Opportunities for improving human and ecosystem health through recreation in nature

The Western Common Wilderness Common

Penelope Kuhn

Plan 6000
Dalhousie School of Planning
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All maps and images were created by P. Kuhn unless otherwise stated.

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Table of Contents

Executive Summary

In Canada, less than 20% of adults and 10% of children and youth are getting the recommended amount of daily physical activity (ParticipACTION, 2015). Concurrently, the amount of sedentary indoor recreational screen time is exceeding recommended guidelines (ParticipACTION, 2015). Considerable research now shows that outdoor activity in natural environments benefits human mental and physical health (Berman *et al.*, 2012; Louv, 2008, p159; Moore, 2014; Taylor, Kuo, & Sullivan, 2001) and the ecosystem (Chawla, 2009; Louv, 2008, p150; McCurdy, Winterbottom, Mehta, & Roberts, 2010). Accordingly, the federal, provincial, and regional levels of government are moving to increase peoples' connection to nature through recreation (CPRA, 2015; Government of Nova Scotia, 2015; G. Gallagher, Active Living Coordinator for Halifax, personal communication, February 1, 2016).

Richard Louv, who created the term 'nature-deficit disorder', and other leaders in the field suggest that creation of spaces that foster interaction with nature need to be incorporated into community plans (Louv, 2008, p151; Moore, 2014; Chawla, 2015). Such spaces should encourage un-programmed hands-on learning experiences for children and families rather than systematic knowledge-based teaching of nature (Louv, 2008, p151). Two ways to foster such experiences are through interpretation and natural playscapes. Interpretation is concerned with how appreciation and understanding of objects, artifacts, landscapes or sites can be communicated in interesting and exciting ways (Ham, 1992; Veverka, 1998, p20). Natural playscapes offer opportunities for hands-on interaction, providing a rich unstructured learning space (Keeler, 2008, p16), where children and families can develop environmental literacy. Both types of experiences can deepen connections to the natural environment and instill a sense of environmental stewardship, which benefits the ecosystem in the long-term (Chawla, 2009; Louv, 2008, p150; McCurdy *et al.*, 2010).

Halifax is creating a new nature trail around Nichols Lake. Phase 1 of the *Western Common Wilderness Common (WCWC) Master Plan*. The *Master Plan's* guiding principles are founded in environmental sustainability and recreation: to uphold both ecological and recreational connectivity and water quality (EDM, 2010, p73). This site offers opportunities for improving ecosystem and human health through interpretive programming for the new trail and nature-based play at the adjacent Prospect Road Community Centre (PRCC). This project represents first steps toward these goals: an interpretive plan for the WCWC Phase 1 initiative, and proposed nature-play locations and design assessments for the PRCC. Principles derived from best practice reviews guide the work.

Interpretation literature by leaders in the field establishes that in order to enhance users' experiences interpretation must have a relevant theme, be organized and enjoyable. A key technique for increasing interpretation's relevance is to make it personal; this can be achieved by drawing upon universal concepts related to natural processes, emotions or ideas.

This interpretive plan focuses on water quality, paying tribute to the WCWC's history as Halifax's back up water supply in the 1950s. The importance of water to all living organisms lends itself well to universal concepts (i.e. life, thirst) and one of the objectives of this project: to spark or strengthen peoples' connection to the landscape and evoke a sense of environmental stewardship. A suggested theme statement is, *Are you thirsty? You won't survive longer than a week without water.* The site's natural history, and specific site resources related to water, create the interpretive plan's backbone. Geology, hydrology, soils, and habitat types are described and interpretive sub-theme topics for 19 identified site resources are recommended. Future interpretive programming can focus on one of three more prevalent sub-theme topics: glaciation, how plants drink water, and water energy environments. Another approach is to have an eclectic interpretive program incorporating numerous sub-theme narratives under the over-arching subject of water. Interpretive programming examples are provided for two site resources. A range of interpretive services (i.e. brochures, signs, guided hikes) is described, as are next steps such as partnering with outside organizations and creating a budget.

Nature-based play experts use design principles to create sensory-rich environments that encourage movement, elements critical to healthy child development. Numerous ingredients can be incorporated into play areas to achieve this: water, sand, plants, hills, pathways, open spaces, and sound.

Four sites around the PRCC have potential to be nature-based play areas with these kinds of ingredients. Site and design assessments reveal a unique mix of opportunities and constraints for each location. A concept design example was created for the site which already has numerous nature-play ingredients and affords opportunity for inclusive design. The concept features a hand water pump, expanded sand play area, loose-parts play, hillslide, and a significant increase in vegetation amount and variety. Next steps involve considering the site and design assessments together with the community's interests and available funding. An Additional Resources section provides the community with a path forward for nature-play space development.

Document Organization

This document includes three main components: introduction, interpretation and nature-based play. The introduction reviews literature related to nature and health relationships, discusses related movements in planning practice, introduces the Western Common Wilderness Common (WCWC) opportunity site, and outlines the purpose and objectives. The interpretive portion includes a best practice review of interpretive planning and the interpretive plan for the *WCWC Master Plan* Phase 1 nature trail. The final section has a best practice review of nature-based play, and site and design assessments for four locations at the Prospect Road Community Centre.

INTRODUCTION

Nature & Health Relationships
Current Movement in Planning
Opportunity Site
Project Purpose & Objectives




Image Sources: Far left - vigorousgroup.com; Far right - hawaiiintegrativehealth.com

Nature & Health Relationships

In Canada, only 13-19% of adults aged 18-59 and 9% of children and youth aged 5-17 are getting the recommended amount of daily physical activity (ParticipACTION, 2015). Concurrently, the amount of sedentary indoor recreational screen time is exceeding recommended guidelines (ParticipACTION, 2015). This trend is linked to adverse effects on human (Louv, 2008, p3) and ecosystem health (Louv, 2008, p159; Moore, 2014).

Human Health

In Nova Scotia, many youth exceed the two-hour recommended maximum recreational screen time: approximately 50% of grade three, 60% of grade seven and 65% of grade eleven students (Thompson & Wadsworth, 2012). Increased time spent indoors has reduced the amount of time children and youth spend outdoors, which harms physical, intellectual, and emotional wellbeing (Louv, 2008, p3; Tantia, Welch & Lin, 2014). The lack of physical activity is one of the main factors contributing to increased youth obesity rates in Canada, which have tripled since 1975 (OMHP, 2016). The economic costs associated with obesity related diseases in Canada, across all demographics, are estimated to be $6 billion (MGI, 2014); if these trends continue the Canadian healthcare system will not be able to function as it does today (Lee, 2014). Spending time in natural environments has numerous health benefits. It can improve children's resiliency (ability to cope with adversity and stress), abilities to self-regulate (to react in one's long-term best interest) (ParticipACTION, 2015, p8), and can decrease incidence of attention deficit disorder (Taylor, Kuo, & Sullivan, 2001; Taylor & Kuo, 2009). Interacting with nature can improve working memory capacity, has affective benefits (related to mood, feelings and attitude) for those with major depressive disorder (Berman *et al.*, 2012), and may simply lead to overall human happiness (Zelenski & Nisbet, 2014). One study has shown that children living in neighbourhoods that are more 'green' tend to be more active outdoors (Grigsby-Toussaint, Chi, & Fiese, 2011). Another study found that children living within one km of a park were almost five times more likely to be a healthy weight than those who lived further than one km; increased activity in natural environments may decrease the risk of childhood obesity (Potwarka, Kaczynski, & Flack, 2008; McCurdy *et al.*, 2010). Activity levels are twice as high in play areas that use natural elements like logs, stumps, rocks and flowers, compared to more traditional play structures made with metal and plastic equipment (University of Tennessee at Knoxville, 2012). Natural play areas tend to be more challenging. Children of all ages and sizes can engage in appropriate risk-taking activities, essential for holistic growth and development (Little & Wyver, 2008).

Ecosystem Health

Developing a connection to the natural environment can inspire protection of nature and form a foundation for environmental stewardship (Louv, 2008, p150; McCurdy *et al.*, 2010), leading to long-term preservation of biodiversity and improved ecosystem health (Chawla, 2009). The current trend of increased amounts of time spent indoors cuts children off from nature and may cause them to have little concern for the natural world and lack of understanding of human dependency on it (Louv, 2008, p159; Moore, 2014). To counter this trend, curiosity, respect, and attentiveness of nature must be instilled in our youth (Louv, 2008, p151; Chawla, 2009).

Current Movement in Planning

Strategies for Connecting People & Nature

The mounting evidence of nature's benefits to mental and physical health has spurred health care providers to recommend outdoor activity in natural environments such as parks and trails (McCurdy *et al.*, 2010). Several notable organizations are calling for the same 'prescription', including the Centre for Disease Control (McCurdy *et al.*, 2010), and the American Public Health Association (APHA) (Chawla & Litt, 2013). The 2014 APHA policy statement, *Improving Health and Wellness Through Access to Nature*, calls for cross-disciplinary alliances among policymakers, parks departments and planners, and public health practitioners, in order to prioritize access to natural areas for people of all ages, abilities, and incomes (Chawla & Litt, 2013). The National Recreation and Parks Association position statement calls for connecting children and youth to nature, providing education and interpretation about the value of conservation, and coordinating environmental stewardship with public and private groups (NRPA, 2016).

The Canadian Park and Recreation Association (CPRA) (CPRA, 2015), and the Province of Nova Scotia (Government of Nova Scotia, 2015) have outlined *Connecting People with Nature Through Recreation* as a specific goal in their recreation strategies. Both frameworks include objectives related to engaging children and seniors in recreation. Similar to the APHA's call for cross-disciplinary cooperation, the Nova Scotia strategy appeals for coordination between various stakeholders including recreation and planning departments, not-for-profit groups, and the private sector (Government of Nova Scoita, 2015). The frameworks address ecosystem health. For example, in its vision statement, the CPRA strategy states that natural environments should be "…appreciated, nurtured and sustained" (CPRA, 2015, p3).

Canadian Parks & Recreation

Goal 3: Connecting People and Nature

Help people connect to nature through recreation.

Interpretive Planning & Play Spaces

The increasing disconnect with nature can partially be attributed to uninspiring playgrounds and schoolyards and to neighbourhood layouts that limit safe access to natural areas (Moore & Marcus, 2008). Richard Louv, who created the term 'nature-deficit disorder', and other leaders in the field suggest that community plans need to incorporate spaces which foster interaction with nature (Louv, 2008, p151; Moore, 2014; Chawla, 2015). Previous generations took natural play areas for granted; now play areas need to be deliberately created (Moore, 2014). Spaces should encourage un-programmed hands-on learning for children and families rather than systematic knowledge-based teaching of nature (Louv, 2008, p151). Experiences in nature need to be meaningful but not overly structured (Louv, 2008, p151). One way to foster such experiences is through interpretive programming. Interpretation is concerned with enhancing a user's experience and how appreciation of objects, artifacts, landscapes or sites can be communicated in interesting and exciting ways (Ham, 1992; Veverka, 1998, p20). The main aim of interpretation is to make information engaging and meaningful. Interpretation can also change attitudes and behaviour, motivate, and inspire (Veverka, 1998, p20). Freeman Tilden, a pioneer of interpretive planning, taught that landscape interpretation geared toward conservation needs to convey enthusiasm and love of place (Carter, 1997, p3). Media conveying interpretation can include publications, guided hikes, wayside exhibits, or audiovisual programs (NPS, 2016). Elements of successful interpretation are visual aids and hands-on interaction; both greatly improve retention of information (Veverka, 1998, p10). Natural playgrounds or playscapes offer opportunities for such hands-on interaction, providing a rich unstructured learning space (Keeler, 2008, p16), where children and families can develop environmental literacy (Moore, 2014). If designed well, natural spaces such as trails with interpretive plans and playscapes will balance the needs of the ecosystem and the users (CPRA, 2015), foster physical exercise, spark imagination (Moore, 2014), increase knowledge (Veverka, 1998, p10; Keeler, 2008, p16), provide the optimum amount of risky play (Coe, 2016), attract multiple age ranges (Moore, 2014), and nurture environmental stewardship (CPRA, 2015).

Opportunity Site

Halifax Regional Municipality

The region of Halifax offers close to 7000 recreation programs, events and opportunities; while some are outdoor, most are indoors (G. Gallagher, personal communication, February 1, 2016). There is, however, a shift towards more outdoor programming. The national and provincial goal of *Connecting People with Nature Through Recreation* will influence new policy being drafted in Halifax within the coming year (G. Gallagher, personal communication, February 1, 2016). Key Halifax recreation deliverables for 2015/16 include provision for "… Unstructured Play Opportunities" and "… Opportunities for Senior and Youth Interaction" (Halifax, 2015, p7).

Western Common Wilderness Common

Halifax is creating a new nature trail around Nichols Lake as Phase 1 of the *Western Common Wilderness Common (WCWC) Master Plan* implementation (Figure 1). Development of the WCWC as a regional park is phased over 60 years and when complete will be one of the largest regional parks serving the Halifax Regional Municipality. The *WCWC Master Plan's* guiding principles are founded in environmental sustainability and recreation: to uphold both ecological and recreational connectivity and water quality (EDM, 2010, p73). Unlike some park plans, the *WCWC Master Plan* does not mandate interpretation beyond the identification of these guiding principles. Development of an interpretive plan built upon one or more of these principles will therefore fill this gap and foster an understanding and appreciation for the natural environment at the site.

A community access point to the new trail is located at the Prospect Road Community Centre (PRCC) (EDM, 2010, p85). Currently all recreation programming at the PRCC focuses indoors (J. Morissey, PRCC staff, personal communication, February 11, 2016). The community centre does have a traditional outdoor play structure for younger children, but the centre's executive director and operations manager have expressed desire for the addition of a natural play space to increase outdoor recreation opportunities (P. Ullman and A. Hockin, personal communication, March 4, 2016). Natural play spaces are gaining popularity throughout North America, including Nova Scotia. The city of Halifax recently constructed one at Sir Sandford Fleming Park.

Because the new trail is located at the PRCC, where there is little outdoor recreation, this site affords an ideal location to fulfill national and provincial goals of connecting people with nature through recreation and the region-specific directives of providing opportunities for unstructured play and senior/youth interaction. The combination of a new trail with interpretation and a natural play space will engage users of all ages in outdoor nature-based recreation where they can reap the associated health benefits. These opportunities could spark or deepen peoples' connection to the landscape, evoking a sense of environmental stewardship.

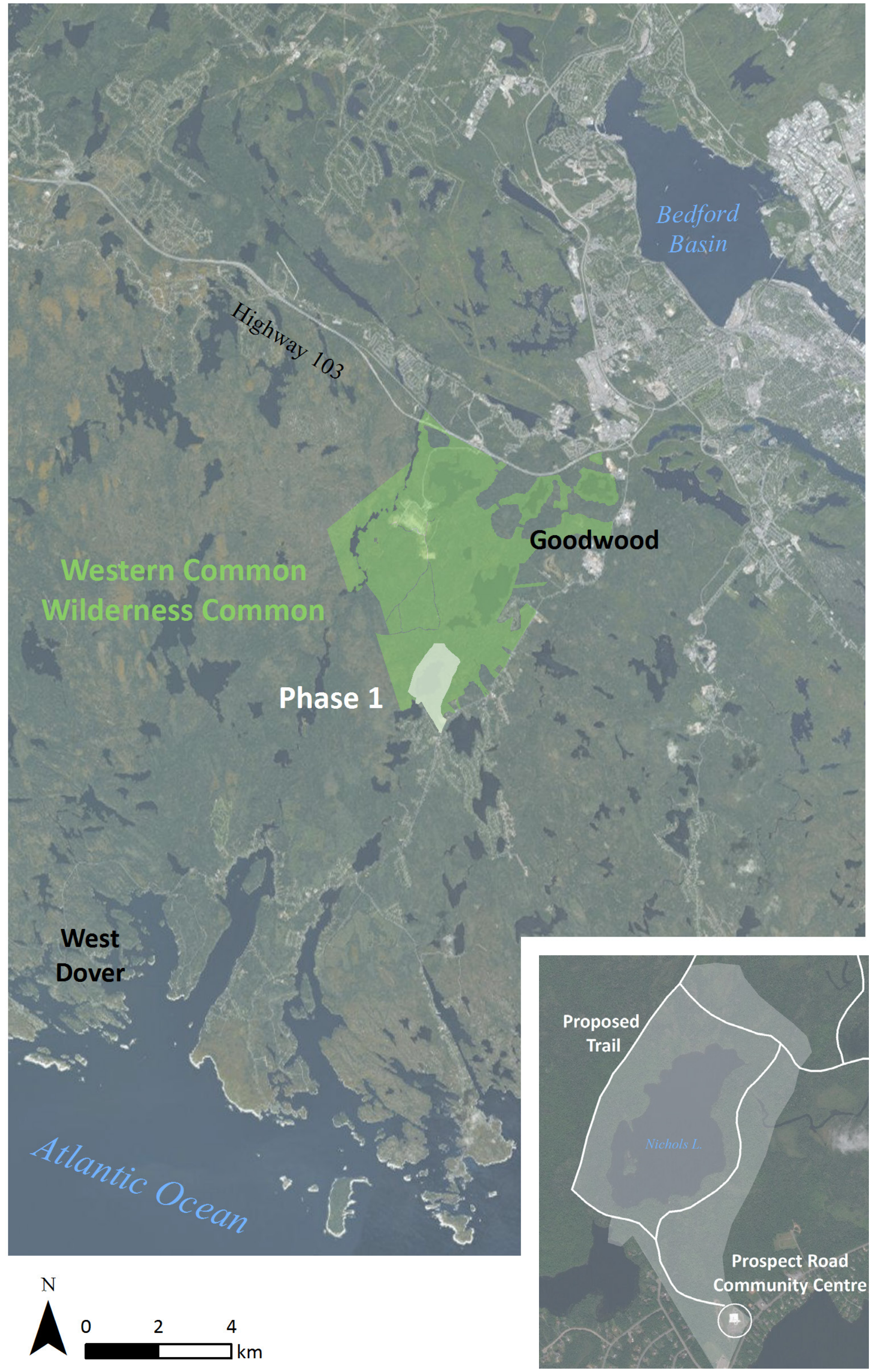


Figure 1 Location of the Western Common Wilderness Common (WCWC) with inset map showing the Phase 1 trail as proposed in the *WCWC Master Plan*.

Data is from the WCWC Master Plan (EDM, 2010) and the background image is from ESRI.

Project Purpose & Objectives

Capitalize on opportunities for improved ecosystem and human health through an interpretive plan for a new nature trail at the Western Common Wilderness Common and a site and design assessment for nature-based play at the adjacent Prospect Road Community Centre. Objectives are threefold:

1. Identify best practices regarding interpretive planning and the design of natural play spaces that promote recreation in nature and environmental stewardship for all ages; use best practices to guide objectives two and three.

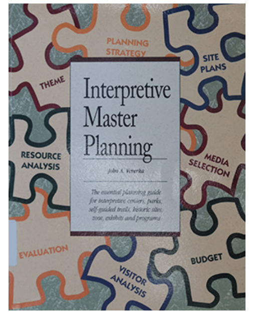
2. Evaluate site opportunities for Phase 1 of the *WCWC Master Plan* and area surrounding the Prospect Road Community Centre (Figure 1).

3. Foster recreation in nature and environmental stewardship for all ages by creating an interpretive plan for the Phase 1 initiative based upon the *WCWC Master Plan's* guiding principles, and propose site location(s) and design requirements for a natural playscape at the Prospect Road Community Centre.

INTERPRETATION

Best Practice Review of Interpretive Planning

Two seminal books by leaders in interpretive planning, *Interpretive Master Planning* (1998) by Veverka and Ham's *Interpretation – Making a difference on purpose* (2013) direct the approach of the WCWC Phase 1 interpretive plan.



Interpretive Master Planning outlines pioneer interpretive planner Freeman Tilden's fundamental principles of interpretation, explains a planning process model, and describes how to plan self-guided trails. These three aspects of interpretive planning are summarized below.

Tilden's Fundamental Principles

Interpretive-style communication reveals information and tells a story; this differs from informational-style communication, which only conveys facts. The interpretive style of communication is appropriate at recreational learning environments such as historic sites, parks, and forests, where people's primary reason for visiting is likely for recreation, not interpretation. Freeman Tilden's interpretive principles reflect this interpretive style of communication and include the following:

- **Provocation** is the main aim of interpretation; it should be used to hold a visitor's attention.
- Interpretation needs to **relate** information to the visitor in a personal or experiential way; this can be achieved through metaphors and analogies.
- Interpretation should attempt to present a **complete picture** rather than a portion; a unifying theme should form the backbone.
- Through interpretation, knowledge is revealed to the visitor in **unique and memorable** ways.

The Interpretive Planning Process

Over a period of twenty years Veverka developed an interpretive planning process model useful for large or small planning projects (Figure 2). This model includes six phases (p32):

1. What
The theme to be interpreted

2. Why
The objectives of the interpretation

3. Who
The site visitors and how they relate to the theme(s)

4. How/When/Where
The location(s) for interpretation and appearance of interpretation services/media (i.e. signs, guided tour)

5. Implementation & Operations
The costs of implementing the plan

6. So What
The evaluation of interpretation which ensures objectives are being met

The six phases are presented below in a slightly modified fashion.

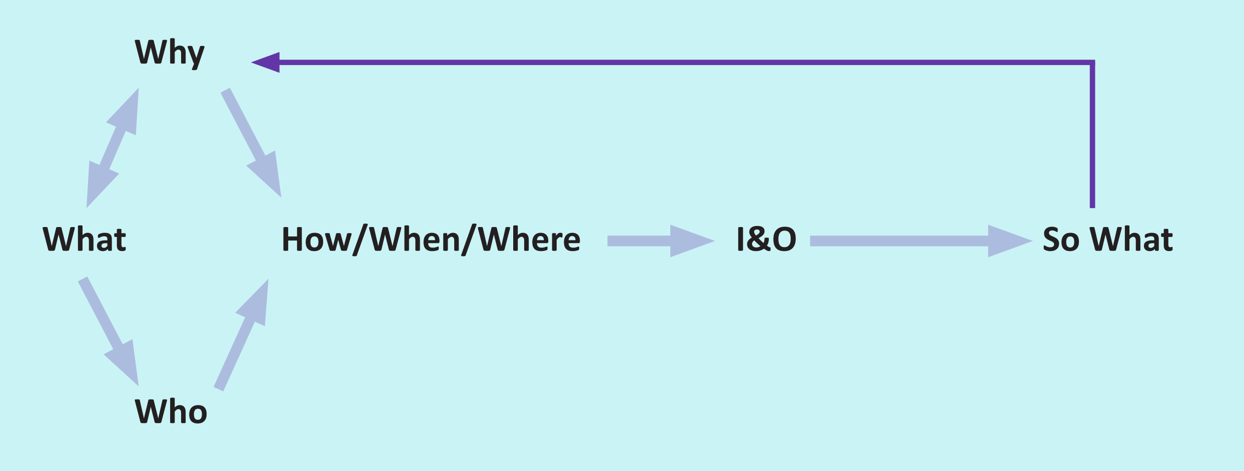


Figure 2 Veverka's interpretation planning process model. I&O = Implementation & Operations.
Image source: Veverka (1998, p32) - recreated by P. Kuhn

1. What – Complete a site inventory of potential resources in order to develop an interpretive theme and sub-themes. Depending on the site this can include biological, geological, cultural and sensory information, available facilities and orientation areas. Themes contain one central idea and are both purposeful and interesting; they are not just names of topics. For example: 'The multiple use of the forest benefits people and wildlife.' (p40); 'Exploring caves is a sensuous experience.' (p41); and, 'There are many ways you can help protect this historic park.' (p.41).

2. Why – Develop a clear set of objectives. Objectives are layered with an overarching objective for the site and nested specific objectives for individual stops/locations within the site. When developing objectives consider why a visitor would want to know something and how the visitor is to use the information they are gaining. There are three basic objective types: learning, emotional, and behavioural. Learning objectives are the most prevalent; emotional and behavioral objectives are not always present. Learning objectives involve visitors retaining some knowledge from their interpretive experience. Emotional objectives evoke strong feelings within visitors to help them remember the interpretive theme. For example, 'The majority of visitors will be surprised and amazed to see how the forest landscape has changed since being totally logged over in the 1920s to become the lush, green landscape they see today.' (p47). Emotional objectives are a pre-requisite to generating behavioural objectives that involve visitors altering their behaviour based on their interpretive experience. For instance, 'The majority of visitors will treat all of our site resources with a sense of respect and stewardship.' (p46).

3. Who – Understand visitor demographics and gear interpretive material to their interests. Determine visitation patterns on diurnal and seasonal time scales to understand when a site or service is in highest demand. Knowledge of where visitors are coming from (or not coming from) can help with marketing strategies.

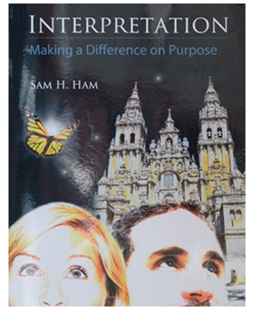
4. Where – With potential interpretive locations identified, decide which to develop sub-themes about. Sub-themes relate back to the overall theme of the sites interpretive plan. During this planning stage consider the types of interpretive media to use. Justification as to why a particular location or media type is appropriate happens during this stage of planning.

5. How – Create a budget for interpretive plan implementation and operation. This planning stage will help determine project phasing, as well as prioritize interpretive locations and media to use.

6. Why (revisited) – Establish evaluation metrics to determine if plan objectives established in the earlier 'Why' phase are being met. Evaluation techniques can include interviews, surveys, and direct observation. Once evaluated, make recommendations about how to improve the interpretive experience if objectives are not being met. It is best to perform such evaluation before interpretive media is formalized.

Planning Self-guided Trails

Self-guided trails are a common form of interpretation at outdoor sites such as forests and parks, especially if staff constraints prohibit guided walks and hikes. Self-guided trails are more likely to be used if they are near amenities already used by visitors. Initially, the best media to use for self-guided trails is a brochure. Brochures are cost-effective, can be created relatively quickly, and can be used to test and fine-tune the interpretation. Later, other media forms can be explored, such as permanent signs. All forms of interpretive media should be visually rich and avoid lengthy sections of text. Keeping text to ~50 word is ideal. Prompts in the text such as, 'look for', and 'touch the' can be used when appropriate to engage users.



Building on the interpretive planning fundamentals outlined by Veverka (1998), Ham's *Interpretation – Making a difference on purpose* (2013) details a 4-tiered model of interpretive planning that includes principles related to organization and enjoyment. The model delves into the psychology behind successful interpretation. Successful interpretation holds the attention of a noncaptive audience, transfers information, and provokes thought. Ham's term 'noncaptive audience' is analogous to audiences found in recreational learning environments as described by Veverka.

Four-Tiered Interpretation Planning Model

Four qualities of Ham's interpretation model are **Theme, Organized, Relevant and Enjoyable (TORE).** Although theme and relevance are included in Veverka's model, Ham's discussion offers a deeper understanding of the psychology behind interpretive-style communication.

Theme & Relevant

Relevant themes must be meaningful or personal to the audience. In order for something an audience sees or hears to be meaningful it needs to remind them of something they already know. Metaphors, contrasts and analogies can be used in this context and to improve understanding of difficult or foreign concepts. For example, 'The internal plumbing system of an active volcano works just like a pressure cooker and an agitated bottle of champagne.'(p127). For an audience to care about interpretive material it needs to connect to their values, beliefs, well-being, or family. In 2003, the US National Park Service started using universal concepts to make their interpretive material more personally relevant to their audience. Universal concepts are significant to everyone and include concepts related to natural processes, emotions and ideas. Interpretation themes that can be linked to universal concepts are intrinsically interesting. A theme example which uses the universal concept of life and death is, 'If you were an ancient Maya [sic], being clever was often more important than being strong, especially if you wanted to stay alive.' (p126).

Organized

Organization in the TORE model states that interpretation will be more successful when an audience requires minimum effort to understand it. This principle is used by mass media experts and can be expressed as a formula:

$$\textbf{Probability that a noncaptive audience pays attention} = \frac{\textbf{Reward}}{\textbf{Effort}}$$

Noncaptive audiences are not required to spend time and effort to understand interpretive information; it must therefore be easy to follow. The information being conveyed should be kept manageable. Based on studies of memory capability no more than four main ideas should be used (Klingberg, 2009; Cowan, 2001). Limiting the amount of information makes it easier to understand and provokes thought.

Enjoyable

Successful communication must be enjoyable. Paying attention to the interpretive material must be mentally pleasing. This can be achieved by presenting information in an informal manner (i.e. not like in a traditional classroom). This aspect of interpretation varies greatly according to the media used for communication. For instance, publications with alluring titles and colorful illustrations, or audiovisual programs with background music, not only the narrator's voice, are more likely to attract attention and be enjoyable. Some ways to make technical information more enjoyable include exaggerating size or timescale, linking science to stories about people, using personification, and telling a story by focusing on a fictitious individual. An example of the latter would be to, 'Follow the journey of an individual grape from growth on the vine to harvest to fermentation to bottling, and decades later when the bottle is opened to commemorate a special event.' (p48).

The best practices described here are used to guide the interpretive plan for the Western Common Wilderness Common Phase 1 initiative.

Interpretive Plan for the WCWC Phase 1 Initiative

Introduction

The Western Common Wilderness Common (WCWC) spans 8,000 acres, and contains six lakes connected via the Prospect River. It is west of downtown Halifax on the Chebucto Peninsula. In 2010 the Halifax Regional Council adopted a master plan for the region. The plan is phased over 60 years. When completed the WCWC will be one of the largest regional parks serving the Halifax Regional Municipality (HRM). Several other significant tracts of wilderness surround the WCWC: a large parcel of crown land lies to its west; Long Lake Provincial Park to the east; and, the protected Terrance Bay Wilderness Area to the southeast. The large size and central location of the WCWC makes it ecologically important; in addition to supporting many native species (EDM, 2010, p37), movement of wide ranging animals such as mainland moose, brown bear, and the great horned owl are facilitated (EDM, 1999, p24). The centrality of the WCWC makes it a key link for recreation trails throughout the Chebucto Peninsula (EDM, 1999, p11). The WCWC's extensive waterways permit water recreation via canoe and kayak from the northern border of the WCWC to the Atlantic Ocean (Figure 3; EDM, 2010, p135).

In the 1950s, when Chain Lake was the main water supply to the City of Halifax, the WCWC area was the backup supply. Because of their close proximity to headwaters, the lakes in the WCWC were pristine. The Common ceased being the backup in the 1970s when Lake Pockwock became the primary supply (EDM, 2010, p20). With its history of stewardship and limited development, water quality in the WCWC remains high (EDM, 2010, p20). The WCWC's central location on the Chebucto Peninsula and water supply history inspired the *WCWC Master Plan's* guiding principles of upholding water quality and both recreational and ecological connectivity.

Phase 1 of the WCWC, currently underway, will create a wilderness trail around Nichols Lake (Figure 1). The trail will be open during all seasons. The main trailhead is located adjacent to the Prospect Road Community Center (PRCC). The trail will benefit communities within the service area of the PRCC, from Goodwood to West Dover, and all of HRM when the WCWC becomes a regional park (Figure 1). Currently, the PRCC attracts citizens ranging from pre-school aged children to seniors (S. Jollimore, personal communication, September 14, 2016).

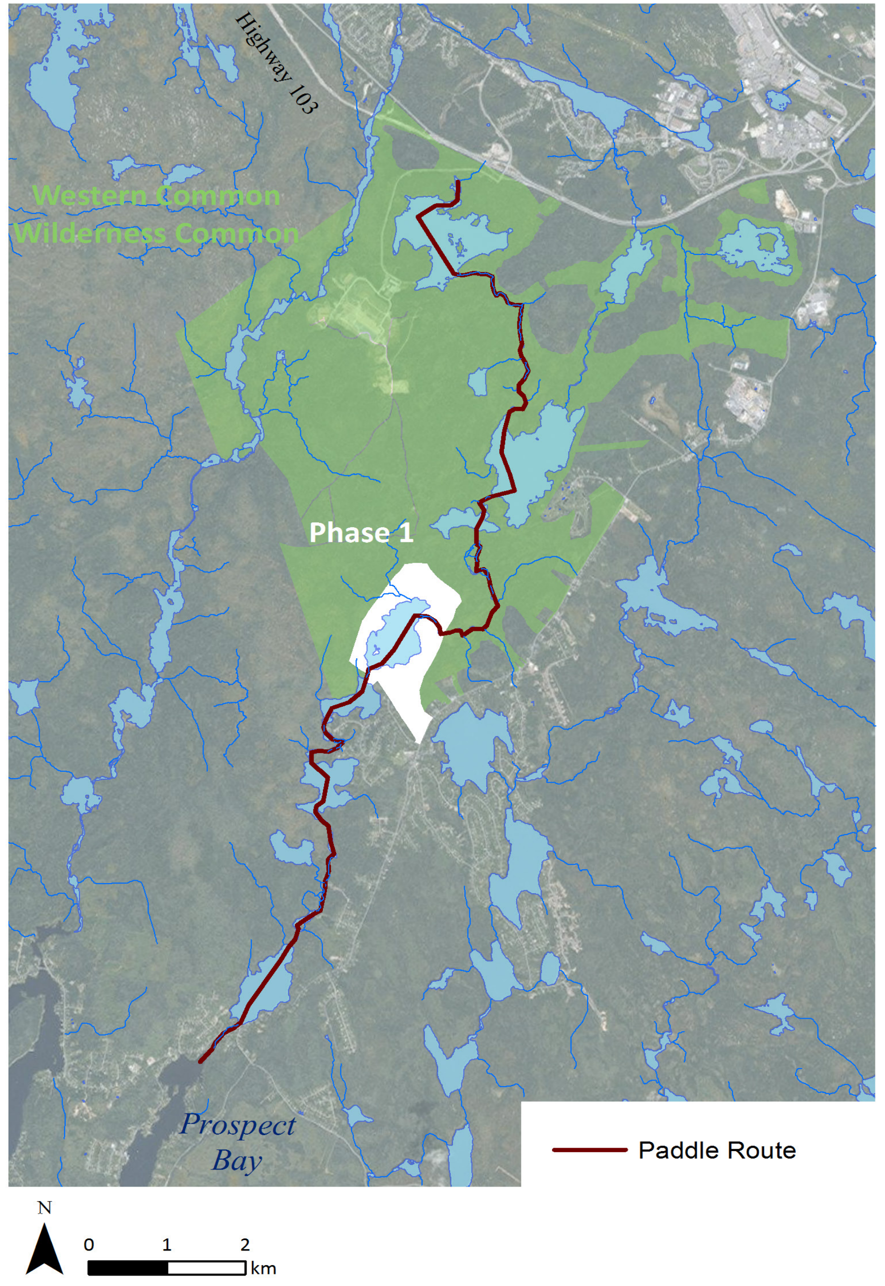


Figure 3 Paddle route identified within the *Western Common Wilderness Common Master Plan*. The route goes through Nichols Lake.

Data is from the WCWC Master Plan, the background image is from ESRI.

Interpretive Theme & Objective

The *WCWC Master Plan* guiding principle related to water quality is the topic upon which interpretation is built. The importance of clean water to all living organisms supports one of the objectives of this project: fostering environmental stewardship. The specific objective of this interpretive theme is to help visitors deepen their understanding and connection to the natural environment through an appreciation of water.

An example of a captivating theme statement that draws upon universal concepts of life, death and thirst, bringing relevance to the topic is,

Are you thirsty? You won't survive longer than a week without water.

This theme statement would appear at the trailhead or beginning of an interpretive paddling route and can be combined with several types of information suitable for the start of an interpretation experience in the Nichols Lake area (refer to example on facing page and associated objectives). This example is meant to engage a wide range of age groups, with a focus on children. A water molecule character is introduced at the beginning of the interpretation and will be present throughout the interpretive program.

Water
Molecule
Character

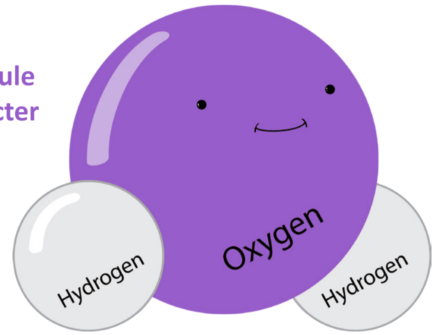
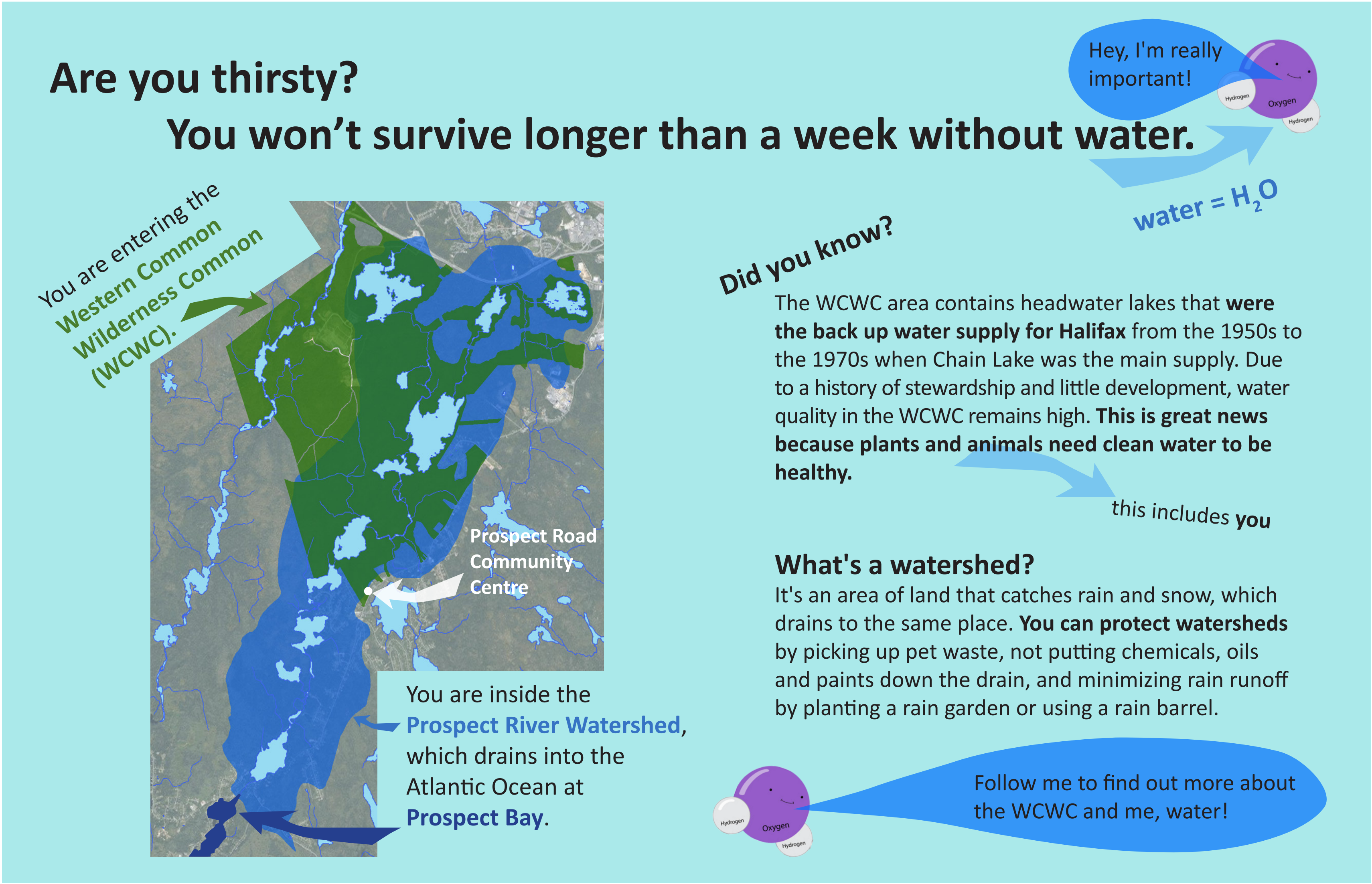


Image source: null-entropy.com



Data sources: NS Dept. of Environment; EDM (2010); ESRI *Image source: Water molecule - null-entropy.com* *References: EDM (2010); houselogic.com*

Learning objective – Most visitors will understand what a watershed is and the water supply history of the site.

Emotional objective – Most visitors will understand their intrinsic connection to and dependence on the natural environment and clean water.

Behavioural objective – Most visitors will think and act more carefully about how they are impacting their watershed.

Natural History & Site Description

Geology and Hydrology

Bedrock on the Chebucto Peninsula consists of granite, a hard impermeable crystalline rock. From the late Devonian Period (ca. 370 mya), the granite is part of the South Mountain Batholith, the largest granite formation within the northern Appalachians (Shellnutt & Dostal, 2015), extending from the Chebucto Peninsula to Yarmouth (NS, 1996a, p26). Repeated glaciation during the last two million years altered the landscape throughout the province by widening narrow valleys and depositing glacial material (NS, 1996a, p65). This glacial material, called till, consists of non-sorted sediments, including erratics (large boulders), drumlins (elongated hills) and ground moraine (thin widespread deposits with gently sloping knolls or plains) (Flint & Skinner, 1974, p209). Ground moraine derived from granite bedrock tends to be a thin layer consisting of angular stones and pebbles (NS, 1996a, p65). The area surrounding Nichols Lake consists of stony ground moraine (Figure 4) and contains numerous granite erratics derived from the South Mountain Batholith.

Freshwater drainage patterns are closely tied to the underlying geology. Across Nova Scotia these patterns developed primarily after the Tertiary Period and are therefore no older than 1.6 my (NS, 1996a, p53). Generally, water flows with gravity into areas of weakness such as faults and soft material. Standing (lentic) surface water such as lakes and wetlands form when there is an interruption of drainage (NS, 1996a, p157). Most lakes in Nova Scotia are glacial lakes, formed by water pooling in basins that had been scoured out by glaciers or by till that blocked original drainage pathways (NS, 1996a, p158). Southwest Nova Scotia has more lakes than the north because of underlying relatively impermeable bedrock. There is more permeable sedimentary and basalt rock in the northern part of the province (NS,

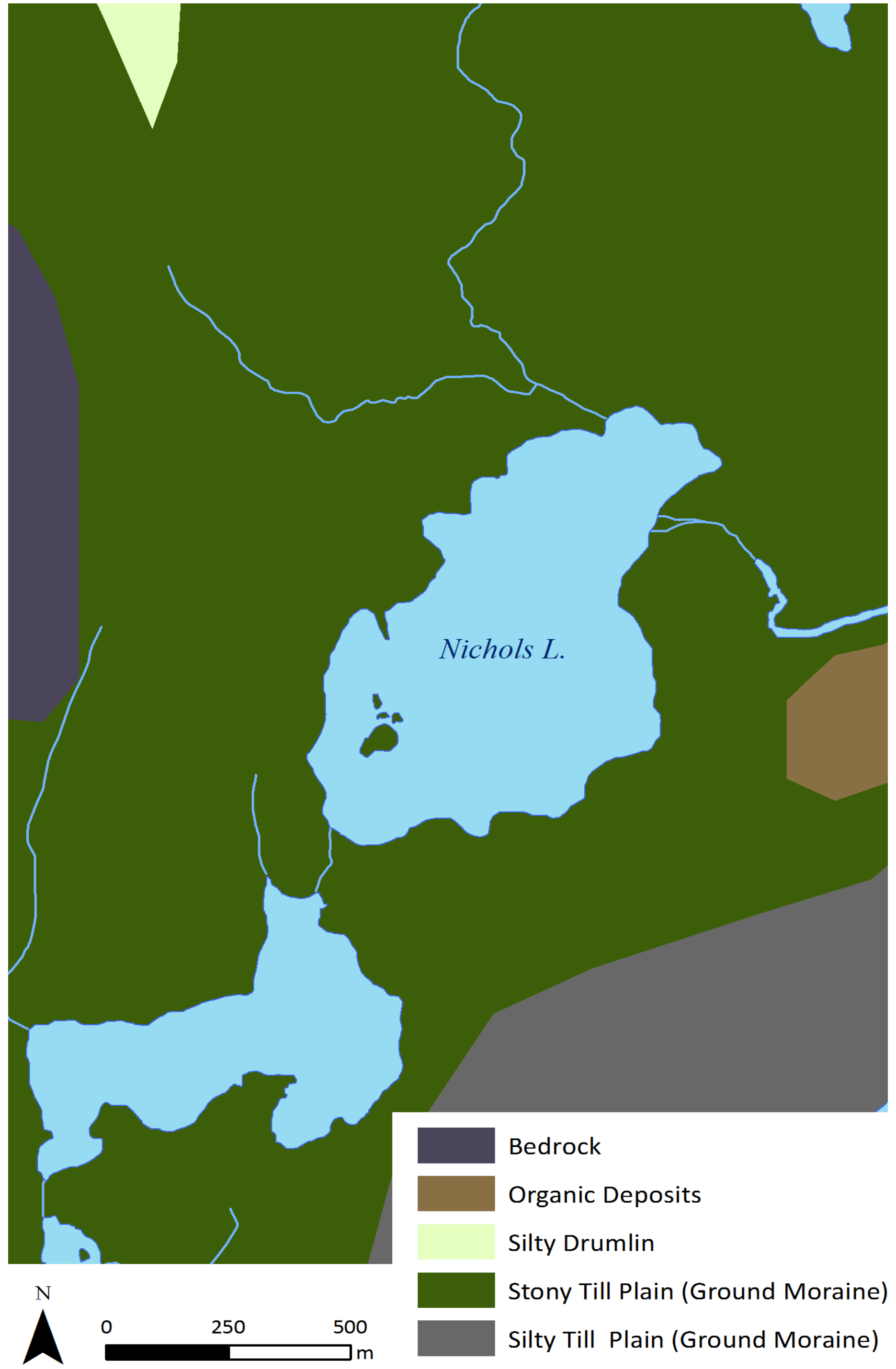


Figure 4 Surficial geology around Nichols Lake.

Data is from NS Open Data.

Figure 5 WCWC lakes, wetlands, and Prospect River form a deranged drainage pattern and sit in the Prospect River Watershed, which drains into the Atlantic Ocean via Prospect Bay.

Data is from NS Dept. of Environment and Halifax Open Data.

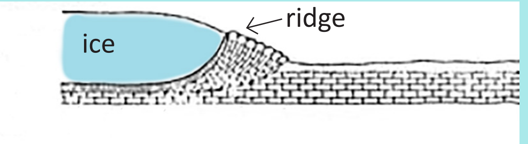
1996a, p157). In addition to granite's impermeability, it tends to have few joints. Water therefore sits on its surface in a disorganized array of streams lakes and wetlands. This disorganized arrangement is referred to as a deranged drainage pattern (NS, 1996a, p53).

Most lakes within the WCWC drain into the Prospect River, part of the Prospect River Watershed (Figure 5), which reaches the Atlantic Ocean at Prospect Bay. The drainage pattern is deranged (Figure 5; EDM, 1999, p19). Drainage of ground moraine varies with its thickness, topography, composition (clay/sand/stone), and permeability of bedrock underneath (NS, 1996a, p67). Wet areas mapping around Nichols Lake indicates a range of well to poorly drained areas (Figure 6). Ice-thrust ridges (see sidebar) can impede drainage; they appear along the east shore of Nichols Lake. Erosion of ice-thrust ridges may account for the beaches around Nichols Lake.

Running water (lotic) in streams and rivers begins in headwater areas from springs or lake outlets (NS, 1996a, p160) and has different energy environments. The speed water travels depends on the slope of the land; moving faster in steep areas and slower in level areas. Fast-moving water carries higher amounts and larger particles of sediment due to increased erosion rates. Sediment consists of sand, silt, or mud. As water slows sediments are deposited, larger sediments fall out first, resulting in sorting (NS, 1996a, p160). Water flow rates vary seasonally; they are four times higher in spring and winter than in summer (NS, 1996a, p161). Geological obstacles can cause waterfalls where water picks up speed and energy; the stream or river is referred to as rejuvenated at this point. Rejuvenated streams are common along the Atlantic Coast of Nova Scotia (NS, 1996a, p161). The Prospect River passes through two different energy environments just prior to entering Nichols Lake: a wetland and then a waterfall (Figure 5).

Ice-thrust Ridge

- Floating ice is pushed by wind.
- Lake deposits and beach gravel are pressed onto the banks forming ridges.



Reference: Fairbridge, 1968
Image source: Fairbridge (1968) - modified by P. Kuhn

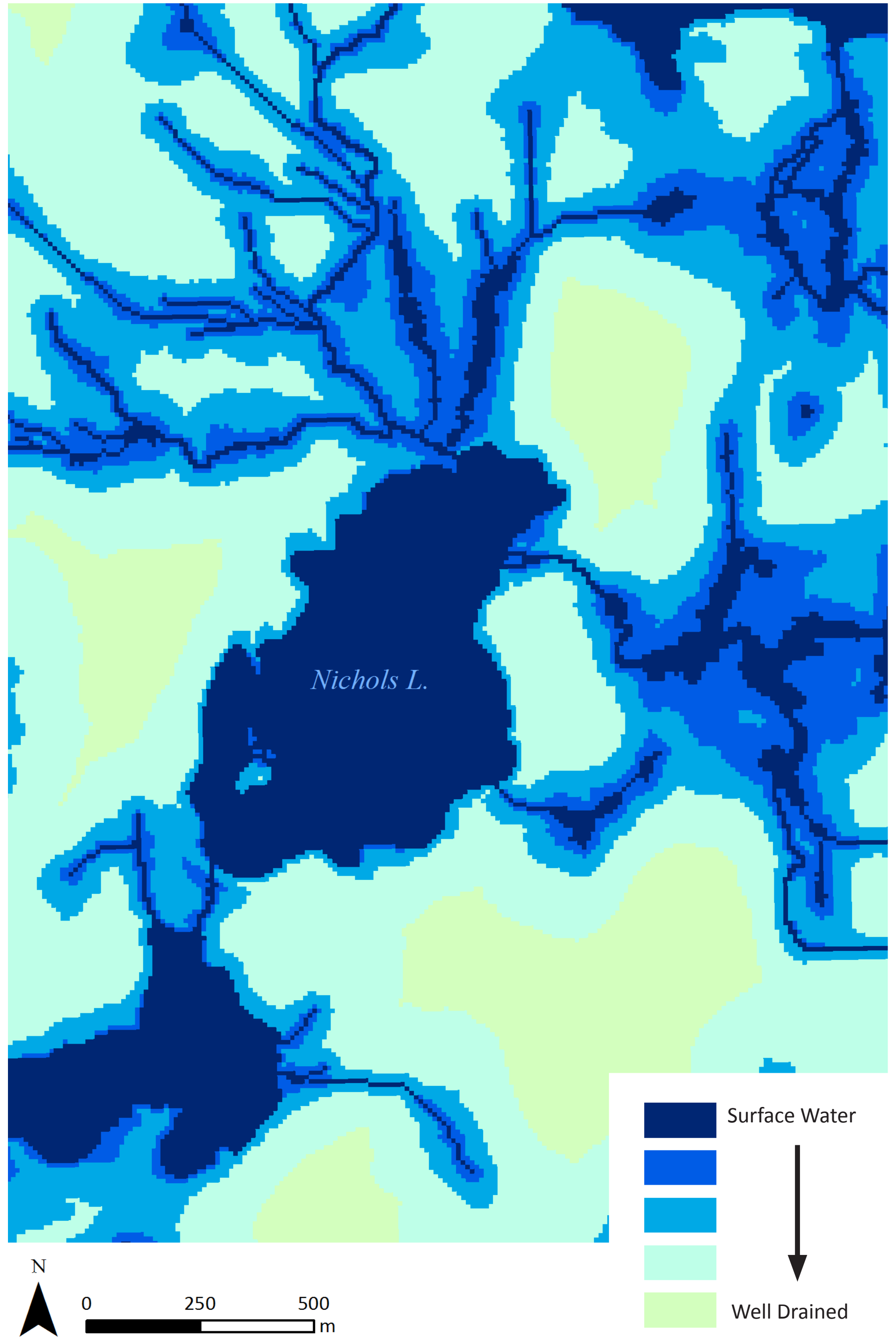
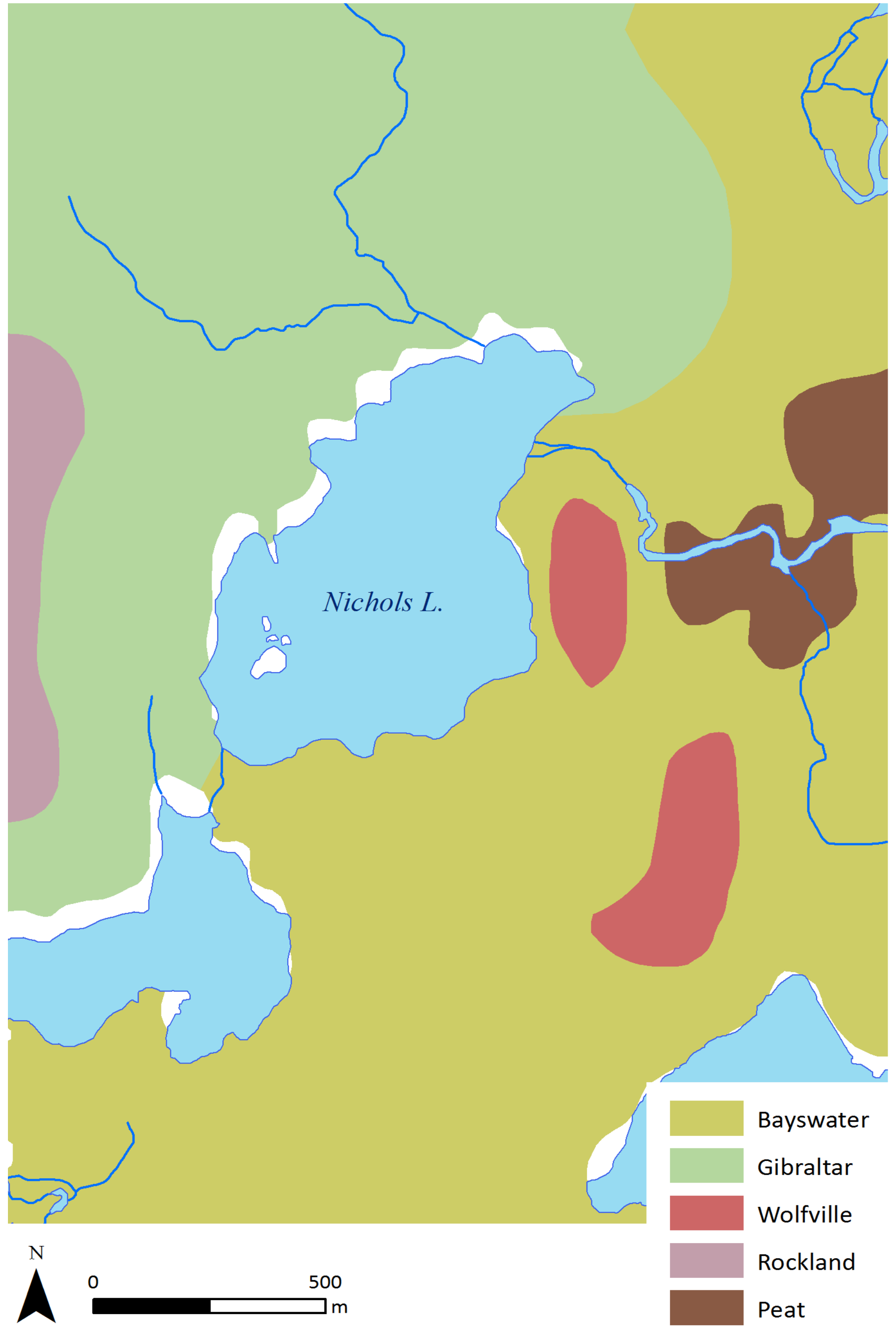


Figure 6 Wet area mapping around Nichols Lake showing areas with surface water to those well drained.

Data is from NS Dept. of Natural Resources.

Figure 7 Soil formations around Nichols Lake.

Data is from Halifax Open Data.



Soils

Soils are composed of mineral and organic material, water, air, and living organisms. Factors such as parent material (which is mostly derived from granite in the WCWC), climate, and organisms interact over time to give soils different characteristics (NS, 1996a, p176). Around Nichols Lake there are two major soil types: Gibraltar on the west side and Bayswater on the east (Figure 7). Smaller deposits of Wolfville are found east of Nichols Lake (Figure 7). Wolfville soils are derived from an unknown parent material that may have been left undisturbed by the last glaciation; glaciers don't always erode previous deposits (NS, 1996a, p65). Gibraltar soils are coarse in texture, well drained, generally shallow, and acidic (pH <5.6) (EDM, 1999, p13; Government of Canada, 2013). Bayswater soils are similar to Gibraltar but tend to be deeper (EDM, 2010, p153). Wolfville soils consist of sandy clay and are deeper than Bayswater, having developed over thicker amounts of glacial till (EDM, 1999, p13-14). Areas with thick soils in the northern part of the WCWC were farmed in the nineteenth and early twentieth centuries (EDM, 2010, p29). Peat deposits, derived from organic parent material, are located east of Nichols Lake in wetlands (Figures 7, 8).

Terrestrial Habitats

Pre-glaciation vegetation in Nova Scotia developed over millions of years and likely consisted of shade-tolerant (trees that don't require direct sunlight to regenerate) deciduous and mixed coniferous forests, not unlike today's forests (NS, 1996a, p85). The Wisconsin glaciation, which began ~85,000 years ago, eliminated all of Nova Scotia's vegetation. Once the ice retreated, tundra vegetation consisting of small vascular plants (e.g. shrubs, grasses) and nonvascular (e.g. bryophytes) came to dominate the landscape (see sidebar about nonvascular plants). This occurred between 10,000 and 7,300 years ago through the process of succession - a natural process where species change over time. The next successional stage brought fir, birch, and spruce trees, followed by pine, oak, hemlock, and beech (NS, 1996a, p85).

Just as a parent material influences soil type, soil type and moisture influences the distribution of plant species. Climatic variables (i.e. availability of light, water and temperature), natural and anthropogenic disturbances, and successional stage also play a role (EDM, 2010, p32). Poorly drained soils contain species such as black spruce, and larch. Red and sugar maple, oak, and white and yellow birch grow in well-drained soils. Imperfectly drained soils host species such as white and red spruce, fir and pine (NS, 1996a, p195). The WCWC is at the boundary of two distinct geographic regions: the Atlantic Coast Granite Barrens and the inland Granite Uplands (NS, 1996b, p.ix). The WCWC's proximity to the coast results in milder winters and cooler summers than are experienced further inland. In general, the WCWC is cool and wet (EDM, 1999, p14). Natural disturbances include wind, fire, disease, and insects, while anthropogenic influences involve vegetation removal, watercourse alterations, and introduction of invasive species. In the WCWC there is evidence of disturbance from fire, wind (e.g. from Hurricane Juan), the brown spuce longhorn beetle, and agriculture (EDM, 2010, p34). For the last ~60 years there hasn't been any forest cutting in the WCWC, producing an even aged stand of mature to over-mature 60-80 year old spruce and fir trees (~80% of forest) with ~20% shade-intolerant hardwoods (trees that need direct sunlight to regenerate) consisting mostly of red maple (EDM, 1999, pii; EDM, 2010, p33). The balsam fir and red maple would have come in when large openings allowed enough light for them to thrive. The absence of tree removal has resulted in an intact riparian zone - interface between a stream and land - a buffer that has helped maintain water quality (EDM, 2010, p37).

The main forest type in the WCWC, present around much of Nichols Lake, is a Spruce/Balsam Fir/Red Maple Forest (Figure 8; EDM, 1999, p15).[1] This forest type is found on well to imperfectly drained soils and has an open overstory of black spruce, balsam fir and red maple. Much of the balsam fir is over-mature and dying. The understory has regeneration growth of the same tree species, especially balsam fir, and shrubs such as lambkill and witherod. Ground cover is a well-developed layer of Schreber's, bazzania, sphagnum and broom mosses, plus liverworts.

Another forest type present throughout the WCWC, and around Nichols Lake, is a deciduous forest type: Red Maple/White Birch/Balsam Fir/Spruce + other hardwoods Forest (Figure 8; EDM, 1999, p17). This type of forest is found in well-drained areas that have thicker soils, commonly found on upper slopes of hills. The stand of this forest type around Nichols Lake is over top of the Wolfville soils (Figure 7). The dominant overstory species are red maple, white birch and balsam fir. Spruce and yellow birch may be present as well. The understory includes balsam fir and red and black spruce trees and shrubs such as Canada blueberry, late lowbush blueberry, and witherod. The ground vegetation varies between stands but can include knight's plume moss, bunchberry, goldthread and several fern species.

A less common type of forest is the Spruce/Red Maple/Balsam Fir Forest; it is found along lake edges and is present on the eastern shore of Nichols Lake (Figure 8; EDM, 1999, p16). This particular stand contains some large red spruce trees that may be over 150 years old. Other overstory trees are red maple and a few white and yellow birch. The understory features balsam fir, and red and black spruce trees. The ground cover has patches of moss and liverwort and vascular plants such as wild sarsaparilla and goldthread.

Barrens are another terrestrial habitat found scattered within the WCWC (EDM, 1999, p18). Barrens occur in well-drained locations where the bedrock is close to the surface or the till is very stony, often on hilltops. Tree overstory consists of sparse black spruce and red maple. The shrub layer is well developed containing lambkill, late low-bush blueberry, huckleberry, rhodora, witherod, and reindeer lichen (see lichen side bar). The ground layer is poorly developed with wintergreen, Schreber's moss, and bracken fern. There is a small patch of barrens on the west side of Nichols Lake (Figure 8).

A variety of fauna live in the WCWC forest.[2] A number of mammal species have been documented: the eastern chipmunk, muskrat, beaver, northern flying squirrel, porcupine, snowshoe hare, striped skunk, coyote, white-tailed deer, American black bear, little brown bat and mainland moose. The latter two are classified as vulnerable (EDM, 1999, p23). The extensive riparian zone adjacent to the waterway system within the WCWC provides a travel corridor for wildlife (EDM, 2010, p37). Seventy-six species of bird have been observed, including vulnerable species such as the common loon and northern goshawk (EDM, 1999, p21). Common bird species include several types of owl, hawk, woodpecker, jay, and warbler (EDM, 1999, Table 17). Numerous amphibians and reptiles have been spotted in the WCWC. The following species are forest dwelling but like moist environments and therefore live close to water: American toad, yellow-spotted salamanders, redback salamander, Maritime garter snake, northern redbelly snake, eastern smooth green snake, and northern ringneck snake (EDM, 1999, p23).

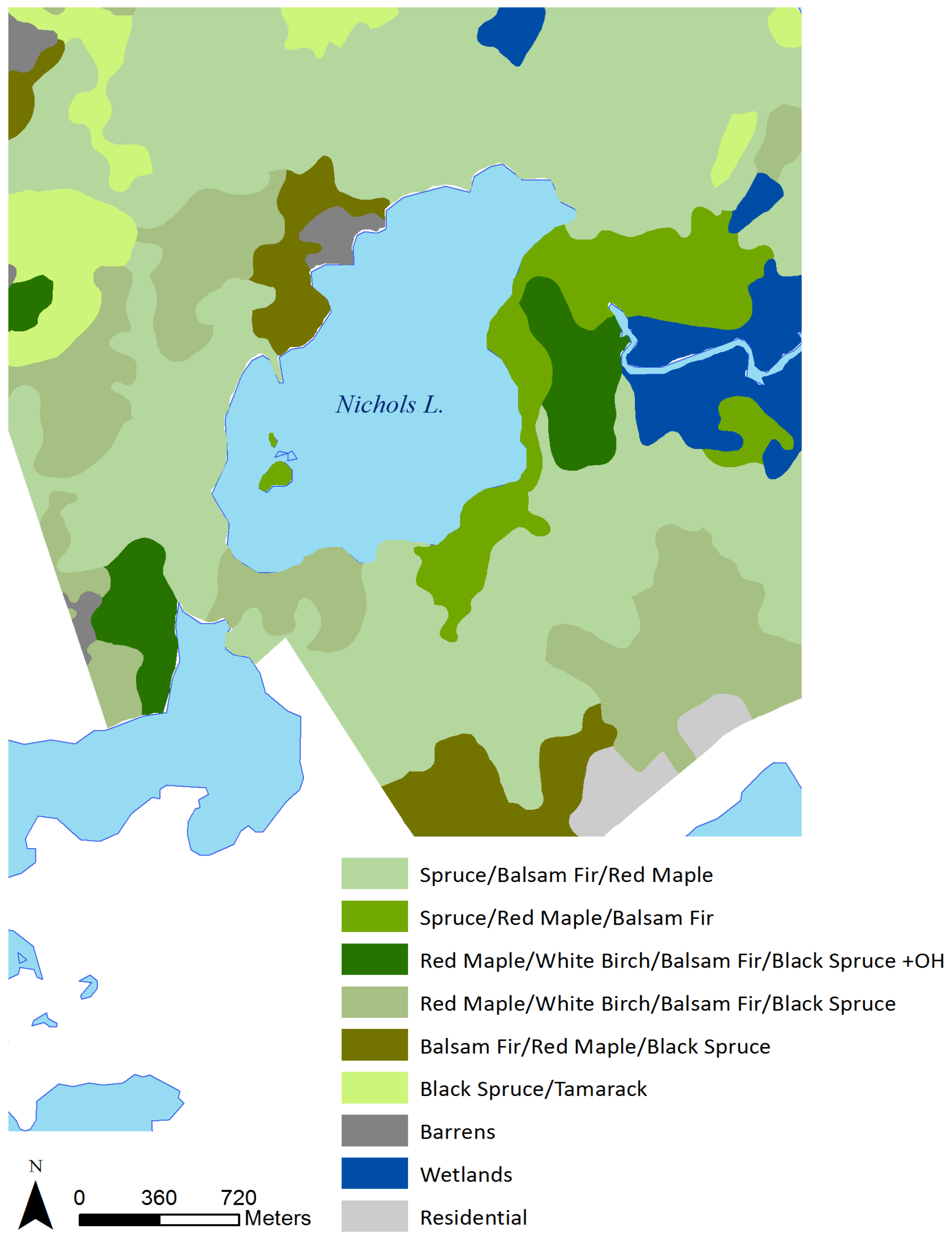


Figure 8 Habitat types around Nicoles Lake. OH = Other Hardwood.

Data is from EDM (1999).

Opportunities for improving human & ecosystem health

Vascular Plants

- Trees and flowering plants that have vascular vessels to transport food (phloem) and water (xylem).
- Roots anchor the plant and soak up water from a distance (varies with species).

Grass and Coniferous trees

Nonvascular Plants

- Small plants (bryophytes) without infrastructure to transport water or food long distances.
- Bryophyte types consist of mosses, liverworts and hornworts.
- Lack roots but use rhizoids, small hairs, to anchor plant.
- Found in moist environments where they can absorb water from the air.
- There are about 25,000 species and are found throughout most of the world.
- Play an important part in regulating humidity levels within an ecosystem because of their ability to absorb and retain water.
- Phytoplankton are also nonvascular, absorbing water from their surroundings.

Moss

Hornwort

Liverwort

Phytoplankton

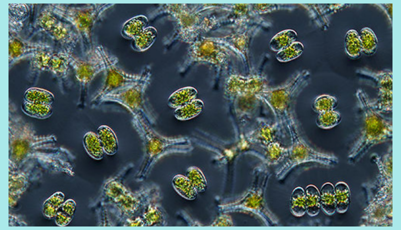


Image sources: Hornwort - ucmp.berkeley.edu; Phytoplankton - Petr Znachor, brphyscoc.org

Reference: Krosnick & Indoe (n.d.)

Wetland Habitats

Over geologic time lakes become wetlands as organic and inorganic sediments accumulate through the process of succession (NS, 1996a, p159). Wetlands are defined as land saturated with water for part of the year. Typically wetlands have poorly drained soils and plants that grow partially or completely submerged – hydrophytic plants (NS, 1996a, p170). Wetland development is contingent upon the topography, climate, bedrock, soil types, amount of flooding, and nutrient load of the incoming water. In Nova Scotia most wetlands are peatlands and occur where the water table is high or the surface water flow has been obstructed (NS, 1996a, p170). There are five general wetland classes: bog, fen, marsh, swamp and shallow water (NS, 1996a, p171).

The area surrounding Nichols Lake contains notable wetlands consisting of bogs and fens (Figure 8). Smaller wetlands are likely to occur in many low-lying areas not mapped (EDM, 2010, p31). Bogs are nutrient-poor mossy peatlands that form in basins with limited drainage (NS, 1996a, p448). Fens are nutrient-rich peatlands found along edges of lakes and streams (NS, 1996a, p453). Five categories of bogs and fens appear in the Nichols Lake area.

Basin Bog

Basin bogs are found in poorly drained depressions. A sparse tree canopy of black spruce and tamarack is common. Typical shrubs include lambkill and bog lambkill with ground cover of reindeer lichen, sphagnum moss, deer grass, bake apple and bog goldenrod (EDM, 1999, p20).

Dry Treed Bog

Dry Treed Bogs tend to be older and have a dry hummocky (hilly) surface with a developed tree canopy of stunted black spruce. The shrub layer is well developed containing species such as lambkill, Labrador tea, leatherleaf, witherod, false holly and rhodora. Ground vegetation is dominated by sphagnum moss with patches of bunchberry and bake apple (EDM, 1999, p19).

Wet Treed Bog

These bogs are young with fewer hummocks, which makes them wetter. The flora is similar to that found in a dry treed bog with a few differences. In the shrub layer rhodora is absent but black crowberry and huckleberry are present. In the ground cover layer deer grass, three-leaved-false-Solomon's-seal, cotton-grass, and sedges are common.

Low Shrub-Dominated Stream Bog

This bog type occurs along the margins of slow streams and is often flooded during high water events. The tree layer contains sparse black spruce and tamarack. The shrub layer is fairly well developed and consists of leatherleaf, sweet gale, Labrador tea, rhodora and lambkill. The ground vegetation varies with the amount of moisture. Moist sites with open shrub layers contain a mat of sphagnum. Dry sites tend to have a thicker shrub layer with scattered patches of sphagnum, sedge and reindeer lichen (EDM, 1999, p19).

Stream Fen

This wetland type has sparse tree and shrub layers consisting of black spruce and tamarack, rosemary, sweet gale and rhodora. Ground vegetation contains moderately dense sedges, a carpet of sphagnum moss, pitcher plants and large cranberry (EDM, 1999, p20).

Amphibians present in WCWC wetlands include the green frog, pickerel frog, wood frog, spring peeper, and red-spotted newt (EDM, 1999, p23).

Aquatic Habitats

Lakes and wetlands are home to autotrophic organisms (i.e. those creating energy through photosynthesis), such as phytoplankton and aquatic vegetation. Conversely, streams and rivers are dominated by heterotrophs (i.e. those gaining energy from outside sources) (NS, 1996a, p157).

Lakes within the Chebucto Peninsula, along with most of NS, are categorized as having soft water and low productivity (NS, 1996a, p163). Soft water occurs over hard rocks like granite, contains low levels of calcium and magnesium ions, and is susceptible to acidification (NS, 1996a, p162). Soft water and low productivity go hand in hand, as low levels of dissolved minerals limit the amount of primary productivity that can be supported. Because primary productivity forms the basis of aquatic food webs, lakes in the Chebucto Peninsula cannot support high levels of fish biomass (NS, 1996a, p162).[3] However, there may be some minnow species, eel, killifish and stickleback within WCWC lakes (EDM, 1999, p21). River otter have been recorded within the WCWC (EDM, 1999, p22).

Lichens

- Lichens are a mutualistic symbiotic relationship (i.e. both parties benefit) between algae or cyanobacteria and fungus.
- The algae/cyanobacteria fix nitrogen and provide the fungus with food (carbohydrates).
- The fungus collects moisture and nutrients from the environment and provides an anchor.
- There are two main forms: macrolichens which are leafy and microlichens which are crusty.

Macrolichen

Microlichen

- Some cyanolichen species are sensitive to acid rain and can be used to monitor pollution.
- The cyanolichens *Leptogium laceroides* and *Pannaria conoplea* are two such species, and are found in the WCWC (EDM, 2010, p32).
- The WCWC also contains species of Usnea (bearded lichen) which are sensitive to air pollution (sulpher dioxide).
- Lichens tend to be nutrient rich and are associated with a wide array of invertebrate fauna.

Reference: Richardson & Cameron (2004)

[1]The flora and fauna listed within this interpretive plan are based on findings from EDM (1999), which include using field surveys, interviews with naturalists, results of an environmental assessment of Otter Lake Landfill, and existing literature for flora and fauna species. Species of arboreal lichen are present at the site but were not included in the descriptions (EDM, 1999, Appendix A). Fungi were also excluded.
[2]Land and freshwater invertebrates are excluded from the site description but they are an integral part of the ecosystem, widespread and diverse (~15 000 species in Nova Scotia) (NS, 1996a, p288).
[3]Note that Otter and Big Indian Lake are stocked by the province for sport fishing (EDM, 2010, p62).

Site Resources & Sub-Themes

Resources with interpretation potential were identified along the new wilderness trail (the section which has been marked to date), and the waterway along the east shore of Nichols Lake, extending back ~500m along the Prospect River to a prominent wetland (Figure 9). Features along the waterway can be accessed by canoe or kayak. Resource descriptions, potential sub-theme interpretation topics, and the strength of the topic's connection to water are listed in Table 1. Examples of language to use and action prompts are provided. GPS locations of each resource are provided in Appendix A.

Because water is ubiquitous and integral to so many natural processes, a diverse array of sub-theme topics were derived from the site resources (Table 1). Three topics, however, appear more frequently:

Glaciation
(Sites 1, 6, 7, 10, 16, 17),

How plants (and lichens) drink water
(Sites 2, 3, 6, 7, 12, 14), and

Water energy environments
(Sites 6, 7, 13, 14, 18, 19).

Interpretive programming can focus sub-theme development on one of these more dominant topics. Another approach is to have an eclectic interpretive program incorporating numerous sub-theme narratives under the over-arching subject of water. Interpretive programming examples for two of the prevalent topics, glaciation (site resource #1 - an erratic), and how plants drink water (site resource #3 - an uprooted tree with exposed roots and moss), follow. Like the previous interpretation example, these are geared to all ages with a focus on children.

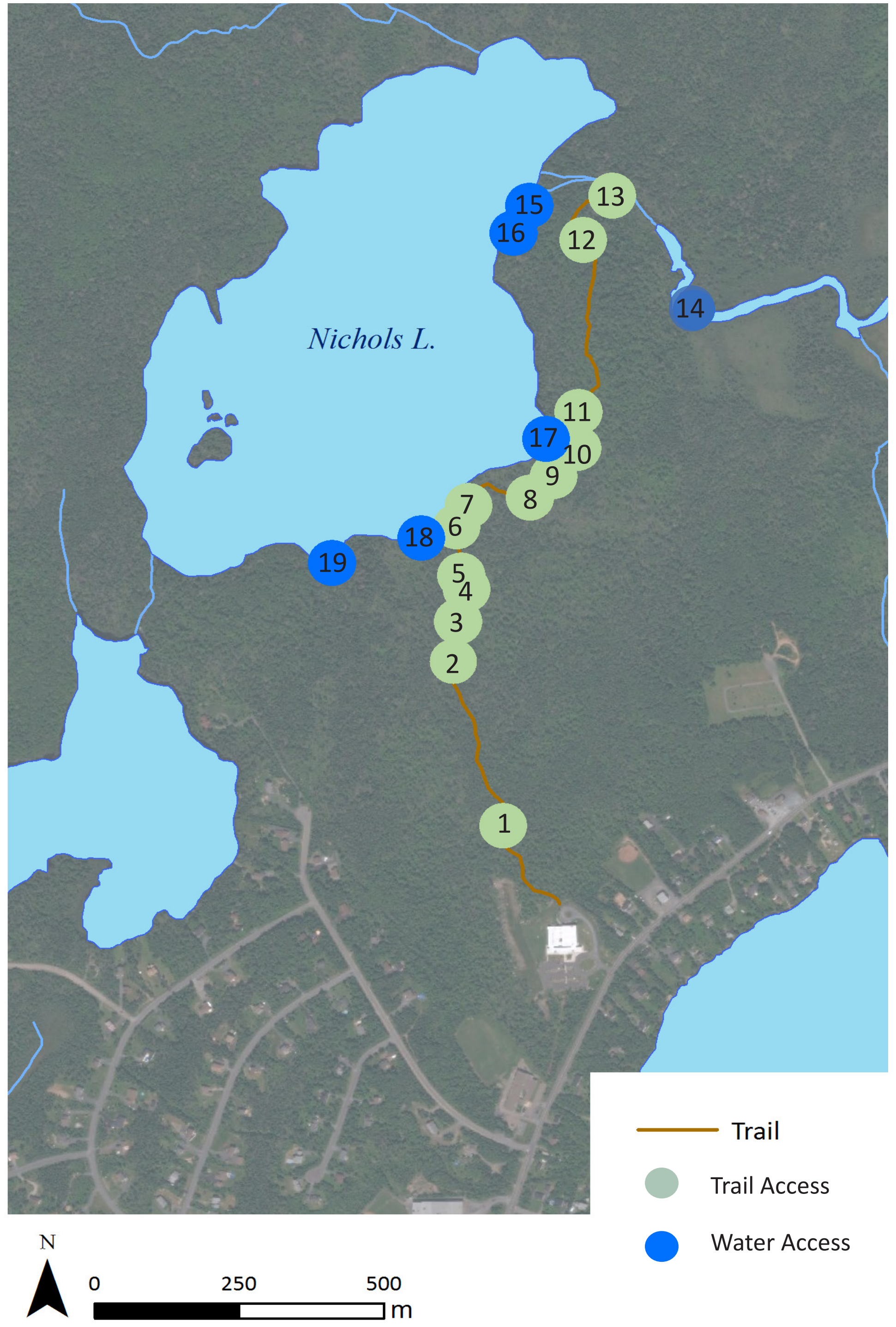


Figure 9 Site resource locations along the new Nichols Lake trail and the WCWC paddle route. GPS locations of each resource are provided in Appendix A.

Background image from ESRI.

Site #	Resource	Potential Topic(s)	Language & Action Prompts
1, 10	Erratic	Wisconsin glaciation; Local surficial geology; Water in solid state	Look out for more erratics. How many can you count along the trail?
2	Elkhorn lichen	What is a lichen?; Symbiosis; Use in pollution monitoring (e.g. acid rain); How lichens drink water	Watch out for more lichen along the trail; it's even hanging from trees.
3, 12	Uprooted tree with exposed roots and moss	How plants drink water (vascular vs. nonvascular)	Which water delivery system is more like yours? Gently touch the moss, how does it feel?
4	Many broken trees, possibly from Hurricane Juan	Natural and anthropogenic disturbances found in the WCWC; Succession	How do you think all these trees broke? What kind of young trees are growing?
5	Snag with woodpecker holes	Animal habitat types; Woodpecker and other bird species in the WCWC	Who do you think made these holes in this snag and why? Can you hear any woodpeckers now? Keep listening for them and other birds.
6, 7	View of Nichols Lake	Glacial lake formation; Deranged drainage; Aquatic habitat; Water energy environments; Lentic environments; How plants drink water	Why is this lake here? Where does this water go? What animals live in the lake?
8	Poorly drained area	Impermeable properties of granite; Soil types and drainage; Water table; Terrestrial habitats	Why do you think the ground is so wet here?
9	Slope incline out of wet and into drier area	Change in soil type, drainage, and vegetation; Terrestrial habitats	Can you spot differences in vegetation along this slope?
11	Hardwood stand	Wolfville soil type and associated changes in vegetation; Terrestrial habitats	What's different about this part of the forest? What are the kinds of big and little trees?
13	Prospect River and waterfall	Riparian corridors and water quality; Water energy environments; Aquatic habitats; Lotic environments	What types of animals do you think travel along riparian corridors?
14	Wetlands	Wetland formation; Wetlands types/ habitats; Wetland succession; Water energy environments; How plants drink water	Can you identify different types of wetlands?
15	Portage sign	Traditional modes of travel	Can you imagine using a canoe as your main mode of transportation?
16, 17	Ice-thrust ridge	Wisconsin glaciation; Process of ice-thrust ridge formation; Water in solid state	Watch out for other ridges along the shoreline. Can you see any signs of the ridges blocking drainage to the lake?
18, 19	Sand beach	Beach formation; Water energy environments	How was this beach created? Pick up some sand; is the texture fine or coarse?

Topic Connection
Weak Strong

Table 1 Resource site locations and descriptions, potential interpretation topics, and examples of language and action prompts.

Opportunities for improving human & ecosystem health

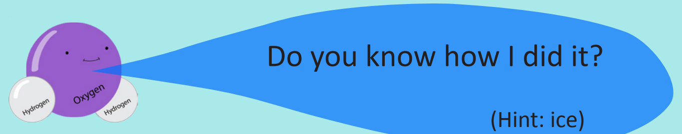
Site Resource # 1 Erratic

The sub-theme, 'Can you move this boulder...WATER can!' engages the audience in a personal way by using the pronoun 'you', and intrigues the reader to continue. There are fewer than 50 words and three main points of information, two of which are supported by visual aids. The interpretation encourages interaction by suggesting the audience watch for and count more erratics along the trail.

Learning objective – Most visitors will understand that water, in the form of a glacier, brought this erratic here and that it is composed of very old granite.

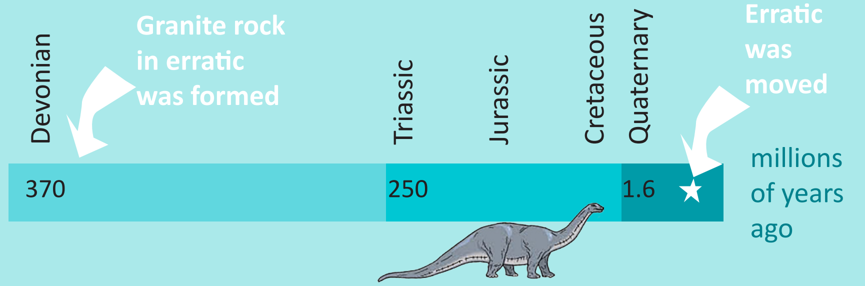
Can you move this boulder... WATER can!

called an erratic



The **Wisconsin glaciation** moved this **erratic** here between 85,000 -12,000 years ago. **The glacier covered all of Canada** and parts of Northern USA.

This erratic is made of granite rock and was formed in the **Devonian Period**, making it older, **much older, than dinosaurs.**



AMAZING FACT

The ice sheet covering Canada during the Wisconsin glaciation was over **3 km thick** in some places! **That's a lot of ice.**

Be on the look out for more erratics along the trail. How many can you count?

Image sources: Glaciation - geocaching.com modified by P. Kuhn; Dinosaur - pinterest.com *Reference: NS (1996a)*

Site Resource #3 Uprooted tree with exposed roots and moss

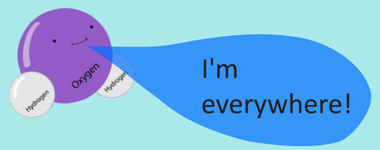
The sub-theme, 'What do trees and your brain have in common... they are both made up of 75% water' makes a personal connection between visitors and trees. Although there are more words than in the previous example, there are only two main points: vascular and nonvascular plants get water in different ways; and, humans also have a vascular-type of transport system. The interpretation encourages interaction by inviting visitors to look for tree roots and specific types of moss, to touch the moss, and to look for other vascular and nonvascular plants along the trail. The format/ layout of this and the preceding example would lend itself well to a brochure or digital media. If digital media is used links to additional resources could be included.

Learning objective – Most visitors will understand the two ways in which plants can get water.

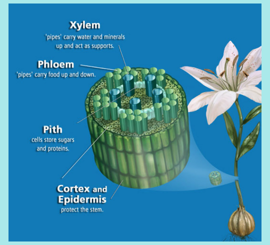
Emotional objective – Some visitors may make an emotional connection to plant life based on the parallels made with the human vascular system and by touching the moss.

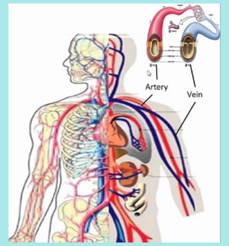
Behavioural objective – Some visitors may treat plant life with more respect.

What do trees and your brain have in common ... they are both made up of 75% WATER.



The similarities don't stop there. Trees and other flowering plants have a **vascular system** for transporting food (phloem) and water (xylem), **just like you have a vascular system for transporting blood** (arteries and veins).



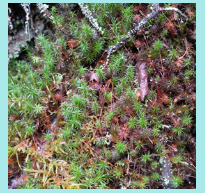


Vascular plants get their water through roots (you can see the roots of this overturned tree). The vascular system can transport water from the roots to the tallest branches and leaves.

Not all plants have a vascular system. A group of plants called **Bryophytes are nonvascular**. **They absorb water directly from the air** and are therefore found in moist environments, like the WCWC.

Bryophytes are mosses, liverworts, and hornworts.

Can you locate these 2 types of moss on this overturned tree?



Hair cup moss

Schreber's moss

Gently touch them, how do they feel?

Bryophytes are small because they don't have a vascular system to transport water or food over long distances.

Can you spot more vascular and nonvascular plants along the trail?

Image sources: Plant vascular - lifeofscience.weebly.com; Human vascular - i.ytimg.com *References: Krosnick & Indoe (n.d.); epa.gov*

Interpretation Services

Interpretive services can be personal, consisting of guided hikes and programming, or impersonal, through the use of interpretive centres, signs, brochures, and other media. Personal interpretation allows face-to-face contact with an interpreter and can be tailored according to group size, composition and abilities (California State Parks, 2013). For example, a group of 20 young children on a walk will have different needs and interests than a small group of teens on a canoe excursion. Impersonal interpretation is always available at a site via permanent signage, brochures (although they need to be stocked), or smartphone technology (Figure 10). The latter may be appealing to younger generations and is immune to vandalism, a concern for permanent signage.

As suggested by Veverka (1998), starting with a brochure style of media is cost effective and allows the interpretive material to be tested. This could be a good starting place for the Nichols Lake interpretive trail. Simple wooden markers with numbers could

identify interpretive locations. However, personal interpretation with its inherent flexibility may be advantageous because of the broad age range of visitors to the PRCC. If financially feasible, interpretive programming tailored for specific user groups could be developed and administered through the community centre.

Given the proximity of the trailhead to the PRCC, a small interpretive kiosk within the centre would complement the interpretive trail. The kiosk could contain informational and interactive panels, resources such as books and maps, and a lending library of backpacks. Backpacks would contain tools for exploration along the trail such as magnifying glasses, note/sketch book, pencil, a trail map, and flora and fauna field guides.

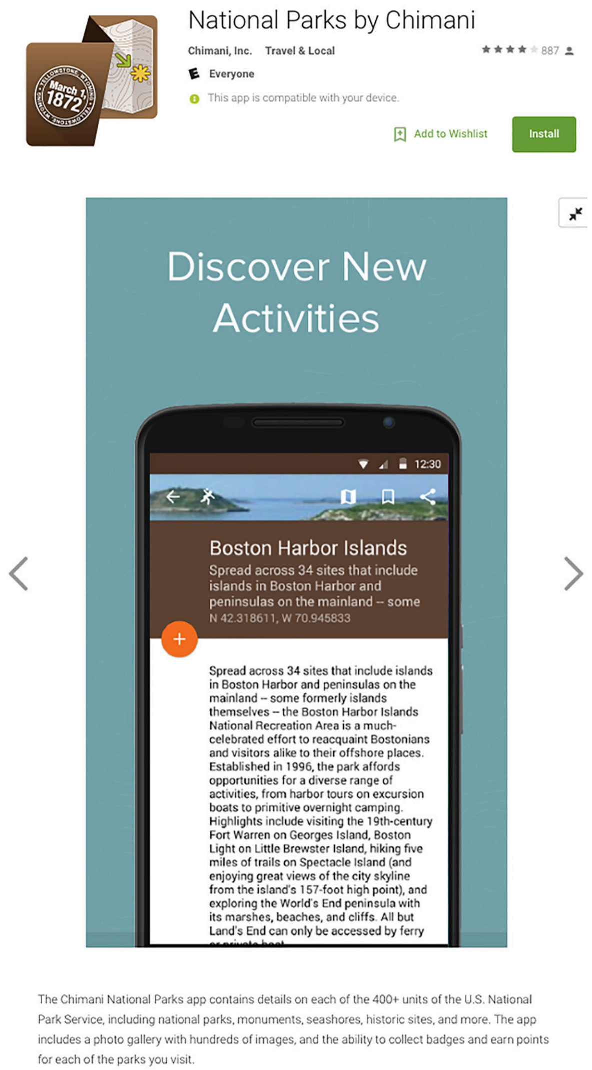


Figure 10 Example of a smartphone app for the US National Park Service. The app includes an interactive map, descriptions and images of park features and links to additional information and resources.

Image Source: Google Play

Next Steps

This interpretation plan provides background information regarding the site's natural history and history as a backup water supply for Halifax. Nineteen site resources are identified along with potential topics that can be interpreted at those locations. The next step will be to determine which sites should be fully developed into sub-themes as shown in the examples for site resources one and three. This step should be done in conjunction with the last two steps of Veverka's interpretive planning process model: *How* and *Why (revisited)*. *How* involves creating a budget, which will help prioritize which interpretation locations and services to use. The *Why (revisited)* phase of the model involves establishing evaluation metrics to ensure that interpretation objective(s) are met. The evaluation step is essential to improving interpreation programming. Recall, the objective of this interpretation plan is to help visitors gain understanding and connect to the natural environment through appreciation of water. Individual interpretation locations have their own set of nested objectives.

To complete these final phases it may be necessary to hire an interpretive designer, interpreter, or to partner with organizations such as the Dalhousie School of Planning, Halifax Parks and Recreation Department, Young Naturalists Club of Nova Scotia, Nova Scotia Trails, Ecology Action Centre, Nova Scotia Nature Trust, and the Nova Scotia Wild Flora Society.

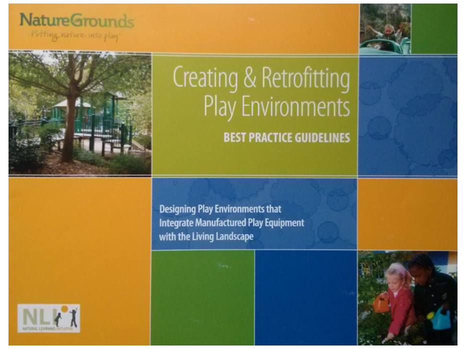
Image source: kevinodes

NATURE-BASED PLAY

Best Practice Review of Nature-based Play Spaces

Publications about nature-based play by the Nature Learning Initiative (NLI) and Rusty Keeler complement each other and guide the site and design assessment of nature-based play at the PRCC. The NLI focuses on environmental design, research and education. Keeler has decades of hand-on experience planning and creating outdoor play spaces.

The NLI is a group based at NC State University in Raleigh, NC, that promotes the importance of children receiving daily exposure to the natural environment. Sections related to research and design principles from two of their publications, *Pathways for Play – Best Practice Guidelines* (NLI, 2010) and *Creating & Retrofitting Play Environments Best Practice Guidelines* (NLI, 2009) are summarized.



Research

The dramatic rise in childhood obesity and related health issues has spurred a revaluation of how outdoor play infrastructure can foster healthy child development. Environments that permit sensory integration are critical to healthy child development. Natural environments are inherently sensory-rich, and those that encourage movement are key, as movement activates the proprioceptive and vestibular sensory systems. The proprioceptive system describes the position of limbs relative to neighbouring parts of the body and the effort used in movement. The vestibular system is responsible for balance and detecting motion and speed; spinning, rocking and moving quickly, can activate it. Stimulation of these and other sensory systems (sight, smell, visual, touch, hearing) lead to healthy development.

Children who play outside are more likely to be self-confident, seek adventure, take healthy risks, and respect nature. Providing opportunities for repeatedly spending time in a landscape can lead to development of an emotional attachment to that place. Research shows that early interaction with nature provides long-term memories and a positive attitude toward the natural environment, which can turn into a lasting environmental ethic. Children aged ~8-12 should be encouraged to extend their independent play territory away from home (i.e. away from parents or caregivers). This expansion of territorial range promotes self-efficacy, which stimulates self-esteem and psychological health. Access to safe pathway systems or play areas should be made available to this age group.

Design Principles

Three main factors should be considered in creating or retrofitting for natural play areas: siting - where it is located in relation to its surrounding; user needs; and, layout or design. Best practice design principles should be considered.

Site Access

- Connect play area to an existing trail or school pathway system.
- Locate the play area close to accessible routes and facilities such as restrooms.
- Connect the play area to local greenways or trails.

Site Topography

- Preserve topographical variation or add it by design.
- Combine topographic features with creative play equipment to inspire socio-dramatic play and physical activity.
- Embed slides into slopes.

Site Surface Drainage

- Create well-designed surface drainage.
- Use innovative solutions such as rain gardens to absorb stormwater runoff.

Site Environmental Protection

- Provide sun protection with placement of play equipment, trees, or pergolas.
- Plant trees strategically in cold climates to block prevailing winds.

Site Mature Trees

- Aim to conserve trees and other significant vegetation.
- Seek professional advice regarding construction adjacent to existing mature trees.
- Consider adding mature trees for shade and aesthetic qualities.

Planting Pockets

- Add pockets of plants to naturalize existing traditional play structures where space is available.
- Plant pockets to act as buffers between pathways and play features or to define boundaries.

Layout Structure

- Design entrances to convey a sense of welcome and express community values (e.g. art work, vine-covered arbour).
- Use creative boundaries to organize the play space; for example, a vegetated chain link fence or pockets of plantings between play structures.
- Use pathways to define circulation patterns, encouraging gross motor movement.

Inclusive Design

- Use natural elements to improve accessibility for those with physical, sensory, social and cognitive special needs.
- Elevate planting systems or sand and water play to improve accessibility for those using mobility devices.

Multigeneration Use

- Arrange play area with adjacent or overlapping age-group territories (early childhood, middle, adolescence, and adult).
- Emphasize dramatic play, sand and water, motor play, music, nature exploration and cozy spots for early childhood spaces.
- Add gross motor play opportunities and open areas for multi-purpose play in middle childhood areas.
- Provide appropriate developmental challenges and allow unsupervised exploration in areas geared toward adolescents. Research shows that female adolescents enjoy natural play areas because they provide opportunities to withdraw from the centre of activity and observe.
- Include comfortable social gathering areas for adults.

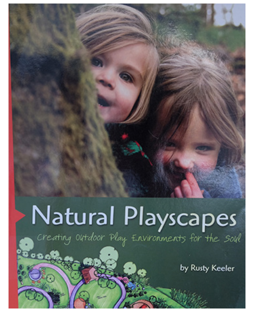
Physical Activity

- Include elements that stimulate physical activity through balancing, spinning, swinging, sliding, and climbing.
- Space play elements far apart to promote running.
- Consider an interconnected and continuous pathway that enables running, chasing, and hide and seek games.
- Connect play space to adjacent areas such as community gardens, trails, and outdoor interpretive education.

Gathering Places

- Consider a multi-purpose open area with seating and a stage, depending on the size, this can be used for special community events.
- Add larger spaces within a natural play space to facilitate outdoor educational activities and after school programs.

The best practices reviewed here are used to guide the site and design assessment for a nature-based play space at the Prospect Road Community Centre.



Natural Playscapes- Creating Outdoor Play Environments for the Soul by Keeler (2008) is a culmination of the authors 20 years' of experience working with communities around the globe planning and constructing outdoor play environments for children. The book discusses the basic ingredients required for natural playscapes.

Ingredients for nature play

Each natural play area will be unique according to the local landscape, available resources, and philosophy of the community creating the space. Several key ingredients should be considered in creating healthy outdoor play and learning areas: areas outside of fences, artwork, water, plants, sound, sand, hideouts, pathways, gardens, hills, open areas, stages, and seating.

Areas outside of fences

For nature-play areas that are enclosed by fences, landscapes extending beyond the boundaries should be taken advantage of. Planned outings to nearby woods, trails, and meadows can increase human-nature contact and inspire new types of exploration and learning. Places outside the fence can provide unique settings for routine activities such as story time.

Artwork

Addition of artwork to outdoor play spaces can inspire creativity on a large scale. Murals, mosaics and sculptures made with natural material lend themselves well to these types of environments. Children will gain a sense of ownership if they participate in the art making.

Water

Properties of water fascinate children and permit hands-on experimentation; from playing with cups and buckets to hand pumping water down a hill into a 'construction' sand pit. Naturally occurring streams and ponds are ideal for exploration. When no natural water source is available adding false creeks or ponds can create water habitats. Freshwater can be brought into play areas by tapping nearby plumbing or simply adding a hose. Safety concerns negate the use of standing water in playscapes.

Plants

Plants engage the senses with their variety of colour, smell, size, and shape; they can also provide shade and food. Plants, including trees, provide 'loose parts' for exploration in the forms of seeds, flowers, fruit and dead branches. Sunflowers and corn are particularly effective in nature play spaces as they are inexpensive and can be used to cover a fence, planted in a square or circle to create a 'house', or planted to create a living labyrinth. Deciduous trees can be planted for shade. Coniferous trees can create natural windbreaks in winter.

Sound

A soundscape can be created in natural play areas by using various materials. Sounds can range from trickling water in a fountain or pond to metallic wind chimes. Large-scale instruments for the outdoors, such as boom drums made from 55 gallon barrels, or a bamboo Marimba with attached mallets allow children to create their own sound.

Sand

The medium of sand naturally fosters imaginative and creative play. Small sand boxes can be used but the more sand the better. Large areas can be delineated using log rounds or boulders for retaining walls. Sand pits can be created; these can be lined or unlined. If the use of sand isn't a possibility providing opportunities for digging into pea gravel, dirt or mud should be considered. Sand and water combined give children a chance to manipulate their environment.

Hideouts

Hideouts can take the form of small tucked away spaces such as a tunnel big enough for one or can be larger gathering spots such as a treehouse. Hideouts offer children a safe spot to 'get away from it all'. Strategic planting of sunflowers, willow or ornamental grasses can create hideouts, as can well-placed straw bales. Hideouts can inspire imagination. For example, they can take the form of a dinosaur nest.

Pathways

Pathways can range from wide paths that accommodate wheeled vehicles such as tricycles to narrow raised paths that test balance. The former accommodates those with mobility issues. Paths can be made from a wide range of materials such as pavement, woodchips, stepping stones, or log rounds.

Image Source: Keeler (2008)

Gardens

Gardens provide opportunities for children to learn about seasonal change, the cycles of life, and where food comes from. Gardens offer kids a chance to become caretakers; they learn how care and attention enable things to grow. Gardens can naturally facilitate partnering with community elders; a rewarding experience for everyone as elders' knowledge is passed to younger generations.

Hills

Hills give children a different vantage point, work different muscle groups when ascending and descending, and can provide winter fun. Hills provide space for tumbling, which activates the vestibular system. Existing hills can be altered or new hills added to create interesting topography. Slides can be embedded directly into hills.

Open areas

Children need open areas that allow for running and roaming. Large grassy areas are flexible and can accommodate a wide range of actives such as ball games, picnics, or celebrations.

Stages

A performance stage can stimulate imaginative play. A raised flat area could be an elaborate stone amphitheater or a simple stump.

Seating

Seating provides a place where children can get some quiet time for rest or reading. Benches can be made from logs, stumps and boulders. Soothing swing benches can be added too. Seating should be placed in naturally low-traffic areas, perhaps beside a garden or birdbath.

Nature-based Play Spaces at the Prospect Road Community Centre

Open and forested areas surround the Prospect Road Community Centre (PRCC). Several spaces could be enhanced to create sensory-rich nature play opportunities for the community.

Siting Assessment

Four potential locations suitable for nature-based play were identified (Figure 11). A wedge-shaped area on the west side of the community centre is off limits because of its use for weddings and wedding photography.

Figure 11 Four potential nature play locations were identified at the Prospect Road Community Centre. The wedding viewshed area is off limits.

Image source: Site plan by Davison Seamone Rickard Adams Architects Inc. - modifed by P. Kuhn

1

Site One is ~ 30m from the trailhead and can be reached directly from the trail. The trail can be accessed through the back door of the community centre or by walking around to the back of the building. There is a grade of ~8% on the site, sloping down toward north. The area has numerous mature deciduous trees, which would provide some shade in the summer. There is a thick understory of young conifers. There doesn't appear to be a surface drainage problem.

2

Site Two is west of the community centre on an open grassy hill that flattens out toward the boundary of the property where the septic bed lies. The site is close to the west-side community centre entrance. The area is exposed; there are two young pine trees ~2m tall. No evidence of poor drainage was found.

3

Site Three is adjacent to the path that connects the community centre to the Prospect Road Elementary School. The path is accessed via the front doors of the centre; through the parking lot small tree lawns and young deciduous trees line the path. Access to the site is down a ~50% slope. The area has a mix of level and sloped areas, with a slight grade toward the west. One section of the site is open with meadow grasses and another is thick with a conifer understory and tall deciduous trees. The latter would offer some sun protection. The entire site is sunken which may protect it from wind. A small wet area in the centre of the site indicates poor drainage. Logs and boulders are present. Vehicular traffic on Prospect Road can be heard from this site.

4

Site Four is east of the community centre, within a fenced area containing a traditional play structure and a community garden. There is a gate in the northwest corner. A hill runs along the edge of the site. Toward the north lies a grassy area with a ~2m pine tree and numerous boulders. Water runoff flows into a drainage swale funneled into a grate located toward the south. The site is exposed, although the building would offer some sun protection later in the day. The hill and building may offer some wind protection.

Opportunities for improving human & ecosystem health

Design Assessment

Each site was assessed according to the design principles and nature-play ingredients outlined in the best practice review.

Nature-play Ingredients

Each site has its own unique set of opportunities and constraints with respect to nature-play ingredients. The ease or difficulty with which a nature-play ingredient can be included is described in Table 2. Site One is sensory-rich as it lies directly in the forest. The dense understory, however, makes it difficult to include many of the ingredients. Conversely, Site Four can include the most ingredients but not all of them would fit because of the limited size (the site is fenced). Sites Two and Three can easily accommodate many of the same ingredients, but are quite different. The open area of Site Two easily allows for a gathering space but is sensory-poor compared to Site Three's rich environment.

Design Principles

Site One is in the heart of the forest but lacks accessibility due to dense understory. Extensive tree removal will be required to accommodate gathering spaces and pathways that enable gross motor movements such as running. Inclusive design will be a challenge because of the rough terrain. Multigenerational use can be accommodated because available land isn't a constraint and the nearby trail can be used by older youth. Signage or an arbour could mark the entry.

Site Two provides good opportunity for gross motor movement and creation of a gathering space. Pathways and plantings can be added to define the boundaries. Extensive plantings will be needed to create a sensory-rich environment. Inclusive design will be difficult because of the large hill. Multigenerational use may be restricted because of limited space (i.e. the nature play area can't infringe on the wedding area). Signage or an arbour could mark the entry.

Site Three is inherently sensory-rich with its range of vegetation types and wet area, which can be developed into a pond. Pathways can be added to stimulate gross motor movement and to delineate the play area; this will require tree removal on the south side, which is heavily forested. The spacious site can accommodate multigenerational use, but the hilly terrain may make inclusive design and creation of gathering spaces difficult. Adding native plantings along the parking lot path leading to the area will focus attention to the nature-play entrance.

Site Four can become more naturalized and sensory-rich by planting along the fence and creating planting pockets throughout the space. This location has stormwater and fresh water sources and offers the best opportunity for inclusive design. The hill and open area allow for some gross motor movement. Multigenerational use will be difficult due to the limited amount of space. Adding access along the south side (i.e. a gate) will allow easy movement to other outdoor spaces on the property; it could be marked with an arbour and sign.

A concept design example was created for Site Four because it already has numerous nature-play ingredients (Table 2), is the most accessible, and affords the best opportunity for inclusive design.

Nature-play Ingredient	Site 1	Site 2	Site 3	Site 4
Outside of Fence	Already Present	Already Present	Already Present	Difficult
Art Work	Easy	Easy	Easy	Easy
Water	Difficult	Difficult	Easy	Already Present
Plants (added)	Easy	Easy	Easy	Easy
Garden	Difficult	Easy	Difficult	Already Present
Sand	Easy	Easy	Easy	Already Present
Sound	Easy	Easy	Easy	Easy
Hills	Difficult	Already Present	Already Present	Already Present
Pathways	Difficult	Easy	Easy	Difficult
Hideouts	Easy	Easy	Easy	Easy
Open Areas	Difficult	Already Present	Already Present	Already Present
Stages	Easy	Easy	Easy	Easy
Seating	Easy	Easy	Easy	Easy

Table 2 Nature-play ingredients at the four potential nature-play sites at the Prospect Road Community Centre. Ingredients are considered easy or difficult to implement or already present.

Design Concept

Site Four - Existing Conditions

Site Four - Nature-Play Concept

The design concept features a hillslide, sound garden and an expanded sand play area, which allows for water/sand interaction and manipulation. Water is delivered into the sand zone via a hand pump and hollowed out log track (precedence image A). Water for the pump is from a stormwater-collection cistern. A large loose-parts play area lies north of the existing play structure (precedence image B); an adjacent log climb (precedence image C) leads to the highest spot in the play space, a nest (precedence image D). Vegetation is added as planting pockets, trees, fence flower boarder, raingarden, vegetable garden and willow tunnels that create hideaways (precedence image E). Not all nature-play ingredients were added to the design in order to maintain some open space. The fence restricts size but is a positive feature for inclusive design. Eighty percent of children with autism will experience a 'fight or flight' response and run; enclosed spaces are safer for these individuals (Kaplan, 2016). A trellis along the south fence marks the new entrance conveying a sense of welcome, and improves access. The gate along the north side gives quick entry to the trailhead. The open unfenced grassy area north of the play space may be expanded into.

A Hand Water Pump & Log Track

Champoeg State Park, OR

B Loose Parts

Tryon Creek, Portland, OR

C Log Climb

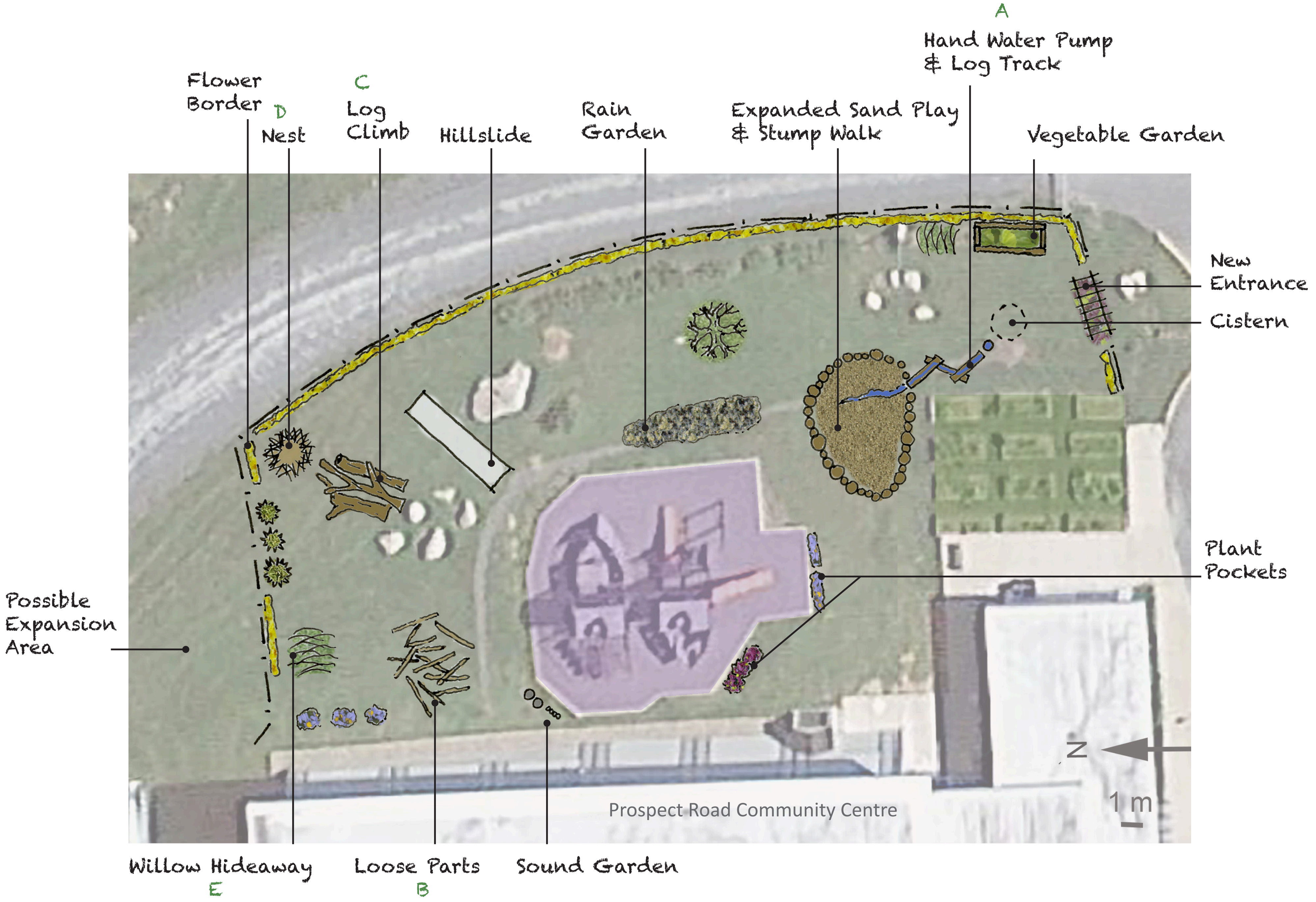
Westmoreland Park, Portland, OR

D Nest

Middle Musquoidoboit Nature Play Space, NS

E Willow Hideaway

Westmoreland Park, Portland, OR



Opportunities for improving human & ecosystem health

Next Steps

Each of the four sites offer a unique set of opportunities, challenges and constraints; some will require considerably more planning, cost and effort. Decisions about which site(s) to develop will depend on the community's interests, available resources and goals. It is recommended that the nature-play section of this report be shared with the community. Interested parties, together with PRCC staff, should then form a working group. The working group could seek partnerships with organizations such as the Nova Scotia Forest School (wildchildforestschool.ca), Clean Foundation, Dalhousie University's Faculty of Architecture and Planning or Landscape Architecture program, and the Halifax Parks and Recreation Department. Resources related to community-led nature-playspace planning and implementation are listed under Additional Resources.

Even without formally creating nature-play infrastructure, programming at the PRCC can expand in order to take advantage of outdoor areas as they currently exist. For example, Site Two can be used to encourage gross motor movements and tumbling, and Site Three for building with loose parts and balancing atop the existing logs. The new trail can be used for hiking and nature exploration.

Additional Resources

The following nature play resources are related to community involvement and implementation strategies.

Part 2 – Resources: **10 Keys to Community-Built Success** in Keeler, R. (2008). *Natural Playscapes*. Redmond, WA: Exchange Press.

Case Studies (community led) in Moore, R.C. (2014). *National Guidelines - Nature play & learning places – Creating and managing places where children engage with nature.* Version 1.0. Natural Learning Initiative and National Wildlife Federation.

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Image source: kevinodes

Concluding Summary

This report outlines research documenting the physical and mental health benefits of recreation in nature, explores how being connected to the natural environment can benefit the ecosystem in the long run, and reports policy shifts reflecting this research. The interpretive plan for the WCWC Phase 1 initiative, and proposed nature-play locations and design assessments for the PRCC, are in-line with these policies. These are first steps toward increasing opportunities for all ages within the local community to recreate in and connect to the natural environment.

Next steps for the interpretive plan involve choosing which site resources to develop into sub-themes. This may require hiring an interpretive designer or connecting with other organizations such as the Dalhousie School of Planning or the Halifax Parks and Recreation Department. Subsequent steps for the nature-play space include forming a community-working group, and partnering with organizations such as the Clean Foundation, and Dalhousie University's Faculty of Architecture and Planning or Landscape Architecture program. It is recommended that current PRCC programming be expanded to take full advantage of the adjacent outdoor areas in their current state.

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Appendix A

GPS locations of site resources. Data was collected using a Garmin 60csx GPS unit.

Site Resource	Latitude	Longitude	Elevation
1	44.56867103	-63.73042597	64.05310059
2	44.57136171	-63.73155216	53.71899414
3	44.57201198	-63.73146675	54.43994141
4	44.57254406	-63.73128184	49.63342285
5	44.57276828	-63.73140011	48.19152832
6	44.57356439	-63.7315157	43.86547852
7	44.5739145	-63.73125083	45.78820801
8	44.5740616	-63.72992582	43.14453125
9	44.57439956	-63.72940044	42.9041748
10	44.57487239	-63.72890959	51.31567383
11	44.57546465	-63.72888797	55.64160156
12	44.57828399	-63.72880382	53.23828125
13	44.57902051	-63.7281854	49.39306641
14*	44.57719	-63.725325	41
15	44.57883828	-63.7299912	41.94287109
16	44.57838482	-63.73033133	41.70251465
17	44.57501924	-63.72957193	41.94287109
18	44.57337144	-63.732273	41.94287109
19	44.57296282	-63.73422481	41.94287109

*Location and elevation of site resource #14, wetlands, was determined using Google Earth (2016).