

25 July 1997

Giant Mines  
Box 3000  
Yellowknife, NWT

Attn: John Stard

Dear Sir:

**RE: Baghouse dust stored underground**

Ecological Services for Planning Ltd. and Lakefield Research would like to help you put the issue of the arsenic trioxide dust to rest.

You have two options:

- ◆ leave it in the mine,
- ◆ take it out and process it.

From the environmental perspective, it is probably best to leave it in the mine and immobilize it. We could conduct a Human Health and Ecological Risk Assessment on the two options to see what represents greater risks to humans and environment. A Risk Assessment involves characterization of the contaminant, definition of the effects on humans and the environment, an analysis of how humans and environment could be exposed to the contaminant, and a quantification of risks.

Ecological Services would do the risk assessment and talk to the public and government. Lakefield Research would be our partner and provide the engineering and science on arsenic trioxide processing.

You should consider this proposal because:

- ◆ The problem won't go away without some environmental study,
- ◆ Ecological Services has an excellent reputation in the risk assessment field,
- ◆ Lakefield Research are world experts in arsenic. In fact, the two stage roasting process for treatment of the arsenopyrite ores to recover arsenic trioxide (and prevent formation of ferric arsenate in the roaster) was developed at Lakefield by F.R. Archibald (CMM Bulletin, March 1949),
- ◆ The project manager, Richard Nancarrow, P.Eng., has extensive northern experience in the environmental field. Mr. Nancarrow was the Chief Engineer for Environment Canada in the 1980s and is familiar with Giant Mines.
- ◆ Rod Williamson of Lakefield Research has had extensive experience in the field of arsenic processing and has worked at northern mine sites.



ECOLOGICAL  
SERVICES for  
PLANNING LTD.

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GUELPH, ONTARIO  
CANADA N1G 3M5

PHONE (519) 836-6050  
FAX (519) 836-2493

We would like to discuss this further after you read our proposal. We have an office in Timmins and could meet with you the next time you are there. We could make a presentation and discuss costs.

We have included the resumes of key individuals in our firm and our company brochure. If you have any questions, please call the undersigned.

Yours sincerely,

**ECOLOGICAL SERVICES FOR PLANNING LTD.**



Richard Nancarrow, P.Eng.  
Senior Engineer

RN/jdf

Enc.

cc: Rob Arnup, Manager, Timmins office  
Dr. Chris Wren, Manager, Mining, ESP  
Rod Williamson, Lakefield Research



**RICHARD D. NANCARROW**

**B.A.Sc., M.Eng.**

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**EDUCATION**

B.A.Sc., Civil Engineering, University of Waterloo, 1978.

M.Eng., Ocean Engineering, Memorial University of Newfoundland, St. John's, 1988

**MEMBERSHIPS**

Registered Professional Engineer, Nova Scotia, Ontario.

Member, Association of Consulting Engineers of Canada.

**ENGINEERING EXPERIENCE**

1995: Ecological Services for Planning Ltd., Guelph, Ontario. Senior Associate.

Provision of environmental site assessment, remediation on a diverse range of projects and decommissioning consulting. Participation in all aspects of environmental site assessment study teams.

1995: Nancarrow Associates Limited, Dundas, Ontario. Principal Engineer

Responsible for all aspects of environmental consulting practice. Areas of practice include environmental site assessment, environmental impact assessment, site remediation, risk assessment, hazardous waste management, waste audits, indoor air quality and environmental management training.

1994-1995: Golder Associates, Mississauga, Ontario, Senior Environmental Engineer

Responsible for project management of large multi discipline projects related to all aspects of Golder Associates practice including mining, environmental assessment, site remediation and site assessments.

1992-1994: Porter Dillon Limited, Halifax, Nova Scotia. Manager of Environmental Sciences

Responsible for environmental science division of office, developing business in areas of environmental impact assessment, environmental site assessment and hydrogeological studies. Project management experience included site investigation of an abandoned military base in Argentia, Newfoundland, Initial Environmental Evaluations of Nuclear, Biological, Chemical Warfare Training Facility, waste rock Initial Environmental Evaluations for Devco and the demolition and reconstruction of a jetty facility for Department of National Defence.

1988-1992: Jacques Whitford and Associates, Halifax, Nova Scotia. Manager, Environmental Engineering

Responsible for environmental engineering division of Halifax office. Supervised staff of environmental engineers and hydrogeologists. Project management experience included risk assessment and site assessment for 21 DEW Line sites in Canada's Arctic, and decommissioning of an elemental phosphorus mining operation.

1981-1988: Federal Government, Yellowknife, and St. John's. Manager, Environmental Engineering  
Responsible managing federal programs in waste management, air quality, surface water  
quality contaminants and environmental aspects of mining, oil and gas, and other development  
activities.

1978-1981: M.M. Dillon Limited, Yellowknife NWT. Project Engineer  
Project Engineer responsible for design and site supervision of municipal and civil engineering  
projects in the Northwest Territories and Yukon Territory.

### **TEACHING EXPERIENCE**

1988-1994: Technical University of Nova Scotia, Continuing Education Division. Developed 13 week  
evening courses and lectured in the following areas:

- ◆ Environmental Auditing
- ◆ Total Quality Environmental Management
- ◆ Hazardous Waste Management
- ◆ Environmental Project Course

Developed and participated in two days seminars on the following topics:

- ◆ Environmental Auditing
- ◆ Environmental Impact Assessment
- ◆ Environmental Legislation
- ◆ Environmental Issues in Land Development
- ◆ Indoor Air Quality
- ◆ Environmental Aspects of Geotechnical Engineering
- ◆ Environmental Issues in Mining



## **CHRISTOPHER D. WREN**

**Ph.D., B.Sc.**

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### **EDUCATION**

B.Sc. Marine Biology, University of Guelph, 1977

Ph.D. Fisheries Science, University of Guelph, 1983

### **AWARDS**

Ontario Graduate Scholarships, 1979-80; 1981-82.

Postdoctoral Fellowship, Royal Norwegian Council for Industrial and Scientific Research, 1986-87.

NATO Travel Grant, 1987.

### **EMPLOYMENT**

Present: Principal, Ecological Services for Planning Ltd., Guelph, and Manager, Natural Ecosystems Section

June, 1987 - November, 1989: Scientific consultant, B.A.R. Environmental, Guelph, Ontario.

October, 1986 - June, 1987: Postdoctoral Fellow, University of Trondheim, Norway.

1985-1986: Contract Research, Canadian Wildlife Service, Ottawa.

1983-1985: Postdoctoral Fellow, Institute for Environmental Studies, University of Toronto.

1976-1983: Summer Technician positions.

Fisheries Assessment Unit, Ministry of Natural Resources, Port Dover, Ontario

Department of Fisheries and Oceans, Burlington, Oceanographic Surveys, Hudson Bay

Huntsman Marine Laboratory, St. Andrews, New Brunswick.

University of Guelph, Bluefin Tuna physiology research, Nova Scotia.

### **PROJECT EXPERIENCE**

#### **Risk Assessment**

Potential risk to wildlife using contaminated stormwater ponds for habitat. Study for Environment Canada. 1996-97.

Ecological and human health Risk Assessment of benzene in the St. Clair River, for Bayer Rubber, Sarnia. 1996. Provided expert testimony in court proceedings.

Risk assessment of diazinon to earthworms and passerine birds. Ontario Ministry of Environment and Energy. 1995.

Human health and ecological risk assessment of crude oil spill at St. Leons, Manitoba. Interprovincial Pipe Line Ltd. 1995-96.

Occupational risk of workers at a gold processing facility exposed to mercury vapours, Indonesia, for Hatch Associates. 1995.

Exposure and risk assessment of personnel in the natural gas industry exposed to mercury in the workplace. Centra Gas Ontario. 1995.

Risk assessment of wildlife exposed to Lindane. Canadian Wildlife Service. 1993.

**Mining and Aggregate Extraction**

Baseline water quality, benthos and fisheries study in Night Hawk Lake, Timmins, Ontario, for a proposed gold mine operation for Royal Oak Mines Inc. 1996.

Impact assessment and fisheries compensation for a proposed gold mine expansion in Three Nations Lake, Timmins, Ontario, for Royal Oak Mines Inc. 1996 - present.

Aquatic effects monitoring of Placer Dome Ltd. Gold Mine on the Porcupine River for the Aquatic Effects Technology Evaluation Program, Natural Resources Canada and Mining Association of Canada. 1996.

Aquatic effects monitoring of Inco Ltd. and Falconbridge Ltd. Mines on the Onaping River for the Aquatic Effect Technology Evaluation Program, Natural Resources Canada and Mining Association of Canada. 1996.

Aquatic impact assessment of mine operation for Placer Dome Canada, Detour Lake mine, 1995.

Retained by Mining Association of Canada (MAC) to synthesize AQUAMIN (Aquatic Effects of Mining in Canada) documents into a Final Report. 1996.

Fisheries and water quality inventory at West Morgan Lake for Falconbridge, Sudbury Division, 1995.

Development of soil transport model for cadmium and other metals. Ministry of Environment. 1995.

Aquatic impact assessment of Porcupine River for Falconbridge Ltd., Kidd Creek Division, Timmins, Ontario, 1995.

Due diligence and tailings restoration study for bauxite mine, Brazil for Gencor Ltd. 1995.

Fisheries monitoring and impact assessment of aggregate extraction on Mill Creek, a coldwater trout stream. S. Ontario for Dufferin Aggregates. 1993-present.

Aquatic impact assessment of three gold mines in N.W. Ontario for Hemlo Gold Mines, Williams Operating Corporation and Tech Operating Corp. 1992-93.

Screening of over 600 mining studies and development of a database for the AQUAMIN program. Environment Canada. 1993.

Representative for Mining Association of Canada (MAC) in discussions for Accelerated Reduction of Environmental Toxics. 1993.

External expert for study design and impact assessment at the Anaconda smelter, Montana, a U.S. Super Fund site under CERCLA and NRDA legislation. 1992.

Fish habitat and impact assessment for proposed Mardon limestone quarry in Mara Township for Dufferin Aggregates. 1990-94.

Aquatic impact assessment of ERG tailings spill into the Porcupine River, Timmins. Ministry of Natural Resources. 1993.

Evaluation of aggregate removal on brown trout habitat in Brantford County in southern Ontario for Oxford Sand and Gravel. 1993.

Environmental impact assessment of dredging and aggregate removal in Lake Superior on fish habitat for A.B. McLean Ltd. 1989-93.

Evaluation of techniques to reduce effluent toxicity for Ontario Mining Association. 1988.

#### **Chemical Substance Hazard Evaluation**

Review of World Health Organization Environmental Health Criteria document (EHC) on Copper for Environment Canada, Toxic Substance Branch. 1996.

Review of World Health Organization Environmental Health Criteria document (EHC) on Nickel for Environment Canada, Toxic Substances Branch. 1996.

Development of toxicity profile on Polychlorinated BiPhenyls (PCBs) for Priority Substance List assessment for Environment Canada. 1996.

Retained to provide expert advise on mercury in fish by MacLaren Hart, California, for the Oak Ridge Superfund Site, Tennessee. 1995.

Field and laboratory studies of diazinon uptake and toxicity to earthworms. 1993.

Investigation of sources and chemistry of dioxins on industrial property in Ontario. Praxair Ltd. 1993.

Hazard assessment of eight organic chemicals found in pulp and paper effluent for Ontario Ministry of the Environment. 1993

Development of soil quality guidelines for Toluene, Ethylbenzene and Xylene for Environment Canada. 1992

Development of soil quality guideline for mercury for Environment Canada. 1992.

Development of Federal water quality criteria for Linuron and Chlorothalonil, for Environment Canada. 1993.

Development of water quality guidelines for 12 organic chemicals for Ontario Ministry of the Environment. 1991-92.

Technical review of aquatic toxicity data for Noranda Research Centre (1988).

Development of water quality criteria for arsenic, thallium, vanadium and antimony for Ontario Ministry of the Environment (1988).

Development of water quality criteria for methylated naphthalenes for Ontario Ministry of the Environment (1988).

Development of water quality objectives for lead, cadmium, copper and zinc for the Ontario Ministry of the Environment (1989).

Development of background data for establishing tissue contaminant guidelines in aquatic biota - Ontario Ministry Environment (1988).

Data reviews for As, Cr, Ni, Sn, F for Health and Welfare, Canada. 1989.

Experimental study on the effects of PCBs and methylmercury on mink reproduction for National Research Council (1985).

#### **Planning and Development**

Expert testimony at Ontario Municipal Board Hearing regarding potential impacts of nutrients and sewage on coldwater fisheries. Buffalo Springs Rural Estate - Seeley and Arnill. 1995.

Assessment of potential impacts of cottage development on the Grass Lake lake trout populations, Muskoka. M. Michaelski and Associates. 1995.

Expert testimony at Ontario Municipal Board Hearing regarding potential impacts of septic systems on coldwater fish and aquatic habitat. Soga Gakki International. 1995.

Fisheries habitat assessment for proposed natural gas pipeline in S. Ontario for IPL. 1993.

Survey and investigation of mercury contamination of soils at natural gas compressor sites - TransCanada Pipelines Ltd. 1994.

Survey and investigation of mercury contamination of soils at natural gas compressor sites - Consumers Gas. 1993.

Environmental impact assessment and 600km route selection for 500kv transmission line in Northwestern Ontario for Ontario Hydro. 1992.

Environmental impact assessment and route selection for proposed Hwy 407 extension for Ontario Ministry of Transportation and Parker Engineering. 1990.

Aquatic impact assessment and route selection for K-W Loop natural gas pipeline for Union Gas. 1991.

Natural resources impact assessment and site selection for new landfill site for City of Guelph and Wellington County. 1993.

Environmental survey and study report for proposed hydroelectric development on the Abitibi River for Ontario Hydro. 1990.



Fish habitat assessment of the Pine Ridges rural estate development near Newmarket on a cold water stream. 1990.

**Fisheries and Fish Habitat (involved in excess of 100 fish habitat studies - select examples provided)**  
Assessment of impacts of seepage from Caledon Landfill on fisheries of the Credit River: for Region of Caledon. 1996-97.

Fisheries habitat survey and mitigation for proposed bridge replacement at Eden Mills for Triton Engineering. 1996.

Fish habitat survey and habitat enhancement measures for proposed bridge replacement over the Grand River at Inverhaugh for K. Smart and Associates. 1996.

Environmental Effects Monitoring studies of fisheries habitat for DOMTAR Ltd. at Cornwall, Trenton and Red Rock, Ontario. 1993-1995.

Cumulative impact assessment of activities affecting fisheries in the Nipigon River for the North Shore Remedial Action Plan. 1992-93.

Development of fish habitat replacement model for Ontario Ministry of Transportation. 1993.

Detailed fisheries habitat assessments in Northern Ontario for proposed pipeline construction for TransCanada Pipelines Ltd. 1991-93.

Fish habitat impact assessment of log transportation on the Kapuskasing River and development of habitat restoration techniques for Spruce Falls Inc. Pulp and Paper. 1991-92.

Fish habitat mapping study in Lake Simcoe for City of Barrie. 1991.

Habitat mapping in Fathom Five National Park for Parks Canada. 1992.

Assessment of growth and reproduction of lake trout stocked in an acidic lake after neutralization for Ontario Ministries of Environment and Natural Resources (1987).

Efficiency of site-specific shoal liming for lake trout egg survival in an acid-stressed lake (1988).

#### **Other**

Wildlife use of stormwater ponds and constructed wetlands. Survey for Environment Canada. 1997.

External review of report on environmental impact of atmospheric emissions from coal-fired generating stations for Maryland Power. 1993

Involved with developing soil toxicity testing methods using earthworms, other invertebrates and plants. 1993-present.

Appointed to Wildlife Working Group, to develop a policy and strategy for wildlife in Ontario by Minister of Natural Resources (1989-91).

Watershed management strategy for Laurel Creek - City of Waterloo. 1990-92.

Technical review of Ontario Hydro Little Jackfish Hydroelectric Environmental Assessment document for Department of Fisheries and Oceans. 1992.

Organization of scientific workshop on using mink and otter as monitors of environmental contamination for Canadian Wildlife Service. 1993.

Preparation of the Environmental Effects Report on the Atikokan Thermal Generating Station for Ontario Hydro. 1990-93.

Sessional lecturer in Aquatic Toxicology (1988) University of Guelph.

Relationship between bedrock geochemistry and mercury concentrations in fish.

Cause/effect links between toxic chemicals in the Great Lakes and native populations of mink and otter for International Joint Commission. 1992.

Terrestrial impact assessment of atmospheric emissions from thermal generating stations in Ontario for Ontario Hydro. 1990.

Studies of metal uptake in wild grouse in Norway (1987).

Feasibility studies of fur farming on James Bay for the Wemindji Cree Indian Band (1986).

A study of mercury cycling in hydroelectric reservoirs for the Canadian Electric Association (1985).

Field studies of metal levels in mink and otter and their food for Canadian Wildlife Service (1985).

An assessment of mercury burdens in furbearing animals for Ontario Hydro (1984).

Literature reviews and field studies of metal levels in Ontario mink and otter for the Canadian Wildlife Service (1985).

## PUBLICATIONS

Wren, C.D. and D. Wismer. 1997. Auditing environmental impact predictions at a coal-fired generating station. Environ. Management (submitted, under review).

Wren, C.D., N. Harttrup, B. Michelluti and G. Hall. 1997. Recovery of an aquatic ecosystem exposed to mining effluent at Sudbury, Ontario (in preparation).

Wren, C.D., N. Harttrup, W. Yerex and M. Zimmer. 1997. Population and spawning trends of Brown trout (*Salmo trutta*) relative to groundwater and habitat variables in a southern Ontario stream (in preparation).

Fletcher, T., G.L. Stephenson, J. Wang, C.D. Wren and B.W. Muncaster. 1996. Scientific criteria document for the development of an interim provincial water quality objective for antimony. Ontario Min. Environ. and Energy. Queens Printer, Toronto. 32 pp.

Stephenson, G.L., D.J. Spry, B.W. Muncaster, C.D. Wren and T. Fletcher. 1996. Scientific criteria document for the development of an interim water quality objective for thallium. Ont. Min. Environ. and Energy. Queens Printer, Toronto. 29 pp.

Stephenson, G.L., C.D. Wren, I.C.J. Middelraad, and J. Warner. 1996. Exposure of the earthworm, *Lumbricus terrestris*, to diazinon and the relative risk to passerine birds. Soil Biology and Biochemistry (in press).

Wren, C.D., and C.W. Farrell. 1995. Mercury in the natural gas industry in Canada. Water, Air, Soil Pollut. 80:1203-1206.

Wren, C.D., N. Harttrup and S. Harris. 1995. Ecotoxicology of mercury and cadmium. In: Handbook of Metals Ecotoxicology, Lewis Pub. D.J. Hoffman (ed.) pp.392-423.

Stephenson, G.L., R.P. Lanno, R.A. Kent, and C.D. Wren. (in preparation). Toxicity of pesticides to earthworms in artificial and natural soils. Environmental Toxicology and Chemistry.

Lanno, R.P., G.L. Stephenson, and C.D. Wren. 1997. Application of toxicity curves in assessing the toxicity of diazinon and pentachlorophenol to *Lumbricus terrestris* in natural soils. Soil Biology and Biochemistry (in press).

Stephenson, G.L., C.D. Wren, I.C.J. Middelraad and J. Warner. 1994. Toxicity and bioaccumulation of diazinon in the earthworm, *Lumbricus terrestris*, and an assessment of the relative risk to worm-eating birds. Proceedings Ontario Environment and Energy Conference, Ontario Ministry of the Environment and Energy, Toronto, Ontario.

Wren, C.D. and E. Steinnes. 1994. Use of willow grouse as biological indicators of metal levels in Norway. Environ. Pollut. 85:291-295.

Lanno, R. and C. Wren. 1992. Predictive modelling of fisheries habitat loss and replacement. Research and Development Branch, Ontario Ministry of Transportation MAT-92-01, Downsview, Ontario. 36 pp.

Wren, C.D., G.L. Stephenson and R. Lanno. 1993. The use of biological testing for contaminated soil assessment. Environmental Science and Engineering. September 26-27.

Gunn, J., C.D. Wren and G.M. Booth. 1993. Site specific efficacy of shoal liming on lake trout egg survival in acidic lake. Trans. Am. Fish. Soc. 13:766-774. (\*Won Best Paper of the Year Award from American Fisheries Society).

Wren, C.D., I. Gray, B. Muncaster, W. Scheider and D. Wales. 1991. Relationship between mercury levels in walleye and northern pike in Ontario lakes and influence of environmental factors. Can. J. Fish Aquat. Sci. 48:132-139.

Wren, C.D. and G. Stephenson. 1991. The effect of acidification on the accumulation and toxicity of metals to invertebrates. Environ. Pollut. 71:205-241.

Wren, C.D., 1991. Relationship between chemicals in the Great Lakes and mink and otter populations. J.Environ. Toxicol. 33:549-585.

Gunn, J.M., J. Hamilton, G.M. Booth, C.D. Wren and G. Beggs. 1990. Survival, growth and reproduction of lake trout and yellow perch after neutralization of an acidic lake near Sudbury, Ontario. *Can. J. Fish. Aquat. Sci.* 47(2):446-453.

Steinnes, E., Solberg, W., Petersen, H., and C.D. Wren. 1989. Metal levels in soils of Norway in relation to Long Range transport of atmospheric deposition. *Water, Air, Soil Pollution.* 45:207-218.

Wren, C.D., K.L. Fischer and P.M. Stokes. 1988. Levels of lead, cadmium and other elements in mink and otter from Ontario, Canada. *Environ. Pollut.* 52:193-202.

Wren, C.D. and P.M. Stokes. 1988. Depressed mercury levels in biota from acid and metal stressed lakes near Sudbury, Ontario. *Ambio* 17: 28-30.

Richman, L.A., C.D. Wren and P.M. Stokes. 1988. Facts and fallacies concerning mercury uptake by fish in acid stressed lakes. *Water, Air and Soil Pollution.* 37: 465-473.

Wren, C.D., D.B. Hunter, J.F. Leatherland and P.M. Stokes. 1987. The effects of Polychlorinated biphenyls and methylmercury, singly and in combination, on mink, 1: Uptake and toxic responses. *Arch. Environ. Contam. Toxicol.* 16:441-447.

Wren, C.D., D.B. Hunter, J.F. Leatherland and P.M. Stokes. 1987. The effects of Polychlorinated biphenyls and methylmercury, singly and in combination, on mink, 2: Reproduction and kit development. *Arch. Environ. Contam. Toxicol.* 16:449-454.

Wren, C.D., N. Cloutier, T.P. Lim and N.K. Dave. 1987. Ra-226 concentrations in otter (*Lutra canadensis*) trapped near uranium tailings at Elliot Lake, Ontario. *Bull. Environ. Contam. Toxicol.* 38:209-212.

Wren, C.D. 1987. Toxic substances in furbearing animals. Chapter In *Fur Management and Conservation in North America*. M. Novak (ed) Ministry of Natural Resources and Ontario Trappers Assoc. pp. 930-936.

Wren, C.D., P.M. Stokes and K. Fischer. 1986. Mercury levels in Ontario mink and otter relative to dietary levels and watershed acidification. *Can. J. Zool.* 64(12): 2854-2859.

Wren, C.D. 1986. Metal accumulation and toxicity in wild mammals, 1: Mercury. *Environ. Res.* 40:210-244.

Wren, C.D., and H.R. MacCrimmon. 1986. Comparison of the distribution and accumulation of mercury in two adjacent freshwater ecosystems. *Water Res.* 20(6):763-769.

Wren, C.D. 1986. Mammals as biological indicators of environmental metal loading. *J. Environ. Monitor. and Assess.* 6:127-144.

Stokes, P.M., and C.D. Wren. 1986. Bioaccumulation of mercury by aquatic biota in hydroelectric reservoirs: A review and consideration of mechanisms. In *Occurrence and Pathways of Lead, Mercury, Cadmium and Arsenic in the Environment*. T.C. Hutchinson and K.M. Meema (eds), pp. 255-277. John Wiley and Sons Ltds. Toronto.

Wren, C.D. 1985. Probable case of mercury poisoning in a wild otter, *Lutra canadensis*, in Northwestern Ontario. Can. Field Naturalist. 99(1):112-114.

Wren, C.D. 1984. Distribution of metals in tissues of beaver, raccoon and otter from Ontario, Canada. Sci. Total Environ. 34:177-184.

Wren, C.D., and H.R. MacCrimmon. 1983. Mercury levels in sunfish (*Lepomis gibbosus*) relative to pH and other environmental variables of Precambrian shield lakes. Can. J. Fish. Aquat. Sci. 40:1737-1744.

Wren, C.D., H.R. MacCrimmon and B. Loescher. 1983. Examination of biomagnification and bioaccumulation of metals in a freshwater ecosystem. Water, Air Soil Poll. 19(3):277-292.

MacCrimmon, H.R., C.D. Wren and B.L. Gots. 1983. Mercury accumulation in lake charr (*Salvelinus namaycush*) in an undisturbed Precambrian shield lake. Can. J. Fish. Aquat. Sci. 40(2):114-120.

Wren, C.D. 1982. Potential effects of metals on benthic organisms after liming acid-stressed lakes. Water Poll. Res. J. Canada 17:149-151.

Wren, C.D., H.R. MacCrimmon, R. Frank and P. Suda. 1980. Total and methylmercury levels in wild mammals from the Precambrian shield area of south central Ontario. Bull. Environ. Contam. Toxicol. 25:100-105.

## PRESENTED PAPERS AND OTHER PUBLICATIONS

Wren, C.D., N.A. Harttrup, B. Michelluti and G. Hall. 1997. Ecosystem recovery in the Onaping River. Paper presented at the 8th annual Sudbury Restoration Workshop. Laurentian University, February 18, 1997.

Wren, C.D. 1997. Aquatic ecological research outside of academia. Invited paper to be presented at Ontario Ecology and Ethology Colloquium. University of Western Ontario. May 13.

Wren, C.D. and C.R. Bishop. 1996. Risk of chemicals in stormwater ponds and constructed wetlands to fish and wildlife. Paper presented at 31st Canadian Symposium on Water Pollution Research. Feb. 8, 1996. Burlington, Ontario.

Wren, C.D. 1996. Presentation to government-industry panel on environmental effects monitoring in Ontario pulp and paper mills. September, Toronto.

Wren, C.D. and C.W. Farrell. 1995. Mercury contamination in the natural gas industry. Presented at Conference on Mercury as a Global Pollutant, Whistler, B.C. July.

Stephenson, G.L., C.D. Wren, I.C.J. Middelraad and J. Warner. 1994. Toxicity and bioaccumulation of diazinon in the earthworm, *Lumbricus terrestris*, and an assessment of the relative risk to worm-eating birds. First Ontario Environmental and Energy Conference, Toronto, Ontario. Nov.15-16, 1994.

Scroggins, R., M. Bonnell, and G.L. Stephenson. 1994. Development of Canadian soil invertebrate and terrestrial plant toxicity tests for assessment of contaminated soils. Symposium on Groundwater and Soil Remediation, Calgary, Alberta. Sept. 22-23, 1994.

Wren, C.D., G.L. Stephenson and I. Middelraad. 1994. Risk assessment of Diazinon to earthworms and passerine birds. Paper presented at 15th Annual Meeting: Society of Environmental Toxicology and Chemistry. November. Boulder Colorado.

Stephenson, G.L., I.C.J. Middelraad, C.D. Wren and J. Warner. 1994. The exposure of earthworms (*Lumbricus terrestris*) to diazinon and risk assessment to passerine birds. Fifth International Symposium on Earthworm Ecology. Ohio State University, Columbus, OH. July 4-9, 1994.

Lanno, R.P., C.D. Wren, and G.L. Stephenson. 1994. The use of acute lethality thresholds in assessing the toxicology of four chemicals to the earthworm, *Lumbricus terrestris*, in three natural soils. Fifth International Symposium on Earthworm Ecology. Ohio State University, Columbus, OH. July 4-9, 1994.

Stephenson, G.L., K.E. Day, R. Scroggins and A. Mudroch. 1994. Current status of Environment Canada's guidance document on control of test precision using a spiked sediment toxicity test: What to spike and how? American Society for Testing and Materials, Montreal, Quebec. April 11-13, 1994.

Lanno, R.P., C.D. Wren and G.L. Stephenson. 1993. Earthworm and seed germination toxicity tests to assess the efficacy of bioremediation of chlorophenol and PAH-contaminated soils. Society of Environmental Toxicology and Chemistry, Houston, Texas, Nov. 14-18, 1994.

Lanno, R.P., C.D. Wren and G.L. Stephenson. 1993. The toxicity of four chemicals to the earthworm *Lumbricus terrestris* in three natural soils. Society of Environmental Toxicology and Chemistry, Houston, Texas. Nov. 14-18, 1994.

Wren, C.D. 1993. The cost of conducting Environmental Effects Monitoring (EEM) studies in the pulp and paper industry. Invited paper. Presented at 20th Aquatic Toxicity Workshop. October 21, 1993. Quebec City.

Wren, C.D. 1990. Wildlife as biological indicators of Ecosystem Health. Invited paper. International conference on Aquatic Ecosystem Health and Management. August 23-26. Waterloo, Ontario.

Wren, C.D. 1989. Viewpoints on MISA - the Ontario Municipal Strategy for Abatement Program - from a biologist's perspective. Invited paper to the Annual Meeting of the Canadian Water Resources Association, April 25, Black Creek Pioneer Village, Toronto.

Wren, C.D. 1989. An epidemiological approach to examining the effects of chemicals in the Great Lakes to wild mink and otter populations. Invited paper presented at Workshop on Cause-Effect Linkages. Council of Great Lakes Research Managers. March 28-31. Chicago.

Wren, C.D. 1989. Aquatic bioassays in MISA. Water Pollution Control magazine. April issue.

Wren, C.D. 1988. Relationship of mercury levels in sportfish to water quality and lake sediment characteristics. Proc. Ont. Min. Environ. Technol. Transfer Conference. November 28-29, Toronto.

Wren, C.D. 1988. Influence of water chemistry on food chain transfer of lead, cadmium and mercury. Invited review paper presented at Society Environmental Toxicology and Chemistry, Ninth Conference. Arlington, VA, November 14-18.