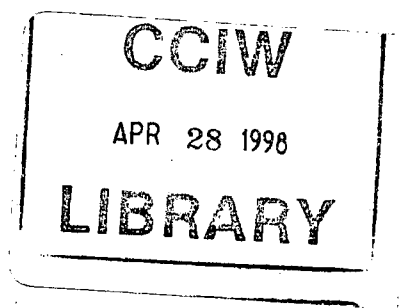
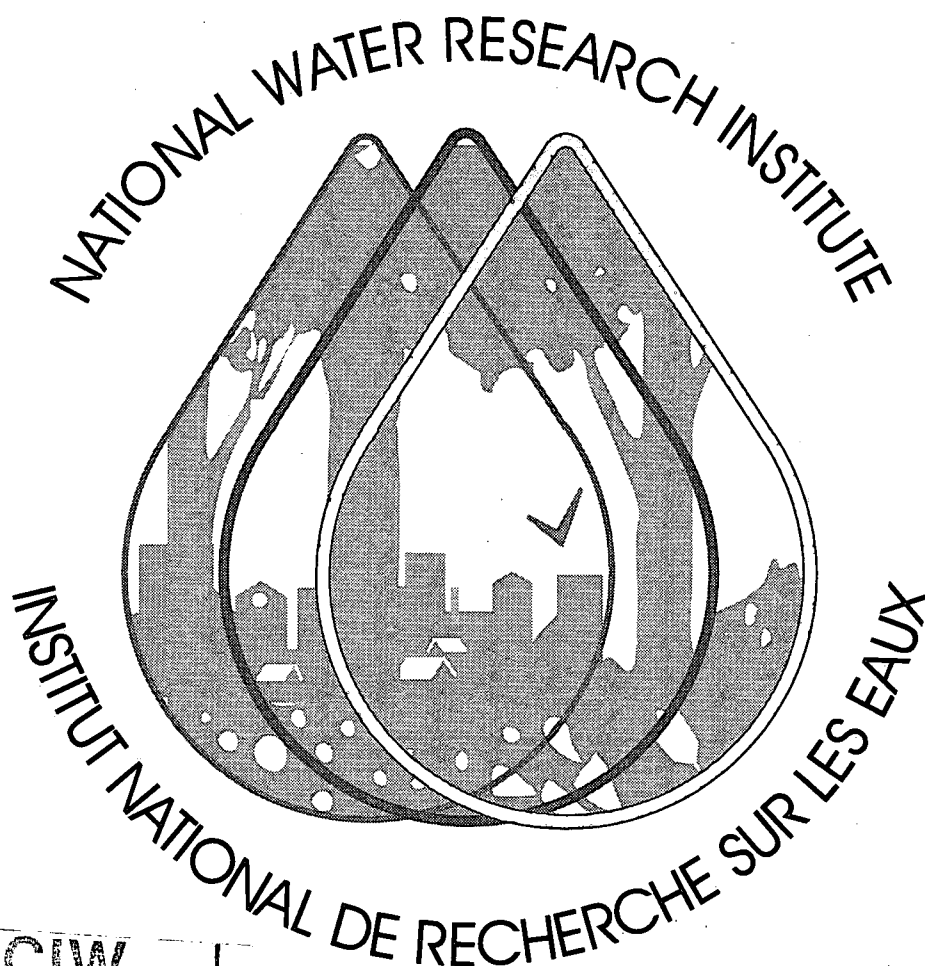


97-100



**INVENTORY OF
HEAVY METALS ACTIVITIES IN
ENVIRONMENT CANADA**

R.J. Allan

NWRI Contribution No. 97-100

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INVENTORY OF HEAVY METALS ACTIVITIES IN ENVIRONMENT CANADA

Compiled by:

R.J. Allan

Aquatic Ecosystem Restoration Branch
National Water Research Institute
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NWRI Contribution No. 97-100

DEPARTMENT OF THE ENVIRONMENT

SUMMARY OF METALS IN THE ENVIRONMENT ACTIVITIES

Early metals in the environment issues such as with Pb in gasoline and Hg releases from chlor-alkali plants (only one remains in operation in Canada) are past history. Metals studies related to these past issues for Canada (they are still major issues in other countries) are usually conducted to show further decreases in Pb and Hg pollution from these former sources. Likewise, the extensive metal pollution from mining and smelting activities has been dramatically reduced partly as a result of acid emission regulations and controls; smelting process changes such as shifting from pyrometallurgy to hydrometallurgy at Flin Flon; other process related and technological advances at mines and smelters; restoration at major mining sites such as at Sudbury; and voluntary emission and effluent release reductions undertaken by the mining industry under the ARET program.

Meanwhile, heavy metal pollution problems around the world are still serious and major issues in many locations. There are now two major international conferences held on Heavy Metals in the Environment (next in 1997 in Washington, D.C., USA) and Mercury as a Global Pollutant (next in 1998 in Rio de Janeiro, Brazil). Interest in metal pollution in Europe, especially northern, central and eastern Europe is very high.

The scope of and resources assigned to metals work in the Department of Environment is not extensive given the department's total size and budget. There is no metals program *per se* although studies of metals in the environment are to be found in all headquarters and regional units of the department. Part of the reason for this inventory, or rather snapshot in time, was to assess the scale of the metal activities and to see how integrated they were.

The DOE Metals program is not consolidated. It does not appear as a program on its own. It does not have a central source of funding such as the acid rain programme. Rather, it exists as part of the greater toxic chemicals program or through involvement in specific mining related projects and programs such as MEND and AETE. On the international scene, metals are simply additional analyses of samples collected for resolution of organic chemical issues.

However, the department does have what appear to be three main "nodes" or coherent groups working on metals issues. The first is the Mining, Metals and Minerals Division of EPS-HQ in Ottawa, which is devoted to policy development in the mining sector and conducts or contracts scientific activities related to these. Both national, such as MMLERS, and international policy related issues are dealt with. The second is the research on mining pollution and remediation conducted at NWRI. The third is the NWRC and regional CWS programs, co-ordinated through the NWRC and dealing with the coast to coast studies of metal accumulation by birds and terrestrial mammals. These are where most of the DOE budget appears to be spent on metals research.

Metals work done in the regions deals primarily with metal analyses added on to the monitoring of organic chemicals in waters, sediments and biota or related to compliance monitoring. There are exceptions to this such as the studies related to lead shot and lead sinkers (CWS). Regional metals activities are related to regional priorities such as the Great Lakes or Fraser River Regional Ecosystem Programs, or the Atlantic Region priority to investigate Hg in loons. HQ metals activities are related to general HQ priorities and acts such as input to CEPA or CEAA; regulations such as the MMLERS or development of EEM for the mining industry; intergovernmental mining related programs such as MEND and AETE; or international negotiations such as under the UNECE or NAFTA.

There is no apparent duplication of effort in the department. Some of the activities are complementary and some of them are closely linked at the working level. Interestingly, the same research and monitoring activities are important for a wide range of policy issues such as listed above i.e. UNECE, NAFTA, CEPA, MMLERS, EEM, CEAA, GLWQA, federal-provincial agreements, MEND, AETE and others. Yet, the metal-expert scientific staff are few and many respond to several of these policy and regulatory activities. Namely, the same expert may be asked the same questions by several people who individually deal with only one of these policy and regulatory files.

To date, there has been no "metals" reporting system as such and this inventory is the first time that a departmental "snapshot" of what is being done on metals in the environment has been attempted. It has not been easy, as the metals activities are often buried as part of larger programs devoted to "higher" priority issues. In particular, much of the budgetary input is very subjective since a program may have metals added on to a much larger field and laboratory activity related to organic chemicals.

The most recent issues which have revived interest in metals are the UNECE Protocol on Heavy Metals and especially Hg, the NAFTA interest in Hg, and the GLWQA interest in Hg in Lake Superior.

From the inputs provided from the three headquarters services (ECS, EPS, AES) and five regional units, the overall budget total devoted to metals is given on the next page. This should be taken as a reasonable estimate but in detail many of the individual activity budgets had to be very subjectively estimated as noted above because only rarely was one person's whole PY or budget devoted to metals. Where salaries were calculated, a figure of \$50K was normally used. The figures should be considered rough estimates because many metals activities are minor but valuable additions, as noted above, to other programs and estimates of resources devoted to them are quite judgmental.

**Department of Environment
Summary of Resources**

Branch	Salaries \$K	O&M \$K	Cap \$K
NWRI	666	254	53
NHRI	90	115	
CWS/HQ	190	199	15
ECS/HQ	235	440	
EPS/HQ	1035	592	20
AES	150	169	460
ATLANTIC REGION	214	154	15
QUEBEC REGION	226	900	
ONTARIO REGION	60	561	47
PRAIRIE & NORTHERN REGION	63	26	
PACIFIC & YUKON REGION	224	227	
TOTAL	3153	3637	610

WORKING GROUP

REP	BRANCH	PHONE & FAX	ADDRESS
ROD ALLAN (Lead)	ECS-HQ-NWRI (Bob Slater, ADM)	Phone (905) 336-4678 Fax (905) 336-6430	867 Lakeshore Road Burlington, Ontario L7R 4A6
MARLENE EVANS	ECS-HQ-NHRI (Bob Slater, ADM)	Phone (306) 975-5310 Fax (306) 975-5143	NHRI, 11 Innovation Blvd. Saskatoon, Saskatchewan S7N 3H5
KEITH MARSHALL	ECS-HQ-CWS (Bob Slater, ADM)	Phone (819) 997-3044 Fax (819) 953-6612	Canadian Wildlife Service National Wildlife Research Centre 100 Gamelin Blvd. Building #9 Hull, Quebec K1A 0H3
ED PORTER	ECS-HQ-ESD (Bob Slater, ADM)	Phone (819) 997-7174 Fax (819) 994-1691	Place Vincent Massey, 8 th Floor 351 St. Joseph Blvd Hull, Quebec K1A 0E7
SHEILA JONES	EPS-HQ-OTTAWA (Tony Clarke, ADM)	Phone (819) 953-1103 Fax (819) 953-5053	Place Vincent Massey, 13 th Floor 351 St. Joseph Blvd Hull, Quebec K1A 0E7
KEITH PUCKETT	EPS-HQ-AES DOWNSVIEW (Gordon Mc Bean, ADM)	Phone (416) 739-4836 Fax (416) 739-5708	Atmospheric Environment Service 4905 Dufferin Street Downsview, Ontario M3H 5T4
FIVE REGIONS			
NEIL BURGESS	ATLANTIC REGION (Garth Bangay, RDG)	Phone (506) 364-5049 Fax (506) 364-5062 E-mail Burgessn@ns.ec.gc.ca	Canadian Wildlife Service P.O. Box 1590, 63 East Main St. Sackville, NB E0A 3C0
JOHN AYRES	QUEBEC REGION (Francois Guimont, RDG)	Phone-Hull (819) 953-2268 Phone-Mtl (514) 496-6858 Fax -Hull (819) 953-5053 Fax -Mtl (514) 496-6982	105 McGill Street, 4 th Floor Montreal, Quebec H2Y 2E7
RON SHIMIZU	ONTARIO REGION (John Mills, RDG)	Phone (416) 739-5850 Fax (416) 739-4159	Atmospheric Environment Service 4905 Dufferin Street Downsview, Ontario M3H 5T4
DON WAITE	PRAIRIE & NORTHERN REGION (Jim Vollermshausen, RDG)	Phone (306) 780-6438 Fax (306) 780-6466	300-2365 Albert Street Regina, Saskatchewan S4P 4K1
COLIN GRAY	PACIFIC & YUKON REGION (Art Martell, RDG)	Phone (604) 664-4002 Fax (819) 664-9126	224 West Esplanade North Vancouver, BC V4K 3Y3

ECS - HQ - OTTAWA

- 1) **ECS-HQ (NWRI AND NHRI)**
 - A) NWRI - CONTACT: ROD ALLAN
 - B) NHRI - CONTACT: MARLENE EVANS
- 2) **ECS-HQ-CWS - CONTACT: KEITH MARSHALL**
- 3) **ECS - HQ - ESD - CONTACT: ED PORTER**

NWRI

CONTACT: ROD ALLAN

SUMMARY OF NWRI METALS RELATED RESEARCH

NWRI has a very limited metals research program focused primarily on metal sources, fate and effects in the Great Lakes and in the vicinity of operating abandoned mines in Atlantic Region, Ontario and B.C.; and on remediation of metal contaminated sediments and groundwaters.

REGIONAL ECOSYSTEMS - GREAT LAKES

- 1) Metals in suspended sediments in the Great lakes - Hamilton Harbour
- 2) Fate and transport of metals in urban runoff in Great Lakes Hamilton Harbour
- 3) Trends of metals inputs to the Great Lakes using sediment cores; migration of metals in pore waters; metal transport by resuspension in lower Great Lakes
- 4) Thallium in waters and sediments

Total Resources: Sal. \$291K O&M \$335 Cap \$40K

SUSTAINABLE MINING

- 5) Modeling of water quality in abandoned mine pits
- 6) Feasibility of sub-aqueous tailings disposal and in-situ remediation of acid generation
- 7) Metal pollution near mines in Atlantic Canada
- 8) Remediation of metal contaminated groundwater from tailings
- 9) Hg deposition from the atmosphere and fate in the Arctic

Total Resources: Sal. \$205.5K O&M \$139K Cap \$13K

TOXIC METAL FATE/ANALYSES

- 10) Sources, occurrence and toxicity of organometals
- 11) QA/QC for metals analyses for all DOE laboratories, major provincial laboratories and OGD laboratories

Total Resources: Sal. \$170K O&M \$90K

GRAND TOTAL RESOURCES: Sal. \$666.5K O&M 254.3 Cap \$53K

POLICY ISSUES ADDRESSED: These fall under the Canada-USA GLWQA and the Canada-Ontario COA; CEPA, PCPA, MMLEERS and Mining EEM; AMAP, UNECE and NAFTA - LRTAP air issues.

PROJECT SHEET FORMAT VISTAS IN THE ENVIRONMENT

PROJECT TITLE: Response of Hamilton Harbour to Loading Reductions

LEAD [Scientist, Laboratory, Manager, Individual]: Murray N. Charlton, National Water Research Institute, Environment Canada, PO Box 5050, Burlington, Ontario, L7R 4A6

TYPE OF ACTIVITY [State as policy development, regulatory/compliance monitoring, or scientific studies (source, trends, monitoring, research, etc.)]:

Research on mobilization, sedimentation, trends in contaminant status of Hamilton Harbour.

BRIEF STATEMENT OF WORK: Ambient particles are collected with sediment traps. The collections represent the most recent sources of contaminants. Samples are analyzed for Fe, Cu, Pb, Zn, Hg etc. Results are compared in time trends relative to loadings.

BUDGET 1995/96 [Itemize A-Base and other resources. Should include FTCs, Salary, O&M, Capital and Total Dollars. Identify key contractors]:

\$10K

LINKAGES TO POLICY OR REGULATION [Identify key client or intended purpose of the work, nationally or internationally (see attached). Eg, OECD, UNECE, GLWQA, NACEC, Fisheries Act regulations/MMLER, CEPA, MEND, AMAP, SOE, EEM. It is important to identify a hook to somewhere]:

GLWQA

INTERDEPARTMENTAL COOPERATION: [Identify existing cooperation/partners/contacts. Identify potential cooperation]:

DFO, OMEE (Ontario)
potential : Health Can for organics

**PROJECT SHEET FORMAT
METALS IN THE ENVIRONMENT**

PROJECT TITLE: Fate and Transport of Contaminants in Aquatic Systems

LEAD: T. Mayer

TYPE OF ACTIVITY: Scientific study (research)

BRIEF STATEMENT OF WORK:

Fate and transport of metal contaminants in a variety of aquatic ecosystems is investigated. The study focusses on the metal contaminants in urban and highway runoff, and in Hamilton Harbour, which is one of the Areas of Concern. In keeping with the objectives of the study, quantification of metals in the suspended and bottom sediments of urban stormwater management ponds was carried out to estimate their efficiency and assess the metals levels in sediments for the management of these ponds. The metal content of the highway runoff, as well as partitioning of metals between the particulate and dissolved fraction of the highway runoff, was estimated. In Hamilton Harbour, a correlation between the heavy metals in suspended sediments and their magnetic susceptibility was investigated to assess the feasibility of using this non-destructive, rapid and cost-effective technique as a suitable proxy of sediment contamination.

BUDGET 1995/96

A-Base:	O&M	\$ 5.0 K
	FTC	\$21.0 K
Great Lakes Funding:	O&M + Capital	<u>\$ 3.0 K</u>
Total:		\$29.0 K

LINKAGES TO POLICY OR REGULATIONS:

The work is carried out largely in support of the GLWQA.

INTERDEPARTMENTAL COOPERATION:

Potential DFO cooperation

PROJECT SHEET FORMAT

METALS IN THE ENVIRONMENT

PROJECT TITLE: Transport of Sediment-Associated Metals in the Great Lakes

LEAD [Scientist, Laboratory, Manager, Individual]: Sediment Remediation Project, Aquatic Ecosystem Restoration Branch, National Water Research Institute, Burlington, Ontario

TYPE OF ACTIVITY [State as policy development, regulatory/compliance monitoring, or scientific studies (source, trends, monitoring, research, etc.)]: Research studies of past and present trends of inputs and pathways of metals in the Great Lakes. Research studies of feasibility of in situ capping of contaminated sediments to prevent the migration of metals from the sediment into overlying waters.

BRIEF STATEMENT OF WORK: Determination of concentration profiles of metals in radio-dated sediment cores to evaluate the trend in inputs of metals to the Great Lakes. Determination of migration of metals via sediment pore water through a layer of a clean sediment cap. Quantification of transport of metals across the lake by sediment resuspension.

BUDGET 1995/96 [Itemize A-Base and other resources. Should include FTCs, Salary, O&M, Capital and Total Dollars. Identify key contractors]:

A-Base: O&M, \$30K; Capital, \$30K;
GLAP (O&M), \$80K; GL Clean Up Fund, \$193K;
Salaries, \$150K. Total: \$483K

LINKAGES TO POLICY OR REGULATION [Identify key client or intended purpose of the work, nationally or internationally (see attached). Eg, OECD, UNECE, GLWQA, NACEC, Fisheries Act regulations/MMLER, CEPA, MEND, AMAP, SOE, EEM. It is important to identify a hook to somewhere]: GLWQA

INTERDEPARTMENTAL COOPERATION: [Identify existing cooperation/partners/contacts. Identify potential cooperation]:

EP, Ontario Region, Toronto;
US Army Corps of Engineers, Waterways Exp. Station, Vicksburg, Mississippi;
UFZ, Leipzig, Germany;
University of Hamburg/Harburg, Hamburg, Germany;
Department of Chemistry, McMaster University, Hamilton, Ontario;

PROJECT SHEET FORMAT METALS IN THE ENVIRONMENT

PROJECT TITLE: Sediment Remediation Project / Application of Laser Spectroscopy in sediment remediation and mining impacts

LEAD: V. Cheam

TYPE OF ACTIVITY:

Scientific studies: monitoring, trends, method Research

BRIEF STATEMENT OF WORK:

Applications of LEAFS to study sediment - water - pore water interaction. To monitor lead and thallium in the Great Lakes and the Canadian Arctic by LEAFS and other metals by GFAAS. Develop analytical methods.

BUDGET 1995/96:

4K O&M A-base; 10k O&M Great Lakes; 10K capital
2 FTC's Salary approximately 120K
Total 144K

LINKAGES TO POLICY OR REGULATION:

GLWQA, AMAP and to some extent MMLER

INTERDEPARTMENTAL COOPERATION:

Geological Survey of Canada (Dr. Fritz Koener)
University of Michigan (Dr. Jerome Nriagu)
Collect Arctic samples; LEAFS analysis for Pb, Tl and AAS analysis of other metals; Data interpretation.

**PROJECT SHEET - FORM VI
WATER QUALITY MODELING OF DECOMMISSIONED MINING PIT LAKES**

PROJECT TITLE: Water Quality Modelling of Decommissioned Mining Pit Lakes

LEAD [Scientist, Laboratory, Manager, Individual]: P.F. Hamblin, Aquatic Ecosystems Restoration Branch, National Water Research Institute

TYPE OF ACTIVITY [State as policy development, regulatory/compliance monitoring, or scientific studies (source, trends, monitoring, research, etc.)]:

Scientific study

BRIEF STATEMENT OF WORK: See attached

BUDGET 1995/96 [Itemize A-Base and other resources. Should include FTCs, Salary, O&M, Capital and Total Dollars. Identify key contractors]:

0.1 PY; \$1,300.00 O&M

LINKAGES TO POLICY OR REGULATION [Identify key client or intended purpose of the work, nationally or internationally (see attached). Eg, OECD, UNECE, GLWQA, NACEC, Fisheries Act regulations/MMLER, CEPA, MEND, AMAP, SOE, EEM. It is important to identify a hook to somewhere]:

Key client: Environmental Protection Service, P&Y Region
MEND

INTERDEPARTMENTAL COOPERATION: [Identify existing cooperation/partners/contacts. Identify potential cooperation]:

- Partners:
- 1) Members of Department of Civil Engineering, University of British Columbia
 - 2) Staff, Brenda Mine

The water quality modeling of mining pit lakes is unusual in that the meteorological forcing is modified by the sheltering and shading effects of the rim surrounding the pit and by the fact that these lakes tend to be even deeper relative to their lengths than cratered lakes. From time series of winds, solar radiation, air temperature and humidity collected on the rim and on the surface of Brenda Pit, relations between the series were established. As far as the effects of reduced horizontal scales relative to depth, it is argued that bottom induced mixing ought to be important in these small but deep water bodies. A novel mixing scheme, taking into account the bottom stirring induced by wind driven seiches has been formulated and implemented in a standard water quality model of Brenda Pit Lake. Further progress awaits the transmittal of meteorological data from the Atmospheric Environment Service from nearby stations to fill in gaps in the coverage of our field stations.

**PROCEEDINGS OF THE
NATIONAL WATER RESEARCH INSTITUTE**

PROJECT TITLE: Remediation of Effects of Metals Originating from Mining Activities

LEAD [Scientist, Laboratory, Manager, Individual]: Sediment Remediation Project, Aquatic Ecosystem Restoration Branch, National Water Research Institute, Burlington, Ontario

TYPE OF ACTIVITY [State as policy development, regulatory/compliance monitoring, or scientific studies (source, trends, monitoring, research, etc.)]: Research studies of effects of metals in mine wastes on aquatic ecosystems, and development of techniques for remediation of release of metals from mine tailings and waste rock.

BRIEF STATEMENT OF WORK: Multidisciplinary studies of effects of metals released from mining activities on aquatic ecosystems in Canada. Research and evaluation of 1) feasibility of subaqueous disposal of mine tailings and waste rock to prevent release of metals from acid drainage generating tailings; and 2) neutralizing potential of slag from steel industries to remediate acid drainage and subsequent release of metals from mine tailings.

BUDGET 1995/96 [Itemize A-Base and other resources. Should include FTCs, Salary, O&M, Capital and Total Dollars. Identify key contractors]:

A-Base: O&M, \$60K; Capital, \$10K;
MEND (O&M), \$20K; Salaries, \$110K;
Total: \$200K

LINKAGES TO POLICY OR REGULATION [Identify key client or intended purpose of the work, nationally or internationally (see attached). Eg, OECD, UNECE, GLWQA, NACEC, Fisheries Act regulations/MMLER, CEPA, MEND, AMAP, SOE, EEM. It is important to identify a hook to somewhere]:

National : EEM, AQUAMIN, MEND, AETE
International: bilateral cooperation Canada-Germany (UFZ
Leipzig, Germany)

INTERDEPARTMENTAL COOPERATION: [Identify existing cooperation/partners/contacts. Identify potential cooperation]:

Geological Survey of Canada, Ottawa, Ontario;
Department of Chemistry, McMaster University, Hamilton, Ontario;
Department of Biology, Laurentian University, Sudbury, Ontario.

PROJECT SHEET FORMAT

METALS IN THE ENVIRONMENT

PROJECT TITLE: Impact of toxic metals from mining in the Maritime Provinces

LEAD: H.K.T Wong, AERB, NWRI
(Member(s): V. Cheam, AERB, NWRI; S. Beauchamp, AES, Bedford; C. Maclean, EPB, NFLD; A. Gauthier, EPB, Dartmouth, N.S.)

TYPE OF ACTIVITY:

Scientific study: source, sink and effect (Major)
Compliance monitoring, remediation (Minor)

BRIEF STATEMENT OF WORK:

To determine the environmental impact (inc. AMD) of Hg, Cd, As, Pb, Cu, Zn, V, TI at selected abandoned gold, base metal and coal mining sites re CEPA, MMLER. Discharge, Transport and Biota (AERB, EPB Atlantic).
To determine that selected operating metals and coal mining site(s) discharge abide by MMLERS (AERB, EPB Atlantic).

BUDGET 1995/96:

A - BASE O&M 14 + 4K from AES CAP 3K
FTC 1.1 SALARY 50K
CONTRACTOR(S): none

LINKAGES TO POLICY OR REGULATION:

CEPA, MMLERS

INTERDEPARTMENTAL COOPERATION:

(1) Environment Protection Branch, at Dartmouth Nova Scotia and St. John's Newfoundland. (2) Atmospheric Environment Service, Downsview Ontario and Bedford, Nova Scotia.

PROJECT TITLE:

Remediation of Metals Contaminated Groundwater

LEAD [Scientist, Laboratory, Manager, Individual]:

Dr. C. Ptacek, Groundwater Remediation Project, NWRI

TYPE OF ACTIVITY [State as policy development, regulatory/compliance monitoring, or scientific studies (source, trends, monitoring, research, etc.)]:

Scientific research

BRIEF STATEMENT OF WORK:

Development of remedial techniques for remediating metals-contaminated mine drainage water. The procedure is used to halt the migration of tailings-derived metals in aquifers by promoting *in situ* bacterial sulfate reduction and metal sulfide precipitation.

BUDGET 1995/96 [Itemize A-Base and other resources. Should include FTCs, Salary, O&M, Capital and Total Dollars. Identify key contractors]:
Approximately \$20K A-base O&M and 0.5 FTC PY will be allocated for 1995/96. Approximately \$100K in-kind resources through collaboration with the University of Waterloo.

LINKAGES TO POLICY OR REGULATION [Identify key client or intended purpose of the work, nationally or internationally (see attached). Eg, OECD, UNECE, GLWQA, NACEC, Fisheries Act regulations/MMLER, CEPA, MEND, AMAP, SOE, EEM. It is important to identify a hook to somewhere]:
Work supports both CEPA and MEND activities.

INTERDEPARTMENTAL COOPERATION: [Identify existing cooperation/partners/contacts. Identify potential cooperation]:
Cooperation and direct collaboration with NRCan (CANMET Environment Laboratory). Addition collaboration with the US Geological Survey and the US EPA (which provides resources to the U. of Waterloo).

**PROJECT SHEET FORMAT
METALS IN THE ENVIRONMENT**

PROJECT TITLE: Hg in Amituk Lake

LEAD: Ray Semkin

TYPE OF ACTIVITY:

Research

BRIEF STATEMENT OF WORK:

Mass balance for Hg at Amituk Lake near Resolute, NWT

BUDGET 1995/96:

Sal 10K O&M 20K

LINKAGES TO POLICY OR REGULATION:

AMAP, UNECE

INTERDEPARTMENTAL COOPERATION:

OMEE (Analysis); DIAND

Project Title: Environmental Effects of Metals and Organometals

Leads: Y.K. Chau and R.J. Maguire (NWRI/AEPB)

Type of Activity: Research study (sources, occurrence, toxicity)

Brief Statement of Work:

- (1) finish the national survey of water and sediment for pesticidal and non-pesticidal organotin compounds
- (2) assess the toxicity of the antifouling pesticide tributyltin to aquatic and benthic invertebrates
- (3) assess current status of alkyllead contamination in previously-identified hot-spots in the St. Clair and St. Lawrence Rivers
- (4) investigate the occurrence of MMT (methylcyclopentadienylmanganese tricarbonyl) in environmental media in selected Great Lakes basin locations.

Budget 1995/96

Salary: 150K est.
 O&M: 60K
 Capital: OK
 Total: 210K est.

Linkages to Policy or Regulation:

- (1) This work addresses research recommendations on (i) the pesticide tributyltin (PCPA - assessing environmental contamination status of tributyltin 5 years after the 1989 regulation of its antifouling uses), and (ii) on non-pesticidal organotins, identified in the CEPA-PSL1 assessment
- (2) Linked to PCPA status of tributyltin in existing hot-spots
- (3) Alkylleads are on IJC list of critical pollutants, and were initially proposed as candidates for virtual elimination
- (4) It has been proposed to ban MMT in Canada

Interdepartmental Cooperation:

Existing: with DFO in sample collection in PYR for organotin analyses (IOS - J.A.J. Thompson)

Potential: with DFO in sample collection in AR and QR for organotin analyses

PROJECT TITLE: Environmental Standards & Statistics (AEPB, NWRI)

LEAD: K.L.E Kaiser

TYPE OF ACTIVITY: Quality Assurance support for scientific studies on all aspects of metals in the environment.

This activity includes:

- routine interlaboratory performance studies;
- monitoring and documenting the performance of laboratories;
- maintaining database on laboratory performance for analytical data users;
- developing and distributing reference materials.

BRIEF STATEMENT OF WORK:

1. Design and execute interlaboratory performance evaluation studies to insure that the measurements in federal, provincial and private sector laboratories are quantitatively comparable; to identify deficiencies and to initiate corrective action when results indicate poor precision, inaccuracies or blank contamination.
2. Develop and distribute certified reference materials (water, sediment and soil) for calibration and in-house quality control use by laboratories.
3. Undertake performance evaluations and provide individual laboratory specific appraisals to help improve and maintain measurement precision and accuracy for the benefit the data users.

BUDGET:

K\$ 250 SAL (A-Base), K\$250 O&M/CAP (A-Base, GLWQA, VNR);

METALS COMPONENT: SAL 20K; O&M 30K

LINKAGES TO POLICY AND REGULATIONS:

Key clients: All DOE metals laboratories, major provincial laboratories in BC, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Nova Scotia, laboratories in OGDs such as NRCan, DFO, AAFC and Health Canada, as well as several laboratories in US and Canadian universities.

Participating laboratories are involved in research, surveillance and monitoring under a variety of federal programs, MOUs, and other agreements or programs, such as COA, GLWQA, CEPA, MISA, MEND, EEM, drinking water or effluent regulations.

INTERDEPARTMENTAL CO-OPERATION:

Existing or recently completed co-operative arrangements include:

- provision of blind audit samples to CAEAL laboratories for CAEAL certification;
- provision of blind audit samples to the BC MOE to monitor major contract laboratory performance;
- provision of blind audit samples to Health Canada (Ottawa) to monitor performance of several contract laboratories analysing heavy metals in drinking water;
- a contractual arrangement with the US EPA to monitor and to verify the performance of several laboratories in the Great Lakes and in EMAP programs,
- the sale of hundreds of reference water samples for metals to a wide variety of Canadian, US and environmental laboratories,
- sale of rainwater reference samples to European air monitoring laboratories.

Potential co-operative arrangements:

- discussions with US-NOAA, US-EPA and AES are underway to provide trace metal performance evaluation samples to laboratories participating in WMO and NAFTA precipitation programs.
- Recently, many Canadian federal and provincial laboratories have switched from AA to ICP-MS systems for trace metal analysis. To date, no concerted effort has been made to verify that these new systems are producing comparable data. As these data are used in research, surveillance and enforcement programs, an interdepartmental round robin study is highly recommended.

NHRI

CONTACT: MARLENE EVANS

NHRI Summary

In 1995/1996, NHRI had one active program inventorying heavy metals in the environment. This study (acid mine drainage and environmental impacts of mining) was terminated in May 1996 as a result of program review. An ongoing activity, the preparation of an Atlas on the biogeography of Russian wetlands, will contain information on heavy metals in these wetlands. In 1996/1997, a study will be conducted of metals in water, sediments, and fish in the West Basin of Great Slave Lake.

Budget

Fiscal Year	Financial	FTC
1995/1996	\$115,200	1.5

**PROJECT SHEET FORMAT
METALS IN THE ENVIRONMENT**

PROJECT TITLE: Heavy metals in wetland ecosystems

LEAD: Dr. John V. Headley

TYPE OF ACTIVITY: Scientific studies (source, trends, research)

BRIEF STATEMENT OF WORK: To date work has been performed in support of the Canada-Russia Bilateral. An atlas has been prepared on the biogeography of Wetlands in Russia and the Russian Arctic along with the concentrations determined for heavy metals.

BUDGET 1995/96: \$8K

LINKAGES TO POLICY OR REGULATION: CEPA; Mining impacts; and development of international policies to protect wetland ecosystems

INTERDEPARTMENTAL COOPERATION:

Russia:	Dr. Zhulidov, Hydrochemical Institute
NIIRI:	Dr. R. D. Robarts

Project Title: Metals in water, sediments, and fish in Resolution Bay and the West Basin of Great Slave Lake, N.W.T.

Lead: Marlene Evans, Research Scientist, NHRI

Brief Statement of Work:

This study is investigating metals in water, sediments, and selected fish species from the Resolution Bay area of Great Slave Lake. This baseline study is being conducted in response to community (Fort Resolution) concerns that the Pine Point Mine (which is no longer operational) may represent a significant source of metals to the community through various transport pathways. A sediment core from the West Basin of the lake will be examined for time trends in metal deposition: time trends, if observed, may be related to the mining operation and/or long-range atmospheric trends. Metals and metallothionein will be measured in predatory fish, including burbot from the Slave River delta. Previous research conducted under the Northern River Basins Study has suggested that burbot inhabiting the Slave River delta may have elevated levels of this protein. This study is linked with ongoing studies of organochlorine contaminant biomagnification in fish and invertebrates in the Resolution Bay and East Arm regions of Great Slave Lake.

Budget 1996/1997:

DIAND (Yellowknife): \$26,000 K: NHRI: 0.1 FTC
Other related resources: AES (to M. S. Evans) \$33,000
AES (to Fort Resolution) \$20,000

Linkages to Policy or Regulation:

Circumpolar Nation Arctic Environment Protection Strategy, UNECE Protocol on Metals, AMAP, Toxic Substances Management Policy.

Interdepartmental cooperation:

This study is being conducted in collaboration with L. Lockhart (metals in water and sediments: PAHs in sediments and biota), J. Klaverkamp (metals and metallothionein in fish tissue), and D. Muir (organochlorines, PCDFs, PCDDs in sediment and biota) at FWI. Fisheries and Oceans, Hay River, is providing logistic support and assisting in sample collection. The community of Fort Resolution (Deninu Kue First Nation) will participate and collaborate in the study.

METALS IN THE ENVIRONMENT - PROJECT SHEET

PROJECT TITLE: Acid Mine Drainage and Environmental Impacts of Mining
(To be terminated May 1, 1996 as result of Program Review)

LEAD: John Kwong, Research Scientist (Environmental Sciences Division, NHRI)

TYPE OF ACTIVITY: Scientific studies - research.

BRIEF STATEMENT OF WORK:

Acid mine drainage (AMD) is one of the most costly environmental problems facing the mining industry today and can detrimentally affect both surface- and ground-water resources. The goal of AMD research at NHRI is to better understand the acid generation and metal leaching processes so that more accurate predictive methods and preventive measures can be developed to ensure environmental health and to sustain economically viable mining activities. Both field and laboratory investigations are emphasized to obtain a practical insight into AMD and the related metal contamination problems.

The subject project includes three separate study plans, namely, (1) Acid Mine Drainage with a strong focus on the mining scene in British Columbia; (2) Mineralogical Controls of Sulfide Oxidation which is essentially an industry-funded laboratory study; and (3) Contaminant Transport in Northern Environments which addresses special topics in the Yukon Territory. Specific studies addressed in these study plans in 1995-96 include the following:

- (i) Copper-contaminated sediments in the Tsolum River near Courtenay, B.C.
- (ii) Waste rock characterization at selected mine sites in northwestern B.C.
- (iii) Arsenic transport and attenuation in the Cobalt mining camp, Ontario.
- (iv) Interplay of geochemical, electrochemical and microbial mediation processes in the oxidation of natural sulfide assemblages.
- (v) Lithochemistry and aqueous metal transport in the Keno Hill mining district, central Yukon Territory (with special focus on Zn, Cd and Pb).
- (vi) Pre-mine acid rock drainage assessment in the Clear Lake prospect, central Yukon.

BUDGET 1995/96

NHRI Resources: \$30,600 A-Base O&M and 1.5FTC

Other Resources:

Industry contribution - \$26,600

Funding from BC Mineral Development Agreement - \$30,000

In-kind support from DIAND (Whitehorse), GSC (Ottawa and Vancouver) and B.C. Environment - \$20,000(estimate)

Total Dollars (excluding salary): \$107,200

LINKAGES TO POLICY OR REGULATION:

Data and knowledge acquired in the subject project contribute to provide a scientific basis for the applications of MMLER, CEPA and CEAA. Prior to being notified of the 'surplus' status, the lead scientist for the project also served as a member in the MEND Prediction Committee and a member of Working Group 5 (B.C. and Yukon) in the AQUAMIN process.

INTERDEPARTMENTAL COOPERATION:

All studies under the subject project have been conducted in collaboration with personnel from other government agencies and industry partners. Active participants in the project outside NHRI include the following:

From Energy, Mines & Resources: Dr. J. Percival (GSC, Ottawa); Dr. C. Roots (GSC, Vancouver and currently at the Canada-Yukon Geoscience Office, Whitehorse).

From Indian and Northern Affairs Canada: Mr. P. Roach and Mr. G. Whitley (Water Resources, Whitehorse).

From Headquarters, EC: Mr. C. Dumaresq (AQUAMIN Secretariat).

From B.C. Energy, Mines & Petroleum Resources: Dr. W. Price (Victoria)

From B.C. Environment, Lands & Parks: Mr. J. Deniseger (Nanaimo)

From Placer Dome Canada Limited: Mr. K. Ferguson.

CWS

CONTACT: KEITH MARSHALL

**CANADIAN WILDLIFE SERVICE
WILDLIFE TOXICOLOGY PROGRAM**

METALS RESEARCH, MONITORING AND ASSESSMENT PROGRAM - 1996-97.

The objective of the Wildlife Toxicology Program of the Canadian Wildlife Service is to protect wildlife and their ecosystems from toxic substances. To achieve this research, monitoring and assessment activities are undertaken in order to identify and interpret the impacts of environmental contaminants on Canadian wildlife, to provide advice and recommendations to prevent or mitigate these effects and to inform Canadians. The program examines impacts on the health of wildlife and their habitats, the loss of use of wildlife as wildfoods, and the use of wildlife as early warning indicators health of ecosystems and humans. Program activities are lead out of the National Wildlife Research Centre in Hull, P.Q. and delivered in close cooperation with wildlife toxicology biologists in the five regions of Environment Canada.

Environmental contamination by metals is an important concern of the Program. The main metals issues on which the Wildlife toxicology program will be focused for the next few years are listed below.

1. **Lead shot.** Evaluate the effectiveness of the forthcoming ban on the use of lead shot for hunting migratory game birds in reducing the incidence of lead poisoning of waterfowl and their predators and the need to extend controls to other game.
2. **Lead sinker.** Continue to document the incidence of lead poisoning of loons and other fish-eating birds which inadvertently ingest lead fishing weights.
3. **Environmental Lead.** Delineate the impacts, and sources, of lead other than shot and sinkers and their effects on wildlife.
4. **Mercury contamination of loons and other fish-eating birds.** Delineate the types of environments where loons and other fish-eating birds are most at risk from increased atmospheric deposition of mercury; document adverse effects. Achieve better understanding of mercury-selenium interactions.
5. **Metal mining and smelting.** Complete review of literature on metal mining and smelting on wildlife. Preliminary review indicates very little research on the effects of mine wastes on wildlife has been conducted. Improve ability to model and asses metal uptake in by wild vertebrates and identify species at risk.
6. **Metals in wildfoods.** Determine whether high selenium concentrations in scoters may pose health risks to consumers and to the birds themselves and whether these high levels are naturally associated with mercury.
7. **Co-ordinate CWS metals program for NWRC and Regions and provide laboratory support services for analyses, data management, specimen banking etc.).**

PROJECT TITLE: Studies of Mercury, Lead and other metals in wildlife: determination of sources, levels of exposure, effects, and impacts, especially in fish-eating birds.

LEADER: Dr. A. Scheuhammer, Wildlife Toxicology Division, National Wildlife Research Centre, Canadian Wildlife Service

TELEPHONE: 819 997-6128

TYPE OF ACTIVITY: Scientific research studies involving methods development and applications for delineating exposure and effects of metals in wildlife; assessment of impacts for influencing regulatory policy; coordination of the CWS National metals toxicology program.

BRIEF STATEMENT OF WORK. Tissues of loons, common mergansers, and other fish-eating birds from carcasses turned in to us by collaborators are being analysed for total and methyl mercury, selenium and lead, other metals and effects. The technique of Pb isotope ratios by ICP-MS is being assessed for its usefulness in distinguishing among different sources of Pb exposure in wildlife including Pb shot, fishing weights, mining and smelting wastes, and sediments and plant material from environments heavily contaminated with 'urban' or industrial Pb. The extent of lead sinker/jig ingestion and Hg exposure and damage to waterfowl, loons, and other fish-eating birds in Canada will be determined. The relative contribution of environmental chemistry variables (e.g. - acidification) to explain elevations in fish-Hg concentrations will be investigated. Dead common loons to determine the range of tissue-Pb, -Hg and -Se concentrations in this species, and interpret concentrations from a toxicological perspective will be surveyed. The incidence of lead shot poisoning of woodcock in Eastern Canada and waterfowl in BC are being assessed.

BUDGET(1996-97)

	No. of Indeterminate	Salary	O&M	Capital	Total
A-Base	2	\$120,000	\$75,000	5,000	\$200,000

LINKAGES TO POLICY

Results are to be used to influence policy concerning needs for further controls on metal releases and uses, primarily under MBCA and CEPA. Result support OECD Lead risk and Mercury risk reduction, UNECE LRTAP Protocol development, Can-US transboundary air and other international initiatives.

INTERDEPARTMENTAL COOPERATION: OGD are currently not involved in this research. Partnerships with other Departments to undertake wildlife-metals effects research, impact assessments, and improvements in analytical methodology and throughput are welcome.

ECS - HQ - ESD

CONTACT: ED PORTER

SUMMARY OF ENVIRONMENTAL SCIENCE DIRECTORATE HEADQUARTERS METALS ACTIVITIES

The program has only two aspects.

The first deals with effects of mine effluents on aquatic ecosystems and includes AQUAMIN. Thwe AQUAMIN final report mentioned in the Project Sheet has now been published.

The other activity is the development of environmental quality guidelines for metals in various environmental media.

RESOURCES :

5 PY (Salaries: 235K); A-base: 170K; Third party: 270K

Project Title: Assessment of the Aquatic Effects of Mining in Canada (AQUAMIN)

Lead: Connie MacDonald, Chief, Environmental Effects Monitoring Division, Evaluation and Interpretation Branch

Timeframe: June 1993 to April 1996

Type of Activity: multistakeholder, scientific assessment of existing information on the effects of mining on aquatic ecosystems in Canada, to make recommendations regarding: amendments to the Metal Mining Liquid Effluent Regulations (MMLER); the design of a national Environmental Effects Monitoring (EEM) program; and information gaps and research needs.

Brief Statement of Work: over 700 reports on environmental monitoring at mine sites in Canada were collected, screened and entered into a database. Reports were from a variety of sources including government reports, journal articles and consultants reports prepared for mining operations. Information from over 90 sites represented in the database was summarized, and detailed case studies were completed for 17 of the sites. This material was summarized in syntheses for the following regions: Appalachian region (NF, NS and NB), the eastern Canadian Shield (PQ and ON), the western Canadian Shield (MN, SA and NT) and the Western Cordillera (BC and YT). The case studies and regional syntheses have been used as the basis for a Final Report, in preparation, which presents recommendations from the AQUAMIN process.

Budget 1995/96: funding for this fiscal year has been provided by ECS, EPS, DIAND, NRCan and the Mining Association of Canada. 2.0 PY (Salaries: 95K) A-base: 80K; Third Party : 70K.

Linkages to Policy or Regulation: the recommendations from AQUAMIN will have a significant impact of the nature of upcoming revisions to the MMLER, and Environment Canada policy regarding the metal mining sector. Further, the recommendations will also have implications for the conduct of Environmental Effects Monitoring.

Interdepartmental Cooperation: strong participation in AQUAMIN from:

- DFO headquarters, regions and scientific institutes
- Environment Canada headquarters, regions and scientific institutes
- NRCan staff from CANMET and the GSC
- DIAND staff from headquarters and regions
- AECB
- also have participation of provincial governments, the Mining Association of Canada, environmental non-government organizations, and aboriginal groups

PROJECT TITLE: Monitoring and Surveys of metals in wildlife

LEADER: Dr. Birgit Braune, Wildlife Toxicology Division, National Wildlife Research Centre, Canadian Wildlife Service

TELEPHONE: 819 953- 5959

TYPE OF ACTIVITY: Surveys and monitoring studies to establish spatial and temporal trends of metal contamination and edibility of wildlife.

BRIEF STATEMENT OF WORK.

The levels of mercury, cadmium, lead, selenium and arsenic in edible portions of waterfowl and selected other wildfoods have been systematically collected throughout Canada including the Arctic over the period from 1988 to 1994. Results are evaluated by Health Canada and reported to consumers. Spatial and temporal trend monitoring of especially mercury, occasionally other metals, in seabirds, shorebirds, waterfowl, fish-eating birds, and other wildlife including mammals from the Arctic, Pacific and Atlantic Oceans and various freshwater and terrestrial ecosystems (e.g., Great Lakes) has been undertaken since as early as the late 1960's. Contaminants levels and effects in Polar bears are systematically monitored by Dr. R. Norstrom. Most analyses are conducted by NWRC Lab. Services. All data are electronically available in our National Registry of Toxic Chemical Residues. In addition tissues from most specimens collected are maintained frozen in our National Specimen Bank. All survey and monitoring studies have been carried out in close collaboration with CWS Regional staff.

BUDGET(1996-97)					
	Salary	O&M	Capital	Total	No. of Indeterminates
A-Base	\$50,000	\$75,000	\$10,000	\$135,000	3
Other		24,000			

LINKAGES TO POLICY

Results are to be used to influence policy concerning needs for further controls on metal releases and uses, primarily under MBCA and CEPA and for advising Canadians of safety of wildfoods for consumption. Result support OECD Lead risk and Mercury risk reduction, UNECE LRTAP Protocol development, Can-US transboundary air and other international initiatives.

INTERDEPARTMENTAL COOPERATION: Health Canada conducts all evaluations of the safety of wildfood for human consumption and advises on the need for health advisories. The more recent data in the Arctic has been significantly funded by the DIAND. Collaborative studies with ODGs are welcome.

PROJECT TITLE: Development of methodologies for estimation of exposure and assessment of impacts of metals on wildlife

LEADER: Lorna Brownlee, Wildlife Toxicology Division, National Wildlife Research Centre , Canadian Wildlife Service

TELEPHONE: 819 953- 3907 FAX: 819 953 6612

TYPE OF ACTIVITY: Scientific evaluation of available data sets and models. Development of databases and applications of bioaccumulation models as tools for assessment of impacts of metal contaminants on wildlife.

BRIEF STATEMENT OF WORK. The development of the Wildlife Contaminant Exposure Model (WCEM) is one ongoing project that addresses the need for methods for estimating contaminant exposure to wildlife. This model has been developed using Visual Basic and Microsoft Access databases and currently contains a biological database of 18 birds, 12 mammals, 4 amphibians and 3 reptiles. It contains information on weights and diets relevant to the Canadian environment, and allometric models for estimating daily intake via inhalation, drinking water and diet and addresses adults only. The biological database is linked to a chemical specific database shell. The user creates a wildlife exposure model that corresponds to the exposure routes of a specific chemical and enters environmental levels of air, water, soil, sediment, dietary components or physical chemical properties into the chemical database. The chemical database also contains QSARs for estimating contaminant uptake into wildlife food from the aquatic environment. Using these two databases, site-specific approximate daily intakes (ADIs) can be estimated. Major data gaps are estimation of metal contaminant uptake into diet in aquatic systems and both organics and metal uptake in terrestrial systems. Also a draft literature review of the impacts of mining industries on wildlife is to be updated depending on availability of funds.

BUDGET (1996-97)

	Salary	O&M	Capital	Total	No. of Indeterminates
A-Base	\$20,000	\$20,000	0	\$40,000	0.5
Other		5,000			

LINKAGES TO POLICY

Results are to be used to influence policy concerning needs for further controls on metal releases and uses, primarily under MBCA, and CEA processes.

INTERDEPARTMENTAL COOPERATION: There is currently no collaboration with OGDs. Cooperation with OGDs to extend the model to metals and complete the mining assessment is welcome.

PROJECT TITLE: Canadian Environmental Quality Guidelines for Metals

LEAD: Connie Gaudet, Head, Soil and Sediment Quality Guidelines Section
Robert Kent, Head, Aquatic Guidelines and Assessment Section
Guidelines Division, Ecosystem Conservation Directorate, ECS, Environment Canada

TYPE OF ACTIVITY: Under CEPA Part I, the Minister of Environment has an obligation to formulate national guidelines specifying goals towards which an environmental control effort is directed and recommendations to support and maintain particular uses of the environment. National environmental quality guidelines are developed to protect, maintain and restore specific water (drinking water, recreational water, aquatic life, irrigation and livestock water, industrial) and land uses (agricultural, residential/parkland, commercial and industrial). The guidelines are developed in collaboration with OGDs and the provinces/territories.

The Canadian environmental quality guidelines are science-based, non-regulatory instruments which provide nationally consistent measures for preservation and restoration of environmental quality, targets for pollution control and guidance for interpreting sources, trends and trends data.

BRIEF STATEMENT OF WORK: National scientific assessment of the available information related to a specific metal includes: its forms and fate; sources and pathways for entering the Canadian environment; its environmental concentrations and toxicological effects. The scientific information is assessed and guidelines are recommended based on existing national protocols for soil quality, water quality, and sediment quality.

BUDGET 1995/96: The budget fluctuates yearly based on the Departmental priorities and partnerships. This year, 3.0 PY (Salaries: 140K); A-base: 90K; Third party: 150-200K.

LINKAGES TO POLICY OR REGULATION: Canadian Environmental Quality Guidelines have become accepted nationally and internationally (see attached UN/ECE document). They are extensively used in over 40 countries including the UN/ECE, OECD countries, the AESEAN group, Mexico, and Chile.

The guidelines are mandated under CEPA Part I and also support CEPA Part IV. They are also used under the pollution prevention and the protection of fish habitat portions of the Fisheries Act. They can be used as reference for contaminated sites remediation, marine disposal, EEM, MMLER, GLWQA, and NAFTA/NACEC.

INTERDEPARTMENTAL COOPERATION: The national guidelines are developed in cooperation with OGDs.

EPS - HQ - OTTAWA

CONTACT: SHEILA JONES

SUMMARY OF ENVIRONMENTAL PROTECTION SERVICE HEADQUARTERS METALS ACTIVITIES

Most of the EPS-HQ metals related activities are to be found in the Mining, Minerals and Metals Division. They involve policy development in relation to SOP, UNECE Protocol on Metals and MMLER/Mining EEM revision. The summary for the division follows on the next page.

Resources: Sal. \$800K. O+M \$435K (both approx.)

Another EPS-HQ metal activity is in the Renewable Resource Division on wood preservative facilities design.

Resources: Sal and O+M \$10K

At the Environmental Technology Centre ambient air monitoring is conducted of metals in particulates from rural and urban sites across Canada.

Resources: Sal. \$100K O+M \$75K Cap \$20K

The Commercial Chemicals Branch develops criteria applicable for metals in terms of regulatory policy development and conducts assessments of the ecological risk of metal as input to the CEPA and the IPCS program.

Resources: Sal. \$55K O+M \$12K

The Chemical Industries Division develops SOPs for the metal finishing industries and in relation to chlor-alkali plant regulations.

Resources: Sal. \$80K O+M \$70K

Mining, Minerals and Metals Division

PROGRAMS/PROJECTS

UNECE Heavy Metals Protocol

AQUAMIN/MMLER

Strategic Options Process (SOP)

- Steel Sector Studies

- Base Metals Smelting Studies

Arsenic Studies

PERD/H.A.P. Studies

LEAD

Patrick Finlay

Bill Blakeman

Ray Capowski

John MacLachy

Kin Mah

Bill Wong

Sheila Jones

John Ayres

TYPE OF ACTIVITY

Policy Development, Regulatory, Scientific Studies (co-funding). About 80% of the work done by the division is related to metals. Three major activities are the SOP, UNECE Heavy Metal Protocol and AQUAMIN/MMLER revisions.

BUDGET 1995/96

Total Base A - 800K approx.

Total O&M - 435K approx. (407K Env. Canada, 28.0K PERD)

LINKAGES

UNECE, Fisheries Act, MMLER, MEND, CEPA, etc.

INTERDEPARTMENTAL COOPERATION

Natural Resources Canada, Industry Canada, Health Canada

Note: See attached project sheets for details.

PROJECT SHEET FORMAT METALS IN THE ENVIRONMENT

PROJECT TITLE: Arsenic Emission Control from Pyrometallurgical Operations

LEAD: R. Capowski, Program Engineer, 3M Division, N.O.P.P., Environment Canada, Ottawa.

TYPE OF ACTIVITY:

Scientific studies, research

BRIEF STATEMENT OF WORK:

Assessment of arsenic air pollution control technology options within the metallurgical industrial sector, and more specifically, Royal Oak Mines, Yellowknife, NWT.

BUDGET 1995/96

O&M - 25K (transferred from P&N Region)

Key contractor: W.R. Hatch Engineering Ltd., (Ron Hatch) Brampton, Ontario

LINKAGES TO POLICY OR REGULATION:

Support to possible development of arsenic management strategy with respect to CEPA (PSL-1) designation of arsenic as a CEPA toxic.

INTERDEPARTMENTAL COOPERATION:

- 1) Health Canada
- 2) Government of Northwest Territories
- 3) Royal Oak Mines, Yellowknife, NWT

PROJECT SHEET FORMAT
METALS IN THE ENVIRONMENT

PROJECT TITLE: STEEL MANUFACTURING SECTOR STRATEGIC OPTIONS
REPORT

LEAD: Patrick Finlay

TYPE OF ACTIVITY:

State as: scientific studies

BRIEF STATEMENT OF WORK:

Prepare Strategic Options Report for Steel Manufacturing Sector for the management of CEPA
Toxic Substances.

BUDGET 1995/96

O&M - 150K

Key contractor: APOGEE RESEARCH

LINKAGES TO POLICY OR REGULATION:

UNECE, GLWQA, Fisheries Act regulations, CEPA

INTERDEPARTMENTAL COOPERATION:

- 1) Natural Resources Canada
- 2) Industry Canada
- 3) Health Canada

PROJECT SHEET FORMAT METALS IN THE ENVIRONMENT

PROJECT TITLE: BACKGROUND INFORMATION RE: HEAVY METALS
PROTOCOL UNDER THE UNECE.

LEAD: P. Finlay

TYPE OF ACTIVITY:

State as: scientific studies

BRIEF STATEMENT OF WORK:

Provide a summary of the "State of Science Knowledge" derived from the documents and associated background.

BUDGET 1995/96

O&M - 50K

Key contractor: C.C. Doiron & Associates

LINKAGES TO POLICY OR REGULATION:

UNECE, CEPA.

INTERDEPARTMENTAL COOPERATION:

- 1) Natural Resources Canada
- 2) Health Canada

PROJECT SHEET FORMAT METALS IN THE ENVIRONMENT

PROJECT TITLE: BASE METALS SMELTING STRATEGIC OPTIONS STUDY

LEAD: Patrick Finlay/Ray Capowski

TYPE OF ACTIVITY:

Scientific studies (source, trends, monitoring, etc.).

BRIEF STATEMENT OF WORK:

Provide technical data/info; regulatory, economic info., pollutant release inventory, technical options, preliminary narrowing of substance facility type combinations and focussing MAE SOP and recommendations.

BUDGET 1995/96

O&M - 150K

Key contractor: HATCH ASSOCIATES

LINKAGES TO POLICY OR REGULATION:

UNECE, Fisheries Act regulations/MMLER, CEPA, MEND.

INTERDEPARTMENTAL COOPERATION:

- 1) Natural Resources Canada
- 2) Industry Canada
- 3) Health Canada

PROJECT SHEET FORMAT

METALS IN THE ENVIRONMENT

PROJECT TITLE: Assessment of Status of Coal Cleaning Technologies Capable of Achieving Reductions of H.A.P. Emissions From Combustion Sources

LEAD: William Blakeman, Head; Mining & Milling, Mining, Minerals and Metals Division

TYPE OF ACTIVITY:

State as: scientific studies. Review and assessment of existing and emerging coal cleaning technologies.

BRIEF STATEMENT OF WORK:

Genetic relationships and associations of H.A.P. Precursor elements in coal identified and assessed. Existing and emerging precombustion H.A.P. precursor removal through coal cleaning assessed reviewed and assessed. Phase 1 report submitted to PERD.

BUDGET 1995/96

O&M: 27.8K PERD

A Base Sal: 5.0K

Key contractor: O&M to consultant D.S. Webster Technical Services Co. Continuation of project will depend on availability of PERD funding and Power Generation SOP recommendations re needs and measures that could be taken to reduce H.A.P. Emissions.

LINKAGES TO POLICY OR REGULATION:

Project supports Environment Canada H.A.P. Program, CEPA Power Generation SOP Issue Table and PERD Task 2 Program.

INTERDEPARTMENTAL COOPERATION:

- 1) Natural Resources Canada; Coal Research Laboratory Devon, Alberta
- 2) Natural Resources Canada; GSC - Institute of Sedimentary and Petroleum Geology, Calgary
- 3) U.S. Dept. of Energy; Pittsburgh Energy Technology Centre, Pittsburgh
- 4) U.S. Geol. Survey (Dr. R. Finkelman), Washington D.C.

PROJECT SHEET FOR M/M METALS IN THE ENVIRONMENT

PROJECT TITLE: AQUAMIN (Assessment of the Aquatic Effects of Mining in Canada) a Multistakeholder program, to assess known effects of mine effluents and mining activity on natural receiving waters.

LEAD: B. Blakeman as member: Steering Committee, Co-Chair Technical and Regulatory Aspects Committees
Co-chairs: H. Meade (MAC), C. MacDonald (ECS/DOE)

TYPE OF ACTIVITY:

State as: scientific studies - Review of existing scientific data on effects of mining on aquatic environment in Canada and recommend revisions to update and strengthen the MMLER, Design an EEM Program for Mines and identify future research needs.

BRIEF STATEMENT OF WORK:

Program was started in June 1993 and completed in May 96. Final report is ready for release pending completion of translation. Project reviewed over 700 scientific reports on effects of Canadian metal mines on aquatic environment. Report contains recommendations re: amending MMLER, designing an EEM Program for mines, effluent testing characterization and reporting; updating the Environment Code of Practice for Metal Mines, and future research.

BUDGET 1995/96

O&M: 32.0 K O&M (To support AQUAMIN Program [ECS] and M3D Travel)
Sal: 25.0 K

LINKAGES TO POLICY OR REGULATION:

AQUAMIN Recommendations will be considered by Environment Canada in amending (updating & strengthening) the 1977 Metal Mining Liquid Effluent Regulations under the Fisheries Act.

INTERDEPARTMENTAL COOPERATION:

Multistakeholder process involving DFO, NRCan, DIAND, Ontario, N.S., Quebec, B.C., N.B., Sask. and Manitoba Environment Depts., the Mining Association of Canada, the Canadian Environmental Network, the Inuit Tapirisat of Canada, Regional First Nations organizations - Follow-up actions/Departmental response to recommendations in AQUAMIN report will involve similar multistakeholder participation.

Renewable Resources Division

Project Title

Technical Recommendations: Documents for the design and operation of wood preservation facilities.

Lead

Gautam Das

Brief Statement of Work

Recommended practices to reduce or eliminate the release of wood preservative chemicals to the environment and minimize exposure of workers.

Budget 1995/96

Base - A 10K approx.

Linkages

Toxic Substances Management Policy, Fisheries Act.

Interdepartmental Cooperation

Natural Resources Canada, Agriculture Canada, Health Canada

Metals

Chromium, Copper & Arsenic.

PROJECT TITLE: National Air Toxics Sampling Network

LEAD: Tom Dann and R. Turle ETC, Ottawa

TYPE OF ACTIVITY: Scientific Studies (Ambient air trend monitoring)

BRIEF STATEMENT OF WORK:

Fine (< 2.5 μm) and coarse (2.5 - 10 μm) particulate samples are collected at 20 sites (4 rural, 16 urban) sites across Canada. Samples are analyzed by EDXRF for 55 elements (including Pb, Cd, Hg, Ni, Cu, Zn, Cr, As) and by IC for 16 anions/cations. Sampling began in 1986 and continues. Samples are collected over 24 h once every six days.

BUDGET 1995/96:

Salary	\$ 100K
O&M	\$ 75K
Capital	\$ 20K

LINKAGES:

PSL 1 and 2.
HAPS - UNECE
GLWQA
CEPA

COOPERATION:

All provincial and municipal environment agencies participate in program and provide in kind contribution. Portions of work are carried out jointly with AES and Health Canada.

DOE Metals Network - Project Sheet

PROJECT TITLE: Harmonization of classification systems of metals (OECD)

LEAD:

Karen Lloyd
Commercial Chemicals Evaluation Branch
Toxics Pollution Prevention Directorate
Environmental Protection Service, Hull
(819) 953-0356

TYPE OF ACTIVITY:

Regulatory; policy development

BRIEF STATEMENT OF WORK:

Criteria for classifying organic chemicals as dangerous to the environment are based on persistence, bioaccumulation and toxicity. The aim of the project is to develop criteria applicable to metals. In addition, the project addresses the need for separate testing protocols.

BUDGET 1995/96:

A-Base:

FTC: 0.3
Salary: \$25 K
O&M: \$10 K
Capital: 0

Total: \$35 K

LINKAGES TO POLICY OR REGULATIONS:

- 1) OECD Harmonization of Classification
- 2) Canada's Toxic Substance Management Policy

INTERDEPARTMENTAL COOPERATION:

NRCan: Led organizing committee of workshops to address toxicity (Ottawa), persistence and bioaccumulation (Brussels).

DOE Metals Network - Project Sheet

PROJECT TITLE: Assessment of the ecological risk of priority substances.

LEAD:

Karen Lloyd
Commercial Chemicals Evaluation Branch
Toxics Pollution Prevention Directorate
Environmental Protection Service, Hull
(819) 953-0356

TYPE OF ACTIVITY:

Regulatory

BRIEF STATEMENT OF WORK:

Several metals and their compounds were listed on the first Priority Substances List of the Canadian Environmental Protection Act. In addition, releases from primary and secondary copper and zinc smelters and refineries are listed on the second Priority Substances List. The ecological risk of these substances will be assessed in the next three years. Methods to assess this risk have been developed and published in a draft guidance manual.

In addition, contributions are made to reviewing and writing sections of international documents which assess the risk of specific metals (e.g., International Program on Chemical Safety reports on copper and zinc).

BUDGET 1995/96:

A-Base:

FTC: 0.5
Salary: \$30 K
O&M: \$2 K
Capital: 0
Total: \$32 K

LINKAGES TO POLICY OR REGULATIONS:

- 1) Canadian Environmental Protection Act
- 2) Canada's Toxic Substance Management Policy

INTERDEPARTMENTAL COOPERATION: (DFO, NRCan., and HC)

- 1) reviewed the guidance manual on assessment methods
- 2) members of PSL2 OGD Contact Group and
- 3) Environmental Resource Groups for specific substance assessments

CHEMICAL INDUSTRIES DIVISION

Programs/Projects

**Strategic Options Process (SOP) for Metal Finishing Industry
Chlor-Alkali Mercury Liquid Effluent Regulations
Chlor-Alkali Mercury Release Regulations**

Lead

**Peter Paine
John Prinsen
Fred Chen**

Type of Activity

Policy Development, Regulatory Activities and Scientific Studies. Less than 15% of the work done by the division is related to metals. The Division is responsible for the maintenance of the Chlor-Alkali Mercury Regulations under the Fisheries Act and CEPA, which are the only federal regulations relating to mercury. However, the major activity is the SOP for the Metal Finishing Industry, covering cadmium, nickel and chromium.

Budget 1995/96

Base - A	80K approx.
O&M	70K approx.

Linkages

Fisheries Act, CEPA, UNECE Heavy Metals Protocol

Interdepartmental Cooperation

Natural Resources Canada, Industry Canada, Health Canada, National Defence

AES DOWNSVIEW

CONTACT: KEITH PUCKETT

Summary Statement

The intent of the AES Program on Metals is Through research, provide Canadians with scientific information and advice on air quality issues as a basis for informed decision making. The research focus is on describing the emissions (natural), atmospheric transport and transformation of metals and their subsequent loss from the atmosphere.

1996/1997

PY's	Salary	O&M	Capital
2.5	150k	NS	460k

Title: Atmospheric Measurements of Toxic Trace Elements in the Great Lakes Basin:
Estimation of Atmospheric Loadings and Source Identification.

Lead: R.M. Hoff, Air Quality Research Branch,
Atmospheric Environment Service, Environment Canada

Type of Activity: Scientific studies in support of Annex 15 of the Great Lakes Water Quality Agreement, comprising atmospheric measurements and research, data analysis and interpretation.

Brief Statement of Work: This project represents a significant component of AES efforts within the Integrated Atmospheric Deposition Network (IADN), in support of the GLWQA Annex 15. Atmospheric particulate matter is routinely collected at three locations in the Canadian Great Lakes Basin: Point Petre (PPT) on Lake Ontario; Burnt Island (BNT) on Lake Huron; Egbert (EGB) and inland site north of Toronto. Sampling at PPT and EGB commenced in 1989, with BNT starting in 1992.

Samples are taken for a twenty-four hour period with a current frequency of one day in twelve (prior to April 1994 frequency was 1 day in six): a Sierra Anderson High Volume Sampler (Hi-Vol) with a PM-10 inlet head is used to collect the sample on a 8" x 10" rectangular Whatman 41 cellulose filter. Approximately 1100m³ of air is sampled in this manner.

After collection, the exposed filter is cut into four 8" x 2.5" strips: two of these strips are archived, while the other two strips are submitted for trace element analysis using two different instrumental techniques. One of the strips is subjected to instrumental neutron activation analysis (INAA), performed under external contract: elements currently determined by this procedure include arsenic, selenium, aluminum, bromine, calcium, chlorine, copper, iodine, manganese, titanium, vanadium, antimony, nickel, rubidium, europium, silver, gold, silicon, uranium, tungsten, potassium, samarium, chromium, cesium, cobalt, hafnium, iron, scandium, tantalum, thorium, zinc, tin and indium. The second strip is subjected to high-temperature ashing, acid digestion and subsequent analysis by inductively coupled plasma-emission spectroscopy (ICP-ES) performed under external contract: elemental data are obtained for lead, cadmium, silver, aluminum, boron, barium, beryllium, bismuth, cobalt, chromium, copper, iron, molybdenum, nickel, vanadium, zinc, manganese, tin, strontium, titanium and phosphorus. The overlap between the two techniques on several of the commonly observed elements in the atmospheric particulate matter provides useful quality information. (NOTE: Primary elemental targets for IADN are highlighted in the above list)

Budget: This project makes substantial use of the infrastructure created by AES to meet its responsibilities under Annex 15 of the GLWQA.

Actual sampling costs can be approximated by a proportion of the total requirement to maintain the operations at the IADN sites:

Site operations:	\$15K
Station support (contractors)	\$15K
Supplies and repairs	\$ 6K

Analytical costs for the 1 day in 12 sampling frequency at the three sites are:

Filter cutting, archiving and shipping	\$ 2K
INAA (Dr. S. Landsberger, U. of Illinois)	\$18.5K
ICP-ES (EPL Inc. Mississauga)	\$ 8.2K

Approximately 0.5PY of scientific/technical support (\$30K salary) is required to coordinate the above operations and provide preliminary quality control on the field and laboratory data.

For data analysis and interpretation, the estimate of resources required is essentially more open-ended and depends upon the objectives and scope of the interpretation being sought--however, it is conservatively estimated that 0.4 PY of scientific/technical support (\$24K salary) is dedicated annually to achieve full data quality control and final reporting of validated atmospheric concentration levels and statistics required for loading calculations. This estimates does not include scientific resources required to investigate data patterns and trends in terms of air mass back-trajectories or seasonal cycles; similarly, source-receptor modelling efforts are not included--both these investigations are underway at present, directed by various scientific staff at AES as separate projects.

Based on the above, the total dollar figure for this project is $\$36K + \$28.7K + \$30K + \$24K = \$118.7K$.

Linkage to Policy or Regulations: The primary purpose of the measurements is to contribute to an assessment of the atmospheric loading to the Great Lakes system for selected toxic trace elements. As such, they permit an estimate of the dry deposition contribution to the loading, which must be combined with estimates of wet deposition loading (trace elements in precipitation are determined by NWRI in a parallel project conducted at the IADN sites) and net gas phase transfer where appropriate. By means of various data analysis techniques (source-receptor modelling, air-mass back-trajectory analysis), it is also anticipated that source type, location (local or long-range transport) and contribution can also be assessed. These objectives are clearly linked to the information needs of Annex 15 of the GLWQA.

Information on the long-range transport and/or transboundary movement of metals is key to the continued development of management options under the auspices of the US/Canada Air Quality Agreement and the UNECE Protocol on Heavy Metals.

Interdepartmental Co-operation: The IADN is a joint US/Canada entity, with all US involvement being the responsibility of the EPA (GLNPO). Canadian efforts under IADN to determine atmospheric loadings for trace elements requires co-operation with Dr. W. Strachan (National Water Research Institute (NWRI), Burlington, Ontario) for measurement of wet deposition concentrations.

Publications:

Biegalski, S.R., S. Landsberger, S. and Hoff, R.M. (1996) "Source receptor modelling using trace

metals in aerosols collected at three rural Canadian Great Lakes sampling stations". J. Great Lakes Res. (submitted).

Hoff, R.M. and Brice, K.A. (1994) "Atmospheric dry deposition of PAHs and trace metals to Lake Ontario and Lake Huron". Paper 94-RA110.04 in Proceedings of 1994 Annual Meeting of the Air and Waste Management Association, AWMA, Pittsburgh, 1994.

Hoff, R.M., Strachan, W.M.J., Sweet, C.W., Chan, C.H., Shackleton, M., Bidleman, T.F., Brice, K.A., Burniston, D.A., Cussion, S., Gatz, D.F., Harlin, K. and Schroeder, W.H. (1996) "Atmospheric deposition of toxic chemicals to the Great Lakes: a review of data through 1994". Atmos. Env. (accepted for publication).

Hoff, R.M. (1994) "Environment Canada, Great Lakes Water Quality Agreement Annex 15, Integrated Atmospheric Deposition Network, 1988-1992 Trace Elements in Air and TSP/TOC Results". Atmospheric Environment Service Draft Report.

Title: Metal in the Canadian Arctic: their sources, occurrence [levels], trends and fate.

Lead: L.A. Barrie, Air Quality Research Branch
Atmospheric Environment Service, Environment Canada

Type of Activity: Policy Development\Scientific Studies

Brief Statement of Work:

Changes in air concentrations of Pb, As, Se, Sb, V, Mn, Cu and Zn [not Cd] are described by taking integrated [weekly] measurements using a Hi-Vol sampler at Alert, NWT. The sampling regime has been in place since 1980. The Hi-vol filters are analysed by INAA/ICP ESMS. The data are interpreted using time series statistical analyses, air mass back trajectories, multivariate statistical techniques such as PFA and Lagrangian transport and budget models.

All the data from this project are archived in the AMAP directory.

Budget 1995/96:

PY	0.2
O & M	\$25K
Capital	0

Key Contractors: Hancock, University of Toronto SLOWPOKE Facility
Landsberger, University of Illinois

Linkages to Policy or Regulation: The intended purpose of the measurements is to assess the significance of the role of the atmosphere in delivering metals to the Arctic. Information on the long range transport and/or transboundary movement of metals is key to the continued development of policy options in the context of the Circumpolar Nation Arctic Environment Protection Strategy and the UN ECE Protocol on Heavy Metals.

Interdepartmental Co-operation: There are no formal links between this activity and activities in the Departments of Agriculture, Fisheries and Oceans and NRCan. However, the information is being used as part of the DLAND Northern Contaminants Assessment which involves collaborative interpretive efforts by researchers in Environment, Fisheries and Oceans and Health Canada.

Publications:

Barrie, L.A. and R.M. Hoff (1985). Five years of air chemistry observations in the Canadian Arctic. Atmospheric Environment 19: 1995-2010

Sturges, W.T. and L.A. Barrie (1989) Stable lead isotope ratios in Arctic aerosols: Evidence for the origin of Arctic Air pollution. Atmospheric Environment 23: 2513-2519

Barrie, L.A. and M.J. Barrie (1990). Chemical components of lower troposphere aerosols in the High Arctic: Six years of observations. *Journal of Atmospheric Chemistry* 11: 211-226

Sirois, A. and L.A. Barrie (1996). Arctic lower tropospheric aerosol trends and composition at Alert, Canada, 1980-1993. [In preparation].

Title: Mercury in the atmosphere

Lead: W.H. Schroeder, Air Quality Research Branch,
Atmospheric Environment Service, Environment Canada

Type of Activity: Policy Development/Scientific Studies (Air quality research, atmospheric processes, air-surface exchange).

Brief Statement of Work:

An automated instrumental technique is being used to describe gas-phase mercury levels in the atmosphere at locations in Eastern and Northern Canada. Currently, characterisation of levels in the Arctic is in progress. Measurements are also being made in collaboration with Environment Canada regions [Ontario, Quebec and Atlantic] to describe levels over the Great Lakes, the Gulf of St. Lawrence and the Atlantic region. Improved methods for the collection and subsequent chemical analysis of different forms of mercury in the atmosphere are being developed.

Budget 1995/96:

FTC	1 P.Y. (SE-RESH)
PDF	1 (as of January 1996)
Co-op Students	1 (Winter 1996 Work term)
O & M	\$ 94K
Capital	\$110K

Key Contractors: Tekran Inc. [instrument developers]

Linkages to Policy or Regulation: Mercury, lead and cadmium are the metals chosen for the first phase of the ECE Protocol on Heavy Metals. Mercury is one of the 7 priority substances singled out for further consideration by Annex 15 of the Great Lakes Water Quality Agreement. Mercury is a priority pollutant in the Arctic Monitoring and Assessment Program (AMAP).

Interdepartmental Co-operation: There are no formal links between this activity and activities in the Departments of Agriculture, Fisheries and Oceans and NRCan. However, the information is being used as part of the DIAND Northern Contaminants Assessment which involves collaborative interpretive efforts by researchers in Environment, Fisheries and Oceans and Health Canada.

Publications:

Schroeder, W.H. (1994). "Atmospheric Mercury Measurements at a Rural Site in Southern Ontario, Canada". In: Mercury Pollution: Integration and Synthesis. Watras, C.J. and Huckabee, J.W. (Eds.), Lewis Publishers, Boca Raton, FL. pp. 281-291.

Expert Panel on Mercury Atmospheric Processes (1994). "Mercury Atmospheric Processes: A Synthesis Report". Electric Power Research Institute, Palo Alto, CA. Report No. TR-104214. 23 + vii pp.

Schroeder, W.H., Keeler, G., Kock, H., Roussel, P., Schneeberger, D. and Schaedlich, F. (1995). "International Field Intercomparison of Atmospheric Mercury Measurement Methods". Water, Air, Soil Pollut. 80: 611-620

Schroeder, W.H., Ebinghaus, R., Shoeib, M., Timoschenko, K. and Barrie, L.A. (1995). "Atmospheric Mercury Measurements in the Northern Hemisphere from 56° to 82.5°N Latitude". Water, Air, Soil Pollut. 80: 1227-1236

Title: Chemistry of High Elevation Fog (CHEF) Project

Lead: R.S. Schemenauer, Meteorological Research Branch,
Atmospheric Environment Service, Environment Canada

Dr. Z.Q. Lin
Department of Renewable Resources, McGill University
Ste. Anne-de-Bellevue, Quebec

Type of Activity: Scientific Study, research, monitoring, trends

Brief Statement of Work: The CHEF project began in 1985. Its goals were to measure fog and precipitation chemistry at mountain sites in southern Quebec and to make chemical and meteorological data bases available to the effects community. Current activities are limited to continuous ozone measurement at two sites (850m elev.) and modelling of deposition rates to the high elevation forests. Filters used in the ozone sampling component of the CHEF project were analyzed for metals. The results complement the extensive fog and precipitation data base.

Budget 1995/96: Nil

Key Contractors: N/A

Linkages to Policy or Regulation:

Interdepartmental Co-operation: There are no formal links between this activity and activities in the Department of Agriculture, Fisheries and Oceans and NRCan. Co-operation is with the Department of Renewable Resources of McGill University and the Energy Engineering Institute of the Ecole Polytechnique in Montreal.

Publications:

Lin, Z.Q., P.H. Schuepp, R.S. Schemenauer and G.G. Kennedy. (1995). Trace Metal Contamination in and on Balsam Fir (*Abies Balsamea* (L) Mill.) foliage in Southern Quebec, Canada. *Water, Air and Soil Pollution* 81: 175-191

Lin, Z.Q., R.S. Schemenauer, P.H. Schuepp, N.N. Barthakur and G.G. Kennedy (1996). Airborne metal pollutants in high elevation forests of southern Quebec, Canada and their likely source regions. Submitted to *Journal of Agriculture and Forest-Meteorology*.

Title: Metal levels aloft in Ontario and the Atlantic Provinces

Lead: C. Banic, Meteorological Research Branch,
Atmospheric Environment Service, Environment Canada

Type of Activity: Scientific Studies

Brief Statement of Work:

In March and April of 1990, cloud water, precipitation and aerosol were sampled in Central Ontario as part of the Eulerian Model Evaluation Field Study for analysis for As, Ba, Cd, Cu, Fe, Mn, Pb, Se, Al, I, Sc and Zn.

In August-September, 1993 and 1995 cloud water and aerosols aloft were sampled in New Brunswick and Nova Scotia for analysis for As, Ba, Cd, Cu, Fe, Mn, Mo, Ni, Pb, Se, Tl, and Zn. The 1995 cloud water and aerosol samples were also analysed for Hg, and the concentration of Hg in the gas phase was determined at altitudes up to 5 km.

The sampling for most species was done both in background conditions and in pollutant plumes carried off the coast of North America.

This research provides:

- 1) Estimates of deposition of these species to the Gulf of Maine and Bay of Fundy;
- 2) Information on the vertical distribution of metals;
- 3) Estimates of flux of metals off the coast of North America

Key Contractors:

Linkages to Policy or Regulation:

Interdepartmental Co-operation:

There are no formal links between this activity and activities in the Departments of Agriculture, Fisheries and Oceans and NRCan.

Publications:

Banic, C.M., W.R. Lasitch, G.A. Isaac and J.W. Strapp, Scavenging of trace metals by cloud and precipitation, in Precipitation Scavenging and Atmosphere-Surface Exchange, Vol. I, S.E. Schwartz and W.G.N. Slinn (coordinators), Hemisphere Publishing Corp., pp. 421-431, 1992.

Wong, H.K.T., C.M. Banic and W.M.J. Strachan, Trace metals in cloud water and precipitation, Proceedings of the 9th International Conference on Heavy Metals in the Environment, Vol. I, pp. 273-277, 1993.

Banic, C.M. and H.K.T. Wong, Transport of Trace Metals to the North Atlantic Atmosphere
During NARE, to be submitted to J. Geophys. Res. June, 1996.

Title: Metal levels in Canada and their contribution to visibility degradation.

Lead: R.M. Hoff, Air Quality Research Branch,
Atmospheric Environment Service, Environment Canada

Type of Activity: Policy development/Scientific Studies

Brief Statement of Work: Atmospheric particulates are collected at three locations (In British Columbia, Ontario and New Brunswick) and analyzed for their metal content. Integrated, size fractionated [$<2.5 \mu\text{m}$], air samples [24 hrs.] are taken every three days and the resulting particulate loading is analyzed for 31 metals by PIXE. Changes in visibility at the sampling location are then considered in terms of the varying metal levels as well as the other components of the sampled aerosol. These data are used to predict both total fine particle aerosol mass and the reduction in visibility from these aerosols. This prediction is compared to ambient visibility measurements made by nephelometry and is used to refine the visibility-aerosol linkages.

Budget:

Field operations [changing filters etc.] 0.1 PY
Chemical analyses [14K]. Sponsored by the AES Research Subvention Program
Data analysis/interpretation 0.2 PY

Key Contractors: Campbell, University of Guelph

Linkages to Policy or Regulation

Under the auspices of the US/Canada Air Quality Agreement, Canada is committed to the development of a policy for the Prevention of Significant Deterioration and Visibility Degradation. The factors which influence visibility across Canada are not well described and especially the role of changing air quality. The information will be used to assess the relative contributions of natural and anthropogenic sources to the different visibility regimes across Canada.

Interdepartmental Co-operation:

There are no formal links between this activity and activities in the Departments of Agriculture NRCan and Fisheries and Oceans. Nevertheless, this work is carried out in conjunction with the Provinces of British Columbia and New Brunswick.

Publications:

Pryor, S.C., R.J. Barthelmie, R.M. Hoff, S. Sakiyama, R. Simpson and D.G. Steyn,
REVEAL: "Characterizing fine aerosols in the Fraser Valley", Atmospheric Environment
(submitted)

Nejedly, Z., J.L. Campbell, W.J. Teesdale, J.R. Brook, H.A. Wiebe, R.M. Hoff, J. F. Dlouhy, and T.F. Dann, " Comparison of multi-elemental analyses of aerosol samples by PIXE, EDXRF, and IC.", Nuclear Instruments and Methods in Physics Research B, 103, 473-476, 1995.

R.M. Hoff, L. Guise-Bagley, K.J. Puckett, K. Macdonald, "Considerations in the Assessment of Canadian National Visibility", Proceedings of AGU/AWMA Radiation in the Atmosphere Specialty Conference, Snowbird, Utah., Sept. 26-30, 1994, 109-112.

Title: Toxicity of metals within airborne particulate matter

Lead: J. Brook, Air Quality Research Branch
Atmospheric Environment Service, Environment Canada

Renaud Vincent, Environmental and Occupational Toxicology Division
Bureau of Chemical Hazards, Health Canada

Type of Activity: Policy development/Scientific Studies

Brief Statement of Work: Aerosol samples are collected from urban and rural locations across Canada. They are analyzed for their metal content (ICP, NAA) and extent of water solubility (measure of bioavailability). Acute toxicity of the samples are evaluated using *in vitro* methods. Relative toxicity of the samples are compared to their metal concentrations and other chemical constituents.

Budget 1995/96:

FTC	0.6
Salary	\$50K (Contract/Student/Fellows)
O & M	\$50K
Capital	0
Total	\$100K (95/96)
Total	\$200K (94/95)

Key Contractors: Bovar Environmental (94/95)
Prof. D. Nadeau, Laval (94/95)

Linkages to Policy or Regulation: Linkages between aerosol (metal) levels and their health impacts are being evaluated as part of efforts to define National Ambient Air Quality Guidelines.

Interdepartmental Co-operation: There are no formal links between this activity and activities in the Departments of Agriculture, Fisheries and Oceans and NRCan. However, there is considerable collaboration with Health Canada.

Publications:

Biran R., Tang Y-Z., Brook J.R., Vincent R. and Keeler G.J., (1996): Aqueous extraction of airborne particulate matter collected on hi-vol filters. *Int. J. of Envir. Anal. Chem.*, (in press).

Nadeau D., Vincent R., Brook J.R., and Dufresne A., (1996): Cytotoxicity of ambient air particulates to rat lung macrophages: comparison of cellular and functional assays. *Toxicology in Vitro*, (in press).

ATLANTIC REGION

CONTACT: NEIL BURGESS

SUMMARY STATEMENT FOR ATLANTIC REGION

The CWS (Wildlife) component is included in the summary provided earlier by CWS Headquarters. It includes Hg in loons and seabird eggs.

Resources: Sal. \$53K O+M \$71K

The Atmospheric Environment Branch conducts studies on the spatial and temporal trends of Hg in the atmosphere and in precipitation.

Resources: Sal. \$44K O+M \$53K

The Environmental Conservation Branch is studying Hg in lake waters and sediments and the role of DOM and coordinatuing the various inputs to an assessment of Hg sources and impacts on freshwaters.

Resources: Sal. \$117.5 O+M \$30K Cap \$15K

Grand Total Resources: Sal. \$214.5 O+M \$154K Cap \$15

PROJECT SHEET FORMAT
METALS IN THE ENVIRONMENT
Environment Canada - Atlantic Region

PROJECT TITLE: Impacts of Mercury Exposure on Common Loons Breeding in the Maritimes

LEAD: Neil Burgess, Canadian Wildlife Service/Environmental Conservation Branch,
Environment Canada, Sackville, New Brunswick

TYPE OF ACTIVITY: Scientific studies to determine the importance of mercury exposure and acidification in affecting the breeding behaviour and impairing the health and reproductive success of Common Loons breeding in Maritime Canada.

BRIEF STATEMENT OF WORK:

- 1) Field work, funded by CWS, and conducted by Atlantic Coop Wildlife Ecology Research Network (ACWERN) students and a CWS technician will focus on monitoring reproductive success and observing crucial breeding behaviours of loons in Kejimikujik Park, NS and Lepreau, NB. Additional surveys of territorial loons will be conducted by helicopter in May by CWS.
- 2) A cooperative team, again funded by CWS, will join the project in early August to capture and band breeding loons and young, and to collect blood and feather samples for heavy metal and stable isotope analyses. American experts in loon capture (Evers & Kaplan) will be contracted again to assist. Collaboration with Tufts University School of Veterinary Medicine will be continued, examining clinical health and immune function parameters in loon blood.
- 3) Water samples will be collected for lake chemistry analysis by ECB collaborators. Cooperators from Parks Canada have joined to collect fish samples for mercury and stable isotope analysis from the study lakes in Kejimikujik National Park;
- 4) Cooperators will continue to be encouraged to salvage Common Loon carcasses and abandoned eggs wherever possible in the Maritimes. A network has been established to forward the carcasses to the Atlantic Veterinary College (AVC) and the eggs to CWS. The carcasses will be necropsied at AVC and tissue samples forwarded to CWS for contaminants analysis.

BUDGET 1995/96

Source	FTEs	Salary	O&M	Capital	TOTAL
A-Base	0.50	24 K	67 K	0	91K
B-Base	0.25	14K			14 K

TOTAL					105 K
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LINKAGES TO POLICY OR REGULATION: This study will determine the extent of ecological impacts of elevated mercury exposure on breeding loons. The results will be integrated with those from studies of mercury uptake by fish in the same lakes, and associations between lake chemistry and mercury levels in biota. These studies will support Canada in international negotiations on heavy metals, the development of international agreements under the UN ECE, OECD and NAFTA, and the development of a national strategy to reduce anthropogenic mercury in the environment (under CEPA?).

INTERDEPARTMENTAL COOPERATION:

Cliff Drysdale, Peter Hope, Robert Nicolas, Parks Canada, Kejimikujik NP, CanH
 Andre d'Entremont, Gary Corbett, Parks Canada, Halifax, CanH
 Philip Taylor, Joe Nocera, Jessica Scott, ACWERN-Acadia University
 Tony Diamond, Glenn Tikkanen, Nikki Benjamin, ACWERN-UNB
 David Evers and Joe Kaplan, BioDiversity Inc. (contractors)
 Pierre-Yves Daoust, CCWHC Atlantic Veterinary College, UPEI
 Harry Vogel, Canadian Lakes Loon Survey, Bird Studies Canada
 Tufts University School of Vet. Medicine, Mass.

PROJECT SHEET FORMAT
METALS IN THE ENVIRONMENT
Environment Canada - Atlantic Region

PROJECT TITLE: Assessment of Temporal Trends of Mercury in Seabird Eggs from Atlantic Canada, 1968-96

LEAD: Neil Burgess, Canadian Wildlife Service/Environmental Conservation Branch, Environment Canada, Sackville, New Brunswick

TYPE OF ACTIVITY: Scientific studies to determine the levels of mercury in the eggs of four species of seabirds on the Atlantic coast, and trends in those levels over the last three decades.

BRIEF STATEMENT OF WORK:

Eggs from four species of seabirds have been collected every four years since 1968 or 1972 from several areas in the Atlantic Region. Different species are monitored to provide information on contaminants in different trophic compartments of the marine environment: Double-crested Cormorant, an inshore-subsurface feeder; Leach's storm-petrel, an offshore-surface feeder; Atlantic Puffin, an offshore-subsurface feeder; and Herring Gull, an inshore omnivore. Eggs have been collected from colonies in three study areas: the outer Bay of Fundy, the east coast of Newfoundland and the St. Lawrence River estuary. The eggs were analysed for total mercury from 1972 to 1980, but not since. We will analyse total mercury in the eggs collected in 1992 and 1996. If the results warrant, archived samples from 1984 and 1988 will also be analysed. Once again, Quebec Region staff will collect the eggs from the St. Lawrence River colonies, to reduce overall field expenses.

BUDGET 1995/96

Source	FTEs	Salary	O&M	Capital	TOTAL
A-Base	0.30	15 K	4 K	0	19 K
B-Base					
TOTAL					19 K

LINKAGES TO POLICY OR REGULATION: This study will determine the trends in mercury levels in marine biota over the last three decades. The results will be integrated with those from studies of mercury uptake by fish in the same lakes, and associations between lake chemistry and mercury levels in biota. These studies will support Canada in international negotiations on heavy metals, the development of international agreements under the UN ECE, OECD and NAFTA, and the development of a national strategy to reduce anthropogenic mercury in the environment (under CEPA?).

INTERDEPARTMENTAL COOPERATION:

None so far

New Brunswick Museum

Memorial University of Newfoundland

DFO-Maritimes has been repeatedly approached to collaborate in this project. Little interest has been expressed by them thus far.

PROJECT SHEET FORMAT
METALS IN THE ENVIRONMENT
Environment Canada - Atlantic Region

PROJECT TITLE: Atmospheric Mercury in the Atlantic Region

LEAD: Robert Tordon & Stephen Beauchamp, Atmospheric Environment Branch,
Environment Canada, Bedford, Nova Scotia

TYPE OF ACTIVITY: Scientific studies to determine spatial and temporal trends in atmospheric mercury, atmospheric transport patterns, phase partitioning, deposition and eventually the exchange (flux) of atmospheric mercury with terrestrial, marine and freshwater ecosystems in the region.

BRIEF STATEMENT OF WORK: Research into atmospheric mercury in the Atlantic region began in 95/96 with the acquisition and deployment of vapour phase Hg analyzers at two regional EMAN sites, Kejimikujik NS and St. Andrews NB. In the summer of '95 AEB and ARMP cooperated in the measurement of vertical and horizontal vapour phase Hg concentration profiles during RACE. In 95/96, AEB developed linkages through EMAN with the US Mercury Deposition Network (MDN). This collaboration resulted in the acquisition and modification of 2 collectors designed for collection of Hg in precipitation. In 96/97, these collectors were installed at the above noted EMAN sites to contribute to the overall assessment of atmospheric Hg deposition in North America as part of the Canada/Gulf of Maine/US Mercury Deposition Network (MDN) under the auspices of the US National Acid Deposition Program (NADP) and EMAN. We will complete the data analysis of the vertical and horizontal distribution and phase partitioning of atmospheric mercury observed during RACE to determine regional scale fluxes and atmospheric transport patterns over short time scales. We will begin to analyze spatial and temporal patterns in Hg, source regions and examine local vs long range (transboundary) transport. A literature review will be conducted related to flux chamber design and construction, atmospheric Hg speciation, phase partitioning and particulate mercury.

BUDGET 1995/96

Source	FTEs	Salary	O&M	Capital	TOTAL
A-Base	0.80		53 K	0	
B-Base					
TOTAL					

LINKAGES TO POLICY OR REGULATION: These studies will support Canada in

international negotiations on heavy metals, the development of international agreements under the UN ECE, OECD and NAFTA, and the development of a national strategy to reduce anthropogenic mercury in the environment (under CEPA?).

INTERDEPARTMENTAL COOPERATION:

W. Schroeder (ARQP)

W. Pilgrim (NBDOE)

PROJECT SHEET
METALS IN THE ENVIRONMENT
Environment Canada - Atlantic Region

PROJECT TITLE: Mercury contamination in Atlantic Canada lake waters, dissolved organic carbon and sediments

LEAD: Tom Clair, Scientist, Environmental Conservation Br.- Atlantic Region, P.O. Box 1590, Sackville, N.B. E0A 3C0 (506) 364-5070, FAX 364-5062, Teamlinks Clairt@am@cpdar

Other Team members: Daniel Leger, O. Vaidya, G.L. Brun, Environmental Conservation Br.- Atlantic Region, Moncton, N.B.; N. Burgess, Environmental Conservation Br.- Atlantic Region, Sackville, N.B.

TYPE OF ACTIVITY: Scientific studies to assess the extent and relative distribution of aquatic mercury contamination in freshwater ecosystems in the Region

BRIEF WORK STATEMENT: Mercury levels in loon blood are higher in the Kejimikujik National Park region than anywhere else in North America, even though this region does not receive the highest Hg loads in the country. Hg is either deposited by atmospheric processes or transported from soils and bedrock eventually reaches lakes where it is subject to a number of chemical reactions. First ionic Hg is probably complexed to dissolved organic matter (DOM). DOM contains a large number of anion sites which will complex free metals thus tying them up. The DOM is either precipitated to lake sediments where it is converted by microbes, or broken down to CO₂ and a Hg ion by pelagic bacteria or is exported out of the lakes by streams.

Lakes located in the Kejimikujik National Park area are probably especially likely to have high levels of Hg because they have very high levels of DOM which should scavenge Hg from surrounding waters and soils. In order to see if DOM is a major influence on Hg accumulation in our lakes, we are studying Hg's abiotic environmental pathways by analyzing total dissolved as well as Hg complexed to DOM at all lakes being sampled for fish and loons. These are located on a range of geological and DOM values which should allow us to assess the relative importance of these two key variables. Time and resources permitting, we will also conduct a regional survey of lakes in this region and possibly in southwestern New Brunswick to determine the extent of the Hg complexation in Atlantic Canada lakes.

Note: Funds are currently lacking for sample analysis, though collections are being done.

BUDGET 1995/96 (\$K)

Source	FTE's	Salary	O&M	Capital	Total
A-Base	1.5		5		5
B-Base			10	15	25
Total			15	15	30

Deliverables: a) Hg sample results water, sediment, DOM samples by Jan 1, 1997
b) Interpretive report describing and explaining potential Hg pathways in brown water ecosystems as opposed to clear waters, by March 31, 1997.

INTERDEPARTMENTAL COOPERATION:

Parks Canada, CanH

PROJECT SHEET FORMAT
METALS IN THE ENVIRONMENT
Environment Canada - Atlantic Region

PROJECT TITLE: Assessment of Sources and Impacts of Mercury in Freshwater Ecosystems in Atlantic Region

LEAD: Daniel Leger & Neil Burgess, Environmental Conservation Branch,
Environment Canada, Moncton & Sackville, New Brunswick

TYPE OF ACTIVITY: Scientific studies to integrate and assess research results from collaborators, in order to assess for the Atlantic Region: 1) the extent of adverse ecological impacts caused by mercury contamination in freshwater ecosystems in the Region; 2) the relative importance of potential natural and anthropogenic sources of mercury contamination; 3) the local environmental factors influencing the severity of ecological impacts, and 4) the temporal and spatial trends in mercury contamination.

BRIEF STATEMENT OF WORK: Coordination and integration of mercury-related research by EC researchers, OGDs and universities in the Maritimes will be accomplished through hosting planning meetings in spring 96. Existing multimedia mercury data will be gathered, compiled in a common database and shared between collaborators. Existing computer models of the aquatic fate and biological uptake of mercury will be acquired and tested, using mercury data from summer 96 sampling of water, fish and wildlife. Comparative data and assessments will be evaluated from neighbouring New England states, Quebec, Ontario and elsewhere. A preliminary assessment will be made of mercury sources, trends, aquatic transport and fate, and ecological impacts. This draft assessment will provide the basis for input from collaborators and outside experts. A workshop will be held to bring collaborators together, as the assessment process advances.

BUDGET 1995/96

Source	FTEs	Salary	O&M	Capital	TOTAL
A-Base	0.7	35 K	20 K	0	55 K
B-Base			[50 K] unfunded		
TOTAL					55 K

LINKAGES TO POLICY OR REGULATION: The outcomes of this multi-year effort are preliminary assessments for the Atlantic Region of: 1) the relative importance of anthropogenic mercury sources; 2) the temporal and spatial trends in mercury contamination;

3) the physical and biological factors influencing the aquatic fate and biological uptake of mercury; and 4) the extent of ecological impacts of mercury contamination. These studies will support Canada in international negotiations on heavy metals, the development of international agreements under the UN ECE, OECD and NAFTA, and the development of a national strategy to reduce anthropogenic mercury in the environment (under CEPA?).

INTERDEPARTMENTAL COOPERATION:

Kejimikujik National Park, Parks Canada, CH

Andrew Rencz, Geological Survey of Canada, NRCan

NS & NB Depts. of Natural Resources and Environment

Allen Curry, Coop Fish & Wildlife Research Unit, University of New Brunswick

Cindy Staicer, Dalhousie University

Terry Haines, US National Biological Service

Barry Mower, Maine Dept. of Environmental Protection

Donald Porcella, Electric Power Research Institute

Further cooperation with NRCan, especially with the GSC in Atlantic Region, is needed.

QUEBEC REGION

CONTACT: JOHN AYRÈS

INVENTORY OF HEAVY METALS ACTIVITIES

QUEBEC REGION SUMMARY 1996 - 1997

Project	Budget 1996-97 Salary	Budget 1996-97 O&M	Budget 1996-97 F&E	Budget 1996-97 Total	P/A	Resource Person
SLV 2000, Volet Protection 1994-98	135K	-	800K	935K	2.0	Gilles Legault Tel: (514) 283-3452
Impact of the Sorel- Tracy Industrial Zone on HMs and PAHs	10K	-	-	10K	0.1	Andre Germain/ Stefan Grenon. Tel: (514) 283-0191/ 283-7303
Survey and Monitoring of Metals in Wildlife in Quebec	65K	75K	-	140K	1.1	Jean Rodrigue Tel: (418) 648 - 5016
Effects of Mine Tailings on Wildlife.	11K	20K	-	31K	0.2	Louise Champoux Tel: (418) 648-4657
Mercury Contaminati on in fish	5K	5K	-	10K	0.1	Louise Champoux Tel: (418) 648-4657
TOTAL	226K	100K	800K	1126K	3.5	

TITRE DU PROJET:

Saint-Laurent Vision 2000. Volet Protection (1994-1998)

RESPONSABLE:

Ministère de l'Environnement et de la Faune du Québec et Environnement
Canada

TYPE D'ACTIVITÉS:

Réduction des rejets liquides toxiques et élimination virtuelle des rejets de substances toxiques persistantes de 106 établissements industriels prioritaires du Québec

ÉTAT D'AVANCEMENT DES TRAVAUX:

50 des 106 industries visées ont fait l'objet du Plan d'action Saint-Laurent (1988-1994) et ont été évaluées. Des systèmes d'assainissement ont été implantés pour rencontrer les objectifs fixés, à savoir de réduire de 90 % les rejets toxiques dans le fleuve Saint-Laurent. En date de 1995, La réduction obtenue est de 95 %. Les 56 autres industries qui ont été ajoutées au programme en 1994, sont entrain d'évaluer leurs rejets liquides. Des mesures seront prises pour rencontrer les objectifs du programme.

BUDGET 1996-1997:

- Salaire: (Base A) 135 K\$ (2 P/A)
- F&E: 800 K\$
- Contribution au MEF: 750 K\$ (15 P/A)

LIENS AVEC LA POLITIQUE OU RÉGLEMENTATION::

- Politique de gestion des substances toxiques
- Loi des pêcheries
- Loi de la Protection et de la Conservation de l'Environnement (LPCE)
- Loi sur la qualité de l'Environnement du Québec (LQE)
- Programme d'assainissement des eaux du Québec (PAE)
- Règlements fédéraux et provinciaux sur les pâtes et papiers
- Programme de réduction des rejets industriels du Québec (PRRI)
- Règlement sur les attestations d'assainissement en milieu industriel du Québec
- Etc.

COOPÉRATION INTERGOUVERNEMENTALE

Ce programme est une entente fédérale-provinciale qui implique la participation des deux niveaux de gouvernements et en particulier pour le volet protection, le Ministère de l'Environnement et de la Faune du Québec et Environnement Canada. Les industries et leur association sont aussi impliquées au programme sur une base volontaire.

Préparé par: Gilles Legault, ing.
Le 15 avril 1996

PROJECT TITLE: Survey and Monitoring of Metals in Wildlife in Quebec

LEAD: Jean Rodrigue, Canadian Wildlife Service, Environmental Conservation Branch, Environment Canada - Quebec Region, Sainte-Foy, Quebec.

TELEPHONE: 418 648 5016

TYPE OF WORK: Scientific studies to determine trends in levels and effects of metals in wildlife and, where necessary, elucidate sources and needs for further control of releases.

BRIEF STATEMENT OF WORK : Selenium in the kidneys three species of Scoters collected from the Bay of Many Islands and Laforce Regions of N. Quebec, and from the Saguenay and Kamouraska estuaries will be measured in order to determine whether these elements may be factors in the observed population declines of these birds. Mercury will be measured in those samples with high Se levels.

As part of a long term study to identify appropriate wildlife indicators of contamination of terrestrial and aquatic ecosystems outside the St. Lawrence River and its major tributaries the levels of mercury including organic mercury, lead, cadmium, selenium, and arsenic will be determined in various tissues (e.g., feathers, fur) from a variety of birds, mammals and reptiles that have been collected on an opportunistic (e.g., by animal rehabilitation centres) and/ or a systematic basis (e.g. trappers). Mercury levels in skins of museum specimens of Great horned and Great owls and N. Goshawk collected from 1930 to 1995 will also be measured. The birds to be collected are mainly predators: Bald and Golden Eagles, Great horned and Barred owls, Red-shouldered and Cooper's Hawks, Turkey and black vultures, N. Goshawk, and Peregrine Falcon. Mercury levels in skins of museum specimens of Great horned and Great owls and N. Goshawk collected from 1930 to 1995 will also be measured. Mammals to be analysed include mink, otter, martin and fox. The two reptiles collected are the Eastern Spiny soft-shell and the Common map turtle.

Levels of organic mercury, selenium and arsenic will be measured in the two wildlife indicator species, the Great Blue Heron and the mudpuppy, as part of a proposed long term program for surveillance of contamination and health of the Saint Lawrence River and its major tributaries. Every four years Heron eggs, 5-day chicks, and adult blood and feathers will be collected from four fluvial stations starting in 1996 and estuarine stations in 1997. Mudpuppies will be collected for Hg, Pb, Cd, As, and Se analysis from four sites starting in 1997.

BUDGET(1996-97)

	Salary	O&M	Capital	Total	No. of Indeterminates
A-Base	\$65,000	\$75,000	0	\$140,000	1.1

LINKAGES TO POLICY

Results are to be used to assess the effectiveness of the clean-up of the St. Lawrence River and to influence policy concerning needs for further controls on metal releases and uses, primarily under MBCA, CEPA and provincial legislation. Result support OECD Lead and Mercury risk reductions, UNECE LRTAP Protocol development, Can-US transboundary air and other international initiatives.

INTERDEPARTMENTAL COOPERATION: Surveillance of the St. Lawrence is in cooperation with DFO and OGDs and their provincial counterparts..

TITLE: Effects of mine tailings on wildlife

LEAD: Louise Champoux, Service Canadian de la Faune, Environment
Canada-Quebec Region , Ste. Foy , PQ.

TELEPHONE: 1 418 648 4657

TYPE OF ACTIVITY: Scientific studies to determine the levels and effects of metals from mine tailings wildlife and, where warranted , elucidate sources and needs for controls of releases.

BRIEF STATEMENT OF WORK:

A inventory of wildlife and collection of indicator species will be undertaken in order to evaluate the biodiversity, the abundance , contamination and health of wildlife in the area of mine tailing deposits at Aldermac. Copper, silver and gold mine tailings have been deposited there. Duplicate sampling sites have been established at various distances from the tailings and mice, voles, shrews, and frogs have been collected. Samples will be analyzed for lead, cadmium, copper, zinc, arsenic and phorphyrins. Collections may be repeated this summer pending findings of previous year.

BUDGET(1996-97)

	Salary	O&M	G&C	Capital	Total	No
of						
Indeterm.						
A-Base	\$11,000	\$20,000	\$31,000	0	\$62,000	
0.2						

LINKAGES TO POLICY

Results are to be used to assess needs for further controls on metal releases and uses, primarily under MBCA , CEPA and provincial legislation.

INTERDEPARTMENTAL COOPERATION: None to date; provincial Ministries of Environment and Resources are collaborating. Partnerships with other federal Departments welcome.

TITLE: Mercury contamination in fish-eating birds in the Lower St. Lawrence Region

LEAD: Louise Champoux, Service Canadian de la Faune, Ste. Foy, Environment Canada-Quebec Region, Ste. Foy, PQ.

TELEPHONE: 1 418 648 4657

TYPE OF ACTIVITY: Scientific studies to determine the levels and effects of metals in wildlife and, where warranted, elucidate sources and needs for controls of releases.

BRIEF STATEMENT OF WORK: The levels, extent and toxicological significance of mercury contamination of loons, mergansers and other fish-eating birds in rivers and lakes in the Lower St. Lawrence Region, from Levis to Matane, south to the border with USA will be ascertained. An inventory of lakes where these birds are known to be nesting will be compiled based on evaluations of available lake and bird inventories. Territorial occupation and nesting will be confirmed by site visits. Nesting females will be banded and feather and blood samples as well as carcasses and unhatched eggs will be taken for mercury analyses.

BUDGET(1996-97)

	Salary	O&M	Capital	Total	No of
Indeterm.					
A-Base	\$5,000	\$5,000	0	\$10,000	
0.1					

LINKAGES TO POLICY

Results are to be used to assess needs for further controls on metal releases and uses, primarily under MBCA, CEPA and provincial legislation. Result support OECD Mercury risk reductions, UNECE LRTAP Protocol development, Can-US transboundary air and other international initiatives.

INTERDEPARTMENTAL COOPERATION: None to date. Partner ships with other Departments welcome.

ONTARIO REGION

CONTACT: RON SHIMIZU

SUMMARY FOR ONTARIO REGION

The Environmental Conservation Branch monitors metals in water samples at the St. Lawrence outlet from Lake Ontario; in precipitation on the Canadian shore of the Great Lakes; and in water and suspended sediments at the head and mouth of the St. Clair and Niagara Rivers. The CWS aspects of the work are summarised under the CWS Headquarters summary and include metal levels in vertebrates in the Great Lakes Basin.

Resources: Sal. \$10K (CWS only) O+M \$94.8K

The Environmental Protection branch does monitoring to enforce the MMLERs; assesses sources of Hg in Ontario; samples stack emissions at lead smelters; develops pollution prevention plans for industries using metals to manufacture products; and plans to decommission chlor-alkali plants.

Resources: Sal. \$50K O+M \$464K

The Atmospheric Environmental Service Ontario region samples gaseous Hg at the two Canadian IADN Master Stations in the Great Lakes Basin.

Resources: O+M \$3 Cap \$47.1

Total Resources: (not accurate) Sal. \$60K O+M \$561K Cap \$47.1

ENVIRONMENT CANADA

PROJECT TITLE:

St. Lawrence River (Wolfe Island) Water Quality Evaluation

LEAD:

John Merriman, Ecosystem Health Division, Environmental Conservation Branch,
Ontario Region, Environment Canada, PO Box 5050, Burlington, Ontario, L7R 4A6.

TYPE OF ACTIVITY:

Ongoing project to monitor changing water quality and trends with time at outlet of Lake Ontario.

BRIEF STATEMENT OF WORK:

Water samples are collected weekly for Ag, Al, Ba, Be, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sr, V, and Zn. As, Se, Sb and Hg are collected in water on a monthly basis. Suspended solids samples are analysed, on a monthly basis if sufficient quantity is collected, for Al, As, Cd, Co, Cr, Cu, Fe, Hg, Pb, Mn, Ni, and Zn. Exit loads from Lake Ontario are estimated and trends over time are evaluated.

BUDGET 1995/96:

\$13.0K O&M

LINKAGES TO POLICY OR REGULATION:

GLWQA, Lake Ontario LAMP, CEPA

INTERDEPARTMENTAL COOPERATION:

DFO, OMEE (Ontario), USEPA, NYDEC

Environment Canada

PROJECT TITLE: Great Lakes Precipitation Network

LEAD :

C.H.Chan, Ecosystem Health Division,
Ontario Region, Environment Canada, PO Box 5050, Burlington, Ontario,
L7R 4A6

TYPE OF ACTIVITY :

Ongoing project to measure ambient chemical composition of Great Lakes Precipitation

BRIEF STATEMENT OF WORK:

Atmospheric precipitation samples are collected monthly at nine stations along the Canadian shore of the Great Lakes. Samples are analyzed for Al, Be, Ba, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sr, V, Zn, Hg, Ag, Sb, As and Se. Results are used for atmospheric loading estimates and trend evaluation,

BUDGET 1995/96:

Analysis costs \$3.6K

O&M: \$10K

LINKAGES TO POLICY OR REGULATION:

GLWQA, SOE, EEM, LAMP, and US Clean Air Act

INTERDEPARTMENTAL COOPERATION:

DFO, OMEE (Ontario), USEPA

Environment Canada

PROJECT TITLE: St Clair River Water Quality Monitoring

LEAD:

C.H.Chan, Ecosystem Health Division,
Ontario Region, Environment Canada, PO Box 5050, Burlington, Ontario,
L7R 4A6

TYPE OF ACTIVITY :

Ongoing project to monitor changing water quality and trends with time at head and mouth of St. Clair River.

BRIEF STATEMENT OF WORK:

Water and suspended sediment samples are collected weekly at both upstream and downstream ends of the St. Clair River. Samples are analyzed for Al, Be, Ba, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sr, V, Zn, Hg, Ag, Sb, As and Se. Results are compared as time trends relative to loadings and remediations

BUDGET 1995/96:

Analysis costs \$14K
O&M: \$2K

LINKAGES TO POLICY OR REGULATION :

GLWQA, St. Clair River RAP, and Lake Erie LAMP.

INTERDEPARTMENTAL COOPERATION:

DFO, OMEE (Ontario), USEPA, MNR

Environment Canada

PROJECT TITLE: Niagara River Water Quality Evaluation

LEAD:

Ken Kuntz, Ecosystem Health Division,
Ontario Region, Environment Canada, PO Box 5050, Burlington, Ontario,
L7R 4A6

TYPE OF ACTIVITY :

Ongoing project to monitor changing water quality and trends with time at inlet and outlet of Niagara River.

BRIEF STATEMENT OF WORK:

Water and suspended sediment samples are collected weekly at both upstream and downstream ends of the Niagara River. Samples are analyzed for Al, Be, Ba, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sr, V, Zn, Hg, Ag, Sb, As and Se. Results are compared as time trends relative to loadings and remediations

BUDGET 1995/96:

Analysis costs \$44.2K

O&M: \$2K

This is part of a much larger project, so determining salary costs is not realistic.

LINKAGES TO POLICY OR REGULATION

GLWQA, Niagara River RAP, Lake Ontario and Lake Erie LAMPs, CEPA

INTERDEPARTMENTAL COOPERATION:

DFO, OMEE (Ontario), USEPA, NYDEC

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE: Enforcement of MMLER

LEAD:

Pollution Prevention and Abatement Division
Environmental Protection - Ontario Region
Environment Canada

Inspection and Technical Services
Emergencies and Enforcement Division
EP-OR, Environment Canada

TYPE OF ACTIVITY: *(regulatory/compliance monitoring, or scientific studies)*

Regulatory/Compliance monitoring

BRIEF STATEMENT OF WORK:

Monitoring two regulated mines in Ontario, as well as other guideline mines, when applicable.
Samples of process effluent are taken during these inspections.

BUDGET 1995/96: \$2000 per year

LINKAGES TO POLICY OR REGULATION:

Identify key client or intended purpose of the work, nationally or internationally (e.g. GLWQA, Fisheries Act regulation/MMLER, CEPA, EEM, etc.)

Fisheries Act regulation - MMLER

INTERDEPARTMENTAL COOPERATION:

Identify existing cooperation/partners/contacts
None

Identify potential cooperation
Ontario Ministry of the Environment and Energy

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE: Mercury Elimination and Reduction Challenge Project

LEAD: Environmental Contaminants Division
Environmental Protection - Ontario Region
Environment Canada

TYPE OF ACTIVITY: *(regulatory/compliance monitoring, or scientific studies)*

Voluntary initiatives

BRIEF STATEMENT OF WORK:

During the initial phases of the project, the uses, sources and emissions of mercury in Ontario were researched. A pollution prevention workshop was held in June 1995 to help identify possible sectors for partnerships. Current activities have been focused on the health care sector (hospitals in particular).

BUDGET 1995/96: \$60000 and 0.15 PY

LINKAGES TO POLICY OR REGULATION:

Identify key client or intended purpose of the work, nationally or internationally (e.g. GLWQA, Fisheries Act regulation/MMLER, CEPA, EEM, etc.)

Great Lakes/St. Lawrence Pollution Prevention Initiative

INTERDEPARTMENTAL COOPERATION:

Identify existing cooperation/partners/contacts
Health Canada, Ontario Ministry of the Environment and Energy, Pollution Probe, Ontario Hospital Association, Health Care Environmental Network, individual hospitals

Identify potential cooperation
None

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE: Enforcement of Secondary Lead Smelter Release Regulations

LEAD: Pollution Prevention and Abatement Division
Environmental Protection - Ontario Region
Environment Canada

Inspection and Technical Services
Emergencies and Enforcement Division
EP-OR, Environment Canada

TYPE OF ACTIVITY: *(regulatory/compliance monitoring, or scientific studies)*

Regulatory/Compliance monitoring

BRIEF STATEMENT OF WORK:

Actively regulating four facilities in Ontario. Stack sampling is conducted at these facilities. Six other facilities that process or use lead are also inspected.

BUDGET 1995/96: \$4000 per year

LINKAGES TO POLICY OR REGULATION:

Identify key client or intended purpose of the work, nationally or internationally (e.g. GLWQA, Fisheries Act regulation/MMLER, CEPA, EEM, etc.)

Canadian Environmental Protection Act - Secondary Lead Smelter Release Regulations

INTERDEPARTMENTAL COOPERATION:

Identify existing cooperation/partners/contacts
Ontario Ministry of the Environment and Energy

Identify potential cooperation
None

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE:

Pollution Prevention Projects: Metal Finishing, Motor Vehicles' Manufacturing,
Automotive Parts Manufacturing

LEAD:

Pollution Prevention and Abatement Division
Environmental Protection - Ontario Region
Environment Canada

TYPE OF ACTIVITY: *(regulatory/compliance monitoring, or scientific studies)*

Voluntary initiatives

BRIEF STATEMENT OF WORK:

Site-specific pollution prevention plans are being developed and implemented for member companies in each sector. The Automotive Manufacturers have implemented pollution prevention plans and have reported on their progress.

BUDGET 1995/96: \$200K for Metal Finishing & 0.2 PY
\$100K for Motor Vehicles' Manufacturing & 0.2 PY
\$100K for Automotive Parts Manufacturing & 0.2 PY

LINKAGES TO POLICY OR REGULATION:

Identify key client or intended purpose of the work, nationally or internationally (e.g. GLWQA, Fisheries Act regulation/MMLER, CEPA, EEM, etc.)

Great Lakes/St. Lawrence Pollution Prevention Initiative

INTERDEPARTMENTAL COOPERATION:

Identify existing cooperation/partners/contacts

Industry Associations, Ontario Ministry of the Environment and Energy

Identify potential cooperation

None

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE: Decommissioning of ICI Canada (Cornwall)

LEAD: Pollution Prevention and Abatement Division
Environmental Protection - Ontario Region
Environment Canada

TYPE OF ACTIVITY: *(regulatory/compliance monitoring, or scientific studies)*

Decommissioning of a chlor-alkali facility.

BRIEF STATEMENT OF WORK:

Division is currently involved with the review of the decommissioning plan for the chlor-alkali plant at ICI Canada in Cornwall, Ontario.

BUDGET 1995/96: 0.02 PY (5 days/year)

LINKAGES TO POLICY OR REGULATION:

Identify key client or intended purpose of the work, nationally or internationally (e.g. GLWQA, Fisheries Act regulation/MMLER, CEPA, EEM, etc.)

Canadian Environmental Protection Act - Chlor-Alkali Mercury Release Regulations

Fisheries Act - Chlor-Alkali Mercury Liquid Effluent Regulations

INTERDEPARTMENTAL COOPERATION:

Identify existing cooperation/partners/contacts
Ontario Ministry of the Environment and Energy

Identify potential cooperation
None

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE: Wildlife Toxicology. Levels and effects of metals in vertebrates in the Great Lakes Basin - St. Lawrence River

LEAD: Environmental Conservation Branch - Ontario Region
Environment Canada

TYPE OF ACTIVITY: *(regulatory/compliance monitoring, or scientific studies)*

Scientific studies

BRIEF STATEMENT OF WORK:

The Canadian Wildlife Service (Ontario)/ECB has monitored mercury and lead concentrations in avian, reptilian and amphibian tissues in the Great Lakes-St. Lawrence River basin since 1971.

Since 1971, the herring gull (*Larus argentatus*) has been used as a sentinel species for monitoring the levels of persistent contaminants in the Great Lakes ecosystem. In this study, 21 herring gull colonies in the Great Lakes and connecting channels were sampled during 1972-1976, 1981-1983, 1985 and 1992. For each year, 10 eggs (usually) were collected from each colony site and analysed for total mercury ($\mu\text{g/g}$, wet weight). Results indicated that eggs from Lake Ontario displayed the highest mercury levels (0.28-0.73 $\mu\text{g/g}$), followed by Lake Superior (0.21-0.48 $\mu\text{g/g}$). Lake Erie typically displayed the lowest mercury levels (0.18-0.24 $\mu\text{g/g}$). Overall, mercury levels ranged from 0.12 $\mu\text{g/g}$ in 1985 to 0.88 $\mu\text{g/g}$ in 1982 for Channel Shelter Island (Lake Huron) and Pigeon Island (Lake Ontario) respectively. Generally, all colony sites showed peak egg mercury levels in 1982. A significant decline in egg mercury levels was observed in five colony sites for the period 1972 to 1992 and in three different colony sites for the period 1981 to 1992. Mercury levels in the eggs of herring gulls for the period of this study were below levels associated with acute toxic effects in this species but were within a range, for certain years, which potentially reduces hatchability in other avian species.

In osprey (*Pandion haliaetus*) eggs collected at six sites in Ontario during 1971-1992, mercury concentrations ranged from non-detectable to 0.14 $\mu\text{g/g}$ among five Great Lakes sites and were 0.22 $\mu\text{g/g}$ in eggs from Ogoki Reservoir in northern Ontario in 1992.

Wildlife Toxicology. Levels and effects of metals in vertebrates in the Great Lakes Basin - St. Lawrence River (continued)

Since 1989, mercury concentrations have been measured in common snapping turtle (*Chelydra serpentina*) and mudpuppy (*Necturus maculosus*) carcasses. In 1989-1991, mercury concentrations ranged from 50 to 150 ng/g in turtle eggs from Eastern Lake Ontario and the St. Lawrence River (Ontario). In mudpuppy eggs collected in the St. Lawrence River at locations from Cornwall east to St. Anne River, concentrations ranged from non-detectable to 290 ng/g in the St. Anne River.

In 1994, approximately fifty great horned owl (*Bubo virginianus*) carcasses collected throughout Ontario were submitted to the Canadian Cooperative Wildlife Centre/Ontario Veterinary College for pathological evaluation. Approximately 10% of those carcasses died of causes which could not be determined through examination. Therefore, mercury and lead are currently being analysed in the owl tissues by ECB (Ontario) in cooperation with National Wildlife Research Centre to determine if the contaminant concentrations, particularly lead, in the birds could have been a causal factor in the owl morbidity. Since this species tends to hunt mice and other small game and nest within the same area throughout the year and over its life span, these data will also provide a spatial distribution of mercury and lead concentrations in upland areas of Ontario.

BUDGET 1995/96: Staff time and contractor: \$10000
Analyses: 100 tissues x \$60/sample = \$6000

LINKAGES TO POLICY OR REGULATION:

Identify key client or intended purpose of the work, nationally or internationally (e.g. GLWQA, Fisheries Act regulation/MMLER, CEPA, EEM, etc.)

Canadian Environmental Protection Act, Migratory Bird Act (enforcement)

INTERDEPARTMENTAL COOPERATION:

Identify existing cooperation/partners/contacts
National Wildlife Research Centre
Canadian Wildlife Service - Quebec Region

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE: Investigation of the Ambient Air Concentrations of Mercury Measured at Integrated Atmospheric Deposition Network (IADN) Sites in Ontario

LEAD: Atmospheric Environmental Services - Ontario Region
Environment Canada

TYPE OF ACTIVITY: *(regulatory/compliance monitoring, or scientific studies)*

Scientific study

BRIEF STATEMENT OF WORK:

Mercury is one of the critical pollutants identified by the International Joint Commission. Although the role of the atmosphere in the global mercury cycle has been recognized, there is still a lot of uncertainty with regards to ambient gaseous concentrations due to the paucity of the data. In Canada, the Atlantic and Quebec regions of EC are currently measuring ambient air gaseous mercury. Around the Great Lakes, the Integrated Atmospheric Deposition Network (IADN) was created in 1988 to assess the ambient concentrations of the IJC critical pollutants. However, gaseous mercury concentrations are not currently measured at the Canadian stations of IADN. This project, endorsed by senior AES scientists, involves the acquisition of a commercially available continuous mercury analyzer to measure gaseous mercury in ambient air at the IADN sites of Point Petre and Burnt Island. These measurements will provide an essential record of atmospheric concentrations of gaseous mercury around the Great Lakes and will allow assessment of potential deposition to the Lakes.

Deliverables:

- | | | |
|----|---|---------------|
| 1) | Initial training and installation | March '96 |
| 2) | Preliminary report, data from Point Petre | September '96 |
| 3) | Installation of analyzer at Burnt Island | March '97 |

The instrument is automated and thus requires minimum on-site attention. The IADN field operators will provide basic supervision of the instrument performance.

BUDGET 1995/96:

Capital: \$47100 for mercury vapour analyzer
O&M: \$3000 for calibration system components

Investigation of the Ambient Air Concentrations of Mercury Measured at Integrated Atmospheric
Deposition Network (IADN) Sites in Ontario (continued)

LINKAGES TO POLICY OR REGULATION:

*Identify key client or intended purpose of the work, nationally or internationally (e.g. GLWQA,
Fisheries Act regulation/MMLER, CEPA, EEM, etc.)*

None given

INTERDEPARTMENTAL COOPERATION:

Identify existing cooperation/partners/contacts

None given

Identify potential cooperation

None

**PRAIRIE & NORTHERN
REGION**

CONTACT: DON WAITE

REPORT

METALS IN THE ENVIRONMENT PROGRAMS

PRAIRIE AND NORTHERN REGION

Don Waite, Research Scientist
Environmental Conservation Branch, Regina
March 5, 1996.

The following is a summary of project sheets describing various regional activities involving metals in the environment. The report consists of three appendices, one for each Branch which reported activities in this area. Each appendix consists of a summary page and individual project sheets. The branches with activities are Environmental Conservation, Environmental Protection and Atmospheric Environment. The Departmental Affairs Branch has no activities in this area.

The sheets describing discrete projects, such as research activities, were easy to complete. Problems occurred where metals were part of another program as with "advice to other departments". This "advice" includes environmental impact assessment of metal mines, contaminated site remediation and a host of other things. As a result, no specific costs could be applied to this sheet. Similarly, monitoring activities at routine stations result in the collection of samples for a wide range of samples. The activity is not driven by metals, but samples are collected for this purpose. We have included only the incremental costs of collecting these samples such as special bottles and preservatives and the field time required to cover specific activities such as sample filtration. The lab analyses are not included and should be covered by the Burlington labs which charge by lab credit.

APPENDIX A
ENVIRONMENTAL CONSERVATION BRANCH II
SUMMARY

PROJECT	O&M	SALARY	PROJ. LEADER
Atmospheric Sampler	1K	6K	D. Waite
Lead Shot Exposure	12K	16K	M. Wayland
Lead & Hg in Loons	1.5K	5.3K	M. Wayland
Hg in Glaciers Ice	2.5K	2.0K	D. Donald
PPWB Monitoring	2.5K	5.0	G. Dunn
Canada/Man Agree	1.8K	3.0K	G. Dunn
Poplar River	0.1K	0.5K	J. Wood
Souris River	0.1K	0.35K	J. Wood
Red & Souris	0.1K	0.35K	J. Wood
Integrated Management Plans	2K	10K ¹	T Swerdfager
Impact Assessment	2K	15K ¹	T. Swerdfager
TOTAL ERD	25.6K	63.5K	

¹ Estimated at 0.1 py = \$5K

The following Divisions reported no metals activities:

Northern Conservation
Nongame
Ecological Research
Migratory Birds

PROJECT SHEET METALS IN THE ENVIRONMENT

PROJECT TITLE

Long-term Depositional History of Organochlorine and other Contaminants (mercury) - Snow Dome Glacier.

LEAD

David Donald - Head, Ecosystem Health Assessment Section, Ecological Research Division. Regina, Sask. (306)-780-6723.

BRIEF STATEMENT OF WORK

Objectives:

1. Determine the long-term depositional history (1930 to 1995) of toxic substances (including mercury) in precipitation for west-temperate North America and to identify trends and concentrations for these substances.

Samples were collected for mercury and other contaminants by sampling annual ice layers up to 50 metres deep within Snowdome Glacier, Jasper National Park. Results of this project will provide the first record of the depositional history of mercury and other contaminants for temperate North America.

BUDGET 1995/96

Analytical (O&M) - \$2,500.00

Technical (Salary), 0.1PY - \$2,000.00

LINKAGES TO POLICY OR REGULATION

National - National mercury monitoring Network, Environmental Monitoring and Assessment Network, State of Environment Reporting.

International - Great interest in mercury monitoring

INTERDEPARTMENTAL COOPERATION

Fisheries and Oceans Canada, Parks Canada, Environmental Services Branch (AES), the University of Alberta, the Arctic Institute of North America and Yamnuska Mountain School were all partners in the project.

DFO contributed some analytical services, Parks and AES were stakeholders in the project, the U of A is working on a companion project on Bow Lake to determine the fate

and pathways of contaminants in this ecosystem, the Arctic Institute is involved in the glaciological component of the study and Yamnuska provided technical/safety support.

PROJECT SHEET
METALS IN THE ENVIRONMENT

PROJECT TITLE CANADA- MANITOBA WATER QUALITY AGREEMENT

LEAD

Gary Dunn, Ecological Reseach Division, ECB, Regina PH: (306)780-8468

TYPE OF ACTIVITY

state as:

Monitoring Agreement

BRIEF STATEMENT OF WORK

Monitor 20 sites for metals and a wide variety of other variables in water on a monthly basis.

BUDGET 1995/96

O&M 0.1 k Salary 0.50k

LINKAGES TO POLICY OR REGULATION

Bilateral Agreement between ^{manitoba} Sask. and Canada

INTERDEPARTMENTAL COOPERATION

EC and External Affairs

**PROJECT SHEET
METALS IN THE ENVIRONMENT**

PROJECT TITLE PRAIRIE PROVINCES WATER BOARD

LEAD

Gary Dunn Ecological Research Division, ECB, Regina PH: (306)780-8468

TYPE OF ACTIVITY

state as:

Agreement/compliance monitoring

BRIEF STATEMENT OF WORK

Twelve interprovincial monitoring sites are collected for a wide variety of variables in water and fish on a monthly, quarterly or bimonthly basis. Results are compared with PPWB Water Quality objectives and used to identify water issues

BUDGET 1995/96

O&M 2.5k Salary 5.0k

LINKAGES TO POLICY OR REGULATION

The 1969 PPWB Master Agreement on Apportionment says that EC shall monitor interprovincial streams for the Board. Agreement signed by Federal Gov't, Sask., Alberta, and Manitoba

INTERDEPARTMENTAL COOPERATION

EC and Ag Canada (PFRA) are members on the Board

METALS IN THE ENVIRONMENT

PROJECT TITLE

Adaptation of an atmospheric sampler to measure mercury and other metals depositing into aquatic ecosystems.

LEAD

Dr. D. T. Waite, Research Scientist, Ecological Conservation Branch, Regina, SK. (tele 306-780-6438)

TYPE OF ACTIVITY

research

BRIEF STATEMENT OF WORK

A novel atmospheric sampler has been developed and patented. It collects dry deposits of organic toxics being deposited to aquatic ecosystems. The current project will determine if the sampler can be adapted for sampling mercury and other metals and will attempt to design a prototype.

BUDGET 1995/96

A-base \$1000.00 O&M

0.1 person year including student help (\$6000.00)

Laboratory costs are covered by EPB labs and not included in estimate

LINKAGES TO POLICY OR REGULATION

Nationally - technology development and sales (intellectual properties); National mercury monitoring network, Environmental Monitoring and Assessment Network, State of Environment reporting

Internationally - great interest in mercury monitoring

INTERDEPARTMENTAL COOPERATION

Initial sampler developed and tested with Saskatchewan Research Council and Agriculture Canada and field tested with them and with U.S. Department of Agriculture and Fisheries and Oceans Canada. It was used as part of the BOREAS study

Potential cooperation: State and Federal regulatory agencies in North America and throughout the world; research agencies such as universities and government; industry involves in metals production (eg uranium mines), power companies, smelters etc.

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE

Lead poisoning and mercury exposure in Common Loons in P&NR.

LEAD

Mark Wayland, CEPA Wildlife Biologist, Ecosystem Research Division, Saskatoon

TYPE OF ACTIVITY

Research/Monitoring

BRIEF STATEMENT OF WORK

Common loons that are found dead throughout P&NR are being autopsied and their tissues analyzed for lead and mercury. Project started in 1995 and will continue until 1999.

BUDGET 1995/96

0.1 PY (BI-03) - \$5.3K

O&M - \$1.5K

CAP - \$0.0K

Contractors - none

LINKAGES TO POLICY OR REGULATION

This is part of a national effort by the Canadian Wildlife Service to assess the extent of lead poisoning and mercury exposure in common loons. The Canadian Wildlife Service is in the process of determining the extent of lead poisoning in common loons that results from their ingestion of lead fishing sinkers. Loons are protected under the Migratory Birds Convention Act and the CWS must take a position on the use of lead sinkers for sportsfishing in view of the poisoning problems that have been noted in some parts of Ontario. This information will contribute to a national perspective on this issue. Also, loons appear to be quite sensitive to sublethal mercury intoxication. The mercury information can be linked to the broad-based DOE effort to monitor mercury trends in the environment. Part of this effort is reflected in the EMAN Mercury Monitoring initiative.

INTERDEPARTMENTAL COOPERATION

DOE's National Wildlife Research Centre is the main cooperator. Also, Heritage Canada has been asked to provide any loon carcasses found in National Parks. DFO has provided information about commercial fishermen who may obtain dead loons in their fishing nets.

The project also receives cooperation from several non-federal government groups, including the Fish and Wildlife Branches of the governments of Manitoba, Saskatchewan, Alberta and the NWT.

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE

Lead shot exposure and poisoning in non-waterfowl avian species in P&NR.

LEAD

Mark Wayland

TYPE OF ACTIVITY

Research

BRIEF STATEMENT OF WORK

Bald eagles and golden eagles are being examined for lead exposure and lead poisoning in the three prairie provinces. The relationship between waterfowl hunting activity, the importance of waterfowl in the diets of eagles and lead exposure/poisoning in eagles is being examined.

BUDGET 1995/96

0.3 PY (BI-03) - \$16.0K O&M - \$6.0K

CAP - \$0.0K

Contractor - Dr. G. Bortolotti, Dep't. of Biology, University of Saskatchewan received \$6.0K of the O&M. Dr. Bortolotti also supplied > \$8.0K from his own research budget for this project.

LINKAGES TO POLICY OR REGULATION

The key client is DOE. Last summer, the Minister announced that lead shot for waterfowl hunting will be banned nationally starting in 1997. This research contributed to the information base that resulted in that decision. The information has been collected in support of her decision. It will continue to be collected after the implementation of the ban to assess the ban's efficacy.

INTERDEPARTMENTAL COOPERATION

The main cooperator is the National Wildlife Research Centre in Hull. They perform the lead analyses. There are also a number of non federal government cooperators including the University of Saskatchewan, the Wildlife Branches of the governments of Manitoba, Saskatchewan and Alberta and the Canadian Cooperative Wildlife Health Centre in Saskatoon.

PROJECT SHEET
METALS IN THE ENVIRONMENT

PROJECT TITLE EAST POPLAR R. BILATERAL MONITORING
AGREEMENT

LEAD

J. Wood, Ecological Research Division, ECB, Regina PH: (306)780-8468

TYPE OF ACTIVITY

Bilateral Agreement

BRIEF STATEMENT OF WORK

Monitor one site (East Poplar River) for metals and a wide variety of other variables in water on a monthly basis.

BUDGET 1995/96

O&M 0.1 k Salary 0.50k

LINKAGES TO POLICY OR REGULATION

Bilateral Agreement between Sask. Montana and Canada

INTERDEPARTMENTAL COOPERATION

EC and External Affairs

PROJECT SHEET
METALS IN THE ENVIRONMENT

PROJECT TITLE INTERNATIONAL RED R. POLLUTION CONTROL
BOARD

LEAD

J. Wood, Ecological Reseach Division, ECB, Regina PH: (306)780-8468

TYPE OF ACTIVITY

state as:

Bilateral Agreement

BRIEF STATEMENT OF WORK

Monitor one site (Red River @ Emerson) for metals and a wide variety of other variables in water on a monthly basis.

BUDGET 1995/96

O&M 0.1 k Salary 0.35k

LINKAGES TO POLICY OR REGULATION

Bilateral Agreement between Sask. Manitoba, N. Dakota and Canada

INTERDEPARTMENTAL COOPERATION

EC and External Affairs

PROJECT SHEET
METALS IN THE ENVIRONMENT

PROJECT TITLE SOURIS RIVER

LEAD

John Wood, Ecological Reseach Division, ECB, Regina PH: (306)780-8468

TYPE OF ACTIVITY

state as:

Bilateral Agreement

BRIEF STATEMENT OF WORK

Monitor one site (Souris R. @ Westhope) for metals and a wide variety of other variables in water on a monthly basis.

BUDGET 1995/96

O&M 0.1 k Salary 0.35k

LINKAGES TO POLICY OR REGULATION

Bilateral Agreement between Sask. Manitoba, N. Dakota and Canada

INTERDEPARTMENTAL COOPERATION

EC and External Affairs

PROJECT SHEET METALS IN THE ENVIRONMENT

PROJECT TITLE

Environmental Impact Assessment in Resource Conservation Division.

LEAD

Trevor Swerdfager/Pauline Erickson RCD

TYPE OF ACTIVITY

Is regulatory overall, but our involvement is Industry compliance and monitoring

BRIEF STATEMENT OF WORK

Review Environmental Impact Statements and conduct environmental assessments of proposals submitted to DOE as a regulatory or advocacy role. Wildlife/habitat implications.

Pertinent projects reviewed relating to heavy metals include Bisset Gold mine MB, Cheviot Coal Mine AB, Goldfields Mine SK, Suncor Oil Sands AB, and BHP Diamond Mine NWT.

BUDGET

A-base \$2000

PY's 0.3

LINKAGES TO POLICY OR REGULATION

Canadian Environmental Assessment Act, Wildlife Policy for Canada, Wetland Policy for Canada, Biodiversity Convention, CEPA.

INTERDEPARTMENTAL COOPERATION

Environmental Protection (Alberta and Sask. district offices), Alberta Fish & Wildlife, Industry.

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE

Saskatchewan Integrated Resource Management Plans

1. Pasqua/Porcupine Hills IRMP Sask/Man
2. Manitou Sandhills IRMP Sask.

LEAD

Trevor Swerdfager/Peter Farrington

TYPE OF ACTIVITY

provincial policy development (planning)

BRIEF STATEMENT OF WORK

DOE sits on resource management plan committee. Review/planning for such items as future industry development in these ecological areas.

BUDGET

A-base \$2000

PY's 0.2

LINKAGES TO POLICY OR REGULATION

Wildlife Policy for Canada, Wetland Policy for Canada, Biodiversity Convention, Migratory Birds Convention Act.

INTERDEPARTMENTAL COOPERATION

Saskatchewan and Manitoba governments, Oil and Gas industry, Grazing committees, Rural municipalities, Rural Economic Development.

APPENDIX B

ENVIRONMENTAL PROTECTION BRANCH SUMMARY

PROJECT	O&M	SALARY	PROJ. LEADER
Arsenic	30K	37.5 ¹	Ed Collins
Diamond Mines	50K	10K ¹	Stephen Harbicht
Radionuclides	42K	minor	Dennis Lawson
Advise OFDs	not stipulated	not stipulated	Env. Protect. Br.
TOTAL ERD	122K	not stipulated	

¹ estimated at 0.1 py = \$5K

PROJECT SHEET
METALS IN THE ENVIRONMENT

PROJECT TITLE:

Controlling Arsenic releases to the environment in the Northwest Territories: A discussion of management options.

LEAD:

Ed Collins, Environmental Protection Branch, Yellowknife, (403) 920-6061

Type of Activity

Modified Strategic Options Program (MSOP)

Brief Statement of Work

This study will (1) evaluate the effectiveness of the existing regulatory regime and control measures in reducing arsenic releases to the environment to the greatest extent possible and (2) determine if further reductions in arsenic releases should be recommended given current human exposure and/or release levels, and taking account of scientific, technology and socio-economic considerations. If reductions are recommended, assess various management options for reducing arsenic releases and recommend the most cost-effective and environmentally efficient option for implementation

Budget

O&M A base funds . 30K

Salary 0.5 py EPB, 0.25 PY other Environment Canada

0.75 PY total = \$37.5K

Linkages to Policy or Regulation

Nationally - Linkages to environmental impacts associated with gold mining, CEPA Part II, Priority Substance List and Strategic Option Program

Interdepartmental Cooperation:

Other departments that are involved with the MSOP are: Health Canada , the Government of the Northwest Territories, Dept. of Health and Social Service and the Department of Renewable Resources, Environmental Protection Division.

Others involved includes the public in general, Aboriginal groups and the mining industry.

PROJECT SHEET METALS IN THE ENVIRONMENT

PROJECT TITLE

LEAD

Environmental Protection Branch

TYPE OF ACTIVITY

Advice to other Federal Departments

BRIEF STATEMENT OF WORK

Advice is provided to other Federal Departments with respect to metals in the environment through a number of programs. The most significant of these are in the area of environmental impact assessment. However, advice is also provided related to contaminated sites, waste management and spills.

BUDGET 1995/96

Total resources committed to these activities are substantial, but it is not possible to break out information on resources that are specific to metals.

LINKAGES TO POLICY OR REGULATION

Canadian Environmental Assessment Act, Fisheries Act

INTERDEPARTMENTAL COOPERATION

Key departments receiving advice include: Fisheries and Oceans, Natural Resources Canada (Atomic Energy Control Board), Indian and Northern Affairs

PROJECT SHEET
METALS IN THE ENVIRONMENT

PROJECT TITLE:

Studies on the acute lethality of contaminants associated with Diamond Exploration and Mining.

LEAD:

Stephen Harbicht, Environmental Protection Branch, Yellowknife, (403) 920-6062

Dr. Jack Klaverkamp, Fisheries and Oceans, Winnipeg, (204) 983-5003

Type of Activity

Research

Brief Statement of Work

In acute lethality investigations on fish conducted in DFO's laboratory last year using effluents from the Fox and Misery kimberlite pipes, it was confirmed that the toxicity is associated with the fine solids, and that ammonia and alkaline pH, although by themselves were at sub-lethal concentrations, were present at levels very close to those that have been reported to be lethal to fish. It was also found that gill filaments from fish exposed to these effluents accumulated six contaminants, aluminium, barium, chromium, cobalt, iron and nickel, at levels ranging from six to ninety-four times higher than concentrations observed in non-exposed fish.

Following from these results, additional testing should be conducted on the toxicity of the tailings, and on the individual toxicity of the six contaminants in the presence of ammonia and alkaline pH. The objectives of this additional toxicity testing would be to determine concentrations of tailings producing acute lethality in fish and to identify the causative chemical(s) or mechanism(s) for this lethality.

Budget

EACC Research and Development fund	40K
Other Federal departments	10K
Salary 0.2PY =	10K

Linkages to Policy or Regulation

Nationally - Information gained will provide an understanding of the toxicity which can then be used in establishing effluent parameters for a new type of mining industry in Canada, with possible linkages to the Fisheries Act, MMLER, Aquamin and Environmental Effects Monitoring.

International- This pioneering study will add to the available literature and should assist in providing environmental protection at cold-climate diamond operations around the world.

Interdepartmental Cooperation:

To date: (1) the Department of Fisheries and Oceans has been actively involved by providing the scientific expertise and are conducting the Laboratory research and analysis of results; (2) the Department of Indian and Northern Affairs has provided funds to assist in this project; and (3) private industry (BHP Diamond Inc.) has provided logistical support and kimberlite samples. Other diamond mining companies have shown interest due to the toxicity concerns associated with kimberlite.

PROJECT SHEET

METALS IN THE ENVIRONMENT

PROJECT TITLE

Study of natural and artificial radionuclides in small mammals of the Saskatchewan Prairie

LEAD

Dr. Dennis W. Lawson, Uranium Development Specialist, Environmental Protection
Prairie and Northern Region, Regina, Saskatchewan, (306) 780-6462

TYPE OF ACTIVITY

Scientific Study

BRIEF STATEMENT OF WORK

This pioneering study provided a needed understanding of radionuclides in prairie food chains. The field sampling program was complemented by a comprehensive literature review. A tentative plan for the more extensive monitoring of similar food chains in the northern Boreal forest and Arctic tundra was proposed.

BUDGET 1995/96

The University of Saskatchewan (Toxicology Research Centre) undertook the study under contract in 1995/1996 for \$42K. This study utilized internal DOE Prairie and Northern Region funds for research addressing the requirements of future EIAs.

The next phase of the work is to implement and assess the proposed environmental monitoring program. A budget (1996/1997) of \$60K is anticipated.

LINKAGES TO POLICY OR REGULATION

The study has implications as related to the design of environmental monitoring networks for Candu nuclear reactors and uranium mines. Linkages exist to the Environmental Effects Monitoring, any revisions to the MMLER and State of the Environment reporting. The key clients are the nuclear industry (mining, processing, power generators and disposal) and the federal and provincial regulatory agencies.

INTERDEPARTMENTAL COOPERATION

Saskatchewan Environment and Resource Management, National Health and Welfare, Saskatchewan Labour, Atomic Energy Control Board and the Atomic Energy of Canada Ltd. participated on the scientific review committee for the study.

For the next phase of the study, the review committee agencies may be expanded to include Cogema Resources (a uranium mining company) and Saskatchewan Health.

APPENDIX C
ATMOSPHERIC ENVIRONMENT BRANCH

SUMMARY

PROJECT	O&M	SALARY	PROJ. LEADER
Nahanni Park	3.3K	8K	0.3K
NWT Aquatic Quality Program	32.4 ¹	19K	0.6K
TOTAL AEB	35.7	27K	0.9K

¹ Multiple sources, see project sheet for details

PROJECT SHEET METALS IN THE ENVIRONMENT

PROJECT TITLE

Nahanni National Park Reserve Environmental Monitoring and Assessment Program

LEAD

Douglas Halliwell, Regional Aquatic Quality Officer, Arctic Section, Atmospheric & Hydrologic Sciences Division, Yellowknife, NWT, (tele 403-920-8516)

TYPE OF ACTIVITY

regulatory/compliance/monitoring

BRIEF STATEMENT OF WORK

Water, suspended sediment, and fish tissue quality sampling (and water quantity measuring) at 7, 2, and 2 sites; respectively within NWT's most visited NP downstream from past & possible future minesites (Tungsten-Flat River W-Cu Mine, Cadillac-Prairie Creek Zn-Pb-Cu-Ag Mine, etc.). Spatial & temporal variability studies and compliance monitoring for exceedances of CWQGs, interim CSQGs, & site-specific, 28-variable water quality long- & short-term objectives (for reference use in future mine water licences). Phase II, Year 4 of 6. Follows Phase I (1988-91). Annual, annual compliance, & final roll-up reports produced by EC-AEB (operator). One-third of resources involves metals analyses in water, sediment, & fish tissue (remaining 2/3 for water quantity & non-metals analyses).

BUDGET 1995/96 (metals portion)

\$3.3K O&M (Canada Water Act), including lab analyses,

0.2 P-Y (\$8K A-Base Salary), \$0.3K Capital

LINKAGES TO POLICY OR REGULATION

Canada Water Act (short-term inventory/study of water quality/quantity),

Canadian Environmental Protection Act (application of CCME Guidelines: CWQGs, interim CSQGs, site-specific objectives)

Future linkages in Phase III with Taiga & Tundra Cordillera Ecozones EMAN (EC) & ITEX (CH) programs

INTERDEPARTMENTAL COOPERATION

Canadian Heritage/Parks Canada (Ft. Simpson) MOUs & annual schedules (1988-91, 1992 onwards)

\$6.7K O&M (A-Base), including helicopter charters & fuel (1995/96 F.Y, metals portion)

0.05 P-Y (\$2.2K) A-Base Salary, \$5K Capital

Fisheries & Oceans (Yellowknife/Hay River/Winnipeg) support for fish tissue sampling & analyses (\$2.8K, at Freshwater Institute)

PROJECT SHEET METALS IN THE ENVIRONMENT

PROJECT TITLE

NWT Aquatic Quality Program (includes Alberta-NWT Transboundary Rivers (JIR) Program

LEAD

Douglas Halliwell, Regional Aquatic Quality Officer, Arctic Section, Atmospheric & Hydrologic Sciences Division, Yellowknife, NWT, (Tele 403-920-8516)

TYPE OF ACTIVITY

regulatory/compliance/monitoring

BRIEF STATEMENT OF WORK

Water and lesser sediment quality sampling & analyses throughout NWT for field & lab physicals, nutrients, major ions, trace metals, bacteriologicals, radionuclides, organics on Mackenzie, Liard, Slave, Hay, Coppermine, Yellowknife, Back, Thelon, Dubawnt, Peel, South Nahanni, Kazan & other NWT rivers. Monthly, bi-monthly, quarterly/seasonal, & opportunistic sampling for transboundary, trend analysis & reconnaissance purposes. Includes water chemistry/potability characterization and contaminants monitoring. Deals with Global/Arctic Climatic Change, Acid Precipitation, LRTAP+/- Cold Condensation Hypothesis, Anthropogenic Cumulative Effects, and other long-term issues. Network began in 1960 (Alberta-NWT transboundary rivers program began in 1988). EC-AEB/TWD is/has always been the project operator. Media & variables analyzed are site-specific & issue-related. 12 Federal-Territorial (FT), 9 Federal (F), 2 NWT-Alberta transboundary rivers water quality sites currently exist. 1 FT & 1 FT/NWT-Alberta transboundary rivers sediment quality sites currently exist. Metals sampling & ICAP-AES analyses account for 25% of total project dataset & 20% resources (Metals are an important issue since mining is/always has been the most important industry in NWT, great mineral resource potential underlying 34% of Canada's landmass)

BUDGET 1995/96 (metals portion)

\$21K O&M (A-Base) + \$5.2K NLET EC Burlington lab credits + \$6.2K INAC Yellowknife lab credits

0.3 P-Y (\$19K A-Base Salary), \$0.6K Capital

LINKAGES TO POLICY OR REGULATION

Canada Water Act, Parts I-III (Federal-Territorial-Provincial arrangements covering cooperative inventories & major studies of water quantity and quality, Canada/NWT

Water Quality Monitoring MOU-1995 onwards & LOAs-1993 onwards, management of water quality, including nutrients, and pollution)

Canadian Environmental Protection Act (Comparison of analysis results to CCME's CWQGs and interim CSQGs, Promotion of Compliance, Some monitoring of substances on Priority Substances List)

Future linkages to EMAN program, Arctic Ecosystem studies, ECB activities, SOE Reporting.

Past (1991-95) linkages to Green Plan: Arctic Environmental Strategy's Action on Water & Action on Contaminants, SOE Reporting.

INTERDEPARTMENTAL COOPERATION

Indian & Northern Affairs Canada (Water Resources Division), Yellowknife cost- & work-sharing at 15 FT (EC-INAC) water quality sites with INAC Water Resources Division, Yellowknife.. INAC contributes \$6.2K O&M (GP-AES/A-Base), 0.1 P-Y (\$6K GP-AES/A-Base Salary), \$0.2K Capital for metals portion.

Alberta Environment (Environmental Protection), Edmonton contributes \$0.7K O&M for metals portion & assists with workplanning.

Government of Northwest Territories (Renewable Resources) & Fisheries & Oceans, Yellowknife/Hay River/ Winnipeg have contributed to project during 1988-95 period.

PACIFIC & YUKON REGION

CONTACT: COLIN GRAY

Nation Metals in the Environment Review Inventory

Pacific and Yukon

TITLE	ORGANIZATION
1. Metal Mining Liquid Effluents Regulations O&M 15K Sal 12K (0.2 PY)	EPB (Enforcement)
2. Arsenic remobilization from Gold Ore Tailings O&M 1K, CANMET 16K; Sal 20K	EP (Yukon)
3. EEM confirmatory sampling O&M 5K Sal 30K	EP (Yukon)
4. Air Sources and Deposition of heavy metals O&M 4K, TRANS Boundary Air Issues Branch 10K; Sal 5K (0.1PY)	EP (Com Chem)
5. Atmospheric Content & Deposition O&M 100K Sal 30K	EC (Science Div)
6. Fraser River Bed Sediment O&M 12K Sal 13K	EC (Science)
7. Fraser River Suspended Sediments O&M 15K Sal 25K	EC (Science)
8. Trace Metals in Fraser River Fish O&M 20K Sal 26	EC (Science)
9. Water Quality Monitoring Network O&M 49K Sal 55	MSB
*10. Heavy metals in seabirds O&M 2K Sal 2K	EC (Wildlife)
*11. Lead in raptors O&M 5K Sal 5K	EC (Wildlife)
12. Hg, Cd, Pb in Cougar Livers (Vancouver Island) O&M 2K Sal 1K	EC (Wildlife)

* Resources used for metal work only. These projects are also looking at organic contaminants.

<p>PROJECT SHEET FORMAT METALS IN THE ENVIRONMENT</p>

PROJECT TITLE:

Metal Mining Liquid Effluent Regulations (Fisheries Act) inspections

LEAD:

Gerry Mitchell

TYPE OF ACTIVITY:

Regulatory/compliance monitoring

BRIEF STATEMENT OF WORK:

Compile and review company submitted monitoring data and conduct facility inspections, to insure compliance with the MMLER

BUDGET 1995/96

\$15000 operation and maintenance, \$12000 in salary (0.2 person years)

No specific capital cost for mining although the capital cost of 1/2 a vehicle amortised over 5 years could be applied against mining.

LINKAGES TO POLICY OR REGULATION:

Enforcement Fisheries Act Regulations

INTERDEPARTMENTAL CO-OPERATION:

Ministry Environment Lands and Parks, Environmental Protection Division

METALS IN THE ENVIRONMENT

PROJECT SUMMARY - EP YUKON

Prepared by: Vic Enns, Head Pollution Abatement Section - EP Yukon

PROJECT TITLE: Arsenic Remobilization from Gold Oxide Ore Tailings

LEAD: E. Soprovich/V.Enns EP Yukon

Brief Statement of Work:

The objective of this project is: 1) to identify the potential for arsenic remobilization from oxide tailings; 2) to identify the mechanism of that release, and; 3) to identify mitigation strategies to control or prevent its release. To date the project has identified that arsenic is released at significant levels from at least some oxide tailings. Work on objectives 2 and 3 is on-going. The project involves laboratory column leach tests and a variety of analytical and mineralogical work.

Budget 1995/96

A-base Salary Est'd at \$20k.

CANMET Mineralogical Assessment \$16k

Capital nil, O&M \$1k

Linkages to Policy or Regulation: - Fisheries Act

Interdepartmental Co-operation: Results relevant to DIAND's CEA screening of a proposal to re-open a Yukon mine.

METALS IN THE ENVIRONMENT

PROJECT SUMMARY - EP YUKON

Prepared by: Vic Enns, Head Pollution Abatement Section - EP Yukon

PROJECT TITLE: Site Specific Mining Environmental Effects Monitoring

LEAD: B. Godin/V. Enns EP Yukon

Brief Statement of Work:

This work could actually be best described as a series of small projects. Work is triggered when we become aware of a potential significant effect on a fisheries resource related to a metals release from a mining project. To date the monitoring required to be carried out by the polluter is often inadequate for an assessment of a potential aquatic impact. The work will normally consist of a receiving water quality survey at the key time of the year and may include sediment sampling, benthic sampling and a fish survey. Zinc is normally the metal of principle concern.

Budget: 1995/96

Estimated at \$30k of A-base support, \$5k O&M support.

Linkages to Policy or Regulation: - Fisheries Act

Interdepartmental Co-operation: DFO/DIAND

PROJECT SHEET FORMAT METALS IN THE ENVIRONMENT

PROJECT TITLE: Water Quality Monitoring Network

LEAD: Andrea Ryan
Monitoring Support Division
Monitoring and Systems Branch

TYPE OF ACTIVITY: Scientific Studies - trend assessment, emerging issues

BRIEF STATEMENT OF WORK: At present we operate a total of 42 monitoring stations in B.C. and the Yukon. At most sites, water samples have been collected on a bi-weekly basis since the mid-1980's, for the purpose of assessing long term changes in water quality (i.e. trend assessment). Water samples are collected for a variety of basic water quality characteristics (major ions, physical variables, nutrients), in addition to trace metals (Al, Ba, Be, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sr, V, Zn at all sites; As, Se, Hg, Th at selected sites).

The network is presently being re-designed with the view of operating an environmental network (including other media and indicators in addition to water) with some core long-term sites and a number of shorter-term, "regional issue" sites. Metals monitoring will be continued at appropriate stations (i.e. long term, and where metals are an issue).

BUDGET 1995/96: This is a very rough estimation, as metals monitoring only makes up a portion of the larger program. Additionally, we are facing a budget cut next year, which we have conservatively estimated at 10% for this exercise.

A-Base: 35K
A-Base Capital: 2.5K
Green Plan (Arctic Environmental Strategy): 14K
Green Plan Capital: 5K

FTC: Approximately 1 (combination PC-02/EG-06)

LINKAGES TO POLICY OR REGULATIONS: Linkages to Fisheries Act, Boundary Waters Treaty, State of Environment Reporting. Also operate two "GEMS" sites (Global Environmental Monitoring Stations; purpose to assess coastal water quality loadings).

INTERDEPARTMENTAL COOPERATION:

- Existing cooperation with Parks (Heritage Canada) and DFO, although few formal agreements exist at present time.
- Memorandum of Understanding with Northern Affairs (DIAND) to operate territorial stations under the Arctic Environmental Strategy
- (- Federal-Provincial Water Quality Monitoring Agreement)

PROJECT TITLE: Fraser River Action Plan (FRAP) - Survey of Contaminants in Bed Sediment in the Fraser River Basin

LEAD: Mark Sekela, Science Division, Environment Canada, Pacific and Yukon Region

TYPE OF ACTIVITY: Scientific Study

STATEMENT OF WORK:

The objective of this project is to develop an indicator of ecosystem stress in the Fraser River basin based on levels of contaminants in bed sediments and to determine the current level of contaminants in the basin bed sediments. Trace metals determination represents a minor component of this project. Hence resource estimates have been estimated accordingly.

Bed sediments have been collected from 14 reaches throughout the Fraser River basin, including the estuary. All samples have been collected at sediment depositional areas during the fall low flow period using a minimum of five grabs with an Ekman dredge. Four samples are collected per reach in order to characterize each reach. Samples are analysed for trace organic and trace metal contaminants.

BUDGET 1995/96

A-Base Salary - 5K

FRAP Salary - 8K

FRAP O&M - 12K, Canadian Helicopters, Elemental Research Laboratory

Total Dollars - 25K

LINKAGES TO POLICY/REGULATIONS:

Key Clients include Greater Vancouver Regional District (GVRD), BCMOE, DFO, EMR, CEPA, EEM, SOE, universities, industry

INTERDEPARTMENTAL COOPERATION:

Existing cooperation/partners - GVRD, BCMOE, NLET, DFO

PROJECT TITLE: Fraser River Action Plan (FRAP) - Survey of Contaminants in Suspended Sediment in the Fraser River Basin

LEAD: Mark Sekela, Science Division, Environment Canada, Pacific and Yukon Region

TYPE OF ACTIVITY: Scientific Study

STATEMENT OF WORK:

The objectives of this project are to determine levels of contaminants in suspended sediment and water from the Fraser River basin and to measure changes in contaminants due to abatement measures implemented by the Annacis Island sewage treatment plant upgrade. Trace metals determination represents a minor component of this project. Hence resource estimates have been estimated accordingly.

Suspended sediment samples will be collected using a continuous flow centrifuge from approximately eight sites in the Fraser River basin (including two sites in the estuary) during the spring and/or fall low flow period. Sites will be located upstream and downstream of major urban centres in the Fraser River basin. All samples will be analysed for trace organic and inorganic contaminants.

BUDGET 1995/96

A-Base Salary - 15K

FRAP Salary - 10K

FRAP O&M - 15K, Elemental Research Laboratory

Total Dollars - 40K

LINKAGES TO POLICY/REGULATIONS:

Key Clients include Greater Vancouver Regional District (GVRD), BCMOE, DFO, EMR, CEPA, EEM, SOE, universities, industry

INTERDEPARTMENTAL COOPERATION:

Existing cooperation/partners - GVRD, BCMOE, NLET

PROJECT TITLE: Fraser River Action Plan (FRAP) - Basin-Wide resident Fish Condition and Contaminants Assessment

LEAD: Beverly Raymond, Science Division, Environment Canada, Pacific and Yukon Region

TYPE OF ACTIVITY: Scientific Study

STATEMENT OF WORK:

The objective of this project is to develop an indicator of ecosystem condition in the Fraser River basin based on the health and contaminant levels in two resident fish species.

Health and contaminant levels at sites exposed to contaminants will be compared to reference sites and the scientific literature. Fish health is based on visual inspection for internal and external abnormalities and analysis of histology, growth rates, somatic indices and maturation age. Tissue contaminants are measured as indicators of exposure and include both trace organic and inorganic contaminants. Trace metals determination represents a minor component of this project. Hence resource estimates have been estimated accordingly.

BUDGET 1995/96

A-Base Salary - 1K

FRAP Salary - 25K

FRAP O&M - 20K

Total Dollars - ~~41K~~ 46 K

LINKAGES TO POLICY/REGULATIONS:

Key Clients include Greater Vancouver Regional District (GVRD), BCMOE, DFO, EMR, CEPA, EEM, SOE, universities, industry

INTERDEPARTMENTAL COOPERATION:

Existing cooperation/partners - BCMOE, NLET, DFO

PROJECT TITLE: "A study on the Sources and Depositions of Heavy Metals in the Lower Fraser Valley of British Columbia "

LEAD: Michael DeAbreu

TYPE OF ACTIVITY: Scientific study

BRIEF STATEMENT OF WORK:

The study investigates relationships between emissions and deposition of lead, cadmium, chromium, nickel, zinc and manganese. Heavy metal emission estimates for point, area and mobile sources were compared with deposition patterns characterized by analyzing the metal content in over 60 samples of the indigenous moss *Isoetes stoloniferum*.

BUDGET 1995/96:	5,000.00	Salary (0.1 FTE)
	4,000.00	A-base O&M
	10,000.00	Transboundary Air Issues Branch
	\$19,000.00	TOTAL

Principal Contractor:	Ms. Ute Pott
	Environmental Services
	Vancouver, BC.

LINKAGES TO POLICY OR REGULATION:

Input to provincial and regional inventories of hazardous air pollutants.
Input to proposed UNECE protocols on heavy metals.

INTERDEPARTMENTAL COOPERATION:

BC Environment
Greater Vancouver Regional District
Transboundary Air Issues Branch

Metals in the Environment

Project Title: Metals in the Atmosphere of the Lower Fraser Valley, B.C.

Lead: Wayne Belzer, Science Division, Conservation Branch, EC P&Y Region, Vancouver

Type of Activity:

A series of scientific studies have been conducted to quantify and qualify the atmospheric loading of metals in the Lower Fraser Valley of southwestern B.C.

Statement of Work:

1. Snow pack Study (1995).

Snow samples were taken in coastal mountains bordering the Lower Fraser Valley to determine the influence of the urban environment at elevated sites. The analyses included anions and cations (Silver, Aluminum, Arsenic, Boron, Barium, Beryllium, Calcium, Cadmium, Cobalt, Chromium, Copper, Iron, Potassium, Magnesium, Manganese, Molybdenum, Sodium, Nickel, Phosphorus, Lead, Antimony, Selenium, Silicon, Tin, Strontium, Titanium, Vanadium, Zinc). This data will also be compared to snow sample studies in 1982 and 1985 to assess long term trends.

2. Air Toxics Survey (1995).

Airborne particulate samples were taken at a series of air quality sites in the Greater Vancouver area to assess metals content of the samples. These metals (As, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Se, Zn) are a part of the PSL priority chemicals. Data will be compared to studies in 1991-1994, to assess long term trends.

3. Burnaby Lake Study (1995).

A lake in an urban setting in Vancouver, Burnaby Lake, was used for a year long sampling program. At this site samples were taken for particulate and metals analyses (Silver, Aluminum, Arsenic, Boron, Barium, Beryllium, Bismuth, Calcium, Cadmium, Cobalt, Chromium, Copper, Iron, Mercury, Potassium, Magnesium, Manganese, Molybdenum, Sodium, Nickel, Phosphorus, Lead, Sulphur, Antimony, Selenium, Silicon, Tin, Strontium, Tellurium, Titanium, Thallium, Vanadium, Zinc, Zirconium) in both rainfall and dry air. This data will be used to characterize the urban aerosols and to determine wet and dry deposition values.

4. Cassiar Tunnel (1995).

Air samples were taken in a tunnel on a major freeway in Vancouver, the Cassiar Tunnel, to determine PM₁₀ and PM_{2.5} particulate and metals (Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Si, Sn, Sr, Te, Ti, Tl, V, Zn, Zr) values from traffic sources.

Other Sources of Atmospheric Metals Data:

1. NAPS survey (continuous).

The National Air Pollution Survey has routinely taken samples every sixth day for airborne particulates and metal (lead) analyses. There are a series of NAPS sites within the GVRD

and also at locations within the province. This data is available from Ottawa.

2. **GVRD sites (continuous).**

The GVRD has a network of air monitoring sites in the Vancouver area and up the Fraser valley. These sites routinely sample for particulates and metals (same as for B.C. MoELP). Data is available from Greater Vancouver Regional District.

3. **MoELP sites (continuous).**

The B.C. Ministry of Environment, Lands and Parks has a network of air monitoring sites in the province. These sites routinely sample for particulates and metals. Data is available from B.C. MoELP.

4. **CAPMoN Samples (continuous).**

The Canadian Air and Precipitation Monitoring network has a site at Saturna Island that samples wet and dry deposition for a limited number of metals (NH₄, Na, Ca, Mg, K). This data set starts in 1989. Data is available from headquarters office in Downsview Ontario.

Budget (1995/96): (metals only)

Fraser River Action Plan	\$100.0K
Salary	\$ 30.0K

Major partners include; Greater Vancouver Regional District, B.C. Ministry of Environment, University of British Columbia

Linkages to Policy or Regulation:

- Fraser River Action Plan
- UNECE Protocols providing Regional information on heavy metals
- Agricultural Codes of Practice
- Regional health issues related to fine particulate
- SOE

Interdepartmental Cooperation:

Agriculture Canada; Health Canada

PROJECT TITLE: Studies of lead, cadmium, mercury, selenium and other metals in wildlife in the Pacific and Yukon region: sources, exposure and biological effects.

LEADER: John Elliott, Wildlife Ecology Division, Canadian Wildlife Service, Delta, BC.

TELEPHONE: 604 946-8546

TYPE OF ACTIVITY: Research and monitoring studies primarily to determine exposure and effects of toxic metals on wildlife species at risk and in selected wildlife indicator species in the Pacific and Yukon region; identification of specific regulatory and non-regulatory approaches to reduce identified risks.

BRIEF STATEMENT OF WORK: Four main metals related projects are being presently pursued by CWS, P&Y region:

- 1) **Effects of lead from hunters shot and fishing sinkers on migratory birds and raptors.**
A considerable data base has been compiled on lead exposure of dabbling ducks, swans and eagles to determine lead exposure. This data was instrumental in bringing about a nation-wide ban on lead shot for waterfowl hunting in Canada. Future work will involve monitoring the effectiveness of the regulations.
- 2) **Exposure and effects of Cd, Hg, Se and Pb in seabirds.** Seabirds carry some of the highest body burdens ever measured in free-living vertebrates. Research has been undertaken and further work is planned to examine sources and possible effects, particularly Cd in storm-petrel species.
- 3) **Exposure and effects of Cd, Hg and Se in diving ducks.** Many species of diving ducks, particularly eiders and scoters, appear to be in serious population decline. Work by the US Fish and Wildlife Service on Alaskan and Washington populations has implicated high metal exposure, particularly Cd, as an important risk factor requiring further investigation. Canadian populations are now being examined.

Budget (1996-97)

A-base	No. indetermin.	Salary	O&M	Cap	Total
	0.4 21,000	6,000	0..0		27,000

LINKAGES TO POLICY

Results have been used to influence policy concerning needs for further controls, primarily under MBCA and CEPA. Indications of a relationship with population effects in marine birds will require determination of sources and possible influence on cross-border activities.

INTERDEPARTMENTAL COOPERATION

In P&Y, this work has involved extensive collaboration with the provincial environment ministry, with DFO and internationally with the US Fish and Wildlife Service.

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