Wildcat Brook Shale Pit Restoration

Andy Sharpe & Mike Parker

and the

Bluenose Coastal Action Foundation

Bluenose Coastal Action Foundation is a community-based charitable organization with a mandate to address the environmental concerns along the South Shore region of Nova Scotia. Coastal Action's goal is to promote the restoration, enhancement, and conservation of our ecosystem through research, education, and action. They do this in collaboration with the community, stakeholders, and other leaders in environmental protection and improvement. Coastal Action places emphasis on the collection and reporting of factual information, and where possible, is the catalyst for action by using their unbiased factual results of collaborative research, to inform, educate, and inspire the local population to get involved.

The organization has been an established member of the Lunenburg County community since its inception in December 1993. Over the past 20+ years, Coastal Action has successfully completed a vast number of projects within the South Shore region of the province. Project themes have included such issues as River Restoration on the Mushamush, Gold, and LaHave River systems; Water Quality Monitoring in the LaHave River watershed; Endangered Species Projects addressing the Roseate tern, Atlantic whitefish, Atlantic salmon, and American eel; Climate Change and Pollution Prevention initiatives (i.e., Active Transportation, Water and Energy Conservation, Solid Waste Education, etc.); and Clean Boating...to name but a few.

Caring for the environment

Environmental Outreach

Environmental Education

Environmental Stewardship

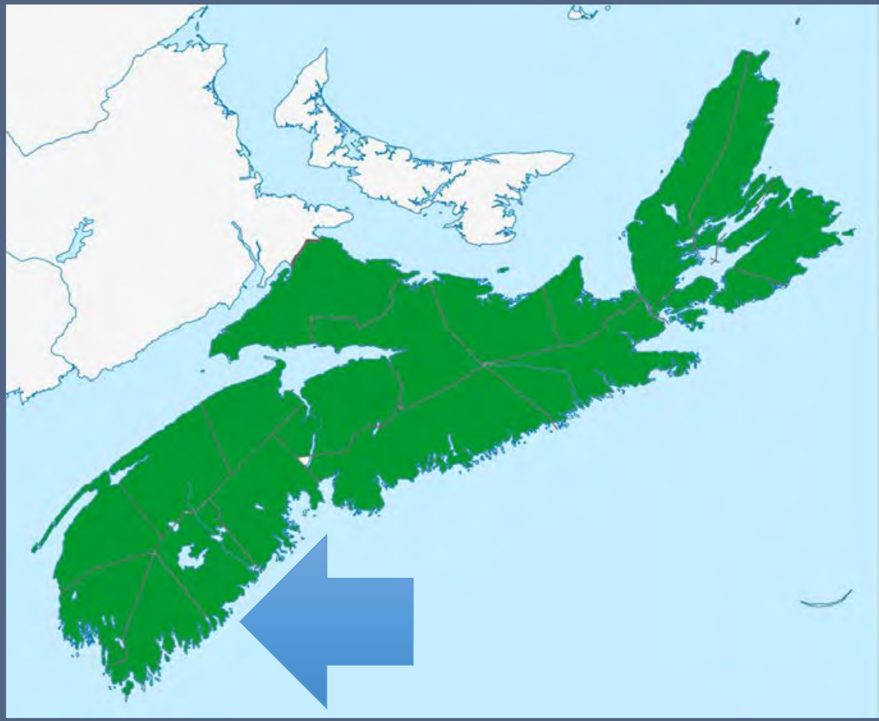
Species at Risk

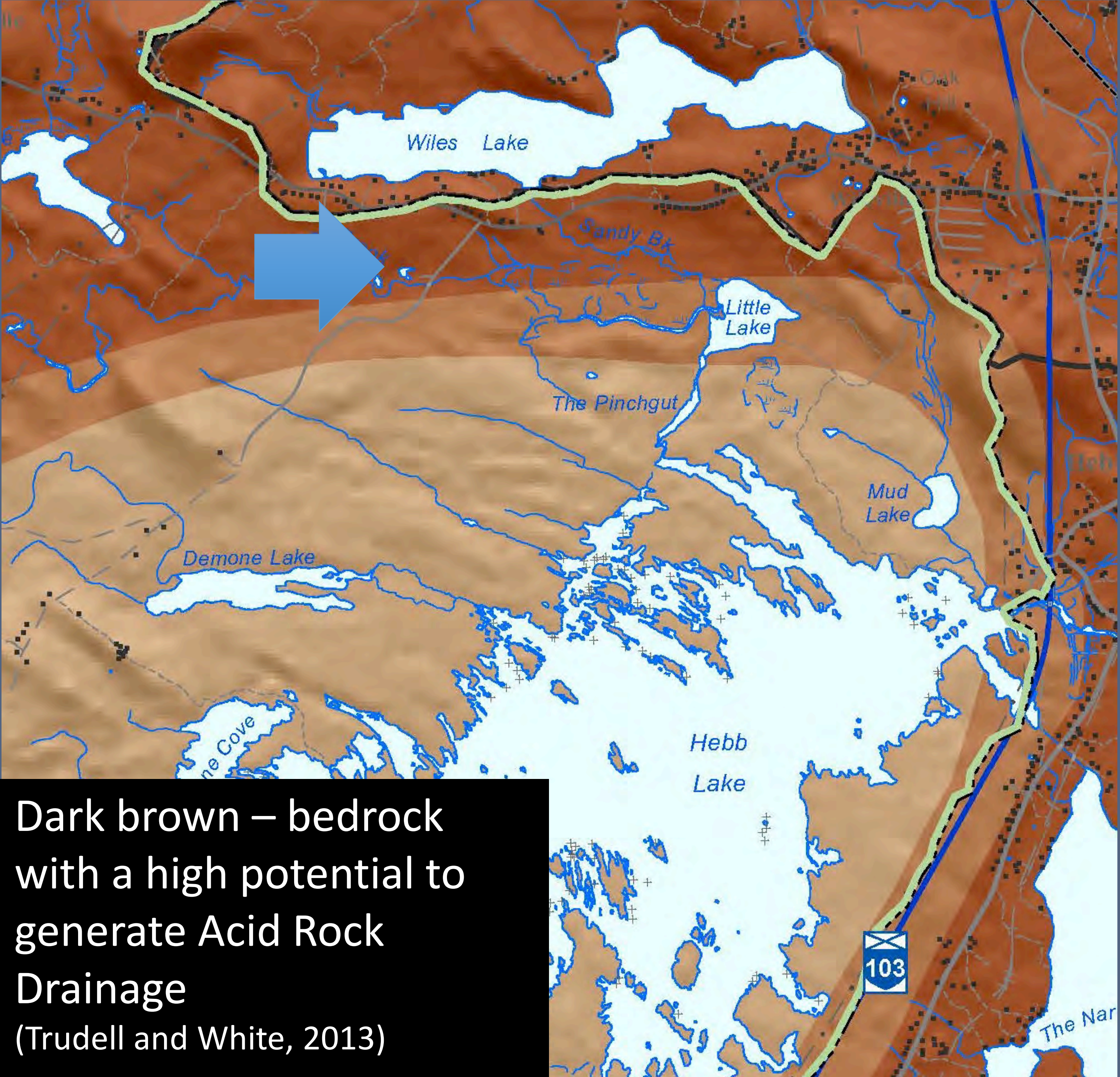
Water Quality

Habitat Restoration

Wildcat Pit Background

- 1.1 ha abandoned aggregate pit
- Excavation concluded +/-20 years ago
- No intentional restoration undertaken
- Surrounded on 3 sides by wetlands
- Adjacent (<25m) to +/- 400m of Wildcat Brook
- Periodic flooding with multiple connection points to brook

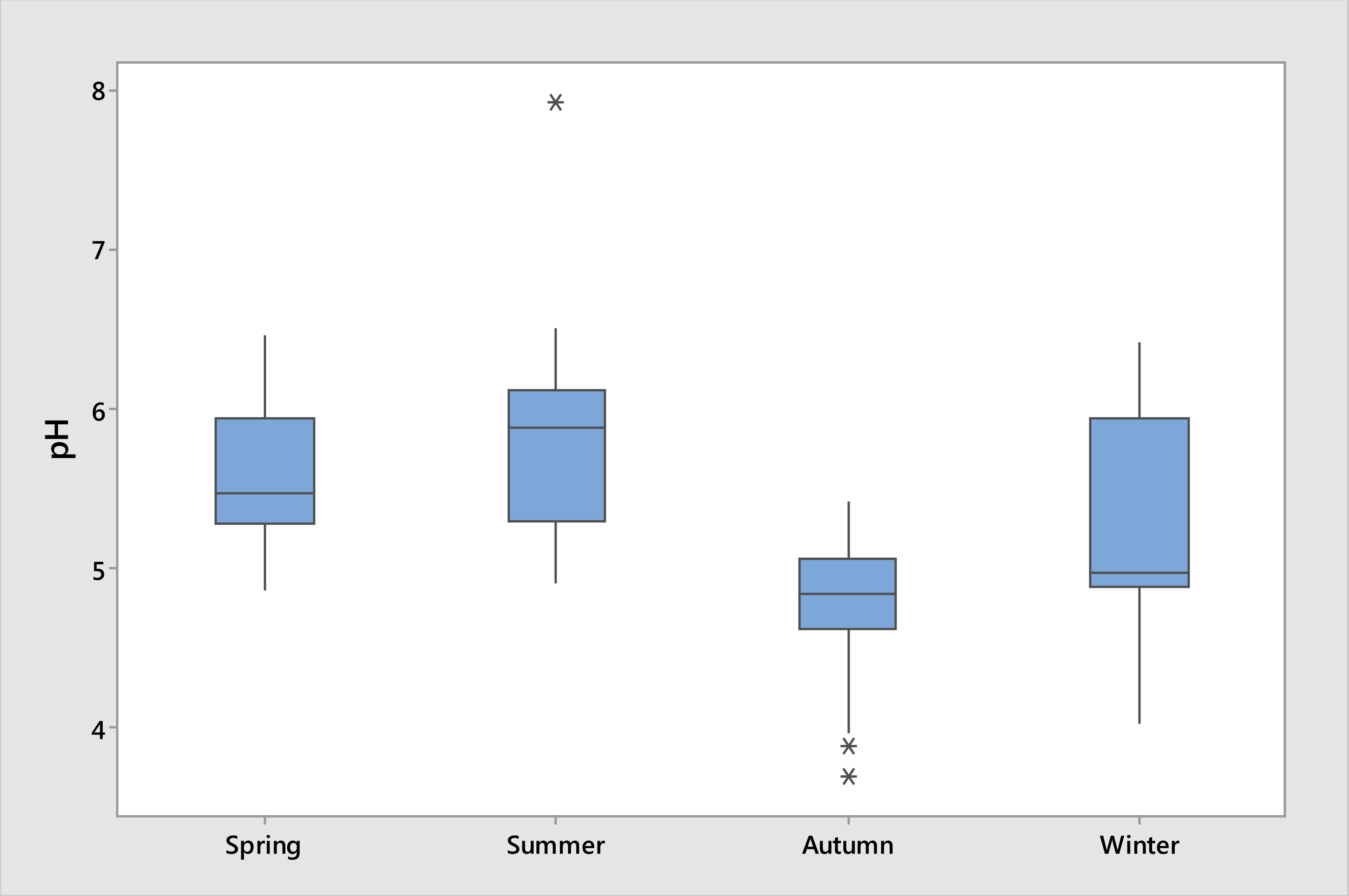




Dark brown – bedrock with a high potential to generate Acid Rock Drainage
(Trudell and White, 2013)

Wildcat Shale Pit is one of numerous abandoned pits in region.

Operations pre-dated Sulphide Bearing Material Disposal Regulations (1995)



Seasonal pH in Wildcat Brook, immediately downstream of pit

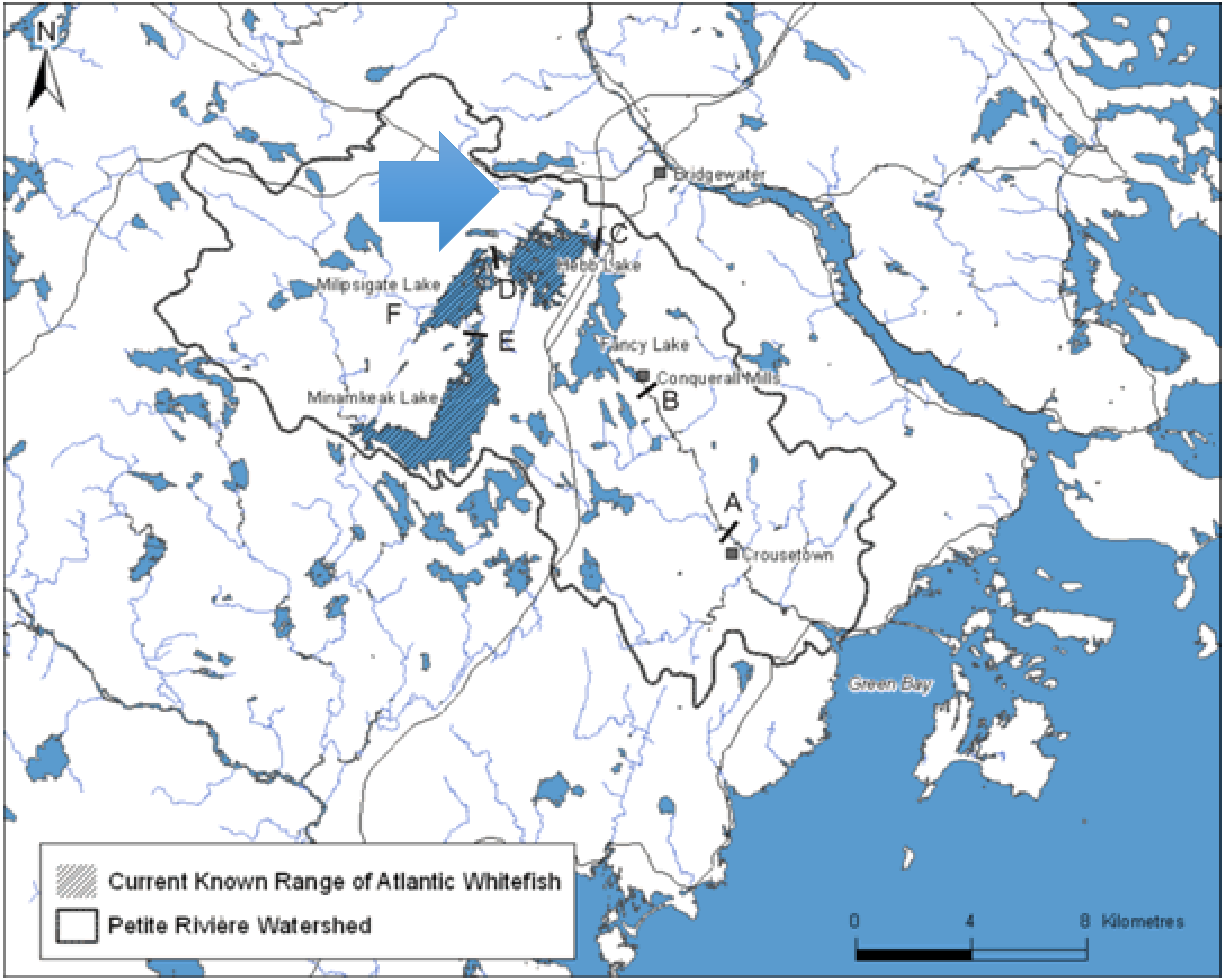
Surface Water Quality
Parameters falling outside WQO

Parameter	Surface Waters within pit	CCME Water Quality Objective
pH	4.48 to 4.58	6.5 to 9
Total Aluminum (µg/L)	340 to 720	5
Total Cadmium (µg/L)	0.021 to 0.032	0.09
Total Chromium (µg/L)	1.9 to 3.6	1.0
Total Copper (µg/L)	2.4	2.0
Total Iron (µg/L)	62 to 550	300
Total Lead (µg/L)	0.6 to 1.1	1.1

Parameter	Surface Waters within pit	CCME Water Quality Objective
pH	4.48 to 4.58	6.5 to 9
Total Aluminum (µg/L)	340 to 720	5
Total Cadmium (µg/L)	0.021 to 0.032	0.09
Total Chromium (µg/L)	1.9 to 3.6	1.0
Total Copper (µg/L)	2.4	2.0
Total Iron (µg/L)	62 to 550	300
Total Lead (µg/L)	0.6 to 1.1	1.1

Dennis and Clair (2012) – impacts of complexation of ionic Aluminum (Al_i) on fish gills leading to respiratory impairment.

[Al_i] exceeds calculated guideline by 2 to 9 times



Headwater tributary for the limited range of the endangered Atlantic Whitefish (*Coregonus hunsmani*)

Tributary to Town of Bridgewater's protected water supply

Restoration Objectives

- moderate abrupt drops in surface water pH
- limit acute toxicity events
- reduce the bioavailability of metals originating from the oxidation of pyritic shales at the abandoned Wildcat pit
- creation and expansion of wetland habitat
- establish a template for the assessment, remediation and monitoring of the shale pit, which could be replicated at other abandoned sites in the catchment.

Restoration Approach

- creation of suitable hydrology conditions to limit the exposure of pyritic rock to oxygen and

- the provision of both organic substrate and a vegetation community to increase the surface water pH and bind soluble metals.

Evaluation of Organic Substrate Options

Organic Substrate Option	Pros	Cons
Municipal Compost	- Large supply locally available (~14km). - Available at low cost. - Use of locally produced material through municipal recycling program.	- Compliance with CCME Level II compost standards. - High nutrient content may create conditions atypical of a nutrient-poor wetland. - Would require seeding and planting with native wetland species.
Organic (hydric) soils salvaged from off-site wetland alterations	- Available at low cost. - Re-use of a material typically requiring disposal when wetlands are altered. - Contains seeds, cuttings and live plant material of wetland species adapted to local climatic conditions. - Nutrient-poor, allowing for rapid establishment saturated reducing conditions and wetland development.	- Supply may be intermittent and dependent of the approval of off-site wetland alterations. - Potential for introduction of invasive species.
Biosolids	- Available at low cost. - Re-use of a material generated from municipal sewage treatment.	- NS Environment indicated that the use of Biosolids at the Wildcat Brook site would not be permitted.

Restoration Plan

1. Site preparation
2. Leveling waste rock piles
3. Placement of salvaged organic soils
4. Alter local hydrology to create saturated to shallow flooded conditions
5. Re-vegetate (as needed): seeding, transplanting, moss innoculation


East Coast Aquatics
eastcoastaquatics.ca
Bobcat
430

Bobcat


eastcoastaquatics.ca
Bobcat
430


Bobcat


Bobcat


Bobcat


Bobcat

WASTE MUSSEL SHELLS TO TREAT ACID MINE DRAINAGE: A New Zealand Initiative

Benjamin Uster[1], Dave Trumm[2], James Pope[2], Paul Weber[3], Aisling D. O'Sullivan[1], Chris Weisener[4], Zach A. Diloreto[4]
[1] University of Canterbury, Department of Civil and Natural Resources Engineering, Christchurch, New Zealand; [2] CRL Energy Ltd., Christchurch, New Zealand; [3] O'Kane Consultants Ltd., New Zealand; [4] University of Windsor, Great Lake Institute for Environmental Research, Windsor, Canada

Introduction

Mine-influenced water (MIW), commonly referred to as acid mine drainage, is a significant environmental issue in New Zealand. Even though MIW geochemistry specific to New Zealand geology and climatic regimes has been extensively studied, little passive treatment remediation work has been fulfilled to date apart from a few small-scale trial systems (Trumm et al. 2005; Trumm 2007; Weber et al. 2007; Weber et al. 2008; Trumm et al. 2008; Cavanagh et al. 2010; Pope et al. 2010; Trumm and Watts 2010). The majority of acidic MIW in New Zealand occurs on the West Coast of the South Island of New Zealand where the main coal fields are located. The topography of the West Coast makes remediation efforts quite challenging as most of the mining sites are remotely located on high plateaus and are surrounded by thick native temperate rainforests established on steep slopes (Figure 1). This tough topography combined with a harsh climate dominated by low temperatures with an annual mean of about 9°C and annual precipitation of 6 meters per year, results in high MIW flows and limited space for reclamation (Davies et al. 2011). In addition, the remote mine locations associated with a low overall population results in a contamination largely hidden from the public view.

Figure 1. A typical abandoned mine adit on the West Coast of New Zealand. The mine drainage is strongly acidic (pH <3) with elevated concentrations of iron (>100 mg/L) and aluminum (>40 mg/L). CREDIT: DAVE TRUMM

Other political reasons explaining the lack of remediation include the absence of a specific MIW reclamation fund (no Superfund financing plan exists in New Zealand), a vague regulation and a poor enforcement policy (Trumm 2007). Neither the Resource Management Act nor the Australian and New Zealand Guidelines for fresh and marine water quality (MfE 1991; ANZECC 2000) specifically addresses MIW issues and most of the legislative and executive work is left to the regional environmental authorities.

To date, passive remediation work consisted of small to medium-scale pilot studies and treatment trials. These have been completed and funded by mining companies and by government research programs, including the Ministry of Business, Innovation and Employment, the Coal Association of New

Figure 2. Example of the New Zealand Mussel long-line farming system.

NATIONAL CONSERVATION PLAN

NOVA SCOTIA
NOUVELLE-ÉCOSSE

RRFB
NOVA SCOTIA

Canada

NOVA SCOTIA SALMON ASSOCIATION

NSLC adopt a stream

sage ENVIRONMENTAL PROGRAM

Nova Scotia Youth Conservation Corps
Clean Foundation

Town of Bridgewater

Aspotogan Ridge