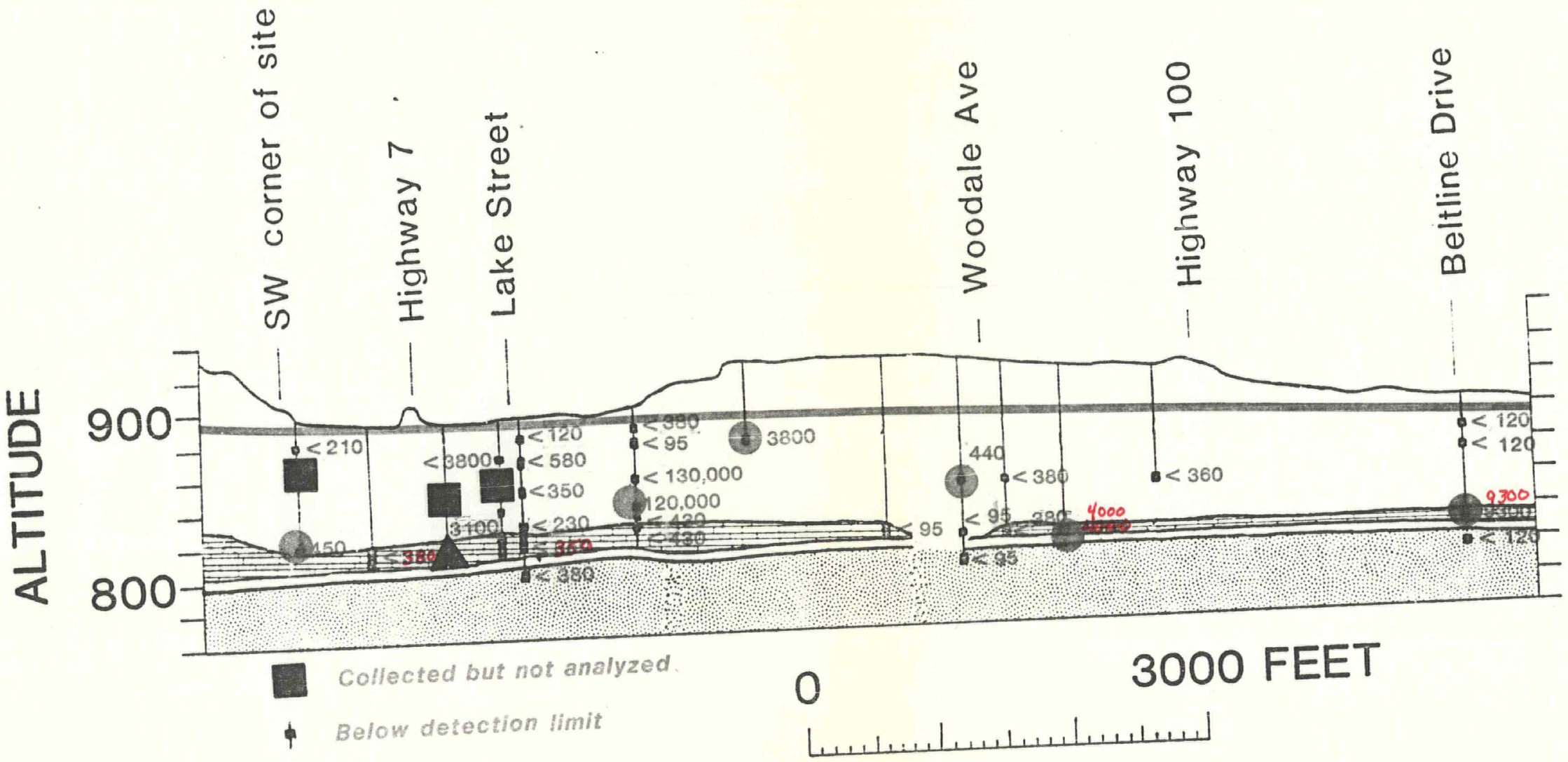
GC/FID normalized on Naphthalene

9605188



ACENAPHTHENE, NG/L BY GC/MS

9605189



Collected but not analyzed

Below detection limit

Unconfirmed

Confirmed on one detector

Confirmed on two detectors

ACENAPHTHENE, NG/L BY HPLC

There are none of these!

9605190