GEOTECHNICAL RESEARCH CENTRE

CONTINUING EDUCATION ENVIRONMENTAL STUDIES FOR GRADUATE ENGINEERS: *NEEDS ANALYSIS*

Study Director: R.N. Yong

Study Team: J. Hadjinicolaou
E. Turcott-Rios
R. Galvez-Cloutier
A.M.O. Mohamed

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PRELIMINARY STATEMENTS

The following NEEDS ANALYSIS Report is the outcome of a survey conducted in response to the charge given by the Engineering Institute of Canada EIC-Environmental/IAS Committee in early 1993 ..... to study whether a need exists for continuing education in environmental sciences and engineering for members of the engineering profession working (in Canada) directly and indirectly with environmental problems and issues. The specific charge read as follows:

The **"Needs Analysis"** which will be conducted will cover the various engineering disciplines included in the consulting engineering field, government agencies and institutions dealing with environmental engineering problems and environmental issues. By and large, these engineering disciplines will cover civil, chemical, mechanical, environmental, agricultural, mining, and geotechnical engineering disciplines.

The **Analysis** will be conducted throughout Canada, on a Regional Basis. A basic Needs questionnaire will be developed for use as a letter survey to be sent to representative industries, groups, government representatives, institutional groups, etc. The questionnaire will be followed up by personal interviews with selected focus groups, and key industry groups, companies, government representatives, and institutional representatives in the various Regions -- from B.C. to Nova Scotia. From the personal meetings with focus groups, industry representatives, etc., the necessary sets of numbers will be generated to produce an overall "numbers" picture of the need or lack of need for the Engineers' Environmental Studies program for the graduate engineer (or equivalent) working in the "field", office, or institution, etc. as a means for upgrading herself/himself, expanding her/his opportunities, or "just simply keeping up".

From the preceding, if the survey shows that a need exists, the **Needs Analysis** will seek to establish (a) the nature of the need, i.e. the extent thereof for continuing education study programs in the environmental studies area (general science and engineering); (b) the direction and emphasis or focus, and how these can be related to the "source of the need"; (c) the scope and type of continuing education courses or information transfer vehicles.

The **Needs Analysis** should lay the basis for decisions to be made by the EIC-Environmental/IAS Committee with respect to the following questions: (1) Is there a need? What is the extent of the need vis-a-vis Canada? Regionally? Or by type of "client"? (2) What is the nature of the need? *i.e. Information or formal course?* At what level? *i.e. undergraduate or graduate level?* (c) How can this need be satisfied? -- bearing in mind that the "Needs" to be addressed, for each group or interested "party" will not likely be similar.

Whereas the original plan was to provide the reporting of the survey results in two stages, -- with the first stage concerned with the establishment of whether a need exists, and the nature of the need, and the second with the implementation of solutions to satisfy the need (if such exists), -- events occurring subsequent to the initial survey outside the control of EIC resulted in the aborting of the total study. The preceding notwithstanding, the Geotechnical Research Centre (of McGill University) researchers who conducted the study undertook to complete the analyses inasmuch as it appeared to have considerable information value. Whilst much more can be reported and analyzed (from the data available in this report), the present set of analyses constitute the basic pieces of information which show not only that "environmental engineering" is a branch of engineering that is not well identified, and "means several things", depending on who perceives "it" and "why", there is total consensus on the need to develop a better understanding of "environmental sciences and engineering" through continuing education.

STRUCTURE AND PROTOCOL OF THE "Needs" STUDY

The "Needs" Study, (hereafter referred to as the "Study"), required interaction with several "select" representatives to determine the extent and nature of the questions and problems to be posed. From the preliminary interactions, a questionnaire was developed (see Appendix). The basic questionnaire shown in the Appendix which was used in the Study survey, via indirect contact (telephone/mail) and direct meeting with individuals and contact groups, has three separate "first" pages, reflecting the nature of the "clientele" surveyed -- i.e. government, industry, institution. The survey format consisted of telephone, mail, and direct contact Interviews conducted throughout Canada.

Three kinds of Interviews/Contacts were conducted: (1) Preliminary interviews and contacts designed to provide input into the problem being studied; (2) Telephone contacts and discussion with Industry, Institutional, Professional, and Government representatives designed to set up meetings with their Focus Groups and/or alert them about the questionnaires that would be sent to them for their own use and for their distribution. In all instances, telephone contact was established before any questionnaire was sent to the individual. (3) Actual face-to-face contact and interviews with Focus Groups and various representatives. A summary of the Industry, Professional, Institutional and Government groups or representatives contacted and/or interviewed is given in the next Section, taken as a whole (Canada) and also grouped on a Regional basis. For simplicity in categorization, the 'Professional' groups are listed under "Institutional" groups.

The direct contact survey is considered to be the most significant part of the Study. In addition to personal contacts for setting up meetings with various parties, meetings with focus

groups and individuals were in many instances facilitated by assistance and cooperation from members of the Committee, Professional Society officials and other interested group representatives. Meetings with groups and individuals were conducted in Halifax, St. John (N.B.), Fredericton, Quebec City, Montreal, Ottawa, Toronto, Hamilton, Regina, Calgary, and Vancouver.

The questionnaire survey by telephone/mail is also of considerable significance insofar as an indication of the interest of the "general population" is considered, and also insofar as the inputs obtained without having to "face the interviewer". In all, about 400 questionnaires were sent across Canada[1], distributed roughly as follows: about 80 in the West (i.e. west of Ontario), 160 in Ontario, and about 100 in Québec and the Maritimes (Eastern Region). The number of returns was 134, includes questionnaires prepared during the course of Interviews and others returned by mail without benefit of interviews. The percentage of return for questionnaires is about 34%, which is indeed a very respectable return percentage. The distribution of participants is given in Figure 1. Note that the total numbers given for each region are the number of participants interviewed directly (face-to-face or by telephone), -- with the follow-up completed questionnaire.

The statistics and percentages given based on the raw data, with no weighting of numbers to take into account size of industry or operation, level of responsibility of the respondent, and importance of the respondent's place or type of occupation. Whereas "weighting" schemes can indeed be introduced to provide some measure of sophistication in data evaluation and study, it is not immediately clear how one can provide a "reasonable weighting ratio/number" which can cover job type and responsibility with type of industry and productivity.

For convenience in presentation of the information obtained, the Appendix for this Report contains a sample of the blank questionnaire form used in the Survey. Whereas only the "English" version is included in this Appendix, one should be assured that a "French" version was also used in the Survey. The individual responses for each "line item" in Sections B and C of the questionnaire have been recorded. To briefly explain the "notations" used in the "individual responses" sheets, item B1 refers to question 1 in section B, etc.[2]

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[1] It is difficult to establish a firm figure for the number of questionnaires sent inasmuch as the total number sent by some "volunteers" in certain parts of the country, e.g. the Vice-President of CGS, are only available as "soft" numbers.

[2] The coding given as 1 A-1-001 in the first page of Section B-General, for the B1 question is as follows: First number refers to questionnaire #, A=Eastern region, (B=Ontario, C=Western), number after A,...1=industry, (2=institution, 3=government), and last number=coding number for GRC analysis.

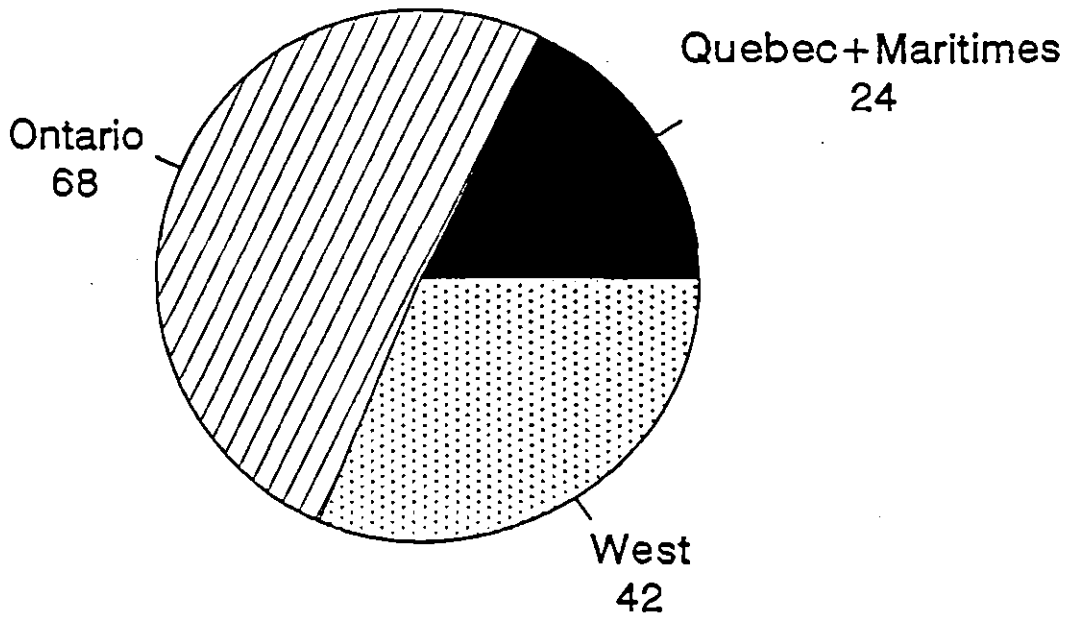
Total number of questionnaires and interviews: 134

Sector	**Number of quest/interv.**
Industry	73
Institution	33
Government	28

Region	**Number of quest/interv.**
A = Quebec+Mar	24
B = Ontario	68
C = West	42

Participants

By region



By sector

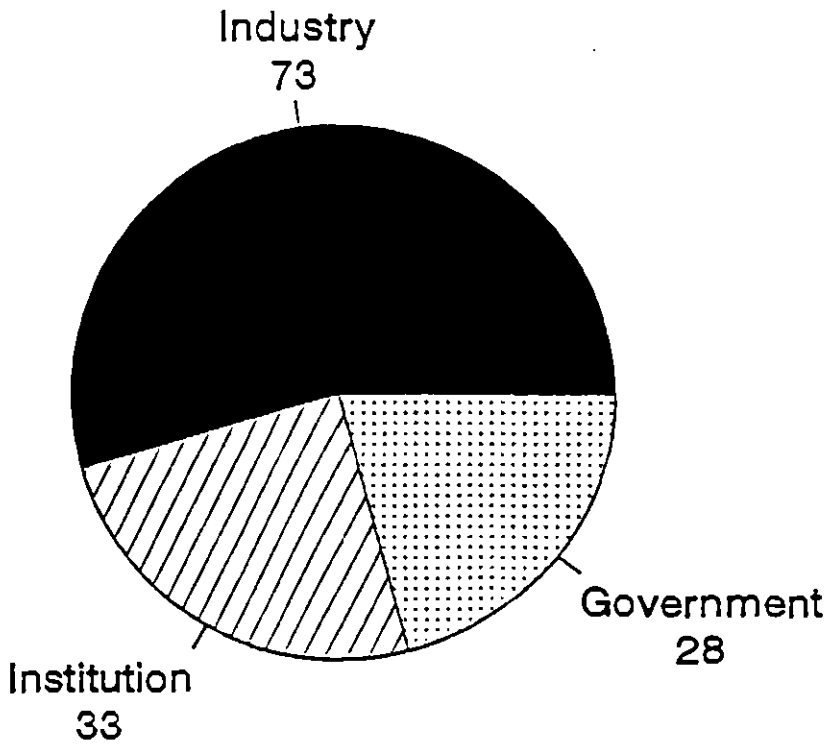


Fig.1 - Distribution of participants in study

GROUPS, "PEOPLE" SURVEYED

The choice of "people", companies, groups, etc. to be surveyed by questionnaire and to be followed-up by direct contact interviews posed a very difficult problem in that the time constraints demanded that a "representative" viewpoint be obtained within a very short time period. There was a deliberate effort to target all levels of engineering/government responsibility, i.e. top managers, middle managers, and "workers in the trenches". In addition, the various activity groups included government, industry, academia, and professional societies. Targeting specific engineering professions, e.g. mechanical, civil, electrical, agricultural, and chemical, did not really provide a "true" picture of the individual profession inasmuch as each profession working in the field of "environmental engineering" generally included recent graduates that had some "exposure" to "environmental courses". Environmental engineering companies (??) generally included engineers from various engineering disciplines, geologists, biologists, etc. Effort was made to survey workers in these kinds of companies. In the following discussion, a summary recounting of some of the "people", groups, etc. interviewed is given, not for the purpose of "book-keeping", but to highlight the level of interest and also to indicate the cooperation received from many key individuals and institutions.

The various Target Groups/Individuals in the different regions and cities are listed below in summary form:

Vancouver:

Government:-- *B.C. Environment* (Special Waste Section),

Industry:-- *Morrow Environmental Consultants, Golder Associates*

University:-- *U.B.C.* (Department of Civil Engineering).

Calgary:

Professional Association:-- *Association of Professional Engineers, Geologists and Geophysicists of Alberta, APEGGA,*

Industry:-- *Komex International Ltd., HBT Agra Ltd. CH2M Hill Engineering Ltd.*

Regina:

Government:-- *Saskatchewan Environment and Public Safety* (Municipal Unit) *Saskatchewan Highways and Transportation* (Geotechnical and materials, Environmental, Bridge, and Construction and Design Sections), *Environment Canada* (Conservation and Protection), *City of Regina* (Environmental Engr. Div.)

Industry:-- *Clifton and Associates, HBT Agra Ltd.*

University:-- *University of Regina* (Civil Engineering Dept.)

Toronto-Hamilton-Kitchener Region:

Government:-- *Ontario Ministry of Environment* (Environmental Planning and Prevention Div.; Waste Management Policy Section), *Regional Municipality of Waterloo, Ontario*

Waste Management Corp.; Ontario Hydro; (Toronto), *Wastewater Technology Centre* (GOCO, Burlington).

Industry:-- *ACG Technology; Acres International Ltd.; Anchor Cap; Gartner Lee; Strata Engineering; Bechtel Inc; Paragon Engineering* (Kitchener); *Conestoga-Rovers and Associates*, (Waterloo); *CH2 M Hill Engineering*, (Waterloo).

Association:- *Ontario Association of Certified Engineering Technicians & Technologists.*

(Note that whereas no visit was made to the University of Toronto and other universities, questionnaires "returns" from U. of T., and also from Queen's University and RMC were received in response to telephone interviews.

Ottawa-Hull Region:

Government:-- *NRC Institute of Environmental Chemistry; Environment Canada;*

Industry:-- *Golder Associates; Gore and Storrie Ltd.; Webco International,*

University:-- *University of Ottawa.*

Montreal Region:

Government:-- *St. Lawrence Centre* (Ecotoxicology and Ecosystems), *City of Montreal* (Environmental Div.).

Industry:- *Cogesult; Cartier; Serrener; Tecsult; SNC-Lavalin;*

University:-- *McGill and Univ. of Montreal*

Québec City:

Government:-- *Gouvernment du Québec Ministère de l'Environnement* (Direction des programmes de gestion des déchets at des lieux contaminés); *Agricultural Research Station* (Agriculture Canada);

Associations:-- *Association of professional engineers in the government of Québec.*

University:- *Institut national de la recherche scientifique (U. du Q.), Laval U.*

New Brunswick:

Government:-- *Agriculture New Brunswick.,*

Associations:-- *Association of Professional Engineers of New Brunswick*

University:-- *UNB*

Halifax:

University:- *TUNS*

Industry:-- *Jacques Whitford; CBCL Ltd.*

ANALYSIS

The data from the questionnaires and the discussions in the meetings with the various Focus groups can be evaluated in terms of response to the questions posed directly in the Needs Analysis mandate. In the following, the answers to the questions posed in Section B of the questionnaire form (Appendix) will be given.

SECTION B - GENERAL

Questions B1 and B2

What does the term "environmental engineering" mean in your context of work or needs?

The intent of this question was to determine the general perception "what constitutes environmental engineering -- in the industry practising in the environmental field". The variety of answers to the above question (B1) reflect, as expected, the kinds of disciplines involved and also the level of responsibility, -- as can be seen in the distributions given in the B2 response. Thus one has responses that range from *"A discipline which is non-existent"* through "water supply, waste disposal, regulations, bioremediation, remediation, site assessment, " and "*A blend of chemistry, biology, civil and chemical engineering"*. In short, the answers show a very wide (and disparate?) view of environmental engineering as a discipline and as a profession. This variety of views can be better examined in the responses given to the next question posed as B2.

What are the main areas of your environmental work?

Having established the diversity of opinion of "what constitutes environmental engineering", it would be interesting to determine the areas of "environmental work" of the respondents reporting on this diversity of opinion. The "pie-chart" for areas of work in the B2 response shows that the *water and wastewater, site remediation,* and *solid waste management* groups were the largest groups (outside the "other" group) responding to the questionnaires. These so-called "groups" were initially listed in the questionnaire, and may (as one might argue) not be sufficiently discriminatory or inclusive. The 21.6% response included in "other" testifies to the very wide array of "work" in the environmental field, thus creating some confusion in classification of "environmental work" within the traditional classes given in the remaining parts of the pie-chart.

The variety of answers to the B1 question can now be examined in relation to the distribution of work areas, and also in relation to the regional and group (government, institution, industry) distributions. These patterns provide some very interesting observations, e.g. the high proportion of *"other area of work"* recorded in the West, and the high proportion of *"water and wastewater area of work"* in the "government group". The types of activities included under the category of "other" include food processing engineering, oil and gas industry, etc.

B1. What does the term Environmental Engineering mean in your context of work or needs?

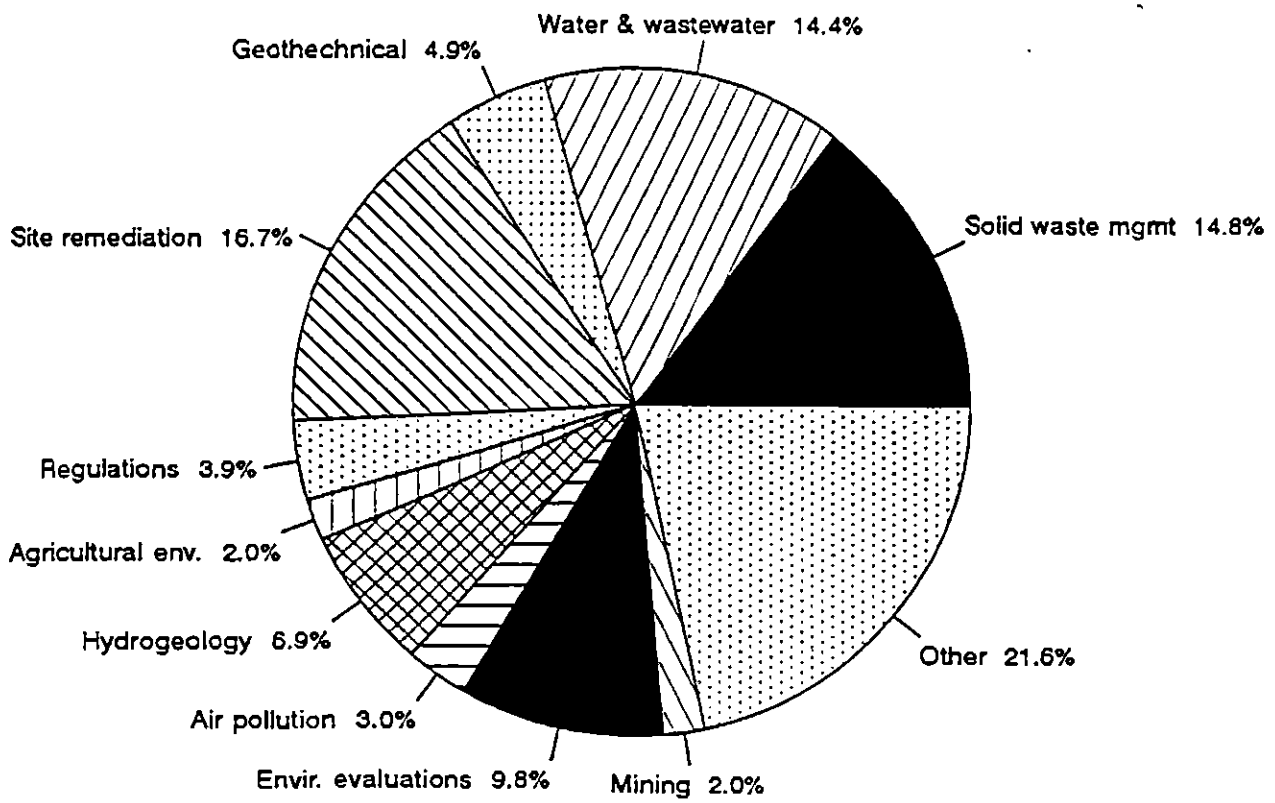
1	A-1-001	Site assessments, Land use, Watershed, Remediation
2	A-1-002	Engineering design, applications related to the environment
5	A-1-006	Application of engineering principles to solve env.problems
92	A-1-017	All technical work related to cleaning environment
87	A-1-019	Soil and groundwater quality evaluation, control, remediat.
93	A-1-020	Regulations, wastes/transfer/disposal
94	A-1-021	Treatments, contaminant transport, ecosystems (soil,air,wat)
123	A-1-025	Requirements to minimize impacts of projects on the envir.
124	A-1-026	Design/construction/operation of struct. that impact envir.
6	A-2-007	Design of facilities related to waste mgmt., ocean/air poll.
7	A-2-008	Engineering related to protection/conservation of environ.
49	A-2-009	Treatment/control of groundwater polluted by agric. practice
50	A-2-010	Environmental engineering
52	A-2-012	Environmental Engineering does not exist as such
88	A-2-014	Multidisciplinary approach to solving industry needs
3	A-3-004	Global vision of environmental problems and solutions
4	A-3-005	Development of equipment/techniques for protection of env.
51	A-3-011	Environmental control systems, Agric. waste mgmt., pesticide
121	A-3-023	Many specialists in the areas of geology, chem., bio, eng.
9	B-1-001	Mostly geotech. eng.
13	B-1-005	Ambient air quality, process eng. at plant level, modelling
14	B-1-006	Facilities to safe-guard environment, spills, recycling
16	B-1-008	Knowledge of contaminants, remediation plans, treatment proc
18	B-1-010	Assessing and mitigation of human activities on environment
19	B-1-011	Municipal water treatment, collection, distribution, EIA
20	B-1-012	Familiar with env. regulations and knowledge of process eng.
22	B-1-014	Control on products/materials, waste disposal, air, water
23	B-1-015	Engineering for clean-ups
25	B-1-017	Audits, service station clean-ups, testing
26	B-1-018	Subsurface
29	B-1-021	Solving of environmental problems, specially geotechnical
30	B-1-022	Engineering/planning showing concern for env. protectiòn
55	B-1-025	Integrating protection of environment with land use change
56	B-1-026	Env. geotechnique, waste mngm't process&design, hydrology
65	B-1-035	Ground & geoscience related
66	B-1-036	Groundwater supply, aquifer remediation, site clean-up
67	B-1-037	Soil/rock contamination, groundwater contamination
69	B-1-039	Testing and compliance of industrial facilities
70	B-1-040	Environmental site assessment, clean-up, landfill monitoring
72	B-1-042	Strategies for managing environmental impacts of products
74	B-1-044	Approval/control of emissions to the environment (air/wat/s)
77	B-1-047	Assessment of physical environ. impacts to water/air/soil
79	B-1-049	Water suply, waste disposal, decommissioning of sites, EIA
84	B-1-054	Water supply/treatment, Ind. wastewater treat., waste mngmt
85	B-1-055	Site assessments and cleanups
86	B-1-056	Ensuring that environ. is considered in technical decisions
110	B-1-058	Any study, review or design where protection of env. is key
113	B-1-061	Assist in environmental permitting, W&WW process studies
115	B-1-063	Very broad term: air, water, soil quality. Waste mgmt.
24	B-2-016	Identify client needs
57	B-2-027	EIA, Mitigation methods
58	B-2-028	Waste mgmt, hydrogeology, site clean-up, radioact. disposal
59	B-2-029	No context in my work
68	B-2-038	A discipline which is non-existant
71	B-2-041	Minimize impact of waste disposal on environment
75	B-2-045	Assessing envir. impact of landfills, transportation, energy
76	B-2-046	Hydrogeotechnical, Industrial waste mngnt, env. chemistry

80	B-2-050	The study and solution of environmental problems
82	B-2-052	Improve standard of living in a sustainable/non-damaging way
83	B-2-053	Many fields: water/wastewater treatment, landfill, air poll.
109	B-2-057	Developing plans to minimize impact of transportation
112	B-2-060	A blend of chemistry, biology, civil and chemical eng.
120	B-2-068	Broad area of engineering solutions that are benign to env.
15	B-3-007	Solutions to environmental problems created by mining indust
21	B-3-013	Industrial process knowledge and pollution control processes
27	B-3-019	Regulations development, best available tech. for poll.ctrl
54	B-3-024	Very broad meaning. Studies, design, operation, assessments
60	B-3-030	Design and implementation of environmental technologies
62	B-3-032	Combined disciplines of biology, chemistry, physics and rel.
63	B-3-033	Wastewater treatment
73	B-3-043	Water supply, treatment, wastewater treatment, landfills
78	B-3-048	Dealing with any potential contamination of surface/groundwa
117	B-3-065	Control, options, assessment, regulations
118	B-3-066	Evaluation of impacts to environment and implement controls
119	B-3-067	Application of eng. principles to oil/chem spill clean-up
38	C-1-008	A new euphemism for Sanitary Engineering
40	C-1-010	Contaminant hydrogeology, site/risk assessment, health haz.
41	C-1-011	Subsurface soil & GW investigations, risk assessment, hazwas
42	C-1-012	Treatment, hazardous waste, assesment, audits, clean up, etc
43	C-1-013	Water & waste treatment, enviro. assessment, remediation,etc
97	C-1-019	Inv Soil and GW contam/ remediation /risk assessment
98	C-1-020	Appl of eng tech to undrstand and manage nat res & poll prob
99	C-1-021	Contaminated sites, acid rock drainage, mine closure
102	C-1-024	Waste manag/contam hydrogeology/mining-../env matallurgy
103	C-1-025	Solving environmental problems for clients
104	C-1-026	Involves aspects of civ/mech/geotech & chemical engineering
105	C-1-027	Developing feasible solutions to environmental problems
106	C-1-028	Protect the environment and public health, minimize costs
107	C-1-029	Geo. or chem. eng. with background in soils/groundwater
108	C-1-030	Assessment and remediation of hydrocarbon and metal contam.
95	C-1-031	Solving problems related to contaminated water/soil/air
96	C-1-032	Applying expertise to the assessment and remediation of env.
126	C-1-034	Pollution control, W&WW treatment, remediation, waste mgmt.
127	C-1-035	Management to minimize environmental impact/liabilities/cost
130	C-1-038	Water, wastewater, hazardous waste, solid waste
133	C-1-041	Site clean-up, audits, reclamation, EIA's
134	C-1-042	Envir. site investigation/remediation, Geo-env. + Bio-env.
44	C-2-014	Broad Enviro. Eng. Hydro, atmo. and geosphere
45	C-2-015	Waste disposal, eng interact with plants, animals & bio mat.
46	C-2-016	Control of pollution Water supply
47	C-2-017	Geo-enviro, geotechnical,air, water quality & ind waste prob
48	C-2-018	Bioremediation
125	C-2-033	Design of environmentally related facilities/equipment/strat
129	C-2-037	The stody of ecological/social science impact by hydro-dev.
131	C-2-039	Water treatment, waste treatment/management, water quality
132	C-2-040	Groundwater contamination, waste management, remediation
8	C-3-001	Understanding physical/biol. envir., processes that drive it
32	C-3-002	Deals with water pollution, air, land resources
33	C-3-003	Provide solution to water, air and land quality problems
34	C-3-004	General understanding of environmental issues, laws, impacts
35	C-3-005	Coordinating technical envir. reviews, env. policy/planning
36	C-3-006	Meeting regulations; envir. issues that may affect construc.
39	C-3-009	Water quality, solid waste, sewage treat., air qual., EIA
100	C-3-022	Rgulation of discharges/effects of pollution soil,water,air

B.2 What are the main areas of your environmental work?

Area	Number	Percent
Solid Waste Management	45	14.8
Municipal Eng./W & WW Treatment	44	14.4
Environmental Evaluations	30	9.8
Site Remediation	51	16.7
Regulations	12	3.9
Agricultural Env. Problems	6	2.0
Software Applications	3	1.0
Air Pollution	9	3.0
Research & Development	5	1.6
Hydrogeology	21	6.9
Geotechnical	15	4.9
Mining	6	2.0
Health & Safety	4	1.3
Other	54	17.7

Areas of work



B.2 What are the main areas of your environmental work? (cont.)

Group: A (QUEBEC+MARITIMES)

Area	Number	Percent
Solid Waste Management	8	15.7
Municipal Eng./W & WW Treatment	3	5.9
Environmental Evaluations	3	5.9
Site Remediation	9	17.6
Regulations	2	3.9
Agricultural Env. Problems	4	7.8
Software Applications	2	3.9
Air Pollution	1	2.0
Research & Development	4	7.8
Hydrogeology	5	9.8
Geotechnical	3	5.9
Mining	1	2.0
Health & Safety	1	2.0
Other	5	9.8

Group: B (ONTARIO)

Area	Number	Percent
Solid Waste Management	27	19.1
Municipal Eng./W & WW Treatment	21	14.9
Environmental Evaluations	10	7.1
Site Remediation	23	16.3
Regulations	5	3.5
Agricultural Env. Problems	0	0.0
Software Applications	0	0.0
Air Pollution	8	5.7
Research & Development	0	0.0
Hydrogeology	10	7.1
Geotechnical	11	7.8
Mining	4	2.8
Health & Safety	1	0.7
Other	21	14.9

Group: C (WEST)

Area	Number	Percent
Solid Waste Management	10	8.8
Municipal Eng./W & WW Treatment	20	17.7
Environmental Evaluations	17	15.0
Site Remediation	19	16.8
Regulations	5	4.4
Agricultural Env. Problems	2	1.8
Software Applications	1	0.9
Air Pollution	0	0.0
Research & Development	1	0.9
Hydrogeology	6	5.3
Geotechnical	1	0.9
Mining	1	0.9
Health & Safety	2	1.8
Other	28	24.8

B.2 What are the main areas of your environmental work? (cont.)

Group: Industry

Area	Number	Percent
Solid Waste Management	29	16.0
Municipal Eng./W & WW Treatment	25	13.8
Environmental Evaluations	23	12.7
Site Remediation	37	20.4
Regulations	3	1.7
Agricultural Env. Problems	0	0.0
Software Applications	2	1.1
Air Pollution	6	3.3
Research & Development	2	1.1
Hydrogeology	14	7.7
Geotechnical	7	3.9
Mining	2	1.1
Health & Safety	3	1.7
Other	28	15.5

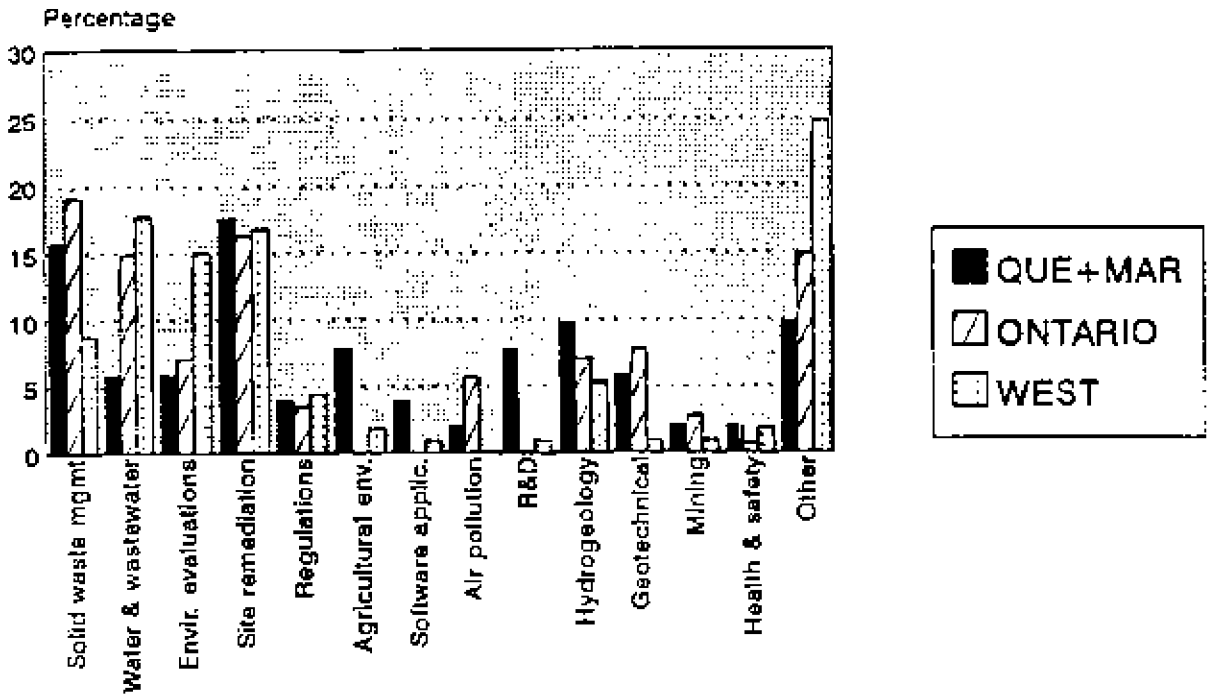
Group: Institution

Area	Number	Percent
Solid Waste Management	9	15.3
Municipal Eng./W & WW Treatment	4	6.8
Environmental Evaluations	3	5.1
Site Remediation	8	13.6
Regulations	1	1.7
Agricultural Env. Problems	3	5.1
Software Applications	1	1.7
Air Pollution	1	1.7
Research & Development	1	1.7
Hydrogeology	5	8.5
Geotechnical	5	8.5
Mining	3	5.1
Health & Safety	0	0.0
Other	15	25.4

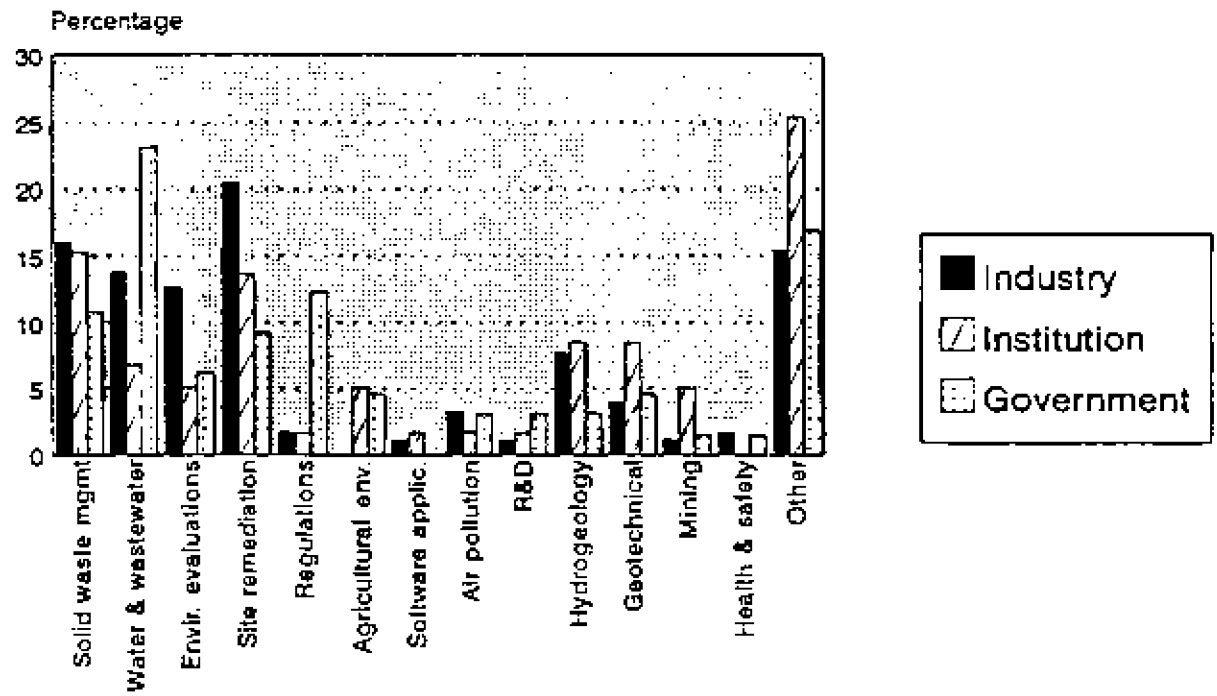
Group: Government

Area	Number	Percent
Solid Waste Management	7	10.8
Municipal Eng./W & WW Treatment	15	23.1
Environmental Evaluations	4	6.2
Site Remediation	6	9.2
Regulations	8	12.3
Agricultural Env. Problems	3	4.6
Software Applications	0	0.0
Air Pollution	2	3.1
Research & Development	2	3.1
Hydrogeology	2	3.1
Geotechnical	3	4.6
Mining	1	1.5
Health & Safety	1	1.5
Other	11	16.9

Areas of work
(by Region)



Areas of work
(by Group)



B2. What are the main areas of your environmental work?

38	C-1-008	Monitoring & reporting/Studies & assesment/Design & contract
41	C-1-011	Subsurface enviro. investigations, site audits & assesment
42	C-1-012	Treatments, management, assesment, remediation, audits, etc.
43	C-1-013	Municipal, Government, Industry
97	C-1-019	Chem/Ind site/assessment/remediation/inv/risk/audit/
98	C-1-020	Geophysical appl to ground-water,soil,archeo & shallow eng
99	C-1-021	Contaminated sites, acid rock drainage, mine closure
102	C-1-024	Industrial & Mining
103	C-1-025	Oil and gas industry
104	C-1-026	Enviro assesssment and comliance fed/prov/regional regulatio
108	C-1-030	Petroleum industry sites
44	C-2-014	Chem, biochem & microbiolo. proc. to clean water, soil,solid
45	C-2-015	Food process engineering
46	C-2-016	Site Characterization
47	C-2-017	R&D nuclear waste disposal for AECL
48	C-2-018	Clean up of spilled diesel/home heating fuel using bacteria
35	C-3-005	Policy & Planning
36	C-3-006	Waterway's disruption of nat habitat & navigable waters
37	C-3-007	Abiding by Regulations e.g. Hazardous Waste, Dangerous goods
39	C-3-009	Sewage treatment/solid waste/hazardous materials/site contam
100	C-3-022	Special waste regulations/contam sites review consult rep
101	C-3-023	Cont site assess/PCB Reg/Contingency plan hazard waste manag

Questions B3 and B4

Do the professional engineers in your company/institution/government undertake any type of continuing education courses in environmental studies?

The two questions in this group are an attempt to determine whether the engineers practising in the environmental field are presently engaged in some form of "continuing education". Two-thirds of the respondents answered positively. It is interesting to note that "Industry" registers almost 80% in the "yes" category, a testimony to Industry's awareness for the need for "upgrading" for its professionals to meet competitive requirements in the environmental field. Along the same lines, the response from the "Government" group shows a higher percentage in the "no" category. Since "Institutions" include universities and professional associations, analysis of responses in this category is somewhat difficult -- to a very large extent "swayed" by the university professionals who presumably consider themselves as the "continuing education givers" and thus do not respond positively to the question posed.

It is also interesting to observe that whereas the proportion of "yes" answer is not regionally biased, the "no answer" appears to be considerably smaller as one progresses towards the West -- suggesting perhaps that the areas of work (see charts for B2 response) might have some influence on the responses. The individual responses (for those who chose to respond) show that the kinds of courses or continuing education studies taken varied from structured post-graduate programs leading to M.Eng., M.Sc., and Ph.D. degrees, to seminars, special one-day to three-day type of information courses, adjuncts to conferences, workshops, etc. Much of this depends on the "group" and the type of work being undertaken by the responder.

If the answer to question B3 is yes, can you please indicate where and what kind?

As might be expected from the above, the main "information givers" were universities. Other sources of information givers were short courses associated with conferences, developed by professional associations or professional "information givers" who perform this function for "gain", and workshops crafted by individual industry groups for self-improvement. The interesting feature in the answers is the variety of "*what kind*" responses. One notes that within the context of "where", some of the respondents provided such answers as: Waste management (100%); groundwater and geophysical, and the general term "environmental engineering", for the kinds of "instruction" needed. This type of information should be compared with the responses to the preceding questions, particularly in regard to the perception of "background preparation" and "environmental engineering".

B3. Do the professional engineers in your Company/Institution/Government undertake any type of continuing education courses in environmental studies?

2	A-1-002	Seminars, Conferences
53	A-1-013	On a personal basis
87	A-1-019	Design/const. clay liners
123	A-1-025	Generally short courses
124	A-1-026	Univ. course; Association sponsored seminars; in-house train
52	A-2-012	INRS is a University they give courses and assist to confere
88	A-2-014	Research institution
3	A-3-004	Specific needs: PCBs, incineartion
51	A-3-011	Atla.Comm. Agr. Eng. organizes annual workshops
12	B-1-004	Some internal activities; reprocessing
13	B-1-005	Give courses to clients
14	B-1-006	Univ. of Madison, Wisconsin
16	B-1-008	Specialized seminars, short courses
17	B-1-009	Seminars/conferences
19	B-1-011	Cont-ed on a case-by-case
22	B-1-014	One professional engineer involved
23	B-1-015	Company fonded short courses in the past at various places
26	B-1-018	Specify courses offered by univ.
29	B-1-021	Attending conferences and seminars
30	B-1-022	Seminars, short courses
31	B-1-023	Not at present
56	B-1-026	Landfill design, waste treatment, hydrogeology, hydrology
64	B-1-034	Master (some), Ph.D. (some)
65	B-1-035	Conferences, university courses, degrees
67	B-1-037	Chemical background, contaminants, hydrogeology
69	B-1-039	Permiting
72	B-1-042	Do not know
74	B-1-044	Some do post-grad courses or degree work, some conferences
77	B-1-047	Post-graduate programs in chemistry, hydrogeology
79	B-1-049	Seminars, conferences, courses
81	B-1-051	University courses at graduate level/prived sector courses
85	B-1-055	Short courses in various subjects
86	B-1-056	On occasion
113	B-1-061	There are exceptions when staff take night courses
114	B-1-062	Seminars/M.Sc. courses
115	B-1-063	Contaminant transport; seminars/short courses in treatment
57	B-2-027	Several taken speciality training courses
58	B-2-028	Conferences, short courses
59	B-2-029	Mostly related to groundwater issues
68	B-2-038	Graduated courses/short courses/conferences/symposia
71	B-2-041	Technical transfer conferences and seminars
75	B-2-045	No engineers members of the board
80	B-2-050	Occasional participation to short courses
83	B-2-053	Specific subjects like env. sampling techniques
109	B-2-057	Environmental planners take courses in Environ. Sciences
111	B-2-059	M.Eng. (civil); short courses
27	B-3-019	It is not mandatory, post-graduate courses
54	B-3-024	Primarely in the hands of idividuals
61	B-3-031	Graduate courses (part time) or cont-ed
62	B-3-032	Speciality courses at university + conferences/workshops
63	B-3-033	Through univ. of Guelph and McMaster
118	B-3-066	Individually initiated
119	B-3-067	1 training course/yr (specific to their area)
40	C-1-010	Monthly conferences and seminars / internal and external
42	C-1-012	Master's degree in environmental engineering
97	C-1-019	AGSE,APEGGA short courses/Univ,Ind tech conf/short courses
98	C-1-020	Adv GW,remed strat,new geophysical tech etc viaSEG/NWWA/USGS

99	C-1-021	short courses, seminars & conferences
102	C-1-024	Company in house professional development program
103	C-1-025	Groundwater and remediation courses
104	C-1-026	Courses & seminars often available only in US
105	C-1-027	From Graduate level work supported by Company & short course
106	C-1-028	Workshops, conferences, seminars
107	C-1-029	Short courses, conferences NGWA/Waterloo or others
108	C-1-030	Sent to seminars at least once a year
95	C-1-031	Conferences
96	C-1-032	Courses/seminars avg. 3 days/year
128	C-1-036	Industry programs to upgrade skills
130	C-1-038	Courses, seminars, graduate degrees (part-time)
134	C-1-042	Hydrogeology, risk assessment, haz-was management, computers
44	C-2-014	We teach short courses for engineers
45	C-2-015	some
47	C-2-017	Training of full-time and part-time graduate students
48	C-2-018	Masters and Ph.D. courses
125	C-2-033	Short courses (< 1 week) and evening univ. courses
129	C-2-037	Attend seminars
8	C-3-001	Water quality, Chemistry, Irrigation management
34	C-3-004	Attend workshops & seminars when available locally
35	C-3-005	Extension Division
37	C-3-007	not pre-requisite to construction/design
39	C-3-009	Conference attendance (i.e. Western Canada Water&Waste Assoc
100	C-3-022	Short courses/ conferences/ seminars
101	C-3-023	Seminars

B.3 Do the professional engineers in your Company/Institution/Government undertake any type of continuing education courses in environmental studies?

Total

Answer	Number	Percent
Yes	88	65.6
No	34	25.4
No answer	12	9.0

Group: Industry

Answer	Number	Percent
Yes	58	79.5
No	10	13.7
No answer	5	6.8

Group: Institution

Answer	Number	Percent
Yes	18	54.5
No	10	30.3
No answer	5	15.2

Group: Government

Answer	Number	Percent
Yes	12	42.9
No	14	50.0
No answer	2	7.1

B.3 Do the professional engineers in your Company/Institution/Government undertake any type of continuing education courses in environmental studies? (cont.)

Group: A (QUEBEC + MARITIMES)

Answer	Number	Percent
Yes	13	54.2
No	7	29.2
No answer	4	16.7

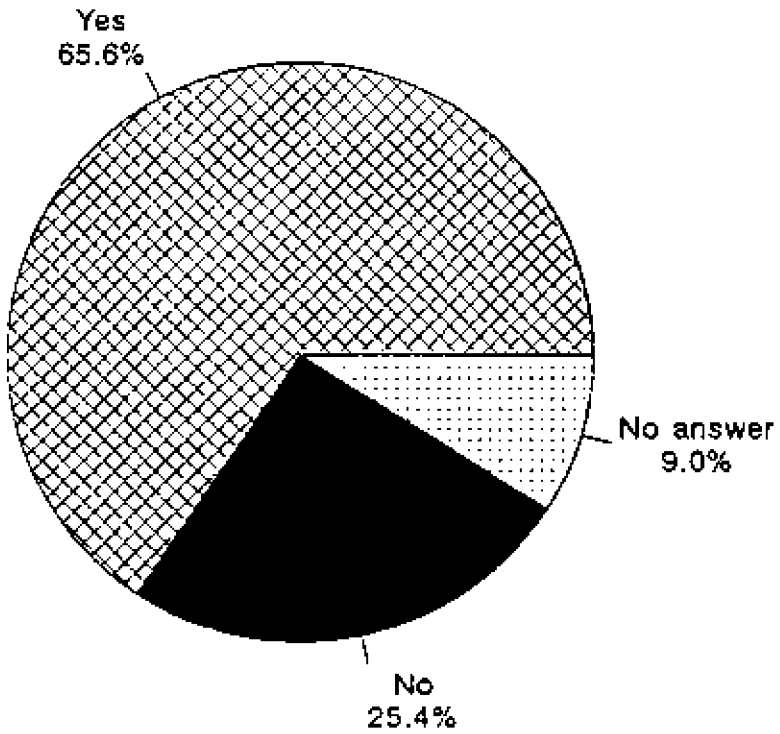
Group: B (ONTARIO)

Answer	Number	Percent
Yes	46	67.6
No	16	23.5
No answer	6	8.8

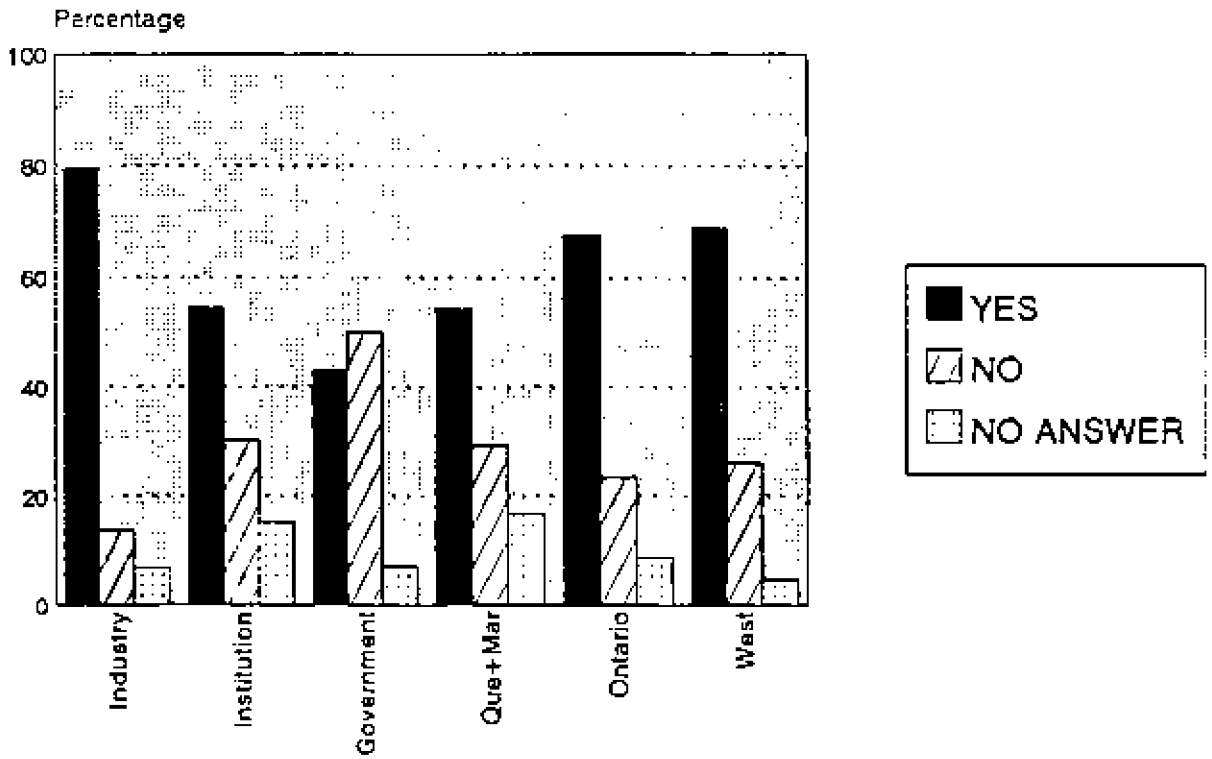
Group: C (WEST)

Answer	Number	Percent
Yes	29	69.0
No	11	26.2
No answer	2	4.8

Undertaking Cont-ed courses



Undertaking Cont-ed courses



B4. If the answer to question No. 3 is yes, can you please indicate where and what kind?

1	A-1-001	Underground tank, CAP, Accounting, Cont-Ed
2	A-1-002	University
87	A-1-019	U. of Wisconsin
123	A-1-025	Short courses sponsored by Universities or Technical Assoc.
88	A-2-014	Conferences and research
9	B-1-001	Waterloo Univ., UFT, McMaster Univ.
14	B-1-006	Waste management (100%)
23	B-1-015	Short term courses
26	B-1-018	London (Ont), Wisconsin, Seattle
56	B-1-026	Univ. of Waterloo, Toronto, Guelph, Ottawa, Ohio State
66	B-1-036	National Water Well Assoc., Groundwater Research Institute
69	B-1-039	Part time
77	B-1-047	Civil engineering and Groundwater Institute (Waterloo)
79	B-1-049	MOE training courses, Univ. of Ottawa, WPCF
84	B-1-054	Conferences, seminars, workshops
115	B-1-063	Universities/Geotechnical Eng. or Env. Eng. faculty
116	B-1-064	Workshops, seminars, conferences, univ. courses
24	B-2-016	Env. technologies, waste minimization, haz-was, sales
57	B-2-027	Specialized institutions
58	B-2-028	Mainly short courses
59	B-2-029	National Groundwater Association, Univ. of Missouri-Rolla
71	B-2-041	Environmental geoscience
111	B-2-059	Training focused at senior undergraduate/graduate levels
112	B-2-060	University courses in Env. Sciences, by correspond./person
61	B-3-031	McMaster Univ.
73	B-3-043	Univ. of Wisconsin, Madison
38	C-1-008	Technical Workshops / Conferences
40	C-1-010	10% Univ., 60% ext. seminars & conferences, 30% int. trainin
41	C-1-011	Technical Univ. of Nova Scotia & Univ. of Western Ontario
42	C-1-012	University - environmental engineering
97	C-1-019	short courses and conferences
98	C-1-020	85% GW / 15% geophysical
99	C-1-021	100% University or professional institution
102	C-1-024	In house 70%, Univ extension UBC 15%, Courses & seminars 15%
103	C-1-025	Prof association 70%, University 30%
104	C-1-026	Universities 50%
105	C-1-027	U of Waterloo/US EPA/IAH/NWWA Grad work,corresp & short cour
106	C-1-028	Univ of Waterloo short course on groundwater remediation
107	C-1-029	NGWA short courses at locations USA, Univ of Waterloo
108	C-1-030	Seminars
126	C-1-034	Some post-grad courses&degrees env. eng./sci.; conferences
130	C-1-038	Varies
47	C-2-017	Graduate school in civil, geotech. & chemical process eng.
48	C-2-018	University
125	C-2-033	University (organic chemistry); short courses & seminars
129	C-2-037	Environmental science/engineering
132	C-2-040	Personal research, technical conferences in groundwater
35	C-3-005	Univ. of Sask./Saskatoon Enviro. Laws & Enviro. Processes
100	C-3-022	Training Institute 30%, Consultant 20%, In house train 50%
101	C-3-023	Seminars BC/T, US EPA, Mount Royal College, Marine tr. inst.

Questions B5 and B6

What are the main driving forces of your company/institution/government which are responsible for the perceived needs of continuing education training for your professional engineers?

At least a third of the respondents indicated that "technological change" was the main driving force responsible for the "push" towards continuing education, followed closely by the realization that regulatory changes in environmental issues needed better background preparation for practice in the "market place". The views on technological change as the driving force appeared to be equally shared throughout the country, and the respondents from "Government" were more responsive. The several obvious conclusions that one would be tempted to make should be carefully avoided!

In regard to "regulatory change" as the driving force, it would appear that there was a greater awareness of this as a driving force in the "West" in comparison to the "East", and that the perception of this as a driving force for seeking continuing education and training appears to be almost uniformly held between the three major groups (industry, institution, government) surveyed.

Does your company/institution/government rely upon a number of sources for the upgrading of your professionals working in the environmental area?

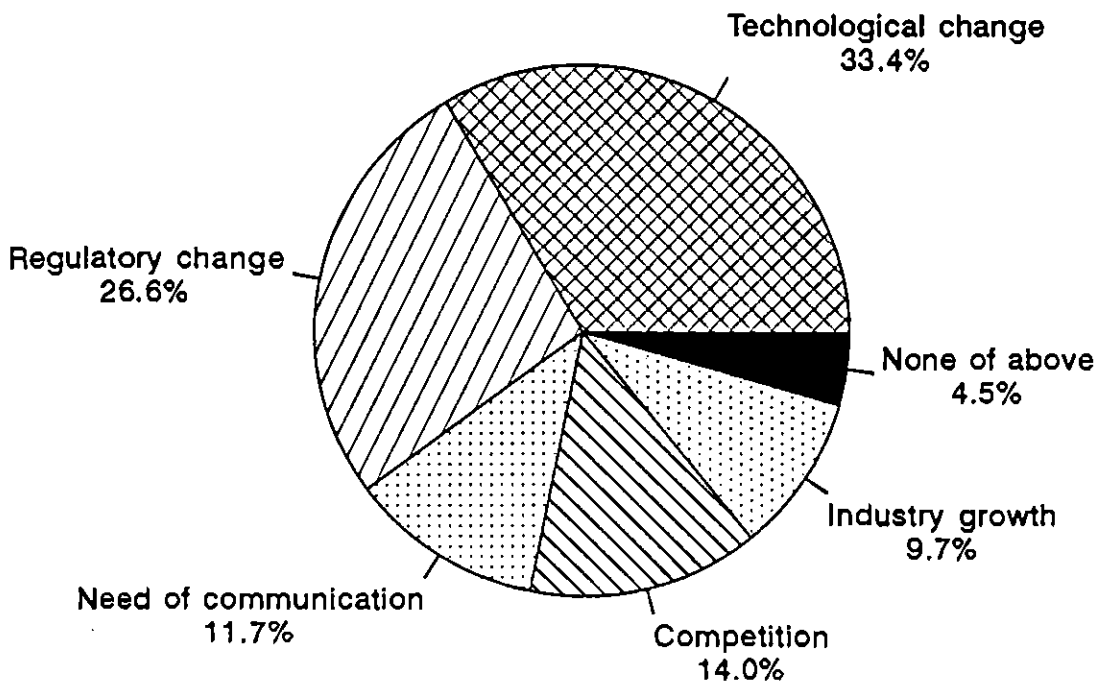
Seminars and conferences appear to be the major source of "upgrading information", with universities coming in at a close second. However, if we add "Colleges and technical institutes" to "Universities", the major source for upgrading would be "universities/colleges" followed very closely by "seminars/conferences". Together, these two channels for upgrading constitute almost one half the "sources". These views appear to be commonly held throughout the country and between the various Groups -- with minor differences between the groups and regions.

Taken on the whole, if we consider structured programs to include seminars/conferences, universities/colleges, continuing education and industry association programs, almost two thirds of the sources for upgrading can be considered to come from such structured programs. This is very interesting, inasmuch as one might be tempted to conclude that the "profession" is very responsive to upgrading its capability, and that if one offered structured programs via a recognized source, the response would indeed be very positive. The inescapable conclusion is that "there is a need for upgrading" of the profession, and that both on-the-job training and structured programs are needed.

B.5 What are the main driving forces of your Company/Institution/Government which are responsible for the perceived needs of continuing education training for your professional engineers?

Driving Force	Number	Percent
Technological change	103	33.4
Regulatory change	82	26.6
Need of communication	36	11.7
Competition	43	14.0
Industry Growth	30	9.7
None of the above	14	4.5

Driving forces
for Cont-ed



B.5 What are the main driving forces of your Company/Institution/Government which are responsible for the perceived needs of continuing education training for your professional engineers? (cont.)

Group: A (QUEBEC + MARITIMES)

Driving Force	Number	Percent
Technological change	10	37.0
Regulatory change	6	22.2
Need of communication	3	11.1
Competition	2	7.4
Industry Growth	5	18.5
None of the above	1	3.7

Group: B (ONTARIO)

Driving Force	Number	Percent
Technological change	61	33.3
Regulatory change	47	25.7
Need of communication	22	12.0
Competition	27	14.8
Industry Growth	17	9.3
None of the above	9	4.9

Group: C (WEST)

Driving Force	Number	Percent
Technological change	32	32.7
Regulatory change	29	29.6
Need of communication	11	11.2
Competition	14	14.3
Industry Growth	8	8.2
None of the above	4	4.1

B.5 What are the main driving forces of your Company/Institution/Government which are responsible for the perceived needs of continuing education training for your professional engineers? (cont.)

Group: Industry

Driving Force	Number	Percent
Technological change	60	31.7
Regulatory change	48	25.4
Need of communication	17	9.0
Competition	36	19.0
Industry Growth	22	11.6
None of the above	6	3.2

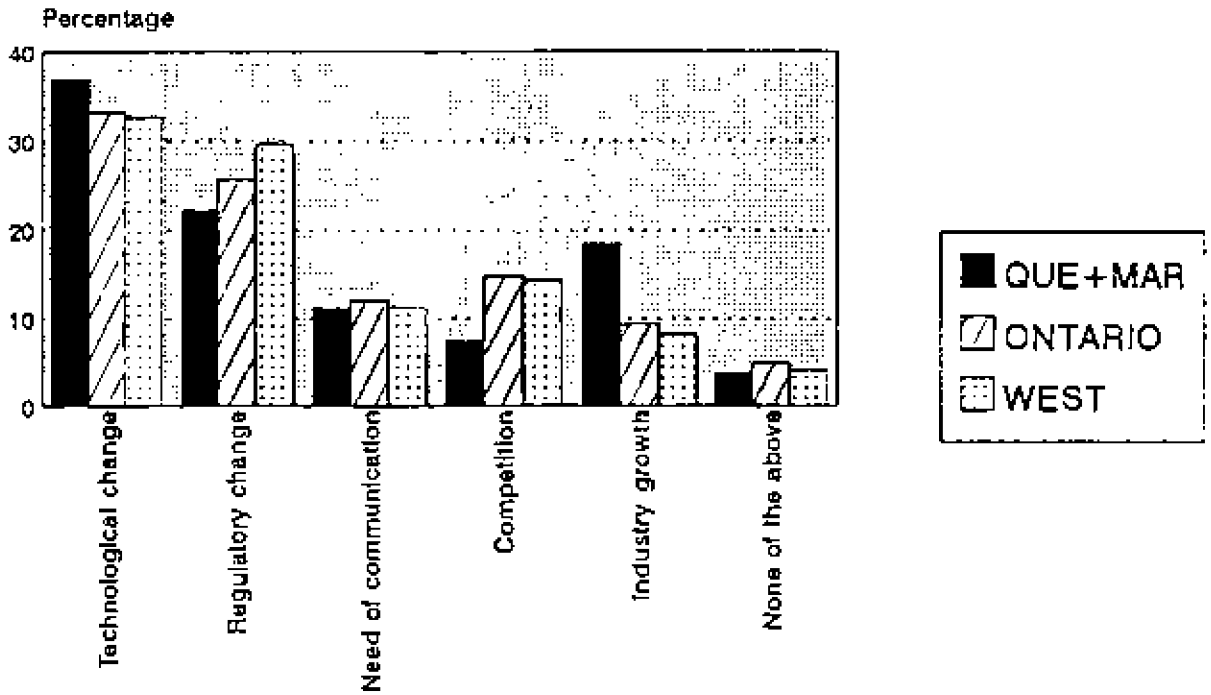
Group: Institution

Driving Force	Number	Percent
Technological change	21	31.8
Regulatory change	18	27.3
Need of communication	12	18.2
Competition	5	7.6
Industry Growth	4	6.1
None of the above	6	9.1

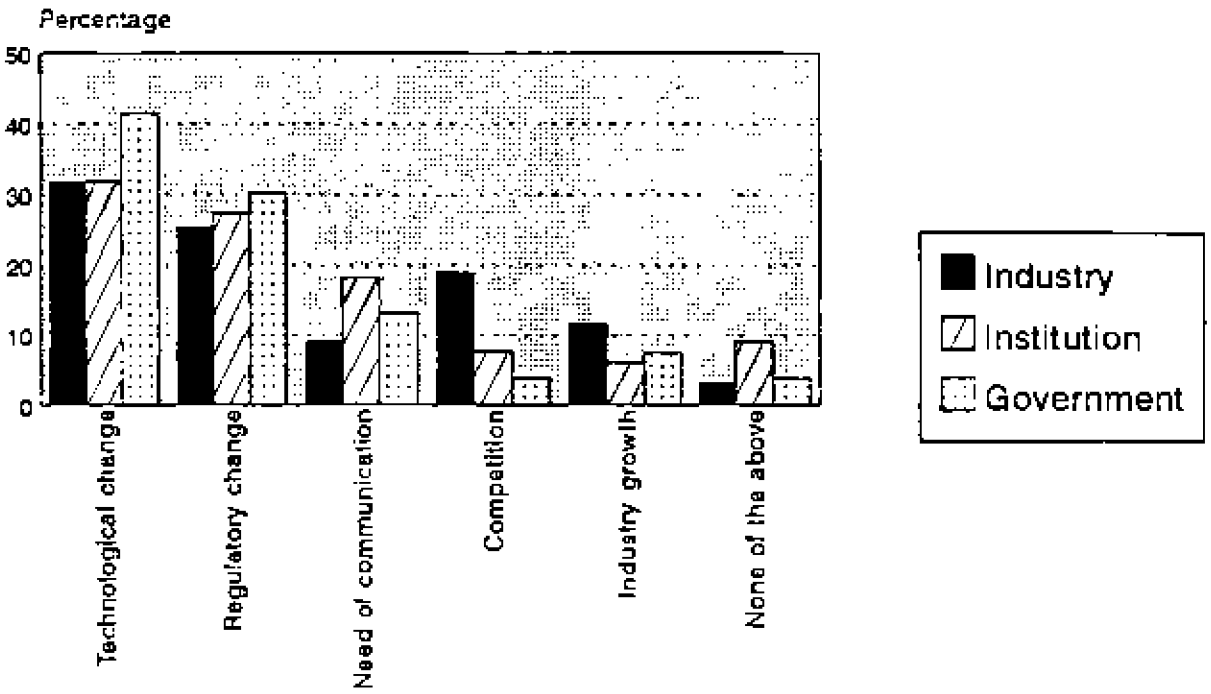
Group: Government

Driving Force	Number	Percent
Technological change	22	41.5
Regulatory change	16	30.2
Need of communication	7	13.2
Competition	2	3.8
Industry Growth	4	7.5
None of the above	2	3.8

Driving forces
(by Region)



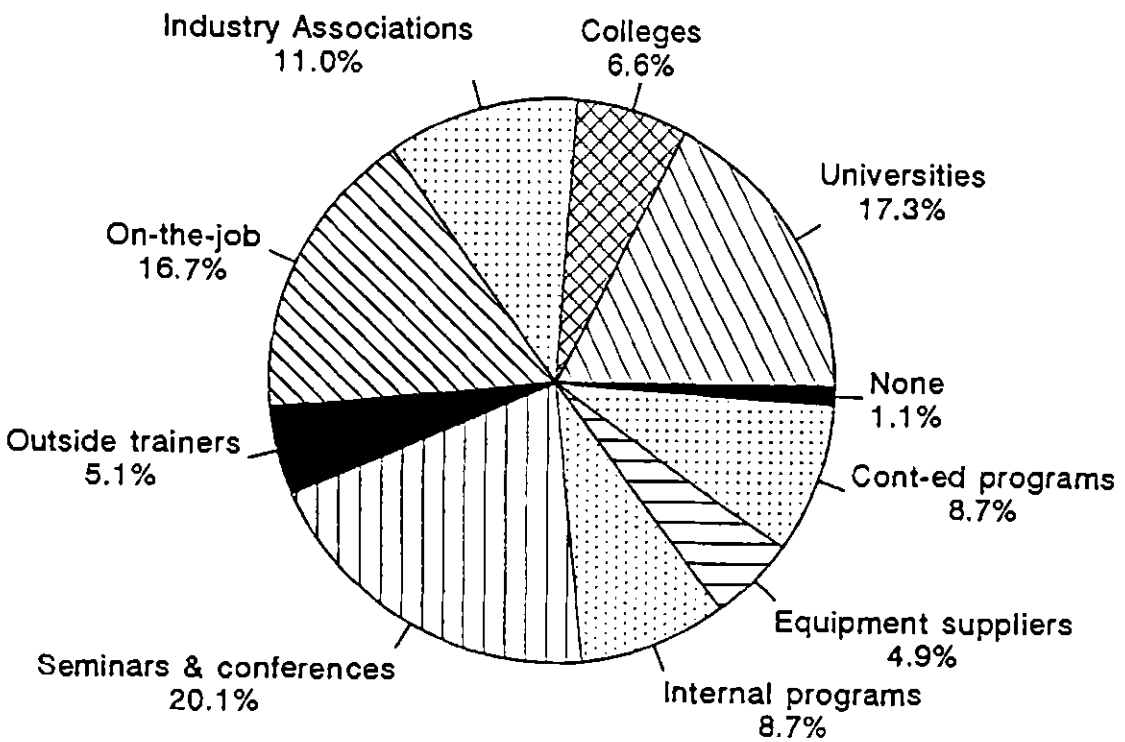
Driving forces
(by Group)



B.6 Does your Company/Institution/Government rely upon a number of sources for the upgrading of your professionals working in the environmental area?

Source	Number	Percent
None	5	1.1
Universities	82	17.3
Colleges & technical institutes	31	6.6
Industry Associations	52	11.0
On the job training	79	16.7
Outside trainers	24	5.1
Ind. Seminars & conferences	95	20.1
Internally devel. train. prog.	41	8.7
Equipment suppliers	23	4.9
Cont-ed programs	41	8.7

Sources for upgrading



B.6 Does your Company/Institution/Government rely upon a number of sources for the upgrading of your professionals working in the environmental area? (cont.)

Group: A (QUEBEC + MARITIMES)

Source	Number	Percent
None	1	2.0
Universities	9	18.0
Colleges & technical institutes	2	4.0
Industry Associations	6	12.0
On the job training	8	16.0
Outside trainers	2	4.0
Ind. Seminars & conferences	10	20.0
Internally devel. train. prog.	6	12.0
Equipment suppliers	1	2.0
Cont-ed programs	5	10.0

Group: B (ONTARIO)

Source	Number	Percent
None	2	0.8
Universities	47	18.0
Colleges & technical institutes	21	8.0
Industry Associations	28	10.7
On the job training	38	14.6
Outside trainers	13	5.0
Ind. Seminars & conferences	50	19.2
Internally devel. train. prog.	24	9.2
Equipment suppliers	13	5.0
Cont-ed programs	25	9.6

Group: C (WEST)

Source	Number	Percent
None	2	1.2
Universities	26	16.0
Colleges & technical institutes	8	4.9
Industry Associations	18	11.1
On the job training	33	20.4
Outside trainers	9	5.6
Ind. Seminars & conferences	35	21.6
Internally devel. train. prog.	11	6.8
Equipment suppliers	9	5.6
Cont-ed programs	11	6.8

B.6 Does your Company/Institution/Government rely upon a number of sources for the upgrading of your professionals working in the environmental area? (cont.)

Group: Industry

Source	Number	Percent
None	0	0.0
Universities	50	17.0
Colleges & technical institutes	19	6.5
Industry Associations	37	12.6
On the job training	52	17.7
Outside trainers	11	3.7
Ind. Seminars & conferences	57	19.4
Internally devel. train. prog.	25	8.5
Equipment suppliers	18	6.1
Cont-ed programs	25	8.5

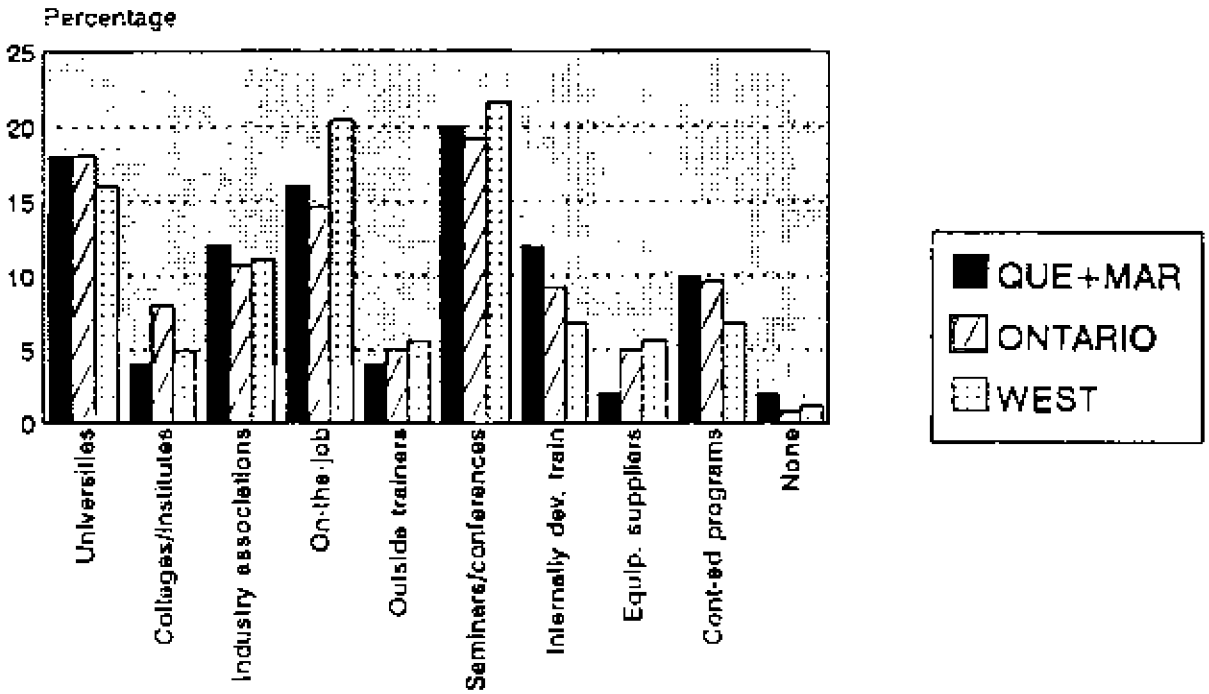
Group: Institution

Source	Number	Percent
None	4	4.8
Universities	17	20.2
Colleges & technical institutes	3	3.6
Industry Associations	8	9.5
On the job training	11	13.1
Outside trainers	5	6.0
Ind. Seminars & conferences	17	20.2
Internally devel. train. prog.	6	7.1
Equipment suppliers	2	2.4
Cont-ed programs	11	13.1

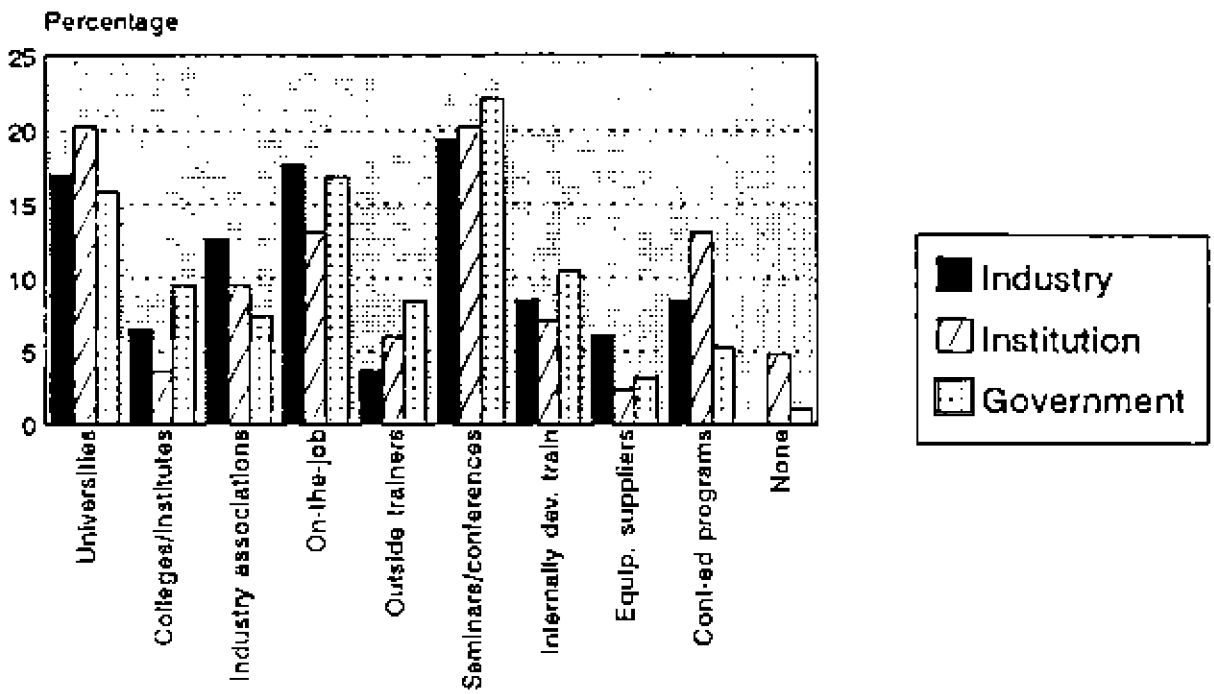
Group: Government

Source	Number	Percent
None	1	1.1
Universities	15	15.8
Colleges & technical institutes	9	9.5
Industry Associations	7	7.4
On the job training	16	16.8
Outside trainers	8	8.4
Ind. Seminars & conferences	21	22.1
Internally devel. train. prog.	10	10.5
Equipment suppliers	3	3.2
Cont-ed programs	5	5.3

Sources for upgrading
(by Region)



Sources for upgrading
(by Group)



Question B7

Prioritize your needs in the environmental education and training of your employees according to the following list:

In trying to establish the basic motivation for continued learning of "material in one's area of practice", one needs to determine what sets of priorities govern the situation. The tables given in the graphical and tabular sections (following) gives values ("points") which were obtained by multiplying the "1st" choice with 5 points, and the 2nd. choice with 4 points, etc. The 5th. choice carried a "point weighting" of one. Using this scheme, one sees that the need to "develop specialized skills" constituted the highest priority. However, if one combines "general training" with "on-going training", the priority for education is one which provides the basis for "training" of the professional in his job responsibility. The views on "general training" requirements appear to be remarkably uniformly held throughout the country. The "East" appears to consider "on-going" training as a lesser importance in comparison to the rest of the country, but considers the development of special skills to be more important.

It is pertinent to note that in response to "*Other*", given as B7e, regulatory issues and concerns appear to preoccupy the respondents. One sees answers such as "regulatory update; regulatory issues; regulatory changes; environmental regulations/law; changing provincial regulations....."

SUMMARY FOR SECTION B

The responses to the general sets of questions dealing with "environmental engineering" and "upgrading/continuing education" needs or priorities, clearly demonstrate that there does not seem to be a clear consensus as to "what constitutes environmental engineering". A distinction seems to be made between the "environmental engineering degree" as received in those institutions that clearly identify such a "degree option", and the practice of "environmental engineering" as seen by the broad spectrum of engineers surveyed. One could argue that the survey should have been confined to the qualified degree option designated environmental engineers. If such restrictions were made, one would need to identify all the other workers (engineers) working in the environmental "field" as "???". As the survey shows, the perception of "what constitutes (or is) an environmental engineer" varies considerably between the various respondents, groups, and regions.

Apart from the vast diversity of opinion on "what constitutes the environmental engineering field", it is useful to observe that there is a large consensus on the need for

continued learning "outside" (i.e. outside of university undergraduate days), either as a means to upgrade the engineer, or for purposes of "staying with the competition and /or government regulations and requirements". It is refreshing to note that the profession perceives the need to "learn" more about the nature of the field within which it is practising, and that structured programs of learning are a very good source for learning and upgrading. The source of "upgrade information" most favoured appears to be "university/college" and "conferences and seminars". It is interesting to note that as in the case of the diverse opinions on "what constitutes environmental engineering", similar kinds of varying answers were perceived in the kinds of upgrading information required or desired. One should obviously not be surprised since both these kinds of information essentially relate directly with each other.

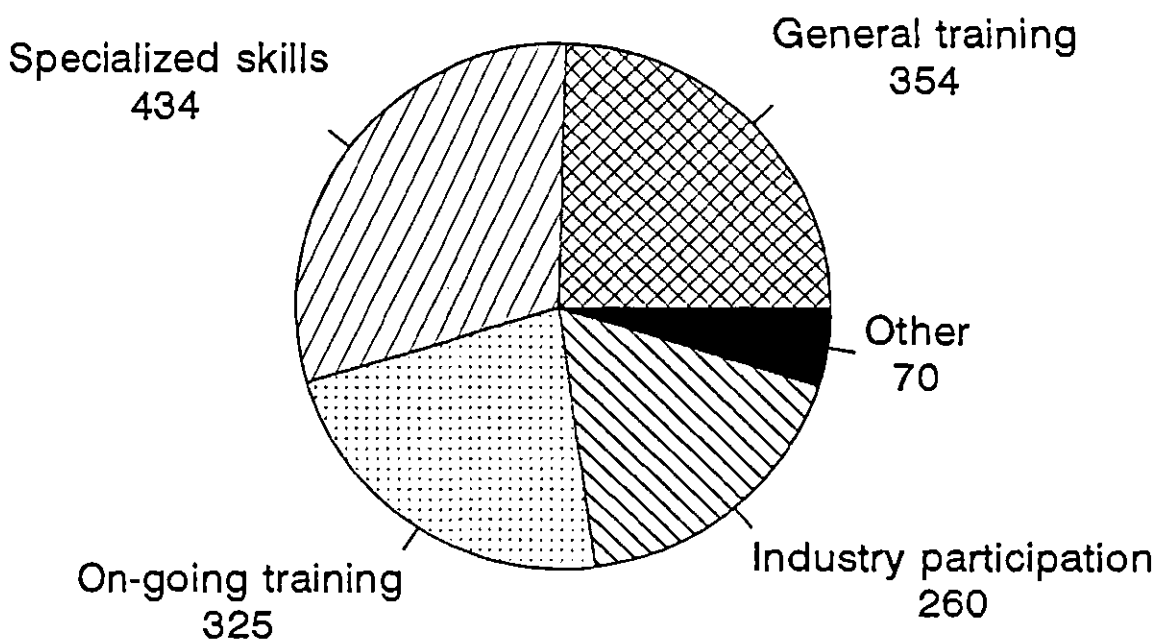
Having now ascertained that there is a need for some kind of upgrading program, structured or unstructured, for professional engineers working in the "environmental field", it now remains to determine whether one could obtain a consensus on what type of upgrading program would be acceptable, and the also the kinds (and level) of information required. This will be addressed in the Section C and Section D part of the questionnaire returns.

B.7 Prioritize your needs in the environmental education and training of your employees according to the following list.

Needs	1st	2nd	3rd	4th	5th	Points
General training	32	20	29	13	1	354
Develop specialized skills	56	21	19	6	1	434
On-going training	16	37	20	18	1	325
Industry participation	11	22	16	31	7	260
Other	6	8	2	1	0	70

Needs in education

(in points)



B.7 Prioritize your needs in the environmental education and training of your employees according to the following list (cont.).

Group: A (QUEBEC + MARITIMES)

Needs	1st	2nd	3rd	4th	5th	Points
General training	4	3	3	1	0	43
Develop specialized skills	9	3	1	0	0	60
On-going training	1	3	2	3	0	29
Industry participation	2	4	2	3	0	38
Other	0	1	0	0	0	4

Group: B (ONTARIO)

Needs	1st	2nd	3rd	4th	5th	Points
General training	16	9	21	10	0	199
Develop specialized skills	26	12	11	4	1	220
On-going training	10	21	10	12	0	188
Industry participation	8	14	7	14	5	150
Other	5	4	0	0	0	41

Group: C (WEST)

Needs	1st	2nd	3rd	4th	5th	Points
General training	12	8	5	2	1	112
Develop specialized skills	21	6	7	2	0	154
On-going training	5	13	8	3	1	108
Industry participation	1	4	7	14	2	72
Other	1	3	2	1	0	25

B.7 Prioritize your needs in the environmental education and training of your employees according to the following list (cont.).

Group: Industry

Needs	1st	2nd	3rd	4th	5th	Points
General training	20	5	21	10	1	204
Develop specialized skills	29	13	13	4	1	245
On-going training	11	23	8	10	1	192
Industry participation	4	17	7	18	5	150
Other	4	5	2	0	0	46

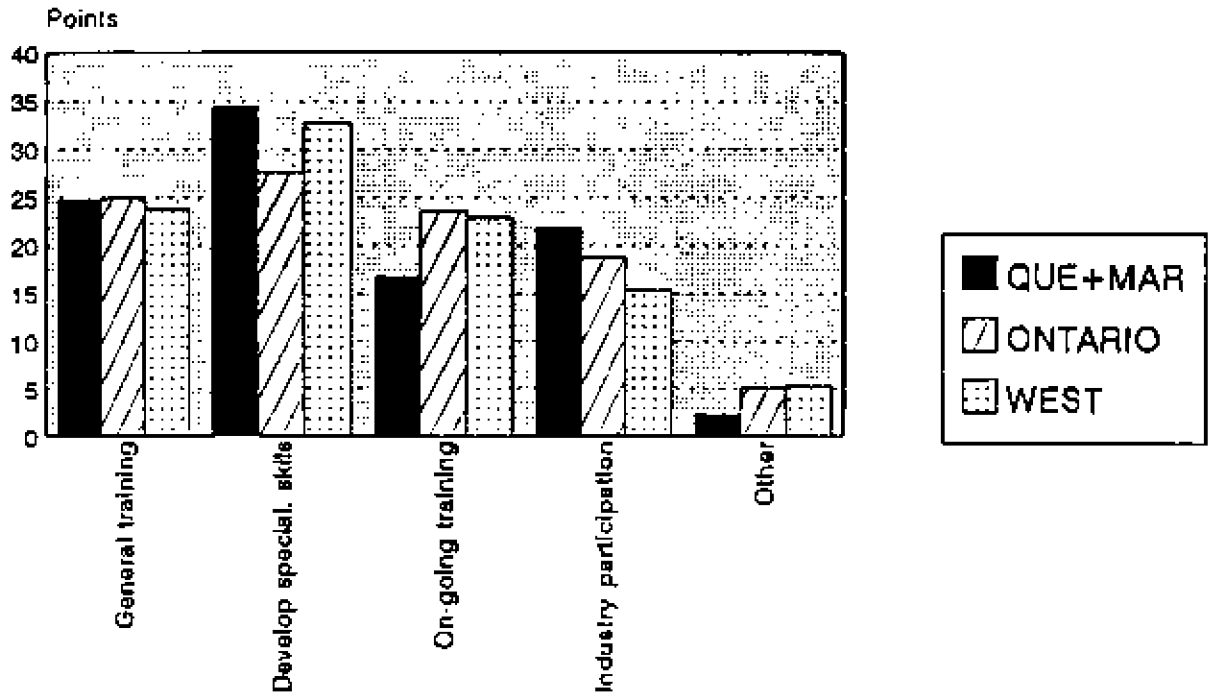
Group: Institution

Needs	1st	2nd	3rd	4th	5th	Points
General training	4	7	4	2	0	64
Develop specialized skills	16	6	0	0	0	104
On-going training	1	7	6	5	0	61
Industry participation	5	0	7	6	0	58
Other	1	2	0	0	0	13

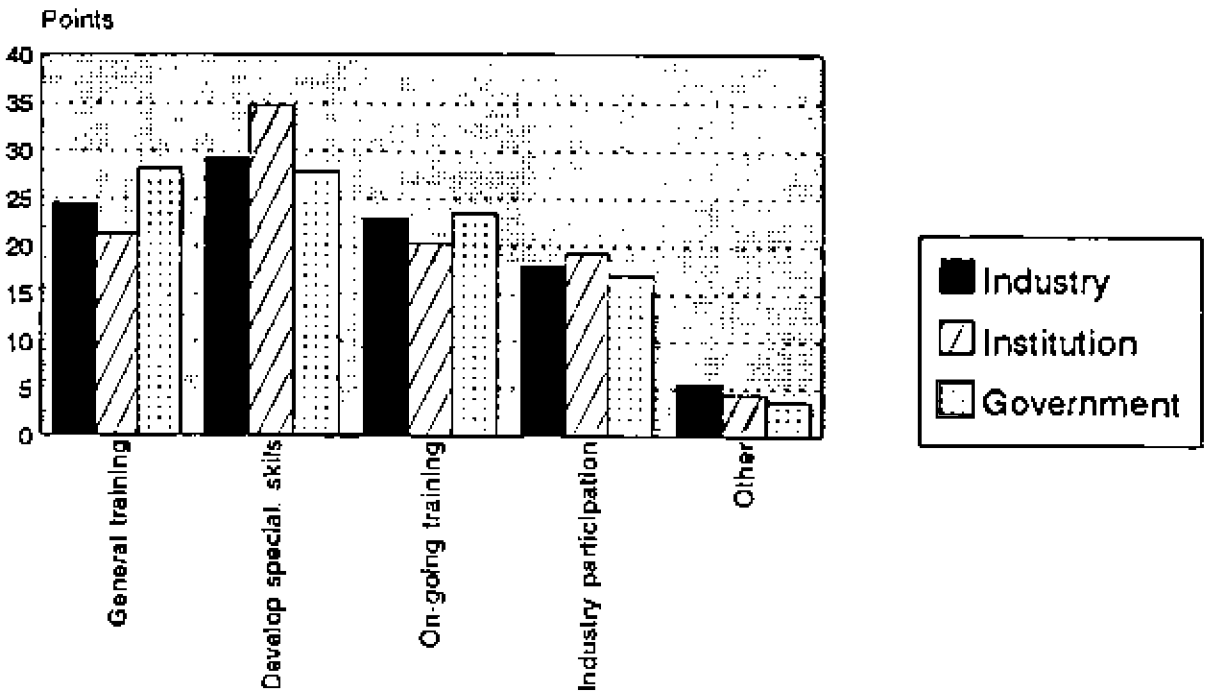
Group: Government

Needs	1st	2nd	3rd	4th	5th	Points
General training	8	8	4	1	0	86
Develop specialized skills	11	2	6	2	0	85
On-going training	4	7	6	3	0	72
Industry participation	2	5	2	7	2	52
Other	1	1	0	1	0	11

Needs in education
(by Region)



Needs in education
(by Group)



B7. Prioritize your needs in the environmental education and training of your employees according to the following list.

[] e. Other (specify) .....

88	A-2-014	Education
51	A-3-011	stress technical sk.
19	B-1-011	Changing prov.regul.
26	B-1-018	Government regulator
30	B-1-022	Microbiological env.
64	B-1-034	Need for training
79	B-1-049	Conferences
114	B-1-062	Health & Safety
116	B-1-064	Regulatory issues
68	B-2-038	Professional practic
119	B-3-067	Chem.eng./env.prob.
105	C-1-027	Regulations
126	C-1-034	Regulatory update
127	C-1-035	Regulatory issues
133	C-1-041	Project mgm./commun.
46	C-2-016	5th year reg. BEng
33	C-3-003	Regulatory changes
34	C-3-004	Enviro. Reg./Law
36	C-3-006	None

SECTION C - THE NEW PROGRAM

CONTINUING EDUCATION PROGRAM FOR ENGINEERS

Recalling that the motivation for the Needs Analysis was in response to the charge given by the Committee structured under the Engineering Institute of Canada (EIC), the sets of questions relating to continuing education training were cast in relation to the overall umbrella provided by the EIC. However, it should be noted that there is "no magic" to this requirement, and that the questions and responses given in relation to the EIC involvement should be assessed in terms of EIC or an equivalent oversight body composed of professional engineers working in the environmental field, representing their engineering profession through their respective learned societies. The reasoning for this type of "peer oversight body" is obvious and clear. The engineers practising in this field constitute a wide array of engineering skills and disciplines, ranging from chemical engineers to agricultural engineers, forest engineers, civil engineers, environmental engineers.....etc., all of whom are licensed in their own right as professional engineers and permitted to practice as such. Their affiliation with their own (respective) learned societies testify to their professionalism, and if the need to establish continuing education, training, and upgrading is to be realized, the requirements, details, mechanisms, implementation, etc. should obviously (and correctly) be provided by these same engineers through their learned societies, either individually or collectively through some umbrella organization (EIC?) or oversight body.

In structuring questions C1 and C2, there was considerable debate within the study group that the two questions really addressed the same issue, i.e. there was no need for question C2. However, it was reasoned that question C1 addressed the continuing program in the context of a coordinated scheme via the EIC, whereas the question C2 was more directly concerned with whether the need really existed (for a coordinated and structured continuing education program in environmental engineering). One could argue that the need has already been established in the preceding section questions (Section B), and that C2 is irrelevant. However, the intent of C2 is directly tied into a structured continuing education program, separate from upgrading information or conferences. Admittedly, this intent is not immediately clear if question C2 is viewed by itself. However, if C2 is viewed directly in context with C1, the intent would be more obvious. The question that really needs to be asked is "Is there a need for a common set of courses for all engineers practising in the field of 'environmental works'?". This question was not directly posed because the object of the Needs Analysis was to determine whether such a need (i.e. common set) could be identified.

Questions C1 and C2

Do you support a continuing education program in environmental engineering studies coordinated by the EIC (Engineering Institute of Canada), in conjunction with the engineering learned societies.?

The 87% positive response to the question should be viewed together with the individual answers given as part of the "explanations/caveats". Answers received in support of the program included "good idea" to "it's a place to start". Negative or "no interest" answers included comments which questioned why the EIC should be involved to comments that the private sector should be involved. The consensus is that whereas there is a need for structured environmental engineering courses to be given to the practising profession in the field of "environmental works", there is no consensus on the manner in which such should be given. To further elucidate the problem, the answers to question C2 need to be examined.

Do you think there is a need for such a program?

From the responses to the preceding question, it would be expected that the respondents would be supportive of a program in continuing education, as witness the greater than 50% response in the "considerable" and "absolutely" categories. Only 25% percent of the respondents thought that there was a "medium" need, and about 10% thought that the need was small. Of the 3.1% who thought that there was no need for such a program, one obtained answers which "said" that there were "lots of other programs out there" and that "training was already being given to those who need it".

The supporting statements for the positive responses ran the gamut from "environmental engineering consultants do not have formal courses in this area" through "need for constant update" to "the industry is changing rapidly -- education is essential". The general consensus from the responses appears to centre around the fact that the "real world" being faced by the practitioners that responded demands skills that have not been given to them in their undergraduate training. In addition, it also appears that a significant number of them have yet to come to terms with "what environmental engineering" requires from them (or other professionals) in regards to responsibility in the discharge of their profession.

C.1 Do you support a continuing education program in environmental engineering studies coordinated by the EIC (Engineering Institute of Canada), in conjuction with the engineering learned societies?

Answer	Number	Percent
Yes	107	87.0
No	1	0.8
Indifferent	15	12.2

Group: Industry

Answer	Number	Percent
Yes	58	92.1
No	4	6.3
Indifferent	1	1.6

Group: Institution

Answer	Number	Percent
Yes	25	78.1
No	4	12.5
Indifferent	3	9.4

Group: Government

Answer	Number	Percent
Yes	24	85.7
No	2	7.1
Indifferent	2	7.1

C.1 Do you support a continuing education program in environmental engineering studies coordinated by the EIC (Engineering Institute of Canada), in conjuction with the engineering learned societes? (cont.)

Group: A (QUEBEC+MARITIMES)

Answer	Number	Percent
Yes	22	91.7
No	1	4.2
Indifferent	1	4.2

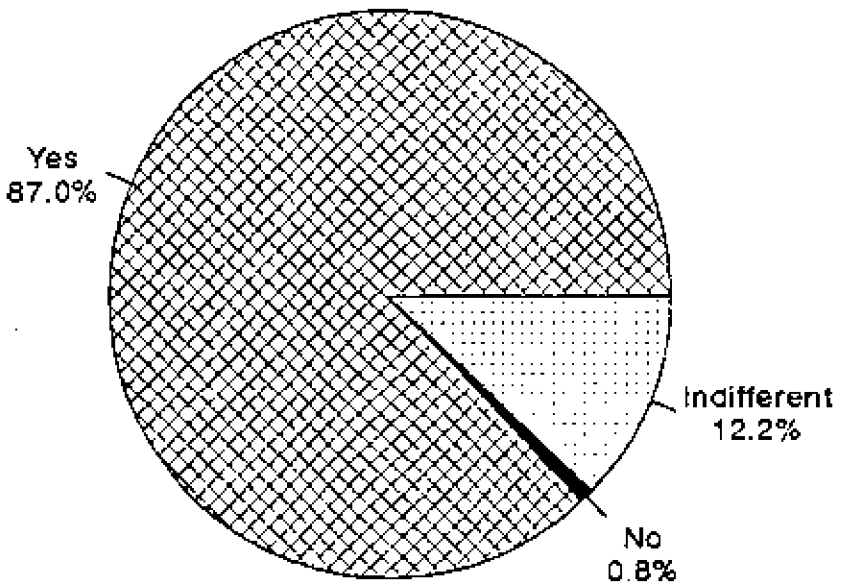
Group: B (ONTARIO)

Answer	Number	Percent
Yes	49	84.5
No	8	13.8
Indifferent	1	1.7

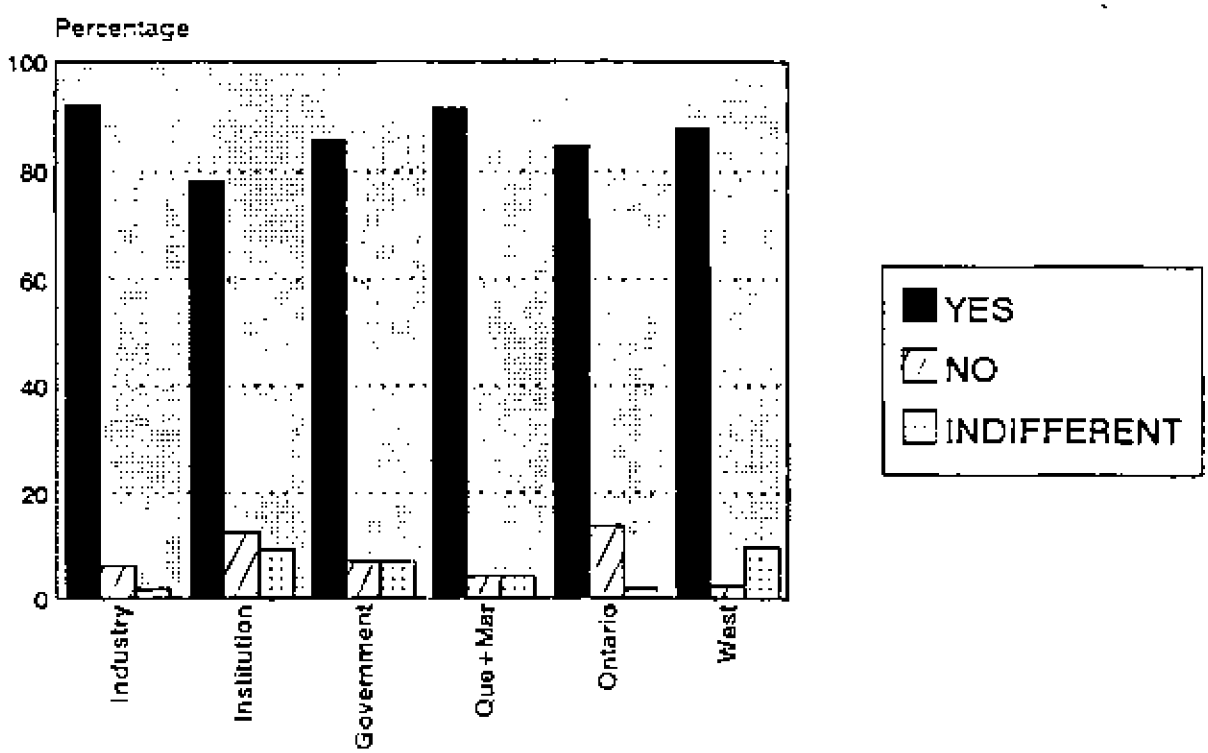
Group: C (WEST)

Answer	Number	Percent
Yes	36	87.8
No	1	2.4
Indifferent	4	9.8

Support to EIC program



Support to EIC program



C.1 Do you support a continuing education program in environmental engineering studies coordinated by the EIC (Engineering Institute of Canada), in conjuction with the engineering learned societes?

52	A-2-012	under conditions
88	A-2-014	Do not duplicate existing prg.
3	A-3-004	For industrial specific needs
4	A-3-005	If prived sector is interested
51	A-3-011	good initiative
122	A-3-024	Practical courses
12	B-1-004	Not interested/Not applicable
13	B-1-005	Unsure, not an eng. himself
14	B-1-006	Never heard from EIC since 64
16	B-1-008	Depends on structure, cost
17	B-1-009	Sponsored by industry
19	B-1-011	On-going training
22	B-1-014	Our personnel has science back
23	B-1-015	Environ. work of non-engineers
29	B-1-021	It is very important
30	B-1-022	Depends on definition
31	B-1-023	Effective develop./coordinat.
69	B-1-039	Upgrade
70	B-1-040	Good incentive for engineers
74	B-1-044	EIC is not well known in Ont.
81	B-1-051	Try to standarize
86	B-1-056	No agreement EIC/Env.Can.
115	B-1-063	short courses, no semesters
10	B-2-002	Sounds interesting
11	B-2-003	No need for EIC to be involved
28	B-2-020	Unaware of such program
59	B-2-029	Existing programs are American
68	B-2-038	It is the place to start
71	B-2-041	Include geoscience profession.
80	B-2-050	Without prof. eng. certificate
82	B-2-052	Be aware of university courses
21	B-3-013	Depends how program fits
54	B-3-024	In conjunction with societies
61	B-3-031	Currently only few available
38	C-1-008	Why EIC?
40	C-1-010	Lack of availability in Sask.
41	C-1-011	Must be focused through T.Soc.
43	C-1-013	Tech. Soc. undertake courses
98	C-1-020	if focussed useful & spe tech
104	C-1-026	Difficult to visualize now
106	C-1-028	Reduce dupli/coord across Cana
108	C-1-030	More practical more info
127	C-1-035	Training for non-specialists
134	C-1-042	With industry interaction
44	C-2-014	short courses
129	C-2-037	It's a good idea
131	C-2-039	Less intensive than grad-cours
32	C-3-002	Coord. Prov. P. Engs.
34	C-3-004	seminars/workshops new technol
36	C-3-006	Ourselves not likely intereste
37	C-3-007	with general application
39	C-3-009	Excellent Idea
100	C-3-022	Budget allows attendance in BC

C.2 Do you think there is a need for such a program?

Total

Answer	Number	Percent
YES - Small	12	9.4
YES - Medium	32	25.0
YES - Considerable	63	49.2
YES - Absolutely Necessary	17	13.3
NO	4	3.1

Group: Industry

Answer	Number	Percent
YES - Small	7	11.5
YES - Medium	16	26.2
YES - Considerable	35	57.4
YES - Absolutely Necessary	1	1.6
NO	2	3.3

Group: Institution

Answer	Number	Percent
YES - Small	1	3.2
YES - Medium	9	29.0
YES - Considerable	16	51.6
YES - Absolutely Necessary	3	9.7
NO	2	6.5

Group: Government

Answer	Number	Percent
YES - Small	4	14.8
YES - Medium	7	25.9
YES - Considerable	12	44.4
YES - Absolutely Necessary	4	14.8
NO	0	0.0

C.2 Do you think there is a need for such a program? (cont.)

Group: A (QUEBEC + MARITIMES)

Answer	Number	Percent
YES - Small	1	4.2
YES - Medium	6	25.0
YES - Considerable	12	50.0
YES - Absolutely Necessary	5	20.8
NO	0	0.0

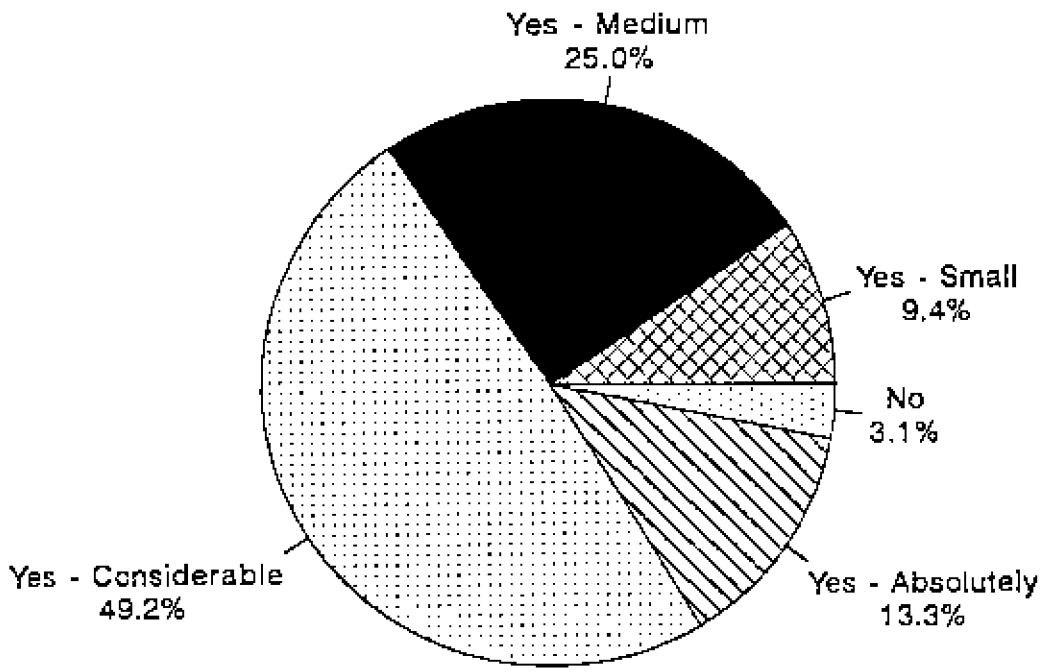
Group: B (ONTARIO)

Answer	Number	Percent
YES - Small	8	12.3
YES - Medium	14	21.5
YES - Considerable	32	49.2
YES - Absolutely Necessary	8	12.3
NO	3	4.6

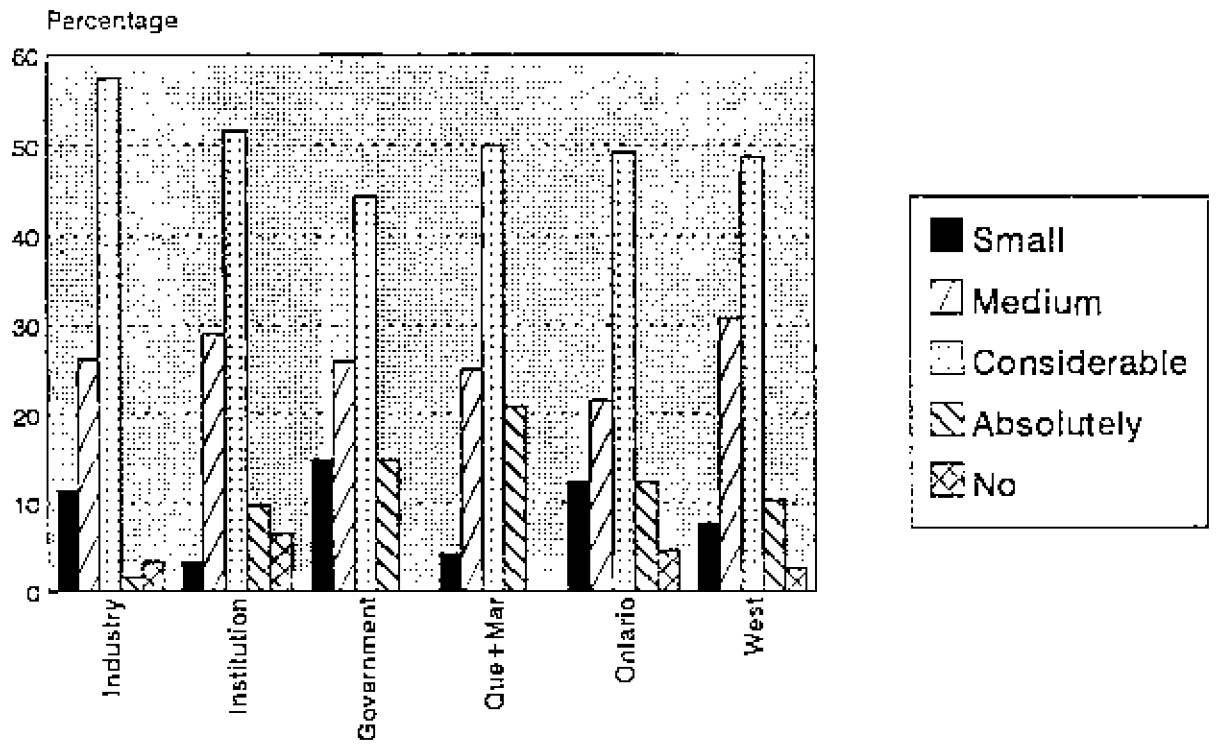
Group: C (WEST)

Answer	Number	Percent
YES - Small	3	7.7
YES - Medium	12	30.8
YES - Considerable	19	48.7
YES - Absolutely Necessary	4	10.3
NO	1	2.6

Need for EIC program



Need for EIC program



C.2 Do you think there is a need for such a program?

5	A-1-006	Depends on the nature of program
7	A-2-008	Updating courses is a need to be fulfilled
3	A-3-004	Environment is present everywhere in industry
13	B-1-005	Unsure; not knowledgeable
14	B-1-006	Need of North American survey; cooperation with universities
17	B-1-009	Transfer of technology for economic benefits
19	B-1-011	Company support discretionary (depends on the market)
22	B-1-014	Small seminars more practical to adjust to changes
23	B-1-015	Implies a national program. Depends on content
29	B-1-021	Unify claims of environmental professionals
30	B-1-022	Expansion at the undergraduate level to all engineers
74	B-1-044	Training already being given by those that need it
77	B-1-047	Require a link between industry, research and consulting
81	B-1-051	But specify area of specialization
110	B-1-058	for regulation & standardization of industry
116	B-1-064	Cont-ed courses must be geared to needs of marketplace
10	B-2-002	Needs have to be cohesive (in Toronto, enrollment large)
11	B-2-003	A national program = too much bureaucracy; recom. local lev.
59	B-2-029	Many env. specialist practice without proper background
68	B-2-038	In large centers need of external registration in eve. cours
71	B-2-041	Standardized "status quo" practices and methodologies
80	B-2-050	Not to traing practitioners but rather to educate eng.
82	B-2-052	No contradiction with existing programs
83	B-2-053	There are already university programs
109	B-2-057	There is a need to educate engineers in Environ. sciences
111	B-2-059	Universities should remain the focus of Env.Eng. studies
120	B-2-068	Until univ. produces enough trained graduates in the area
21	B-3-013	This program vs. other programs (competition)
27	B-3-019	Need for constant update
61	B-3-031	Need to exchange info and ideas
63	B-3-033	The industry is changing rapidly-education is essential
118	B-3-066	Env. field is constantly changing
40	C-1-010	Medium & considerable
99	C-1-021	Lots of other programs out there
104	C-1-026	Depends how practical with respect to real problems in field
105	C-1-027	A lot available/not coordinated approach/ad hoc at present
107	C-1-029	Evolving field/If you dont continue to learn you fall behind
126	C-1-034	Many players in the field. Env. Eng. is not simple/narrow
44	C-2-014	Need to educate non-enviro eng in their limits of competence
131	C-2-039	Targeted for upgrade only
32	C-3-002	At this time small program with potential for expansion
34	C-3-004	Varies with area & existing regulations. Changes - more need
37	C-3-007	Interest regulations affecting constr/design highways Sask.
100	C-3-022	Env Eng consultants do not have formal courses in this area

Questions C3 and C4

Do you see a need in the future for an Environmental Division (or expansion) in your Company, Institution/Government?

More than 50% of the respondents saw a need for either an expansion of their division, or the creation of a division dealing with environmental matters. This should not be surprising since the "people" interviewed were all involved, one way or another, with "environmental matters". Grouping together the respondents registering "considerable, very big, and absolutely" one obtains a better than 58% response, with 19% registering a "medium" need. About 9% of the respondents were hesitant on the future need for environmental "matters", citing in part the poor economic state of the "business" and also the uncertain future of "environmental attitudes".

What type of engineering background do you require/will require from the engineers (employees) working in the environmental area?

Considering that there is no single concept pertaining to "what constitutes environmental engineering" in the present market place, it was thought that the answers to this question would provide some inkling into what the common perceptions are vis-a-vis market place requirements for "environmental engineering practice". The answers obtained show that at least 31% of the respondents considered a background in the sciences of geology, biology, chemistry and ecology to be essential for the "environmental work" presently in the market place. Surprisingly, of the engineering group, civil engineering registered the highest demand, and chemical engineering was seen to be in slightly higher demand than "environmental engineering", reflecting perhaps a less than clear understanding of what "environmental engineering" really means.

Whereas "mechanical engineering" was not listed as a separate "demand area" in the questionnaire, many respondents stated that "mechanical engineering" was needed as an engineering background for work in the environmental area. Other areas mentioned included mining, hydrology, hydrogeology (*included in geology*), sanitary engineering, genetics, economics, political science, hygienics microbiology, and "mixture of all". Of the sciences required, biology was seen to be the more "important" requirement, particularly as seen by the "government" group. The interest in "process engineering" as background requirement shown in the East (Québec and Maritimes) is significantly higher than the rest of the country. This contrasts with a lesser interest in Civil Engineering as a requirement in comparison to the rest of the country.

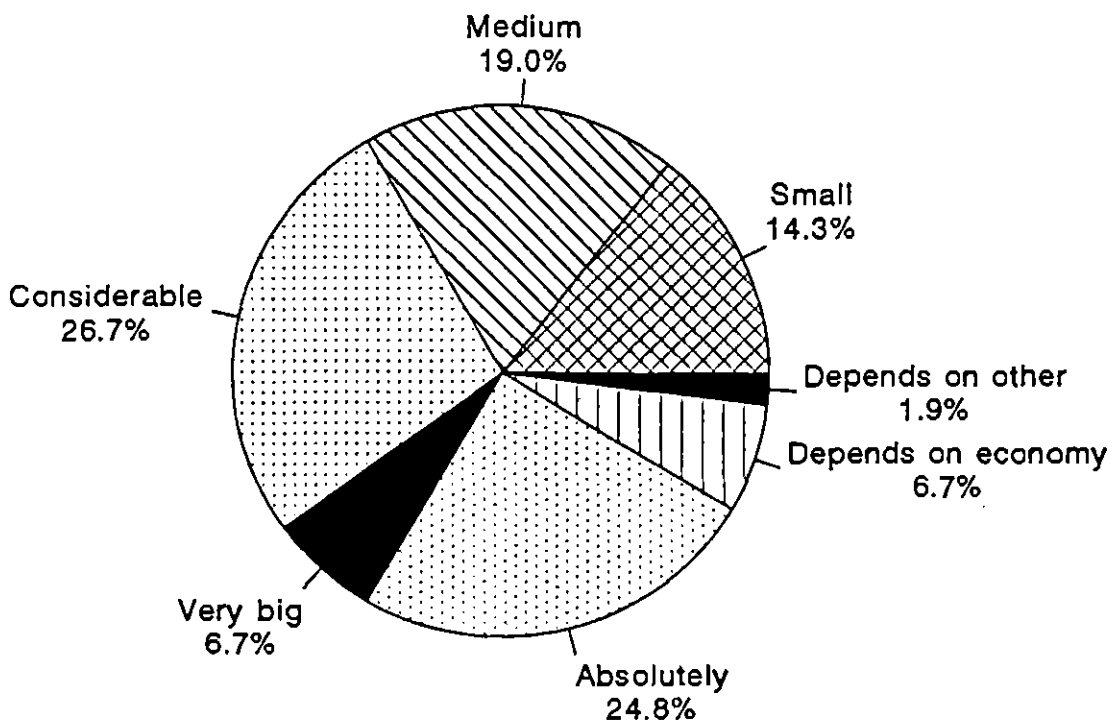
C.3 Do you see a need in the future for an Environmental Division (or expansion) in your Company/Institution/Government?

Total

Answer	Number	Percent
Small	15	14.3
Medium	20	19.0
Considerable	28	26.7
Very big	7	6.7
Absolutely	26	24.8
Depends on economy	7	6.7
Depends on other	2	1.9

Need for Env. Division

(in the future)



C.3 Do you see a need in the future for an Environmental Division (or expansion) in your Company/Institution/Government? (cont.)

Group: Industry

Answer	Number	Percent
Small	7	11.9
Medium	7	11.9
Considerable	19	32.2
Very big	3	5.1
Absolutely	20	33.9
Depends on economy	3	5.1
Depends on other	0	0.0

Group: Institution

Answer	Number	Percent
Small	2	8.7
Medium	8	34.8
Considerable	6	26.1
Very big	2	8.7
Absolutely	3	13.0
Depends on economy	1	4.3
Depends on other	1	4.3

Group: Government

Answer	Number	Percent
Small	6	26.1
Medium	5	21.7
Considerable	3	13.0
Very big	2	8.7
Absolutely	3	13.0
Depends on economy	3	13.0
Depends on other	1	4.3

C.3 Do you see a need in the future for an Environmental Division (or expansion) in your Company/Institution/Government? (cont.)

Group: A (QUEBEC + MARITIMES)

Answer	Number	Percent
Small	2	11.1
Medium	4	22.2
Considerable	7	38.9
Very big	1	5.6
Absolutely	3	16.7
Depends on economy	1	5.6
Depends on other	0	0.0

Group: B (ONTARIO)

Answer	Number	Percent
Small	6	11.8
Medium	11	21.6
Considerable	9	17.6
Very big	4	7.8
Absolutely	16	31.4
Depends on economy	3	5.9
Depends on other	2	3.9

Group: C (WEST)

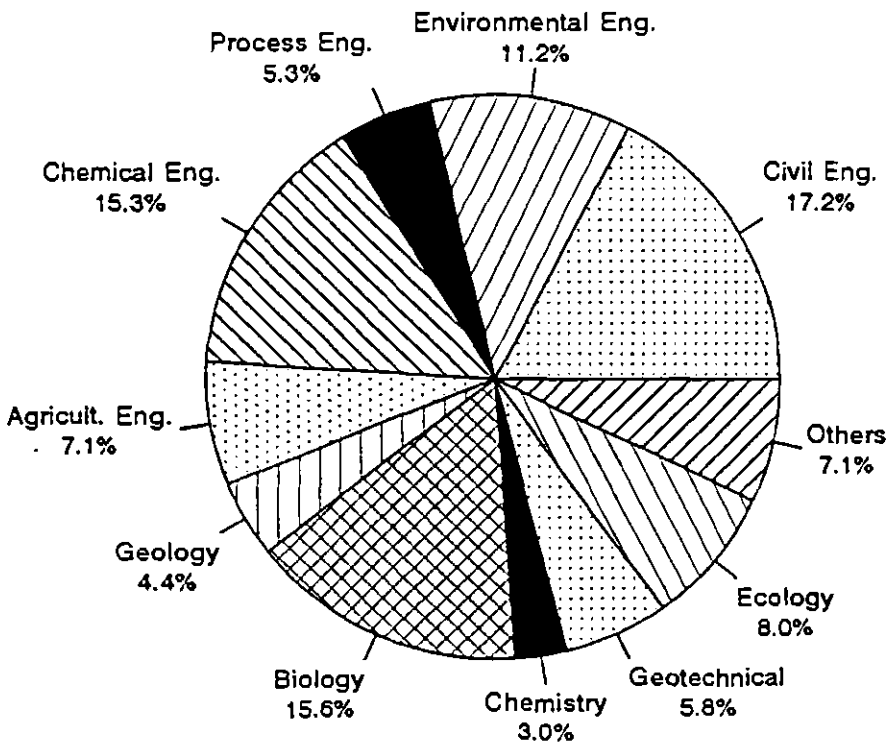
Answer	Number	Percent
Small	7	19.4
Medium	5	13.9
Considerable	12	33.3
Very big	2	5.6
Absolutely	7	19.4
Depends on economy	3	8.3
Depends on other	0	0.0

C.4 What type of engineering background do you require/will require from the engineers (employees) working in the environmental area?

Total

Area	Percent
Civil Engineering	17.21
Environmental Engineering	11.24
Process Engineering	5.26
Chemical Engineering	15.26
Biology	15.56
Geology	4.42
Agricultural Engineering	7.06
Chemistry	3.00
Geotechnical Engineering	5.83
Ecology	8.02
Others	7.13

Background



C.4 What type of engineering background do you require/will require from the engineers (employees) working in the environmental area? (cont.)

Group: Industry

Area	Percent
Civil Engineering	16.64
Environmental Engineering	11.73
Process Engineering	1.25
Chemical Engineering	17.63
Biology	14.66
Geology	4.30
Agricultural Engineering	7.63
Chemistry	3.44
Geotechnical Engineering	6.28
Ecology	9.10
Others	7.32

Group: Institution

Area	Percent
Civil Engineering	18.57
Environmental Engineering	10.30
Process Engineering	10.65
Chemical Engineering	13.78
Biology	12.09
Geology	4.04
Agricultural Engineering	6.43
Chemistry	3.83
Geotechnical Engineering	3.70
Ecology	7.91
Others	8.70

Group: Government

Area	Percent
Civil Engineering	17.44
Environmental Engineering	10.85
Process Engineering	10.47
Chemical Engineering	10.66
Biology	20.93
Geology	5.04
Agricultural Engineering	6.20
Chemistry	1.16
Geotechnical Engineering	6.59
Ecology	5.43
Others	5.23

C.4 What type of engineering background do you require/will require from the engineers (employees) working in the environmental area? (cont.)

Group: A (QUEBEC + MARITIMES)

Area	Percent
Civil Engineering	9.24
Environmental Engineering	9.55
Process Engineering	23.50
Chemical Engineering	10.51
Biology	12.99
Geology	5.35
Agricultural Engineering	5.73
Chemistry	2.23
Geotechnical Engineering	9.17
Ecology	8.22
Others	3.50

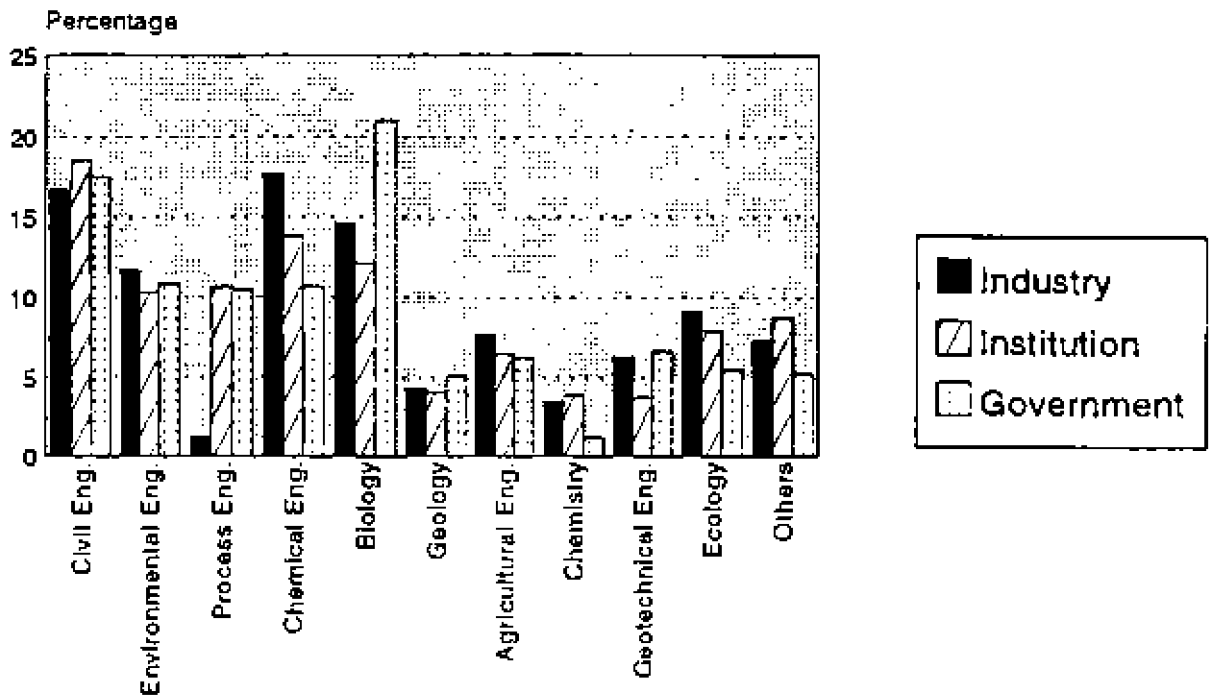
Group: B (ONTARIO)

Area	Percent
Civil Engineering	17.25
Environmental Engineering	11.69
Process Engineering	0.80
Chemical Engineering	14.40
Biology	14.49
Geology	4.11
Agricultural Engineering	9.16
Chemistry	3.95
Geotechnical Engineering	6.31
Ecology	7.02
Others	10.82

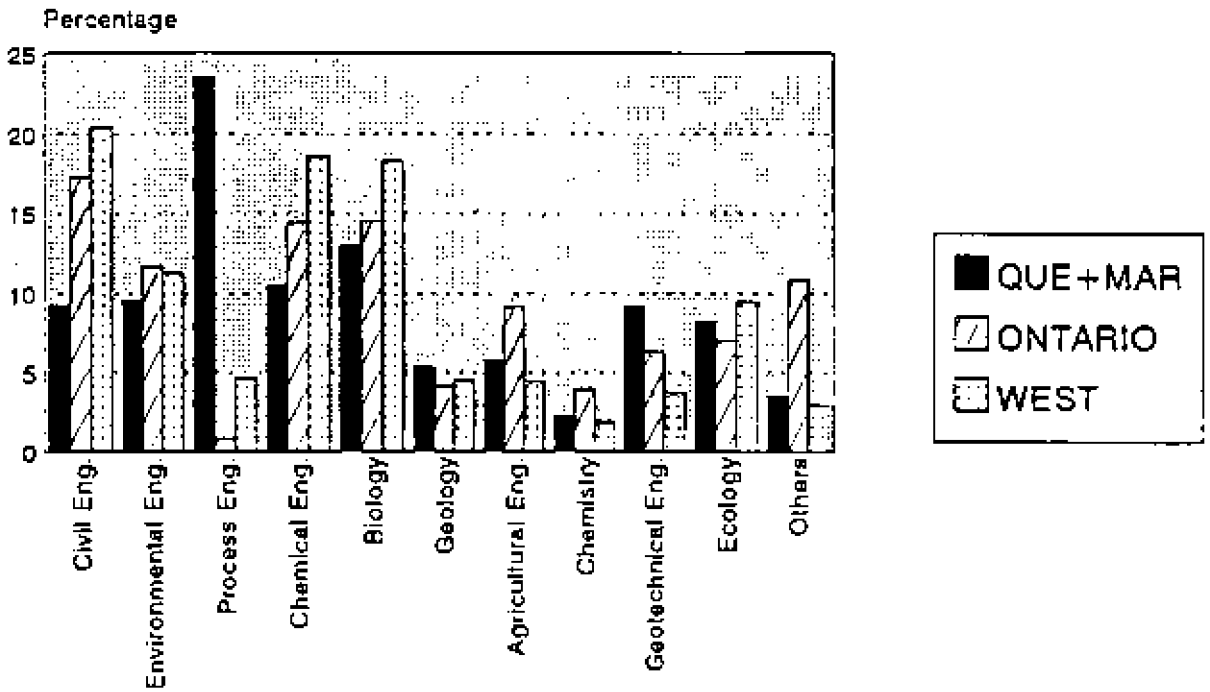
Group: C (WEST)

Area	Percent
Civil Engineering	20.39
Environmental Engineering	11.25
Process Engineering	4.65
Chemical Engineering	18.50
Biology	18.25
Geology	4.52
Agricultural Engineering	4.41
Chemistry	1.86
Geotechnical Engineering	3.74
Ecology	9.47
Others	2.97

Background
(by Group)



Background
(by Region)



C.4 What type of engineering background do you require/will require from the engineers (employees) working in the environmental area?

Others (%)
Specify .....

2	A-1-002	Safety
53	A-1-013	mechanical
52	A-2-012	Sanitary 20%
122	A-3-024	Geological Eng.
12	B-1-004	Mechanical
13	B-1-005	Mechanical
14	B-1-006	Mechanical
19	B-1-011	Struct/Instrum.
20	B-1-012	Mechanical
29	B-1-021	Hydrogeology
56	B-1-026	Hydrology
77	B-1-047	Elect./Mech.
81	B-1-051	Hygienist
86	B-1-056	Genetics
113	B-1-061	Mechanical
115	B-1-063	Hydrogeology
109	B-2-057	Env. Sciences
111	B-2-059	Mixture of all
15	B-3-007	Mining
27	B-3-019	Hydrogeology
117	B-3-065	Economics/Polit
118	B-3-066	Mechanical
119	B-3-067	Mechanical
98	C-1-020	geophysical
99	C-1-021	hydrogeology
105	C-1-027	Microbiology
106	C-1-028	Mechanical
95	C-1-031	Mechanical
47	C-2-017	hydrologists
101	C-3-023	Int Res Manager

Questions C5 and C6

What do you require as a basic training and background for your environmental engineers?

Question C5 supports the previous question and seeks to determine areas of specialty within the disciplines previously identified. Although the sciences (biology, chemistry, geology and ecology) was considered to be predominant in the responses received to the previous question, the statements in support of the answers to this question showed a high proportion of the respondents considered geology (hydrogeology, geophysics, geochemistry) to be very important. Included in the areas of specialty, as "very often mentioned", are chemical engineering/chemistry, geoenvironmental/earth sciences, geotechnical, regulations, environmental engineering. It would be useful to examine the "subject/area" requirements shown in the answers in relation to the courses presently being offered by various institutions now offering training in "environmental engineering".

Whereas some respondents specified minimum degree qualification as Master's level (even one with Ph.D.), the Bachelor's level was considered as a prerequisite. Two or three respondents declared that "nothing" or "none" were required as background training for their environmental engineering.

Will your company/institution/government be interested in encouraging your professionals to register in this type of program?

Two kinds of programs were identified in the questionnaire: (a) 6 courses plus exams, and (b) a less formal set of instructional/information courses. By and large, both "industry" and "institution" favoured the less formal set (about two-thirds), and the "government" was highly in favour of the less formal set (75%). The intent of the question was to determine if a proper structured program of learning, leading to some form of recognized achievement as testified by the successful completion of examinations, would be favourably considered and received by the profession. About one-third of the "non-government" respondents showed that this route would be useful, leading one to believe that perhaps such a program should be structured -- not only to satisfy this need, but to provide the basis for some form of "standardized" training for professionals in the present (and ever changing) market place. The individual responses in support of the answers to the question are very interesting and varied, ranging from "yes, will encourage" through "depends on program" to "obtaining knowledge is more important than certificate". The conclusion that one reaches.....from the various responses suggests that whereas there is general support for continuing education, until details are available, and until these are properly evaluated by the responsible parties, no firm commitment can be expected.

C5. What do you require as a basic training and background for your environmental engineers?

1	A-1-001	B.Eng.
2	A-1-002	Regulations, Operation practice, Equipment design
5	A-1-006	Technical degree
53	A-1-013	B. eng or B. Sci.
92	A-1-017	Groundwater hydrology, waste management, soil remediation
91	A-1-018	Basic training/process
93	A-1-020	Hydrogeology, analytical methods, sampling
94	A-1-021	Chemistry, data analysis, contaminant transport
123	A-1-025	Groundwater, Earth sciences, Geotechnical, Chemical
124	A-1-026	University level
6	A-2-007	Lab techniques, field instruments and testing
7	A-2-008	Specialized studies on particular aspects of research
52	A-2-012	Chemical/civil eng.
88	A-2-014	Course and field work
51	A-3-011	Agric. Manag. water quality, NPSpollution, pest. manag.
121	A-3-023	Soil treatment, regulations
9	B-1-001	Geotechnical eng., geology
12	B-1-004	Nothing
13	B-1-005	Experience in air quality
14	B-1-006	Some business/accounting practice; most have M.A. in hydrog.
16	B-1-008	Geotechnical eng., geology, hydrogeology, civil eng.
17	B-1-009	Geology and chemistry
18	B-1-010	Earth sciences, Air, water, soil, biophysical environment
19	B-1-011	Bachelor degree + 2 yrs. exp.
22	B-1-014	University or community college degree related subjects
23	B-1-015	Masters in hydrogeology, hydraulics, waste management
26	B-1-018	Chemistry, Env. biology, Geotechnical, Geology
29	B-1-021	Civil - Env. eng. (geotechnical, geochemistry, hydrogeology)
30	B-1-022	Civil or survey engineering (emphasis on ecosystem approach)
31	B-1-023	Flexible
55	B-1-025	Hydrology, Environmental assessment, Regulations
56	B-1-026	Both in-house and university/college exposure
64	B-1-034	Regulations, hydrogeology, water and wastewater treat., soil
65	B-1-035	Geoenv. with civil, specialist rather than generalists
66	B-1-036	Earth sciences
67	B-1-037	Understanding of the whole system (generalists/specialists)
69	B-1-039	Good analytical and regulatory law
70	B-1-040	Geotechnical-Civil Engineering
72	B-1-042	Any undergraduate prog. to chem. or mech. grads
74	B-1-044	Project experience, case studies, law and regulations
79	B-1-049	Basic engineering
81	B-1-051	Math, chemistry, hydraulics, hydrogeology, geology
84	B-1-054	Bachelor degree
85	B-1-055	Geotechnical, hydrogeology, chemistry, civil eng.
86	B-1-056	Area quite specialized, knowledge of biochemistry/genetics
110	B-1-058	Engineer (civ/chem/geol,etc) + 3-4 yr exp (or Graduate deg.)
113	B-1-061	M.Sc. or PhD from Env. program; written/oral technical skill
114	B-1-062	Civil/Env. Engineering plus regulatory understanding
115	B-1-063	Hydrogeological/Geotechnical eng. + specialized courses
116	B-1-064	B.A.Sc/M.A.Sc preferably with 2-5 yrs experience
10	B-2-002	Technical background
24	B-2-016	Marketing and operations (waste minim./treat./impact)
28	B-2-020	Members working in environmental areas (civil and chemical)
57	B-2-027	Understanding env. impacts and remedial measures
58	B-2-028	Waste management, hydrogeology, geochemistry, wastewater
59	B-2-029	Geochemistry, Groundwater flow behaviour, remedial measures
68	B-2-038	Civil environmental and geoenvironmental

71	B-2-041	Hydrogeological sciences
76	B-2-046	Geotech. eng., env. chemistry, env. biology and ecology
83	B-2-053	Groundwater migration, water/wastewater treatment
109	B-2-057	Planning, env. sciences, chemical/process eng., water res.
111	B-2-059	M.Eng. (civil) in Env. Eng.
120	B-2-068	Specialized in Civil/Chemical/Environmental engineering
15	B-3-007	Hydrogeochemistry, geotechnics, mine waste disposal, milling
21	B-3-013	Good understanding of industrial processes; pollution contro
27	B-3-019	Industrial processes and pollution control technologies
54	B-3-024	Certification by APEO, no prerequisites defined
61	B-3-031	Minimum Master degree in env. eng.
62	B-3-032	Basic env. sciences with enphasis on graduate training
63	B-3-033	B.A. Sc.
73	B-3-043	Usually experience gained with consultants after graduation
78	B-3-048	No requirements as yet
117	B-3-065	Chemical or other engineer, knowledge of PCs, Economics
118	B-3-066	Professional Eng. with a broad environmental background
119	B-3-067	Good understanding of basic sciences/strong of general eng.
38	C-1-008	MSc.
40	C-1-010	groundwater contaminants, bioremediation & land farming etc.
42	C-1-012	Master's Environmental Engineering
43	C-1-013	Water quality, soils, chemical background
97	C-1-019	Bachelor's civil/geotech/agric/chemical/enviro or geology
98	C-1-020	GW sci,gelogy,geophysics,chemistry,comp. modelling,field exp
99	C-1-021	Chemistry, hydrogeology, geotechnical
102	C-1-024	Basic understanding of environmental chemistry
103	C-1-025	BSc, BASc
104	C-1-026	Bachelor's:if Jr edu/strengths & attitude;Specialized Exp
105	C-1-027	BASc,BSc,BEng/ prefear Master's or postgraduate
106	C-1-028	Geol/Hydrogeol, enviro processes/water/wastewater/air/solidw
107	C-1-029	Bachelors or higher /Geol/hydrogeol/chemistry/geochemistry
108	C-1-030	geotech, soils, chemistry, geology, bioresource eng.
95	C-1-031	Hydrogeology, geotechnical chemistry
96	C-1-032	Eng. degree, environmental project exp.
126	C-1-034	Degree in civil, chemical, mechanical, sanitary, environment
127	C-1-035	Engineering background, commitment to environ. protection
128	C-1-036	B.Sc. in earth science discipline, bio-chem, biology, etc.
130	C-1-038	Varies with discipline
133	C-1-041	Communication skills, basic analytical skills
44	C-2-014	Chem, microbiology, hydraulics, materials, atmosph & soil sc
45	C-2-015	Engineering + appreciation & awareness of biological process
46	C-2-016	B. Eng
47	C-2-017	Chemical, civi, geotech with chem, microbio, hydrolo, geote
48	C-2-018	Ph.D.
125	C-2-033	Many basic training prog. available; need more skill train.
129	C-2-037	Environmental engineering
132	C-2-040	Broadly based, but main focus in geotechnical eng. & geology
8	C-3-001	Geology, chemistry, water quality, soils
32	C-3-002	Good solid background in Chemistry & Ground water principals
33	C-3-003	Undersatnding of water/wastewater processes & regulatory req
34	C-3-004	Nothing specific since don't have specific Enviro. Eng.
35	C-3-005	Civil Eng. degree supplemented by environmental studies
36	C-3-006	None
37	C-3-007	Do not have any now
39	C-3-009	Civil Eng. with experience in Eviro. areas or post-grad educ
100	C-3-022	Either civil,geological,chemical,agric univ/college degree
101	C-3-023	BEng geology or geoscience, Masters' degree preferable

C.6 Will your Company/Institution/Government be interested in encouraging your professionals to register in this type of program?

Total

Program	Percent
6 courses + exams	35.01
Instructional/Information courses	64.99

Group: Industry

Program	Percent
6 courses + exams	39.44
Instructional/Information courses	60.56

Group: Institution

Program	Percent
6 courses + exams	33.89
Instructional/Information courses	66.11

Group: Government

Program	Percent
6 courses + exams	24.74
Instructional/Information courses	75.26

C.6 Will your Company/Institution/Government be interested in encouraging your professionals to register in this type of program?

Group: A (QUEBEC + MARITIMES)

Program	Percent
6 courses + exams	34.29
Instructional/Information courses	65.71

Group: B (ONTARIO)

Program	Percent
6 courses + exams	31.88
Instructional/Information courses	68.13

Group: C (WEST)

Program	Percent
6 courses + exams	41.67
Instructional/Information courses	58.33

C.6 Will your Company/Institution/Government be interested in encouraging your professionals to register in this type of program?

```
 91  A-1-018 Special courses for the company
 87  A-1-019 Depends on development of company
  6  A-2-007 Depends on funds
  7  A-2-008 Obtaining knowledge is more important than certificate
 50  A-2-010 Laval University would be interested in give the courses
  3  A-3-004 Upgrading in technological development
  4  A-3-005 No finance source for cont-ed courses
 12  B-1-004 General knowledge is enough for us
 13  B-1-005 Reserve judgement
 23  B-1-015 Depends on content, location and cost
 25  B-1-017 Night courses (8 weeks), 1-2 days seminars
 29  B-1-021 Yes
 31  B-1-023 Yes
 56  B-1-026 Evening degree courses on interdisciplinary management level
 74  B-1-044 Course commitment (6 courses) people would need degree
 84  B-1-054 Our needs are well served by existing conf./sem./workshops
 86  B-1-056 Would have to see the curriculum first
110  B-1-058 certificate recognized if regulated by eng. assoc.
116  B-1-064 Update or add-on courses
 28  B-2-020 Yes, will encourage
 57  B-2-027 Perhaps both options should be available
 58  B-2-028 I suspect Ontario-Hydro will support
 59  B-2-029 Flexible cont-ed programs
 76  B-2-046 Program schedule and budgetary limitations
 82  B-2-052 Preference for program after undergraduate level
 83  B-2-053 No, direct employees in existing programs in univ/colleges
109  B-2-057 erosion of soils, automobil pollution, control technology
111  B-2-059 6 grad. courses + thesis = M.Eng. (already in place)
 27  B-3-019 Need to be discussed with Human Resources
 54  B-3-024 On voluntary basis
 60  B-3-030 Individual courses wouldbe applicable to work at hand
 61  B-3-031 Employees expect to have advanced degree to start
 63  B-3-033 They currently do
 73  B-3-043 Our people usually do not follow a program
 78  B-3-048 Responsability of individuals
 40  C-1-010 Yes,corporate practice encourage technical upgrade
 41  C-1-011 Will be targeted to specialized professionals
 98  C-1-020 Depends on economy, what course, level, cost, *****
103  C-1-025 ?
104  C-1-026 Yes/difficult to break down since program content not known
105  C-1-027 Depends program content/too specific/...
 96  C-1-032 Yes, if there is a perceived benefit
126  C-1-034 These type of programs are already available
127  C-1-035 Needs vary with individues
130  C-1-038 Depends on program
 44  C-2-014 no need retrain eng into env eng, will create glut, s. cours
 46  C-2-016 NA
 47  C-2-017 N/A but yes in principle
 48  C-2-018 They have Ph.D.'s now
125  C-2-033 Depends upon background
132  C-2-040 Waste materials; remediation; groundwater; reg's; aqu.chem.
  8  C-3-001 Depends
 32  C-3-002 Our Dept. promotes career development of its emloyees
 34  C-3-004 Prog. support cont. edu. all fields/budget limit. & workload
 37  C-3-007 limited interest and need in Construction/Design Section
 39  C-3-009 Yes would encourage for either type of program
100  C-3-022 Don't know
101  C-3-023 Sampling protocol/lab test proc/GIS/Nat Resources management
```

Questions C7 and C8

Would your company be willing to support partially or fully, employees wishing to "follow" this type of program?

The results obtained are very surprising and revealing. Whereas the overall numbers and percentages show that two-thirds of the respondents answered positively, i.e. indicating that their respective company/institution/government would be willing to (financially) support employee participation in a continuing program, the breakdown in terms of "groups" and "regions" provides some very interesting distributions. The results indicate that the overall percentages hold well for "industry" participation. However, one half of the "institution" response was negative,....in contrast to the 86.7% positive response from "government", and that the "West" was more receptive to full or partial support of employee continuing education training support. One can draw several conclusions from this limited survey and distribution, not the least of which is that the kinds of services and responsibilities are perhaps the key factors in determination of the "positive or negative" response. The reader can draw conclusions reflective of the pre-disposition of the reader! A perusal of the various individual responses shows that some "agencies/companies" are already actively supporting such a scheme, and that others are in the process of developing policies for such a scheme.

Summarize your present future needs in the environmental section/division of your establishment.

The list of individual answers responding to this question should be studied to provide the reader with an idea of the highly diverse sets of opinions concerning "what is important" in the environmental market place. "Hydrogeology" appears most often in the answers given, followed by "geotechnical, geochemistry, site remediation,...." The answers are not necessarily totally focussed, a reflection perhaps of the general perception of the complex interactions between "engineering" and "science" in what is defined as the "environmental market place".

SUMMARY OF SECTION C: NATURE OF THE NEED FOR CONTINUING EDUCATION IN "ENVIRONMENTAL STUDIES" FOR ENGINEERS

Across the country, and by Regions, there is almost unanimous (if not unanimous) agreement that there is a need for some type of environmental "engineering, science, etc" information, educational, extra-curricular type of "course" for workers engaged in the business of "environmental engineering and management", i.e. on a scale varying from Low to High, the need is HIGH, and that support for a program of study can be found if the program can be structured to satisfy specific needs -- ranging from unstructured to structured courses.

C.7 Would your company be willing to support partially or fully, employees wishing to follow this type of program?

Total

Answer	Number	Percent
Yes	71	65.1
No	7	6.4
With conditions	31	28.4

Group: Industry

Answer	Number	Percent
Yes	48	70.6
No	2	2.9
With conditions	18	26.5

Group: Institution

Answer	Number	Percent
Yes	1	12.5
No	4	50.0
With conditions	3	37.5

Group: Government

Answer	Number	Percent
Yes	13	86.7
No	1	6.7
With conditions	1	6.7

C.7 Would your company be willing to support partially or fully, employees wishing to follow this type of program? (cont.)

Group: A (QUEBEC + MARITIMES)

Answer	Number	Percent
Yes	14	73.7
No	2	10.5
With conditions	3	15.8

Group: B (ONTARIO)

Answer	Number	Percent
Yes	37	63.8
No	3	5.2
With conditions	18	31.0

Group: C (WEST)

Answer	Number	Percent
Yes	20	87.0
No	2	8.7
With conditions	1	4.3

C.7 Would your company be willing to support partially or fully, employees wishing to follow this type of program?

1	A-1-001	Partial support
53	A-1-013	depending on workload
3	A-3-004	If it does not interfere with regular work
51	A-3-011	budget availability
14	B-1-006	Scrutiny of curriculum to ensure applicability
17	B-1-009	Provided employee will continue
22	B-1-014	Depends on the owner
23	B-1-015	Yes, as we already do for other courses
25	B-1-017	Provided employees will pay for the course cost if leaving
26	B-1-018	Company will refund fees upon succesful completion
29	B-1-021	Limited to a small number of employees
30	B-1-022	Partial support
66	B-1-036	Depends on the recession
69	B-1-039	Work study
72	B-1-042	Employees would have to take courses on their own time
74	B-1-044	If project seems valuable there are project needs for educ.
77	B-1-047	Direct relevance to projects
79	B-1-049	Prior approval, passing grade if to be reimbursed
81	B-1-051	Cost would need to be considered
85	B-1-055	Length of time and cost
86	B-1-056	Certainly, it must be directly related to our needs
113	B-1-061	2-3 day programs or night courses would be supported
115	B-1-063	Full time enrollment - no salary remuneration
24	B-2-016	Waste minim.-pollution prevention techniques
28	B-2-020	Limited employees with technical background
57	B-2-027	At least two years of employment following the course
59	B-2-029	If specific to internal work programs
68	B-2-038	We do
71	B-2-041	Succesful completion
109	B-2-057	We presently support continuing education
111	B-2-059	Already support personnel going through Masters programs
21	B-3-013	Will depend on the course content
27	B-3-019	Interested stuff, will present request to supervisors
61	B-3-031	Policy is positive, but economic conditions will dictate
78	B-3-048	We are not in a position to comment on gov. policy
117	B-3-065	If it does not take people away from their job for too long
118	B-3-066	Subject to funding availability
38	C-1-008	Depends on siting
97	C-1-019	partially (time/partial compensation consideration)
98	C-1-020	Depends on quality of employee and cost benefit
99	C-1-021	Appropriate to individual's carreer plans & growth potential
104	C-1-026	Not for me to comment on what the support might include
105	C-1-027	Program dependent, we sponsor cont educ for our prof staff
107	C-1-029	If can justify costs/being recuperable/staff satisf & produc
95	C-1-031	If applicable to person's career path
126	C-1-034	According to company policies on time, tuition
130	C-1-038	If program is relevant & practical
45	C-2-015	N/A
46	C-2-016	NA
8	C-3-001	Depends
32	C-3-002	I believe so
34	C-3-004	Work loads and budget restrictions could apply
36	C-3-006	If program content was of benefit to our needs
37	C-3-007	for general information
39	C-3-009	Local availability (i.e. Province)
100	C-3-022	Budget, course content, other courses available
101	C-3-023	available funds allocatable for training purposes

C8. Summarize your present and future needs in the environmental section/division of your establishment.

1	A-1-001	More business
2	A-1-002	Need 1-2 engineers with experience in Env.Eng./Safety
5	A-1-006	Department is new in this company
53	A-1-013	qualified people with experience
91	A-1-018	Company specialized courses
87	A-1-019	R&D
93	A-1-020	Anticipated expansion
94	A-1-021	Ecotoxicological needs
124	A-1-026	Solid waste management
6	A-2-007	Need for information, need for outside instructors
7	A-2-008	Refining knowledge on environ./conservation natural resources
3	A-3-004	Remediation techniques, legal aspects, reduction/recycling
4	A-3-005	Better environmental evaluation of new technologies
121	A-3-023	Promote solutions for soil remediation
122	A-3-024	Soil Ecotoxicity, risk analysis, industrial wastewater treat
9	B-1-001	Regulations, many needs, very technical content
14	B-1-006	Geo-eng, groundwater chemistry, monitoring
16	B-1-008	DNAPL studies, process design, treatment methods
17	B-1-009	Interested for the future
19	B-1-011	Needs are presently declining (recession), growth anticipate
20	B-1-012	Process and project eng. for the supply of systems
22	B-1-014	Waste control management - emissions
23	B-1-015	Hydrogeologists, solid waste
25	B-1-017	1 Env. eng. + 1 Geotech. eng./chem. + 1 Geotech. eng./env.
26	B-1-018	Field monitoring techniques, quality protocols, regulations
29	B-1-021	Needs on instrumentation-construction of envir. works
30	B-1-022	Clients with greater sensitivity will benefit
31	B-1-023	Expand to cover areas currently supported by intl. specialis
55	B-1-025	Keeping current techniques and regulations
56	B-1-026	Hydrogeology, Env. Planning, Hydrology, Process Eng., Biol.
65	B-1-035	Env. engineers with geotechnical orientation
66	B-1-036	Innovative technologists for site cleanup
69	B-1-039	Two new employees/work study
70	B-1-040	Site assessment landfill design
72	B-1-042	An understanding of life cycle analysis (solid/liq. waste)
74	B-1-044	Formal envir. assessment understanding/technical experience
77	B-1-047	Strong expansion in remedial design construction
81	B-1-051	Experienced hydrogeologists, solid backg. in civil, geology
84	B-1-054	If economy improves (1 Jr. engineer)
86	B-1-056	Graduates and undergraduates of process eng. (biological)
110	B-1-058	Trends towards contaminated hydrogeology; groundwater
114	B-1-062	An environmental division is necessary
115	B-1-063	Process eng. with emphasis on waste stream eval./management
116	B-1-064	Hydrogeologists, civil/geotechnical/process eng., biotech.
10	B-2-002	We need guidance to encourage - compel engineers
24	B-2-016	Present needs none, future needs haz-was treatment facility
28	B-2-020	Availability of courses through university locations
57	B-2-027	Present (general courses); future (more detailed courses)
68	B-2-038	Continuing funding
75	B-2-045	We rely upon analytical and problem solving skills of eng.
76	B-2-046	Geotechnical engineers and geochemist
111	B-2-059	Emergency response, EIS, clean-up of sites
112	B-2-060	Waste management, occupational health & safety
15	B-3-007	No needs for personnel; courses on mine waste disposal mgt.
27	B-3-019	Is difficult to assess the needs for the future
60	B-3-030	Hydrogeology, geochemistry, remediation design
62	B-3-032	Government funding is important for research

63	B-3-033	Our company is involved in all aspects of waste treat. tech.
78	B-3-048	Very limited (more specialized expertise)
118	B-3-066	Broad range of professionals including professional eng.
38	C-1-008	Work to justify additional staffing.
40	C-1-010	as above
41	C-1-011	Accessibility to info. on Regul. Industry Req. & Tech. Eval.
42	C-1-012	Lack of qualified applicants
97	C-1-019	detailed instr current remediation tech/demo new technology
98	C-1-020	Tech skills comp appl, chem, soil chem, gen ind agr appl
99	C-1-021	Remed technolo & patented proce need to be better understood
102	C-1-024	Senior people who can develop environmental consulting
103	C-1-025	unknown
104	C-1-026	Engs committed work quality/underst regul fmwk/exp remed tech
107	C-1-029	7 additional engs/ geoscientists geological/chemical
95	C-1-031	Further chemical and process treatment background
96	C-1-032	More work/experience/expertise/money
127	C-1-035	General environmental courses (contaminated sites,EIA,reg.)
133	C-1-041	Flexible people with good analytical/communication skills
134	C-1-042	20 people over 5 years
44	C-2-014	Need Broad
45	C-2-015	N/A
47	C-2-017	Forming new Env Eng prog, Geoenvironmental, Civil-WW treatme
48	C-2-018	Training in new analytical techniques (i.e. @ tech. level)
125	C-2-033	Envir. Div. = multidisciplinary = variety of skills required
129	C-2-037	Needs more quality staff in this area; expansion of lab
132	C-2-040	Trying to modify Geol.Eng. to add more environ. topics
8	C-3-001	Water quality, agricultural practices, land & water protect.
32	C-3-002	Our people need to keep abreast with new & emerging technolo
33	C-3-003	Upgrading tech skills allow better regulatory decision makin
34	C-3-004	General awareness & understanding of Enviro. Regul. / Law
35	C-3-005	Environmental policy and planning for transportation
37	C-3-007	Limited needs/general interest to understand & accept regul.
100	C-3-022	Employment equity-qualified related degrees & experience

SECTION D - COURSES

SECTION D QUESTIONS: PROGRAM COURSES AND DELIVERY

The problem of program type, courses and course contents, and "manner of delivery" i.e. "how to deliver the program such that it can reach the most engineers", constitutes the main package of information sought in the Section D type of questions. The discussion for this section can be summarized on a "general" basis. However, particular attention should be given to the individual answers, not only because of the diversity of answers, but also because of the remarkable insight shown by many of the respondents in their evaluation of the problem at hand.

Leading the list of "core" courses common to all the engineering disciplines (civil, chemical, geotechnical, agricultural) is "chemistry -organic, inorganic and environmental". Aside from chemistry, we note that the grouping of such subjects as "geology, hydrogeology, groundwater", "soil, geotechnical" and "biology, microbiology" are also prominent as "core" subjects, together with "regulations" and "wastes". Preference for 1-2 day courses following conferences and seminars is shown by more than 40% of the respondents. Surprisingly, 20% of the respondents favoured term courses.

SUMMARY AND CONCLUDING REMARKS

Across Canada, the data show that when asked the question "Will your Company/Institution/Government be interested to encourage your professionals to register in a continuing education type of program", about two-thirds of the respondents favoured the instructional/information courses whereas the remaining one-third favoured the formal 6 courses with exams. However, when the respondents were asked if they could clarify the "instructional/information" type of course program, most respondents argued in terms of TIME constraint in relation to WHAT IS AVAILABLE NOW. It is interesting to study the responses given in the questionnaires for the items concerned with "taking continuing education courses" and also with "future needs in the environmental section" of the companies. There seems to be a very large area of "confusion" in the minds of most of the respondents -- confusing "what one needs" with how one should "go about the business" of getting trained for future needs.

The apparent conclusion reached in discussion with the respondents is that the only alternative at present is the "evening course" extension program given in Universities, either as a "shopping list" non-structured scheme of overall continuing education courses, or a structured graduate program scheme. Hence, the general opinion given concerning continuing education, most often concentrated on the "instruction/information" format lasting about 3 to 5 days on a concentrated basis. This seems to be principal experience of the respondents, i.e. courses tagged on to major conferences or workshops. There seems to be obvious dissatisfaction with these

types of "courses" in the present form. In consequence, the majority of the respondents made it a point to emphasize that if one had a 3-5 day type of program, this should be all-day programs with proper meat and rigour, and that they would be willing to take an examination at the end of the course to ensure that proper credit is obtained. In addition, the respondents wanted this type of 3-5 day program to be part of a larger "scheme of things"; -- hence the "credit" system which seemed to be a popular response.

When faced with the proposition of a "proper" structured program of courses lasting one semester each, and given in a university as part of a continuing education program, many of the respondents favoured such a program. It is apparent that if one could construct a "respectable/acceptable" program, there would be a highly significant need. The program should: (a) develop specialized skills for the "worker" and "manager ", (b) upgrade and/or broaden the knowledge and training of the "worker" and "manager" in the technical and scientific aspects of the "environmental field" particular to his job and responsibilities, and (c) increase the awareness and knowledge base of the "worker", "manager" and "regulator" in the policy requirements, regulatory climate and legal aspects of the "environmental field".

Considering all the engineering professions covered in the Survey (and some geologists, earth scientists, biologists etc. working with environmental engineering companies) as a whole, the answers to the various questions depend on whether the respondent was an academic, a manager, middle manager or the worker in the trenches. By and large, we can "summarize" the very broad sets of responses as follows:

1. The higher level managers preferred courses leading to increase in managerial overview of the "environmental engineering" problem, i.e. courses in environmental management preferred.
2. The workers in the trenches preferred more specialized technical courses.
3. Industry preferred technical courses and/or management courses depending on where one was on the worker/management scale, whereas government preferred specific detailed courses which would enable them (it) to better monitor or "regulate" the particular industry under their (its) charge.
4. The discussions and interviews showed that considerable confusion exists in regard to what "continuing education", "upgrading", and "information" courses mean. The idea of a proper structured curriculum given in the context of a University continuing education program was not considered by any of the respondents except by some of the University staff respondents. Almost all the respondents were in favour of having continuing education instructional courses available. The majority favoured "short" courses (with credits) as opposed to the present "going back to university" type course (i.e. pre-EIC Engineers' Environmental Studies program), where the "going back to university" type of scenario was generally associated with post-graduate training for Masters or Ph.D. degrees.

A coherent and structured program package of instructional and information courses covering basic elements of environmental sciences, engineering, management and policy/law/regulations must be responsive to:

1. Regional differences in requirements for treatment of the "environmental" problem, resulting most often from different waste generation problems and site specificities, and from regulatory requirements and policies which are the jurisdiction of the individual Provinces.
2. The need for proper qualified instructors, course content, rigour, and most of all..... a high degree of "respectability".
3. "Acceptance" by the various Associations of Professional Engineers, responsible bodies involved in "managing" the "environmental field". This means "recognition" that the program has substance and has the "backing" of these groups.
4. Particular requirements for "learning" of the individuals and their responsibilities; meaning that upper management requirements are different from workers in the trenches, and that geotechnical engineers are different from chemical engineers insofar as "problems addressed in the trenches" are concerned, etc. This means that there should be sufficient types of courses in the program that can satisfy the "training" requirements.
5. Provision of courses in various "digestible" packages so that employers can allow their employees the "time off" without undue hardship to the conduct of the "business" or the individual privilege and right of the employee.
6. Capability of the "student" to complete the course package, i.e. course and instruction at the proper time and place without the "student" having to "go out of town" to finish the package or program.

ACKNOWLEDGEMENTS

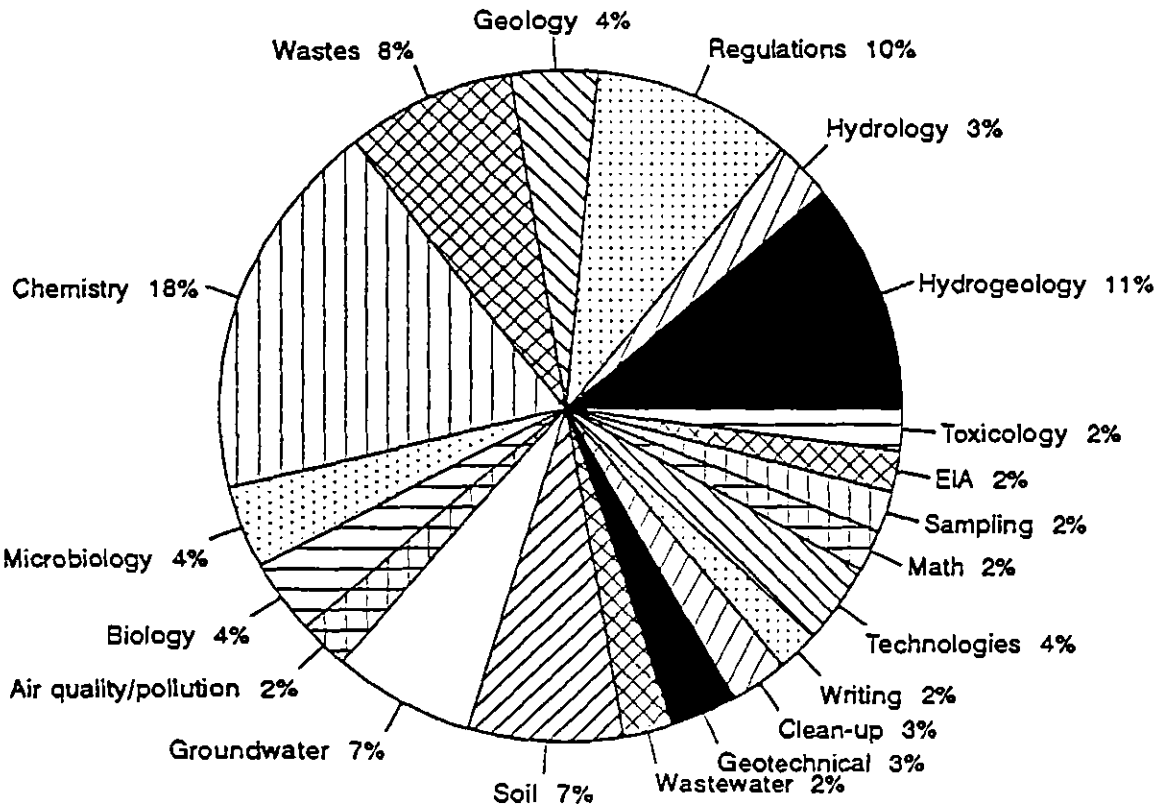
The inputs and assistance from the members[3] of the EIC/IAS Committee were most timely and helpful. Acknowledgement of the considerable cooperation received from the respondents needs to be made. Their "open" discusions provided considerable insight into the problem at hand.

[3] Committee members: P. Adams (Chairman), J. Tucker, W. Clifton, S. Bonk, A. Tremblay, A. St.-Yves, G. Matthews, W. James, A. Voth, R. Blais.

D.1 Your suggestions/recommendations or strong opinions about the core courses common to all disciplines. (Civil, chemical, geotechnical, agricultural engineering).

Chemistry (organic, inorganic, environmental)	46
Hydrogeology	28
Regulations	24
Wastes (management, treatment)	20
Soil (mechanics, behaviour, treatment)	18
Groundwater (flow, contamination)	17
Microbiology	10
Geology	10
Technologies	10
Biology	9
Geotechnical	8
Hydrology	7
Clean-up / remediation	7
Ecology	7
Air quality/pollution	6
Wastewater treatment	6
Environmental Impact Assessment	5
Writing reports	5
Math	5
Sampling	5
Toxicology	5
Water quality	3
Water treatment	3
Modeling	3
Project management	3
Computers	3
Civil	3
Health and Safety	2
Hydraulics	2
Risk assessment	2
Hazardous materials	2
Recycling	2
Soil mechanics	2
Agricultural	2

Courses requested



D.1 Your suggestions/recommendations or strong opinions about the core courses common to all disciplines. (Civil, chemical, geotechnical, agricultural engineering)

A-1-001	Better reading and writing
A-1-001	Engineering ethics
A-1-001	Keep math, chem, physics strong
A-1-006	Introductory course on Env. issues
A-1-015	Operational analysis
A-1-015	Organic chemistry
A-1-016	Data analysis
A-1-016	Hydrogeology
A-1-016	Water treatment
A-1-017	Groundwater hydrology + remediation
A-1-017	Industrial waste management
A-1-017	Sampling air, soil, water
A-1-017	Soil remediation
A-1-017	Waste management
A-1-018	Air, water, soil general course
A-1-018	Characteristics/transport of pollutants
A-1-018	Environmental Impact pollution
A-1-018	Regulations, ethics
A-1-019	Budgeting environmental work
A-1-019	Chemistry (organic + inorganic)
A-1-019	Environmental investigations & sampling
A-1-019	Hydrogeology
A-1-019	Soil behaviour
A-1-020	Analysis methodology
A-1-020	Hydrogeology
A-1-020	Regulations
A-1-020	Sampling
A-1-021	Chemistry
A-1-021	Combined Treatment - data analysis
A-1-021	Contaminant transport - modeling
A-1-021	Recycling, remediation, incineration
A-1-025	Chemistry and Biological processes
A-1-025	Groundwater, surface water, erosion
A-1-025	Practical on past problems
A-2-008	Biochemistry
A-2-008	Environment-industries relations
A-2-008	Microbiology of soil/water
A-2-008	Principles of ecology
A-2-014	Contaminant transport
A-3-004	Ecosystems' balance
A-3-004	Pollution (soil, air, water)
A-3-004	Practical solutions for decontamination
A-3-004	Recycling

A-3-005	Environmental impact of technology
A-3-005	Human activities and use of ressources
A-3-005	Regulations
A-3-011	Agricultural management practices
A-3-011	Biological waste treatment facilities
A-3-011	Pesticides management
A-3-023	Contaminants nature
A-3-023	Soil and groundwater treatment
A-3-023	Soil nature
A-3-023	Soil-contaminants interactions
A-3-023	Water-soil interactions
A-3-024	Air quality
A-3-024	Biology
A-3-024	Chemicals: pollution and health effects
A-3-024	Industrial processes
A-3-024	Waste management, 3RV (4R)
B-1-001	Amalgamation of what is offered at Univ.
B-1-001	Regulations
B-1-001	Waste management
B-1-004	Regulatory requirements
B-1-004	Waste treatment systems
B-1-006	Basic chem. & phase chem.
B-1-006	Basic math
B-1-006	Drafting and sketching, computer draft.
B-1-006	Properties of materials
B-1-006	Written and spoken english
B-1-008	Environmental assessment process
B-1-009	Basic air/water pollution control
B-1-009	Basic environmental regulations
B-1-009	Chemistry & environment
B-1-009	EIA
B-1-010	Air pollution
B-1-010	Biology
B-1-010	Finite element/finite differences SW
B-1-010	Hydrogeology
B-1-011	Changing legislation - Provincial
B-1-011	Environmental planning - assessments
B-1-011	Hydrogeology
B-1-011	Process engineering
B-1-011	Project financing
B-1-012	Chemistry - Organic & Inorganic
B-1-012	Legal environmental laws - provincial
B-1-012	Project management
B-1-012	Survey of technologies for remediation
B-1-014	Air emission
B-1-014	Legislation, liabilities
B-1-014	Waste management, transportation
B-1-017	Chemical testing of soil & groundwater
B-1-017	Hydrogeology
B-1-017	Regulations

B-1-018	Chemical
B-1-018	Geology
B-1-018	Geotech.
B-1-021	Contaminant Hydrogeology
B-1-021	Environmental Geotechnique
B-1-021	Flow through porous media
B-1-021	Geochemistry
B-1-021	Groundwater modelling
B-1-022	Communication
B-1-022	Environmental Law
B-1-022	Moral/ethical implications of engineeri.
B-1-022	Natural Sciences
B-1-023	Hydrology/hydrogeology
B-1-023	Pollution prevention/management practice
B-1-023	Solid waste management
B-1-023	Water management & wastewater treatment
B-1-025	Environmental assessment process
B-1-025	Environmental Laws and Regulations
B-1-025	Environmental Risk Assessment
B-1-025	Natural Environmental Integration
B-1-025	Survey of topics (e.g. noise, air, wat.)
B-1-026	Environmental planning
B-1-026	Waste management
B-1-034	Biology/Chemistry
B-1-034	Hydrogeology
B-1-034	Regulations
B-1-034	Soil treatment
B-1-034	Water and wastewater treatment
B-1-035	Regulations
B-1-037	Chemistry
B-1-037	Geology
B-1-037	Geotechnical
B-1-037	Hydrogeology
B-1-039	Training in analytical methods
B-1-039	Training in industrial practices
B-1-040	More chemistry and ecology courses
B-1-040	The courses in Civil Eng. need to be upd
B-1-044	Emerging technologies
B-1-044	Environmental economics
B-1-044	Environmental law
B-1-044	Special wastes management/treatment
B-1-047	Chemistry (aquatic chemistry)
B-1-047	Groundwater flow - Contaminant transport
B-1-047	Groundwater/soil treatment
B-1-047	Waste treatment
B-1-047	Water quality
B-1-049	Environm. Assessment Reg's & Processes
B-1-049	Sewage & industrial effluent treatment
B-1-049	Site cleanup technology
B-1-049	Solid waste handling technology

B-1-051	Geology, chemistry
B-1-051	Hydrogeology
B-1-051	Problem solving
B-1-051	Report writing
B-1-054	Energy conservation & management
B-1-054	Environmental laws and regulations
B-1-054	Hazardous materials management
B-1-054	Occupational health & safety
B-1-056	Environmental economics
B-1-056	Environmental law
B-1-056	Environmental planning
B-1-056	Introduction to environmental sciences
B-1-058	Introductory ecology
B-1-058	Introductory hydrogeology
B-1-058	Introductory hydrology
B-1-058	Introductory statistics
B-1-058	Introductory water chemistry
B-1-061	Field & hands on training
B-1-061	Oral communications
B-1-061	Problem solving activities
B-1-061	Writing
B-1-062	Health and Safety
B-1-062	Regulatory understanding
B-1-063	Hydrogeological subjects
B-1-063	Strong interaction between Env/Civ Eng.
B-1-064	Geological processes
B-1-064	Hydrogeology/hydrology
B-1-064	Organic chemistry
B-1-064	Process engineering
B-1-064	Project management
B-2-016	Basic toxicology
B-2-016	Environmental regulations
B-2-016	Pollution control technologies
B-2-016	Waste minimization/pollution prevention
B-2-020	Include Material relating EI in core c.
B-2-027	Groundwater technology
B-2-027	Hydrogeology
B-2-027	Waste disposal in landfills
B-2-028	Fate of contaminants
B-2-028	Overview of Environmental Eng.
B-2-028	Toxicology
B-2-028	Wastewater treatment
B-2-029	Aqueous geochemistry
B-2-029	Flow in porous media
B-2-029	Remedial measures for clean-up
B-2-029	Site investigation techniques
B-2-038	Basic maths, physics, chemistry
B-2-038	Geology/biology
B-2-038	Mechanics/materials
B-2-038	Numerical analyses/computing
B-2-038	Professional practice

B-2-046	Chemical
B-2-046	Geotechnical
B-2-053	Biology
B-2-053	Chemistry (inorganic, some organic)
B-2-053	Geology & hydrogeology
B-2-053	Hydraulics
B-2-053	Mass transfer
B-2-059	Contaminant clean-up/emergency response
B-2-059	EIA
B-2-059	Environmental management + legislation
B-2-059	Groundwater transport of contaminants
B-2-059	Water quality engineering
B-2-060	Air monitoring
B-2-060	Air quality
B-2-060	Waste management
B-2-068	EIA
B-2-068	Environmental Planning and Decision make
B-3-007	Basic course on bacteria & activities
B-3-007	Containment structures
B-3-007	Ecology
B-3-007	Groundwater contamination & decontamin.
B-3-007	Soil contamination
B-3-019	Air pollution control, Solid waste mngt
B-3-019	Industrial Processes
B-3-019	Pollution prevention
B-3-019	Regulations
B-3-019	Wastewater treatment
B-3-030	Aquatic chemistry
B-3-030	Environmental modeling
B-3-030	Hydrogeology
B-3-030	Treatment system design
B-3-030	Wastewater treatment
B-3-031	Environmental chemistry
B-3-031	Environmental Law
B-3-031	Hydraulics
B-3-031	Process design
B-3-031	Statistics - Experimental design
B-3-032	Geological/Geotechnical
B-3-032	Microbiology
B-3-032	Organic chemistry
B-3-032	Soil science
B-3-032	Water resources engineering
B-3-033	A little more focus (less general)
B-3-043	Landfill techniques
B-3-043	Wastewater treatment technologies
B-3-043	Water treatment, storage, distribution
B-3-048	Chemistry
B-3-048	Hydrogeology
B-3-065	Chemistry
B-3-065	Economics & business
B-3-065	Hydrology, geology

B-3-065	Political sciences
B-3-065	Process
B-3-066	Chemistry
B-3-066	Civil
B-3-066	Environmental
B-3-066	Geotechnical
B-3-066	Mechanical
B-3-067	Basic hydrogeology
B-3-067	Chemistry & biology relevant to environ.
B-3-067	Modern treatment technologies for remed.
B-3-067	Oceanography
B-3-067	Soil clean-up technologies
C-1-008	Biology
C-1-008	Chemistry
C-1-008	Communications
C-1-008	Data Analysis
C-1-008	Risk Assessment
C-1-010	Analytical chemistry
C-1-010	More training in groundwater contaminant
C-1-010	Soil chemistry
C-1-011	Must be leading edge technology
C-1-011	Must enhance technology transfer
C-1-011	Must have specific prerequisites
C-1-011	Must provide adecuate fundamentals
C-1-012	Introductory Environmental Engineering
C-1-013	Soils
C-1-013	Water & waste treatment
C-1-019	Flow through porous media
C-1-019	Geochemistry and chemistry of pollution
C-1-019	Geology
C-1-019	Soil mechanics
C-1-020	Applied chemistry (organic+inorganic)
C-1-020	Field technique
C-1-020	Geology
C-1-020	PC computer applications
C-1-021	Geotechnical
C-1-021	Hydrogeology
C-1-021	Law
C-1-021	Organic and Inorganic chemistry
C-1-024	Design of waste containment systems
C-1-024	Environmental chemistry
C-1-024	Hydrogeology
C-1-024	Monitoring and sampling
C-1-025	Chemistry
C-1-025	Geology
C-1-025	Math
C-1-025	Physics
C-1-025	Writing
C-1-027	Geology
C-1-027	Groundwater flow / hydrogeology
C-1-027	Microbiology

C-1-027	Organic/inorganic chemistry
C-1-027	Soil mechanics / soil physics
C-1-028	EIA
C-1-028	Environmental ethics
C-1-028	Environmental processes/treatment option
C-1-028	Introductory Environmental science
C-1-028	Microbiology
C-1-029	Environmental regulations
C-1-029	Field processes and protocols
C-1-029	Process evaluation and solution
C-1-031	Groundwater chemistry
C-1-031	Hydrogeology
C-1-032	Basic training in an outside discipline
C-1-035	EIA
C-1-035	Environmental management programs
C-1-035	Site assessments
C-1-035	Statistics re: site assessment/sampling
C-1-035	Waste reduction/management
C-1-038	Chemical
C-1-038	Civil
C-1-038	Hydrogeological
C-1-038	Microbiology
C-1-041	English
C-1-041	Hydrogeology
C-1-041	Project management
C-1-041	Soil Chemistry/Physics
C-1-041	Toxicology
C-1-042	Contaminant Hydrogeology & Chemistry
C-1-042	Geology
C-1-042	Groundwater Flow
C-1-042	Microbiology
C-1-042	Water Chemistry
C-2-014	Biochemical transformations & toxicology
C-2-014	Chemistry/biochemistry for Env.Eng.
C-2-014	Ecology, Ecosystem mngt. & sustain.dev.
C-2-014	Microbiology for Env.Eng.
C-2-014	Unit processes & unit operations
C-2-015	Basic physiscs, chemistry, mathematics
C-2-015	Computer, modeling, heat transfer, energ
C-2-015	Design methods, thermodynamics
C-2-015	Mechanics, stress/strain strength
C-2-015	Organic chemistry, biochemistry, biology
C-2-016	Ecology
C-2-016	Groundwater or hydrogeology
C-2-016	Microbiology
C-2-016	Organic chemistry
C-2-016	Sanitary engineering & waste management
C-2-017	Chemistry
C-2-017	Environmental management
C-2-017	Geotechnical materials & analysis
C-2-017	Groundwater hydrology
C-2-017	Microbiology

C-2-018	based to environmental based.
C-2-018	Change geotechnical program from struct.
C-2-018	more political/social component
C-2-018	Require interdisciplinary approach with
C-2-037	Agricultural
C-2-037	Chemical
C-2-037	Civil
C-2-037	Environmental
C-2-037	Geotechnical
C-2-039	Contaminant transport
C-2-039	Environmental fluid mechanics
C-2-039	Environmental microbiology & chemistry
C-2-039	Fundamentals of liquid biowaste treat.
C-2-039	Solid/toxic waste management
C-2-040	Chemistry
C-2-040	Fluid flow in permeable materials
C-2-040	Heat & mass transfer
C-2-040	Numerical modelling
C-2-040	Systems engineering
C-3-001	Chemistry
C-3-001	Climate
C-3-001	Ecology/biology
C-3-001	Groundwater
C-3-004	Dealing with environmental professionals
C-3-004	Environmental law
C-3-004	Federal/provincial regulations
C-3-004	Identifying and understanding problems
C-3-005	Environmental Law
C-3-005	Federal/prov. assessment requirements
C-3-007	Air pollution by asphalt plants
C-3-007	Road construction materials
C-3-007	Waste material transport and storage
C-3-009	Air pollution/water pollution control
C-3-009	Environmental assessment
C-3-009	Groundwater hydrology basics
C-3-009	Hazardous materials / risk
C-3-009	Water quality/contaminant chemistry
C-3-022	Management
C-3-022	Organic chemistry
C-3-022	Regulatory framework/aspects
C-3-022	Report writing, oral presentation
C-3-022	Toxicology
C-3-023	Hydrogeology
C-3-023	Management of solid wastes
C-3-023	Soil science
C-3-023	Thermal technologies
C-3-023	Water chemistry

D.3 Suggestions and recommendations for instructional/information courses.

A-1-001	Emerging environmental technologies
A-1-001	GIS
A-1-001	Water chemistry
A-1-006	Canada wide: course on new Federal regs
A-1-006	Local: course on provincial env. regs
A-1-017	Very many short courses + good instruct.
A-1-018	Specific courses
A-2-008	Colloques, conferences, 2-3 day courses
A-2-009	Solute transport
A-3-004	Emerging technologies
A-3-004	Environmental regulations
A-3-004	Hazardous substances storage
A-3-004	Soil decontamination, waste treatment
A-3-005	Global resources utilisation
A-3-005	Waste management
B-1-001	Hydrogeology
B-1-001	Mine closure (big potential in Canada)
B-1-006	Lab work should be 55% of total load
B-1-006	Principles of legislation
B-1-009	Complimented with refresher courses
B-1-009	Practical
B-1-011	Legislative changes
B-1-011	PC applications for small system design
B-1-011	Public input
B-1-012	Overview on air + water regulations
B-1-012	Process technologies (new types)
B-1-018	Do's & dont's for QC/QA
B-1-018	Legal implications/liabilities
B-1-025	Environmental philosophy & ethics
B-1-034	Changes in regulations
B-1-037	Environmental chemistry
B-1-037	Regulations
B-1-037	Treatment processes
B-1-039	Simposiums with industry participation
B-1-039	University sponsored
B-1-040	Field methods
B-1-040	Landfill design
B-1-040	Liability
B-1-040	Modelling of contaminant transport
B-1-040	Site remediation

B-1-044	Project case studies - success/failure
B-1-047	New products from industry
B-1-047	Regulatory framework & regulations
B-1-047	Use of computer models
B-1-055	Legal aspects of our work
B-1-055	Should be practical
B-1-055	Should encourage research
B-1-056	Bring in gov't eng. to discuss engineeri
B-1-056	ng in a government context
B-1-058	Case studies, participation
B-1-058	from industry
B-2-016	Environmental auditing
B-2-016	Environmental planning
B-2-016	Environmental regulations
B-2-016	Total environmental quality management
B-2-016	Updating on pollution prevention tech.
B-2-016	Waste reduction auditing
B-2-029	Environmental Laws and Guidelines
B-2-029	Geophysical techniques in site investig.
B-2-029	Hydrocarbon chemistry and clean-up
B-2-029	Statistical methods in Env. Eng.
B-2-041	Communicating
B-2-060	Environmental Legislation
B-2-060	Safety
B-2-060	WHMIS
B-3-007	Available also in French
B-3-007	Course material suitable for profess.use
B-3-007	Given in Hotel facilities
B-3-007	Organized lunches
B-3-013	Environmental auditing
B-3-013	Environmental liability / Law
B-3-013	Pollution prevention
B-3-019	Environmental ethics
B-3-031	Overview course for each discipline
B-3-032	Evening courses
B-3-032	Presentation by industry experts
B-3-032	Strong component involving local problem
B-3-033	Courses should be practical in nature
B-3-066	Communication
B-3-066	Environmental audits
B-3-066	Pollution prevention
B-3-066	Project management
B-3-066	Statistics
B-3-066	Sustainable development
C-1-008	Hazardous substances
C-1-008	Legal implications
C-1-008	Public communications
C-1-008	Regulatory interpretation/compliance

C-1-013	Bioremediation of soils
C-1-013	Effluent / discharge modelling
C-1-013	Geotechnical
C-1-013	Groundwater contamination
C-1-013	Waste treatment & discharge
C-1-013	Water treatment
C-1-019	Chemistry of pollution
C-1-019	Environmental Law
C-1-019	Project management
C-1-021	Law and professional liabilities
C-1-021	Project management
C-1-021	Report writing
C-1-025	Field methods
C-1-025	Regulatory agency interaction
C-1-025	Report writing
C-1-026	Planning and executing env. audits
C-1-026	Regulatory framework
C-1-028	Structured univ. level courses
C-1-028	Variety of short courses
C-1-031	Bioremediation
C-1-031	Gov't regulations
C-1-031	New technologies / remediation
C-1-035	Technological developments
C-1-035	Waste management: 5R's
C-2-014	Cost-effectiveness analysis; EIS; EIA
C-2-014	Innovative ideas & development trends
C-2-014	Microbiology of groundwater & soil
C-2-014	Principles of design
C-2-014	Principles of planning
C-2-014	Sustainable development
C-2-017	not covered in primary programs
C-2-017	Series of "booster" courses for topics
C-2-037	Preventing measures/assessment
C-2-037	Regulations
C-2-037	Remedial work
C-2-037	Risk analysis
C-2-040	Environmental legislation
C-2-040	Environmental toxicology
C-2-040	Work place health & safety
C-3-001	Overviews of certain fields
C-3-003	Advanced water/wastewater treatment
C-3-003	Hazardous wastes
C-3-003	Hydrogeotechnical understanding
C-3-004	Specific courses/workshop on groundwater
C-3-009	Environmental auditing
C-3-009	Environmental monitoring
C-3-009	Environmental regulations / liabilities
C-3-009	Use of environmental specialists

D.4 Do you prefer: **1-2 day courses associated with conferences**
1 week course (8 hours a day)
Term courses (Fall, Winter, Summer semesters)
Other (specify) .....

Results:

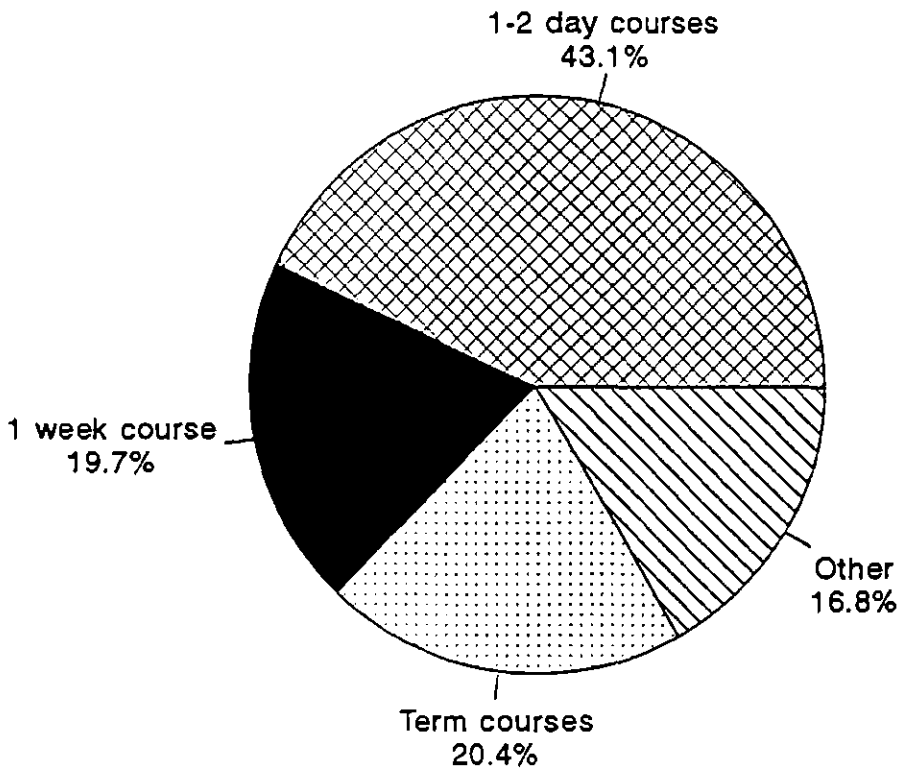
Note: same person could select more than one option

1-2 day courses associated with conferences	59
1 week course (8 hours a day)	27
Term courses (Fall, Winter, Summer semesters)	28
Other (specify)	23

Answers to "Other (specify)":

3-day
Correspondence
1-2 days, short, compact
All the above, in order of priority CAB
All depending on course
1-2 d courses + correspondence material
Evening
2-5 da extension courses
Evening courses
Night
Term courses at night
2-3 day intensive course
Either type depending on the topic
1-2 day courses/workshops/lectures
Seminars 1-2 days
All previous, including video conferenc.
1-2 weeks
2-3 day hands on short courses
A mixture of the three options
3-4 day courses
2-day courses
A mix of the three options
Evenings (if possible)

Courses preferred



A P P E N D I X

QUESTIONNAIRE

NEED ANALYSIS FOR ENGINEERS' ENVIRONMENTAL STUDIES PROGRAM THROUGH CONTINUING EDUCATION DEPARTMENTS ACROSS CANADA

NAME: ..... TITLE: .....

COMPANY/INSTITUTION/GOVERNMENT AFFILIATION: .....

ADDRESS: .....

TELEPHONE: ..... FAX: .....

INTERVIEWED BY: .....

DATE: ..... PLACE: .....

QUESTIONNAIRE COMPLETED WITHOUT INTERVIEW: .....
(NAME AND DATE) .....

SECTION A - PROFILE/STATISTICS

A1: INDUSTRY

Name: .....
Address: .....
Type of industry: ..... Size: .....
Products: .....
Number of Employees: ..... Number of offices across Canada: .....

ENVIRONMENTAL DIVISION(S):	Division A	Division B	Division C
Name:			
No. of people working at present:			
No. of engineers working at present:			
Type of engineers:			
Evolution of the division and future forcasts:			

QUESTIONNAIRE

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NAME: ..... TITLE: .....

COMPANY/INSTITUTION/GOVERNMENT AFFILIATION: .....

ADDRESS: .....

TELEPHONE: ..... FAX: .....

INTERVIEWED BY: .....

DATE: ..... PLACE: .....

QUESTIONNAIRE COMPLETED WITHOUT INTERVIEW: .....
(NAME AND DATE) .....

SECTION A - PROFILE/STATISTICS

A2. INSTITUTION

Name: .....
Address: .....
Type: .....
Main area of expertise: ..... No. of employees: .....

ENVIRONMENTAL DIVISION(S):	Division A	Division B	Division C
Name:			
No. of People working at present:			
No. of engineers working at present:			
Type of engineers:			
Evolution of the division and future forcasts			

QUESTIONNAIRE

NEED ANALYSIS FOR ENGINEERS' ENVIRONMENTAL STUDIES PROGRAM THROUGH CONTINUING EDUCATION DEPARTMENTS ACROSS CANADA

NAME: ..... TITLE: .....

COMPANY/INSTITUTION/GOVERNMENT AFFILIATION: .....

ADDRESS: .....

TELEPHONE: ..... FAX: .....

INTERVIEWED BY: .....

DATE: ..... PLACE: .....

QUESTIONNAIRE COMPLETED WITHOUT INTERVIEW : .....
(NAME AND DATE) .....

SECTION A - PROFILE/STATISTICS

A3 GOVERNMENT

Name: .....
Address: .....
Type/Branch: ..... Domaine: .....
Number of employees:

ENVIRONMENTAL DIVISION(S):	Division A	Division B	Division C
Name:			
No. of people working at present:			
No. of engineers working at present:			
Type of engineers:			
Evolution of the division and future forcasts:			

SECTION B : GENERAL

1. **What does the term Environmental Engineering mean in your context of work or needs?**

_____

_____

_____

2. **What are the main areas of your environmental work?**

_____

_____

_____

3. **Do the professional engineers in your Company/Institution/Government undertake any type of continuing education courses in environmental studies?**

YES ◯ NO ◯ Specify _____

_____

_____

4. **If the answer to question No. 3 is yes, can you please indicate where and what kind?**

(i.e. University or professional institution)
(i.e. Environmental science, environmental engineering)
(i.e. 10%)

_____

_____

_____

_____

5. **What are the main driving forces of your Company/Institution/Government which are responsible for the perceived needs of continuing education training for your professional engineers.**

Technological change ◯ Regulatory change ◯ Need of communication ◯

Competition ◯ Industry growth. ◯ None of the above ◯
specify.....

6. **Does your Company/Institution/Government rely upon a number of sources for the upgrading of your professionals working in the environmental area (Please check from the following list the ones that apply to your establishment)**

- O None
- O Universities
- O Colleges and technical institutes
- O Industry associations
- O On the job training
- O Outside trainers
- O Industry seminars and conferences
- O Internally developed training programs
- O Equipment suppliers (vendor training programs)
- O Continuing education programs

7. **Prioritize your needs in the environmental education and training of your employees according to the following list.**

- ☐ a. Need for general training in the environmental engineering studies
- ☐ b. Need for programs to develop specialized technical skills
- ☐ c. Need for on-going training
- ☐ d. Need for industry participation in course development
- ☐ e. Other (specify).....

SECTION C - THE NEW PROGRAM

1. **Do you support a continuing education program in environmental engineering studies coordinated by the EIC (Engineering Institute of Canada), in conjuction with the engineering learned societies?**

   YES ◯ Comments:.....

   NO ◯ .....

   ◯ INDIFFERENT.....

2. **Do you think there is a need for such a program?**

   ◯ YES

   ◯ NO

   Small △ · Medium △ Considerable △ Absolute Necessary △

   Comments: _____

   _____

3. **Do you see a need in the future for an Environmental Division (or expansion) in your Company/Institution/Government?**

   Small ◯ Medium ◯ Considerable ◯ Very big ◯

   Absolutely ◯ Depends on the economy ◯ Depends on ◯

4. **What type of engineering background do you require/will require from the engineers (employees) working in the environmetal area?**

Civil Eng.	(%)	Envir. Eng.	(%)	Process Eng.	(%)
Chemical Eng.	(%)	Biology	(%)	Geology	(%)
Agricultural Eng.	(%)	Chemistry	(%)	Others	(%)
Geotechnical Eng	(%)	Ecology	(%)	Specify.....	

5. **What do you require as a basic training and background for your environmental engineers?**

   _____

   _____

   _____

6. **Will your Company/Institution/Government interested to encourgage your professionals to register in this type of program?**

   (6 continuing education courses + exams and program completion certificate (%)

   (Instructional/information courses) (%)

specify.....

.....

.....

7. **Would your company be willing to support partially or fully, employees wishing to follow this type of program?**

   YES ◯ NO ◯ ◯ With conditions specify _____

   _____

   _____

8. **Summarize your present and future needs in the environmental section/division of your establishment**

   _____

SECTION D: COURSES

1. **Your suggestions/recommendations or strong opinions about the core courses common to all disciplines. (Civil, chemical, geotechnical, agricultural engineering)**

a).....

b).....

c).....

d).....

e).....

2. **Do you require extra courses, in addition to core courses, which are specific to the background disciplines**

Type of Engineers .....

.....

.....

.....

.....

.....

.....

.....

3. **Suggestions and recommendations for instructional/information courses**

a).....

b).....

c).....

d).....

e).....

f).....

4. **Do you prefer**

1-2 day courses associated with conferences
1 week course (8 hours a day)
Term courses (Fall, Winter, Summer semesters)
Other (specify).....

SECTION E: COMMENTS

1. **General comments about the program including suggestions and recommendations**

_____

_____

_____

_____

2. **Specific comments in relationship to your Company/Institution/Government and other issues related to the program (in your opinion) not covered by this questionnaire.**

_____

_____