

## Demonstrated Expertise in Pit Lake Management, Environmental Chemistry and Modeling – Curriculum Vitae for Jerry Vandenberg

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### ABSTRACT

Developing large-scale industrial projects poses risks to surface water bodies and their connected ecological systems. At all stages of project development, from initial site investigations to approvals to operations and closure, environmental models can be employed to predict the risk to the environment. More importantly, models can be used to derive and test mitigation strategies to avoid or minimize the risk. However, models are often mis-applied during this process – not through nefarious means but through lack of understanding and communication of the model's limitations, uncertainty and range or reliability.

A special case where models are often mis-applied is mine pit lakes. Mine pit lakes are formed at the cessation of open-pit mining, when the void is filled either passively or actively with water and other materials. In the past decade, many case studies have been published from which lessons can be derived about how to avoid the failures of the past and create beneficial uses in existing and future pit lakes. In some cases, this may require the use of numerical models, whereas in other cases, especially where applicable analog pit lakes have been created, best practices and lessons learned can guide the development of the pit lake toward beneficial end uses.

This document describes case studies of relevant projects undertaken by Jerry Vandenberg over the past two decades and serves as his curriculum vitae.

**Keywords:** *water quality modelling; mine pit lakes; fate and transport models; expert witness services; best practices; maximizing environmental performance*

### Introduction

Vandenberg Water Science, Ltd. was formed as a consulting firm that specializes in three core areas:

1. Pit Lake Management
2. Review of Environmental Models
3. Expert Witness Services

Jerry Vandenberg is the sole proprietor of VWS, and his demonstrated expertise over the past two decades is highlighted below.

### Background

Jerry Vandenberg is registered as a Professional Chemist in Alberta and B.C. He holds an M.Sc. (Environmental Chemistry) and B.Sc. (Environmental Science, Chemistry Major) from the University of Calgary and a Water Quality Technology diploma from Okanagan University College.

Jerry was a Principal Environmental Chemist at Golder Associates from 2004 to 2019. Between 1998 and 2004, he held positions as a water treatment and environmental technologist. He has also worked for environmental departments in all three levels of government for short-term assignments since 1997.

He now divides his time among consulting at Vandenberg Water Science; as a sessional instructor of Environmental Science, Environmental Impact Assessment and Limnology at UBC (Okanagan); and as a paid-on-call fire fighter.

### Methods

Jerry has developed and applied methods for water quality monitoring and modelling that have become part of university course material (Vandenberg et al. 2005) and industry best practices (Vandenberg et al. 2016). Notable projects related to model development, model application, water quality monitoring, pit lake management and expert witness services is provided in Table 1.

Jerry has taught these methods to staff at Golder Associates, as well as external courses for Indigenous Communities, Environment Canada model reviewers and at pre-conference workshops (Vandenberg 2011). Courses and workshops developed and delivered include:

- Aquatics Monitoring Protocols and Interpretation
- Best Practices for Mine Water Modelling
- Water Quality, Hydrodynamic & Dispersion Modelling
- Visual Basic for Applications
- Mental Health and Wellness in the Workplace

**Table 1.** Summary of Experience

Expertise	Services	Projects applied to
<b>Model developer</b>	Sediment diagenesis model ( <i>Vandenberg et al. 2015; Prakash et al. 2015</i> )	Alberta oil sands pit lakes
	Oil sands pit lake model ( <i>Mackenzie 2006; Lauzon et al. 2009</i> )	Alberta oil sands pit lakes
	Oil sands reclamation wetlands model ( <i>Vandenberg and MacKenzie 2006</i> )	Regional oil sands reclamation research
	Cooling pond mass balance and geochemical model	Capital Power Genesee
<b>Modeller or Reviewer</b>	Pit lake hydrodynamic and water quality models	All Alberta oil sands mines; all NWT diamond mines; Burnco McNab; Greater Phoenix; Eagle Mine
	Multiple linked models including site-wide water quality, receiving environment dispersion and far-field ( <i>Lauzon et al. 2011; Vandenberg et al. 2015; Zawadzki et al. 2017</i> )	Mines: Mount Polley; Amaruq; Wolverine; Constanca; Gahcho Kué; Jackpine; Frontier; Kearl; Muskeg River
	Aerial deposition model ( <i>Dayyani et al. 2016</i> )	Alberta oil sands mines
	Sediment-water partitioning model	Alberta oil sands mines
	Tailings storage facility spill model	Nickel Plate Mine; Alberta oil sands mines
	Lake hydrodynamic and water quality model ( <i>Snow et al. 2014</i> )	Snap Lake, NWT; Lac de Gras, NWT; Bootjack Lake, BC
	Cooling pond thermal model	TransAlta Sundance
	Hydroelectric reservoir and river model	Site C Dam
	CORMIX dispersion modelling	Meadowbank Mine
	<b>Water Quality Monitoring</b>	Automated instrumentation ( <i>Vandenberg 2008</i> )
Forensic monitoring		Calgary Zoo; Shorncliffe Lake; Abbotsford; Lussier Hot Springs
Routine monitoring		Teck Beaverdell Mine; Okanagan Lake; Kearl Lake
Spill monitoring		Nickel Plate Mine
<b>Pit Lake Management</b>	Beneficial use of pit lake for water treatment ( <i>Moger et al. 2017; Vandenberg and Litke 2017</i> )	Mount Polley Mine
	Third-party review of internal model	Rio Tinto, Australia
	Determine optimal use of pit lakes for mine waste disposal	NWT diamond mines; Alberta oil sands mines
	Develop industry guidance documents, roadmaps, global reviews and expert workshops for pit lake development ( <i>McCullough et al. 2018; Vandenberg et al. 2014; Vandenberg 2016</i> )	Alberta oil sands mines
	Physical limnology of pit lakes used for passive selenium treatment	BC coal mines
<b>Expert Witness</b>	Reservoir model	BC Hydro Site C Dam
	Water quality and aquatic health components and pit lakes	Teck Frontier Oil Sands Mine
	Water quality component and pit lakes	Total Joslyn North Mine
	Water quality component and pit lakes	Shell Jackpine Mine Expansion
	Hydrodynamic and water quality model	De Beers Snap Lake Mine
	Water quality component and pit lakes	De Beers Gahcho Kué Mine
	Pit lake and water quality expert	Lafarge Phelan Pit
	Provide expert opinion (not testimony) on evidence	Multiple cases, under privilege, for law firms

## Results

Jerry has applied the best available scientific information to approximately 40 large-scale industrial projects to minimize environmental disturbance, balance cost with environmental performance, obtain the necessary permits and approvals, safely operate and close facilities. Many of these projects were multi-year endeavors with rounds of review by government, stakeholders and third-party experts.

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