PRELIMINARY ENVIRONMENTAL ASSESSMENT HAINES - FAIRBANKS PIPELINE PACKAGE 95-0038

HJ-012 / HJ-032

Prepared by:

UMA Engineering Ltd.
Engineers, Planners & Surveyors
17007 - 107 Avenue
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May 1995

P95-48

UMA Engineering Ltd.
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1995 05 25

File No. 8801-555-18-66 / P95-48

Department of Indian Affairs
and Northern Development
Central Operations Complex
Mile 917.8 Alaska Highway
Whitehorse, Yukon
Y1A 5X7

Attention: Contracting Services

Dear Sir/Madam:

RE: PROPOSAL FOR CONSULTING SERVICES
HAINES - FAIRBANKS PIPELINE SITE ASSESSMENT
CONTRACT NO. 95-0038
MILLION DOLLAR FALLS, THE HAINES JUNCTION PUMP STATION AND MILE 207.6 SPILL

In response to your letter of invitation dated May 15, 1995, we are pleased to submit three copies of our proposal for the above noted project.

This proposal has been prepared in accordance with the required format and we trust that it demonstrates our understanding of your requirements and our capability of completing the project within the required schedule. The prices quoted in this proposal are exclusive of the GST. UMA's GST number is R105441760.

To implement our proposed methodology we have assembled an integrated project team that draws on the combined resources of UMA Engineering Ltd. and AMBIO Research Associates (a group of scientists formerly with the Environmental Sciences Group of Royal Roads Military College). The key members of the team have developed a solid working relationship as a result of joint participation since June 1992 in the DEW Line Clean Up Project for the Department of National Defence. Local involvement will include K. Bisset and Associates and Midnight Sun Drilling Co. Ltd. Ms. K. Bisset represented the project team at the May 17, 1995 briefing.

Our team looks forward to the opportunity of working with you on this challenging project. We would be pleased to respond to any questions or to provide any further information.

Yours truly,

UMA Engineering Ltd.

A. S. Washuta, P.Eng.
Manager, Special Projects

cc Dr. S. Grundy, AMBIO Research Associates

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1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

This Proposal is provided by UMA Engineering Ltd. and AMBIO Research Associates in response to the May 15, 1995 Request for Proposal (RFP) received from Indian and Northern Affairs under the Arctic Environmental Strategy (AES) for the preliminary Environmental Site Assessment of facilities/features along the Canadian portion of the Haines-Fairbanks Pipeline route, Package 95-0038.

The AES Action on Waste Program is currently researching activities related to the operations of the pipelines in the Yukon and requires data from the preliminary environmental assessments to identify requirements for future assessment and the resources required for remediation.

The sites comprising this study are listed below and are indicated on the **Location Plan** presented in Figure 1.1.

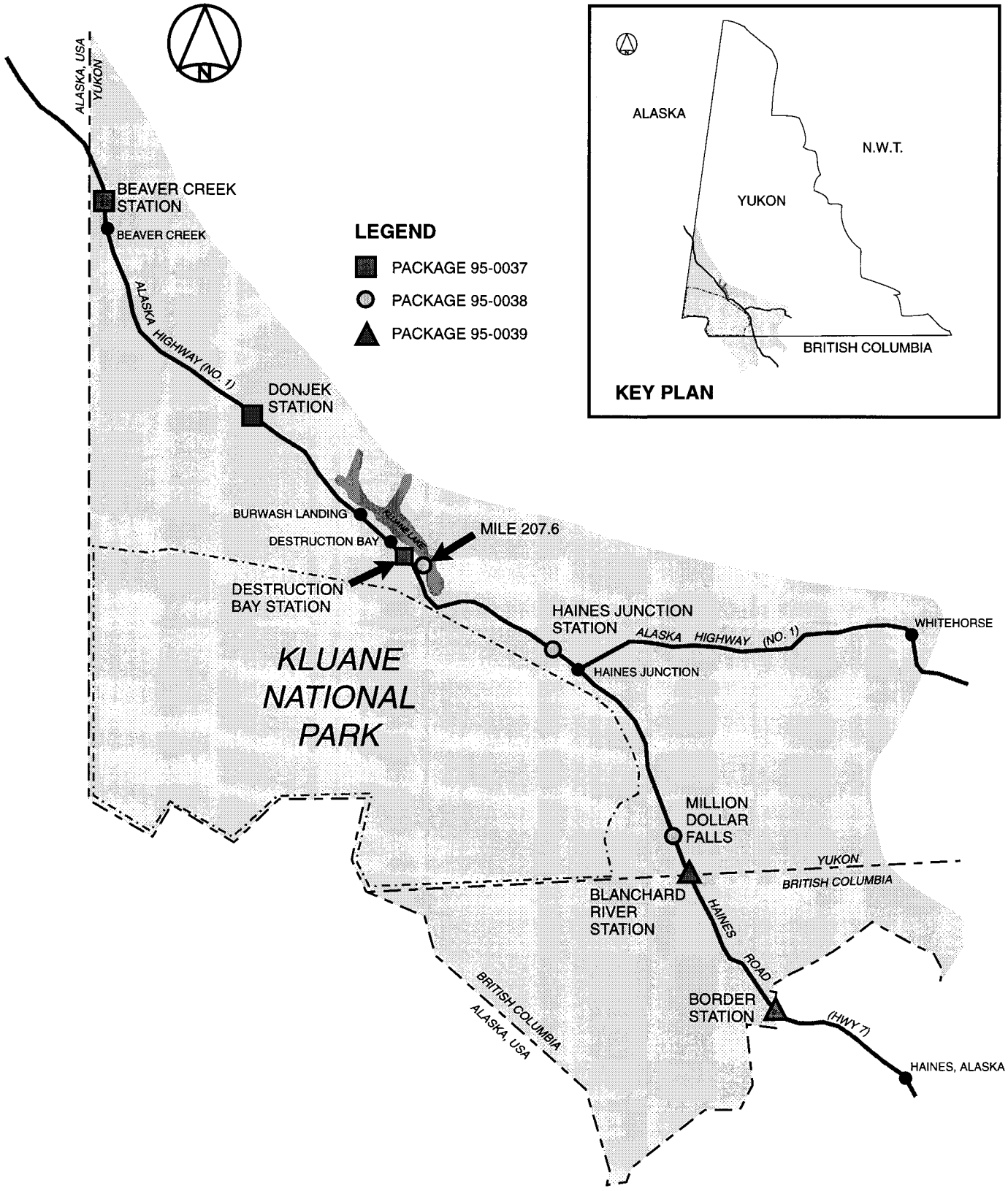
PACKAGE 95-0038

- Million Dollar Falls
- Haines Junction Pump Station
- Mile 207.6 Spill Site

1.2 PROJECT OBJECTIVES

The **primary objective of the study** is to provide a preliminary environmental assessment of the impact of past practices and land use at specific locations along the pipeline route. Project requirements to achieve this objective include:

- a review of historical data, including aerial photographs, site maps, maintenance or operations records, anecdotal information;
- characterization of the biophysical environment at each location, including geology, hydrogeology, vegetation, fauna and land use;



PRELIMINARY
ENVIRONMENTAL ASSESSMENT
HAINES - FAIRBANKS PIPELINE

LOCATION PLAN

FIGURE 1.1

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- identification and where possible determination of the possible degree and extent of environmental contamination;
- preliminary assessment of the impact of any contamination;
- development of recommendations for further assessment and/or remediation.

1.3 PROPOSAL ORGANIZATION

The information presented in this Proposal is based on:

- a detailed review of the Terms of Reference in the Request for Proposal;
- our understanding of the project requirements based on our discussions with Mr. Brett Hartshorne, DIAND - AES - Action on Waste Program;
- the experience of the Project Team on numerous projects similar to the requirements of this project such as environmental assessments, hydrogeological investigations, contaminant sampling, northern investigations, environmental risk assessment, and remediation assessment.

The remainder of the Proposal is organized as follows:

- Section 2.0 provides a description of the History and Capabilities of the Project Team.
- Section 3.0 presents the Project Methodology and includes a detailed description of the proposed Work Plan and Project Schedule. A project schedule is also provided. This section also outlines the project management techniques to be used on this project.
- Section 4.0 provides cost estimates for the project. Specific information also includes:
  - person-hour allocations for each project task,
  - a breakdown of disbursements,
  - a proposed method of payment.

2.0 PROJECT TEAM HISTORY AND CAPABILITIES

2.1 CORPORATE STRUCTURE

The combined capabilities of **UMA Engineering Ltd.** and **AMBIO Research Associates**, will be utilized for the successful completion of this project.

The UMA Group is a privately held Canadian company in which all shareholders are employees. Currently there are 925 employees, of whom 350 are professionals in engineering, procurement, construction, management, planning and environmental science. The size of the company is probably best measured by gross income, some 105 million dollars in 1994.

Additional information on the structure of the UMA Group is provided in Appendix A.

2.1.1 UMA Engineering Ltd.

UMA Engineering Ltd. is a principal company of the UMA Group, an international organization that provides professional planning, engineering, project management and engineering contracting services from offices in Canada and the United States.

The company was founded as a partnership in 1911 and has provided professional services on a continuous basis to the present time. It was incorporated in Saskatchewan in 1952 as Underwood McLellan & Associates Limited. In 1985, the UMA Group was restructured as the parent organization of a number of associated companies providing consulting and contracting services related to planning, design, construction, operation of facilities and resource development.

UMA Engineering Ltd. is a major Canadian consulting firm of engineers, planners, environmental scientists, computer programmers, economists, surveyors and other professionals offering full services in a wide range of disciplines. UMA Engineering Ltd. has developed a broad range of capabilities to provide project services based on

engineering experience gained on Canadian and international project work. In Western Canada, UMA offices are located in the Northwest Territories, British Columbia, Alberta, Saskatchewan and Manitoba.

UMA Engineering Ltd. has been involved in a wide range of projects in the traditional consulting engineering field, in project management, and engineering contracting. Many of these projects have involved a multidisciplinary approach requiring sound project management and coordination of various technical disciplines including:

- Environmental Engineering and Waste Audits
- Public Consultation
- Regulatory Approvals and Permitting
- Northern Development Engineering
- Mapping and Photogrammetry
- Airport Planning and Development
- Legal and Construction Surveying
- Resource Access Planning and Development
- Transportation Planning and Engineering
- Workforce Logistics
- Water Resources, Hydraulics, River Engineering
- Municipal Engineering and Land Development
- Solid Waste Management
- Planning and Community Development
- Structural, Bridge and Heavy Civil Engineering
- Electrical and Instrumentation
- Mechanical/HVAC
- Heavy Industrial, Process, Piping Design Engineering
- Commercial and Industrial Engineering
- Geotechnical Engineering
- Water and Wastewater Treatment
- Hydro/Micro Hydro Projects

Administratively, the Company operates on the branch office concept, with each office responsible for specific geographic areas. The Edmonton branch office is responsible for provision of services to the Northwest Territories and the Yukon.

The Project Manager for this study will be Ms. Tanya Schulz, P.Eng., of the Edmonton Office.

UMA Engineering Ltd.
17007 - 107 Avenue
Edmonton, Alberta
T5S 1G3
Telephone: (403) 486-7000
Facsimile: (403) 486-7070

2.1.2 AMBIO Research Associates

AMBIO Research Associates is a newly formed company which specializes in providing practical solutions to environmental problems. The principals of AMBIO are former senior members of the Department of National Defence's Environmental Sciences Group at Royal Roads Military College. AMBIO has developed a broad range of capabilities to provide environmental management services based on experience gained on Canadian, and specifically Arctic project work. AMBIO is based in Victoria, British Columbia.

The principals of AMBIO have been involved in a wide range of environmental projects with specific emphasis on terrestrial and aquatic contaminant distributions and cycling. Environmental services are provided in the following areas:

- Environmental Site Assessments
- Environmental Screening and Impact Assessments
- Soil and Groundwater Contamination Investigation
- Environmental Monitoring
- Regulatory Compliance
- Contaminant Remediation
- Cleanup Protocol Development
- Risk Assessment
- On-Site Contaminant Testing

Dr. Steve Grundy of AMBIO will be the Technical Coordinator for this project.

AMBIO Research Associates
6097 Timberdoodle Road
RR6 Sooke, British Columbia
V0S 1N0
Telephone: (604) 642-7728
Facsimile: (604) 642-7728

2.1.3 Subconsultants

Ms. Kathy Bisset of K. Bisset and Associates of Whitehorse will be engaged as a subconsultant to AMBIO Research Associates on this project. Ms. Bisset will provide services related to the Information Collection and Review Task.

Midnight Sun Drilling Co. Ltd. of Whitehorse will provide all drilling contractor services for this contract. Midnight Sun will be a subcontractor to UMA.

2.1.4 Environmental Policy

Our objectives are to:

- Conduct our business in an environmentally responsible manner.
- Maintain a rigorous monitoring program to observe compliance with applicable laws, regulations and professional codes of practice.
- Seek continuous improvement in the environmental aspects of our practices and procedures.

We are committed to the concept of sustainable development, which requires balancing the need for economic growth with good stewardship in the protection of the natural environment.

2.2 RELEVANT EXPERIENCE

The Project Team has extensive experience in environmental assessments, as well as considerable experience in northern Canada. A summary of our combined project experience directly related to the specific requirements of this project is presented in the **Project Experience Summary Matrix** in Figure 2.1. Detailed project descriptions are provided in Appendix B.

2.3 CLIENT REFERENCES

We encourage you to contact our client references to confirm our commitment to excellence in consulting services.

- **Department of National Defence**
  (Contract through Public Works and Government Services Canada)
  Major Scott Munn, P.Eng.
  Design Manager, DEW Line Clean Up
  Ottawa, Ontario
  Telephone: (613) 945-7738
  Fax: (613) 992-9422

PROJECT	PROJECT MANAGEMENT	ENVIRONMENTAL ASSESSMENT	CONTAMINANT ASSESSMENT	SOIL/SURFACE WATER/GROUNDWATER/SAMPLING	FACILITY INSPECTION	HYDROGEOLOGICAL/GEOTECHNICAL	ENVIRONMENTAL RISK ASSESSMENT	REMEDIATION ASSESSMENT	MULTIPLE SITE PROJECTS	NORTHERN PROJECTS	REPORT PREPARATION	CLIENT	YEAR
	ELEMENTS												
DESIGN AND COST ESTIMATING OF THE CLEAN UP OF 21 DEW LINE SITES	●	●	●	●	●	●		●	●	●	●	DEPARTMENT OF NATIONAL DEFENCE	1995
ENVIRONMENTAL CLEAN UP STUDY OF 21 DEW LINE SITES	●	●	●	●	●	●	●	●	●	●	●	UNITED STATES AIR FORCE	1991
ENVIRONMENTAL SITE ASSESSMENT CFB CALGARY	●	●	●	●		●	●	●	●		●	DEPARTMENT OF NATIONAL DEFENCE	1995
GUIDELINES FOR SPILL CLEAN UP IMPLEMENTATION PLANNING	●							●	●		●	INTERPROVINCIAL PIPE LINE INC.	1993
CORAL HARBOUR, N.W.T. ENVIRONMENTAL ASSESSMENT	●	●	●	●	●	●		●		●	●	INDIAN AND NORTHERN AFFAIRS CANADA	1992
COST ESTIMATING FOR THE CLEAN UP OF 26 DIAND SITES	●								●	●	●	INDIAN AND NORTHERN AFFAIRS CANADA	1993
SOIL AND GROUNDWATER CONTAMINATION STUDY	●	●	●	●		●		●			●	BRISTOL AEROSPACE LTD.	1994
PUKATAWAGAN DIESEL GENERATING STATION CLEAN UP	●	●	●	●		●		●			●	MANITOBA HYDRO	1993
HYDROGEOLOGICAL ASSESSMENT LANDFILL SITES	●	●	●	●		●					●	WELDWOOD OF CANADA LTD.	1990–1995
ENVIRONMENTAL STUDY OF ASHIHIK AIRSTRIP, YUKON ✸	●	●	●	●			●			●	●	INDIAN AND NORTHERN AFFAIRS CANADA	1995
ENVIRONMENTAL STUDY OF THE CANOL TRAIL, N.W.T. ✸	●	●	●	●	●		●		●	●	●	INDIAN AND NORTHERN AFFAIRS CANADA	1994
ENVIRONMENTAL STUDY OF ELEVEN DEW LINE SITES ✸	●	●	●	●			●		●	●	●	DEPARTMENT OF NATIONAL DEFENCE	1993
ENVIRONMENTAL STUDY OF ABANDONED DEW LINE SITES: FIVE INTERMEDIATE SITES FROM THE WESTERN ARCTIC ✸	●	●	●	●			●		●	●	●	INDIAN AND NORTHERN AFFAIRS CANADA	1992

✸ WORK COMPLETED BY PRINCIPALS OF AMBIO WHILE WITH ESG – RRMC

PRELIMINARY ENVIRONMENTAL ASSESSMENT HAINES - FAIRBANKS PIPELINE

PROJECT EXPERIENCE/ SUMMARY MATRIX

FIGURE 2.1

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- **Indian and Northern Affairs Canada**
  Mr. Scott Mitchell, Regional Manager
  Arctic Environmental Strategy Action on Waste
  Yellowknife, NWT
  Telephone: (403) 920-8547
  Fax: (403) 920-7510

- **Department of Indian Affairs and Northern Development (DIAND)**
  Mr. Gary Nicholl, Manager Resource Strategies
  Hull, Quebec
  Telephone: (819) 997-0222

- **Canadian Forces Base Calgary**
  Mr. Kevin van Velzen, Environmental Officer
  Telephone: (403) 240-7011, Local 7817

2.4 PROJECT TEAM ORGANIZATION

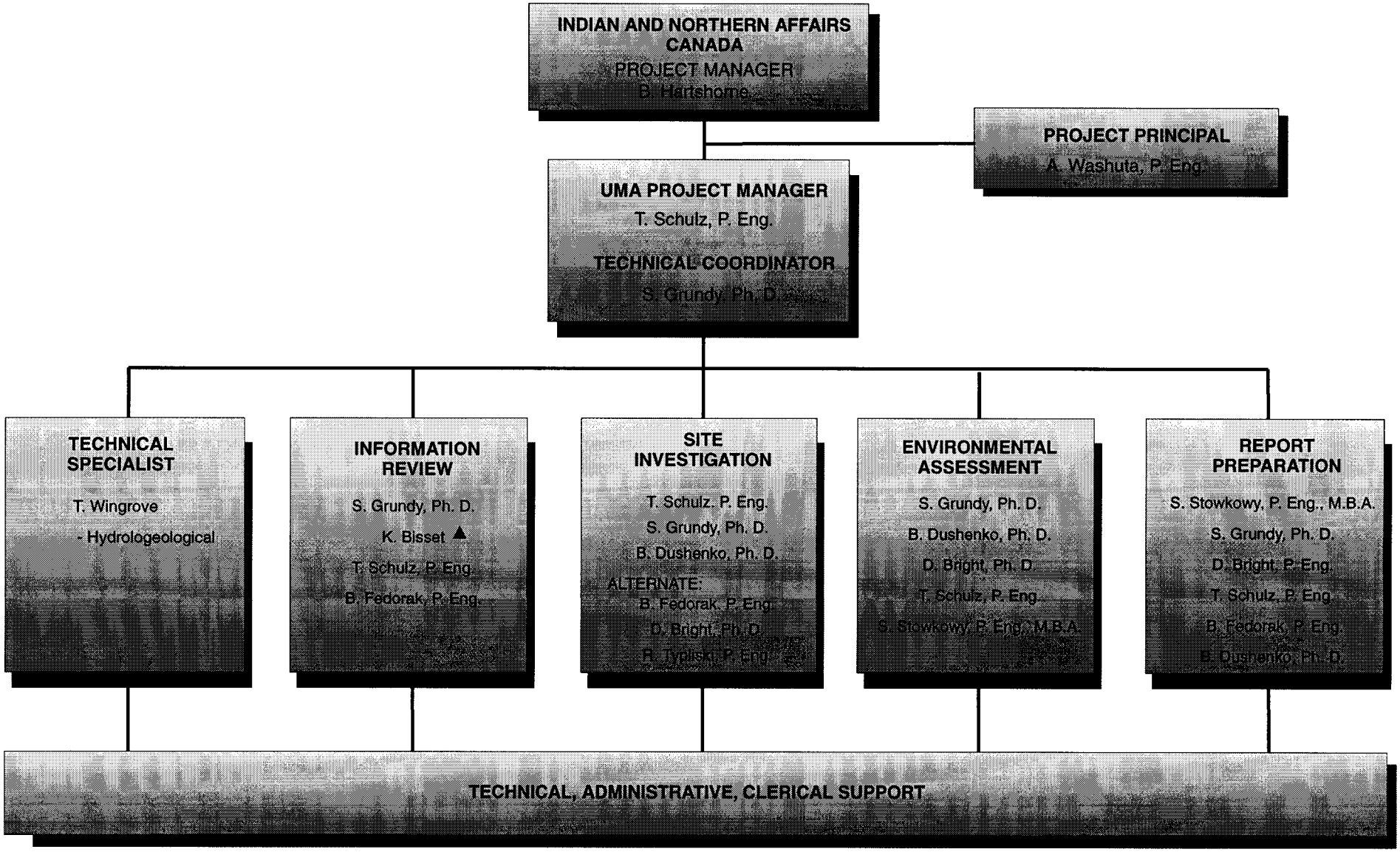
We propose to assign a team of experienced professionals to provide the management and technical services required for this project. A **Project Team Organization Chart** outlining the responsibilities and reporting relationships of the key project team members is presented in Figure 2.2. The proposed project team possesses a substantial depth of experience relevant to this project, and the key team members have the proven ability to carry out their functions in an efficient, effective and professional manner.

We have reviewed the future commitments of all project team members, and can confirm that they will be available to carry out their respective tasks in a timely manner. The team will be assisted by engineering, scientific, technical, and clerical support staff.

In order to ensure consistency in the format and quality of information obtained from the site visits, the environmental assessment of all the sites will be carried out by senior personnel: Tanya Schulz, P.Eng., Steve Grundy, Ph.D., and Bill Dushenko, Ph.D. Communication between offices will be maintained on a regular basis by telephone, fax, courier and E-Mail. Communication with the DIAND Project Manager will be facilitated through a single point of contact, the Project Manager, Tanya Schulz, P.Eng., at UMA Edmonton. In the event of changes in workload, Steve Stowkowy, P.Eng., MBA, is available to serve as Project Manager on this project. Ron Typliski, P.Eng., and/or Barry Fedorak, P.Eng. are available as backup to the Site Investigation Team.

2.4.1 Project Team Experience

The following information provides a description of the responsibilities of each of the team members, and the record of relevant past experience. Detailed resumes for all project personnel are included in Appendix C.



▲ Subconsultant to AMBIO

PRELIMINARY
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PROJECT TEAM ORGANIZATION CHART

FIGURE 2.2

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NAME:	**Kathy Bisset**
TITLE:	Principal, K. Bisset and Associates
PROJECT TITLE:	Information Researcher
YEARS OF EXPERIENCE:	17

PROJECT RESPONSIBILITIES: Ms. Bisset will be responsible for compiling, organizing and extracting relevant information in the information and review task.

RECENT RELATED EXPERIENCE:

As Principal of K. Bisset and Associates, Ms. Bisset has been directly involved in the development of an archival record of past activities along the Haines - Fairbanks Pipeline for DIAND.

Other relevant experience includes:

- Archival research, site generation survey, compiled volumes of cutting locations, and data bases for the History of Logging in the Yukon 1896 - 1970 for the Yukon Government.
- Preparation of maps and land use information as part of the site selection process for a hazardous waste storage facility for the Yukon Government.

Ms. Bisset is familiar with the requirements of this project, research facilities and archival sources.

EDUCATION:	B.Sc. Plant and Soil Science, 1976.
	Urban and Regional Planning Correspondence Program, 1984.
	Alberta Regeneration Survey Course, 1993.

NAME: **Doug A. Bright**

TITLE: Principal, AMBIO Research Associates

PROJECT TITLE: Alternate Site Investigation Team
Environmental Risk Assessment

YEARS OF EXPERIENCE: 8

PROJECT RESPONSIBILITIES: Dr. Bright is available as an alternate for the site investigation. In addition, he will provide input to the Environmental Risk Assessment.

RECENT RELATED EXPERIENCE:

Doug Bright holds a Ph.D. in marine ecology and environmental physiology (University of Victoria, 1991), and specializes in the geochemical cycling and biological uptake of metals/metalloids, polycyclic aromatic hydrocarbons, and chlorinated organic substances in aquatic environments. He has also done extensive research on the effects of contaminants and disturbance on marine benthic communities, and on tissue structure in clams. Specific projects include:

- 1991 - Present: Research Associate, Environmental Sciences Group, Royal Roads Military College, Victoria, B.C.
- Biogeochemical cycling of arsenic and other metals/metalloids in coastal marine and fresh water systems: arsenic speciation, environmental compartmentalization, and bioaccumulation, including studies of organoarsenicals and the microbial methylation/demethylation of arsenic.
- Environmental cycling of 2,3,7,8-TCDD and other dioxins/furans in the Canadian Arctic.
- Chemical contamination of sediments in Esquimalt Harbour, B.C., associated biological uptake, and impacts on biota (histopathology of infaunal clams, crabs, and English sole; effects on benthic community structure; sediment bioassays).
- Environmental study of North Warning System (Arctic) radar installations and abandoned DEW Line sites - marine ecosystem impact associated with local inputs versus long-range atmospheric transport of polychlorinated biphenyls, organochlorine pesticide residues, and inorganic elements; fate of PCBs and other organochlorines in Arctic marine and terrestrial systems.
- Environmental effects associated with the historical ocean disposal of electronic components and other debris in the Canadian Arctic.
- 1995 (May - June): Sessional Lecturer, Camosum College, Victoria. Geog. 110: Introduction to Oceanography.
- 1988 (January - April): Visiting Researcher: Plymouth Marine Laboratory, Plymouth, England with Dr. Geoff W. Bryan. Effects of tributyltin-containing anti-fouling paints on marine snails.

EDUCATION:

Ph.D. Biology, University of Victoria, 1991.
M.Sc. Biology, University of Victoria, 1987.
B.Sc. Biology, University of Victoria, 1984.

NAME: **William T. Dushenko, Ph.D.**

TITLE: Principal, AMBIO Research Associates

PROJECT TITLE: Site Investigation Team Member
Environmental Risk Assessment

YEARS OF EXPERIENCE: 9

PROJECT RESPONSIBILITIES: Dr. Dushenko will assist in the site investigation and provide input to the Environmental Risk Assessment.

RECENT RELATED EXPERIENCE:

Bill Dushenko holds a Ph.D. in plant ecology (Queen's University, 1990), and specializes in contaminant uptake into terrestrial plants and animals, as well as plant - soil and plant - sediment interactions as influences on contaminant bioavailability. He has considerable expertise in evaluating analytical quality assurance/quality control. Specific experience includes:

- 1990 - Present: Research Associate, Environmental Sciences Group, Royal Roads Military College, Victoria, B.C.
- Bioavailability of arsenic contamination, its relationship to nutrient acquisition and potential toxicity to aquatic macrophytes from mine tailings.
- Environmental study of North Warning System radar installations and abandoned DEW Line sites; fate of PCBs and other environmental contaminants in Arctic terrestrial systems.
- Accumulation of PCBs, inorganic elements and other contaminants in Arctic vascular plants, their use as environmental indicators of ecosystem impact in environmental site assessments, and bioaccumulation through the food web.
- Use of vascular plants as indicators of the atmospheric distribution of environmental contaminants in the Arctic.
- 1994: Guest Lecturer, Fourth Year Arctic short course, Royal Roads Military College, Victoria.
- 1993 - 1994: Chairman, Organizing Committee, 34th Annual Meeting of the Canadian Society of Biologists, Royal Roads Military College, June 1-4, 1994.
- 1992 - Present: Director (British Columbia), Canadian Society of Environmental Biologists.
- 1990 - 1995: Member of Scientific Advisory and Project Management Team for the DEW Line Clean Up Project (former military installations in the Canadian Arctic).
- 1988 - 1989: Graduate Teaching Assistant, Cell Biology, Biology Department, Queen's University. Guest Lecturer, Second Year Ecology Course. Biology Department, Queen's University.
- 1988: Scientific Advisory Team, Bay of Quinte Remedial Action Plan Ecosystem Modelling Workshops.
- 1986 - 1987: Instructor, Cell Biology, Biology Department, Queen's University.
- 1984 - 1986: Graduate Teaching Assistant, Cell Biology, Biology Department, Queen's University.

EDUCATION:

Ph.D. Biology, Queen's University at Kingston, 1990.
M.Sc. Biology, Queen's University at Kingston, 1986.
Honors B.Sc. Ecology and Evolution, University of Western Ontario, 1983.

NAME:	**Barry Fedorak, P.Eng.**
TITLE:	UMA Environmental/Geotechnical Engineer
PROJECT TITLE:	Back Up Resource/Site Assessment
YEARS OF EXPERIENCE:	6

PROJECT RESPONSIBILITIES: Barry is available as a back-up resource for Tanya Schulz in completing the on site assessment, including the drilling program.

RECENT RELATED EXPERIENCE:

- Project Engineer - Suncor Gas Plants - Groundwater Monitoring Program: Responsible for the supervision of installation of groundwater monitoring wells, sampling, and interpretation of hydrogeological and chemical data.
- Project Engineer and Field Coordinator (various clients).
- Conducted field investigations for Phase I and Phase II Environmental Assessments. Work included supervision of installation of groundwater monitoring wells, soil and water sampling, and interpretation of analytical results. Clients include industrial site owners, gas stations, and pipeline companies. Responsibilities also include supervision and coordination of cleanup for specific clients.

EDUCATION: B.Sc. Civil Engineering, 1989.

NAME:	**Steve Grundy, Ph.D.**
TITLE:	Principal, AMBIO Research Associates
PROJECT TITLE:	Technical Coordinator
YEARS OF EXPERIENCE:	11

PROJECT RESPONSIBILITIES: Dr. Grundy will serve as the Technical Coordinator and ensure that project objectives are met. He is also responsible for coordinating all site investigation activities, and is a member of the site investigation team.

RECENT RELATED EXPERIENCE:

Stephen Grundy holds a Ph.D. in synthetic chemistry (Sheffield, England, 1984), and has conducted extensive research on the environmental chemistry of organic and inorganic contaminants. Dr. Grundy has conducted applied studies of groundwater contamination, as well as basic research into the photocatalytic destruction of chlorinated organics. Specific experience includes:

- 1994 - Present: Associate Professor, Chemistry Department, Royal Roads.
- 1990 - 1995: Senior Member, Environmental Sciences Group, Royal Roads Military College, Victoria, B.C.
- Discrimination of Local versus Distant Contaminant Sources for PCBs and other Organochlorines in the Canadian Arctic.
- Short-range atmospheric transport and weathering of PCBs in the Canadian Area.
- Environmental study of the Canol Trail in the Northwest Territories; environmental assessment of military sites in the Yukon. Studies of the long term environmental fate of persistent organic compounds.
- Environmental management in Antarctica and the Arctic.
- Development of groundwater remediation technologies by the use of semiconductor catalysts.
- 1993 - Present: Adjunct Assistant Professor, Chemistry Department, University of Victoria.
- 1988 - 1994: Assistant Professor, Chemistry Department, Royal Roads.
- 1991: Instructor, Chemistry Department, Camosum College.
- 1990 - 1991: Research Associate, Chemistry Department, University of Victoria.
- 1989 - 1990: Visiting Professor, Chemistry Department, University of Victoria.
- 1988: Instructor, Chemistry Department, Camosum College.
- 1985 - 1988: Sessional Lecturer, Chemistry Department, University of Victoria.
- 1985 - 1988: Research Associate, Chemistry Department, University of Victoria.
- 1984 - 1985: Post-Doctoral Research Fellow/Lab Instructor, University of Victoria, Victoria, B.C.
- 1995 - Present: Vice-Chair, Chemical Institute of Canada, Vancouver Island Section.
- 1994 - 1995: Program Chair, Chemical Institute of Canada, Vancouver Island Section.
- 1994 - 1995: Member, Forest Practices Code, Guidelines Technical Working Group.
- 1990 - 1992: Vice-President, British Columbia Speleological Federation.
- 1986 - Present: Member, Chemical Institute of Canada.

EDUCATION: Ph.D. (Organometallic Chemistry) Sheffield, England, 1984.
B.Sc. (Hons Chemistry) Sheffield, England, 1981.

NAME:	**Tanya Schulz, P.Eng.**
TITLE:	Senior UMA Environmental/Geotechnical Engineer
PROJECT TITLE:	Project Manager/Site Assessment
YEARS OF EXPERIENCE:	13
PROJECT BACK-UP RESOURCE:	Steve Stowkowy - Project Manager Barry Fedorak - Site Assessment

PROJECT RESPONSIBILITIES: As Project Manager, Tanya will be responsible for client liaison, quality control, schedule and budget control, internal resource allocation, review of professional services agreement. In addition, Tanya will be a member of the field investigation team. Specific tasks will include planning of site investigation activities, logistics planning, interpretation of geophysical surveys, and hydrogeological data. Tanya will also provide input to the final report presentation.

RECENT RELATED EXPERIENCE:

- Project Engineer and Field Coordinator - DEW Line Clean Up Project, DND. As field coordinator, supervised multi-disciplinary teams during the engineering site surveys of 21 sites. Responsibilities included engineering data management, work scheduling and logistics planning, assisting in soil and water sampling, surveying, and geotechnical investigations. Assisted in evaluation of remediation alternatives, supervised engineering design and drawing review, preparation of Environmental Screening Reports and development of the Environmental Protection Plan.

- Project Engineer and Field Coordinator - Environmental Clean Up Study of 21 DEW Line Sites in Canada, USAF/DND. Specific field work at the sites included soil and water contaminant sampling, identification of biological and archaeological resources and inventory of all facilities and features on each site. Responsible for coordination of multidisciplinary field teams, audit of fuel storage facilities and other infrastructure. Also provided assistance in the preparation of the environmental assessment of each site.

- Project Engineer and Field Coordinator - Coral Harbour Environmental Assessments - Indian and Northern Affairs Canada. Coordinated field work of a multi-disciplinary team for contaminant sampling and characterization of the biophysical environment. Directed laboratory testing program and assisted in the preparation of the environmental assessment and conceptual cleanup plans.

- Project Engineer - Assessment of Contaminated Soil Remediation Alternatives - Interprovincial Pipe Line Inc. Responsible for the preparation of an evaluation of contaminated soil treatment options and coordinated the development of guidelines for spill cleanup implementation planning for the six provincial/territorial jurisdictions in which IPL operates.

- Project Engineer - Hydrogeological Assessment (Weldwood) - Responsible for the development, implementation and assessment of groundwater monitoring programs for the pulp mill facilities, including the hydrogeological assessment of the new landfill site. Provide yearly evaluation of monitoring program. (1990-1995)

EDUCATION: B.Sc. Civil Engineering, University of Alberta, 1982.

NAME:	**Ron Typliski, P.Eng.**
TITLE:	Senior Environmental Engineer
PROJECT TITLE:	Site Investigation Team Member, Backup
YEARS OF EXPERIENCE:	17

PROJECT RESPONSIBILITIES: R. Typliski will serve as backup to Tanya Schulz, P.Eng., as a member of the Site Investigation Team.

RECENT RELATED EXPERIENCE:

- Managed and conducted comprehensive environmental compliance audits for three northern Ontario airports at Timmins, Kapuskasing and Earlton for Transport Canada.
- Conducted numerous environmental audits and site assessments of various facilities including, decommissioned hydroelectric plants, manufacturing plants, real estate property, and buildings.
- Coordinated and audited ongoing environmental monitoring programs for a number of mine, mill and metallurgical plant operations.
- Coordinated soils investigation studies at a number of underground petroleum storage tanks to determine the extent and degree of soil contamination, and recommended remedial measures for site clean up.
- Prepared environmental impact assessment reports for contaminated soil remediation projects, an aerospace manufacturing plant operation and a proposed sewage treatment plant upgrading.
- Coordinated hazardous waste disposal studies.
- Conducted audits and developed workplace safety and health programs at plant and industrial sites.

EDUCATION: B.Sc. Civil Engineering, University of Manitoba, 1978.

NAME:	**Steve Stowkowy, P.Eng., MBA**
TITLE:	Senior Project Manager
PROJECT TITLE:	Report Coordinator/Backup Project Manager
YEARS OF EXPERIENCE:	17

PROJECT RESPONSIBILITIES: Coordination of the final report preparation, as well as provide input as required to the various aspects of the project in an informal advisory position. Steve Stowkowy is also available to serve as Project Manager, if required.

RECENT RELATED EXPERIENCE:

- Project Manager - CFB Calgary Environmental Site Assessment: responsible for client liaison, schedule and budget control, general coordination, internal resource allocation, and preparation of the final report.

- Design Manager - Design and Cost Estimating of the Clean Up of 21 DEW Line Sites, DND: responsible for coordination of design including landfill remediation, demolition, disposal of hazardous materials and contaminated soil, special double-contained Northern Disposal Facilities, cleanup of site debris, and general grading; coordination and preparation of detailed construction specifications; editing of all contract documentation and reports; project management support including preparation of budgets, progress reports, submission schedules, invoices, meeting minutes; and various presentations at Project and Quality Review Meetings.

- Assistant Project Manager / Design Manager - Forward Operating Location Project, Inuvik, DND: responsible for the coordination of the design and preparation of tender documents for the various site development components including facility siting, building foundations, site electrical requirements, apron and taxiway, site grading, etc.; and project management support.

- Design Engineer - Zone 1 Short Range Radar Sites, DND: participated in the site reconnaissance for locating specific site components including radar facilities, runways, helipads, access roads, beach landing sites, and contractor support requirements; responsible for the design of various civil works and facility components.

EDUCATION: B.Sc. Civil Engineering, University of Alberta, 1979.
Master of Business Administration, University of Alberta, 1988.

NAME:	**Tom Wingrove, P.Eng.**
TITLE:	Director of Earth Sciences, UMA Winnipeg
PROJECT TITLE:	Environmental Specialist
YEARS OF EXPERIENCE:	22

PROJECT RESPONSIBILITIES: Provide technical expertise related to hydrogeological components of the study, as well as provide an overview of the study to ensure that the scientific and technical objectives of the project are met.

RECENT RELATED EXPERIENCE:

- Project Manager - Initial Environmental Evaluations for the DND Infrastructure Rationalization Plan: the project includes the determination of environmental impacts associated with the reorganization of the Air Force, and includes the evaluation of ten Air Command Bases.

- Project Manager - Environmental site assessments for numerous industrial facilities for mine reclamation, tailings management, groundwater protection/monitoring, landfill design, contaminated site rehabilitation, and facility demolition requirements.

- Quality Review Panel Member - CFB Calgary Environmental Site Assessments, DND.

- Quality Review Panel Member - DEW Line Clean Up Project, DND.

- Evaluation of candidate sites for a hazardous waste disposal facility including conductivity geophysical surveys, drilling and piezometer installation program to establish water chemistry, and assessment of air quality, agricultural soil capability, hydrogeology and hydrology as a measure of site suitability.

- Development and implementation of a multi-media environmental baseline study for a new hazardous waste management facility. The project addresses air, surface water, groundwater, snow, cereal and root crops, native grasses and biota, as part of a comprehensive predevelopment audit of environmental conditions.

- Development of a remediation plan for the disposition of PCB contaminated soils at an agricultural processing plant. Work included problem definition, and the consideration of cleanup levels and technologies.

- Management of the investigation and remediation of soil and groundwater contamination around an industrial facility where the use of chlorinated solvents resulted in contaminated groundwater plumes. Remediation strategies were also developed.

EDUCATION: B.Sc. Geological Engineering, University of Manitoba, 1973.

NAME:	**Art Washuta, P.Eng.**
TITLE:	Manager, Special Projects
PROJECT TITLE:	Project Principal
PROJECT BACKUP RESOURCE:	Art Washuta, P.Eng.
YEARS OF EXPERIENCE:	22

PROJECT RESPONSIBILITIES: Overseeing quality of work and client relationship for duration of the project. Mr. Washuta is available as backup to the Project Manager.

RECENT RELATED EXPERIENCE:

- Project Manager - Design and Cost Estimating of the Clean Up of 21 DEW Line Sites: he is responsible for the overall project management of this $150 million project for DND including client liaison, general coordination of all technical activities, major involvement in the public consultation program, schedule and budget control. Visited five communities in the East Group sites in 1992 and 1993 as part of the community consultation.

- Project Manager - Order of Magnitude Construction Cost Estimate for the Clean Up of 26 abandoned military sites in the Arctic, for the Department of Indian Affairs and Northern Development.

- Project Manager - Forward Operating Location, Inuvik, NWT for DND: responsible for the overall project management of this $30 million multidiscipline assignment that included six aircraft hangars for fighter aircraft, a 200-person accommodations building, operations building, equipment storage building, taxiway and aircraft apron, including an extension to the existing Transport Canada runway.

- Project Manager - Asset Condition Reporting Study including site investigations and audits of 335 assets at 35 Indian and Northern Affairs sites in the Yukon. Class D cost estimates were prepared for required health, safety and maintenance projects.

- Quality Coordinator - Currently Corporate Coordinator for the UMA Group's total quality management initiative.

EDUCATION: B.Sc. Civil Engineering, University of Alberta, 1973.

3.0 METHODOLOGY

To demonstrate our understanding of the project objectives and requirements, and to provide a basis for establishing a project schedule and budget, the project will be organized into specific work tasks. Figure 3.1 presents in graphic form, our proposed **Work Plan** for completing this project. This figure also indicates the major project **deliverables** to be provided to DIAND throughout the various work tasks.

The following sections provide a detailed description of the various work tasks. An overall **Project Schedule** is also included at the end of this section.

3.1 TASK 1 - PROJECT INITIATION

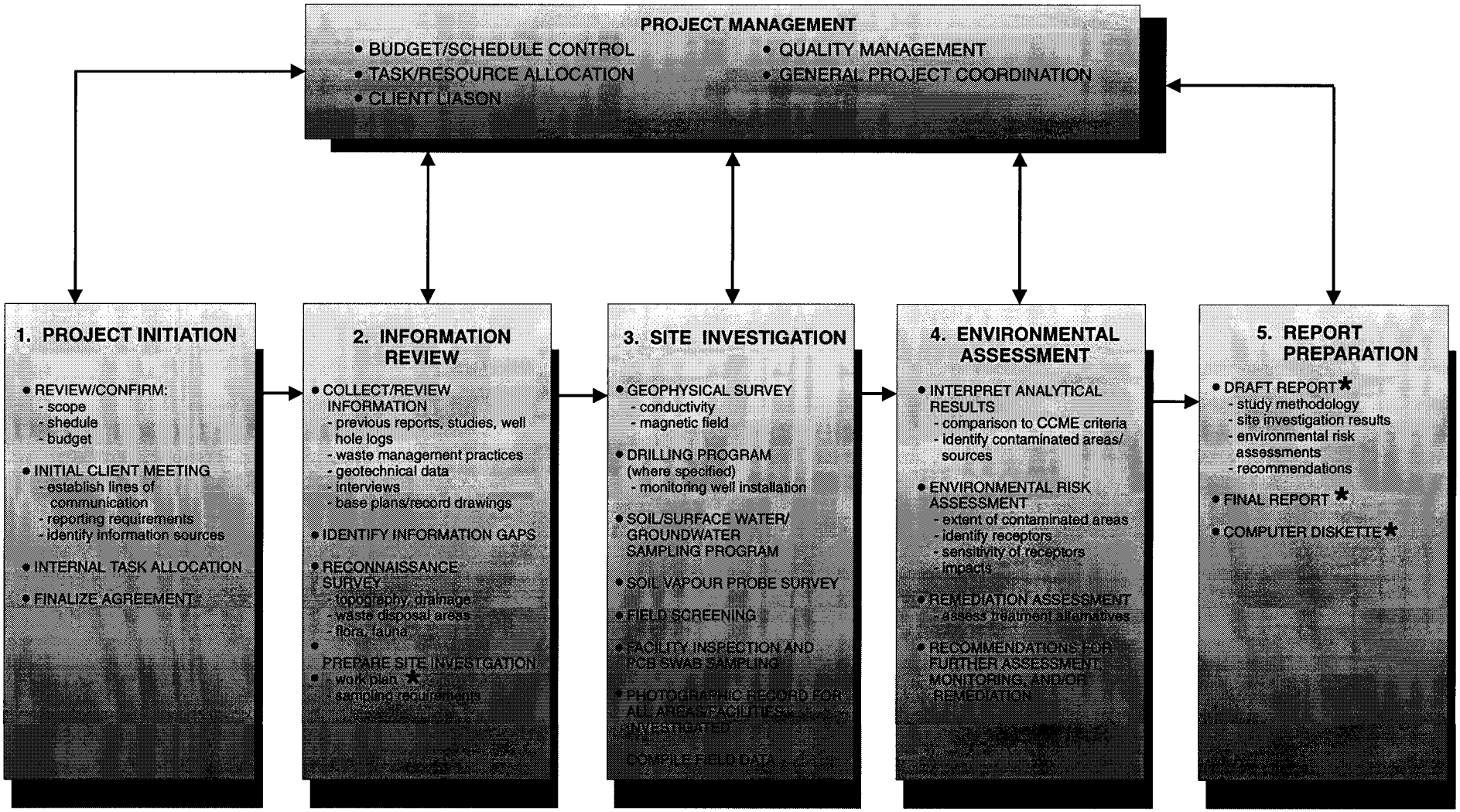
Upon notification of authorization to proceed, the UMA Project Manager and Technical Coordinator will meet with DIAND in Whitehorse to:

- review and confirm the proposed project scope, schedule and budget;
- establish lines of communication and project management reporting and invoicing requirements; and
- identify and collect information sources.

This work task will also include the internal assignment of tasks to project team members, and the establishment of a project control and filing system. At the conclusion of this task, the Environmental Professional Services Agreement between UMA and DIAND will be finalized.

3.2 TASK 2 - INFORMATION REVIEW

The objectives of this task are to collect and review all available information in advance of the site assessments, investigate past operations, identify information gaps, and develop Site Investigation Work Plans. The information collection and review will be carried out primarily by Ms. Kathy Bisset of Whitehorse, a subconsultant to AMBIO, with support from other project team members as required. Ms. Bisset has directly applicable experience having recently completed a similar review for DIAND in 1994.



* Project Deliverables

PRELIMINARY
ENVIRONMENTAL ASSESSMENT
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PROPOSED WORK PLAN

uma

FIGURE 3.1

The information to be collected and reviewed as part of this task is anticipated to include:

- aerial photographs: to ascertain current and past land use conditions, and to describe the biophysical environment including surface drainage, surficial geology, and permafrost features (where applicable);
- base maps and record drawings;
- inventories of hazardous/toxic materials and regulated substances;
- emergency response, remediation action plans within an applicable distance of the site being assessed;
- interviews with on-site personnel and neighbouring parties to determine the past history of the site, status of permits, disposal practices;
- environmental regulations and guidelines, Federal and Territorial;
- base geological and hydrogeological mapping;
- reports and studies from previous site investigations.

The objective of the Information Review Task is to evaluate historical land use at each of the facilities to be investigated and identify practices or events which may have impacted the environment. In addition, background information on the components of the biophysical environment, such as geology, hydrogeology, drainage, vegetation, and wildlife are to be obtained to allow characterization of each of the sites.

It is understood that a significant portion of this information is currently available through DIAND.

Also as part of the Information Collection and Review Task, a **Reconnaissance Survey** will be carried out at each of the sites. The objectives of the reconnaissance are to:

- verify base data obtained during the information review task;
- provide information to facilitate the development of the Site Investigation Work Plan, specifically identifying soil and water sampling locations and requirements;
- evaluate geophysical survey requirements; and
- identify drilling requirements.

The Reconnaissance Survey will be carried out by Steve Grundy, Ph.D. and Tanya Schulz, P.Eng. It is understood that a representative of DIAND will accompany the UMA team. Ms. Schulz has extensive field experience in the Arctic, having been involved in the site assessment and engineering design surveys for the cleanup of the 21 DEW Line sites over the past five years. She also has experience in the development, implementation, and assessment of groundwater monitoring programs. Steve Grundy has considerable experience in completing environmental assessments in the Arctic and brings to the team an in-depth knowledge of the types of contaminants, sampling requirements, and waste disposal practices typical of the operations in the Arctic.

Based on the information obtained during the preceding tasks, a **Site Investigation Work Plan** will be prepared for each site. We anticipate early submission of the work plan to accommodate overall schedule requirements. The Work Plan will include detailed descriptions of the drilling and sampling program to be carried out, and will address:

- geophysical surveys;
- drilling requirements including proposed test hole locations;
- soil and water sampling programs;
- soil vapour probe survey; and
- building surface swab sampling program.

In addition, the Work Plan will include contingency plans for Health and Safety, and emergency response plans. UMA's Health and Safety Plan utilizes OSHA/EPA Hazardous Waste Site Management Procedures and is designed to meet Canadian Occupational Health and Safety Regulations for the protection of field personnel. It is also recognized that the sites in this study are located in areas frequented by grizzly bears. All field personnel are familiar with procedures outlined in "Safety in Bear Country" and, at minimum, one member of the field team will hold a current Firearms Acquisition Certificate.

Information to be included in each site package is as follows:

- a base plan of each area to be investigated showing facilities, potential locations of previous waste disposal areas, and other features to be investigated as identified during the information review and reconnaissance survey;

- an inventory of features to be investigated;
- checklists for each aspect of the field program to ensure that a consistent data base is developed.

A carefully prepared Site Investigation Work Plan is essential for the successful completion of a project, as we have demonstrated in our combined work on the DEW Line Clean Up project, which involved the investigation and survey of 21 remote sites in the Canadian Arctic.

The proposed Site Investigation Program Schedule is included in the overall Project Schedule provided in Figure 3.2 at the end of this Section.

The field investigation of the sites will be carried out by a three person field team: Tanya Schulz, P.Eng., Steve Grundy, Ph.D. and Bill Dushenko, Ph.D. As indicated previously, both Ms. Schulz and Dr. Grundy have extensive field experience. Dr. Dushenko also brings considerable experience to the team, having worked on the assessments of the DEW Line Sites in Arctic Canada for both DIAND and DND.

In the event of changes in the workload, we have identified personnel with comparable experience who are available as backup.

The use of senior personnel will ensure that the site environmental assessment is carried out efficiently and that practical decisions can be made in the field to optimize sampling and investigation requirements. This is especially important in view of the restricted schedule. This inspection of the sites by senior personnel will also provide valuable information for the identification of potential environmental risks and development of remediation options.

3.3 TASK 3 - SITE INVESTIGATION

Given the past activities that occurred at these site, there are a limited number of potential pathways for the introduction of contaminants to the local environment. These include:

- direct spillage or discharge of contaminant-containing materials onto the soil or into a surface water body;

- burial of contaminated or hazardous materials; and/or
- surface or subsurface migration of contaminants from a primary source.

Identification of primary contaminant sources, either highly contaminated soils or buried materials, will form a major portion of the assessment, as well as a basis for the cleanup recommendations. The extent of migration of contaminants away from the primary source(s) is a key determinant in the assessment or prediction of environmental risk.

A major portion of the field work will be on the identification and delineation of subsurface waste materials, for example, buried electrical equipment or barrels containing potentially contaminated or hazardous materials. This is particularly relevant given the discovery of buried canisters of DDT at Rainy Hollow.

As related to these requirements, the primary components of the site investigation are:

- geophysical surveys;
- surface sampling program; and
- drilling and subsurface sampling program;
- facility inspection.

The **Geophysical Survey** will consist of a conductivity and total magnetic field survey, and will be used to determine the presence and extent of buried materials. The grid to be surveyed will be referenced to UTM coordinates using GPS (global positioning system). Grid spacing and the minimum number of readings will be as stipulated in the Terms of Reference.

The conductivity survey will be carried out using an EM-31 equipped with a programmable datalogger. All data from the EM-31 will be downloaded to a laptop computer for data manipulation. The conductivity survey will be used to identify anomalous subsurface conditions. Anomalies in conductivity measurements may be the result of variations in surficial deposits, including water content, contaminants, void ratio, as well as the presence of buried materials. Interpretation of conductivity measurements will require careful consideration of the surficial geology in the area of the survey.

To assist in the interpretation of the conductivity survey, a magnetic field survey will be carried out using a magnetometer. The tools are complimentary in that the magnetometer is sensitive to ferrous debris and is not affected by soil conditions. By combining data obtained from both tools with site specific knowledge, the results can be corrected and a clear interpretation of site conditions will be obtained.

Shallow test pits will be excavated using handtools (pick and shovel) in areas where anomalous readings occur to provide additional information on the subsurface materials. Soil descriptions will be recorded for all test pits.

A **Surficial Sampling Program** will be carried out at all sites. Proposed sampling locations, where contaminants may have been introduced to the local environment, will be identified based on evidence from aerial photographs (over more than one time period), other information obtained during the information review, and areas of disturbance observed during the Site Reconnaissance.

A small number of soil samples will be collected in areas suspected of being contaminant sources. The top 5 cm of soil, excluding gravel, will be collected with non-contaminating utensils into contaminant-free glass jars or into Whirlpak bags for inorganic elements. These samples will be sent to Axys Analytical Services and analyzed as per the Statement of Work (inorganic elements, PCBs, PAHs, BTEX, phenoxy-herbicides and DDT and its breakdown products). The three week turnaround for receipt of analytical results is critical relative to the project schedule.

The **Soil Vapour Probe Survey** will be carried out in conjunction with the soil sampling program. A minimum of 10 locations will be identified for the vapour survey. At these locations, shallow test pits will be excavated manually to allow a depth profile of vapour measurements. A Thermo Environmental Instruments Inc. Organic Vapour Monitor or a Photovac MicroFID equipped with a Flame Ionization Detector would be used to detect the presence of volatile organic compounds in the field.

It is recommended that prior to collection of the soil samples, field test kits and methods be used to delineate hot spots.

The primary advantage of using field test kits is that it allows delineation of contaminated areas in the field, reducing costs associated with additional investigation, contaminated soil volumes requiring cleanup can be more accurately defined, and

correspondingly, cleanup requirements and associated costs are more accurately estimated. As per the Terms of Reference for this proposal, the costs associated with this option are provided separately.

Field analytical techniques that have a proven record of reliability and are cost-effective include the following:

- PCBs, TPH, PAH and PCP concentrations in samples would be determined on site by using Millipore EnviroGard kits. The kits utilize the enzyme-linked immunoabsorbent assay technique which is based on antibodies that are specifically designed to bind to target analyte molecules. Once the antibody is bound to the analyte, the amount can be measured. These kits are accepted for US EPA SW-846 Draft Methods (PCB, PCP, TPH, BTEX, DDT, Toxaphene, Chlordane.) Detection limits are in the range of 0.5 ppm.

- A TN Technologies Inc. Spectrace 9000 Field Portable X-Ray Fluorescence Analyzer (FPXRF) would be used for field screening of inorganic elements. THE FPXRF is equipped with a high resolution solid state (mercuric iodide) detector and fundamental parameters quantitative analysis software. Fundamental parameters quantitative analysis involves measuring all major elements present and compensating for the effects of the interferences on one another by computer calculations. This allows for a good estimate of inorganic element concentrations for all soil matrix types without the necessity for several standard samples having the same general concentrations and matrix; pure elements or standard reference materials are used for calibration standards. This equipment is routinely used by the US EPA Technical Assistance Teams and the Emergency Response Teams for on-site analysis. The minimum detection limits for a few of the elements are: Copper - 44 ppm, Nickel - 63 ppm, Arsenic - 25 ppm, Lead - 14 ppm, Zinc - 35 ppm. Good correlations between the FPXRF and laboratory AAS results have been obtained.

We advocate the use of all of the aforementioned field analytical techniques as a means for obtaining detailed information on volumes of contaminated soil and pathways of migration into sensitive environmental components at a very reasonable cost.

Our previous contaminant investigations of the Canol Pipeline and four pumping stations suggest that contamination of the Haines-Fairbanks pumping stations should be limited in terms of maximum concentration, spatial extent, and the range of contaminants found, the only exception being the possible further discovery of further buried canisters containing pesticides, herbicides, PCB containing fluids, or other toxicants. This further suggests that the need for field analytical tests will not be extensive.

In addition to the four soil samples to be collected, as specified in the Statement of Work, additional soil samples will be collected and archived in the event that additional information is required.

Surface water samples will be obtained from areas of standing water which receive drainage from suspected areas of contamination. Data from these samples will provide evidence of contaminant leachability, migration and inputs into waters supporting aquatic life.

All sample locations will be referenced using GPS, and indicated on an overall site plan of the area.

A **Drilling Program** will be carried out at the Million Dollar Falls Pump Station. A minimum of four holes will be drilled to a maximum depth of 15 metres.

Midnight Sun Drilling Company Ltd. of Whitehorse will be retained for the drilling of test holes. In accordance with the Terms of Reference, costs are based on air rotary drilling of two test holes and hollow stem augering of the remaining two holes. It should be noted that air rotary and hollow stem augering requires two separate drill rigs.

The primary objective of the drilling program is the installation of monitoring wells to allow the sampling of the groundwater, as well as determine the groundwater flow regime.

The subsurface profile will be described using the Modified Unified Soil Classifications System based on visual examination of the auger cuttings and rotary chips. Soil samples will be retrieved at a minimum of 0.75 metre depth intervals and at every stratigraphic change. Select samples will be field screened with a HNU photoionization detector.

This field instrument provides an initial indication of the presence of elevated volatile concentrations in soil samples, and are most applicable to granular soils contaminated with products such as gasoline.

Two soil samples from each well installation will be retained for laboratory analytical testing as per the requirements in the Statement of Work. Select soil samples will be retained for determination of geotechnical index properties and will complement existing data. Index properties are used in the evaluation of hydraulic conductivity of the subsurface soils and correspondingly contaminant migration potential.

The monitoring wells will be constructed using 50 mm diameter PVC slotted and soil pipe. A sand filter will be placed around the slotted section and the hole backfilled with bentonite pellets and chips.

The locations of the monitoring wells will be referenced to UTM coordinates using GPS. Simple levelling techniques will be used to calculate relative elevations between monitoring wells, from which the hydraulic gradient will be determined.

Groundwater samples will be obtained from each of the monitoring wells for analyses of specific parameters as detailed in the Statement of Work.

A **Building Inspection** will be carried out at the remaining facilities. The purpose of the inspection is to obtain surface swab samples from the walls/floors of the facilities for assessment of PCB contamination and associated human health risks. Those buildings which are presently used or may be used in the future by humans will be assessed using hexane swabs over a 10 cm by 10 cm surface area. Inspection of the facilities to determine decommissioning requirements is **not** included in the scope of work of this contract.

An important component of the field program is ensuring that **Quality Assurance/ Quality Control** (QA/QC) requirements are fulfilled. Field blanks will be obtained for all sampling containers used. In addition, field duplicate samples will be obtained for 10 percent of the samples and/or one at each different station.

A rigorous chain-of-custody will be maintained to conform to regulations regarding sample control. Chain-of-custody forms will be completed and verified for each sample before shipping; the contents of the shipment will be confirmed on receipt by the analytical laboratory.

Typically, samples are submitted "blind" to the analytical laboratory such that no site specific information is provided to the laboratory. However, the Terms of Reference for this proposal stipulates a specific numbering system. It is proposed that all samples be submitted to the laboratory identified using a consecutive numbering system which is cross-referenced to the identification requirements outlined in the Request for Proposal.

As related to the above activities, the field team will be provided with the following equipment:

- field books for data recording;
- 35 mm camera equipped with the data-back feature, flash and film;
- video camera and film;
- Site Investigation Work Plan, which includes existing maps and drawings, checklists for the field program, and analytical request forms;
- a laptop computer for data entry.
- hand-held GPS for survey reference;
- all required sampling equipment and shipping forms;
- EM-31 and magnetometer;
- pick and shovel, measuring tape, and other misc. tools;
- water level reader.

The drilling contractor will be responsible for providing all drilling supplies and monitoring well components.

3.4 TASK 4 - ENVIRONMENTAL ASSESSMENT

The primary component of this task is the development of an environmental risk assessment for each site. The requirement for the environmental risk assessment is necessitated by the recognition that not all contaminated sites pose the same risk to the environment, and correspondingly, cleanup or remediation requirements may vary.

The assessment of risk can be measured or modelled using a wide variety of methods. A necessary condition for there to be an environmental risk due to a contaminant is the immediate or future presence of bioavailable forms. If a contaminant is present and bioavailable, then the associated risk varies as a function of the exposure concentration, extent of the contaminated area, and sensitivity/characteristics of the local ecosystem (microbes, flora, fauna). There are several formal mathematical models available for estimating risk; however, we adhere to a practical approach where real data is invariably more accurate and appropriate than modelled data.

The assessment of risk will be based initially on the confirmation of the presence of contaminated media, using the CCME Residential/Parkland Criteria for the initial assessment. The risks associated with concentrations below these criteria would be assumed to be minimal, unless a highly sensitive biotic element is present. Evidence of migration of contaminants at any concentration, along water courses and into fish bearing waters is indicative of direct risk and has implications under the Fisheries Act. Evidence of risk will also include visual observations of the use of a contaminated area by wildlife and humans.

If moderately or highly contaminated areas are identified, the risk assessment will be based upon predictions of contaminant partitioning and uptake into the food web. The ingestion, assimilation, and biomagnification of organic contaminants in terrestrial food webs in the Yukon (including humans) will be estimated from the local concentrations and existing data.

At the Million Dollar Falls site, risk will also be evaluated based on potential for subsurface contaminant migration and hence the possibility of an increase in the spatial extent of a contaminated area.

It is proposed that plant samples be taken in parallel with soil samples and also archived (stored frozen). The use of plants for assessing ecosystem impact has been extremely valuable in the environmental investigations of the DEW Line sites. Should the necessity arise, these samples could be analyzed and the data used by DIAND to estimate ingestion rates of contaminants by herbivores and humans. At this time, it is not anticipated that DIAND would require this additional information; however, there would be little cost associated with collection of plants, and the costs associated with archival storage would be insignificant relative to collection at a later date.

As part of the assessment, we will carry out an evaluation of the data to determine if sufficient information is available to provide detailed recommendations for cleanup, and identify additional information requirements.

3.5 TASK 5 - REPORT PREPARATION

The results of the various tasks of the assessment process will be assembled into a final technical report. The report will provide a clear and concise record of the activities completed, the results and interpretation of the data collected and provide recommendations for further remediation.

The final report will include:

- an overview of the study methodology, including the information review, site investigation and laboratory program;
- a summary of the results for each site including:
  - identification of information sources used and data obtained;
  - site conditions, topography, facilities, identification of areas of concern, ie spills, waste disposal;
  - a description of the subsurface stratigraphy depicted on the test hole logs, hydrogeological conditions and assumptions made;
  - results of the sampling and testing programs, including the field screening, comparison of field and laboratory analytical data, a discussion of the QA/QC procedures;
- interpretation of results:
  - conclusions related to the characterization and extent of contamination;
  - evaluation of the hydrogeologic setting and contaminant migration potential;
- preliminary environmental risk assessment;
- recommendations for additional assessment and/or remediation.

The following information will be included in appendices to the main report:

- geophysical survey data;
- test hole logs and monitoring well installation records;
- detailed results of the analytical program including QA/QC procedures;
- site photographs; and
- biological checklist.

A copy of the draft final report will be submitted to DIAND no later than August 18, 1995. As per the Terms of Reference, five days for review by DIAND has been allowed. Comments from DIAND project personnel will be considered and incorporated into the Final Report as appropriate. Ten bound copies of the final report, one reproducible original, and one diskette copy will constitute the final submission on August 29, 1995.

3.6 TASK 6 - PROJECT MANAGEMENT

A separate task has been identified for the activities associated with project management to outline the means and methods of communication, task allocation, schedule, budget and cost control and quality management. This project will be managed by the Project Manager, Project Principal and Technical Coordinator. The Project Manager will be UMA's representative responsible for the overall coordination of the project from inception to completion. The Project Principal will be UMA's corporate representative responsible for overseeing the quality of work and client relationship throughout the duration of the contract. The Technical Coordinator will plan and supervise the overall Environmental Assessment according to the project requirements.

The designated Project Management Team includes:

- Project Manager - Tanya Schulz, P.Eng.
- Technical Coordinator - Steve Grundy, Ph.D.
- Project Principal - Art Washuta, P.Eng.

All three of these individuals have extensive experience in environmental and multidiscipline projects in the north. Further information regarding their experience is included in Section 2.4.

The following paragraphs describe the basic project management procedures which will be utilized to achieve the successful management of this project to the satisfaction of DIAND.

A close **client/consultant relationship** is fundamental to any successful project. It is our intention that a good working relationship be established and maintained between our project team and DIAND throughout this project.

Following the Project Initiation Meeting during the week of June 5, 1995, it is anticipated that the Project Team will meet with DIAND in Whitehorse following the conclusion of the Reconnaissance Survey and the Site Investigation. These meetings will allow an informal review of the project. If required, an additional meeting can be scheduled for the presentation of the final reports.

At the start of the project, the Project Team will conduct an evaluation of the project objectives and corresponding scope of work in order to **Allocate Project Tasks**. Principal tasks as outlined previously in this section, will be further subdivided as appropriate. Task instructions will be prepared to outline all tasks to be conducted, the person(s) responsible, the schedule for completion and the associated person-hours and cost budgets.

For this study, Microsoft Project will be used to prepare, update and monitor the **Project Schedule.** Our Project Manager is completely familiar with the software immediate access to the system. Existing reporting formats will be reviewed and modified to suit DIAND requirements as required. Schedules will be updated on a monthly basis in consultation with the DIAND Project Manager.

UMA Engineering Ltd. has developed and implemented a cost control system that will use weekly time information sheets to produce a set of detailed reports on person-hours, time costs and expenditures for this project. The available reports cover a range of detail from general (e.g. total hours spent on a project in the current period and to date) to very detailed (number of hours expended by each individual team member on various tasks).

This information will be used in conjunction with the schedule control system to allow our Project Manager to monitor and control both budget and schedule simultaneously and to take timely corrective action in the event of deviations from the work plan in consultation with DIAND.

Prior to commencement of each of the tasks identified in this section, the scope definition will be reviewed and finalized with DIAND. Any changes in the scope beyond this point will be brought to the attention of DIAND. Our scope change reporting system will include a description of the reason for the proposed change, details of the work requirements, the estimated impact on the project schedule and the impacts on consulting costs, if applicable.

The UMA Group is committed to total **Quality Management** and continuous improvement through a program called UMA Quality Focus. Our emphasis is on teamwork, innovation, process improvement and most importantly, customer satisfaction.

Our Project Principal is currently the UMA Group Quality Coordinator for implementation of Total Quality Management within the company and will adopt all available resources to the successful management and completion of this project.

A **Reporting System** will be initiated in accordance with DIAND requirements and monthly reports will be provided with the following information:

1. Project Status
2. Project Progress
   - Work Carried Out in Current Period
   - Work Planned in Next Period
   - Trips During Reporting Period
   - Outstanding Issues
3. Information Requirements
4. Schedule Update
   - Bar Chart Schedule (Microsoft Project)
5. Cash Flow Update

3.7 PROJECT SCHEDULE

Figure 3.2 presents the proposed schedule for Contract Package 95-0038 for the Environmental Assessment of the Haines - Fairbanks Pipeline using Microsoft project format. It includes the duration of the various work tasks, and identifies the schedule for the submission and/or completion of specific project milestones. The schedule is based on the following assumptions:

- Project Award Date: June 5, 1995;
- a three week period for the completion of laboratory analysis of samples following receipt of samples;
- a five day period for DIAND's review of any submissions;
- current scope of drilling and sampling.

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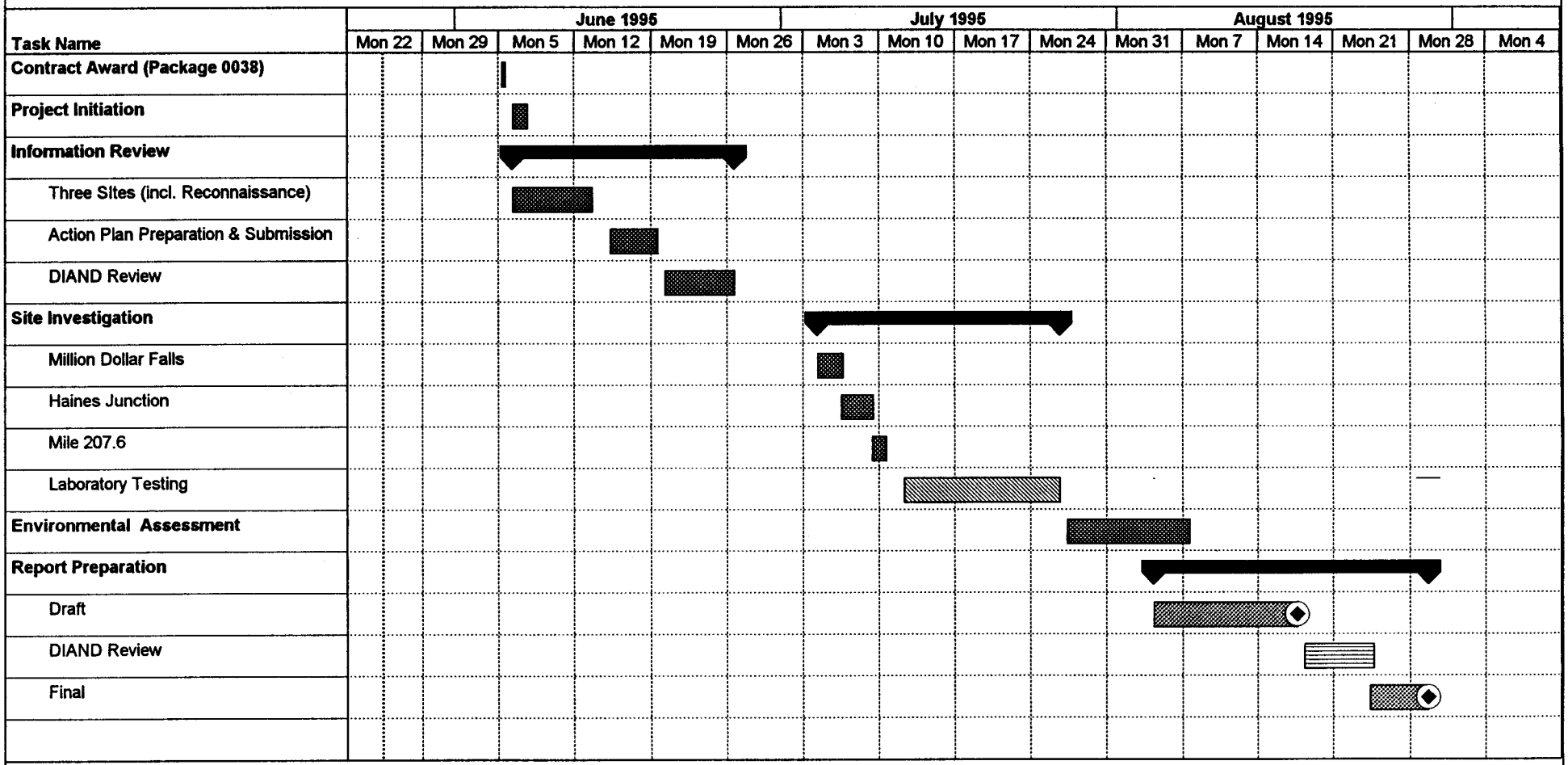


PROPOSED PROJECT SCHEDULE

FIGURE 3.2

4.0 FINANCIAL PROPOSAL

The cost estimate is presented in a format consistent with the Terms of Reference in the Request for Proposal.

TABLE 4.1 PROJECT COST ESTIMATE	
FEES	
$637.50/day to a maximum of 64.2 days	$40,875.00
Miscellaneous Expenses	
- Administrative	$7,600.00
- Drilling Subcontractor	$18,000.00
Travel and Living Expenses	$11,350.00
TOTAL COSTS - FEES AND EXPENSES	$77,825.00
GST (at 7%)	$5,447.75
TOTAL PROJECT COSTS	**$83,272.75**

In accordance with the Terms of Reference, the costs for on-site testing have been provided separately. These costs are **not** included in Table 4.1.

Field Test Kits	$14,915.00
GST (at 7%)	$1,044.05
TOTAL COSTS - FIELD TEST KITS	**$15,959.05**

The remainder of this section presents a breakdown of the costs estimated for the various project tasks. Details of the proposed method of payment are also presented.

4.1 CONSULTING FEES

Table 4.2 presents an estimate of the hours required by each project team member to complete the project tasks as described in Section 3.0 of this proposal. Table 4.3 presents the corresponding time cost estimate.

The fees provided in Table 4.1 are based on total time costs divided by the estimated number of days of work based on an 8 hour work day.

4.2 EXPENSES

Miscellaneous administrative expenses include:

- communication - telephone, fax, modem, E-Mail;
- photocopying - internal, report preparation;
- miscellaneous - courier, photo development, sample shipping, EM-31 rental, magnetometer rental.

Drilling costs have been included as a separate line item. A detailed breakdown of drilling costs is provided in Table 4.4. This estimate is based on a quotation provided by Midnight Sun Drilling Company Ltd. and our experience in completing similar projects. A copy of the quote received from Midnight Sun is appended to this section. The estimate is based on encountering reasonable ground conditions and does not include allowances for:

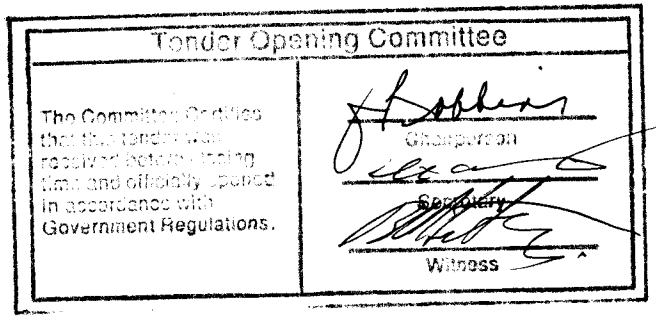
- delays due to mechanical breakdown, and/or additional costs incurred as a result thereof;
- delays due to inclement weather, and corresponding costs;
- substantial changes in the scope of work as a result of information obtained while drilling.

A detailed estimate of the costs for travel/living disbursements is presented in Table 4.5. Miscellaneous expenses associated with the Site Investigation are included in Table 4.6.

PRELIMINARY ENVIRONMENTAL ASSESSMENT
HAINES - FAIRBANKS PIPELINE

PACKAGE 0038
TABLE 4.2 MANHOUR ESTIMATE

TEAM MEMBER	PROJECT INITIATION	INFORMATION REVIEW	SITE INVESTIGATION	ENVIRONMENTAL ASSESSMENT	REPORT PREPARATION	TOTAL MANHOURS
UMA						
A. Washuta	2			2	4	8
T. Wingrove				4	2	6
T. Schulz	8	50	70	40	8	176
S. Stowkowy					24	24
B. Fedorak				16		16
AMBIO						
S. Grundy	8	50	70	30	10	168
B. Dushenko			35	20		55
D. Bright				10		10
K. Bisset		16				16
Drafting					12	12
Steno.	2	4		8	8	22
TOTALS	20	120	175	130	68	513



PRELIMINARY ENVIRONMENTAL ASSESSMENT
HAINES-FAIRBANKS PIPELINE
COST ESTIMATE - PACKAGE 0038
TABLE 4.3: COST ESTIMATE

TEAM MEMBER	CLASS	RATE ($/HR)	PROJECT INITIATION	INFORMATION REVIEW	SITE INVESTIGATION	ENVIRONMENTAL ASSESSMENT	REPORT PREPARATION	TOTAL COSTS
TIME COSTS								
UMA								
A. Washuta	E6	$95.00	$190			$190	$380	$760
T. Wingrove	E6	$95.00				$380	$190	$570
T. Schulz	E5	$85.00	$680	$4,250	$5,950	$3,400	$680	$14,960
S. Stowkowy	E5	$85.00					$2,040	$2,040
B. Fedorak	E2	$50.00				$800		$800
AMBIO								
S. Grundy		$85.00	$680	$4,250	$5,950	$2,550	$850	$14,280
B. Dushenko		$85.00			$2,975	$1,700		$4,675
D. Bright		$85.00				$850		$850
K. Bisset	P2	$50.00		$800				$800
Drafting	T4	$40.00					$480	$480
Steno.	A3	$30.00	$60	$120		$240	$240	$660
TOTAL TIME COSTS			$1,610	$9,420	$14,875	$10,110	$4,860	$40,875
DISBURSEMENTS								
Travel / Living				$4,250	$7,100			$11,350
Communications			$200	$500	$200	$200	$200	$1,300
Printing			$50	$200	$50	$200	$500	$1,000
Miscellaneous				$200	$23,000	$50	$50	$23,300
TOTAL DISB.			**$250**	**$5,150**	**$30,350**	**$450**	**$750**	**$36,950**
TOTAL COST			**$1,860**	**$14,570**	**$45,225**	**$10,560**	**$5,610**	**$77,825**

TABLE 4.4

DRILLING ESTIMATE
MILLON DOLLAR FALLS SITE

Auger - 2 holes to 15 metres

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL COST
Rig Mobilization				$3,200
Equipment Rates				
Auger	hours	10.0	$80.00	$800
Steamer	day	2.0	$225.00	$450
Auger	meter	30.0	$9.84	$295
Sampling Equip.	day	1.0	$100.00	$100
Crew Rates	hour	22.0	$80	$1,760
Subtotal				**$6,605**

Air Rotary - 2 holes to 15 metres

Rig Mobilization				$4,600
Equipment Rates				
Air Rotary	hours	10.0	$200.00	$2,000
Steamer	day	2.0	$225.00	$450
Sampling Equipment	day	1.0	$100.00	$100
Crew Rates	hours	22.0	$80	$1,760
Subtotal				**$8,910**
Crew Room & Board	per night	6.0	$125	$750
Total Drilling Costs				**$16,265**

Monitoring Well	Bentonite Chips	15.0	$23.90	$359
	Frac Sand	15.0	$23.90	$359
	2" PVC Pipe (screen)	6.1	$15.91	$97
	2" PVC Pipe (solid)	53.9	$8.86	$478
	2" PVC Caps	8.0	$3.60	$29
	Protective Casing	4.0	$92.60	$370
Subtotal Monitoring Wells				**$1,691**
TOTAL MONITORING WELL INSTALLATION INCL. DRILLING				**$17,956**

TABLE 4.5 Travel and Living Cost Estimate - Package 95-0038	
Task 2 - Information Collection and Review (Site Reconnaissance)	
Air Travel	
. T. Schulz Edmonton - Whitehorse Return	$1,150
. S. Grundy Victoria - Whitehorse Return	$1,100
Accommodation & Meals	
4 nights @ 150/night - 2 persons	$1,200
Vehicle Rental	
Rental, Mileage and Gas	$800
Subtotal	**$4,250**
Task 3 - Site Investigation	
Air Travel	
. T. Schulz Edmonton - Whitehorse Return	$1,150
. S. Grundy Victoria - Whitehorse Return	$1,100
. B. Dushenko Victoria - Whitehorse Return	$1,100
Accommodation & Meals	
7 nights @ 150/night - 2 persons	$2,100
3 nights @ 150/night - 1 person	$450
Vehicle Rental	
Rental, Mileage and Gas	$1,200
Subtotal	**$7,100**

TABLE 4.6
MISCELLANEOUS DISBURSEMENTS - Package 95-0038

Task 3 - Site Investigation

▪ EM-31 Rental (Incl. Datalogger) 2 weeks @ 850 p	$1,700
▪ Magnetometer Rental	
- 2 weeks @ 375 per + $100 take-out charge	$850
▪ Organic Vapour Monitor - 2 weeks @ 500/week	$1,000
▪ Sample Jars, Shipment	$500
▪ Film, Photo development	$150
▪ GPS	$800
Subtotal	**$5,000**

4.3 ON-SITE TESTING

We have recommended the use of on-site field test kits for contaminant delineation in our proposal. Table 4.7 provides a breakdown of the associated costs.

TABLE 4.7
FIELD TEST KITS - COST BREAKDOWN

• **Assume 20 Screening Samples per Site - Total 60 Samples**	
- Extraction Kit - Sufficient for 100 Samples	$695.00
- Portable Spectrometer - Supply	$1,350.00
- Power Supply	$95.00
- PCBs - $305/12 Samples	$1,525.00
- PAHs - $305/12 Samples	$1,525.00
- TPH - $305/12 Samples	$1,525.00
- FPXRF (Inorganic Elements) - 1 Month Rental Only	$8,200.00
TOTAL COST	**$14,915.00**
COST PER SITE	$4,972.00

4.4 METHOD OF PAYMENT/INVOICING

It is proposed that UMA will invoice Indian and Northern Affairs Canada on the following milestone dates:

- Milestone #1 - Following Completion of Site Investigation
  July 31, 1995 (not including GST) $61,655.00

- Milestone #2 - Submission of Final Reports
  August 29, 1995 (not including GST) $16,170.00

UMA Engineering
17007 107th. Ave.
Edmonton, Alberta
T5S 1G3

23-May-95
File: RIG4BID
UMAPUM5J

ATTENTION: Barry Fedorak

SUBJECT: Drilling with a truck mounted CME 75 Million Dollar Falls.

Dear Sir:

Please find enclosed our unit costs and estimated total cost for drilling with a CME 75 truck mounted rig at Million Dollar Falls.

Our quotation is based on 2 holes to 50 feet with hollow stem augers and 2 holes to 50 feet with mud rotary.

The rig will come equipped to drill with hollow stem, solid shaft augers and mud rotary.

If you have any questions, please do not hesitate to contact the undersigned at (403) 633-3070 or fax at (403) 633-5758.

Yours truly,

MIDNIGHT SUN DRILLING CO. LTD.

Ruth Jamieson

9[illegible] David Jamieson

436-3960

SOIL TESTING, PLACER DRILLING, WATER WELLS

MOBILIZATION / DEMOBILIZATION: (UMAPUM4J)

-Loading in yard, travel from Whitehorse to Million Dollar Falls and return. $3,144

EQUIPMENT:				
-C.M.E. 75	$80.00 /hr.	48 hrs.	$3,840.00	
-Steamer and trailor	$225.00 /day	5 days	$1,125.00	
-Mud drilling equipment	$125.00 /day	5 day(s)	$625.00	
CREW:				
-Two man drill crew, lodging to site and return.	$80.00 /hr.	60 hrs.	$4,800.00	
EXPENDABLES:				
-Hollow Augering	$3.00 /foot	100 feet	$300.00	
-Solid Shaft Augering	$2.25 /foot	0 feet	$0.00	
-Bentonite Chips	$23.90 /bag	15 bags	$358.50	
-Quick Gel	$14.95 /bag	8 bags	$119.60	
-Frac Sand	$23.90 /bag	15 bags	$358.50	
-Cement	$16.75 /bag	0 bags	$0.00	
-Sampling Eqmt (Est)	$100.00 /day	5 day(s)	$500.00	
-2" PVC pipe	$2.70 /ft	180 feet	$486.00	
-2" PVC slotted pipe	$4.85 /ft	20 feet	$97.00	
-2" PVC caps	$8.60 /cap	8 caps	$68.80	
-Protective caps	$92.60 /box	4 caps	$370.40	
ROOM AND BOARD:				
-Room and board	$125.00 /man/	12 Man d	$1,500.00	
			$14,548.80	$14,549

Note: Any equipment lost or damaged in the hole is charged at cost plus freight plus 10%.

		$17,693
Plus	7% GST	$1,238
ESTIMATED TOTAL COST		$18,931

MIDNIGHT SUN DRILLING CO. LTD.

MOBILIZATION / DEMOBILIZATION: (UMABLA4J) 23-May-95 Page 2

-Loading in yard, travel from Whitehorse to Blanchard, Border and return. $3,576

EQUIPMENT:			
-C.M.E. 75	$80.00 /hr.	96 hrs.	$7,680.00
-Steamer and trailor	$225.00 /day	10 days	$2,250.00
-Mud drilling equipment	$125.00 /day	10 day(s)	$1,250.00
-Two man drill crew; lodging to site and return.	$80.00 /hr.	126 hrs.	$10,080.00
EXPENDABLES:			
-Hollow Augering	$3.00 /foot	200 feet	$600.00
-Solid Shaft Augering	$2.25 /foot	0 feet	$0.00
-Bentonite Chips	$23.90 /bag	30 bags	$717.00
-Quick Gel	$14.95 /bag	16 bags	$239.20
-Frac Sand	$23.90 /bag	30 bags	$717.00
-Cement	$16.75 /bag	0 bags	$0.00
-Sampling Eqmt (Est) -	$100.00 /day	10 day(s)	$1,000.00
-2" PVC pipe	$2.70 /ft	360 feet	$972.00
-2" PVC slotted pipe	$4.85 /ft	40 feet	$194.00
-2" PVC caps	$8.60 /cap	16 caps	$137.60
-Protective caps	$92.60 /box	8 caps	$740.80
ROOM AND BOARD:			
-Room and board	$125.00 /man/	24 Man d	$3,000.00

Note: Any equipment lost or damaged in the hole is charged at cost plus freight plus 10%.

	$29,577.60	$29,578
		$33,154
Plus 7% GST		$2,321
ESTIMATED TOTAL COST		$35,474

APPENDIX A
CORPORATE STRUCTURE

APPENDIX A
CORPORATE STRUCTURE

The UMA Group is an international organization that provides professional planning, engineering, project management and engineering contracting services from offices in Canada and the United States. Offices are located in major cities in Canada from Victoria to Halifax, as well as St. Louis, Missouri and Irvine, California in the United States.

The principal companies in the UMA Group are:

- **UMA Engineering Ltd.**: provides project management, multidisciplinary consulting engineering, procurement and construction management services (EPCM).

- **UMA Environmental Division**: provides services in environmental science, environmental audit/assessment/investigation, public policy studies, site remediation design, hydrogeology, municipal and industrial pollution control, water treatment process, hazardous waste analysis and process design, and solid waste collection and disposal systems.

- **UMA Projects Division**: provides project management and contract management support services utilizing control methods optimized for specific size and type of project.

- **UMA Geomatics Group:** provides surveying, mapping, remote sensing, GIS activities and associated consulting, education and training. Services relate to legal, construction and special surveys, data acquisition and conversion using traditional ground methods and aerial photography, topography and cadastral mapping, and surveys utilizing Global Positioning Techniques (G.P.S.).

- **Western Photogrammetry**: provides a broad range of services related to the capture and conversion of data utilizing aerial photography and applying state of the art technology, computer equipment and software.

- **UMA Spantec Ltd.**: provides full service construction management services for sequential multiple trade construction contracts to project completion and/or design-build project services to a target price or turnkey fixed price.

- **Spantec Constructors Ltd.**: industrial contractors, providing direct hire and specialized subcontract construction services on a fixed price basis. Areas of expertise are in process piping; mechanical equipment erection; material handling systems; structural steel erection; and in turnkey design-build industrial projects.

- **Marston & Marston Inc.**: serves the mining industry with complete mine planning, contract operation and engineering services. Computer capabilities are particularly specialized for reserve determination, orebody modelling, equipment specification, life of mine planning and mine economics.

- **UMA/B&V Ltd.**: specializes in the power generation, transmission and distribution market, and provides project services for management, engineering, procurement and construction. Services are provided in any combination required by the Client including turnkey lump sum contracts.

- **UMATAC Industrial Processes Division**: provides technology, process equipment and services for the extraction of bitumen from oil sands and oil shale as well as the removal of contaminants in the environmental clean up of contaminated sites.

The UMA Group is able to respond to a wide variety of project work - both technically and geographically - by utilizing the best available resources from the principal companies described. Our corporate strength and stability can be illustrated by the UMA Group having observed its 80th Anniversary in 1991.

APPENDIX B
PROJECT DESCRIPTIONS

APPENDIX B
PROJECT DESCRIPTIONS

This section provides detailed descriptions of projects completed by UMA Engineering Ltd. and AMBIO Research Associates. They are provided to show our depth of experience as related to the requirements of this project.

B.1 UMA ENGINEERING LTD.

Project:	**DESIGN AND COST ESTIMATING OF THE CLEAN UP OF 21 DEW LINE SITES**
Date:	1992-1994
Client:	**SUPPLY AND SERVICES CANADA FOR THE DEPARTMENT OF NATIONAL DEFENCE**
Objective:	In accordance with the North American Air Defence Modernization Program (NAADM), the Distant Early Warning (DEW) Line has been replaced with the new North Warning System (NWS). Those portions and facilities of the DEW Line no longer required for the operation of the NWS have been decommissioned. Additional clean up of the sites is required and refers to the physical restoration and remediation of contaminated areas at these sites.
Scope of Work:	Prime Consultant, Project Management, Site Investigations, Public Consultation, Hazardous Waste Management, Civil and Geotechnical Design, Cost Estimating, Implementation Planning.
Description:	UMA Engineering Ltd. in association with Sheppard Green Engineering & Associates Ltd. and Jacques Whitford Environment Ltd., were retained by Supply and Services Canada to provide consulting services for the design and cost estimating of the clean of the DEW Line sites. The DEW Line sites are located on the Arctic Coast between Komakuk Beach in the Yukon Territory and Cape Dyer on Baffin Island in the Eastern Arctic. The DEW Line Clean Up (DLCU) project has included the following components: • detailed site investigations by surveyors and environmental, geotechnical and civil engineers; • development and implementation of public consultation programs to solicit input of the public; • development of waste management solutions for contaminated soils and hazardous materials; • environmental screenings and development of an Environmental Protection Plan; • preparation of comprehensive drawings and specifications for the clean up and demolition work at 21 sites; • the development of cost estimates; • the development and assessment of clean up implementation strategies.
Budget:	$150 to $200 Million
Key Areas:	**PROJECT MANAGEMENT, NORTHERN AND REMOTE SITE LOGISTICS, ENGINEERING SITE INVESTIGATIONS, COST ESTIMATING, IMPLEMENTATION PLANNING, MULTI-SITE, MULTIDISCIPLINARY PROJECTS.**
Key Personnel:	A. Washuta, P.Eng. S. Stowkowy, P.Eng. T. Schulz, P.Eng.

Project:	**ENVIRONMENTAL CLEAN UP STUDY OF 21 DEW LINE SITES IN ARCTIC CANADA**
Date:	1990-1991
Client:	**CANADIAN COMMERCIAL CORPORATION ON BEHALF OF THE UNITED STATES AIR FORCE**
Objective:	The United States Air Force, prior to the replacement of the DEW Line with the North Warning System, through an operations contractor maintained and operated the DEW Line system. As part of the closure and decommissioning of the DEW Line, USAF required an environmental assessment of the DEW Line sites.
Scope of Work:	Prime Consultant, Project Management, Detailed Site Investigations, Environmental Assessments, Remedial Action Planning,
Description:	UMA Engineering Ltd. in association with Hardy Associates and Jacques Whitford Environment Ltd., were retained by the Canadian Commercial Corporation to provide consulting services for the environmental study of the 21 DEW Line sites. The DEW Line sites are located on the Arctic Coast between Komakuk Beach in the Yukon Territory and Cape Dyer on Baffin Island in the Eastern Arctic. The DEW Line Environmental Study included the following components: • detailed site investigations by environmental, geotechnical and civil engineers, biologists and archaeologists; • identification of on site contamination and assessment of appropriate clean up technologies; • development of a baseline risk assessment; • the development of order of magnitude cost estimates for the clean up and restoration of the sites.
Budget:	n/a
Key Areas:	**PROJECT MANAGEMENT, NORTHERN AND REMOTE SITE LOGISTICS, SITE INVESTIGATIONS, ENVIRONMENTAL ASSESSMENTS, COST ESTIMATING, MULTI-SITE, MULTIDISCIPLINARY PROJECTS**
Key Personnel:	R. Mayne, P.Eng., MCIP, CLS, ALS T. Schulz, P.Eng.

Project:	**PROJECT DEVELOPMENT PROPOSAL** **ORDER OF MAGNITUDE CONSTRUCTION COST ESTIMATE FOR THE CLEAN UP OF 26 DIAND SITES**
Date:	1993-1994
Client:	INDIAN AND NORTHERN AFFAIRS CANADA
Objective:	The original Distant Early Warning (DEW) Line system consisted of 42 sites. In 1963, 21 of the sites were transferred to the Department of Indian Affairs and Northern Development (DIAND) and were subsequently decommissioned. Five additional abandoned military and/or staging sites are also under the jurisdiction of DIAND. As part of the Arctic Environmental Strategy in the Government of Canada's Green Plan, Indian and Northern Affairs Canada is committed to the environmental clean up and restoration of these sites. See attached Location Plan and photos. UMA Engineering Ltd. in association with Sheppard Green Engineering and Associates Ltd. were awarded the contract to prepare the Project Development Proposal for the clean up of the 26 DIAND sites. Both consultants have been involved in the Design and Cost Estimating of the Clean Up of 21 DEW Line sites on behalf of the Department of National Defence. The similarity of these two major projects allowed UMA and SGE to provide Indian and Northern Affairs Canada with a consistent and comparable estimate.
Scope of Work:	Prime Consultant, Project Management, Cost Estimating
Description:	Order-of-magnitude construction cost estimates were prepared for the environmental clean up and restoration of 26 DIAND sites. Typically, the scope of work at each site is anticipated to include the removal and disposal of contaminated soil, site debris, hazardous and non-hazardous materials, demolition of structures, and the development of new landfills and the remediation of existing landfills. Construction cost estimates were prepared on the basis of clean up occurring over a five year, ten year and 26 year time period.
Budget:	Confidential
Key Areas:	**NORTHERN AND REMOTE SITE LOGISTICS, CONSTRUCTION COST ESTIMATING**
Key Personnel:	A. Washuta, P.Eng. T. Schulz, P.Eng.

Project:	**ENVIRONMENTAL ASSESSMENT OF AN ABANDONED MILITARY SITE AT CORAL HARBOUR, NWT.**
Date:	1991
Client:	**INDIAN AND NORTHERN AFFAIRS CANADA**
Objective:	As part of the six year, $100 Million northern component of the Federal Government's Green Plan, Indian and Northern Affairs Canada has considered the full and final clean up of the abandoned military facility located near the Hamlet of Coral Harbour, NWT.
Scope of Work:	Prime Consultant, Project Management, Environmental Assessment, Implementation Planning, Cost Estimating.
Description:	UMA Engineering Ltd. in association with Industrial Environmental Services Ltd. and Spencer Environmental Management Services Ltd., conducted an environmental assessment of the abandoned military site at Coral Harbour. The site was used as a field hospital and staging area during the Second World War and subsequently during construction of the DEW Line. As part of the site investigation, soil and water samples were obtained for analyses, surface waste were inventoried and remaining facilities at the site were inspected. A clean up plan was developed which included community involvement. Order of magnitude cost estimates were developed.
Budget:	n/a
Key Areas:	**PROJECT MANAGEMENT, NORTHERN AND REMOTE SITE LOGISTICS, ENVIRONMENTAL ASSESSMENTS, COST ESTIMATING**
Key Personnel:	R. Mayne, P.Eng., MCIP, CLS, ALS T. Schulz, P.Eng.

Project:	**DEVELOPMENT OF OIL SPILL CONTINGENCY PLANS FOR NORTHWEST TERRITORIES POWER CORPORATION DIESEL GENERATING SITES.**
Date:	1992
Client:	**NORTHWEST TERRITORIES POWER CORPORATION**
Objective:	The Northwest Territories Power Corporation (NWTPC) operates diesel power generating stations in 49 communities across the Northwest Territories. The power generating facilities, in some cases vary greatly with the age of the powerhouse, and the type and capacity of the bulk fuel storage facilities. The presence of bulk fuel storage and conveyance systems at these facilities necessitates the requirement for oil spill contingency planning in compliance with regulatory guidelines, and as an overall responsibility of operating such facilities.
Scope of Work:	Project Management, Information Review, Regulatory Affairs, Spill Plan Contingency Planning.
Description:	UMA Engineering Ltd. conducted a review of the existing oil spill contingency plans and oil spill training for all facilities, carried out an evaluation to identify facility deficiencies, updated spill plans where applicable, and developed contingency plans for specific facilities where no plans were in place. UMA also prepared a database of cleanup and containment resources in the NWT.
Budget:	n/a
Key Areas:	**PROJECT MANAGEMENT, NORTHERN SITES, REGULATORY AFFAIRS**
Key Personnel:	K. Johnson, P.Eng., K. Ness, P.Eng.

Defence Construction Canada, Environmental Site Assessment, CFB Calgary

UMA was awarded a contract to conduct Environmental Site Assessments of 73 sites at eight military properties under the responsibility of Canadian Forces Base (CFB) Calgary. Project requirements were carried out by UMA and included:

- identification and delineation of the horizontal and vertical extent of contamination within the site boundaries, including buried underground storage tanks;
- evaluation and determination of the hydrogeology and contaminant migration patterns at each site;
- determination of the existing and potential risks to the environment and human health based on an assessment of the contaminant concentrations to CCME and Provincial criteria;
- identification and assessment of alternative remediation measures, including cost estimates.

The sites comprising the assessment included Currie Barracks and Permanent Married Quarters, Lincoln Park, Lethbridge Armoury, North East (Calgary) Armoury, HMCS Tecumseh, Mewata Armoury, and the Banff National Army Cadet Camp.

A key component of the study was the requirement to carry out geophysical surveys using ground penetrating radar (GPR) equipment. Surface Search Ground Penetrating Radar Technologies, working with UMA, were responsible for the acquisition, processing and interpretation of GPR data.

Environmental Site Assessments - Banff and Yoho National Parks

UMA is currently conducting environmental site assessments of former landfills, maintenance compounds and hazardous waste storage facilities in Banff and Yoho National Parks. The assessments involve geophysical surveys of the landfills and possible contaminant plumes, groundwater monitoring and assessment, soil sampling, and site history evaluations. Remedial measures will be identified and implemented after later investigation stages, should the need arise. This work is being undertaken for Parks Canada as part of the National Contaminated Sites Remediation Program.

Environmental Site Assessment - Montcalm Waste Treatment Facility

The Manitoba Hazardous Waste Management Corporation (MHWMC) engaged UMA Engineering Ltd. to undertake a site assessment for a proposed hazardous waste treatment facility located in the Municipality of Montcalm. The site assessment included an environmental overview, topographic surveys, hydrogeological studies, hydrology and climatology surveys and agricultural assessments of the site.

Upon selection of the Montcalm site for the Manitoba Hazardous Waste Treatment Facility, UMA Engineering Ltd. was further retained by the MHWMC to design and implement the baseline and construction environmental monitoring program for the new facility. The monitoring program involved a multi-media approach which looked at air, surface water, groundwater, snow, soils, cereal and root crops, native grasses and biota. Program development included identification of sample locations, sample frequency, analytical parameters and quality assurance/quality control procedures.

Bristol Aerospace Limited - Soil and Groundwater Contamination Studies

UMA Engineering Ltd. have completed extensive site investigations to characterize a major TCE and TCA solvent contamination problem north of Winnipeg. Usage of chlorinated solvents for cleaning purposes has resulted in a major plume of contaminated groundwater extending in two directions from the plant site. A major drilling, well installation and sampling/analysis program has been completed to define the lateral and vertical extent of solvent contamination in an extensive regional carbonate aquifer. A substantial soils investigation was undertaken at all suspected source areas of contamination on the plant site to verify the extent, location and magnitude of solvent in the soil. Development of a remedial action strategy with public meeting presentation has been completed. Work is now underway implementing the remedial action plan.

Environmental Site Assessment and Site Remediation Study - Pukatawagan, Manitoba

UMA Engineering Ltd. was retained by Manitoba Hydro to conduct a detailed site assessment and develop an appropriate clean up strategy for soil contaminated by diesel fuel spills at a former diesel generating station on the Pukatawagan Indian Reserve in northern Manitoba. UMA Engineering Ltd. conducted a comprehensive site investigation to delineate the extent of contamination, evaluated several strategies to remediate the site, and made recommendations on the most appropriate approach to clean up the site (excavation and removal of contaminated soil with treatment utilizing bioremediation in a landfarm).

UMA was subsequently retained by Manitoba Hydro to provide on-site supervision during the excavation of contaminated soil and transportation to the landfarm site. Over 10,000 m^3 of contaminated soil was removed and replaced with clean fill. Soil treatment utilizing bioremediation began during the summer of 1993.

Manitoba Hazardous retained UMA to oversee the work of preparing a public health, safety and environmental risk assessment report. Public health and safety risk was a major concern of the local community and therefore played a prominent role during the project approval process.

Environmental Site Assessment - CFS Alsask, Saskatchewan - Defence Construction Canada

UMA Engineering was retained by Defence Construction Canada to investigate to what extent fire fighting training exercises may have contaminated the soil at a landfill and fire fighting training area. The work plan identified and delineated petroleum hydrocarbon contamination at the two sites and described remediation options.

The field investigation included a grid of test holes and sampling program in the areas of potential soil contamination. A portable photoionization detector was used to field screen organic vapours released from the collected soil samples to determine which soil samples were contaminated and provide direction for the drilling of subsequent test holes and selection of samples for lab analysis to define the extent of contamination.

Tank Cleaning Facility - Edmonton

As a precursory to a property transaction, UMA performed a preliminary site assessment into the operating practices and facility history at a hydrocarbon-tankard cleaning facility. The assessment comprised of interviewing employees, conducting a site reconnaissance, a soil vapour survey, and the collection of soil-sediment samples. The contamination assessment proceeded to more detailed investigation involving soil and groundwater sampling and additional soil vapour surveys. A Phase I Environmental Audit was also completed.

Wood Preserving Plants

For two former wood preserving plants, UMA Engineering Ltd. was retained to undertake supplementary soil and groundwater characterization to determine the extent of site contamination from wood preserving chemicals, including creosote. The investigation program involved sampling of soil and groundwater at various depths at a series of grid points across the site, evaluation of the extent of the migration of wood preserving chemicals, assessment of potential impact on groundwater quality, and preparation of summary reports.

UMA Engineering Ltd. was also retained to provide construction monitoring services during site remediation activities to remove and replace contaminated soil in off-site areas. The extent of excavation was directed by visual observation and samples were taken at the excavation limits for chemical analysis to confirm the absence or low concentration of specific indicator chemicals within soils remaining on site. A construction monitoring report was prepared to document the construction activities, monitoring observations, and the results of the chemical analyses.

Lacombe Agricultural Building/Claresholm Care Centre

Site investigations in accordance with the Alberta Management of Underground Storage Tank (MUST) Guidelines for subsurface remediation were performed at the Lacombe Agricultural Building and the Claresholm Care Centre sites. As part of the remediation of petroleum hydrocarbon contamination delineated at these locations, UMA Engineering Ltd. coordinated excavation monitoring services for the Lacombe site and designed a vapour extraction system (VES) at the Claresholm site. A site sensitivity assessment was performed in both cases to determine the appropriate clean up level for soils.

PanCanadian Plaza Site Audit

UMA completed a site audit of the 30 storey PanCanadian Plaza in downtown Calgary. Some of the tasks performed included: review of existing drawings and specifications, inspection for presence and extent of toxic materials (including asbestos, radon, UFFI, and PCBs), analysis of probability and/or degree of contamination of soil by toxic materials based on history of site, check for conformity to all codes and bylaws, and a cost estimate to remedy any deficiencies identified.

Hazardous Waste Landfill Expansion

As part of a baseline biomonitoring program for an Alberta Class II hazardous waste landfill, UMA was retained as the subconsultant to the Delta Environmental Management Group Ltd. UMA was responsible for evaluating the current groundwater quality data, evaluating a monitoring program, and making recommendations for an expanded program. The goal of the study was to provide the client with statistically defendable data that could provide accurate, long term data and information which could be used for a facility expansion application.

Environmental Audit - Waste Handling and Disposal - Aerospace Manufacturing Plant - Manitoba

A major aerospace manufacturing plant, Bristol Aerospace Limited, located north of Winnipeg, Manitoba engaged the services of UMA Engineering Ltd. to conduct an environmental audit of waste handling, storage and disposal practices. The audit evaluated all liquid, solid, and air emission sources for compliance with Provincial legislation and accepted environmental management practices. Recommendations for modifications and improvements to waste handling, storage and disposal practices were also provided.

Environmental Audit - Decommissioned Hydro Electric Generating Station - Northwestern Ontario - Ontario Hydro

UMA Engineering Ltd. were retained by Ontario Hydro to conduct an environmental audit of a former hydro electric generating site in northwestern Ontario. The environmental audit consists of an on-site field inspection and sampling program to identify and confirm the presence of hazardous waste and deleterious products. Solid and liquid hazardous wastes were classified and disposal options identified. An overall program of site clean up, decommissioning and permitting requirements for waste transportation and disposal was prepared.

Asset Condition Reporting - Yukon

UMA Engineering was retained by Public Works Canada, Pacific Region to inspect and audit the condition of all Northern Affairs and on-reserve assets funded by Indian and Northern Affairs Canada (INAC) operation and maintenance budgets. The project also served to identify maintenance projects required to protect user health and safety, and to prolong the life of the assets.

The assignment involved the inspection and audit of assets at 24 sites throughout the Yukon Territory for Indian and Inuit Affairs Program and at 11 sites for the Northern Affairs Program. Assets included numerous administration buildings, warehouses, workshops, residences, underground utilities, streetlights, roadways and maintenance vehicles.

Asset Condition Reports were prepared for each site. The reports included an assessment of the existing condition of each asset including the identification of non-compliant conditions of facilities and an assessment of the remaining service life of all assets; the identification of required maintenance or upgrading including prioritization for each maintenance project; and the preparation of Class D cost estimates for all proposed maintenance projects.

Inspection of a total of 335 assets at the 35 sites was completed in five weeks from July to September by a team of site inspectors representing the various technical disciplines. Reports were prepared and submitted to the client over a six week period ending in early November.

Inventory of Fuel Storage Facilities, Northern Manitoba

Public Works Canada, through DIAND Technical Services, engaged UMA Engineering Ltd. to inventory all fuel storage facilities on or near Federal Reserves north of latitude 53°. This involved the collection of all available file information from agencies or companies handling fuel on the reserves, a field inspection of 16 reserves where data was limited, and a report presenting a spreadsheet inventory on all fuel storage facilities, including type and volume of product, noted deficiencies from existing regulations and a discussion on each reserve.

Initial Environmental Evaluations - Ten Air Command Bases

UMA Environmental were retained by DND Air Command Headquarters to complete Initial Environmental Evaluations for air bases affected by the Federal Government's Infrastructure Rationalization Program. As a result of federal budget cuts, several air bases are being closed or seeing their level of activity reduced, while a few bases are being expanded through the consolidation of operations at their location. Ten air bases are involved in the project; Greenwood, Shearwater, St. Jean, Ottawa, Trenton, North Bay, Winnipeg, Edmonton, Penhold and Comox. The work primarily involves those bases that are gaining in size of operation - Greenwood, Trenton and Winnipeg. The issues typically being assessed at the bases include: noise impacts from increased flying; storage, handling and disposal of hazardous materials used in maintenance operations; biophysical issues such as surface runoff impacting surface drainage; and the social issues associated with an increase in base population and military presence. This work is coordinated through a central DND Project Manager in Winnipeg and the Environmental Officers at each base.

Underground Storage Tank Investigations - The Pas, Manitoba

UMA Engineering Ltd. were retained by several local clients in the Town of the Pas to complete preliminary soil investigations around existing underground storage tanks. The tanks were utilized for the storage of diesel fuel, fuel oil, gasoline and waste oil. The tanks were generally being removed as part of site restoration rather than replacement. In all cases an investigative program was completed to delineate the lateral and vertical extent of product migration surrounding the tank locations.

Work at each site was completed in accordance with Manitoba Environment Orders. Samples were collected and screened in the field using an organic vapour analyzer. Selected samples were then submitted for detailed chemical analysis of the BTEX parameters. The contaminated areas at each location were defined and site remediation undertaken. This included removal and salvage of the tank, excavation of the contaminated soils, disposal of the soils at the local landfill as per Environment directions and restoration of the site.

Underground Storage Tank Investigation - Petro-Canada - Grand Motors Site

UMA Engineering Ltd. was retained by Petro-Canada Products to complete a preliminary soils and groundwater investigation at a decommissioned gas station. Test drilling was completed across the site and gas probes were installed to evaluate the level of hydrocarbon contamination in the soils and groundwater. Existing utility corridors around the site were also monitored to evaluate off-site migration. Soil samples were screened in the field utilizing an organic vapour analyzer with selected samples submitted for detailed chemical analysis of the BTEX parameters. Groundwater samples were also collected and analyzed. An interface probe was used to monitor for the presence of free products at each of the monitoring well locations. The limit of soil contamination was identified both vertically and laterally in preparation for future site remediation.

Interprovincial Pipe Line Inc. - Evaluation of Contaminated Soil Treatment Options

UMA was retained to develop a working document for use by IPL which would provide the information necessary to make decisions with respect to cleanup of hydrocarbon contaminated sites. The report was provided as two volumes. The first volume reviewed remediation options and evaluated each in terms of effectiveness, technical and administrative limitations and costs, relative to IPL's operations. The second volume provided guidelines for spill cleanup implementation planning, from characterization and delineation to selection of the most appropriate and cost effective remediation technology. The report also documented the applicable regulations, standards and guidelines for each of the jurisdictions in which IPL operates for spill reporting requirements and cleanup criteria. A reference list of remediation contractors was also developed.

B.2 AMBIO RESEARCH ASSOCIATES

Project:	**CFB COLD LAKE LANDFILL IMPACT STUDY**
Date:	1991/92
Client:	**DEPARTMENT OF NATIONAL DEFENCE**
Objective:	To evaluate the environmental impact of a leaching landfill at CFB Cold Lake, Medley, Alberta, establish an appropriate remediation program and train base personnel to monitor the landfill site.
Scope of Work:	Field Investigation: site survey, electromagnetic conductivity survey. Field Sampling: groundwater sampling, well installation and sample collection. Data Analysis: delineation and properties of the leachate plume. Risk assessment and remediation recommendations.
Description:	The principals of AMBIO Research Associates were heavily involved in this project which was tasked to the Environmental Sciences Group at Royal Roads Military College. The site was visited on three occasions during this project; during those visits an EM survey was carried out and 26 monitoring wells were installed and sampled. The analytical results from these wells allowed detailed isopleth maps to be drawn showing subsurface contaminant concentration and position. From this the source of contamination was located and appropriate remediation action was proposed.
Budget:	$100 K
Key Areas:	**GEOPHYSICAL METHODS, PROJECT MANAGEMENT, GROUNDWATER SAMPLING, ENVIRONMENTAL DATA ANALYSIS, RISK ASSESSMENT, REMEDIATION RECOMMENDATIONS, PERSONNEL EDUCATION**
Key Personnel:	Bill Dushenko, Ph.D. Steve Grundy, Ph.D.

Project:	**ENVIRONMENTAL INVESTIGATIONS OF ABANDONED MILITARY INSTALLATIONS**
Date:	1994
Client:	**INDIAN AND NORTHERN AFFAIRS CANADA, YUKON ARCTIC ENVIRONMENTAL STRATEGY, ACTION ON WASTE**
Objective:	To undertake a preliminary environmental study and derive remediation options for two northwest staging route airstrips and four pumping stations on the Haines-Alaska pipeline.
Scope of Work:	Field Investigation: site survey. Field Sampling: soil, plant and water sampling, building swabs. Data Analysis: to prioritize the sites for full assessment.
Description:	This work was undertaken by the Environmental Sciences Group at Royal Roads Military College in which the four principals of AMBIO Research Associates were senior members. Six sites were visited: Aishihik Airstrip, Snag Airstrip, Haines Junction Pumping Station, Donjek River Pumping Station, Destruction Bay Pumping Station and Beaver Creek Pumping Station. Soil, water, plant and building swabs were collected and analyzed for PCBs and/or inorganic elements. Recommendations were made for the prioritization of detailed site assessments.
Budget:	$15 K
Key Areas:	**PROJECT MANAGEMENT, SAMPLING PROGRAM LOGISTICS AND IMPLEMENTATION, ENVIRONMENTAL DATA ANALYSIS, RISK ASSESSMENT, REMEDIATION RECOMMENDATIONS**
Key Personnel:	Steve Grundy, Ph.D.

Project:	**ENVIRONMENTAL INVESTIGATIONS OF ABANDONED MILITARY INSTALLATION: AISHIHIK AIRSTRIP**
Date:	1994
Client:	**INDIAN AND NORTHERN AFFAIRS CANADA, YUKON ARCTIC ENVIRONMENTAL STRATEGY, ACTION ON WASTE**
Objective:	To undertake a complete surface characterization of Aishihik Airstrip, Yukon Territory.
Scope of Work:	Review airphotos and background information/history. Field Sampling: soil, plant and water sampling, building swabs. Catalogue physical debris, recommend remediation or further subsurface analysis.
Description:	This work was undertaken by the Environmental Sciences Group at Royal Roads Military College in which the four principals of AMBIO Research Associates were senior members. The Aishihik Airstrip was visited on two occasions. 79 soil, 22 plant, 7 fuel/oil, 2 water and 3 plant samples were collected. Limited PCB contamination was found in the vicinity of the powerhouse and appropriate remediation recommendations were submitted.
Budget:	$100 K
Key Areas:	**PROJECT MANAGEMENT, SAMPLING PROGRAM LOGISTICS AND IMPLEMENTATION, ENVIRONMENTAL DATA ANALYSIS, RISK ASSESSMENT, REMEDIATION RECOMMENDATIONS, DIOXIN AND FURAN RISK ASSESSMENT**
Key Personnel:	Steve Grundy, Ph.D.

Project:	**AN ENVIRONMENTAL STUDY OF THE CANOL TRAIL**
Date:	1993/94
Client:	**INDIAN AND NORTHERN AFFAIRS CANADA, ARCTIC ENVIRONMENTAL STRATEGY, ACTION ON WASTE and ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION, NATIONAL CONTAMINATED SITES REMEDIATION PROGRAM**
Objective:	Produce a detailed description of sites along the Canol Trail, an inventory of environmental contaminants and the investigation of areas that require further investigation and/or cleanup.
Scope of Work:	Review background data and field reconnaissance. Site surveys, soil, plant, asbestos, oil barrel and water sampling, building swabs. Data analysis, interpretation, risk assessment and recommendations.
Description:	This work was undertaken by the Environmental Sciences Group at Royal Roads Military College in which the four principals of AMBIO Research Associates were senior members. After a preliminary visit to confirm the sampling program a helicopter supported camp was established in the field for two weeks. 230 miles of old pipeline were inspected, samples were taken at six pumping stations, four maintenance camps and several smaller sites. The environmental problems were itemized and recommendations for remediation given.
Budget:	$100 K
Key Areas:	**PROJECT MANAGEMENT, SAMPLING PROGRAM LOGISTICS AND IMPLEMENTATION, ENVIRONMENTAL DATA ANALYSIS, RISK ASSESSMENT, REMEDIATION RECOMMENDATIONS, ARCTIC AND SUBARCTIC REMOTE AREA ENVIRONMENTAL STUDIES**
Key Personnel:	Steve Grundy, Ph.D. Bill Dushenko, Ph.D.

Project:	**ENVIRONMENTAL INVESTIGATIONS OF ABANDONED MILITARY INSTALLATIONS**
Date:	1992-1994
Client:	**INDIAN AND NORTHERN AFFAIRS CANADA, NORTHWEST TERRITORIES ARCTIC ENVIRONMENTAL STRATEGY, ACTION ON WASTE**
Objective:	To undertake an environmental study and derive remediation options for abandoned Auxiliary and Intermediate DEW Line Sites and other military installations in the Canadian Arctic.
Scope of Work:	Field Investigation: site survey. Field Sampling: soil, plant and water sampling, building swabs. Data analysis. Derivation of cleanup plan.
Description:	This work was undertaken by the Environmental Sciences Group at Royal Roads Military College in which the four principals of AMBIO Research Associates were senior members. Twenty sites were visited: Tununuk, Atkinson Point, Horton River, Pearce Point, Clifton Point, Bernard Harbour, Ross Point, Cape Peel, Sturt Point, Hat Island, Matheson Point, Simpson Lake, Keith Bay, Sarcpa Lake, Rowley Island, Bray Island, Nadluardjuk Lake, Ekalugad Fjord, Kivitoo, Durban Island, Resolution Island and Iqaluit. Soil, water, plant and building swabs were collected and analyzed for PCBs, ABNs, PAHs and inorganic elements. Three reports containing cleanup recommendations were submitted.
Budget:	$2,500 K
Key Areas:	**PROJECT MANAGEMENT, SAMPLING PROGRAM LOGISTICS AND IMPLEMENTATION, ENVIRONMENTAL DATA ANALYSIS, RISK ASSESSMENT, REMEDIATION RECOMMENDATIONS**
Key Personnel:	Matt Dodd, Ph.D. Doug Bright, Ph.D. Bill Dushenko, Ph.D.

Project:	**DECOMMISSIONING OF THE HORTON RIVER DEW LINE INTERMEDIATE SITE**
Date:	1994
Client:	**INDIAN AND NORTHERN AFFAIRS CANADA, NORTHWEST TERRITORIES ARCTIC ENVIRONMENTAL STRATEGY, ACTION ON WASTE**
Objective:	To undertake a complete cleanup of the abandoned Horton River DEW Line Intermediate Site.
Scope of Work:	Scientific advisor to DIAND; community consultations; delineation of contaminated areas using on-site test kits; removal of contaminated soils containing PCBs at concentrations greater than 50 ppm; confirmatory sampling and testing after removal of contaminated soil; sampling and identification of contents in barrels; and sampling and analyses of water, sediment and fish present in some of the lakes near the DEW Line Site.
Description:	This work was undertaken by the Environmental Sciences Group at Royal Roads Military College in which the four principals of AMBIO Research Associates were senior members. Representatives from the group were present on site to undertake testing and all the scientific aspects of the clean up on behalf of DIAND.
Budget:	$100 K
Key Areas:	**PROJECT MANAGEMENT, FIELD SAMPLING, FIELD ANALYSES, COMMUNITY CONSULTATIONS, ENVIRONMENTAL DATA ANALYSIS**
Key Personnel:	Matt Dodd, Ph.D.

Environmental Study of Eleven DEW Line Sites - 1993. Prepared for the Director North Warning Systems Office and Director General Environment, Department of National Defence.

Soils, water and plants were collected and analyzed for PCBs and inorganic elements. Environmental criteria specific for the Canadian Arctic were proposed. This report containing cleanup recommendations formed the basis of the engineering design for the cleanup of these sites which were closed in 1994.

Disposition of Colwood Contaminated Soils: Preliminary Report - Chemical and Physical Characterization - 1993. Report prepared for the Director General Environment, Department of National Defence.

Contaminated soil was excavated from a building site at a western naval base and temporarily stored in a secure landfill. The physical and chemical composition of the material was thoroughly delineated as a prerequisite to assessing disposal options.

Environmental Impact of the DEW Line on the Canadian Arctic - 1992. Report prepared for the Director General Environment, Department of National Defence.

Scientific report reviewing all the literature known at that time on the environmental impact of anthropogenic materials in the Canadian Arctic. The report looked at contaminant burdens from radar sites, other local sources and long range sources. Impacts on the terrestrial and marine ecosystems were investigated in detail, S. Grundy, W. Dushenko and D. Bright were senior authors of this report.

North Warning System Environmental Study, Volume Four: East Coast Site Analysis - 1992. Prepared by the Royal Roads Military College Environmental Sciences Group, Victoria, B.C. for the Director North Warning System Organization.

This report evaluates the current operational practices of three North Warning System Long Range Radar Stations and considered the success of previous cleanup activities. A large sampling and analytical program was part of this review.

Environmental Study of Abandoned DEW Line Sites: I. Five Intermediate Sites from the Western Arctic. Report prepared for the Arctic Environmental Strategy office, Department of Indian Affairs and Northern Development.

Investigation and Clean Up of Polychlorinated Biphenyls at the Saglek (LAB-2) Long Range Radar Site. Report submitted to the Director North Warning System, Department of National Defence.

Three locations containing PCBs in excess of the levels regulated in the storage of materials under the Canadian Environmental Protection Act (CEPA) were investigated using field test kits. The soils in excess of 50 ppm were removed from the site as part of this project.

APPENDIX C
RESUMES

K. BISSET & ASSOCIATES

Kathy Bisset, B.Sc., P.Ag
Box 4793, Whitehorse, Yukon Y1A 4N6
Telephone/Fax (403) 633-4246

K. Bisset & Associates, based in Whitehorse, Yukon provides consulting services to clients that require assistance in the following areas:

PROJECT MANAGEMENT

- The provision of complete project management, including coordination with clients, research and report writing.
- Public meetings and visual presentations.

ENVIRONMENTAL PLANNING

- Soil, forest and vegetation inventories.
- Forest regeneration surveys.
- Environmental impact assessment.
- Resource Management.
- Soil and site suitability for development assessments.
- Land use planning and analysis.
- Landscape rehabilitation and reclamation plans.
- Quarry management plans.
- Visual resource assessment.
- Airphoto interpretation.
- Map preparation.
- Archival research.
- Survey questionnaires and interviews.

COMMUNITY DEVELOPMENT

- Training for environmental planning.
- Preparation of development plans.
- Designs for community improvement.

AGRICULTURAL DEVELOPMENT

KEY PROJECT EXPERIENCE:

Since established in 1993, K. Bisset & Associates projects have included:

- Completed an assessment of former military sites and activities in the Yukon for potential contaminants 1941-1995, for Arctic Environmental Strategy Program, DIAND.
- Prepared a crop manual, "Yukon Crop Guide" for Yukon Agricultural Association, Agriculture Canada, Government of Yukon.
- Carried out a forest inventory in the Teslin River area with Hugh Hamilton Ltd. for Forest Resources, Northern Affairs Program.
- Assisted with the Yukon Farm Survey 1991, with the Agricultural Branch and Bureau of Statistics, Government of Yukon.
- Completed two soil moisture studies for the Green Plan, Yukon Agriculture Branch.
- Designed, provided training and support for a forest and soil reconnaissance survey for Selkirk First Nation.

OTHER RELEVANT EXPERIENCE

- Conducted archival research, a site regeneration survey, compiled volumes, cutting locations and databases for A History of Logging in the Yukon 1896-1970, for Forest Resources, Northern Affairs Program and Economic Development, Government of Yukon.
- Resource planner for community planning projects with UMA Consulting Ltd. for Government of Yukon.
- Completed mapping of fuelwood areas in the Yukon, for Government of Yukon.
- Assisted with the development of quarry reclamation plans within City of Whitehorse, for Government of Yukon.
- Assisted with the development of quarry reclamation plans within City of Whitehorse, for Government of Yukon.
- Project manager for agricultural research projects, for Yukon Agricultural Association and Agriculture Canada.
- Assisted with the National Soil Conservation Program in the Yukon, for Agriculture Canada.
- Managed forestry and quarry resources on Government of Yukon lands for Government of Yukon.
- Land Use and Resource Planner, for Government of Yukon.

PROFESSIONAL AFFILIATIONS

- Professional Agrologist (P.Ag), Registered with B.C. Institute of Agrologists and Agricultural Institute of Canada.

SUMMARY OF QUALIFICATIONS

- Bachelor of Science Degree; Plant & Soil Science
- Professional Agrologist (P.Ag) - Registered with British Columbia
- Sixteen years of employment in Yukon, as a Government of Yukon employee and consultant
- Experience in environmental assessments, land use planning, forestry, vegetation and soil evaluations, reclamation, agricultural research archival research and report writing.

EDUCATION

- 1993 - Alberta Regeneration Survey Course - Yukon College
- 1992 - Introduction to Teaching Adults - Yukon College
- 1980 to 1984 - Post Degree Program: Urban and Regional Planning Correspondence Program - University of Waterloo
- 1972 to 1976 - Bachelor of Science Degree: Plant and Soil Science, University of Vermont.

PROFESSIONAL RECORD:

1993-Date - Principal, K. Bisset & Associates
1989-Date - Principal, Northern Design Consultants
1986-1992 - Principal, Takhini Contracting
1984-1986 - Resource Planner: Forestry/Land Use Officer
Renewable Resources, Government of Yukon
1981-1983 - Land Use Officer, Lands Branch, Government of Yukon
1978-1981 - Planning Assistant, Lands Branch, Government of Yukon

DOUG BRIGHT

Full Name: **Douglas Arthur Bright**
Born: Lacombe, Alberta, Canada; June 26, 1960
Citizenship: Canadian

Address:

7-1276 Ryan Street
Victoria, British Columbia
Canada, V8T 1Y3
Tel.: (604) 386-8727

or

Ambio Research Associates, Inc.
c/o 6097 Timberdoodle Road
RR1, Sooke, B.C.
V0S 1N0

1. DEGREES AND DIPLOMAS

1991: **Ph.D.**, Biology, University of Victoria. Tissue variability in the infaunal bivalve *Axinopsida serricata* (Lucinacea: Thyasiridae) exposed to a marine mine-tailings discharge; and associated population effects.

1987: **M.Sc.**, Biology, University of Victoria. The histology of *Macoma carlottensis* (Bivalvia: Tellinidae) and histopathology related to mine-tailings discharge.

1984: **B.Sc.**, Biology, University of Victoria.

1978: High School Diploma (Honours Matriculation), Parkland Composite High School, Edson, Alberta.

2. ACADEMIC EXPERIENCE

A. Research Experience

January, 1991 to present

Research Associate, Environmental Sciences Group, Royal Roads Military College. The work was supported for the first two years by an NSERC-administered Visiting Fellowship in Government Laboratories (to April, 1993) and includes research in: Biogeochemical cycling of arsenic and other metals/metalloids in coastal marine and fresh water systems: arsenic speciation, environmental compartmentalization, and bioaccumulation, including studies of organoarsenicals and the microbial methylation/demethylation of arsenic.

Environmental cycling and possible biotransformation associated with bioaccumulation of 2,3,7,8-TCDD and other dioxins/furans in Dungeness crabs, *Cancer magister*, from Kitimat Arm, B.C.

Chemical contamination of sediment in Esquimalt Harbour, B.C., associated biological uptake, and impacts on biota (histopathology of infaunal clams, crabs, and English sole; effects on benthic community structure; sediment bioassays).

Environmental study of North Warning System (Arctic) radar installations and abandoned DEW Line sites - marine ecosystem impact associated with local inputs versus long-range atmospheric transport of polychlorinated biphenyls, organochlorine pesticide residues, and inorganic elements; fate of PCBs and other organochlorines in Arctic marine and terrestrial systems.

Environmental effects associated with the historical ocean disposal of electronic components and other debris in the Canadian Arctic.

1988 (January-April)

Visiting Researcher: Plymouth Marine Laboratory, Plymouth, England with Dr. Geoff W. Bryan. I conducted research on imposex in neogastropods, i.e. the manifestation of male morphological sex characteristics in true females (pseudohermaphroditism), associated with environmental contamination by tri-n-butyltin (TBT), a contaminant introduced as an ingredient in antifouling paints. This included research on imposex in British Columbia neogastropods, and on the uptake and tissue partitioning of ^{14}C-labelled TBT by the Atlantic dogwhelk, *Nucella lapillus*.

1984-1985

Summer employment: Safer Agro-Chem Ltd., Victoria, B.C. Research assistant: phytotoxicity testing of insecticidal soaps, fungal bioassays, greenhouse and research plot maintenance.

B. Teaching Experience

May - June, 1995
Sessional Lecturer, Camosun College

Geog110 Introduction to Oceanography
(Taught primarily to 2nd year Environmental Technology students)

1991 - 1994
Occasional Lecturer, Royal Roads Military College

Oceanography 432	Sediment Chemistry
Oceanography 342	Introduction to Oceanography

1985 - 1990
Teaching of undergraduate labs, University of Victoria

Biology 314 A,B	Marine Field Biology
Biology 305 A,B	Animal Physiology
Biology 309	Developmental Zoology
Biology 301 A,B	Invertebrate Adaptations
Biology 200	Introductory Cell Biology

3. ADMINISTRATIVE EXPERIENCE

1993-94: Organizing Committee, Canadian Society of Biology 34th Annual Meeting, Royal Roads Military College, Victoria, June 1 - 4, 1994.

Sept. 1991 to Jan. 1993: Capital Regional District Harbours Advisory Group / Victoria and Esquimalt Harbour Environmental Assessment Panel.

1988-89: Graduate Studies Committee, Department of Biology, University of Victoria.

1987-88: Executive Committee, Department of Biology, University of Victoria.

1986-87: Curriculum Committee, Department of Biology, University of Victoria.

4. RELATED EXPERIENCE

A. Graduate Students

I have assisted in the supervision of 3 doctoral students and 1 masters student at the University of British Columbia (C. Simpson, X.-C. Le, X.-F. Li, J. Jafaar).

B. Coordination of Scientific Research

I have served as acting chief scientist on several research cruises, aboard Dept. of Fisheries and Oceans research vessels CSS Vector (1991, 93) and J.P. Tully (1990, 91), National Defence's CFAV Endeavor (1994), and the Canadian Coast Guard Icebreaker, the CCG Pierre Radisson (1994).

C. Experimental Methods

I have extensive experience in biological experimental methods: zoological microtechnique, electron microscopy, mammalian cell culture techniques, autoradiography, physical oceanography and sediment analysis, taxonomy of marine molluscs.

D. Statistics/Computer

I have received formal training in biostatistical methods (univariate and multivariate techniques), and have extensive computer experience.

5. SCHOLARSHIPS, FELLOWSHIPS, AWARDS

1991	Visiting Fellowship in Government Laboratories (NSERC administered)	$33,000
1990	Visiting Fellowship in Government Laboratories (NSERC administered)	$33,000
1989	Univ. of Victoria Dean's Scholarship	$5,000
1988	Natural Sciences and Engineering Research Council (NSERC) Postgraduate Scholarship	$13,000
1988	Univ. of Victoria President's Scholarship	$3,000
1987	Natural Sciences and Engineering Research Council (NSERC) Postgraduate Scholarship	$13,000
1987	Univ. of Victoria President's Scholarship	$3,000
1986	British Columbia Research Council Graduate Research in Technology (GREAT) Award	$12,000
1985	British Columbia Research Council Graduate Research in Technology (GREAT) Award	$12,000
1983	The Howard English Bursary for Aquatic Conservation	$500

6. RESEARCH FUNDING

1994	Indian and Northern Affairs Canada, Environmental Investigation of Abandoned Radar Facilities in the Canadian Arctic (to ESG/ Reimer)	$1,250,000
1993	Director General Environment, Dept. of National Defence, Scientific Advisory Role in DEW Line Environmental Clean Up (to ESG/ Reimer)	$755,000
1992-94	Director General Environment, Dept. of National Defence, Contaminant Inputs, Loading, and Biological Impact in Esquimalt Harbour, British Columbia (to ESG/Reimer)	$212,000
1990/91	Indian and Northern Affairs Canada , Impact of Mine-Tailings from the Nerco Con Gold Mine on the Aquatic Environment. (to ESG/ Reimer)	$15,000

7. MEMBERSHIPS HELD IN LEARNED AND PROFESSIONAL SOCIETIES

Society of Environmental Toxicology and Chemistry (1994 -) / Pacific Northwest Chapter,
Society of Environmental Toxicology and Chemistry (1994 -)
Canadian Society of Environmental Biologists (1993 -)
Pacific Estuarine Research Society (1986 -)
Estuarine Research Federation (1990 - 1993)
National Shellfisheries Association (1989 - 1992)
Society of Invertebrate Pathology (1987 - 1989)

8. SCHOLARLY AND PROFESSIONAL ACHIEVEMENTS

A. Publications, refereed

Bright, D.A., S.L. Grundy and K.J. Reimer, *accepted, pending revision.* Differential bioccumulation of non-ortho-substituted and other PCB congeners in coastal Arctic invertebrates and fish (*Myoxocephalus quadricornis, M. scorpius, Gadus ogac* and *Salvelinus alpinus*). Environmental Science and Technology.

Dushenko, W.T., D.A. Bright and K.J. Reimer, *in press.* Arsenic bioaccumulation in aquatic plants exposed to gold-mine effluent: the relationship with environmental compartmentalization of As, uptake of metals, and nutrients. Aquatic botany.

Bright, D.A., W.T. Dushenko, S.L. Grundy and K.J. Reimer, 1995. Effects of local and distant contaminant sources: polychlorinated biphenyls and other organochlorines in bottom-dwelling animals from an Arctic estuary. Sci. Tot. Environ., 160/161, 265-284.

Bright, D.A., W.T. Dushenko, S.L. Grundy and K.J. Reimer, 1995. Polychlorinated biphenyl distribution in Canadian arctic soils: the use of congener signatures in source identification. Sci. Tot. Environ., 160/161, 251-264.

Bright, D.A., B. Coedy, W.T. Dushenko and K.J. Reimer, 1994. Arsenic transport in a watershed receiving gold mine effluent near Yellowknife, Northwest Territories, Canada. Sci. Tot. Environ., 155, 237-252.

Bright, D.A., S. Brock, W.R. Cullen, G.M. Hewitt, J. Jafaar and K.J. Reimer, 1994. Methylation of arsenic by anaerobic microbial consortia isolated from lake sediment. Applied Organometallic Chemistry, 8, 415-422.

Bryan, G. W., D.A. Bright, L.G. Hummerstone and G.R. Burt, 1993. Uptake, tissue distribution and metabolism of ^{14}C-labelled tributyltin (TBT) in the Dog-whelk, *Nucella lapillus.* Journal of the Marine Biological Association of the United Kingdom, 73, 889-912.

Bright, D.A. and D.V. Ellis, 1990. A comparative survey of imposex in north east Pacific neogastropods (prosobranchia) related to tributyltin contamination, and choice of a suitable bioindicator. Canadian Journal of Zoology, 68: 1915-1924.

Bright, D.A. and D.V. Ellis, 1989. Aspects of histology in *Macoma carlottenis* (Bivalvia: Tellinidae) and *in situ* histopathology related to a marine mine-tailings discharge. Journal of the Marine Biological Association of the United Kingdom, 69: 447-464.

B. Publications, submitted

Bright, D.A., M. Dodd, and K. J. Reimer. Arsenic in Subarctic Lakes Influenced by Gold Mine Effluent: The Occurrence of Organoarsenicals and 'Hidden' Arsenic. The Science of the Total Environment.

Bright, D.A. The ecology of a stress-tolerant bivalve, *Axinopsida serricata* (Carpenter, 1864) (Lucinacea: Thyasiridae), in Saanich Inlet, British Columbia, Canada. The Veliger.

C. Scientific Meetings/Published Abstracts

Bright, D.A. *Invited speaker*. Uncertainties associated with the dominance of alkylated over parent PAH levels in contaminated soils and sediments. Environment Canada PAH Workshop, Mar. 6-7, 1995. Vancouver, British Columbia.

Bright, D.A. and K.J. Reimer. Characteristics of benthic infaunal communities along a gradient of sediment contamination in Esquimalt Harbour, British Columbia. Presented at Puget Sound Research '95, A Conference About Research on Puget Sound and the Strait of Georgia, Bellevue, Washington, Jan. 12-24, 1995.

Poland, J.S., K.J. Reimer and D.A.Bright. The influence of polychlorinated biphenyls and other organochlorines on bottom-dwelling animals - the Arctic experience. Scientific Committee on Antarctic Research, Sixth Biology Symposium - Antarctic Communities: Speices, Structure and Survival. Venice, Italy, 30 May - 3 June 1994.

Bright, D.A. S.L. Grundy and K.J. Reimer. Does the differential bioaccumulation of coplanar PCBs and other congeners reduce relative PCB toxicity? Evaluation in Arctic sculpins (*Myoxocephalus quadricornis* and *M. scorpius*). Abstract of paper presented at the Pacific North West Society of Environmental Toxicology and Chemistry, Third Annual Meeting, Victoria, British Columbia, May 12-14, 1994.

Bright, D.A., W.T. Dushenko, S.L. Grundy and K.J. Reimer, 1993. Polychlorinated biphenyls and other organochlorines in bottom-dwelling animals from an Arctic estuary. Presented at the 76th Canadian Society of Chemistry Conference, Sherbrooke, Quebec, May 30 - June 3, 1993.

Grundy, S.L., D.A. Bright, W.T. Dushenko and K.J. Reimer, 1993. Sources and distribution of polychlorinated biphenyls in Canadian Arctic soils. Presented at the 76th Canadian Society of Chemistry Conference, Sherbrooke, Quebec, May 30 - June 3, 1993.

Reimer, K.J., M. Dodd, W.T. Dushenko and D.A. Bright, 1992. Antimony cycling and bioavailability in lakes near Yellowknife, Northwest Territories. Presented at the 75th Canadian Society of Chemistry Conference, Edmonton, Alberta, May 31 - June 4, 1992.

Bright, D.A., 1991. Histopathology of clams living in deposited mine-tailings: so what if clams have lesions ? In Chapman, P., F. Bishay, E. Power, K. Hall, L. Harding, D. McLeay, M. Nassichuk and W. Knapp, (eds). Proceedings of the Seventeenth Annual Aquatic Toxicity Workshop: November 5-7, 1990, Vancouver, B.C., Can. Tech. Rep. Fish. Aquat. Sci. No 1774 (Vol. 1), p. 578.

Bright, D.A. and D.V. Ellis, 1989. Imposex in Pacific coast neogastropods related to tributyltin contamination. Abstract of technical paper presented at the 42nd Annual Meeting: National Shellfisheries Association (Pacific Coast Section), September 22-24, 1988. J. Shellfish. Res. 8(1): 318.

Bright, D.A., 1988. The histology of *Macoma carlottenis* Whiteaves, 1880 and histopathology related to mine-tailings discharge. Abstract only, Thesis Record, Mar. Pollut. Bull. 19(2): 84-85.

Bright, D.A., 1987. A case study of histopathology in *Macoma carlottensis* (Bivalvia: Tellinidae) related to mine tailings discharge, and review of pollution-induced invertebrate pathology. Shades of Selye ? Abstract of technical paper presented at the 1987 annual meeting: National Shellfisheries Association, Halifax, Nova Scotia, August 9-13, 1987. J. Shellfish. Res. 7(1): 151.

D. Technical reports

Bright, D., S. Harbicht, L. Johnston, S. Parker, K. Reimer and S. Solomon, 1995. Baffin Region Ocean Disposal Investigation: Seabed Debris and Contaminant Inputs Near iqaluit, Resolution island, Cape Dyer and Kivitoo. Report prepared by Environment Canada and the Department of National Defence.

Bright, D., P. Fortin, S. Harbicht, L. Johnston, S. Parker and K. Reimer, 1994. Historical Ocean Disposal in the Canadian Arctic: Survey of Materials Disposed in Cambridge Bay and State of the Marine Environment. Report prepared by Environment Canada and the Department of National Defence. 77 pp.

Bright, D.A., K.J. Reimer and J. Rogers, 1994. An Assessment of the Colwood Interim Storage Facility: Characterization and Disposal Options. Report prepared for the Director General Environment, Department of National Defence. 98 pp + appendices.

Dushenko, W.T., K.J. Reimer and D.A. Bright, 1994. Environmental Study of a Military Installation at Resolution Island, BAF-5. Report prepared for the Arctic Environmental Strategy office, Department of Indian Affairs and Northern Development, and Environmental Protection, Northwest Territories. 295 pp + appendices.

Bright, D.A., and K.J. Reimer, 1994. An Environmental Study of Esquimalt Harbour: Part I. Historical Input, Marine Sediment Contamination and Biological Uptake. Report prepared for the Director General Environment, Department of National Defence. 198 pp + appendices.

Rogers, J., D.A. Bright and K.J. Reimer, 1993. Disposition of Colwood Contaminated Soils: Preliminary Report - Chemical and Physical Characterization. Report prepared for the Director General Environment, Department of National Defence.

Reimer, K.J., D.A. Bright, M. Dodd, and K. Johnston, 1992. Environmental Study of Abandoned DEW Line Sites: I. Five Intermediate Sites from the Western Arctic. Report prepared for the Arctic Environmental Strategy office, Department of Indian Affairs and Northern Development, 360 pp + appendices.

Reimer, K.J., D.A. Bright, W.T. Dushenko, S.L. Grundy and J. Poland, 1992. Environmental Impact of the DEW Line on the Canadian Arctic. Report prepared for the Director General Environment, Department of National Defence, 488 pp + appendices.

Bright, D.A. and K.J. Reimer, 1992. Scientific Consensus on the State of the Receiving Environment Near the Clover and Macaulay Point Sewage Outfalls. Marine Monitoring Advisory Group, Victoria.

9. WORK IN PROGRESS

A. Manuscripts in Preparation

Bright, D.A. and S.L. Grundy. Soil, plants and marine sediment as sinks for atmospherically-transported organochlorines (polychlorinated biphenyls, polychlorinated dibenzo-*p*-dioxins/furans, and chlorinated pesticides) in the Canadian Arctic: Background concentrations and signatures.

Bright, D.A., S.L. Grundy, C. Simpson and K.J. Reimer. Uncertainties associated with the dominance of alkylated over parent PAH in anthropogenically-influenced Arctic terrestrial and marine environments.

Bright, D.A., S. Harbicht, L. Johnston and K.J. Reimer. Food-chain mediated uptake of toxaphene and other chlorinated pesticide residues in coastal environments in the Canadian Arctic.

Bright, D.A. A quantitative study of tissue variation in an infaunal bivalve, *Axinopsida serricata*, exposed to a marine mine-tailings discharge: the effects of site, size, season, sex and parasitism.

B. Grants Applied For

Bellward, G.D., W.R. Cullen, D.A. Bright, W.W. Mohn and K.J. Reimer. *Institute for Chemical Science and Technology.* Alkylsubstituted Polycyclic Aromatic Hydrocarbons: Environmental Sources, Fate and Toxicology. ($100,000/yr x 3 yr).

Clark, J.I. *et al. NSERC Network of Centres of Excellence.* Environmental Applications Research Network (EARN) for Operations in Extreme Environments. ($9,600,000).

Glickman, B.W. *et al. NSERC Collaborative Special Project.* Public Policy Decision Making and Clashes of Values: Environmental and Aboriginal concerns About Industrial Expansion Into Pristine Ecosystems. (Approx. $300,000/yr x 5 yr).

10. PERSONAL REFERENCES

Dr. W.R. (Bill Cullen)
Department of Chemistry
University of British Columbia
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MATTHEW DODD

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EDUCATION

1988 PhD, Environmental Analytical Chemistry,
University of British Columbia, Vancouver, B.C. Canada.

1981 BSc, Chemistry (First Class Honours),
University of Science and Technology, Kumasi, Ghana.

OTHER TRAINING

1994 Transportation of Dangerous Goods,
Victoria, BC, July 1994

1993 Field Instrumentation,
University of Toronto, Continuing Engineering Program, October 1993

1986 Practical Liquid Chromatography,
Waters Scientific, February 1986

1985 Sampling for Chemical Analysis,
Department of Chemistry, University of Alberta, May 1985.

PROFESSIONAL EXPERIENCE

1989-Present **Research Associate**
Environmental Sciences Group,
Royal Roads Military College,
Victoria, B.C., Canada

- Environmental Sampling - Soil, sediment, water, and plant sampling for PCB, PAH, inorganic elements and other contaminant analysis. Site surveys at remote Arctic locations (over 40 sites); oceanographic sampling along the British Columbia coastline; site assessments at terrestrial and freshwater environments. Equipment used frequently include Corers, Grabs, Niskin, Surface micro-layer sampler, etc.

- Field Instrumentation - Development and application of on-site analytical techniques for the delineation and confirmatory sampling of contaminated areas.

- Site Remediation - Removal, packaging and shipping of contaminated soils (TDGA Certified).

- Analytical Chemistry - Development and application of analytical techniques (HPLC, LCMS, GC, GCMS, HGAA, GFAA, TLC, GPC, IR, UV-VIS) for the speciation of arsenic, antimony and other environmental species. Focuses on the influence of the discharge of wastes from mining activities. Currently working in collaboration with Dr. W. R. Cullen, Department of Chemistry, UBC.

- Data Analysis and Report Preparation - Interpretation (including statistical analysis) and evaluation of data (use of various criteria and regulations), preparation of reports, articles for scientific journals, and conference presentations..

- Project Management - Member of Scientific Advisory Team for the DEW Line Clean Up Project (Clean up of former military installations in the Canadian Arctic) and on-site Scientific Advisor during site cleanup. Co-supervisor of undergraduate and graduate student researchers.

1988 - 1989 **Assistant Professor**
Sabbatical Leave Replacement,
Memorial University of Newfoundland,
Sir Wilfred Grenfell College,
Corner Brook, Nfld., Canada

- Research - Speciation of arsenic, chromium, cobalt, iron and manganese in marine and fresh water invertebrates.
- Teaching - Introductory Chemistry, General Chemistry and Undergraduate Laboratories.

1983 - 1988 **Graduate Research Assistant**
Department of Chemistry,
University of British Columbia,
Vancouver, BC, Canada.
Supervisor - Dr W. R. Cullen.

- Elemental Analysis - Atomic Absorption Spectrometry (Flame, GFAA, HGAA).
- Synthesis - General preparation and synthesis of standard inorganic and organometallic compounds.
- Speciation - Detection and identification of inorganic and organometallic compounds by means of HPLC, Thermospray MS, TLC, GPC, GC, MS, IR and UV-VIS.
- Environmental Sampling - Oceanographic sampling by means of Benthos corer, Smith-McIntyre grab, Niskin water sampler, Surface microlayer sampler.
- Statistical Analysis - of data.
- Teaching - Undergraduate laboratories.

1982 - 1983 **Lecturer**
Advanced Teacher Training College,
Winneba, Ghana.

- Teaching - Introductory Chemistry, General Chemistry and Undergraduate laboratories.

1981 - 1982 **Research and Teaching Assistant**
University of Science and Technology,
Kumasi, Ghana.

- Research - Effect of arsenic present in mine tailings on soil and plant
- Teaching - Inorganic Chemistry and Undergraduate laboratories.

1979-1980 **Research Assistant**
University of Science and Technology,
Kumasi, Ghana.

- Research - Elemental analysis of latex.

Investigation and Clean Up of Polychlorinated Biphenyls at the Saglek (LAB-2) Long Range Radar Site. M. Dodd, K. J. Reimer, and J. S. Poland. Submitted to the Director General Environment and Director, North Warning System, Department of National Defence, 1993, 29 pages + appendices.

Environmental Study of Abandoned DEW Line Sites: I. Five Intermediate Sites from the Western and Central Arctic. K. J. Reimer, D. A. Bright, M. Dodd, W. T. Dushenko and K. Johnston. Prepared by the Environmental Sciences Group at Royal Roads Military College, Victoria, B.C. for Indian and Northern Affairs Canada and Environment Canada, March 1993, Volume One 357 + xxxi pages and Volume Two 305 + xxvi pages.

Environmental Study of Eleven DEW Line Sites. K. J. Reimer, M. Dodd, W. T. Dushenko, S. L. Grundy and K. Johnston. Prepared by the Environmental Sciences Group at Royal Roads Military College, Victoria, B.C. for the Director North Warning Systems Office and Director General Environment, Department of National Defence, June 1993.

Environmental Study of Abandoned DEW Line Sites: II. Six Intermediate Sites in the Eastern Arctic. K. J. Reimer, M. Dodd, K. Johnston, H. Poll and J. Rogers. Prepared by the Environmental Sciences Group at Royal Roads Military College, Victoria, B.C. for Indian and Northern Affairs Canada and Environment Canada, March 1994.

Decommissioning of the Horton River DEW Line Intermediate Site, Volume Two Sampling and Analytical Program. M. Dodd, J. S. Poland and K. J. Reimer. Prepared by the Environmental Sciences Group at Royal Roads Military College, Victoria, B.C. and Queen's University Analytical Services Unit, Kingston, Ontario for Indian and Northern Affairs Canada, November 1994.

Environmental Study of Abandoned DEW Line Sites: III. One Auxiliary and Eight Intermediate Sites in the Canadian Arctic. K. J. Reimer, M. Dodd, K. Johnston, H. Poll and J. Rogers. Prepared by the Environmental Sciences Group at Royal Roads Military College, Victoria, B.C. for Indian and Northern Affairs Canada and Environment Canada.

Implementation of the DEW Line Cleanup Protocol: contaminated Soil and Barrel Testing, Atkinson Point, Pearce Point, Sarcpa Lake. (1995), Prepared by the Environmental Sciences Group at Royal Roads Military College, Victoria, B.C. and Queen's University Analytical Services Unit, Kingston, Ontario for Department of Indian and Northern Affairs Canada, March 1995.

WILLIAM TERRANCE DUSHENKO

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Personal Data:

Birth Date: 18 October 1960
Citizenship: Canadian

EDUCATION

1990: **Ph.D., Biology**, Queens University at Kingston. Dissertation: Physical and chemical factors affecting the nearshore distribution of aquatic macrophytes in the Bay of Quinte, Lake Ontario.

1986: **M.Sc., Biology**, Queen's University at Kingston. Dissertation: Study of morphometric variation and herbicide tolerance in populations of quackgrass (*Agropyron repens*) from different habitats.

1983: **Honors B.Sc., Ecology and Evolution**, University of Western Ontario. Dissertation: Experiments examining the dormancy , ecology and viability of Jerusalem artichoke (*Helianthus tuberosus*).

ACADEMIC/PROFESSIONAL EXPERIENCE

Research

July, 1990 to present:
Research Associate, Environmental Sciences Group, Department of Chemistry, Royal Roads Military College. Study of environmental contaminants in vascular plants:

- Bioavailability of arsenic contamination, its relationship to nutrient acquisition and potential toxicity to aquatic macrophytes from mine tailings.

- Environmental study of North Warning System radar installations and abandoned DEW Line sites; fate of PCBs and other environmental contaminants in Arctic terrestrial systems.

- Accumulation of PCBs, inorganic elements and other contaminants in Arctic vascular plants, their use as environmental indicators of ecosystem impact in environmental site assessments, and bioaccumulation through the food web.

- Use of vascular plants as indicators of the atmospheric distribution of environmental contaminants in the Arctic.

May to October, 1983:
Summer Research Assistant, Plant Sciences Department, University of Western Ontario. Plant and seedling ecology.

May to August, 1982:
Summer Research Assistant, Ridgetown College of Agricultural Technology, Ontario Ministry of Agriculture and Food. Conducting of experiments in herbicide technology and weed ecology.

June to August, 1981:
Summer Research Assistant, Plant Sciences Department, University of Western Ontario. Experiments in sand dune ecology and conservation.

Teaching

Spring, 1994
Guest Lecturer, Fourth year Arctic short course, Royal Roads Military College, Victoria.

January 1988 to May 1989:
Graduate Teaching Assistant, Cell Biology, Biology Department, Queen's University.
Guest Lecturer, Second year ecology course. Biology Department, Queen's University.

September 1986 to April 1987:
Instructor, Cell Biology, Biology Department, Queen's University.

January 1984 to April 1986:
Graduate Teaching Assistant, Cell Biology, Biology Department, Queen's University.

ADMINISTRATIVE EXPERIENCE

1993-1994 Chairman, Organizing Committee, 34th Annual Meeting of the Canadian Society of Biologists, Royal Road Military College, June 1-4, 1994.

1992-Present Director (British Columbia), Canadian Society of Environmental Biologists.

1990-Present Member of Scientific Advisory and Project Management Team for the DEW Line Clean Up Project (former military installations in the Canadian Arctic).

1989-1990 President/Staff Liaison Officer, Board of Directors, Kingston Housing Co-operative.

1988 Scientific Advisory Team, Bay of Quinte Remedial Action Plan Ecosystem Modeling Workshops.

1984-1985 Biology Department Representative, Queen's University Graduate Student Society.

Board of Directors, Kingston Food Co-operative Association.

AWARDS/FUNDING

1994	Indian and Northern Affairs Canada (INAC), Environmental Investigation of Abandoned Radar Facilities in the Canadian Arctic [to K.J. Reimer, Environmental Sciences Group (ESG)]	$1,250,000
1993	Director General Environment (DGE) in Dept. of National Defence (DND): Scientific Advisory Role in DEW Line Environmental Clean Up (to K.J. Reimer, ESG)	$755,000
	INAC/Environment Canada: Environmental Evaluation of Abandoned and Other Military Installations in the Arctic (to K.J. Reimer, ESG)	$1,000,000

1992	INAC: Evaluation of Abandoned Radar Sites in the Canadian Arctic (to K.J. Reimer, ESG)	$550,000
	DGE,DND/ Director North Warning System Office (NWSO); Environmental Investigation of NWS Sites in the Arctic (to K.J. Reimer, ESG)	$742,000
1991	DGE, DND: Environmental Investigation of NWS Sites in the Arctic (to K.J. Reimer, ESG)	$464,500
1990/91	Indian and Northern Affairs Canada, Impact of Mine-Tailings from the Nerco Con Mine in Yellowknife on the Aquatic Environment (to K.J. Reimer, Environmental Sciences Group)	$15,000
1990	Project Man., N. American Air Defence Modernization and Director (NWSO): North Warning System Environmental Investigations (to K.J. Reimer, ESG)	$550,000
1989	Ontario Ministry of the Environment Excellence in Research Award in Water Quality.	$1,000
1987-1990	Queen's University Dean's Award	$4,000
1984-1986	Queen's Graduate Award	$3,000

MEMBERSHIP IN PROFESSIONAL SOCIETIES

- International Association of Impact Assessment (1994 to present)
- Society of Environmental Toxicology and Chemistry (1994 to present)
- International Association for Great Lakes Research (1990 to present)
- Canadian Society of Environmental Biologists, (1989 to present), Director for British Columbia (1992-present)

- Association of Wetland Managers (1989 to 1993)

PUBLICATIONS/PROFESSIONAL ACHIEVEMENTS

Refereed Papers

Dushenko, W.T., D.A. Bright and K.J. Reimer, in press. Arsenic bioaccumulation and toxicity in aquatic macrophytes exposed to gold-mine effluent: relationships with environmental partitioning, metal uptake and nutrients. Aquatic Botany.

Bright, D.A., W.T. Dushenko, S.L. Grundy and K.J. Reimer, 1995. Effects of local and distant contaminant sources: polychlorinated biphenyls and other organochlorines in bottom-dwelling animals from an Arctic estuary. Sci. Total. Environ., 160/161: 265-283.

Bright, D.A., W.T. Dushenko, S.L. Grundy and K.J. Reimer, 1995. Evidence for short range transport of polychlorinated biphenyls in the Canadian Arctic using congener signatures of PCBs in soils. Sci. Total. Environ., 160/161: 251-263.

Bright, D.A., B. Coedy, W.T. Dushenko and K.J. Reimer, 1994. Arsenic transport in a watershed receiving gold mine effluent near Yellowknife, Northwest Territories, Canada. Sci. Total. Environ., 155: 237-252.

Dushenko, W.T., A. Crowder and B. Cameron, 1990. Revegetation in the Bay of Quinte, Lake Ontario: Preliminary Lab and Field Experiments, In (J. Kusler and R. Smardon, Eds.) Proc. International Symposium on Wetlands of the Great Lakes, May 16-19, 1990, Niagara Falls N.Y. pp.245-255.

Crowder, A., W.T. Dushenko, J. Greig and J. Poland. 1989. Metal contamination in sediments and biota of the Bay of Quinte, Lake Ontario, Canada. Hydrobiologia 188/189: 337-343.

Manuscripts In Preparation

Grundy, S.L., D.A. Bright, W.T. Dushenko and K.J. Reimer. The weathering and dispersal of polychlorinated biphenyls from a known source in the Canadian Arctic.

Dushenko, W.T., S.L. Grundy and K.J. Reimer, Vascular plants as sensitive indicators of lead and PCB transport from local sources in the Canadian Arctic.

Dushenko, W.T., D.A. Bright, M. Dodd, S.L. Grundy and K.J. Reimer. Impact of local contaminants to the Arctic terrestrial ecosystem: relationships to soil and remediation criteria.

Dushenko, W.T., D.A. Bright and K.J. Reimer. Contaminants in a soil-plant-lemming food chain system from a local source in the Canadian Arctic.

Dushenko, W.T., D. Pier and K.J. Reimer. Plant interspecific variation in the uptake of PCBs from contaminated soils in the Arctic: implications for transport mechanisms near the base of terrestrial ecosystems.

Scientific Meetings/Seminars

Dushenko, W.T. (ed.). Environmental Impact Assessment and Remediation: Towards 2000. Proc. 34th Annual Meeting of the Canadian Society of Environmental Biologists, June 1 to 4, 1994, Royal Road Military College, Victoria, B.C.

Dushenko, W.T., D.A. Bright, M. Dodd, S.L. Grundy, and K.J. Reimer, 1995. Adaptation of national soil contamination criteria for radar sites in the Canadian Arctic, In (W.T. Dushenko, ed.). Environmental Impact Assessment and Remediation: Towards 2000; Proceedings of the 34th Annual Meeting of the Canadian Society of Environmental Biologists (CSEB). June 1-4, 1994, Royal Roads Military College, Victoria, B.C.

Dushenko, W.T., D.A. Bright, S.L. Grundy and K.J. Reimer, 1994. The use of Arctic vascular plants in assessing the ecosystem impact of contaminants at radar sites in the Arctic. Third Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry. May 12-14, 1994, University of Victoria, B.C. (Abstract).

Grundy, S.L., D.A. Bright, W.T. Dushenko and K.J. Reimer, 1994. Short range transport of contaminants in the Canadian Arctic: northern radar stations as point sources for aerial distribution of PCBs. Proc. Third Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry. May 12-14, 1994, University of Victoria, B.C. (Abstract).

Bright, D.A., W.T. Dushenko, S.L. Grundy and K.J. Reimer, 1993. Polychlorinated biphenyls and other organochlorines in bottom-dwelling animals from an Arctic estuary. Proc. 76th Canadian Society of Chemistry Conference, May 30-June 3, 1993, Sherbrooke, Quebec (Abstract).

Reimer, K.J., M. Dodd, W.T. Dushenko and D.A. Bright, 1992. Antimony cycling and bioavailability in lakes near Yellowknife, Northwest Territories. Proc. 75th Canadian Society of Chemistry Conference, May 31-June 4, 1992, Edmonton, Alberta (Abstract).

Dushenko, W.T. and J. Greig, 1989. Metal contamination in wetland food chains. Ecology and Evolutionary Behaviour Seminar Series, Department of Biology, Queen's University, Kingston (Invited Seminar).

Dushenko, W.T., J. Greig and A. Crowder, 1989. Shoreline distribution of contaminants and submerged macrophytes in the Bay of Quinte, Ontario. Proc. Ontario Wetlands: Inertia or Momentum? Conference, Federation of Ontario Naturalists, October 21-22, 1988.

Dushenko, W.T., J. Greig and A. Crowder, 1989. Metals and their distribution in wetlands of the Bay of Quinte, Lake Ontario. Proc. Int. Conf. Trace Metals in Lakes. August 15-18, 1988, McMaster University, Hamilton (Abstract).

Crowder, A., W.T. Dushenko, and J. Greig, 1988. Metal contamination of wetland food chains in the Bay of Quinte, Ontario. Proc. Environmental Research: 1989 Technology Transfer Conference (Water Quality Research), Environment Ontario, November 28-29, 1989, Toronto, ON.

Dushenko, W.T., 1986. Quack strikes back: early herbicide tolerance to glyphosate in populations of *Agropyron repens*. Ecology and Evolutionary Behaviour Seminar Series, Department of Biology, Queen's University, Kingston (Invited Seminar).

Dushenko, W.T. and L. Aarssen, 1986. Patterns of variation in *Agropyren repens* L. Beauv. from contrasting habitats. Proc. IV International Congress of Ecology, August 10-16, Syracuse, N.Y (Abstract).

Reports

Environmental Sciences Group and UMA Engineering Ltd., 1995. DEW Line Cleanup: Scientific and Engineering Summary Report. Prepared for Minister of National Defence from Royal Roads Military College, Victoria, BC.

Environmental Sciences Group, 1995. Environmental Risk Assessment of Used Oil Contaminants in the Northwest Territories Ecosystem. Prepared for Renewable Resources, Government of the Northwest Territories, at Royal Roads Military College, Victoria, B.C.

Dushenko, W.T. and K.J. Reimer, 1994. Environmental Study of a Military Installation at Resolution Island, BAF-5. Environmental Sciences Group, Royal Roads Military College, Victoria, BC.

Environmental Sciences Group, 1994. Environmental Screening Report for the Cleanup of 12 DEW Line Sites. Prepared for Department of National Defence from Royal Roads Military College, Victoria, BC.

Reimer, K.J., D.A. Bright, W.T. Dushenko, S.L. Grundy and J.S. Poland, 1993. The Environmental Impact of the DEW Line on the Canadian Arctic, 2 Vols. Environmental Sciences Group, Royal Roads Military College, Victoria, B.C., Canada.

Reimer, K.J., D.A. Bright, M. Dodd, W.T. Dushenko and K. Johnston, 1993. Environmental Study of Abandoned DEW Line Sites: I. Five Intermediate Sites from the Western and Central Arctic, 2 Vols. Environmental Sciences Group, Royal Roads Military College, Victoria, B.C., Canada.

Reimer, K.J., M. Dodd, W.T. Dushenko, S.L. Grundy and K. Johnston, 1993. Environmental Study of Eleven DEW Line Sites, 3 Vols. Environmental Sciences Group, Royal Roads Military College, Victoria, B.C., Canada.

Reimer, K.J., M. Dodd, W.T. Dushenko, S.L. Grundy and M.B. Yunker, 1991. North Warning System Environmental Study, 3 Vols. Environmental Sciences Group, Royal Roads Military College, Victoria, B.C., Canada.

BARRY FEDORAK, P.Eng.

Barry Fedorak is a Geotechnical Engineer with UMA. He has undertaken numerous assignments for transportation/construction inspections, geotechnical/environmental investigations and civil/transportation design.

REPRESENTATIVE EXPERIENCE

Transportation/Construction

- Resident Engineer for the construction of Al-Pac Hwy. 55 Connector to km 9.8. Responsible for the provision of survey and geotechnical services, public relations, contractor liaison, quantity estimates and final details preparation. Final quantities were calculated from as-built survey information using the EMXS surface compiler program.

- Conducted geotechnical investigations, including borrow assessment, for various secondary highway and resource road projects.

- Resident inspection including material selection and compaction testing for a tailings dam at the OBED Mountain Coal Mine.

- Coordinated and supervised various field drill investigation programs.

- Cast-in-place pile inspection on numerous commercial and municipal projects.

- Monitoring of slope indicators at various construction projects.

Environmental

- Conducted groundwater monitoring programs at Suncor gas plants. Duties included well installation, field sampling and report preparation.

- Investigated soil and groundwater quality for Sunwapta Broadcasting Ltd. Duties included well installation, soil and groundwater sampling, and report preparation.

- Performed field investigations for various other environmental projects involving soil and groundwater sampling and testing for underground storage tanks, bioremediation facilities and other potentially contaminated sites.

Land Development/Foundations

- Conducted Field Program and provided input for design as part of a comprehensive geotechnical program for the proposed Weyerhaeuser O.S.B. plant near Grande Prairie, Alberta. Field program included testpitting, Becker hammer drilling, plate bearing testing and pump testing.

- Conducted geotechnical/hydrogeological investigations for design and construction of subdivisions and included making recommendations for excavation, backfill, roadway subgrade preparation, stormwater pond development and subsurface drainage.

- Conducted geotechnical investigations and prepared foundation reports for the design and construction of small buildings, commercial and light industrial developments.

Civil/Transportation Design

- Design Engineer for the Weldwood and WMI West Edmonton Landfills. Associated duties included the preparation of drawings and specifications, quantity calculations and report writing.

- Prepared design estimates and contract documents for various surfacing projects on secondary highways. Also involved in design of highway grading projects using the EMXS surface compiler program.

EMPLOYMENT RECORD

1992 - Present	UMA Engineering Ltd., Geotechnical Engineer
1990 - 1991	Torchinsky Engineering Ltd., Design/Resident Engineer
1989	EBA Engineering Ltd., Geotechnical Engineer

EDUCATION

B.Sc. in Civil Engineering (Co-op Program), University of Alberta, 1989

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Place of Birth:
Manchester, England

Citizenship:
Dual (Canadian and British)

Department:
Chemistry

Degrees:

B.Sc.	(Hons Chemistry) Sheffield, England
Ph.D.	(Organometallic Chemistry) Sheffield, England

Academic Experience:

1 Jan 84 - 30 Apr 85	Post-Doctoral Research Fellow, University of Victoria, Victoria, B.C.
1 Sep 84 - 30 Apr 85	Lab Instructor, Chemistry Department, University of Victoria
1 Sep 85 - 30 Apr 86	Sessional Lecturer, Chemistry Department, University of Victoria
1 Sep 85 - 30 Apr 86	Research Associate, Chemistry Department, University of Victoria
1 May 86 - 31 Aug 86	Research Associate, Chemistry Department, University of Victoria
1 Sep 86 - 30 Apr 87	Sessional Lecturer, Chemistry Department, University of Victoria
1 May 87 - 31 Aug 87	Research Associate, Chemistry Department, University of Victoria
1 Sep 87 - 30 Apr 88	Sessional Lecturer, Chemistry Department, University of Victoria
4 Jan 88 - 26 Apr 88	Instructor, Chemistry Department, Camosum College
1 May 88 - 31 Aug 88	Research Associate, Chemistry Department, University of Victoria
1 Sep 88 - 31 Aug 89	Visiting Scientist, Chemistry Department, University of Victoria
1 Sep 88 - 31 May 89	Assistant Professor, Chemistry Department, Royal Roads
1 May 89 - 31 Aug 89	Visiting Assistant Professor, Chemistry Department, University of Victoria

1 Sep 89 - 31 May 90	Assistant Professor, Chemistry Department, Royal Roads
1 Sep 89 - 30 Apr 90	Visiting Assistant Professor, Chemistry Department, University of Victoria
1 Sep 90 - 30 Aug 91	Research Associate, Chemistry Department, University of Victoria
27 Aug 91 - 17 Dec 91	Instructor, Chemistry Department, Camosum College
1 Sep 91 - 30 Jun 92	Assistant Professor, Chemistry Department, Royal Roads
1 Sep 92 - 30 June 94	Assistant Professor, Chemistry Department, Royal Roads
1 July 94 -	Associate Professor, Chemistry Department, Royal Roads
1 Jul 93 -	Adjunct Assistant Professor, Chemistry Department, University of Victoria

Publications:

a) Refereed Papers

1. The Selective Reduction of Benzene to Cyclohexene. Stephen L. Grundy and Peter M. Maitlis. J. Chem. Soc. Chem Commun., 1982, 379.

2. Compartmental Ligands. Part 7. The Reaction of 1,2-Diaminobenzene and cis-1,2-Diaminocyclohexane with Heptane-2,4,6-trione and 1-(o-Hydroxyphenyl)butane-1,3-dione: The Crystal Structures of 1-(o-Aminophenyl)-2,6-dimethyl-4-pyridone hemihydrate and (3,3'-(cis-1,2-Cyclohexanediyldi-imino)bis[1-(o-hydroxyphenyl) but-2-enonato]-(N,N',O^{I},O^{II})copper(II). Neil A. Bailey, Kevin C. Cox, Christopher P. Falshaw, David E. Fenton, Stephen L. Grundy, Paul Haigh, Carl Phillips and Trevor J. King. J. Chem. Soc., Dalton Trans., 1983, 2241.

3. The Selective Reduction of Benzene to Cyclohexene mediated by Platinum Metal Complexes: X-Ray Crystal Structure of $[(\eta^5\text{-}C_5Me_5)Ir(\eta^5\text{-}C_6H_6CH_2NO_2)][BF_4]$. Stephen L. Grundy, Arnold J. Smith, Harry Adams and Peter M. Maitlis. J. Chem. Soc., Dalton Trans., 1984, 1747.

4. Double Nucleophilic Attack on η^6-Arene(pentamethylcyclopentadienyl) Iridium Dications. Routes from Substituted Benzenes to Substituted Cyclohexenes by Addition of Two Hydrides and Two Protons. Stephen L. Grundy and Peter M. Maitlis. J. Organomet. Chem., 1984, 272, 265.

5. Phosphinoalkylsilyl Complexes. 6. Isolation of a Silyl Complex of Iridium(1). Crystal and Molecular Structure of Dicarbonyl-(triphenylphosphine)-[((diphenylphosphino)ethyl)dimethylsilyl]-iridium. Mary J. Auburn, Stephen L. Grundy, Stephen R. Stobart and Michael J. Zaworotko. J. Am. Chem. Soc., 1985, 107, 266.

6. Preparation of Cyclohexene Rings. Stephen L. Grundy and Peter M. Maitlis, U.K. Patent GB 2 114 149A.

7. Process for Catalytic Hydroformylation, Stephen L. Grundy, Stephen R. Stobart and Frederick Joselyn. Canadian Patent 570803, June 1988, U.S. Patent 07/284,366 Dec. 1988.

8. Metal-mediated Functionalization of Tetrahydronaphthalene, Octahydroanthracene, and Tetrahydroquinoline: Stereochemical Control of Nucleophilic Addition to Cationic Cyclopentadienyl (η^6-arene) iron (II) Complexes via Benzylic Substitution, Stephen L. Grundy, Anthony R.H. Sam, and Stephen R. Stobart. Department of Chemistry, University of Victoria, P.O. Box 1700, Victoria, B.C., Canada V8W 2Y2. J. Chem. Soc. Perkin Trans. I, 1989, 1663.

9. Core Conformational Rearrangement Accompanying Two-Center, Bimetallic Redox Reactions. Chemical and Structural Properties of the Pyrazolyl-Bridged Rhodium Dimers $[Rh(\eta^5\text{-}C_5Me_5)Cl(\mu\text{-}pz)]_2$ and $[Rh(\eta^5\text{-}C_5H_5)(\mu\text{-}pz)]_2$. James A. Bailey, Stephen L. Grundy, and Stephen R. Stobart. Organometallics, 1990, 6, 536.

10. (Phosphinoalkyl) silyl Complexes. 10. Formation of Chelated Bis [(diphenylphosphinoethyl) diorganosilyl] platinum(II) Complexes. Precoordination through Phosphorus, Intermediacy of a Platinum (IV) Disilyl, and Diastereoisomerism at Planar Platinum(II) in "Chelate Assisted" Hydrosilylation. Stephen L. Grundy, Rupert D. Holmes-Smith, Stephen R. Stobart and Mark A. Williams. Inorg. Chem., 1991, 30, 3333.

11. Methylated antimony (V) compounds: synthesis, hydride generation properties and implications for aquatic speciation. Matthew Dodd, Stephen L. Grundy, Kenneth J. Reimer and William R. Cullen. Applied Organomet. Chem. Applied Organomet. Chem., 1992, 6, 207.

12. Transition metal phosphinolkylsilanols: Ligand functionality designed for surface attachment. Chemistry of P-coordinated (diphenylphosphinialkyl)dimethylsilanol complexes of Ru, Rh and Ir. Ron D. Brost, Gregg C. Bruce, Stephen L. Grundy and Stephen R. Stobart. Inorg. Chem., 1993, 32, 5195.

13. Complexation of 1,4,5,8,9,10-hexahydroanthracene (HHA) to Iron or Ruthenium. A bis(diene)diiron HHA Geometry, Hydroaromatic Ruthenium Compounds Related to $Ru(\eta^6\text{-THA})Cl_2(DMSO)$ (THA = 1,4,9,10-Tetrahydroanthracene; DMSO = Dimethyl sulfoxide), and $RU_3(CO)_{12}$-Catalyzed HHA Rearrangements. Timothy J. Beasley, Ron D. Brost, Chit Kay Chu, Stephen L. Grundy and Stephen R. Stobart. Organometallics, (in press).

14. Effects of Local and Distant Contaminant Sources: Polychlorinated Biphenyls and other Organochlorines in Bottom-Dwelling Animals from an Arctic Estuary., D.A. Bright, W.T. Dushenko K. J. Reimer and S.L. Grundy. Science of the Total Environment (in press).

15. Evidence for Short Range Transport of Polychlorinated Biphenyls in the Canadian Arctic Using Congener Signatures of PCBs in Soils. D.A. Bright, W.T. Dushenko K. J. Reimer and S.L. Grundy. Science of the Total Environment (in press).

16. Differential biaccumulation of non-ortho substituted and other PCB congeners in coastal Arctic invertebrates and fish (Myoxocephalus quadricornis, M. scorpius, Gadus ogac and Salvelinus alpinus). Doug A. Bright, Stephen L. Grundy and Kenneth J. Reimer. (submitted).

17. Pyrazolyl-Bridged Rhodium and Iridium Dimers: Reactivity of the Rh(III/II) Couple. James A. Bailey, Stephen L. Grundy and Stephen R. Stobart. (submitted)

18. The Weathering and Dispersal of Polychlorinated Biphenyls from a Known Source in the Canadian Arctic. Stephen L. Grundy, Douglas A. Bright, William T. Dushenko and Kenneth J. Reimer. (submitted)

b. <u>Non-Refereed Papers</u>

1. North Warning System Environmental Study (3 volumes), K. J. Reimer, M. Dodd, W.T. Dushenko, S.L. Grundy, M.B. and J.S. Poland, Royal Roads Military College Environmental Sciences Group, Victoria, B.C., June 1991.

2. CFB Cold Lake Landfill Impact Study, K. J. Reimer, S.L. Grundy and J.S. Poland, Royal Roads Military College Environmental Sciences Group, Victoria, B.C., February 1992.

3. The Environmental Impact of the DEW Line on the Canadian Arctic, K. J. Reimer, W.T Dushenko, D.A. Bright, S.L. Grundy and J.S. Poland, Royal Roads Military College Environmental Sciences Group, Victoria, B.C., February 1993.

4. An Environmental Study of the Canol Trail, NWT. S.L. Grundy, D. Oswald, J.S. Poland and K.J. Reimer. Royal Roads Military College Environmental Sciences Group, Victoria, B.C., March 1994.

5. An Environmental Study of Ashihik Airstrip, Yukon. Environmental Sciences Group, Victoria, B.C., February 1995.

Conference Papers:

Evidence for 'Chelate-Assisted' Hydrosilylation at a Ruthenium Center. Conformational Rigidity in a Sterically Crowned η^6-Arene Ruthenium(II) complex. Gregg C. Bruce, Stephen L. Grundy, Stephen R. Stobart and Mark A. Williams. 42nd Southwest Regional Meeting, American Chemical Society, November 1986.

Sources and Distribution of Polychlorinated Biphenyls in Canadian Arctic Soils. S.L. Grundy, D.A. Bright, W.T. Dushenko and K.J. Reimer. 76th Canadian Society of Chemistry Conference, June 1993.

Polychlorinated Biphenyl Distribution in Candian Arctic Soils: The Use of Congener Signatures in Source Identification. Stephen L. Grundy, D.A. Bright, W.T. Dushenko, and K.J. Reimer. International Symposium on the Ecological Effects of Arctic Airborne Contaminants, Reykjavik, Iceland, October 1993.

Effects of Local and Distant Contaminant Sources: Polychlorinated Biphenyls and other Organochlorines in Bottom-Dwelling Animals from an Arctic Estuary. Kenneth J. Reimer, D.A. Bright, W.T. Dushenko and S.L. Grundy. International Symposium on the Ecological Effects of Arctic Airborne Contaminants, Reykjavik, Iceland, October 1993.

Short Range Transport of Contaminants in the Candian Arctic: Northern Radar Stations as Point Sources for Aerial Distribution of PCBs. Stephen L. Grundy, D.A. Bright, W.T. Dushenko, and K.J. Reimer. Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry. Annual Meeting, Victoria, BC, Canada. May 1994.

The Use of Arctic Vascular Plants in Assessing the Ecosystem Impact of Contaminats at Radar Sites in the Arctic. W.T. Dushenko, D.A. Bright, Stephen L. Grundy, and K.J. Reimer. Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry. Annual Meeting, Victoria, BC, Canada. May 1994.

Does the Differential Bioaccumulation of Coplanar PCBs and Other Congeners Reduce Relative PCB Toxicity? Evaluation in Arctic Sculpins. D.A. Bright, Stephen L. Grundy and K.J. Reimer. Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry. Annual Meeting, Victoria, BC, Canada. May 1994.

Investigation of Groundwater Contamination in the Vicinity of an Old Landfill Site at CFB Cold Lake, Medley, ALTA. Stephen Grundy, Ken Reimer and William Dushenko. Canadian Society of Environmental Biologists, 34th Anuual Meeting, Victoria, June, 1994.

Evidence for Short Range Transport of Polychlorinated Biphenyls in the Candian Arctic Using Congener Signatures of PCBs in Soils. Stephen L. Grundy, D.A. Bright, W.T. Dushenko, and K.J. Reimer. Canadian Society of Environmental Biologists, 34th Anuual Meeting, Victoria, June, 1994.

Invited Conferences

McMurdo Dry Valleys Environmental Management Workshop, March 14-17, 1995, Sante Fe, New Mexixo.

Professional Associations:

1986- Member, Chemical Institute of Canada
1994- Member, Society of Environmental Toxicology and Chemistry

Work in Progress:

Bright, D.A. and S.L. Grundy. Soil, plants and marine sediment as sinks for atmospherically-transported organochlorines (polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins/furans, and chlorinated pesticides) in the Canadian Arctic: Background concentrations and signatures.

Bright, D.A., S.L. Grundy, C. Simpson and K.J. Reimer. Uncertainties associated with the dominance of alkylated over parent PAH in anthropogenically-influenced Arctic terrestrial and marine environments.

TANYA M. SCHULZ, P.Eng.

Tanya Schulz, P.Eng. is a Senior Environmental/Geotechnical Project Engineer with UMA.

EXPERIENCE

1989 - Present - UMA Engineering Ltd. - Project engineer responsible for geotechnical site investigation, design input for civil/municipal projects, environmental assessments for contaminated sites and landfills. She has been involved in the following projects:

- Project Engineer - Design and Cost Estimating of the Clean Up for 21 DEW Line Sites for Department of National Defence - coordination of all engineering site surveys, review of landfill designs and all environmental documentation including Environmental Screening Reports, Environmental Protection Plan, and provided input to the construction specifications.
- Project Engineer - Evaluation of Treatment Alternatives for Oil Contaminated Soil for Interprovincial Pipe Line Inc. - developed guidelines for spill cleanup implementation planning.
- Site investigation and hydrogeological assessment for proposed Industrial Landfill sites for Weldwood of Canada Ltd. (Hinton Division).
- Environmental assessment of the abandoned Military Installation of Coral Harbour, NWT for Indian and Northern Affairs. The project included site characterization, contaminant evaluation and cleanup recommendations.
- Environmental Clean Up Study of 21 DEW Sites in Canada for USAF - an environmental site assessment and evaluation of remedial actions for contaminated areas.
- Background groundwater assessment and groundwater monitoring program for Slave Lake Pulp Corporation. Work included supervision of installation of groundwater monitoring wells, hydrogeological and hydrochemical assessment.
- Environmental Assessment of an Abandoned Landfill for the City of Leduc; installation of groundwater monitoring wells; hydrogeological and hydrochemical evaluation, methane gas measurement.
- Geotechnical investigations and design input for foundations, underground utilities and roadways for development companies including Genstar Developments, Maclab Enterprises, Rosedale Estates Inc. Alldritt Development Ltd.
- Slope Stability Analyses for the City of Edmonton, Town of Sangudo and Maclab Enterprises. Projects involved identification of subsurface stratigraphy and groundwater conditions through field exploration, and slope stability analyses with recommendations for remedial action or set-back distances.

1982 - 1989 - Department of Civil Engineering, University of Alberta - Professional Research Associate; contracts included:

- Theoretical assessment and laboratory modelling of the transient behaviour of gas evolution in oil sands.
- Strength, deformation and hydraulic conductivity characteristics of oil sands under standard and high temperatures and pressures.
- Evaluation of geotechnical characteristics of surface mined land.
- Strength and deformation characteristics of saline permafrost.

EDUCATION

Graduate Course in Rock Engineering, University of Alberta, Edmonton, 1984
B.Sc., Civil Engineering, University of Alberta, Edmonton, 1982

SHORT COURSES/SEMINARS

Short Course in Soil and Groundwater Remediation, University of California, Los Angeles, 1993

PROFESSIONAL AFFILIATIONS

Member, Association of Professional Engineers, Geologists and Geophysicists of Alberta, 1984

Member, Northwest Territories Association of Professional Engineers, Geologists, and Geophysicists, 1995

PUBLICATIONS

Thomson, S., Scott, J.D., Sego, D.C., and Schulz, T.M., 1987.
Research on the Testing of Model Footings on Reclaimed Land, Wabamun, Alberta. Canadian Geotechnical Journal, 23, pp. 541-547.

Thomson, S., Sonnenberg, R., and Schulz, T.M., 1987.
A Study of Urban Restoration of Surface Mined Land in Western Canada. Proceedings of the Conference on Building on Marginal and Derelict Land, Glasgow, Scotland.

Schulz, T.M., and Thomson, S., 1984. Settlement Studies of an Open Pit Mine Backfill in Western Canada. Proceedings of the 3rd International Conference on Ground Movements and Structures. U.W.I.S.T., Cardiff, Wales, Vol. 3, pp. 480-495.

Sego, D.C., Schulz, T., and Banasch, R., 1982. Strength and Deformation Behaviour of Frozen Saline Sand. Proceedings of the 3rd International Symposium on Ground Freezing, Hanover, N.H., 1, pp. 11-18.

S.M. STOWKOWY, P.Eng., M.B.A.

Steve Stowkowy, P.Eng., M.B.A. is a Senior Project Manager in the Infrastructure Department of UMA.

EXPERIENCE

1988 - Present - UMA, Project Manager/Engineer, responsible for project management and design on various civil and environmental engineering assignments. Typical assignments include:

- Project Manager for the Environmental Site Assessment of CFB Calgary for the Department of National Defence.
- Design Manager for the Design and Cost Estimating of the Clean Up of 21 DEW Line Sites in the Canadian Arctic for the Department of National Defence.
- Tunnel Design Engineer for the preliminary design for the Relocation of the Rossdale Intake for the City of Edmonton.
- Assistant Project Manager for the City of Edmonton's Drainage Planning Task Force.
- Assistant Project Manager and Design Manager for the design and construction administration of the site development components of the Inuvik, N.W.T., Forward Operating Location for the Department of National Defence.
- Project Manager Assistant on the site survey and design of nine Short Range Radar Stations forming part of Canada's North Warning System.

1980 - 1988 - UMA, Project Engineer, responsible for preliminary engineering, traffic analyses, functional planning, design, specification preparation, and construction services for urban and rural transportation projects. He was responsible for:

- Engineering design of the site access roads for the Oldman River Dam near Pincher Creek, Alberta for Alberta Environment.
- Final design for the 35 km Caribou Lake Access Road for Husky Oil Operations Ltd. in the Primrose Lake Air Weapons Range.
- Preliminary engineering design of the Outer Ring Road from 68 Avenue to 116 Street for the City of Edmonton. The project included the preliminary design of five diamond interchanges and one cloverleaf interchange.
- Final design and preparation of contract specifications for construction of the site access roads and rail spur line for the Medium Density Fibreboard Plant at Blue Ridge, Alberta for Alberta Energy Ltd.
- Engineering design and preparation of contract documents for the proposed radar developments at Calgary and Beaverlodge, Alberta as part of Transport Canada's Radar Modernization Project (RAMP).

- Design of the aircraft aprons, parking lot, and roadway network for the fuel system/composite/F404 engine bay facility at C.F.B. Cold Lake, Alberta for the Department of National Defence
- Development and assessment of functional plans for the interchange and adjacent rail grade separation at the intersection of 50 Street and Yellowhead Trail for the City of Edmonton.
- Preparation of the N.E. Corridor Functional Planning Study (115 Avenue to 134 Avenue) for the City of Edmonton.

1979 - 1980 - UMA, Design Engineer, Land Development Department, and Research Assistant with Special Projects. During this time he was involved in the following projects:

- Airport facilities masterplan studies for communities within the Thompson-Nicola Regional District of British Columbia.
- Airstrip upgrading on the Alsands Project Lease for the Alsands Project Group.
- An evaluation of the kinetic energy in Canadian rivers and estuaries for the National Research Council of Canada.
- Lessard Subdivision (Edmonton) for George Wimpey Canada Limited. He was Project Coordinator and was responsible for field layout, contract administration, and construction inspection of surface and underground utilities.

1978 - Cicon Engineering Ltd., Edmonton, Undergraduate Engineering Student, responsible for field layout, contract administration, and construction inspection of subdivisions throughout northern Alberta.

EDUCATION

Master in Business Administration, University of Alberta, 1988
Bachelor of Science (First Class Standing), Civil Engineering, University of Alberta, 1979

AFFILIATIONS

Member, Association of Professional Engineers, Geologists and Geophysicists of Alberta
Licensee, The Association of Professional Engineers, Geologists, and Geophysicists of the Northwest Territories

R. TYPLISKI, P.ENG.

Ron Typliski, P. Eng. is a Senior Environmental Engineer in the Environmental Division of UMA Engineering Ltd., responsible for environmental engineering and occupational health and safety projects and studies. Prior to joining UMA, Ron was employed by Hudson Bay Mining and Smelting Co. Ltd. from 1978 to 1991 in a number of senior environmental engineering positions. Ron's knowledge and experience in project management supports his extensive experience in environmental engineering, auditing, risk assessment, site assessments and occupational health and safety.

EXPERIENCE

ENVIRONMENTAL IMPACT ASSESSMENT

- Familiar with provincial environmental assessment review procedures and permitting requirements for new developments and existing operations
- Coordinated the preparation of an environmental impact statement for a contaminated soil remediation project in Northern Manitoba under the Federal environmental review process (EARP)
- Coordinated the preparation of environmental impact statements and environment license applications under the Manitoba Environment Act for a major aerospace manufacturing plant operation and a proposed sewage treatment plant upgrading project for a city in rural Manitoba

ENVIRONMENTAL AUDITING AND RISK ASSESSMENT

- Conducted numerous environmental audits and risk assessments of real estate, property, plant operations and buildings
- Conducted an environmental audit and review of waste handling, storage and disposal practice at a major aerospace manufacturing plant
- Conducted an environmental audit and risk assessment of a decommissioned hydro electric generating site for Ontario Hydro
- Coordinated soils investigation studies at underground petroleum storage tank sites to determine the extent and degree of soil contamination and further recommended remedial measures for site cleanup
- Coordinated an environmental audit and risk assessment of air emissions sources from a wood particle board plant and their impacts on the surrounding community

WASTEWATER TREATMENT

- Coordinated laboratory and pilot plant testing, design and construction of a number of mine wastewater treatment plants for a northern Manitoba mining company to treat acid mine drainage
- Coordinated development and operation of tailings waste storage and treatment systems at several northern Manitoba mining operations. Responsible for embankment and spillway design, construction and tailings treatment operation

- Coordinated a study of options for treating oil and grease wastewaters from a Winnipeg based railway maintenance facility
- Assisted in the study and review of nickel chemistry and metal loading at a wastewater and tailings disposal area in Sudbury to identify options reducing metal loadings in the final effluent discharge
- Coordinated tailings evaluation and metal hydroxide sludge studies at an abandoned tailings site in northern Manitoba

HAZARDOUS/SOLID WASTE

- Coordinated a study of hazardous waste disposal at a major Winnipeg Landfill
- Coordinated site selection and site development for Class III solid waste disposal sites at a number of northern Manitoba mine/mill operations
- Coordinated site selection, development and operation of a hazardous waste storage site for a northern Manitoba mining company

OCCUPATIONAL HEALTH AND SAFETY EXPERIENCE

- Industrial hygiene monitoring for worker exposure to total dust, respirable dust, heavy metals, asbestos fibre, SO_2, CO, noise and heat stress
- Respiratory protection requirements for worker protection against dust, fumes, mist and gases in the workplace
- Workplace and plant auditing for compliance with Workplace Safety and Health legislation at a number of industrial plant sites
- Workplace Safety and Health program development and employee training to comply with Manitoba WS & H Act requirements
- Loss Control Management program development for the prevention of accidental loss to people, process and plant

EDUCATION

B.Sc. in Civil Engineering, 1978
Post Graduate short courses in Design and Construction of Tailings Dams and Impoundments, Industrial Ventilation, (ILCI) Total Loss Control Management, Respiratory Protection, and Environmental Risk Assessment

AFFILIATIONS

Member, Association of Professional Engineers of Manitoba
Member, Canadian Institute of Mining and Metallurgy
Metal Mining Representative on National C.I.M.M. Environment Committee
Member, Western Canada Chapter of Air and Waste Management Association
Member, Manitoba Chapter of American Industrial Hygiene Association
Member, Canadian Society of Safety Engineers
Member, Canadian Standards Association - Winnipeg Advisory Committee

A.S. WASHUTA, P.Eng.

Art Washuta, P.Eng., is a Senior Project Manager with UMA as well as Quality Coordinator for the UMA Group's Total Quality Management initiative.

EXPERIENCE

1977 - Present - Since joining UMA he has been involved in the planning, design, project management and construction management for many heavy civil and environmental projects. He has over 22 years experience and is a principal of UMA.

He is currently Project Manager for the design and cost estimating of the Environmental Clean Up of 21 DEW Line sites, a $150 million project for the Department of National Defence. Major projects in which he has participated include:

Heavy Civil and Environmental Projects

- Project Development Proposal, Order of Magnitude construction cost estimate for the Clean Up of 26 DIAND sites
- Site Restoration Costs, Power Plants for Northwest Territories Power Corporation
- Oldman River Dam, Project Engineer - Spillway, a $50 million project for Alberta Environment/Alberta Public Works
- Forward Operating Location (FOL) Department of National Defence, $30 million project in Inuvik, NWT
- Foundations for 10 Short Range Radar Sites, $40 million North Warning System project, Department of National Defence
- E.L. Smith Water Treatment Plant, $40 million Stage 3 Expansion, City of Edmonton
- Edmonton Regional Wastewater Treatment Plant, Alberta Environment
- Red Deer River Water Supply low lift station and river intake, Stettler, Alberta.
- Dickson Dam Service Spillway, Alberta Environment
- Gold Bar Wastewater Treatment Plant, City of Edmonton
- Pumphouses, lift stations and treatment plants for various municipal projects in Alberta, Yukon and Northwest Territories.

Transportation Projects

- 111 Street/Blackmud Creek Bridge - City of Edmonton
- Blindman River Bridge, Alberta Transportation and Utilities
- Tuchitua River Bridge, Yukon Community and Transportation Services
- Yukon River Bridge at Dawson City, Conceptual Design Study, Yukon Department of Community and Transportation Services

- Peace River Pulp Mill Railway Overpasses, Alberta Transportation and Utilities
- Oldman River Bridge, site access bridge for Alberta Environment near Pincher Creek, Alberta
- Six conveyor overpasses, highway overpasses, conveyor causeway across Mildred Lake, Syncrude Canada Ltd.
- Hoole River Bridge, Yukon Department of Community and Transportation Services
- Whitemud Drive Retaining Walls and Noise Barrier Walls and 167 Street Pedestrian Overpass, City of Edmonton
- Preliminary Engineering Report, North Tunnel South Light Rail Transit Phase II, City of Edmonton
- Athabasca River Bridge near Hinton, Alberta, Union Oil Company of Canada Ltd.
- Macleod Trail Grade Separation, South Corridor Light Rail Transit Project, City of Calgary

Other Projects

- CFB Cold Lake, Upgrade Electrical Distribution System
- CFB Cold Lake, Fire Hall addition
- Abattoir for Northwest Territories, Hay River
- City of Fort Saskatchewan, Public Works Shop Facility
- City of Spruce Grove, RCMP Building Renovations
- Asset Condition Reporting Study, Yukon Region, Public Works Canada
- Diversion Chamber Mill Woods drainage Improvements, Meyokumin area Storm Water Management Lake, City of Edmonton
- Glu-lam Beam Study and design of repairs, Kehewin School, Indian and Northern Affairs, Public Works Canada
- Little Strawberry Creek Spillway for Ashland Oil, Warburg, Alberta
- Rainbow Lake spillway and reservoir modifications for Mobil Oil

1976 - 1977 - Alberta Transportation, Bridge Branch, - Bridge Design Engineer, responsible for the design of steel and concrete bridge structures, including:

- Red Deer River Bridge at Joffre
- Carrot Creek Bridge near Carrot Creek
- Design check on Star Mine suspension bridge at Aerial
- Preliminary design of two railway overpass structures on Highway 16A east of Edmonton

1973 - 1976 - Bolter Parish Trimble Ltd., Design & Resident Engineer. He participated in a variety of projects in structural design and hydraulic design as well as construction inspection. Assignments included:

- Design of a cantilevered pile retaining structure for highway stabilization near Fort McMurray
- Geometric and structural design of a reinforced concrete tunnel structure for the 66 Street Light Rail Transit Project for the City of Edmonton
- Preliminary design of railway underpasses at 112 Avenue and 82 Street, in conjunction with the North East Light Rail Transit Line, Edmonton
- Design of a temporary bridge and retaining structure for a report on construction techniques for rail bridges constructed under traffic, Edmonton
- Resident engineer during construction of the 118 Avenue - CN Rail underpass and rapid transit station near the Northlands Coliseum
- Hydraulic design of many large culverts and bridges at stream crossings of the proposed Mackenzie Highway
- Hydraulic design of an inverted syphon and related drop structures at Mountain View Aetna main canal, Cardston

EDUCATION

B.Sc., Civil Engineering (with distinction), University of Alberta, 1973

AFFILIATIONS

Member, Association of Professional Engineers, Geologists and Geophysicists of Alberta
Member, Association of Professional Engineers and Geoscientists of British Columbia
Member, American Concrete Institute, Project Management Institute and American Society for Quality Control
Member, Association of Professional Engineers, Geologists and Geophysicists of Northwest Territories
Member, Association of Professional Engineers of the Yukon Territory

TECHNICAL PUBLICATIONS

"Thermal Analysis of Forced Air and Thermosyphon Cooling Systems for the Inuvik Forward Operating Location" - co-author with L.B. Smith, J.P. Graham and J.F. Nixon, March 1990

"Design of the Oldman River Dam Spillway" - co-author with C.P.S. Simonsen and M.M. Davachi, Proceedings of the Canadian National Committee on Large Dams (CANCOLD) Waterton Lake, Alberta, September, 1989

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T. WINGROVE, P.ENG.

Tom Wingrove, P.Eng., is Regional Manager for Manitoba and Saskatchewan of UMA's Environmental Division. He is responsible for the management and technical direction of projects related to environmental assessments, contaminant investigations, solid and hazardous waste management, engineering geology and hydrogeology. He has participated in environmental audits and remediation studies for solvent and hydrocarbon contamination and the site assessment and environmental monitoring for a hazardous waste management treatment facility. Currently he serves as a technical reviewer on the environmental cleanup of ten former Dew line sites. Relevant projects include:

EXPERIENCE

- Evaluation of candidate sites for a hazardous waste disposal facility. Studies included conductivity geophysical surveys to determine overburden thickness, drilling and piezometer installation program to establish water chemistry, measurement of formation permeabilities and vertical groundwater gradients, and assessment of air quality, agricultural soil capability, hydrogeology and hydrology as a measure of site suitability based on set criteria.
- Development and implementation of a multi-media environmental baseline study for a new hazardous waste management facility. The project addresses air, surface water, groundwater, snow, cereal and root crops, native grasses and biota, as part of a comprehensive predevelopment audit of environmental conditions. The program addresses sampling locations, sampling frequency, analytical parameters and quality assurance/quality control procedures.
- Managed the investigation and remediation of soil and groundwater contamination around an industrial facility. The use of chlorinated solvents as cleaners has resulted in contaminated groundwater plumes extending several kilometres east and south of the plant. The extensive investigations determined the magnitude and horizontal/vertical extent of contamination and the major source areas beneath the property. Remediation strategies are now being developed.
- Development of a remediation plan for the disposition of PCB contaminated soils at an agricultural processing plant. Work included problem definition and the consideration of clean-up levels and technologies. Through discussion with the owner and the Environmental Regulatory Agency, a clean up level was established and a decision made to store the contaminated soil on the property in a lined containment cell.
- Remediation of diesel contaminated soil at an abandoned generating station. Work included a detailed drilling and sampling program to define the extent of contamination; evaluation of alternative clean up strategies and recommendations on the most appropriate approach to site clean-up.

- Tailings management studies at Fox Mine, MacLellan Mine and Ruttan Mine in northern Manitoba. At Fox Mine, an abandonment plan and effluent management system was developed as part of an abandonment plan for mine closure. Studies involved hydrological assessments, groundwater investigations, treatment plans and dyke upgrading. The MacLellan project involved development of a tailings management system for new gold mine at Lynn Lake. The major components of the environmental impact assessment included establishing existing conditions, developing a conceptual waste management system utilizing an existing open pit and abandoned underground workings, and developing an impact assessment. The environmental assessment was defended through a Clean Environment Commission review with successful award of a CEC operating order.
- Hydrogeologic characterization and preliminary design of a major landfill expansion in Winnipeg. Studies included establishment of site stratigraphy, formation permeabilities, groundwater flow systems and baseline geochemistry. The preliminary design addressed geometry, environmental protection, site servicing, access, facilities design and a review of landfill operational procedures.
- Development of a comprehensive environmental monitoring plan for the Brady Road Landfill that addresses groundwater quality, surface water quality, leachate, landfill gas and hydrometric parameters. The report included a location plan and schedule for instrumentation installations, analytical parameters and sampling frequency and recommendations on the reporting of information.

EDUCATION

B.Sc. in Geological Engineering, 1973
Post Graduate Short Courses in Air Photo Interpretation, Groundwater Development, Contaminant Hydrogeology and IBM PC Applications in Groundwater Pollution and Hydrology

AFFILIATIONS

Member, Solid Waste Association of North America
Member, Association of Professional Engineers
Member, Canadian Geotechnical Society
Member, National Groundwater Association