Penetrating the U.S. Environmental Market: Prospects and Strategies for Canadian Consulting Engineers

U.S. Eastern Seaboard Focus

ASSOCIATION OF CONSULTING ENGINEERS OF CANADA
ASSOCIATION DES INGÉNIEURS-CONSEILS DU CANADA

External Affairs and International Trade Canada
Affaires extérieures et Commerce extérieur Canada

February 1992

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A Final Report for External Affairs and International Trade Canada

ASSOCIATION OF CONSULTING ENGINEERS OF CANADA
ASSOCIATION DES INGÉNIEURS-CONSEILS DU CANADA

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EVALUATION QUESTIONNAIRE

Please complete and return the following evaluation questionnaire. Your comments will assist us in planning future initiatives to promote consulting services. Please indicate your response by circling a number or elaborating in words where appropriate.

1. Please tell us a little about your company.

   _____

   _____

2. How did you find out about this study?

   _____

   _____

3. How would you rate this study as a guide to assist consulting engineering firms in their efforts to penetrate the eastern seaboard U.S. market? Please circle one only.

Unsatisfactory		Average		Excellent	No Opinion
1	2	3	4	5	0

4. If your answer to question #6 was less than 5, please comment on how you think this study could be improved.

   _____

   _____

5. If your answer to question #6 was greater than 3, please tell us which part(s) of the study was/were of particular interest to you.

   _____

   _____

6. Any other comments? _____

   _____

   _____

Thank you for your comments!

QUESTIONNAIRE D'ÉVALUATION

Veuillez remplir et retourner le questionnaire d'évaluation suivant. Vos commentaires nous aideront à planifier des initiatives pour promouvoir les services d'experts-conseils. Indiquez votre réponse en encerclant un chiffre ou par un court texte.

1. Parlez-nous un peu de votre entreprise.

_____

_____

2. Comment avez-vous entendu parler de cette étude?

_____

_____

3. Dans quelle mesure trouvez-vous que cette étude aide les entreprises de génie-conseil à pénétrer le marché de la côte est américaine? N'encerclez qu'une seule réponse.

Insatisfaisant		Moyen		Excellent	Sans opinion
1	2	3	4	5	0

4. Si votre réponse à la question 6 est inférieure à 5, dites-nous comment il serait possible à votre avis d'améliorer cette étude.

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_____

5. Si votre réponse à la question 6 est supérieure à 3, dites-nous quelle(s) partie(s) de l'étude a (ont) été d'un intérêt particulier?

_____

_____

6. D'autres observations? _____

_____

_____

Merci!

Executive Summary

Penetrating the U.S. Environmental Market: Prospects and Strategies for Canadian Consulting Engineers

U.S. Eastern Seaboard Focus

Executive Summary

The professional service industries play a very important role in the Canadian economy. Within the professional services area, the Canadian consulting engineering sector is highly competitive both in domestic and international markets. As well, the environmental service market is sizeable and enjoying rapid growth in Canada and the United States. Furthermore, Canada's international image in the environmental and engineering sectors is positive, although arguably under-promoted.

Our discussions suggest that Canadian engineering firms benefit from U.S. market activity in a number of ways, including:

- a market diversification which reduces dependence on a single marketplace;
- an exposure to new technologies, new financing concepts and evolving trends;
- a first-hand knowledge of the strategies of potential future competition;
- an enhanced access to more ideas and broader skills;
- an increased level of revenues and profit;
- an extended life for the firm's service concepts;
- a better utilization of company personnel, facilities and overheads.

Background to the Study

For these and other reasons, the federal government and the Canadian industrial community have placed an emphasis upon fostering the growth of Canadian capabilities in the U.S. environmental engineering market.

This study is one result of this emphasis. The study has been commissioned by External Affairs and International Trade Canada and conducted by Ernst & Young Management Consultants[1] with the guidance of the Association of Consulting Engineers of Canada and Industry, Science and Technology Canada.

[1] Additional information may be obtained from Tony Going and/or Paul Stothart in the Ottawa office of Ernst & Young at (613) 232-1511.

The study's main report comprises four chapters and six appendices. The chapters discuss respectively the study background, the market size and trends, the criteria for market entry, and the methods of identifying specific opportunities. The appendices describe the available government assistance, trade shows, documents, universities, U.S. engineering firms and other sources of information that should be of interest to Canadian engineers and environmentalists wishing to penetrate the U.S. market.

The study focuses upon the Eastern United States market, although much of the information and observations are applicable to the entire U.S. market. Similarly, the study concentrates on private sector opportunities, although some information is also provided pertaining to public sector markets. The findings and information contained in the report are based upon a review of existing documents, as well as over 100 interviews with manufacturers, utilities, engineers, governments, and other organizations in Canada and the United States.

American Market Potential

While the Canadian market represents a sizeable base of activity for Canadian environmental engineering firms, it is quite small in comparison to the market to our immediate South. The American environmental market potential is of staggering proportion in its size, its diversity, and its growth rates. The United States market totals some $130 billion in 1991 spending, encompassing about $33 billion in air-related spending, $52 billion in water and wastewater spending, and $45 billion in solid and hazardous waste management. Around 60 percent of the market involves private sector spending, while 40 percent involves spending at the federal, state, and municipal government level.

The market is growing at a rapid pace - most indications suggest a market growth of around 20 percent annually. By the Year 2000, some 3 percent of the U.S. GDP will be spent on environmental matters, compared to a current level of around 1.8 percent.

Existing studies and projections indicate the rapid growth of various industry sectors, many of which have substantial process engineering service elements associated with them. The following statistics provide an indication of the magnitude of potential market opportunities:

- Recycling markets are projected to grow at 13 percent in the United States through 1994. Recycling will account for 43 percent of plastic waste disposal in 2002 versus one percent in the late-1980s.
- The U.S. government expects $60 billion to be spent by 2000 in order to meet the requirements of the Clean Water Act amendments of 1987.

- The Clean Air Act revisions of November 1990 are expected to generate $25-35 billion in annual spending as organizations attempt to meet its requirements.
- The annual water supply budget in the U.S. amounts to some $150 billion. Some sources estimate American water supply infrastructure investment needs of $139 billion by the year 2000 and wastewater treatment infrastructure needs of $508 billion.

While there are a number of studies available, and a range of market statistics and growth projections, we have conveyed a view in the report that such studies have only limited usefulness. Our overall view of the market is that it is large, growing at approximately 10-20 percent annually, and likely to exhibit strong growth well into the future.

The key element for Canadian engineering firms is to ride their own niche areas of expertise into the U.S. market using the broadest possible network of contacts, information, and alliances.

American Market Trends and Characteristics

The U.S. environmental engineering market exhibits a wide range of general trends and characteristics. Some of the most important are summarized below.

- As in Canada, legislation is the driving force behind the market. Companies tend to meet, though not exceed, the environmental requirements placed upon them. Spending on environmental areas, particularly those with little immediate financial benefit, tends to be done grudgingly. Packaging an offer/proposal in terms of payback period is thus a useful technique for environmental engineering firms.

- The market is volatile and it is consequently quite difficult to predict market size and targets. The legislators and enforcement agencies generally establish ambitious targets that tend to slip as the target dates approach.

- The State governments are the prime enforcement agencies. It has been suggested that environmental enforcement by state governments tends to lag during tough economic periods and that even in periods of economic growth, enforcement is constrained by the large number of emitting sources and the limited resources of the responsible enforcement agencies.

- As in Canada, individual state governments are responsible for engineering licensing. Generally, in order to conduct U.S. work, Canadian engineers must either pass a two-step accreditation process or enter arrangements with local firms to handle the "stamping" of all work in the given state.

- There is a more active legal involvement in the U.S. environmental sector than in the Canadian community. Among other factors, this stems from the greater profile of liability questions in the U.S., as well as from the number of government policies which emphasize private-sector solutions to problems. The high legal involvement is perhaps best illustrated by the Superfund, where we are aware of one (unsubstantiated) estimate that 55 percent of all Superfund spending since its inception in 1980 has been directed toward legal fees.

- Regarding the above point, there is a growing effort being made toward addressing liability and insurance concerns. For instance, the government is including liability limitations in recent legislative changes and legal disputes are increasingly being settled through mediation and other out-of-court means. More attractively priced insurance is again becoming available.

- Academic institutions are also actively involved in the U.S. community. Substantial numbers of Environmental Protection Agency (EPA) and Department of Defence (DOD) contracts are channelled through universities. University interaction with business is common.

- While the U.S. environmental market demand arguably exceeds its supply capabilities, competition is nonetheless intense in many environmental areas. The American engineering and environmental community encompasses hundreds of qualified firms.

- There is a high degree of government-industry interaction in the U.S. environmental community. This interaction is mainly in two areas. First, U.S. legislators and policies place a very high reliance upon industry suggestions, technologies and initiatives. Second, there is a trend toward the privatization of infrastructure-related developments, as city and county governments attempt to find funding for sewage treatment, water treatment and other projects.

- There is a trend in the U.S. toward process improvements, rather than end-of-line treatments, as a means of solving environmental problems. This trend places a greater emphasis upon environmental engineering as a key solution.

- Many American defence contractors are making substantial shifts into the environmental area. According to varying sources, it is unlikely that the so-called "peace dividend" will actually be transferred from DOD to other environmental departments. A more likely scenario is that DOD will become actively involved in environmental clean-ups.

Areas of Canadian Expertise

Canada's infrastructure-related development, resource base, and geographic diversity has required the nation to build a wealth of expertise in various engineering areas. There are a total of around 4000 engineering firms in Canada, some sixteen of which employ more than 500 people. Total annual international billings of Canadian engineering firms are approximately $450 million. A number of Canadian firms already rank among the largest foreign engineering firms in the United States.

A further eighty Canadian engineering firms employ between 100-500 people and it is largely this group (and smaller firms) that may benefit most from this report.

Canada has expertise to offer the U.S. Eastern Seaboard market in a number of environmental engineering consulting areas. Some of these include the following:

Hazardous Waste

- Hazardous waste management strategies, including technologies addressing the remediation of leaky underground storage tanks, the destruction of PCBs, and the handling of low level radioactive waste.
- Mine tailing rehabilitation and the rehabilitation of coal mining sites.
- Medical waste management services.
- Novel approaches to site remediation.
- Destruction of high strength, complex bioresistant chemical wastes.

Solid Waste

- Sludge management, including energy recovery from high-strength organic waste and oil production from sludge.
- The management of landfill sites (leachate management), including the control and management of migrating and emitted gases.

Water and Wastewater

- Aquifer remediation technologies.
- Photo-oxidation of complex compounds in contaminated aquifers.
- Sewers and sewage-related expertise, including the removal of biological and chemical nutrients from wastewater, the dynamic modelling of wastewater treatment plants and controlling of sewage flows and combined sewer overflows, and the application of expert systems to trouble-shoot at wastewater facilities.

- Water and wastewater disinfection technology using UV.

Air Pollution

- Air pollution monitoring devices and services, including acid rain and sulphuric emission management and the analysis and improvement of "sick buildings".

Recovery and Recycling

- Services oriented toward the recovery, recycling, and re-use of various products (solvents, oils, metals, etc) and recovery and recycling technologies involving membrane systems.
- The approval process in all environmental areas, including impact assessment and risk assessment.

Entry Barriers and Strategies

Exports of engineering services to the U.S, as is the case in most service industries, generally require the establishment of an actual physical presence through a local office or joint venture of some type. This stems from a couple of realities, including the requirement to provide on-site service to successfully complete the job, the necessity of having local contacts and connections to win business, the need to have adequate insurance and a familiarity with the local regulations, and the fact that certain jobs (particularly government procurement projects) may quite simply require local content in order to qualify.

Canadian engineering firms have already entered the U.S. market through this strategy. One example, Gore & Storrie, has recently signed an agreement with an American firm to conduct water-related projects in the United States. The two firms jointly own a new firm that benefits from Gore & Storrie's environmental engineering expertise and from the U.S. partner's 24 nationwide offices. A second example, Acres International, has several American offices that are active in waste management and other environmental work. To obtain the necessary certificates for structural designs, Acres uses its American personnel certified in the appropriate states to affix the necessary seal. To access Superfund projects, Acres has established affiliations with laboratories that are certified by the Environmental Protection Agency. A final example, W.F. Baird and Associates, a small marine and coastal engineering firm, has conducted a number of environmental projects, initially through aligning with a local partner and subsequently through opening a local office.

The accreditation process for professional engineers in the United States is handled by individual states and generally involves a two-step approach. First, an "EIT" exam is written shortly after graduation and covers a range of engineering disciplines. Approximately three years later an engineering "business practices" exam is written. The latter generally does not pose problems for Canadians, although the former does present problems for those Canadian engineers who are several years past graduation. There are centres in Canada where the EIT exam can be written - Canadian firms entering the U.S. market are increasingly having their recent engineering graduates write these exams.

In former years, Canadian professional service firms have often experienced considerable border delays in entering the United States. Among other service industry benefits, the Free Trade Agreement (FTA) aims to reduce border annoyances and delays for professionals entering the United States for business purposes.

Recommendations

The research and interviews conducted during this study have provided an indication of the kinds of strategies that Canadian environmental engineering firms could use to successfully enter the U.S. market. Many of these are consistent with those noted in Ernst & Young's recent study of the U.S. construction market.[2]

It should, however, be made clear that there is no one strategy that will suit all firms. The particular strategy that a firm ultimately chooses to follow should be based on a number of factors including the firm's experience and knowledge of the U.S. market, the resources (both financial and personnel) at the firm's disposal for market expansion into the U.S., and the objectives that the firm wishes to achieve in selling its services to the United States market.

In the text of the report, we have suggested a number of documents that could assist Canadian firms in quantifying the market size, identifying specific companies of interest, detailing trends, and researching other matters. Conducting such "homework" will allow Canadian firms to either develop projects themselves or bring added "clout" to any local partnership they may have entered.

The following documents might be particularly useful for those firms, governments and associations that are seriously interested in the U.S. environmental engineering market. The names and numbers where such documents can be obtained are presented in the main report.

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[2] *Penetrating the United States Construction Market*, January 1990.

- Manufacturing USA - $US 169
- ACEC Annual Directory - $US 140
- Environmental Engineer Selection Guide - free
- The Cost of a Clean Environment - $US 50
- Resource Guide to State Environmental Management - $US 40
- Encyclopedia of Associations - $US 305

Once the appropriate market research has been conducted, there are a number of activities that all firms should consider in formulating a strategy for entering the U.S. market. Some of these are practical, common business sense suggestions that we have found are sometimes overlooked when firms approach a foreign market. Other suggestions are related to the particular nature of service industries and specifically the environmental engineering consulting industry.

The following recommendations should, therefore, be considered when Canadian environmental engineering firms are preparing their entry strategies. Most are addressed to Canadian engineering firms, although some recommendations to governments and other organizations are also included.

1) Buying a company or "buying" some local people may be the preferred and most profitable route to market entry. Local contacts, reputation, and knowledge are very important in capturing environmental business in any U.S. region. Teaming with local partners serves a number of purposes, including reducing risk, increasing the chances of winning, lowering marketing and bid costs, and increasing the number of opportunities to pursue.

2) In establishing their U.S. operations, Canadian firms should extend maximum autonomy to the U.S. operation, in effect facilitating the growing of American roots. Our discussions suggest that the Canadian benefit is derived from management fees, profit sharing, employee sharing, and technical advances, rather than through exerting tight managerial control from a Canadian base.

3) Successful penetration of the American market begins at home. Canadian firms should pursue opportunities within their own fields of expertise and not be unwittingly led into unfamiliar areas. In essence, Canadian firms should "ride" their own expertise and contacts into the identified U.S. market niches. Straying outside of "core competences" may place firms on unfamiliar and risky terrain. In this respect, one source stated that "a confused client doesn't buy", the suggestion being that firms should not confuse their potential clients by venturing into areas with which they are not familiar.

4) It is important that Canadian firms establish a market plan prior to investing resources in their U.S. marketing effort. The plan should articulate the objectives, strategies, financial resources, and managerial and technical complement that will be directed toward the U.S. effort. The

importance of this formal requirement should not be minimized by Canadian engineering firms. For instance, studies conducted by the Canadian Exporters' Association have indicated that firms with previously defined market plans enjoy greater long-term success in their export marketing efforts. Firms without such plans tend to discontinue their efforts.

5) Canadian engineers should be aware that U.S. firms will probably expect Canadian market assistance as a quid pro quo to any mutual U.S. market success. Canadian engineering firms should also be fairly aggressive in their dealings with U.S. partners, ensuring that U.S. market benefits are maximized and that they have appropriate portions of the potential benefits without assuming disproportionate shares of the potential liability.

6) Canadian firms should maintain close relations with (and follow into the market) those Canadian industrial and real estate firms which are increasing their American investments. Through this strategy, Canadian environmental engineering firms may benefit from Canadian direct investment in the United States, just as American engineers and other service firms have so benefitted over the years from the substantial U.S. direct investment in Canada.

7) Firms should visit the region(s) of interest in order to "get a first-hand feel" for the area into which they are considering entry. Visiting local companies, local governments, associations, Canadian consulate officials, and other organizations will provide a wealth of information for potential market entrants.

8) Maintaining tight control on overheads is considered essential in the U.S. service industries. Some sources suggest that competition is tighter in the U.S. market, although potentially higher profits accrue to qualified firms.

9) A commitment to a region and market niche is required to successfully enter the U.S. environmental market. Some have suggested that "brawn beats brains" in the early stages of market penetration, implying that substantial work is required in identifying and following up on contacts and opportunities. As well, a trend toward increased service/quality emphasis in the U.S. market suggests that "client follow-up" upon completion of a project is important, both to determine levels of client satisfaction and to stay abreast of future work opportunities. Toll-free telephone numbers might also be considered by Canadian firms as another means of providing service and quick access to their client base.

10) Over time, most Canadian engineering firms develop a surprisingly broad range of American contacts. Some of these may be direct contacts, while others may be indirect contacts, through existing clients and other channels. In our view, each contact represents one step closer to a

potential contract. Governments, associations, municipalities, management consultants, multi-national companies, competitors, construction firms, architects, previous clients, and developers are among those contacts who may have U.S. contacts or clients who could benefit from Canadian environmental engineering consulting expertise. Each Canadian firm must exploit and expand its own network.

11) There is a growing appreciation in some circles for the linkage that exists between legislative enforcement, environmental investment and increased economic competitiveness. While such a linkage may be true in the long-term, our U.S. industry conversations suggest that environmental dollars are still spent somewhat grudgingly. Short-term earnings and shareholder pressures are widespread in the United States. As such, Canadian engineers should be able to package their approach to U.S. clients in terms of payback period, economic spin-offs, long-term benefits, and other such terms. Canadian engineering firms who can present a strong cost/benefit rationale for their proposal will enjoy long-term success. Sources cited examples such as lower sewer surcharges, enhanced feedstock recovery, increased process water recycling, reduced heat loss, etc.

12) Trade missions and shows are an important part of successful export market penetration. In this regard, it is vital that Canadian firms be fully prepared for such activities, with relevant company and product information in hand. One-on-one appointments (at the trade shows) with potential partners are also vital to success, as is constant on-the-feet contact with other interested parties.

13) In this report, we have emphasized the importance of Canadian industry drawing upon its network of contacts and support. We view the Association of Consulting Engineers of Canada, ISTC and EAITC as playing valuable roles in this market penetration effort. Such a role encompasses, among other activities, the promotion and distribution of this report, the acquisition of the key documents identified, the organization of and participation in relevant missions and trade shows, and the facilitating of relations with U.S. counterparts. The latter point might include aiding in negotiating mutual accreditation agreements such as that which exists between New Brunswick and Maine.

Section One: Introduction

Section One: Introduction

1.1 Rationale for this Study

The professional service industries play a very important role in the Canadian economy. Within this general area, the Canadian consulting engineering sector is highly competitive in domestic and international markets. As well, the environmental service market is sizeable and enjoying rapid growth in Canada and the United States. Canada's international image in the environmental and engineering sectors is positive, although arguably under-promoted. For these and other reasons, the federal government and the Canadian industrial community have placed an emphasis upon fostering the growth of Canadian capabilities in the U.S. environmental engineering market. This study is one result of this emphasis.

These and other areas are expanded upon below.

Market Potential

At the most basic level, this study has been initiated because international environmental opportunities are rapidly growing and represent potentially lucrative areas of business for Canadian suppliers of products and services. Many nations have recognized the reality that the environment will be a major source of industrial opportunities for many years. In the case of the United States, the data for the environmental market size and growth vary, although in all instances these data and projections are substantial.[1] As well, future environmental market opportunities in Mexico, South America and other regions may be more attainable for Canadian firms with U.S. market exposure and/or with U.S. alliances.

The link which many argue exists between environmental standards and international competitiveness is another rationale for this study. The view that tough standards and enforcement will in the long-term generate more internationally competitive companies suggests that nations should encourage the development of strong, active environmental industries and requirements. Within the current Canadian competitiveness debate, this is a rationale which holds increasing appeal.

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[1] A number of aspects of this study are also relevant to other engineering sectors. The overall U.S. engineering market is enormous, totalling some $US 45 billion annually, of which foreign firms account for about 5 percent.

Benefits of Foreign Work

In addition, while penetrating a new service market such as the United States may not bring economies of scale in a traditional manufacturing sense, market expansion does bring geographic diversification and a resulting decrease in the fluctuation of business levels.

Diversified markets also increases a service firm's exposure to new technologies, new financing concepts, and evolving trends. In the case of the American market, for instance, trends and technologies often precede those in Canada. The legislation and trends prevalent in California, New Jersey, and New England and in the Environmental Protection Agency are often a precursor of future Canadian directions. Thus having a presence in the U.S. market may also provide a competitive advantage for Canadian firms in the domestic market.

As well, exports of engineering services are often doubly beneficial to Canada as the procurement role of the winning engineering firms can lead to associated exports of manufactured goods.

Free Trade Agreement

The three-year old Canada-U.S. Free Trade Agreement (FTA) also represents part of the rationale for this study. In former years, Canadian professional service firms have often experienced considerable border delays in entering the United States. Among other service industry benefits, the FTA aims to reduce border annoyances and delays for professionals entering the United States for business purposes.

In addition to reduced border delays, the FTA stipulates that Canadian firms will be treated in the same way as American suppliers in the U.S. with regard to all future laws. Tariffs on engineering drawings have been removed by the United States. Future negotiations in the government procurement area may also lead to a reduction of government's ability to discriminate based on nationality.[2]

Canadian Capabilities and Image

Sizeable markets and growth potential are, in themselves, insufficient to merit a market study. What is also required is a base of domestic expertise that can identify and sell into niche markets. Canada's infrastructure-related development, resource base, and geographic diversity has required the nation to build a wealth of expertise in various engineering areas.

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[2] External Affairs and International Trade Canada has information which describes the relevant provisions of the FTA in further detail.

There are a total of approximately 4000 engineering firms in Canada, some sixteen of which employ more than 500 people. Total annual international billings of Canadian engineering firms are approximately $450 million. A number of Canadian firms already rank among the largest foreign engineering firms in the United States. A further eighty Canadian engineering firms employ between 100-500 people and it is largely this group (and smaller firms) that may benefit most from this report.

Canada has expertise to offer the U.S. Eastern Seaboard market in a number of environmental engineering areas. Some of these include the following:

Hazardous Waste

- Hazardous waste management strategies, including technologies addressing the remediation of leaky underground storage tanks, the destruction of PCBs, and the handling of low level radioactive waste.
- Mine tailing rehabilitation and the rehabilitation of coal mining sites.
- Medical waste management services.
- Novel approaches to site remediation.
- Destruction of high strength, complex bioresistant chemical wastes.

Solid Waste

- Sludge management, including energy recovery from high-strength organic waste and oil production from sludge.
- The management of landfill sites (leachate management), including the control and management of migrating and emitted gases.

Water and Wastewater

- Aquifer remediation technologies.
- Photo-oxidation of complex compounds in contaminated aquifers.
- Sewers and sewage-related expertise, including the removal of biological and chemical nutrients from wastewater, the dynamic modelling of wastewater treatment plants and controlling of sewage flows and combined sewer overflows, and the application of expert systems to trouble-shoot at wastewater facilities.
- Water and wastewater disinfection technology using UV.

Air Pollution

- Air pollution monitoring devices and services, including acid rain and sulphuric emission management and the analysis and improvement of "sick buildings".

Recovery and Recycling

- Services oriented toward the recovery, recycling, and re-use of various products (solvents, oils, metals, etc) and recovery and recycling technologies involving membrane systems.
- The approval process in all environmental areas, including impact assessment and risk assessment.

Our discussions with U.S. manufacturers indicate that they have minimal knowledge of Canadian environmental or engineering capabilities, although they do hold an overall perception of Canada as a clean, advanced, friendly and progressive country. Such a positive impression is one that Canadian firms can build upon in further exploring U.S. opportunities.

The resource, power, and infrastructure-related expertise which Canada has developed over time has helped the engineering consulting industry to become one of the country's most internationally competitive industries. However, Canadian activities in the U.S. market have been fairly limited, with developing-world markets and projects financed by the Canadian International Development Agency often being the preferred route. This reality, and the desire to encourage Canadian environmental engineers to become more active in the U.S. market, is another rationale for conducting this study.[3]

1.2 Study Objectives

1.2.1 General Objectives

For the above reasons, External Affairs and International Trade Canada (EAITC) has chosen to fund an examination of "prospects and strategies in the Eastern U.S. market for the Canadian environmental consulting engineering sector". The project has been conducted in close consultation with the Association of Consulting Engineers of Canada (ACEC) and with Industry, Science and Technology Canada (ISTC).

[3] Continuing further south to assist Mexico in addressing some of its massive environmental problems may also form part of the rationale. For further information on market opportunities in Mexico, Canadian firms should contact the Mexico Trade Division of External Affairs (EAITC) at (613) 996-8625.

The document is to serve primarily as a guide to Canadian firms who are less experienced in the U.S. market, as opposed to larger firms who may already be highly active in the market. Small and medium sized Canadian engineering firms should thus find the report particularly useful. There is felt to be substantial U.S. market potential for these firms.

The above reasons may apply to a range of industry sectors in the United States. In our view, some aspects of this report might be of interest to various engineering disciplines, as well as to academics, environmental equipment producers, construction firms, and others. As well, the "Eastern U.S." focus of the study is not particularly limiting, as the study contains information on the entire market and many of the recommendations and trends are applicable across the country.

The management consulting firm of Ernst & Young[4] was selected to conduct the assignment. Ernst & Young benefitted from the guidance of an advisory committee representing EAITC, Industry, Science and Technology Canada (ISTC), and the Association of Consulting Engineers of Canada.

1.2.2 Specific Objectives

To fulfill the rationale described above, it is necessary that the study address a number of subjects. These include the following areas:

- market size and trends in the region;
- costs of doing business;
- relevant licensing requirements;
- major hindrances, inconveniences, and legislated barriers facing potential entrants;
- relevant legislation;
- strategies of other Canadian entrants into the American market;
- options regarding acquisition or joint venturing as a means of entering the market; and
- local trade shows, trade journals, seminars, associations, companies and government information sources.

The study's focus is on the Eastern Seaboard states with an emphasis on private sector projects, and a lesser emphasis on public sector projects.[5] This focus stems from a view that private sector opportunities are substantial, are likely to expand rapidly, and have fewer "strings" attached than publicly-funded projects.

[4] The team of Paul Stothart, Tony Going, Rhoda Caldwell, and Nathalie Sabourin conducted the assignment.

[5] Canadian engineering consulting billings in the United States are estimated at $90 million per annum. The export work in the U.S. has traditionally been derived 80% from private sector clients and 20% from public sector clients, a division which coincides nicely with the study's emphasis on private sector opportunities.

1.3 Organization of the Report

This report is organized into four chapters. In order to keep the report as concise and readable as possible, we have presented a considerable amount of information in the Appendices. Firms can access this information to the extent that it is useful to them.

Each of the four chapters of the report should be read by Canadian engineering firms considering entry into the American market.

The first chapter provides an introduction to this study. The second chapter provides the reader with information on the U.S. environmental market. While a number of statistics are included, we have attempted to minimize the statistical content of the section. In our view, the importance of the statistics and growth projections rests simply in observing that the particular market niche of interest to Canadian firms will likely be an expanding one for at least the next decade. Specific numbers and studies are transient - they reflect only a snapshot of the situation at a given point in time. We thus have attempted to stress in the text that Canadian firms examine seriously their own area(s) of expertise and *ride* this expertise, experience and contact base into the United States market. Also included in the second chapter is information pertaining to environmental trends, major legislation, and regional characteristics.

The third chapter requires Canadian firms to diagnose their degree of readiness to enter the American market. In the chapter, we have attempted to raise those questions that Canadian firms should be able to respond to prior to entering the highly competitive market to our South.

The fourth chapter flows directly from the previous chapter, specifically in answering the question of how to obtain information on the U.S. market niche of interest. The section attempts to "walk" firms through the process of identifying specific opportunities and contacts in the American market. As is often the case in the 1990s, the problem facing Canadian firms in this regard is not a shortage of information. Rather, it is the contrary. In this section, we attempt to identify those information sources that are most relevant and that Canadian firms should access first. We also present some of the lessons that have been offered by Canadian firms already experienced in the American environmental engineering market. As well, the opinions of American manufacturers and other sources are presented in Section Four.

Section Two: The U.S. Market

Section Two: The U.S. Market

2.1 Summary of the Market

The United States is a collection of regional markets of significant wealth and population. For example, there are 41 metropolitan areas in the U.S. which have populations exceeding one million, compared to only three in Canada. Five of the nine geographic divisions in the United States have populations exceeding that of Canada as a whole, while the remaining four regions each exceed one-half of Canada's total population. Some thirty percent of the American population resides in the states which border Canada.

In the environmental area, the United States market totals some $130 billion in 1991 spending. As indicated, this market encompasses about $33 billion in air-related activities, $52 billion in the water and wastewater sector, and $45 billion in solid and hazardous waste management. The market is divided approximately 60 percent private sector spending and 40 percent public sector spending.

The market is growing at a rapid pace - most indications suggest a market growth of around 20 percent annually. It is projected that, by the Year 2000, approximately 3 percent of the U.S. GDP will be spent on environmental matters, compared to a current level of 1.8 percent.

The Air Pollution Control segment encompasses some 26 thousand industrial and utility facilities which each emit more than 100 annual tons of air pollutants annually. The recent amendments to the Clean Air Act are expected to generate $25-35 billion in annual spending as organizations attempt to adhere to its requirements. Main problem areas include air toxins, acid rain, greenhouse gases, incineration emissions, factory emissions, and clean coal development.

The Water and Wastewater Management involves a range of problem areas, including groundwater clean-up, water purification, industrial waste treatment, and oil/gas spill technology. The segment encompasses some 3800 cities (generally with population greater than 10,000) holding major water pollution permits and 3300 industrial utility plants with similar permits. In total, there are 15 thousand municipal sewage treatment facilities in the United States, with a further five thousand to be built over the next 20 years. The industrial wastewater market encompasses 300 thousand manufacturing plants, of which an estimated 30 percent are felt to be of sufficient size to interest engineering firms and other environmental suppliers.

The US Environmental Market (1991)

Polluted Media	*Amount ($US bil)*	*Share (%)*
Air	33	25
Wastewater	52	40
Solid, Toxic Waste	45	35
Total Market	*130*	*100*

Source: WA Lorenz

Sector	*Amount ($US bil)*	*Share (%)*
Industrial/Commercial Firms	78	60
Municipal Governments	29	22
Federal Government	19	15
State Governments	4	3
Total Market	*130*	*100*

Source: WA Lorenz

The Solid Waste Management segment accounts for $30 billion annually and addresses such problem areas as land use and abuse, industrial recycling, and solid waste combustion. The number of solid waste disposal sites in the U.S. is declining rapidly, from 20 thousand in the mid-1970s to a projected figure of 1800 in the Year 2010. As existing landfills become filled and as new sites have increased difficulty securing community approval, the need for waste reduction technologies is becoming critically important. Recycling, resource recovery, and waste-to-energy programs and technologies will be widespread, forced by rising disposal costs, by new regulations, and by local and global pressure. A recent Supreme Court ruling prohibiting inter-state barriers to solid waste trade means that shipping and trading of solid waste will also continue to increase.

The Hazardous Waste Management segment encompasses some 20 thousand municipal and utility facilities with each generating more than 55 gallons of hazardous waste monthly. The $15 billion market addressing such problems as site assessment, remediation and detection, and waste treatment through recycling, detoxification and stabilization. Chemical companies, primary metal producers, paper manufacturers, electrical equipment manufacturers, and transportation companies will be increasingly pressured in hazardous waste management areas.

As indicated, there are a number of individual market statistics and studies available describing different aspects of the U.S. environmental market. The conclusion which runs through many of the studies, not surprisingly, is that environmental markets are sizeable and rapidly growing.

While there are many such studies which have detailed the size and scope of the U.S. environmental market, we believe that they are of only limited value for Canadian firms for a number of reasons.

First, statistics and market projections change almost on a daily basis and become "dated" quite quickly. They are often based on estimates, forecasts and numerous assumptions and may change substantially based on changes to the assumptions.

Second, such studies presume that environmental enforcement by state governments will be predictable and comprehensive. This may not be a valid assumption, as enforcement authorities are often over-burdened with responsibilities, yet under-funded and under-staffed. State enforcement is also described as loosening somewhat during periods of economic slowdown. At the federal level of enforcement, some sources have stated that "the EPA has never once conformed to an original target", implying that ambitious targets and target slipping is part and parcel of the U.S. environmental scene.

Selected U.S. Environmental Market Studies and Statistics

- Recycling is projected to account for 43 percent of all plastic packaging waste disposal in 2002 versus 1988 levels of one percent.
- While approximately 96 percent of solid waste disposal was managed in landfills in 1988, this is expected to decrease to 36 percent in 2002.
- Recycling markets are expected to grow at 13 percent annually in the United States through 1994. Waste-to-energy markets are projected to grow at 11 percent annually in the U.S. through 1994.
- Hazardous waste cleanup in the U.S. could eventually total over $200 billion - only six of the EPA's 850 priority sites have been cleaned up as of 1988.
- The market for inorganic membranes for use in industry, biotechnology and other environmental areas, is projected to grow at 33 percent annually through 2000.
- In the category of "household appliances", air cleaners (12 percent) and trash compactors (8 percent) rank among the fastest growing segments.
- The annual U.S. demand for air pollution abatement equipment in 1992 is projected to be $25 million for mechanical collectors, $35 million for solvent recovery, $40 million for wet scrubbers, $160 million for flue gas desulfurization, $100 million for electrostatic precipitators, $135 million for oxidation systems, and $195 million for fabric filters.
- Municipal wastewater treatment capital expenditures in the United States will total around $2.8 billion in 1995, with three-times this amount being directed toward operations and maintenance. Engineering ($240 million), equipment ($370 million), instruments ($65 million), construction ($1.7 billion), and materials ($490 million) are the main capital expenditure components.
- Electric utilities ($1.2 billion) and industrial facilities ($4.5 billion) also project sizeable capital spending in 1995 for wastewater treatment.
- The U.S. government expects $60 billion to be spent by 2000 in order to meet the requirements of the Clean Water Act amendments of 1987.
- Wastewater facilities in the U.S. require $10 billion in annual work, while potable water treatment facilities require $4 billion annually.
- The American market for industrial air filters exceeds $500 million annually.
- The medical waste management market will increase from $1.5 billion in 1991 to $5 billion in 1994.
- The market for removal and cleanup of underground storage tanks will grow at 30 percent annually through 1995.
- The American water purification equipment and services market will approach $8 billion in 1990, while the water management chemical market will exceed $2 billion.
- The annual water supply expenditure budgets in the U.S. amount to $100-150 billion. The Associated General Contractors estimate American water supply infrastructure needs of $139 billion by the year 2000. Real spending on public sewer systems in the U.S. increases at about 3-4 percent annually and currently totals $13 billion. The Associated General Contractors estimates that $508 billion will be required by the year 2000 on American wastewater treatment infrastructure.
- Public spending in the U.S. for solid waste disposal amounts to $7 billion annually, versus $600 million in Canada.
- Expenditures on air pollution abatement from mobile sources (cars,trucks) totalled $20 billion in North America in 1985. A further $18 billion was spent on air pollution abatement from industrial, public and other stationary sources.

Source: a 1990 Ernst & Young literature search of environmental market studies

Third, such studies are quite costly and may encompass a number of activities that Canadian firms could best undertake on their own. Conducting these steps themselves will allow Canadian firms to acquire more of an on-the-ground sense of their U.S. market potential.

Thus, rather than becoming overly dependant on existing market statistics, Canadian firms would not be off-base in simply assuming that their niche markets are larger in the United States and will likely be growing for several years to come. A firm's marketing efforts should be directed toward making new contacts, developing existing contacts, conducting on-the-ground research, identifying partners and competitors, meeting potential clients, and honing current expertise.

2.2 Environmental Market by Region and Segment

2.2.1 The Eastern Seaboard Market

The Eastern Seaboard region, which is the geographic focus of this study, consists of 16 states and represents a population of around 90 million. Based on its share of the manufacturers' pollution abatement capital spending (25 percent of all US) and operating spending (30 percent of all US), it is likely not unreasonable to estimate that the region accounts for between one-quarter and one-third of the nation's environmental market. This then suggests an annual environmental market of about $40 billion for the region.

A substantial portion of this figure (perhaps 40 percent) is related to capital spending by governments on infrastructure areas such as sewers and water treatment. As discussed in Section One, these areas are not a priority of this study primarily because the United States has broad domestic capability and secondarily because there are often a range of barriers and commitments associated with them. The main priority of the study is on private sector opportunities. Through pursuing a range of contacts in niche private areas, we are of the view that Canadian firms can best exploit their own capabilities, experience and techniques. (Government opportunities are discussed in Section Four as well as in the appendices).

The table opposite presents a range of information on each state included in this study. The population, projected growth through the 1990s, manufacturing orientation, and environmental spending figures presented in the table may be of particular value to interested Canadian companies.

State Statistics - Population, Growth, Manufacturing Orientation, and Abatement Spending

	Population in Millions				Population Growth (%)			PCI	M/E	PACE	PAOC
	2000	*1991*	*1980*	*1950*	*'90-2000*	*'80-91*	*'50-91*	*1988*	*1988*	*1988*	*1988*
United States	268	250	227	151	7%	10%	66%	17055	17%	3423	**12630**
Connecticut	3.4	3.3	3.1	2	5%	6%	65%	22188	23%	25	149
Delaware	0.7	0.7	0.6	0.3	10%	17%	133%	17143	20%	13	160
Washington, D.C.	0.6	0.6	0.6	0.8	3%	0%	-25%	48333	5%	-	1
Florida	15.4	13.1	9.7	2.8	20%	35%	368%	14355	8%	64	278
Georgia	8	6.8	5.5	3.4	19%	24%	100%	16094	19%	81	255
Maine	1.3	1.2	1.1	0.9	5%	9%	33%	14167	18%	47	194
Maryland	5.3	4.8	4.2	2.3	12%	14%	109%	16739	10%	37	182
Massachusetts	6.1	5.9	5.7	4.7	4%	4%	26%	19661	19%	37	82
New Hampshire	1.3	1.2	0.9	0.5	17%	33%	140%	17273	18%	11	32
New Jersey	8.5	8	7.4	4.8	8%	8%	67%	20130	18%	85	473
New York	18	17.8	17.6	14.8	1%	1%	20%	20279	16%	102	501
North Carolina	7.5	6.8	5.9	4.1	12%	15%	66%	15538	26%	89	298
Pennsylvania	11.5	11.8	11.9	10.5	-3%	-1%	12%	15333	19%	119	705
Rhode Island	1	1	0.9	0.8	5%	11%	25%	15000	22%	13	50
South Carolina	3.9	3.6	3.1	2.1	10%	16%	71%	12857	23%	47	217
Virginia	6.9	6.2	5.3	3.3	12%	17%	88%	17333	14%	70	235

- Source: U.S. Department of Commerce, Bureau of the Census for population data. Current Industrial Reports for abatement spending data.
- The "PCI" column denotes the per-capita income of the state.
- The "M/E" column denotes the manufacturing orientation of the state - its portrays manufacturing employment over total employment
- The "PACE" column ($US million) refers to total pollution abatement capital expenditures by manufacturing establishments of > 20 employees.
- States not included in our geographic scope that have large PACE include Tenn ($148), Texas ($365), Calif ($408), Illin ($147), Mich ($154), Ohio ($172).
- The "PAOC" column ($US million) refers to total pollution abatement operating costs by manufacturing establishments of > 20 employees.

As indicated, it is evident that the states differ widely in size, industrial orientation, wealth and environmental spending. For example, Maine is a small state by American standards, with around one million residents, and with relatively slow growth projected through the 1990s. (The northeastern region as a whole is expected to continue its slow population growth through the next decade.) It has an average industrial orientation, with an important focus resting in the pulp and paper industry. As such, it might be of appeal to New Brunswick companies, particularly given that the engineering associations of the two regions have reached a mutual accreditation understanding.

North Carolina, on the other hand, is a larger state (7 million people) which is enjoying fairly rapid population growth. It has a very high industrial orientation, with some 26 percent of its employment resting in the manufacturing industries. It, along with a number of other large Southern states (Florida, Georgia, Virginia, South Carolina) is projected to exceed 10 percent annual population growth during the next decade and will be making sizeable investments in pollution abatement. Florida is unique in the sense that its economic base is oriented toward tourism, aerospace, entertainment, agriculture and other non-manufacturing industries. Canadian firms interested in Florida would be less oriented toward solving manufacturing pollution problems and more oriented toward automotive, municipal, agricultural, and other types of environmental problems.

New Jersey exhibits a high level of industrial concentration, and is one of the leading states in petrochemical and pharmaceutical production. The state therefore is an active environmental player and indeed leads the EPA in certain legislative areas. New Jersey has the largest number of Superfund sites in the United States (110), as well as having some 5-600 hazardous sites being cleaned using state funds.

Pennsylvania and New York State are the two largest Eastern Seaboard spenders on pollution abatement in the manufacturing sector. In the two states, manufacturers with greater than 20 employees spent around $US 220 million on capital equipment and $US 1.2 billion on related operational matters in 1988.

Canadian firms can obtain further state-specific information from any U.S. almanac or through contacting the individual state governments. The information in the appendices, which lists contacts within each state "environmental department" and within each "industry department" may be of some value to Canadian firms. For instance, the state industry department officials would likely be able to provide information on local companies, associations, and other contacts, while the state environment department officials could provide insight and contacts pertaining to

legislation, liability, licensing, trends and other subjects. In our experiences, these individuals have been helpful and cooperative.

2.2.2 The Market by Segment

Of the total environmental spending by U.S. industry, *Pollution Engineering Magazine* lists the following industries as the most important spenders:

- Chemical Industry - 22 percent of the total;
- Transportation Industry - 20 percent;
- Petroleum and Coal - 15 percent;
- Metals - 13 percent;
- Paper - 10 percent;
- Food - 7 percent;
- Others - 13 percent.

As discussed in Section Four, we believe that key criteria for successfully penetrating the U.S. market is to understand one's strengths and resources and to conduct homework in the U.S. market based on these strengths. In this sense, all U.S. environmental engineering areas offer potential and revenues for Canadian firms.

"Hot" Areas

However, there are some areas that appear to offer particular appeal. Based on a range of information sources consulted during this study, it is our view that the following environmental activities will be particularly "hot" in the United States during coming years.

- Indoor Air Pollution has acquired a fairly high profile during the past year. A 1991 report to the U.S. Senate[1], entitled *Indoor Air Pollution - A Growing Problem*, concluded that considerable research must be conducted concerning sources and materials that emit harmful indoor air pollutants and developing control strategies for biological pollutants such as molds and bacteria.

- Environmental audits (or preacquisition site assessments or PSAs) have become an important market area for engineering and science consulting firms. This stems from concerns regarding the acquisition of contaminated property and its associated liability.

[1] Reports submitted to the U.S. Congress are available from the General Accounting Office (GAO) in Gaithersburg, Maryland through telephoning (202) 275-6241. Such reports are free of charge and generally cover a wide range of social, economic, legislative, and cultural areas.

- Operation and maintenance services in the environmental areas are also becoming more important as firms increasingly contract outside parties to provide these ongoing services.

- Pre-treatment of inputs (source control) and improving of processes is high priority in all environmental areas. This will be reflected both through changes to existing industrial facilities and through building new industrial facilities containing environmentally smart processes.

- The storage, transportation and treatment/disposal of waste (especially solid waste) receives a very high priority in virtually all regions. Recent court rulings prohibiting inter-state barriers to transported waste will further enhance this area.

- The recycling and reuse of water will remain a high priority for decades to come. For example, the management and cleanup of contaminated groundwater and sewer overflow control are important priorities at the municipal level. Water desalination will receive increased public and private profile in coming years. The industrial wastewater treatment market also offers particularly strong market potential, where clients will essentially be purchasing solutions to existing problems. Minimizing water usage and maximizing its recycled portion is a priority in all regions and sectors.

- The Department of Defence will play an increasing role in the environmental area. One source, for example, estimates that 300 research contracts will be awarded in the "next six months" to examine the question of disposing of bombs, ordinance, and chemical weapons.

- The Clean Air Act amendments will pressure a number of industries, with the automotive industry near the top of this list. For example, some 22 cities have to reach levels of 30 percent of their fleet vehicles being "clean" (no emissions) by the Year 2000. This will heighten a trend toward clean fuels such as hydrogen and/or electricity.

- There are 33 privately-owned utilities in the United States which each spend over $200,000 annually on environmental areas. On average, 60 percent of this spending is on air pollution control, 30 percent on water pollution control and 10 percent on solid waste management. The amount directed toward air pollution control will increase in future years, as utilities become increasingly pressured by the requirements of the Clean Air Act.

Environmental Spending by Manufacturers

As indicated below, according to the U.S. Department of Commerce, American manufacturing firms (of greater than 20 employees) invested roughly $US 3.4 billion nationwide in pollution abatement capital expenditures (PACE) in 1988 and a further $US 12.6 billion in pollution abatement operating expenditures (PAOE).

Polluted Media	**Amount ($US mil)**	**Share (%)**
Capital Spending		
Air	1520	44
Water	1290	38
Solid - Hazardous	330	10
Solid - Non-Hazardous	280	8
Total PACE	*3420*	*100*
Operating Spending		
Air	4470	35
Water	4220	33
Solid - Hazardous	1690	14
Solid - Non-Hazardous	2250	18
Total PAOE	*12630*	*100*

The tables opposite and overleaf provide a more detailed breakdown of the spending of manufacturing companies (by state and sector) on their pollution abatement efforts. This information is drawn from the only source[2] that we are aware of that provides such detailed delineation. Canadian firms may wish to obtain this document (the 1989 version will be released imminently) as it contains details on *which industries are abating what types of emissions in which states.*

As indicated, some $US 12.6 billion is spent by American manufacturers annually on operating expenditures (30 percent on services) and a further $US 3.4 billion on capital equipment. The chemical industry, oil and coal industry, metals industry, and pulp and paper industry are the four largest spenders according to this source, while Pennsylvania, New York and New Jersey are the largest spending states.

For example, the New Jersey chemical industry spent around $US 168 million in environmental operating expenditures and a further $US 48 million in capital expenditures. The Pennsylvania

[2] US Department of Commerce, Census Bureau, Current Industrial Reports, *Manufacturers Pollution Abatement Capital Expenditures and Operating Costs.* Contact Patricia Garner or Pamela Harvey at (301) 763-1755 to obtain a copy of this useful document.

Manufacturers' Pollution Abatement Capital Expenditures - by Industry and State ($US million)

	Food	W&F	P&P	Chem	Oil,Coal	Metals	E&E	Textile	Trans. Eq.	Printing	Mach	Other	Total
United States	**211**	**73**	**418**	**1095**	**483**	**457**	**154**	**19**	**210**	**70**	**77**	**156**	**3423**
Connecticut	-	-	*	7	-	3	2	-	9	-	*	-	25
Delaware	*	-	-	5	*	-	-	-	-	-	-	-	13
Washington, D.C.	-	-	-	-	-	-	-	-	-	-	-	-	-
Florida	4	-	26	22	-	-	*	-	*	-	-	6	64
Georgia	4	-	21	6	-	20	2	4	*	3	2	*	81
Maryland	2	-	*	13	*	*	1	-	-	7	-	-	37
Massachusetts	-	2	2	8	-	*	4	-	-	1	3	1	37
Maine	-	*	*	-	-	-	-	-	-	-	-	-	47
New Hampshire	-	-	*	*	-	-	-	-	-	-	-	-	11
New Jersey	9	-	-	48	12	4	2	-	2	-	-	5	85
New York	4	-	17	37	-	17	3	-	2	3	3	16	102
North Carolina	7	8	32	15	-	3	4	-	-	-	-	*	89
Pennsylvania	6	3	9	23	23	26	3	-	5	6	4	9	119
Rhode Island	-	-	-	*	-	6	*	-	-	-	-	1*	13
South Carolina	*	-	7	8	-	1	3	3	2	-	11	7	47
Virginia	9	6	8	23	*	3	4	-	*	4	-	1	70

Manufacturers' Pollution Abatement Operating Expenditures - by Industry and State ($US million)

	Food	W&F	P&P	Chem	Oil,Coal	Metals	E&E	Textile	Trans. Eq.	Printing	Mach	Other	Total	*Services Portion*
United States	**762**	**323**	**1202**	**2893**	**1975**	**2434**	**573**	**115**	**892**	**165**	**373**	**923**	**12630**	**3917**
Connecticut	3	-	7	31	1	34	18	1	26	6	9	13	149	62
Delaware	5	-	1	35	*	2	1	-	*	-	-	4	160	29
Washington, D.C.	-	-	-	-	-	-	-	-	-	1	-	-	1	0.5
Florida	35	4	46	104	-	25	18	-	12	2	3	19	278	71
Georgia	17	5	75	45	*	15	5	13	41	12	5	17	255	58
Maryland	10		*	47	*	8	14	-	9	*	3	10	194	73
Massachusetts	12	2	35	20	-	30	23	2	12	5	7	34	182	86
Maine	2	8	61	-	-	-	7	0.5	*	-	-	7	82	27
New Hampshire	*	-	10	*	-	-	4	-	2	-	2	2	32	13
New Jersey	25	2	13	168	131	44	15	1	16	5	8	45	473	200
New York	37	24	43	90	1	78	42	1	25	10	69	81	501	213
North Carolina	28	40	45	54	-	18	17	35	5	4	8	44	298	74
Pennsylvania	40	20	81	100	68	250	27	4	19	14	22	60	705	245
Rhode Island	*	-	*	-	-	15	5	1	3	1	-	14	50	18
South Carolina	4	7	49	70	-	21	11	23	2	1	9	20	217	57
Virginia	19	14	59	60	*	14	13	8	14	10	*	16	235	67

Source: U.S. Department of Commerce, Bureau of the Census

P&P denotes pulp and paper; E&E denotes electronic and electrical; W&F denotes wood and furniture. The "services portion" column includes leasing costs.

Asterisk (*) denotes that the figure was withheld to avoid disclosing individual company information.

Manufacturers' Pollution Abatement Capital Expenditures - by Media ($US million)

	Air	*Water*	*Hazardous*	*Non-Hazardous*	*Total*
United States	**1524**	**1290**	**332**	**278**	**3423**
Connecticut	4	13	4	4	25
Delaware	*	7	*	*	13
Washington, D.C.	-	-	-	-	-
Florida	34	17	2	11	64
Georgia	24	36	12	9	81
Maryland	19	12	4	2	37
Massachusetts	11	22	2	2	37
Maine	22	10	1	*	47
New Hampshire	*	7	1	*	11
New Jersey	24	46	5	10	85
New York	46	33	11	12	102
North Carolina	51	30	2	6	89
Pennsylvania	51	47	10	11	119
Rhode Island	6	5	1	1	13
South Carolina	15	22	3	7	47
Virginia	29	26	11	4	70

Manufacturers' Pollution Abatement Operating Expenditures - by Media ($US million)

	Air	*Water*	*Hazardous*	*Non-Hazardous*	*Total*
United States	**4467**	**4223**	**1687**	**2253**	**12630**
Connecticut	28	53	38	31	149
Delaware	84	52	14	10	160
Washington, D.C.	0.2	0.1	0.2	0.5	1
Florida	124	76	17	61	278
Georgia	87	100	19	49	255
Maryland	70	67	21	36	194
Massachusetts	34	53	40	55	182
Maine	15	41	5	21	82
New Hampshire	3	15	6	8	32
New Jersey	163	138	70	102	473
New York	88	163	126	124	501
North Carolina	109	104	26	59	298
Pennsylvania	271	208	76	149	705
Rhode Island	9	20	9	12	50
South Carolina	52	95	30	40	217
Virginia	77	85	21	52	235

Source: U.S. Department of Commerce, Bureau of the Census, 1988 data
* = withheld to avoid disclosing individual company information

Abatement Technique, by US Industry (1988 PACE in $US million)

Industry and Media	*[1]EOL*	*Process*	*Total*	*P/T*
All Industries				
Air	1111	413	1524	27
Water	1074	216	1290	17
Food Industry				
Air	83	17	100	17
Water	80	11	91	12
Wood Industry				
Air	28	3	31	10
Water	7	1	8	10
Paper Industry				
Air	147	86	233	36
Water	71	26	97	27
Chemicals				
Air	318	53	371	14
Water	412	76	488	16
Petroleum and Coal				
Air	95	113	208	54
Water	164	40	204	20
Primary Metals				
Air	101	67	168	40
Water	89	12	101	12
Fabricated Metals				
Air	35	10	45	22
Water	61	14	75	19
Machinery				
Air	14	7	21	33
Water	25	8	33	24
E&E Equipment				
Air	74	7	81	9
Water	44	10	54	19
Transportation Equipment				
Air	67	21	88	24
Water	73	8	81	10

Source: U.S. Department of Commerce, Bureau of the Census, 1988 data

[1] EOL denotes end of line techniques; P/T denotes the share of the total pollution abatement capital spending which is accounted for through process improvements.

pulp and paper industry spent around $US 81 million in environmental operating expenditures, while the State's metals industry (steel) spent around $US 250 million in the area.

As detailed in the table "PACE Abatement Technique by Industry", a substantial majority of pollution abatement capital spending is directed toward end-of-line (EOL) techniques such as scrubbers, clarifiers and other equipment. Specifically, about 73 percent of manufacturers' air pollution control capital expenditures are EOL and 83 percent of water pollution control expenditures are EOL. The paper, petroleum and coal, and primary metals industries appear to be most advanced in terms of addressing air pollution problems through process improvements, although it is felt that all sectors will place a greater emphasis upon solving emission problems through process improvements as opposed to through simply adding equipment onto the end of an unchanged process.

2.3 Environmental Market Trends and Characteristics

The U.S. environmental industry exhibits a wide range of general trends and characteristics. Some of the most important are summarized below.

- As in Canada, legislation is the driving force behind the market. The Clean Air Act revisions of November 1990, for instance, are expected to generate $25-35 billion in annual spending as organizations attempt to adhere to its requirements. Public pressure is also a driving force (particularly in consumer goods and resource industries) and tends to be more advanced in the United States than in Canada.

- Companies tend to adhere to, though not exceed, requirements. American companies face substantial earnings pressure from shareholders and stockmarkets. Spending on environmental areas, particularly those with little immediate financial benefit, tends to be grudging. Packaging an offer/proposal in terms of payback period is thus a useful technique for environmental firms.

- The EPA is substantially increasing its enforcement capabilities. One-quarter of all EPA civil penalties ever collected were obtained during 1990. Fines imposed in 1990 totalled $US 91 million, and will likely continue to increase as the EPA augments its enforcement efforts.

The United States Environmental Market

Trends and Characteristics

- public pressure and regulation are driving forces
- grudgingly spent private dollars
- volatile, difficult to predict size and targets
- states enforce - degree of enforcement varies
- each state with licensing requirements
- high legal involvement
- high academic involvement
- utilities privately owned
- service becoming more important
- trend toward government-industry interaction
- trend toward process integration
- strong competition, large firms entering

- The market is volatile and it is consequently quite difficult to predict market size and targets. The legislators and enforcement agencies generally establish ambitious targets that tend to slip as the target dates approach.

- The State governments are the prime enforcement agencies. In some cases, state governments establish more ambitious targets than the minimums set by the federal EPA. However, it has been suggested that environmental enforcement by state governments tends to lag during tough economic periods. Even in periods of economic growth, the number of polluted sites and emitting sources generally outweigh the enforcement capabilities and resources of the state in question, thus making enforcement a challenging task.

- As in Canada, individual state governments are responsible for the licensing requirements in the region. While many states have reciprocal engineering accreditation arrangements, there are very few such arrangements with Canada (New Brunswick and Maine being one example). To conduct U.S. work, Canadian engineers must either write and pass the two-step accreditation process[3] or enter arrangements with local firms to handle the "stamping" of all work in the given state.

- There is a more active legal involvement in the U.S. environmental sector than in the Canadian community. Among other factors, this stems from the greater profile of liability questions in the U.S., as well as from the policies of the government which emphasize private-sector solutions to problems. For instance, there is a substantial amount of "credit trading" in the U.S. community - this often involves legal firms to facilitate the process.

- The high legal involvement is perhaps best illustrated by the Superfund - a federally funded program established in 1980 to clean up hazardous waste sites. We are aware of one (unsubstantiated) estimate that 55 percent of all Superfund spending since its inception in 1980 has been directed toward legal fees. From its searches of 420 hazardous sites, the EPA has identified 14 thousand "potentially responsible parties". A full decade after the establishment of the Superfund, fewer than 5 percent of the National Priority List (NPL) of sites have been fully cleaned up. There are currently 1200 sites on the list.

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[3] The "EIT" exam is written shortly after graduation and covers a range of engineering disciplines. Approximately three years later an engineering "business practices" exam is written. The latter generally does not pose problems for Canadians, although the former does present problems for those Canadian engineers who are several years past graduation. There are centres in Canada where the EIT exam can be written - Canadian firms entering the U.S. market should have their younger engineers write these exams.

- Academic institutions are also actively involved in the U.S. environmental community. Substantial volumes of EPA and DOD contracts are channelled through universities. As well, there is a considerable degree of joint environmental work being conducted between universities and business.

- Electric utilities are much more likely to have private equity or outright ownership than are utilities in Canada. They are, therefore, less bound to political considerations such as favouring local suppliers. American utilities are also much more reliant upon coal generated power and have contributed substantially to the Acid Rain problem in Canada and the United States. These utilities will face substantial pressures from recent revisions to the Clean Air Act.

- Generally, the U.S. environmental market demand exceeds its supply capabilities. However, competition in many environmental areas is intense. The American engineering community, for example, encompasses some 5200 firms in the engineering association and 675 firms in the Academy of Environmental Engineers. Penetrating regional markets will therefore not be easy for Canadian engineers and, according to Canadian firms in the market, will require a serious effort for 2-3 years.

- As in many other sectors today, quality and service (both before and after the sale) is important and will become increasingly so in the U.S. environmental engineering sector. Following up on a client's satisfaction with prior projects is one increasingly common practice, both of staying abreast of future work and improving one's own level of quality and service.

- There is a high degree of government-industry interaction in the U.S. environmental community. This interaction is mainly in two areas. First, U.S. legislators and policies place a very high reliance upon industry suggestions, technologies and initiatives. Second, there is a trend toward the privatization of infrastructure-related developments, as city and county governments attempt to find funding for road-tunnel, sewage and water treatment projects.

- There is a substantial trend in the U.S. toward process improvements, rather than end-of-line improvements.[4] This trend places a greater emphasis upon environmental engineering as the key solution. One recent example of an environmentally beneficial process improvement is

[4] As stated by President George Bush in 1989, "For too long, we've focused on cleanup and penalties after the damage is done. It's time to reorient ourselves using technologies and processes that reduce or prevent pollution - to stop it before it starts".

that of Northern Telecom's substantially reduced need for CFC solvents in its printed circuit board production process.

- Many American defence contractors are making substantial shifts into the environmental area. According to varying sources, it is unlikely that the so-called "peace dividend" will actually be transferred from DOD to other environmental departments. A more likely scenario is that DOD will become actively involved in environmental clean-ups and that defence contractors will receive contracts to "undo" much of the environmental damage caused at munitions sites, defence depots and other facilities.

2.4 Major Legislation

It is a very difficult task to keep abreast of all existing and emerging environmental legislation. For example, some 500 environmental bills were introduced into Congress in 1990 alone. Clearly, knowledge of local relevant legislation would be an important criteria in choosing a local partner should Canadian firms elect to follow this route.

Canadian firms should as well be cognizant of the major pieces of legislation which affect their particular areas of expertise. This section provides a brief overview of major legislation, although more comprehensive reviews can be easily obtained from the Environmental Protection Agency (see Section Four).

The Environmental Protection Agency was formed in 1970 to consolidate 15 components from five government departments into one independent agency. Currently, the EPA consists of 17 thousand employees with an annual budget of $6 billion and implementing programs to cover fourteen major laws passed by Congress.

The 14 laws implemented by the EPA are the following:

- Clean Air Act;
- Clean Water Act;
- Comprehensive Environmental Response Compensation and Liability Act (CERCLA or "Superfund");
- Resource Conservation and Recovery Act;
- Safe Drinking Water Act;
- Emergency Planning and Community Right-to-Know Act;
- Federal Insecticide, Fungicide and Rodenticide Act;
- Toxic Substances Control Act;
- Marine Protection, Research and Sanctuaries Act;
- Uranium Mill Tailings Radiation Control Act;

- Indoor Radon Abatement Act;
- Ocean Dumping Ban Act;
- Coastal Zone Management Act;
- Pollution Prevention Act.

The EPA conducts both general policy and goal setting as well as the writing of technical industry and chemical standards. About 65 percent of the agency's employees are located in regional offices and work directly with state and local governments and other groups to implement the nation's environmental laws and regulations. The remaining employees work in a policy, research, or enforcement role in Washington, D.C. or at facilities in Colorado, North Carolina and Michigan. The EPA directs significant efforts in the research area identifying and testing treatment technologies for different types of hazardous wastes.

The first four Acts listed above are those that are most generally applicable to U.S. companies. They are briefly summarized below.

Clean Air Act
- passed in 1955;
- early focus on vehicle pollution;
- numerous amendments (1960, 63, 67, 70, 77, 90) broadened scope;
- each state develops implementation plans;
- *maximum achievable control technology* must be implemented;
- recent acid rain (SO2) commitments;
- toxic emissions, alternative fuels, input/source, indoor air pollution, and clean vehicles are among the priorities.

Clean Water Act
- passed in 1956;
- initial focus on building sewage plants;
- numerous amendments (1961, 65, 66, 70, 72, 77, 87) broadened scope;
- if EPA find state standards inadequate, it can set the standards;
- industry must comply with the stricter of the two standards;
- *best practicable control technology currently available* must be implemented;
- future focus on toxics, oil spills, storm overflow, pollution at source, recycling, and agricultural runoff.

Resource Conservation and Recovery Act
- origins in 1965;
- initial focus on garbage and burning;
- subsequent amendments broadened it to dumps, hazardous waste, medical waste;
- future focus on contaminated sediment, solid waste storage and disposal, hazardous waste;
- requires that the *best demonstrated available technology* be implemented.

CERCLA (Superfund)
- 1978 Love Canal incident raised awareness in hazardous waste areas;
- led to CERCLA in 1980;
- authorizes funds for cleanup of abandoned waste sites;
- Act enlarged and strengthened in 1986;
- entrants need legal and bureaucratic awareness;

- underground tanks, impact assessment, groundwater contamination, site assessment;
- particular focus on developing new technologies to treat hazardous waste.

2.5 The Liability Issue

Many of the interviews during this study have identified the liability question as being very important. From a potential client's perspective, the engineer supplying a service must be adequately covered to accommodate any potential liability problems. From the Canadian engineer's perspective, our view is that adequate insurance and extreme caution should ensure that questions of liability can be accommodated.

Engineers in the United States can be held liable for damages resulting from overly-optimistic cost estimates. These damages are allotted amongst the various liable parties. In the engineering community, deviations (from the cost estimate) of around 10 percent are probably acceptable, while deviations in excess of 33 percent will probably result in liability. The gray area between these two levels may result in liability judgements depending on the legitimacy of the engineer's legal case.

Avoiding Liability

According to one source, in addressing the cost liability issue, engineers must obviously be extremely cautious in their cost preparations. This entails checking cost estimates with various sub-contractors and suppliers, reviewing actual costs of earlier projects, and maintaining records identifying the sources of all information reviewed. The precise project scope must be described, and any client requests and changes to this scope should be confirmed in writing. Where possible, contract language should also include a clause similar to "the only person who may rely upon an engineer's cost estimate is the client". Other recommended steps in this regard include: files of all documents should be maintained; approximate costs should be quoted where possible; written contracts or letters of agreement for small projects should be obtained detailing the services to be performed; construction procedures should be observed where possible; and close client contact should be maintained.

Problem is Being Addressed

There are a number of criticisms being voiced stating that the U.S. legal system has failed to deliver economic solutions to the equitable resolution of environmental disputes. In response, a number of shifts are occurring that are of relevance to this study.

INSURANCE TRENDS

All Firms: 1985-1990

Year	Insurance Cost As A % Of Billings	Percent Of Firms Uninsured	Percent of Firms Insured By: DPIC	CNA	Other
1990	3.98%	21.6%	36%	24%	17%
1989	4.21	19	38	24	19
1988	4.50	21	35	27	17
1987	5.07	24	33	28	15
1986	4.11	19	34	27	20
1985	2.87	13	37	19	31

1990

Firm Size By Number Of Employees					
1-5	6.25%	43%	28%	19%	10%
6-10	4.52	22	37	22	18
11-25	3.69	14	42	25	19
26-100	2.82	10	42	26	22
101-500	2.18	2	25	34	38
Over 500	1.38	9	9	23	59
Firm Discipline					
Structural	6.82%	16%	53%	10%	21%
Mech/Elec	3.43	12	39	33	16
Civil	3.50	26	32	25	17
Arch/Eng	3.10	11	40	28	21
Geotech	3.23	33	0	3	64
Other	3.46	44	25	17	15

DEDUCTIBLES

By Size Of Firm 1990

Number of Employees	$5,000 Or Less	$5,001-$10,000	$10,001-$25,000	$25,001-$100,000	Over $100,000
1-5	70%	24%	6%	0%	0%
6-10	39	35	24	2	0
11-25	14	23	51	11	1
26-100	1	8	42	46	3
101-500	0	0	3	54	41
Over 500	0	0	0	11	89

All Firms: 1985-1990

Year					
1990	25%	19%	30%	19%	5%
1989	23	24	29	19	5
1988	24	25	28	18	5
1987	27	25	28	17	3
1986	28	31	23	15	3
1985	30	36	21	11	2

LIMITS OF COVERAGE

By Size Of Firm 1990

Number of Employees	Under $250,000	$250,000-$499,999	$500,000-$999,999	$1,000,000-$2,499,999	$2,500,000-$9,999,999	Over $10M
1-5	15%	40%	27%	18%	0%	0%
6-10	7	34	36	22	0	0
11-25	2	20	30	47	1	0
26-100	1	4	14	80	1	0
101-500	0	0	0	71	28	1
Over 500	0	0	6	24	59	12

All Firms: 1985-1990

Year						
1990	5%	20%	24%	46%	4%	0%
1989	6	23	25	42	4	0
1988	7	26	22	41	4	0
1987	8	25	23	40	3	1
1986	7	23	24	41	4	1
1985	8	20	22	42	6	2

- First, several large companies have withdrawn from the hazardous waste area until liability questions are brought under control.

- Second, the federal government has begun to introduce liability limitations into new legislation.

- Third, disputing parties are increasingly turning to the more timely and economical option of mediation as a method of resolving disputes.

- Fourth, public pressure is increasingly being applied to activities such as the Superfund because of its excessively high legal and paperwork orientation.

- Fifth, an emphasis upon negotiation, mediation, and pre-court settlements means that less than 10 percent of liability disputes are settled by court award (according to the American Consulting Engineers Council's annual liability survey).

One Canadian firm described the liability question as "maybe not as risky as we perceive", stating that new insurance programs have been introduced during the past 1-2 years offering environmental insurance for professionals at reasonable prices. As well, the number of insurance claims has decreased dramatically in the past year because of the reasons stated above.

Presented opposite is information from the journal *American Consulting Engineer* pertaining to engineering liability trends, deductibles and coverage. It indicates, for instance, that insurance costs represent about 4 percent of the average engineering firm's billings and ranges from 1.4 percent for large U.S. firms to 6.3 percent for small firms.

Small firms generally have deductibles of less than $5000 and coverage limits in the $250,000 to $1 million range, while large firms have deductibles exceeding $100,000 and coverage limits in the $1-10 million range.

Section Three: Being Prepared

Section Three: Being Prepared

Before entering the U.S. market, it is necessary that Canadian firms understand the extent to which they are prepared for, and committed to, the effort. This section addresses these matters, essentially examining the *why* and *when* of market entry. Section Four then examines the more detailed *who*, *what*, *where* and *how* aspects of U.S. market penetration.

Discussions during the study have suggested that it may take two years or more for Canadian firms to see their U.S. efforts begin to pay off. While smart management can control costs during this period, it is nonetheless possible that the effort may cost small and medium sized firms hundreds of thousands of dollars. For these reasons, it is important that firms be comfortable with their rationale for market entry, with their relative expertise in the marketplace, and with the level of financial, technical and managerial resources available to support the effort.

Why Make the Effort?

Canadian firms may be in a situation where they are fully satisfied with their current position and not particularly enthusiastic toward risking a penetration of the U.S. market. This may be a proper response, provided the firm is confident of its ability to withstand the future competition in Canada that may come from foreign and domestic firms. It is conceivable that, by standing still in the domestic market, such firms risk falling behind their competitors.

Generally, expansion into the U.S. market can bring service industries and engineering firms a number of benefits. Each of the following benefits serves to enhance the overall competitiveness of the Canadian industry.

- a market diversification which reduces dependence on a single marketplace;
- an exposure to new technologies, new financing concepts and evolving trends;
- a first-hand knowledge of the strategies of potential future competition;
- an enhanced access to more ideas and broader skills;
- an increased level of revenues and profit;
- an extended life for the firm's service concepts;
- a better utilization of company personnel, facilities and overheads.

Be Aware

Such payoffs, however, are not attained without making an investment of time and money and without incurring some immediate risks. The following possibilities, for instance, may occur:

Are you ready to enter the U.S. market?

Use the following evaluation process to determine how prepared you are to answer essential marketing questions.
Remember, your risk of failure in the U.S. market increases if you are less than honest about your responses.

Essential Questions to be Answered Before Market Entry.
How much confidence do you have in your existing ability to answer these questions?
(Mark an "X" in the appropriate column)

	No Confidence 1	2	3	4	*High Confidence* 5
Does your environmental engineering expertise have the following features?					
1. Originality or uniqueness in the U.S.?					
2. Appeal in the U.S. marketplace?					
3. Delivery feasibility in the U.S.?					
Does your marketing approach have the following features?					
1. Adequate managerial and professional resources?					
2. Strong financial support and the ability to be patient?					
3. The ability to satisfy local concerns?					
4. The flexibility to accommodate change?					
5. Your commitment?					
What are your prospects in the U.S. market?					
1. Size of the U.S. market for your service?					
2. Your likely market share in the U.S.?					
3. U.S. market growth potential?					
4. Best locations for your service?					
5. Obstacles blocking your market entry?					
How familiar are you with what the U.S. competition is doing?					
1. Their ability to replicate your services?					
2. Extent of their geographic penetration?					
3. Their reputation and success rate?					
4. Their financial resources?					
5. Their ability to compete on price?					

- the already established competitors in the U.S. market are stronger than the potential entrant;
- the Canadian firm has insufficient managerial, marketing and financial resource to support its effort;
- the Canadian firm has insufficient focus, confidence and commitment to persevere through difficult periods;
- the Canadian firm has an insufficient presence, reputation and contact base in the local market and/or runs into direct barriers for these reasons;
- the Canadian firm finds that distances and communication costs inhibit their personal client contact and make more difficult the obtaining of information on the U.S. market.

In these instances, it is necessary to control expenditures while re-examining or re-focussing the export strategy.

Understand the Fit

To minimize the impact of the above possibilities, it is important that the U.S. effort mesh smoothly with the Canadian firm's current organization, "products", market commitments, and resources. This entails having an understanding of two areas - the Canadian firm's own capabilities and the requirements of the U.S. market.

The diagnostic opposite provides firms with a brief, general set of criteria that should be satisfied prior to investing resources in the United States. It entails a self-examination of the Canadian firm, an external examination of the U.S. market, and an examination of the U.S. competition. As we suggest in the fourth section, individual companies can amass a substantial amount of U.S. market and competitor information by themselves. Where necessary, this can be supplemented through drawing upon a base of contacts. This then leaves the initial activity - the internal examination of the Canadian firm's capabilities - as the remaining requirement.

Formulating a Plan

It is important that Canadian firms establish a market plan prior to investing resources in their U.S. marketing effort. The plan should articulate the objectives, strategies, financial resources, and managerial and technical complement that will be directed toward the U.S. effort. Forming a plan also stimulates internal feedback and discussion, assists in obtaining outside funding, and helps identify missing information.

The importance of this formal requirement should not be minimized by Canadian engineering firms. For instance, studies conducted by the Canadian Exporters' Association have indicated that firms with previously defined market plans enjoy greater long-term success in their export marketing efforts. Firms without such plans tend to discontinue their efforts.

Questions that should be addressed in a market plan include the following:

- who should you contact and in what order?
- what promotional strategies should you follow?
- what manpower and selling expenses are budgeted for the effort?
- has flexibility, fallback strategies, and patience been built into the plan?
- what sales size and growth is projected for the marketing effort?
- what milestones and timing constraints are guiding the process?

Why Partner?

Canadian engineers may enjoy some success in conducting U.S. environmental assignments from their Canadian offices. Our discussion suggest, however, that any such success is likely to be short-lived. Quite simply, American companies that are purchasing outside environmental engineering services must be satisfied regarding a number of local concerns. It is unlikely that Canadian firms will satisfy these insurance, licensing, regulatory knowledge and other concerns through simply supplying a service from Canada. To some degree, such concerns may also remain if Canadian firms choose to open a new office in the United States without hiring knowledgeable local representatives.

In our view, Canadian firms will enjoy the highest likelihood of success through either

- aligning with a local partner; or
- staffing a new office with personnel enticed from firms who already have a local presence.

The former strategy may be the preferred route for a number of reasons, including:

- it provides access to new geographical or niche markets;
- it increases knowledge about the supply and demand side of a new market;
- it enhance one's advantage over competitors;
- it strengthens management skills in Canada and the United States;
- it allows firms to pool resources and thus spread risks and costs;
- it assists in raising capital.

Selecting a Partner

Successful joint ventures are generally those that meet a number of criteria, including the following:

- they are well defined from an operational point of view;
- they have clear and common strategic goals;
- the results and possible improvements are regularly evaluated;
- the alliance's future is based upon performance;
- they involve a smooth meshing of the strengths of each partner;
- they have an agreed upon procedure for termination.

Selected Criteria for Rating Potential Partners

How important are the following areas to your success? *How does your potential partner rate in these areas?*	**Rating** (1-10)	**Weight** (1-100)	**Weighted Rating**
Synergy with Your Areas of Expertise			
Service Niche			
Technical Capability			
New Ideas or Concepts			
Success in Previous Joint Ventures			
Research and Development Capabilities			
Contacts in Manufacturing			
Contacts in Government			
Other Local Contacts			
Management Philosophy			
Management Credentials and Reputation			
Marketing Capabilities			
Financial Strengths			
Existing Client Base			
Short-Term and Long-Term Goals			
Liability and Insurance Concerns			
Overall Business Reputation			

The table opposite provides an indication of the types of characteristics that Canadian firms should seek in examining a potential U.S. partner. Among other areas, matters of image, culture, attitude, and technology should be assessed. In examining such areas, Canadian firms may wish to contact prior clients of the prospective partner and may wish to review Dun & Bradstreet and other reports on the company.

Essentially, the table requires that Canadian engineers tabulate the relative importance of various criteria and the relative ranking of the prospective partners. Obviously firms seeking partners for "local contact" reasons, will attribute more importance to the *contacts* and *local reputation* criteria. While the table may appear somewhat formal, firms should keep in mind that a comparison of, say, ten or more prospective partners could become confusing and that it will have to be drawn in some objective manner. A listing such as this table may assist in the process.

Our discussions with Canadian engineers already in the U.S. market suggest that a given alliance may not be a permanent institution. With the passing of time, for example, it may become apparent that the partnership is not the ideal combination and the two parties may drift apart. Or, it may become evident that the synergies are not as strong as they were when the alliance was formed. In these not uncommon instances, the parties may choose to open their own offices and/or pursue other alliances.

Conducting Interviews

Throughout the report, we have emphasized the importance of Canadian firms drawing upon their contact base, communicating freely and often with potential clients, and investigating the wisdom and fit of possible alignment partners. We have also identified a range of relevant information sources both in Canada and the United States.

In pursuing each of the angles, it is important that Canadian firms conduct well-planned, sequential and insightful interviews, both on the telephone and in-person. The comments presented in the accompanying table should assist Canadian engineers in this process.

In examining the U.S. market, it is important to conduct insightful interviews. The following tips can assist in this process.

Set objectives - Before starting your unstructured interviews, you must have some objectives in mind. Set these objectives by asking: what kind of information would help reduce the risk of entering a new market? What is the respondent likely to know about your potential market? Choose some "must have" questions to ask, if you cannot get a long interview.

Revise objectives - Experienced market research interviewers know that the list of questions to be asked will change as your knowledge grows. Basically you should analyze the responses as you move forward. Never go into the next interview asking the same questions as in the last one. Go for greater depth.

Ask simple open-ended questions - To ask "what makes a supplier good?" is much better than going down a whole list of possible items and then trying to find an order to the ones that matter.

Do not accept generalizations - If someone answers "big" or "large" - this does not mean anything. Ask if it means 1,000 or 10,000 or 2% or 50%. If they respond with "we often use this service", enquire as to how often and in what ways?

Probe - "Yes/no" answers in interviews are not very useful. Ask: Who is good? Why? What do you mean by good? Aid respondents recall by prompting them to remember some information which otherwise might not come out.

Make it interesting - Most people like to talk about their business and what they are looking for in a good supplier of services. Let them talk. But keep bringing them back to the point. Offer some of your experiences, in Canada or in previous interviews, to make them feel they are also learning from the interview.

Keep it short and simple - Do not take more of the respondent's time than you need. Cover the key points - the fewer, the better - and then see if the respondent wants to talk on.

Start with the least important interviews - Professional market researchers leave the key interviews to the last when they have polished up their approach and know the really important points they want to cover.

Leverage your contacts - Conclude with "is there anything I can tell you that you would like to know, or anything else we should discuss?" Also, ask the respondent "if you were in my position, who would you go and see?", "which companies?", "what job function?", "who by name?". Finally, ask if you can call back in the event that you missed something.

Keep track - Take good notes. Fill out and expand these notes immediately after the interview so the maximum information is recorded. Studies in the U.S. have shown that one-half the value of an interview is lost if it is not written up for one week. Remember, you have made an investment in doing the interview; do not lose it.

Section Four: Identifying Opportunities

Section Four: Identifying Opportunities

This section is aimed at assisting Canadian engineering firms in actually identifying particular leads, contacts, and opportunities in the United States environmental market. It is targeted toward those firms that have already assessed their own ability to enter the market through addressing the questions in the previous section.

As we have emphasized in previous chapters, we do not believe that firms need conduct or purchase an extensive U.S. market projection, unless they are intending to make substantial up-front investments in the market. Generally, market analyses are based on assumptions, predictions and opinions that may not be valid a year or two down the road. Such studies can also cost a substantial amount of money - money that could perhaps be best directed toward making contacts, attending shows and opening doors. Our overall view is that the U.S. environmental engineering market is growing at 10-20 percent annually and that Canadian engineering firms with marketable techniques and experience will be able to identify growing niche opportunities within the American market regardless of what a particular market study may project.

Another reason that we do not believe a major up-front study is necessary is because Canadian firms can conduct a significant amount of research on their own, without engaging outside consultants. This section is aimed at reviewing some of these research steps, while also identifying a number of important sources and techniques to pursue.

As is the case in most service industries, it is necessary for Canadian engineers to pursue as many relevant leads and information sources as possible - to in essence have as many "irons in the fire" as can be managed at any one time. These leads should then be prioritized and pursued in the appropriate sequence.

4.1 Identifying Potential U.S. Clients

This section illustrates certain steps that can be followed by Canadian engineering firms to identify potential environmental opportunities in the American manufacturing and service sectors.[1]

[1] In identifying these steps, we have attempted to include up-to-date telephone numbers. Canadian firms should note that any long-distance number in Canada and the United States can be obtained from operator information by dialing the area code in question, followed by **555-1212**.

Examining U.S. Market Opportunities

The following factors should be considered by companies in determining potential demand for their service.

- level of U.S. industry spending
- level of U.S. public spending
- potential institutional/research work
- insights from associations, shows, seminars, lobby groups, reference documents, governments and agencies
- U.S. industries to be publicly and legislatively pressured
- companies in U.S. owing industrial benefits
- potential U.S alliance partners - general engineers, environmental engineers, universities, governments
- potential Canadian industrial alliance partners and/or sources of information - developers, contractors, legal firms, consultants, financiers, engineers, environmental companies
- current clients with Canada/US interaction
- experiences of other Canadian entrants

4.1.1 Manufacturing Clients and Contacts

The Ward's Business Directory entitled *Manufacturing USA* provides a comprehensive collection of industry analyses, statistics and companies. It encompasses some 460 manufacturing industries and within these sectors provides information on 26 thousand companies. The SIC codes covered in this document are included in the appendices.

The directory is an invaluable source of information for Canadian engineering firms who are interested in selling their solutions to American manufacturers. It is available from Gale Research at **(313) 961-2242** at a cost of $US 169 and might be of value to government libraries as well as by firms who are seriously interested in identifying potential U.S. contacts and clients.

To walk through one particular example from this document, we will focus upon the case of a hypothetical Canadian engineering consulting firm who may have experience assisting meat packaging and processing firms in addressing certain environmental problems. The problems may relate to any environmental area, whether solid waste disposal, wastewater treatment, air emissions or other areas.

Such a firm might then examine *SIC Code 2013 - Sausage and Other Prepared Meats* of the Directory (see Appendix H). This section would then provide fairly detailed information on the industry size, structure, recent performance and trends, as well as a comprehensive listing of main companies, contacts, size, and location. For a Nova Scotia firm most interested in the Eastern Seaboard States, say, the document would indicate that some 80 meat processors operate in Pennsylvania, 111 in New York State and so on. Immediate contacts in the region could then be identified from the following firms:

- Fast Food Merchandisers, North Carolina;
- Hatfield Quality Meats, Pennsylvania;
- National Food, New York;
- Goodmark Foods, North Carolina and Pennsylvania;
- Zartic, Georgia;
- Mash's, Maryland;
- Jordan Meats, Maine;
- Castleberry's, Georgia;
- Doughtie's Foods, Virginia;
- Freda Corporation, Pennsylvania;
- Devro, New Jersey;
- Carando, Massachusetts;
- Dixie Packers, Florida;
- Sandy Mac Foods, New Jersey.

The subjects reviewed in telephone discussions with the "environmental officer" of such firms might include:

- current environmental problems;
- immediacy of these problems;
- receptiveness to out-of-state suppliers;
- satisfaction with current suppliers;
- interest in receiving your firm's brochure (include in a followup letter);
- your previous experience in solving meat processing industry problems in Canada; and
- referrals to other companies who might also be interested in your services.

Where possible, Canadian firms should develop a relationship with the environmental officers of the firms, rather than simply with the procurement officers (who often already have their list of vendors).

4.1.2 Service Industry Clients and Contacts

Canadian engineers who have assisted service companies with certain tasks can also identify a number of potential clients in similar U.S. industries. Similar to the manufacturing document, the Ward's Business Directory entitled *Service Industries USA* provides a comprehensive collection of industry analyses, statistics and companies covering 150 service industries and providing information on 4000 companies. It is available from Gale Research at **(313) 961-2242** at a cost of $US 169.

To walk through one particular example from this document, we will focus upon the case of a hypothetical Canadian engineering consulting firm who may have developed a particular niche assisting galleries and museums in addressing certain environmental problems. These institutions may have light and humidity problems, toxic waste disposal problems, and indoor air pollution problems, among others.

Such a firm could refer to *SIC code 8412 - Museums and Art Galleries* in order to gather information on the industry size and structure, as well as a comprehensive listing of main institutions, contacts, size, and location. Within the Eastern Seaboard region, some 12 institutions would be identified, ranging from the Agricultural Museum of New Jersey to the Chesapeake Bay Maritime Museum in Maryland.

As mentioned, this procedure could be repeated in 150 different service sectors, depending on the particular niche expertise of the engineer.

4.1.3 Resource Clients and Contacts

A similar process can be followed to derive a list of potential clients and contacts in the U.S. resource industries. This segment, however, is not covered in one comprehensive sourcebook. Generally the various resource sectors each have their own reference document(s). Firms should refer to the appropriate industry association, government contact, or industry contact to obtain the relevant sourcebook.

In a similar manner to the above, we have selected two areas of Canadian strength (pulp and paper and forestry) to walk through the process of how pertinent information may be obtained on the U.S. market. The document *Pulp and Paper North American Factbook* is available from Millar Freeman Publications in San Francisco for $US 275, and should be obtained by firms and governments that are seriously interested in examining the U.S. market potential in this sector. The document has a five-page chapter which discusses environmental spending and regulations and also provides a schematic documenting the location of paper and pulp mills by state. Sources such as the American Paper Institute or the individual state governments could then be accessed to obtain more detailed information on names, locations, sizes, etc.

The *Forest Industries North American Factbook* provides a range of interesting information including a listing of the size and location of the prominent lumber mills in North America. From this document, for example, a firm could identify the fact that J.D. Irving has various mills in New Brunswick and Quebec, as well as in Maine. The operative question would then be whether an engineering firm who has assisted Irving with their New Brunswick environmental concerns, say, has inquired regarding the feasibility of also being involved with Irving's U.S. environmental expenditures and solutions.

Generally, all resource industries, ranging from petroleum to metals mining to power generation, would have corresponding associations, reference documents, and other information sources. Canada is an international force in many resource areas. Canadian engineers with expertise in these areas may wish to broaden their horizons, canvas the appropriate sources, and promote their expertise into the U.S. market. The various forces discussed in Section One suggest that Canadian engineering firms in general should start examining U.S. market opportunities with more interest.

4.1.4 American Engineering Firms

In many instances, Canadian firms should probably choose to align themselves in some manner with U.S. engineering firms in a given region. This alliance may be to act as a subcontractor on a given project or it may be to act together in proactively pursuing certain opportunities. The form of

the alignment may range from joint venture to merger to office sharing, among others. Our discussions with Canadian engineering firms already present in the United States indicate that they have generally followed a strategy of forming some form of local alliance. Similarly, our discussions with U.S. engineering firms suggest that these firms are generally open to being approached by Canadian firms with the appropriate expertise, and that alliances and joint bids are very common within the U.S. community. Finally, our discussions with over 100 American "buyers" of environmental services suggest that they place a premium upon local knowledge, local credibility, and satisfaction of local insurance concerns.

For these reasons, we have directed some effort in this study toward identifying prominent American engineering firms and describing the U.S. community. More importantly, we have identified how individual Canadian firms can begin the task of researching the engineering community and finding appropriate partners.

American Consulting Engineers Council

The American Consulting Engineers Council (ACEC) is the largest national organization of consulting engineers, with some 5000 member companies employing 160 thousand engineers. The Council's annual directory is available from Washington, D.C. at **(202) 347-7474** for a non-member price of $US 140.[2] The directory is described further in the appendices. As indicated, there are some 39 committees comprising the ACEC, of which the following may be of particular interest to Canadian firms:

- Business Insurance Advisory Committee, James Pierce, Staff;
- Education and Registration Committee, Sally Keene, Staff;
- International Engineering Committee, Jane Sidebottom, Staff;
- Hazardous Waste Action Coalition, Terre Belt, Staff;
- Small Firm Coalition, James Pierce, Staff;
- Environmental Committee, Lee Garrigan, Staff.

The staff members are permanent employees of the ACEC and can be contacted at the above number. With the proviso that these members work first and foremost for the U.S. community, they would nonetheless be a useful source of information for Canadian firms. The approach taken with them by Canadian firms should be to indicate an interest in the U.S. market, an interest in possibly aligning with local partners, an interest in teaming together for third-country markets, etc.

In general, the ACEC in the U.S. would forward Canadian firms to the Consulting Engineers Council in the appropriate State. The ACEC does provide a computerized search listing through

[2] Foreign firms cannot be direct members of this organization.

which firms in given states and given disciplines can be identifed, printed and mailed out. For instance, all environmental firms in Pennsylvania could be identified in this manner. The cost of such a computerized list would range from $US 50-150, according to the ACEC.

Detailed Industry Surveys

Detailed information describing the human resource practices, the average fees, and the typical financial statistics of U.S. engineering firms is available from three separate survey studies, each costing $US 195. These studies are conducted by the Professional Services Management Journal of Newton, Massachusetts, and can be obtained by calling **(617) 965-0055**. Firms interested in obtaining quite detailed information on, for example, professional fees charged certain client types by American engineering firms might wish to obtain the appropriate study.

The *1991 Fee Survey* covers the following billing and professional fee areas based on an extensive survey of the U.S. engineering community.

- Billing Rates and Markup;
- Contract Forms and Terms;
- Government Pricing Data;
- Bidding/Price Competition;
- Computer Pricing;
- Marketing Department Structure;
- Project Type Fee Data;
- Other Reference Sources;
- Regional Analysis.

The *1991 Financial Statistics Survey* covers the following financial areas based on an extensive survey of the U.S. engineering community.

- Key Survey Results;
- The Income Statement;
- The Balance Sheet;
- Marketing Costs;
- Cash Basis Results;
- Staff Ratios;
- Multi-Discipline/Branch Office Impact;
- Automation Analysis;
- Non Financial Managers Data;
- Historical Trends and Patterns;
- Regional Analysis.

The Environmental Engineering Community

There is a well organized formal environmental engineering community in the United States. The document *Environmental Engineering Selection Guide 1991* is published by the American

Academy of Environmental Engineers and provides a description of the capabilities, location, number of employees, and key personnel of each member firm of the Academy. The Guide can be obtained free of charge from Annapolis, Maryland at **(301) 266-3311** and is structured as follows:

History of the Academy
Consulting
- Selecting Consultants
- Selection Procedures & Forms
- Specialty Listing
- Geographical Listing
- Alphabetical Listing

Education
- Objectives in Education
- Accredited Environmental Programs
- Diplomates in Education

Reference
- Objectives
- Officers, Trustees, Staff
- Certification Requirements and Procedures
- Bylaws of the Academy Governing Certification

The Academy also publishes an annual document *Who's Who in Environmental Engineering 1991* which identifies specialists in all facets of environmental engineering. It is available at the above number for $US 60.

4.1.5 American Governments

While not a major focus of this study, the public sector also represents an area of potential interest and business for Canadian firms. However, Canadian engineering firms should note that purchases by state and local governments are not covered by the Free Trade Agreement's chapter on government procurement. Some 32 states and many local governments routinely include domestic preference clauses in their contracts. Some of these clauses are intended to favour local suppliers, while others favour American products in general. The extent to which such clauses exist in purchases of engineering services is obviously a subject that Canadian firms should investigate before attempting to sell directly to this market.

Canadian firms should also be aware that economic development agencies and downtown core development agencies play a relatively strong role in the United States and may represent a useful source of information and/or contracts.

Federal Government

The U.S. government by itself represents a substantial environmental market. In total, it is estimated that the federal government spends $US 19 billion in the environmental area.

The Environmental Protection Agency, the general telephone number for which is **(202) 382-2090**, is the largest federal player in the environmental area, with an annual budget of $US 6 billion. The Agency was formed in 1970 to consolidate 15 components from five government departments into one independent agency. Currently, the EPA consists of 17 thousand employees and implements programs to cover fourteen major laws passed by Congress. About two-thirds of its annual budget is directed to cover two areas - sewage treatment construction grants amount to $2.1 billion, and the Superfund hazardous waste cleanup amounts to $1.6 billion.

As indicated opposite, the organization also spends some $US 700 million annually on engaging outside environmental services (other federal departments spend around $US 250 million annually on such services). These funds allow companies to in effect prove their technology to the Agency. Major recipients of this spending are indicated overleaf. The largest recipient, Camp Dresser & McKee, received almost $US 90 million in such contracts during the three years profiled. Note as well the emergence of large defence contractors such as Lockheed, Rockwell, and Litton in this area.

Deborah Janes is a public affairs specialist at the EPA who has extensive knowledge of the organization and key players within the Agency. She has expressed a willingness to assist Canadian firms in "finding their way around the EPA". She can be contacted at **(919) 541-4577** in North Carolina.

Information on the more technical and research-oriented aspects of the EPA can be obtained from the Office of Research and Development (ORD) in Cincinnati at **(513) 569-7562.** For instance, project summaries for some 1100 research projects (covering the 09/90 to 07/91 period) can be obtained from this source.

The *EPA Journal*, produced by the Office of Communications and Public Affairs in Washington, D.C. at **(202) 382-4454**, might also be a useful source of information for Canadian firms. The issue of January 1991, for instance, is entirely devoted to a discussion of the Clean Air Act amendments and implications.

The document *Environmental Investments: The Cost of a Clean Environment* is a comprehensive compilation of information that might also prove useful to Canadian firms. It is available from the

EPA Contracts for Environmental Services (1990)

Category	*Amount ($US million)*
Management Engineering	103
Air Quality Management	25
Water Quality Support Services	41
Hazardous Substance Analysis	17
Hazardous Substance Cleanup and Disposal	54
Leaking Underground Storage Tank Support	3
Other Environmental Program Data	147
Technical Assistance	38
Others	228
Total: EPA Contracts for Services	*656*

Source: Environmental Protection Agency

Non-EPA Federal Contracts for Services (1990)

Category	*Amount ($US million)*
Interior - Bureau of Reclamation	12
Corps of Engineers - Montana	56
Corps of Engineers - Nebraska	15
Army - Chemical R&D	49
Air Force - Aeronautical	20
Others	103
Total: Non-EPA Contracts for Services	*255*

Source: International Teaming Associates

Top Contractors ENVIRONMENTAL PROTECTION AGENCY SERVICES CONTRACTS

Company	Contract Amount ($000) By Fiscal Year 86	87	88	Total	%
CAMP DRESSER & MCKEE	18235	49006	18924	86165	15.0
COMPUTER SCIENCES CORP	10669	15512	19584	45765	8.0
VIAR & COMPANY INC	13813	11718	17434	42965	7.5
LOCKHEED AIRCRAFT CORP	13806	14052	7769	35627	6.2
WESTON ROY F & HARR JV	13138	12026	10365	35529	6.2
ECOLOGY & ENVIRONMENT INC	0	10800	14650	25450	4.4
NUS CORP	695	13500	11227	25422	4.4
SYSTEM DEVELOPMENT CORP	10161	11529	1364	23054	4.0
PLANNING RESEARCH CORP	2537	15206	1597	19340	3.4
UNISYS CORP	0	0	18161	18161	3.2
SHUNKS EXXON SERVICE INC	14531	3000	0	17531	3.1
ROCKWELL INTERNATIONAL	3795	4339	3104	11238	2.0
CH2M HILL	0	0	8119	8119	1.4
T R C COMPANY METATRACE INC	0	7800	0	7800	1.4
I C F INC	1502	2535	2562	6599	1.2
BATTELLE MEMORIAL INSTITUTE	4695	965	874	6534	1.1
AUTOMATED SCIENCES GROUP INC	3221	1752	1450	6423	1.1
EBASCO SERVICES INCORPORATED	0	0	5911	5911	1.0
TECH LAW INC	0	3361	2295	5656	1.0
GEO/RESOURCE CONSULTANTS INC	1107	2572	1674	5353	0.9
NSI/NORTHROP CORP	1910	1348	1997	5255	0.9
AMERICAN MANAGEMENT SYSTEMS I	1505	712	2692	4909	0.9
VERSAR INC	1623	2366	566	4555	0.8
TETRA-TECH INC	1676	1888	700	4264	0.7
SCIENCE APPLICATIONS INC	293	1279	2575	4147	0.7
LABAT-ANDERSON INC	0	1424	2516	3940	0.7
COLEJON MECHANICAL CORP	508	1854	1516	3878	0.7
P R C ENVIRONMENTAL MANAGEMEN	0	0	3764	3764	0.7
P E I ASSOCIATES INC	200	2242	1154	3596	0.6
ACUREX CORP	822	1214	1517	3553	0.6
PEER CONSULTANTS INC	0	1000	2185	3185	0.6
C R C SYSTEMS INC	1075	795	1310	3180	0.6
TYMNET INC	231	1336	1612	3179	0.6
DE BRA FRED B CO THE	1459	1518	0	2977	0.5
TRANSCONTINENTAL ENTERPRISES	500	1425	1039	2964	0.5
MIDWEST RESEARCH INSTITUTE	0	2239	485	2724	0.5
RESEARCH TRIANGLE INSTITUTE	877	499	1217	2593	0.5
PROGRAM RESOURCES INC	862	1234	461	2557	0.4
LITTON INDUSTRIES INC	0	465	1660	2125	0.4
MAR INC	555	615	848	2018	0.4
ALL OTHERS	25189	18321	22246	65756	11.5
TOTALS:	151190	223447	199124	573761	100.0

National Technical Information Service of the federal Department of Commerce in Springfield, Virginia at **(703) 487-4650** for approximately $US 50.

The *Government Agencies Directory*, published by the Air and Waste Management Association in Pittsburgh, provides an overview of the federal, state, and local agencies involved in environmental matters. Canadian firms might wish to obtain this directory from the Association.

In our view, Canadian firms with strong research/technical capabilities are most likely to profitably penetrate this market through the use of a U.S. partner. The partner might be a university, an engineering firm, an environmental lobby group, or some of the other channels discussed in this report. The federal market is notorious for its bureaucratic layers - small Canadian firms attempting to penetrate it directly may find that they devote substantial resources without a corresponding payback. Buy American requirements[3] can also appear often without much warning and often in rather unpredictable ways. Similarly, projects which are publicized in the Commerce Business Daily (a daily publication which describes federal projects being tendered) are generally felt to be "wired", with the winning firms having laid the necessary groundwork several months previous. By law, federal contracts are generally awarded to the firm submitting the lowest bid.

It has also been suggested that Canadian firms should extend their marketing effort beyond the "procurement" people at federal agencies to encompass higher ranking officials in other managerial, engineering and/or industry sector areas. The small business liaison offices and the "advocacy officers" of government departments may represent a channel worth pursuing as well.

State Governments

According to the Council of State Governments, the state governments spend approximately $US 7.3 billion annually on the environment, or an average of $150 million per state. (These figures include natural resource spending, and thus may be on the high end of the actual "pollution abatement" figure).

The leading spending sectors are 22 percent on water quality areas; 17 percent on water resources; 17 percent on fish and wildlife; 13 percent on forestry; and 5 percent on hazardous waste matters.

[3] The Buy American Act of 1933 represents a potentially significant U.S. federal legislation limiting the use of Canadian materials and services in U.S. public sector contracts. This Act generally requires price preferences (six percent on most contracts; twelve percent on those contracts partially set aside for U.S. small business or labour surplus areas) to be applied in favour of domestic suppliers. Services are not covered by the FTA chapter on government procurement. The Buy America Act therefore applies for services which are tendered for by the U.S. Federal Government.

California, New Jersey, Florida, Illinois and Pennsylvania are the five leading states ranked by environmental spending, accounting for 43 percent of spending by the fifty states.

In addition to spending substantial sums on environmental goods and services, the state governments are perhaps one of the best sources of information on the industry, including information such as industrial permits and compliance orders (which could lead to identifying laggard companies).

The Council of State Governments in particular is an excellent source of information for Canadian engineering firms looking to penetrate markets in particular states. The Council produces a document entitled *Resource Guide to State Environmental Management* which encompasses a broad range of information such as:

- Organization Charts of State Environment Departments;
- State expenditures by 15 environmental categories;
- State environmental orientation (per-capita spending and percent of total budget);
- number of manufacturers by State;
- names, positions, and telephone numbers for the 80 most important State government environmental officials in each State.

To obtain this document, contact the Council in Lexington, Kentucky at **(606) 231-1866.** The cost is $US 40. It should be purchased by all Canadian firms who are seriously interested in entering certain regional markets in the United States. Technical information on the document can be obtained from R. Steven Brown at the above number. The document, levels of state spending and names of appropriate contacts are further illustrated in the appendices.

The documents *Government Finances* and *State Government Finances* provide comprehensive information on sewerage, highway, and education capital outlays by state governments and local governments. The latter are divided into county, municipal, township, school district, and special district governments. This information is available from the Governments Division of the Census Bureau at **(301) 763-7664.**

4.2 Using Your Existing Contact Base

Canada represents the largest export market for the United States, receiving 22 percent of all U.S. exports. Similarly, the U.S. is Canada's largest export destination, receiving some 72 percent of Canadian goods and services exports. Literally thousands of Canadian companies have some form

of daily business interaction with Americans - interaction and contacts which the engineering community could conceivably draw upon in some manner in entering the U.S. market.

Similar patterns are displayed in the direct investment area, where Canada is resident to 18 percent of all U.S. foreign direct investment, and in turn represents the fourth largest foreign investor in the United States after the United Kingdom, Japan, and the Netherlands.

Given this degree of interaction, it would be unusual for a Canadian engineering firm to not have among its existing client base a selection of companies with some form of connection to the United States. In our view, Canadian firms interested in penetrating the U.S. market should be more active in drawing upon these contacts in order to advance their own interests. Such contacts would be most beneficial in those instances where Canadian engineering firms have provided services, where the client is pleased with the services, and where U.S. contacts of the client may be undertaking similar activities and have a need for similar services. This then represents a natural means of opening a door to a potential opportunity.

These and other similar channels are discussed in the following paragraphs.

4.2.1 Foreign Companies with Canadian Investments

Canada has the heaviest reliance upon foreign investment of any of the world's industrialized nations. This characteristic was established during the 1890-1930 period, when the nation's Industrial Policy caused many foreign companies to establish in Canada to avoid paying high tariffs. The characteristic was reinforced during the period following the Second World War, as Canadian policy-makers emphasized the benefits of foreign investment.

Presently, some 175 of the largest 500 corporations in Canada are foreign-controlled. Of the entire manufacturing industry asset base in Canada, approximately 55 percent is controlled by foreign interests. Within manufacturing, the following industries have substantial levels of U.S. direct investment: tobacco (99 percent of industry sales are foreign controlled[4]); transport equipment (86 percent); rubber products (87 percent); chemicals (76 percent); petroleum (74 percent); electrical products (58 percent); machinery (53 percent); textiles (46 percent); and beverages (38 percent).

The largest foreign-controlled corporations include the following: General Motors of Canada; Ford Motor Company of Canada; Imperial Oil; Chrysler Canada; Canada Safeway; IBM Canada; Amoco Canada; Great Atlantic and Pacific (A&P); FW Woolworth; Dow Chemical; General Electric

4 Generally, 75-80 percent of the investment is American. The source of the foreign investment levels information is Statistics Canada.

Canada. A comprehensive list of foreign-owned companies operating in Canada is provided in the annual *Largest Industry* publications of the Financial Post and Canadian Business.

Beyond these, among other sources, a number of regional *Made In* publications are also of value in identifying local companies who may have a substantial contact base in the United States. For example, the publication "1991 Manitoba Trade Directory" provides a comprehensive listing of all firms producing in the province. From this Directory, one could then identify the Campbell Soup Company or Nabisco Brands, for example, as local investors who are also prominent international players in the food processing industry. Similarly, the "Alberta Manufacturers Index" lists those companies active in the local petroleum products area, such as Esso Petroleum Canada and Shell Canada. Engineering firms who might have conducted environmental work for such companies in Canada, assuming a level of client satisfaction with the work, might then "ride" these contacts into the market opportunity of solving similar environmental problems for the affiliate company in the United States.[5]

Similar documents are available in each Canadian region. Such documents usually cost around $25-50 and would likely be housed in any sizeable business or govemment library. The provincial industry departments should be able to provide the document or a number where such documents could be obtained.

4.2.2 Canadian Companies with American Investments

While not to the same extent as our levels of inward direct investment, Canada also has a substantial degree of capital (and contacts) invested in foreign nations.

The list of Canadian companies active as foreign direct investors is broad and includes the following resource, service, telecommunications, real estate, food and beverage, and retail companies: Alcan, Cominco, Bata, Seagrams, Denison Mines, Domtar, Drake Personnel, Gandalf, National Sea Products, Moore Corporation, Northern Telecom, TransCanada Pipelines, Polysar, Reed Stenhouse, Tridon, McCain Foods, Bombardier, Inco, CAE, MacMillan Bloedel, Royal Trustco, Royal Bank, Digital Communications, Newbridge, Olympia & York, Lawson-Mardon, Hiram Walker, Amca, Dominion Textiles, Molson, Cognos, Cascades, Canadian Airlines, Canadian Forest Products, Mitel, Air Canada, Canadian Tire, AECL, Thomson Newspapers, and Geac Computers. Many of these firms have direct investments in the U.S. market.

[5] For example, it was suggested to us that Dow Canada is advanced in its efforts to address environmental problems and that its U.S. parent could arguably benefit from some of the Canadian expertise. Canadian engineers involved with this client might then have an obvious door into the U.S. market.

Canadian engineering firms who have conducted environmental work for these companies, or who have some form of relationship with them, may wish to investigate possible foreign market opportunities. Again, such opportunities depend largely on having provided innovative solutions and top quality service to the client in previous dealings.

4.2.3 Canadian Governments

The federal and provincial governments represent very useful contacts for Canadian firms in a number of ways. These are discussed in some detail in Appendix A.

At the federal level, as described in the Appendix, the industry department (ISTC) and the trade department (EAITC) are the most relevant to Canadian firms interested in the U.S. market. The former provides industry sector information and insight, while the latter provides a range of export programs and services both in Canada and in the United States. For instance, EAITC Trade Commissioners can promote Canadian firms to local customers, recommend appropriate fairs and marketing channels, help find information on potential foreign partners, and assist with joint venturing and other strategic arrangements.

Canadian engineering firms should, however, have reasonable expectations of what can and cannot be conducted by government officials abroad. While officers in both departments attempt to assist all Canadian companies, they concentrate their efforts on small and medium size companies that are "export ready". There are obviously many such companies in Canada and officers are consequently faced with a multitude of demands.

In this regard, EAITC officials that we have spoken with suggest the following techniques as ways of maximizing the benefit of a Trade Commissioner:

- Do as much advance homework as possible such that requests can be precise and detailed.
- Apply a personal touch (rather than mass mailing) to your contact with the Commissioner such that a level of seriousness is indicated.
- Follow an initial faxed contact with a telephone call - again, such that a level of seriousness is indicated.
- In the initial contact letter or fax, provide a succinct description of your company, type of service offered, capabilities and areas of competitive edge, current customers and projects, types of contacts sought, and your specific request. The tone should not be overly technical.

- In the followup telephone discussion with the Commissioner, review the nature and background to your request and discuss the timing of a potential visit.
- Provide at least two weeks advance notice for a Commissioner to attempt to arrange the requested meetings and/or open the appropriate doors.
- If attending a trade show, remain on your feet and constantly meeting and talking with potential clients. Obtain and review the show's agenda in advance and establish a strategy for the show. American trade shows tend to reward such practices.
- If attending personal meetings, the Commissioner may be free to also attend if you so desire. In any event, follow-up with the Commissioner in the week following the interviews to bring him/her up to date and to indicate your next steps.
- Recognize that some Commissioners are well-established in a region and have extensive contacts, while others may be new to the region and have only a relatively new contact base.

4.2.4 Other Private Firms

In implementing an environmental project, there are generally as many as eight separate steps that must be covered.

- the situation must be diagnosed, analysed, and a decision made;
- conceptual plans must be devised;
- financing matters must be arranged;
- design and engineering procedures must be conducted;
- procurement must be completed;
- construction and installation must be completed;
- training manuals and courses must be prepared and presented to those affected;
- the implemented project must be operated and maintained.

The above activities are handled by a range of industries, including engineering, real estate, architectural, financial, construction, legal, and environmental companies. In a sense, each of these activities provides opportunities for engineering firms and those industries conducting each activity may also represent a source of information and/or partnership for Canadian engineers.

Many individuals and documents have argued that these Canadian communities (particularly engineering, architectural and construction) do not work in a sufficiently coordinated manner and that improvements should be made in this regard. While we have not attempted to address this matter in any detail, we do feel that Canadian engineering firms should be exploring a range of professional contacts, as part of their overall market penetration strategy.

Examples of Recent U.S Projects of Canadian Contractors

Company	*Project*
Atlas-Gest	Submerged tunnel in Mobile, Alabama
	Underground pumping station in Chicago, Illinois
Banister Continental	Crude oil line in Louisiana
	Sewer tunnel in Wisconsin
Bechtel Canada	Coal handling facility in the U.S.
Black and McDonald	Defence and Aerospace projects in the Florida region
Both Belle Robb	Office and hotel complexes throughout the U.S.
Canron	Steel Erection for Office building in New York City
	Bridge in Troy, New York
Commonwealth Construction	Gold mine in Butte, Montana
Concordia	Learning stores throughout the U.S
	Apartments in Oklahoma City, Oklahoma
Fitzpatrick Construction	Subway station in Buffalo, New York
	Rapid transit extension in New York State
Frankel Steel	Steel Supply and Erection for Office Buildings in New York
Milne & Nicholls	Various U.S. projects
Mollenhauer Construction	Commercial developments in Florida
PCL Construction	21 U.S projects underway in 1988
Petrifond Foundation	Office building in Baltimore, Maryland
	Power dams in Washington and Alabama
W.A. Stephenson	Mass transit projects in Seattle and other areas
Schokbeton	Prefab concrete for casino in Atlantic City and hotel in D.C.
Taylor Woodrow	Airport in Florida, among other projects
Western Caissons	Subway piling in Washington, D.C.
George Wimpey Canada	Rapid transit in Miami, Florida
	Roads and sewers work in Florida

Source: Canadian Construction Association and other sources.

For example, a number of Canadian construction firms have entered the U.S. market in recent years. The table opposite indicates a selection of these firms, as well as the types of projects that they have undertaken. Given that many real estate development projects in the United States require that some form of environmental assessment be conducted, it may be worthwhile for Canadian engineering firms to contact real estate firms and construction contractors (in Canada and the United States) in order to broaden the current scale of their services to these types of clients.

There are also a handful of Canadian engineering firms that are currently working in the U.S. environmental market. Agra, Gore & Storrie, SNC-Lavalin, Conestoga-Rovers, Monenco, Acres, Golder, and Simons are among the prominent Canadian firms active in the United States environmental market. In Atlantic Canada, Jacques, Whitford and ADI Engineering have substantial expertise to offer particular niches in the United States. While such firms might be somewhat sensitive to divulging information to potential competitors, they nonetheless represent a potential source of information, experiences, advice, and alliance for Canadian engineers.

The sale of pollution abatement equipment and services in foreign countries often requires engineers capable of providing pre-sales and post-sales counselling. The Canadian environmental equipment and service community (4000 companies) has some sectors which are foreign controlled and not particularly active in export markets. Other segments are, however, active in foreign markets and may view some form of engineering alliance as being potentially beneficial to them in their long-term export efforts. Companies such as Laidlaw, Browning Ferris, Waste Management, and Wheelabrator sells goods and services in both Canada and the United States. Canadian engineering firms with previous contacts in the machinery, equipment and service community may wish to investigate this channel in further detail.

As discussed below, each of these industries have their own representative association(s). Beyond using existing contacts in individual companies, Canadian firms might wish to also derive information from the appropriate associations.

4.2.5 Companies Owing Offsets

The Canadian government has an "offset" program, wherein it attempts to maximize benefits to Canada resulting from its major capital projects. Typically, as part of the negotiations with a foreign supplier of goods and/or services, the federal government will attempt to commit the company to providing future benefits to Canada. One such benefit might be the company subsequently purchasing a good or service from a Canadian firm. It is important to note that these

companies need not themselves purchase the Canadian goods/services to reduce their commitment. They need simply be involved in the process.

One intent of the program is that Canadian exporters to the United States (or the country which owes the offset) might use the leverage of owed offsets to assist in landing an export contract. The Canadian firm might contract directly with an offset company or it might use the influence of the offset company to secure a contract.

International companies which may currently "owe" offsets to Canada include those listed below. The person responsible for offsets is also listed as well as the contact telephone number. If the person is not available or no longer in the position, then firms should speak with the "offsets manager", "industrial benefits manager" or "contracts manager" available. If a Canadian engineering firm is seriously pursuing this angle as a possible route to a contract, it is best that the firm first talk with the appropriate person in the Canadian federal government.

- Raytheon, Bob Danner, (508) 440-6986, or George Lehner, (508) 490-1473;
- Martin Marietta, Denise Clarke, (613) 783-4718;
- Exide Electronics, John Milloy, (416) 625-9627;
- Hughes Aircraft, DN Turner, (604) 279-5608;
- Canadian Marconi, David Woodhouse, (613) 592-6500;
- General Electric, Kenneth Porter, (416) 858-5472;
- E.H. Industries Canada, Victor Ingram, (613) 563-2180;
- Oerlikon Aerospace, Jean LaPointe, (514) 358-2000;
- Lockheed Aeronautical, Noreen Field, (404) 494-8455;
- McDonnell Douglas, Michael Murphy, (314) 232-6531;
- Litton Systems, Cliff Kinney, (613) 236-2358;
- General Motors Diesel, K. Yamashita, (519) 452-5184.

The federal department of Industry, Science and Technology is the responsible government department. For further information on the program, contact the appropriate Director of Industrial Benefits in the Department.[6]

4.2.6 Management Consulting Firms

Management consulting firms are often a valuable tool to be accessed in entering a particular region or market segment. These firms can conduct market assessments as well as identify and/or screen potential partners for strategic alliances.

Prior to engaging a management consulting firm, it is most advantageous for Canadian firms to conduct as much *homework* in-house as possible. Through conveying targeted and specific

[6] Currently, these are Mr. R.E. Rantz at (613) 954-3425, Mr. Rick Thomas at (613) 954-3748, or Mr. M.J. Taylor at (613) 954-3740.

requests to a consulting firm, Canadian engineering firms will generally obtain higher quality and more useful reports and recommendations.

The *Big Five* consulting firms[7] have an extensive array of offices throughout the United States and Canada, as well as a strong base of local contacts and sectoral expertise.

4.2.7 Industry Associations and Lobby Groups

While the numbers and combinations of firms in these sectors are too numerous to conduct any detailed assessment in this study, we have provided below the location and number for some appropriate industry associations. More detailed information on American "national associations" can be found in the Encyclopedia of Associations, a reference which describes 22 thousand associations[8] in the United States, providing:

- name, address and telephone numbers;
- Executive Director or other contact;
- number of members;
- focus of organization;
- upcoming shows, meetings, conventions; and
- organization's publications and periodicals.

Information or copies of this reference may be obtained from the Encyclopedia of Associations, Gale Research Company in Detroit at **(313) 961-2242.** The cost is $US 305 for the three-volume set. The same firm produces a five-volume document which describes 47 thousand "regional, state and local" associations and which costs $US 405 for the set or $US 95 per geographic region (five in total). Local business libraries and government offices might have copies of these documents.

Further information on Canadian associations is available from the Directory of Associations in Canada, produced by Micromedia in Toronto. The document costs $C 190 and can be obtained by calling **(416) 362-5211** or toll-free at **(800) 387-2689.** This publication describes 20 thousand Canadian organizations (including around 70 environmental groups).

There are actually three types of associations that may provide useful information to Canadian environmental engineering firms. The first group encompasses those organizations which represent and accredit firms and individuals in the service industries. The second group includes associations which represent particular manufacturing sectors, while the third group consists of

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[7] Ernst & Young, Deloitte Touche, Price Waterhouse, Coopers & Lybrand, and Peat Marwick Thorne.

[8] This comprehensive guide also lists 54 "Elvis" organizations, including the Elvis Presley Fan Club of Luxembourg.

lobby firms and environmental pressure groups. Interested Canadian engineering companies should identify and pursue the appropriate sources, either individually or through their own association. We believe that such organizations might be helpful, both in Canada and the United States.

Service Industry Organizations

The following Canadian organizations would be among those who might be of relevance to the Canadian engineering community. Similar organizations exist in the U.S. and potentially represent another source of information and contacts for interested Canadian firms.

- Association of Consulting Engineers of Canada, Ottawa, (613) 236-0569;
- Royal Architectural Institute of Canada, Ottawa, (613) 232-7165;
- Canadian Environmental Industries Association, Toronto, (416) 777-0015; and
- Canadian Construction Association, Ottawa, (613) 236-9455.

Manufacturing and Resource Organizations

There are a few general organizations that may provide U.S. information and/or contacts to Canadian engineering firms. The Canadian Manufacturers Association in Ottawa at (613) 233-8423 represents the manufacturing community in Canada. The Canadian Exporters Association in Ottawa at (613) 238-8888 assist Canadian exporters. The various Chambers of Commerce might have some useful information at the local community level.

Beyond these organizations, there are hundreds of industry specific organizations that Canadian engineers might wish to identify and contact. For instance, the Machinery and Equipment Manufacturers Association of Canada, the Pharmaceutical Manufacturers Association of Canada, the Canadian Mining Association, and the Canadian Pulp and Paper Association would potentially represent good sources of contacts and information relating to the U.S. market. These are all listed in the Directory of Associations in Canada, described above.

Environmental Groups

The following environmental organizations represent a sampling of those who might be of relevance to the Canadian engineering community.

- Sierra Club, San Francisco, (415) 776-2211;
- Canadian Environmental Industries Association, Toronto, (416) 777-0015;
- Environmental Action Foundation, Washington D.C., (202) 745-4870;
- Canada-United States Environmental Council, Washington D.C., (202) 659-9510;
- National Association of Environmental Professionals, Virginia, (703) 660-2364;
- Greenpeace, Washington D.C., (202) 462-1177;

- Air and Waste Management Association, Pittsburgh, (412) 232-3444;
- Water Pollution Control Federation, Alexandria, Virginia, (703) 684-2400.

These organizations are generally active in lobbying and pressuring organizations into making environmental commitments. They may represent a good source of information pertaining to industries, policies, and trends.

4.3 Canadian Firms in the United States - Lessons and Case Studies

The are a handful of Canadian engineering firms that are currently conducting environmental work in the United States. These firms have generally entered the market for reasons similar to those described in Section One, namely to diversify market risk, to access greater revenues and profits, and to shift the entire company further toward the technical and managerial "cutting edge" of the industry.

With the notable exception of Golder Associates, Canadian engineers have generally entered the U.S. environmental market through a local partner. This approach allows access to local credibility and contacts, while also addressing the "Catch 22" situation wherein Canadians "require a U.S. track record to obtain business yet need U.S. business to develop a track record".

One Canadian firm suggested that "one well satisfied client will bring in other business", implying that through developing a network and conducting quality work Canadian firms will succeed in the United States. Another source presented the view that Canadian firms have to "become American" in order to succeed, suggesting that firms that attempt to control their U.S. operation with excessively tight strings from Canada will not succeed. This source felt that Canadians often attempt to sell Canadian services to Americans ("as if the U.S. is some third-world market") when these firms should be selling American services to Americans.

One firm expressed the view that its success is based upon technical expertise and quality, responsive service. A combination of these two elements is required for successful market penetration in the opinion of this company, although the fundamental question that must be asked is "do I have a product and/or service of interest to Americans?" It is also necessary to view the penetration strategy as "going North American" wherein the border essentially disappears.

To provide a further indication of strategies followed by other firms, we have selected five anonymous companies and briefly profiled their path in the following case studies.

Case Study A

This case profiles one British Columbia engineering consulting firm that entered the U.S. market approximately ten years ago. The firm broke into the U.S. market through a joint venture arrangement with a twenty-year old Georgia firm. Over time, the firm has become one of the largest engineering companies in the United States. The U.S. operation is now a wholly owned subsidiary of the Canadian company.

Through entering into the original joint venture arrangement, the Canadian firm effectively acquired a U.S. experience and client base which had been developed over two decades. The move also facilitated penetration of the lucrative and large American market and allowed the Canadian organization to broaden the spread of its expertise in the pulp and paper industry. Its sphere of activity in the United States has broadened to also include a range of clients in the chemical, food and beverage, and public sector areas. As a result, the subsidiary organization is less oriented to the pulp and paper industry than the Canadian company. The subsidiary company currently has offices in four states and, through the benefit of reciprocal arrangements, many of the firm's engineers are registered in 5-6 states.

The Canadian parent and American subsidiary work very closely on many projects. A number of specialists have been transferred back and forth across the border to accommodate work permit problems, with some specialists having settled in the U.S. and acquired citizenship. The organization used to have some difficulty in having Canadian engineers' credentials accepted and they needed an L1 permit to work on projects in the United States. These matters pose fewer problems today.

Liability is a significant consideration for the U.S. operation because the profit margin on their services contracts is small (accounting for around 5-10 percent of profit) and the risks are relatively large. The organization has countered this by leaving most of the long term liability in the hands of their clients. Having a well-established reputation with their client base has allowed the firm to follow this strategy without facing any major restriction in business.

Case Study B

The key success factor for this Western Canada firm is the narrow niche market that it fills (designing such as aquariums) and the high expertise that it has developed in this area. Company Bs initial contracts in the U.S. engineering market resulted from its reputation in the field and from being approached by certain institutions. With its subsequent success, mainly resulting from word-of-mouth marketing, B decided to open an office in neighbouring Seattle. The office

currently employs a number of Americans who assist in the process of licensing and accreditation. Most of the design work continues to be conducted in its Canadian office. The Free Trade Agreement has assisted Company B through reducing border delays formerly associated with transferring design drawings to the United States.

The company suggests that 2-3 years are necessary to "become established" in the U.S. market and that smaller organizations could make a reasonable penetration effort with a well-spent minimum of $100,000.

Case Study C

This small Ontario firm has a high level of technical knowledge and respect in certain coastal and marine engineering areas. More specifically, the firm has compiled considerable experience in waterfront, shoreline and breakwater areas.

In entering the U.S. market, Company C appears to have followed a "textbook model" of market penetration. Building upon a previous contact in a bordering state, the firm entered an informal alliance for its first project. The Canadian firm brought technical insight and modelling capabilities which it had developed through its previous Canadian public (NRC) and private projects. The American firm brought a knowledge of the local conditions and players to the partnership.

The Canadian firm has continued to enhance its reputation through such channels as writing articles in the appropriate journals, speaking at the appropriate seminars, publishing papers, appearing as expert witnesses, and developing and mailing a marketing brochure. The founding partner of the company is also a member of the appropriate committee board of the American Society of Civil Engineers.

The original partnership continued to conduct a series of waterfront development projects in the Great Lake states, although after 2-3 years each partner began to acquire expertise in the other partner's traditional areas. Eventually a split made the most sense, at which time the Canadian company opened a U.S. office and hired an engineer away from its original partner to head up the office. The firm has continued to enjoy success in the U.S. market, receiving a Standing Offer arrangement with the Corps of Engineers for coastal engineering work, and expanding its office to four professionals. Maintaining such an office in the northern U.S. costs an estimated total of $100,000 per person annually.

Case Study D

Company D, a large Canadian engineering firm with service lines in a number of different sectors, has developed a client base in the United States through a combination of gradual, word of mouth publicity and an aggressive acquisition program. The firm has opened a number of branch offices during their 25 years in the U.S. market.

A prime challenge faced by D in penetrating the market has been the building of credibility with U.S. clients. In D's view, such credibility takes 2-3 years to establish and the market should thus be viewed as requiring a long-term commitment.

Regarding the question of liability, the company emphasized that this is relatively more important in the United States, as more claims are made and laws appear to be more punitive. In addressing such obstacles, D simply follows a strategy of insuring themselves to the fullest extent possible.

Although D would provide no specific figures on market penetration costs, they do suggest that their U.S. operations are more profitable than their Canadian operations at this point in time. Substantial U.S. growth is anticipated over the next five years.

Case Study E

This successful entrant has offices in over a dozen U.S. cities. The initial penetration of the market followed two simultaneous paths - namely opening an office in a border state and acquiring an environmental company. The former route did not succeed in the long-term as it "did not become sufficiently American" and the firm subsequently closed the office.

The latter route did succeed and E proceeded to acquire a total of four firms during the early 1980s. These acquisitions generally arose out of previous contacts and/or working relationships. The firm has used the professional associations, contacts and networking route for its advancement, the foundation of which is based upon its technical expertise and its quality, responsive service. In the view of E's management, to succeed in the U.S. market, it is necessary to run the companies autonomously "with U.S. roots". This is particularly true in the southern states where residents are arguably more parochial than in the northern states. Company E's four subsidiaries have grown internally since the acquisitions and indeed have progressed into other states as well.

The Canadian benefit from U.S. market penetration is obtained through collecting management fees, through moving engineers back and forth, and through accessing U.S. ideas and technology. In E's words "we are definitely benefitting in Canada from our American specialists and

experiences". The transferring of ideas and the exchange of expertise is fostered through the formation of a joint management committee which encompasses the President of each company and which converses regularly.

4.4 Advice from American Manufacturers

A substantial aspect of the study involves the probing of American manufacturers regarding a number of subjects, including the process they follow in buying engineering services, the qualities they seek in selecting a firm, their preferences regarding local versus foreign (or out-of-state) firms and their environmental spending intentions during the coming years.

In general, there has been a wide variance in responses from the firms in the survey. This leads us to a first and fairly basic (yet nonetheless important) observation that there does not seem to be any distinguishing characteristic of U.S. firms that purchase environmental engineering (EE) services. Each case appears to be distinct.

Earlier in the report, we have identified the industrial sectors in which firms are most likely to be buyers of these services. Beyond this, Canadian suppliers will have to thoroughly canvass individual U.S. companies in particular sub-sectors of interest in order to qualify the demand for their services. Obviously, this effort may be lessened in the case where a Canadian firm seeks to create a joint venture with a U.S. partner wherein the marketing activities may be shared.

In our discussions, we have found that some U.S. companies are not particularly open to, or enthusiastic regarding, the use of Canadian service firms. These firms typically source their engineering expertise in-house or from small local firms. Thus, in this (roughly) one-third proportion of calls, it is unlikely that Canadian firms will uncover any opportunities without the use of local alliances.

The majority of manufacturers interviewed have not rejected the idea of using Canadian firms. These firms generally engage outside assistance to solve their environmental problems on a case-by-case basis. These firms typically place a selection emphasis upon quality firms, experienced personnel and local knowledge. Thus, even in these specific instances of receptiveness to Canadian suppliers, it may be advisable for Canadian firms to acquire some form of local credibility, whether through acquisition or partnership.

The Views of U.S. Manufacturers

During the assignment, over 100 manufacturers were probed regarding their environmental purchases, the process followed, qualities sought in engineering firms, spending intentions, and other subjects.

- wide range of responses - therefore view on case-by-case basis
- most use a blend of in-house and external engineering expertise
- firms' decisions to source externally are made on a case by case basis
- selection criteria vary from one manufacturer to another
- experience of the firm and engineers is the most important
- local credibility and familiarity also very important
- third selection criteria varies and includes costs, liability considerations, reputation in engineering community
- firms face environmental pressures in a very wide range of areas
- there is a general preference for a firm with a local office but most important is the credentials of the firm
- except for border states there is very little knowledge of Canadian capabilities
- firms hold a general impression of Canada as clean, friendly, progressive
- manufacturers are generally still reactive - ie. they comply with but do not surpass or anticipate regulations
- the majority foresee increased expenditure but few could/would disclose actual amounts
- the majority of companies are open to being approached by Canadian firms

The following paragraphs provide added detail regarding the opinions of American manufacturing firms.

4.4.1 Purchasing Process

Do you acquire environmental engineering services or do you have such capabilities in-house? What process do you follow in acquiring environmental engineering services? How should prospective contractors approach you?

- Most companies have their own engineering department and are involved in environmental matters. However, they also acquire outside services when the need exists, the workload is too great, the in-house expertise is unavailable and/or when a particular problem needs to be resolved.

- Most large corporations use a competitive process and pre-qualify vendors who then go on a bidders list. The majority of firms are open and willing to add new firms to their list.

- A number of firms will purchase outside services but this decision depends on the particular project at hand - for example, they will use small firms for small contracts and look for large national engineering firms to handle the large contracts where there is more exposure to liability.

- Small manufacturers tend to either stick to a small group of trusted firms or they rely on their insurance company, or raw materials vendors to provide assistance.

- There does not appear to be any generally preferred way in which environmental affairs managers of U.S. firms would like to be approached by Canadian environmental engineering consulting firms. The preferred approach varies from one firm to the next depending on a number of factors, including the type of project work, the purchasing policies of the firm and even the personality of the manager hiring the consultants. Many respondents state that they don't have time for telephone calls, but admit that they are often approached in this way. As well, many state that they prefer to be sent promotional literature outlining the firm's capabilities, but only that which is relevant to their particular problems. One firm mentioned that they would be interested in receiving a directory of Canadian engineering firms.

- Representatives of a number of larger corporations indicated that they preferred to gather information about potential consultants themselves through the conferences and seminars

they attend. They appreciate hearing from consultants who are well recognized in their field.

- A few representatives of the larger companies remarked that they look to their head office or parent company for recommendations regarding which environmental engineering consulting firms to hire.

- When questioned regarding the types of services that would be sourced externally, respondents listed (in no particular order): groundwater monitoring; site assessment; oil removal from sludge; soil and groundwater remediation; site contamination assessments; environmental audits; design and modelling of specific equipment, machinery and applications; emission reduction and clean-up processes to adapt to air and water regulations; plant dust reduction; handling of chemical spills; waste management through recycling; employee training; and the preparation of documents for the government.

- When questioned regarding relevant trade shows and information sources, respondents suggested a number of shows and associations. Most of these are of a regional nature and include state environmental expositions, the American Iron and Steel Engineers Conference, the Carolina Air Pollution Control Association, the Water Environment Federation in Washington, an upcoming Environmental Exposition in Boston in the Spring of 1992, and the Hazardous Substances Management Research Center at the New Jersey Institute of Technology, among others. In general, Canadian firms will have to determine the most appropriate regional and sectoral shows through following the steps outlined earlier in this section.

4.4.2 Selection Criteria

What qualities do you look for in a contractor for environmental engineering consulting services? Do you have preferences with regard to origins of the contractor?

- The top selection criteria always revolve around the issue of reliability and competence. Managers comment that there are a lot of new firms in this business and they need to separate the true specialists from those that are only marginally competent.

- Some firms have standard EE hiring practises which are set by their purchasing department and incorporate a variety of requirements. These may include proof of insurance coverage, financial capacity to complete the project, listing in business directories such as Dun & Bradstreet Directories, etc.

- None of the firms contacted placed competitive *price* before *quality of work* performed and *reputation* in their selection criteria. However, competitive costs were generally ranked among the top three criteria.

- Another key issue was "mobilization rate" or response time. Managers who expressed a preference for using local consultants explained that this was because "out of state" firms could not respond as quickly and would have to be a great deal more competitive in order to justify extensive travel expenses. There may also be a concern with after-sale service. In this regard, respondents suggested that Canadian firms might wish to open a local office or buy a small state firm in order to demonstrate the ability to be responsive.

4.4.3 Perceptions of Canadian Capabilities

What are your views regarding Canadian engineering capabilities?

- Very few of the interviewees had any previous experience with Canadian consultants. Those who did commented that their perception of Canadian environmental engineers was that they were as sound and technically competent as their American counterparts but that they lacked a fundamental knowledge of the regulatory environment south of the border (and specifically how it affects the industry they are working in).

- Receptiveness to Canadian firms, as stated earlier, varies from firm to firm. Most expressed the views that "a competent, competitive Canadian firm who has quality work is as appealing to us as any American firm".

4.4.4 Spending Trends

How will your operating expenditures for environmental projects change over the next five years?

- The majority of interviewees anticipate an increase in operating expenditures over the next five years in the range of 10-20 percent annually. The majority foresee increased expenditure but relatively few would disclose actual dollar amounts. In some cases, firms appear to include their environmental fees in capital expenditures and they are thus difficult to separate.

- The manufacturers still tend to be reactive with regard to environmental spending, in that they will comply with, but not exceed or anticipate, the relevant regulations. Firms, perhaps moreso in the United States, face quarterly pressures and often view environmental spending as a drain upon quarterly earnings. Firms in the consumer products area tend to

be more aware of the need for environmental sensitivity and how this can affect sales and earnings.

4.5 Advice from Other American Sources

In conducting this assignment, we also spoke with a selection of American utilities, engineering consulting firms, universities, and municipalities regarding their priorities, strategies and activities in the environmental field. Most of these insights are reflected in other parts of this study - this section summarizes some of the more pertinent views.

4.5.1 Engineering Consulting Firms

A number of the firms that we spoke with displayed a willingness, if not total enthusiasm, to speak with and possibly meet with appropriate Canadian firms. At the risk of making a sizeable generalization, we would also state that Americans and their industrial managers are quite outgoing, enjoy talking, and are quite approachable.

In general, there is a substantial amount of interaction that currently occurs among U.S. engineering firms. Large firms often align with particular smaller companies to fill certain technical and experience gaps. The geographic location of this expertise is less important than its nature, experience and reputation. Many of the firms appear to already have some form of informal Canadian connection, whether through having conducted work in Canada, having Canadians on staff, etc.

In discussions with U.S. firms, the approach taken by Canadian firms should be along the lines of "we have conducted these types of projects, solved these types of problems, are interested in examining some U.S. opportunities, are interested in working with an appropriate firm to improve our joint prospects in the U.S. and Canadian markets, believe we could also work together in penetrating the Mexican market, etc".

Canadian consulting engineers should be aware that American firms will probably expect Canadian market assistance as a quid pro quo to any mutual U.S. market success. Canadian engineering firms should also be fairly aggressive in their dealings, ensuring that U.S. market benefits are maximized and that they have appropriate portions of the potential benefits without assuming disproportionate shares of the potential liability.

4.5.2 Utilities

Like most of the opportunities and sources identified in this study, the utilities must be approached on a case-by-case basis. One utility that we contacted, for example, (Boston Edison) is located in the same Boston building as the Ontario government's industry department. This source was very familiar with the government's marketing officer and would be receptive to approaches from Canadian firms. This anecdote is not atypical of the strategy that we have emphasized in this study. Canadian firms must spread their network broadly and pursue the various people-related opportunities that will inevitably arise.

There are two particularly important characteristics of the U.S. utility community. First, this sector has substantial private ownership and is generally less bound to local pressures and purchasing commitments. Second, this segment is being directly struck by recent amendments to the Clean Air Act. The fossil fuel burning side of this sector must make substantial investments in stack technology and in process efficiency in order to comply with sulphuric emission requirements. Canadian firms with utility experience and with knowledge of local regulations (again probably acquired through a local alliance) might wish to pursue these opportunities further.

4.5.3 Universities

Universities play an active role in the U.S. environmental scene and many institutions interact regularly with industry and government. One source, for instance, suggests that "Georgia Tech receives $US 90 million annually in Defence dollars for environmental and related work". It should be noted as well that universities themselves represent environmental markets. For instance, Duke University is resident to a Superfund-related medical waste site.

In discussions with Canadian industry, some firms have mentioned the fact that the scientific/academic route has played an integral role in helping them penetrate the U.S. environmental market. Such firms, and specifically the scientific and research element of these firms, may wish to investigate some of the appropriate academic contacts presented in the appendices.

The appendices present descriptions of approximately 100 institutions in the United States that conduct environmental research and/or provide environmental training. Generally, these institutions are open to working together with Canadian or American industries (provided industry money is invested) on environmental matters.

4.5.4 Municipalities

American municipalities spend an estimated $US 29 billion annually on the environment. While this is a substantial sum and may be appealing to Canadian industry, our view is that the industrial segment offers more potential and will likely prove easier to penetrate.

Canadian firms may have some success in entering the municipal environmental market if they offer highly specialized expertise and align locally. For these firms, we offer the following random insights obtained from representatives of U.S. municipalities.

- Some, though not all, municipalities adhere to the Brooks Act[9], which generally stipulates that qualifications-based selection be followed and that lowest price bids need not necessarily win the contract.

- Contracting is generally administered by individual municipal departments, such as engineering, water, etc.

- Municipal requirements are usually advertised in the local newspapers, to which firms respond with a Letter of Interest outlining their qualifications to do the work.

- The city then reviews these, shortlists on the basis of firm's experience and qualifications and issues an RFP for two documents - a Technical Proposal and a Price Proposal.

- If not simply awarded to the lowest bid, the municipal government will evaluate the technical proposals first and rank the firms according to a number of selection criteria, before negotiating an acceptable price with the first ranked firm. Some of the selection criteria include; location of firm, participation of minority peoples, etc. In the case profiled, out-of-state and out-of-country firms are awarded equally - each receiving no points for this category (versus 10 points for an in-city firm).

- It is not at all unusual for six or more months to elapse from initial notification to signing of contract. Some municipalities have standing offer agreements, where certain specialized services would be procured directly without a competitive process. For example, one municipality uses a standing offer to procure geo-technical services for eroded slopes which have caused landslides.

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9 The Brooks Act generally stipulates that qualifications-based selection be followed, where lowest price bids need not necessarily win the contract. Around 35 states apply Brook's Act requirements to their procurement, while a number of other states that do not have state procurement laws generally adhere to Brooks Act selection procedures. The ACEC in the United States generally has the advancement of qualifications-based selection as a priority activity.

- Company expertise is however the most important qualification criteria and if states cannot source the appropriate expertise locally, outside firms would certainly be called upon.

- As a result of the insurance crisis of the late-1980s, some municipalities loosened their requirements. Rather than carrying full insurance, firms needed only general liability coverage (and workman's compensation).

4.5.5 Conclusions

The preceding pages have provided some commentary as obtained directly from potential U.S. clients. Generally, it seems likely that firms with a local knowledge and the ability to offer interesting cost-effective environmental engineering solutions will enjoy success in the American market. Our recommendations toward this end are included in the Executive Summary section.

List of Appendices

Appendix A: Canadian Government Assistance

External Affairs and International Trade Canada

The federal Department of External Affairs and International Trade Canada has Trade Centres located in every region of Canada, as well as 27 trade offices/consulates in the United States, to offer a comprehensive and integrated program of assistance to Canadian industry.

The consulates in the United States are staffed by Trade Commissioners and Commercial Officers who assist Canadian firms in winning export contracts in their region. These individuals generally have good knowledge of the local environment and are often of valuable assistance in penetrating the market and region in question. They are helpful in a variety of ways, including promoting Canadian companies to local customers, recommending appropriate technical experts to assist in negotiating a deal, selecting appropriate sales agents, assisting in the settlement of payments, and assisting in travel matters. Canadian trade office locations are indicated below. Ask to speak to the Trade Commissioner or Commercial Counsellor.

The Department provides a trade development program which, both, introduces new exporters to the U.S. market, and supports experienced exporters by increasing their exposure to new regional markets using the NEBS and NEXUS programs (described below) as well as trade shows. The program plays a prominent role in the federal Government's strategy of ensuring that the Canadian business community is well positioned and well supported when accessing the U.S. market.

Promotion of trade into the United States is managed by the U.S. Trade, Tourism and Investment Development Bureau. Canadian companies can take advantage of the following trade development initiatives, sponsored by the Bureau. The activities would be of varying degrees of relevance to Canadian engineering firms.

Trade Shows

Trade shows are proven tools for companies to use in the U.S. market to introduce new products, raise awareness of capabilities and services, establish representation, transact business and obtain a very clear, concise picture of the competition.

In 1989, External Affairs and International Trade participated in over 400 major events in some 72 industrial sectors, as well as in smaller, regional trade shows. The Department typically establishes a Canadian pavilion and shares related expenses with the Canadian companies participating in the pavilion. In cooperation with the local Embassy, receptions are often organized to bring the participants and local buyers together for one-on-one discussions.

Missions

The Department sponsors various missions, such as an Incoming Buyers' Mission, whereby key decision-makers from the U.S. will be brought to a location in Canada to offer presentations and meet with Canadian companies. Similarly, outgoing missions to the U.S. are conducted in which Canadian companies are taken to a geographic location to meet prospective buyers.

Market Studies/Directories/Seminars

External Affairs and International Trade also publishes market studies, such as this one, on a sectoral basis. In addition, the Department sponsors seminars and workshops for industry groups on specific subjects.

New Exporters to Border States (NEBS)

A NEBS mission "walks" a group of approximately 25 small companies through the entire process of exporting. Documentation and customs clearance procedures are explained in Canada and at one of the northern border posts where further information is provided on banking, insurance, agents and distributors, and other aspects of export activity. Studies indicate that fifty percent of NEBS participants eventually make an export sale.

New Exporters to the United States (NEXUS)

NEXUS is a relatively new program for the numerous small to medium sized companies from every region of the country who have traditionally traded just over the Canada/U.S. border, as a logical extension of their operations. Under NEXUS, companies will be encouraged to venture into other U.S. regional markets by participating in outgoing, sectorally-based missions, usually to a post or a selected regional trade fair. In the new markets, participants receive a briefing on local opportunities from post trade officers who will organize an itinerary of meetings with manufacturers' agents, distributors and/or buyers.

Marketing Information and Assistance

The International Trade Development Branch is the Department's focal point for export promotion activities. The branch administers the following programs offered by the Department:

a) *Program for Export Market Development:* a cost-sharing assistance program that helps Canadian businesses participate in, or undertake various types of export promotion activities. The activities for which PEMD funding is available include: participation in trade fairs; visits outside Canada to identify markets; visits of foreign buyers to Canada; project bidding; and formulating marketing agreements. Further information on this program is available from the International Trade Centre within the local office of Industry, Science and Technology Canada. These numbers are provided below.

b) *The World Information Network for Exports (WIN Exports):* a computerized directory of Canadian exporters designed to help trade development offices around the world respond more quickly to opportunities identified in their territory.

c) *Info Export Toll Free Number*: information and questions relating to any aspect of exporting may be directed to the toll free number (1-800-267-8376) for assistance.

Trade Officers

The Department has a number of sectoral desk officers in Ottawa who are responsible for co-ordinating international initiatives with the posts abroad. Each officer prepares a calender of events and attaches certain priorities to the international development efforts in his or her area of responsibility. Canadian firms should contact the appropriate officers to find out more regarding the priorities and upcoming activities of relevance.

Canadian Consulates and Trade Offices in the United States

Location	*Telephone*	*Fax*	*Territory*
Washington D.C	(202) 682-1740	(202) 682-7726	DC, DE, MD, VA, East.PA
Atlanta	(404) 577-6810	(404) 524-5046	AL, FL, GA, MS, NC, SC, TN
Boston	(617) 262-3760	(617) 262-3415	ME, MA, NH, RI, VT
Buffalo	(716) 852-1247	(716) 852-4340	west, central NY
Chicago	(312) 427-1031	(312) 922-0637	IL, MO, WI, IA
Cincinnati	(513) 762-7655	(513) 762-7802	satellite office
Cleveland	(216) 771-0150	(216) 771-1688	KY, OH, WV,west PA
Dallas	(214) 922-9806	(214) 922-9815	TX, AR, KS, LA, NM, OK
Dayton	(513) 255-4382	(513) 255-1821	satellite office
Denver	(303) 291-9611	(303) 291-9615	satellite office
Detroit	(313) 567-2340	(313) 567-2164	Toledo, MI, IN
El Segundo, CA	(213) 335-4439	(213) 335-4185	satellite office
Houston	(713) 627-7433	(713) 621-0193	satellite office
Los Angeles	(213) 687-7432	(213) 620-8827	AZ, south CA, NV
Miami	(305) 372-2352	(305) 374-6774	satellite office
Minneapolis	(612) 333-4641	(612) 332-4061	IA, NE, MN, MT, ND,SD
New York	(212) 768-2400	(212) 768-2440	CT, NJ, south NY, Bermuda
Orlando	(407) 841-7337	(407) 425-6408	satellite office
Philadelphia	(215) 697-1264	(215) 697-5299	satellite office
Pittsburgh	(412) 392-2308	(412) 392-2317	satellite office
Princeton	(609) 452-9027	(609) 452-8464	satellite office
San Diego	(619) 546-4467	(619) 457-2844	satellite office
San Juan	8-1-(809) 758-3500	8-1-(809) 250-0369	satellite office
San Francisco	(415) 495-6021	(415) 541-7708	north CA, CO, HI, NV, UT, WY
Santa Clara	(408) 988-8355	(408) 988-6315	satellite office
Seattle	(206) 443-1777	(206) 443-1782	AK, ID, OR, WA
St. Louis	(314) 862-0130	(314) 862-3129	satellite office

Note: Speak with the Trade Commissioner or Commercial Officer in the appropriate office.

Addresses of Canadian Consulates in the United States

Canadian Embassy, 501 Pennsylvania Avenue, Washington, D.C., 20001, U.S.A.

Canadian Consulate General, Atlanta , One CNN Center, South Tower, Suite 400,
Atlanta, Georgia, 30303-2705, U.S.A.

Canadian Consulate General, Boston, Three Copley Place, Suite 400
Boston, Massachusetts, 02116, U.S.A.

Canadian Consulate General, Buffalo, One Marine Midland Center, Suite 3150
Buffalo, New York, 14203-2884, U.S.A.

Canadian Consulate General, Chicago, 310 South Michigan Avenue, 12th Floor
Chicago, Illinois, 60604-4295, U.S.A.

Canadian Consulate General, Cleveland, Illuminating Building, 55 Public Square, Suite 1008
Cleveland, Ohio, 44113-1983, U.S.A.

Canadian Consulate General, Dallas, St. Paul Place, 750 N. St. Paul Street, Suite 1700
Dallas, Texas, 75201-3281, U.S.A.

Canadian Consulate General, Detroit, 600 Renaissance Center, Suite 1100
Detroit, Michigan, 48243-1704, U.S.A.

Canadian Consulate General, Los Angeles, California Plaza, 300 South Grand Avenue, 10th Floor
Los Angeles, California, 90071, U.S.A.

Canadian Consulate General, Minneapolis, 701 Fourth Avenue South, Suite 900
Minneapolis, Minnesota, 55415-1899, U.S.A.

Canadian Consulate General, New York, 1251 Avenue of the Americas
New York City, New York, 10020-1175, U.S.A.

Canadian Consulate General, San Francisco, 50 Fremont Street, Suite 2100
San Francisco, California, 94105, U.S.A.

Canadian Consulate General, Seattle, 412 Plaza 600, Sixth and Stewart Streets
Seattle, Washington, 98101-1286, U.S.A.

Industry, Science and Technology Canada

The federal department of Industry, Science and Technology Canada has regional offices in all Canadian provinces. These offices house EAITC's International Trade Centres, as indicated below. The appropriate Trade Commissioner in these Centres may be able to assist Canadian engineering firms with their export-related questions.

Location	*Telephone*	*Fax*
St. John's, Nfld.	(709) 772-5511	(709) 772-2373
Charlottetown, P.E.I.	(902) 566-7400	(902) 566-7450
Halifax, N.S.	(902) 426-7540	(902) 426-2624
Moncton, N.B.	(506) 857-6452	(506) 857-6429
Montreal, Que.	(514) 283-8185	(514) 283-3302
Toronto, Ont.	(416) 973-5053	(416) 973-8161
Winnipeg, Man.	(204) 983-8036	(204) 983-2187
Saskatoon, Sask.	(306) 975-5925	(306) 975-5334
Calgary, Alta	(403) 292-6600	(403) 292-4578
Edmonton, Alta.	(403) 495-2944	(403) 495-4507
Vancouver, B.C.	(604) 666-1444	(604) 666-8330

As well, the Department has sector officers responsible for developing and maintaining a knowledge base regarding Canada's various manufacturing and service sectors. General information in this regard can be obtained from (613) 995-5771.

The Environmental Affairs Division contains officers knowledgeable of the Canadian industry and pertinent government contacts, services and programs. Lucien Bradet at (613) 954-3080 and John Mihalus at (613) 954-1890 are the appropriate starting calls for this information. The Consulting and Engineering Services Division, directed by Chris Charette at (613) 954-2948, might also be of assistance to Canadian engineering firms interested in penetrating the American market.

Provincial Industry Departments

Provincial industry departments also offer expertise and programs to assist companies in penetrating export markets. Firms may wish to contact the Industry Department offices listed below in order to obtain further information in this regard.

Location	*Telephone*	*Fax*
St. John's, Nfld.	(709) 576-2781	(709) 576-3627
Charlottetown, P.E.I.	(902) 566-4222	(902) 566-4030
Halifax, N.S.	(902) 424-4242	(902) 424-5739
Moncton, N.B.	(506) 453-2875	(506) 454-8410
Montreal, Que.	(514) 873-5575	(514) 873-4230
Toronto, Ont.	(416) 963-2501	(416) 963-1526
Winnipeg, Man.	(204) 945-3172	(204) 945-2775
Regina, Sask.	(306) 787-2222	(306) 787-2198
Edmonton, Alta.	(413) 427-4809	(403) 427-0610
Vancouver, B.C.	(604) 660-3935	(604) 660-2457
Whitehorse, Yukon	(403) 667-5466	(403) 667-3518
Yellowknife, N.W.T.	(403) 873-7381	(403) 873-0101

Appendix B: Environmental Trade Shows

Many firms are taking advantage of trade shows, an activity which ranks among the most important of all marketing vehicles, particularly in the United States. A trade show provides sellers with the opportunity to exhibit products or services, to meet with top buyers in the industry, and to investigate the competition. Trade show are fast-paced - typically a trade show lasts 2-3 days, during which the sales representative attempts to meet as many buyers as possible, while often in the midst of direct competition.

In interviews regarding trade shows, many of our sources have suggested that firms should: 1) return each year to maintain visibility; 2) not expect to "make a sale" in the first year; 3) remain on their feet and in active conversation throughout the duration of the show; 4) observe the practices, exhibits, strategies of competing firms; and 5) enhance the aggressiveness and confidence of their approach, in line with general American practices.

Following is a partial list of trade shows related to the environmental sector. The listed individuals and organizations should be able to provide the most topical information on upcoming shows. Interested firms may wish to contact appropriate industry associations to find out more topical information on other relevant upcoming trade shows.

Generally, these trade shows are offered on an annual basis, usually during the autumn season. External Affairs and International Trade Canada (contacts also presented in the Appendices) are very active in the trade show area, sponsoring Canadian pavilions at hundreds of trade shows each year. Department officials could also be contacted by firms in search of more topical information on upcoming shows.

Major U.S. Environmental Trade Shows (1992)

Show	Focus	Exhibitors/ Attendees (91)	Date	Location	Contact
Pittsburgh Conference & Exhibition	Analytical	840/35,000	March 9-13	New Orleans	(412) 825-3220
HAZMAT Central Management Conf. & Exhibition & Emergency Response	Handling, treatment, storage and transportation of hazardous materials and wastes	300/7,000	March 10-12	Rosemont, IL	(708) 469-3373
Environmental Technology Expo	Equipment, systems and services for pollution control and abatement	350/8,000	Feb 24-27	Chicago, IL	(708) 299-9311
Waste Expo '91	Equipment and services	400/12,000	May 6-8	New Orleans	(202) 659-4613
HAZMACON	Hazardous material	320/3,600	Mar 31-Apr 2	Long Beach, CA	(415) 949-2050
HAZMAT International	Handling and treatment of hazardous materials and wastes	550/8,600	June 10-12	Atlantic City, NJ	(708) 469-3373
Northeast Waste Management Expo	Waste disposal equipment, suppliers and service	200/4,500	Sept 16-17	Hartford, CT	(203) 247-8363

Water Pollution Control Federation	Water quality management	400/13,000	Sept 20-24	New Orleans	(703) 684-2400
HAZMAT West Management Conference & Exhibition	Equipment, supplies and services for clean-up of hazardous materials	550/13,000	Nov. 10-12	Long Beach, CA	(708) 469-3373
Globe '92	Environmentally sustainable economic development	670/17,000	Mar. 16-20	Vancouver, BC	(604) 681-6126

Source: 1991 Trade Show Week Data Book

Federal Government Priority Shows (1992)

The federal Department of External Affairs and International Trade Canada participates and establishes "Canadian pavilions" at a number of trade shows each year. In 1992, the Department has identifed 14 priority shows in the environmental area. They are as follows:

Shows	Date
Waste Expo '92 - New Orleans	May 6 - 8
HazMat International - Atlantic City	June 10 - 12
Air & Waste Management Assoc. - Kansas City	June 22 - 26
Solid Waste Association of North America - Tampa	August 3 - 6
Water Environment Federation - New Orleans	September 20 - 24
World Recycling Expo Information Booth - Chicago	June 2 - 4
HazMat West - Long Beach, CA	November 10 - 12
HazMat '92 - Washington, DC	November '92
New England Environmental Expo - Boston	April 28 - 30
Lower Great Lakes Waste and Recycling Expo - Buffalo	November 13 - 14
Water Pollution Control Association - Atlantic City	May 5 - 7
Petro-Safe - Houston	January '93
HazMat Central '93 - Chicago	March '93
HazMat - Pittsburgh	September '92

Source: External Affairs and International Trade Canada

Appendix C: List of Industry Interviewees

The following firms were selected from the *Manufacturing USA* directory and contacted during the assignment. They provided a range of opinions and suggestions - as presented in Section F firms were willing to talk with Canadian engineers regarding potential opportunities. The asterisk (*) in the list below denotes those firms that are either non-responsive or not interested in bein Canadian firms.

Canadian firms could follow a similar procedure in developing their base of contacts and obtaining information on the U.S. market potential for their service.

Company	City	Contact	Telephone	Sales ($ mil)	Empl ('000)	Product
Connecticut						
Bell Detroit Diesel*	Middletown	Mike McNeil	(203) 632-0218	9	0.1	engines
Union Carbide	Danbury	Fred Moore	(203) 794-2000 ext.2948	6,914	43.1	organic chem.
Dexter*	Windsor Loc	Herb Hoffman	(203) 627-9051 ext.295	783	5.3	adhesive
Coldwater Seafood*	Rowayton	Gerald Clark	(203)852-1600	250	0.4	pkged seafood
Ansonia Coppers*	Ansonia	Craig Schatzlein	(203) 736-2651	50	0.5	sec nonferrous metals
Waterbury Rolling Mills*	Waterbury	Richard Silco	(203) 754-0151	17	0.5	sec nonferrous metals
Klock C.*	Manchester	Tom Martin	(203) 646-0700	11	0.1	primary metals
Xerox Corp.*	Stamford	M. Lovit	(203) 968-3000	10,866	99	photographic equip
DFM Enterprises	North Haven	Bob Hofmiller	(203) 288-9502	2	0.1	transportation equip
Delaware						
Dupont Polymer*	Wilmington	Suzanne Dorty	(302) 774-7799	3,811	-	chemicals
WL Gore*	Newark	Bob Bartley	(302) 738-4880	400	4	chemicals
Florida						
St. Joe Paper Co.	Jacksonville	Tracy Norwood	(904) 227-1171	596	5.7	paper
Waler Jim Corp.	Tampa	Lee Colburn	(813) 873-4000	2,386	16.8	paper
Sundor Brands	Mount Dora	Bob Baraglia	(904) 383-4191 ext. 304	200	0.7	canned fruit
Beaver St. Fisheries*	Jacksonville.	Randy Gunther	(904)354-5661	110	0.3	canned seafood
Variety Seafoods Inc.	Tampa	John Pestalozzi	(813) 872-4411	25	0.3	pkged seafood
P&G, Foley Division	Perry	Clifford Henry	(904) 584-0121	100	1.0	pulp mills
Jacksonville Shipyards*	Jacksonville	A. Dix Stevens	(904) 355-1711	190	2.3	ship building
Georgia						
Forstmann & Co.*	Dublin	Danny Duggar	(912) 275-5400	200	3.5	textiles
SCT Yarns	Washington	Donald Derden	(404) 678-1511	30	0.2	textiles
Shaw Indus.*	Dalton	Keith Smith,	(404) 278-3812	694	6.5	carpet
Amoco Fabrics*	Bainbridge	Keith Ragsdale	(912) 246-7676	135	1.6	weaving mills
Georgia Pacific*	Atlanta	Gerald Tice	(404) 521-5084			wood containers
Athens Newspapers*	Athens	Mary Maize	(404) 549-0123	9	0.2	printing & publishing
E-Z-Go Textron	Augusta	Russel Owen	(404) 798-4311	100	1.0	transportation equip
Maine						
Lincoln P & P*	Lincoln	Rich Webber	(207) 794-6721 ext. 360	75	0.5	pulp
St. Croix Pulpwd	Woodland	Scott Beal	(207) 427-3311	6	0.1	pulpwood
Stinson Canning*	Propspect Hrbr	Dawayne Webber	(207) 963-7331	30	0.5	canned seafood
Bath Ironworks	Bath	Ron Lessard	(207) 443-3311	635	7.0	ship building

Maryland						
Duron*	Beltsville	Tom Brice	(301) 937-4600	100	1.0	paints
Noxell Corp.	Hunt Valley	Jean Russell	(301) 785-7300	489	2.1	toiletries
Kline Richard F.Inc.*	Frederick	Jerry Row	(301) 662-8211	32	0.5	paving, mixtures
Dryden Oil	Baltimore	Scott Schnur	(301) 682-9174	41	0.2	oils, greases
Clendenin Brothers	Baltimore	Ray Shamblin	(301) 327-4500	37	0.2	primary metals
Massachusetts						
GE Power Deliv.*	Pittsfield	Mr. Desgroseilliers	(413) 494-1110 ext.3500	55	1	electrical
Stakepole*	Boston	Tom Bridges	(617) 423-3520	205	4	graphite
Micro Mech.*	Ipswich	Gail	(508) 356-2966	2	0.1	electrical
The Gorton Group	Gloucester	Dave Weber	(508) 283-3000 ext. 244	260	2.5	pkged seafood
Hollingsworth & Vose	E. Walpole	Paul Walker	(508) 668-0295	110	0.7	pressed & molded pulp
Hoechst Ceramtec*	Mansfield	environmental rep	(508) 339-1911			
Lee Lime Corp.*	Lee	environmental rep	(413) 243-0053	112	0.5	lime
New Hampshire						
Polyclad Laminate Inc	Franklin	Mike McCuthion	(603) 934-5642	n/a		adhesive and sealants
New Jersey						
BASF*	Parsippany	Keith Fry	(201) 397-2700	4,300	20.8	chemical
Wellman Inc.	Clark	Martin Huggins	(803) 386-2011	261	1.8	chemical
Anheuser-Busch*	Newark	Richard Guindon	(201) 645-7700	480	1.2	malt beverages
Johnson and Johnson*	Milltown	environmental rep	(908) 524-0400	130	1.8	sanitary paper
Amer Paper Towel Co.*	Hackensack	environmental rep	(201) 487-2500	5	<0.1	sanitary paper
Mykroy/Mycalex Corp.*	Clifton	Bill James	(201) 779-8866	5	<0.1	ceramics/insul'n
Englehard Corp.	Edison	Edmond Giebel	(908) 205-5000	2479	6.7	lead
Halocarbon Products*	Hackensack	environmental rep	(201)262-8899	25	0.1	oils, grease
New York						
Grace Specialty Chem.	NYC	Gary Peacock	(513) 554-4200	2,300	23	chemical
Jesup Group*	NYC	Richard Nelson	(813) 361-2100	388	4.5	rubber
Salant Corp.*	NYC	Brad Kovaly	(212) 392-5858	136	2.8	trousers
Cliffstar Corp.	Dunkirk	Don Baylin	(716) 366-6100	46	0.2	wines & spirits
McIntosh Box & Pallet*	E. Syracuse	Tom Ryan	(315) 446-9350	4	<0.1	wood containers
Shorewood Packaging	Farmingdale	Steve Montano	(516) 694-2900	78	0.7	pressed & molded pulp
Brystol Myers*	NYC	Thomas Halmen	(212) 546-4000	341	5401	pharmatical products
Hearst Corp.	NYC	Paul Dimko	(212) 649-2000	-		
North Carolina						
Goodmark Foods Inc.	Raleigh	Al Blaylock	(919) 790-9940	103	0.9	food
Holly Farms*	Wilkesboro	Gene Newman	(501) 756-4000	862	10.5	food
Renfro Hosiery	Mt. Airy	David Holder	(919) 789-5531	74	1.2	textiles
Stroh Brewery*	Winston-Salem	Greg Millar	(919) 788-6710 ext. 2121	75	0.7	malt beverages
Burlington Industries	Greensborough	Ted Lejune	(919) 379-2000	3,300	34	weaving mills
M.J. Brown & Sons*	Eliza City	Mr. Foreman	(919) 335-5454	1	<0.1	wood containers
Masonite Corporation*	Spring Hope	Jeff Rose	(919) 459-3141	5	<0.1	particleboard
Pennsylvania						
Sun Refining	Philadelphia	Nancy Kilbourne	(215) 977-3882	6,930	9.6	petroleum

Atlantic Petr.	Southeastern	environmental rep	(215) 977-3882	1,150	4.0	petroleum
Carbonite Filter Co.*	Delano	Jim Monahan	(717) 467-3359	1	0.1	coal
Union Elec. Steel*	Carnegie	Ken Uzar	(412) 947-9595	65	0.6	coal
Bally Block Co.*	Bally	Robert Walp	(215) 845-7511	5	<0.1	particleboard
Scott Paper	Philadelphia	Maurice Carron	(215) 522-5000	4122	25.4	sanitary paper
P&G Paper	Mehoopany	Drew Hadley	(717) 833-5141	290	3.0	sanitary paper
Bethlehem Steel Corp.	Bethlehem	David Boltz	(215) 694-2721	4621	34.4	steel mills
Armco Advanced Mat.	Butler	Dan Szwed	(412) 284-2000	547	3.5	fabricated metals
Talco Metals*	Philadelphia	Edna Brown	(215) 333-6800	48	0.2	lead
Bayer USA Inc.*	Pittsburgh	Fred Giel	(412) 394-5578	3,392	18.6	pharmatical product
<u>Rhode Island</u>						
Cookson Amer.*	Providence	Brenda Howard	(401) 521-1000	750	5	lead
Pease & Curren	Warwick	Kip Curran	(401) 739-6350	17	0.1	lead
Hudson John Inc.*	Providence	Ed Abbenamte	(401) 781-5200	32	0.5	
Technical Materials *	Lincoln	Peter Lynch	(401) 333-1700	30	0.2	copper rolling
Carbon Technologies*	Slocum	Roy Waldheger	(401) 295-8877	5	0.1	carbon & graphite prod
Arkwright Inc	Fiskville	Raymond Kizor	(401) 821-1000	50	0.3	photographic equip
<u>South Carolina</u>						
Ambac Intl.	Columbia	Jimmy Cooper	(803) 735-1400	60	0.9	machinery
Marley Elec. Htg.	Bennettsville	Danny Holt	(803) 479-4006	55	0.4	electric
Carolina Eastman	Columbia	Bill Arnold	(803) 791-3014	250	1.2	organic fibre
Alice Manufacturing*	Easley	Ray Youngblatt	(803) 859-6323	125	2.0	weaving mills
Georgetown Steel Corp	Georgetown	Bill Debensky	(803) 546-2525	240	0.8	steel mills
Braswell Shipyards	Charleston	Richard Meitzler	(803) 720-8235	60	0.3	ship building
<u>Virginia</u>						
Davenport Insul.*	Springfield	environmental rep	(703) 550-9600	32	0.4	particle board
Arden Eliz.*	Roanoke	Mo Glover	(703) 563-3000	65	0.6	toiletries
RCV Seafood*	Morattico	Weston Connolly	(804) 462-5101	34	0.2	pkged seafood
Smalley Packaging Co.*	Berryville	Roy Harris	(703) 955-2550	5	0.1	wood containers
Gannett Co. Inc.*	Arlington	environmental rep	(703) 284-6000			
Metro Machine corp	Norfolk	Eric Lasalle	(804) 494-0714	75	0.7	ship building

Appendix D: State Government Contacts

State government officials can provide a wealth of information concerning the region's industrial base, employment, number of establishments, trends, environmental regulations and other areas. Generally, individuals within the "economic bureau" or "research desk" of the industry and environment departments would be the most appropriate starting point for this search.

Industry Departments

In conducting this assignment, we spoke with various officials in the state governments. A preliminary list of industry department contacts includes the following. If the given individual is no longer in the position, ask for the appropriate economic development or research person.

- Walt Causey, Department Of Commerce, Albany, New York, (518) 474-4100
- Mr. Minde, Office of Economic Research, Commerce & Economic Development Department, Trenton, New Jersey, (609) 984-3550
- Kenneth S. Slaysman, Bureau of Economic Research, Department of Commerce, Harrisburgh, Pennsylvania, (717) 787-3003
- Vincent Harrington, Research Division, Department of Economic Development, Providence, Rhode Island, (401) 277-2601
- Evelyn Glazier, Department of Economic Development, Richmond, Virginia, (804) 371-8270
- Michael Lawson, Economic Development Commission, Jacksonville, Florida, (904) 366-6654
- Jim Reichardt, Volusia County Business Development Corporation, Daytona Beach, Florida, (904) 255-8888
- Lawrence Wensch, Brevard Economic Development Corporation, Melbourne, Florida, (407) 242-1800
- Rick Tesch, Economic Development Commission of Mid- Florida Inc., Orlando, Florida, (407) 422-7159
- Charlie Gatlin or Gloria Hardnet, Department of Industry, Trade & Tourism, Atlanta, Georgia, (404) 656-3556
- Tony Doster, Research Section, Department of Economic & Community Development, Raleigh, North Carolina, (919) 733-4151
- Gary Powers, Information Resource Centre, State Development Board, Columbia, South Carolina, (803) 737-0422
- Bill Pillsbury, Department of Resources & Economic Development, Concord, New Hampshire, (603) 271-2341

- Bob Cannino, Connecticut Business Industry Association, (203) 244-1900
- Irene Tashlick, Department of Economic & Employment Development, Baltimore, Maryland, (301) 333-6947
- Thomas M. Butts, Office of Business Development, Department of Economic & Community Development, Augusta, Maine, (80) 541-5872, (207) 289-3153
- Joe Donovan, Office of Economic Affairs, Massachusetts Office of Business Development, Boston, Massachusetts, (617) 727-1130

Environment Departments

For contacts within the state environment community, we recommend that firms acquire the document *Resource Guide to State Environmental Management* for $US 40 from the Council of State Governments at (606) 231-1850. The document lists approximately 80 environmental contacts for each state, covering all facets of air, water, solid, toxic and other pollution.

The following pages provide an indication of the types of contacts and information that can be identified through this document. The first three pages detail the environmental spending levels of each state government. The next two pages then use the example of Georgia to illustrate the type of information available.

Expenditure Rankings

The following tables rank the states' environmental and natural resource spending across four categories. Although spending is one method for addressing a state's concern about environmental issues, it is by no means the only, nor even necessarily the most important. We also acknowledge that there are other ways to rank the states' spending (some readers of our first edition suggested ranking by the area of the state, for example). Although we have limited our selection of rankings to those presented here, readers are encouraged to use this data as part of other studies.

Table 1, *Ranked by Total Environmental Expenditures*, is simply a ranking of the total amount of money spent by each state for environmental and natural resource matters.

Table 2, *Ranked by Per Capita Expenditures*, is a ranking of the amount of environmental/natural resource money spent per state resident.

Table 3, *Ranked by % State Environmental Expenditures of Total State Expenditures*, is an expression of the % of the total state budget spent on environmental/natural resource matters.

Table 4, *Ranked by Average Expenditure Per Manufacturing Industry*, is an expression of the total environmental/natural resource money spent, divided by the number of manufacturing industries in the state (SIC codes 2000-3900.) We are indebted to the American Business Information, Inc., of Omaha for these manufacturing data.

It is apparent to us that there may be some difficulties with this last ranking. A few of these industries might not require environmental permits for example. Some of the state money spent on natural resources may not be for industrial regulatory programs, but instead for resource development. Also, such a ranking does not take into account the size of the industry, or the relative difficulties in regulating it, or that municipal governments are also regulated, and that some state money is spent to regulate and/or assist them. We do believe, however, that such a ranking gives a general picture of the relative effort made to regulate an "average" manufacturing industry. Readers wishing a finer breakdown of environmental spending per particular type of industries are encouraged to pursue these efforts.

Ranked by Total Environmental Expenditures	
1. California	$1,486,124,000
2. New Jersey	523,874,000
3. Florida	465,591,276
4. Illinois	392,844,000
5. Pennsylvania	288,766,000
6. Washington	246,873,000
7. Massachusetts	237,936,245
8. New York	236,484,000
9. Michigan	221,424,840
10. Louisiana	193,835,955
11. Oregon	186,438,200
12. Wisconsin	167,779,368
13. Virginia	152,149,051
14. Maryland	150,091,393
15. Alaska	131,684,237
16. Wyoming	128,050,724
17. Minnesota	126,236,105
18. Ohio	125,669,234
19. Kentucky	120,289,400
20. Texas	113,796,559
21. Missouri	106,300,846
22. North Carolina	96,942,764
23. Georgia	93,344,466
24. Iowa	88,065,353
25. Tennessee	81,180,056
26. Colorado	76,150,000
27. South Carolina	71,124,250
28. Montana	69,559,793
29. Alabama	64,906,954
30. Connecticut	61,996,000
31. Idaho	61,440,400
32. West Virginia	56,189,209
33. Mississippi	54,153,592
34. Indiana	51,580,177
35. Utah	51,419,000
36. Kansas	47,817,000
37. Arizona	46,612,900
38. New Mexico	44,782,182
39. Arkansas	44,188,570
40. Oklahoma	40,868,619
41. Maine	39,332,000
42. Nevada	36,487,054
43. Rhode Island	35,878,756
44. New Hampshire	33,588,000
45. Delaware	33,170,000
46. North Dakota	32,524,000
47. Nebraska	27,988,000
48. Hawaii	27,832,208
49. South Dakota	21,264,000
50. Vermont	20,222,111

Ranked by Per Capita Expenditures		Environmental Expenditures as a % of the State Budget		Average Expenditure per Manufacturing Industry	
1. Wyoming	267.33	1. Wyoming	7.73	1. Wyoming	124,805 77
2. Alaska	251.31	2. Montana	4.29	2. Alaska	101,217 71
3. Montana	86.41	3. Idaho	4.22	3. Montana	42,030 09
4. New Jersey	67.85	4. Alaska	4.00	4. Delaware	35,475 94
5. Oregon	67.38	5. New Jersey	3.61	5. Louisiana	26,607 54
6. Idaho	61.26	6. Oregon	3.03	6. New Jersey	25,890 78
7. Washington	53.11	7. Louisiana	2.64	7. North Dakota	25,134 47
8. California	52.49	8. Washington	2.63	8. West Virginia	25,062.09
9. Delaware	50.26	9. California	2.60	9. Idaho	24,976.59
10. North Dakota	48.76	10. Nevada	2.57	10. Maryland	23,763 68
11. Louisiana	43.97	11. Florida	2.51	11. Washington	23,318 50
12. Massachusetts	40.40	12. New Hampshire	2.41	12. California	19,027 99
13. Florida	37.75	13. North Dakota	2.32	13. Oregon	17,779 73
14. Vermont	36.31	14. Illinois	2.26	14. Kentucky	17,362 79
15. Rhode Island	36.13	15. Vermont	1.94	15. Nevada	17,219 00
16. Nevada	34.62	16. Maine	1.88	16. Virginia	17,083 88
17. Wisconsin	34.56	17. Rhode Island	1.86	17. Massachusetts	16,292.54
18. Illinois	33.83	18. South Dakota	1.85	18. Florida	15,697 62
19. Maine	32.64	19. Delaware	1.80	19. South Dakota	14,664.83
20. Maryland	32.47	20. Utah	1.80	20. New Mexico	14,658 65
21. Kentucky	32.28	21. Wisconsin	1.70	21. Maine	13,595 58
22. Iowa	31.07	22. West Virginia	1.68	22. Utah	13,137 20
23. New Hampshire	30.96	23. Colorado	1.65	23. Illinois	12,134 93
24. Utah	30.43	24. Kentucky	1.64	24. Vermont	12,072.90
25. West Virginia	29.95	25. Maryland	1.60	25. Iowa	11,905 55
26. South Dakota	29.82	26. Massachusetts	1.56	26. Pennsylvania	11,763.32
27. New Mexico	29.72	27. Missouri	1.53	27. Wisconsin	11,616.66
28. Minnesota	29.31	28. Pennsylvania	1.49	28. Hawaii	11,364 72
29. Hawaii	25.35	29. New Mexico	1.48	29. South Carolina	11,239 67
30. Virginia	25.29	30. Virginia	1.47	30. Mississippi	10,845 [illegible]
31. Pennsylvania	24.06	31. Minnesota	1.46	31. Minnesota	9,517 [illegible]
32. Michigan	23.96	32. Iowa	1.44	32. Arkansas	9,205 [illegible]
33. Colorado	23.07	33. Michigan	1.42	33. New Hampshire	9,184 [illegible]
34. Missouri	20.68	34. Mississippi	1.40	34. Nebraska	8,953 29
35. Mississippi	20.67	35. Tennessee	1.34	35. Rhode Island	8,863 33
36. South Carolina	20.50	36. Nebraska	1.29	36. Colorado	8,516 94
37. Connecticut	19.18	37. Kansas	1.23	37. Michigan	8,422 72
38. Kansas	19.17	38. South Carolina	1.21	38. Kansas	7,895 81
39. Arkansas	18.45	39. Arkansas	1.15	39. Missouri	7,836 41
40. Nebraska	17.47	40. Georgia	1.07	40. Tennessee	7,608 25
41. Tennessee	16.58	41. Alabama	1.02	41. Georgia	6,928 26
42. Alabama	15.82	42. North Carolina	1.00	42. Alabama	6,808 66
43. North Carolina	14.94	43. Arizona	0.96	43. New York	6,699 83
44. Georgia	14.72	44. Hawaii	0.85	44. North Carolina	6,494 89
45. Arizona	13.36	45. Oklahoma	0.79	45. Connecticut	6,290 82
46. New York	13.20	46. Connecticut	0.77	46. Arizona	6,255 93
47. Oklahoma	12.61	47. Indiana	0.68	47. Oklahoma	5,400 19
48. Ohio	11.58	48. Ohio	0.65	48. Ohio	4,213 84
49. Indiana	9.50	49. Texas	0.60	49. Indiana	3,870 19
50. Texas	6.76	50. New York	0.59	50. Texas	2,740 57

State Environmental and Natural Resources Expenditures, FY 1988 Expenditure Category Totals and Averages

Category Totals		Category Averages	
Air Quality	287,278,509	Air Quality	5,745,570
Drinking Water	158,572,787	Drinking Water	3,171,456
Forestry	981,505,377	Forestry	19,630,108
Fish and Wildlife	1,266,646,664	Fish and Wildlife	25,332,933
Geological Survey	95,193,207	Geological Survey	1,903,864
Hazardous Waste	362,928,558	Hazardous Waste	7,258,571
Land Management	226,989,192	Land Management	4,539,784
Marine & Coastal Programs	184,759,792	Marine & Coastal Programs	6,158,660
Nuclear Waste	44,027,245	Nuclear Waste	1,572,402
Pesticides Control	78,768,374	Pesticides Control	1,575,367
Soil Conservation	111,933,971	Soil Conservation	2,238,679
Mining Reclamation	303,328,393	Mining Reclamation	8,198,065
Solid Waste	326,532,182	Solid Waste	6,530,644
Water Quality	1,626,537,391	Water Quality	32,530,748
Water Resources	1,272,638,762	Water Resources	25,452,775
Total, Environmental/Natural Resource	7,327,640,404	Total, Environmental/Natural Resource	146,552,808

GEORGIA

	CATEGORY	PERSON'S NAME	TITLE	ORGANIZATION
1	Legislative Chairman:	Sen. Hugh M. Gillis, Sr. (D)	Chairman	Committee on Natural Resources and Environmental Quality
2	Legislative Chairman:	Rep. Robert L. Patten (D)	Chairman	Committee on Natural Resources and Environment
3	Environmental Protection:	Lonice C. Barrett	Commissioner	Department of Natural Resources
4	Air Pollution Agency:	Robert H. Collom	Chief	Air Protection Branch
5	Acid Rain:	Robert H. Collom	Chief	Air Protection Branch
6	Air Monitoring Network:	William D. Estes	Chief	Air Quality Evaluation Section
7	Air Quality Modeling	Dale Kemmerick		Planning and Technical Support Program
8	Asbestos	Marvin Bradford	Program Manager	Asbestos Certification Unit
9	Compliance Enforcement Inspection	John W. Mitchell	Program Manager	Air Pollution Compliance Program
10	Noise Pollution Control:	NONE		
11	Permits:	John W. Mitchell	Program Manager	Air Pollution Compliance Program
12	Radon:	Jim Drinnon	Environmental Spec.	Environmental Radiation Program
13	State Implementation Plan:	Marvin M. Lowry		Air Protection Branch
14	Toxic Air Pollutants:	John W. Mitchell	Program Manager	Air Pollution Compliance Program
15	Vehicle Emission Inspection:	Lt. Russell Abernathy		Department of Public Safety
16	Waste Management Agency:	John Taylor	Chief	Land Protection Branch
17	Hazardous Waste	Jennifer R. Kaduck	Program Manager	Hazardous Waste Management Program
18	Community Right-to-Know	Albert K. Langley	ER Coordinator	Program Coordination Branch
19	Emergency Response:	Albert K. Langley	ER Coordinator	Program Coordination Branch
20	Inspection Enforcement:	Jennifer R. Kaduck	Program Manager	Hazardous Waste Management Program
21	Manifest/Information System:	Randolph E. Williams	Program Manager	Industrial Waste Management Program
22	Medical Waste:	John Taylor	Chief	Land Protection Branch
23	Nuclear Waste/Nuclear Safety:	Jim Setser	Branch Chief	Program Coordination Branch
24	RCRA Permit Review:	Jennifer R. Kaduck	Program Manager	Hazardous Waste Management Program
25	Superfund, Federal:	Randolph E. Williams	Program Manager	Industrial Waste Management Program
26	Superfund, State:	NONE		
27	Waste Reduction	Jennifer R. Kaduck	Program Manager	Hazardous Waste Management Program
28	Solid Waste:	James W. Dunbar	Program Manager	Municipal Solid Waste Management Program
29	Abandoned Landfill Reclamation:	Harold Gillespie		Permit Review Unit
30	Enforcement Inspection:	James W. Dunbar	Program Manager	Municipal Solid Waste Management Program
31	Municipal Landfill Permit Review:	Harold Gillespie		Permit Review Unit
32	Recycling Programs:	Denny Jackson	Environmental Spec.	Municipal Solid Waste Management Program
33	Resource Recovery:	Denny Jackson	Environmental Spec.	Municipal Solid Waste Management Program
34	Water Agency:	David Word	Branch Chief	Water Protection Branch
35	Coastal Zone Management:	Duane Harris	Director	Coastal Resources Division
36	Construction Grants:	Pete Mave	Program Manager	Municipal Engineering
37	Dam Safety:	Francis E. Fiegle II	Program Manager	Safe Dams Program
38	Drinking Water	Fred Lehman	Program Manager	Surface Water
39	Water Shortage Response:	Fred Lehman	Program Manager	Surface Water
40	Emergency Response Team:	Albert K. Langley	ER Coordinator	Program Coordination Branch
41	Erosion and Sediment Control:	Lewis Tinley	Program Manager	Land Reclamation and Sedimentation Control
42	Enforcement:	Alan Hallum	Program Manager	Municipal Permitting Program
43	Flood Plain Management:	Donna Mack	State Coordinator	Georgia Geological Survey
44	Industrial Pre-treatment Program:	Drew Zorow	Program Manager	Industrial Waste Water Program
45	Groundwater:	William McLemore	State Geologist	Geological Survey Branch
46	NPDES	Alan Hallum	Program Manager	Municipal Permitting Program
47	Non-Point Source Pollution:	Jim Chandler	Program Manager	Water Quality Management Program
48	Program Development:	David Word	Branch Chief	Water Protection Branch
49	Permits, Water Withdrawal:	Nolton Johnson	Branch Chief	Water Resources Management Branch
50	Stormwater Management:	NONE		
51	Underground Injection Control (UIC):	William McLemore	State Geologist	Geological Survey Branch
52	Underground Storage Tanks (UST):	Randolph D. Williams	Program Manager	Land Protection Branch
53	Wastewater Training & Certification:	Gaynell Hill	Coordinator	Water Protection Branch
54	Water Quality:	David Word	Branch Chief	Water Protection Branch
55	Water Quantity:	Nolton Johnson	Branch Chief	Water Resources Management Branch
56	Water Resources Planning:	David Ashley	Manager	Water Resources Management Branch
57	Water Rights Administration:	NONE		
58	Water Well Training and Certification	William McLemore	State Geologist	Geological Survey Branch
59	Wetlands:	David Word	Branch Chief	Water Protection Branch
60	Natural Resources Agency:	Lonice C. Barrett	Commissioner	Department of Natural Resources
61	Public Information & Conservation Education:	Kaki Thurber	Director	Communications Division
62	Fish and Wildlife:	Leon Kirkland	Director	Game and Fish Division
63	Forestry:	John W. Mixon	Director	Georgia Forestry Commission
64	Energy:	Paul Burks	Director	Office of Energy Resources
65	Geological Survey:	William McLemore	State Geologist	Geological Survey Branch
66	Parks	Rick Cothran	Director	Parks and Historical Sites Division
67	Nature Preserves Commission:	NONE		
68	Citizen Environmental Advisory Boards	Kaki Thurber	Director	Communications Division
69	Geographic Information System:	William McLemore	State Geologist	Geological Survey Branch
70	Mined Land Reclamation:	Lewis Tinley	Program Manager	Land Reclamation and Sedimentation Control
71	Pesticides Control:	Ron Conally	Director	Pesticides Division
72	State Environmental Laboratory:	Otis Woods	Director	Environmental Laboratories
73	Laboratory Certification:	Otis Woods	Director	Environmental Laboratories
74	State Health Department:	James W. Alley	Director	Division of Public Health
75	Radiation Control:	James C. Hardeman Jr.	Coordinator	Environmental Radiation
76	Occupational Health	Don R. Bryant	Assistant Comnr	Field Services
77	Biotechnology	Jamen R. Drinnon		Department of Human Resources
78	Climatology	Dr. Gaither L. Plummer	State Climatologist	Institute of Natural Resources

ADDRESS LINE 1	ADDRESS LINE 2	CITY	ST	ZIP CODE	TELEPHONE	
State Senate	State Capitol	Atlanta	GA	30334	404 656 0028	1
House of Representatives	State Capitol	Atlanta	GA	30334	404 656 5912	2
	205 Butler Street, S.E., Suite 1252	Atlanta	GA	30334	404 656 3500	3
Department of Natural Resources	205 Butler Street, S.E., Room 1162	Atlanta	GA	30334	404 656 6900	4
Department of Natural Resources	205 Butler Street, S.E., Room 1162	Atlanta	GA	30334	404 656 6900	5
Air Protection Branch	4279 Memorial Drive Suite D	Decatur	GA	30032	404 656 5916	6
Air Protection Branch	4291 Memorial Drive Suite M	Decatur	GA	30032	404 656 7410	7
Air Protection Branch	156 Trinity Avenue Suite 315	Atlanta	GA	30303	404 656 4999	8
Air Protection Branch	205 Butler Street, S.E. Room 1162	Atlanta	GA	30334	404 656 6900	9
			GA			
Air Protection Branch	205 Butler Street, S.E., Room 1162	Atlanta	GA	30334	404 656 6900	11
Department of Natural Resources	878 Peachtree Street, N.E. Room 100	Atlanta	GA	30309	404 656 6905	12
Department of Natural Resources	205 Butler Street, S.E., Room 1162	Atlanta	GA	30334	404 894 6644	13
Air Protection Branch	205 Butler Street, S.E., Room 1162	Atlanta	GA	30334	404 656 6900	14
State Patrol Emissions Section	30331 Atlanta Industrial Parkway	Atlanta	GA	30331	404 699 4380	15
Department of Natural Resources	205 Butler Street, S.E. Room 1154	Atlanta	GA	30334	404 656 2833	16
Land Protection Branch	205 Butler Street, S.E. Room 1154	Atlanta	GA	30334	404 656 7802	17
Department of Natural Resources	205 Butler Street, S.E. Room 1152	Atlanta	GA	30334	404 656 6905	18
Department of Natural Resources	205 Butler Street, S.E. Room 1152	Atlanta	GA	30334	404 656 6905	19
Land Protection Branch	205 Butler Street, S.E., Room 1154	Atlanta	GA	30334	404 656 7404	20
Land Protection Branch	205 Butler Street, S.E., Room 1154	Atlanta	GA	30334	404 669 3927	21
Department of Natural Resources	205 Butler Street, S.E., Room 1154	Atlanta	GA	30334	404 656 2833	22
Department of Natural Resources	205 Butler Street, S.E., Room 1152	Atlanta	GA	30334	404 656 4713	23
Land Protection Branch	205 Butler Street, S.E., Room 1154	Atlanta	GA	30334	404 656 7802	24
Land Protection Branch	205 Butlet Street, S.E., Room 1154	Atlanta	GA	30334	404 669 3927	25
			GA			
Land Protection Branch	205 Butler Street, S.E. Room 1154	Atlanta	GA	30334	404 656 7802	27
Land Protection Branch	205 Butler Street, S.E. Room 1154	Atlanta	GA	30334	404 656 2836	28
Land Protection Branch	3240 Norman Berry Drive	Hapeville	GA	30354	404 656 2836	29
Land Protection Branch	3240 Norman Berry Drive	Atlanta	GA	30334	404 656 2836	30
Land Protection Branch	3240 Norman Berry Drive	Hapeville	GA	30354	404 656 2836	31
Land Protection Branch	205 Butler St., S.E., Room 1154	Atlanta	GA	30334	404 656 2833	32
Land Protection Branch	205 Butler St., S.E., Room 1154	Atlanta	GA	30334	404 656 2833	33
Department of Natural Resources	205 Butler Street, S.W., East Toiwer	Atlanta	GA	30334	404 656 4708	34
Department of Natural Resources	1200 Glynn Avenue	Brunswick	GA	31523	912 264 7221	35
Water Protection Branch	205 Butler Street, SW, Room 1058	Atlanta	GA	30334	404 656 4769	36
Department of Natural Resources	205 Butler Street, S.E.	Atlanta	GA	30334	404 656 7404	37
Water Protection Branch	205 Butler Street, SW Room 1066	Atlanta	GA	30334	404 656 4807	38
Water Protection Branch	205 Butler Street, SW Room 1166	Atlanta	GA	30334	404 656 4807	39
Department of Natural Resources	205 Butler Street, S.E., Room 1152	Atlanta	GA	30334	404 656 6905	40
Land Protection Branch	3420 Norman Berry Drive	Hapeville	GA	30354	404 656 7404	41
Water Protection Branch	3420 Norman Berry Drive	Hapeville	GA	30354	404 656 7400	42
Division of Environmental Protection	19 Martin Luther King, Jr. Drive, S.W.	Atlanta	GA	30334	404 656 3214	43
Water Protection Branch	205 Butler Street, S.E., Room 1058	Atlanta	GA	30334	404 656 4887	44
Department of Natural Resources	19 Martin Luther King, Jr. Drive, S.W.	Atlanta	GA	30334	404 656 3214	45
Water Protection Branch	3420 Norman Berry Drive	Hapeville	GA	30354	404 656 7400	46
Water Protection Branch	205 Butler Street, S.E.	Atlanta	GA	30334	404 656 4905	47
Department of Natural Resources	205 Butler Street, S.W.	Atlanta	GA	30334	404 656 4708	48
Department of Natural Resources	205 Butler Street, SW, Room 1066	Atlanta	GA	30334	404 656 4807	49
			GA			
Department of Natural Resources	19 Martin Luther King, Jr. Drive, S.W.	Atlanta	GA	30334	404 656 3214	51
Department of Natural Resources	3420 Norman Berry Drive, 7th Floor	Hapeville	GA	30354	404 656 7404	52
Department of Natural Resources	3240 Norman Berry Drive	Hapeville	GA	30354	404 836 6754	53
Department of Natural Resources	205 Butler Street, S.W., Room 1058	Atlanta	GA	30334	404 656 4708	54
Department of Natural Resources	205 Butler Street, S.W., Room 1066	Atlanta	GA	30334	404 656 4807	55
Department of Natural Resources	205 Butler Street, SW Room 1166	Atlanta	GA	30334	404 656 3094	56
			GA			
Department of Natural Resources	19 Martin Luther King, Jr. Drive, S.W.	Atlanta	GA	30334	404 656 3214	58
Department of Natural Resources	205 Butler Street, SW Room 1058	Atlanta	GA	30334	404 656 4708	59
	205 Butler Street, S.E., Room 1252	Atlanta	GA	30334	404 656 3500	60
Department of Natural Resources	205 Butler Street, S.W., Room 1258	Atlanta	GA	30334	404 656 0772	61
Department of Natural Resources	205 Butler Street, S.W., Room 1362	Atlanta	GA	30334	404 656 3523	62
Department of Natural Resources	P.O. Box 819	Macon	GA	31298	912 744 3237	63
	20 Washington Street, S.W., Room 615	Atlanta	GA	30334	404 656 5176	64
Department of Natural Resources	19 Martin Luther King, Jr. Drive, S.W.	Atlanta	GA	30334	404 656 3214	65
Department of Natural Resources	205 Butler Street, SW Room 1352	Atlanta	GA	30334	404 656 2753	66
			GA			
Department of Natural Resources	205 Butler Street, SW Room 1258	Atlanta	GA	30334	404 656 0772	68
Department of Natural Resources	205 Butler Street, SW Room 1252	Atlanta	GA	30334	404 656 3214	69
Land Protection Branch	3420 Norman Berry Drive	Hapeville	GA	30354	404 656 7404	70
Department of Agriculture	Agricultural Building, 19 MLK Parkway	Atlanta	GA	30334	404 656 4960	71
Program Development Branch	205 Butler Street, S.W., Room 1166	Atlanta	GA	30334	404 656 6905	72
Program Development Branch	205 Butler Street, S.W., Room 1166	Atlanta	GA	30334	404 656 6905	73
Department of Human Resources	878 Peachtree Street, N.E.	Atlanta	GA	30309	404 894 7505	74
Department of Natural Resources	205 Butler Street	Atlanta	GA	30334	404 656 6905	75
Department of Labor	254 Washington Street, SW	Atlanta	GA	30334	404 656 3014	76
	878 Peachtree Street, N.E.	Atlanta	GA	30309	404 894 6644	77
Ecology Building	University of Georgia	Athens	GA	30602	404 542 1535	78

Appendix E: Useful Documents

There are literally hundreds of journals, references, studies and other types of documents which provide useful information relating to the U.S. environmental engineering market. For particular regions and narrow sector niches, firms will best locate the most appropriate journals through speaking with the state governments, industry associations, academics, and other channels mentioned throughout the main text of this study.

In the text of the report, we have suggested a number of documents that could assist Canadian firms. The following documents might be particularly useful for those firms (and governments and associations) that are seriously interested in the U.S. market. Through selecting the appropriate documents, an expenditure of around $US 4-500 might then provide these organizations with substantial savings during the selling process.

- Manufacturing USA - $US 169
- Service Industries USA - $US 169 (less relevant)
- Pulp and Paper Factbook - $US 275 (or other similar resource factbooks)
- American Consulting Engineers Council, Annual Directory - $US 140
- Environmental Engineer Selection Guide - free
- The Cost of a Clean Environment - $US 50
- Resource Guide to State Environmental Management - $US 40
- Encyclopedia of Associations - $US 305

Beyond these documents, many associations produce their own monthly or periodical publication. For example, the Water Pollution Control Federation produces the monthly *Water, Environment and Technology*, while the National Association of Environmental Professionals produces the monthly document *Environmental Professional*. Canadian firms should gather this documentation through the appropriate organizations.

Various regions also produce documents of potential interest to Canadian engineering firms. For instance, *Waste Business West* is a bi-monthly journal aimed at providing waste generating companies with information on new technologies and regulations in the Western United States. Most such documents will be identified by Canadian firms through their discussions with state governments, local associations and the like.

This appendix lists a sampling of other documents which can be collected and reviewed by Canadian firms considering market entry.

American Consulting Engineer

This document is published quarterly by the American Consulting Engineers Council (ACEC) and is available by calling Washington, D.C. at (202) 347-7474. Annual cost for non-members of the association (Canadian firms cannot be members of the ACEC) are $US 40. This journal is the best available publication for discussing the issues, players, and strategies that are at the forefront of the U.S. engineering community.

ENR Magazine

Formerly known as Engineering News Record, ENR is a weekly publication of McGraw-Hill. It reviews activities, trends, forecasts, companies, and issues which are topical in the U.S.

construction and engineering industries. Each weekly issue contains information on specific projects by state and specific proposals by city. ENR is described by some industry contacts as the best source of construction information in the country. Further information and subscriptions may be obtained from ENR at (609) 426-5129. Subscriptions cost around $US 60 annually.

United States Industrial Outlook

The Outlook is produced annually by the International Trade Administration of the U.S. Department of Commerce. The telephone number for the industry publications staff is (202) 377-4356, and the document costs around $US 30. It is a large book which provides a general perspective on the recent status, long-term outlook, trends, and characteristics for some seventy industries. Particularly useful are the names and numbers of the appropriate federal government contact for each of these 70-odd industry sectors.

Trade Show and Convention Guide

This annual publication, available in June of each year, lists and provides information on U.S., Canadian and international trade shows by industry. The guide is available for approximately $US 85 from Billboard Publications in Nashville at (615) 321-4250.

Other Environmental Engineering Periodicals

The following documents deal with a range of environmental subjects of both a technical and general nature. The periodicals are available from Executive Enterprises in New York City at (212) 645-7880. Their contents and annual costs are described below.

Environmental Claims Journal - a quarterly journal which provides information on legal, technical and insurance issues surrounding environmental claims ($US 152).

Environmental Finance: The Journal of Environmental Financing, Accounting, Taxation & Reporting - a quarterly journal that assists finance and accounting professionals and environmental engineers in planning for the impact of environmental laws and regulations on the corporation's bottom line ($US 195).

Environmental Manager - a monthly issue which tracks environmental regulations and the techniques being used to comply with them (US 132).

Federal Facilities Environmental Journal - a quarterly journal which assists firms in answering their detailed compliance questions ($US 144).

Journal of Environmental Permitting - a quarterly journal which assists environmental engineers and managers in developing a method of obtaining and maintaining the necessary air, water and RCRA permits ($US 168).

Journal of Environmental Regulation - a quarterly publication which provides a detailed overview of all major existing and potential environmental legislation ($US 168).

Municipal Environmental Journal - a quarterly hournal which addresses the environmental problems facing local political areas and the strategies being adopted ($US 168).

Pollution Prevention Review - a quarterly journal which discusses source reduction and waste minimization, focussing on solving problems before they begin ($US 132).

Remediation: The Journal of Environmental Cleanup Costs, Technologies & Techniques - a quarterly journal which focusses on remediation techniques and technologies including the economic aspects ($US 168).

Supervisor's Environmental Alert - a monthly newsletter that offers advice to managers and supervisors regarding the handling of daily environmental problems ($US 132).

Total Quality Environmental Management - a quarterly journal that discusses the application of TQM to environmental issues and which addresses industry attitudes and perceptions regarding environmental regulation ($US 168).

Environmental Engineering Books

The following books deal with a range of environmental subjects of both a technical and general nature. Like the above periodicals, they are available from Executive Enterprises in New York City at (212) 645-7880. Their contents and costs are described below.

Chemical Hazard Communication Guidebook - OSHA, EPA, and DOT Regulation - this guide concentrates on chemical hazards, including proper communication, transportation, labeling, and other matters ($US 75).

The Environmental Audit Handbook Series - this five-volume set examines each component of environmental auditing in detail, including the reporting, recordkeeping, management, staffing, government inspection, and other areas ($US 175).

The Environmental Compliance Handbook Series - this six-volume set details the issues and actions surrounding the major environmental regulations and examines how to comply with the legislation governing water, air, solid, toxic and other pollution ($US 195).

The Environmental Dictionary - this 500 page guide defines around 5000 terms used by the EPA and cross-references these to specific regulations ($US 70).

The Environmental Litigation Deskbook - this book details each step of litigation, covering discovery, expert witnesses, causes of action, exposures, statutes and other related matters ($US 60).

Insurance Claims for Environmental Damages - this book examines the legal aspects of insurance claims, what is necessary to manage claims, and technical and engineering strategies ($US 75).

PCB Management Handbook - this guide updates regulations and practices regarding PCBs and their effects ($US 50).

The Pesticide Regulation Handbook - this guide discusses the registration and regulation of pesticides and analyses the complex web of federal and state procedures governing production, distribution and use of pesticides ($US 75).

Protecting Trade Secrets Under SARA Title III - this 300 page book examines how confidentiality and trade secrets can be protected while complying with government regulations on right-to-know matters ($US 60).

Real Estate Transactions and Environmental Risks - this reference explores how different parties to real estate transactions can be affected by environmental complications and outlines steps that can be followed to minimize liability ($US 80).

SARA Title III - Community Right-to-Know - this handbook examines the requirements for reporting, data gathering and information sharing stemming from the SARA requirements for community right-to-know ($US 60).

The Superfund Claims and Litigation Manual - this guide provides insights, lessons and strategies absorbed from firms involved in Superfund projects ($US 50).

Understanding Ground-Water Contamination: An Orientation Manual - this guidebook examines ground-water contamination questions such as cleanup requirements, potential sources, cost estimates, liability costs, and others ($US 60).

Waste Reduction: Policy and Practice - this book explains means of waste reduction such as recycling and source reduction, and also examines other related areas such as government requirements ($US 40).

Appendix F: Contacts at U.S. Universities

As mentioned in the body of the report, universities play a fairly active role supporting environmental research, industrial interaction, and government policy making, among other areas. The document *Peterson's Guide to Graduate Programs in Engineering and Applied Sciences* is an excellent source of information on the main environmental institutions. It is available from Peterson's Guides in Princeton, New Jersey at (609) 243-9111 for $US 33.

This appendix provides excerpts from the document. The two pages that follow provide selected one-paragraph descriptions of the environmental interests and contacts at about 35 U.S. universities. In total, the document presents information on approximately 100 U.S. universities (including a few Canadian universities). This document should be obtained by those Canadian firms that intend to enter the U.S. market through research, scientific or other interaction with an American environmental university.

geomorphology, hydrology, and natural science (MA, MSE, PhD); human geography, urban and regional studies, and spatial location (MA, MSE, PhD); systems and economics for public decision making (MA, MSE, PhD). Faculty: 14 full-time (1 woman), 6 part-time (2 women). Matriculated students: 59 full-time (18 women), 2 part-time (1 woman); includes 2 minority (1 Asian American, 1 Hispanic American), 19 foreign. Average age 25. 109 applicants, 25% accepted. In 1989, 14 master's awarded (5% entered university research/teaching, 59% found other work related to degree, 36% continued full-time study); 8 doctorates awarded (65% entered university research/teaching, 35% found other work related to degree). Terminal master's awarded for partial completion of doctoral program. *Degree requirements:* For master's, 1 foreign language, thesis (for some programs); for doctorate, 1 foreign language, dissertation. *Entrance requirements:* GRE General Test. Application deadline: 2/1. Application fee: $40. *Expenses:* Tuition of $14,000 per year full-time, $1420 per course part-time. Fees of $380 per year. *Financial aid:* In 1989–90, $492,300 in aid awarded. 4 fellowships (1 to a first-year student), 32 research assistantships (10 to first-year students), 2 teaching assistantships (1 to a first-year student), 0 grants were awarded; federal work-study, institutionally sponsored loans also available. Aid available to part-time students. Financial aid application deadline: 2/1; applicants required to submit FAF. *Faculty research:* Systems analysis and economics, surficial earth processes, human geography. Total annual research budget: $876,604. • Dr. Charles R. O'Melia, Chairman, 301-338-7090. Application contact: Dr. Hugh Ellis, 301-338-6116.

Johns Hopkins University, School of Hygiene and Public Health, Department of Environmental Health Sciences, Division of Environmental Health Engineering, Baltimore, MD 21205. Division awards MHS, Sc M, Dr PH, PhD, Sc D. *Degree requirements:* For master's, thesis (for some programs); for doctorate, 1 foreign language, dissertation. *Entrance requirements:* GRE. Application deadline: 2/1. Application fee: $40. *Tuition:* $14,200 per trimester full-time, $295 per credit part-time. *Financial aid:* Federal work-study, institutionally sponsored loans available. Aid available to part-time students. Financial aid application deadline: 4/15; applicants required to submit GAPSFAS or FAF. *Faculty research:* Industrial hygiene and safety, biofluid mechanics, environmental microbiology, aerosol science, microbiological water hazards. • Dr. Morton Corn, Director, 301-955-3602.

Louisiana State University and Agricultural and Mechanical College, College of Engineering, Department of Civil Engineering, Program in Environmental Engineering, Baton Rouge, LA 70803. Program awards MS, PhD. *Degree requirements:* For master's, computer language required, thesis optional, foreign language not required. *Entrance requirements:* GRE General Test, TSE, TOEFL (minimum score of 525 required). Application deadline: 7/1. Application fee: $20. *Tuition:* $1023 per semester full-time, $225 per semester (minimum) part-time for state residents; $2623 per semester full-time, $370 per semester (minimum) part-time for nonresidents. *Faculty research:* Water quality, hazardous waste management, biological treatment processes, modeling-stochastic, lakes management.

See full description on page 489.

Loyola Marymount University, College of Science and Engineering, Department of Civil Engineering and Environmental Science, Programs in Civil Engineering, Los Angeles, CA 90045. Offerings include environmental engineering (MS). Faculty: 2 full-time (0 women), 2 part-time (0 women). *Application fee:* $35. *Expenses:* Tuition of $265 per unit. Fees of $4 per semester. • Dr. James Foxworthy, Chairman, Department of Civil Engineering and Environmental Science, 213-338-2828.

Manhattan College, Leo School of Engineering, Program in Environmental Engineering, Riverdale, NY 10471. Program awards ME, MS. One or more programs accredited by ABET. Part-time and evening/weekend programs available. Faculty: 5 full-time (0 women), 1 part-time (0 women). Matriculated students: 26 full-time (8 women), 40 part-time (14 women); includes 7 minority (6 Asian American, 1 Hispanic American), 9 foreign. Average age 27. 51 applicants, 88% accepted. Nonmatriculated students: 14. In 1989, 16 degrees awarded (100% found work related to degree). *Degree requirements:* Computer language, thesis or alternative. *Entrance requirements:* Minimum GPA of 3.0. Application deadline: 8/10. Application fee: $50. *Expenses:* Tuition of $350 per credit. Fees of $30 per semester. *Financial aid:* In 1989–90, $64,450 in aid awarded. 2 fellowships (both to first-year students), 6 laboratory assistantships (5 to first-year students) were awarded; federal work-study also available. Financial aid application deadline: 2/1. *Faculty research:* Mathematical models of water quality, adsorption-desorption studies, toxic substances modeling. Total annual research budget: $330,000. • Dr. John S. Jeris, Director, 212-920-0276. Application contact: John J. Brennan, Dean of Admissions, 212-920-0200.

Marquette University, College of Engineering, Department of Civil Engineering, Milwaukee, WI 53233. Offerings include environmental/water resources engineering (MS, PhD). Terminal master's awarded for partial completion of doctoral program. Department faculty: 13 full-time, 2 part-time. *Degree requirements:* For master's, thesis or alternative, comprehensive exam required, foreign language not required; for doctorate, dissertation required, foreign language not required. *Entrance requirements:* TOEFL (minimum score of 550 required). Application fee: $25. *Tuition:* $275 per credit (minimum) full-time, $275 per credit part-time. • Dr. Keith F. Faherty, Chairman, 414-288-7030.

Massachusetts Institute of Technology, School of Engineering, Department of Mechanical Engineering, Cambridge, MA 02139. Offerings include environmental engineering (Env E). Department faculty: 61 full-time (2 women), 1 part-time (0 women). *Application deadline:* 1/15. *Application fee:* $40. *Tuition:* $7800 per semester. • Dr. David N. Wormley, Head, 617-253-2246.

McGill University, Faculty of Graduate Studies and Research, Faculty of Engineering, Department of Civil Engineering and Applied Mechanics, Program in Environmental Engineering and Water Resources Management, Montreal, PQ H3A 2T5, Canada. Program awards M Eng, M Sc, PhD. Part-time and evening/weekend programs available. *Degree requirements:* For master's, computer language required, thesis optional, foreign language not required; for doctorate, computer language, dissertation required, foreign language not required. *Entrance requirements:* TOEFL (minimum score of 550 required). Application deadline: 4/1. Application fee: $15. *Faculty research:* Aerobic biological processes, polyelectrolytes, stochastic processes, respirometry, real time operations.

Michigan State University, College of Engineering, Department of Civil and Environmental Engineering, East Lansing, MI 48824. Department offers programs in civil engineering (MS, PhD), civil engineering-urban studies (MS), environmental engineering (MS, PhD), environmental engineering-urban studies (MS). Faculty: 16 full-time (0 women), 0 part-time. Matriculated students: 60 full-time (13 women), 36 part-time (2 women); includes 7 minority (3 Asian American, 2 black American, 2 Hispanic American), 57 foreign. 86 applicants, 38% accepted. In 1989, 28 master's, 7 doctorates awarded. *Degree requirements:* For master's, foreign language and thesis not required; for doctorate, dissertation. *Application fee:* $25. *Expenses:* Tuition of $98 per credit for state residents; $198 per credit for nonresidents. Fees of $110 per quarter. *Financial aid:* In 1989–90, 15 research assistantships, 5 teaching assistantships awarded. • Dr. William E. Saul, Chairperson, 517-355-5107.

Michigan Technological University, College of Engineering, Program in Interdisciplinary Engineering, Houghton, MI 49931. Offerings include environmental engineering (PhD). *Degree requirements:* Dissertation required, foreign language not required. *Entrance requirements:* TOEFL (minimum score of 520 required). Application fee: $20. *Expenses:* Tuition of $812 per quarter full-time, $68 per credit hour part-time for state residents; $2000 per quarter full-time, $164 per credit hour part-time for nonresidents. Fees of $26.25 per quarter full-time, $8.75 per quarter part-time. • Dr. A. Barry Kunz, Dean, College of Engineering, 906-487-2005.

Montana State University, College of Engineering, Department of Civil and Agricultural Engineering, Program in Environmental Engineering, 901 West Garfield Street, Bozeman, MT 59717. Program awards MS. *Degree requirements:* Thesis or alternative required, foreign language not required. *Entrance requirements:* GRE General Test, TOEFL (minimum score of 525 required). Application deadline: 8/1. Application fee: $20. *Tuition:* $1766 per year full-time, $44.60 per credit (minimum) part-time for state residents; $3839 per year full-time, $97.60 per credit (minimum) part-time for nonresidents. • Dr. Ted Lang, Head, Department of Civil and Agricultural Engineering, 406-994-2111.

New Jersey Institute of Technology, Department of Civil and Environmental Engineering, Program in Environmental Engineering, Newark, NJ 07102. Program awards MS, D Eng, DES. Matriculated students: 39 full-time, 41 part-time. In 1989, 47 master's awarded. *Degree requirements:* For master's, foreign language not required. *Application deadline:* 6/5. *Application fee:* $30. *Tuition:* $2350 per semester full-time, $226 per credit part-time for state residents; $3450 per semester full-time, $312 per credit part-time for nonresidents. *Financial aid:* Application deadline 2/5. • Dr. R. Dresnack, Director, 201-596-2469.

North Dakota State University, College of Engineering and Architecture, Department of Civil Engineering, Fargo, ND 58105. Offerings include environmental engineering (MS). Department faculty: 9 full-time (0 women), 0 part-time. *Degree requirements:* Computer language, thesis or alternative required, foreign language not required. *Entrance requirements:* TOEFL (minimum score of 525 required). Application deadline: 7/1. Application fee: $20. *Tuition:* $52.25 per credit for state residents; $132 per credit for nonresidents. • Dr. O. Don Richard, Chair, 701-237-7244.

Northeastern University, Graduate School of Engineering, Department of Civil Engineering, Program in Environmental Engineering, Boston, MA 02115. Program awards MS, MSCE, PhD. Evening/weekend programs available. Terminal master's awarded for partial completion of doctoral program. *Degree requirements:* For master's, thesis required, foreign language not required; for doctorate, 1 foreign language, dissertation, departmental qualifying exam. *Application deadline:* 4/15. *Application fee:* $40. *Expenses:* Tuition of $10,080 per year full-time, $280 per quarter hour part-time. Fees of $12.50 per quarter hour full-time, $0.75 per quarter hour part-time. *Financial aid:* Fellowships, research assistantships, teaching assistantships and career-related internships or fieldwork available. Financial aid application deadline: 2/15. • Dr. Mishac K. Yegian, Chairman, Department of Civil Engineering, 617-437-2444.

Northwestern University, Robert R. McCormick School of Engineering and Applied Sciences, Department of Civil Engineering, Evanston, IL 60208. Offerings include environmental health engineering (MS, PhD). Terminal master's awarded for partial completion of doctoral program. *Degree requirements:* For master's, thesis (for some programs); for doctorate, dissertation. *Entrance requirements:* GRE General Test. Application deadline: 8/30. Application fee: $30. *Tuition:* $13,023 per year full-time, $1628 per course part-time.

Oklahoma State University, College of Engineering, Architecture and Technology, School of Civil Engineering, Program in Environmental Engineering, Stillwater, OK 74078. Program awards M Engr, MS, PhD. *Degree requirements:* Thesis/dissertation required, foreign language not required. *Entrance requirements:* TOEFL (minimum score of 550 required). Application deadline: 7/1. Application fee: $0. *Expenses:* Tuition of $58.20 per credit for state residents; $187 per credit for nonresidents. Fees of $41.75 per semester (minimum). *Financial aid:* Research assistantships, teaching assistantships available. Financial aid application deadline: 3/1. • Robert Hughes, Head, School of Civil Engineering, 405-744-5190.

Oregon Graduate Institute of Science and Technology, Department of Environmental Science and Engineering, Beaverton, OR 97006. Department offers program in environmental science (MS, PhD), including atmospheric physics, atmospheric science. Part-time programs available. Faculty: 11 full-time (0 women), 1 part-time (0 women). Matriculated students: 27 full-time (10 women), 0 part-time; includes 10 foreign. Average age 30. 21 applicants, 52% accepted. Nonmatriculated students: 1. In 1989, 2 master's awarded (100% found work related to degree); 1 doctorate awarded (100% found work related to degree). Terminal master's awarded for partial completion of doctoral program. *Degree requirements:* Thesis/dissertation required, foreign language not required. *Entrance requirements:* GRE General Test, GRE Subject Test, TOEFL (minimum score of 550 required). Application deadline: 3/1. Application fee: $40. *Expenses:* Tuition of $8000 per year full-time, $200 per credit part-time. Fees of $200 per year full-time, $25 per quarter part-time. *Financial aid:* In 1989–90, $308,000 in aid awarded. 0 fellowships, 18 research assistantships (1 to a first-year student) were awarded; partial tuition waivers, institutionally sponsored loans also available. Financial aid application deadline: 3/1. *Faculty research:* Air and water science, hydrogeology, estuarine oceanography. Total annual research budget: $1.34 million. • Dr. James F. Pankow, Chairman, 503-690-1080. Application contact: Margaret B. Day, Director of Admissions and Records, 503-690-1028.

See full description on page 497.

Oregon State University, Graduate School, College of Forestry, Department of Forest Engineering, Corvallis, OR 97331. Department awards MF, MS, PhD. Part-time programs available. Faculty: 9 full-time (0 women), 0 part-time. Matriculated students: 31 full-time (3 women), 3 part-time (0 women); includes 0 minority, 5 foreign. Average age 29. 18 applicants, 72% accepted. In 1989, 6 master's awarded. *Degree requirements:* Computer language, thesis/dissertation required, foreign language not required. *Entrance requirements:* GRE General Test, TOEFL (minimum score of 520 required), minimum GPA of 3.0 in last 90 hours. Application deadline: 2/28. *Tuition:* $912 per quarter full-time, $181 per credit (minimum) part-time for state residents; $1346 per quarter full-time, $252 per credit (minimum) part-time for nonresidents. *Financial aid:* In 1989–90, $84,000 in aid awarded. 3 fellowships (2 to first-year students), 10 research assistantships (4 to first-year students) were awarded; federal work-study and career-related internships or fieldwork also available. Financial aid application deadline: 3/1. *Faculty research:* [illegible] soil and water, training of [illegible]. Total annual research budget: $920,000. • Dr. William A. Atkinson, Head, 503-737-4952.

Directory: Environmental Engineering

Pennsylvania State University at Harrisburg—The Capital College, Division of Science, Engineering and Technology, Program in Environmental Pollution Control, Middletown, PA 17057. Program awards M Eng, MEPC. Evening/weekend programs available. Faculty: 13. Matriculated students: 3 full-time (1 woman), 41 part-time (9 women). In 1989, 3 degrees awarded. *Degree requirements:* Thesis required, foreign language not required. *Entrance requirements:* GRE General Test, TOEFL (minimum score of 560 required), minimum GPA of 2.75. Application deadline: 7/26. Application fee: $35. *Expenses:* Tuition of $2225 per semester full-time, $187 per credit part-time for state residents; $4445 per semester full-time, $370 per credit part-time for nonresidents. Fees of $35 per semester full-time, $12 per semester (minimum) part-time. • Dr. Lawrence A. Ezard, Chairman, 814-865-1415. Application contact: Dr. Charles Cole, 717-948-6133.

Pennsylvania State University University Park Campus, College of Engineering, Department of Civil Engineering, Program in Environmental Engineering, 212 Sackett Bldg., Box E, University Park, PA 16802. Program awards M Eng, MS, PhD. Faculty: 10. Matriculated students: 15 full-time (4 women), 7 part-time (3 women); includes 3 foreign. In 1989, 4 master's, 0 doctorates awarded. *Degree requirements:* For master's, final paper (M Eng), thesis (MS) required, foreign language not required; for doctorate, 1 foreign language, dissertation. *Entrance requirements:* GRE General Test, BS in engineering or science. Application fee: $35. *Tuition:* $2225 per semester full-time, $187 per credit part-time for state residents; $4445 per semester full-time, $370 per credit part-time for nonresidents. *Financial aid:* Fellowships, research assistantships, teaching assistantships available. *Faculty research:* Physical, chemical, biological treatment processes; reclamation and treatment of hazardous and toxic wastes; subsoil transport of pollutants. • Dr. Michael S. Bronzini, Head, Department of Civil Engineering, 814-865-8391. Application contact: Dr. Thomas B. Davinroy, Graduate Admissions Officer.

Polytechnic University, Brooklyn Campus, Division of Engineering, Department of Civil and Environmental Engineering, 333 Jay Street, Brooklyn, NY 11201. Department offers programs in civil and environmental engineering (MS), civil engineering (PhD, Eng), environmental health science (MS). Evening/weekend programs available. *Degree requirements:* For master's, thesis or alternative. *Tuition:* $5820 per semester full-time, $485 per credit part-time.

Rensselaer Polytechnic Institute, Schools of Engineering and Science, Department of Environmental Engineering and Environmental Sciences, Troy, NY 12180. Department awards M Eng, MS, PhD. Faculty: 2 full-time (0 women), 2 part-time (0 women). Matriculated students: 17 full-time (6 women), 11 part-time (5 women); includes 1 minority (Asian American), 4 foreign, 45 applicants, 64% accepted. In 1989, 2 master's, 0 doctorates awarded. *Degree requirements:* For master's, thesis, oral exam required, foreign language not required; for doctorate, dissertation required, foreign language not required. *Entrance requirements:* GRE, TOEFL. Application fee: $30. *Expenses:* Tuition of $430 per credit hour. Fees of $185 per semester. *Financial aid:* Fellowships, research assistantships, teaching assistantships, and career-related internships or fieldwork available. Financial aid application deadline: 2/1. *Faculty research:* Ground water contamination, combustion/incineration, biological treatment, land application, ecosystem modeling. Total annual research budget: $100,000. • Dr. Nicholas Clescen, Director, 518-276-6416.

See full description on page 501.

Rice University, George R. Brown School of Engineering, Department of Environmental Science and Engineering, Houston, TX 77251. Department offers programs in environmental engineering (MEE, MES, MS, PhD), environmental science (MEE, MES, MS, PhD). Part-time programs available. *Degree requirements:* For master's, thesis required (for some programs), foreign language not required; for doctorate, dissertation required, foreign language not required. *Entrance requirements:* GRE General Test, TOEFL. Application deadline: 3/1. Application fee: $0. *Expenses:* Tuition of $3650 per semester full-time, $320 per credit hour part-time. Fees of $50 per semester. *Faculty research:* Biology and chemistry of groundwater, pollutant fate in groundwater systems, water quality monitoring, urban storm water runoff.

Rutgers, The State University of New Jersey, New Brunswick, Program in Civil and Environmental Engineering, New Brunswick, NJ 08903. Program awards MS, PhD. Part-time and evening/weekend programs available. Faculty: 15 full-time (1 woman), 0 part-time. Matriculated students: 28 full-time (4 women), 42 part-time (9 women); includes 27 minority (24 Asian American, 1 black American, 2 Hispanic American), 31 foreign, 122 applicants, 43% accepted. Nonmatriculated students: 21. In 1989, 14 master's, 2 doctorates awarded. *Degree requirements:* For master's, thesis optional, foreign language not required; for doctorate, dissertation required, foreign language not required. *Entrance requirements:* GRE General Test. Application deadline: 6/1. Application fee: $35. *Expenses:* Tuition of $2033 per semester full-time, $168 per credit part-time for state residents; $2980 per semester full-time, $247 per credit part-time for nonresidents. Fees of $173 per semester full-time, $45 per semester part-time. *Financial aid:* In 1989–90, 1 fellowship (to a first-year student), 5 research assistantships (2 to first-year students), 6 teaching assistantships (1 to a first-year student), 2 scholarships (both to first-year students) awarded; federal work-study also available. Financial aid application deadline: 3/1. *Faculty research:* Soil mechanics, structural analysis and design, environmental geotechnology, water resources, composite materials. Total annual research budget: $240,000. • Yong S. Chae, Director, 201-932-2232.

State University of New York at Buffalo, Graduate School, School of Engineering and Applied Sciences, Department of Civil Engineering, Buffalo, NY 14260. Offerings include water resources and environmental engineering (ME, MS, PhD). Department faculty: 29 full-time (0 women), 0 part-time. *Degree requirements:* For master's, computer language, thesis or project required, foreign language not required; for doctorate, computer language, dissertation required, foreign language not required. *Entrance requirements:* GRE General Test, TOEFL (minimum score of 550 required). Application deadline: 2/1. Application fee: $35. *Expenses:* Tuition of $2150 per year full-time, $90 per credit part-time for state residents; $5465 per year full-time, $230 per credit part-time for nonresidents. Fees of $40 per semester. • Dr. Dale D. Meredith, Chairman, 716-636-2157. Application contact: Dr. A. Scott Weber, Director of Graduate Admissions, 716-636-2783.

State University of New York College of Environmental Science and Forestry, Faculty of Environmental and Resource Engineering, Syracuse, NY 13210. Faculty awards MS, PhD. Part-time programs available. Faculty: 27 full-time (0 women), 0 part-time. Matriculated students: 40 full-time (8 women), 48 part-time (9 women); includes 1 minority (Hispanic American), 34 foreign, 41 applicants, 66% accepted. In 1989, 8 master's, 1 doctorate awarded. *Degree requirements:* For master's, thesis or alternative required, foreign language not required; for doctorate, variable foreign language requirement, dissertation. *Entrance requirements:* GRE General Test (minimum combined score of 1800 on all three sections required), minimum GPA of 3.0. Application deadline: 7/15. Application fee: $35. *Expenses:* Tuition of $2150 per year full-time, $90 per credit part-time for state residents; $5465 per year full-time, $230 per credit hour part-time for nonresidents. Fees of $55 per year full-time, $14.50 per semester (minimum) part-time. *Financial aid:* In 1989–90, $189,529 in aid awarded; 0 fellowships, 27 research assistantships, 14 teaching assistantships were awarded; federal work-study also available. Aid available to part-time students. *Faculty research:* Forest engineering, paper science and engineering, wood products engineering. • Dr. Robert Brock, Chairperson, 315-470-6510. Application contact: Robert H. Frey, Dean, Instruction and Graduate Studies, 315-470-6599.

Syracuse University, L. C. Smith College of Engineering, Department of Civil Engineering, Syracuse, NY 13244. Offerings include environmental engineering (MS). Department faculty: 7 full-time, 1 part-time. *Degree requirements:* Foreign language not required. *Entrance requirements:* GRE General Test, GRE Subject Test. Application fee: $40. *Expenses:* Tuition of $357 per credit. Fees of $276 per year full-time, $34 per semester part-time. • Dr. Samuel P. Clemence, Chairman, 315-443-2554.

Texas A&M University, College of Engineering, Department of Civil Engineering, Program in Environmental Engineering, College Station, TX 77843. Program awards M Eng, MS, D Eng, PhD. Faculty: 10 full-time. *Degree requirements:* For master's, thesis (MS) required, foreign language not required; for doctorate, internship (D Eng), dissertation (PhD) required, foreign language not required. *Entrance requirements:* GRE General Test, TOEFL. Application deadline: 7/15. Application fee: $25. *Tuition:* $233 per semester (minimum) full-time, $165 per semester (minimum) part-time for state residents; $857 per semester (minimum) full-time, $431 per semester (minimum) part-time for nonresidents. *Financial aid:* Fellowships, research assistantships, teaching assistantships available. *Faculty research:* Prediction and control of environmental consequences, water resources, air resources, liquid and solid waste control technology, public health and sanitation. • Dr. Roy W. Hann, Jr., Head, 401-845-1418.

Université de Sherbrooke, Faculty of Applied Sciences, Program in the Environment, Sherbrooke, PQ J1K 2R1, Canada. Program awards M Env. *Degree requirements:* Thesis. *Application deadline:* 6/30. *Application fee:* $15. *Expenses:* Tuition of $410 per trimester full-time, $31.67 per credit part-time for Canadian residents: $290 per trimester full-time, $195 per credit part-time for nonresidents. Fees of $128 per trimester full-time, $7.75 per credit part-time for Canadian residents: $680 per year full-time, $7.50 per credit part-time for nonresidents.

University of Alabama, College of Engineering, Department of Civil Engineering, Program in Environmental Engineering, Tuscaloosa, AL 35487. Program awards MSE. Faculty: 10 full-time (0 women), 0 part-time. Matriculated students: 4 full-time (1 woman), 3 part-time (0 women); includes 2 foreign. Average age 28. 5 applicants, 100% accepted. *Degree requirements:* Thesis or alternative required, foreign language not required. *Entrance requirements:* GRE General Test (minimum combined score of 1500 on all three sections required, minimum score of 1600 on all three sections for international students), minimum GPA of 3.0 in last 60 hours. Application deadline: 7/6. Application fee: $20. *Expenses:* Tuition of $1810 per year full-time, $77 per credit hour part-time for state residents; $4486 per year full-time, $204 per credit hour part-time for nonresidents. Fees of $152 per semester (minimum) part-time. *Financial aid:* In 1989–90, 0 fellowships, 1 research assistantship (0 to first-year students), 0 teaching assistantships awarded; federal work-study also available. *Faculty research:* Water treatment, ozonation, waste treatment, incineration of hazardous waste. • Dr. Daniel S. Turner, Head, Department of Civil Engineering, 205-348-6550.

University of Alaska Anchorage, School of Engineering, Program in Environmental Quality Engineering and Environmental Quality Science, Anchorage, AK 99508. Offers environmental quality engineering (MS), environmental quality science (MS). Part-time and evening/weekend programs available. Faculty: 2 full-time (0 women), 2 part-time (1 woman). Matriculated students: 0 full-time, 31 part-time (8 women); includes 0 foreign, 10 applicants, 90% accepted. Nonmatriculated students: 0. In 1989, 2 degrees awarded. *Degree requirements:* Computer language required, foreign language and thesis not required. *Entrance requirements:* Degree in engineering or a scientific field. Application deadline: 5/1. Application fee: $40. *Expenses:* Tuition of $765 per semester full-time, $85 per credit part-time for state residents; $1530 per semester full-time, $170 per credit part-time for nonresidents. Fees of $37 per semester. *Financial aid:* Federal work-study available. Aid available to part-time students. Financial aid application deadline: 4/15; applicants required to submit FAF. *Faculty research:* Wastewater treatment, environmental regulations, water resources management, justification of public facilities. • Dr. Robert Miller, Head, 907-786-1900. Application contact: Linda Berg Smith, Director, Admissions and Student Relations, 907-786-1525.

University of Alaska Fairbanks, School of Engineering, Department of Civil Engineering, Fairbanks, AK 99775. Offerings include environmental quality engineering (MS), environmental quality science (MS). Department faculty: 7 full-time, 3 part-time. *Application fee:* $20. *Expenses:* Tuition of $90 per credit part-time for state residents; $3240 per year full-time, $180 per credit part-time for nonresidents. Fees of $420 per year full-time. • Dr. Leroy Hulsey, Head, 907-474-7241.

University of Arkansas, College of Engineering, Department of Civil Engineering, Program in Environmental Engineering, Fayetteville, AR 72701. Program awards MS En E. Matriculated students: 1 full-time (0 women), 2 part-time (0 women); includes 0 minority, 0 foreign. In 1989, 1 degree awarded. *Degree requirements:* Thesis optional, foreign language not required. *Application fee:* $15. *Tuition:* $3000 per year full-time, $104 per credit hour part-time for state residents; $4450 per year full-time, $222 per credit hour part-time for nonresidents. • Dr. James C. Young, Chairperson, Department of Civil Engineering, 501-575-4954.

University of California at Berkeley, College of Engineering, Department of Civil Engineering, Division of Sanitary, Environmental, Coastal, and Hydraulic Engineering, Berkeley, CA 94720. Division offers programs in hydraulic and coastal engineering (M Eng, MS, D Eng, PhD), sanitary and environmental engineering (M Eng, MS, D Eng, PhD). *Degree requirements:* For master's, thesis or comprehensive exam (MS); for doctorate, dissertation, qualifying exam. *Entrance requirements:* GRE General Test, minimum GPA of 3.0. Application deadline: 2/10. *Expenses:* Tuition of $958 per semester. Fees of $2000 per semester for nonresidents. *Financial aid:* Fellowships, research assistantships, teaching assistantships available. • J. F. Thomas, Chairman.

University of California, Los Angeles, School of Engineering and Applied Science, Department of Civil Engineering, Los Angeles, CA 90024. Department offers programs in earthquake engineering (MS, PhD), geotechnical engineering (MS, PhD), structures and structural mechanics (MS, PhD), water resources and environmental engineering (MS, PhD). Faculty: 17. Matriculated students: 85 full-time (12 women), 0 part-time; includes 34 foreign, 106 applicants, 57% accepted. In 1989, 23 master's, 11 doctorates awarded. *Degree requirements:* For master's, thesis or comprehensive exam required, foreign language not required; for doctorate, dissertation, qualifying exams required, foreign language not required. *Entrance requirements:* For master's, GRE General Test, GRE Subject Test, minimum GPA of

Appendix G: U.S. Engineering Firms

As mentioned in the body of the report, Canadian firms may wish to explore alliance possibilities with appropriate U.S. engineering/environmental companies. Generally, firms would identify partners through seminars, shows, discussions with local people, and other channels. At this point, Canadian firms can then obtain further information from references that are available in Canada describing U.S. engineering firms and environmental engineering firms. This appendix provides a sampling of the information contained in these references. Such references are available through the Association of Consulting Engineers in Ottawa, or through contacting the numbers described in Section 4.1.4.

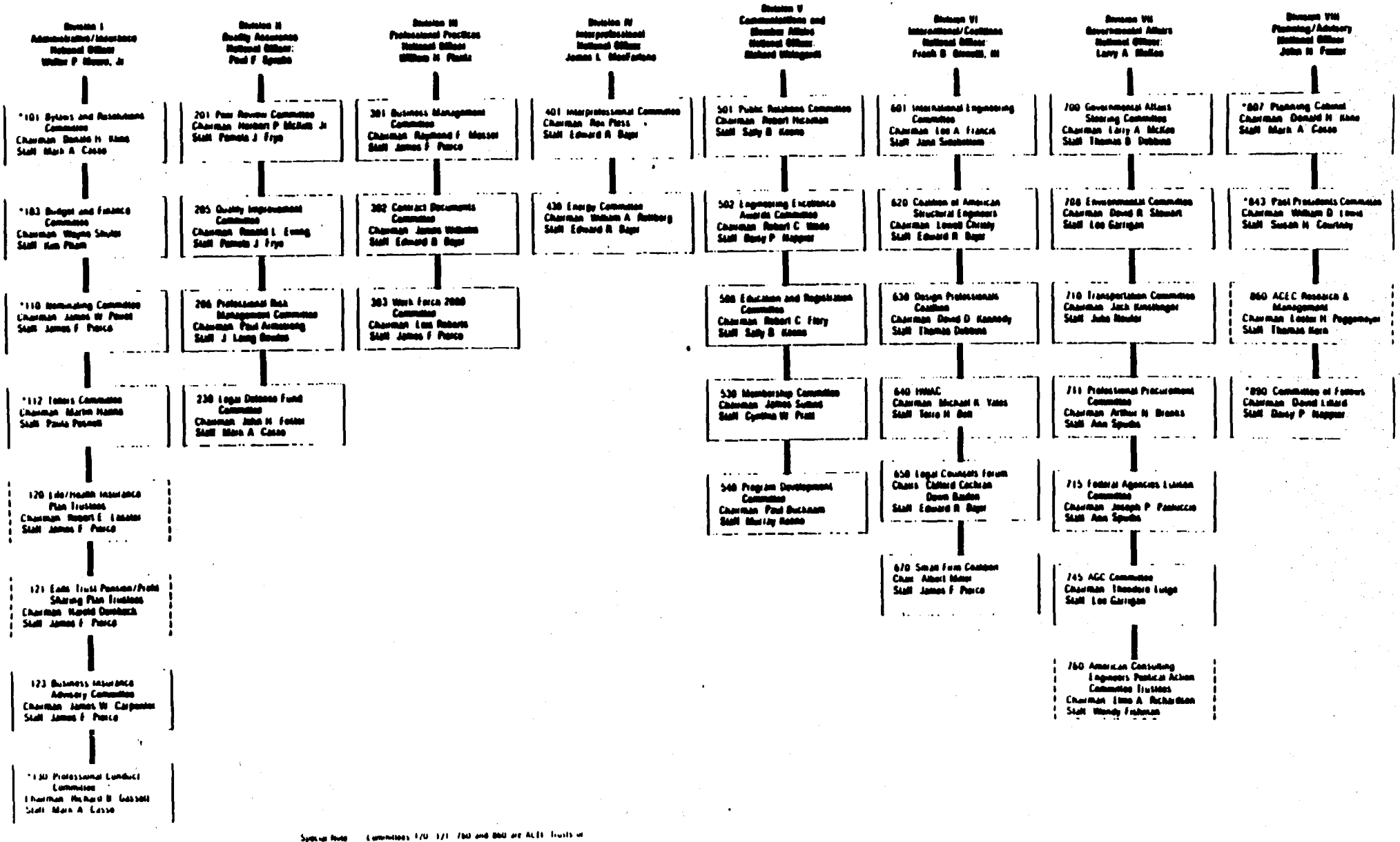
The first three pages of this appendix provide an overview of the organization of the American Consulting Engineers Council (ACEC) in the United States. As indicated, the ACEC has 50 member organizations as well as some 39 Committees formed to address a wide range of industry issues. Also included in this appendix is an indication of the type of information that can be obtained on individual firms - the example in this case being engineering firms in New Jersey.

The fourth page illustrates the names of some 150 U.S. environmental engineering firms, as taken from the Consulting Organizations Directory. As described in Section Four, the Directory can then be referred to in order to obtain more detailed information on each company.

The final page of the appendix, derived from the ACEC Directory, indicates the size and number of engineering consulting firms in the sixteen states included in this study.

THE FIFTY-ONE ACEC MEMBER ORGANIZATIONS

1991–92
ACEC Committees



Special Note: Committees 120, 121, 780 and 860 are ACEC Trusts or Corporations with legally designated committees having fixed term appointments.

New Jersey

Terms of office commenced in July 1991.

President
Leo A. Santowasso
HERITAGE CONSULTING ENGINEERS
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P O Box 3400
Flemington NJ 08822
(908) 782-3400

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70 South Orange Avenue
Livingston NJ 07039-4903
(201) 994-4520

Vice President
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FRANK H. LEHR ASSOCIATES
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(201) 673-2320

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(201) 994-4520

Vice President
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(201) 377-8500

Secretary
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Raritan Plaza I
Raritan Center
Edison NJ 08818-3687
(201) 225-7000

Treasurer
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Morristown NJ 07960-1519
(201) 539-8050

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H. Clay McEldowney
STUDER AND McELDOWNEY, P.A.
120 Highway 22
Clinton NJ 08809
(201) 730-6000

Alternate Director
John P. Talenco
FREDERIC R. HARRIS, INC.
Parkway Towers, Building B
485 U.S. Route One South
Iselin NJ 08830
(201) 636-4990

Past President
John P. Talenco
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Iselin NJ 08830
(201) 636-4990

Director
Dominic B. Carruno
TIGHE, FIRTION, CARRINO & ASSOCIATES, INC.
854 8th Street
P O Box 1098
Secaucus NJ 07096-1098
(201) 348-1607

Director
Arthur L. Doran
MOSHER & DORAN CONSULTING MECHANICAL & ELECTRICAL ENGINEERS
3090 Woodbridge Avenue
Suite 300
Edison NJ 08818
(908) 225-9669

Executive Director
Peter Allen, CAE
Consulting Engineers Council of New Jersey
66 Morris Avenue
P O. Box 359
Springfield NJ 07081
(201) 379-1100
FAX: (201) 379-6507

MEMBER FIRMS

RICHARD A. ALAIMO ASSOCIATES 130
200 High Street
Mount Holly, NJ 08060-0458
(609) 267-8310
FAX: (609) 267-7452
Branch Office
#2 Market Street
Paterson NJ 07501
(201) 523-6200
Principals: Richard A. Alaimo, Eugene W. Engelbrecht, T. R. Gaell, A. L. Talbot
Activities: Consulting and municipal engineering, sanitary sewerage, highways and roads, environmental impact and feasibility studies. Architectural studies and design - commercial, industrial, institutional, and residential. Solid Waste and Resource Recovery, Urban and Land Planning.
Ownership: Privately-owned Corporation

ALMEC ENGINEERING, INC. 1
33 Second Street
Raritan, NJ 08869
(908) 526-2224
FAX: (908) 526-8666
Principals: Michael E. Curne
Activities: Electrical consulting engineering.
Ownership: Publicly-held Stock

AMERCOM CORP., COSULTING ENGINEERS 1
83 No Beverwyck Road
Lake Hiawatha, NJ 07034
(201) 402-6111
Principals: Young Lee
Activities: Civil and transportation consulting engineering firm; involves engineering Planning, inspection, traffic/studies and site design.
Ownership: Sole Proprietorship

ANDREWS & CLARK, INC. 5
744 Broad Street
Suite 522
Newark, NJ 07102
(201) 623-3336
Principals: Adolph A. Trinidad, Jr., Lane K. Hardin, William Cohon, Leonard J. Schneidt, Steven R. White, Chris A. Halpin
Activities: Transportation planning and design services for highway and railroad projects, including steel and concrete bridge design, bridge inspection and rehabilitation. Planning and design for major sites, parks and waterfront development including drainage, sanitary and utility systems. Services include land surveying, traffic engineering and preparation of environmental assessments.
Ownership: OWNERSHIP CODE 00 Branch office of Andrews & Clark, Inc., New York, New York

APPLIED ENGINEERING & TECHNOLOGY, P.C. 1
418 Wall Street
Princeton, NJ 08540
(609) 921-8999
FAX: (609) 921-0483
Principals: Harald Greve
Activities: Structural Engineering Consulting. Design, evaluation, and investigation of buildings, bridges, sanitation facilities, storage tanks, underpinning, formwork, and corrosion. Perform monoring, instrumentation and computer modeling services.
Ownership: Professional Corporation

BARER ENGINEERING, P.A. 1
515 Clifton Avenue
Lakewood, NJ 08701-3290
(908) 363-0714
Principals: Seymour Barer
Activities: Chemical, mechanical, environmental, and forensic engineering. Specializing in industrial wastewater treatment facilities; industrial process engineering; hazardous and toxic wastes engineering; Clean-up disposal systems and landfill sites; plant decontamination. Also included are accident investigation and reports, building inspections, product liability and fire/explosion, industrial accidents, construction claims, hazardous/toxic wastes, slip/fall, machinery & equipment cases.
Ownership: Privately-owned Corporation

BARNICKEL ENGINEERING CORPORATION 6
860 King George Road
Fords, NJ 08863
(201) 738-3777
FAX: (201) 738-4577
Principals: Donald J. Barnickel, Pres. Steven Langan, Vice Pr
Activities: Feasibility studies, budgets, design and field administration of heating, ventilating, air conditioning, plumbing and electrical systems for commercial, industrial, and multiple dwelling buildings, energy conservation, life-cycle cost analysis.
Ownership: Privately-owned Corporation

RICHARD L. BAUGHMAN & ASSOCIATES 1
32 Charlemagne Place
Pine Brook, NJ 07058
(201) 808-1544
Principals: Richard L. Baughman
Activities: Design of material handling systems for distribution centers, development of methods, preparation of bid specifications for equipment used in design, training.
Ownership: Sole Proprietorship

BAY POINTE ENGINEERING ASSOCIATES, INC. 20
P.O. Box 1731
Pt. Pleasant Beach, NJ 08742
(908) 892-5700
FAX: (908) 892-2943
Principals: John E. Walsh, Glenn R. Gerken, Thomas T. Crader, Paul L. Clare
Activities: Municipal and consulting engineers, planners and surveyors.
Ownership: Privately-owned Corporation

BCM ENGINEERS 60
302 Evesham Commons
Route 73 and Evesham Road
Mariton, NJ 08053-9644
(609) 596-6600
FAX: (609) 596-1614
Branch Office
101 Two Hundred Building
Scarborough Dr. Eng., Cenk Ctr
Pleasantville NJ 08232
(609) 645-9500
Branch Office
Bromley Corporate Center
Two Tern Lane
Burlington NJ 08016
Principals: J. Michael Mullin, Gary P. Franklin, Benjamin F. Blair, Jr., John W. Fowler
Activities: Environmental engineering; wastewater treatment; water supply; air toxics; solid waste and resource recovery; toxic and hazardous waste management; preparation of environmental assessment studies; scientific studies; land planning and engineering; water supply and treatment, feasibility studies and reports, laboratory services; construction management and forensic engineering.
Ownership: Privately-owned Corporation
Division of BCM Engineers, Plymouth Meeting, PA

M. BENTON & ASSOCIATES 4
Research Park, 314 Wall St
Princeton, NJ 08540-1515
(609) 921-6754
FAX: (609) 921-0704
Principals: Maurice Benton, Albert Pressler
Activities: Heating, ventilating, air conditioning, fire safety and sanitary system design for commercial, institutional, industrial and residential building structures.
Ownership: Privately-owned Partnership

LOUIS BERGER INTERNATIONAL, INC. 459
100 Halsted Street
East Orange, NJ 07019-2612
(201) 678-1960
FAX: (201) 672-4284
Principals: Dr. Louis Berger, Dennis M. Wolff, Pat Quinn, Thomas L. Weck, Fredric Berger, Rudolph Wrubel, Gerald Shea, John Hotson, Nicholas Masucci, Patrick Malone, C. Donald Wood, Roy Attride, Roger Patton
Activities: Technical and economic feasibility studies, final design, supervision of construction and construction management services, covering transporation (ports, highways, mass transit, railways, and airfields), water resources, environmental engineering, agriculture, urban services, regional and physical planning, architecture, environmental impact analysis, cultural resources, hazardous materials management, and computer applications, in U.S. and worldwide
Ownership: Employee-Owned Corporation

BERGMAN HATTON ASSOCIATES 3
741 Alexander Road
Princeton, NJ 08540-6390
(609) 452-0580
FAX: (609) 452-9254
Principals: Elmer W. Bergman, James B. Hatton
Activities: Consulting Civil Engineering Services: Design, site development, subdivisions, feasibility studies, municipal engineering and inspection services, stormwater management, drainage, hydraulics/hydrology, sewerage facilities and sanitation services.
Ownership: Privately-owned Corporation

MORRIS BERKOWITZ, CONSULTING ENGINEER 1
10 Glen Mawr Drive
Trenton, NJ 08618
(609) 882-9206
Principals: Morris Berkowitz

Belcher Engineering, Incorporated (Westfield, NJ) ■ 13852
Lewis H. Bell and Associates (Trumbull, CT) ■ 604
Bellomo-McGee Inc. (Vienna, VA) ■ 8579
Bendix Environmental Research, Inc.—BERI (San Francisco, CA) ■ 8581
Benham Group (Oklahoma City, OK) ■ 6799
Bennett Laboratories (Tacoma, WA) ■ 6800
Louis Berger International (East Orange, NJ) ■ 8584
Berger/Abam Engineers Inc. (Federal Way, WA) ■ 6802
Bergmann Associates (Rochester, NY) ■ 6803
W. Gale Biggs Associates (Boulder, CO) ■ 8593
Bio-Conseil Inc. (Ste-Foy, PQ, Canada) ■ 8596
Biological Environmental Consultant Services, Inc. (Phoenix, AZ) ■ 8598
Biological Monitoring, Inc. (Blacksburg, VA) ■ 8600
Bioscience Management, Inc. (Bethlehem, PA) ■ 8601
Bison Engineering/Research (Helena, MT) ■ 8604
Warren Blazier Associates, Inc. (San Francisco, CA) ■ 614
Clinton Bogert Associates (Englewood Cliffs, NJ) ■ 8611
Bolme Engineering (Seattle, WA) ■ 13877
Bolstad Engineering Associates, Ltd. (Edmonton, AB, Canada) ■ 618
Floyd C. Bossard & Associates, Inc. (Butte, MT) ■ 8615
Boyle Engineering Corporation (Newport Beach, CA) ■ 8619
BR Laboratories Inc. (Huntington Beach, CA) ■ 6843
Bradbury & Drenning, Ltd. (Woodbridge, VA) ■ 8621
Clifford R. Bragdon & Associates (Stone Mountain, GA) ■ 8623
Braun Engineering Testing Inc. (Eden Prairie, MN) ■ 8625
Bredberg & Associates (Newfields, NH) ■ 94
Bregman & Company, Inc. (Chevy Chase, MD) ■ 8626
Allen Brodsky Consultants (Berlin, MD) ■ 9931
Warner A. Broughman, III, & Associates (Lexington, KY) ■ 6856
Brown and Caldwell (Walnut Creek, CA) ■ 6859
K.W. Brown Associates, Inc. (College Station, TX) ■ 8631
Brown, Vence & Associates, Energy and Environmental Engineers (San Francisco, CA) ■ 8633
Walter Brown Associates (Mississauga, ON, Canada) ■ 8634
Brucker and Associates Ltd. (Saint Louis, MO) ■ 8637
Bryant Associates, Inc. (Boston, MA) ■ 8865
BSC Group (Boston, MA) ■ 8638
Buchart-Horn, Inc. (York, PA) ■ 636
Jack J. Bulloff (Schenectady, NY) ■ 8642
Burk & Associates, Inc. (New Orleans, LA) ■ 8644
Burns & McDonnell—Engineers-Architects-Consultants (Kansas City, MO) ■ 6878
BWC (Parkersburg, WV) ■ 9955
Ed Caicedo, Inc. (Lexington, KY) ■ 8650
Calocennos & Spina Engineers (Liverpool, NY) ■ 6894
Camargo Associates, Limited (Cincinnati, OH) ■ 6896
CAMO Pollution Control, Inc. (Poughkeepsie, NY) ■ 8657
Camp and Associates, Inc. (Atlanta, GA) ■ 6899
Camp Dresser and McKee Incorporated (Cambridge, MA) ■ 6900
Carnow, Conibear & Associates, Ltd. (Chicago, IL) ■ 9977
John Carollo Engineers (Phoenix, AZ) ■ 8669
Carpenter Environmental Associates, Inc. (Northvale, NJ) ■ 8670
Carr Research Laboratory, Inc. (Wellesley, MA) ■ 8671
Les A. Cartier & Associates, Inc. (Candia, NH) ■ 8674
Cartwright Consulting Co. (Minneapolis, MN) ■ 6917
Catalyst Group, Inc. (Spring House, PA) ■ 13930
CBC—Environmental Services (Oak Creek, WI) ■ 8681
CDS Laboratories (Durango, CO) ■ 8682
The Center for Blast Resistant Design (Silver Spring, MD) ■ 6927
Center for Environmental Information, Inc. (Rochester, NY) ■ 8685
Central Engineers & Architects (Beaver Dam, WI) ■ 6929
Central States Environmental Services (Centralia, IL) ■ 8686
Century West Engineering Corporation (Bend, OR) ■ 6932
Cerami and Associates, Inc. (Long Island City, NY) ■ 659
Certified Engineering & Testing Company, Inc. (Weymouth, MA) ■ 8687
Howard H. Chang (Rancho Santa Fe, CA) ■ 8689
Chapman Environmental Controls, Inc. (Osceola, IN) ■ 8692
Homer L. Chastain & Associates (Decatur, IL) ■ 6938
Chemical Engineering Research Consultants, Ltd. (Toronto, ON, Canada) ■ 6943
Chemlab Environmental Service (Amarillo, TX) ■ 8695
Chester Engineers (Pittsburgh, PA) ■ 8697
CH2M Hill (Corvallis, OR) ■ 6954
Circuit Engineering (Weston, MA) ■ 6957
Citi-Chem, Inc. (Cherry Hill, NJ) ■ 6958
CKY Inc. (Torrance, CA) ■ 8699
Frederick P. Clark Associates (Rye, NY) ■ 8700
Claymore Engineering (Fullerton, CA) ■ 6965
Clayton Environmental Consultants, Inc. (Novi, MI) ■ 8704
Clean Air Engineering, Incorporated (Palatine, IL) ■ 8705
Coastal Resources, Inc. (Annapolis, MD) ■ 8709
Coffman Engineers, Inc. (Seattle, WA) ■ 6970
W.T. Cohan, Inc. (Grand Junction, CO) ■ 8717
Collaboration in Science and Technology Inc.—CSTI (Houston, TX) ■ 6976
Combustion Processes, Incorporated (Danen, CT) ■ 6979
Commercial Testing Laboratory, Inc. (Colfax, WI) ■ 6980
Commonwealth Technology, Inc. (Lexington, KY) ■ 8723
Conservtech (Vernon, CA) ■ 8729
Consulting Services Inc. (Exton, PA) ■ 8731
Controls for Environmental Pollution, Inc. (Santa Fe, NM) ■ 8733
Cooksley Geophysics, Inc. (Redding, CA) ■ 8734
Coolex Technologies International Inc. (Upper Marlboro, MD) ■ 7003
Cotton/Beland/Associates Inc. (Pasadena, CA) ■ 8737
Covert and Associates (Hendersonville, TN) ■ 10047
Cox-Walker & Associates, Inc. (Baton Rouge, LA) ■ 7016
Eugene P. Coyle & Associates (San Francisco, CA) ■ 2448
Craver & Craver, Inc. (Glendale, MO) ■ 7018
CSI (Novato, CA) ■ 8750
Tomi Curtis (Washington, DC) ■ 8753
Dames and Moore (Los Angeles, CA) ■ 7041
Daniel Consultant, Inc. (Columbia, MD) ■ 8757
D'Appolonia (Monroeville, PA) ■ 8758
Daub & Associates Consulting Geologists (Grand Junction, CO) ■ 8760
Dell Engineering, Inc. (Holland, MI) ■ 8770
Dena Ewing Stratford and Associates (South Lake Tahoe, CA) ■ 8772
Denver Knight Piesold Environmental Consultants Inc. (Denver, CO) ■ 8774
Detail Associates, Inc. (Englewood, NJ) ■ 8777
D/E3, Inc. (Cleveland, OH) ■ 8778
Dicesare Bentley Engineers Inc. (Groton, CT) ■ 8783
Schaefer Dixon Associates, Inc. (Irvine, CA) ■ 8788
DKI Group Engineers, Inc. (Clifton Park, NY) ■ 8789
Dolan & Domenici (Albuquerque, NM) ■ 8795
Domingue, Szabo & Associates, Inc. (Lafayette LA) ■ 7098
Dominion Ecological Consulting Ltd. (Calgary, AB, Canada) ■ 8796
DOWL Engineers (Anchorage, AK) ■ 7105
Brian W. Doyle Engineering (Putnam Valley NY) ■ 7106
DPRA Incorporated (Manhattan, KS) ■ 8801
D.R. Technology (Clarksburg, NJ) ■ 8802
S.M. Draganov & Associates (Tustin, CA) ■ 7109
DSA Group, Inc. (Tampa, FL) ■ 7115
E.I. du Pont de Nemours & Co., Inc. (Wilmington, DE) ■ 8804
E.I. du Pont de Nemours and Company, Inc. (Wilmington, DE) ■ 10100
Dubois & King, Inc. (Randolph, VT) ■ 8805
Dunbar Geotechnical Engineers (Columbus, OH) ■ 8806
Duncan and Jones (Berkeley, CA) ■ 8807
Dunn Geoscience Corporation (Albany, NY) ■ 8810
The Dynamic Consultants (San Juan Capistrano, CA) ■ 7124
Dytec Engineering, Inc. (Huntington Beach, CA ■ 721
E-Three Inc. (Buffalo, NY) ■ 8811
Earth Metrics Inc. (Brisbane, CA) ■ 8813
Earth Science Associates/ESA Consultants (Palo Alto, CA) ■ 8814
Earth Systems Consultants (Palo Alto, CA) ■ 8816
Earth Technology Corporation (Long Beach, CA) ■ 8817
East Texas Testing Lab. (Tyler, TX) ■ 7130
Eberhard Engineering (Smithtown, NY) ■ 7133
ECM Environmental Consultants (Hanover, MD ■ 8822
Ecological Services (Urbana, IL) ■ 8823
Ecologistics Limited (Waterloo, ON, Canada) ■ 8824
Ecology and Environment, Inc. (Lancaster NY ■ 8825
Economic & Engineering Services, Inc. (Bellevue, WA) ■ 2578
EDECO, Inc. (Tulsa, OK) ■ 7144
Eder Associates Consulting Engineers (Locust Valley, NY) ■ 8829
Edeskuty Engineering (Minnetonka, MN) ■ 7148
EG&G WASC Oceanographic Services (Waltham, MA) ■ 8835
Eldredge Engineering Associates, Inc. (Naperville, IL) ■ 8838
Emanco Inc. (Houston, TX) ■ 8844
EMCON Associates (San Jose, CA) ■ 8846
EMS Laboratories, Inc. (Indianapolis, IN) ■ 8847
Energmaneutic Resource Group—E R G (Portola Valley, CA) ■ 7171
Energy & Environment Incorporated (Sebastopol, CA) ■ 8849
Energy & Environmental Analysis, Inc. (Arlington, VA) ■ 8850
Energy & Environmental Management, Inc — E2M (Murrysville, PA) ■ 8851

Engineering Consulting Firms, by State (1991-92)

State	*Number*	*Size Range*	*Average Size*
Connecticut	78	1-82	14.5
Delaware	26	1-112	22.0
Washington, D.C.	155	1-1100	29.6
Florida	273	1-1050	32.8
Georgia	188	1-3500	50.7
Maine	37	1-660	36.8
Maryland	53	1-843	68.9
Massachusetts	77	1-2120	100.0
New Hampshire	10	1-30	27.1
New Jersey	125	1-459	40.4
New York (total)	285	1-1798	66.7
• New York City	104	1-1798	94.2
• New York State	181	1-581	39.1
North Carolina	148	1-890	31.7
Pennsylvania	119	1-2730	96.0
Rhode Island	n/a	n/a	n/a
South Carolina	53	1-1600	111.1
Virginia	44	1-225	46.6

Source: American Consulting Engineers Council (ACEC) Directory 1991-92

Notes: 1) The number of firms denotes members of the ACEC only. 2) Firm sizes are in number of employees, including support staff. According to surveys by the Professional Services Management Journal, the average firm has around 5 technical staff for every support staff.

Appendix H: SIC Codes - Manufacturing and Services

The Ward's Business Directory entitled *Manufacturing USA* provides a comprehensive collection of industry analyses, statistics and companies. It encompasses some 460 manufacturing industries and within these sectors provides information on 26 thousand companies. The SIC codes covered in this document are included in this appendix.

Similar to the manufacturing document, the Ward's Business Directory entitled *Service Industries USA* provides a comprehensive collection of industry analyses, statistics and companies covering 150 service industries and providing information on 4000 companies. These SIC Codes are also included in this appendix.

We have included these primarily to give Canadian firms an indication of the level of detail that can be obtained from these documents. Such detail can then assist Canadian firms in identifying a more relevant preliminary set of potential clients.

SIC INDEX

The SIC Index shows all 4-digit SICs covered in *Manufacturing USA: Industry Analyses, Statistics, and Leading Companies* in numerical order. A separate section, listing the industries in alphabetical order, follows. This SIC structure is based on the new 1987 definitions published in *Standard Industrial Classification Manual*, 1987, Office of Management and Budget. The abbreviation 'nec' stands for not elsewhere classified.

Food and kindred products

Tobacco products

Textile mill products

Apparel and other textile products

Lumber and wood products

Furniture and fixtures

Paper and allied products

Printing and publishing

Chemicals and allied products

Petroleum and coal products

Rubber and plastic products

Leather and leather products

Stone, clay and glass products

Primary metal industries

Fabricated metal products

Machinery, except electrical

Electric and electronic equipment

Transportation equipment

Instruments and related products

Miscellaneous manufacturing industries

SIC INDEX

The SIC Index shows all 4-digit SICs covered in *Service Industries USA* in numerical order. A separate section, listing the industries in alphabetical order, follows. This SIC structure is based on the new 1987 definitions published in *Standard Industrial Classification Manual*, 1987, Office of Management and Budget. The abbreviation 'nec' stands for not elsewhere classified.

Hotels and Other Lodging Places

Personal Services

Business Services

Auto Repair, Services, and Parking

Miscellaneous Repair Services

Motion Pictures

Amusement & Recreation Services

Health Services

Legal Services

Educational Services

Social Services

Museums, Botanical Gardens, Zoos

Membership Organizations

Engineering & Management Services

Services, nec

MAJOR U.S. ENVIRONMENTAL COMPANIES

THE AIR POLLUTION CONTROL INDUSTRY

Air Pollution Control

Air & Water Technologies
U.S. Highway 22 W. & Station Road
Branchburg, NJ 08876
908/685-4000

BHA Group, Inc.
8800 E. 63rd Street
Kansas City, MO 64133
816/356-8400

Donaldson Co.
P.O. Box 1299
Minneapolis, MN 55440
612/887-3475

Dravo International, Inc.
1 Oliver Plaza
Pittsburgh, PA 15222
412/566-3000

McDermott International, Inc.
1010 Common Street
P.O. Box 60035
New Orleans, LA 70115
504/587-4080

RCM Industries
P.O. Box 6554
Concord, CA 94524
415/687-8363

Wahlco, Inc.
3600 W. Segerstrom Avenue
Santa Ana, CA 92704
714/979-7300

Zurn Air Systems Division
4200 Pinson Valley Parkway
Birmingham, AL 35215
205/853-4112

THE HAZARDOUS WASTE INDUSTRY

Analytical Services

Compuchem Laboratories
3308 Chapel Hill
Nelson Research
Triangle Park, NC 27709
800/833-5097

Enseco, Inc.
2200 Cottontail Lane
Somerset, NJ 08873
201/469-5800

Enviropact, Inc.
7975 Miami Lakes Drive
No. 240
Miami Lakes, FL 33016
305/362-8522

National Technical Systems, Inc.
24007 Ventura Boulevard
Calabasas, CA 91302
818/348-7101

Princeton Testing Laboratory
3490 U.S. Route 1
Princeton, NJ 08543
800/548-8378

Wadsworth/Alert Laboratories, Inc.
4101 Shuffel Drive, N.W.
North Canton, OH 44720
216/497-9396

MAJOR U.S. ENVIRONMENTAL COMPANIES
(Continued)

Asbestos Abatement Services

Acmat Corporation
P.O. Box 8307
East Hartford, CT 06108
203/289-6493

Allwaste, Inc.
3040 Post Oak Boulevard
Suite 1300
Houston, TX 77056
713/623-8777

Brand Companies, Inc.
1420 Renaissance Drive
Park Ridge, IL 60068
708/298-1200

Chempower
807 E. Turkeyfoot Lake Road
Akron, OH 44319
216/896-4202

Eastern Environmental Services, Inc.
1620 E. Adamo Drive
Tampa, FL 33605
813/248-2200

Engineering & Design Consultants

ABB Lummus Crest, Inc.
1515 Broad Street
Bloomfield, NJ 07003
201/893-1515

Bechtel Corporation
50 Beale Street
P.O. Box 2965
San Francisco, CA 94119
415/768-9243

Black & Veatch Consulting Engineers
1500 Meadow Lake Parkway
Kansas City, MO 64114
913/339-2000

Camp Dresser McKee, Inc.
One Cambridge Center
Cambridge, MA 02142
617/621-8181

CH2M Hill
6060 South Willow Drive
Englewood, CO 80111
303/771-0900

Donohue & Associates
4738 N. 40th Street
Sheboygan, WI 53083
414/458-8711

Ebasco Services, Inc.
160 Chubb Avenue
Lyndhurst, NJ 07071
201/460-6075

Ecology & Environment, Inc.
Buffalo Corporate Center
368 Pleasantview Drive
Lancaster, NY 14086
716/684-8060

EMCON Associates
1921 Ringwood Avenue
San Jose, CA 95131
408/453-7300

ENSR Consulting & Engineering
35 Nagog Park
Acton, MA 01720
508/635-9500

MAJOR U.S. ENVIRONMENTAL COMPANIES
(Continued)

Halliburton NUS Environmental Corp.
910 Clopper Road
Gaithersburg, MD 20877
301/258-6000

ICF Kaiser Engineers
1800 Harrison Street
Oakland, CA 94612
415/268-6000

Jacobs Engineering Co.
521 S. Lake Avenue
Pasadena, CA 91109
818/449-2171

Malcolm Pirnie, Inc.
2 Corporate Park Drive
White Plains, NY 10602
914/694-2100

McLaren/Hart Environmental Engineering Corporation
11101 White Rock Road
Rancho Cordova, CA 95670
916/638-3696

Metcalf & Eddy Companies, Inc.
P.O. Box 4043
Wakefield, MA 01880
617/246-5200

PRC Environmental Management, Inc.
303 E. Wacker Drive
Suite 500
Chicago, IL 60601
312/856-8700

Roy F. Weston, Inc.
1 Weston Way
West Chester, PA 19380-1499
215/692-3030

Hazardous Waste Management

Allwaste, Inc.
3040 Post Oak Boulevard
Suite 1300
Houston, TX 77056
713/623-8777

Chemical Waste Management, Inc.
3003 Butterfield Road
Oak Brook, IL 60521
708/218-1500

Clean Harbors, Inc.
P.O. Box 9137
1200 Crown Colony Drive
Quincy, MA 02269
617/849-1800

ENSCO Environmental Services, Inc.
41674 Christy
Freemont, CA 94538
415/695-0404

Envirosafe Services, Inc.
P.O. Box 833
Valley Forge, PA 19482
215/962-0800

Laidlaw Environmental Services, Inc.
220 Outlet Pointe Boulevard
Columbia, SC 29210
803/798-2993

Rollins Environmental Services, Inc.
One Rollins Plaza
Box 2349
Wilmington, DE 19899
302/479-2768

MAJOR U.S. ENVIRONMENTAL COMPANIES
(Continued)

Safety-Kleen Corp.
777 Big Timber Road
Elgin, IL 60123
708/697-8460

USPCI
515 W. Greens Road
No. 500
Houston, TX 77067
713/775-7800

Nuclear Waste Management

Babcock & Wilcox
A McDermott Company
Power Generation Group
20 S. Van Buren Avenue
Barberton, OH 44203
216/753-4511

Quadrex Environmental Co.
1940 N.W. 67 Place
Gainesville, FL 32606
904/373-6066

Chem Nuclear Systems, Inc.
240 Stoneridge Drive
Suite 100
Columbia, SC 29210
803/252-0450

U.S. Ecology, Inc.
9200 Shelbyville Road
Suite 300
P.O. Box 7246
Louisville, KY 40222
502/426-7160

Pacific Nuclear Systems, Inc.
1010 South 336 Street
Federal Way, WA 98003
206/874-2235

Remediation

Canonie Environmental Services, Inc.
800 Canonie Drive
Porter, IN 46304
219/926-8651

OHM Corporation
16406 U.S. Route 224E
P.O. Box 551
Findlay, OH 45839
419/423-3526

International Technology Corporation
23456 Hawthorne Boulevard
Torrance, CA 90505
310/378-9933

Riedel Environmental Services, Inc.
4611 N. Channel Avenue
Portland, OR 97217
503/286-4656

Kimmins Environmental Service Corp.
1501 2nd Avenue
Tampa, FL 33605
813/248-3878

Sevenson Environmental Services, Inc.
2749 Lockport Road
Niagra Falls, NY 14302
716/284-0431

MAJOR U.S. ENVIRONMENTAL COMPANIES
(Continued)

Underground Storage Tank

Geraghty & Miller, Inc.
Environmental Services
125 E. Bethpage Road
Plainview, NY 11803
516/249-7600

Groundwater Technology, Inc.
220 Norwood Park South
Norwood, MA 02062
617/769-7600

Handex Environmental Recovery
500 Campus Drive
Morganville, NJ 07751
908/536-8500

THE SOLID WASTE INDUSTRY

Medical Waste Management

Browning-Ferris Industries, Inc.
757 N. Eldridge Road
Houston, TX 77079
713/870-8100

Laidlaw Environmental Services
P.O. Box 210799
220 Outlet Pointe Boulevard
Columbia, SC 29221
803/798-2993

National Medical Waste
555 Marriott Drive
Suite 340
Nashville, TN 37210
615/889-2700

Waste Management, Inc.
3003 Butterfield Road
Oak Brook, IL 60521
708/218-1500

Solid Waste Management

Browning-Ferris Industries, Inc.
757 N. Eldridge Road
Houston, TX 77079
713/870-8100

Chambers Development Co., Inc.
10700 Frankstown Road
Pittsburgh, PA 15235
412/242-6237

Laidlaw Environmental Services
P.O. Box 210799
220 Outlet Pointe Boulevard
Columbia, SC 29221
803/798-2993

Mid-American Waste
P.O. Box 156
Canal Winchester, OH 43110
614/833-9155

MAJOR U.S. ENVIRONMENTAL COMPANIES (Continued)

Waste Management, Inc.
3003 Butterfield Road
Oak Brook, IL 60521
708/218-1500

Western Waste Industries
19803 South Main Street
Carson, CA 90745
310/327-2522

Waste-to-Energy/Resource Recovery

ABB Environmental Services
261 Commercial Street
Portland, ME 04112
207/775-5401

American Ref-Fuel Co.
P.O. Box 3151
Houston, TX 77253
713/531-4233

Commercial Metals Co.
P.O. Box 1046
Dallas, TX 75221
214/631-4120

Horsehead Industries, Inc.
110 E. 59th Street
New York, NY 10022
212/527-3000

IMCO Recycling, Inc.
5215 North O'Connor Boulevard
Suite 940
Central Tower at Williams Square
Irving, TX 75039

Ogden Environmental Services
P.O. Box 85178
San Diego, CA 92186
619/455-3045

Wheelabrator Air Pollution Control
441 Smithfield Street
Pittsburgh, PA 15222
412/562-7300

THE WATER & WASTEWATER INDUSTRY

Water Utilities

American Water Works Co., Inc.
1025 Laurel Oak Road
Voorhees, NJ 08043
609/346-8200

Aqua Corporation
P.O. Box 546
Lexington, KY 40585
606/278-5412

California Water Service Co.
1720 N. 1st Street
San Jose, CA 95112
408/298-1414

MAJOR U.S. ENVIRONMENTAL COMPANIES
(Continued)

GWC Corporation
P.O. Box 6508
Wilmington, DE 19804
302/663-5918

United Water Resources
200 Old Hook Road
Harrington Park, NJ 07640
201/784-9434

Water and Wastewater Services

American Pacific Corporation
4045 S. Spencer Street
Suite B-28
Las Vegas, NV 89119
702/735-2200

Betz Industrial
One Quality Way
Trevose, PA 19053
215/355-3300

Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, PA 15230
412/787-6700

Davis Water & Waste Industries
2650 Tallevast Road
Tallevast, FL 34270
813/355-2971

Lancy Environmental Services Co.
181 Thorn Hill Road
Warrendale, PA 15086
412/772-1257

Nalco Chemical Co.
One Nalco Center
Naperville, IL 60563
708/305-1000

MAJOR U.S. ENVIRONMENTAL PROTECTION AGENCY CONTRACTORS

ABB Environmental Services, Inc.
261 Commercial Street
Portland, ME 04101
207/775-5401

Bechtel Corporation
50 Beale Street
P.O. Box 2965
San Francisco, CA 94119
415/768-9243

Black & Veatch Consulting Engineers
1500 Meadow Lake Parkway
Kansas City, MO 64114
913/339-2000

Camp Dresser McKee, Inc.
One Cambridge Center
Cambridge, MA 02142
617/621-8181

CH2M Hill
6060 South Willow Drive
Englewood, CO 80111
303/771-0900

Donohue & Associates
4738 N. 40th Street
Sheboygan, WI 53083
414/458-8711

Ebasco Services, Inc.
160 Chubb Avenue
Lyndhurst, NJ 07071
201/460-6075

Ecology & Environment, Inc.
Buffalo Corporate Center
368 Pleasantview Drive
Lancaster, NY 14086
716/684-8060

Halliburton NUS Environmental Corp.
910 Clopper Road
Gaithersburg, MD 20877
301/258-6000

ICF Kaiser Engineers
1800 Harrison Street
Oakland, CA 94612
415/268-6000

Jacobs Engineering Co.
521 S. Lake Avenue
Pasadena, CA 91109
818/449-2171

Malcolm Pirnie, Inc.
2 Corporate Park Drive
White Plains, NY 10602
914/694-2100

Metcalf & Eddy Companies, Inc.
P.O. Box 4043
Wakefield, MA 01880
617/246-5200

OHM Corporation
16406 U.S. Route 224E
P.O. Box 551
Findlay, OH 45839
419/423-3526

PRC Environmental Management, Inc.
303 E. Wacker Drive
Suite 500
Chicago, IL 60601
312/856-8700

Roy F. Weston, Inc.
1 Weston Way
West Chester, PA 19380-1499
215/692-3030