APPENDIX B. PROJECT TEAM MEMBERS' *CURRICULUM VITAE*

McCallum Environmental Ltd.

Meghan Milloy, BSc. (Bio), MES
meghan@mccallumenvironmental.com
Vice President

Years in Practice
21

Certifications

Nova Scotia Advanced Wetlands Delineator and Evaluator

Memberships

Nova Scotia Wetlands Delineation, Maritime College of Forest Technology

Education

- Master in Environmental Studies (MES), York University, Toronto, Ontario, 1997-1999
- BSc. (Biology), Dalhousie University, 1992-1997
- BA (Political Science), Honours, Dalhousie University, 1992-1997

Training

- Wetland Construction: Principles, Planning and Design, Rutgers, 2016
- Wetland Functional Assessment Training Workshop, NSE 2013
- Urban Wetland Restoration: A Watershed Approach, 2012
- Nova Scotia Advanced Wetlands Delineation and Evaluation Course, 2009;
- Water Management and Wetland Restoration Training Course, 2009;
- Identifying and Delineating Wetlands for Nova Scotia, 2008
- Saint John Ambulance Standard First Aid, AED, CPR(C). 2013

Summary

Ms. Milloy oversees, manages, and executes regulatory and environmental projects. She provides project management for Federal and provincial environmental assessment processes and is an experienced EA practitioner. She manages and completes environmental baseline surveys including habitat surveys, species at risk and wildlife surveys, botany and bird surveys, wetland and watercourse delineations, characterizations and functional assessment, fish habitat evaluation, HADD authorizations, and bat hibernacula identification. Ms. Milloy also completes watershed evaluations, and guides clients through the environmental and permitting stages of mining, industrial, alternative energy, and development projects.

Ms. Milloy supports clients through provincial and federal environmental assessment requirements and supports project teams to identify and evaluate project environmental risk. Ms. Milloy has completed several Federal and Provincial environmental assessment registration documents in the past two years and is currently preparing two Impact Assessment Agency of Canada (IAAC) environmental impact statements (EIS) for two mining projects in Nova Scotia. Ms. Milloy consults regularly with federal and provincial regulatory agencies, First Nation communities and local landowners and stakeholder groups.

Ms. Milloy regularly completes applications for wetland, watercourse alteration and HADD authorizations across Atlantic Canada, and has developed and implemented wetland compensation programs, fish habitat offsetting projects, and wetland and fish habitat restoration projects. Ms. Milloy is a trained wetland evaluator, biologist, and restoration professional. Ms. Milloy regularly implements species at risk, habitat and biodiversity mitigation planning, permitting, monitoring plans and offsetting.

Project Experience

- Project Manager and Team Lead for two Environmental Impact Statements (EIS) for submission to the Impact Assessment Agency of Canada (IAAC) (2017-2021).
- Biophysical Lead for Nova Scotia Environmental Assessment Registration Document (EARD) for a gold mining project in Nova Scotia, with planned submission in 2021.
- Provision of biophysical project management and coordination of field surveys to support the IAAC environmental assessment process for three proposed mining projects in Nova Scotia (2014-current).
- Completion of biophysical field surveys to support expansion efforts for several mines in Nova Scotia (2014-2017) and aggregate quarries (2017-2020) to meet requirements under the provincial environmental assessment process.
- Completion of provincial environmental assessments for multiple quarry expansions in Nova Scotia (2016-2020).
- Completion of environmental baseline surveys for the provincial environmental assessment process for a proposed re-development of a gold mine in eastern Nova Scotia in 2013.
- Completion of four provincial environmental assessments for community wind projects in Nova Scotia from 2013-2018.

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Vice President

- Watershed evaluation for wetlands and watercourses at a 500 hectares golf and residential development and associated wetland alteration permitting, compensation planning, wetland restoration activities, and enhancement of several wetlands to increase functionality.
- Surface water assessment and functional assessment, wetland permitting, watercourse permitting, and compensation planning and implementation at an 18 hole golf course and residential development along the south shore of Nova Scotia in 2014. Provision of environmental project management and regulatory lead role for the Project.
- Completed the Provincial Environmental Assessment for the 80 MW Glen Dhu South Wind Power Project, Nova Scotia, for Shear Wind Inc.
- Project Management of regulatory permitting and environmental assessments for a 50 MW Wind Power Project in Nova Scotia for Sprott Power Corp.
- Evaluation of the Musquodoboit River Watershed for wetland restoration opportunities (GIS based and ecology/field based study).
- Evaluation of the Sackville River Watershed for wetland restoration opportunities (GIS based and ecology/field based study).
- Completion of 35-45 projects involving watershed evaluation, land use classification, wetland delineation and alteration and infill, and compensation planning for numerous residential and commercial large-scale developments across Nova Scotia and New Brunswick.

Work Experience

McCallum Environmental Ltd., Nova Scotia, 2010-Present

Vice President/Senior Project Manager - Provides project management expertise for site and/or route selection, constraints mapping, regulatory consultation, environmental assessments, environmental baseline surveys, wetland alteration and restoration planning, environmental protection plan development, regulatory applications, construction monitoring, and reclamation for small and large scale industrial projects. Other responsibilities include marketing, budget management, report preparation and client service.

Strum Environmental Services Ltd., Nova Scotia 2000-2010

Project Manager- From 2000- 2010, provided project management expertise for development clients across Atlantic Canada. Projects included environmental assessment, large scale commercial and residential developments, wetland alteration projects, wetland compensation planning and implementation, wetland restoration and creation projects, phased site assessments, and risk assessment and management.

Environmental Sciences Group, Kingston, ON 1998

Environmental Scientist- in 1998, provided contaminant and project management expertise to Department of National Defense in the Canadian Arctic in support of remediation of several remote military sites. Identified areas required for remediation and completed associated boundary soil and sediment confirmatory sampling and analysis.

Jeff Bonazza, BSc., M.Env.Sci
Jeffb@mccallumenvironmental.com

Years in Practice
8

Education
Master of Environmental Science, *Memorial University of Newfoundland,* 2015

B.Sc. Major in Biology, *St. Francis Xavier University,* 2010

Certifications
- Wetland Plants and Delineation, Fern Hill Institute
- Backpack Electrofishing, Canadian Rivers Institute
- Project Management Planning Course, Environmental Project Management & Sustainability Solutions

Training
- Brook Floater Virtual Workshop, Fisheries and Oceans Canada Species at Risk Program, Jan. 19-20, 2021
- Land Bird Species at Risk in Forested Wetlands Workshop, Jan. 2018
- Technical Writing for Professionals, Natural Resource Training Group, July 2019
- Fish and Fish Habitat Characterization, Natural Resource Training Group, July 2019
- Standard First Aid AED CPR "A", St.

Experience

Mr. Jeff Bonazza has been in the environmental consulting profession since 2015, after completing a master's degree in environmental science. He has managed projects, authored reports, and conducted regulatory consultation and First Nations engagement. Mr. Bonazza has worked as a field biologist on projects throughout Atlantic Canada as well as in western Canada and Ontario. Mr. Bonazza has conducted surveys including; bird surveys, wildlife surveys, evaluation for Species at Risk, herpetofaunal and reptile evaluations, wetland functional assessment, wetland delineation, fish habitat characterization and electrofishing.

McCallum Environmental Ltd., Halifax, NS
Project Manager
Feb. 2022 – present
- Project management
- Report writing
    - Federal Environmental Impact Statements, Provincial Environmental Assessments, Species at Risk permitting, wetland alteration applications etc.
- Regulatory consultation and First Nations engagement
- Design and lead field programs
    - Flora and fauna surveys, Species at Risk assessments, wetland delineation, wetland functional assessment (WESP-AC completed on >50 wetlands in NS), etc.
- Create maps using ArcGIS
- Projects:
    - Dexter Construction Company Limited
        - Environmental assessment registration
    - Cabot Gypsum
        - Environmental assessment registration

McCallum Environmental Ltd., Halifax, NS
Project Coordinator
Dec. 2016 – Feb. 2022
- Project management
- Report writing
    - Federal Environmental Impact Statements, Provincial Environmental Assessments, Species at Risk permitting, wetland alteration applications etc.
- Regulatory consultation and First Nations engagement
- Design and lead field programs
    - Flora and fauna surveys, Species at Risk assessments, wetland delineation, wetland functional assessment (WESP-AC completed on >50 wetlands in NS), etc.
- Create maps using ArcGIS
- Projects:
    - NextBridge Infrastructure LP.
        - Species at Risk permitting.
    - Atlantic Mining Nova Scotia
        - EIS reporting, wetland alteration applications, field surveys.
    - Zutphen Resources

Jeff Bonazza, BSc., M.Env.Sci
Jeffb@mccallumenvironmental.com

John Ambulance, Dec. 2017
- Geographic Information System (GIS) Training, ESRI, Feb. 2015
- WHMIS, CCOHS, March 2018
- PADI Open Water certified scuba diver, Nov. 2010
- MED A1, Canadian Sailing Expeditions Inc. and Transport Canada, May 2008

        - Environmental Protection Plan, reporting and permitting requirements.
    - Bio Design Earth Products
        - Environmental Assessment registration.

McCallum Environmental Ltd., Halifax, NS
Environmental Coordinator
Sept. 2015 – Dec. 2016
- Environmental monitoring
    - Regulatory advising, spill response, erosion/sediment control, wildlife monitoring, water quality monitoring, and reporting on construction activity.
- Provided field support for flora and fauna surveys, Species at Risk assessments, and wetland delineation/functional assessment.
- Report writing (monitoring reports, wetland alteration applications).
- Created maps using ArcGIS
- Projects
    - Valard Construction
        - Environmental coordinator for Muskrat Falls Transmission Line in Newfoundland and Labrador.
    - Terra Firma Development Corp
        - Reporting and permitting requirements.

Memorial University of Newfoundland, St. John's, NL
Research Assistant
2014- 2015
- Conducted a literature review investigating the role of predator/prey interactions of freshwater fish in Ontario.
- Developed a food web of piscivorous fish species in Ontario.

Agriculture and Agri-Food Canada, Truro, NS
Research Technician
2011- 2014
- Entered and analyzed scientific data
- Conducted quadrat sampling and botanical separation
- Prepared samples for analysis
- Operated specialized laboratory instruments
- Supervised and trained laboratory visitors and volunteers
- Assisted research scientists and graduate students in their research

McCallum Environmental Ltd.

Sarah Scarlett, M.Sc.
sarah@mccallumenvironmental.com

Years in Practice
9

Education
M.Sc, Wetland Hydrology, *University of Waterloo,* 2015

B.ES, Geomatics Option, *University of Waterloo,* 2013

Memberships
- Society for Ecological Restoration – Eastern Canada Chapter Board Member

Certifications
- WESP-AC Certified
- Certificate of Indigenous Relations Program, Government of Manitoba

Training
- WESP-AC V3 training, Dr. Paul Adamus/NSECC, 2022
- Electrofishing Training – Crew Supervisor, NRTC, 2021
- Wetland Delineation Training, Co-Instructor and Participant, MEL, 2021
- Indigenous Relations Program, Apr. 2017 – Jan. 2018
- Online Geographic Information System (GIS) Training, ESRI, Ongoing
- WHMIS 2015, CCOHS, Apr. 2020
- Standard First Aid, May 2020

Experience

Sarah Scarlett has been in the environmental profession since 2014, specializing in wetland and biophysical sciences. Sarah holds an MSc in wetland sciences, with a focus on hydrology and restoration. She has worked across Canada in as an academic researcher, provincial regulator, private industry representative and environmental consultant. She has experience in developing and implementing field/research programs, wetland and biological surveys, project management, regulatory permitting, policy development, and Indigenous engagement and consultation.

McCallum Environmental Ltd., Halifax, NS
Project Coordinator
May 2020 - Present
- Project management, reporting, field surveys and regulatory consultation
- Field program design, implementation, and management
- Trained on the utilization of the WESP-AC wetland functional assessment tool, with in-field experience across Nova Scotia in support of regulatory wetland alteration permitting, provincial and federal environmental assessment, wetland monitoring and research programs
- Conduct wetland delineation and functional assessments
- Preform various biophysical assessments (e.g., flora surveys, nest sweeps, turtle surveys, fish habitat surveys), including species at risk
- Report writing for provincial and federal environmental assessments, regulatory applications (e.g. wetland and watercourse alterations), permits and proposals
- GIS spatial database management, map production and spatial analyses (ArcGIS and QGIS)
- Primary Projects:
    - Dexter Nova Alliance – Hwy 104 Twinning Project
        - Project management and implementation of wetland and wildlife surveys
        - Species at risk assessments and permit support
        - Wetland impact assessment and monitoring
    - NS Transportation and Active Transit Highway Projects
        - Project management, development and implementation of wetland monitoring programs
    - WESP-AC Calibration Study
        - Study management, site selection and implementation
        - Coordination and consultation with provincial and academic project partners
    - Atlantic Mining NS Inc.
        - Federal EIS reporting and project management
        - Emphasis on wetland and terrestrial effect assessments
    - Signal Gold – Goldboro Gold Mine
        - Provincial EARD reporting and environmental permitting
    - Valard Construction – ON EWT Transmission Project
        - Field program and project management

Sarah Scarlett, M.Sc.
sarah@mccallumenvironmental.com

Sunterra Horticulture Inc., Winnipeg, MB
Director of Environmental Affairs
Jan. 2018 – Apr. 2020

- Ensure corporate compliance with regulatory requirements and environmental standards for the peat harvesting industry
- Manage environmental reporting, monitoring and peatland restoration programs
- Complete regulatory applications and permitting
- Participate in regulatory consultation and program advisement
- Upkeep environment, health and safety program
- In-field biological assessments, sample collection and laboratory processing

Government of Manitoba, Winnipeg, MB
Peatland Specialist
Jan. 2016 – Dec. 2017

- Lead the implementation of Manitoba's peatland management Act and regulations
- Manage provincial peatland program, peat resources, harvesting industry operations
- Develop best-management-practices and restoration policies in partnership with industry and public stakeholders
- Participate in public and Indigenous consultations
- Seek out and manage collaborative research partnerships

University of Waterloo, Waterloo, ON
Research and Teaching Associate
2011 – 2015

- Participated in a variety of multidisciplinary research projects in wetland ecosystems across Canada
- Research projects focused on the hydrology of natural, disturbed and restored wetlands
- Taught wetland ecosystem functions through lectures and hands-on field and laboratory classes
- Supervised and trained research assistants
- Primary Projects:
    - Nikanotee Fen: Oil Sands Reclamation Project, Alberta
    - Bic-St. Fabien Peatland Restoration Project, Quebec

Mark Alexander MacDonald
mark@mccallumenvironmental.com

Years in Practice
16

Education

M.ScF, University of New Brunswick, 2012.

B.ScF Major in Forest Management, Minor in Wildlife Ecology University of New Brunswick, 2004.

Certifications

- Class 5 driver's licence (1996)
- Emergency First Response and CPR (2022)
- Wilderness First Responder (2014)

Summary
Mr. MacDonald is a versatile, conservation focused ecologist with over 16 years' experience in adaptive project management in challenging environments. A dedicated learner, with a proven record of quickly developing new skills, and an excellent writer for both a technical and general audience. Diplomatic and capable when navigating differing values of multiple stakeholders.

Experience

McCallum Environmental Ltd., Halifax, NS
Project Manager
April 2022 - Present

- Project Management
- Report writing
  - Provincial Environmental Assessments
- Design and lead field programs
  - Flora and fauna surveys, Species at Risk assessments, wetland delineation, wetland functional assessments
- Create maps using ArcGIS
- Projects:
  - Antrim Gypsum Mine

Dept. of Marine and Wildlife Resources, Pago Pago, American Samoa
Wildlife Ecologist
2012-2020

- Principle Investigator on wildlife conservation projects and responsible for grant management, project design, field implementation, permit oversight, and all reporting.
- Designed and implemented a marine turtle conservation programme including a nesting beach monitoring protocol to assess reproductive output on American Samoan beaches and biotelemetry investigation on nesting females. Developed a stranding programme to respond to reports of distressed turtles or dead animals in near shore waters.
- Responsible for designing a Pacific Black Duck monitoring protocol and managing technicians conducting surveys. Developed a trapping protocol for the deployment of satellite transmitters needed to map habitat use and home range of ducks.

USFWS North-western Hawaiian Island National Wildlife Refuge, HI
Guest Researcher
2004-2007

- Led a 2.5-month expedition to Nihoa Island to collect data for Nihoa Millerbird pre-translocation assessment.
- Developed and executed sample design and methods for data collection.
- Responsible for planning camp logistics which included organising all equipment, food and water necessary for living 2.5 months on Nihoa. Netted 85 critically endangered Millerbirds and morphometric data was used to create a method for in-field sexing. Prey density analysis allowed for translocation to proceed.
- Deployed 7 months on Laysan Island investigating the impacts of invasive ant species on nesting success of Tristram's Storm-petrel (TRSP).
- Responsible for implementing project experimental design on the

Mark Alexander MacDonald
mark@mccallumenvironmental.com

ground.

- Included plot layout, eradicating ants from experimental plot, finding active TRSP nests, building nest boxes. Monitored active TRSP nests and measured growth rates of chicks (body mass, tarsus & wing chord measurements, and notes on feather development).

McCallum Environmental Ltd.

Emma Halupka, M.Sc.
ehalupka@mccallumenvironmental.com

Years in Practice
4

Education

M.Sc. in Ecological Restoration, 2017-2019. Simon Fraser University & BC Institute of Technology

B.Sc. Hons. Environmental Science, 2011-2015. Dalhousie University

Training

- Pleasure Craft Operator licence (2022)
- Canadian Red Cross First Aid & CPR/AED level C (2021)
- Class 5 driver's licence (2011)
- Alberta Safety Council All Terrain Vehicle (ATV) Safety Training (2019)
- Introduction to Lichens, Eagle Hill Institute (October 2022)
- AMA Demerit Reduction Defensive Driver Course certification

Summary

Emma is an environmental professional with a wide range of skills in tree and vegetation surveys, wetland monitoring and functional assessments, and species at risk conservation planning. She has a background in non-profit work, designing habitat restoration strategies for birds and reptiles, and organizing citizen science projects. Emma has a wide variety of field work experience in upland, wetland, and aquatic ecosystems.

Select Project Experience

Wetland Ecosystem Services Protocol Calibration Study

Field Lead. 2021- 2022.

- Assisted project manager to organize field work across Nova Scotia including route planning, field logistics, and desktop evaluation of wetlands and access.
- Helped to conduct field assessments of >600 wetlands covering different ecoregions in Nova Scotia over the 2021 and 2022 growing seasons.
- Project is in collaboration with Nova Scotia Environment wetland scientist Ian Bryson, who developed the WESP-AC evaluation system.

Wetland Monitoring Program at Highway 104 Twinning Project

Field Lead. 2021- present.

- Completed wetland monitoring and baseline monitoring for Highway 104 twinning project near Barney's River, Nova Scotia on behalf of Dexter Nova Alliance.
- Conducted visual observations of wetlands along the study site, soil conditions, vegetation surveys, and collected data from monitoring wells.
- Contributing to planning and logistics for the project and assisted in reporting.
- Trained other staff in wetland observational study methods.

Goldboro Gold Mine Biophysical Assessments.

Field technician/ Biologist.. 2021

- Wetland delineation and functional assessments using WESP-AC for 300 wetlands in Goldboro, Nova Scotia to support the biophysical components of a provincial Environmental Assessment.
- Evaluated habitat using the Forest Ecosystem Classification guidelines, surveys for Species at Risk, and assisted in data organization and analysis.
- GIS and geospatial data management

Haliburton Habitat Health Check-up Program.

Project Manager and Conservation Technician. 2019-2020.

- Developed an assessment and mentorship program to help private landowners improve the quality of wildlife habitat on their properties.

McCallum Environmental Ltd.

Emma Halupka, M.Sc.
ehalupka@mccallumenvironmental.com

Experience

McCallum Environmental Ltd. Halifax, NS.

Junior Environmental Scientist. *April 2021- present*

- Wetland delineation, functional assessments, and long-term monitoring.
- Vegetation surveys and species at risk habitat assessments.
- Electrofishing, fish rescues, and fish habitat assessments.
- Species habitat modelling and GIS analysis.

The Land Between Charity. Haliburton, ON.

Project Manager and Conservation Technician. *November 2019 – October 2020*.

- Helped to develop and implement regional conservation strategies for species at risk in Central Ontario, especially birds and turtles. Projects included citizen science programs, public educational events, field work, webinars, and direct population recovery.
- Managed partnerships with Birds Canada, the Kawartha Land Trust, Couchiching Conservancy, post-secondary researchers, and volunteers.
- Led educational tours and presentations for kids and the general public.
- Encouraged local stewardship by developing a Habitat Health Check-up program to help interested landowners manage their property in an ecologically-friendly manner.

Toronto and Region Conservation Authority. Vaughn, ON.

Restoration Field Crew. *September 2019 – November 2019.*

- Worked with a field crew to implement restoration initiatives on the ground throughout the Rouge, Humber, and Don River watersheds.
- Followed moisture and nutrient codes to plant a range of native vascular plants in appropriate microsites.
- Gained an understanding of native species and ecosystems in Southern Ontario and the challenges of ecological work in urban areas.

Alberta Biodiversity Monitoring Institute. Lac La Biche, AB.

Vegetation Field Technician. *May 2019 – August 2019*

- Followed government-issued protocols to establish plots and track biodiversity in remote sites across Northern Alberta.
- Assessed vascular plant coverage, moss and lichen diversity, measured trees, and collected soil cores within one-hectare plots.
- Navigated to sites via helicopter, truck, and ATV, and navigated to remote locations using GPS units. Set up plots using compass and measuring tape.
- Practiced in-lab taxonomic classification for several bryophyte genera and species.

McCallum Environmental Ltd.

Jessica Lohnes, B.Sc.H.
jessica@mccallumenvironmental.com

Years in Consulting
2

Education

Bachelor of Science, Biology (honours and co-op programs) and Environment, Sustainability and Society, *Dalhousie University*, 2016

Training

- Emergency First Aid AED CPR "C", Red Cross
- Electrofishing Certification – Crew Supervisor
- WHMIS
- OHS training for multiple work environments
- Advanced GIS, mapping, and modelling
- Introduction to the Care and Use of Wildlife
- Avid bird watcher since 2014: skilled in identifying bird species by sight and sound. Also skilled in identifying nests
- Participates in the ECCC/CWS North American Breeding Bird Survey and the Christmas Big Count yearly through the Audubon Society
- Volunteer with the Marine Animal Rescue Society (MARS)

Experience

Ms. Jessica Lohnes has been in the environmental consulting profession since May 2021. She primarily performs environmental monitoring for a variety of large and small-scale development, construction and exploration initiatives, as well as project related field assessments across Nova Scotia, Prince Edward Island, Ontario, and Alberta, Canada.

Since beginning with McCallum Environmental Ltd. Ms. Lohnes has completed environmental assessment reporting, specialized avifauna surveys, nest sweeps, species at risk assessments, various fauna assessments, wetland delineation, watercourse assessments, fish and fish habitat assessments, fish rescues, and construction monitoring. She also has experience with environmental regulation and project management/coordination (e.g., regulator and client collaboration, budgets, proposals, and survey design/scoping).

McCallum Environmental Ltd., Halifax, NS

Environmental Scientist

May 2021 - Present

- Environmental monitoring of transmission line construction project (Wataynikaneyap Power Transmission Project):
  - Regulatory advising, spill response/reporting, erosion/sediment control, wildlife monitoring/reporting, wildlife surveys (e.g., nest sweeps and caribou surveys) water quality monitoring, hazardous waste and environmental supply management, camp/equipment inspections, watercourse delineation, and reporting on construction activity,
- Report writing:
  - Monitoring reports, Crown Land use applications, wetland alteration applications, water withdrawal applications, environment assessments, constraints analysis, management plans,
- Conducted fauna surveys (e.g., PGI and track surveys), water quality sampling and surface water flow sampling,
- Species at risk surveys,
- Conducted watercourse assessments and wetland monitoring,
- Conducted fish and fish habitat assessments including electrofishing, fish collection, and fish rescues during construction,
- Completion of watercourse and wetland boundary determination and characterizations for regulatory wetland and watercourse alteration permitting,
- Avifauna surveys: nest sweeps, nocturnal owl surveys, nightjar surveys, spring/fall migration surveys and breeding bird surveys,
- Company mentor/trainer for bird identification and nest sweeps.

Noble Grape, Burnside, Dartmouth, NS

Full Time Sales Associate/Winery Worker - Team Lead - Manager

August 2016 – April 2021

Jessica Lohnes, B.Sc.H.
jessica@mccallumenvironmental.com

Canadian Wildlife Service (Atlantic Region), Environmental Stewardship Branch, Environment and Climate Change Canada, Queen Square, Dartmouth, NS

Wildlife Technician/Biologist

May 2015 – Aug 2015

- Support and assistance in mapping the distribution of marine and coastal birds in New Brunswick and Nova Scotia through research, fieldwork, data compilation, and analysis,
- Aiding with advancing knowledge on bird species and their occurrence and abundance in the Maritimes for landscape planning and the conversation/management of birds (e.g., SARA),
- Assistance with field work relating to birds (e.g., colonial bird and nest census/surveys, banding, deploying tags (GPS and VHF tags), telemetry studies, collecting blood/feather samples, weighing birds, aerial/vessel-based surveys, and other studies at bird colonies),
- Avifauna population assessments and monitoring (e.g., nests with chicks, adults in a colony, species at risk, etc.),
- Working in various field conditions (e.g., IBAs and remote islands),
- Completed honours project for Dalhousie University: *Foraging ecology and diving behaviour of the black guillemot (Cepphus grylle) during nesting season from Country Island, Nova Scotia, Canada.*

Maritime Brain Tissue Bank, Department of Medical Neuroscience, Dalhousie University, Halifax, NS

Technician and Research Assistant

Sep 2014 – Dec 2014

- Research in this laboratory is focused on cholinergic involvement in Alzheimer's disease (and other neurodegenerative diseases) as well as the development of tools for the diagnosis of this disease,
- Research paper published as a result of work: Reid, G. A., Geula, C., & Darvesh, S. (2018). The cholinergic system in the basal forebrain of the Atlantic white-sided dolphin (*Lagenorhynchus acutus*). Journal of Comparative Neurology. https://doi.org/10.1002/cne.24460.

Compliance Promotion, Export Support and Environment Effects Monitoring Section – Environmental Protection Operations Directorate (Atlantic Region), Environmental Stewardship Branch, Environment and Climate Change Canada, Queen Square, Dartmouth, NS

Jan 2014 – Apr 2014

- Assisting Environment Canada with its efforts to improve compliance with federal environmental laws and regulations (under the Canadian Environmental Protection Act and the Fisheries Act).

Aquaculture Association of Nova Scotia, Halifax, NS

Outreach Biologist

May 2013 – Aug 2013

McCallum Environmental Ltd.

Katrina Ferrari, B.Sc.
katrina@mccallumenvironmental.com

Years in Practice
3

Education
Bachelor of Science with Major in Biology, *Saint France Xavier,* 2019

Training
- Emergency First Aid and CPR "A", Nova Scotia Lifesaving Society,
- WHMIS, CCOHS,
- Electrofishing
- Pleasure Craft Operator
- Open Water Scuba Instructor

Experience

Ms. Katrina Ferrari has been in the environmental consulting profession since June 2020. She primarily performs environmental monitoring for a variety of large and small-scale development, construction and exploration initiatives, as well as project related field assessments across Nova Scotia, Canada.

Since beginning with McCallum Environmental Ms. Ferrari has completed wetland delineation, watercourse assessments, fish and fish habitat assessments, and construction monitoring for environmental compliance for a 1300km transmission line project.

Ms. Ferrari is certified in electrofishing.

McCallum Environmental Ltd., Halifax, NS
Junior Environmental Scientist
June 2020 - Present
- Environmental monitoring of transmission line construction project
  - Regulatory advising, spill response, erosion/sediment control, wildlife monitoring, water quality monitoring, and reporting on construction activity.
- Report writing
  - Monitoring reports, Crown Land use applications, wetland alteration applications, water withdrawal applications
- Conducted fauna surveys, water quality sampling and surface water flow sampling
- Conducted watercourse assessments
- Conducted fish and fish habitat assessments including electrofishing and fish rescue during construction.
- Completion of wetland boundary determination and characterizations for regulatory wetland alteration permitting.

Melissa Dubé, BES
melissa@mccallumenvironmental.com

Years in Practice
5

Education
Bachelor of Environmental Studies, *Saint Mary's University, 2014*

Photography Diploma, *Nova Scotia Community College, 2008*

Training
- Aboriginal Awareness Training
- Wildlife Awareness and Bear Safety
- Standard First Aid & CPR + AED
- Transportation of Dangerous Goods
- WHMIS
- Energy Sector Driver Improvement Training
- Fire Extinguisher Training
- OSSA Basic Safety Orientation

Experience

Melissa Dubé has been in the environmental profession since 2015 and brings a blend of field based and administrative expertise. Melissa has coordinated and supported projects related to air quality monitoring, cumulative effects monitoring, deposition monitoring, Traditional Knowledge Community Based Monitoring, and forest health surveys. Melissa is responsible for GIS analysis and mapping, reporting, supporting engagement with community members, landowners and stakeholder groups, data collection and documentation related to field activities and is a member of the company's Joint Occupational Health and Safety Committee. Melissa is a detail-oriented and organized individual and has extensive experience from providing administrative program support to working at remote field sites accessed by helicopter. Her time spent working in the Alberta Oil Sands Region (Wood Buffalo) has provided her with experience working with First Nations Communities and a commitment to health and safety standards and procedures.

McCallum Environmental Ltd., Halifax, NS
Junior Environmental Scientist
January 2022 – Present
- Completing GIS analysis and creating maps using ArcGIS
- Report writing, formatting and compilation (Environmental Assessments, engagement reports, wetland alteration application reports, technical reports)
- Supporting public and community engagement
- Planning, coordination and support for community open houses
- Data entry and administrative project tasks
- Developing and writing procedures and policies
- Providing field support for flora and fauna surveys, Species at Risk assessments, and wetland delineation/functional assessments
- Supporting the Joint Occupational Health and Safety Committee as a committee member since its establishment in 2022

McCallum Environmental Ltd., Halifax, NS
Office Administrator
September 2021 – January 2022
- Created company operating procedures.
- Developed an extensive Employee Manual for the company.
- Assisted in the revision of the Health and Safety Manual.
- Managed and maintained electronic administrative files, document management system and team collaboration software.
- Managed daily administrative functions of the office.
- Prepared meeting agendas, facilitated meetings and took meeting minutes for internal meetings.
- Provided administrative support to senior Management as required.
- Assisted with recruitment and onboarding of new employees.
- Developed an Onboarding procedure for the company.
- Responsible for purchasing and ordering of office inventory and supplies.
- Provided formatting and revisions for client reports.

Wood Buffalo Environmental Association, Fort McMurray, AB
Office Administrator
August 2019 – April 2021
- Provided administrative support to the Executive Director.
- Prepared meeting agendas, facilitated meetings and took meeting minutes for internal and technical meetings with the organization's Members and stakeholders.

- Supported technical Program Leads and Stakeholder Engagement Coordinators in meeting administrative obligations.
- Developed and maintained administrative standard operating procedures.
- Managed daily administrative functions of the office.
- Acted as the first point of contact in the office, including reception duties (answering phones and greeting visitors).
- Managed and maintained electronic administrative files, document management system and team collaboration software.
- Facilitated the organization's implementation of an electronic security access system.
- Responsible for recruitment and onboarding for new employees.
- Compiled monthly progress reports in collaboration with programs and Team Leads.
- Responsible for purchasing and ordering of office inventory and supplies.

Wood Buffalo Environmental Association, Fort McMurray, AB

Terrestrial Environmental Effects Monitoring Field Technician

May 2016 – August 2019

- Actively participated in Traditional Knowledge Program for 3 consecutive field seasons working with Elders of the Fort McKay First Nation.
- Supervised junior team members, including training for new employees.
- Recorded thorough notes and documentation of field activities.
- Contributed to meeting agendas and meeting material preparations.
- Managed assigned tasks and personal workflow with tracking in team collaboration programs.
- Conducted year-round sample change-outs for multiple Forest Health Programs in remote wilderness safely and efficiently.
- Developed and updated Standard Operating Procedures.
- Assisted in the establishment of new sampling sites including location scouting, site relocations, plot staking and site documentation.
- Completed site maintenance at all remote and local sites as required.
- Prepared samples and field supplies for 7 Terrestrial Environmental Effects Monitoring Programs at up to 98 monitoring sites including monthly, bi-monthly, and bi-annually sampling schedules.
- Packaged and prepared all retrieved samples for lab shipments and corresponded with lab contacts regularly.
- Tracked inventory and sent requests for replenishments as needed.
- Samples collected were for long term cumulative effects monitoring including passive air sampling, precipitation sampling, lichen sample collection, as well as assisting with vegetation surveys, soil sampling and deposition studies.
- Conducted maintenance of meteorological equipment and site infrastructure (access trails, helipads, plot markers, sampling equipment, etc.).

Wood Buffalo Environmental Association, Fort McMurray, AB

Program Support

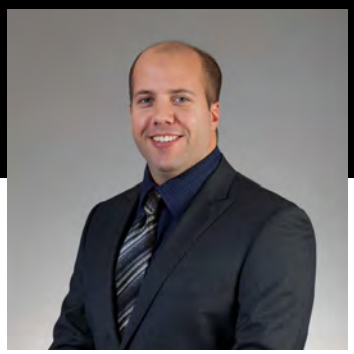
January 2016 – April 2016

- Worked directly under the Executive Director to catalogue and copyright registration of WBEA scientific reports.
- Established the WBEA library as a physical document database.
- Recorded data, searching for, and reproducing historical WBEA related reports and organizing documents for future reference.
- Assisted with administrative duties as needed including filing for accounting and answering telephone calls.

A GHD Associate

Andrew Betts MASc, P.Eng.

Business Group Leader - Ontario Integrated Water



Location
Waterloo, Ontario, Canada

Experience
16 years

Qualifications/Accreditations
- Registered Professional Engineer: Ontario, Alberta, and Nova Scotia
- MASc Water Resource Engineering, 2013
- BEng, Water Resources Engineering, 2007

Key technical skills
- Water Resource Modelling, Design, and Construction
- Water Distribution Modelling
- Hydrologic, Hydraulic, and Water Quality Modelling

Memberships
- Member, Environment Canada Road Salt Working Group and Salt Vulnerable Area Subgroup

Relevant experience summary

Andrew is a Project Director and the Business Group Leader for GHD's Integrated Water Management Group. He has over 16 years of experience in water resource modelling, design, and construction, and is a licensed engineer in Ontario and Nova Scotia. Andrew has experience as a design engineer on numerous surface water projects, including dams, mine water management, stormwater management, water distribution modelling studies, natural channel design, green infrastructure design and environmental monitoring. Andrew's technical background specialises in hydrologic, hydraulic, water quality and sediment transport modelling, stormwater management design, hydrotechnical studies, hydraulic design, erosion control, and litigation support.

Project experience – Mine water management

Goldboro Gold Mine Feasibility Study and Environmental Assessment

Technical Lead Mine Water Management | Signal Gold | Goldboro, NS, Canada

GHD was retained by Signal Gold to assist with the development of a prefeasibility economic assessment, feasibility study and Environmental Assessment Registration Document.

Andrew was the technical lead responsible for the development of a Mine Water Management Plan for the Goldboro Gold Mine. This included the development of a conceptual design, detailed water balance analysis, predictive water quality model, receiving waterbody mixing zone model, water treatment design, detailed construction cost estimate and additional impact assessment and mitigation strategy support. Signal Gold has received EA approval and GHD has since been retained for continual support through Industrial Approval and Fisheries Act Authorization amongst other permitting support.

Beaver Dam Gold Mine Feasibility Study and Environmental Compliance Approval

Technical Lead Mine Water Management | Atlantic Mining Nova Scotia | Marinette, NS, Canada

GHD was retained by Atlantic Mining Nova Scotia to assist with the completion of a feasibility study and Environmental Assessment Registration Document for the mine water management infrastructure.

Andrew was the technical lead responsible for the development of a Mine Water Management Plan for the Beaver Dam Gold Mine. This included the development of a conceptual design, detailed water balance analysis, predictive water quality model, water treatment design, detailed construction cost estimate and additional impact assessment and mitigation strategy support.

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Touquoy Gold Mine Environmental Impact Assessment and Water Withdrawal Application

Hydrologic/Hydraulic Technical Lead | Atlantic Mining Nova Scotia | Moose River, NS, Canada

GHD was retained by Atlantic Mining Nova Scotia to design and implement surface water and groundwater monitoring programs, develop a flood impact study, perform water balance and water quality assessments, and obtain a water withdrawal approval at its Touquoy Gold Mine Project. At Touquoy, GHD set up initial SW monitoring stations and GW monitoring wells for baseline assessment and installed additional monitoring wells in 2017 for long term project monitoring. Prior to project construction, GHD successfully completed an application for surface water withdrawal to support milling operations at the Touquoy Gold Mine.

Mresser Industries-Magcobar (DIM) Mine Closure Design

Hydrologic/Hydraulic Technical Lead | Haliburton Energy Services | Hot Springs County, AR, USA

GHD was retained by Haliburton Energy Services Inc to design remedial activities at the former Dresser Industries-Magcobar (DIM) Mine site in Hot Springs Arkansas. The DIM former Mine site ceased mining activities in 1977. The remedial activities at the DIM Mine were completed to address the low pH and elevated metals that affect drainages from the site.

As part of the remedial design, Andrew and his team completed:

- A detailed water balance assessment to determine the impacts of remedial design activities on the contributing drainage areas
- Design of collection ditches, retention ponds and dam spillways
- Water quality modelling post remedial design

Ojibway Salt Mine Stormwater Environmental Compliance Approval and Mine Closure Plan

Hydrologic/Hydraulic Technical Lead and Design Project Manager | K+S Windsor Salt | Windsor, ON, Canada

GHD was retained by K+S Windsor Salt to investigate and design water quality treatment for stormwater discharge, as well as design the mine closure plans for their Ojibway Mine site in Windsor, Ontario. The main objective of this scope of work was to design a water quality treatment system to treat the elevated chloride levels observed on-site prior to discharging to Detroit River. As part of this work, GHD conducted a water quality monitoring program (surface water and groundwater), detailed water quality modelling and design of mine contact water collection and treatment system.

Long Lake Gold Mine Reclamation and Closure Detailed Design

Mine Water Management Technical Lead | Ontario Ministry of Mines | Greater Sudbury, ON, Canada

GHD was retained by Ontario Ministry of Mines to perform the design optimization for the reclamation of the abandoned Long Lake Gold Mine. The technical components of the mine remediation include development and evaluation of appropriate engineering controls for tailings delta removal from the southern end of Long Lake and along the surface water course from the tailings areas to Long Lake, tailings dewatering evaluation and removal assessment including tailings stabilization options. The design will include development of a design for a capped impoundment for all tailings at the mine site. The project included re-evaluation of the excavation limits based on investigation of local background concentrations in the area of the mine site to limit excavation within the limits of a wetland. GHD will support permitting, tendering and construction contract administration on behalf of the Ontario Ministry of Mines.

Fancy Hill Mine and Mill Reclamation and Closure Plan

Hydrologic/Hydraulic Modeller | Caddo Gap | Montgomery County, AR, USA

Andrew developed a non point source watershed water quality model to characterize the fate and transport of contaminants at the Fancy Hill Mine and Mill site. The model was calibrated with dry and wet weather data and used to develop and assess the effectiveness of various mitigation measures (capping, highwall, diversion ditches, and treatment pond). Andrew also developed a 2D hydrodynamic model to aid in designing a pond retrofit. The 2D model was used to determine the preferred configuration of berms (baffle plates) that would maximize detention time in the existing treatment pond, establish a more uniform flow distribution throughout the treatment pond to improve flow circulation and decrease sediment accumulation, and eliminate existing short circuiting from the pond inlet to the pond outlet.

Little Narrows Gypsum Mine Water Management Plan

Technical Lead Hydrology/Hydraulics | CGC Inc | Little Narrows, NS, Canada | 2015 – Ongoing

GHD was retained to provide consulting services in the development of a reclamation plan for the Little Narrows Gypsum facility. Using current aerial and LiDAR data, GHD developed a plan based on a three category system for reclamation of the site. Demolition costs were also prepared by GHD. Annual activities address planning and monitoring of reclamation activities and regulatory liaise. GHD also developed a passive water management plan with engineered outfalls.

Former Consolidated Rambler Mine Hydrologic Study

Project Coordinator/Technical Lead |
Confidential Client | Baie Verte, NL, Canada

GHD was retained to perform an existing condition infrastructure assessment to determine the hydraulic capacity and a conditions assessment. GHD developed an existing hydrologic and hydraulic model to determine the hydraulic capacity and asset conducted a field investigation for determining any required upgrades to diversion channels, spillways and associated dams located on site.

Centennial Coal Mine Flood Retention Dam and Spillway Design

Hydrotechnical Design Lead |
Centennial Coal | New South Wales, Australia

GHD was retained by Centennial Coal Company to design a flood retention dam and emergency spillway at their Airly Mine in New South Wales, Australia. GHD completed a detailed hydrologic and hydraulic assessment to size the flood retention reservoir, embankment dam and emergency spillway. The hydraulic assessment also included the design of erosion protection through the spillway and connection with the receiving water course downstream of the dam.

MacLeod Mine PTTW Amendment Application

Project Manager and Technical Lead |
Ministry of Energy, Northern Development and Mines | Wawa, ON, Canada

GHD was retained to complete a PTTW amendment application for an abandoned mine in Northern Ontario. As part of the amendment application, GHD performed a water balance assessment in GoldSIM to determine the hydrologic effects of increased water taking on Moran Lake. The water balance assessment included comparing estimated yearly flows to Moran Lake with required pumping rates at to determine if there was a potential for impacts to local fish and wildlife due to increased pumping.

Site Plan Application – Boyington Aggregate Pit

Technical Reviewer |
Uxbridge, ON, Canada

GHD was retained to complete a review on the site plan application and agreement for the proposed excess fill placement operation at the Miller Paving Boyington Pit site in the Township of Uxbridge. In summary, responsibilities included:

- Review of Traffic Impact Assessment is required
- Stormwater Management
- Hydrogeological Study
- Spill Management
- Site Plans
- Phase I and II ESA

CGC Little Narrows Gypsum Mine Emergency Culvert Replacement

Engineering Assistant |
CGC Inc. | Victoria County, NS, Canada |
2019

GHD prepared design alternatives for the replacement of culverts that were at risk of failure at the CGC Little Narrows gypsum mine.

Andrew led the development of design alternatives including hydrologic and hydraulic calculations to size pipes/channels, material selection, and preparation of cost estimates.

Frood Stobie Mine FEL3 study and detailed design

Water Resource Engineer |
Vale Canada Ltd. | Sudbury, ON, Canada |
2012 – 2018

Vale has evaluated a series of remedial measures to improve surface water quality discharging from their property that is impacted from acid rock drainage (ARD). Vale retained GHD to develop a remedial workplan (FEL3 Study) for two contributing watersheds followed by the detailed design, permitting and tendering of the workplan. The workplan is divided into multiple phases comprised primarily of the removal ARD generating material and installation of a variety of passive treatment methods using limestone to improve the surface water quality. The FEL3 Study consisted of an environmental assessment and monitoring program and conceptual design of a series of passive treatment systems including permeable reactive barriers, lined channels, and open water treatment cells to treat water. The overall system was also designed to safely convey water through the engineered features during high discharge events.

Hydrologic and Hydrogeologic Modelling Study

Hydrologic/Hydraulic Modeller |
CGC Inc. | Windsor, NS, Canada

GHD performed hydrologic and hydrogeologic modelling studies to determine potential effects of creating an open pit mine on the total quantity of surface water runoff within the study area, as well as any potential watershed impacts. The Hydrologic Modeling System (HEC HMS) computer model was selected to generate runoff hydrographs for the site because of its particular applicability to rural design settings and potential interactions with groundwater. To streamline the HEC HMS modelling, the Geospatial Hydrologic Modeling (HEC GeoHMS) model extension was used with ArcView Geographic Information System (GIS). HEC GeoHMS was also used to delineate the watershed and sub catchments, based on GIS data. Sub catchment parameters were also extracted from HEC GeoHMS.

Four general scenarios were examined using this HEC HMS model:

– Existing conditions of the hydrologic study area
– Proposed mine pit and stockpiles in 20 years
– Proposed mine pit and stockpiles in 40 years
– Proposed mine pit and stockpiles in 70 years

Dufferin Milton Quarry

Hydrologic/Hydraulic Technical Lead |
Holcim (Canada), Inc. | Milton, ON, Canada

The rehabilitation plan for the Dufferin Milton Quarry includes three lakes, separated by rock pillars and connected by hydraulic flow control structures. The rock pillars were designed as dams. They were designed to pass the Probable Maximum Flood and retain sufficient freeboard to account for wind and wave effects.

Andrew led the team to calculate the Inflow Design Flood, Hazard Potential Classification, Dam Breach analysis, flood inundation mapping and design of emergency spillway freeboard.

Project experience – Water balance studies

Cranberry Farm Water Balance Study

Project Coordinator/Technical Lead |
Bathurst, NB, Canada

A pre development and post development water balance study (THORNPRO) on a proposed cranberry farm operation.

In addition to the Project Coordinator role, Andrew performed a water balance study which involved analyzing the hydrologic condition of the site during climate normal conditions as well as during the 1 in 25 year wet and dry (precipitation and temperature) conditions.

Birette's East Uniacke Quarry Expansion Project

Hydrologic Modeller |
East Uniacke, NS, Canada

GHD was retained to complete a water balance study for the Birette's East Uniacke Quarry Expansion Project. The purpose of the study was to evaluate the potential effects of the project to water quantity and water quality, to evaluate the potential effects to fish and fish habitat, and to provide recommendations for future monitoring and mitigation. Andrew performed the monthly water balance calculations to facilitate the assessment.

Sheet Harbour Aggregate Quarry

Technical Lead |
Dexter Construction Co. Ltd. | Sheet Harbour, NS, Canada

GHD was retained to provide consulting services in the development of an environmental assessment report for a proposed aggregate quarry.

Andrew was responsible for the development of a preliminary water balance to determine the effects of developing the project site. Tasks included delineating subcatchments, assessing existing and proposed conditions on a monthly basis and performing a preliminary assessment on the site water balance.

Project experience – Dams

Misner Dam Inflow Design Flood Study and Rehabilitation

Hydrologic/Hydraulic Modelling Lead |
Norfolk County | Port Dover, ON, Canada

GHD was retained by Norfolk County to undertake an inflow design flood study for Misner Dam. Visual inspection of the dam revealed that portions of the dam structure are in a deteriorated condition. The Ontario Ministry of Natural Resources determined that an IDF study was essential to establish feasible options for the dam reconstruction and required to determine the forces/loading/stresses on the dam.

Andrew developed a calibrated hydrologic model (PCSWMM) and hydraulic model (HEC RAS) of the watershed and river systems, totaling 294 square kilometres. The hydraulic model was used to predict the flooding extent and elevation of the 1,000 year flood event and the Probable Maximum Flood Event.

GHD then completed the detailed design for the dam rehabilitation, as well as compiled the construction tender package.

Thomson Lake Dam Rehabilitation

Hydrologic/Hydraulic Technical Lead | Confidential Client | Erin, ON, Canada

GHD was retained to design and construct dam rehabilitation on an existing dam structure, which was structurally unstable.

Andrew performed the required hydrologic and hydraulic calculations and design components required to obtain the Ministry of Natural Resources and Forestry permit approval under the Lake and Rivers Improvement Act.

Dufferin Milton Quarry Rehabilitation Plan

Hydrologic/Hydraulic Technical Lead | Holcim (Canada), Inc. | Milton, ON, Canada

The rehabilitation plan for the Dufferin Milton Quarry includes three lakes, separated by rock pillars and connected by hydraulic flow control structures. The rock pillars were designed as dams. They were designed to pass the Probable Maximum Flood and retain sufficient freeboard to account for wind and wave effects.

Andrew led the team to calculate the Inflow Design Flood, Hazard Potential Classification, Dam Breach analysis, flood inundation mapping and design of emergency spillway freeboard.

Dam Floodway and Gate Performance Evaluation

Hydrotechnical Engineer | Confidential Client | Lake White, OH, USA

GHD was retained to review the hydraulic performance/capacity of radial gates on a dam in Lake White, Ohio. The assessment was initiated after gate failure during a flood event that resulted in flooding upstream of the dam and extensive erosion downstream, caused by the dam being overtopped.

Evaluation of the Effects of Dam Floodway Rebuilding on Downstream Flooding

Hydrotechnical Expert | Vorys, Sater, Seymour and Pease LLP | Grand Lake St. Mary's, OH, USA

GHD was retained to perform hydraulic capacity calculations of the newly constructed spillway of a dam in Grand Lake St. Mary's, Ohio after a significant storm event caused severe flooding downstream. GHD concluded that the hydraulic capacity of the newly built spillway was the cause of the extensive flooding in the downstream reach.

Flood Retention Dam and Spillway Design

Hydrotechnical Design Lead | Centennial Coal | New South Wales, Australia

GHD was retained by Centennial Coal Company to design a flood retention dam and emergency spillway at their Airly Mine in New South Wales, Australia. GHD completed a detailed hydrologic and hydraulic assessment to size the flood retention reservoir, embankment dam and emergency spillway. The hydraulic assessment also included the design of erosion protection through the spillway and connection with the receiving water course downstream of the dam.

Cause and Effect of Dam Gate Operations on Severe Flooding

Hydrotechnical Expert | Ingram Barge Company | Marseilles, IL, USA

GHD was retained by Ingram Barge Company to investigate the cause and effect of multiple barges crashing into radial gates of a dam near Marseilles, Illinois. Shortly after the barges crashed into the radial gates of the dam across the Illinois River, the town of Marseilles was flooded. GHD was tasked with determining if the town would have flooded if the barges did not crash into the dam, and if there was a large enough 'window of opportunity' for the barges to safely enter the lock without causing the town to flood.

Chaudière Island Floodplain Mapping

Project Manager/Technical Lead | Windmill Development Group | Ottawa, ON, Canada

GHD was retained by Windmill Development Group (Windmill) to develop a floodplain map for Chaudière Island and 1 kilometre of shoreline in Hull, Quebec along the Ottawa River immediately downstream of the Chaudière Dam. Windmill was converting the island and portions of the shoreline from a heavy industrial site to a multi use residential and commercial community.

Andrew acted as the Project Manager and Technical Lead. He coordinated with City and Conservation Authority regulators and performed all hydraulic modelling efforts. The hydraulic modelling involved updating the existing Rideau Valley Conservation Authority HEC RAS model to include greater detail (i.e., more cross sections and hydraulic structures) in the vicinity of the project site using GIS (HEC GeoRAS) based on the site topographic data. The hydraulic model was used to performed steady flow analysis and floodplain delineation for the 100 year flood event.

Hanksville Diversion Reconstruction

Hydrodynamic Modeller | Confidential Client | Hanksville, UT, USA

GHD was retained for the site assessment, design and construction of a diversion structure consisting of a relatively low profile, concrete gravity dam structure. The diversion dam structure consisted of ground

improvements, cut off wall, foundation and ogee weir with sluice gates spanning the river channel section.

Andrew analyzed the river flood flow regime, using a 2D hydrodynamic model, to predict floodplain extents and shear velocities for erosion protection. The 2D model was also used to support the design and construction of a wing wall to protect a diversion structure from erosion forces.

Project experience – Stormwater management experience

Seaton Lands Regulatory Floodplain Mapping

Lead Hydraulic Modeller |
Infrastructure Ontario | City of Pickering, ON, Canada

GHD performed regulatory floodplain mapping for the Seaton Lands within the City of Pickering for a large-scale proposed development project. Andrew was technical lead for floodplain mapping of the Whitevale Creek, Ganatsekiagon Creek, Urfe Creek, Brougham Creek, and a small tributary of the West Duffins Creek within the Seaton MESP study area. GHD received approval for regulatory floodplain mapping from the TRCA.

Muskoka River Watershed IWM – Release 1

Project Director
District Municipality of Muskoka | Bracebridge, ON, Canada

The Muskoka River Watershed Council desired a hydrologic model to inform watershed management planning and address flood risk concern. GHD developed a hydrologic model of the Muskoka River using SWAT+, which simulated snowmelt processes, evaporation, infiltration and groundwater recharge, and surface water runoff. The Muskoka watershed is 5,100 km^2 in size and includes 38 provincially significant wetlands and over 2,000 lakes and 65 water control structures (dams and weirs). The model was calibrated and validated for continuous simulation at daily, monthly and annual timesteps. Over 30 scenarios were run using the model to evaluate climate change, urbanization, deforestation, extreme events, and wetland enhancement impacts on the flow regime compared to existing conditions.

Carolyn Creek Regulatory Floodplain Mapping

Project Coordinator/Lead Hydraulic Modeller |
Credit Valley Conservation Authority | Mississauga, ON, Canada

GHD was retained by the Credit Valley Conservation Authority (CVC) to update floodplain mapping for Carolyn Creek as a part of the National Disaster Mitigation Program (NDMP). Carolyn Creek is a tributary, which discharges into the Credit River immediately upstream of Eglinton Avenue West. GHD built a hydraulic model and provided updated floodplain mapping of Carolyn Creek to CVC to reflect the latest state of development in the watershed. The hydraulic model was developed for the purpose of generating flood lines and floodplain mapping for the 100 year and the Regional (Hurricane Hazel) storm events.

Joshua Creek Flood Mitigation Opportunities Study

Project Director and QA/QC Lead |
Town of Oakville | Oakville, ON, Canada

GHD prepared a flood mitigation opportunities study on Joshua Creek for the Town of Oakville. The study involved work to characterize the current flood risk conditions along Joshua Creek downstream of Upper Middle Road and to recommend solutions to mitigate the flood risk. Comprehensive hydrologic and hydraulic models of the watershed were developed, and flood risk sites were identified through GIS integrated review of modelling results.

Sackville Rivers Floodplain Study

Lead Hydraulic Modeller |
Halifax Regional Municipality | Halifax, NS, Canada

The Sackville River is a complex river system. Intensive urbanization and climate change are becoming significant factors altering the existing flood regime in the watershed. The main objectives of this first phase of the project were to perform preliminary floodplain modelling and collect information so that the floodplain mapping for the Sackville Rivers could be updated. GHD completed the following tasks to achieve the project objectives:

- Statistical flood and sea level frequency analyses, including joint probability analysis
- High level hydraulic floodplain modelling and floodplain delineation for the lower Sackville River
- Topo bathymetric survey data collection
- Historical review of flooding factors, including the largest precipitation events and the regional rainfall events

Regulatory Floodplain Delineation Study

Project Manager and Technical Lead |
Town of Antigonish | Antigonish, NS, Canada

GHD was retained by the Town of Antigonish to undertake a floodplain delineation study. The objectives of the assignment were to use hydrologic and hydraulic models to identify the flooding extents during the 1:20 and 1:100 year flood events, analyze and identify potential ice jamming locations, and develop a general understanding of the hydrologic and hydraulic effects of

widening the Trans Canada Highway 104 through the Town. Andrew was the Project Manager and Technical Lead on the project and performed all client communication and modelling efforts. As part of the project, Andrew assisted the client in navigating future planning opportunities in the town by identifying locations where development could occur with minimal additional flood proofing within the flood fringe.

Caledon Village Flood Mitigation Study

Peer Reviewer |
Town of Caledon | Caledon, ON, Canada

GHD was retained to identify and assess opportunities to alleviate flooding within Credit River Subwatershed #16 in Caledon, Ontario.

Andrew performed the technical peer review of the hydrologic and hydraulic modelling, which was completed using a combination of PCSWMM and Geo HEC RAS to assess the existing condition and potential alternatives for flood mitigation. The project is currently ongoing.

GM Romulus Plant Renovation Floodplain Investigation

Technical Lead Hydraulic Modeller |
Romulus, MI, USA |
2019

GHD prepared a floodplain investigation for the proposed development at the GM Romulus Powertrain Facility in order to meet State permitting requirements. The proposed development is within the floodplain of the McClaughrey Drain. GHD developed a HEC RAS model of the McClaughrey Drain in order to assess the change in energy gradeline elevation between existing and proposed conditions and to demonstrate that there was no harmful interference with the discharge or stage of the watercourse based on Michigan Department of Environmental Quality Hydraulic Report Guidelines.

Detailed Design of Drainage Infrastructure Improvements and Stormwater Management Controls

Project Director and QA/QC Lead |
Town of Caledon | Caledon, ON, Canada

GHD was retained by the Town of Caledon to provide the detailed design and permitting services for drainage infrastructure improvements and stormwater management controls within the Alton Estates Subdivision in Alton Village, Caledon, Ontario.

Andrew performed QA/QC of the detailed design, including the review of a hydrologic/hydraulic model, design calculations, and a technical report.

Environmental Assessment, Detailed Design and Contract Administration for Retrofitting Stormwater Management Pond

Project Director and QA/QC Lead |
Town of Caledon | Caledon, ON, Canada |
2017 – Ongoing

GHD was retained by the Town of Caledon to complete a Schedule “B” Municipal Class Environmental Assessment study, preliminary design, detailed design, secure agency approvals, and conduct contract administration services for the construction of the Columbia Way Stormwater Management Pond Retrofit project in Bolton, Ontario.

Andrew is assisting in finalizing the design and securing agency approvals for the proposed wetland facility.

Nova Scotia Environment Watercourse Alteration Standard Assessment

Reviewer/Researcher |
Nova Scotia Environment | NS, Canada

GHD was retained to complete a review of the Nova Scotia Environment (NSE) Watercourse Alteration Standard and identify potential program improvements. GHD specifically provided a review of the design criteria for constructing or modifying a single closed bottom culvert under the notification process, and for constructing alternative energy dissipation measures at culvert outlets. Project tasks included a literature review of culvert design criteria and permitting requirements in Nova Scotia and other Canadian provinces; technical review of the design flow rate calculation and culvert sizing methodologies presented in NSE guidelines; and provide recommendations on additional considerations for culvert sizing.

Site Assessment Risk Assessment and Remedial Action Planning

Senior Water Resource Engineer |
Boat Harbour Effluent Treatment Facility | Pictou County, NS, Canada

The project included design and planning for the Remediation of the 500 Ha Boat Harbour Effluent Treatment Facility. A key concept of the project for consideration included returning the harbour to a tidal estuary and reconnecting the First Nations community to the land and waters of Boat Harbour.

Andrew’s specific responsibilities were related to hydrologic modelling of the watershed, 2D hydraulic modelling of the removal of the downstream dam and the resulting sediment transport during tidal fluxes, design of stormwater management controls for sediment landfill, supporting documentation for Environmental Assessment approvals, impact assessment, restoration

design, senior review of the environmental management plan, and project environmental protection plan.

Maple Hill Creek Rehabilitation EA and Detailed Design

Senior Water Resources Engineer QA/QC |
City of Waterloo | Waterloo, ON, Canada

Water Resource Engineer for the Class EA, detailed design and construction services for the rehabilitation of Maple Hill Creek and the retrofit of two stormwater management areas. Maple Hill Creek is a channelized system that over time has become impacted due to the urbanization of its catchment areas. GHD worked with the City to address the imminent issues impacting neighboring private properties and provide enhancements to aquatic and terrestrial habitat potential. The project also included a culvert replacement, sediment management with potential dredging, and addressing the existing failing erosion control structures along the creek. The Class EA was completed in early 2018.

Project responsibilities include attending client and internal meetings, preparing project related deliverables including Public Information Centres, facilitating effective communication between the project team and client, analysis of surface water and shallow groundwater quality and quantity data, schedule and budget development, and preparing project updates to the client.

Former Willow Run Powertrain Redevelopment

Design Project Manager/Technical Lead |
RACER Trust | Ypsilanti, MI, USA

Design coordinator and technical lead responsible for design of a post demolition storm water management plan for the former Willow Run Powertrain facility, approximately 270 acres, in Ypsilanti, Michigan. Project tasks involved installation of sewer flow monitoring equipment, development of detailed hydrologic and hydraulic models, and completion of a storm water management design package. Stormwater Management features included concrete lined collection channels that drained the former plant slab and directed stormwater to a lined dry/vegetated detention basin. Construction was completed in 2018.

Culvert Rehabilitation Hydrologic Study

Project Coordinator/Lead Hydrologist |
General Motors | Milford, MI, USA

GHD was retained by General Motors to replace/repair twin culverts that diverted Mann Creek under the main test tracks at the Milford Proving Grounds.

Andrew acted as the Project Coordinator and lead hydrologic and hydraulic modeller. A hydrologic model was created for the 3,928 acres contributing drainage area and used to provide the inflows for the hydraulic model used to design the repair work of the twin culverts. The hydraulic model considered the flow restrictions caused by the existing baffles covering the top portion of the pipes at the mouth of the twin culverts and predicted that the proposed culvert design would not cause flooding to the test track during the 100 year storm event.

Highway Expansion Stormwater Management Control

Modelling Specialist |
Confidential Client | Ashville, NC, USA

GHD was retained to review a proposed highway expansion design to determine the potential for erosion damage potential downstream of the proposed expansion. GHD developed a hydrologic and hydraulic model (using PCSWMM), in support of legal actions, of the proposed highway expansion to determine if the NCDOT design would cause erosion damage downstream and produced an expert summary report.

South Louisiana Methanol Site Development Floodplain Assessment

Hydrologic/Hydraulic Modeller |
PPM Consultants Inc. | St. James Parish, LA, USA | 2018

GHD completed a 100-year flood assessment for the proposed South Louisiana Methanol development in St. James Parish, Louisiana. The objective of the assessment was to determine if the proposed development would be inundated in the event of a 24-hour, 100-year storm for flood insurance purposes. Andrew completed the hydrologic and hydraulic modelling using PCSWMM and GeoHEC-RAS to calculate the 100-year flood extent and water surface elevations of the proposed site drainage channels. Flood inundation maps were prepared using the modelling results.

Concrete Plant Stormwater Retrofits

Project Manager/Technical Lead |
Ontario Redimix (ORM) | Milton, ON, Canada

GHD was retained to design stormwater retrofits to a surface water pond at a concrete mixing plant in Milton, ON.

Andrew was the Project Manager and Technical Lead for the project. The project involved a site visit to collect survey data, hydrologic/hydraulic modelling, and redesign of a stormwater pond, outlet structure and emergency spillway. The stormwater pond and emergency spillway discharges into a regulated water way governed by the local conservation authority.

Concrete Plant Stormwater Management Environmental Compliance Approval

Project Manager/Technical Lead |
Ontario Redimix (ORM) | Peterborough, ON, Canada

GHD was retained to assist with obtaining ECA approval for stormwater management design at a concrete mixing plant in Peterborough, ON. Andrew was the Project Manager and Technical Lead. The project involved a site visit and collection of survey data, design of sediment removal components (check dams, OGS and settling pond), and regulatory approval with the Ontario Ministry of Environment sediment.

630 Weber Street Commercial Development

Project Design Engineer |
Cooper Construction | Waterloo, ON, Canada

Andrew completed the grading and municipal servicing design for the redevelopment of an approximately 6 hectare industrial lot into a commercial development. Andrew developed plans to maximize use of developable land while maintaining a sufficient buffer to protect wetlands on Site and developed storm water management plans that included an oil/grit separator, underground sediment forebay and detention basin, and oversized pipes for additional attenuation and treatment. The stormwater management design directly contributed to obtaining Rate and Quantity LEED credits.

Stormwater Management for Brownfield Development

Project Design Engineer |
Centre for International Governance and Innovation | Waterloo, ON, Canada

Andrew assisted with the grading and municipal servicing design for the brownfield redevelopment of an approximately 1.56 hectare industrial lot into an academic campus. Andrew designed the stormwater management plan for the development. Some of the key challenges on the project included:

- The proposed development is located within the regulatory flood lines, thus requiring close coordination with multiple agencies to obtain approval
- The existing City storm sewers adjacent to the development were already at capacity
- Development is located within a Natural Hazard Special Policy Area

Design was successfully approved and construction has been completed.

Site Expansion Stormwater Management

Project Design Engineer |
CAMI Automotive | Ingersoll, ON, Canada

GHD was retained to obtain a Certificate of Approval amendment for a building and parking lot expansion at the CAMI Automotive plant in Ingersoll, Ontario.

Andrew's responsibilities include calculating the impact of the proposed building and parking lot expansions on the stormwater management system as well as the technical letter describing the site's ability to control the increased stormwater quantity without causing any adverse effects off-site.

Landfill Stormwater Management

Stormwater Design Engineer |
East Greenbush, NY, USA

Andrew developed a hydrologic model and designed the stormwater management plan for a 10-acre landfill cover system along the banks of the Hudson River. The stormwater management plan included the design of stormwater conveyance and outlet structures, as well as a sediment and erosion control plan and floodplain assessment.

Hawkesbury Lagoon Design and Closure Plan – Ottawa River and Lagoon Hydrodynamic Model

Hydrologic/Hydraulic Modelling Lead |
MNRF | Hawkesbury, ON, Canada

GHD was retained to prepare a Design and Closure Plan and construction oversight for a 260,000 cubic meter fibre bearing sludge lagoon from a pulp and paper mill. The lagoon was constructed of dykes between islands within the Ottawa River and the chemicals of concern included heavy metals, polycyclic aromatic hydrocarbons (PAHs), phenols, volatile organic compounds (VOCs), and hydrogen sulfide (H2S). The remedial solution involved the development of a landfill containment cell that would allow for the natural attenuation of leachate and a lagoon attenuation channel and assimilation pond. Andrew developed a hydrologic/hydraulic model of the proposed landfill and designed the stormwater management controls. In addition, Andrew developed a 2 D hydrodynamic model of the Ottawa River, lagoon attenuation channel and assimilation pond. The 2 D model was used to design the attenuation channel and assimilation pond to ensure velocities in the lagoon we low enough, during multiple flow events, to promote the settling of particles.

Environmental Remediation

Design Engineer/Modeller |
Confidential Client | Southern Indiana, USA

GHD was retained to conduct a large remedial project to remove contamination from a creek and surrounding floodplain resulting in a complete reconstruction of the natural channel. Restoration initiatives included natural channel design, wetland and upland design.

Andrew assisted in the natural channel design as well as:

- Developed a detailed stormwater management plan for an 18 acre landfill, which involved design of five stormwater management ponds, channels/storm sewer, energy dissipaters, and associated sediment and erosion control plan
- Performed the Revised Universal Soil Loss (RUSLE) calculation within the Arc View GIS environment which allowed calculation of the soil loss erosion automatically, from digital watershed information
- Provided construction oversight for the construction of approximately 3,000 feet of natural channel and 6 acre wetland
- Developed and maintained a wireless stream and environmental monitoring network

Oceanographic Model Study of the Tignish/Jude's Point Harbour

Hydrologic Modeller |
PWGSC | Prince County, PEI, Canada

Developed a coupled 1D hydrologic (HEC HMS) and assisted in the development of a 3D hydrodynamic model (GEMSS) for the existing harbour and for the proposed harbour expansion. The model included tidal dynamics for simulating the interaction of the harbor and estuaries with the Gulf of St. Lawrence. Andrew evaluated potential environmental effects of the proposed harbour expansion. A new harbor configuration was determined through incrementally modelling changes to the harbor with the objective to reduce coastal and environmental impacts, deposition and retention, flushing and wave action. Andrew also aided in the design of a salt marsh island in the estuaries of Tignish River as an economic means of disposing dredge spoils associated with the proposed harbor expansion.

Sediment Cap Design Kanawha River

Hydrodynamic Modeller |
Monsanto | Nitro, WV, USA

GHD was retained to complete an Engineering Evaluation/Cost Analysis under the non time critical Removal Action Program of USEPA. The consent Decree for the Site requires the investigation of a 14 mile stretch of the river in the area of Nitro, West Virginia. One of the tasks was to perform a sediment stability evaluation of the sediments in the river. Andrew developed a 2D hydrodynamic model to predict 100 Year floodplain elevation and shear velocities to identify potential sites for erosion along the banks of the Kanawha River for the purpose of contaminated sediment transport.

Drain Screening Facility Design and Optimization

Hydrodynamic Modeller |
City of Hamburg | Buffalo, NY, USA

Performed a detailed 2D hydrodynamic modelling (FESWM) of the existing and proposed conditions of the Hamburg Drain between Washington Street and Michigan Avenue with the objectives of determining the optimal configuration of wing walls in the screening facility to achieve even division of flow to the screens, and of determining the change in head loss for existing and proposed conditions in the Drain.

Andrew aided in optimizing the configuration by iteratively modelling the system to provide even division of flow to the screens and tested the configurations under different flow distribution scenarios. The preferred configuration was selected based on the smallest head losses with uniform distribution of flow.

Project experience – Network modelling experience

Transient Analysis and Strategic Options Study

Project Director/QA/QC |
District of Municipality of Muskoka | Bracebridge, ON, Canada |
2021

GHD was retained by the District of Muskoka to investigate transient conditions in the existing water distribution system. A recent failure in a section of the distribution system resulted in a Boil Water Advisory for the District. The objective of GHD's investigation was to determine if transient pressures were the cause or part of the cause of the failure. In addition, GHD was asked to undertake a high-level strategic water system review to consider methods to reduce water security risks associated with this pipeline.

Town of Bracebridge Water Main, Transient Analysis and Strategic Options Study

Project Director/QA/QC |
District Municipality of Muskoka | Bracebridge, ON, Canada

The project included the investigation of transient conditions in the existing pipeline system extending between the Ecclestone Reservoir and Hamblin Reservoir and a strategic planning study to investigate possible methods to improve water security for this pipeline.

Water/Wastewater Network Modelling

Project Director/QA/QC |
City of Belleville | Belleville, ON, Canada |
2019 – Ongoing

Andrew assisted with the review of water network modelling for the City of Belleville. A watermain upgrade was being considered, and the modelling was used to confirm network operation under the proposed alternatives. GHD also conducted various hydraulic modelling analyses to study the feasibility of proposed capital projects in the City and provide recommendations on preferred designs for the capital projects based on the findings in the analyses.

Muskoka New Developments Water and Wastewater Modelling

Project Director/QA/QC |
District of Municipality of Muskoka | Muskoka, ON, Canada |
2017 – Ongoing

Andrew reviewed water and wastewater modelling results and reporting in support of development applications for the District Municipality of Muskoka. The data for each development were entered into InfoWater and InfoSWMM water and wastewater model for the community, and model results are compared to the model results without the development. Deficiencies due to the development were highlighted and solutions to address the deficiencies were proposed.

Town of Aurora Water and Wastewater Model Development

Project Director/QA/QC |
Town of Aurora │ Aurora, ON, Canada

GHD was retained to undertake a hydraulic model (InfoWater and InfoWorks ICM) build and calibration of current and future planning horizons for a water distribution and wastewater collection system, and supplemental system performance analyses. GHD used the water model to study the feasibility of decommissioning a watermain and evaluated the impact of the proposed decommissioning on the surrounding system under normal and emergency conditions. An investigation into water quality and system performance under future population projections was also undertaken.

Salt Management Experience

Salt Vulnerability Analysis and Salt Reduction Plan

Project Manager/Technical Lead |
City of Richmond Hill, ON, Canada

GHD completed a Salt Vulnerability Analysis and Salt Reduction Plan for all lands under the City's jurisdiction. The Study results identify the locations that are most impacted by road salting and prioritize the areas that would benefit most from salt reduction strategies, while balancing the requirement to maintain safe roads, walkways, parking lots, parks, and trails for public use. The final component of the Study includes the development of a Salt Reduction Plan, which provides an overview of available best management practices, and identifies which options the City may consider for implementation.

Guideline for Management of Salt Vulnerable Areas

Project Manager |
Environment and Climate Change Canada

Project Manager and technical lead for the development of new guidelines for the identification and management of salt vulnerable areas (SVAs). The guideline provides a methodology for identifying, categorizing, and mapping the impacts of road salts on SVAs. The guide also assists the user in identifying and tracking potential mitigation measures to minimize the negative impacts of chlorides caused by salt application on roads, parking lots and sidewalks within SVAs. The methodology helps to focus the management of road salts by determining priority areas where improved road operations, strategic planning and public education and outreach will be most beneficial.

Design Guideline to Reduce Salt Application on Parking Lots

Project Coordinator |
Lake Simcoe Region Conservation Authority |
Simcoe, ON, Canada

Project Coordinator and technical lead for the development of new design guidelines for the Lake Simcoe Region Conservation Authority to promote the reduction of salt application on commercial and institutional parking lots. The project involved identifying parking lot design features that reduce salt application and provide design fact sheets, design feature drawings and site design examples.

Various Salt Management Plans

Project Manager

Project Manager for numerous Salt Management Plan updates, including:

– District of Muskoka
– Town of Bracebridge
– Town of Gravenhurst
– United Counties of Stormont, Dundas and Glengarry

– County of Dufferin
– City of Guelph

The Salt Management Plans updates included review of previous salt management plans, site visits to all patrol garages and snow disposal sites, assessment of current practices to best management practices and recommendations to improve salt use and storage within each jurisdiction. An assessment of salt-vulnerable areas was also completed for several of the plans that identified vulnerable receptors and outlined a mitigation action plan that included a monitoring plan.

Snow Disposal Facility

Water Resources Engineer |
City of Guelph | Guelph, ON, Canada

Completed the site selection assessment study, preliminary design, permitting, detail design, tendering and construction of an approximately 2 hectare (5 acre) snow disposal facility. Design included secure remote access controls, screening berms, perimeter lighting, asphalt deck, geosynthetic liner, sub-drainage, and stormwater treatment train consisting of level spreaders, vegetated filter strips, vegetated swales, oil/water separator, wet pond, and emergency shut-off valve.

Battler Road Snow Storage Disposal Facility

Technical Advisor/Water Resources Engineer |
City of Kitchener | Kitchener, ON, Canada

Technical Advisor for a 5-year surface water and groundwater monitoring program at the Battler Road Snow Storage Disposal Facility for the City of Kitchener. The chloride monitoring program includes continuous and chemistry monitoring of eight surface water locations, ten groundwater well, and a stormwater/sanitary sewer diversion chamber. The objective of the program is to monitor and identify any environmental impacts related to operation of the SSDF. Other project responsibilities include the assessment of the field and laboratory data against predetermined Impact Threshold Triggers, coordination of additional sampling and monthly memos and annual reports.

Salt Optimization Plan

Technical Advisor/Peer-Reviewer |
City of Greater Sudbury | Sudbury, ON, Canada | 2017

GHD developed a Salt Optimization Plan (SOP) for the City of Greater Sudbury. The SOP assessed salt vulnerability throughout the Sudbury based on multi criteria analysis of mapped salt sensitive areas including source water protection areas, wetlands, fish spawning areas, etc. A salt vulnerability index map was generated showing areas ranging from low to high risk with respect to salt vulnerability.

Frobisher Risk Management Plan

Technical Advisor/Peer-Reviewer |
City of Greater Sudbury | Sudbury, ON, Canada | 2017

Andrew acted as technical advisor and performed peer-review of a Risk Management Plan (RMP) for the City of Greater Sudbury's Frobisher Winter Maintenance Depot as required by the Greater Sudbury Source Protection Area Source Protection Plan, Policy Sa 4E RMP. The final RMP included a description of vulnerable areas in and around the Site, and provided recommended risk management measures and associated monitoring based on industry standards and best management practices.

Litigation Support

– Modelling and design related to flooding issues under the Municipal Drain Act – Amberly Beach, ON, Canada
– Evaluation of dam floodway and gate performance – OH, USA
– Evaluation of the effects of re building a floodway at a dam on downstream flooding – Grand Lake St. Mary's, OH, USA
– Floodplain and erosion modelling due to roadway expansion – Ashville, NC, USA
– Modelling and research related to a severe flooding accident on the Illinois River – Marseilles, Il, USA
– Impacts to water quantity caused by resource investigation – St. John's, NL, Canada
– Investigation to the source of sediment within a watershed – Lower Big Creek, AR, USA
– Erosion control assessment on a solar farm – Cochrane, ON, Canada
– Flood impacts from road expansion – Aurora, ON, Canada

Other related areas of experience

Recognized (Certifications/Trainings)

– Leading Professional Service Firms, Harvard Business School Leading, 2022
– ROSGEN Level 2 Stream Restoration 2017
– ROSGEN Level 1 Stream Restoration 2016
– MIKE SHE Integrated Watershed Modelling Training Workshop, 2011
– Water Quantity and Quality Modelling and Monitoring, University of Guelph, 2011
– Finite Element Methods, University of Guelph, 2011
– Assessment of Engineering Risk, University of Guelph, 2011
– 2D Hydrodynamic Flow and Transport, SMS 2009

Papers Presented and Published in Conference Proceedings and Refereed Journals

- Lembcke, D, Thompson, B, Read, K, Betts, A, Singaraja, D, 2017, Reducing Road Salt Application by Considering Winter Maintenance Needs in Parking Lot Design. Journal of Green Building. Vol 12, No. 2
- Betts, AR, Gharabaghi, B, McBean, E, Levison, J, Parker, B, 2015, Salt Vulnerability Assessment Methodology for Drinking Water Wells, Journal of Hydrology. Vol 531 pp. 523 533.
- Betts, AR, Gharabaghi, B, and McBean, EA, 2014, Salt vulnerability assessment methodology for urban streams. Journal of Hydrology. Vol. 517 pp. 877 888.
- Betts, A, Trenouth, W, Gharabaghi, B, and Kilgour, B, 2012, Chloride Vulnerability Identification and Mitigation Project. Presentation at the Annual Ontario Ministry of Transportation Maintenance Technology Symposium.

Career history

2019 - present	GHD, Business Group Leader
2019 - present	GHD, Associate
2007 - present	GHD, Senior Water Resource Engineer

Chris Muirhead M.A.Sc., P.Eng.

Water Resources Engineer

Location

Waterloo, Ontario, Canada

Experience

5 years

Qualifications/Accreditations

– Professional Engineer Ontario, 2021
– M.A.Sc, Civil and Environmental Engineering, University of Waterloo, 2018
– B.Eng, Water Resources Engineering, University of Guelph, 2021

Relevant experience summary

Chris is a Water Resources Engineer and Project Manager with the Integrated Water Management group at GHD's office in Waterloo, Ontario. He specializes in surface water management including natural channel design, hydrologic and hydraulic modelling and stormwater management infrastructure design. Chris also has experience with construction inspection and administration, Rapid Geomorphic Assessments, sediment transport studies, energy dissipation and spillway design, water balance studies and Mine Water Management Plan development. Chris' Master's thesis focused on the investigation of bedload transport in urban restored streams.

Saginaw Metal Casting Operations Landfill

Water Resources Engineer |
General Motors | Saginaw, MI, USA |
2023 – Ongoing

GHD was retained by General Motors to complete the design of site infrastructure for the purpose of closing the SMCO Landfill. Chris was responsible for development of a hydrologic model for the SMCO Site including investigating existing and proposed conditions. The hydrologic model was developed in PC-SWMM to size and design the network of SWM ditches conveying stormwater to the on-site treatment ponds.

Lake Scugog Oil Grit Separator Design

Water Resources Engineer |
Township of Lake Scugog | Port Perry, ON, Canada |
2022 – Ongoing

GHD was retained by the Township of Lake Scugog to design Oil Grit Separator units for two stormwater outlets to Lake Scugog. Chris was responsible for the conceptual and detailed design of these Oil Grit Separator units.

Port Hope Highland Drive South Ravine

Hydraulics Engineer |
Canadian Nuclear Laboratory | Port Hope, ON, Canada | 2023 – Ongoing

GHD was retained by Canadian Nuclear Laboratory to remediate contaminated soil within the Highland Drive South Ravine. Chris was responsible for the design of a natural channel through the ravine, following the removal of all contaminated material. This included a hydrologic and hydraulic assessment of the existing site conditions as well as the design of stable watercourse through the ravine.

Hickory Beach Shoreline Revetment Design

Hydraulics Engineer |
Ontario Power Generation | Nanticoke, ON, Canada |
2022 – Ongoing

GHD was retained by Ontario Power Generation to perform a hazard assessment of a series of shoreline properties along Lake Erie and develop a design to protect near-by residential properties. Chris was responsible for performing hydraulic calculations to determine the required revetment design for erosion protection.

Allanburg Erosion Assessment and Protection

Hydraulics Engineer |
Ontario Power Generation | Niagara Falls, ON, Canada | 2023 – Ongoing

GHD was retained by Ontario Power Generation to develop an erosion protection design for erosion of a channel bank downstream of a dam outlet. Chris was responsible for characterizing the source of the erosion

and developing a design to protect the bank and prevent further erosion.

Scotia Mine SARA Permit

Water Resources Engineer |
Scotia Mine Limited | Gays River, NS, Canada | 2023 – Ongoing

GHD was retained by Scotia Mine Limited to complete all necessary studies in support of a SARA permit for expansion of the existing mine on Site. Chris was responsible for developing and executing a strategy for assessing the impacts of mine expansion on the surrounding surface waterbodies. Chris completed a water balance assessment and assessment of ecological flow changes to aid in determining impacts to fish habitat as a result of mine development.

D'Aubigney Creek Bank Stabilization Design

Project Manager & Hydraulics Engineer |
City of Brantford | Brantford, ON, Canada | 2022 – Ongoing

GHD was retained by the City of Brantford to undertake a hydraulic assessment and bank stabilization design for a portion of the Grand River to aid in the development of an accessible boat launch for the public. Chris was responsible for performing the hydraulic analysis of the Grand River in HEC-RAS while managing a budget in excess of $20,000.

Yellow Creek Summerhill Stream Restoration

Project Manager & Hydraulics Engineer | Toronto Region Conservation Authority | Toronto, ON, Canada | 2022 – Ongoing

GHD was retained by the Toronto Region Conservation Authority to develop a stream restoration design for a portion of Yellow Creek which has been prone to failure historically. Chris was responsible for the development of a 2D model to facilitate the design of a stable channel through a 750m long stretch of creek. Chris was the Project manager for this project with responsibilities including managing a mulit-disciplinary scope of work with a budget in excess of $50,000.

CMTC Dredging Assessment

Water Resources Engineer |
Caledon Mountain Trout Club | Caledon, ON, Canada | 2023 - Ongoing

GHD was retained by the Caledon Mountain Trout Club to determine the impacts of dredging of 4 artificial ponds adjacent to CMTC property. Chris was responsible for the development of a hydraulic model to determine the floodlines surrounding the site and the impacts of dredging the ponds on the existing hydraulics of the system.

City of Toronto Priority Infrastructure Protection

Water Resources Engineer |
City of Toronto - Water | Toronto, ON, Canada | 2022 – Ongoing

GHD was retained by the City of Toronto – Water division for the design of natural channel measures to protect priority infrastructure throughout the City. Chris was responsible for the existing and proposed conditions hydraulic and floodplain assessments. In addition, Chris assisted with the design of protection measures within the watercourses.

Dawson Creek Stabilization Design

Water Resources Engineer |
City of Dawson Creek | Dawson Creek, BC, Canada | 2022

GHD was retained by the City of Dawson Creek to provide engineering services related to the landfill closure design. Chris was responsible for assessing the hydraulics of Dawson Creek and assisting with the design of stabilization measures to protect nearby infrastructure.

Highway 511 DFO Violation

Water Resources Engineer |
Confidential | Lanark, ON, Canada | 2022 - 2023

GHD was retained to aid in the design of a bypass channel to divert water away from an unauthorized stormwater pond. Chris was responsible for assessing the hydrology and hydraulics of the Site and assisting with the design of a natural channel which would support fish passage while providing a stable long-term solution for water conveyance.

Copeland Forest Dam Failure Stabilization

Water Resources Engineer |
Ministry of Natural Resources and Forestry | Martinville, ON, Canada | 2022 – 2023

GHD was retained by the MNRF to provide an emergency stabilization design for a natural channel downstream of a failed dam. Chris was responsible for the hydraulic assessment while assisting with the detailed design of the restoration measures for the failed reach.

EcoSpace Stream Restoration Design

Water Resources Engineer |
Toronto Region Conservation Authority | Toronto, ON, Canada | 2021 - 2023

GHD was retained by the TRCA to develop detailed design drawings for the restoration of a portion of West Mimico Creek. Chris was responsible for the existing and proposed conditions hydraulic assessment while assisting with the detailed design of the restoration measures.

Long Lake Tailings Remediation Design

Water Resources Engineer |
Ministry of Northern Development, Mines, Natural Resources and Forestry | Sudbury, ON, Canada | 2022 – Ongoing

GHD was retained by NDMNRF to develop a remediation design for historic tailings located at the abandoned Long Lake Mine. Chris was responsible for the development of a conceptual stormwater management design, water balance and predictive water quality studies and detailed design of stormwater management infrastructure.

Bagdad Wash Rack Water Treatment System

Water Resources Engineer |
Freeport McMoran Bagdad Inc. | Bagdad, AZ, USA | 2021 – Ongoing

GHD was retained by FMBI to develop the design of a treatment system for wash rack runoff. The treatment system was comprised of a multi-cell sedimentation basin with a hydrocyclone for removal of fine particles and a recycle water system to re-use treated wash rack water for future use. Chris was responsible for the design of the sedimentation basin and the recycle water system.

Centennial Park Stream Restoration Design

Project Manager & Water Resources Engineer |
Toronto Region Conservation Authority | Toronto, ON, Canada | 2022 – Ongoing

GHD was retained by the TRCA to develop detailed design drawings for the restoration of a tributary of Etobicoke Creek. Chris was the Project Manager for this project with responsibilities including managing a multi-disciplinary scope of work with a budget in excess of $50,000. Chris was responsible for the existing and proposed conditions hydraulic assessment, preparation of multiple concept alternatives while assisting with the detailed design of the restoration measures.

Wilket Creek Restoration Preliminary Design

Water Resources Engineer |
City of Toronto - Water | Toronto, ON, Canada | 2022 - Ongoing

GHD was retained by Toronto Water to develop preliminary design drawings for the re-alignment and restoration of Wilket Creek north of Lawrence Ave. Chris was responsible for the existing and proposed conditions hydraulic and floodplain impacts assessment while assisting with the preliminary design preparation.

Walden Quarry Water Balance Assessment

Project Manager & Water Resources Engineer |
McCallum Environmental | Walden, NS, Canada | 2022 - Ongoing

GHD was retained by McCallum Environmental to develop a water balance assessment for a quarry in Nova Scotia. Chris was the Project Manager for this project with a budget of $15,000. Chris' responsibilities included working with the client to ensure all deliverables were provided on a timely basis. Chris also developed a water balance model in GoldSIM to determine the impacts of the proposed quarry on the surrounding watercourses.

Lantz Quarry Water Balance Assessment

Project Manager & Water Resources Engineer |
McCallum Environmental | Lantz, NS, Canada | 2022 - Ongoing

GHD was retained by McCallum Environmental to develop a water balance assessment for a quarry in Nova Scotia. Chris was the Project Manager for this project with a budget of $15,000. Chris' responsibilities included working with the client to ensure all deliverables were provided on a timely basis. Chris also developed a water balance model in GoldSIM to determine the impacts of the proposed quarry on the surrounding watercourses.

Oshawa Creek Airport Trail Hazard Assessment

Project Manager & Surface Water Resources Engineer |
Harrington McAvan | Oshawa, ON, Canada | 2022

GHD was retained by Harrington McAvan to provide a Hazard Assessment for the proposed upgrades to the Oshawa Creek Airport Trail. Chris was the Project Manager for this project with responsibilities including managing a multi-disciplinary scope of work in excess of $15,000, ensuring all deliverables were provided on a timely basis. In addition, Chris completed a hydrologic and hydraulic assessment for 3 conveyance pathways across the trail.

Thornton Community Park SWM Design

Project Manager & Surface Water Resources Engineer |
Harrington McAvan | Oshawa, ON, Canada | 2023

GHD was retained by Harrington McAvan to provide a stormwater management design for Thornton Community Park in Oshawa. Chris was the Project Manager for this project with responsibilities including managing a multi-disciplinary scope of work in excess of $25,000, ensuring all deliverables were provided on a timely basis. In addition, Chris completed a hydrologic and hydraulic assessment for the park including design of Green Infrastructure to increase infiltration across the park.

Dexter Sheet Harbour Quarry Expansion

Surface Water Resources Engineer |
Dexter Construction | Sheet Harbour, NS, Canada | 2019 – Ongoing

GHD was retained by Dexter Construction to assist in the procurement of an Environmental Assessment Approval for the expansion of an existing quarry in Sheet Harbour, Nova Scotia. Chris was responsible for the development and updating of a preliminary water balance assessment for the Site over 4 phases of quarry development. The water balance assessment included high-level calculations for surface water-groundwater interactions at the Site.

Clarinda Drive Scour Protection Detailed Design

Project Manager & Hydraulics Engineer |
Toronto Region Conservation Authority | North York, ON, Canada | 2021 – Ongoing

GHD was retained by the Toronto Region Conservation Authority to develop the detailed design for scour protection for 2 reaches of a tributary to the East Don River. Chris is the Project Manager for this project with responsibilities including managing a multi-disciplinary scope of work with a budget in excess of $140,000 as well as working with the TRCA to ensure all deliverables were provided in a timely basis. Chris also performed the hydraulic assessment on the design work including scour assessment and erosion protection design work.

Ashfield Gypsum Quarry Water Balance Assessment

Project Manager & Water Resources Engineer | McCallum Environmental | Ashfield, NS, Canada | 2021 – Ongoing

GHD was retained by McCallum Environmental to develop a water balance assessment for a proposed gypsum mine in Nova Scotia. Chris was the Project Manager for this project including working with the client to ensure all deliverables were provided on a timely basis. Chris also developed a water balance model in GoldSIM to determine the impacts of the proposed quarry on the surrounding watercourses.

West Perth Industrial Park SWM Design

Project Manager & Water Resources Engineer | Municipality of West Perth | Mitchel, ON, Canada | 2020 – 2021

GHD was retained by the Municipality of West Perth to perform a conceptual design of a stormwater management facility. Chris was the Project Manager for this project including managing client communication, status updates and progress reports. Chris delivered monthly progress updates to the Municipality of West Perth and other consultants to ensure project needs were met. Chris also developed a hydrologic and hydraulic model to determine the predicted stormwater management controls required for the site.

McCallum Settlement Quarry Development

Project Manager & Hydrologic Modeller |
McCallum Environmental | McCallum Settlement, NS, Canada |
2019 – 2020

Chris was the project manager for the development of a preliminary water balance in support of submission of an Environmental Impact Assessment. Chris performed a contributing drainage area assessment to determine the impacts of mining on the local watercourses including the development of a water balance model in GoldSIM. The water balance model included existing conditions, 3 phases of quarry development and reclamation conditions.

MacLeod Mine PTTW Amendment Application

Project Manager |
Ministry of Energy, Northern Development and Mines | Wawa, ON, Canada |
2019 – 2020

Chris was responsible for coordinating the completion of a PTTW amendment application for an abandoned mine in Northern Ontario. Chris performed a water balance assessment in GoldSIM to determine the hydrologic effects of increased water taking on Moran Lake. The water balance assessment included comparing estimated yearly flows to Moran Lake with required pumping rates at to determine if there was a potential for impacts to local fish and wildlife due to increased pumping.

Sheridan Creek Environmental Assessment

Hydraulic Modeller |
City of Mississauga | Mississauga, ON, Canada |
2021 – Ongoing

GHD was retained by the City of Mississauga to develop an Environmental Assessment for the restoration of Sheridan Creek in the area around Inverness Road and Lushes Ave. Chris was responsible for evaluating the existing conditions model and performing hydraulic modelling of the environmental assessment alternatives in HEC-RAS.

Etobicoke Creek Erosion Project

Hydraulic Modeller |
City of Mississauga | Mississauga, ON, Canada |
2021 – Ongoing

GHD was retained by the City of Mississauga to develop a Geomorphic Assessment and Conceptual Design Report. Chris was responsible for evaluating the existing conditions model and performing hydraulic modelling of the proposed concept design in HEC-RAS.

Timber Trails Subdivision Development

Water Resources Engineer |
Farsight Developments | Bowmanville, ON, Canada |
2021 – Ongoing

Chris was responsible for the development of a hydraulic model to determine the Regional floodline elevation throughout the site as well as quantify the impacts of proposed development on the Regional flood elevation. Chris utilized an existing HEC-RAS model provided by the Central Lake Ontario Conservation Authority to determine the impacts of development. In addition, Chris designed energy dissipation structures for pond and overland flow outlets.

Goldboro Mine Water Management Plan

Hydraulic Modeller & Designer |
Anaconda Mining Company | Goldboro, NS, Canada
| 2020 – Ongoing

Chris was responsible for the development of a Mine Water Management Plan for the Goldboro Gold Mine. This included the development of a predictive water quality model using inputs from both groundwater and surface water. Chris led the development of a hydrologic model using PC-SWMM for the Site in order to design the mine surface water infrastructure and erosion and sediment control measures during construction. Chris assisted with the development of a Feasibility Study for the Site.

Beaver Dam Mine Water Management Plan

Hydraulic Modeller & Designer |
Atlantic Mining Nova Scotia | Marinette, NS, Canada |
2018 – Ongoing

Chris was responsible the development of a Mine Water Management Plan for the Beaver Dam Gold Mine. This included the design of the mine surface water infrastructure from conceptual layout to detailed design using a hydrologic model using PC-SWMM. The PC-SWMM model was calibrated to available stream gauging data for the adjacent watercourses. Additionally, Chris was responsible for the development of a predictive water quality model including inputs from both surface water and groundwater. Finally, Chris performed conceptual design calculations for stormwater infrastructure on the Beaver Dam Site.

DIM Mine SWM Infrastructure Design

Water Resources Designer |
Halliburton | Hot Springs, AR, USA |
2018 – 2021

GHD was retained by Halliburton to complete the design of site infrastructure for the purpose of remediating the DIM Mine site. Chris was responsible for development of a hydrologic model for the DIM Mine site including investigating existing and proposed conditions. The hydrologic model was developed in PC-SWMM to size and design the network of SWM ditches conveying stormwater to the on-site treatment ponds. Chris also aided in the development of construction drawings while developing specifications for the tender package

City of Sarnia Dock Expansion

Hydraulic Designer and Water Resources Engineer |
City of Sarnia | Sarnia, ON, Canada |
2019 – Ongoing

GHD was retained by the City of Sarnia to provide structural and civil design related to a dock expansion along the St. Clair River in Sarnia, Ontario. Chris was responsible for the hydraulic design including stormwater conveyance controls. Chris completed the 30%, 60% and 90% design for the Site including preparation of construction specifications for tender documents.

Gatineau Railway

Hydrologic/Hydraulic Modeller & Designer |
Chemins de Fer Quebec-Gatineau Inc. | Thurso, QC,
Canada | 2019 – 2020

GHD was retained by Chemins de Fer Quebec-Gatineau to assist with the design of a railway in Thurso, Quebec. Chris performed a hydrologic assessment of multiple

inlet channels to determine peak flow rates to an existing channel and determine if the channel had sufficient capacity to convey peak flows and prevent erosion of the adjacent railway. Chris performed hydraulic calculations in FlowMaster and assessed the peak shear stress expected in the channel. Chris designed a vegetated riprap revetment to provide erosion protection for the railway and increase aesthetic appeal to adjacent landowners

Kam Kotia Mine Site

Hydrologic Modeller & Designer |
Confidential | Timmins, ON, Canada |
2019 – 2021

Chris developed a hydrologic model in PC-SWMM to size and design a SWM swale network for the closure of Kam Kotia Mine Site. Chris used the PC-SWMM model to inform the swale dimensions. Results from the PC-SWMM model were also used to perform shear stress calculations for the designed swales to determine appropriate channel lining material.

Wonowon Landfill Water Balance Analysis

Water Resources Engineer |
Tetra Tech | Wonowon, BC, Canada |
2018 – 2021

GHD was retained by Tetra Tech complete a water balance assessment of a proposed landfill in Wonowon, British Columbia. Chris was responsible for the development of a conceptual level water balance assessment to determine the impacts of landfill development to the surrounding watercourses.

MacLellan's Quarry Expansion SWM Design

Hydrologic Modeller & SWM Designer |
McCallum Environmental | New Glasgow, NS, Canada |
2018 – 2019

Chris was responsible for coordinating the completion of a water balance assessment and preliminary stormwater infrastructure design for a quarry expansion in Nova Scotia. The water balance assessment included determining the effects of quarry expansion on the local watercourses including Stewart Brook. Chris provided several discharge alternatives to ensure minimal impact to surrounding watercourses. In the second phase of the project Chris was responsible for preliminary design of the stormwater infrastructure including preparation of permit-level drawings using PC-SWMM.

Surface Water Management Design

Water Resources Designer |
New Chester Renewable Energy | Grand Marsh, WI, USA | 2019 – 2020

Chris was responsible for the design of a swale to be incorporated into an existing stormwater design. Chris's responsibilities included performing Rational Method calculations for the proposed swale and existing SWM infrastructure. Chris created a design which allowed for all existing SWM requirements such as peak flow control and infiltration and water quality requirements to be met. Chris prepared 100% design drawings for the construction of the swale.

Upstate New York Remediation Construction Oversite

Construction Oversite Engineer |
Confidential | New Hartford, New York |
2019 – 2020

GHD was retained to design and implement a remedial design work plan for a contaminated site in upstate New York. Chris was responsible for performing construction oversite activities, acting as a liaison with local residents and tracking overall budgeting during construction. Chris was on-site daily working with the contractor to ensure proper implementation of the design.

N95 Respiratory Facility Expansion

Hydrologic Modeller |
3M Canada | Brockville, ON, Canada | 2020

Chris assisted with the development of an ECA Application for the purpose of expanding the 3M Brockville manufacturing plant to manufacture N95 masks for the COVID-19 crisis. Chris developed a hydrologic model in PC-SWMM to assess existing conditions to proposed conditions and determine what, if any, updates were required to the existing stormwater management infrastructure on Site.

Career history

2018 - present	GHD, Water Resources Engineer
2016 - 2016	Stantec Ltd, Water Resources Engineering Intern
2014 - 2014	Wood Engineering (Formerly AMEC Foster Wheeler), Water Resources Engineering Intern

CULTURAL RESOURCE MANAGEMENT GROUP LTD.

KYLE G. CIGOLOTTI, BA

Managing Partner - Archaeologist

Education: Bachelor of Arts – Anthropology, Saint Mary's University, 2009

Affiliations: Nova Scotia Archaeology Society (Member 2012 – present; Treasurer 2018 – 2023; President 2023 - present)
Canadian Archaeology Association (Conference Chairperson; Safety Committee Chairperson)
Ontario Archaeological Research License Holder, R1281

Awards: Placide Rivette Family Archaeology Award, 2009

REPRESENTATIVE ARCHAEOLOGICAL EXPERIENCE

2023

Permit Holder during an Archaeological Resource Impact Assessment within the Eastern Passage Commons.

Permit Holder during an Archaeological Resource Impact Assessment for future highway upgrades for Nova Scotia Public Works in Shelburne County.

Permit Holder during a facility upgrade project on Lake Banook, Dartmouth.

Project Manager during the development of Archaeological and Cultural Heritage Resource Impact Management Protocols for resource mining projects in Nova Scotia and New Brunswick.

Project Manager during the development of Archaeological Best Practices Protocol for the Government of Canada during Underwater Benthic Habitat Surveys.

Permit Holder during the archaeological monitoring of urban development projects in Halifax, Nova Scotia.

2022

Project Manager during the Archaeological Resource Impact Assessment for a wind energy project for NSPI in Nuttby, Nova Scotia.

Project Manager during the Archaeological Resource Impact Assessment for a wind energy project for NSPI in Bear Lake, Nova Scotia.

Project Manager during the Archaeological Resource Impact Assessment for a wind energy project for Dillon in Benjamins Mill, Nova Scotia.

Project Manager during the Archaeological Resource Impact Assessment for a wind energy project for Dillon in Westchester, Nova Scotia.

Principal Investigator during the Archaeological Resource Impact Assessment for a wind energy project for MEL in Wedgeport, Nova Scotia.

Licensed Field Director during the Stage 4 Property Assessment in Amherstburg, Ontario.

Project Manager for the development of an Exhibition and Outreach program of the Naval Museum of Halifax.

Project Manager during the built heritage assessment of federally protected structures in Nappan, Nova Scotia.

Principal Investigator during the Archaeological Resource Impact Assessments of a series of proposed mining projects for Atlantic Mining Nova Scotia;

Licensed Field Director during the Stage 2 Archaeological Assessment of a proposed mixed commercial/residential development in Kincardine, Ontario.

Principal Investigator during the Archaeological Resource Impact Assessment of a directional drilling program in Shubenacadie East;

Principal Investigator during Archaeological Monitoring at the Fort Belcher Marsh Aboiteau project for the Nova Scotia Department of Agriculture;

Principal Investigator during Archaeological Monitoring of the directional drilling operations in at Shipyard Landing for the Municipality of Bridgewater;

2021 Principal Investigator during the Archaeological Resource Impact Assessment of the proposed Tote Road Quarry Expansion project in Halifax Regional Municipality, Nova Scotia for GHD;

Principal Investigator and Archaeological Monitor for the Sallyport Upgrade project at the Nova Scotia Law Courts in Halifax Regional Municipality, Nova Scotia for Nova Scotia Department of Transportation and Infrastructure Renewal;

Principal Investigator and Archaeological Monitor for the Canadian Forces Housing Agency garage project at the Halifax Dockyard in Halifax Regional Municipality, Nova Scotia for Bell Multi Construction Inc;

Principal Investigator during the Archaeological Resource Impact Assessment of the proposed Westchester Wind Farm project in Colchester County, Nova Scotia for Dillon;

Principal Investigator during the Archaeological Resource Impact Assessment of the proposed expansion of the Touquoy Gold project in Halifax Regional Municipality, Nova Scotia for Nova Scotia Mining Inc;

Archaeological Monitor during the Fort Needham services upgrade project in Halifax Regional Municipality, Nova Scotia for Halifax Regional Municipality;

Archaeological Monitor during the Summer Street Parking Garage project in Halifax Regional Municipality, Nova Scotia for the Nova Scotia Department of Transportation and Infrastructure Renewal;

Principal Investigator during the archaeological testing program at the Fifteen Mile Stream Gold project in Halifax Regional Municipality, Nova Scotia for Nova Scotia Mining Inc.;

2020 Principal Investigator during the archaeological testing program at the Fifteen Mile Stream Gold Project in Halifax Regional Municipality, Nova Scotia for Nova Scotia Mining Inc;

Assistant Field Director during the archaeological testing program at the Beaver Dam Gold Project in Halifax Regional Municipality, Nova Scotia for Nova Scotia Mining Inc;

Principal Investigator during the Archaeological Resource Impact Assessment of the Allain River Marsh project in Annapolis County, Nova Scotia for the Nova Scotia Department of Agriculture;

Principal Investigator during the Archaeological Resource Impact Assessment of the St. Mary's Bay Marsh project in Digby County, Nova Scotia for the Nova Scotia Department of Agriculture;

Project Coordinator for the Stage 3 Archaeological Assessment during the 849 Front Road development project in Amherstburg, Ontario for Dillon;

Project supervisor for the development of GIS archaeological potential modeling for Mineral Exploration Claims throughout Nova Scotia;

2019 Principal Investigator during the archaeological monitoring at St. Paul's Church in Halifax, Nova Scotia for Halifax Regional Municipality;

Principal Investigator during the Archaeological Resource Impact Assessment of the proposed Gabarus Quarry Expansion project in Cape Breton Regional Municipality, Nova Scotia for Dexter;

Principal Investigator during the Archaeological Resource Impact Assessment of the proposed Sporting Mountain Quarry Expansion project in Richmond County, Nova Scotia for GHD;

Principal Investigator during the Archaeological Resource Impact Assessment of the proposed Isgonish Aboiteau infrastructure upgrade project in Colchester County, Nova Scotia for the Nova Scotia Department of Agriculture;

Principal Investigator during the Archaeological Resource Impact Assessment of the proposed Nappan Dam infrastructure upgrade project in Colchester County, Nova Scotia for the Nova Scotia Department of Agriculture;

Project Coordinator and Archaeological Field Director during the Stage 3 Archaeological Assessment of the 849 Front Road development in Amherstburg, Ontario;

Principal Investigator during the Archaeological Resource Impact Assessment of the Beaver Dam Gold Mine redevelopment project in Halifax Regional Municipality, Nova Scotia for Nova Scotia Mining Inc;

Principal Investigator during the Archaeological Resource Impact Assessment of the Fifteen Mile Stream redevelopment project in Halifax Regional Municipality, Nova Scotia for Nova Scotia Mining Inc;

Principal Investigator during the Archaeological Monitoring of the St. Andrew's Community Centre redevelopment project in Halifax Regional Municipality, Nova Scotia for Halifax Regional Municipality;

Project Coordinator and Assistant Field Director during the Stage 2 Archaeological Assessment of the Sandwich and Mill development project in Sandwich, Ontario for Dillon;

Assistant Field Director during the Stage 1 Archaeological Assessment of the Sandwich South Master Servicing Report in Windsor, Ontario for Dillon;

2018 Principal Investigator during the archaeological monitoring at St. Paul's Church in Halifax, Nova Scotia for Halifax Regional Municipality;

Principal Investigator during the archaeological monitoring at the Canal Greenway development in Dartmouth, Nova Scotia for Halifax Regional Municipality;

Principal Investigator during the archaeological monitoring at the St. Andrew's Community Centre Redevelopment project in Halifax, Nova Scotia for Halifax Regional Municipality;

Principal Investigator during the archaeological screening and reconnaissance at the Beaver Dam Gold Mine Haul Road project in Beaver Dam, Nova Scotia for GHD;

Principal Investigator during the archaeological screening and reconnaissance at the Beaver Dam Gold Mine Waste Rock Storage Pile project in Beaver Dam, Nova Scotia for GHD;

Principal Investigator during the archaeological screening and reconnaissance at the Cochrane Hill Gold Mine development project in Guysborough County, Nova Scotia for McCallum Environmental;

2017 Principal Investigator during archaeological screening and reconnaissance of the Louisdale Water Treatment Plant in Richmond County, Nova Scotia for Dillon Halifax;

Principal Investigator during archaeological monitoring at the Canal Greenway Project in Dartmouth, Nova Scotia for Halifax Regional Municipality;

Principal Investigator during the archaeological monitoring at St. Paul's Church in Halifax, Nova Scotia for Halifax Regional Municipality;

Principal Investigator during the archaeological screening and reconnaissance of the proposed quarry in Sheet Harbour for Dexter Construction Company Limited;

Principal Investigator during the archaeological screening and shovel testing of the Lake William Trail development for the Shubenacadie Watershed Environmental Protection Society;

2016 Principal Investigator during archaeological screening and reconnaissance of the Brazil Lake Quarry in Yarmouth County, Nova Scotia for GHD;

Principal Investigator during archaeological screening and reconnaissance of the Duncan Gillis Quarry in Victoria County, Nova Scotia for Municipal Enterprises Limited;

2015 Archaeological Field Supervisor during the archaeological impact assessment of the proposed Sisson Mine for the Government of New Brunswick and the Maliseet Communities of New Brunswick;

2014	Field Technician in the archaeological and cultural/heritage landscape screening of 317 hectares of private land in Port Wallace, HRM, for a consortium of landowners;
	Archaeological Technician during design and coordination of the Canal Greenway in Dartmouth undertaken with CBCL on behalf of Halifax Regional Municipality;
2013	Field/GIS Technician during archaeological reconnaissance and testing of the Maritime Link Project for EMERA Newfoundland and Labrador Incorporated; Identified and evaluated archaeological potential on transmission lines on Cape Breton Island;
2012-2013	Archaeological Technician during archaeological mitigation of seven Pre-contact habitation sites for a dam replacement project at the outlet of Gaspereau Lake, Kings County for Nova Scotia Power Incorporated;
2011	Data Entry/Report Preparation for the San Felice Field School in Gravina, Italy through Saint Mary's University;
2010	Archaeological Field Technician in the San Felice Archaeological Field School in Gravina, Italy, through Mount Allison University;
2009	Participant in Grand Pré Archaeological Field School in Grand Pré, Kings County, through Saint Mary's University;

EMPLOYMENT HISTORY

Cultural Resource Management Group Limited, Halifax, Nova Scotia

2012-present Managing Partner, Project Manager, Principal Investigator, addressing archaeological projects throughout Atlantic Canada and Southern Ontario.

Saint Mary's University, Halifax, Nova Scotia

2011 Data Entry/Report Preparation for the San Felice Field School in Gravina, Italy.

HEALTH & SAFETY CERTIFICATIONS

OSH Training for Managers & Supervisors
Standard First Aid; CPR Level C & AED
CCOHS Hazard Identification, Assessment, & Control; Accident Investigation
WHMIS 2015

CULTURAL RESOURCE MANAGEMENT GROUP Ltd.

LOGAN ROBERTSON, BA

Archaeologist

Education: Saint Mary's University, Honours Bachelor of Arts Anthropology, 2021

Affiliations: Nova Scotia Archaeology Society (Member 2018 – present; Director at Large 2019-2023)
Ontario Archaeology Society
Ontario Archaeological Research License Holder, R1368 (2023-Present)

REPRESENTATIVE ARCHAEOLOGICAL EXPERIENCE

2023

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of a property in Antrim, Nova Scotia for GHD;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of a property in Lake Echo, Nova Scotia for Nova Scotia Department of Public Works;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of a property in Schubenacadie East, Nova Scotia for Xplore Inc.;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of a property in Cogmagun, Nova Scotia for Dillon Consulting Limited;

Archaeologist during the Stage 3 site specific assessment of AbHr-57 in Tecumseh, Ontario for Old Castle Heights Inc.;

Archaeologist during the Stage 2 assessment of Old Castle Heights in Tecumseh, Ontario for Old Castle Heights Inc.;

Archaeologist during the Stage 1 & 2 assessment of 0 Munich Court in Windsor, Ontario Mid South Land Development Corp.;

2022

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of a property in Little Forks, Nova Scotia for Dexter Construction Company;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Nuttby Ridge Wind project near Earltown, Nova Scotia for Nova Scotia Power Incorporated;

Archaeologist during the Archaeological Resource Impact Assessment of the Bear Lake Wind project near Vaughan, Nova Scotia for Nova Scotia Power Incorporated;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Waterville Transmission Line project in South Mountain, Nova Scotia for Nova Scotia Power Incorporated;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Mary Barker Trail Realignment project in Cape Breton, Nova Scotia for Cabot Snowmobile Club;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Port La Tour Ditching project in Yarmouth, Nova Scotia for the Nova Scotia Department of Public Works;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Westchester Wind Environmental Assessment project in Westchester, Nova Scotia for Dillon Consulting Limited;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Highway 103 Repaving project in Chester, Nova Scotia for the Town of Chester;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Former Penhorn Mall Property Redevelopment project in Dartmouth, Nova Scotia for Clayton Developments Limited;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Windsor Road Quarry Expansion project in Chester, Nova Scotia for South Shore Sand & Gravel;

2021 Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Lightfoot Farms Barn Addition project in Wolfville, Nova Scotia for Equilibrium Engineering Inc;

Archaeologist and Permit Holder during the Archaeological Resource Impact Assessment of the Glenwood Provincial Park Development project in the Municipality of Argyle, Nova Scotia for the Municipality of Argyle;

Archaeological Field Supervisor during the Archaeological Resource Impact Assessment of the Debert Low Pressure Sewer System in Debert, Nova Scotia for the Municipality of Colchester;

Archaeological Technician during the Archaeological Resource Impact Assessment of the Touquoy Mine in Middle Musquodoboit, Nova Scotia for the Atlantic Mining NS;

Archaeological Technician during the Archaeological Resource Impact Assessment of the Fifteen Mile Stream Mine in Halifax Regional Municipality, Nova Scotia for the Nova Scotia Mining Inc;

Archaeological Technician during the Archaeological Monitoring of the Summer Street Parkade project in Halifax, Nova Scotia for the NS Department of Transportation and Active Transit;

Archaeological Technician during the Archaeological Resource Impact Assessment of the Plains Road Water Valve Replacement project in Debert, Nova Scotia for the Municipality of Colchester;

2020 Archaeological Technician during the Archaeological Resource Impact Assessment of the MacElmon Road West in Debert, Nova Scotia for the Municipality of Colchester;

Archaeological Technician during the Stage 3 Archaeological Assessment of the 849 Front Road property in Amherstburg, Ontario for Dillon Consulting;

Archaeological Technician during the Archaeological Resource Impact Assessment of the Beaver Dam Gold Project in Halifax Regional Municipality, Nova Scotia for Nova Scotia Mining Inc;

EMPLOYMENT HISTORY

Cultural Resource Management Group Limited, Halifax, Nova Scotia

2020-date Principal Investigator, Archaeological Field/Lab Technician, addressing archaeological projects throughout Nova Scotia and in Southern Ontario;

Saint Mary's University, Halifax, NS

2017-date Previous positions included Senate Office Assistant (2017-2019) and Teaching Assistant (2018-2021). Current position with SMU as a Forensic Osteology Curator.

TRAINING AND CERTIFICATES

Red Cross Standard First Aid/CPR Level C
WHMIS Training
Commercial Diver DCBC Category 1

DATE AWARDED PROFESSIONAL DESIGNATIONS

Nova Scotia Heritage Research Permits Held since 2021.

EDUCATION & ACADEMIC AWARDS

Bachelor of Arts, Honours in Anthropology 2016 – 2021, Saint Mary's University, Halifax, NS
Dean's List 2017, 2018
Saint Mary's Academic Writing Awards 2017 and 2018, undergraduate social sciences.
Benoit Ouellette Cartography Prize 2018
John Harvey Award 2018/2019
Saint Mary's University President's Hall of Academic Excellence Award 2021

CULTURAL RESOURCE MANAGEMENT GROUP Ltd.

ROBERT H. J. SHEARS, MA, RPA

Partner | Archaeologist

Education: Master of Arts - Atlantic Canada Studies, Saint Mary's University, 2013
Bachelor of Arts (Adv.) - History/Anthropology, Saint Mary's University, 2004
Bachelor of Science - Biology, Saint Mary's University, 2000

Affiliations: Member of the Registry of Professional Archaeologists
Nova Scotia Archaeology Society (Director 2003-2016; President 2007-2009)
Canadian Archaeological Association (Member of Organizing Committee 2011 Annual Conference, Halifax)
Council of Northeast Historical Archaeology
Association of Professional Archaeologists of New Brunswick
Gorsebrook Research Institute (Graduate Research Fellow, 2010)

REPRESENTATIVE ARCHAEOLOGICAL EXPERIENCE

2022 Principal Investigator during Potential Modelling and Field-Truthing for the Bear Lake Wind Project, for Nova Scotia Power Inc.;

Principal Investigator during Archaeological Reconnaissance for the Bear Lake Wind Project, for Nova Scotia Power Inc.;

Field Archaeologist during Archaeological Reconnaissance for the Nuttby Ridge Wind Project, for Nova Scotia Power Inc.;

Principal Investigator during the Preliminary Investigation of the Glenvale Gypsum Project, in Glenvale, NB, for Dillon Consulting;

Principal Investigator during an Archaeological Impact Assessment (Initial Assessment) for the Fundy Nation Park Dickson Trail Pedestrian Bridge in New Brunswick, for Parks Canada via CBCL Limited;

Principal Investigator during archaeological monitoring for the Dugau-Ryerson Marsh Upgrade Project, located in Annapolis County, for the Department of Agriculture;

Principal Investigator during archaeological screening and reconnaissance of the Birch Plain Dredging Material Management Site in Victoria County, Nova Scotia, for the Department of Fisheries and Oceans Small Craft Harbours Branch via GHD;

Principal Investigator during the Preliminary Investigation of the Hampton Multiuse Centre Project, in Hampton NB, for Dillon Consulting;

Principal Investigator during archaeological screening and reconnaissance of the 760 Maplewood Lane Infilling Project, for the Landowner;

Principal Investigator during archaeological screening and reconnaissance of the 1454 Birchdale Avenue Infilling Project, for McCallum Construction;

Principal Investigator during archaeological screening and reconnaissance and borehole monitoring of the MacLellans Brook Depot Pole Barn Removal Project, for the Department of Natural Resources and Renewables;

Principal Investigator during archaeological monitoring of upgrades to 131 King Street in Grand Pre, for Landscape Grand Pre and the Landowner;

Principal Investigator during archaeological monitoring and back-dirt screening for the Plains Road Water Valve Removal Project, for the Municipality of Colchester;

Principal Investigator during archaeological screening and reconnaissance of 2858 Gottingen Street Development Project, for FH Development;

Principal Investigator during archaeological screening and reconnaissance of the Louisbourg Visitor Centre Project, for Develop NS;

Principal Investigator during archaeological screening and reconnaissance of the R.C. MacGillivray Guest Home Project, for R.C. MacGillivray Guest Home;

Principal Investigator during Field Evaluation (shovel testing) of the Route 11, Culvert 40 Replacement Project, for the New Brunswick Department of Transportation and Infrastructure;

Principal Investigator during archaeological screening and reconnaissance of the Wood Islands Ferry Terminal Upgrade Project, for GHD;

2021 Principal Investigator during archaeological assessment of the Plains Road Water Valve Removal Project within the Debert Business Park, for the Municipality of the Colchester County;

Principal Investigator during archaeological assessment of the Debert Low Pressure Sewer within the Debert Business Park, for the Municipality of the Colchester County;

Principal Investigator during the Preliminary Investigation of the Nepisiguit Dam Life Extension Project, for New Brunswick Power;

Principal Investigator during archaeological screening and reconnaissance of the Kiwanis Grove Park Upgrade Project, located in Dartmouth, for Halifax Regional Municipality;

Principal Investigator during archaeological screening and reconnaissance of 287 Old Post Road in Grand Pre, for the Landowner and Landscape Grand Pre Inc.;

Principal Investigator during archaeological assessment of the Benjamins Mill Wind Project, for Dillon Consulting;

Principal Investigator during archaeological screening and reconnaissance of Lot 5 Grand Pre Road in Grand Pre, for the Landowner and Landscape Grand Pre Inc.;

Principal Investigator during archaeological screening and reconnaissance of 131 King Street in Hortonville, for the Landowner and Landscape Grand Pre Inc.;

2020-2021 Principal Investigator during archaeological monitoring for the Brigadoon Village Phase II, Expansion in Aylesford, Nova Scotia, for Grey Cardinal;

2020 Principal Investigator during an archaeological screening and reconnaissance for the Welshtown Quarry in Welshtown, Nova Scotia for Municipal Construction;

Principal Investigator during an archaeological screening and reconnaissance for Black Duck Brook 9Phase 7-3A/B in West Bedford, Nova Scotia for Clayton Development;

Principal Investigator during an archaeological screening and reconnaissance for the Fort View Golf Course Expansion in Lequille, Nova Scotia, for 3314197 Nova Scotia Limited;

Principal Investigator during an archaeological screening and reconnaissance for the Panuke Road Quarry Expansion in Windsor, Nova Scotia, for Nova Construction;

Principal Investigator during an archaeological screening and reconnaissance for the Shot Rock Property – Piedmont Land in Pictou County, Nova Scotia, for Northern Shield Resources Inc.;

Principal Investigator during an archaeological screening and reconnaissance for the Sheet Harbour Lands in Sheet Harbour, Nova Scotia, for Halifax Regional Municipality;

2019-2020 Principal Investigator during an archaeological impact assessment for the Canadian Centre for Climate Change and Adaptation in Saint Peters, PEI for UPEI;

2019 Principal Investigator during an archaeological screening and reconnaissance for the Pocologan Sand and Gravel project in Pocologan, New Brunswick for Amkis Resources;

Principal Investigator during preliminary investigation for the Milltown Generating Station Decommissioning Project in Milltown, New Brunswick for NB Power (via Dillon Consulting);

2018-2020 Principal Investigator during archaeological impact assessment of the Town of Woodstock Water Supply project in Woodstock, New Brunswick, for the Town of Woodstock (via Dillon Consulting);

2018-2019 Principal Investigator during archaeological impact assessment of the Upham East Gypsum Quarry project in Upham, New Brunswick, for Hammond River Holdings Ltd. (via Dillon Consulting);

2018 Principal Investigator during archaeological assessment of the Debert Well 1C Connection project within the Debert Air Industrial Park, for the Municipality of the County of Colchester;

Principal Investigator during archaeological assessment of the Kohltech Expansion Property within the Debert Air Industrial Park, for the Municipality of the County of Colchester;

Principal Investigator during archaeological screening and reconnaissance of the Greenwood Subdivision Wastewater Upgrade project in Saint John, New Brunswick, for the City of Saint John (via Dillon Consulting);

Principal Investigator during archaeological screening and reconnaissance of the Morna Heights Subdivision Wastewater Upgrade project in Saint John, New Brunswick, for the City of Saint John (via Dillon Consulting);

2017 Principal Investigator during archaeological screening and reconnaissance, monitoring and mitigation of the Proposed Irving Parking Garage project in Saint John, New Brunswick for Irving (via CBCL);

Principal Investigator during archaeological assessment of two lots within the Debert Air Industrial Park, for the Municipality of the County of Colchester;

Principal Investigator during archaeological shovel testing of the Canada 150 Shannon Park Observation Deck, in Halifax Regional Municipality for Canada Lands Company;

Principal Investigator during additional archaeological reconnaissance of the Truro Salt Marsh Dyke Restoration and Habitat project, for the Department of Transportation and Infrastructure Renewal;

2016 Principal Investigator during archaeological screening and reconnaissance of the Scots Bay Small Craft Harbour in Scots Bay, Kings County, Nova Scotia for GHD;

Principal Investigator during the archaeological assessment of seven lots (7 hectares) within the Debert Air Industrial Park, for the Municipality of the County of Colchester;

Field Director during archaeological mitigation for a dam replacement project amid three Precontact and historic sites at the outlet of Gaspereau Lake, Kings County for Nova Scotia Power Inc;

2015 Principal Investigator during archaeological screening and reconnaissance of the Seabrook Quarry in Digby County, Nova Scotia for Dexter Construction;

Field Director during the archaeological assessment of three commercial lots (15.6 hectares) within the Debert Air Industrial Park, for the Municipality of the County of Colchester;

2014 Principal Investigator during archaeological screening and monitoring of the redevelopment of the Roy Building in Halifax, Nova Scotia, for Starfish Properties;

Principal Investigator during archaeological screening and reconnaissance of the proposed water treatment and wastewater treatment facilities in Oromocto, New Brunswick, for Defence Construction Canada;

Field Director during the archaeological assessment of three lots (7.4 hectares) within the Debert Air Industrial Park, for the Municipality of the County of Colchester;

Principal Investigator during archaeological screening of the Prince Albert Road Option of the Sullivan's Pond Storm Sewer Renewal Project, Dartmouth, Nova Scotia, for CBCL Limited;

2013-2014 Principal Investigator during archaeological monitoring at the Nova Scotia Fisheries Museum of the Atlantic Inshore Fisheries Display Building Renovation and Stabilization Project (BcDb-8) for the Nova Scotia Department of Transportation and Infrastructure Renewal;

2013 Principal Investigator during archaeological screening and reconnaissance of the Hankinson Quarry, Annapolis County, the James River Quarry, Antigonish County, the Irish Cove Quarry, Victoria County and the Porters Lake Quarry, Halifax Regional Municipality, Nova Scotia, for Dexter Construction;

Principal Investigator during archaeological assessment of the Department of Fisheries - Canadian Coast Guard Base, Dartmouth, Nova Scotia, for Public Works and Government Services Canada;

Principal Investigator during archaeological reconnaissance and screening of the preferred pipeline alignment in Pictou County, Nova Scotia, for Heritage Gas;

Principal Investigator during archaeological shovel testing at four sites along the preferred pipeline alignment in Pictou County, Nova Scotia, for Heritage Gas;

2012-2013 Principal Investigator during archaeological monitoring for the Storm Water Easement for South Queens School in Liverpool, for the Nova Scotia Department of Transportation and Infrastructure Renewal;

Field Director during archaeological mitigation for a dam replacement project amid seven Precontact and historic sites at the outlet of Gaspereau Lake, Kings County for Nova Scotia Power Inc.;

Researcher for the Archaeological Resource Impact Assessment of Lovett Lake Estates in Beechville, Nova Scotia, for Armco Capital Inc.;

2012 Researcher for the Archaeological Screening and Reconnaissance of the Red Bridge Replacement in Baddeck Bridge, for the Nova Scotia Department of Transportation and Infrastructure Renewal;

2011-2012 Principal Investigator during archaeological monitoring at the Nova Scotia Fisheries Museum of the Atlantic Wharf Repair Project (BcDb-8) for the Nova Scotia Department of Transportation and Infrastructure Renewal;

2011 Field Archaeologist during archaeological assessment and testing for the Route 2, St. Jacques to Quebec: Heritage Resource Impact Assessment Testing Program, near Edmonston, for the New Brunswick Department of Transportation and Infrastructure;

2010-2011 Principal Investigator during archaeological survey and testing at the Lawrencetown Township (BdCu-8) and Green Estate (BdCu-9) Sites in Lawrencetown, Nova Scotia, related to graduate research conducted as part of a Master of Arts degree with the Atlantic Canada Studies program at Saint Mary's University;

2004-2011 Archaeological Site Supervisor at the Grand Pré Archaeological Field School at Grand Pré National Historic Site, for Saint Mary's University;

2010 Field Archaeologist during archaeological testing on the proposed Mi'kmawey Debert Cultural Centre Site, in Debert, Nova Scotia, for the Confederacy of Mainland Mi'kmaq;

Field Archaeologist during archaeological survey of a proposed 70 kilometre extension of Provincial Highway 11, Pokemouche to Janeville, for the New Brunswick Department of Transportation and Infrastructure;

2009 Principal Investigator during a geophysical survey of residential properties in Grand Desert, Nova Scotia, related to research as part of a Master of Arts degree with the Atlantic Canada Studies program at Saint Mary's University;

2004-2008 Collections Specialist (Assistant to the Archaeology Collections Manager) at the Parks Canada Archaeology Lab in Halifax, for Parks Canada Agency;

EMPLOYMENT HISTORY

Cultural Resource Management Group Limited, Halifax, Nova Scotia

2011-date Archaeological Technician (Casual) to Company Partner & Archaeologist, involved in all aspects of assessment and mitigation, including: research; survey, excavation and recording; supervision of field and lab personnel; and, report writing;

Saint Mary's University, Halifax, Nova Scotia

2004-2011 Archaeological Site Supervisor (Seasonal) at the Grand Pré Archaeological Field School, involved in the instruction of undergraduate students in archaeological field and laboratory techniques.

Parks Canada Agency, Halifax, Nova Scotia

2009-2010 Archaeological Site Assistant and Field Archaeologist (Contract), responsible for archaeological excavation on a mitigation project at Grand Pré NHS; and site assessment, excavation, recording and report writing for a monitoring and mitigation project on George's Island National Historic Site;

Parks Canada Agency, Halifax, Nova Scotia

2004-2008 Collections Specialist (Term), performing a variety of collections management duties including: processing of artifacts from point of excavation to final storage; compilation of electronic databases of archaeological site records, research library and map collection; and, material culture research.

NON-ACADEMIC COURSES

WHMIS 2015 (workplace hazardous materials) training
St. John Ambulance Standard First Aid / CPR Level A

DATE AWARDED PROFESSIONAL DESIGNATIONS

Nova Scotia Heritage Research Permits held since 2009
New Brunswick Archaeological Field Research Permits held since 2014
Prince Edward Island Archaeological Permits held since 2019
Member of the Registry of Professional Archaeologists since 2014

January 2023

CULTURAL RESOURCE MANAGEMENT GROUP Ltd.

SHAWN MACSWEEN, BA

Drafting/GIS Support, Archaeological Technician

Education: Saint Mary's University, Bachelor of Arts Psychology, 2010
Nova Scotia Community College, Occupational Health & Safety Program, 2015

REPRESENTATIVE EXPERIENCE

2022 Drafting/GIS Support and Archaeological Field Technician for the Archaeological Resource Impact Assessment of the Xplornet Directional Drilling project in Shubenacadie East, Nova Scotia for TEP Canada;

Drafting/GIS Support for the Archaeological Shovel Testing of the Kelly Point Vessel Demolition and Removal project study area in Prospect, Nova Scotia for Nova Scotia Lands Inc.;

2021 Drafting/GIS Support and Archaeological Field Technician for the Archaeological Resource Impact Assessment of the Debert Low Pressure Sewer System in Debert, Nova Scotia for the Municipality of Colchester;

Drafting/GIS Support and Archaeological Technician for the Archaeological Resource Impact Assessment of the Touquoy Mine in Middle Musquodoboit, Nova Scotia for the Atlantic Mining NS;

Drafting/GIS Support and Archaeological Technician for the Archaeological Resource Impact Assessment of the Fifteen Mile Stream Mine in Halifax Regional Municipality, Nova Scotia for the Nova Scotia Mining Inc;

Drafting/GIS Support for the Archaeological Monitoring of the Summer Street Parkade project in Halifax, Nova Scotia for the NS Department of Transportation and Active Transit;

Drafting/GIS Support and Archaeological Technician for the Archaeological Resource Impact Assessment of the Twin Lakes Development project in Dartmouth, Nova Scotia for Twin Lakes Development Inc;

Drafting/GIS Support and Archaeological Technician for the Archaeological Resource Impact Assessment of the Sheet Harbour Lands in Sheet Harbour, Nova Scotia for HRM;

Drafting/GIS Support for the Archaeological Resource Impact Assessment of the Cunard Development in Halifax, Nova Scotia for Southwest Construction Management Ltd;

Drafting/GIS Support for the Nova Scotia Archaeological Potential Project Nova Scotia for Atlantic Mining NS Inc;

Drafting/GIS Support for the Archaeological Resource Impact Assessment of the Panuke Quarry Expansion in Windsor, Nova Scotia for Nova Construction;

Drafting/GIS Support and Archaeological Technician for the Archaeological Resource Impact Assessment and Shovel Testing of the Highway 107 Extension Phase 3 in Dartmouth, Nova Scotia for NS Department of Transportation and Infrastructure Renewal;

2020 Drafting/GIS Support and Archaeological Technician for the Archaeological Resource Impact Assessment of the MacElmon Road West in Debert, Nova Scotia for the Municipality of Colchester;

Drafting/GIS Support and Archaeological Technician for the Stage 3 Archaeological Assessment of the 849 Front Road property in Amherstburg, Ontario for Dillon Consulting;

Drafting/GIS Support and Archaeological Technician for the Whycocomagh Quarry Archaeological Resource Impact Assessment in Victoria County, Nova Scotia for Nova Construction Co. Ltd;

Drafting/GIS Support and Archaeological Technician for the Archaeological Resource Impact Assessment of the Beaver Dam Gold Project in Halifax Regional Municipality, Nova Scotia for Nova Scotia Mining Inc;

Drafting/GIS Support for the Stage 1 Archaeological Assessment for the Sandwich South Master Service Plan project in Amherstburg, Ontario for Dillon Consulting;

Drafting/GIS Support for the Stage 2 Archaeological Assessment for the Sandwich and Mill Street project in Amherstburg, Ontario for Dillon Consulting;

Drafting/GIS Support and Archaeological Technician for the Canadian Centre for Climate Change and Adaptation building project in Saint Peters, Prince Edward Island for UPEI.

EMPLOYMENT HISTORY

Cultural Resource Management Group Limited, Halifax, Nova Scotia

2016-date Safety Coordinator, Drafting/GIS Support (2020-present), Archaeological Field/Lab Technician (2016-present) addressing archaeological projects throughout Atlantic Canada and Southern Ontario;

Blue Water Agencies Ltd, Dartmouth, Nova Scotia

2015-2016 Health, Safety, Security and Environment Coordinator at the supply base.

TRAINING AND CERTIFICATES

St. John Ambulance Standard First Aid/CPR Level C
WHMIS Training

APPENDIX C. FIRST NATIONS AND PUBLIC ENGAGEMENT LOG

First Nations Engagement Communication Log

Community or Organization	Individual	Method	Date	Details
KMKNO	Shawn Taylor	Video call	January 28, 2022	Presentation provided to KMKNO by McCallum/Dexter on a separate Dexter project. Within this presentation, Dexter provided information to KMKNO on general quarrying operations and procedures which are applicable to the Walden Quarry Expansion Project.
	Twila Gaudet Shawn Taylor	Email	October 19, 2022	Dexter provided a Project overview letter and extended an invitation to meet to discuss the Project.
	Twila Gaudet Shawn Taylor	Email	October 10, 2023	Dexter provided an updated Project summary, the EA notice, and photo of the existing quarry, and extended an invitation to meet to discuss the Project. Dexter also informed the KMKNO of their intent to register the EA on October 25, 2023, and provided information on how to submit comments to the EA branch during the review period (i.e., prior to November 24, 2023).
Acadia First Nation	Chief Robinson	Email	October 19, 2022	Dexter provided a Project overview letter and extended an invitation to meet to discuss the Project.
	Chief Robinson	Email	October 10, 2023	Dexter provided an updated Project summary, the EA notice, and photo of the existing quarry, and extended an invitation to meet to discuss the Project. Dexter also informed Acadia First Nation of their intent to register the EA on October 25, 2023, and provided information on how to submit comments to the EA branch during the review period (i.e., prior to November 24, 2023).
Millbrook First Nation	Chief Gloade	Email	October 19, 2022	Dexter provided a Project overview letter and extended an invitation to meet to discuss the Project.
	Chief Gloade Barry Gloade	Email	October 10, 2023	Dexter provided an updated Project summary, the EA notice, and photo of the existing quarry, and extended an invitation to meet to discuss the Project. Dexter also informed Millbrook First Nation of their intent to register the EA on October 25, 2023, and provided information on how to submit comments to the EA branch during the review period (i.e., prior to November 24, 2023).

Community or Organization	Individual	Method	Date	Details
Sipekne'katik First Nation	Chief Sack	Email	October 19, 2022	Dexter provided a Project overview letter and extended an invitation to meet to discuss the Project.
	Chief Glasgow	Email	October 10, 2023	Dexter provided an updated Project summary, the EA notice, and photo of the existing quarry, and extended an invitation to meet to discuss the Project. Dexter also informed Sipekne'katik First Nation of their intent to register the EA on October 25, 2023, and provided information on how to submit comments to the EA branch during the review period (i.e., prior to November 24, 2023).
Native Council of Nova Scotia	Chief Augustine	Email	October 19, 2022	Dexter provided a Project overview letter and extended an invitation to meet to discuss the Project.
	Chief Augustine	Email	October 10, 2023	Dexter provided an updated Project summary, the EA notice, and photo of the existing quarry, and extended an invitation to meet to discuss the Project. Dexter also informed the Native Council of Nova Scotia of their intent to register the EA on October 25, 2023, and provided information on how to submit comments to the EA branch during the review period (i.e., prior to November 24, 2023).

APPENDIX D. ARCHEOLOGICAL RESOURCE IMPACT ASSESSMENT (ARIA) EXECUTIVE SUMMARY, HERITAGE RESEARCH PERMIT, AND HERITAGE RESEARCH PERMIT REPORT

WALDEN QUARRY EXPANSION
ARCHAEOLOGICAL RESOURCE IMPACT ASSESSMENT
SCREENING & RECONNAISSANCE 2022
WALDEN, NOVA SCOTIA

FINAL REPORT

Submitted to:
Dexter Construction Company Limited
and the
Special Places Program of the
Nova Scotia Department of Communities, Culture, Tourism and Heritage

Prepared by:
Cultural Resource Management Group Limited
Ten Mile House
1519 Bedford Highway
Bedford, Nova Scotia
B4A 1E3

Heritage Research Permit Holder: Logan Robertson
Author: Logan Robertson

Heritage Research Permit Number: A2022NS075
CRM Group Project Number: 22-0016-01

JULY 2022

The following report may contain sensitive archaeological site data. Consequently, the report must not be published or made public without the written consent of Nova Scotia's Coordinator of Special Places, Department of Communities, Culture, Tourism and Heritage

EXECUTIVE SUMMARY

Cultural Resource Management Group Limited (CRM Group) was retained by Dexter Construction Company Limited to undertake the Screening and Reconnaissance phase of an Archaeological Resource Impact Assessment in conjunction with the proposed expansion of an existing quarry located in Walden, Lunenburg County. Involving Mi'kmaw engagement, background research, and archaeological fieldwork, the project was designed to identify, document, interpret, and make management recommendations for potential cultural resources within the potential impact area.

The ARIA was conducted by CRM Group Archaeologist, Logan Robertson, with the assistance of CRM Group Partner and Archaeologist, Kyle Cigolotti, according to the terms of Heritage Research Permit A2022NS075 (Category 'C'), issued to Robertson through the Special Places Program of the Nova Scotia Department of Communities, Culture, Tourism and Heritage. This report describes the screening and reconnaissance of the study area, presents the results of these efforts, and offers cultural resource management recommendations.

Although the study area is situated along Big North Brook, a minor watercourse that flows into the Atlantic, the southwestern shoreline of the brook could have been an appealing place for temporary encampment along the associated river and lake system. The gentle slope from the shore onto relatively level and dry land would have been a convenient location for landing.

As evidenced by the background study and engagement, the study area and vicinity have likely been utilized and occupied at some point by the Mi'kmaq from at least the Archaic Period to the historic period (9,000 BP to present). Therefore, as part of the archaeological potential model, portions of the study area are ascribed elevated potential for encountering Pre-contact and historic period Mi'kmaw archaeological resources. Land within the study area situated within 50 metres from the shore or bank of Big North Brook is ascribed high archaeological potential. Land from 50 to 80 metres from the shore or bank of Big North Brook is ascribed moderate archaeological potential.

The remainder of the study area is ascribed low archaeological potential, and it is recommended that no further archaeological assessment should be required. This ascription is based on most of the study area consisting of sloped, wet, hummocky terrain that lies distant from navigable waters and known areas of cultural concern. Additionally, a large portion of the study area has previously been disturbed by the development of an existing quarry.

NOVA SCOTIA

Heritage Research Permit (Archaeology)

Special Places Protection Act 1989

(Original becomes Permit when approved by Communities, Culture and Heritage)

Office Use Only
Permit Number:
A2022NS075

Greyed out fields will be made publically available. Please choose your project name accordingly

Surname Robertson	First Name Logan

Project Name: Walden Quarry Expansion Archaeological Resource Impact Assessment, Screening & Reconnaissance

Name of Organization: Cultural Resource Management Group Ltd

Representing (if applicable): Dexter Construction Company Ltd

Permit Start Date May 19, 2022	Permit End Date December 31, 2022

General Location: The proposed expansion study area is part of PIDs 60696549 & 60690302 located on Woodstock Road in Walden, Nova Scotia

Specific Location: *(cite Borden numbers and UTM designations where appropriate and as described separately in accordance with the attached Project Description. Please refer to the appropriate Archaeological Heritage Research Permit Guidelines for the appropriate Project Description format)*

20 T 4932958.65 m N 380479.83 m E

Permit Category:
Please choose one

- ☐ Category A – Archaeological Reconnaissance
- ☐ Category B – Archaeological Research
- ☑ Category C – Archaeological Resource Impact Assessment

☑ I certify that I am familiar with the provisions of the *Special Places Protection Act* of Nova Scotia and that I have read, understand and will abide by the terms and conditions listed in the Heritage Research Permit Guidelines for the above noted category.

Signature of applicant	Date May 04, 2022
Approved by Executive Director — Digitally signed by Christopher Shore Date: 2022.05.17 14:38:19 -03'00'	Date May 17, 2022

NOVA SCOTIA
Communities, Culture and Heritage
Culture and Heritage Development

1741 Brunswick Street, 3rd Floor
PO Box 456, STN Central
Halifax, NS B3J 2R5
902-424-8443

February 1, 2023

Logan Robertson
Cultural Resource Management Group Limited
Ten Mile House
1519 Bedford Highway
Bedford, Nova Scotia
B4A 1E3

Dear Logan Robertson:

RE: Heritage Research Permit Report
A2022NS075 – Walden Quarry Expansion Archaeological Resource Impact Assessment, Screening & Reconnaissance

We have received and reviewed the report on work conducted under the terms of Heritage Research Permit A2022NS075 for archaeological resource impact assessment of the Walden Quarry Expansion Archaeological Resource Impact Assessment, Screening & Reconnaissance Project in Lunenburg Breton County, Nova Scotia.

Dexter is planning to expand an existing quarry that is situated in Walden, Nova Scotia. The Walden Quarry study area is located along Woodstock Road in Lunenburg County, approximately 12.5 kilometres northwest of Highway 103. The study area is situated 140 metres southeast of Bagpipe Lake and 375 metres south of Whale Lake and is accessible via an existing gravel access road. The survey addressed a portion of two properties (PIDs 60696549 & 60690302), with a proposed impact area of approximately 44 hectares, which includes the existing quarry. This ARIA included Mi'kmaq engagement, background research, field reconnaissance and strategic shovel testing. Background research indicated that the study area and surrounding landscape were likely occupied by the Mi'kmaq from at least the Archaic Period (9,000 BP). As the study is situated along a minor watercourse (Big North Brook), terrain within 50 m of the bank of Big North Brook is ascribed high archaeological potential, and terrain between 50 m and 80 m of the brook's banks is ascribed moderate archaeological potential. Field reconnaissance showed the remainder of the study area to be predominantly wet, sloping and hummocky terrain that is distant from navigable watercourses and has been previously disturbed from development of an existing quarry. The remainder of the study area was ascribed low archaeological potential.

Based on the above, CRM Group offered the following recommendations:

1. It is recommended that any worksite activity or ground disturbance within the areas of high archaeological potential, as depicted on the archaeological potential model of the study area be preceded by a program of shovel testing undertaken at 5- metre intervals to search for archaeological resources and assess requirements for further archaeological testing or archaeological mitigation.

2. It is recommended that any worksite activity or ground disturbance within the areas of moderate archaeological potential, as depicted on the archaeological potential model of the study area be preceded by a program of shovel testing undertaken at 10-metre intervals to search for archaeological resources and assess requirements for further archaeological testing or archaeological mitigation.

3. It is recommended that the remainder of the study area, ascribed as low potential and depicted in ***Figure 9***, be cleared of the requirement for further archaeological investigation. No operational buffer is recommended from the areas of high and moderate archaeological potential.

4. If any further changes are made to the layout of the study area beyond the area assessed in this report, it is recommended that those proposed areas be subjected to an Archaeological Resource Impact Assessment.

5. In the event that archaeological deposits or human remains are encountered during construction activities associated with the study area, all work in the associated area(s) should be halted and immediate contact made with the Special Places Program (John Cormier: 902-229-3159).

CCH Staff have reviewed the report and find it acceptable as submitted. Please do not hesitate to contact me with any questions or concerns.

Sincerely,

John Cormier
Coordinator, Special Places

APPENDIX E. WATER BALANCE REPORT

Water Balance Assessment

Walden Quarry Expansion Project

McCallum Environmental Ltd.

11 August 2023

→ The Power of Commitment

Project name		Walden Quarry Expansion					
Document title		Water Balance Assessment | Walden Quarry Expansion Project					
Project number		12588822					
File name		12588822-RPT-1-Water Balance Assessment (Final)					
Status Code	**Revision**	**Author**	**Reviewer**		**Approved for issue**		
			Name	**Signature**	**Name**	**Signature**	**Date**
S3	A	T.Taylor	C.Muirhead	On File	C.Muirhead	On File	04/04/23
S4	0	T.Taylor	C.Muirhead		C.Muirhead		11/08/23

GHD

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Waterloo, Ontario N2L 3X2, Canada

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Appendices

1. Introduction

1.1 Purpose of this report

GHD Limited (GHD) was retained by McCallum Environmental Ltd. (McCallum) to perform a Water Balance Assessment for the development of the Walden Quarry Expansion (Project) in Walden, Lunenburg County, Nova Scotia (Site). The Project Site location can be seen on **Figure 1.1**. The Water Balance Assessment was performed in two phases: Initial Contributing Drainage Area Assessment, and Water Balance Modelling Assessment. The methodology and results from the two phases will be discussed in this report.

1.2 Scope and limitations

This report: has been prepared by GHD for McCallum Environmental Ltd. and may only be used and relied on by McCallum Environmental Ltd. for the purpose agreed between GHD and McCallum Environmental Ltd. as set out in Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than McCallum Environmental Ltd. arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

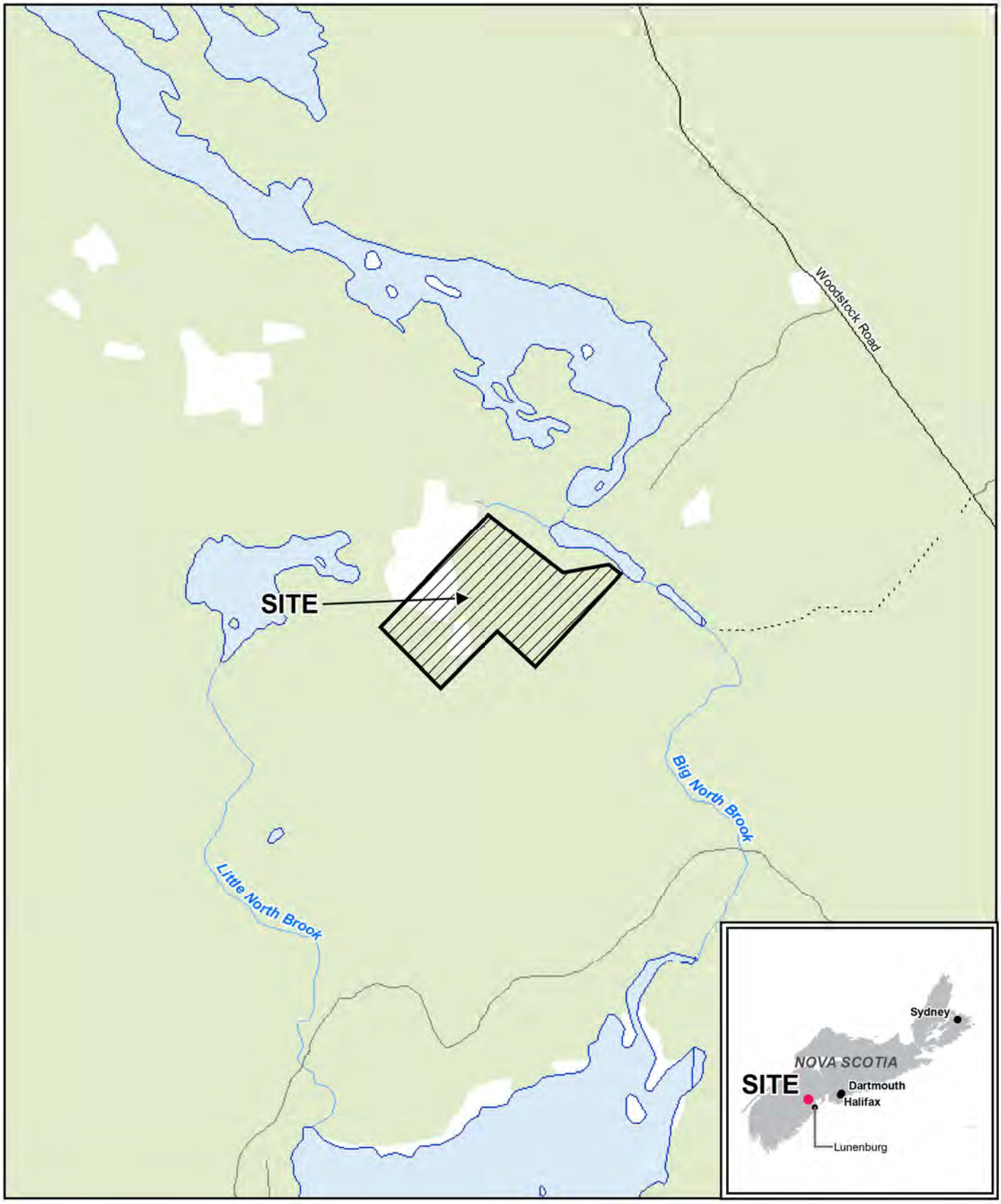
1.3 Background Information & Assumptions

The proposed Project Site has a footprint of approximately 27.9 hectares (ha) and is surrounded by wetlands, streams, and forested lands. Approximately 4.0 ha of the Site has already been developed as an existing quarry. The Project is an expansion of this existing aggregate quarry to continue to mine and produce aggregate material.

As per the Environmental Assessment Regulations, a quarry with a footprint greater than 4 ha with the purpose of extracting ordinary stone, building or construction stone, sand, gravel, or ordinary soil is classified as a Class 1 undertaking. Once mining of aggregate material has been completed the Site will be reclaimed to more natural conditions.

The objective of the Water Balance Assessment is to quantify the potential impacts of the quarry development on the surface water runoff to the surrounding watercourses. The Water Balance Assessment was performed for 3 stages of quarry life: Existing Conditions, Operating Conditions and Reclamation Conditions. Operating conditions assumed full development of the Site, while Reclamation Conditions assumed all Site infrastructure has been removed and the Site has been returned to natural conditions.

Local watercourses surrounding the Site include Big North Brook and Little North Brook. As a part of the Water Balance Assessment GHD determined Points of Interest (POI) where impacts of quarry development were investigated. The changes to surface water volumes and runoff at each POI were determined and discussed.



Paper Size ANSI A

0 150 300 450

Meters

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 20N

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GHD

MCCALLUM ENVIRONMENTAL LTD.
WALDEN QUARRY EXPANSION
WATER BALANCE ASSESSMENT

Project No. 12588822
Revision No. -
Date Mar 27, 2023

PROJECT SITE LOCATION

FIGURE 1.1

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2. Contributing Drainage Area Assessment

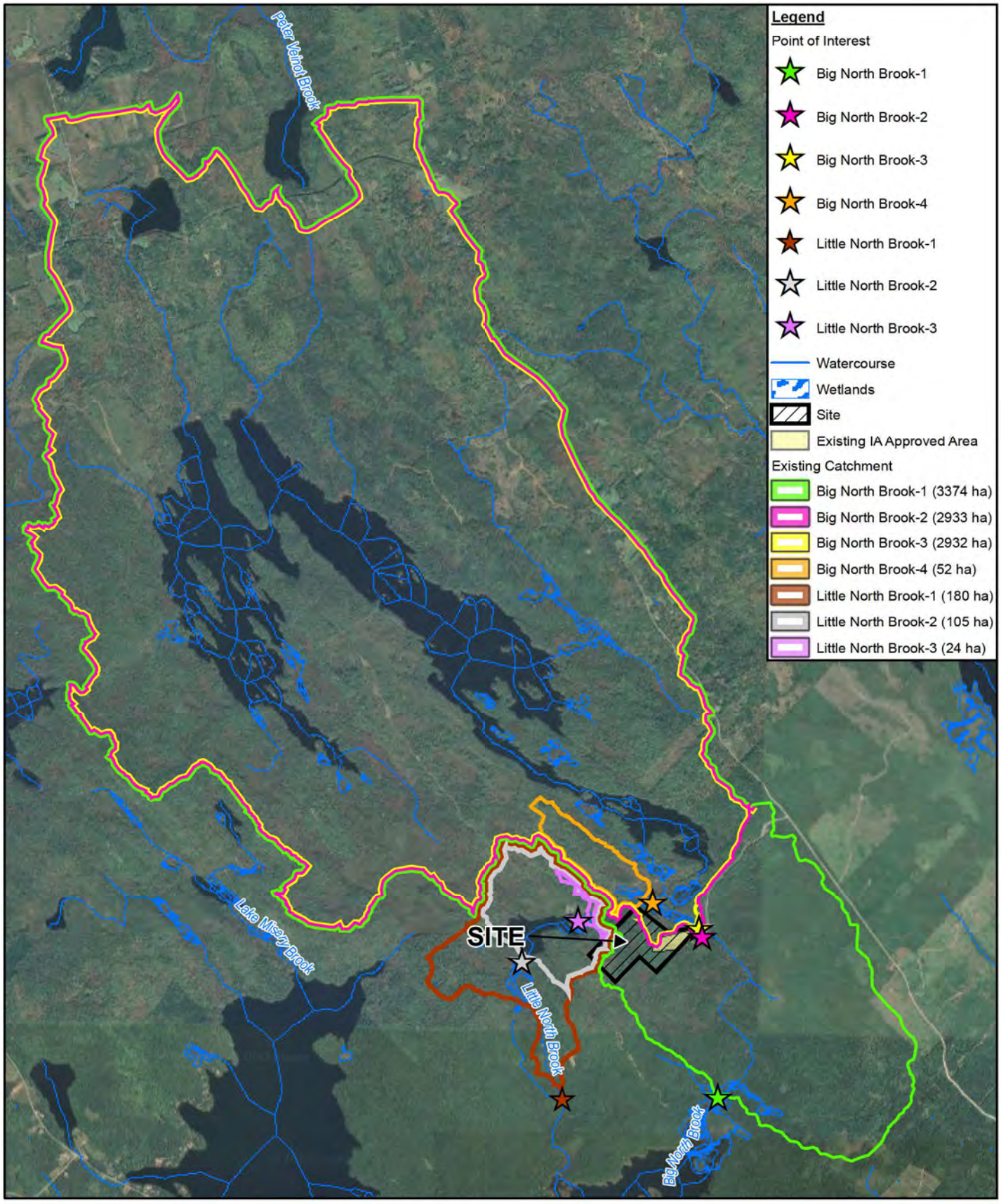
2.1 Point of Interest Assessment

The quarry development will impact two watercourse systems, which will be referred to as Big North Brook and Little North Brook. Both Big North Brook and Little North Brook drain into Little Mushamush Lake downstream of the Site. Seven POIs were identified for the surrounding watershed and are shown in **Table 2.1**.

Table 2.1 Points of Interest for Walden Quarry

Watershed	Subwatershed/POI	Watercourse
Little Mushamush lake	Big North Brook-1	Big North Brook
	Big North Brook-2	Big North Brook
	Big North Brook-3	Big North Brook
	Big North Brook-4	Big North Brook
	Little North Brook-1	Little North Brook
	Little North Brook-2	Little North Brook
	Little North Brook-3	Little North Brook

The total contributing drainage area to Big North Brook (Including the Project Site and natural areas surrounding the Site) is approximately 3,374 ha. The total contributing drainage area to Little North Brook (Including the Project Site and natural areas surrounding the Site) is approximately 180 ha. The existing Site contributing drainage areas and POIs can be seen on **Figure 2.1** and **Figure 2.2**.



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Meters

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Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 20N

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GHD

MCCALLUM ENVIRONMENTAL LTD.
WALDEN QUARRY EXPANSION
WATER BALANCE ASSESSMENT

EXISTING CONTRIBUTING DRAINAGE AREAS

Project No. 12588822
Revision No. -
Date Apr 4, 2023

FIGURE 2.1

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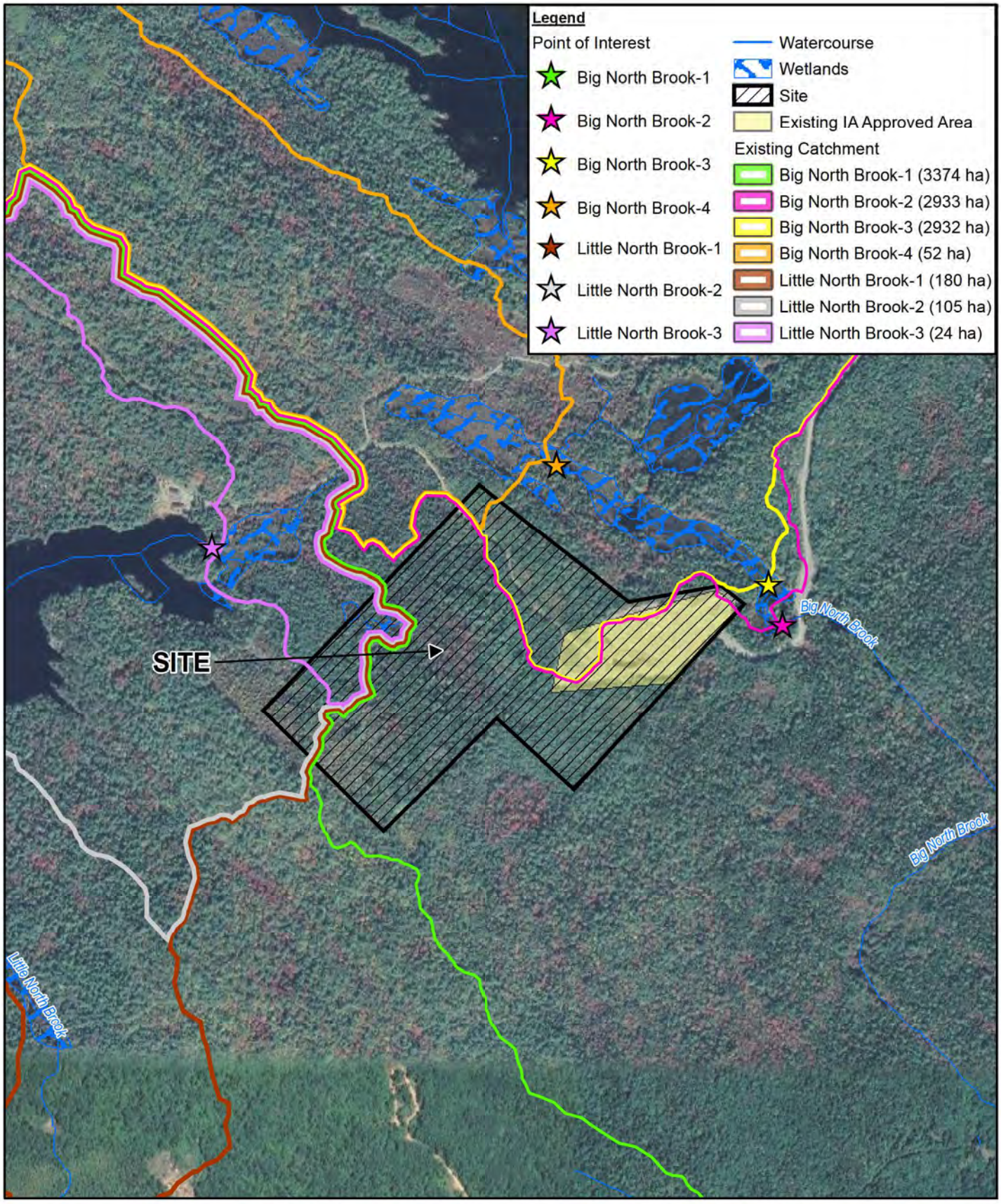

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 20N

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GHD

MCCALLUM ENVIRONMENTAL LTD.
WALDEN QUARRY EXPANSION
WATER BALANCE ASSESSMENT

EXISTING CONTRIBUTING DRAINAGE AREAS (DETAILED VIEW)

Project No. 12588822
Revision No. -
Date Apr 4, 2023

FIGURE 2.2

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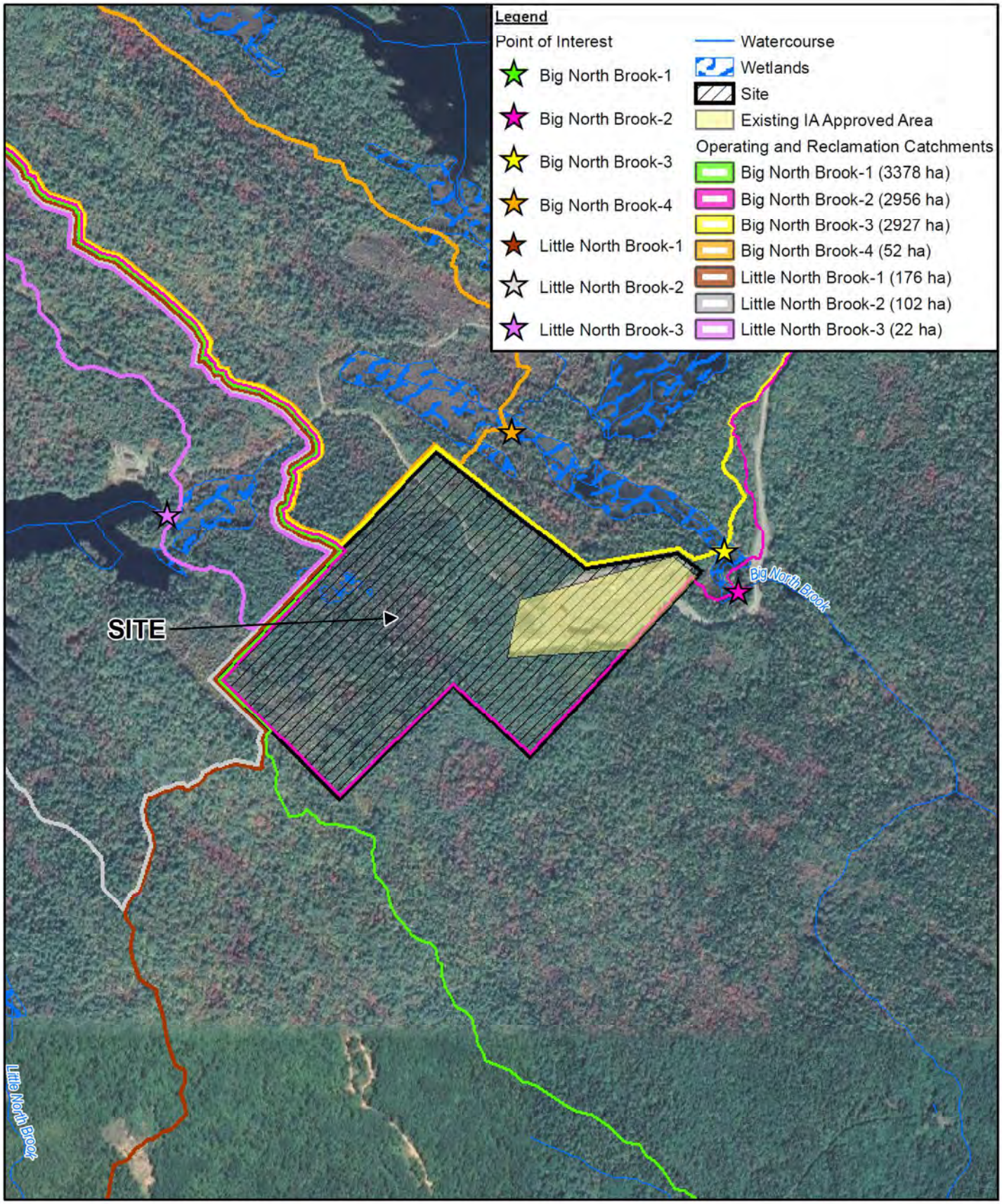
As a preliminary assessment of the potential impacts of quarry development, the percent change to contributing drainage areas under Operating and Reclamation conditions at each POI was determined. Based off this percent change, and the characteristics of each individual watercourse, it was determined if additional modelling was required. This assessment allows for a preliminary quantitative understanding of the potential impacts to the surrounding watercourses. Based on this quantitative assessment additional modelling was required for one POI. See **Section 3** for further details.

In the Existing conditions, a small portion of the stormwater runoff from the proposed site will runoff into Little North Brook while the majority of the stormwater runoff is directed to Big North Brook based on available contour data. In the operating conditions, all the stormwater runoff from the Site will runoff into Big North Brook.

The discharge point from the quarry is currently on the East side of the Site, into Big North Brook, downstream of Big North Brook-3 and upstream of Big North Brook-2. During quarry expansion it was assumed all Site surface water from the quarry would be continuing to be directed to the Big North Brook-2 POI. If the discharge point changes during quarry development the contributing drainage area assessment will be updated accordingly.

The contributing drainage areas for the operating and reclamation conditions of Site development can be seen on **Figure 2.3**.



Paper Size ANSI A

0 50 100 150 200

Meters

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 20N

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GHD

MCCALLUM ENVIRONMENTAL LTD.
WALDEN QUARRY EXPANSION
WATER BALANCE ASSESSMENT

OPERATING AND RECLAMATION CONTRIBUTING DRAINAGE AREAS (DETAILED VIEW)

Project No. **12588822**
Revision No. **-**
Date **Apr 3, 2023**

FIGURE 2.3

Q:\GIS\PROJECTS\12588000s\12588822\Maps\Working\Walden Quarry Expansion_03242023\12588822-QuarryExpansion-GIS004.mxd

The results of the contributing drainage area assessment can be found in **Table 2.2**. There were no changes between Operating and Reclamation Conditions contributing drainage areas.

Table 2.2 Contributing Drainage Area Assessment

Subcatchment	Existing Area (ha)	Operating/Reclamation Area (ha)	Difference
Big North Brook-1	3,375.74	3,379.13	0.10%
Big North Brook-2	2,934.35	2,957.40	0.79%
Big North Brook-3	2,932.81	2,928.13	-0.16%
Big North Brook-4	51.81	52.42	1.19%
Little North Brook-1	179.87	176.47	-1.89%
Little North Brook-2	105.00	101.60	-3.23%
Little North Brook-3	23.99	21.70	-9.52%

As demonstrated in **Table 2.2** all Big North Brook POIs and Little North Brook-1 and Little North Brook-2 contributing drainage areas experience minimal changes to contributing drainage area due to quarry development activities while the Little North Brook-3 point of interest experiences a larger change in contributing drainage area during development of the quarry.

The Little North Brook-3 POI was selected to require additional hydrologic modelling due to the large changes in contributing drainage area and the potential for changes in land use within the contributing drainage area itself. All other POIs are predicted to see minimal impacts due to quarry development and require no further analysis.

3. Hydrologic Water Balance

In order to determine the potential impacts of quarry Operating and Reclamation conditions on Little North Brook-3 POI, GHD developed a predictive water balance model (WBM). The WBM was developed using the GoldSim software.

GoldSim is a highly graphical program used for carrying out dynamic, probabilistic simulations to support decision making (**https://www.goldsim.com/Web/Home/**, last accessed March 29, 2023). GoldSim is especially well-suited to simulating dynamic, computationally intensive, but well-defined network models such as water balances. GoldSim permits inputs to be entered as probability distributions, performs Monte Carlo simulations, tracks outputs from those simulations and provides a graphical interface to facilitate the review and identification of interactions between system components.

The WBM takes into account surficial interactions between precipitation, baseflow and baseflow recharge. However, this WBM does not perform an in-depth analysis on groundwater flows on the Project Site. The WBM results are used to quantify the changes in surface runoff and do not account for baseflow entering or leaving the watercourse.

The WBM was developed to utilized climate inputs at a daily time-step; allowing the results to be summarized at monthly or annual intervals. The WBM was employed to calculate runoff at 1 POI (Little North Brook-3) for Existing Conditions, Operating Conditions, and Reclamation Conditions.

3.1 Climate Data Inputs

Average daily temperature values and daily precipitation totals from 1962 to 2013 were obtained from the Environment Canada Bridgewater Climate Station (Station ID:8200600). The station was selected based on its proximity to the Project Site. The Bridgewater Climate Station is 16 kilometers (km) south of the Site. Monthly lake evaporations normals were obtained from the Environment Canada Truro Climate Station (Station ID: 8205990) based on Climate

Normals from 1981 to 2010. The Truro Climate Station was selected as the closest climate station to the Site which records lake evaporation data.

Monthly potential evapotranspiration (PET) normals were calculated using the Hamon equation (1961). The Hamon equation requires monthly average hours of daylight and monthly average temperature as input. Monthly average hours of daylight were calculated for Walden, Nova Scotia using the Sunrise and Sunset Calculator (**https://www.timeanddate.com/sun/**, last accessed 6 February 2023).

Table 3.1 summarizes the mean monthly temperatures, precipitation totals, lake evaporation rates and potential evapotranspiration rates used in the analysis.

Table 3.1 Climate Normals (Data from Bridgewater and Truro, Nova Scotia Environment Canada Climate Stations)

	January	February	March	April	May	June	July	August	September	October	November	December
Average Temperature (°C)	-5.2	-4.8	-0.5	4.8	10.4	15.5	19.0	18.7	14.3	8.8	3.9	-1.8
Precipitation (mm)	140.6	119.6	137.3	120.4	115.8	102.6	89.9	102.9	106.2	140.9	164.4	162.7
Lake Evaporation (mm/day)	0.00	0.00	0.00	0.00	2.90	3.40	3.80	3.10	2.30	1.30	0.00	0.00
PET (mm/day)	0.42	0.51	0.76	1.26	1.97	2.83	3.41	3.13	2.17	1.33	0.83	0.52

The WBM sought to model the interaction between climate inputs and the hydrologic response. In order to capture the inherent uncertainty of daily climate, the climate input parameters were modelled stochastically. The use of stochastic climate inputs allows the user to consider the uncertainties of the system when making decisions related to water management. The model was constructed in such a way to assess the POI during Existing conditions, Operating conditions, and Reclamation conditions.

Temperature was determined stochastically from the observed daily temperature records from the Bridgewater Climate Station. The temperature simulated the snowmelt process. Precipitation was included as an input to the water balance calculations.

Daily precipitation totals from the Bridgewater Climate Station were used in this analysis. These daily precipitation totals were represented in the model stochastically. The daily precipitation was determined from the observed daily rainfall and snowfall of the Bridgewater Climate Station from 1962 to 2013.

Lake evaporation and potential evapotranspiration normals were input as constant and discrete monthly values to the WBM.

3.2 Modelling Hydrological Processes

This section describes the hydrological processes represented in the WBM including rainfall, snowmelt generation and rainfall-runoff modelling.

3.2.1 Rainfall and Snowmelt Generation

The WBM uses daily rainfall and snowfall totals based on historical data from the Bridgewater Climate Station. When snowfall occurs it accumulates in a ‘snowpack’ that is modelled as a storage element in the WBM. Input to the snowpack is snowfall, and output form the snowpack is snowmelt. Snowmelt occurs when the average daily temperature is greater than 0 degrees Celsius, and it is calculated using the degree-day method (USDA, 2004).

3.2.2 Rainfall-Runoff Modelling

The contributing drainage areas present under Existing and Reclamation conditions were classified based on the three predominate land uses within the catchments, wetland area, natural area and impervious area. Impervious area is relatively scarce under Existing and Reclamation conditions, other than the presences of several local roadways as the catchments largely consist of wetland area and natural area. A runoff coefficient of 0.9 was used for the roadways to account for the low level of infiltration and high amount of runoff generated from a compacted gravel or asphalt roadway.

In order to account for baseflow storage and recharge in the natural areas of the Site a modified Australian Water Balance Model (AWBM) was used to calculate runoff depths from rainfall/snowmelt (Boughton, 2004). The modified AWBM is a conceptual model that is used to estimate runoff from rainfall based on the 'surplus' of water from the soil storage after losses (i.e., evapotranspiration) have been subtracted. The AWBM generally does not represent snow accumulation/snowmelt processes; however, GHD incorporated these processes into the methodology as previously described to better represent hydrologic processes in Nova Scotia. This modified version of the AWMB can be used to approximate hydrologic processes in Nova Scotia, reported at a monthly time step.

Runoff and snowmelt are added to the soil storage element as inputs, and potential evapotranspiration is subtracted from the soil storage element as output. Actual evapotranspiration equals potential evapotranspiration when there is a sufficient amount of water within the soil storage element to meet the evapotranspiration demand. Otherwise, actual evapotranspiration equals the depth of available water within the storage element. Daily runoff is calculated based on the surplus of rainfall/snowmelt from the soil storage element, after it has reached its storage capacity or 'available water capacity'. Surplus is calculated as the overflow rate (in millimeters (mm) per day) from the soil storage element. Surplus flow will occur when the available water capacity has been exceeded. An available water capacity of 300 mm was assigned to the soil storage element. This soil storage capacity was estimated based of Table 3.1 in the SWM Planning & Design Manual (MOE, 2003). Table 3.1 estimates the water holding capacity for mature forest fine sandy loam of 300 mm.

Surplus is partitioned into surface runoff and baseflow recharge according to the baseflow index (BFI). A BFI of 0.14 was estimated for the Site from the local geology (Kennedy, 2010). The BFI represents the fraction of surplus that recharges the baseflow storage element, and (1-BFI) represents the fraction of the surplus that discharges as surface runoff. Baseflow recharge and baseflow discharge represent the input to and output from the baseflow storage element. Baseflow recharge is calculated as the product of surplus and the BFI. Baseflow discharge is calculated using a recession constant (Kb) of 0.95 as estimated for the area around the Site (Beck et al., 2013). Baseflow discharge is computed daily as the product of (1-Kb) and the available water within the baseflow storage element. Runoff totals equal the sum of surface runoff and baseflow runoff rates (mm/day), multiplied by the catchment area, non-inclusive of the lake area.

The wetlands present around the Site were assumed to act similar to a lake in that evaporation rates from the wetland areas were assumed to be equal to lake evaporation rates and direct precipitation onto the wetlands bypasses the AWBM to produce runoff as a result of the combination of rainfall and snowmelt rates. The runoff rate from the wetland area is calculated to be the sum of the daily rainfall and snowmelt rates multiplied by the area of the wetlands less the lake evaporation rate.

Figure 3.1 shows how the rainfall-runoff modelling process was represented in the WBM. **Figure 3.2** shows the inputs to and outputs from the soil storage elements in units of depth per time. The inputs are rainfall and snowmelt, the output is actual evapotranspiration, and the overflow is surplus. The processes shown on **Figure 3.1** and **Figure 3.2** do not change for Existing conditions versus Operating and Reclamation conditions.

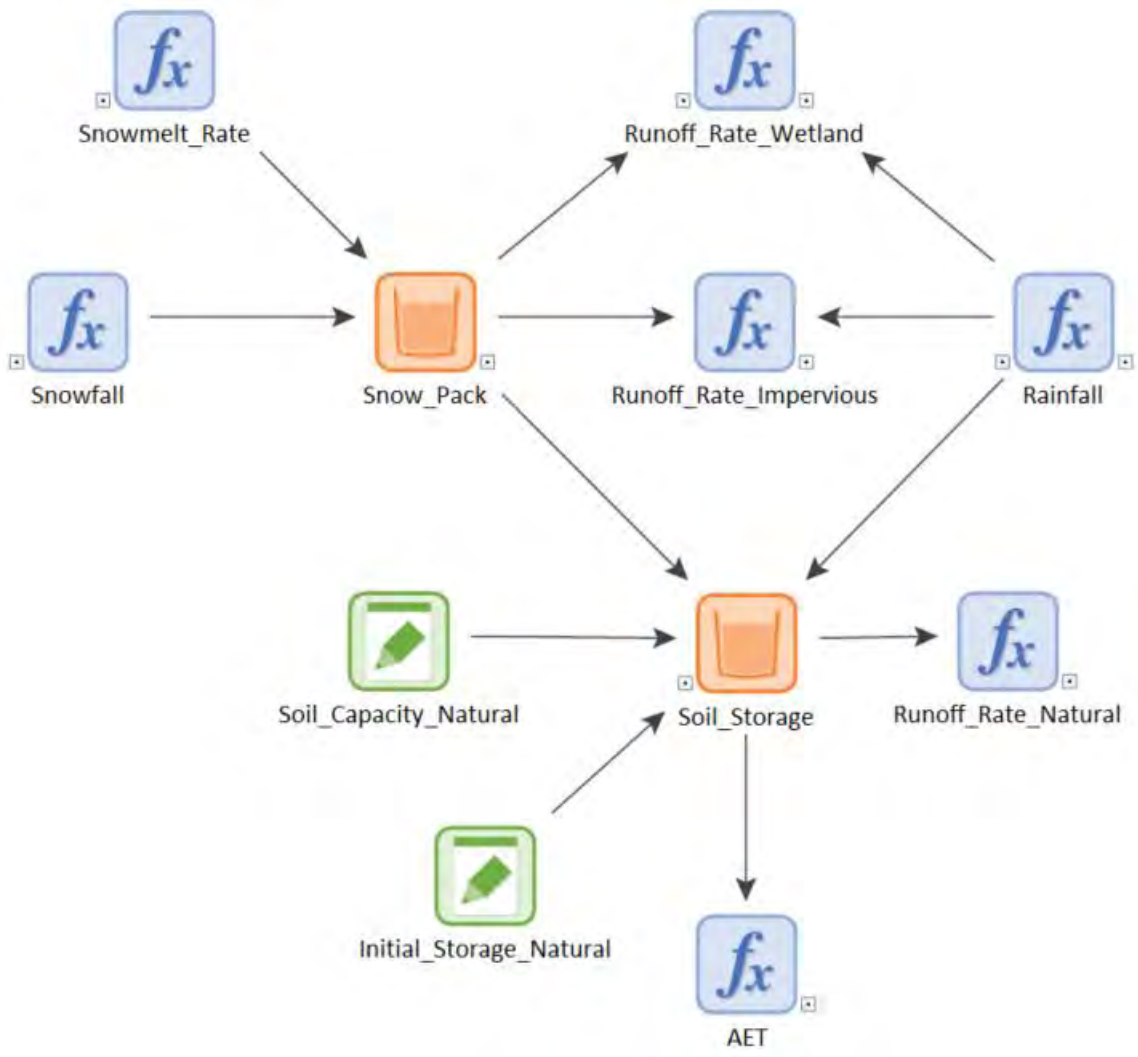

Figure 3.1 GoldSim Rainfall-Runoff Model Diagram

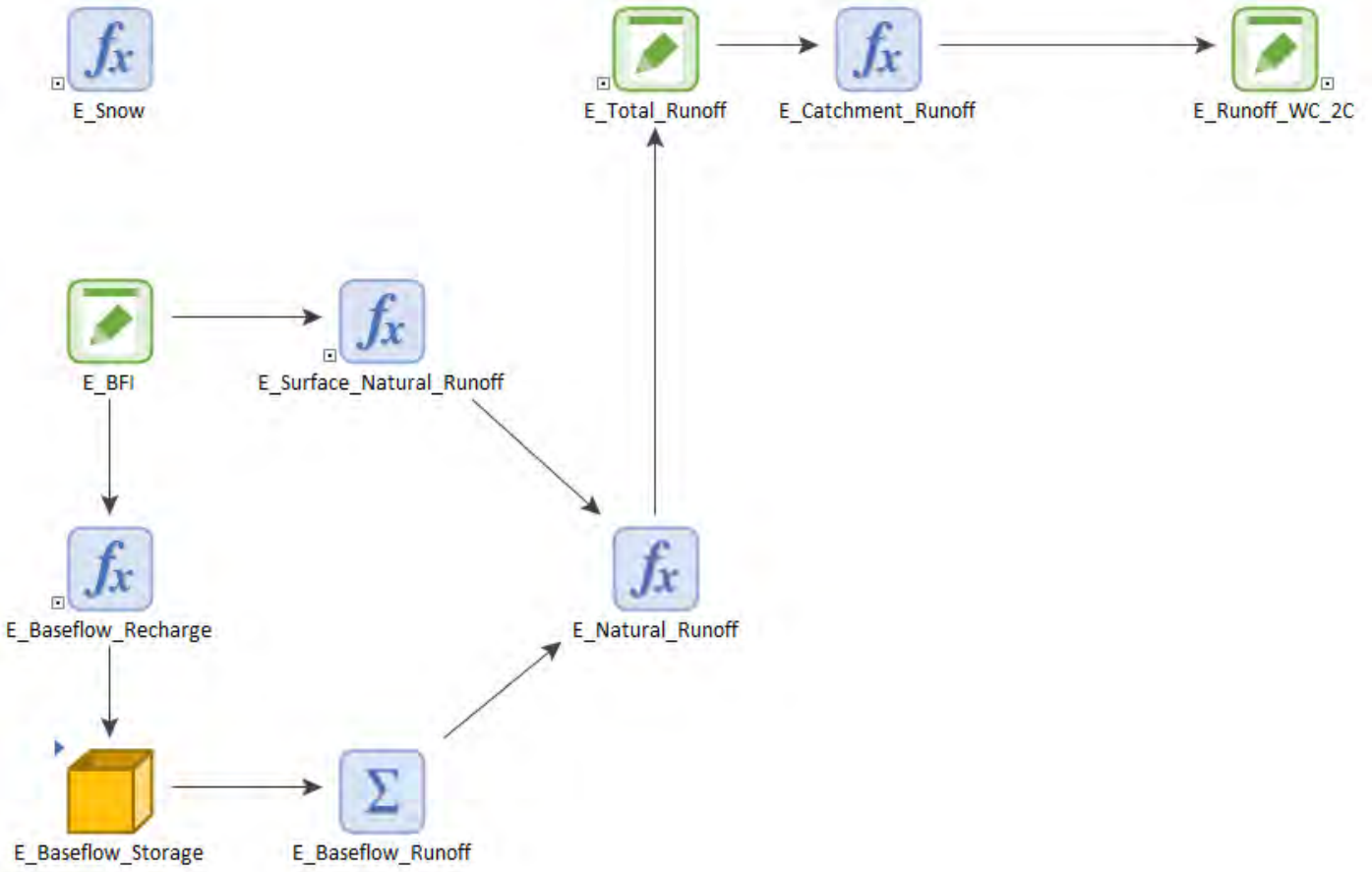

Figure 3.2 GoldSim Hydrology Diagram

3.3 Water Balance Results

This section presents a summary of the results of the water balance analysis for the Project Site during Existing, Operating and Reclamation conditions. The purpose of the water balance analysis is to assess the impact of quarry development on the POI identified in **Section 2**. This is done by assessing the forecasted runoff to the relevant POI (Little North Brook-3) on a monthly basis and comparing the resulting change in monthly storage volumes for Existing, Operating and Reclamation conditions. Full results for the relevant POI (Little North Brook-3) under each phase can be found in **Appendix A – Water Balance Results**.

A conservation check was performed on a yearly time scale for each scenario to ensure all incoming precipitation was accounted for in either evaporation or runoff. The conservation check demonstrated the inputs to the model (precipitation) and the outputs form the model (lake evaporation, actual evapotranspiration, and runoff) are within 0.16% of each other with regards to total yearly volume. As such, the model is accurately accounting for all inputs and outputs.

3.3.1 Little North Brook-3 Water Balance Model Results

Table 3.2 presents a summary of the predicted annual Runoff volume for Little North Brook-3 POI under each scenario along with the percent change from Existing conditions and the maximum monthly percent change.

Table 3.2 Little North Brook-3 Results

Scenario	Annual Runoff (m^3)	% Change in Annual Flow	Max. Monthly % Change	Month of Maximum Change
Existing Conditions	225,866	-	-	-
Operating Conditions	204,509	-9.46%	-9.53%	January, February, December
Reclamation Conditions	204,509	-9.46%	-9.53%	January, February, December

The WBM results shown in **Table 3.2** demonstrate there are potential reductions in annual runoff for the Little North Brook-3 POI during the Operating and Reclamation phase of development of 9.46% on an annual basis and up to 9.53% on a monthly basis. Maximum monthly changes in runoff do not vary greatly from the predicted annual change in flow as the reduction in flow rates is due to a reduction in contributing drainage area.

4. Conclusions and Future Recommendations

The results presented in this Water Balance Assessment demonstrate that impacts of quarry development on the Big North Brook POIs as well as Little North Brook-1 and Little North Brook-2 POIs are minimal as predicted in the contributing drainage area assessment and WBM. Little North Brook-3 POI will experience a decrease in annual and monthly runoff during quarry development and reclamation conditions as predicted in the WBM.

Little North Brook-3 will experience decreases in annual runoff of 9.46% during Operation and Reclamation conditions while experiencing maximum changes in monthly runoff of 9.53% during these conditions.

5. References

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All of Which is Respectfully Submitted,

GHD

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Water Resources Engineer

Andrew Betts, P. Eng.
Water Resources Engineer

Appendices

Appendix A

Water Balance Results

Table 1: Monthly and Annual Water Balance Results for Little North Brook-3

Existing Conditions														Change from Existing Conditions
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
Precipitation (m^3)	34,307	29,539	32,772	27,833	27,452	24,527	22,550	25,194	25,646	33,126	38,727	39,350	361,020	-
Evaporation (m^3)	2,538	3,005	5,165	8,083	15,550	22,019	26,971	22,343	13,658	8,193	4,254	2,808	134,587	-
Runoff (m^3)	26,282	24,312	34,705	24,289	14,457	6,716	2,937	4,022	6,170	18,390	30,659	32,927	225,866	-
Conservation Check (m^3)	5,486	2,222	-7,098	-4,540	-2,555	-4,208	-7,358	-1,172	5,819	6,542	3,814	3,614	567	-
Operations Conditions														**Change from Existing Conditions**
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	
Precipitation (m^3)	31,040	26,726	29,651	25,182	24,838	22,191	20,402	22,795	23,204	29,971	35,039	35,603	326,643	-
Evaporation (m^3)	2,299	2,721	4,673	7,309	14,046	19,890	24,363	20,184	12,338	7,404	3,851	2,544	121,622	-
Runoff (m^3)	23,778	21,996	31,400	21,978	13,101	6,104	2,689	3,670	5,607	16,655	27,742	29,790	204,509	-9.46%
Conservation Check (m^3)	4,963	2,010	-6,422	-4,105	-2,309	-3,803	-6,649	-1,059	5,258	5,912	3,447	3,269	513	-
Percent Change (%)	-9.53%	-9.53%	-9.52%	-9.51%	-9.38%	-9.11%	-8.44%	-8.76%	-9.11%	-9.44%	-9.52%	-9.53%	-9.46%	
Reclamation Conditions														**Change from Existing Conditions**
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	
Precipitation (m^3)	31,040	26,726	29,651	25,182	24,838	22,191	20,402	22,795	23,204	29,971	35,039	35,603	326,643	-
Evaporation (m^3)	2,299	2,721	4,673	7,309	14,046	19,890	24,363	20,184	12,338	7,404	3,851	2,544	121,622	-
Runoff (m^3)	23,778	21,996	31,400	21,978	13,101	6,104	2,689	3,670	5,607	16,655	27,742	29,790	204,509	-9.46%
Conservation Check (m^3)	4,963	2,010	-6,422	-4,105	-2,309	-3,803	-6,649	-1,059	5,258	5,912	3,447	3,269	513	-
Percent Change (%)	-9.53%	-9.53%	-9.52%	-9.51%	-9.38%	-9.11%	-8.44%	-8.76%	-9.11%	-9.44%	-9.52%	-9.53%	-9.46%	


GHD

APPENDIX F. PRIORITY SPECIES LIST

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description
			VASCULAR PLANTS			
Acer saccharinum	Silver Maple	S1	-	-	-	Generally found near flowing water and in wetlands. In Nova Scotia, it has been found along the Cornwallis River, Kings Co. (Munro, Newell & Hill, 2014).
Agalinis purpurea	Purple False-Foxglove	S2S3	-	-	-	Bogs, calcareous and mafic fens, open floodplain swamps, depression ponds, interdune swales, tidal freshwater marshes and swamps; more numerous in a variety of wet to mesic, open, disturbed habitats, including old fields, clearings, and roadsides. Flowers in late summer to early fall (Digital Atlas of Virginia Forest, nd).
Agalinis tenuifolia	Slender Agalinis	S1	-	-	-	Anthropogenic (man-made or disturbed habitats), brackish or salt marshes and flats, fresh tidal marshes or flats, meadows and fields, woodlands https://gobotany.nativeplanttrust.org/species/agalinis/tenuifolia/; Exotic to Nova Scotia, http://www.accdc.com/webranks/NSall.htm.
Ageratina altissima	White Snakeroot	S1S2	-	-	-	Grows in moist soils at the edge of fields and forests. Flowers in late summer, August and September. Known from Mill Brook, McGahey Brook and a brook near Refugee Cove, all in Cape Chignecto Provincial Park; older collection from Antigonish County. (Munro, Newell and Hill, 2014)
Ageratina altissima var. altissima	White Snakeroot	S1S2	-	-	-	Grows in moist soils at the edge of fields and forests. Flowers in late summer, August and September. Known from Mill Brook, McGahey Brook and a brook near Refugee Cove, all in Cape Chignecto Provincial Park; older collection from Antigonish County. (Munro, Newell and Hill, 2014)
Allium tricoccum var. burdickii	Narrow-leaved Wild Leek	S1?	-	-	-	DISTRIBUTION NOT KNOWN IN NS. Dry soil in upland woods. Flowering early June (Flora North America).
Alnus serrulata	Smooth Alder	S3	-	-	-	Favors lakeshores. Flowers appear from February to May throughout their range. No phenology data exists for NS material. Uncommon and local in southwestern NS from Lunenburg Co (Munro, Newell & Hill, 2014).
Amelanchier spicata	Running Serviceberry	S3S4	-	-	-	Man-made or disturbed habitats, cliffs, balds, ledges, forest edges, grassland, meadows and fields, woodlands (GoBotany, nd). Flowers in the spring (NC State Extension, nd)
Andersonglossum boreale	Northern Wild Comfrey	S1	-	-	-	A generalist. along the borders of woods and thickets, along trails and pathways through woods, and within upland deciduous woods. It appears to prefer circumneutral or even calcareous areas. The soils are usually sandy or rocky (New York Natural Heritage Program 2005). Rare in open woods and roadsides (Rhoads and Block 2000). Borders, openings, and clearings or under dense shade in coniferous or mixed woods (fir, cedar, spruce, pine, birch, aspen, and occasionally beech and maple), especially in sandy or rocky soil (Voss 1996). Uplands woods (Gleason & Cronquist 1991). Rich woods and thickets (Fernald 1970). flowers of this plant begin to appear mid-May and persist into early July
Angelica atropurpurea	Purple-stemmed Angelica	S3	-	-	-	Grows in swamps, meadows, in ditches and along streams. Flowers from late May until September. Very abundant in northern Cape Breton (Munro, Newell & Hill, 2014)
Antennaria parlinii	Parlin's Pussytoes	S2	-	-	-	Found in dry soils of pine and oak forests, pastures, old fields, and rocky banks. Flowers in June or July. Only known from along the LaHave River (Bridgewater), the Halfway River (Hants County) and from several Kings County locations. More recently found along the Kennetcook River, Hants County and East Branch River John, Pictou County (Munro, Newell and Hill, 2014).
Antennaria parlinii ssp. fallax	Parlin's Pussytoes	S2	-	-	-	Found in dry soils of pine and oak forests, pastures, old fields, and rocky banks. Flowers in June or July. Only known from along the LaHave River (Bridgewater), the Halfway River (Hants County) and from several Kings County locations. More recently found along the Kennetcook River, Hants County and East Branch River John, Pictou County (Munro, Newell and Hill, 2014).
Antennaria rosea	Rosy Pussytoes	S1	-	-	-	The rosy-coloured flowers are distinctive and like no others of the genus in NS. It has very recently been confirmed at Cape d'Or (Munro, Newell and Hill, 2014).
Antennaria rosea ssp. arida	Rosy Pussytoes	S1	-	-	-	The rosy-coloured flowers are distinctive and like no others of the genus in NS. It has very recently been confirmed at Cape d'Or (Munro, Newell and Hill, 2014)
Bartonia virginica	Yellow Bartonia	S3S4	-	-	-	Flowers July to September. Dry barrens, sandy or peaty soils, bogs, lakeshores. Common in the southwestern counties becoming scarcer east to Annapolis and Halifax; St. Peter's area of Cape Breton.

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description
Boehmeria cylindrica	Small-spike False-nettle	S2S3	-	-	-	Understory herb of moist deciduous forests in Nova Scotia. Flowers from July - September. Elsewhere found in swamps. locally very abundant on the LaHave R from New Germany to Bridgewater , local on the Annapolis River at Kingston and there's one record from the Shubenacadie Wildlife Park (Munro, Newell & Hill, 2014)
Botrychium lanceolatum	Triangle Moonwort	S2S3	-	-	-	Kentville Ravine (Kings County); Colchester, Cumberland and a few sites in western Cape Breton. Rare where found and of limited distribution in the Northern counties. Found where there are fertile soils on wooded hillsides. Bogs, fens, forests, meadows, fields, swamps and edges of wetlands. This species releases its spores later than most moonworts (July to August) (Minnesota Environment and Natural Resources Trust Fund, Go Botany and Munro et al., 2014).
Botrychium lanceolatum ssp. angustisegmentum	Narrow Triangle Moonwort	S2S3	-	-	-	Kentville Ravine (Kings County); Colchester, Cumberland and a few sites in western Cape Breton. Rare where found and of limited distribution in the Northern counties. Found where there are fertile soils on wooded hillsides. Bogs, fens, forests, meadows, fields, swamps and edges of wetlands. This species releases its spores later than most moonworts (July to August) (Minnesota Environment and Natural Resources Trust Fund, Go Botany and Munro et al., 2014).
Botrychium lunaria	Common Moonwort	S1	-	-	-	Known from Conrad's Beach, Halifax County and from New Campbellton and Indian Brook in northern Cape Breton. Found on open slopes, sand or gravel; shores and meadows. Basic soils. Anthropogenic habitats (man-made or disturbed habitats), fields and edges of wetlands. Spores are produced throughout the summer (Go Botany and Munro et al., 2014).
Botrychium simplex	Least Moonwort	S2S3	-	-	-	Scattered locations from Yarmouth County to Cape Breton: Cedar Lake (Digby-Yarmouth border), West Berlin (Queens County), Petpeswick and in Antigonish, Victoria and Inverness Counties. Reported from various habitats, usually involving damp or mossy streambanks or lakeshores. Also, anthropogenic habitats (man-made or disturbed habitats), meadows and fields. Subspecies: occurs primarily in open sites, including prairies, wetlands, and abandoned mine sites. Spores produced in late May and June (Minnesota DNR, Go Botany and Munro et al., 2014).
Botrychium simplex var. simplex	Least Moonwort	S2S3	-	-	-	Scattered locations from Yarmouth County to Cape Breton: Cedar Lake (Digby-Yarmouth border), West Berlin (Queens County), Petpeswick and in Antigonish, Victoria and Inverness Counties. Reported from various habitats, usually involving damp or mossy streambanks or lakeshores. Also, anthropogenic habitats (man-made or disturbed habitats), meadows and fields. Subspecies: occurs primarily in open sites, including prairies, wetlands, and abandoned mine sites. Spores produced in late May and June (Minnesota DNR, Go Botany and Munro et al., 2014).
Bromus latiglumis	Broad-Glumed Brome	S2	-	-	-	Floodplain (River or stream floodplains), forest, shores of rivers or lakes (Go Botany)
Callitriche hermaphroditica	Northern Water-starwort	S1	-	-	-	Flowers from August through December throughout its range. Grows in quiet alkaline or brackish waters. Collected only once from Lunenburg Co.
Cardamine dentata	Toothed Bittercress	S1	-	-	-	rare species of calcareous swamps and fens
Cardamine maxima	Large Toothwort	S2	-	-	-	rich, moist forests. Floodplain (river or stream floodplains), forests, talus and rocky slopes
Carex grisea	Inflated Narrow-leaved Sedge	S1	-	-	-	floodplain forest and deciduous woods (Munro, Newell & Hill, 2014)
Carex lupulina	Hop Sedge	S3	-	-	-	Found in muck soils, in forests, swamps, swales. Flowers and fruits in June (Munro, Newell & Hill 2014)
Carex normalis	a Sedge	S1	-	-	-	Open, often wet, woods, thickets, meadows and roadsides. Fruiting early summer (Flora of North America, nd)
Carex peckii	White-Tinged Sedge	S2?	-	-	-	Dry or mesic slopes, mixed deciduous forests, rocky outcrops, old quarry. Flowering and fruiting from May - mid-July. So far known from White Rock, Kings Co., Rhodes Co.,

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description
						Lunenburg Co. and Halifax and the Pennants area, Halifax Co. (DAL herbarium only) (Munro, Newell & Hill 2014)
Carex pensylvanica	Pennsylvania Sedge	S1?	-	-	-	Grows in dry, rocky soils as in dry open woodlands. Flowers and fruits produced early to mid-May (Munro, Newell & Hill 2014)
Carex plantaginea	Plantain-Leaved Sedge	S1	-	-	-	Rich, moist, deciduous or mixed deciduous-evergreen forests, on slopes along streams or along edges of moist depressions, southward in mountain gorges. Fruiting in spring (Flora of North America, nd)
Carex rosea	Rosy Sedge	S3	-	-	-	Grows in dry soils beneath deciduous forests and thickets. Flowers from May to early July.
Cerastium arvense ssp. strictum	Matted Field Chickweed	S1?	-	-	-	Flowers from May until frost. Located on cliffs, talus slopes, quarries, rocky beaches, coastal headlands, and in high-pH and serpentine communities. Compacted soils, especially on moist lawns and other arable land
Comandra umbellata ssp. umbellata	Bastard's Toadflax	S2	-	-	-	Found in swamps and bogs, rich mesic sites, dry, sandy or rocky soils, savannas, early successional forests. Flowers March - August (Flora of North America, nd)
Conioselinum chinense	Chinese Hemlock-parsley	S3	-	-	-	Found in treed swamps, mossy coniferous forest, seepy coastal slopes. Flowers from August to October. Common on Saint Paul Island and infrequent elsewhere (Munro, Newell & Hill, 2014).
Conopholis americana	American Cancer-root	S2	-	-	-	Reported from the western half of the province - Parasitic plant found in trees, particularly oaks and other deciduous trees - Flowers April to July (Munro, Newell & Hill, 2014)
Crataegus submollis	Quebec Hawthorn	S2?	-	-	-	Anthropogenic (man-made or disturbed habitats), forest edges, meadows and fields, shrublands or thickets. Flowers in June (GoBotany, nd).
Crataegus succulenta	Fleshy Hawthorn	S3S4	-	-	-	Forest edges, forests, meadows and fields. Also found in abandoned farmland, along streams and in forest openings. Flowers in late spring (Natural Resources Canada, nd).
Crataegus succulenta var. succulenta	Fleshy Hawthorn	S3S4	-	-	-	Forest edges, forests, meadows and fields. Also found in abandoned farmland, along streams and in forest openings. Flowers in late spring (Natural Resources Canada, nd).
Cypripedium parviflorum var. makasin	Small Yellow Lady's-Slipper	S2	-	-	-	Mesic to wet fens, prairies, meadows, thickets, open coniferous, and mixed forest. Flowering in May to August (Flora of North America).
Diphasiastrum complanatum	Northern Ground-cedar	S3S4	-	-	-	Infrequent, scattered through the Cobequid hills southwest to the Annapolis Valley and east to Cape Breton. Deciduous forests and brushy hillsides spreading out into abandoned fields. Anthropogenic (man-made or disturbed habitats) habitats, forest edges, forests, meadows and fields. Flowers from July to October (Minnesota Environment and Natural Resources Trust Fund, Go Botany and Munro et al., 2014).
Diphasiastrum sitchense	Sitka Ground-cedar	S3S4	-	-	-	Has been observed in Kings County to Northern Victoria County. Commonly found on alpine and subalpine barrens or wooded slopes in Northern Nova Scotia. Also found in anthropogenic habitats (man-made or disturbed habitats), meadows and fields. Subspecies: somewhat rare but widespread ground-cedar hybrid that frequently occurs in the absence of its parents. No sources that state specific flowering time, most likely during the general growing season in Nova Scotia: June to September (Go Botany and Munro et al., 2014).
Diphasiastrum x sabinifolium	Savin-leaved Ground-cedar	S3?	-	-	-	Has been observed in Kings County to Northern Victoria County. Commonly found on alpine and subalpine barrens or wooded slopes in Northern Nova Scotia. Also found in anthropogenic habitats (man-made or disturbed habitats), meadows and fields. Subspecies: somewhat rare but widespread ground-cedar hybrid that frequently occurs in the absence of its parents. No sources that state specific flowering time, most likely during the general growing season in Nova Scotia: June to September (Go Botany and Munro et al., 2014).
Empetrum atropurpureum	Purple Crowberry	S2S3	-	-	-	Alpine or subalpine zones, mountain summits and plateaus, ridges or ledges
Epilobium lactiflorum	White-flowered Willowherb	S1?	-	-	-	Alpine or subalpine zones, cliffs, balds or ledges, shores of rivers or lakes (GoBotany, nd).
Fagus grandifolia	American Beech	S3S4	-	-	-	Forests
Festuca prolifera	Proliferous Fescue	S1S2	-	-	-	Alpine or subalpine zones, cliffs, balds, or ledges, talus and rocky slopes (Go Botany).

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description
Fragaria vesca	Woodland Strawberry	S3S4	-	-	-	Forming dense patches in shady forests, ravines. Flowers in June. A white-berried form of this species persists in a number of locations within the province: White Rock, Wolfville, Grand Pré and Barrington. (Munro, Newell & Hill, 2014).
Fragaria vesca ssp. americana	Woodland Strawberry	S3S4	-	-	-	Forming dense patches in shady forests, ravines. Flowers in June. A white-berried form of this species persists in a number of locations within the province: White Rock, Wolfville, Grand Pré and Barrington. (Munro, Newell & Hill, 2014).
Fraxinus nigra	Black Ash	S1S2	Threatened	Not on Schedule 1	Threatened	Black ash is typically found in poorly drained areas that are often seasonally flooded. It is most common on peat and muck soils, but also grows on fine sands over sands and loams. Although this species can tolerate still semi-stagnant conditions, there is a preference for swampy woodland stream and riverbanks with moving water. It is often associated with species such as Red maple, Speckled alder, Balsam poplar, and Black spruce. The species is shade intolerant, and seedlings, saplings and sprouts tend to regenerates only in partially opened forest canopies.
Fraxinus pennsylvanica	Red Ash	S1	-	-	-	Flowers May - June. Found in riparian and upland forest and shelter belts (Minnesota Wildflowers, nd)
Gentianella amarella ssp. acuta	Northern Gentian	S1	-	-	-	Open and forested riverbanks, subalpine gullies and brook sides, occurring in regions of high-pH bedrock and/or till.
Goodyera repens	Lesser Rattlesnake-plantain	S3S4	-	-	-	Shady, moist, coniferous or mixed woods, on mossy or humus-covered ground. Sometimes it is found in bogs or cedar swamps. Flowering early July-early September (Flora North America).
Hieracium paniculatum	Panicled Hawkweed	S3S4	-	-	-	Mixed forest on dryish soils, especially oak. Occasional from Yarmouth east to Kings and Halifax counties. Common about Kentville and at Keji. Flowers August and September (Munro, Newell & Hill, 2014).
Humulus lupulus var. lupuloides	Common Hop	S1?	-	-	-	Anthropogenic (man-made or disturbed habitats), floodplain (river or stream floodplains), forests, shrublands or thickets
Hylodesmum glutinosum	Large Tick-trefoil	S2	-	-	-	Anthropogenic (man-made or disturbed habitats), cliffs, balds, or ledges, forest edges, forests, ridges or ledges, talus and rocky slopes. Flowers June to August
Lactuca hirsuta	Hairy Lettuce	S2S3	-	-	-	Grows in dryish soils in open forest and cut-overs. Scattered in the western part of NS. Flowers from July through September (Munro, Newell & Hill, 2014).
Liparis loeselii	Loesel's Twayblade	S3S4	-	-	-	Cool, moist ravines, bogs, or fens, wet peaty or sandy meadows, and exposed sand along edges of lakes, often colonizing previously open and disturbed habitats during early and middle stages of reforestation. Flowering May-August (Go Botany).
Lorinseria areolata	Netted Chain Fern	S3S4	-	-	-	Bogs, meadows and fields, swamps, wetland margins (edges of wetlands) (Go Botany).
Malaxis monophyllos var. brachypoda	North American White Adder's-mouth	S1	-	-	-	Found in swamps and bogs. Flower in summer (Flora of North America).
Mononeuria groenlandica	Greenland Stitchwort	S3	-	-	-	peak flowering time of two weeks in the middle of July,[4] although it does flower anywhere between June to August. isolated and elevated areas. Thin coarse soil or in cracks of acidic rock on open rocky alpine and sub-alpine areas. Sometimes forming large masses in the appropriate habitat.
Neottia bifolia	Southern Twayblade	S3	-	-	-	Bogs and swamps (Go Botany)
Ophioglossum pusillum	Northern Adder's-tongue	S2S3	-	-	-	Known from Yarmouth and Digby Counties; scattered east to Halifax and Amherst; a single Cape Breton record from George River. Found in sterile soils, swamps and sandy or cobbly lakeshores. Anthropogenic habitats (man-made or disturbed habitats), marshes, meadows, fields and edges of wetland margins. Spores produced May to August (Go Botany and Munro et al., 2014).
Osmorhiza longistylis	Smooth Sweet Cicely	S2S3	-	-	-	Intervale soils where fertility is high; deciduous forests. Flowers Late June to July. Scattered along the North Mountain in Annapolis and Kings counties to Cumberland Cobequid, infrequent in Cape Breton (Munro, Newell and Hill, 2014)
Panicum dichotomiflorum ssp. puritanorum	Spreading Panicgrass	S1?	-	-	-	Flowering and fruiting from June through October

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Parnassia parviflora	Small-flowered Grass-of-Parnassus	S1S2	-	-	-	Rocky seeps. Flowers August to September (Jepson Herbarium, 2021)
Persicaria amphibia var. emersa	Long-root Smartweed	S3?	-	-	-	Bloom on moist soil and are terrestrial-adapted. Flower June - September (Flora of North America)
Persicaria arifolia	Halberd-leaved Tearthumb	S3	-	-	-	Found inf shaded swamps, ponds, tidal marshes along rivers, wet ravine in forests. Flowers July - October (Flora of North America, nd)
Persicaria pensylvanica	Pennsylvania Smartweed	S3S4	-	-	-	Moist, disturbed places, ditches, riverbanks, cultivated fields, shorelines of ponds and reservoirs. Flowers May - December (Flora of North America, nd)
Piptatheropsis canadensis	Canada Ricegrass	S3	-	-	-	Dry sandy or gravelly soil. Open woods clearings, pine plantations, barrens, wooded slopes. Fruiting season-July (Minnesota Wildflowers).
Platanthera hookeri	Hooker's Orchid	S3	-	-	-	Scattered in most of the province, local in the southwestern counties. So far absent from the eastern shore. Grows in open dry forests of mixed conifers. Flower appear from May to August (Munro, et al., 2014).
Platanthera huronensis	Fragrant Green Orchid	S1S2	-	-	-	No good record found. Habitat are known from streamsides, in wetlands, even forests. Flowers throughout the summer (Munro, et al., 2014).
Platanthera obtusata	Blunt-leaved Orchid	S3S4	-	-	-	Fens, Forests, Meadows field and swamps
Polygonum aviculare ssp. buxiforme	Box Knotweed	S2S3	-	-	-	Roadsides, vacant lots, sidewalks, packed and nondrifting sands, borders of marshes and dunes. Flowering July - December (Flora of North America, nd)
Polygonum aviculare ssp. neglectum	Narrow-leaved Knotweed	S3?	-	-	-	Found in disturbed areas. Flowers June - November (Flora of North America, nd)
Ranunculus sceleratus	Cursed Buttercup	S2	-	-	-	Anthropogenic (man-made or disturbed habitats), fresh tidal marshes or flats, marshes, swamps (GoBotany, n.d.). Flowers May - September (Minnesota Wildflowers, nd)
Rhinanthus minor ssp. groenlandicus	Little Yellow Rattle	S1	-	-	-	Grows on disturbed, compacted soils as on roadsides, abandoned fields and the like. Flowers from mid-June through July (Munro, Newell & Hill, 2014)
Rosa acicularis ssp. sayi	Prickly Rose	S1	-	-	-	Across its range, it grows in a wide variety of forested and open habitats, with a wide variety of soil and moisture conditions. Flowers in the spring (Schori, 2003)
Rudbeckia laciniata	Cut-Leaved Coneflower	S2	-	-	-	Grows in wet fertile soils along the edge of swamps, swales or streams. Often colonial. Flowers in August. Common in Kings Co., isolated colonies from Annapolis and Cumberland counties to Guysborough (Munro, Newell & Hill, 2014).
Rumex triangulivalvis	Triangular-valve Dock	S2S3	-	-	-	Grows in moist areas and disturbed habitats, meadows and fields (GoBotany, nd)
Salix myrtillifolia	Blueberry Willow	S1	-	-	-	Reed bogs, fens, stream banks, subalpine spruce thickets, Pinus contorta woods, sand dunes, coal spoils. Flowers early May - late July (Flora of North America, nd)
Salix sericea	Silky Willow	S3	-	-	-	Low-lying ground as in riparian zones. Flowers from late March until May. Rare and only reported from western NS. Parr Lake and Lake Fanning, Yarmouth Co.; Queens and Lunenburg counties to Halifax County (Munro, Newell & Hill, 2014).
Salix serissima	Autumn Willow	S1	-	-	-	Fens, meadows and fields, swamps (GoBotany, nd). Also found in brackish marshy strands, marly lakeshores, treed bogs, gravelly stream banks, lakeshores. Flowers from early June to early July (Flora of North America, nd).
Sisyrinchium atlanticum	Eastern Blue-Eyed-Grass	S3S4	-	-	-	Found in damp peat, sandy soils that are poorly drained. Flowers in June. (Munro, et al. 2014).
Solidago rugosa var. sphagnophila	Cedar-swamp Goldenrod	S1S3	-	-	-	Frequents waste soils, forests and fallow fields. Flowers bloom late in August through September. Common throughout the province (Munro, Newell & Hill, 2014).
Symphyotrichum undulatum	Wavy-leaved Aster	S3	-	-	-	Favors edges of fields and forests. Flowers during August and September. Scattered about Lunenburg Co, Queens, Hants, Kings, and Halifax (Munro, Newell & Hill, 2014).
Symplocarpus foetidus	Eastern Skunk Cabbage	S3S4	-	-	-	Frequents riparian swamps, swales, bogs, sphagnous spruce woods and wet thickets. Flowers in May (Munro, Newell & Hill 2014)
Toxicodendron vernix	Poison Sumac	S1	-	-	-	Usually found in swamps or marshes. Flowers from May to July. Only known in Telfer Lake and Apple Tree Lake in Queens county (Munro, Newell & Hill, 2014)

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Triosteum aurantiacum var. aurantiacum	Orange-fruited Tinker's Weed	S3	-	-	-	Dry-mesic to mesic forests, woodlands, and forest borders
Turritis glabra	Tower Mustard	S1	-	-	-	Flowers in May and June. Usually on drier sites. part shade, sun; dry fields, roadsides, woodland edges Located in Lunenburg Co., the Forties.; very recently found on gravel of Tupper Brook Trail, a former railroad bed, Coldbrook, Kings Co.
Veronica catenata	Pink Water-Speedwell	S1	-	-	-	Shores of rivers or lakes, wetland margins (edges of wetlands) (GoBotany, nd). Flowers May - September (Minnesota Wildflowers, nd)
Viola sagittata	Arrow-Leaved Violet	S3S4	-	-	-	Sterile woods, clearing and fields. Flowers April - May (Munro, Newell & Hill 2014)
Viola sagittata var. ovata	Arrow-Leaved Violet	S3S4	-	-	-	Open woods and thickets, disturbed ground, roadsides, powerline rights-of-way. Flowers April - June (Flora of North America, nd)
Zizia aurea	Golden Alexanders	S2	-	-	-	Found in meadows, shores, thickets and wooded swamps. Flowers May and June. Occasionally reported in: Pomquet and South River, Antigonish County, Upper Musquodoboit, Halifax County (Munro, Newell and Hill, 2014).
LICHENS						
Anzia colpodes	Black-foam Lichen	S3	Threatened	Threatened	Threatened	Anzia colpodes requires mature deciduous tree habitats with high humidity and high light levels. The required humidity is supplied by wetlands, nearby brooks, lakes or by the host's position on upland slopes above a water body. Host tree trunks are usually free of dense undergrowth and the lichen usually occurs at or above the height of the undergrowth (in swamps and fens). A few of the Anzia collections are reported to be from the canopy of Red Maple trees. Recent searches have found that A. colpodes occurs from 20 cm above the ground to 2 m up the tree trunks.
Erioderma pedicellatum	Boreal Felt Lichen	S1	Endangered	Endangered	Endangered	The existing boreal felt lichen occurs within 25 km of the sea coast at an elevation of up to 300 m above sea level and they are found in forested habitats with low open crown closure. Boreal Felt Lichens are typically found in balsam fir stands, on north-facing trunks of mature and overmature trees. Habitat preference for boreal felt lichen is cool and moist and remains relatively constant throughout the year. They are often located on or at the base of slopes with northern or northeastern exposure.
Fuscopannaria leucosticta	White-rimmed Shingle Lichen	S3	Threatened	Not on Schedule 1	-	The second subpopulation in Nova Scotia occurs mainly on the east coast of southwestern Nova Scotia (in Shelburne and Queens counties), with sporadic sites throughout the eastern mainland. Common understory associates of Fuscopannaria leucosticta include ferns in the genus Osmundastrum, hollies, and ash, with peat mosses dominating the ground cover in depressions and feathermosses dominating on hummocks. Fuscopannaria leucosticta grows on the bark of Red Maple trees in Nova Scotia (COSEWIC Assessment and Status Report).
Pannaria lurida	Wrinkled Shingle Lichen	S2S3	Threatened	Threatened	Threatened	The Wrinkled Shingle Lichen colonizes mature deciduous trees, most often Red Maple that grow near, but not usually within, imperfectly drained habitats. Hence, this lichen is found on trees close to the edge of treed swamps or floodplains. The Wrinkled Shingle Lichen most frequently inhabits sites near imperfectly drained, humid habitats dominated by deciduous trees. Such sites are close to the edge of treed swamps or riparian floodplains or are at the base of moderate to steep slopes. A few occurrences are known from upland hardwood stands at the tops of slopes that are less than 100m in elevation. Only two occurrences are within a few kilometers of the coast. Canopy density is moderately open. The lichen grows on the rough bark of mature trees, mainly on the more sun-exposed sides. Red maple is the main host species, with poplar the second most frequent species. It is also known from Black and White Ash, Sugar Maple, Red Oak and American Beech.
Pannaria lurida ssp. russellii	Wrinkled Shingle Lichen	S2S3	Threatened	Threatened	Threatened	The Wrinkled Shingle Lichen colonizes mature deciduous trees, most often Red Maple that grow near, but not usually within, imperfectly drained habitats. Hence, this lichen is found on trees close to the edge of treed swamps or floodplains. The Wrinkled Shingle Lichen most frequently inhabits sites near imperfectly drained, humid habitats dominated by deciduous trees. Such sites are close to the edge of treed swamps or riparian floodplains or are at the base of moderate to steep slopes. A few occurrences are known from upland hardwood stands at the tops of slopes that are less than 100m in elevation. Only two occurrences are within a few kilometres of the coast. Canopy density is moderately open. The lichen grows on the rough bark of mature trees, mainly on the more sun-

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						exposed sides. Red maple is the main host species, with poplar the second most frequent species. It is also known from Black and White Ash, Sugar Maple, Red Oak and American Beech.
Pectenia plumbea	Blue Felt Lichen	S3	Special Concern	Special Concern	Vulnerable	The Blue Felt Lichen is usually found on the trunks of old broad-leaved trees growing in moist habitats or close to streams and lake margins. This lichen occurs in coastal suboceanic areas but also some distance inland in damp valleys. It prefers cool, humid woodlands that may be mixed coniferous/hardwood or dominated by deciduous trees. The Blue Felt Lichen seems to prefer mature deciduous trees, particularly maple, ash and yellow birch. At its northerly limit of distribution in Nova Scotia, the Blue Felt Lichen has once been found on moss-covered rocks.
Sclerophora peronella (Atlantic pop.)	Frosted Glass-whiskers (Atlantic population)	S3S4	Special Concern	Special Concern	-	This lichen has only been collected in two localities in Nova Scotia. It was observed on Cape Breton Island, in two forests in Inverness County. Collections from Nova Scotia were on exposed heartwood of living red maple trees growing in old-growth hardwood stands. Frosted Glass-whiskers grows on old deciduous trees, usually on the exposed heartwood of living trunks and more rarely on bark, in humid and rather shaded situations. This arboreal lichen is often associated with old-growth forests in coastal regions, but it is also found in open forests, in clearings, and on the margins of old deciduous forests (COSEWIC Assessment and Status Report).
MAMMALS						
Alces alces americana	Mainland Moose	S1	-	-	Endangered	Moose are herbivores who live in boreal and mixed-wood forests. They are often found where there is an abundance of food (twigs, stems, and foliage of young deciduous trees and shrubs). In spring, islands and peninsulas are often used by cows when giving birth. In summer, access to wetlands (and aquatic vegetation) is important.
Glaucomys volans	Southern Flying Squirrel	S3S4	Not at Risk	No Status	-	Southern Flying Squirrel occurs in southern Nova Scotia in an area roughly bounded by the South Mountains in the north, the Gaspereau Valley (Kentville) to the west, the New Ross area in north-east Lunenburg County to the south and Kejimkujik National Park in the west. Southern Flying Squirrel selected forests with American beech, eastern hemlock, red oak, white ash and white pine. Nest trees (dead or alive) also tend to be larger in diameter than trees without nests (COSEWIC Assessment and Status Report).
Myotis lucifugus	Little Brown Myotis	S1	Endangered	Endangered	Endangered	Little Brown Myotis is one of the few bat species that uses buildings and other anthropogenic structures (e.g., bat boxes, bridges, and barns) to roost (particularly for maternity roosting), but it will also use cavities of canopy trees, foliage, tree bark, crevices on cliffs, and other structures.
Myotis septentrionalis	Northern Myotis	S1	Endangered	Endangered	Endangered	Northern Myotis may hibernate in cooler sections of a cave. Northern Myotis will generally return to the same hibernaculum, but not always in consecutive years. Northern Myotis roost singly or in small groups and favor tree roosts (under raised bark and in tree cavities and crevices), but they can also be found in anthropogenic structures (e.g., under shingles). Northern Myotis' maternity roosts are strongly associated with forest cover, streams, and tree characteristics (e.g., species, height, diameter, age, and decay). Females prefer to roost in tall, large diameter trees in early- to mid-stages of decay. Maternity colonies in Nova Scotia were generally in larger-than-average trees. Males generally roost alone under raised bark or within cavities of trees in mid-stages of decay.
Pekania pennanti	Fisher	S3	-	-	-	They are often found in deciduous and mixedwood forest stands in the forested region. They can also be found in wetland vegetation types including shrubby swamps, shrubby bogs, and marshes. There is a higher likelihood to find them in harvested stands compared to naturally regenerating stands of similar age.
Perimyotis subflavus	Tricolored Bat	S1	Endangered	Endangered	Endangered	Tri-colored Bat often select the deepest part of caves or mines where temperature is the least variable, have strong humidity level preferences, and use warmer walls than other species. They have been recorded within any one hibernacula, possibly because they tend to hibernate solitarily (i.e., not in clusters) in the deepest sections of the caves/mines. Tri-colored Bats exhibit high fidelity to hibernacula. Roosts provide thermal regulation, shelter from weather and predation, and can be sites for social interaction. Individuals may switch roosts regularly and therefore, may use a network of roosts in a roosting area. The tendency to switch roosts may depend on species, sex, age, reproductive status, and roost type.
Synaptomys cooperi	Southern Bog Lemming	S3	-	-	-	They are often found in sphagnum bogs and low moist places, but they are also found in grasslands, mixed deciduous/coniferous forests, spruce-fir forests, freshwater wetlands, marshes, and meadows. They prefer areas with a thick mat of herbaceous and shrubby vegetation.
HERPETOFAUNA						

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Chelydra serpentina	Snapping Turtle	S3	Special Concern	Special Concern	Vulnerable	They are common in southwestern Nova Scotia and less common on the northeastern mainland. Although Snapping Turtles occupy a wide variety of habitats, the preferred habitat for this species is characterized by slow-moving water with a soft mud bottom and dense aquatic vegetation. Established populations are most often found in ponds, marshes, swamps, peat bogs, shallow bays, river and lake edges, and slow-moving streams. turtles appear to prefer the following characteristics for their hibernacula: water shallow enough to let the turtle reach the surface to breathe, but deep enough so the water will not freeze to the bottom; a location that is likely to freeze over later in the season and thaw earlier in the spring; a thick layer of mud in which the turtle can bury itself; and additional submerged cover, such as a floating mat of vegetation, roots, stumps, branches or logs, a muskrat dwelling or an overhanging bank.
Chrysemys picta picta	Eastern Painted Turtle	S4	Special Concern	Special Concern	-	Eastern Painted Turtle is found in New Brunswick, Nova Scotia, and the Atlantic coastal states east of the Appalachian Mountains. Painted Turtles occupy slow moving, relatively shallow and well-vegetated wetlands (e.g., swamps, marshes, ponds, fens, bogs, and oxbows) and water bodies (e.g., lakes, rivers, creeks, and streams) with abundant basking sites and organic substrate. These turtles are found in association with submergent aquatic plants, which are used for cover and feeding. The species is semi-tolerant of human-altered landscapes and may occasionally be found occupying urban ponds and lands subject to anthropogenic disturbance (e.g., farm ponds, impoundments, water treatment facilities). Suitable nesting habitat includes open, often south-facing, and sloped areas with sandy-loamy and/or gravel substrate usually within 1200 m of aquatic active season habitats. Painted Turtles overwinter in shallow water with deep sediment (COSEWIC Assessment and Status Report).
Hemidactylium scutatum	Four-toed Salamander	S3	-	-	-	Four-toed salamanders have specialized habitat requirements which require suitable breeding wetlands within or adjacent to mature forests. They prefer mature, mesic forests with dense canopy cover to preserve body moisture, an abundance of downed woody debris for cover and foraging opportunities, and vernal pools, ponds, bogs, shallow marshes, or other fishless bodies of water for nesting and larval success. Wooded wetlands such as seepage swamps or cedar swamps with many moss mats are ideal. Male adults can be located under leaves, bark, and logs in the upland forest, while females are most often found during the breeding season nesting in moss mats which overhang pools of water. (Harding 1997).
AVIFAUNA						
Accipiter cooperii	Cooper's Hawk	S1?B,SUN,SUM	-	-	-	Not common in Nova Scotia but does breed in the province. Found in mature forest, open woodlands, wood edges and river groves. Nests in coniferous, deciduous and mixed woods, typically those with tall trees and with openings or edge habitat nearby. Also found among trees along rivers through open country, and increasingly in suburbs and cities where tall trees exist for nesting (e.g., parks, open fields and even backyards with feeders). Breeds between April and July (Audubon and The Cornell Lab)
Accipiter gentilis	Northern Goshawk	S3S4	-	-	-	Found in coniferous and mixed forests. Generally restricted to wooded areas (along riparian corridors) but may be in relatively open woods or along edges. Often more common as a breeding bird in mixed woods (e.g., mature and old-growth forests with more than 60% closed canopy). In the East, goshawks seek out nest sites in mixed-hardwood forests where beeches, birch, hemlock and maples dominate. Goshawks often build nests near breaks in the canopy, such as a forest trail, road or opening created by a downed tree and prefer sites with a creek, pond or lake nearby. Breeds between April and July. May mate for life (Audubon and The Cornell Lab).
Asio flammeus	Short-eared Owl	S1B	Threatened	Special Concern	-	Short-eared Owls breed primarily in well-drained grasslands near coastal wetlands. In areas with extensive coastlines, some caution is warranted in summarizing breeding habitat as inland marshes and bogs are less frequently monitored and thus may be under-represented in assessments of breeding habitat (COSEWIC Assessment and Status Report).
Asio otus	Long-eared Owl	S2S3	-	-	-	Known to breed throughout Nova Scotia. They occur at elevations ranging from near sea level to above 6,500 feet. May be nomadic at times, moving about in response to changing food supplies. Favored habitat includes dense trees for nesting and roosting and open country (e.g., grasslands and shrublands) for hunting. Inhabits a wide variety of such settings, including forest with extensive meadows to groves of conifers or deciduous trees. Generally avoids unbroken forest. Known to be an early breeder. Breeds between April and July (Audubon and The Cornell Lab).

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Cardellina canadensis	Canada Warbler	S3B	Special Concern	Threatened	Endangered	Forest undergrowth, shady thickets. Breeds in mature mixed hardwoods of extensive forests and streamside thickets. Prefers to nest in moist habitat: in luxuriant undergrowth, near swamps, on stream banks, in rhododendron thickets, in deep, rocky ravines and in moist deciduous second-growth.
Cardellina pusilla	Wilson's Warbler	S3B,S5M	-	-	-	Found in thickets along wooded streams, moist tangles, low shrubs, willows, alders. Breeds in thickets, second-growth, bogs, or in alder and willow groves near streams and ponds. In migration and winter, occurs from hot lowland thickets up to cool mountain woods; always in scrubby overgrown clearings and thin woods, not in the interior of dense forest. Breeds between April and July (Cornell Lab, Audubon).
Cathartes aura	Turkey Vulture	S2S3B,S4S5M	-	-	-	In past was not surveyed/very rare to see Turkey Vultures in Nova Scotia, but as the climate warms, they are now sighted across the province (MBBA and Nova Scotia Bird Society). Look for Turkey Vultures as they soar high over open areas. They are particularly noticeable along roadsides and at landfills. At night, they roost in trees, on rocks and other high secluded spots. Most common over open or semi-open country (including mixed farmland, forest, rangeland and even small offshore islands), especially within a few miles of rocky or wooded areas providing secure nesting sites. Generally avoids densely forested regions. Breeds between April and July (Audubon and The Cornell Lab)
Chordeiles minor	Common Nighthawk	S3B	Special Concern	Threatened	Threatened	Common Nighthawk breeds in a range of open and partially open habitats, including forest openings and post-fire habitats, prairies, bogs, and rocky or sandy natural habitats, as well as disturbed areas. It is also found in settled areas that meet its habitat needs, those with open areas for foraging and bare or short-cropped surfaces for nesting. The species use of a wide range of habitats makes it difficult to estimate trends in habitat availability, except in urban habitats, where their main nesting sites – flat graveled roofs – are disappearing.
Chroicocephalus ridibundus	Black-headed Gull	S3N	-	-	-	Most of this species in Nova Scotia likely comes from Iceland (followed by a sudden growth of the Icelandic nesting population in the 1930s). In winter, found primarily along seacoasts, estuaries and protected bays (generally rare on fresh waters well inland). Breeds along lakes, rivers, bogs, moors, grasslands, swamps and coastal marshes. Usually nests in colonies, sometimes in isolated pairs. Breeds in scattered colonies between April and July (Audubon and The Cornell Lab).
Coccothraustes vespertinus	Evening Grosbeak	S3B,S3N,S3M	Special Concern	Special Concern	Vulnerable	Evening Grosbeak breeding habitat generally includes open, mature mixedwood forests, where fir species and/or White Spruce are dominant, and Spruce Budworm is abundant. Outside the breeding season, the species seems to depend largely on seed crops from various trees such as firs and spruces in the boreal forest but is also attracted to ornamental trees that produce seeds or fruit, and bird feeders stocked with sunflower seeds.
Coccyzus erythropthalmus	Black-billed Cuckoo	S3B	-	-	-	Black-billed Cuckoos are birds of woodlands and thickets, including aspen, poplar, birch, sugar maple, hickory, hawthorn and willow. They tend to occur more frequently in larger and denser woodlands than the Yellow-billed Cuckoo. On their wintering grounds, they live in forest, woodlands and scrub. A long-distance migrant, going to South America for the winter. Migrates at night; sometimes heard calling in flight overhead at night during the spring. During migration, they seek any kind of dense vegetation cover (e.g., young trees or tall shrubs). Common breeder in Nova Scotia. Breeds mostly in deciduous thickets and shrubby places, often on the edges of woodland or around marshes. Also in second growth of mixed deciduous-coniferous woods, or along their brushy edges. Breeds between April and July (Audubon and The Cornell Lab).
Contopus cooperi	Olive-sided Flycatcher	S3B	Special Concern	Threatened	Threatened	Olive-sided Flycatcher has been widely observed in open coniferous or mixed coniferous forests, often located near water or wetlands with the presence of tall snags or trees from which the species sallies for prey and advertises its territory. Mature conifer stands within patchy landscapes influenced by natural disturbance (e.g., recent burns) support the highest densities of Olive-sided Flycatcher. Nests are generally placed toward the tip of coniferous branches (although other tree types have been used).
Contopus virens	Eastern Wood-Pewee	S3S4B	Special Concern	Special Concern	Vulnerable	The Eastern Wood-pewee is mostly associated with the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is most abundant in forest stands of intermediate age and in mature stands with little understory vegetation. During migration, a variety of habitats are used, including forest edges, early and successional clearings.
Empidonax traillii	Willow Flycatcher	S2B	-	-	-	Uncommon breeder throughout mainland Nova Scotia, not Cape Breton (MBBA, as of July 2021). In winter, they use shrubby clearings, pastures and woodland edges often near water. Migrates relatively late in spring and early in fall. Breeds in thickets of deciduous trees and shrubs, especially willows, or along woodland edges. Often near

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						streams or marshes and may be found in drier habitats than the Alder Flycatcher. Breeds between April and July (Audubon and The Cornell Lab).
Euphagus carolinus	Rusty Blackbird	S2B	Special Concern	Special Concern	Endangered	Breeding habitat is characterized by coniferous-dominated forests adjacent to wetlands, such as slow-moving streams, peat bogs, sedge meadows, marshes, swamps and beaver ponds. On migration, the Rusty Blackbird is primarily associated with wooded wetlands. In winter, it occurs primarily in lowland forested wetlands, cultivated fields and pecan groves. Suitable habitat for the species appears to be decreasing on its breeding range and wintering grounds, due mainly to the loss and degradation of wetlands by human activities.
Falco sparverius	American Kestrel	S3B,S4S5M	-	-	-	Breeds in Nova Scotia but also can be a permanent resident. American Kestrels favor open areas with short ground vegetation and sparse trees (e.g., meadows, wood edges, grasslands, deserts, parks, farm fields, cities and suburbs). When breeding, kestrels need access to at least a few trees or structures that provide appropriate nesting cavities. American Kestrels are attracted to many habitats modified by humans, including pastures and parkland, and are often found near areas of human activity including towns and cities. In winter, females may occupy open habitats more so than males. Breeds between April and July (Audubon and The Cornell Lab).
Gallinago delicata	Wilson's Snipe	S3B,S5M	-	-	-	Common across Nova Scotia during breeding and also known as a permanent resident in the southern areas of the province. Wilson’s Snipes can be found in all types of wet, marshy settings, including wet fields, bogs, fens, swamps, wet meadows and along muddy edges of rivers and ponds. They avoid areas with tall, dense vegetation, but need patches of cover to hide in and to provide a safe lookout for predators. During the breeding season they are mainly found around fresh marshes and bogs, shrubby streamsides and northern tundra. Breeds between April and July (Audubon and The Cornell Lab).
Icterus galbula	Baltimore Oriole	S2S3B,SUM	-	-	-	Baltimore Orioles are often very common in open woods and groves in summer. Found in open woods, riverside groves, elms, shade trees. Breeds in deciduous or mixed woodland, generally in open woods or edges rather than interior of dense forest. May be common in trees in towns (Audubon). Breeds between April and July (Audubon and The Cornell Lab).
Lanius borealis	Northern Shrike	S3S4N	-	-	-	They occur in open but brushy habitats, and on calm, sunny days they may sit up on utility wires, bushes, and trees (Cornell Lab).Nests are usually placed in a low tree or large shrub, often in spruce or willow, usually 6-15' above the ground. Breeds between April and July (Audubon and The Cornell Lab).
Loxia curvirostra	Red Crossbill	S3S4	-	-	-	Found throughout the entire province year-round. Red Crossbills can be found in conifer forests and groves, and breeds in pines (predominately), spruce, hemlock, Douglas-fir, or other evergreens. Breeding occurs from April to July (The Cornell Lab, Audubon)
Myiarchus crinitus	Great Crested Flycatcher	S1B	-	-	-	Uncommon breeder throughout mainland Nova Scotia, not Cape Breton (MBBA, as of July 2021). Migrates mostly at night. Breeds mainly in deciduous forest or mixed forest but avoids pure stands of conifers. May be found in either continuous deep forest or in more open wooded areas, around edges of clearings or abandoned orchards. Dead snags and dying trees are important sources of the cavities they need for nesting (will even search out cavities in old orchards and in woody urban areas like parks, cemeteries and golf courses). If there are enough trees, they will claim territories in pastures, along streams and rivers, and in swamps and wetlands. Breeds between April and July (Audubon and The Cornell Lab).
Nycticorax nycticorax	Black-crowned Night-heron	S1B	-	-	-	Not common in Nova Scotia and only has been observed in the southern counties - Requires aquatic habitat for foraging and terrestrial vegetation for cover. Found in wetlands, including salt marshes, freshwater marshes, swamps, streams, rivers, lakes, ponds, lagoons, tidal mudflats, canals, reservoirs and wet agricultural fields. Roosts in trees and nests in groves of trees, in thickets, or on ground (usually on islands or above water). Breeds throughout the year, but mostly spring to late summer (April to August). May breed or nest earlier than other herons (Audubon and The Cornell Lab)
Passerella iliaca	Fox Sparrow	S3S4B,S5M	-	-	-	Found year round in Cape Breton, and throughout the migration season (late March and early November) in the rest of the province. Migrates at night. Found in wooded areas, undergrowth, brush. Breeds in brushy areas including woodland edges and clearings, streamside thickets, scrubby second growth, stunted coastal forest. Winters in similar habitats, also in brushy fields, chaparral, well-vegetated suburbs and parks. Breeds from April to July (The Cornell Lab, Audubon)
Passerina cyanea	Indigo Bunting	S1?B,SUM	-	-	-	This species favors brushy edges rather than unbroken forest. Indigo Buntings breed in brushy and weedy areas. They're common on the edges of woods and fields; along roads, streams, rivers, and powerline cuts; in logged

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description
						forest plots, brushy canyons, and abandoned fields where shrubby growth is returning. They are also in clearings within deciduous woods, edges of swamps. Breeds between April and July (Audubon and The Cornell Lab).
Perisoreus canadensis	Canada Jay	S3	-	-	-	Year-round resident throughout Nova Scotia and commonly referred to as the Gray Jay. No regular migration. On rare occasions, small invasions of Canada Jays will move a short distance out of boreal forest in winter. Prefers boreal and subalpine forests across northern North America, usually where black or white spruce trees are common (also aspen, white birch, balsam fir, sugar maple, jack pine, red spruce, eastern white cedar, etc.). Found in various kinds of coniferous and mixed forest, but rarely occurs where there are no spruce trees. Mated pairs stay together all year and defend permanent territories. Breeding and nesting for this species begins very early, during late winter, with breeding grounds still snow-covered. Breeds until, approximately, July (Audubon and The Cornell Lab).
Pheucticus ludovicianus	Rose-breasted Grosbeak	S3B	-	-	-	Look for these birds in forest edges and woodlands. Rose-breasted Grosbeaks breed in moist deciduous forests, deciduous-coniferous forests, thickets, and semi open habitats. They gravitate toward second-growth woods, suburban areas, parks, gardens, and orchards, as well as shrubby forest edges next to streams, ponds, marshes, roads, or pastures. They favor edges or openings with combination of shrubs and tall trees, rather than unbroken forest. Breeds from April to July (The Cornell Lab, Audubon)
Picoides arcticus	Black-backed Woodpecker	S3S4	-	-	-	Known throughout Nova Scotia year-round. Not strictly migratory but may move around in response to changing conditions (e.g., destruction of habitat). Eastern birds occasionally stage southward irruptions in winter, with scattered individuals showing up well south of breeding range. Habitat includes boreal forests of firs and spruces (pine, Douglas-fir, hemlock, tamarack and spruce, especially spruce bogs). Favors areas of dead or dying trees (coniferous and deciduous) and may concentrate at burned or flooded areas with many standing dead trees. Frequents lowlands in the North and mountains in the West. Breeds between April and July (Audubon and The Cornell Lab).
Pinicola enucleator	Pine Grosbeak	S3B,S5N,S5M	-	-	-	Found throughout the province year-round. Pine grosbeaks can be found in conifers; in winter, other trees. Breeds in open coniferous forest, especially of spruce and fir. In winter often found in deciduous trees (especially fruiting trees), and also in groves of pines and other conifers. Breeding occurs from April to July (The Cornell Lab, Audubon).
Piranga olivacea	Scarlet Tanager	S2B,SUM	-	-	-	These birds can be found in oak forests in summer, but they often remain out of sight as they forage in the leafy upper branches. Nest site is in tree (usually deciduous), typically 20-30' above ground. Found in forests and shade trees (especially oaks). Breeds mostly in deciduous forest, predominately oaks but also in maple, beech, mixed pine-oak woods, and coniferous woods dominated by pine or hemlock. Breeding Scarlet Tanagers prefer large forest tracts with large trees. During spring and fall they use similar forest habitats as well as open spaces such as parks and gardens. Breeds between April and July (The Cornell Lab, Audubon)
Poecile hudsonicus	Boreal Chickadee	S3	-	-	-	Year-round resident throughout Nova Scotia. Occasional small southward invasions in fall, with a few appearing south of breeding range (similar to Black-capped Chickadees invasions). Boreal Chickadees inhabit mostly mature coniferous forests (sometimes mixed forests), usually spruce and balsam fir, often near water. During late fall and winter irruptions, they tend to be found mostly in areas dominated by coniferous trees. Occurs in low stunted spruces as far North as treeline (e.g., spruce bogs). May mate for life, the birds remaining together all year. Nests in a hole in a tree, either a natural cavity or one they created (or from another species). Breeds between April and July (Audubon and The Cornell Lab).
Setophaga castanea	Bay-breasted Warbler	S3S4B,S4S5M	-	-	-	Bay-breasted warblers are found in woodlands and conifers in summer. Usually breeds in northern coniferous forest, in thick stands of spruce and fir. They are predators of spruce budworm and are abundant in spruce forests during outbreaks. Where spruce is not found, will nest in deciduous or mixed second-growth woods of birches, maples, firs, and pines. Breed from April to July, typically in the latter half of the breeding window (The Cornell Lab, Audubon)
Setophaga pinus	Pine Warbler	S2S3B,S4S5M	-	-	-	Pine Warblers live in pine or mixed pine-deciduous forest. Also sometimes in cedar or cypress. Various spottings throughout Nova Scotia, generally in the southern portion of the province. Breeds April to July (The Cornell Lab, Audubon)
Setophaga striata	Blackpoll Warbler	S3B,S5M	-	-	-	The blackpoll warbler can be found in conifers; broadleaf trees in migration. Breeds in low northern spruce forest. In migration, moves through forests, parks and gardens, they stop over in scrubby thickets and mature evergreen

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description
						and deciduous forests. Found in the southern half of Nova Scotia during migration and the northern half during the breeding season. Breeding occurs from April to July (The Cornell Lab, Audubon).
Setophaga tigrina	Cape May Warbler	S3B,SUM	-	-	-	The Cape May Warbler can be found in spruce forest; other trees in migration. Breeds in spruce forest, especially during spruce budworm outbreaks, either in pure stands or mixed with firs or other trees, generally in more open woods or near the forest edge. During migration often favors conifers, but also forages in deciduous trees and thickets. Breeding occurs from April to July (The Cornell Lab, Audubon)
Spinus pinus	Pine Siskin	S3	-	-	-	Found throughout the province year-round. Pine Siskins can be found in conifers, mixed woods, alders, weedy areas. Breeds mostly in coniferous and mixed woods, often around edges or clearings; sometimes in deciduous woods, isolated conifer groves. In migration and winter, many kinds of semi-open areas, woodland edges, weedy fields. Breeding occurs from April to July (The Cornell Lab, Audubon)
Toxostoma rufum	Brown Thrasher	S1B	-	-	-	Not common and rarely seen in Nova Scotia, with no recorded sightings in Cape Breton (MBBA, as of July 2021). In eastern North America, Brown Thrashers nest in thickets, brush, shrubbery, hedgerows, forest edges and overgrown clearings in deciduous forest. On rare occasions they breed in backyards and gardens with shrubs and hedges (but in general - areas of dense low growth, especially thickets around edges of deciduous or mixed woods, shrubby edges of swamps or undergrowth in open pine woods). Breeds between April and July (Audubon and The Cornell Lab).
Tyrannus tyrannus	Eastern Kingbird	S3B	-	-	-	Common breeder throughout Nova Scotia. A long-distance migrant that uses many habitats and migrates in flocks. Unlike many of the migratory songbirds, kingbirds may travel mostly by day. The Eastern Kingbird usually breeds in fields with scattered shrubs and trees, in orchards and along forest edges (also clearings, roadsides, parks, newly burned forest, beaver ponds, golf courses and urban environments with tall trees and scattered open spaces). It is drawn to water, often nesting densely in trees that overhang rivers or lakes. In summer, requires open space for hunting. Often common around edges of marshes, farmland and native tallgrass prairie. Breeds between April and July (Audubon and The Cornell Lab).
Vireo gilvus	Warbling Vireo	S1B,SUM	-	-	-	Occurs in deciduous and mixed woods, aspen groves, poplars, shade trees. Breeds in open deciduous or mixed woodland; also in orchards, shade trees of towns (Audubon). They stay high in deciduous treetops (Cornell Lab). Breeds between April and July (Audubon and The Cornell Lab).
Vireo philadelphicus	Philadelphia Vireo	S2?B,SUM	-	-	-	Occurs in second growth; poplars, willows, alders. Breeds in deciduous and mixed woodlands, especially near their edges, or in the young growth of overgrown pastures. Also nests in willows and alders along streams, lakes, and ponds. Breeds between April and July (Audubon).
INVERTEBRATE						
Bombus bohemicus	Ashton Cuckoo Bumble Bee	S1	Endangered	Endangered	Endangered	Currently, nothing is known about the mating and overwintering habitat requirements for the Gypsy Cuckoo Bumble Bee. Overwintering habitat for bumble bees in Ontario may include rotting logs, leaf litter and mulch, burrows in soil, and garden compost. Forage habitat includes the plant species mentioned below as well as other flowering plants which bloom from early spring (e.g., Willow) to late autumn (e.g., Goldenrod). Forage habitat occurs in old fields, grasslands, dunes, alvars, woodlands (especially in the spring) and road sides.
Bombus suckleyi	Suckley's Cuckoo Bumble Bee	SH	Threatened	Not on Schedule 1	-	Suckley's Cuckoo Bumble Bee occurs in most Canadian ecozone including the Atlantic Maritimes. Suckley's Cuckoo Bumble Bee occurs in diverse habitats including open meadows and prairies, farms and croplands, urban areas, boreal forest, and montane meadows. Records are from sea level to 1200 m although the species could potentially occur at higher elevations where its host(s) occur. In the early spring, hosts typically establish nests in abandoned underground rodent burrows or other dry natural hollows; because Suckley's Cuckoo Bumble Bee is a nest parasite these same host residence sites also serve as its habitat. Adults have been recorded feeding on pollen and nectar from many flowers (COSEWIC Assessment and Status Report).
Bombus terricola	Yellow-banded Bumble Bee	S3	Special Concern	Special Concern	Vulnerable	Habitat generalist within open coniferous, deciduous and mixed-wood forests, wet and dry meadows and prairie grasslands, meadows bordering riparian zones, and along roadsides, urban parks, gardens and agricultural areas, subalpine habitats and more isolated natural areas.
Coccinella transversoguttata	Transverse Lady Beetle	SH	Special Concern	Special Concern	Endangered	The Transverse Lady Beetle is reported to be a habitat generalist occurring within agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows, sand dune edges and riparian areas.

APPENDIX G. ACCDC REPORT

DATA REPORT 7249: Upper New Cornwall, NS

Prepared 5 May 2022
by J. Churchill, Data Manager

CONTENTS OF REPORT

Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
UpNwCornwallNS_7249ob.xls	Rare or legally-protected Flora and Fauna in your study area
UpNwCornwallNS_7249ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney
Senior Scientist / Executive Director
(506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko
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Data Management, GIS
James Churchill
Conservation Data Analyst / Field Biologist
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Billing
Jean Breau
Financial Manager / Executive Assistant
(506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
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Eastern: Elizabeth Walsh
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Elizabeth.Walsh@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

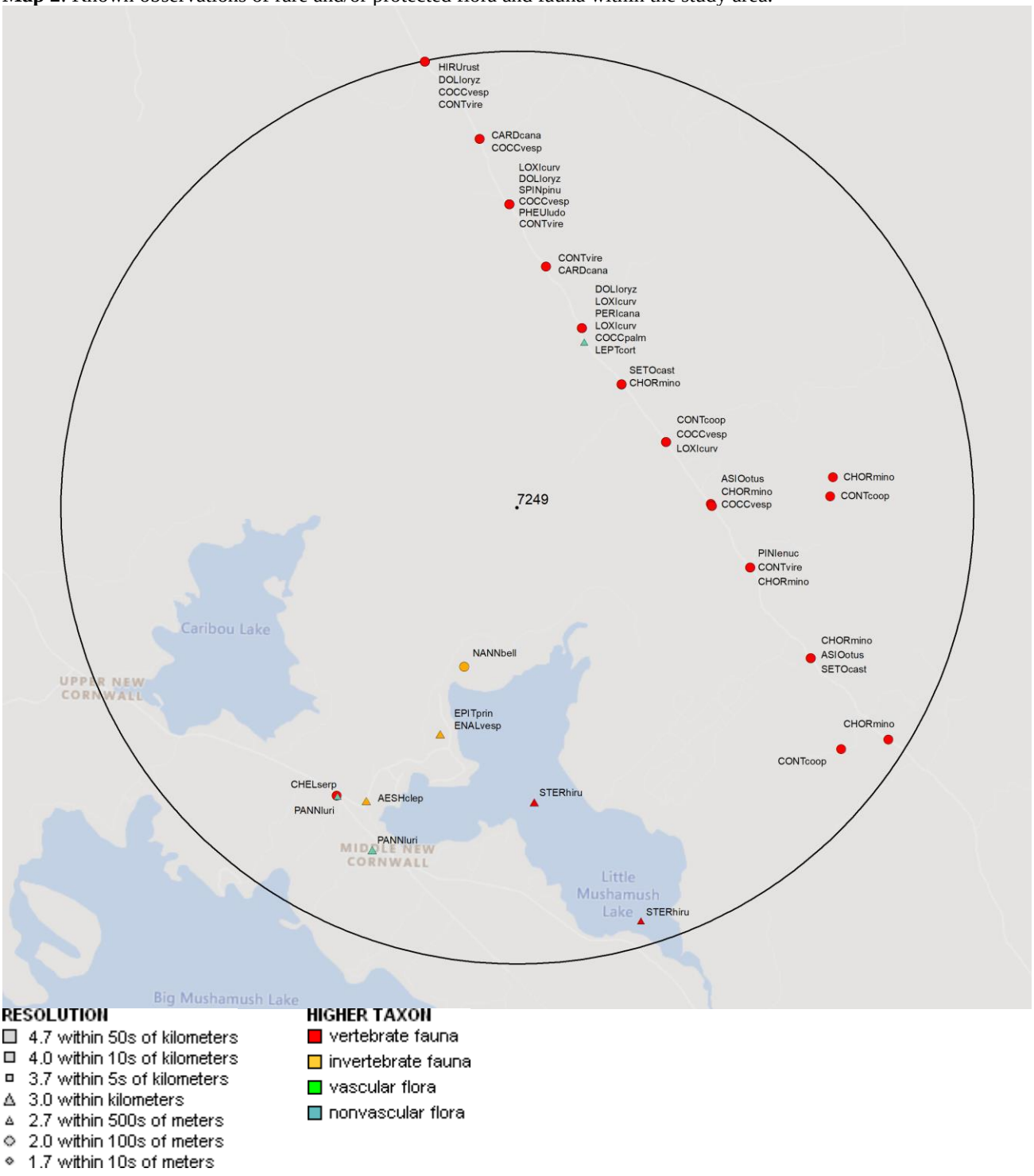
2.1 FLORA

The study area contains no records of vascular, 4 records of 3 nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA

The study area contains 47 records of 16 vertebrate, 7 records of 4 invertebrate fauna (Map 2 and attached data files - see 1.1 Data List). Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.



3.0 SPECIAL AREAS

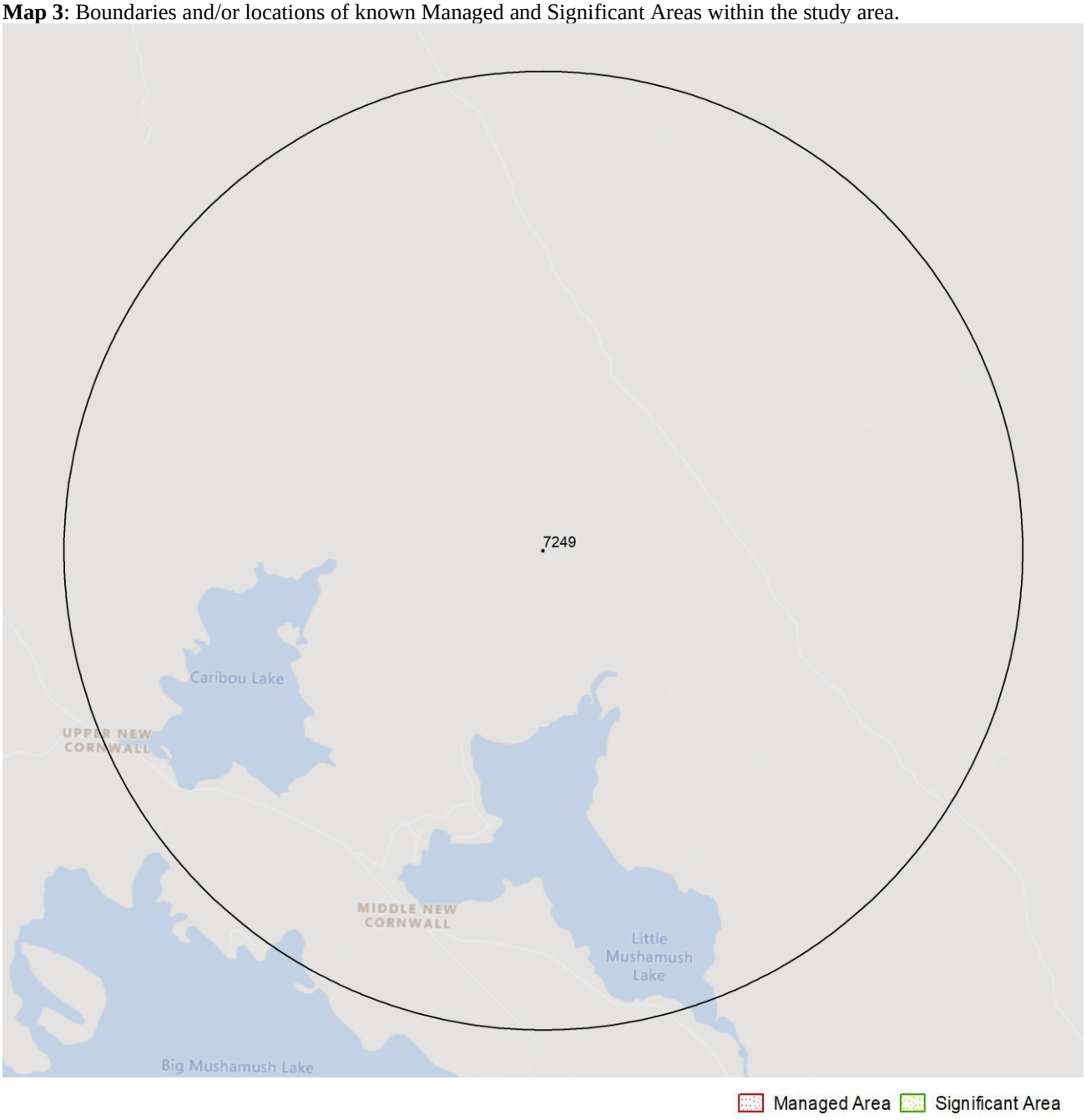
3.1 MANAGED AREAS

The GIS scan identified no managed areas in the vicinity of the study area (Map 3).

3.2 SIGNIFICANT AREAS

The GIS scan identified no biologically significant sites in the vicinity of the study area (Map 3).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S2S3	2	3.7 ± 0.0
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S3S4	1	2.0 ± 0.0
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	1	2.0 ± 0.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Vulnerable	S3B	5	2.1 ± 0.0
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	1	3.7 ± 0.0
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Endangered	S3B	1	5.0 ± 0.0
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	2	2.7 ± 0.0
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S3B	8	1.8 ± 0.0
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S3B	3	1.8 ± 0.0
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M	5	1.8 ± 0.0
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	5	2.6 ± 0.0
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	2	3.2 ± 1.0
A	*Asio otus*	Long-eared Owl				S2S3	3	2.1 ± 0.0
A	*Perisoreus canadensis*	Canada Jay				S3	1	2.1 ± 0.0
A	*Spinus pinus*	Pine Siskin				S3	1	3.3 ± 0.0
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	2	3.3 ± 0.0
A	*Pinicola enucleator*	Pine Grosbeak				S3B,S5N,S5M	1	2.6 ± 0.0
A	*Loxia curvirostra*	Red Crossbill				S3S4	4	1.8 ± 0.0
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B,S4S5M	3	1.8 ± 0.0
I	*Epitheca princeps*	Prince Baskettail				S3	3	2.6 ± 1.0
I	*Aeshna clepsydra*	Mottled Darner				S3S4	1	3.6 ± 1.0
I	*Nannothemis bella*	Elfin Skimmer				S3S4	1	1.8 ± 0.0
I	*Enallagma vesperum*	Vesper Bluet				S3S4	2	2.6 ± 1.0

Nova Scotia

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Fraxinus nigra	Black Ash		Threatened	No
Emydoidea blandingii	*Blanding's Turtle - Nova Scotia pop.*	Endangered	Vulnerable	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.	Special Concern	Vulnerable	No
Bat hibernaculum or bat species occurrence		[Endangered][1]	[Endangered][1]	No

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NS Endangered Species Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
34	Pardieck, K.L., Ziolkowski Jr., D.J., Lutmerding, M., Aponte, V.I., and Hudson, M-A.R. 2020. North American Breeding Bird Survey Dataset 1966 - 2019: U.S. Geological Survey data release, https://doi.org/10.5066/P9J6QUF6
10	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
7	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
3	Clayden, S. Digitization of Wolfgang Maass Nova Scotia forest lichen collections, 1964-2004. New Brunswick Museum. 2018.
1	Benjamin, L.K. (compiler). 2012. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 4965 recs.
1	Richardson, D., Anderson, F., Cameron, R, Pepper, C., Clayden, S. 2015. Field Work Report on the Wrinkled Shingle lichen (Pannaria lurida). COSEWIC.
1	Scott, F.W. 2002. Nova Scotia Herpetofauna Atlas Database. Acadia University, Wolfville NS, 8856 recs.
1	Wilhelm, S.I. et al. 2011. Colonial Waterbird Database. Canadian Wildlife Service, Sackville, 2698 sites, 9718 recs (8192 obs).

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 50682 records of 153 vertebrate and 1340 records of 60 invertebrate fauna; 14961 records of 290 vascular, 5067 records of 207 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including “location-sensitive” species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Coregonus huntsmani*	Atlantic Whitefish	Endangered	Endangered	Endangered	S1	128	12.1 ± 1.0	NS
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	751	11.2 ± 0.0	NS
A	*Myotis septentrionalis*	Northern Myotis	Endangered	Endangered	Endangered	S1	98	11.4 ± 0.0	NS
A	*Perimyotis subflavus*	Tricolored Bat	Endangered	Endangered	Endangered	S1	202	11.4 ± 0.0	NS
A	*Emydoidea blandingii*	Blanding's Turtle	Endangered	Endangered	Endangered	S1	10048	22.2 ± 0.0	NS
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy population	Endangered	Endangered		S1	30	45.7 ± 0.0	NS
A	*Salmo salar pop. 6*	Atlantic Salmon - Nova Scotia Southern Upland population	Endangered			S1	21	9.1 ± 50.0	NS
A	*Eubalaena glacialis*	North Atlantic Right Whale	Endangered	Endangered		S1	1	95.3 ± 50.0	NS
A	*Charadrius melodus melodus*	Piping Plover melodus subspecies	Endangered	Endangered	Endangered	S1B	1690	19.3 ± 0.0	NS
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	62	17.9 ± 0.0	NS
A	*Dermochelys coriacea pop. 2*	Leatherback Sea Turtle - Atlantic population	Endangered	Endangered		S1S2N	3	14.1 ± 1.0	NS
A	*Morone saxatilis pop. 2*	Striped Bass - Bay of Fundy population	Endangered			S2S3B,S2S3N	6	55.8 ± 1.0	NS
A	*Melanerpes erythrocephalus*	Red-headed Woodpecker	Endangered	Threatened		SNA	2	60.5 ± 0.0	NS
A	*Protonotaria citrea*	Prothonotary Warbler	Endangered	Endangered		SNA	1	76.2 ± 0.0	NS
A	*Icteria virens*	Yellow-Breasted Chat	Endangered	Endangered		SNA	1	78.7 ± 0.0	NS
A	*Delphinapterus leucas*	Beluga	Endangered	Endangered		SNA	1	89.6 ± 1.0	NS
A	*Colinus virginianus*	Northern Bobwhite	Endangered	Endangered			9	23.3 ± 7.0	NS
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Threatened	Threatened	Threatened	S1?B	14	18.6 ± 7.0	NS
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Threatened	Endangered	S1B	2	95.5 ± 7.0	NS
A	*Asio flammeus*	Short-eared Owl	Threatened	Special Concern		S1B	11	32.0 ± 0.0	NS
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2	869	13.0 ± 5.0	NS
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2B	1574	5.5 ± 7.0	NS
A	*Thamnophis saurita*	Eastern Ribbonsnake	Threatened	Threatened	Threatened	S2S3	2132	15.7 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Endangered	S2S3B,S1M	580	12.0 ± 0.0	NS
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S2S3M	100	26.0 ± 0.0	NS
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened			S2S3N	6	62.3 ± 0.0	NS
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Vulnerable	S3B	1219	2.1 ± 0.0	NS
A	*Hydrobates leucorhous*	Leach's Storm-Petrel	Threatened			S3B	22	35.8 ± 7.0	NS
A	*Tringa flavipes*	Lesser Yellowlegs	Threatened			S3M	831	17.6 ± 0.0	NS
A	*Anguilla rostrata*	American Eel	Threatened			S3N	272	19.4 ± 0.0	NS
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened		SHB	5	35.8 ± 7.0	NS
A	*Melanerpes lewis*	Lewis's Woodpecker	Threatened	Threatened		SNA	1	78.3 ± 0.0	NS
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened		SUB	23	14.9 ± 7.0	NS
A	*Passerculus sandwichensis princeps*	Ipswich Sparrow	Special Concern	Special Concern		S1B	4	71.4 ± 0.0	NS
A	*Bucephala islandica*	Barrow's Goldeneye	Special Concern	Special Concern		S1N,SUM	3	61.8 ± 0.0	NS
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	245	5.5 ± 7.0	NS
A	*Balaenoptera physalus*	Fin Whale	Special Concern	Special Concern		S2S3	1	24.0 ± 0.0	NS
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern	Special Concern		S2S3M	8	37.4 ± 0.0	NS
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern population	Special Concern	Special Concern	Endangered	S2S3N,SUM	47	26.1 ± 7.0	NS
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	427	3.7 ± 0.0	NS
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Endangered	S3B	1050	5.0 ± 0.0	NS
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	723	2.7 ± 0.0	NS
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S3B	530	1.8 ± 0.0	NS
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S3B	861	1.8 ± 0.0	NS
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M	732	1.8 ± 0.0	NS
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern		S3N,SUM	11	34.3 ± 10.0	NS
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	1193	2.6 ± 0.0	NS
A	*Phocoena phocoena*	Harbour Porpoise	Special Concern			S4	9	16.5 ± 1.0	NS
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern	Special Concern		S4	723	9.3 ± 10.0	NS
A	*Calidris subruficollis*	Buff-breasted Sandpiper	Special Concern	Special Concern		SNA	47	32.1 ± 0.0	NS
A	*Zonotrichia querula*	Harris's Sparrow	Special Concern			SNA	1	77.1 ± 0.0	NS
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1?B,SUN,SUM	3	68.1 ± 0.0	NS
A	*Fulica americana*	American Coot	Not At Risk			S1B	9	72.5 ± 0.0	NS
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk	Special Concern	Vulnerable	S1B,SUM	151	35.5 ± 0.0	NS
A	*Sorex dispar*	Long-tailed Shrew	Not At Risk			S2	1	77.3 ± 0.0	NS
A	*Lynx canadensis*	Canada Lynx	Not At Risk		Endangered	S2S3	2	32.4 ± 1.0	NS
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3	1	87.6 ± 0.0	NS
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S3	47	19.6 ± 0.0	NS
A	*Megaptera novaeangliae*	Humpback Whale	Not At Risk			S3	3	72.0 ± 0.0	NS
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	278	3.2 ± 1.0	NS
A	*Sialia sialis*	Eastern Bluebird	Not At Risk			S3B	57	5.4 ± 7.0	NS
A	*Buteo lagopus*	Rough-legged Hawk	Not At Risk			S3N	1	84.0 ± 0.0	NS
A	*Accipiter gentilis*	Northern Goshawk	Not At Risk			S3S4	119	9.3 ± 7.0	NS
A	*Glaucomys volans*	Southern Flying Squirrel	Not At Risk			S3S4	15	48.0 ± 0.0	NS
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4	6	41.3 ± 0.0	NS
A	*Ammospiza nelsoni*	Nelson's Sparrow	Not At Risk			S3S4B	109	23.3 ± 7.0	NS
A	*Calidris canutus rufa*	Red Knot rufa subspecies - Tierra del Fuego / Patagonia wintering population	E,SC	Endangered	Endangered	S2M	606	26.0 ± 0.0	NS
A	*Morone saxatilis*	Striped Bass	E,SC			S2S3B,S2S3N	7	44.0 ± 0.0	NS
A	*Gadus morhua*	Atlantic Cod	E,SC,DD			SNR	2	47.5 ± 0.0	NS
A	*Odobenus rosmarus pop. 5*	Atlantic Walrus - Nova Scotia - Newfoundland - Gulf of St Lawrence population	X			SX	1	83.6 ± 5.0	NS
A	*Alces alces americana*	Moose			Endangered	S1	89	24.9 ± 0.0	NS
A	*Uria aalge*	Common Murre				S1?B	1	91.1 ± 0.0	NS
A	*Passerina cyanea*	Indigo Bunting				S1?B,SUM	14	26.2 ± 7.0	NS
A	*Oxyura jamaicensis*	Ruddy Duck				S1B	5	78.2 ± 7.0	NS

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A	*Gallinula galeata*	Common Gallinule				S1B	7	57.5 ± 7.0	NS
A	*Myiarchus crinitus*	Great Crested Flycatcher				S1B	42	7.6 ± 0.0	NS
A	*Cistothorus palustris*	Marsh Wren				S1B	5	31.6 ± 7.0	NS
A	*Mimus polyglottos*	Northern Mockingbird				S1B	54	9.3 ± 7.0	NS
A	*Toxostoma rufum*	Brown Thrasher				S1B	15	44.7 ± 7.0	NS
A	*Charadrius semipalmatus*	Semipalmated Plover				S1B,S4M	1597	22.1 ± 0.0	NS
A	*Calidris minutilla*	Least Sandpiper				S1B,S4M	1183	22.0 ± 0.0	NS
A	*Anas acuta*	Northern Pintail				S1B,SUM	25	16.9 ± 7.0	NS
A	*Vireo gilvus*	Warbling Vireo				S1B,SUM	20	61.7 ± 7.0	NS
A	*Vespertilionidae sp.*	bat species				S1S2	430	9.2 ± 0.0	NS
A	*Pooecetes gramineus*	Vesper Sparrow				S1S2B,SUM	32	26.8 ± 7.0	NS
A	*Vireo philadelphicus*	Philadelphia Vireo				S2?B,SUM	26	30.8 ± 7.0	NS
A	*Alca torda*	Razorbill				S2B	17	39.3 ± 7.0	NS
A	*Fratercula arctica*	Atlantic Puffin				S2B	20	31.0 ± 0.0	NS
A	*Empidonax traillii*	Willow Flycatcher				S2B	56	42.4 ± 7.0	NS
A	*Molothrus ater*	Brown-headed Cowbird				S2B	180	5.5 ± 7.0	NS
A	*Spatula clypeata*	Northern Shoveler				S2B,SUM	61	59.1 ± 0.0	NS
A	*Mareca strepera*	Gadwall				S2B,SUM	92	42.4 ± 7.0	NS
A	*Piranga olivacea*	Scarlet Tanager				S2B,SUM	58	22.7 ± 7.0	NS
A	*Calidris alba*	Sanderling				S2N,S3M	1265	23.9 ± 0.0	NS
A	*Martes americana*	American Marten			Endangered	S2S3	14	41.1 ± 0.0	NS
A	*Asio otus*	Long-eared Owl				S2S3	22	2.1 ± 0.0	NS
A	*Rallus limicola*	Virginia Rail				S2S3B	21	32.5 ± 7.0	NS
A	*Rissa tridactyla*	Black-legged Kittiwake				S2S3B	9	39.3 ± 7.0	NS
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	228	5.5 ± 7.0	NS
A	*Phalacrocorax carbo*	Great Cormorant				S2S3B,S2S3N	40	34.8 ± 1.0	NS
A	*Cathartes aura*	Turkey Vulture				S2S3B,S4S5M	57	38.4 ± 0.0	NS
A	*Setophaga pinus*	Pine Warbler				S2S3B,S4S5M	20	11.3 ± 0.0	NS
A	*Bucephala clangula*	Common Goldeneye				S2S3B,S5N,S5M	134	19.3 ± 8.0	NS
A	*Icterus galbula*	Baltimore Oriole				S2S3B,SUM	92	9.3 ± 7.0	NS
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	232	25.2 ± 0.0	NS
A	*Numenius phaeopus hudsonicus*	Whimbrel				S2S3M	263	25.2 ± 0.0	NS
A	*Phalaropus fulicarius*	Red Phalarope				S2S3M	4	35.1 ± 0.0	NS
A	*Perisoreus canadensis*	Canada Jay				S3	416	2.1 ± 0.0	NS
A	*Poecile hudsonicus*	Boreal Chickadee				S3	351	5.4 ± 7.0	NS
A	*Spinus pinus*	Pine Siskin				S3	410	3.3 ± 0.0	NS
A	*Salvelinus fontinalis*	Brook Trout				S3	40	25.6 ± 0.0	NS
A	*Sorex maritimensis*	Maritime Shrew				S3	1	75.8 ± 0.0	NS
A	*Synaptomys cooperi*	Southern Bog Lemming				S3	1	77.3 ± 0.0	NS
A	*Pekania pennanti*	Fisher				S3	11	12.8 ± 1.0	NS
A	*Calcarius lapponicus*	Lapland Longspur				S3?N,SUM	2	55.5 ± 0.0	NS
A	*Spatula discors*	Blue-winged Teal				S3B	102	9.3 ± 7.0	NS
A	*Charadrius vociferus*	Killdeer				S3B	499	5.5 ± 7.0	NS
A	*Tringa semipalmata*	Willet				S3B	1780	15.1 ± 7.0	NS
A	*Sterna paradisaea*	Arctic Tern				S3B	65	15.1 ± 7.0	NS
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B	51	11.6 ± 0.0	NS
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	225	5.5 ± 7.0	NS
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	389	3.3 ± 0.0	NS
A	*Alosa pseudoharengus*	Alewife				S3B	17	45.9 ± 0.0	NS
A	*Somateria mollissima*	Common Eider				S3B,S3M,S3N	539	19.3 ± 8.0	NS
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S4M	1742	25.2 ± 0.0	NS
A	*Falco sparverius*	American Kestrel				S3B,S4S5M	204	5.5 ± 7.0	NS
A	*Gallinago delicata*	Wilson's Snipe				S3B,S5M	482	5.5 ± 7.0	NS
A	*Setophaga striata*	Blackpoll Warbler				S3B,S5M	60	9.3 ± 7.0	NS
A	*Cardellina pusilla*	Wilson's Warbler				S3B,S5M	69	13.1 ± 7.0	NS
A	*Pinicola enucleator*	Pine Grosbeak				S3B,S5N,S5M	115	2.6 ± 0.0	NS
A	*Setophaga tigrina*	Cape May Warbler				S3B,SUM	67	16.9 ± 7.0	NS

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A	*Branta bernicla*	Brant				S3M	2	62.1 ± 0.0	NS
A	*Pluvialis squatarola*	Black-bellied Plover				S3M	1817	25.2 ± 0.0	NS
A	*Arenaria interpres*	Ruddy Turnstone				S3M	713	26.0 ± 0.0	NS
A	*Calidris pusilla*	Semipalmated Sandpiper				S3M	1478	26.0 ± 0.0	NS
A	*Calidris melanotos*	Pectoral Sandpiper				S3M	328	32.1 ± 0.0	NS
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	1207	26.0 ± 0.0	NS
A	*Chroicocephalus ridibundus*	Black-headed Gull				S3N	6	81.1 ± 0.0	NS
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	90	11.8 ± 0.0	NS
A	*Loxia curvirostra*	Red Crossbill				S3S4	249	1.8 ± 0.0	NS
A	*Botaurus lentiginosus*	American Bittern				S3S4B,S4S5M	262	5.5 ± 7.0	NS
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B,S4S5M	288	1.8 ± 0.0	NS
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	791	5.4 ± 7.0	NS
A	*Leiothlypis peregrina*	Tennessee Warbler				S3S4B,S5M	207	5.5 ± 7.0	NS
A	*Passerella iliaca*	Fox Sparrow				S3S4B,S5M	61	15.1 ± 7.0	NS
A	*Mergus serrator*	Red-breasted Merganser				S3S4B,S5M,S5N	134	5.4 ± 7.0	NS
A	*Calidris maritima*	Purple Sandpiper				S3S4N	188	29.3 ± 0.0	NS
A	*Lanius borealis*	Northern Shrike				S3S4N	1	87.6 ± 0.0	NS
A	*Morus bassanus*	Northern Gannet				SHB	20	26.0 ± 0.0	NS
A	*Aythya americana*	Redhead				SHB	2	76.6 ± 0.0	NS
A	*Leucophaeus atricilla*	Laughing Gull				SHB	7	34.7 ± 0.0	NS
A	*Progne subis*	Purple Martin				SHB	4	41.4 ± 7.0	NS
A	*Eremophila alpestris*	Horned Lark				SHB,S4S5N,S5M	11	54.9 ± 0.0	NS
I	*Bombus bohemicus*	Ashton Cuckoo Bumble Bee	Endangered	Endangered	Endangered	S1	24	31.9 ± 5.0	NS
I	*Epeoloides pilosulus*	Macropis Cuckoo Bee	Endangered	Endangered	Endangered	S1	2	63.5 ± 5.0	NS
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2?B,S3M	477	7.1 ± 1.0	NS
I	*Danaus plexippus plexippus*	Monarch	Endangered	Special Concern		S2?B,S3M	2	61.4 ± 0.0	NS
I	*Gomphurus ventricosus*	Skillet Clubtail	Endangered	Endangered		SH	2	64.8 ± 1.0	NS
I	*Bombus suckleyi*	Suckley's Cuckoo Bumble Bee	Threatened			SH	1	32.4 ± 5.0	NS
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Threatened	S3	2	12.1 ± 0.0	NS
I	*Bombus terricola*	Yellow-banded Bumble Bee	Special Concern	Special Concern	Vulnerable	S3	80	11.3 ± 0.0	NS
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle	Special Concern		Endangered	SH	3	57.3 ± 2.0	NS
I	*Cicindela formosa*	Big Sand Tiger Beetle				S1	1	58.5 ± 1.0	NS
I	*Erora laeta*	Early Hairstreak				S1	1	70.0 ± 1.0	NS
I	*Ophiogomphus anomalus*	Extra-Striped Snaketail				S1	8	40.7 ± 0.0	NS
I	*Pachydiplax longipennis*	Blue Dasher				S1	4	76.0 ± 0.0	NS
I	*Polygonia comma*	Eastern Comma				S1?	20	58.9 ± 0.0	NS
I	*Polygonia satyrus*	Satyr Comma				S1?	8	57.7 ± 2.0	NS
I	*Boloria chariclea*	Arctic Fritillary				S1S2	2	94.5 ± 2.0	NS
I	*Somatochlora brevicincta*	Quebec Emerald				S1S2	1	97.1 ± 0.0	NS
I	*Coenagrion resolutum*	Taiga Bluet				S2	1	77.8 ± 1.0	NS
I	*Margaritifera margaritifera*	Eastern Pearlshell				S2	15	12.1 ± 0.0	NS
I	*Pantala hymenaea*	Spot-Winged Glider				S2?B	6	72.8 ± 1.0	NS
I	*Nymphalis l-album*	Compton Tortoiseshell				S2S3	20	23.2 ± 2.0	NS
I	*Aglais milberti*	Milbert's Tortoiseshell				S2S3	12	58.4 ± 2.0	NS
I	*Somatochlora kennedyi*	Kennedy's Emerald				S2S3	7	48.1 ± 0.0	NS
I	*Williamsonia fletcheri*	Ebony Boghaunter				S2S3	3	43.9 ± 0.0	NS
I	*Enallagma geminatum*	Skimming Bluet				S2S3	4	11.4 ± 0.0	NS
I	*Stylurus scudderi*	Zebra Clubtail				S2S3	7	60.1 ± 0.0	NS
I	*Alasmidonta undulata*	Triangle Floater				S2S3	7	72.2 ± 0.0	NS
I	*Strophiona nitens*	Chestnut Bark Long-horned Beetle				S3	2	62.3 ± 0.0	NS
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	2	10.3 ± 0.0	NS
I	*Naemia seriata*	Seaside Lady Beetle				S3	18	59.8 ± 2.0	NS
I	*Chilocorus stigma*	Twice-stabbed Lady Beetle				S3	5	15.0 ± 0.0	NS
I	*Trachysida aspera*	Rough Flower Longhorn Beetle				S3	1	77.9 ± 0.0	NS

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I	*Dicerca tenebrosa*	Dark Jewel Beetle				S3	1	75.5 ± 0.0	NS
I	*Astylopsis sexguttata*	Six-speckled Long-horned Beetle				S3	2	76.4 ± 0.0	NS
I	*Satyrium calanus*	Banded Hairstreak				S3	66	58.4 ± 0.0	NS
I	*Callophrys lanoraieensis*	Bog Elfin				S3	19	14.5 ± 0.0	NS
I	*Strymon melinus*	Gray Hairstreak				S3	19	14.5 ± 0.0	NS
I	*Ophiogomphus aspersus*	Brook Snaketail				S3	3	46.4 ± 0.0	NS
I	*Ophiogomphus mainensis*	Maine Snaketail				S3	9	14.4 ± 0.0	NS
I	*Ophiogomphus rupinsulensis*	Rusty Snaketail				S3	30	15.0 ± 0.0	NS
I	*Epitheca princeps*	Prince Baskettail				S3	18	2.6 ± 1.0	NS
I	*Somatochlora forcipata*	Forcipate Emerald				S3	6	12.4 ± 1.0	NS
I	*Enallagma vernale*	Vernal Bluet				S3	3	56.8 ± 1.0	NS
I	*Polygonia interrogationis*	Question Mark				S3B	153	5.4 ± 7.0	NS
I	*Amblyscirtes hegon*	Pepper and Salt Skipper				S3S4	23	49.0 ± 7.0	NS
I	*Cupido comyntas*	Eastern Tailed Blue				S3S4	26	25.1 ± 2.0	NS
I	*Argynnis aphrodite*	Aphrodite Fritillary				S3S4	27	14.1 ± 2.0	NS
I	*Polygonia faunus*	Green Comma				S3S4	11	68.0 ± 2.0	NS
I	*Oeneis jutta*	Jutta Arctic				S3S4	5	64.9 ± 2.0	NS
I	*Aeshna clepsydra*	Mottled Darner				S3S4	36	3.6 ± 1.0	NS
I	*Aeshna constricta*	Lance-Tipped Darner				S3S4	11	60.1 ± 0.0	NS
I	*Boyeria grafiana*	Ocellated Darner				S3S4	14	13.2 ± 0.0	NS
I	*Gomphaeschna furcillata*	Harlequin Darner				S3S4	36	12.8 ± 0.0	NS
I	*Somatochlora franklini*	Delicate Emerald				S3S4	2	64.8 ± 1.0	NS
I	*Erythrodiplax berenice*	Seaside Dragonlet				S3S4	11	17.5 ± 0.0	NS
I	*Nannothemis bella*	Elfin Skimmer				S3S4	33	1.8 ± 0.0	NS
I	*Sympetrum danae*	Black Meadowhawk				S3S4	1	61.3 ± 0.0	NS
I	*Enallagma vesperum*	Vesper Bluet				S3S4	21	2.6 ± 1.0	NS
I	*Icaricia saepiolus*	Greenish Blue				SH	2	70.7 ± 2.0	NS
I	*Chlosyne nycteis*	Silvery Checkerspot				SH	4	70.8 ± 2.0	NS
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1	246	32.4 ± 0.0	NS
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	63	28.4 ± 0.0	NS
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S2S3	195	3.7 ± 0.0	NS
N	*Pannaria lurida ssp. russellii*	Wrinkled Shingle Lichen	Threatened	Threatened		S2S3	1	57.8 ± 0.0	NS
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened	Threatened	S3	171	17.6 ± 0.0	NS
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S3	317	13.2 ± 0.0	NS
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	553	21.7 ± 0.0	NS
N	*Sclerophora peronella (Atlantic pop.)*	Frosted Glass-whiskers (Atlantic population)	Special Concern	Special Concern		S3S4	96	23.7 ± 0.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	30	21.9 ± 0.0	NS
N	*Fissidens exilis*	Pygmy Pocket Moss	Not At Risk			S3	14	58.9 ± 0.0	NS
N	*Aloina brevirostris*	Short-Beaked Rigid Screw Moss				S1	1	60.3 ± 2.0	NS
N	*Orthotrichum pallens*	Pale Bristle Moss				S1	1	57.8 ± 0.0	NS
N	*Sematophyllum demissum*	a Moss				S1	2	17.3 ± 1.0	NS
N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				S1	1	58.4 ± 0.0	NS
N	*Blennothallia crispa*	Crinkled Jelly Lichen				S1	1	82.8 ± 0.0	NS
N	*Umbilicaria vellea*	Grizzled Rocktripe Lichen				S1	4	54.3 ± 5.0	NS
N	*Usnea perplexans*	Powdered Beard Lichen				S1	1	73.5 ± 0.0	NS
N	*Heterodermia leucomela*	Elegant Fringe Lichen				S1	1	60.7 ± 0.0	NS
N	*Scytinium dactylinum*	Brown-buttoned Jellyskin Lichen				S1	2	66.1 ± 0.0	NS
N	*Flavoparmelia baltimorensis*	Rock Greenshield Lichen				S1	1	84.4 ± 1.0	NS
N	*Lathagrium cristatum*	Fingered Jelly Lichen				S1	3	63.3 ± 0.0	NS
N	*Ephebe hispidula*	Dryside Rockshag Lichen				S1	2	69.5 ± 0.0	NS
N	*Ephebe perspinulosa*	Thread Lichen				S1	2	67.7 ± 0.0	NS
N	*Fuscopannaria praetermissa*	Moss Shingles Lichen				S1	1	57.9 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
N	*Lichina confinis*	Marine Seaweed Lichen				S1	2	75.6 ± 1.0	NS
N	*Parmotrema perforatum*	Perforated Ruffle Lichen				S1	4	60.4 ± 0.0	NS
N	*Polychidium muscicola*	Eyed Mossthorns Woollybear Lichen				S1	2	54.4 ± 0.0	NS
N	*Pseudevernia consocians*	Common Antler Lichen				S1	1	24.1 ± 0.0	NS
N	*Spilonema revertens*	Rock Hairball Lichen				S1	4	72.1 ± 0.0	NS
N	*Sticta limbata*	Powdered Moon Lichen				S1	12	30.5 ± 0.0	NS
N	*Leptogium hibernicum*	Hibernia Jellyskin Lichen				S1	21	27.9 ± 0.0	NS
N	*Hypotrachyna horrescens*	Hairy-spined Shield Lichen				S1	1	98.8 ± 0.0	NS
N	*Peltigera lepidophora*	Scaly Pelt Lichen				S1	5	32.7 ± 0.0	NS
N	*Bryoria nitidula*	Tundra Horsehair Lichen				S1	2	78.5 ± 0.0	NS
N	*Hypogymnia hultenii*	Powdered Honeycomb Lichen				S1	4	34.5 ± 0.0	NS
N	*Calypogeia neogaea*	Common Pouchwort				S1?	1	89.1 ± 0.0	NS
N	*Aloina rigida*	Aloe-Like Rigid Screw Moss				S1?	3	59.8 ± 0.0	NS
N	*Imbribryum muehlenbeckii*	Muehlenbeck's Bryum Moss				S1?	2	42.7 ± 0.0	NS
N	*Campylostelium saxicola*	a Moss				S1?	1	74.4 ± 1.0	NS
N	*Conardia compacta*	Coast Creeping Moss				S1?	1	47.5 ± 2.0	NS
N	*Didymodon tophaceus*	Olive Beard Moss				S1?	1	82.7 ± 0.0	NS
N	*Grimmia anodon*	Toothless Grimmia Moss				S1?	2	61.4 ± 3.0	NS
N	*Homomallium adnatum*	Adnate Hairy-gray Moss				S1?	1	61.1 ± 5.0	NS
N	*Meesia triquetra*	Three-ranked Cold Moss				S1?	1	89.5 ± 0.0	NS
N	*Paludella squarrosa*	Tufted Fen Moss				S1?	3	67.8 ± 0.0	NS
N	*Physcomitrium immersum*	a Moss				S1?	1	68.4 ± 0.0	NS
N	*Schistostega pennata*	Luminous Moss				S1?	1	74.4 ± 0.0	NS
N	*Trichodon cylindricus*	Cylindric Hairy-teeth Moss				S1?	1	72.8 ± 3.0	NS
N	*Plagiomnium ellipticum*	Marsh Leafy Moss				S1?	1	60.2 ± 0.0	NS
N	*Syntrichia ruralis*	a Moss				S1?	1	78.2 ± 0.0	NS
N	*Euopsis granatina*	Lesser Rockbud Lichen				S1?	1	72.6 ± 1.0	NS
N	*Melanelia culbersonii*	Appalachain Camouflage Lichen				S1?	1	33.2 ± 0.0	NS
N	*Metzgeria crassipilis*	Hairy Veilwort				S1S2	3	67.5 ± 0.0	NS
N	*Porella pinnata*	Pinnate Scalewort				S1S2	1	37.4 ± 0.0	NS
N	*Arrhenopterum heterostichum*	One-sided Groove Moss				S1S2	2	20.5 ± 5.0	NS
N	*Brachythecium turgidum*	Thick Ragged Moss				S1S2	3	72.8 ± 3.0	NS
N	*Didymodon rigidulus*	Rigid Screw Moss				S1S2	2	57.2 ± 0.0	NS
N	*Hypnum pratense*	Meadow Plait Moss				S1S2	1	58.8 ± 3.0	NS
N	*Mnium thomsonii*	Thomson's Leafy Moss				S1S2	1	59.8 ± 2.0	NS
N	*Tortula acaulon*	Cuspidate Earth Moss				S1S2	1	62.6 ± 2.0	NS
N	*Plagiothecium latebricola*	Alder Silk Moss				S1S2	1	23.0 ± 5.0	NS
N	*Platydictya confervoides*	a Moss				S1S2	1	58.4 ± 0.0	NS
N	*Sematophyllum marylandicum*	a Moss				S1S2	3	57.1 ± 0.0	NS
N	*Tortula mucronifolia*	Mucronate Screw Moss				S1S2	2	61.4 ± 3.0	NS
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	1	60.6 ± 4.0	NS
N	*Hamatocaulis vernicosus*	a Moss				S1S2	2	89.8 ± 0.0	NS
N	*Haplocladium microphyllum*	Tiny-leaved Haplocladium Moss				S1S2	1	81.1 ± 3.0	NS
N	*Enchylium bachmanianum*	Bachman's Jelly Lichen				S1S2	1	63.4 ± 0.0	NS
N	*Pilophorus cereolus*	Powdered Matchstick Lichen				S1S2	1	86.2 ± 3.0	NS
N	*Rhizoplaca subdiscrepans*	Scattered Rock-posy Lichen				S1S2	1	32.3 ± 1.0	NS
N	*Parmotrema reticulatum*	Netted Ruffle Lichen				S1S2	9	21.6 ± 0.0	NS
N	*Parmeliella parvula*	Poor-man's Shingles Lichen				S1S2	40	34.7 ± 0.0	NS
N	*Umbilicaria polyrhiza*	Ballpoint Rocktripe Lichen				S1S3	2	39.5 ± 0.0	NS
N	*Lecanora polytropa*	a lichen				S1S3	2	76.0 ± 1.0	NS
N	*Heterodermia galactophylla*	Branching Fringe Lichen				S1S3	1	32.4 ± 0.0	NS

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N	*Xylopsora friesii*	a Lichen				S1S3	2	72.7 ± 0.0	NS
N	*Peltigera neckeri*	Black-saddle Pelt Lichen				S1S3	1	54.4 ± 0.0	NS
N	*Usnea fragilescens*	Inflationary Beard Lichen				S1S3	1	75.0 ± 2.0	NS
N	*Usnea chaetophora*	Articulated Beard Lichen				S1S3	1	94.6 ± 0.0	NS
N	*Stereocaulon intermedium*	Pacific Brain Foam Lichen				S1S3	5	24.7 ± 0.0	NS
N	*Anacamptodon splachnoides*	a Moss				S2	2	60.8 ± 0.0	NS
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S2	3	67.8 ± 0.0	NS
N	*Sphagnum subnitens*	Lustrous Peat Moss				S2	4	62.3 ± 0.0	NS
N	*Usnea flavocardia*	Blood-splattered Beard Lichen				S2	2	58.7 ± 4.0	NS
N	*Cystocoleus ebeneus*	Rockgossamer Lichen				S2	6	38.1 ± 0.0	NS
N	*Hypotrachyna catawbiensis*	Powder-tipped Antler Lichen				S2	16	28.9 ± 0.0	NS
N	*Scytinium imbricatum*	Scaly Jellyskin Lichen				S2	1	38.7 ± 0.0	NS
N	*Nephroma arcticum*	Arctic Kidney Lichen				S2	1	75.5 ± 1.0	NS
N	*Nephroma resupinatum*	a lichen				S2	14	23.1 ± 0.0	NS
N	*Placynthium flabellosum*	Scaly Ink Lichen				S2	1	54.4 ± 0.0	NS
N	*Weissia muhlenbergiana*	a Moss				S2?	5	58.3 ± 5.0	NS
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S2?	6	58.6 ± 0.0	NS
N	*Ptychostomum pendulum*	Drooping Bryum				S2?	1	60.3 ± 2.0	NS
N	*Drepanocladus polygamus*	Polygamous Hook Moss				S2?	4	47.5 ± 2.0	NS
N	*Pseudocampylium radicale*	Long-stalked Fine Wet Moss				S2?	3	57.9 ± 0.0	NS
N	*Climacium americanum*	American Tree Moss				S2?	9	57.1 ± 0.0	NS
N	*Dicranum condensatum*	Condensed Broom Moss				S2?	5	29.5 ± 0.0	NS
N	*Ditrichum rhynchostegium*	a Moss				S2?	6	56.0 ± 1.0	NS
N	*Fissidens bushii*	Bush's Pocket Moss				S2?	5	58.4 ± 0.0	NS
N	*Fontinalis hypnoides*	a moss				S2?	1	58.9 ± 0.0	NS
N	*Fontinalis sullivantii*	Sullivant's Water Moss				S2?	4	52.2 ± 0.0	NS
N	*Grimmia olneyi*	a Moss				S2?	10	57.1 ± 0.0	NS
N	*Grimmia anomala*	Mountain Forest Grimmia				S2?	1	12.8 ± 1.0	NS
N	*Hygrohypnum bestii*	Best's Brook Moss				S2?	1	71.0 ± 0.0	NS
N	*Orthotrichum anomalum*	Anomalous Bristle Moss				S2?	2	54.0 ± 2.0	NS
N	*Philonotis marchica*	a Moss				S2?	1	57.2 ± 0.0	NS
N	*Physcomitrium collenchymatum*	a Moss				S2?	1	72.9 ± 0.0	NS
N	*Rauiella scita*	Smaller Fern Moss				S2?	16	57.3 ± 0.0	NS
N	*Cyrtomnium hymenophylloides*	Short-pointed Lantern Moss				S2?	1	75.4 ± 5.0	NS
N	*Platylomella lescurii*	a Moss				S2?	9	17.3 ± 1.0	NS
N	*Phylliscum demangeonii*	Black Rock-wafer Lichen				S2?	5	21.5 ± 0.0	NS
N	*Oxyrrhynchium hians*	Light Beaked Moss				S2S3	6	61.1 ± 5.0	NS
N	*Platydictya subtilis*	Bark Willow Moss				S2S3	3	51.6 ± 0.0	NS
N	*Plagiomnium rostratum*	Long-beaked Leafy Moss				S2S3	5	58.6 ± 0.0	NS
N	*Scorpidium revolvens*	Limprichtia Moss				S2S3	2	47.5 ± 2.0	NS
N	*Moelleropsis nebulosa*	Blue-gray Moss Shingle Lichen				S2S3	144	19.4 ± 0.0	NS
N	*Moelleropsis nebulosa ssp. frullaniae*	Blue-gray Moss Shingle Lichen				S2S3	7	32.9 ± 0.0	NS
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S2S3	2	89.2 ± 5.0	NS
N	*Collema leptaleum*	Crumpled Bat's Wing Lichen				S2S3	67	7.2 ± 0.0	NS
N	*Usnea ceratina*	Warty Beard Lichen				S2S3	2	24.1 ± 0.0	NS
N	*Usnea hirta*	Bristly Beard Lichen				S2S3	2	73.6 ± 0.0	NS
N	*Usnea rubicunda*	Red Beard Lichen				S2S3	7	24.0 ± 0.0	NS
N	*Ahtiana aurescens*	Eastern Candlewax Lichen				S2S3	22	12.2 ± 0.0	NS
N	*Usnocetraria oakesiana*	Yellow Band Lichen				S2S3	16	40.5 ± 0.0	NS
N	*Cladonia incrassata*	Powder-foot British Soldiers Lichen				S2S3	1	56.4 ± 3.0	NS
N	*Cladonia mateocyatha*	Mixed-up Pixie-cup				S2S3	4	24.6 ± 0.0	NS
N	*Cladonia parasitica*	Fence-rail Lichen				S2S3	3	67.4 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
N	*Chaenotheca gracilenta*	a lichen				S2S3	1	74.8 ± 0.0	NS
N	*Scytinium tenuissimum*	Birdnest Jellyskin Lichen				S2S3	7	15.1 ± 1.0	NS
N	*Melanohalea septentrionalis*	Northern Camouflage Lichen				S2S3	1	74.0 ± 0.0	NS
N	*Myelochroa aurulenta*	Powdery Axil-bristle Lichen				S2S3	6	58.3 ± 2.0	NS
N	*Parmelia fertilis*	Fertile Shield Lichen				S2S3	3	25.7 ± 0.0	NS
N	*Hypotrachyna minarum*	Hairless-spined Shield Lichen				S2S3	5	22.1 ± 0.0	NS
N	*Parmeliopsis ambigua*	Green Starburst Lichen				S2S3	2	57.6 ± 2.0	NS
N	*Racodium rupestre*	Rockhair Lichen				S2S3	3	34.6 ± 0.0	NS
N	*Umbilicaria polyphylla*	Petalled Rocktripe Lichen				S2S3	1	57.6 ± 2.0	NS
N	*Usnea cavernosa*	Pitted Beard Lichen				S2S3	3	73.2 ± 2.0	NS
N	*Usnea mutabilis*	Bloody Beard Lichen				S2S3	1	73.4 ± 0.0	NS
N	*Fuscopannaria sorediata*	a Lichen				S2S3	12	22.0 ± 0.0	NS
N	*Stereocaulon condensatum*	Granular Soil Foam Lichen				S2S3	2	60.3 ± 0.0	NS
N	*Dimelaena oreina*	Golden Moonglow Lichen				S2S3	2	76.0 ± 1.0	NS
N	*Hypotrachyna revoluta*	Granulating Loop Lichen				S2S3	1	96.9 ± 2.0	NS
N	*Cetraria arenaria*	Sand-loving Icelandmoss Lichen				S2S3	18	29.0 ± 0.0	NS
N	*Cladonia coccifera*	Eastern Boreal Pixie-cup Lichen				S2S3	3	50.0 ± 0.0	NS
N	*Cladonia deformis*	Lesser Sulphur-cup Lichen				S2S3	3	36.8 ± 4.0	NS
N	*Cladonia phyllophora*	Felt Lichen				S2S3	2	59.7 ± 4.0	NS
N	*Hypotrachyna afrorevoluta*	Pustulate Revolute Loop Lichen				S2S3	3	94.7 ± 1.0	NS
N	*Usnea flammea*	Coastal Bushy Beard Lichen				S2S3	3	76.0 ± 1.0	NS
N	*Ephemerum serratum*	a Moss				S3	4	58.3 ± 5.0	NS
N	*Fissidens taxifolius*	Yew-leaved Pocket Moss				S3	7	58.3 ± 5.0	NS
N	*Anomodon tristis*	a Moss				S3	12	60.8 ± 0.0	NS
N	*Sphagnum contortum*	Twisted Peat Moss				S3	4	67.8 ± 0.0	NS
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3	3	25.6 ± 0.0	NS
N	*Rostania occultata*	Crusted Tarpaper Lichen				S3	4	56.0 ± 2.0	NS
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	68	8.0 ± 0.0	NS
N	*Solorina saccata*	Woodland Owl Lichen				S3	9	63.2 ± 0.0	NS
N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	97	12.6 ± 0.0	NS
N	*Heterodermia squamulosa*	Scaly Fringe Lichen				S3	86	12.6 ± 0.0	NS
N	*Scytinium lichenoides*	Tattered Jellyskin Lichen				S3	19	17.6 ± 0.0	NS
N	*Leptogium milligranum*	Stretched Jellyskin Lichen				S3	32	20.4 ± 5.0	NS
N	*Nephroma bellum*	Naked Kidney Lichen				S3	12	52.4 ± 9.0	NS
N	*Placynthium nigrum*	Common Ink Lichen				S3	1	58.2 ± 3.0	NS
N	*Punctelia appalachensis*	Appalachian Speckleback Lichen				S3	137	66.5 ± 0.0	NS
N	*Viridothelium virens*					S3	3	17.9 ± 0.0	NS
N	*Ephebe lanata*	Waterside Rockshag Lichen				S3	1	56.4 ± 0.0	NS
N	*Phaeophyscia adiastola*	Powder-tipped Shadow Lichen				S3	18	74.3 ± 0.0	NS
N	*Phaeophyscia pusilloides*	Pompom-tipped Shadow Lichen				S3	10	12.6 ± 0.0	NS
N	*Peltigera collina*	Tree Pelt Lichen				S3	11	12.6 ± 0.0	NS
N	*Metzgeria conjugata*	Rock Veilwort				S3?	2	77.0 ± 0.0	NS
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3?	3	58.4 ± 0.0	NS
N	*Calliergon giganteum*	Giant Spear Moss				S3?	3	58.8 ± 3.0	NS
N	*Drummondia prorepens*	a Moss				S3?	5	49.7 ± 5.0	NS
N	*Elodium blandowii*	Blandow's Bog Moss				S3?	6	58.2 ± 3.0	NS
N	*Mnium stellare*	Star Leafy Moss				S3?	2	61.9 ± 0.0	NS
N	*Sphagnum riparium*	Streamside Peat Moss				S3?	1	91.8 ± 1.0	NS
N	*Cladonia stygia*	Black-footed Reindeer				S3?	2	57.9 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
		Lichen							
N	*Anomodon rugelii*	Rugel's Anomodon Moss				S3S4	9	51.6 ± 0.0	NS
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S3S4	9	12.8 ± 1.0	NS
N	*Dicranum leioneuron*	a Dicranum Moss				S3S4	3	49.6 ± 0.0	NS
N	*Encalypta ciliata*	Fringed Extinguisher Moss				S3S4	2	83.5 ± 3.0	NS
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	1	72.1 ± 0.0	NS
N	*Splachnum ampullaceum*	Cruet Dung Moss				S3S4	2	57.5 ± 0.0	NS
N	*Thamnobryum alleghaniense*	a Moss				S3S4	6	21.2 ± 1.0	NS
N	*Tomentypnum nitens*	Golden Fuzzy Fen Moss				S3S4	1	67.9 ± 0.0	NS
N	*Schistidium agassizii*	Elf Bloom Moss				S3S4	3	12.8 ± 1.0	NS
N	*Hylocomiastrum pyrenaicum*	a Feather Moss				S3S4	4	60.8 ± 0.0	NS
N	*Enchylium tenax*	Soil Tarpaper Lichen				S3S4	5	63.4 ± 0.0	NS
N	*Sticta fuliginosa*	Peppered Moon Lichen				S3S4	245	23.9 ± 0.0	NS
N	*Arctoparmelia incurva*	Finger Ring Lichen				S3S4	69	39.5 ± 0.0	NS
N	*Scytinium teretiusculum*	Curly Jellyskin Lichen				S3S4	19	52.3 ± 0.0	NS
N	*Leptogium acadiense*	Acadian Jellyskin Lichen				S3S4	54	7.2 ± 0.0	NS
N	*Scytinium subtile*	Appressed Jellyskin Lichen				S3S4	30	8.5 ± 0.0	NS
N	*Cladonia floerkeana*	Gritty British Soldiers Lichen				S3S4	3	18.0 ± 0.0	NS
N	*Vahliella leucophaea*	Shelter Shingle Lichen				S3S4	1	54.4 ± 0.0	NS
N	*Heterodermia speciosa*	Powdered Fringe Lichen				S3S4	63	19.8 ± 0.0	NS
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S3S4	292	2.0 ± 0.0	NS
N	*Melanohalea olivacea*	Spotted Camouflage Lichen				S3S4	8	73.5 ± 0.0	NS
N	*Parmeliopsis hyperopta*	Gray Starburst Lichen				S3S4	1	99.1 ± 0.0	NS
N	*Parmotrema perlatum*	Powdered Ruffle Lichen				S3S4	40	21.9 ± 1.0	NS
N	*Peltigera hymenina*	Cloudy Pelt Lichen				S3S4	1	78.6 ± 2.0	NS
N	*Sphaerophorus fragilis*	Fragile Coral Lichen				S3S4	8	48.0 ± 3.0	NS
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	796	2.0 ± 0.0	NS
N	*Physcia caesia*	Blue-gray Rosette Lichen				S3S4	3	76.0 ± 1.0	NS
N	*Physcia tenella*	Fringed Rosette Lichen				S3S4	6	73.2 ± 0.0	NS
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	165	8.2 ± 0.0	NS
N	*Evernia prunastri*	Valley Oakmoss Lichen				S3S4	31	30.3 ± 1.0	NS
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	222	25.4 ± 0.0	NS
P	*Rhynchospora macrostachya*	Tall Beakrush	Endangered	Endangered	Endangered	S1	57	30.0 ± 0.0	NS
P	*Clethra alnifolia*	Coast Pepper-Bush	Endangered	Threatened	Vulnerable	S2	174	49.3 ± 0.0	NS
P	*Juglans cinerea*	Butternut	Endangered	Endangered		SNA	13	44.2 ± 0.0	NS
P	*Fraxinus nigra*	Black Ash	Threatened		Threatened	S1S2	279	11.8 ± 0.0	NS
P	*Liatris spicata*	Dense Blazing Star	Threatened	Threatened		SNA	5	61.3 ± 0.0	NS
P	*Hydrocotyle umbellata*	Water Pennywort	Special Concern	Special Concern	Endangered	S2	72	57.9 ± 0.0	NS
P	*Eleocharis tuberculosa*	Tubercled Spike-rush	Special Concern	Special Concern	Vulnerable	S2	1	51.6 ± 0.0	NS
P	*Lachnanthes caroliniana*	Redroot	Special Concern	Special Concern	Vulnerable	S2	1470	29.2 ± 0.0	NS
P	*Lophiola aurea*	Goldencrest	Special Concern	Special Concern	Vulnerable	S2	798	22.1 ± 0.0	NS
P	*Lilaeopsis chinensis*	Eastern Lilaeopsis	Special Concern	Special Concern	Vulnerable	S3	150	18.2 ± 0.0	NS
P	*Scirpus longii*	Long's Bulrush	Special Concern		Vulnerable	S3	618	21.8 ± 0.0	NS
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Vulnerable	S3	4	70.1 ± 0.0	NS
P	*Floerkea proserpinacoides*	False Mermaidweed	Not At Risk			S2S3	36	58.4 ± 1.0	NS
P	*Acer saccharinum*	Silver Maple				S1	11	60.4 ± 0.0	NS
P	*Toxicodendron vernix*	Poison Sumac				S1	41	49.5 ± 0.0	NS
P	*Osmorhiza depauperata*	Blunt Sweet Cicely				S1	1	62.0 ± 5.0	NS
P	*Antennaria rosea ssp. arida*	Rosy Pussytoes				S1	1	86.2 ± 0.0	NS
P	*Andersonglossum boreale*	Northern Wild Comfrey				S1	5	59.2 ± 0.0	NS
P	*Turritis glabra*	Tower Mustard				S1	1	22.4 ± 0.0	NS
P	*Lobelia spicata*	Pale-Spiked Lobelia				S1	6	73.7 ± 7.0	NS
P	*Silene antirrhina*	Sleepy Catchfly				S1	5	58.7 ± 0.0	NS
P	*Stellaria crassifolia*	Fleshy Stitchwort				S1	1	59.0 ± 2.0	NS
P	*Astragalus robbinsii var. minor*	Robbins' Milkvetch				S1	31	86.1 ± 0.0	NS
P	*Ribes americanum*	Wild Black Currant				S1	2	58.3 ± 1.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Trichostema dichotomum*	Forked Bluecurls				S1	6	27.2 ± 0.0	NS
P	*Fraxinus pennsylvanica*	Red Ash				S1	11	61.9 ± 0.0	NS
P	*Polygonum achoreum*	Leathery Knotweed				S1	1	72.5 ± 10.0	NS
P	*Phytolacca americana*	Common Pokeweed				S1	1	74.3 ± 0.0	NS
P	*Podostemum ceratophyllum*	Horn-leaved Riverweed				S1	4	13.3 ± 0.0	NS
P	*Montia fontana*	Water Blinks				S1	3	73.0 ± 1.0	NS
P	*Lysimachia minima*	Chaffweed				S1	1	58.5 ± 0.0	NS
P	*Lysimachia quadrifolia*	Whorled Yellow Loosestrife				S1	1	51.6 ± 0.0	NS
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S1	2	54.3 ± 1.0	NS
P	*Carex digitalis*	Slender Wood Sedge				S1	4	37.1 ± 0.0	NS
P	*Carex laxiflora*	Loose-Flowered Sedge				S1	6	54.3 ± 7.0	NS
P	*Carex ormostachya*	Necklace Spike Sedge				S1	5	52.9 ± 0.0	NS
P	*Carex prairea*	Prairie Sedge				S1	2	65.7 ± 1.0	NS
P	*Carex viridula var. saxilittoralis*	Greenish Sedge				S1	1	77.5 ± 0.0	NS
P	*Fimbristylis autumnalis*	Slender Fimbry				S1	3	59.1 ± 0.0	NS
P	*Scirpus atrovirens*	Dark-green Bulrush				S1	3	22.1 ± 0.0	NS
P	*Schoenoplectus torreyi*	Torrey's Bulrush				S1	8	25.8 ± 0.0	NS
P	*Iris prismatica*	Slender Blue Flag				S1	1	51.7 ± 100.0	NS
P	*Sisyrinchium fuscatum*	Coastal Plain Blue-eyed-grass				S1	6	11.4 ± 0.0	NS
P	*Juncus secundus*	Secund Rush				S1	3	37.8 ± 1.0	NS
P	*Trillium grandiflorum*	White Trillium				S1	3	65.7 ± 1.0	NS
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	5	73.7 ± 10.0	NS
P	*Spiranthes casei var. casei*	Case's Ladies'-Tresses				S1	3	40.6 ± 0.0	NS
P	*Dichanthelium xanthophysum*	Slender Panic Grass				S1	9	12.1 ± 0.0	NS
P	*Elymus hystrix*	Spreading Wild Rye				S1	8	64.0 ± 0.0	NS
P	*Torreyochloa pallida var. pallida*	Pale False Manna Grass				S1	2	61.1 ± 1.0	NS
P	*Adiantum pedatum*	Northern Maidenhair Fern				S1	10	46.3 ± 1.0	NS
P	*Dryopteris goldieana*	Goldie's Woodfern				S1	1	14.4 ± 1.0	NS
P	*Equisetum palustre*	Marsh Horsetail				S1	1	59.5 ± 5.0	NS
P	*Botrychium lunaria*	Common Moonwort				S1	8	91.0 ± 0.0	NS
P	*Selaginella rupestris*	Rock Spikemoss				S1	1	62.2 ± 0.0	NS
P	*Solidago hispida*	Hairy Goldenrod				S1?	1	75.9 ± 7.0	NS
P	*Suaeda rolandii*	Roland's Sea-Blite				S1?	4	58.7 ± 0.0	NS
P	*Carex pensylvanica*	Pennsylvania Sedge				S1?	2	18.1 ± 10.0	NS
P	*Bolboschoenus robustus*	Sturdy Bulrush				S1?	1	79.8 ± 5.0	NS
P	*Juncus anthelatus*	Greater Poverty Rush				S1?	1	56.9 ± 0.0	NS
P	*Allium schoenoprasum*	Wild Chives				S1?	2	62.0 ± 0.0	NS
P	*Allium schoenoprasum var. sibiricum*	Wild Chives				S1?	2	90.9 ± 7.0	NS
P	*Panicum dichotomiflorum ssp. puritanorum*	Spreading Panicgrass				S1?	5	44.0 ± 0.0	NS
P	*Huperzia selago*	Northern Firmoss				S1?	1	88.1 ± 1.0	NS
P	*Crocanthemum canadense*	Long-branched Frostweed			Endangered	S1S2	135	32.1 ± 0.0	NS
P	*Cypripedium arietinum*	Ram's-Head Lady's-Slipper			Endangered	S1S2	278	58.3 ± 0.0	NS
P	*Sanicula odorata*	Clustered Sanicle				S1S2	9	58.7 ± 1.0	NS
P	*Ageratina altissima*	White Snakeroot				S1S2	22	87.6 ± 0.0	NS
P	*Draba glabella*	Rock Whitlow-Grass				S1S2	6	84.2 ± 0.0	NS
P	*Cornus suecica*	Swedish Bunchberry				S1S2	2	73.6 ± 0.0	NS
P	*Proserpinaca intermedia*	Intermediate Mermaidweed				S1S2	4	40.9 ± 1.0	NS
P	*Carex haydenii*	Hayden's Sedge				S1S2	3	25.5 ± 0.0	NS
P	*Platanthera huronensis*	Fragrant Green Orchid				S1S2	2	68.8 ± 10.0	NS
P	*Euphrasia farlowii*	Farlow's Eyebright				S1S3	2	40.6 ± 0.0	NS
P	*Carex vacillans*	Estuarine Sedge				S1S3	1	80.7 ± 0.0	NS

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P	*Zizia aurea*	Golden Alexanders				S2	3	86.8 ± 0.0	NS
P	*Antennaria parlinii ssp. fallax*	Parlin's Pussytoes				S2	25	13.5 ± 0.0	NS
P	*Rudbeckia laciniata*	Cut-Leaved Coneflower				S2	14	53.9 ± 5.0	NS
P	*Rudbeckia laciniata var. laciniata*	Cut-Leaved Coneflower				S2	9	53.0 ± 3.0	NS
P	*Arabis pycnocarpa*	Cream-flowered Rockcress				S2	2	94.2 ± 0.0	NS
P	*Cardamine maxima*	Large Toothwort				S2	19	71.2 ± 4.0	NS
P	*Hudsonia ericoides*	Pinebarren Golden Heather				S2	205	27.2 ± 0.0	NS
P	*Desmodium canadense*	Canada Tick-trefoil				S2	9	52.4 ± 7.0	NS
P	*Hylodesmum glutinosum*	Large Tick-trefoil				S2	38	50.1 ± 1.0	NS
P	*Oxytropis campestris var. johannensis*	Field Locoweed				S2	26	86.2 ± 0.0	NS
P	*Conopholis americana*	American Cancer-root				S2	59	16.5 ± 0.0	NS
P	*Anemonastrum canadense*	Canada Anemone				S2	13	14.2 ± 0.0	NS
P	*Hepatica americana*	Round-lobed Hepatica				S2	46	16.1 ± 1.0	NS
P	*Ranunculus sceleratus*	Cursed Buttercup				S2	25	52.2 ± 0.0	NS
P	*Galium boreale*	Northern Bedstraw				S2	6	72.0 ± 0.0	NS
P	*Dirca palustris*	Eastern Leatherwood				S2	64	61.4 ± 1.0	NS
P	*Carex livida*	Livid Sedge				S2	2	57.7 ± 10.0	NS
P	*Juncus greenei*	Greene's Rush				S2	4	42.7 ± 0.0	NS
P	*Allium tricoccum*	Wild Leek				S2	68	58.7 ± 0.0	NS
P	*Lilium canadense*	Canada Lily				S2	33	54.7 ± 7.0	NS
P	*Cypripedium parviflorum var. pubescens*	Yellow Lady's-slipper				S2	23	58.3 ± 0.0	NS
P	*Cypripedium parviflorum var. makasin*	Small Yellow Lady's-Slipper				S2	13	54.2 ± 0.0	NS
P	*Cypripedium reginae*	Showy Lady's-Slipper				S2	20	64.2 ± 0.0	NS
P	*Platanthera flava var. flava*	Southern Rein Orchid				S2	19	16.6 ± 0.0	NS
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S2	25	15.4 ± 0.0	NS
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S2	3	49.9 ± 1.0	NS
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S2	36	11.8 ± 0.0	NS
P	*Elymus wiegandii*	Wiegand's Wild Rye				S2	1	75.9 ± 7.0	NS
P	*Festuca subverticillata*	Nodding Fescue				S2	6	63.9 ± 7.0	NS
P	*Piptatheropsis pungens*	Slender Ricegrass				S2	11	24.3 ± 10.0	NS
P	*Cryptogramma stelleri*	Steller's Rockbrake				S2	2	57.7 ± 0.0	NS
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2?	6	36.0 ± 0.0	NS
P	*Rumex persicarioides*	Peach-leaved Dock				S2?	5	23.7 ± 0.0	NS
P	*Crataegus submollis*	Quebec Hawthorn				S2?	4	35.0 ± 7.0	NS
P	*Carex peckii*	White-Tinged Sedge				S2?	1	65.0 ± 5.0	NS
P	*Thuja occidentalis*	Eastern White Cedar			Vulnerable	S2S3	280	16.2 ± 0.0	NS
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2S3	15	51.0 ± 0.0	NS
P	*Erigeron philadelphicus*	Philadelphia Fleabane				S2S3	1	88.2 ± 0.0	NS
P	*Eutrochium dubium*	Coastal Plain Joe Pye Weed				S2S3	2	38.4 ± 0.0	NS
P	*Lactuca hirsuta*	Hairy Lettuce				S2S3	6	34.0 ± 0.0	NS
P	*Impatiens pallida*	Pale Jewelweed				S2S3	9	62.3 ± 7.0	NS
P	*Caulophyllum thalictroides*	Blue Cohosh				S2S3	47	47.5 ± 7.0	NS
P	*Boechera stricta*	Drummond's Rockcress				S2S3	9	77.7 ± 1.0	NS
P	*Draba arabisans*	Rock Whitlow-Grass				S2S3	24	77.7 ± 1.0	NS
P	*Stellaria humifusa*	Saltmarsh Starwort				S2S3	5	87.4 ± 1.0	NS
P	*Oxybasis rubra*	Red Goosefoot				S2S3	3	82.0 ± 0.0	NS
P	*Hypericum majus*	Large St John's-wort				S2S3	6	34.1 ± 0.0	NS
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2S3	8	21.2 ± 0.0	NS
P	*Empetrum atropurpureum*	Purple Crowberry				S2S3	5	45.1 ± 7.0	NS
P	*Euphorbia polygonifolia*	Seaside Spurge				S2S3	16	17.9 ± 3.0	NS
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S2S3	9	24.4 ± 1.0	NS
P	*Hedeoma pulegioides*	American False Pennyroyal				S2S3	18	16.9 ± 5.0	NS
P	*Oenothera fruticosa ssp.*	Narrow-leaved Evening				S2S3	9	17.5 ± 0.0	NS

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	tetragona	Primrose							
P	*Polygala polygama*	Racemed Milkwort				S2S3	25	55.7 ± 0.0	NS
P	*Polygonum aviculare ssp. buxiforme*	Box Knotweed				S2S3	6	25.1 ± 7.0	NS
P	*Polygonum oxyspermum ssp. raii*	Ray's Knotweed				S2S3	7	27.5 ± 1.0	NS
P	*Polygonum oxyspermum*	Sharp-fruit Knotweed				S2S3	1	68.3 ± 0.0	NS
P	*Rumex triangulivalvis*	Triangular-valve Dock				S2S3	8	17.9 ± 1.0	NS
P	*Anemone quinquefolia*	Wood Anemone				S2S3	23	53.8 ± 0.0	NS
P	*Caltha palustris*	Yellow Marsh Marigold				S2S3	8	13.7 ± 0.0	NS
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S2S3	2	9.3 ± 7.0	NS
P	*Potentilla canadensis*	Canada Cinquefoil				S2S3	11	29.7 ± 0.0	NS
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2S3	8	24.9 ± 0.0	NS
P	*Salix pellita*	Satiny Willow				S2S3	2	70.8 ± 7.0	NS
P	*Tiarella cordifolia*	Heart-leaved Foamflower				S2S3	10	70.8 ± 0.0	NS
P	*Boehmeria cylindrica*	Small-spike False-nettle				S2S3	50	12.1 ± 0.0	NS
P	*Carex adusta*	Lesser Brown Sedge				S2S3	4	70.7 ± 5.0	NS
P	*Carex capillaris*	Hairlike Sedge				S2S3	7	86.2 ± 0.0	NS
P	*Carex comosa*	Bearded Sedge				S2S3	12	53.9 ± 5.0	NS
P	*Carex houghtoniana*	Houghton's Sedge				S2S3	7	38.3 ± 0.0	NS
P	*Carex hystericina*	Porcupine Sedge				S2S3	7	56.8 ± 1.0	NS
P	*Carex longii*	Long's Sedge				S2S3	2	59.7 ± 10.0	NS
P	*Eleocharis ovata*	Ovate Spikerush				S2S3	5	44.0 ± 5.0	NS
P	*Scirpus pedicellatus*	Stalked Bulrush				S2S3	3	99.3 ± 0.0	NS
P	*Vallisneria americana*	Wild Celery				S2S3	11	11.4 ± 0.0	NS
P	*Najas gracillima*	Thread-Like Naiad				S2S3	22	36.2 ± 0.0	NS
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S2S3	91	20.3 ± 5.0	NS
P	*Spiranthes casei*	Case's Ladies'-Tresses				S2S3	2	34.0 ± 0.0	NS
P	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses				S2S3	6	54.9 ± 0.0	NS
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2S3	9	57.1 ± 0.0	NS
P	*Potamogeton friesii*	Fries' Pondweed				S2S3	8	60.2 ± 2.0	NS
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S2S3	4	58.5 ± 0.0	NS
P	*Botrychium simplex*	Least Moonwort				S2S3	5	52.0 ± 1.0	NS
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	8	32.5 ± 7.0	NS
P	*Potamogeton pulcher*	Spotted Pondweed			Vulnerable	S3	27	16.6 ± 0.0	NS
P	*Conioselinum chinense*	Chinese Hemlock-parsley				S3	7	69.9 ± 0.0	NS
P	*Iva frutescens*	Big-leaved Marsh-elder				S3	33	58.6 ± 1.0	NS
P	*Senecio pseudoarnica*	Seabeach Ragwort				S3	10	55.9 ± 0.0	NS
P	*Symphyotrichum boreale*	Boreal Aster				S3	11	14.5 ± 5.0	NS
P	*Symphyotrichum undulatum*	Wavy-leaved Aster				S3	141	11.3 ± 0.0	NS
P	*Symphyotrichum ciliolatum*	Fringed Blue Aster				S3	3	69.9 ± 0.0	NS
P	*Alnus serrulata*	Smooth Alder				S3	703	12.1 ± 0.0	NS
P	*Betula michauxii*	Michaux's Dwarf Birch				S3	60	27.1 ± 0.0	NS
P	*Cardamine parviflora*	Small-flowered Bittercress				S3	17	39.2 ± 0.0	NS
P	*Palustricodon aparinoides*	Marsh Bellflower				S3	8	61.2 ± 1.0	NS
P	*Mononeuria groenlandica*	Greenland Stitchwort				S3	143	23.3 ± 0.0	NS
P	*Sagina nodosa*	Knotted Pearlwort				S3	63	30.0 ± 0.0	NS
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S3	4	64.4 ± 0.0	NS
P	*Ceratophyllum echinatum*	Prickly Hornwort				S3	4	13.3 ± 0.0	NS
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S3	29	62.1 ± 0.0	NS
P	*Crassula aquatica*	Water Pygmyweed				S3	1	47.3 ± 0.0	NS
P	*Empetrum eamesii*	Pink Crowberry				S3	93	42.7 ± 0.0	NS
P	*Vaccinium uliginosum*	Alpine Bilberry				S3	3	76.4 ± 0.0	NS
P	*Halenia deflexa*	Spurred Gentian				S3	3	55.4 ± 0.0	NS
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	19	17.3 ± 5.0	NS

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P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	2	73.8 ± 3.0	NS
P	*Utricularia resupinata*	Inverted Bladderwort				S3	12	22.5 ± 0.0	NS
P	*Epilobium strictum*	Downy Willowherb				S3	6	52.2 ± 0.0	NS
P	*Polygala sanguinea*	Blood Milkwort				S3	15	12.0 ± 0.0	NS
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S3	12	12.6 ± 0.0	NS
P	*Plantago rugelii*	Rugel's Plantain				S3	8	48.0 ± 0.0	NS
P	*Primula laurentiana*	Laurentian Primrose				S3	53	62.3 ± 7.0	NS
P	*Samolus parviflorus*	Seaside Brookweed				S3	58	18.2 ± 0.0	NS
P	*Pyrola minor*	Lesser Pyrola				S3	2	62.3 ± 7.0	NS
P	*Anemone virginiana*	Virginia Anemone				S3	12	16.1 ± 0.0	NS
P	*Cephalanthus occidentalis*	Common Buttonbush				S3	1962	28.0 ± 0.0	NS
P	*Salix pedicellaris*	Bog Willow				S3	96	24.8 ± 0.0	NS
P	*Salix sericea*	Silky Willow				S3	130	11.3 ± 0.0	NS
P	*Saxifraga paniculata ssp. laestadii*	Laestadius' Saxifrage				S3	13	73.7 ± 7.0	NS
P	*Lindernia dubia*	Yellow-seeded False Pimperel				S3	12	12.4 ± 3.0	NS
P	*Laportea canadensis*	Canada Wood Nettle				S3	22	58.9 ± 0.0	NS
P	*Pilea pumila*	Dwarf Clearweed				S3	4	63.6 ± 0.0	NS
P	*Viola nephrophylla*	Northern Bog Violet				S3	1	58.1 ± 1.0	NS
P	*Carex bebbii*	Bebb's Sedge				S3	20	58.4 ± 0.0	NS
P	*Carex castanea*	Chestnut Sedge				S3	1	81.9 ± 0.0	NS
P	*Carex cryptolepis*	Hidden-scaled Sedge				S3	10	26.7 ± 0.0	NS
P	*Carex hirtifolia*	Pubescent Sedge				S3	15	64.1 ± 0.0	NS
P	*Carex lupulina*	Hop Sedge				S3	51	11.7 ± 1.0	NS
P	*Carex rosea*	Rosy Sedge				S3	23	57.1 ± 11.0	NS
P	*Carex swanii*	Swan's Sedge				S3	25	31.2 ± 0.0	NS
P	*Carex tenera*	Tender Sedge				S3	3	15.9 ± 0.0	NS
P	*Carex tribuloides*	Blunt Broom Sedge				S3	13	54.6 ± 3.0	NS
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	27	59.1 ± 0.0	NS
P	*Eleocharis nitida*	Quill Spikerush				S3	19	61.7 ± 7.0	NS
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S3	14	24.2 ± 0.0	NS
P	*Eriophorum gracile*	Slender Cottongrass				S3	10	54.7 ± 0.0	NS
P	*Coeloglossum viride*	Long-bracted Frog Orchid				S3	12	51.3 ± 1.0	NS
P	*Cypripedium parviflorum*	Yellow Lady's-slipper				S3	543	49.9 ± 0.0	NS
P	*Neottia bifolia*	Southern Twayblade				S3	190	11.4 ± 0.0	NS
P	*Platanthera flava*	Southern Rein-Orchid				S3	39	12.1 ± 0.0	NS
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	10	16.0 ± 0.0	NS
P	*Platanthera hookeri*	Hooker's Orchid				S3	26	15.9 ± 5.0	NS
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S3	16	11.3 ± 0.0	NS
P	*Piptatheropsis canadensis*	Canada Ricegrass				S3	25	26.6 ± 0.0	NS
P	*Poa glauca*	Glaucous Blue Grass				S3	15	71.4 ± 1.0	NS
P	*Stuckenia filiformis*	Thread-leaved Pondweed				S3	1	76.0 ± 7.0	NS
P	*Potamogeton praelongus*	White-stemmed Pondweed				S3	1	59.9 ± 1.0	NS
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	7	59.4 ± 1.0	NS
P	*Potamogeton zosteriformis*	Flat-stemmed Pondweed				S3	2	60.1 ± 1.0	NS
P	*Asplenium viride*	Green Spleenwort				S3	1	98.5 ± 7.0	NS
P	*Dryopteris fragrans*	Fragrant Wood Fern				S3	2	87.4 ± 0.0	NS
P	*Sceptridium dissectum*	Dissected Moonwort				S3	5	6.9 ± 0.0	NS
P	*Polypodium appalachianum*	Appalachian Polypody				S3	14	32.1 ± 0.0	NS
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S3?	29	11.4 ± 0.0	NS
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S3?	38	12.7 ± 0.0	NS
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3?	3	58.4 ± 0.0	NS
P	*Bidens vulgata*	Tall Beggarticks				S3S4	2	68.3 ± 0.0	NS
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3S4	3	54.7 ± 7.0	NS
P	*Hieracium paniculatum*	Panicled Hawkweed				S3S4	44	12.6 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Bidens beckii*	Water Beggarticks				S3S4	21	13.2 ± 0.0	NS
P	*Packera paupercula*	Balsam Groundsel				S3S4	60	58.3 ± 0.0	NS
P	*Packera paupercula var. paupercula*	Balsam Groundsel				S3S4	1	61.4 ± 0.0	NS
P	*Atriplex glabriuscula var. franktonii*	Frankton's Saltbush				S3S4	14	58.7 ± 0.0	NS
P	*Shepherdia canadensis*	Soapberry				S3S4	101	58.2 ± 0.0	NS
P	*Vaccinium boreale*	Northern Blueberry				S3S4	1	37.1 ± 0.0	NS
P	*Vaccinium cespitosum*	Dwarf Bilberry				S3S4	43	11.9 ± 0.0	NS
P	*Vaccinium corymbosum*	Highbush Blueberry				S3S4	12	31.1 ± 0.0	NS
P	*Fagus grandifolia*	American Beech				S3S4	396	8.1 ± 0.0	NS
P	*Bartonia virginica*	Yellow Bartonia				S3S4	64	13.9 ± 0.0	NS
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S3S4	66	9.6 ± 5.0	NS
P	*Decodon verticillatus*	Swamp Loosestrife				S3S4	190	31.8 ± 0.0	NS
P	*Nuphar microphylla*	Small Yellow Pond-lily				S3S4	6	41.9 ± 0.0	NS
P	*Persicaria pensylvanica*	Pennsylvania Smartweed				S3S4	28	43.6 ± 0.0	NS
P	*Fallopia scandens*	Climbing False Buckwheat				S3S4	12	12.0 ± 0.0	NS
P	*Pyrola asarifolia*	Pink Pyrola				S3S4	4	82.9 ± 0.0	NS
P	*Endotropis alnifolia*	alder-leaved buckthorn				S3S4	42	62.3 ± 0.0	NS
P	*Amelanchier spicata*	Running Serviceberry				S3S4	60	11.2 ± 5.0	NS
P	*Crataegus succulenta*	Fleshy Hawthorn				S3S4	1	73.2 ± 0.0	NS
P	*Fragaria vesca ssp. americana*	Woodland Strawberry				S3S4	25	63.0 ± 0.0	NS
P	*Galium aparine*	Common Bedstraw				S3S4	22	38.9 ± 0.0	NS
P	*Geocaulon lividum*	Northern Comandra				S3S4	2	60.0 ± 1.0	NS
P	*Limosella australis*	Southern Mudwort				S3S4	14	19.9 ± 0.0	NS
P	*Veronica serpyllifolia*	Thyme-Leaved Speedwell				S3S4	38	16.0 ± 0.0	NS
P	*Ulmus americana*	White Elm				S3S4	48	11.9 ± 0.0	NS
P	*Verbena hastata*	Blue Vervain				S3S4	91	12.1 ± 0.0	NS
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S3S4	62	12.0 ± 0.0	NS
P	*Viola selkirkii*	Great-Spurred Violet				S3S4	2	70.2 ± 4.0	NS
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S3S4	5	67.4 ± 0.0	NS
P	*Carex argyrantha*	Silvery-flowered Sedge				S3S4	29	21.5 ± 1.0	NS
P	*Sisyrinchium atlanticum*	Eastern Blue-Eyed-Grass				S3S4	125	12.0 ± 0.0	NS
P	*Triglochin gaspensis*	Gasp ├ Arrowgrass				S3S4	13	19.4 ± 0.0	NS
P	*Juncus acuminatus*	Sharp-Fruit Rush				S3S4	13	13.0 ± 3.0	NS
P	*Juncus subcaudatus*	Woods-Rush				S3S4	13	37.5 ± 0.0	NS
P	*Luzula parviflora ssp. melanocarpa*	Black-fruited Woodrush				S3S4	4	71.3 ± 7.0	NS
P	*Goodyera repens*	Lesser Rattlesnake-plantain				S3S4	25	51.0 ± 1.0	NS
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	11	42.2 ± 1.0	NS
P	*Platanthera obtusata*	Blunt-leaved Orchid				S3S4	9	12.1 ± 0.0	NS
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3S4	46	48.0 ± 0.0	NS
P	*Alopecurus aequalis*	Short-awned Foxtail				S3S4	4	58.5 ± 0.0	NS
P	*Dichanthelium clandestinum*	Deer-tongue Panic Grass				S3S4	282	11.3 ± 0.0	NS
P	*Coleataenia longifolia*	Long-leaved Panicgrass				S3S4	1636	21.7 ± 0.0	NS
P	*Panicum philadelphicum*	Philadelphia Panicgrass				S3S4	29	16.7 ± 0.0	NS
P	*Koeleria spicata*	Narrow False Oats				S3S4	12	61.3 ± 0.0	NS
P	*Asplenium trichomanes*	Maidenhair Spleenwort				S3S4	18	54.0 ± 0.0	NS
P	*Lorinseria areolata*	Netted Chain Fern				S3S4	65	53.0 ± 7.0	NS
P	*Equisetum pratense*	Meadow Horsetail				S3S4	7	53.3 ± 0.0	NS
P	*Diphasiastrum complanatum*	Northern Ground-cedar				S3S4	14	50.5 ± 0.0	NS
P	*Diphasiastrum sitchense*	Sitka Ground-cedar				S3S4	1	62.4 ± 1.0	NS
P	*Huperzia appressa*	Mountain Firmoss				S3S4	10	77.0 ± 1.0	NS
P	*Sceptridium multifidum*	Leathery Moonwort				S3S4	15	42.4 ± 10.0	NS
P	*Botrychium matricariifolium*	Daisy-leaved Moonwort				S3S4	5	40.7 ± 10.0	NS
P	*Bidens discoidea*	Swamp Beggarticks				SH	1	68.4 ± 0.0	NS
P	*Viola canadensis*	Canada Violet				SH	1	64.2 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Greeneochloa coarctata*	Small Reedgrass				SH	1	69.9 ± 6.0	NS
P	*Dichanthelium meridionale*	Matting Witchgrass				SH	1	95.8 ± 10.0	NS

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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6	McKendry, Karen. 2016. Rare species observations, 2016. Nova Scotia Nature Trust, 19 recs.
6	McMullin, Troy. 2021. Anzia colpodes observations near Kejimkujik National Park. Canadian Museum of Nature.
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4	Mills, Pamela. 2007. Iva frutescens records. Nova Scotia Dept of Natural Resources, Wildlife Div. Pers. comm. to S. Basquil, 4 recs.
4	Newell, R. & Neily, T.; Toms, B.; Proulx, G. et al. 2011. NCC Properties Fieldwork in NS: August-September 2010. Nature Conservancy Canada, 106 recs.
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3	Canadian Wildlife Service, Atlantic Region. 2010. Piping Plover censuses 2006-09. , 35 recs.
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3	Hill, N.M., Myra, M. 2017. Email to Sean Blaney regarding rich intervale flora on Nictaux River. Fern Hill Institute, 3 records.
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3	Mills, Pamela. 2008. Clethra alnifolia at Mudflat Lake. Nova Scotia Dept of Natural Resources, Wildlife Div. Pers. comm. to D.M. Mazerolle, 4 recs.
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2	Chapman, Cody. Unreported Species at Risk Records across Nova Scotia. Chapman, Cody, 5 records.
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2	Hill, N.M. 2019. Observation of Crocanthemum canadense near Auburn, Annapolis Co. NS on May 29, 2019. Fern Hill Institute, 2 recs.
2	Kennedy, B. & Cron, C.; Patriquin, D. 2018. Email to Sean Blaney on observations of Trichostema dichotomum at Shingle Lake, Nova Scotia. , 2 records.
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2	Sabine, M. 2016. NB DNR staff incidental Black Ash observations. New Brunswick Department of Natural Resources.
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2	WIlliams, M. Cape Breton University Digital Herbarium. Cape Breton University Digital Herbarium. 2013.
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1	Amirault, D.L. 2003. 2003 Peregrine Falcon Survey. Canadian Wildlife Service, Sackville, unpublished data. 7 recs.
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1	Basquill, S. P. 2008. Nova Scotia Dept of Natural Resources.
1	Basquill, S.P. 2004. C. americana and Sedum sp records, 2002. Pers. comm. to C.S. Blaney. 2 recs, 2 recs.
1	Basquill, S.P. 2012. 2012 Bryophyte specimen data. Nova Scotia Department of Natural Resources, 37 recs.
1	Basquill, S.P.; Quigley, E. 2006. New Minuartia groenlandica record for NS. Pers. comm. to C.S. Blaney, Oct 6, 1 rec.
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1	Belliveau, A. & Toms, B. 2012. Email regarding Lophiola aurea (Goldencrest) location on Molega Lake, NS. Mersey Tobeatic Research Institute, 3 records.
1	Belliveau, A.G. 2020. Email to Colin Chapman on new NS locations for Allium tricoccum. Chapman, C.J. (ed.) Acadia University.
1	Belliveau, A.G. E.C. Smith Herbarium Specimen Database 2019. E.C. Smith Herbarium, Acadia University. 2019.
1	Benedict, B. Connell Herbarium Specimens, Digital photos. University New Brunswick, Fredericton. 2005.
1	Benjamin, L.K. 2003. Cypripedium arietinum in Cogmagun River NS. Pers. comm. to S. Blaney, 1 rec.
1	Berg, L. 2020. Canada Warbler observations, Birch Lake, NS. pers. comm. to J. Churchill.
1	Bernard, Laurel. 2013. Email to Sean Blaney regarding Listera australis at Lake Rossignol. Nature Conservancy of Canada, 1.
1	Blaney, C.S. Miscellaneous specimens received by ACCDC (botany). Various persons. 2001-08.
1	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
1	Brach, A.R. 2019. Correspondence to Sean Blaney regarding Calamagrostis cinnoides specimen from Halifax NS. pers. comm., Harvard University Herbaria, 1 record.
1	Breen, A. 2017. 2017 Atlantic Whitefish observation. Coastal Action.
1	Bruce, J. 2014. 2014 Wood Turtle email report, Nine Mile River, NS. NS Department of Natural Resources.
1	Brunelle, P.-M. 2009. NS Power odonata records for Mersey, Tusket & Sissiboo systems. Nova Scotia Power, 218 recs.
1	Butt, Brad. 2020. Email from Brad Butt to Sean Blaney regarding a Blue Felt Lichen (Pectenia plumbea) from near Deception Lake, Shelburne Co., NS. pers. comm., 1 record.
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1	Clayden, S.R. 2020. Email to Sean Blaney regarding Pilophorus cereus and P. fibula at Fidele Lake area, Charlotte County, NB. pers. comm., 2 records.
1	Cook, K. 2016. Wood Turtle record. Pers comm. to Nova Scotia Department of Lands and Forestry.
1	Crowell, A. 2004. Cypripedium arietinum in Weir Brook, Hants Co. Pers. comm. to S. Blaney, 1 rec.
1	Crowell, M. 2013. email to Sean Blaney regarding Listera australis at Bear Head and Mill Cove Canadian Forces Station. Jacques Whitford Environmental Ltd., 2.
1	Crowell, M.J. Plant specimens from Nictaux, NS sent to Sean Blaney for identification. Jacques Whitford Limited. 2005.
1	Daury, R.W. & Bateman, M.C. 1996. The Barrow's Goldeneye (Bucephala islandica) in the Atlantic Provinces and Maine. Canadian Wildlife Service, Sackville, 47pp.
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1	Edge, Thomas A. 1984. Status report on the Atlantic Whitefish (Coregonus huntsmani). Committee on the Status of Endangered Wildlife in Canada.
1	Golder Associates Ltd. 2021. Black Ash location from Goff's Quarry Expansion Environment Assessment, 2017. Golder Associates Ltd., 1 record.
1	Hall, Duane. 2018. Martes americana record by Duane Sabine, emailed to J. Klymko on 13 12 2018. pers. comm.
1	Haughian, S. 2019. Pannaria lurida observations in Nova Scotia and New Brunswick. Nova Scotia Museum.
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1	Hill, N.M. 2016. Email communications to Sean Blaney and Alain Belliveau regarding the discovery of Fimbristylis autumnalis on the shores of Loon Lake, Kejimkujik National Park. Pers. comm., 1 rec.
1	Hope, P. 2007. Water-pennywort (Hydrocotyle umbellata) on Ell Island. Parks Canada, Kejimkujik NP, 1 record.
1	Jacques Whitford Ltd. 2003. Cananda Lily location. Pers. Comm. to S. Blaney. 2pp, 1 rec, 1 rec.
1	Johnstone, D.; Churchill J. 2014. 2014 Chimney Swift observation, Kejimkujik NP, NS. Atlantic Canada Conservation Data Centre.
1	Jotcham, J. 2013. email to Sean Blaney regarding the discovery of a Listera australis population at Port Mouton. , 1.
1	Kennedy, B. 2019. observations of Crocanthemum canadense at Bangs Falls, Nova Scotia. iNaturalist.ca.
1	Klymko, J. Dataset of butterfly records at the New Brunswick Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2016.
1	Klymko, J.J.D. 2010. Miscellaneous observations reported to ACCDC (zoology). Pers. comm. from various persons, 3 recs.
1	Klymko, J.J.D. 2012. Insect field work & submissions. Atlantic Canada Conservation Data Centre, 852 recs.
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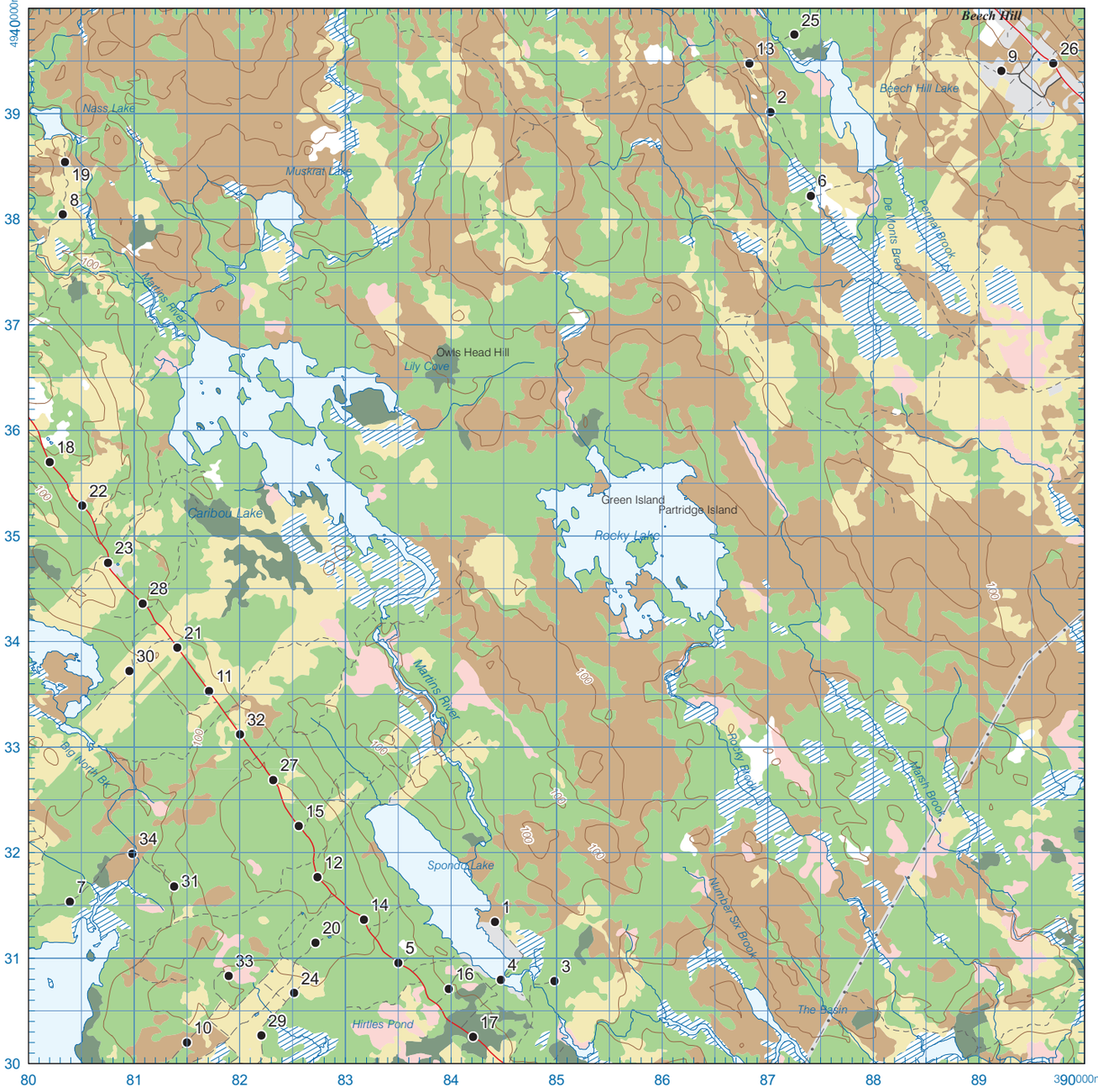
APPENDIX H. MARITIME BREEDING BIRD ATLAS SQUARE

Region 19 Région *Nova Scotia*

Caribou Lake

Nouvelle-Écosse **20LQ83**



Maritime Breeding Bird Atlas 2006 - 2010

Atlas des oiseaux nicheurs des Maritimes

metres 1000 0 1000 2000 mètres

6° Universal Transverse Mercator (UTM) Projection, Zone 20, North American Datum (NAD) 1983.

6° Projection universel transverse de Mercator (UTM), Zone 20, Système de référence nord-américain de 1983.

Disclaimer

The Province of Nova Scotia accepts no liability for any errors, deficiencies, or faults on this map.

Avis

La Province de la Nouvelle-Écosse ne peut être tenu responsable pour des erreurs, défectuosités,ou anomalies dans la présente carte.

Cartographic production by the Nova Scotia Department of Natural Resources, 2006.

Production cartographique de la Province de la Nouvelle-Écosse, Ministère des Ressources naturelles, 2006.

Roadside Point Count Coordinates
Coordonnées de points d'écoute de bordure de route

#	Easting Abscisse	Northing Ordonnée	#	Easting Abscisse	Northing Ordonnée
01	384,417	4,931,344	21	381,410	4,933,941
02	387,027	4,939,016	22	380,508	4,935,288
03	384,981	4,930,782	23	380,753	4,934,746
04	384,474	4,930,794	24	382,516	4,930,669
05	383,503	4,930,954	25	387,255	4,939,751
06	387,409	4,938,222	26	389,707	4,939,478
07	380,391	4,931,534	27	382,318	4,932,686
08	380,324	4,938,046	28	381,082	4,934,359
09	389,214	4,939,406	29	382,205	4,930,268
10	381,499	4,930,200	30	380,955	4,933,721
11	381,709	4,933,530	31	381,379	4,931,679
12	382,737	4,931,766	32	382,004	4,933,119
13	386,827	4,939,477	33	381,895	4,930,831
14	383,176	4,931,365	34	380,984	4,931,988
15	382,560	4,932,251	35		
16	383,981	4,930,708	36		
17	384,211	4,930,254	37		
18	380,200	4,935,699	38		
19	380,344	4,938,543	39		
20	382,719	4,931,146	40		

Legend • Légende

- Trans-Canada highway / Route transcanadienne . . . 104
- Arterial highway / Route artétielle . . . 102
- Trunk highway / Route principale . . . 2
- Collector highway / Artère collectrice . . . 224
- Road, hard surface / Route, revêtement dur . . .
- Road, loose surface / Route de gravier . . .
- Resource access road / Route de ressource . . .
- Vehicle track / Chemin de terre . . .
- Trail / Sentier . . .
- Power transmission line / Ligne de transport d'énergie . . .
- Railway / Chemin de fer . . .
- Railway, abandoned / Chemin de fer, abandonné . . .
- Pipeline underground / Pipeline souterrain . . .
- Contour 20 m / Courbes de niveau 20 m . . .
- Contour 100 m (index) / Courbes de niveau 100 m (Index) . . . 100
- Watercourse or shoreline / Cours d'eau ou rive . . .
- Lake, river, ocean / Lac, rivère, océan . . .
- Tower / Tour . . .
- Pit, quarry, mine / Carrière de cailloux, carrière, mine . . .
- Indian Reserve / Réserve indienne . . .

Habitat • Habitat

- Mature coniferous forest / Forêt de conifères mature . . .
- Mature deciduous forest / Forêt de feuillus mature . . .
- Mature pine forest / Forêt de pins mature . . .
- Young forest / Jeune forêt . . .
- Shrubby wetland / Marécage arbustif . . .
- Open wetland / Marécage . . .
- Upland open country / Terrain ouvert: agricole, non-boisé . . .
- Occupied, urban, other / Terrain occupé, zone urbaine, autre . . .

Map is for Maritime Breeding Atlas work only.

L'usage de cette carte est limité aux activités de l'Atlas des oiseaux nicheurs des Maritimes seulement.

ATLAS DES OISEAUX NICHEURS DES MARITIMES BREEDING BIRD ATLAS

NOVA SCOTIA NOUVELLE-ÉCOSSE

BIRD STUDIES CANADA ÉTUDES D'OISEAUX CANADA

Apr 13, 2006

20LQ83 *Nouvelle-Écosse* **Caribou Lake** *Nova Scotia* **Region 19 Région**

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Species list for square 20LQ83 (number of entries returned: 71)

Region	Square	Species	Breeding Evidence				Point Counts			
			Max BE	Categ	#Sq	Atlasser Name	#PC	%PC	Abun	#Sq
19	20LQ83	Mallard	FY	CONF	1	Jean-François Jetté				
19	20LQ83	Common Merganser	H	POSS	1	James R. Hirtle				
19	20LQ83	Red-breasted Merganser	FY	CONF	1	James R. Hirtle				
19	20LQ83	Ruffed Grouse	FY	CONF	1	James R. Hirtle				
19	20LQ83	Common Loon	NE	CONF	1	Barry Sabean				
19	20LQ83	Spotted Sandpiper	P	PROB	1	Lucas Emmett Berrigan				
19	20LQ83	Mourning Dove	T	PROB	1	James R. Hirtle				
19	20LQ83	Barred Owl	T	PROB	1	Peter Hope				
19	20LQ83	Long-eared Owl	S	POSS	1	Suzanne M Borkowski				
19	20LQ83	Northern Saw-whet Owl	T	PROB	1	Peter Hope				
19	20LQ83	Common Nighthawk	D	PROB	1	2 participants				
19	20LQ83	Ruby-throated Hummingbird	T	PROB	1	James R. Hirtle				
19	20LQ83	Belted Kingfisher	T	PROB	1	James R. Hirtle				
19	20LQ83	Yellow-bellied Sapsucker	FY	CONF	1	James R. Hirtle				
19	20LQ83	Hairy Woodpecker	T	PROB	1	James R. Hirtle				
19	20LQ83	Northern Flicker	FY	CONF	1	James R. Hirtle				
19	20LQ83	Pileated Woodpecker	T	PROB	1	James R. Hirtle				
19	20LQ83	Olive-sided Flycatcher	S	POSS	1	2 participants				
19	20LQ83	Eastern Wood-Pewee	T	PROB	1	James R. Hirtle				
19	20LQ83	Yellow-bellied Flycatcher	S	POSS	1	3 participants				
19	20LQ83	Alder Flycatcher	T	PROB	1	James R. Hirtle				
19	20LQ83	Least Flycatcher	T	PROB	1	James R. Hirtle				
19	20LQ83	Blue-headed Vireo	NB	CONF	1	James R. Hirtle				
19	20LQ83	Red-eyed Vireo	T	PROB	1	James R. Hirtle				
19	20LQ83	Gray Jay	FY	CONF	1	James R. Hirtle				
19	20LQ83	Blue Jay	T	PROB	1	James R. Hirtle				
19	20LQ83	American Crow	S	POSS	1	Blake Maybank				
19	20LQ83	Common Raven	FY	CONF	1	Jean-François Jetté				
19	20LQ83	Tree Swallow	AE	CONF	1	James R. Hirtle				
19	20LQ83	Barn Swallow	AE	CONF	1	James R. Hirtle				
19	20LQ83	Black-capped Chickadee	CF	CONF	1	Lucas Emmett Berrigan				

19	20LQ83	Boreal Chickadee	P	PROB	1	Lucas Emmett Berrigan				
19	20LQ83	Red-breasted Nuthatch	FY	CONF	1	Lucas Emmett Berrigan				
19	20LQ83	Winter Wren	FY	CONF	1	Jean-François Jetté				
19	20LQ83	Golden-crowned Kinglet	FY	CONF	1	Jean-François Jetté				
19	20LQ83	Ruby-crowned Kinglet	T	PROB	1	James R. Hirtle				
19	20LQ83	Eastern Bluebird	AE	CONF	1	James R. Hirtle				
19	20LQ83	Veery	S	POSS	1	James R. Hirtle				
19	20LQ83	Swainson's Thrush	T	PROB	1	James R. Hirtle				
19	20LQ83	Hermit Thrush	CF	CONF	1	James R. Hirtle				
19	20LQ83	American Robin	CF	CONF	1	Lucas Emmett Berrigan				
19	20LQ83	Gray Catbird	S	POSS	1	Suzanne M Borkowski				
19	20LQ83	European Starling	H	POSS	1	James R. Hirtle				
19	20LQ83	Cedar Waxwing	T	PROB	1	James R. Hirtle				
19	20LQ83	Ovenbird	T	PROB	1	James R. Hirtle				
19	20LQ83	Black-and-white Warbler	T	PROB	1	James R. Hirtle				
19	20LQ83	Nashville Warbler	S	POSS	1	3 participants				
19	20LQ83	Common Yellowthroat	A	PROB	1	James R. Hirtle				
19	20LQ83	American Redstart	T	PROB	1	James R. Hirtle				
19	20LQ83	Northern Parula	CF	CONF	1	James R. Hirtle				
19	20LQ83	Magnolia Warbler	CF	CONF	1	James R. Hirtle				
19	20LQ83	Bay-breasted Warbler	H	POSS	1	James R. Hirtle				
19	20LQ83	Blackburnian Warbler	T	PROB	1	James R. Hirtle				
19	20LQ83	Chestnut-sided Warbler	CF	CONF	1	James R. Hirtle				
19	20LQ83	Black-throated Blue Warbler	T	PROB	1	James R. Hirtle				
19	20LQ83	Palm Warbler	CF	CONF	1	Jean-François Jetté				
19	20LQ83	Yellow-rumped Warbler	CF	CONF	1	2 participants				
19	20LQ83	Black-throated Green Warbler	CF	CONF	1	James R. Hirtle				
19	20LQ83	Canada Warbler	A	PROB	1	James R. Hirtle				
19	20LQ83	Chipping Sparrow	S	POSS	1	Suzanne M Borkowski				
19	20LQ83	Song Sparrow	FY	CONF	1	James R. Hirtle				
19	20LQ83	Swamp Sparrow	T	PROB	1	James R. Hirtle				
19	20LQ83	White-throated Sparrow	P	PROB	1	James R. Hirtle				
19	20LQ83	Dark-eyed Junco	FY	CONF	1	James R. Hirtle				
19	20LQ83	Common Grackle	T	PROB	1	James R. Hirtle				

19	20LQ83	Purple Finch	FY	CONF	1	Lucas Emmett Berrigan				
19	20LQ83	Red Crossbill	H	POSS	1	Suzanne M Borkowski				
19	20LQ83	White-winged Crossbill	H	POSS	1	Suzanne M Borkowski				
19	20LQ83	Pine Siskin	H	POSS	1	Jean-François Jetté				
19	20LQ83	American Goldfinch	T	PROB	1	James R. Hirtle				
19	20LQ83	Evening Grosbeak	T	PROB	1	James R. Hirtle				

Disclaimer: Data contained in these summaries are provisional data that have not necessarily been reviewed or edited, and may be subject to significant change. These data have been released for public interest only. If you wish to use the data in a publication, research or for any purpose, or would like information concerning the accuracy and appropriate uses of these data, read the data use policy and request form, or contact the Atlas, at telephone: 1-866-528-5275, e-mail: atlasmaritimes@gmail.com. **These data are current as of 23 Aug 2023 .**