# Katherine Anne Enns

**Principle Owner: Delphinium Holdings Inc., (Est. 1979): Castlegar, B.C.**
**Address:** 602 Tamarack Street, Castlegar, B.C., VIN 2J2: 250:365-5656
**Email:** kenns@delphiniumholdings.ca

**Education:** Masters of Science, Royal Roads University, Victoria, BC, 2000. "Recovery of the Trail Ecosystem from 100 Years of Heavy Metals Smelting"
B.Sc., Botany, University of Victoria. Majored in plant and wildlife biology; 1980

**Affiliations:** Society for Environmental Toxicology and Chemistry, American Chemical Society
Grasslands Conservation Council of B.C. (joined in 2002)
College of Applied Biology: served on the College Board 2003 - 2005

**Advisory roles** Alberta Environment Committee for nomination of toxic substances by Albertan public. (2000- 2002): Science Advisor
Athabasca Oil Sands Wood Buffalo Environmental Effects Monitoring Committee: Impact of emission exposures in the Athabasca (five years: 1995 – 2000). Science Advisor

## Experience:

July 2003- present

**Delphinium Holdings Inc. (Formerly Larkspur Biological Consultants) Castlegar, BC**

***Principle Owner; Ecotoxicology***

*Project Advisor* Heavy metals distribution and abundance in the Trail Environment, and impacts of sulphur dioxide on the ecology of the Columbia Basin (15 years). Reclamation monitoring. Reclamation design and implementation. Ore spill clean-up and remediation in aquatic and terrestrial habitats. Concentrated sulphuric acid spill investigation of effects. Conducting ongoing risk remediation for various heavy metals-impacted areas in B.C. Yuckon and NWT. Continuing the boreal forest research started in 1995 on contaminants in soils and gas well flaring impacts in Northeastern B.C. Artic mine dust impacts for Ekati Mine. Calcification potential for Burns Bog. Vegetation management and biomonitoring for a variety of energy and mining interests in the province.

1979 - 2003 **Larkspur Biological Consultants Ltd. Victoria - Castlegar, BC**

***Principle Owner; Ecotoxicology***

Project manager; impacts of sulphur dioxide, heavy metals, fluoride and salts on plants, wildlife, soils using various field diagnostic tools including soils and groundwater concentrations and extractability / solubility, plant uptake and bioaccumulation in lichens, conifers, indicator vascular plants, insects and small mammals, as well as field interpretation of background pathology and constraints to

insects, vegetation and wildlife population recovery. Use of various mapping and interpretative tools including bird population ecology, vegetation baseline and impact studies, wildlife surveys, slope stability using native plants, ecological risk assessment and weight of evidence approach, guidelines for bioengineering, air and groundwater pollution effects assessment and remediation, forest pathology, wildlife habitat ecology, red and blue listed warbler status reports. Contributions to ecosystem analytical science spanning 32 years,

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## Metals, organics, halides, etc

**SNC Lavalin, for CNRL** **Northern Location**
Impact and fate of multiple spills on groundwater, vegetation and wildlife, COCs include cadmium, barium, arsenic, hydrocarbons. (2011 -2012)

**Teck Metals** **Trail, BC**
Final report summarizing 10 years of study on the fates, transport, uptake and impacts of heavy metals and sulphur dioxide on the Columbia River Basin. (2010)

**EBA for Ministry of Transport** **Vancouver**
Assessment of the water chemistry and fate of calcium and other dust elements in Burns Bog. (2010)

**SNC Lavalin, for DEVON Canada** **Northern Location**
Impact and fate of multiple exposures of sulphur dioxide and trace metals vs ordinary pathology on soils, groundwater, vegetation and wildlife, (2011 -2012)

**SNC Lavalin, for CNRL** **Northern Location**
Impact and fate of ten year old salt brine and metals explosion: assessment of the recovery and review of consultants concludions (2011 -2012)

**Anonymous client**
Toxicity and pathology of heavy metals in soils, groundwater and forage to horses and mules. Ongoing since 2007.

**Rescan, for Ekati Mine** **Ekati Mine, NWT**
Distribution of metals in dust from a mining operation, including snow meltwater analysis, ongoing since 2007.

**Insurance Corporation of B.C.** **Trail, BC**
Impact of a sulphuric acid spill on vehicles; fates of metals and plastics exposed to aqeous concentrated $H_2SO_4$. With forensic automotive specialist in Detroit and plastics specialist in Vancouver (2010)

**Insurance Corporation of B.C.** **Castlegar and Trail, BC**
Management of areas impacted by ore spills. (2007 to 2010)

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**Insurance Corporation of B.C.** **Trail, BC**
Monitoring of red lead paint dust in the environment around area impacted by bridge repair over the Granby River. Reviewed risk and determined impacts in comparison to ambient air $PM_{10.}$ (2007)

**Power Group, Teck Cominco Metals: Pend Oreille** **Waneta, BC**
Monitored, evaluated and suggested remediation options for a hydro development on a rare plant and animal community impacted by past metals smelter emissions near the U.S. border of B.C. (2006)

**Teck Cominco Metals Ltd.** **Trail, BC**
Biomonitoring of the remediation and reclamation of a metals contaminated slope near Trail, B.C. includes the determination of metals concentrations in plants and soils groundwater, interpretation and assessment of risk of uptake to receptors in the Trail Environment. (1995-2001)

**Teck Cominco Metals Ltd.** **Trail, BC**
Collected and interpreted field-based contaminant uptake and bioaccumulation data for heavy metals in a large-area Environmental Impact Assessment. Use of sampling and analysis of uptake, soil metal solubility (sequential extraction), indicator plant reponse and forage species uptake as well as body burden data to design and implement a reclamation plan. Use of bioaccumulation and risk to wildlife data from exposures to accumulated heavy metals. The project was vetted by the Washington State Department of the Environment, the US EPA and Western Washington University. (2000 - 2007)

**INCO Ltd Manitoba Division** **Thompson, Manitoba**
Field determination of impacts of a 50 year old copper mine and smelter on vegetation of area surrounding the mine, smelter and tailings impoundments. Field determination of distribution of metals, distinguishing impacts from ecological constraints from metals and sulphur dioxide deposition. Use of indicator plant pathology and lab analysis of metals concentrations in a series of locations around the smelter (2004).

**Power Group, Teck Cominco Metals: Pend Oreille** **Newly, BC**
Grass seeding and reclamation of a linear development and developed monitoring program for re-vegetation, including rare plants, native vegetation and wildlife habitat (2004)

**Cominco Metals Ltd., Trail Operations** **Trail, BC**
Designed, established and calibrated a large lichen and moss biomonitoring system covering 100,000 hectares including trans-boundary lands (110 sites). The study focused on changes in lichen accumulation of metals and sulphur and subsequent statistically significant decline over time as a result of the decline in emissions over time. Changes in soil coloration, conifer pathology and other common features in each plot were also indicative of long term trends in air quality impacts. (2000)

**Aquila Networks Ltd.** **Creston, BC**
Carried out sampling and analysis of copper sulphate contamination and removal of contaminated materials from the Glenmerry Substation. (2004)

**Alcan Aluminum** **Kitimat Arm, BC**
Provided assessment of existing mapping and biomonitoring of Alcan Aluminum's fluoride and sulphur dioxide emissions. Use of indicator plant response to changes in emissions and particulate deposition over time, as well as pathological conditions of forest stands and wetlands. Small mammal species receptors were included in the design (2000-2002)

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**Golden Bear Mine** **Shelsay River, BC**
Environmental baseline data collection for a gold ore mining and smelting facility in northwestern Cassiar Mountains of B.C. (1990). Using a series of methods including set plot photographic techniques, lichen pathology and changes in lichen uptake of mercury, cadmium, arsenic, and sulphur were used to indicate baseline conditions. (1985 – 1990)

**Wood Buffalo Environmental Effects Committee** **Northern Alberta**
Served as one of six science advisors to an Environmental Effects Management group (Athabasca Oil Sands) on the development of an effective monitoring program for an area impacted by 60 years of bitumen mining and refining. (1990 – 1997).

**Anadarko Canada Ltd** **Klua Creek, BC**
Evaluated and reported on the effects of a severe brine spill on wildlife and native plants in a northern boreal forest. Oversaw the reclamation of steep, unstable slope with native grasses, salt tolerant conifers, and birch. Liaison with Anadarko staff and with Ministry of Water, Land and Air Protection (Waste Management Branch) staff in the Victoria headquarters and the Prince George regional office. (1999-2001)

**Petro Canada** **Blueberry, BC**
Evaluated the effects of a compressor and flare pit emitting heavy metals and hydrogen sulphide, and on the ecology of a sub boreal ridge ecosystem. Scope of work included field assessments, documentation, and public meetings. (1999)

**Alberta Environment** **Alberta**
Served on the science advisory committee for evaluation of the public nomination of toxic substances for consideration for regulation by the Alberta Government, specifically for the evaluation of the direct and indirect effects of 132 nominated substances on wildlife and vegetation, for the duration of the committee's life. (2001)

**Pacific Forestry Centre and Forestry Canada** **Yukon and British Columbia**
Designed, implemented, and published the results of seven years of field-based heavy metals and sulphur dioxide monitoring for the Pacific and Yukon Regional component of the Canadian Forest Service Acid Rain National Warning System. Use of lichens and mosses were the main component of the system, which was maintained with repeated sampling. Data were related to forest health and soil factors.

**Syncrude Canada Ltd.** **northern Alberta**
Completed a study of the distribution of sulphur and heavy metals in lichens from 15 sites near the Birch Mountains, in the Sub arctic to Sub-Boreal ecosystems north of the Tar River, Alberta. (1998)

**Canadian Natural Resources Ltd** **Northwest Territories**
Designed and implemented a biomonitoring system of impacts of sulphur dioxide on lichens, soils and vegetation for a glycol dehydrator, with provision for liaison with First Nations. (2003)

**Talisman Energy Inc.** **Northeastern British Columbia**
Provided field assessments and documentation on the impact of sour gas well flaring on lichens, soils and vegetation on 24 different well sites with variable ecology over several years in boreal and northern Rockies ecosystems. Field work is based on plant biochemistry and symptomology as distinct from ordinary pathology and climate effects. These projects are completed for each well in response to modeled concentrations and regulatory requirements. (2000-2010).

**Duke Energy (now Spectra Energy)** **Northeastern British Columbia**
Designed and implemented a biomonitoring system for evaluating the effects of sulphur dioxide and heavy metals emissions on the Pine River and Sukunka River ecosystem from a new gas facility in northeastern BC. Monitoring of lichens, indicator plants, soils, conifer response and passive monitoring are being used to show changes from the pre-construction baseline, and long term trends are being compiled, to meet regulatory requirements. (2002 - present).

**Canadian Natural Resources Ltd.** **Northeastern British Columbia**
Designed, implemented, and maintained a biomonitoring system for several well sites in sour gas well fields in the Murray and Babcock Mountain area of northeastern BC. This project has provided field assessments and documentation on impacts of continuous flaring and has shown the recovery of vegetation following the installation of a vapor recovery system. (1996-present)

**Oil and Gas Commission** **Northeastern British Columbia**
Conducted three years of field research into the effects of sour gas well production tests on the northeastern British Columbian environment. The project was carried out on behalf of the Oil and Gas Commission in response to research needs regarding short-term exceedance of air quality guidelines. Currently compiling a policy advisory document, using field response measurements of conifers, lichens, soils, and common known indicators of sulphur dioxide impingement. Also providing the design elements for the pad creation to reclamation phase, as required by regulation. (2000-2003)

**Ministry of Environment, Waste Management Branch** **Prince George, BC**
Wrote a guide to monitoring the effects of air pollutants on northeastern BC's resources for the Ministry of Environment, Waste Management Branch, and Prince George regulatory office. (1995)

**Aquila Networks Ltd.** **Creston, BC**
Carried out sampling and analysis of potential petroleum and BTEX contamination of off-site soils used in a substation pad development. (2003)

**BC Hydro** **Lower Arrow Lakes, BC**
Involved in preparation of guide to the use of native vegetation and bioengineering techniques for slope stability in the Columbia Valley. Included photographic and descriptive information on selected native species, illustrated descriptions of bioengineering techniques, and liaison with local and regional native plant nurseries. (2002)

**BC Hydro** **Lower Arrow Lakes, BC**
Impact of inundation on soils, groundwater and plants (2007 to present)

## Impact analysis

**Fairmont Hot Springs Resort** **Fairmont, B.C.**
Rare plant and animal surveys on a proposed linear development; provided advice and design features to a 'Green Resort Development' proposal. Project included public meetings, liaison with First Nations and government agencies. (2006)

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**Ministry of Parks,** **Nelson**
Survey of rare vascular plants, lichens and mosses in the dry Interior Douglas fir zone at Syringa Provincial Park (2005)

**Forestry Canada** **Victoria**
Ten years of design, implementation and interpretation of the impact of acid rain and metals on lichens and mosses in the Forestry Canada Acid Rain National Early Warning System Plots for the Pacific and Yukon Region (1987- 1997)

**Forestry Canada** **Victoria**
Incorporating lichen monitoring into the Forest Chronosequence of Vancouver Island. With Tony Trofymo. (1997- 1999)

**Ministry of Environment** **Williams Lake**
Enhancement and monitoring of lichen forage communities for woodland caribou of the Itcha Ilgatchuz herd of the Chilcotin. (1993- 1998)

**World Wildlife Fund** **Clayoquot Sound**
Assessment of vegetation and wildlife habitat representativeness for meeting the protected area strategy of British Columbia. Mapping ad documentation (1996)

**BC Habitat Conservation Foundation,** **Caycuse, Sayward, Clearwater, Blue River and Woss, BC**
Integrated Wildlife Intensive Forestry Research-funded habitat enhancement in second-growth potential for caribou, deer and elk winter ranges in B.C.. Included baseline data collection, silvicultural treatments and transplanting of lichens to improve habitat (1979-1991)

**Ministry of Forests and Ministry of Environment** **Nanaimo, BC**
Prepared Operational Guide to forested habitat enhancement and maintenance for deer and elk and in coastal forests. Revised to incorporate the Forest Practices Code and new Results-based Code. Vancouver Forest Region. (1997)

**Forest Service of B.C.** **Vancouver Forest Region, BC**
Developed a biophysical relational database, including physiography, geology, hydrology, wildlife, vegetation, fish, rare elements, including lichens, and invertebrates, mapped as land cover at 1:70 000 for Vancouver Forest Region coastal forests. The vegetation polygons were related to physiographic, hydrological, forest classification features lists, and/or maps for the map area. Produced in FoxPro 2.5 for Windows as well as mapped on Mylar base maps. With Bruce Enns. (1997).

**Ministry of Forests** **Cariboo Region**
Several years of repeated monitoring of the efficacy of vegetation management treatments on soils and vegetation at Canim Lake and Reddish Creek (near Barkerville). (1985- 1991)

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**Nature Trust and the Ministry of Environment, Penticton**

Vegetation, terrain mapping and sensitivity assessments of vegetation and stream side riparian areas in dry interior vegetation type at White Lake in South Okanagan. Included documentation of rare grassland plants and evaluation of cattle impacts. (1990-1991)

**Elk Foundation and Ministry of Environment, Cranbrook**

Biophysical evaluation and monitoring of the interior riparian and montane rangeland at Grave Prairie and Elk River. Evaluation of the efficacy of exclosures of various types and ages. This project included repeated measures of changes over time given enhancement treatments of thinning, pruning, ripping, soil amendments, etc. (1985- 1987)

**Ministry of Environment, Fish and Wildlife Branch, Kamloops**

Biophysical habitat analysis and mapping of Lac du Bois dry interior grassland and forested habitats including distribution of rare forested and grassland ecosystem components. (1995).