Towards an Integrated Infrastructure:
Using Architecture to Celebrate a Canadian National Park Town

by

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DALHOUSIE UNIVERSITY

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ABSTRACT

This thesis proposes an architecturally integrated stormwater system and research facility in the town of Wasagaming, Riding Mountain National Park (RMNP), Manitoba. The design proposal provides four-season, interior and exterior space for the integration of resource management operations and park visitor experiences. Visible integration of infrastructure, building and landscape cultivate destination-based travel to RMNP while reducing human impacts on the ecosystem.

Aging infrastructure and diminishing federal funding make responsible ecological and cultural management of parks increasingly difficult. Integration of research and tourism as a component of visitor experience at parks is one way of addressing cost-effective co-location of programme, ensuring future funding can be generated for resource management.

Each system needs to be designed as a negotiation and resolution of the myriad pressures the park's numerous stakeholders and the UNESCO designated Biosphere Reserve as a whole if they are to contribute constructively to the future viability of RMNP.

ACKNOWLEDGEMENTS

I would like to thank my advisor Catherine and my supervisor Roly. So much of what I have learned from this project came from applying principles from our conversations to my design and representation.

At Riding Mountain National Park I would like to thank Dale Wallis, Ken Kingdon and Sean Frey. Without your support, encouragement, ideas and extensive data sets I would not have been able to approach this project as rigorously as I have.

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Finally, I have to thank my partner Ellen, who has patiently and tirelessly made possible my commitment to my studies these past four years.

CHAPTER 1: INTRODUCTION

Towards an Integrated Infrastructure

The world abounds with examples where infrastructure is built to be representative of culture in addition to its primary function. In this way the infrastructure becomes a metonym for larger ideas such as protection (great wall of China) or spatial ordering and power (Roman aqueduct). Water towers across central Canada engender this metonymic relationship with the western expansion of urbanity and the construction of first the railway and then the system of parks, highways, towns and cities.

In this way, when infrastructure is designed to be integrated into site and local culture whether it is tourism, research or civic infrastructure, it becomes part of the public realm.

Thesis Statement

This thesis is situated at the intersection of architecture, infrastructure and landscape design. It seeks to challenge the segregation of the environmental stewardship and visitor experience operations at Riding Mountain National Park (RMNP) and to suggest how infrastructure can be a catalyst for rethinking the visitor experiences of Canadian parks.

The design proposal within this thesis addresses the functional requirements of a sustainable stormwater management plan while addressing RMNP's need for expanded and more efficient environmental monitoring, resource conservation and public education programme. The integration of the infrastructure with the architectural space and the surrounding landscape proposes a progressive way of thinking about contemporary development in our National Parks.

How can architecture mediate between the resource conservation and visitor experience mandates of Parks Canada?

Civic Infrastructure in Canada

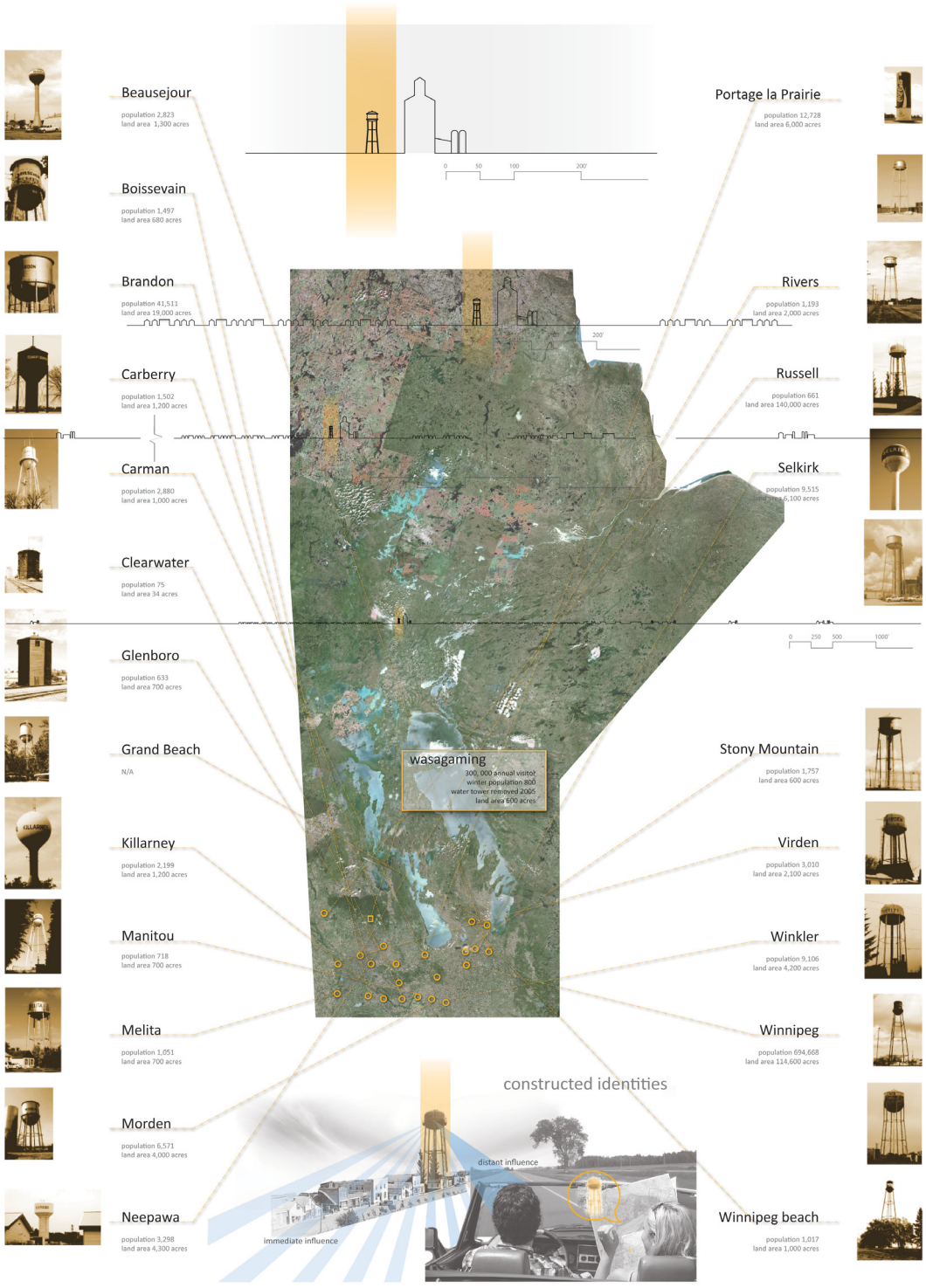
The history of Canada's westward urban expansion is the infrastructure that made urban expansion possible. National parks led to highways which eventually crossed the Rocky Mountains. Throughout the prairies, water towers and grain elevators stand as visible reminders of the relationship between settlement and infrastructure. In Manitoba there are still 25 water towers[1] - each one distinct and recognizable. This rich typological variety is regional and diverse. The large format photos in the books of infrastructure studies by Bernd and Hilla Becher are exemplary collections of these remarkable structures.

City of Brandon water tower, community centre, public pool and skating rink, Brandon, 2011; photograph by Tim Smith

Water tower photos, 1988; photograph by Bernd and Hilla Becher, from Becher, *Water Towers*

Most water towers in the Canadian prairies are highly visible with a strong relationship to either grain elevator, the railway or both. Unlike the grain elevators, water towers are always civic infrastructure - they provide domestic water pressure and the security that water will continue to flow during power outages. This civic presence and function as well as their size is what leads to these civic structures being signage declaring the name of the place like giant markers on a map. This association of name with place made visible by a massive piece of architecture, is part of what makes civic infrastructure monumental in the landscape. Each tower plays a major role in identifying one small prairie town from another. They have an intrinsic relationship to place.

1 Canadian Business and Service Directory, *Standpipes and Watertowers in Manitoba Canada. Index:A*, accessed October 14, 2012, http://www.eureka4you.com/wtower-mb-a/index.htm.



Study of extant Manitoba water towers with town locations, areas and populations; data from Advameg, Inc., city-data

Landscape architect Michael Hough believes it is this visibility that is "crucial to environmentally responsible behaviour". Further he calls "for a re-visioning and 'unveiling' of infrastructure"[2] to move away from singular functions toward an integration of infrastructure systems into their urban, ecological and cultural contexts."

William Wenk imagines an alternative to our now standard models of stormwater infrastructure in his essay *Towards and Inclusive Concept of Infrastructure*: "…we can rethink all components of urban stormwater systems, from individual storm drain inlets to trunk storm sewers, to create surface stormwater systems that are functional and beautiful. We can accommodate both naturalistic and formal expressions and the use of native and nonnative species. We can enrich leftover spaces such as the edges of parking lots, which can become wonderful wetland or conventionally planted environments. We can build on the scientific research and engineering talents of related professionals to create landscapes that function in specific, quantifiable ways, and that are integral with the fabric of the city."[3]

This example articulates a yearning for a comprehensive public realm "including streets, parks, riverfronts, water-delivery systems, and drainage ways;"[4] effectively integrated infrastructure combining "high civic function with recreation, high art, and in some cases,

Photograph of the R. C. Harris Water Treatment Plant and park, Toronto, 1952; from Scarborough Historical Society

2 Alex Bogusat, "Re-interpreting and Re-programming the Edge: Site, Infrastructure and Community" (MArch thesis, Dalhousie University, 2012), 4.

3 William E. Wenk, "Toward an Inclusive Concept of Infrastructure," in *Ecology and Design Frameworks for Learning*., ed. Brent Johnson and Kristina Hill (Washington: Island Press, 2002), 173.

4 Ibid., 174.

natural areas with wildlife habitat."[5] The City Beautiful movement produced a number of these highly integrated solutions to the systemic consequences of urbanism. A classic Canadian example similar to these turn of the century projects that remains relevant, functional and successful today is the R. C. Harris Water Treatment Plant built in the 1930s on the Toronto waterfront. This project is at once civic infrastructure, public space, and prized heritage building in a significant architectural style.

Canadian Identity

Canada's nation-wide system of parks, "...long celebrated by the federal government as an "integral part of the Canadian identity,"[6] are bastions of the kind of open landscape that Canada is known for from tourism promotion to the landscape paintings of the Group of Seven. They play an important role in Canadian self-knowledge.

As cities expand and large portions of the vast landscape have been urbanized or cultivated agriculturally, these protected areas increase in relevance. The industrialized landscape of the southern strip of Canada along the US border is vastly different than the open wilderness of parks. Parks Canada has established parks to preserve a portion of each distinct Nature Region in Canada protecting unique ecosystems and species at risk. When these boundaries are drawn, they define specific places where Canadians can go to experience their country. They define a somewhere in the vast anywhere of an

Winter skating trails in RMNP eliminated by Parks Canada, 2012; photograph by Tim Smith, from Bartley Kives, Budget Cuts Take the Fun Out of Winter

5 Ibid., 183.

6 Jennifer Ditchburn, "Winter Access, Services Put on Ice at National Parks Across the Country," The Winnipeg Free Press, February 20, 2013, http://www.winnipegfreepress.com/breakingnews/winter-access-services-put-on-ice-at-canadas-national-parks-across-the-country-188243191.html.

awesome expanse of open country and ultimately the protect those borders as the human transformation of the surrounding landscape presses in.

Climate has a strong connection to identity in Canada. We are a winter nation and one way in which this culture is celebrated is through winter sport and recreation. Parks Canada has a network of protected areas from coast to coast to coast that is ideally situated to provide public space for this vital cultural tradition of enjoying and engaging with the vast landscape.

Parks Canada

History

Placing Parks Canada in its historical context, we can understand how it became the national parks network that we have today. The collection of essays in A Century of Parks Canada: 1911-2011 edited by Claire Campbell describes an evolution of Parks Canada and reveals the underlying tension inherent in its existence - especially present in the friction between tourism driven towns that lie within these protected boundaries and the ecosystems they were created to protect.

The twin mandate of parks is to preserve the ecological integrity of these protected areas - above all else, while protecting and maintaining parks for the use and enjoyment of future generations of Canadians.[7] These two goals underscore the inherent conflict in Parks Canada's mandate to both use parks recreationally and keep them ecologically integral.

The contemporary context in 2013 has been further complicated by restricted budgets, reductions in programming, limited access to a number of parks during winter months and a multitude of layoffs.[8] The decisions made in Ottawa have consequences for Canadian national park communities like Wasagaming. This period of financial pressures on the park administration need to be seen as an opportunity to be innovative.

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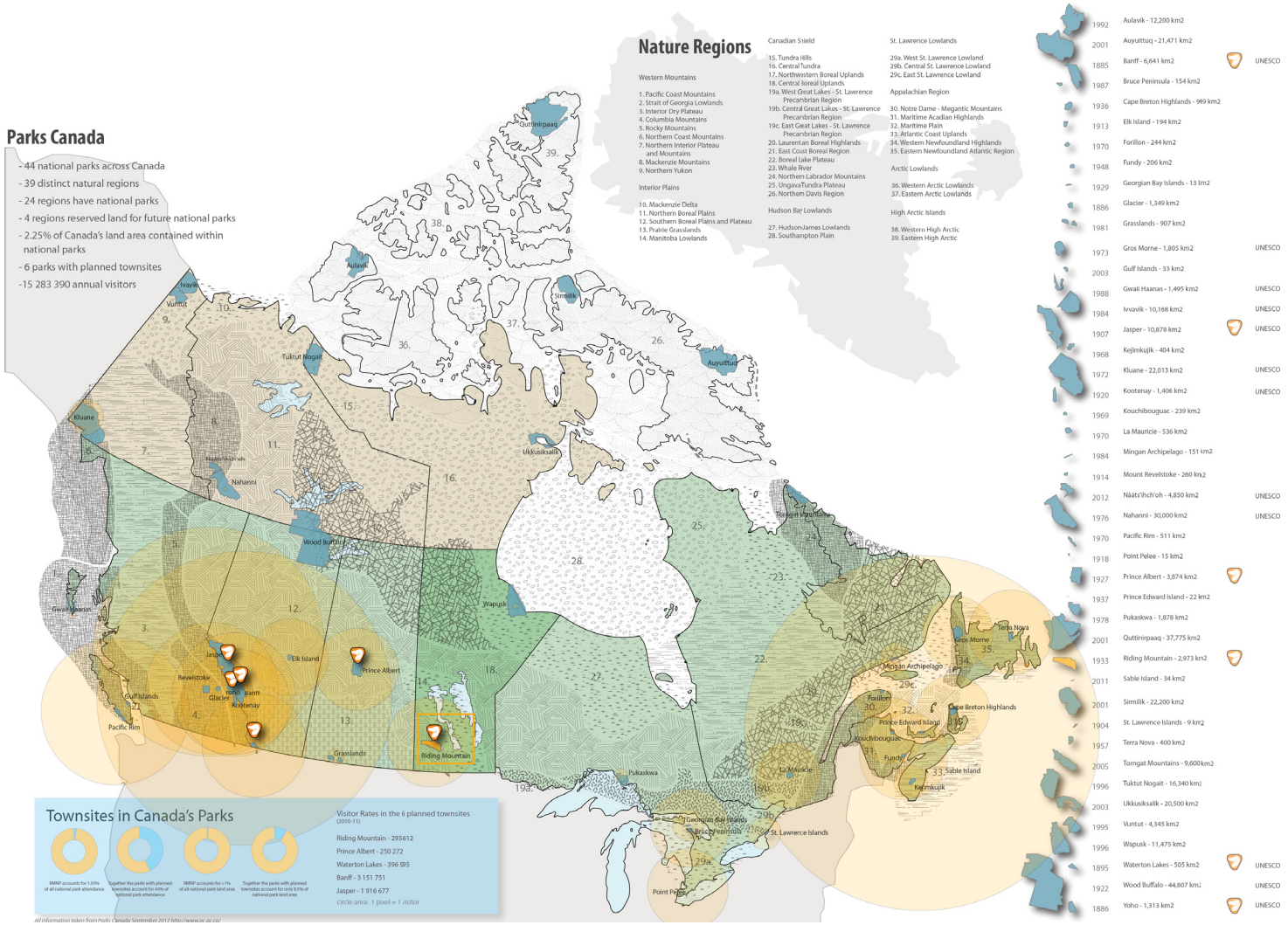
7 Claire Elizabeth Campbell, *A Century of Parks Canada, 1911-2011* (Calgary: University of Calgary Press, 2011), 11.

8 Whittington, Les, and Bruce Campion-Smith. "Federal Budget 2012: Parks Canada Feels the Pinch as Harper Government Makes More Cuts." The Star. April 30, 2012. http://www.thestar.com/news/canada/politics/article/1170516--federal-budget-2012-prime-minister-harper-s-government-making-more-job-cuts.



Locations, areas and visitor rates of Canadian parks mapped onto nature regions and provinces; data from Parks Canada, National Parks of Canada

Site Context

Riding Mountain National Park

Riding Mountain was established in the 1930s and, like the mountain parks before it, played a major role in instigating highway construction projects to connect urban centres.[9] RMNP is located at the intersection of fescue prairie grassland, boreal forest and aspen parkland between the city of Dauphin to the north and Brandon to the south. There is a large escarpment on the east edge of the park running northwest that divides the Assiniboine River Basin to the south from the Lake Manitoba Basin to the north and east. The park is home to a diverse ecosystem including many large mammal populations such as moose, elk, black bear, cougar, lynx, coyote, wolf and bison. Environment Canada's project screening report for RMNP succinctly describes the geological and ecological regions whose convergence creates the unique area known as the Riding Mountain Biosphere Reserve: "Comprising 2,969 square kilometres, RMNP is representative of the southern boreal plains and plateau region of Canada. The park marks the transition from the Manitoba Lowlands to the second prairie level, the Saskatchewan Plain, and preserves a representative example of the Manitoba Escarpment which sharply rises 475 metres from the adjacent lowlands. From this eastern boundary, the parklands roll westward almost 100 kilometres, comprising a patchwork of lakes, hills, wetlands and forests."[10]

The park's visible architectural heritage is mostly an arts and craft style, round timber and round-stone masonry construction dating back as far as the 1931 cabin built by Archibald Belaney - later known as Grey Owl - a staunch defender of Canadian parks. This piece-en-piece style persists due to federal heritage building designations from the Federal Heritage Building Review Office (FHBRO) on the older structures and a resurgence of luxury cottages built or renovated to conform with an interpretation of the community development guidelines.[11]

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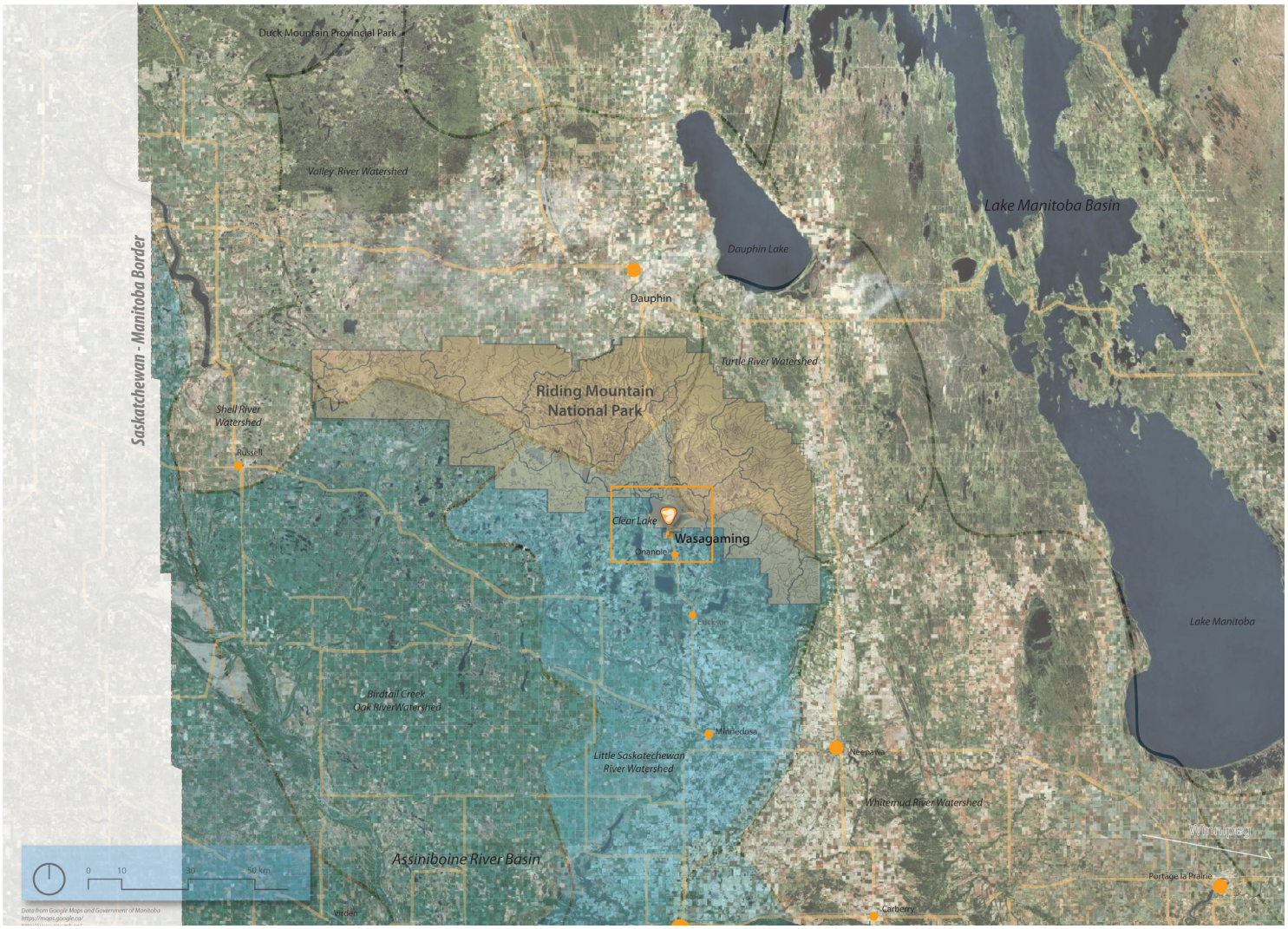
9 Claire Elizabeth Campbell, *A Century of Parks Canada, 1911-2011* (Calgary: University of Calgary Press, 2011), 11.

10 Canadian Environmental Assessment Agency, *Model Class Screening Report for Routine Projects,* accessed January 26, 2013, www.ceaa-acee.gc.ca/050/documents/3023/3023E.pdf.

11 Parks Canada, *Wasagaming Community Plan: A Framework for Managing Land Use and Development in Wasagaming, Manitoba, Riding Mountain National Park* (Ottawa: Parks Canada, 1998), 7-15.



Highways, cities, towns, watersheds and basins of the Manitoba parkland region; data from the Province of Manitoba, Water Conservation and Stewardship

Situated on Highway 10 as it enters the park is the town of Wasagaming. Riding mountain is one of six Canadian national parks with a townsite within the protected borders of the park and it is the eastern most of these six.

Wasagaming

Wasagaming is a planned community within the border of RMNP that was established at the same time as the park and the Number 10 Highway as part of the early 20th century expansion of the Canadian parks system. The name means Clear Lake in Ojibway,[12] which echoes the name of the lake on which the town is situated and upon which it relies for its recreational tourism and drinking water. Clear Lake is the largest, deepest lake in the southern accessible prairies between Falcon Lake in eastern Manitoba and the Rocky Mountains to the west. As such, it is both a unique ecological system and a major tourism destination resort. RMNP sees around 300,000 annual visitors and the majority of these people come to Wasagaming during their visit.

The townsite is planned along two major west-east roadways, Wasagaming Drive which acts as commercial centre for the town and Tawapit Drive parallel to Wasagaming but further from the lakeshore. Both Wasagaming and Ta-Wa-Pit drives have a large number of residences and residential cottages on land parcels leased from the national park. All commercial and residential properties are contributing to the storm-water and waste disposal systems of the park.

In a 2006 State of the Community Report, Parks Canada expressed a vision for Wasagaming that fits well with the intentions of this thesis and the proposed mediation of research and tourism by thoughtfully designed architecture: “Wasagaming will continue to serve as the ‘hub’ of recreational, educational and cultural activity enhancing the enjoyment and appreciation of Riding Mountain National Park. The facilities and services provided in Wasagaming will serve the needs of its visitors. The community will preserve its village-like atmosphere into which nature and recreation are integrated. It will promote nature and people-oriented activities while building upon and strengthening the cultural, architectural and natural heritage that makes Wasagaming a unique and inviting place.”[13]

12 Ted Stone, *The Story Behind Manitoba Names: How Cities, Towns, Villages and Whistle Stops Got Their Names* (Calgary: Red Deer Press, 2006), 241-242.

13 Parks Canada, *State of the Community Report: Wasagaming (*Ottawa: Parks Canada, 2006), 7.

The town of Wasagaming with shoreline data, surrounding waterways, town districts and sites of interest; data from Sean Frey, e-mail to author

Clear Lake Marina and Pier in winter, Wasagaming, 2012; photograph by Cate Watrous

Clear Lake Marina and Pier in summer, Wasagaming 2012; photograph by Ken Johnson

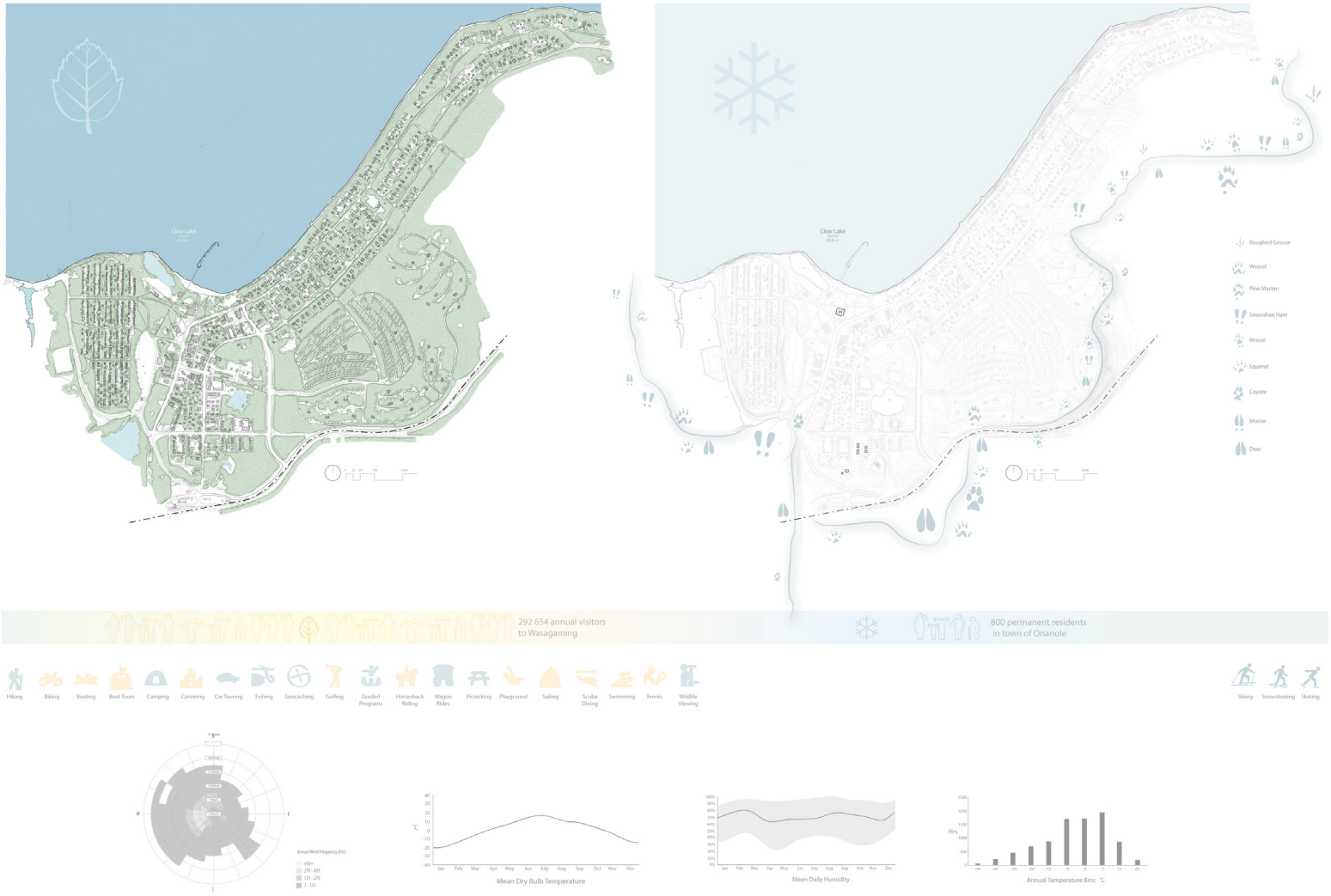
A large packed dirt parking lot highlighted in the site plan on the previous page divides a dense cabin area to the west from the town centre; this surface parking area at the heart of Wasagaming - a convergence of circulation routes, infrastructure, topography and important buildings - is the site of the RCOC and storm water retention pond proposed by this thesis.

During the winter months visitor rates fall - there were just over 60,000 visits between November 2011 and April 2012 compared to 240,000 during the spring summer and fall. During these winter months, when the parkland is blanketed in snow, it is used most heavily by local residents and stakeholders, winter sport enthusiasts, park administration, research staff and wild animals who move in and use winter trails through town.

Fewer than 20 people live in Wasagaming itself over winter and the nearby town of

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
April	12865	13733	13866	13951	14037	14154	13056	15661	14175	15315
May	18693	18178	19139	18383	18405	18108	18109	18133	17182	20180
June	17557	18647	19198	18102	22128	28981	22707	24150	26286	26394
July	58289	61862	62561	61171	79598	82517	77522	79988	86856	80481
August	60235	55035	53049	62335	70586	86705	74606	71665	77518	77324
Septembe	12957	15095	18934	21297	18808	12064	18856	18147	21886	24340
October	12216	11113	11656	11666	11683	9918	13328	13093	13110	14768
Novembe	10410	10478	10497	10390	10431	11179	12797	12751	10258	
Decembe	10985	10945	11185	11100	10927	10750	10640	10591	10161	
January	9018	8966	8671	8791	8875	10474	9593	9630	8427	
February	9644	9380	9460	9469	9557	9711	9781	9874	9227	
March	10942	11070	11200	11289	11243	12726	11998	12017	10656	
TOTAL	**243810**	**244501**	**249416**	**257945**	**286277**	**307287**	**292992**	**295701**	**305741**	

RMNP estimated number of visitors by month and year, Wasagaming, 2013; from Parks Canada.



Seasons contrasted in two town plans providing activities and seasonal climate information; data from Sean Frey, e-mail to author

Onanole's website lists the 1991 population at 404[14] although that number is likely closer to 800 today. For such small communities the 60,000 winter visits represent a huge opportunity to find visitor experience based solutions to the research and management funding crisis at RMNP. Parks need to embrace this fourth season instead of abandoning Canadians to it.

Winter research, cross country ski trails, skating rinks, warming shelters and back country campsites are some of the threatened programs but the downstream affect is potential loss of income to regional parkland businesses during winter months, decreased total use of parks by Canadians and ultimately a loss of awareness of parks as an important collective Canadian resource.

Programme

RCOC

The proposed Resource Conservation programme at RMNP is a mix of resource management laboratories and office space. Lab spaces for animal necropsies, tuberculosis research, water quality testing, fire management, university research partnerships and visitor engagement form the core of the research programme. The black bear and fire management programs, search and rescue and work spaces for researchers and administrative staff to manage the visitor experience at the RCOC make up the remaining human resource allocation of the proposed facility.

A large central public room serves as a flex space for delivering programs, displaying current research and acting as foyer to park visitors. Bridging between the research and management programme and the public room and reception is a large interpretive space to house the Citizen Science program at RMNP and to increase future capacity for delivering tourism experiences. These spaces include adjacent exterior courts to allow for seasonal expansion of usable area. This proposed building is a relocation of the existing RCOC programme from a deficient warehouse structure in the maintenance compound three kilometres to the east.

The large parking lot itself becomes a dry pond with permeable paving that acts as filter

14 Town of Onanole, *Onanole, Manitoba,* accessed March 7, 2013, http://www.onanole.ca/.

and reservoir. The stormwater system is architecturally integrated into the park landscape through the siting and design of the RCOC. The remaining exterior programme includes parking, recycling drop off, a separate service entrance for the labs and a large public square. In winter the square would be flooded as part of the skating rink that, until the 2013 budget cuts, was annually maintained adjacent to the site. Two pedestrian boulevards branch off from this parking lot providing access to the new building site and green swales to move stormwater through the system from the townsite into the dry pond reservoir, and eventually draining into the Clear Lake watershed.

Bonne Bay Marine Station Precedent

An existing Parks Canada facility that integrates visitor experience programme into the design of a purpose-built facility is the Bonne Bay Marine Station in Gros Morne National Park, Newfoundland.

Bonne Bay Marine Station main building; photograph by Celes Davar

Bonne Bay Marine Station wharf with fin whale in foreground; photograph by Celes Davar

View through large porthole windows of Bonne Bay; photograph by Celes Davar

The station includes an interpretive tidal pool tank allowing walk-in or group experiences, education and teaching spaces, an expansive view of the surrounding parkland and presentation space where current research is on display to the general public. The research further benefits from an active partnership with Memorial University making it a hub for research and tourism and effectively increasing the region's renown as a travel destination.

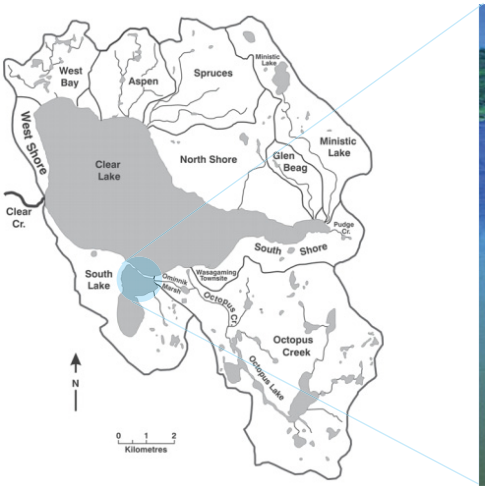
Through its design the building has both enabled and leveraged the relevant research work being done in Gros Morne National Park as an integral part of the Park's visitor experience of Gros Morne.

CHAPTER 2: ANALYSIS

Hydrologic Cycle

The hydrologic cycle in the Clear Lake basin around Wasagaming is a complex and resilient system composed of many parts, some more fragile than others, that center on Clear Lake. The lake is deep, clear and has direct connections to the aquifer, the immediate watershed and the Assiniboine River Basin into which the lake drains through a single creek outlet. The water table can be less than 2 m below grade in low lying areas near the lake.[15]

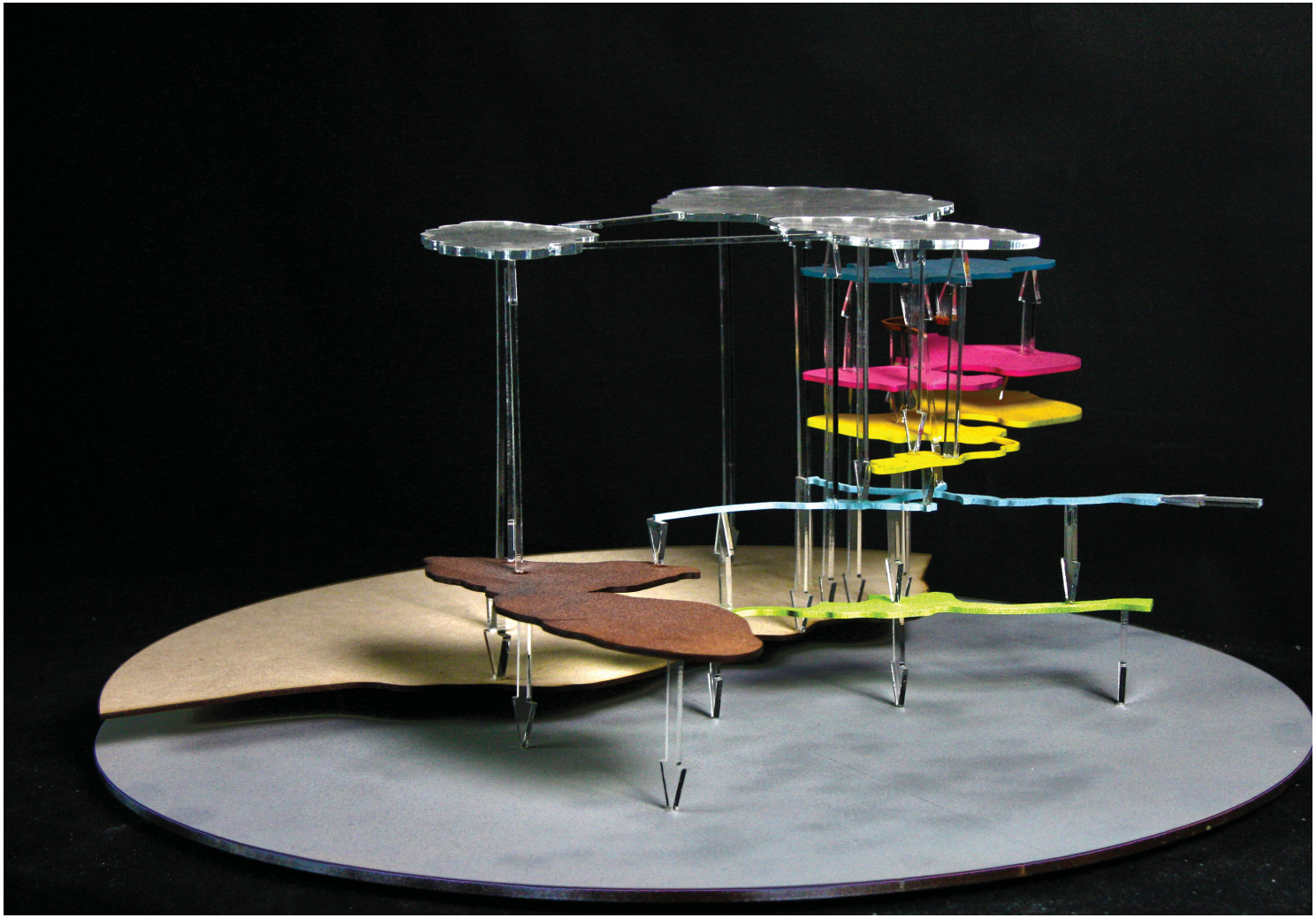
The Octopus Creek waterway flows into Clear Lake via Ominik Marsh slowing the flow rate and cleaning the water. Ominik flows back into Clear Lake directly via Octopus Creek at the town's boat launch and secondhand through South Lake. South Lake only mixes with Clear Lake during high water periods allowing the two ecosystems to mix. Recently the Ominik Marsh system has been coupled with the sewage treatment facility.



F.S. Parsons and R.A. McGinn, Watersheds of the Clear Lake basin showing the Clear Creek outflow connecting Clear Lake to the Assiniboine River Basin; from Parsons and McGinn, *Prairie Perspectives*

South Lake and Clear Lake adjacency; from Parks Canada, *State of the Community Report*

15 Canadian Environmental Assessment Agency, *Model Class Screening Report for Routine Projects*, accessed January 26, 2013, www.ceaa-acee.gc.ca/050/documents/3023/3023E.pdf.



Systems model showing system layers from top to bottom - atmospheric reservoir, stormwater catchment, drinking water supply, wastewater and sewage, Octopus Creek, Ominik Marsh, South Lake, Clear Lake and the aquifer. Flows between layers in the system are modeled as acrylic arrows showing direction of transfer

Existing Wastewater and Sewage

The final phase of the wastewater and sewage upgrade for the town of Wasagaming was begun in 2009 and is fully operation as of 2012. This final phase includes a 3-stage lagoon system with out buildings where effluent is UV treated then biologically processed in a series of shallow aerated lagoons before draining into the Ominik Marsh waterway and eventually to Clear Lake.

The system relies on its integration with the naturally occurring marsh and intermediate lake (South Lake) to slow the nutrient laden, treated sewage effluent and is made more resilient through this coupling. In this way it is a partial model for future infrastructure upgrading.

Wasagaming wastewater and sewage treatment facility, Wasagaming, Manitoba, 2012

Existing Drinking Water

A first priority for water resource management in Wasagaming was to upgrade the drinking water delivery system to a new two-reservoir pumping and filtration station and the removal of the decommissioned town water tower. This station takes in water from Clear Lake northeast of the main beach area and treats the water in a LEED building built in 2004 by Bird Construction just east of the main commercial district.

Wasagaming water treatment plant, 2004; from Bird Construction

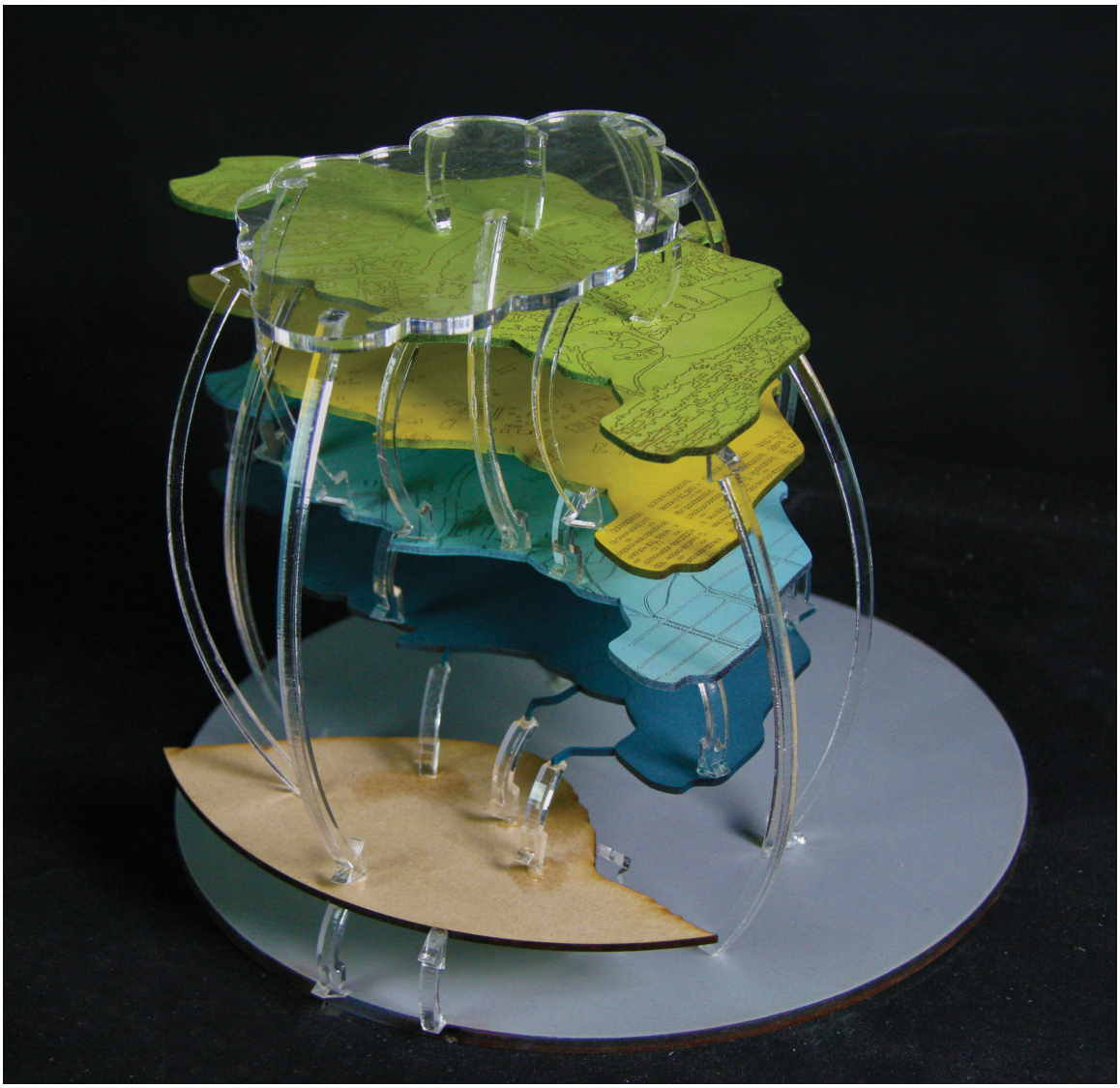
Wasagaming water treatment plant interior, 2004; from Bird Construction

The building was built to conform with community design and water quality guidelines but it is singular in its purpose and currently contributes little to the public realm or tourism economy. This kind of civic infrastructure has the potential to bring together water related research, experiential tourism and educational programs based on the water quality research being done in this facility and the pumping station closer to the lake. If the intention for co-location of program is explicit from the outset of the design process the infrastructure will inevitably be better able to operate as a site for tourism and research.

Existing Stormwater System

The existing stormwater system at Wasagaming has 5 outflow points fed by pipes under the road beds that collect runoff at a number of catch basins and storm drains, finally draining directly into Clear Lake. The primary outflow for downtown Wasagaming occurs at the east end of the main beach swimming area causing algae growth, sedimentation and accumulation of debris. A major conflict with this old system is the extreme proximity to the current drinking water intake. A second outflow occurs west of the main beach area and this catchment area and a third further west are the three priority drains causing aesthetic and health concerns.

In 2005 and 2006 Stantec Consulting Ltd. was retained to develop a Stormwater Drainage System for Wasagaming in order to address the above issues and an analysis of that document is included below.



Model of existing stormwater system showing layers from top to bottom - atmospheric reservoir, vegetation, roofs, roads, catchment areas, Clear Lake and aquifer

Sources of Stormwater

Roofs

Roofs are a source of human generated stormwater runoff with approximately 40,000 m2 of impermeable roofs within the project area of Wasagaming alone. In the future the stormwater management plan could call for net-zero runoff roofing strategies from new constructions but there are many large heritage buildings with expansive roofs and existing buildings that will continue to create flow during rainstorms. As a result the stormwater system in Wasagaming should always account for an input flow from building roofs.

Roads

The major impermeable surface in Wasagaming is asphalt roads and concrete walkways. These man made, vehicle oriented circulation routes cover approximately 250,000 m2 of surface just within the project area. The treatment of these surfaces as stormwater generators and the exploration of alternatives are an important layer in this proposal.

An inventory of existing road sections and related subsurface infrastructure are illustrated on the following page. The locations of these road sections are indicated on the site plan in the description of Wasagaming preceding this analysis.

Parking Lots

Falling between roofs and roads in terms of total area, the packed gravel parking lots in Wasagaming cover approximately 90,000 m2 of impermeable surface area. These parking lots are unshaded, dusty and underutilized land resources within Wasagaming.

Snow

Peak loading of stormwater infrastructure occurs during the spring snowmelt and after major summer storms. These huge influxes of water bring with them pollutants such as nutrients, sediments and organic matter. This flush of water increases flow downstream and is exacerbated by the concentration of impermeable surfaces at the town centre. This flushing effect is nonetheless a component of the natural cycling of the ecosystem and may have benefits or deleterious effects worth investigating.

System Shortfalls

The Stantec Consulting Pre-Design report from 2005 cites unacceptable beach conditions, proximity of stormwater outflows to the town drinking water intake and incidents of flooding as the reasons for upgrading.[16] The Canadian Environmental Assessment Agency also cites coliform bacteria as a concern in their overview of the system: “Storm water in Wasagaming is drained by 5 storm sewer outlets directly into Clear Lake. The 2 largest outfalls drain the commercial area and discharge on the west and east sides of the main

16 Stantec Consulting Ltd., *Wasagaming, Manitoba Riding Mountain National Park Stormwater Drainage System Pre-Design Report*. (Winnipeg, 2006).

Storm Water Sources:

Roofs:	90,041 m2
Parking lots:	40,097 m2
Roads:	249,807 m2
Total:	379,945 m2

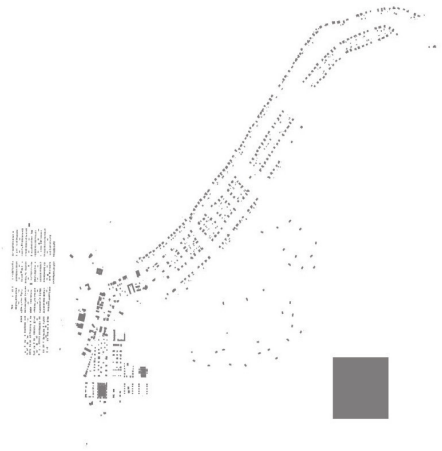
Average annual rainfall (mm) for Winnipeg, MB
415.6 mm

Annual storm water runoff generated by impermeable surfaces
415.6 x 379,945,000 mm2 = 157,905,142,000 mm

= 157,905,142 L

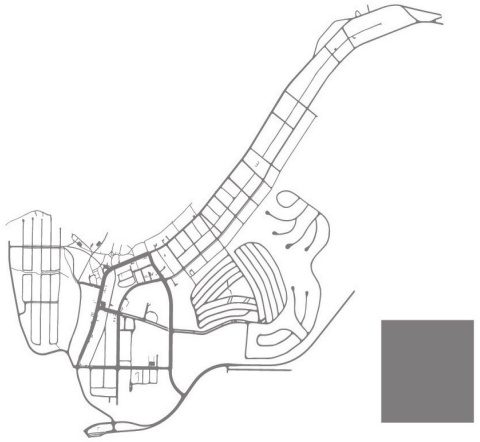
= 157,905 m3

*does not include storm water due to snow



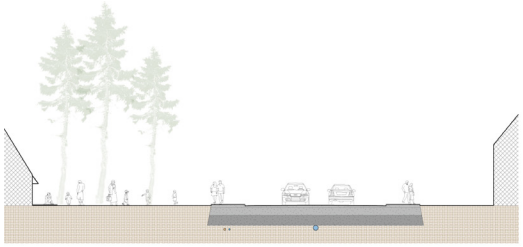
Impermeable Roofs - 40,000 m2

Impermeable Parking Lots - 90,000 m2

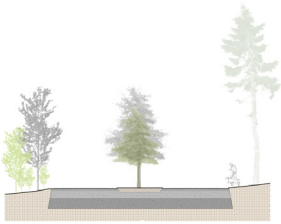


Impermeable Pavement - 250,000 m2

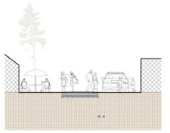
Estimated impermeable surface areas in Wasagaming based on planometric survey; from left to right - roofs, parking lots and roads; data from Parks Canada



Wasagaming Drive 2 sided
commercial / recreational
parking both sides
paved with concrete sidewalks
storm water, waste water and water supply

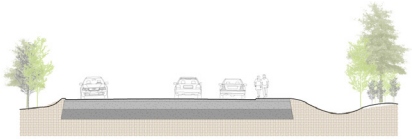


Buffalo Drive
recreational
no parking
asphalt surface - poor condition
no services

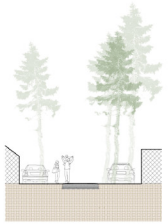


Cabin Area Street Typical
residential / recreational / leisure
informal parking
asphalt surface - poor condition
waste water and water supply

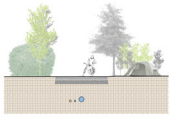
Wasagaming Drive 1 sided
commercial / recreational
parking both sides
paved with concrete sidewalks both sides
storm water, waste water and water supply



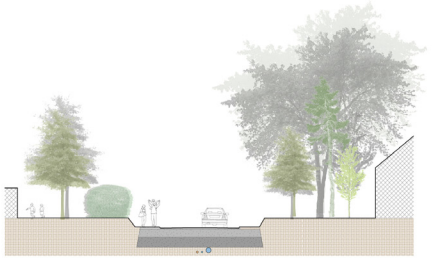
Columbine Drive
transportation / vehicular access
no parking
paved with concrete sidewalk one side
no services



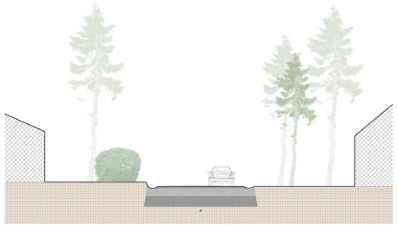
Cabin Area Laneway Typical
residential / recreational
informal parking
dirt / gravel
no services



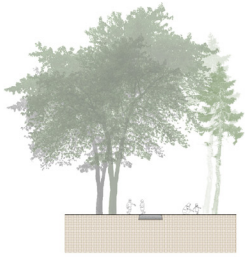
Campground Road Typical
recreational / temporal residential
no parking / informal parking
asphalt surface - poor condition
storm water, waste water, water supply



Wasagaming/Tawapit Cottage Area Typical
residential
no parking
paved with asphalt sidewalk one side
storm water, waste water and water supply



Cottage Area Street Typical
residential
informal parking
compacted dirt and gravel no sidewalks
water supply



Pedestrian Paths
recreation / leisure

Inventory of existing road and walkway cross sections and infrastructure below - section locations are shown on the Wasagaming site plan in the first chapter

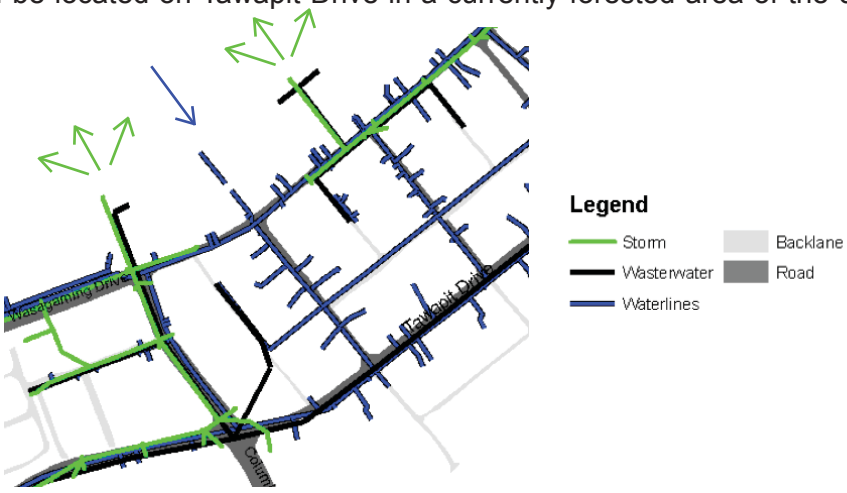
beach area. Coliform “spikes” have been recorded after storm events. Sampling and analysis of storm water and lake water in the vicinity of the outfalls has been carried out for nutrients, hydrocarbons and coliforms.”[17]

Because of its oligotrophic (Clear Lake is a deep and relatively nutrient poor) nature, Clear Lake is thought to be sensitive to any increases in nutrient inputs.[18]

Climate change predictions from The Nature Conservancy show an increase in annual precipitation and temperature that existing infrastructure has not been designed to manage.

Stantec Engineering Stormwater Upgrade

The aforementioned Stantec proposal for stormwater upgrading calls for new pipes to be laid, a dry pond (permeable aggregate bed to filter and store water) constructed to improve water quality and system capacity and a lift station sunk into a pit to pump water away from the lakeshore to upwell finally into the Ominik Marsh system. The dry pond would be located on Tawapit Drive in a currently forested area of the downtown. The lift



Chris Hanson, drinking water, wastewater and stormwater adjacencies showing drinking water intake in blue between two stormwater outflows in green along the top of the drawing, 2006; from Hanson, *Wasagaming Water and Wastewater System Information Product Description*

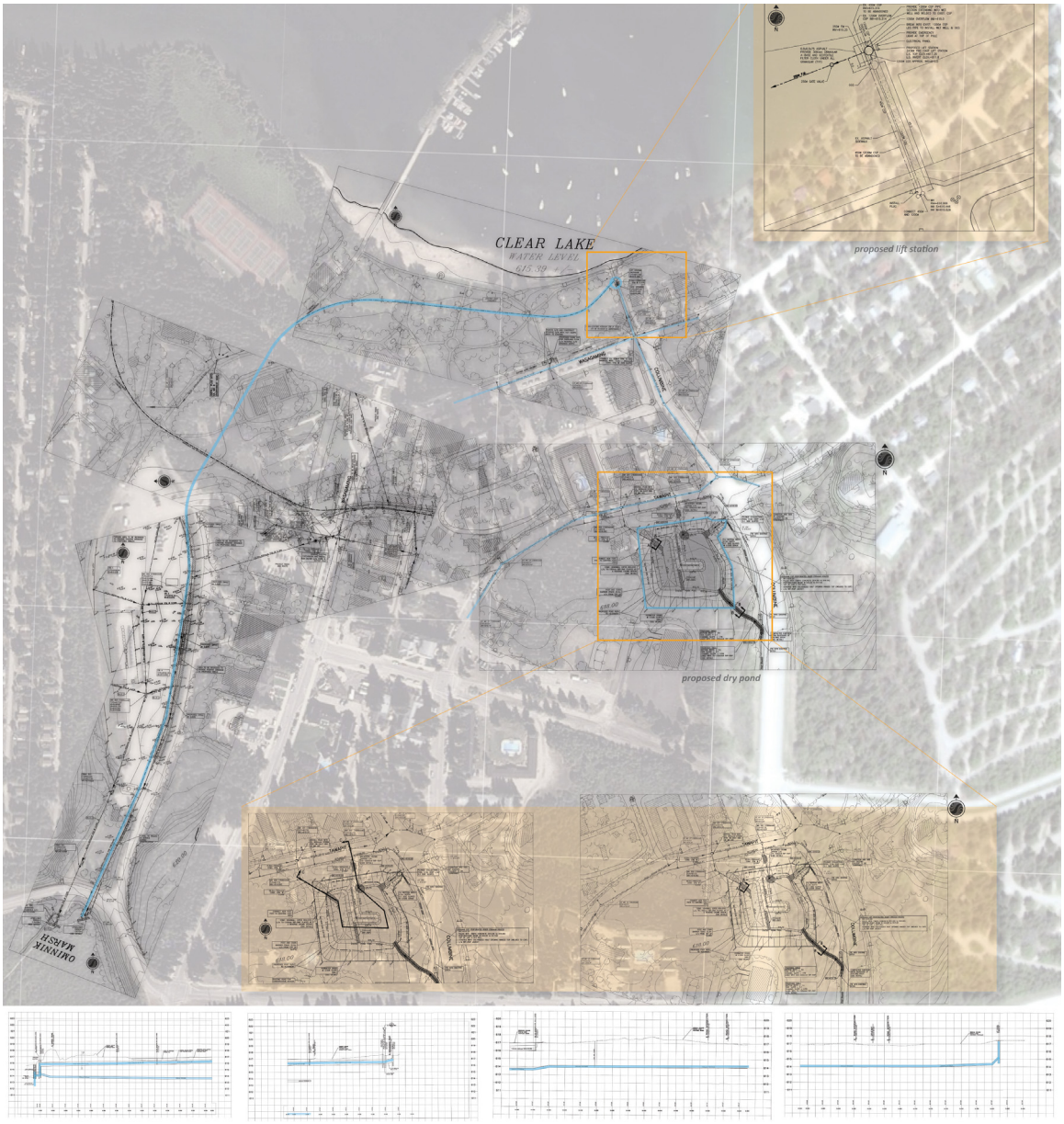
station would be installed at the existing beachfront storm sewer outflow.

17 Canadian Environmental Assessment Agency. *Model Class Screening Report for Routine Projects*. Accessed January 26, 2013. www.ceaa-acee.gc.ca/050/documents/3023/3023E.pdf.

18 Ibid., 84.

Study of the existing systems through a combination of design-led research with digital and physical models raises the following concerns regarding the Stantec proposal for stormwater management:

A review of the appendices of the Wasagaming Stormwater System Concept Design Report reveals that it is based on climate data from the past half century exclusively. Human caused climate change depicted in the below precipitation maps is predicted to

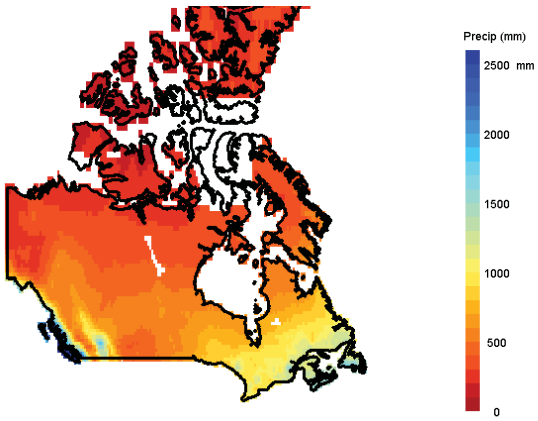


Collage showing proposed stormwater upgrade - pipes are shown in blue and views of the lift station and dry pond are enlarged; data from Public Works Canada, Wasagaming Stormwater Drainage System Riding Mountain National Park

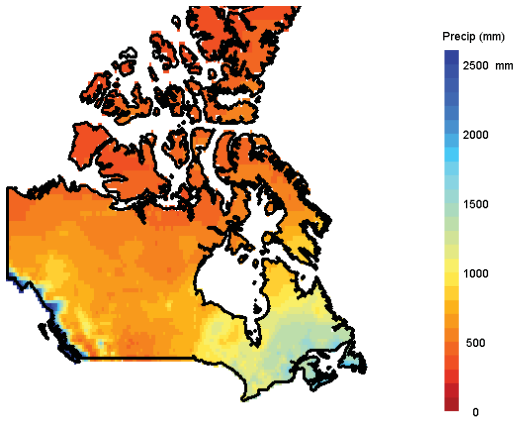
cause an increase in annual temperatures and precipitation in this part of Manitoba in the immediate and long term future. These maps illustrate predictions based on large data sets generated and shared by scientists around the world and are widely accepted by the scientific community. Infrastructure designed for past frequencies and ferocities of storms exclusively could lead to a strategy being implemented that is in essence designed to be below capacity to handle future precipitation levels that can be predicted with some degree of confidence today.

The siting of this dry pond by stantec will remove a stand of mature trees in the downtown of Wasagaming, an area that was not naturally a wetland prior to the establishment of the town. There are existing wetlands within the project area but this strategy does not leverage their capacity to store or filter any stormwater nor were the surface parking lots also within the project area.

The new force main pipe carrying water from the proposed lift station cuts directly across



Precipitation map from 1951-2002, Canada, 2013; map from The Nature Conservancy, Climate Wizard



Predicted precipitation map 2079-2099, Canada, 2013; map from The Nature Conservancy, Climate Wizard

existing green space parallel to the lakeshore. This placement will inevitably disrupt activity and cut the town off - however temporarily - from the lake. Once completed this infrastructure will be hidden under landscaping and made to look as if nothing had ever happened - effectively missing the opportunity to contribute visibly to the important public space it is disrupting.

All of this effort will divert millions of litres of stormwater annually into the Ominik Marsh

waterway which has most recently been integrated into the wastewater and sewage management plan. As far as could be discovered, no rigorous ecological impact assessment has been conducted to understand the effect this much additional water will have downstream or the flushing affect of spring snowmelt. By treating each project individually, further coupling of systems without a holistic strategy for their integration has the potential to detract from the functionality of what has already been achieved and to create unforeseen challenges to ecological sustainability in the future.

Precedents

Glacier Skywalk

The Glacier Skywalk being built in Jasper National Park is a controversial project designed by Sturgess Architects in Calgary for Brewster, an international tourism company. This project is similar to the Grand Canyon Skywalk - a massive cantilevered viewing platform overlooking the glacier below.

The design calls for massive, triangulated, cor-ten steel panels along a 400 m long walkway leading to the main structure - a cantilever reaching out over 30 m over the glacier. Though this kind of private development can bring in tourists and will contribute to the regional economy it builds the infrastructure of parks according to the vision of private corporations. Development of tourism or civic infrastructure in parks should be led by Parks Canada's mandate and stewardship goals, be transparent, collaborative, multidisciplinary and have the interest of the stakeholders of parks at the forefront - not solely the interests of a given developer.

Rendering of Skywalk, Jasper, 2012; from Brewster Travel Canada

Rendering of 400m trail and Skywalk, Jasper, 2012; from Brewster Travel Canada

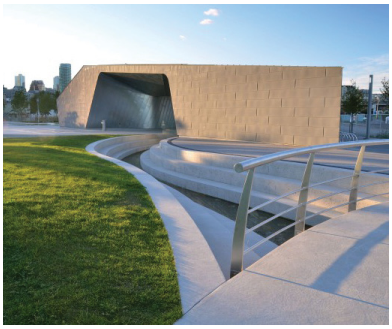
In the end, the experience that Brewster provides will not be the experience that Parks Canada researchers and staff or a Park led private partnership would provide. Any development of this scale deserves careful scrutiny on behalf of the 33 million Canadian stakeholders for whom the parks were created and are maintained.

Although the building will undoubtedly be an incredible thing, in trying to celebrate the glacier and the meltwater that connects the roots of the mountains to far distant places, the skywalk will take the visitor away from it, suspending people high in the sky leaving the experience of the glacier in the valley below.

Sherbourne Common Pavilion

The Sherbourne Common Pavilion designed by landscape architects Phillips Farevaag Smallenberg on the Toronto waterfront stands out as a Canadian, contemporary project that successfully integrates landscape, infrastructure, public space and architecture. According to the Waterfront Toronto website: “Sherbourne Common is the first park in Canada to integrate an ultraviolet (UV) facility for neighbourhood-wide stormwater treatment into its design.”[19] This integrated approach creates an important and safe water resource for Toronto’s downtown.

The park is oriented north - south with playgrounds, shade trees, seating and walking paths along its entire length. At the south edge the park meets the lakeshore and a large recreational green space addresses the water. A creek meanders in its terraced bed from the north end of the park to a scupper where it outflows into the lake.



Sherbourne Common Pavilion, Toronto, 2012; from Waterfront Toronto

Sherbourne Common water sculptures, Toronto, 2012; from Waterfront Toronto

Sherbourne Common skating rink, Toronto, 2012; from Waterfront Toronto

19 Waterfront Toronto, *Sherbourne Common,* accessed November 21, 2012, http://www.waterfrontoronto.ca/sherbourne_common.

Filtration and pumping occurs within a pavilion design by Teeple Architects. This building organizes the space around it, bridging the creek to create a sheltered threshold adjacent to a large fountain courtyard that acts as a public play space during the hot summers and is flooded as a public skating rink in the winter.

This project demonstrates how a high level of integration can add value to a project. Though the surrounding developments are not yet inhabited, this park is already heavily used year-round. If our most dense city can achieve this level of infrastructural integration, surely our parks can at the very least equal the standards set by this precedent.

Sherbourne Common Pavilion, Toronto, 2012; from Waterfront Toronto

CHAPTER 3: DESIGN

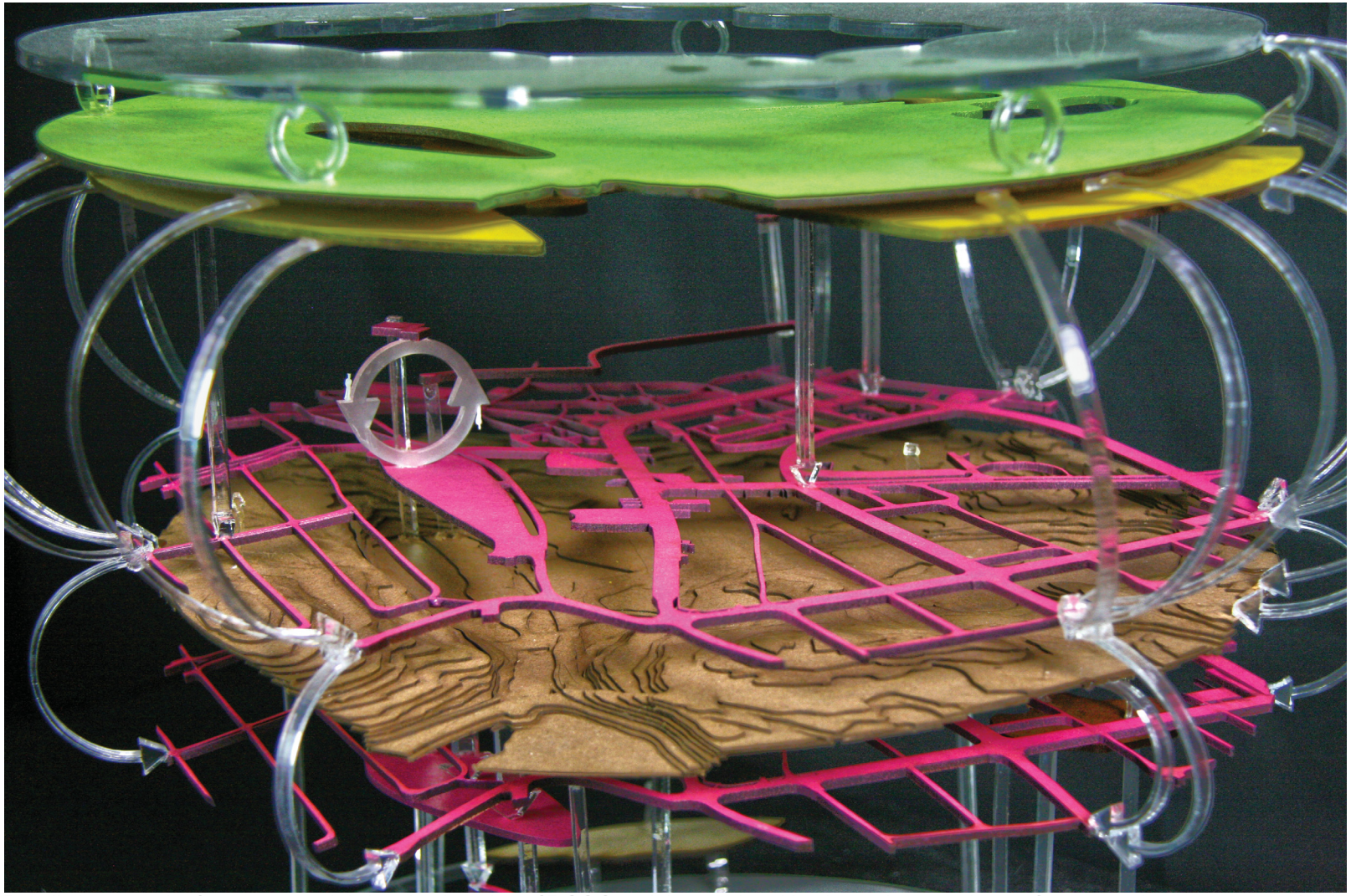
Site plan showing green swales and dry pond locations, RCOC and downtown Wasagaming.

Sustainable Stormwater System

Design Strategy

Catch basins and storm sewers currently drain the three existing catchments within the project area. These will be retained to continue to drain stormwater runoff from the town centre towards the lake shore. The three existing outflows will be decommissioned.

Wasagaming Drive is redesigned from a two-way, four-lane street (parking on both sides) to a two-way, two-lane street with parking on the restaurant side and a wide green swale, sidewalk and bike lane on the lake side. This swale collects water draining in the existing stormwater catchment below the roadbed and either by grading or using a lift station, similar to the one proposed by Stantec, redirects the water to the large central parking lot between the commercial district and the Clear Lake Cabin area to the west.



Detail photograph of systems model showing location of RCOC and dry pond parking lot and system layers from top to bottom - atmospheric reservoir, vegetation, roofs, RCOC, green swale, roadways, topography, road beds, dry pond reservoir, wetlands, Ominik Marsh, Clear Lake and the aquifer

The parking lot was once wetland, contiguous with the Ominik Marsh system. By building a permeable bed for the new parking lot with a series of aggregates and topping it with a permeable paving system and shade plantings the human use of the site (parking) is retained and the natural system is restored.

The RCOC is sited at the northern end of the parking lot with the recycling depot adjacent to it and drainage from the building flowing directly into the sub grade reservoir. This reservoir acts as a dry pond allowing aeration of stormwater, slowed flow rates, deposition of sediment load and partial depletion of nutrient and other pollutant loads.

When water levels are high or when flushing of downstream systems is desirable, water slowly outflows into a second green swale running south and connecting the dry pond with Ominik Marsh. This coupling with the marsh system the potential to mitigate negative downstream effects of rerouting large volumes of water, has the ability to control release of water into the system and increases the in-stream water quality of stormwater runoff.

Resource Conservation Operations Centre

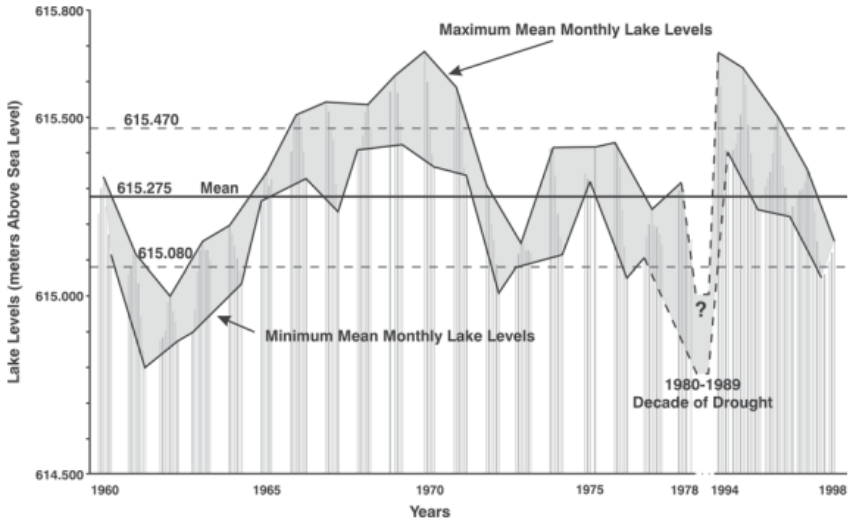
Existing Facility

Existing maintenance compound and RCOC, Wasagaming, 2013; map from Google

The existing Resource Conservation Operations Centre in housed in a 5,000 sqft warehouse in the park maintenance compound approximately 3 km from Wasagaming. This is a reuse of the warehouse space and is insufficient for the needs of the human resources involved in resource conservation.

RMNP currently plans to upgrade the existing facility to make it more habitable, but this research and management hub would remain separated from the visitors in town and the valuable work that is done here remains invisible.

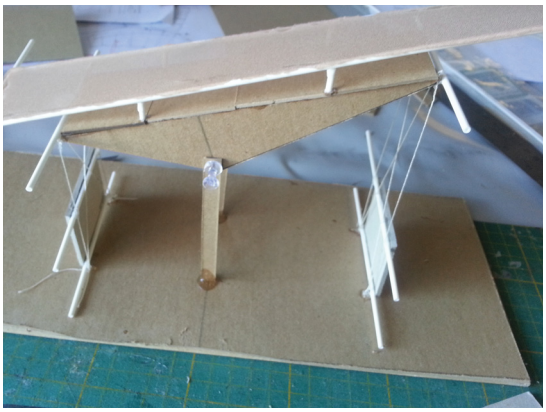
Design Strategy



F.S. Parsons and R.A. McGinn, Clear Lake water levels over time; from Parsons and McGinn, *Prairie Perspectives*

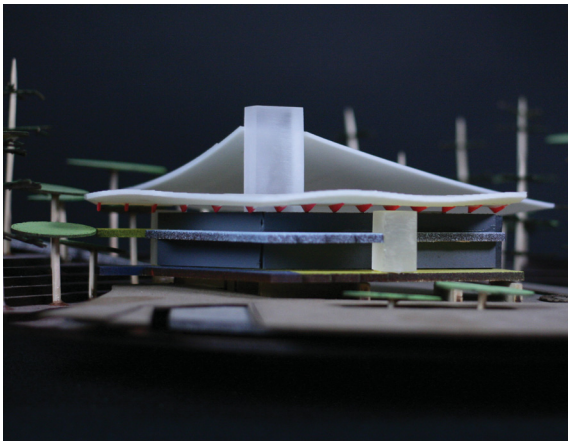
The design of the RCOC is driven by the physical model making analysis of the existing natural and urban systems. Structural forces, drainage and circulation are expressed in the building tectonics emphasizing systemic connections from the building systems to the surrounding town and landscape.

1:50 scale schematic section model studying structure, roof buildup, spatial conditions and building envelope

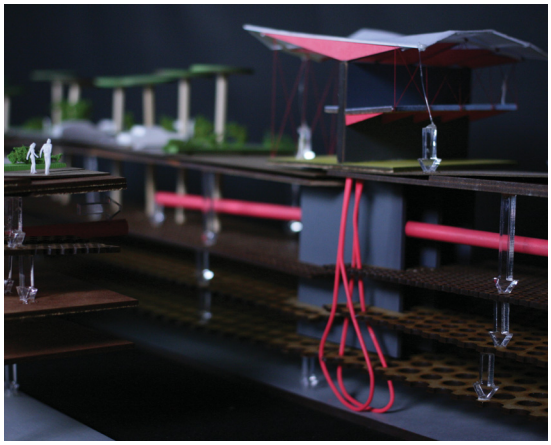


Structural behaviour schematic model showing centrally supported truss and pin joint for rotation and generation of roof geometry.

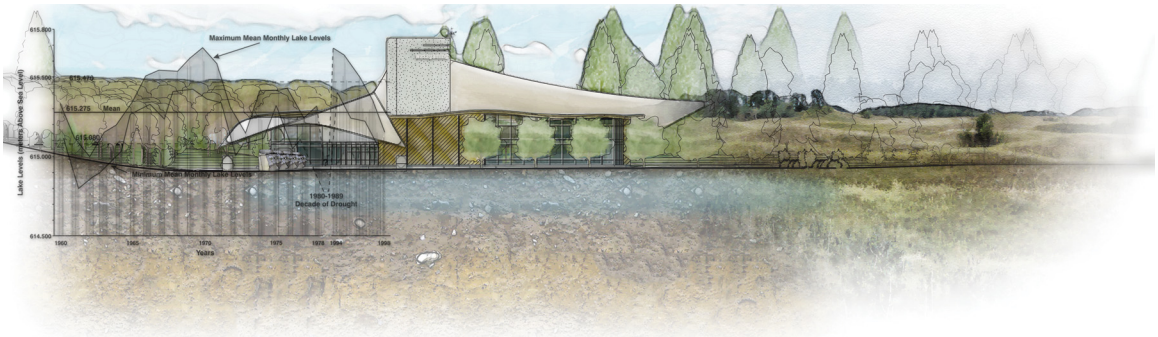
The building reacts to the cyclical water levels of Clear Lake and the larger cycling within the ecosystem with a geometry driven by a modified sine curve generating a roof geometry reminiscent of the rolling landscape of the parkland and representative of an idea about larger cycles affecting the region over time. A simple rotation of a standard, repeating truss around a central axis, one bay at a time, describes the sine curve along the length of the building using straight lines. Tensile members at either end of the centrally supported trusses express the forces they carry while determining the rotation of the truss. Secondary cross braces take up the shear between trusses. Wood joists form secondary spans between trusses creating a fluid framework for the roof deck which is layered sheets of thin plywood, bent to follow the curvature of the roof. Additional layers of rigid insulation panels create a winter-tight envelope exposing the sinuous plywood as a finished surface inside the centre. The top chord of the truss supports a tensioned fabric panel translating the curve of from the trusses through to a taught rain-screen roof. Skylighting in the office area allow this fabric to bring a diffuse light into the building.



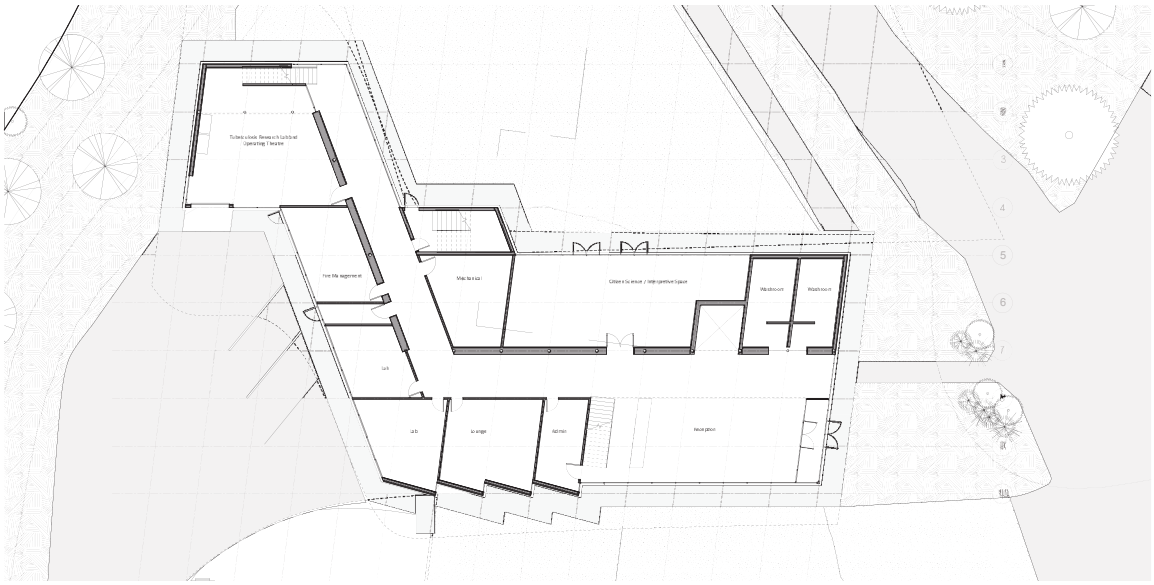
1:300 scale schematic model showing massing, roof curvature and immediate site context



Site section model showing relationship of building design to dry pond, parking, green swales, circulation and topography

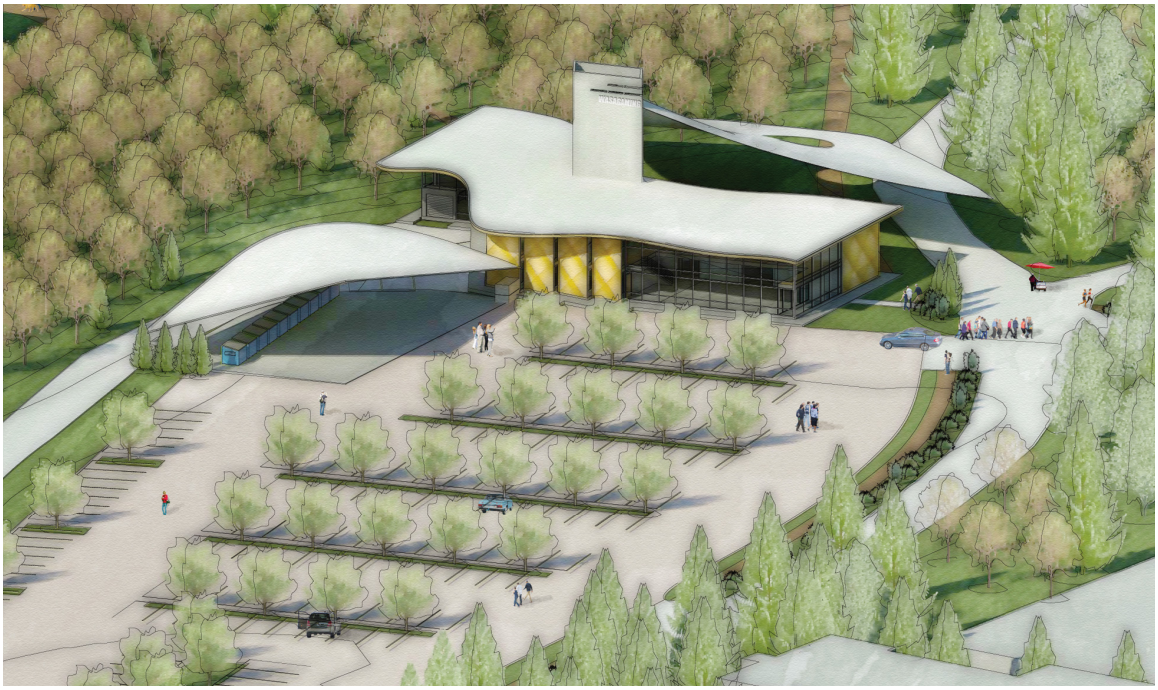


Schematic south elevation showing mast, canopies, sine curvature of roof plane and rolling prairie landscape

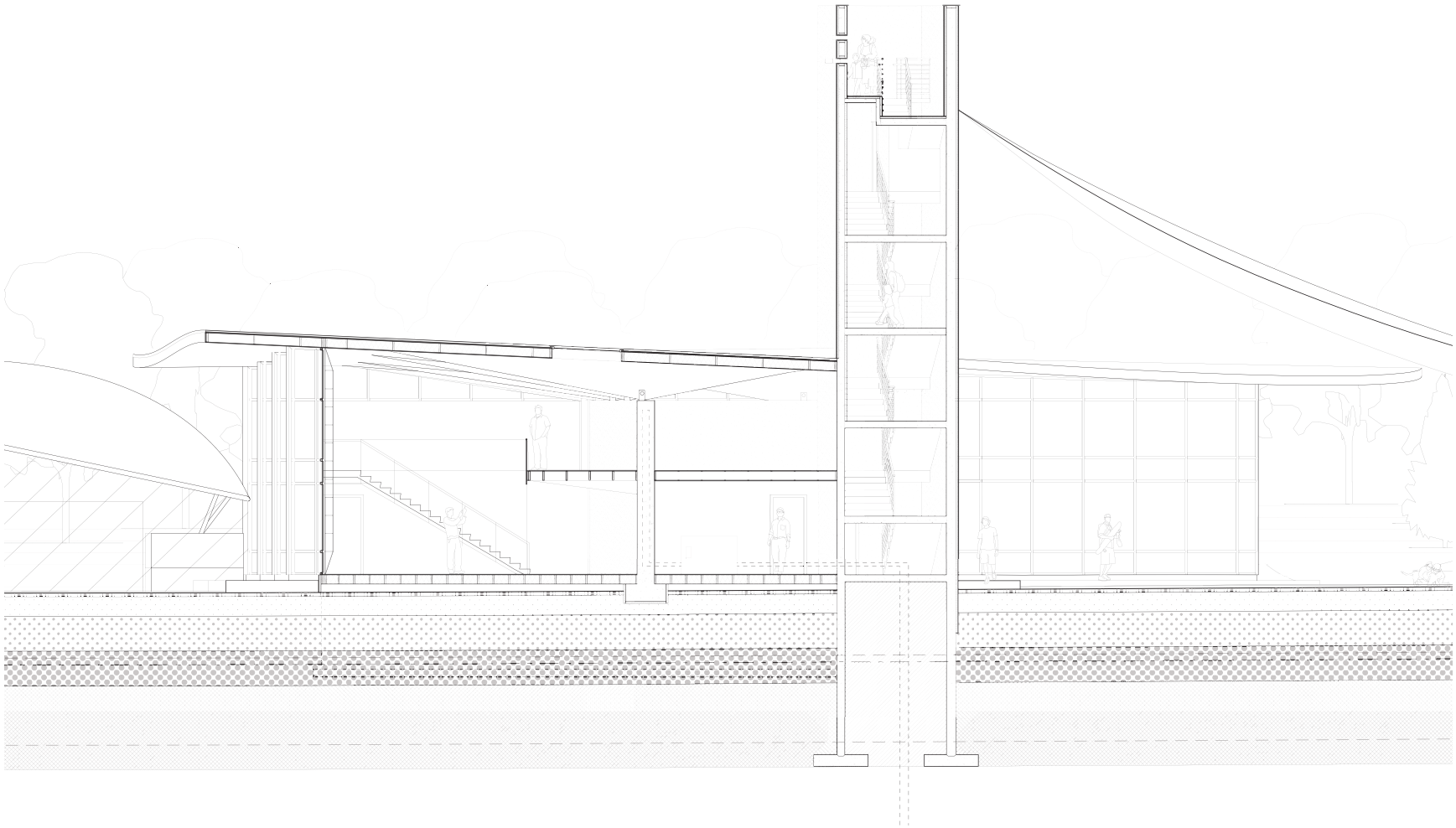


Floor plan in development showing west wing of building with research program and south oriented public programme spaces, L-shape in place forms north courtyard

The layers of the building are held in tension like the layers in the abstract study models; circulation, drainage, directed views, mechanical systems and storm drains make visible the connections into the surrounding landscape. A fabric canopy stretches taught from a central mast, reducing the building to pure surface as it lifts away from the envelope of the building allowing south light to reflect down into the square. The mast supporting the



Aerial perspective shows relationships between programmed areas, building, boulevards and surrounding site



Building section shows light frame wood construction of complex geometry and the grade relationship and layering of the RCOC

canopy bears the name of the town - Wasagaming, ‘Clear Lake’ - like the water towers of the surrounding prairie towns. In addition to acting as an exit stair to the inhabited first and second floors of the RCOC, the top of the tower is an exterior sky room orienting the visitor to the expansive views above and through slot windows out to the surrounding town and landscape. The views are deliberately focused along the path of stormwater drainage rather than to the lake directly.

Sky room by day and by night showing views out to marsh system and views up during the annual perseid meteor showers

On axis with the building to the south, the Number 10 highways drops down a short, steep slope to the park gate. From the crest of the hill, the tower is visible marking out a destination within the surrounding landscape.

Lab programme is arranged north-south against the slope of the hill rising up to the level cabin area to the west. This hill prevents direct west light from disturbing work in the labs and allows a service entrance to the lab spaces to be built along the base of the hill. This entrance is separated from the main parking lot immediately south of the RCOC by the recycling depot programme relocated from its existing location in the middle of the parking lot.

Perpendicular to the labs, the public program is laid out east-west with the offices on a second story overlooking the north courtyard, taking advantage of indirect daylighting. The courtyard and entrance plaza extend the building into the landscape creating four-season public space.

The two programmes come together in the large teaching spaces and public room where current research is on display for visitors and in the operating theatre where a mezzanine allows visitors to watch the tuberculosis research and animal necropsies - some of the most important research done at RMNP. This integration is an inherently architectural solution to the existing segregation of research and tourism at RMNP today - care has been taken to design the spatial relationships so that building programme and function is not compromised in the hope that such a relationship, given space, could flourish.

Perspective view of the north courtyard underneathe the canopy during the summer, the Winnipeg Symphony Orchestra plays for the community as they did in the summer of 2012

Operating theatre - mezzanine seperates researchers from large visitor groups while bringing them closer to the actual work

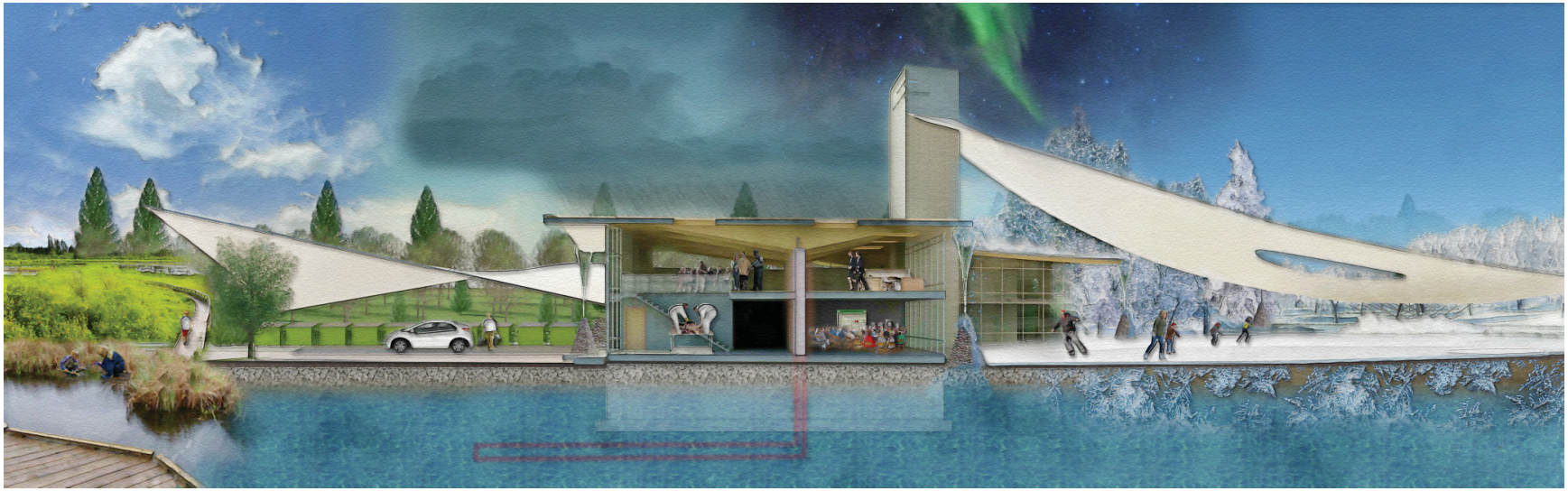
CHAPTER 4: CONCLUSION

Implementation of an integrated proposal would rely on a design lead - probably an architect - capable of delivering a project with such high ambitions of integration. This requires Parks Canada to plan for a wider project scope at the outset when approaching infrastructure development and to seek a prime consultant who is able to effectively act as an advocate for the various stakeholders in the design process. Collaboration across fields from architecture, engineering, landscape architecture, planning, art and ecology to talks with representatives of local stakeholders, first nations groups and chambers of commerce should take place with a project like this in order to celebrate what Wasagaming and RMNP are.

The concept for a lift station has been retained in this thesis though a consulting team with landscape and civil engineering expertise may be able to redirect water along Wasagaming Drive with gravity alone. If this is possible it would be more desireable. The principle strategy for the stormwater infrastructure was to create people friendly spaces where surface water could collect and move through the system. Locating the dry pond based on existing grey fields in the town and a reading of the landscape that revealed the thesis site was part of Ominik Marsh until mid 20th century are a direct criticism of the plan to locate the Stantec dry pond where a stand of mature trees currently grow on higher ground.

Any infrastructure needs to be able to do more than be singularly functional - it needs to be integrated, cross-polinated with building programme, made visible and accessible, present and the ideas it represents should be legible.

One way to do this is to design the building and site to perform - the inhabitation and use of the building is a performance; the layering an integration of the systems; the negotiation of vertical and lateral loading; the drainage detailing; the circulation through building and site; the expression of how and where the building touches the ground; the concepts driving a formal or tectonic approach to design and building massing. All of these strategies are present in this thesis and should be considered as Parks Canada moves forward with the design of the upgrade to the stormwater infrastructure and RCOC so that the move to a more sustainable community in Wasagaming is a seen as a celebration of that place and the Riding Mountain Biosphere Reserve as a whole.



Conceptual section showing integration of park trails, civic infrastructure, natural systems, public space, research, management, tourism and seasonal climate into building design

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