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TABLE OF CONTENTS

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Preface

Prairie Perspectives: Geographical Essays is an annual peer-reviewed publication of the Prairie Division of the Canadian Association of Geographers (PCAG). The scholarly manuscripts included in each volume are a selection of those presented at the PCAG annual meetings, as well as contributions pertaining to the geography of the Western Interior solicited from, or submitted by, members of the Canadian Association of Geographers.

The Prairie Division of the Canadian Association of Geographers' annual meeting in 2011 was hosted by the geography department of the University of North Dakota. Following the tradition of holding the meeting in a small rural centre, the Department elected to hold the meeting in the town of Devils Lake, North Dakota. Some 75 people attended, including students and staff from universities and colleges in Alberta, Saskatchewan, Manitoba, North Dakota and Northwestern Ontario. Numerous papers on a variety of topics in human and physical geography were presented, demonstrating the range of interests embraced by modern geography. The conference was organized by Dr. Douglas Munski of the Department of Geography at the University of North Dakota, ably assisted by Dr. Laura Munski and a number of UND geography faculty and students. Although registration and the social side of the meeting, took place in the Great American Inn and Suites, the academic side of the conference was held on the campus of Lake Region State College. The well attended field trip to the flooded communities in areas surrounding Devils Lake, held on Saturday afternoon after the conclusion of the paper sessions, showed the close relationship between physical and human geography.

This collection of papers is drawn from those presented at the 2011 meeting or submitted by members of the Prairie Division. Following the standard practice of *Prairie Perspectives* all papers were subjected to a double blind peer review editorial process. The editors would like to thank all the anonymous reviewers for agreeing to participate in this time-consuming process.

These papers are drawn from both the human and physical sides of the discipline. The first two papers show how historical geographers can use diaries to provide insights into attitudes and behaviours in the past. The opening paper, by Ann Marie Murnaghan, demonstrates how an analysis of the diaries of Elizabeth Posthuma Simcoe, a government official's wife at the turn of the nineteenth century, illustrates how gender, class, and race influence the way in which our views of nature were, and still are, constructed. Murnaghan argues these discourses of nature are still relevant as they are often uncritically incorporated in current day geographies and, moreover, still bear upon the way in which we see nature.

Lehr and Sawka take a similar, though less theoretical approach, to interpretation of the past when they explore how W.J. Sisler recorded his impressions of the 1893 Columbian Exposition in Chicago. They argue Sisler's diary highlights how this landmark event bore upon the consciousness of the age. Although countless articles and brochures touted the wonders on display at the Exposition, Sisler's account is refreshingly honest, if by today's standards politically incorrect. Lehr and Sawka also suggest that the influence of the Exposition may still be seen in our modern North American landscapes.

The following paper by Robert Patrick and Amy Macdonald tackles the issue of symbolism in the built landscape. New York City's World Trade Center (WTC) was a symbol of the financial might of the United States and, arguably, a symbol of the progressive secular values of the capitalist western world. They point out that how these values were perceived, as positive or negative, depended on the philosophical and political orientation of the observer. In assessing the symbolic attributes of the World Trade Center before the horrific attack of September 11, 2001 and the values embodied in the Freedom Tower later built on the site, Patrick and Macdonald contribute to the growing literature on symbolism in our built environment.

Meaghan Sawka's paper examining the occurrence and location of graffiti in women's washroom stalls at the University of Winnipeg pushes the frontier of micro-geography. Most male geographers will be surprised to learn that graffiti is common in women's washrooms but will probably be equally surprised to learn it seems to be radically different from the graffiti commonly encountered in men's washrooms. That, however, is not the point of her paper, which is concerned with how and why women perceive and use space within the confines of the multi-stall washroom. The collision of the concepts of privacy, territory and personal space translate into a fascinating micro-geography of graffiti within a very small area.

Many of us use, or pass by, city parking lots and parkades on a daily basis, without giving them a second thought. Not so Marc Vachon, who sees them as an integral part of the urban cultural landscape. Like so many urban artifacts, parking lots and parkades carry the values of the communities that host them and parking structures reveal a great deal about the aesthetic attitudes and the social values of the times in which they were built.

The final paper of this collection by Rod McGinn tackles a completely different theme. The only paper that deals with physical geography, it assesses the effectiveness of various models used to estimate rates of snow melt and consequent runoff. Blending field work and theory he argues that models using the arithmetic mean of the degree-day melt ratio tend to overestimate snowpack depletion. His suggestion for adoption of a seven-day smoothed mean may permit more accurate predictions of snowpack melt rates.

These papers are focused on widely scattered locations ranging across North America. Nevertheless they all share common attributes: the concern with place, space, and time that lies at the core of geographical enquiry.

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John Lehr, University of Winnipeg.

Acknowledgements

The 2011 Prairie Division of the Canadian Association of Geographers annual meeting held at Devils Lake was hosted by the Department of Geography of the University of North Dakota. Special thanks are in order to a number of people who contributed to its organization and success.

First, support from the faculty included the chairperson of the department, Dr. Bradley Rundquist, and colleagues Dr. Paul Todhunter, Dr. Gregory Vandeberg, Dr. Devon Hansen, and Dr. Christopher Atkinson. Other assistance from the campus based in Grand Forks came from the Office of the Dean of the College of Arts & Sciences. Particular thanks is given to Dr. Vandeberg and Dr. Todhunter for their outstanding efforts to make the field trip in the Devils Lake Basin highly informative, highly insightful, and highly enjoyable.

Second, the Association of American Geographers is to be thanked for providing the underwriting of the featured guest speaker from the University of Kentucky, Dr. Stanley Brunn. This grant was arranged by Dr. Rundquist and produced a collaboration in the process to the advantage of a number of stakeholders. Other key underwriters to be thanked are the Association of North Dakota Geographers and the Virginia George Inheritance Fund.

Third, faculty at the various institutions associated with PCAG are to be commended for helping to promote student as well as faculty participation at the conference in terms of papers and posters. Seventy five attendees saw thirty-two papers and nine posters presented.

Fourth, the staff of Lake Region State College, the conference site, and the staff of the Great American Inn, the conference hotel, are thanked for their fine efforts to make the venues comfortable as well as pleasant places in which to engage in conference activities. The "lunch room ladies" of the community college especially need recognition for arranging the special treats that were brought as snacks for the field trip.

Fifth, I wish to thank my co-editor, Dr. John Lehr of the University of Winnipeg for his assistance. Mr. Weldon Hiebert, cartographer at the University of Winnipeg, was the technical specialist behind the production of this volume. He went the extra mile to see this volume produced. I truly am grateful to him.

Sixth, Dr. Laura B. Munski, Executive Director of the Dakota Science Center, is given both thanks and a special commendation for helping with the preparation of the abstracts, the field trip packet, the registration, and the schedule as well as general logistics. She always managed to salvage things and is truly a godsend to me in more ways than one.

Finally, I need to give a generic thank-you to all and sundry from across the member institutions of PCAG who helped me to make the PCAG 2011 as successful as it could be under difficult circumstances. Some people working behind the scenes deserve far more credit than do I, for ensuring the conference's success and keeping the PCAG tradition alive through its 35th annual meeting.

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Representing nature in Elizabeth Posthuma Simcoe's Diary: An examination of Toronto's colonial past

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Abstract

In this article the author examines how gender, class, and race are important factors in the construction of historical discourses of nature. Using a close reading of the diary of a government official's wife at the turn of the nineteenth century, three themes of colonialism appear. The contradictions of rationalizing the landscape through cartography, counting nature using botany and natural history, and romanticizing the landscape through painting and nature writing, highlight how the colonial project was a complex weave of ideas about nature, as commodity, scientific fact, and moral instruction. By exploring the diverse media in Elizabeth Posthuma Simcoe's Diary – maps, paintings, and writings – a nuanced picture of an upper-class, white woman's role in the Upper Canadian colonial project is drawn in relief. The article explores the ways that historic discourses of nature remain in cities and are easily (and often uncritically) incorporated in current day geographies. The author argues that the colonial past must be thoroughly interrogated in order to understand how discourses of nature have been constructed to serve certain interests, disguise the processes of colonialism, and reinforce certain ideas about gender and nature in the present.

Introduction

Popular environmental legends underlie the construction of urban natures in most cities. Often competing environmental narratives employ the tropes found in these legends to different ends. As the literature of urban political ecology has shown, these narratives are often integral to urban environmental struggles and exemplify the ways that nature, and ideas about nature, are often used to represent larger questions of social power (Gandy 2002; Desfor and Keil 2004). This article examines how the colonial era diary of the wife of the first Lieutenant-Governor of Upper Canada has been used to represent a romanticized version of life in the Toronto area before the urbanization of the nineteenth and twentieth centuries. This construction of nature, which was clearly set in a historical context that produced it, has in turn been used by environmentalists to call for a "re-naturalization" of a river valley using the language and images that Elizabeth Posthuma Simcoe wrote and drew over two-hundred years ago. The durability of this romantic depiction of nature through the reproduction of her diary, maps, paintings and drawings, both in print and on the Internet, are representative of both the fascination with the diary as an artefact and this woman as a character. The fact that this diary was written by a woman who was seen as more environmentally sensitive than her military husband has added another dimension to the place that it has received in the popular history and legend of the Lower Don Valley.

Through policy documents, media representations, and popular education, the story of Elizabeth Posthuma Simcoe (née Gwillim) has become foundational to the environmental discourses of the Lower Don Valley, Toronto, Canada over the last two hundred years. From 1792-1796, she wrote and illustrated a diary about her travels with her husband John. Elizabeth recorded not only the scenes she saw, but also her interpretations of what she encountered; from this record we can begin to read her place in the imperialist/colonialist project. The parts of her Diary that detail her life from Québec to Niagara-on-the-Lake, including the few years spent in Toronto, have come to represent the 'pristine nature' which 'existed' before gross-scale European settlement in Canada (Miller 2002). Parts of her diary were

published in some form from 1896 to 2002 (Scadding 1896; Robertson 1911[1973]; Innis 1965), and an interest in her art (watercolor paintings, charcoal sketches, and ink drawings) has been sustained until the present through websites where one can explore her work over 200 years later (Welch and Pura 2002). The construction of Elizabeth Simcoe as a young, environmentally sensitive, woman writer and artist has contributed to a mythology where she stands as the "patron saint" (Desfor and Keil 2004: 81) of many local environmental activists of the twentieth century who refer to her descriptions of an 'unspoiled natural landscape' in the current location of the City of Toronto.

However, there is something problematic in this construction of 'nature as pristine' until the 'first (white) contact' that must be noted, and the use of Simcoe as a saint must be problematized. Bruce Braun has argued that colonialism is so entrenched in Canada's history that looking at questions of 'nature' without asking about the influence of the colonialist project is naïve and power-blind (Braun 2002; Braun and Wainwright 2001; Willems-Braun 1997). Historians, social scientists, and policymakers set an artificial base to their understandings of 'nature' by discounting the occupation of territory, and environmental use of aboriginal peoples, and as such are on an unstable foundation. In order to begin to correct this, the colonial encounter must be analyzed as a real event, and set in a historicity that is appropriate to begin illustrating the intellectual and religio-moral contexts of the colonizers and the colonized. Through recognizing the colonial influences on environmental discourses we increase our ability to negotiate tropes that have been inscribed onto our landscapes, and have entered into our understandings in taken-for-granted ways (Gregory 2001).

A postcolonial approach has similarly been applied to researching the intersections between colonialism and gender in historical travel writing and natural history[1]. Two recent edited collections, on women and Canada's colonial past edited by Katie Pickles and Myra Rutherdale (2005) and on women and the Canadian environment by Melody Hessing, Rebecca Raglon, and Catriona Sandilands (2005), are exemplars of the enormous possibilities of research in this vein. A critical, often feminist, look at history and space through personal accounts in the period of British imperialism and colonization (roughly since 1700) has helped uncover the ways in which lived difference influences the interpretation of colonial practices and places (Jacobs 1996; Pratt 1992; Blunt 1994; Blunt and Rose 1994; Stoler 1995). This literature has largely focused on colonial Victorian women travelers from England to South America, Africa, and India. These studies often directly address questions of 'race' and gender and are as such usefully applied to the case of Elizabeth Simcoe in Canada. The narratives in this literature that used a feminist lens also uncover how the disciplines of geography, history, and anthropology have been constructed, and how the restriction of women and racialized peoples has shaped the production of their knowledge bases in exclusionary ways, both substantively and methodologically in the European and North American academy (Domosh 1991; Scott 1999).

The broad narratives of colonialism and nature, and colonialism and gender have incorporated generous doses of discourse analysis (Gregory 2001; Jacobs 1996). This essay draws from political ecologists and feminist geographers to lend context to the issue of how Elizabeth Simcoe's Diary ascribed certain views of nature to the landscape, and how this, in turn, aided the imperialist project. The time in which Simcoe was traveling, her social class, and education set her apart as far too unique a character from whom to make abstract generalizations, but by rewriting Elizabeth Simcoe as a white woman and not a "saint," we have the opportunity to address the concepts of 'race' and gender in the colonial project (Blunt 1994), and how power has defined the discursive and material context of the Don Valley, and Toronto, Canada.

I will examine the three main themes in Simcoe's diary that highlight this colonial narrative. These three different themes were addressed in three different media, and to three different audiences. Through this combination of themes, media, and audiences we can see that although the colonial narrative has a tendency to be simplified as direct exploitation, there is a complex network of processes at work which together form the colonial discourse which helped to entrench it as an ideology in Britain in the time period (Jacobs 1996). The first theme is that of a rationalized knowledge the land that Elizabeth Simcoe aided in by drawing and annotating maps for her husband and his military colleagues. The act of recording on paper, while integral to the research conducted here, carries biases when ascribed with cultural values of what constitutes 'true' knowledge, and irrefutable evidence (Harley and Laxton 2001). The second is that of collecting and describing the 'natural history', that is the plants and animals, of the region which she detailed in her letters to her best friend Mary Anne Burges, who read them to her children (Fryer 1989). These letters incorporated her scientific interest in botany and zoology, and were the beginnings of an inventory of the plants and animals of Upper Canada. Influenced by Carl Linnaeus' *Systema naturae*,1735, and the work it inspired which set out a classification system for biotic organisms, this practice of taxonomy became a popular task for the educated urban élite in the 1700s of which Elizabeth could be considered a part even though she chose mainly to live on her family's country estate (Miller and Reill 1996). The final theme is the romantic which is exemplified in the concept of Picturesque landscape painting and writing where nature is seen as an object, and where wildness is of aesthetic interest for its pureness to the form created by God, and unadulterated by imperfect humans (Miller 2002). Elizabeth Simcoe painted the scenes of Upper Canada on birch bark, some of which she presented to King George III (Gerry 1999). With these themes, I write a nuanced version of one woman's experience early in the colonial project which contrasts with Victorian era (1839-1901) travel accounts into Africa and South America in terms of Simcoe's self-reflexivity to the colonial place and peoples (Blunt 1994).

[1]My use of "postcolonialism" refers not to a period of 'after colonialism', but to the theoretical work which engages with the concept and reality of colonialism to make a conscious effort to examine the history of the colonial moment, and move past colonial constructs, as well as 'colonized minds' which reproduce separation, and dualisms (Gregory 2000; Jacobs 1996; Hooks 1990).

"Mrs. Simcoe's Diary"

Elizabeth Simcoe's Diary is published in three versions: the first is a fragmented set of letters published by Henry Scadding in 1896, the second is Robertson's annotated version of 1911, and the third is Mary Quayle Innis' version (1965) which remains truest to the spelling, and capitalization of the original work (Firth 2003). The diary itself was a collection of letters, paintings, maps, and drawings which were compiled by Mary Anne Burges, Elizabeth Simcoe's best friend in England for the children and friends of the family to stay up to date with the events of the travels (Fryer 1989). Numerous sources have described the Diary as the most complete written and visual history of the landscape before 1820 (Don Valley Conservation Report 1950; Sauriol 1981) and, as such, Elizabeth Simcoe has been mythologized as author of this Eden-like setting, which elevates her from a person with an everyday life to an ethereal being as "saint" (Desfor and Keil 2004: 81) and "ghost" (Davidson n.d: 1) with an omnipotent view.

Elizabeth Simcoe has been described in numerous ways from a "lively, involved, active person" and courageous adventurer (Fryer 1989) to a "little stuttering vixon (sic)" and quiet, romanticizing anthropologist with a superiority complex (Hannah Jarvis, quoted in Firth 2003). Born in Aldwincle, Northamptonshire, England in 1762, she was raised by friends of the family as her father died before she was born, and her mother died in childbirth. As the heiress to her parents' estate, Elizabeth received the benefits of her social status and class and was educated in botany, natural history, and languages at home by tutors and governesses (Fryer 1989). Her uncle and guardian, John Graves, encouraged Elizabeth's marriage to his godson John Graves Simcoe. It wasn't until 1782, when Simcoe was recovering at the home of John Graves from a battle injury incurred fighting with the Queen's Rangers in Virginia, that the couple spent time together. They soon married. With the wealth Elizabeth inherited from both her mother and father she lived comfortably in an estate at Wolford, England, with John who was ten years her senior, and had one child a year for the first five years of her marriage, and eleven children in total (Fryer 1989).

As her husband rose in rank in the military, he was commissioned to travel to North America in order to survey the lands and organize the governance of the territory of Upper Canada as its first Lieutenant-Governor. Elizabeth and John both had Canadian connections: although neither knew them, both their fathers served in Canada before their deaths, her father as an aide to General Wolfe (Scadding 1896). As members of the British upper class, they also had friends who were living in the colonies as government and military officials (Fryer 1989). Elizabeth Simcoe brought along two of her children, Sophia and Francis, a nurse for each of them as well as some servants, while the rest of the children were left in England. After a long voyage by sea, documented in detail in her Diary, they settled into life in the colony.

Discourses of nature in Mrs. Simcoe's Diary

As introduced above, there are three main connections between Mrs. Simcoe's Diary and the colonial project identifyable through a series of external discourses. A discourse analysis can help unravel the colonialist project's construction, how it was maintained through everyday practices, and how it managed (and manages) to objectify nature and strip natural processes of their functionality independent of humanity. Elizabeth's representations –maps, writing, and art– were set in broader artistic discourses of Romanticism and the Picturesque, as well as political and economic investments in natural resources. Through these representations Elizabeth was articulating nature and colonialism in different ways. This rich discourse was durable both across space and time: hundreds of miles across the Atlantic in the period; and over two hundred years to today's cyberspace renderings (Welch and Pura 2002).

Cartographic expressions of colonialism

Elizabeth Simcoe was a skilled cartographer, and her talent in map reproduction was often employed by her husband John in his military reports (Fryer 1989). On these maps she drew mainly the watercourse, and settlements, annotating them with the English names that her husband preferred: the River Don instead of the Algonquin Nechenquakekonk or Wonscoteonach (104[2]; Don Valley Conservation Report 1950); and the City of York instead of its previous Toronto (108; Rayburn 1994). The tradition of naming places co-constitutes the cartographic practice; renaming places is a concrete example of how a colonial project can assert its new 'knowledge' of places and 'resources' on maps. When the colonialists' names replace those of the people who have been living on the land, especially when the settlers use names from their homelands, this becomes a powerful discursive remnant of the colonial project which reasserts the colonial rule in everyday life in years past the initial event. By erasing 'pre-colonial' names, the Aboriginal culture is rendered extinct, eroding awareness of connections between Aboriginal culture and nature.

Even though the Simcoes only spent a few years in Toronto, many of their names have remained entrenched in the landscape today. Castle Frank, the house they named for their son Francis, lends its name to in a subway station and several streets near the house's old site (170). Several municipalities had also kept the names which are linked to the colonial moment: Scarborough was named after the white cliffs that Elizabeth associated with those of her homeland (102); and York, North York, and East York come from John's renaming of the city as York from Toronto (108)[3]. Lake Simcoe to the north, and Gibraltar Point on the Toronto Islands also took their names from John (103). Elizabeth discusses sending and receiving maps in her diary, and makes numerous references to distances from places in miles: it seems she had a 'geographical imagination' and was comfort-

[2]Numbers refer to page references in Innis' edition of Mrs. Simcoe's Diary, 1965.

[3]The City of Toronto was amalgamated in 1998. The old municipality names are now used to represent neighbourhoods and community councils.

able using her intellect to rationalize the landscape (Said 1993; Gregory 1994).

Jacobs drawing on Edward Said (1993) has discussed the spatiality of colonial power, and the ways in which cartographic representations have material influences on the colonized landscape and peoples where knowledge hinges with control (1996). Jacobs posits that "the role of the spatial imaginary in the imperial project is perhaps most clearly evident in the spatial practices of mapping and naming." (1996: 19). This legacy of 'map as property deed' brings interesting issues to a postcolonial cartographic practitioner, but by incorporating these considerations in the mapmaking process, there are again possibilities to challenge the hegemony.

Collecting, counting, and classifying nature

In Mary Beacock Fryer's biography of Elizabeth Simcoe, she uses letters sent to Elizabeth's best friend Mary Anne Burges, a noted English intellectual, artist, linguist, and naturalist in order to flesh out her story and illustrate the context of the letters within an intimate relationship (1989). The women had known each other since childhood, and one should read the diary with the knowledge that while Elizabeth was writing for herself, she was also writing for Mary Anne, who read the letters to the children that Elizabeth had left in England. Although Elizabeth had two children with her in Canada, like many women of her class in the late eighteenth century, she employed nurses to care for them, both in their home of England, as well as on her travels in Canada. The letters she sent back to England served as a narrative for the colonialist project, and in that time period helped to image the colonies to the people in the homeland.

One of the key themes that emerges from her letters is her interest in documenting the biota of the country in terms of scenery and food. For consideration of space I have just selected the references to plants and animals she made while in Toronto, although it should be noted that the descriptions she made on her local travels tend to have more detail, although this could be attributed to the summer season in which she traveled. Her language is particularly evocative. Elizabeth documented birds: loons (103), "wild ducks & swamp black birds with red wings" (104), a bald eagle (106), "beautiful black & yellow bird" (108), "wild Pidgeons" (111), an owl (112), and geese (175); insects: "a green Caterpillar" (106), "musquitos" and a large maggot like insect she could not identify (177); Rattlesnakes (107, 110); fish: salmon (104), Maskalonge and Pickerell (116), Black Bass, perch, and white fish (174); and mammals: "a bat remarkable for its size" (108), a raccoon (112), and deer (113). As well as fruits: berries of Cockspur Thorns (106), and "purple berries from a Creeping Plant" (107), "wild grapes… pleasant but not sweet" (107), "beautiful white berries with a black Eye from red stalks" (107), Cranberries, partridge, fox, and Mountain Tea berries (171); trees: "fine Oaks" (101), poplar (102), Hemlock Spruce (106), "very fine Butternut Trees" (106), Fir trees (110), and birch trees (176); seeds "of Toronto lilies" (108); and other plants: "everlasting Peas creeping in abundance of a purple colour" (102), and a "beautiful species of Polygala" (106). Elizabeth describes ecologies too: "natural meadows" (102), Pine plains (110), and pine ridges (174). She rarely referred to any of the plant or animal life in a negative way, and the adjectives of fine, very fine, excellent, and beautiful abound in her writing. Additionally, the modifiers of natural and wild are often used in her descriptions referring mainly to her experience in England with the domestication of several of the animals, probably in regard to the texture and quality of the flesh for eating.

Elizabeth discusses sending specimens back to England, and being sent specimens she "had not yet seen" (108) from within the region, such as an owl from Niagara (112), and some rattlesnakes in a barrel caught by a military official (107). Her interest in botany, and natural history are clear from her writing, and she is probably further catering to Mary Anne's and her children's interests as well. She comments on a Miss Russell, who has "a Collection of Plants dried by merely shutting them in books, I wish I had thought of doing so," (179) highlighting again that she was not alone in the pursuit of documenting the nature of Upper Canada. Elizabeth often alludes to the animals and foods of England, and compares the Canadian species to them as a reference, with a reflexive notation although not implying the English as a definitive standard. As Miller and Reill discuss, the late 1700s were highly interesting times in the field of taxonomy (1998). They came before the professionalization of the academic disciplines, so women participated in knowledge production more than they would by the mid-1800s (Shteir 1987).

As previously discussed, this idea of rational knowledge of the land is an important part of the colonial project. Similarly, ordering the plants and animals upon that land was a similar process whereby the colonizers could begin to order the people and the cultures into the designs set out for them from the imperial headquarters (Mackay 1996). Although in not the same degree as the Darwinian, or Banksian expeditions to the tropics from works cited above, the British colonial presence in Canada was focused more on wildness than the novelty of different plant species. Instead of being an entirely different setting that was exotic, Upper Canada (now Ontario) seemed to be imagined as England before 'civilization,' although stretched out over a greater geographic extent. As such, this pre-culture ideal easily became a discourse that was embedded in the history of the English landscape. Clearing trees for pastures, and setting up mills to process these trees for log cabins became rationalized as the obvious thing in the discourse of English knowledge as the correct knowledge. As indigenous scholars have discussed, this claimed and colonized knowledge of the land began a process of cultural domination and exploitation that has had devastating effects for local and global environments (Tuhiwai Smith 1999). By examining these narratives in the context of the extreme dispossession of the colonial project, we can move them further from their romanticized innocence that many environmentalists (paradoxically) have used to promote their causes.

The Picturesque in Elizabeth Simcoe's paintings

Elizabeth painted numerous scenes of Canada –she claimed that she had a "picturesque eye" (quoted in Firth 2003)– many

of which she gave to King George III (Gerry 1999). Her painting style was formulaic landscape painting: with large trees in the left or right of the foreground, and the focal point in the centre usually of a structure, or natural feature. Although she was influenced by the Picturesque, she did not replicate its form identically: 'nature' was the subject of many of her studies, but she often incorporated architecture and activities in order to illustrate part of her role in Canada – to document what she saw (Firth 2003). The detail and style in which she painted also varied, from tremendously detailed paintings, to short sketches with only the forms and some colors added. Her media ranged from charcoal, ink, and watercolors on a variety of material from birch bark, board, canvas, and paper. All of her work was relatively small, usually under 20cm by 20cm (Welch and Pura 2002) indicative of the miniature style of painting which was considered 'feminine' in the period. As well as presentations to the King of England, Elizabeth and her daughters published some etchings of the drawings that she made after her return to England (Fryer 1989).

Ultimately Elizabeth was describing the wildness of the landscape, and through the artistic context of the time, this was infused with a positive connotation. Traveling as a woman of privilege, with several servants, and the military apparatus to secure her safety, the wildness could be interpreted as exciting and exotic. The prevalence of this view from the settlers with less privilege is uncertain, but this further emphasizes the importance of contextually illustrating the lives of the authors of the colonial accounts. It is unlikely that another commentator with less interest and education in art, poetry and painting would have described scenes as "very wildly picturesque" (111); or with such an attention to visual contrast, beauty, and colour as this passage illustrates:

> The mouth of this Creek forms a very fine Scene, a bold spur of the Alleghany appears beautiful in the distance. It is about 3 miles off. Some Cottages are prettily placed on the banks of the River, & a saw Mill affords a quantity of boards which piled up in a wood makes a varied foreground…
>
> The banks are very high of a fine Verdure & the summits covered with Wood which was now reflected with the deepest Shades in the Water & had a most beautiful appearance, which was soon heightened by the rising moon giving more forces to the Shades. Two Houses of Coll. Butler's were distinguished at a distance…
>
> We supped by Star light amid this fine scenery of Wood & Water, the bright fires of the Soldiers below the hill, contrasted with a dark sky now & then brightened by a gleam of Moon light had a beautiful effect. (Saturday May 10th, 1794: 121)

Not only does this passage illustrate Elizabeth's scenic interest, but it also incorporates the military, economic, and travel discussion that are characteristic of her diary. This passage also highlights the detailed descriptions of her local travels which were referred to above. In this passage we can see her use of painting terminology in scene, shades, foreground, contrast; emphasis on the visual in the effects of light, reflection, and things beautiful, placed prettily.

What is exploitative about describing the land as only picturesque is that it obscures the rich culture that exists in the peoples of the place. If the scene is portrayed as untouched, or 'natural' thus primitive, there is a hegemonic construction at work. If culture is defined by its interaction with an environment (the landscape and biota) and it is ethnocentrically biased by the power position of the reporter, in this case the colonizing people, there is an erasure of any interaction which is not the interaction of the dominant group. Neil Smith discussed how this creation of a primordial, 'external' nature was essential to the transition to capitalism, and also how Europeans traveling to America felt superior in their appreciation of nature in contrast to the new (white) Americans who saw nature as a thing to be subdued (1984). Interestingly, the colonial project in Canada as described by Elizabeth Simcoe seemed to tread between these two view points: wilderness was beautiful, but was often composed of forests, containing trees, which could be transformed into boards needed for building, and settlement.

Concluding Remarks

> But reaching truly postimperial or postcolonial perspectives requires more than (re)activating the spatial narratives and imaginings within past project of making empires. The challenge, it would seem, is to register this spatial sensibility in the present and to recognise that while colonialism attempted to carve 'clear outlines' onto the 'haze' of space, this has been an incomplete project. The diasporic movements, the insurgent claims for rights over land, the pervasiveness of imperial nostalgias, all point to the spatial 'haze' of the present. (Jacobs 1996: 22)

This article has argued how Elizabeth Simcoe, because of her social power, could represent Toronto area nature in her Diary which reproduced a colonial discourse in the context of cartography, natural history, and the Picturesque. However, this representation has been illustrated with Jacobs' advice from the above passage in mind. Elizabeth Simcoe's representations have been a part of the spatial imaginary of the nation of Canada, and this conception of pristine nature is continually reproduced in the present through uncontextualized citation of her work. In this sense the discourse is gendered and entirely performative in Judith Butler's sense of the word (1990): people using her work are making an unconscious association with caring and womanhood, and citing the relationship between a woman and her view of nature as somewhat 'purer' than those of, for example, her 'calculating military' husband. Considering this discourse without attention to the power that comes with cultural valuations of 'race', class, and historical positioning is dangerous because, by definition, discourses are embedded and heterogeneous. Removing the context from a discourse forces its meaning to contract, and changes the discourse back into only words decreasing its potential for explanation, and emancipation (Fraser 1997).

These competing visions of nature, both as resource and as beauty, highlight the tensions that are implicit in the colonial project. As numerous other commentators have suggested, the process of colonialism was by no means heterogeneous or monolithic, but a discourse built up through successive layers of representations to and from different individuals who can be connected through similarities of class, gender, nation, race and place, but whose stories will always be unique to their respective historical and geographical specificities. By increasing the intersections of affiliations and identities upon which our analyses of these people and their projects rest, we increase our chances of finding out more about the similarities and differences among the ongoing processes of colonialism which may be hidden within other strategies of power. Analyses of autobiographies and travel writings offer an engaging avenue from which to start this process.

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W.J. Sisler's impressions of the Chicago Columbian Exposition 1893

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The Chicago Columbia Exposition of 1893 was a defining cultural event of the late 19th century. Conceived as an opportunity for Chicago to put itself on the map and to showcase American innovations in engineering and technology, it also became a venue for the city to display American cultural tastes in architecture and landscape design to the world. Leo Marx described it as an attempt to build a human made Eden but, rather than an Eden of nature, it became an Eden of new and wonderful machines (Marx 1964, 226).

The Exposition proved to be wildly popular. It is estimated that some 26 million people attended, approximately one quarter of the United State's population at the time. The Exposition featured the most modern innovations in science and technology. It also introduced a number of now familiar products to the North American public. Cultural staples such as carbonated drinks, the hamburger, Aunt Jemima pancake syrup, Cream of Wheat, Juicy Fruit gum, Welch's grape juice, Pabst Blue Ribbon beer, and the picture postcard, all made their debut at the Exposition.

Nevertheless, the focus of the Exposition was on architectural, technological and educational progress. Although never explicitly articulated, underlying the Exposition was a belief in the inevitability of social and economic improvement fuelled by education and acceptance of technology. It was a public celebration of modernity and style in an age where telephones were rare, automobiles were still in the experimental stage, aeroplanes had yet to be invented, and even bicycles were still a novelty. Frederick Law Olmstead, the premier landscape architect of the day, laid out its grounds. Its 14 major buildings were all in a revolutionary style termed an "American adaptation of neo-classicism" (Wilson 1989, 63) creating an effect marked by Greek or Roman columns, classical domes and imposing white facades, which caused the central part of the exposition housing the display buildings to be known as "The White City." This style was the precursor to the Beaux Arts style that swept across North America a few years later, and left a legacy in the architecture of countless governmental and corporate buildings across western North America. The sheer scale of the exposition reflected the country's continental scale, its buildings were huge and the site sprawled over 686 acres and provided 63 million square feet of floor space housing 65 000 exhibits (Figure 1). The dome of the Hunt's Administration Building soared over 277 feet, dwarfing the National Capitol building in Washington DC., and the Liberal Arts Building was the largest roofed structure in the world.

The Exposition was also diverse, a festival of international culture and the promise of modernity. Among the major attractions were exhibition halls devoted to innovations in agriculture, mining, transportation, machinery and the liberal arts. All of this was complemented by anthropological displays that featured cultural practices and entertainment from various countries. For many people a highlight of the Exposition was the huge mechanical wheel built by George Ferris, located in the Midway Plaisance.

Almost immediately the Exposition generated a host of publications, mostly illustrated guidebooks and souvenir booklets aimed both at the visitor and the curious who were unable to visit Chicago (Bancroft 1893). More recently, scholars have

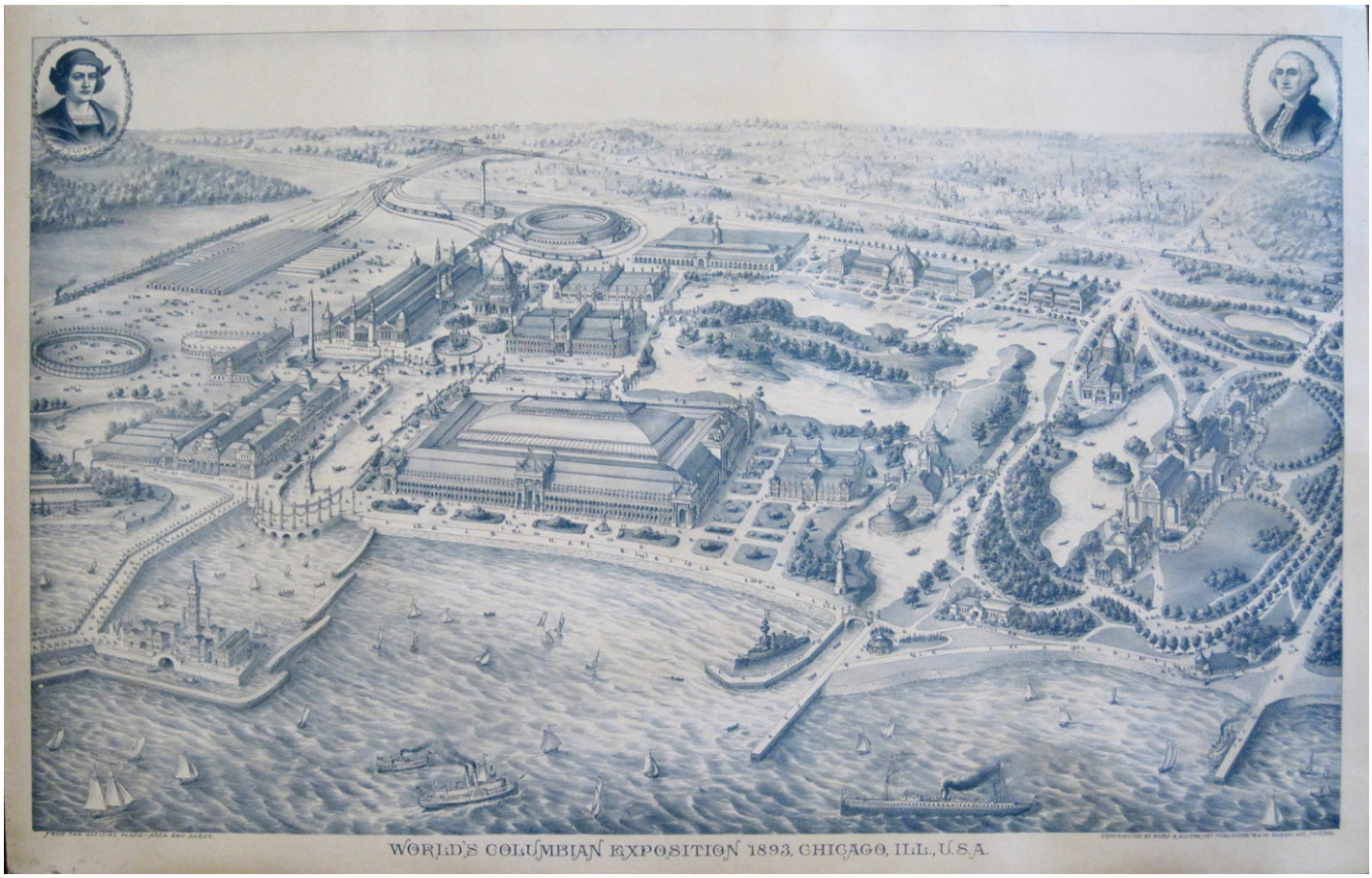

Figure 1: The grounds of the Columbian Exposition 1893. (Source: *World's Columbian Exposition 1893, Chicago, Ill., USA. From the Official Plans-Area 664 Acres* (Chicago: Kurz & Allison, 1893))

examined the exposition from a wide variety of disciplinary perspectives, including, among many, history (Rose 1996), architecture (Wilson 1989, 52-74), theatre studies (Bank 2002), education (Parshall and Rowe 1993), sociology (Rudwick and Meier 1965) and anthropology (Rydell 1978, 253-275). From the time of the Exposition's opening numerous studies described and analyzed the exhibits of a good many nations (Tateno and Bourn, 1893; Cullin 1893, 205-227) and virtually every state in the Union (Ochsner 1995). Nevertheless, published personal impressions of visits to the Exposition are relatively rare, and one such by Madame Léon Grandin (2010), was as much about contemporary Chicago and a Frenchwoman's assessment of American social and cultural customs, as it was about the Exposition. Contemporary accounts by ordinary Canadians are even rarer.

Among the many visitors to the Exposition was William James Sisler, a young man who was to become Manitoba's best known, and arguably most influential, educator of the twentieth century (Figure 2). Sisler was born in 1870 and raised on a farm in Ontario. In 1889 he moved west to work on a farm after which he obtained a job on a CPR construction crew. He completed his high school education in Winnipeg and attended Wesley College (Kotecki 2007, 3). In October of 1893, he returned to Ontario to attend medical school but travelled via Chicago in order to visit the Columbian Exposition.

Figure 2: William James Sisler (Source: Archives of Manitoba)

Sisler kept a diary chronicling his four-day visit to the Exposition in which he recorded his impressions of the exhibits and the behaviour of other visitors (Archives of Manitoba, Sisler papers. MG14. Sisler Notebooks.). He was not a born diarist and his enthusiasm for recording his impressions quickly waned. Nevertheless, his observations about the Exposition and visitor behaviour are detailed and insightful and provide a unique perspective on the Exposition and its settings through the eyes of a Manitoban flâneur, or observer of the crowd. (Vachon 2004). His diary was very much a personal document, one clearly not intended for anyone's eyes but his own, and hence very different from the polished account of Madame Léon Grandin, which was based on a year's residence in Chicago in 1893.

Sisler's entries were generally laconic, although there were exceptions when something piqued his interest and inspired him to note not only the bare facts of his visit, but also to attempt to capture the fair's ambiance. The things that Sisler did not comment on, the things he chose not to see or did not deem to be worthy of comment, are equally revealing. His diary's value thus lies less in his descriptions of the Exposition but more in his reactions to it, the direction of his gaze towards specific displays, his behaviour whilst there, and his comments on the behaviour of other visitors. For example, he made no mention of a Manitoba presence at the exhibition although the Provincial government of the day had invested a considerable sum to ensure that it had a presence in Chicago for the duration of the fair (AM RG 3 C 1 File 15). Either the effort was in vain or Sisler simply chose not to remark upon it.

Sisler arrived in Chicago at 9:30 on Sunday morning, October 8, 1893, and was struck immediately by the crowds of sightseers heading for the exposition (Figure 3):

> I was almost bewildered by the crowd. There seems to be an army of cabmen trying to earn their dollars by taking people to hotels and the fair grounds. It was Sunday but everybody seemed to be pushing his trade the same as on other days. I boarded a state-street-car, which was crowded and went up to the 63rd Street entrance. Secured a room and got into the grounds about 12 o'clock. Most of the buildings were closed.

Undeterred, Sisler set out to see what he could. He paid fifty cents for a daily admission ticket, quite a sum considering he had been earning between 12½ to 15 cents an hour as a labourer on the CPR. Once inside the exposition grounds he proceeded to the Washington State Building where he was entranced by the educational exhibits, which "surpassed anything of the kind which I have ever seen." He commented on the clay and soap modeling, paper cutting, and wire work which were, he thought, "of a high order." He was impressed by the emphasis on physical education. Sisler seemed particularly interested in the educational exhibits and described them in some detail, perhaps because these were the first things that he saw on his tour of the Exposition. His diary contains detailed notes on the displays created by schools from the United States, Canada and Japan. He was sufficiently taken with the exhibit from a school in Pullman, Washington to sketch a small diagram of a fraction chart. For someone who hitherto had shown little interest in pursuing education as a career, his interest in the educational exhibits was remarkable. The exhibit from Vineland, New Jersey particularly impressed him:

> Dr. H. M. Knight was the first to establish the fact that the feeble-minded should be educated and the exhibits from institutions for the feeble minded show that great good has been accomplished by giving them some kind of education. Their work in drawing, the making of embroidery, manufacture of shoes wooden articles etc. compares favorably with that done in the industrial department of the ordinary schools. From Vineland N.J. the pictures showed the boys at drill and they appeared to be smart little fellows. They had also a band.

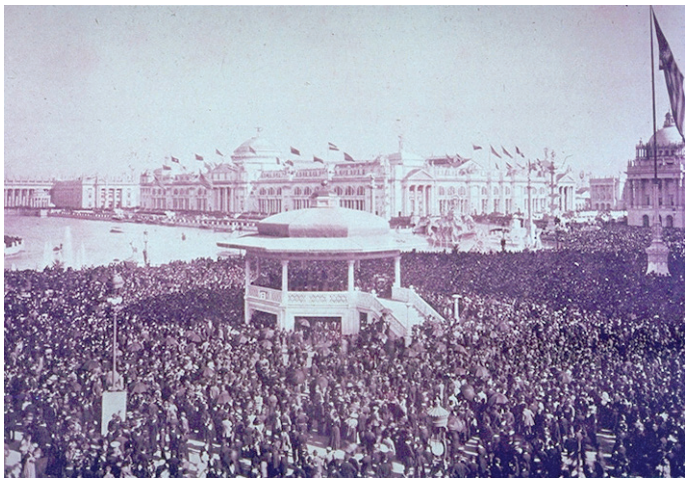

Figure 3: Crowds at the Exposition. (Source: *Chicago Day at the Exposition*, 1893 from the collection of Roland Marchand http://historyproject.ucdavis.edu/ic/image_details.php?id=3667)

Like many other visitors to the Exposition, his interest in the more high-minded cultural and educational exhibits soon waned and he proceeded to the most popular part of the grounds: the Midway. The Midway Plaisance, as it was known, was originally intended to constitute part of the anthropological exhibition and was comprised of a wide street, lined on either side by the "villages" of various nations. The general entrance fee covered admission to the midway but admission to the various attractions lining the street was extra. Patrons could not enter the midway without first entering the fairgrounds, for it was the intention to use the midway a lure, attracting fun-seekers to the exposition, where they then would be exposed to the more high-minded educational exhibits while en route to the more frivolous entertainments provided by the Midway (Figure 4). Significantly, the midway was not included in many of the souvenir and guide maps to the exposition, despite it being one of the fair's most popular attractions.

Sisler was fascinated by the Ferris wheel, (Figure 5) which he described as:

> The most conspicuous object on the fairground and probably the whole city. It is placed in the very centre of the midway and the visitor usually makes straight for it pausing occasionally to look at a red-coated Turk or a half-naked Dahonian. The wheel moves slowly without noise except that made by the great drive chains which fall with a dull sound upon their iron track each time that one cog enters and another leaves the chain. Tickets [are] 50¢. Such a crowd are buying them that they must line up and take their turn in getting their tickets – before they get a turn on the wheel. The cars, 16 in number, are about the size of ordinary street cars but of lighter construction. The windows are covered by a strong iron grating. The seats are supported by wire legs and have wire backs. A pair of young people, an

Figure 4: The Midway. (Source: C. D. Arnold, *Official Views of Pan-American Exposition*)

> old farmer with his wife and a pretty daughter, were in one car. The old man could scarcely contain himself. He shouted to "Rory" who was someone he saw on the ground below, waved his handkerchief and exclaimed, "Golly this is great. I kin go home now. I've seen it all."

At a time before the invention of the aeroplane and when few buildings were more than five or six stories high, very few people had had the opportunity to experience such a lofty view. Even Sisler was entranced by the experience. He described his ascent on the Ferris wheel on a "beautiful sunshiny day:"

> The dark blue waters of Lake Michigan are dotted here with the white sail of a yacht, there with a steamboat and its jet-black cloud of smoke. The whole forming a beautiful background for the panorama which is spread out before the passenger on the Ferris wheel. A crowd of pleasure-seekers throng the street called the Midway. A little higher and the buildings of the whole city come into view. Then the smooth walks, the quiet lagoons and the beautiful green plots of grass which fill the spaces between the walks. On the other side is the great city of Chicago, which is so dirty that it would be no pleasure to pen a description of it. The revolution of the wheel requires about ten minutes and the passenger is carried twice round. On the ground the air was calm but 258 feet up there is a rushing breeze which makes a terrible roar as it rushes through the network of iron which forms the wheel.

At fifty cents, a ride on the Ferris Wheel was a bargain. To ascend to a similar height in an adjacent tethered balloon, a fairgoer had to pay $2.00, a considerable sum at the time, equivalent to almost $200.00 today. After leaving the Ferris wheel, Sisler visited some of the villages along the Midway's central avenue. His comments suggest the exhibits were not particularly imaginative and relied heavily on the stereotypical images that North Americans likely had of various places and peoples. For example, his first stop was at the German village where about 300 old soldiers were celebrating a battle, in which they had allegedly participated, by drinking beer, making speeches and singing songs. On the south side of the German village, there was a beer garden, well supplied with tables and chairs around which men, women and children were sitting drinking beer, talking and listening to the music of a German military band, which Sisler thought to be the finest in the world. Shops in the village sold glass pens that were made on site, amber goods and soap "made into the shape of fruit, sausage, peppers, tomatoes, etc."

Figure 5: The Ferris Wheel. (Source: Image donated by Corbis-Bettman, http://explorepahistory.com/displayimage.php?imgld=1-2-1500)

Leaving the German village, Sisler visited the Turkish bazaar and theatre where he was not impressed either by the "dismal [Turkish] music" or the use of their native language, which "loaded the air with unearthly sounds". He also was hoodwinked when he bought a bottle of "attar of roses" but found out later that the "bottle" was solid glass with just a little scent smeared on the stopper.

Still smarting from the realization he was duped over his attar of roses purchase, Sisler approached the Irish pavilion with an unusual degree of wariness. He was scathing about the fake

Blarney stone in the so-called "Blarney Castle" where people paid 10 cents for the chance to kiss the stone. He noted, "Several women kissed it but I saw no man so foolish as to do it". A "pretty Irish girl" was selling small pieces of "turf" tied about with a green ribbon for 25 cents each, and visitors could buy Irish Republican currency in $20.00 denominations, guaranteed by "John A. Mahoney, Agent for the Irish Republic." Sisler noted with amusement that the Irish orchestra playing on one side of the Irish Village Square was composed chiefly of English and German musicians.

The "Forty beauties from different nations" encountered along the Midway Plaisance also attracted Sisler's attention. This attraction was properly called the International Dress and Costume Display. It featured 40-50 women modelling expensive folk costumes, though Sisler seemed more interested in the women modelling the costumes than the costumes themselves. His appraisal reflected his personal views and current concepts of what constituted female beauty:

> The Norwegian and Swede are the best examples of the blonde type of beauty. The Polander had yellow hair fair complexion and the prettiest lips that can be imagined. She wore a dress which came a little below the knee and nicely polished, high-topped boots. The Grecian representative was of the brunette type and the most beautiful in the show. She was tall and graceful and wore a long, loose gown of a bright red color. The Syrian girl also of the dark type was second in order of merit. The occupants of the Turkish Harem were surrounded by the greatest luxury but they had no claim to the beautiful. The Parisian and American representatives were so painted and powdered as to hide their beauty if they ever possessed any which is doubtful. Nevertheless, they thought they were attractive.

Although Sisler devoted a considerable proportion of his diary to his Midway experiences, there was much in the Midway that he did not visit or chose not to comment upon. For example, he made no mention of the Natatorium (swimming pool), the Hagenbeck Animal Show, the ostrich farm, the Eiffel tower model, the Electric Scenic Theatre or the Cairo Street where "Little Egypt" the world's first "Hoochy-Kootchy" dancer was then stirring controversy and paving the way for later generations of strip-tease artists. At $1.60, about a day's pay for Sisler as a CPR labourer, admission to the Cairo Street to see Little Egypt may have been a little too expensive for his budget. Indeed, few of the Midway attractions were cheap. Admission for most was 25 or 50 cents. If Sisler had paid to enter every Midway exhibit he would have been out of pocket by some $14.00, equivalent to about $320.00 today. Nevertheless, it seems strange that he did not invest 25 cents to visit the Electric Scenic Theatre, generally accepted as the world's first ever moving picture show.

Leaving the Midway, Sisler headed to the Fisheries Building where admission was free. He marvelled at an Australian fur seal but clearly thought that "the Canadian exhibit was the best in the building" with a fishing smack, whale, shark, and seals. Whether his assessment reflected an impartial opinion is doubtful as in later years Sisler was an ardent Canadian patriot, serving as the president of the Manitoba Assembly of the Native Sons of Canada, an organization promoting Canadian nationalism. (AM, MG 14 C28 Box 5 File 48) He did allow, however, that the Norwegians also had a splendid exhibit of skins, boats and instruments such as harpoons and harpoon guns used to catch fish, seals and whales.

In an adjacent building, he lingered over a display of war materials, including artillery pieces used in the War of 1812 and more modern military inventions such as a Gatling gun and a 10 inch calibre gun "20 feet long" with a range of five and three quarter miles. In passing, Sisler noted the presence of Andrew Jackson's sword, the officer's wagon used by the Union Army General Thomas in 1865, and models of soldiers from various nations from various times. The 30 foot long copper cigar-shaped Sim's Edison torpedo boat also caught his attention.

Sisler's last entry was devoted to "education of the feeble minded", where he noted that the work shown in the Exposition led him to the belief that "in many points at least, the inmates of these institutions [for the feeble minded] are of sound mind."

At this point, Sisler's diary entries ceased. He rediscovered his notebook on the 16th of December 1955, when he added a post-script:

> Why I never finished this I do not know. I had forgotten all about it until to-day it was found among a lot of old books. After doing the "fair" for four days I proceeded to Toronto and entered "Trinity Medical College" near the old General Hospital on Spruce St. I spent two years here but never completed the course. When I returned to Winnipeg in 1895 I attended Normal School and returned to Squirrel Creek S.D. where I remained for 3 years. After some time at Ohlen, Sask. and Old Kildonan I took what I thought was a temporary job as teacher of M.T. [Manual Training] in Winnipeg. This led to my making a teaching career my life work.

The legacy of the Columbian exposition is readily seen in Winnipeg and in other metropolitan centres that were growing rapidly at the end of the 19th century. Echoes of the Exposition's architectural legacy can also be seen in the City Beautiful movement that swept across North America a decade later. In Winnipeg, the influence of the City Beautiful movement and the Beaux Arts style (Figure 6) is still reflected in the imposing Provincial Legislative Building and the city's wide treed boulevards and urban parks. Other influences from the Exposition are less obvious; many have been subsumed into the world of popular culture, especially in our tastes for mass-produced convenience foods, beverages and confectionaries. It is hard to imagine North American popular culture without the hamburger, diet carbonated drinks, bubble gum and the picture postcard, all of which were introduced to the world at the Columbian Exposition.

Most contemporary accounts of the World's Fair tend to be "boosterist" in tone, extolling the virtues of bourgeois city planning, the new architecture and promoting more "refined" tastes in landscape and design. Publications emanating from Chicago strove to position that city on the forefront of innovation and

Figure 6: Manitoba's Legislative Building shows the influence of the Beaux Arts style. (Photo credit: W. Hiebert)

progress. In contrast, Sisler's diary is unusual in that it offers an account of an ordinary visitor's experience. His diary provides a more honest evaluation of the nature of the Exposition, coming as it did from the pen of a man with few preconceptions and no immediate political agenda.

Although Sisler was obviously fascinated by the attractions of the Midway, as were most fairgoers, it was the more staid exhibits that caught his attention that may have had a more enduring personal impact, as they began to shape his opinions on the abilities of the "feeble-minded," and caused him to ruminate on the efficacy of various modes of educational instruction. The impressions left by his visit to the educational exhibits were likely the genesis of his later conviction that education should be more than wrote-learning and that the "hands on" experience of vocational education was the approach of the future. As an educator, Sisler advocated incorporating physical activity as a part of the school curriculum. He actively promoted extra-curricular football and lacrosse and for many years served as a volunteer official for both sports (AM MG 14 C28 Box 5-6). Sisler developed a reputation as a progressive and caring educator who advocated the "direct method" of teaching English to immigrants who came to Winnipeg in the early 1900s, instilling knowledge of English through immersion in the language while at school (AM MG 14 C28 Box 6 File 57). His insistence on 'English only' and his suppression of other languages while in the classroom or in the playground aroused the ire of those, particularly in the Franco-Manitoban community, who saw his teaching methods as an attack upon their ancestral languages (La Liberté July 1919, AM MG 14 C28 Box 5 File 48). In his book *Peaceful Invasion*, written years after his visit to Chicago, he stressed the value of vocational work in introducing immigrants to the values and norms of Canadian life (Sisler, 1944, 9-10). His fascination with the practical results of vocational training on display at the Exposition foreshadowed his later conviction that citizenship values could be taught through the act of creation. His advocacy of school gardens and the need to incorporate "hands on" experience exemplified his educational philosophy (AM MG 14 C28 Box 6 File 62). Put simply, his philosophy became "let the hands lead and the heart will follow." Given that at the time of his visit to the Columbian exposition he intended to pursue a medical career, one wonders whether this visit to Chicago had any bearing on his change of heart, leading him to abandon medicine in favour of a career in teaching, thus changing the course of education in Manitoba.

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Symbolism and the city: From towers of power to 'Ground Zero'

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Abstract

This paper explores the symbolism of New York City's World Trade Center (WTC) before and after the devastating attack of September 11, 2001. The many metaphors captured in the built space of the WTC site are interrogated from 'Ground Zero' to the symbolic significance of the new 'Freedom Tower' now nearing completion (2014). In fulfilling the intended symbolism of American economic power, the WTC towers became pop-culture symbols of New York City, and the United States. The WTC towers stood as twin icons of western economic dominance along with 'Wall Street' and 'Dow Jones' reflecting the American ethos of freedom and opportunity. However, the WTC also imbued negative, albeit unintended, symbolism such as the coldness of modernist architecture, social class disparities across urban America, and global domination. Plans for redeveloping the WTC site predominantly highlight the intended positive symbolic connotations of the former Twin Towers, including freedom and opportunity. This article points to the symbolic significance of urban built form and the potential negative consequences that are associated with iconic structures, including the new Freedom Tower.

Keywords: *symbolism, iconic architecture, New York City, World Trade Center*

Introduction

On September 11, 2001 a terrorist attack of horrific proportions destroyed the New York World Trade Center and surrounding structures. In addition to the political, economic, and environmental repercussions of the September 11, 2001 attack on and collapse of the World Trade Center complex in New York City (WTC), this major historical event also had important symbolic effects. Symbolism, both metaphorical and architectural, attached to iconic built structures in the urban environment can have very tangible consequences, as the history of the WTC proves. In this article various interpretations of symbolism attached to both the pre- and post- September 11 WTC are explored. The symbolic significance of the new 'Freedom Tower' now under construction on the former WTC site known as 'Ground Zero' is assessed. The analysis of the architectural representation of iconic structures such as the WTC and the new 'Freedom Tower' may help explain (and predict) human emotions leading to positive and negative actions of individuals and groups. Indeed, there is a long fascination among geographers and planners to the symbolic functions of 'architectural gigantism' as an expression of global economic domination, political power, and nation building (Hajer 2005; King 1996).

Towers of Power

The World Trade Center complex in New York City (WTC) is one of many world-wide financial centres bearing the same name under an umbrella organization, the World Trade Centre Association. For the purposes of this paper, the acronym WTC will refer to the collection of former buildings occupying a site in lower Manhattan, New York, known as the World Trade Center. Specific reference to former or existing buildings on that site, such as the Twin Towers, Tower One, Tower Two, or the new Freedom Tower will be made as required.

The architects and builders responsible for the design and construction of the WTC intended to imbue it with symbolism that would portray boldness and confidence. The project was first proposed in 1946 during a post-World War II period of economic prosperity and optimism enjoyed by many of the former "Allied" countries. However, Lower Manhattan was long considered an undesirable, overcrowded location by many investors and therefore it did not benefit initially from any post-war prosperity (Gillespie 2001). In 1960 the WTC complex was conceived by New York's influential Rockefeller family to stimulate activity and reverse Lower Manhattan's economic stagnation (Bird 2003; Gillespie 2001; Greenberg 2003; Salomon 2002). To accomplish this feat, the Port Authority of New York and New Jersey (Port Authority), an agency responsible for the planning of the WTC in cooperation with architect Minoru Yamasaki and engineer Leslie Robertson, used architectural symbolism to attract tenants and gain attention (Ruchelman, quoted in Greenberg 2003; Wigley 2002). To establish the importance of the WTC, the Port Authority sought a design that would "solidify the United States' global position in international trade" (Salomon 2002:88). The desire for the project to symbolize American economic power was present in the Port Authority's intention to make the WTC the tallest building in the world (Gillespie 2001; Greenberg 2003). Furthermore, the project's placement "at the end of the [Manhattan] island facing Europe to capture world attention" provided a symbolic articulation of its intended position as a centre for America's international dealings (Wigley 2002:73). Over time, these plans for the built structure would strongly influence different kinds of symbolic significance, both positive and negative.

Figure 1: World Trade Center, New York. (Source: http://en.wikipedia.org/wiki/World_Trade_Center)

The Soul of New York: Positive Symbolic Significance

In some ways, the Port Authority's symbolic intentions were fulfilled with positive results. For example, Bird (2003:89) notes that the project's final design included "10 million square feet of office, retail and commercial space," earning it the honour of being the world's biggest office complex and reinforcing its symbolism of America's global economic dominance. Similarly, the Port Authority's goal of crafting the "world's tallest building", Tower One (North Tower), to take advantage of that title's connotations of power was actualized (albeit for a short time) from 1972-1973. The title of "world's tallest building" transferred to Chicago's Sears Tower in 1973, before the WTC complex was officially completed (Gillespie 2001). Still, the Towers' imposing height, visible in Figure 1, continued to carry connotations of power (Gillespie 2001). In addition, the Twin Towers' image provided the backdrop against which CNN reporters presented updates on the global financial market (Gillespie 2001). This supports assertions that the WTC, specifically the iconic Twin Towers, successfully symbolized, and were emblematic of, the financial power of the United States and New York City within the global economy (Greenberg 2003; Zukin 2002). Furthermore, Greenberg (2003) notes that the Twin Towers were prominently featured as symbols of economic regeneration in a marketing campaign that boosted tourism, economic activity, and positive perceptions of New York during that city's fiscal and social troubles of the 1970s, which included bankruptcy, rising unemployment, and high crime rates. The above examples indicate that the WTC in many ways achieved the positive economic symbolism it was intended to portray.

In fact, the relatively positive symbolic connotations accumulated by the WTC, both in America and worldwide, possibly exceeded its intended symbolism of economic might. For instance, the WTC was used in popular culture to symbolize not only the economic power of New York and America, but also of the city itself. Demonstrating this, Bird (2003:87) asserts that the Twin Towers' appearance in the opening credits of the television show Sex and the City conveyed a quintessential "New Yorkness". Similarly, Greenberg (2003:386) writes that the Towers represented "the soul of New York." The extent of the Twin Towers' international visibility as symbols of New York and America is indicated by Gillespie's (2001) comparison of their symbolic strength to that of Big Ben for England, or the Eiffel Tower for France. Gillespie (2001) also observes that no other building in New York was featured on as many postcards. In fact, according to Wigley (2002), no building in the world shared the Twin Towers' postcard popularity.

Nobel (2005) suggests that the Twin Towers acquired the symbolic association of local economic and social regeneration, global prosperity, international sense of place and freedom. In line with this thought, Gillespie (2001:138) notes stories of illegal immigrants to America "clinging to a postcard of the WTC as a symbol for their hopes for a better world". As the above examples indicate, the WTC symbolized New York, America, and

opportunity. To others, the Twin Towers symbolized something more sinister.

Inhumanity and Arrogance: Negative Symbolic Significance

Despite the positive connotations noted above not all of the WTC's symbolic effects were desirable. For instance, despite the Twin Towers' status as a symbol of New York in popular culture, elite architectural critics were almost unanimous in their dislike of the buildings (Gillespie 2001; Nobel 2005). The project's main architect, Minoru Yamasaki, had tried to avoid designing a traditional modernist skyscraper (Gillespie 2001; Salomon 2002), nevertheless Wigley (2002:74) observed the WTC's negative critical reception was due to its symbolism of the "inhumanity of modern architecture." Indeed, many sources (Goldberger, quoted in Gillespie 2001; Greenberg 2003; Nobel 2005) assert that the buildings were blank or bland—qualities that only enhanced their portrayal of inhumanity. Claims that the Twin Towers were unremarkable appear to contrast with the views of critics such as von Eckardt (in Gillespie 2001) and commentators such as Zukin (2002), who suggest that the WTC symbolized power too effectively, conveying an unattractive aura of arrogance. Whether the WTC symbolized architectural inhumanity, ordinary blandness, or overt conceit, critics overwhelmingly viewed the WTC as portraying negative traits.

The WTC also carried undesirable symbolic significance outside of architectural criticism, particularly regarding its social context. Greenberg (2003) asserts that the Twin Towers' grandeur and massive scale, characteristics that established their symbolism of economic power, clashed with their social surroundings during New York's fiscal and social crises in the 1970s. These harder economic times involved high rates of what is arguably, at an individual level, the antithesis of the Twin Towers' symbolic economic strength: unemployment. According to Greenberg (2003), prior to the Towers' inclusion in the economic marketing campaign described above, some believed the Towers' contrast with their social surroundings was actually used by the media to exemplify the city's problems, thus exacerbating the crisis by discouraging investment and tourism. Greenberg (2003:408) further asserts that even after the city's fiscal crisis ended, the Twin Towers' "clean, glossy image contrasted starkly" with New York's rising inequality from the 1970s to the 1990s. A key cause of this increasing disparity was the neoliberal deregulated service economy whose power the Twin Towers was seen to emulate. Greenberg's analysis suggests that the Twin Towers' symbolic connotations of financial dominance were viewed negatively in light of the city's social condition.

This dissonance, with economic prosperity on one hand and social inequality caused by an emergent political economy on the other, also appeared on an international scale. While most sources seem to agree that the WTC embodied America's dominance in the world economy, not everyone viewed this dominance positively. Greenberg (2003:409) notes that "the WTC came "to represent the inequality and injustice so many associated with the US dominated, neoliberal 'New World Order'." As noted, the Twin Towers had enormous symbolic resonance as representations of American economic power, and even of America itself. Therefore, it seems that the WTC would have presented an obvious choice for a terrorist group wishing to target America's economic 'New World Order'. Supporting this line of thought, Greenberg (2003) and Bird (2003) suggest that the political and economic power embodied in the WTC contributed to its selection as a target in 2001, and it seems not unreasonable to suppose that its iconic image played a role in the 1993 attack as well. Indeed, in a video released by Osama bin Laden following the 2001 attacks there is mention of targeting America's "greatest buildings" (Greenberg 2003; Wigley 2002). Further, Bird (2003) and Greenberg (2003) argue that the total economic damage from the attacks cannot be explained by their physical destruction alone; the political and economic damage inflicted by the destruction of a key icon of America's power is, arguably, immeasurable.

Raising 'Ground Zero'

The Towers' symbolic significance was altered in many ways following September 11. Indeed, Scully (quoted in Nobel 2005:42) claims that "when [the Towers] got hit, all the associations changed". It appears that the Twin Towers' negative symbolic significance was downplayed, or changed altogether, in favour of more positive associations. For instance, Nobel (2005) argues that the WTC assumed a human character as its image was linked in popular culture to the images of rescue workers and firefighters, in contrast to the inscription of modernist architectural inhumanity critics had earlier identified. Furthermore, Greenberg (2003:413) argues that New Yorkers who had been "excluded from the starkly rosy version of the city" that the WTC represented were able to overlook the contradictions between its economic symbolism and their own social reality, feeling a "familial sense of loss" when it fell. Almost immediately after the September 2001 attack the WTC site took on yet another symbolic inscription, 'Ground Zero'. A term attached to annihilation of place, but also to the potential of a new beginning (Hajer, 2005).

Renewed emphasis on the positive aspects of the Twin Towers' symbolism is also present in plans for the site's renewal. The Lower Manhattan Development Corporation (LMDC) (2007), the agency determining the site's future along with the Port Authority, notes that "Revitalizing Lower Manhattan" is one of its explicit aims. This goal precisely mirrors one of the Port Authority's original intentions. The Twin Towers' original symbolic purpose of conveying America's economic might is also an intended outcome of 'Ground Zero's' (re)design. "Freedom Tower," a name that recalls the original Twin Towers' positive associations with freedom, will recapture the original WTC's symbolism of American freedom and democracy in its height of 1,776 feet, a numerical reference to the year of the Declaration of Independence (Nobel 2005). The official address, One World Trade Centre, 'Freedom Tower' comprises 104 stories and 3 million square feet. The largest, tallest, of all the New York World

Figure 2: Freedom Tower (Source: http:en.wikipedia.org/wiki/File:Freedom_Tower_New.jpg)

Trade Center buildings. Freedom Tower is now the tallest building in America. Occupancy of the building will undoubtedly be challenged by the tragic history of the site. At just 50% leased space (2013), Silverstein Properties, the building's owner, are advertising Freedom Tower as an "indelible New York landmark". Yet, unlike the original WTC, to attract new occupants the building's owner are promoting more than a desirable address. The owner has made building safety a priority for this location by advertising Freedom Tower's advantage of "structural redundancy, fireproofing, biochemical filters, extra-wide pressurized stairs and optimal firefighter access". Homeland Security necessitates office place safety.

Freedom Tower's original architect, Daniel Libeskind, was inspired by another symbol of American freedom and strength: the Statue of Liberty (Nobel 2005; Kogod and Osman 2003), and although his design has been modified, the symbolic reference to the Statue's raised torch remains in Freedom Tower's spire, as demonstrated in Figure 2. Kogod and Osman (2003:113) have criticized the use of these symbolic elements as "melodramatic" and overwrought, implying that the design is too overtly symbolic. However, though it may have been overdone, Freedom Tower's emphasis on freedom and power demonstrates that the original Towers' positive associations became reinforced following the September 2001 attack. Completion of Freedom Tower (2014) was technically complex with high economic stakes. Respect for victim's families was politically sensitive over the entire period of construction. Now, at completion, we know what 'Ground Zero' looks like, but what will it symbolize and what global message will go forth from this place. Time will decide.

Conclusion

The Twin Towers had symbolic associations in America and worldwide, with considerable political and economic effects. Although these associations of economic power and individual freedom had positive significance for some, others saw them as symbols of political economic domination. Clearly, the economic strength that the Twin Towers came to symbolize attracted more than architectural critiques. The negative symbolism of global political economic domination, even arrogance, presented these towers as a target by those claiming responsibility for the September 11 attack. Moreover, the positive symbolic significance of the towers came to the fore after the attack, as demonstrated by plans for re-developing 'Ground Zero'. If the experience of the original Twin Towers is any indication, Freedom Tower will acquire the same conflicting and unexpected, perhaps undesired, symbolic connotations in the future. The similarities between the intentions of the old and new projects lead us to wonder if Freedom Tower will not gain the associations of economic strength and arrogance that made the original WTC a target of terrorism.

Although it may be impossible to prevent negative associations with iconic structures, a better understanding of architectural symbolism, particularly of iconic structures, may help to inform our understanding of how the built environment influences human behavior. In particular, planners and designers should be mindful of symbolic connotations imbued with built form, both positive and negative. Indeed, symbolic architectural representations such as Freedom Tower can have very tangible consequences, as the history of the Twin Towers has proven.

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This is weird…people do this?: Locational aspects of women's latrinalia at the University of Winnipeg

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Abstract

Literature from a variety of disciplines has examined washroom graffiti, with an emphasis on its social meaning. The location of such graffiti within the micro-environment of the public washroom has not yet been analyzed. This study examines the content and location of graffiti in eight heavily trafficked women's washrooms at the University of Winnipeg. Graffiti locations, numbers and content were monitored on a daily basis. Clear locational preferences for women to write graffiti in the washroom environment were evident. Drawing on ideas of proxemics, territoriality, and Kohn's cluster concept, this article examines the complex dynamics of graffiti and perceived privacy within women's public washrooms.

Introduction

"Graffiti" is generally regarded as anti-establishment and socially unacceptable, conjuring images of old, run-down neighborhoods rife with gang tags. It has mainly been researched as an urban phenomenon (Bruce 2010; Docuyanan 2000; Fischer and Rosenfeld 2006; Ley and Cybriwsky 1974; Nayak 2010; Spoctor 2004) that has been perpetrated by deviant youth (Ferrell 1995; Sorensen n.d.) and as a phenomenon that needs to be removed and eradicated (Craw 2006; Munday, Walsh, 2006; Sorensen n.d.; Spoctor 2004). Some have taken a different approach and use urban graffiti as a mechanism to understand those who create it (Ferrell 1995; Fischer and Rosenfeld 2006; Ley and Cybriwsky 1974; Young 2009). Others have written on graffiti depicting it as unrestricted and uncensored social commentary (Fischer and Rosenfeld 2006; Gonos, Mulkern, and Poushinsky 1976; Nayak 2010; Stocker et al. 1972; Cook 1972).

Many have had experiences with the lewd pictures or foul comments that pepper public washrooms everywhere, thus earning washroom graffiti, also known as "latrinalia", (Dundes 1966) a different but, similarly, "vulgar" reputation as urban graffiti. Although the general public may regard latrinalia as an ugly nuisance, many have analyzed their content in an attempt to understand what they tell us about the nature of the dominant population (Dundes 1966; Farr and Gordon 1975; Gonos, Mulkern, and Poushinsky 1976, 1976; Nwoye 1993; Obeng 2000; Stocker et al. 1972).

Although this area of research has visibly expanded since Kinsey's (1953) psychodynamically slanted study of latrinalia, there remains a lacuna in the literature: the information that we can infer from the location of latrinalia. This article begins to answer this question through a case study at the University of Winnipeg, examining the prevalence of latrinalia in public washrooms and exploring what this pattern may indicate about privacy dynamics within public washrooms. In order to understand the subtle differences between public and private space in public washrooms, Kohn's "cluster concept" of public spaces is employed (Kohn 2004).

Methods

For this study, the main method of data collection was to monitor washrooms and record the location, frequency and content of latrinalia within them. The University of Winnipeg was chosen as the study area for its ease of access and an assumption that the University of Winnipeg is broadly representative of Canadian universities with a downtown campus. Eight heavily trafficked women's public washrooms on the University of Winnipeg campus were monitored twice a day for one week. The number of comments and their location was recorded ac-

cording to the stall in which they were written. Using this data, hypotheses as to why women can feel secure enough in a public washroom stall to inscribe their thoughts on the wall are offered. The complex nature of private and public space is also explored. Although the content of comments was recorded it is not the intention to explore this in this article.

Findings

In total, eight washrooms were monitored for latrinalia and six of these eight had latrinalia present. Latrinalia was exclusively found in stalls of average size with no latrinalia found in wheelchair-accessible stalls. Further, washrooms that contained wheelchair-accessible stalls were the only washrooms included in this study that did not contain any latrinalia.

There was a spatial trend to latrinalia: most comments were written in the stall furthest from the door. In fact, 89 per cent of latrinalia was found in the stall located furthest from the washroom entrance. The closer to the washroom entrance the stall was located the less likely was it to contain latrinalia. This spatial aspect is discussed more fully by Sawka (2013).

Although the content of latrinalia was not a major focus of this study, it is significant that some graffiti writers revealed very personal information which suggests they felt a significant level of security within washroom stalls and felt confident they could retain their anonymity while leaving their comments in a public place.

Private Versus Public in "public" Washrooms

Although public washrooms may seem to be the most mundane of every day spaces, they are actually very complex in terms of privacy dynamics. Some may believe that the term "public washroom" betrays all there is to understand about them—they are public and nothing more. However, if public washrooms are entirely public, why do many women feel comfortable enough to reveal intimate things about themselves through graffiti when in a washroom stall? Clearly, washrooms are more than a public arena.

Women may often assume that the stalls in public washrooms are private and anything that lies outside the stalls, such as the sinks and hand dryers, is public. However, this is an oversimplified notion. This is similar to Young's assertion that university washrooms lie in the middle of the public-private continuum because the washroom as a whole is public but occupancy of the stall is much more private. What factors could be attributed to a perception of privacy in public washroom stalls? Only women are socially and/or legally permitted to even enter the washroom thus making the space more private than, for example, the hallway to which it is connected. Another factor that contributes to a sense of stalls being private is "solitude", which Proshasky, Ittelson and Rivlin (1976) define as "state of privacy in which the person is alone and free from the observation of other persons" (174). This perception of solitude occurs due to the fact that, while a woman is occupying a stall, others in the washroom can only see a limited portion of their body—the lower part of a person's legs and feet.

Another sense of privacy that is caused by the lack of observation experienced in washrooms stalls is "anonymity", which is "a state in which the individual seeks and achieves freedoms from identification and surveillance in a public setting" (Proshansky, Ittelson, and Rivlin 1976, 174). This term can be understood in the context of latrinalia in that, unless a writer leaves their name or other identifying characteristics, it is unlikely that anybody will ever determine who wrote the comment. This is an important factor when examining why women create and respond to latrinalia, since they tend to reveal very personal information or ask for advice about serious issues.

Taken together, solitude and anonymity may provide a strong enough perception of privacy that is conducive to the creation of latrinalia. It is also possible that these concepts change depending on several factors: the location of the washroom, the size of the washroom, of the stall within the washroom and the size of the stall. Therefore, it is conceivable that the location and content of latrinalia differs simply according washroom layout.

The layout of the washroom seems to affect women's perception of solitude and anonymity since most latrinalia is written in the stall furthest from the entrance. This may be due to having to walk further to reach this stall or physically distancing themselves from the most public part of the washroom—the sinks and entrance. Regardless of the reason for the heightened sense of solitude and anonymity, this increase in the perception of privacy appears to be enough to make women feel more comfortable performing and act generally regarded as anti-social if not as an act of vandalism. Further research is required to determine whether the content of latrinalia in the furthest stall from the entrance is more personal than in other stalls.

Kohn's Cluster Concept in the Context of Public Washrooms

Margaret Kohn offers a model of understanding the privacy dynamics in washroom stalls and the space that latrinalia inhabits is through her "cluster concept" of public space. This concept includes three factors: ownership, accessibility and "intersubjectivity." All factors operate on a sliding scale with one side representing completely public space and the other representing completely private space (Kohn 2004).

Ownership refers to who owns a specific space, whether it is a person, corporation or a governing body. A person's house would be at the private end of the continuum whereas, as Kohn argues, government property is public (Kohn 2004).

The accessibility factor describes how effortless or difficult it is for anybody to enter and move within a space. If a wide variety and a large number of people are able to travel to and within a space, it is more public than a space that restricts who may enter. At the private side of the scale, a person's house is only accessible to those who live there or those who have a key and, at the public end of the scale, communal or government property, such as a town square, is available for anybody to enter and move within. It is clear that, depending on who owns

a space, the accessibility to that space my also change (Kohn 2004).

Intersubjectivity is the final factor that comprises the cluster concept of public space. This term, essentially, refers to the way in which people are oriented in a space. More specifically, intersubjectivity pertains to whether or not those who occupy the space are encouraged to position themselves in a way that facilitates interaction. For example, Kohn argues that sports stadiums and movie theatres fall on the private end of the scale because they force people to orient themselves toward one particular object, the screen or the sport being played, thereby producing what she calls "collective isolation" (Kohn 2004). Places like government-owned parks or even sidewalks lie on the public end of the scale because people are facing toward each other and there is a possibility of spontaneous interaction. Intersubjectivity is the most difficult to assess because people's actual actions may contradict the implied and expected behaviour for that space. For instance, people may interact in a space that is meant to separate people (Kohn 2004).

Young (2009) argues that ownership of the washrooms at a public university lies somewhere in the middle of the public-private continuum, making these washrooms a semi-public space. While this is true for the washroom as a whole, the ownership of an occupied stall is more private. Although the occupation of a stall is usually quite brief, a person's perception of ownership is likely to increase during the time of occupancy. This is because an occupant is alone and it would be viewed as unacceptable for another person to enter the space without permission from the occupant.

Accessibility to the washrooms included in this study is influenced both by the location and unusual construction of buildings at the University of Winnipeg. The University is located in a central urban area instead of a more suburban area as are many Canadian universities. Generally, there are a greater number of people who live or work in the downtown area of cities, thereby increasing the possibility that anyone could enter one of the buildings and use a washroom.

Due to this central urban location, at least two washrooms included in this study can be classified as public—they are on the first floor of two connected buildings very near to a set of doors. However, washrooms on upper floors then have reduced accessibility since the public is more likely to use a washroom adjacent to an entrance than one that is on the fourth floor.

Theoretically, all the washrooms in this study could be of equal accessibility because the washrooms on upper floors can be accessed just as easily as those on the first floor for able-bodied people. However, because many of the washrooms included in this study are located on upper floors and not everybody is completely able-bodied, the accessibility is reduced. Accessibility to washrooms on upper floors is also lessened by the fact that it is not always convenient for people, especially the general public, to use washrooms located above the first floor.

Accessibility is further reduced when gender is introduced. All washrooms in the University of Winnipeg, with the exception of several handicap and gender neutral washrooms (single occupant), which were not examined in this study, are divided according to gender. This study only analyzed the content and the location of graffiti in women's washrooms, meaning that approximately half of the population of the university is not socially or legally permitted to enter these washrooms.

Finally, intersubjectivity within public washrooms within the University of Winnipeg must be examined. This is a term that is subject to much interpretation; it must be analyzed in a number of ways. The first factor that will be examined is the layout of public washrooms and the way it dictates how women ought to act within this space. Second, drawing from personal experience and research, the way in which women actually use the space is also explored.

Within the whole of a women's public washroom, intersubjectivity falls somewhere near the midpoint on the public and private scale. This space is private because the space is designed for a specific sequence of events to occur—first a woman enters the washroom and then makes her way over to the stalls; in the washroom, she occupies a stall alone; then, she walks a short distance to the sinks that almost always face a blank wall; after that, she moves over to the hand dryers to face yet another blank wall. It is clear that, under normal circumstances, the environment of the public washroom does not facilitate any interaction because the occupants are either alone or facing a wall instead of others.

In all washrooms included in this study, there is at least one mirror present. Depending on the size of the mirror and how many women are able to gaze at their reflections, mirrors could cause women to, indirectly, face each other. Although simply facing others via reflections in a mirror may not facilitate interaction, this would nudge the intersubjectivity level slightly to the public end of this scale.

The intersubjectivity of a blank stall is similar to the washroom as a whole in that the physical barriers make it extremely difficult for women to face and interact with each other. In fact, it could be argued that washroom stalls are designed to make it nearly impossible for occupants to interact with others in the washroom. Interaction is potentially feasible, because the stall walls and doors do not touch the floor or ceiling which makes it possible for sounds, including voices, to travel from the stall to the rest of the washroom and vice versa.

Drawing from strictly anecdotal evidence, women generally use washrooms in an intersubjective way but it is important to keep in mind that the architecture of washrooms is not conducive to interaction. It is very well known among most of the population that women usually go to the washroom with at least one friend by their side and they will typically carry out a conversation while waiting for stalls to become vacant thus, increasing the intersubjectivity of the place.

Outside of the stalls, where women must usually wait for a stall to become available, a line normally forms during peak usage times. Although a queue does not necessarily facilitate interaction, depending on the length of the wait, spontaneous conversations may commence between strangers. This is especially true in women's washrooms where it is understood that socializing is a part of the nature of the space. This presumed social aspect of women's public washrooms outside of the stalls

may remove the taboo that some may feel about writing latrinalia within the stalls, thus leading to the presence of latrinalia.

Within the stalls of these washrooms it is impossible to face another person and hold a conversation, at least a socially acceptable one. This is determined by the very architecture of the stall. The walls and door are generally taller than the occupant and the gaps between the stall and the ceiling do not allow for occupants to be comfortable facing and interacting with each other. In spite of structural constraints, women manage to interact without being oriented towards each other via conversational graffiti. These extensive conversations that may occupy entire walls or doors allow for the silent, but very tangible interaction between women and, thus, slides the intersubjectivity continuum to the public end of the scale.

Examining all three of Kohn's (2004) factors that define public space—ownership, accessibility and intersubjectivity—in the context of women's washrooms, we encounter ambiguity. Ownership has been deemed semi-public; accessibility lies more on the public end but, it is made semi-public when gender and architecture are included as factors. Intersubjectivity also falls on the public side of the scale but is restricted by the architecture. Overall, in terms of ownership, accessibility and intersubjectivity, the stance taken in this report is that women's public washrooms are slightly more public than private.

It is also interesting to note that Habermas (as cited in Young 2009) argues that the most public spaces allow for a high degree of access as well as for public opinions to be formed. As will be explained later, the nature women's latrinalia at the University of Winnipeg forms a public space by way of intersubjectivity and Habermas's ideas about public space.

Stalls as Temporary Territories

Theories of human territoriality have been contested since the 1920s when Eliot Howard first published his book regarding territorial behaviour of birds. Some believe that territoriality in all animals, including humans, is instinctual so animal models of territoriality can be applied to humans (Ardrey 1966; Edney 1974; Hall 1959, 1966; Hediger 1950; Lorenz 1966; McBride 1964; Tiger and Fox 1966). However, others assert that, because humans have very complicated social relationships, it is entirely different from the territorial behaviours of other animals (Alland 1972; Callan 1970; Ittelson et al. 1974, 1974; Nelson 1982; Roos 1968; Sack 1983; Sommer and Becker 1969).

This contention has carried through to the idea of temporary and micro territories as well, albeit in a slightly different manner. In one corner of the debate, there are those who believe that humans have a personal space that always surrounds them as they move about the world and that they have the ability to establish territory using this personal space almost anywhere, no matter how brief occupation of the area may be (Gold 1982; Hall 1966; Porteous 1977; Sommer and Becker 1969; Taylor and Brooks 1980). However, some researchers argue that the definition of "territory" is not met by the transient occupation of space; they argue that any territory must be defended or else it is not considered a territory (Edney and Buda 1976; Sommer 1959). According to this view, personal distance is real but it cannot be used to establish a temporary territory.

To apply theories of territoriality to women's washroom stalls, one must consider the general script, or series of expected consecutive actions or events that take place in a particular place or situation (Abelson 1981). This can be applied to the setting of a women's public washroom: a woman walks into the washroom, enters the stall, closes and locks the door behind her. Once she no longer needs the privacy that the stall provides, unlocks and opens the door and makes her way to the sinks or the mirror until she exits the washroom. The key part of this script involves the woman closing and locking the door behind her, which can be interpreted as an act to defend the space that she is occupying. In this sense, then, washroom stalls can be viewed as temporary territories and this may also contribute to feelings of solitude, which are conducive to the proliferation of latrinalia.

Proxemics and Washroom Stalls

Edward Hall's (1966) idea of "proxemics" comprises the foundation for the final hypothesis that suggests the reason that women feel secure enough within a washroom stall to write intimate truths about themselves and their lives on the walls.

Central to Hall's theory is the notion that the distance that one is standing from an individual connotes something about the action being performed between the two people; he calls these distances "proxemics zones". For example, Hall terms the zone that surrounds the space zero to 18 inches (0 to 45 centimetres) away from a person as the "intimate distance". This is an area for "love-making and wrestling, comforting and protecting" Hall (1966, 116). There are three other proxemics zones: the "personal distance", where it is socially acceptable to stand and make conversation with someone because it keeps them at an arm's length; the "social distance", which is where business affairs are carried out, and the "public distance", the zone in which public figures occupy to address an audience (Hall 1966).

Intimate distance is germane to average sized stalls in public washrooms when explaining women's latrinalia. Often, they allow only one foot (30 cm) to the left and right of the occupant and two feet (60 cm) in front; most of the stall occupies the intimate distance. Perhaps the reason that women feel solitude and anonymity within washrooms stalls is because the walls of the stall serve as a physical manifestation of the outer boundary of the intimate distance. This logic is able to explain the finding that wheelchair accessible stalls had little or no latrinalia present, which means that the majority of the latrinalia is present in standard-sized stalls.

To further corroborate this claim, Hall's personal and social distance can be used to explain reduced sensations of privacy experienced in wheelchair accessible stalls. Wheelchair accessible stalls are generally much larger than average sized stalls, and for good reason. In terms of privacy, women may feel less solitude and anonymity in these stalls because the walls are quite far away; in some cases, several feet. Just as the walls of average sized stalls can be seen as a physical manifestation of the intimate distance, the walls of wheelchair accessible stalls are

a manifestation of the transition zone between the personal and social distances. These distances, by definition, are less private than the intimate distance. This change in the physical demarcation of proxemic zones may explain the finding that the majority of latrinalia was found in average sized stalls. The more limited mobility of those confined to wheelchairs may also inhibit the writing of latrinalia in such stalls.

Summary and Conclusions

At first glance, the geographical pattern of latrinalia in women's public washrooms may initially appear random and illogical. Using the concepts introduced in this article, an explanation of this spatial pattern can be advanced.

One possible reason that women feel comfortable enough in a public washroom stall to perform actions that nature intended and sometimes reveal their innermost thoughts is that stalls offer both solitude and anonymity (Proshansky, Ittelson, and Rivlin 1976). The underlying cause of these comfortable and private sensations is unknown but may be explained using several theories.

The "cluster concept" (Kohn 2004) is a method of how public or private various spaces are, including public washrooms, using sliding scales of accessibility, ownership and intersubjectivity. In this case, washrooms are fairly accessible to able-bodied women but less so to others outside of this demographic, making the accessibility of public washrooms fall between public and private. In terms of ownership, university washrooms are, government-owned so the ownership is on the public end of the scale. Despite the physical structure of public washrooms, which does not allow for easy communication, intersubjectivity in women's public washrooms is on the public side of the scale due to the presence of latrinalia.

Although, when the "cluster concept" is applied to public washrooms, it appears that they are quite public, theories of territoriality and the idea of proxemic zones demonstrate how the stalls within public washrooms can create feelings of security and privacy. The layout of public washrooms enhances these effects so that, by having to walk further to reach the last stall, it increases the perception of solitude and anonymity. This explains why women prefer to write in the stall that lies furthest from the entrance.

Together, these theories comprise a foundational understanding of the privacy and territoriality dynamics in women's public washrooms. Varying dynamics can then provide an explanation as to the locational trends of latrinalia and bring order to the seemingly random pattern of comments written on the stall.

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Parking issues and aesthetics in downtown Winnipeg

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Abstract

Traditionally, parking studies have been the domain of transportation specialists and/or planners who focus on the land-use allocation and the economic aspects of parking in urban areas. This study examines parking structures in term of their concinnity, sense of place, aesthetics, and their role as public places that can enhance the city's cohesion, image, and streetscape. Winnipeg's downtown parking operations and land use are examined and a typology of downtown Winnipeg parkades is proposed. Recommendations for improving the integration of parking structures within the urban fabric are made.

Keywords: Parking structures, Downtown Winnipeg, parking integration

Introduction

Parking facilities are architectural and spatial constructs that should be integrated within the urban landscape and blended with local architecture[1]. Traditionally, studies on parking have been the domain of transportation specialists and/or planners who focus on the land use allocation and the economic aspects of parking structures and surface lots. Parking lots and parking structures are examined here in terms of their concinnity, sense of place, and aesthetics; their role as public and social places is also considered. Winnipeg's downtown, like the downtowns of many western Canadian cities, has few public social places. It has struggled for 30 years to revitalize its commercial and residential development and overcome its image as a poverty stricken and crime-ridden area. Anyone visiting Winnipeg's downtown will be impressed by the number of large surface parking lots and parking structures. Approximately 41 per cent of its area is allocated to parking. This is a staggeringly high percentage matched only by small American cities (Ben-Joseph 2012). While some Canadian cities, such as Ottawa and Montreal, have striven to incorporate parking structures within the urban fabric, others, such as Winnipeg, lag behind in this respect. Most surface parking lots and many parkades in downtown Winnipeg are unsightly and constitute spaces and places of discontinuity and separateness. They break the cohesion of the urban fabric, fracturing public, commercial, and social life.

Parking Facts and Literature

There is no doubt that the automobile, like the railway in the 19th century, had, and still has, a major impact on the city. In many ways, the advent and use of the automobile became a major determinant of city form and planning during the 20th century. Although we are accustomed to thinking of traffic flows as the most serious problem introduced by automobile use it is the parked car that has the most profound impact on urban form. In other words, the parked car is responsible for the disruption and fragmentation of the contemporary Canadian city. Car parking has become so habitual that one rarely thinks of its impact on land use, urban form or the streetscape. The car is the preferred mode of transportation for everyday travel and car owners expect to be able to park their vehicle close to their destination. Even today, drive-through establishments cater to that expectation. This 'expectation' resulted in the proliferation of large

[1] A parking structure is a multi-storey car park, as opposed to surface lot parking. It can be a stand-alone structure or incorporated with a building. Parking structures are also referred to as parking garages, parking ramps, parking decks, parking podiums (when attached to high-rise buildings), and open-parking structures.

surface parking lots and has spawned new types of buildings designed to accommodate parked vehicles.

On average a typical vehicle is parked for 8,360 hours per year, more or less 340 days (Jakle and Sculle 2004). Studies have demonstrated that typical daily car use consists of 30 minute drives to and from work and 70 minutes of driving for other purposes. This means that a vehicle is parked between 93 to 97 per cent of the time during any given day (Ben-Joseph 2012, 139).

In terms of land use, on average, a car in regular use requires two parking spaces, one at home and one at the destination. Assuming that the average size of a parking space is about 14 square metres, plus the space required to get in and out of the parking space, the space required to accommodate even 500 vehicles is tremendous, almost a square kilometre. It is therefore not surprising that car has become a major determinant of city planning. The result is inevitable: the landscape of a typical town or city is dominated by a sea of parking spaces. Perhaps only railways have disrupted the urban fabric to the same degree; arguably parking has had a greater fragmentary impact. Furthermore, the impact of parking varies: a) it hastens the demolition of viable neighbourhoods and historical landscapes; b) it contributes to the rapid decline of pedestrian and cycle traffic; c) it disrupts the cohesion of traditional cityscapes and downtowns through widened streets; d) it disrupts street life through commercial buildings being set back from the sidewalks and streets; e) it affects the design of commercial buildings (for example, drive-through businesses). Nonetheless, parking demands are likely to increase worldwide as automobile use increases. In the USA, it is estimated there are 800 million surface parking spaces, and this number increases every year. One can only conclude that as the number of parking lots and structures increases, parking demands will continue to influence city planning and determine the appearance of our cities.

Traditionally, parking literature has examined surface lots and structures from an economic and land-use perspective (parking demands and operation, ratio, etc.). Yet, over the last 10 years, academics, other than transportation and engineering specialists, have started to evaluate the aesthetic and social impact of parking on the urban fabric. Some of the major works are John A. Jakle and Keith Sculle's (2004), *Lots of Parking*, Donald Shoup's (2011) *The High Cost of Free Parking*, Mark Childs (1999) *Parking Spaces*, and more recently Eran Ben-Joseph's (2012) *Rethinking a Lot*. The last two works share this article's approach and goal, for their aim is to demonstrate and promote techniques that encourage active pedestrian environments and establish alternate settings for vehicles (Ben-Joseph 2012: xxii). Yet both authors focus mainly on surface parking lots and not parking structures.

Critiques of parking structure design seems to be the domain of architects.The last five years have seen the publication of two major studies: *The Parking Garage: Design and Evolutions of a Modern Urban Form* (McDonald 2007), and *The Architecture of Parking* (Sollohub 2010). While both studies focus on the history and architecture of parking structures, neither discuss in any detail the positive or negative impacts of parking on the built environment.

This brief overview of the literature on parking indicates that there is still a divide between planners, transport specialists, and architects in the field. Planners focus on land use, parking by-laws, and on the impact of parking on the urban landscape. In turn, transportation specialists focus on cost: demand and supply. There are very few studies on the history, design, aesthetics or impact of parking on the built environment. This article uses a case study of downtown Winnipeg parking facilities in an attempt to integrate these various fields.

Downtown Winnipeg and Parking Structures

Downtown Winnipeg consists of four distinct sectors categorized by the City-By-law 100/2004 into Multiple-use Sector (M), Character Sector (C), Downtown Living Sector (D), and Riverbank Sector (R) (Figure 1). Thus, downtown Winnipeg has a highly diversified land use, including a small Chinatown located within the Exchange District (Sector C on the northern section of the Sector Map). It also includes the Forks, a huge green and public space (Sector C and R, eastern part of the Sector Map) and the Legislature (Sector C and R, south-west part of the Sector Map).

This study focuses on the multiple-use sector (M) delimited by Portage Avenue and Broadway Avenue (south and north), Memorial and Main Street (west and east). This quadrilateral area encompasses the greatest number of parking structures and a great many surface parking lots (Figure 2: Winnipeg Downtown Parking 2011).

Other sectors were eliminated for different reasons. The Forks Area (C and R sector east of Main Street) is mainly dominated by surface parking lots with the exception of one parking structure. In turn, the Exchange District and Chinatown (C sector northeast of Portage Avenue) boasts three to six parking structures and other parking is mainly on-street and in surface lots. Finally, north of Portage Avenue, the Downtown Living Sector and the Legislature Sector (west of Broadway Avenue) do not have any parking structures.

While downtown Winnipeg encompasses a wide area, it is truly a horizontal land development as opposed to vertical. Aside from 10 to 15 buildings more than 10 storeys high, the area is dominated by buildings of five storeys or less. Thus, the commercial sector of the study area, while the dominant land use, is small relative to the total area of downtown Winnipeg. This is particularly noticeable if the Legislature, the Forks and the River Bank sectors are included. In fact, in downtown Winnipeg there are approximately 21,500 businesses with a high concentration in the study area. These business ranges from financial services and security, to Manitoba Hydro's head office, banking, retail, government and public services.

It is estimated that downtown Winnipeg is the destination for over 68,000 workers on a daily basis including 10,000 post-secondary students who attend the University of Winnipeg, Red River College, and other post-secondary educational facilities. For its size, the downtown population is quite small, with only

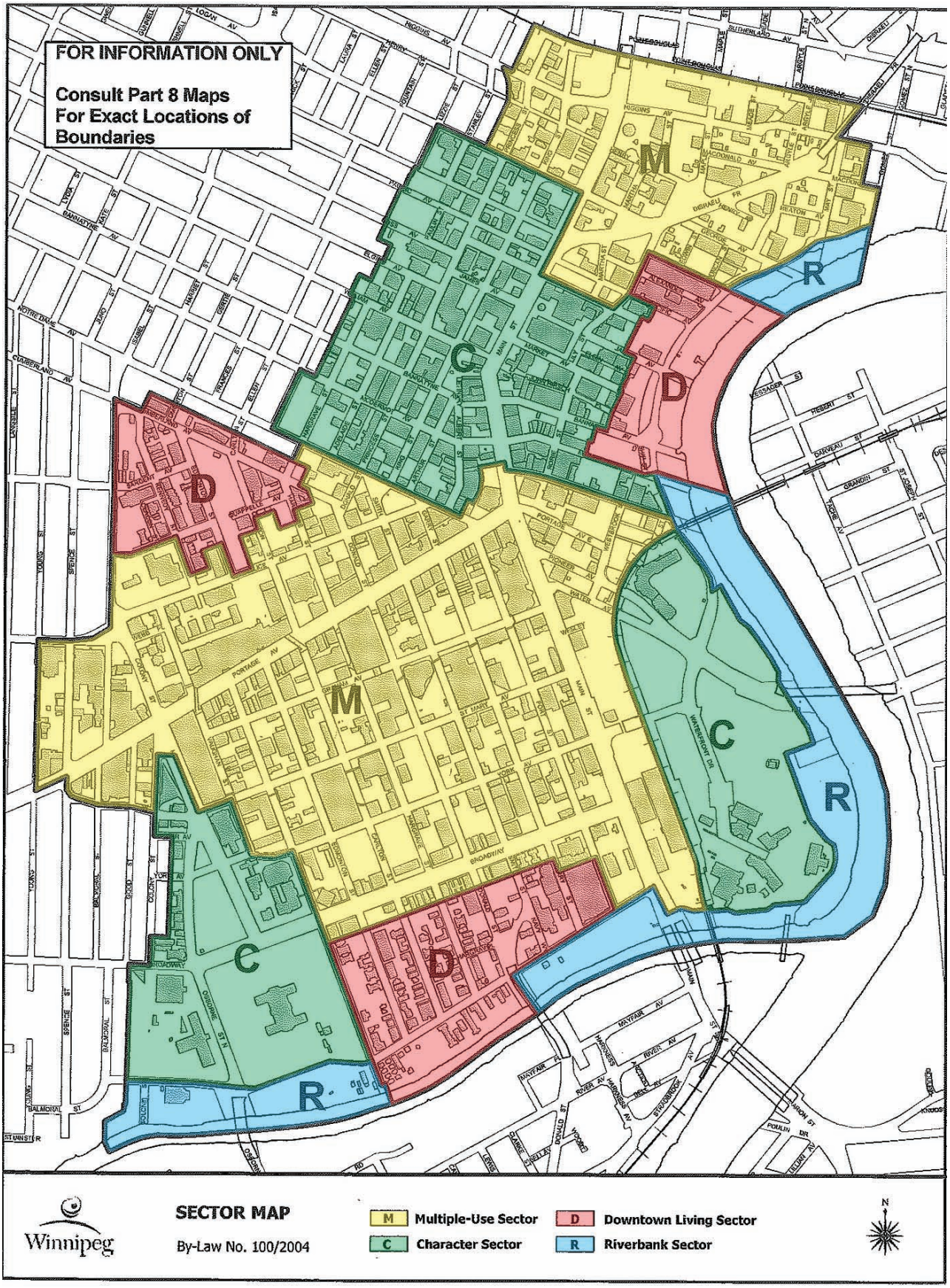

Figure 1: Downtown sector map. (Source: City of Winnipeg 2004)

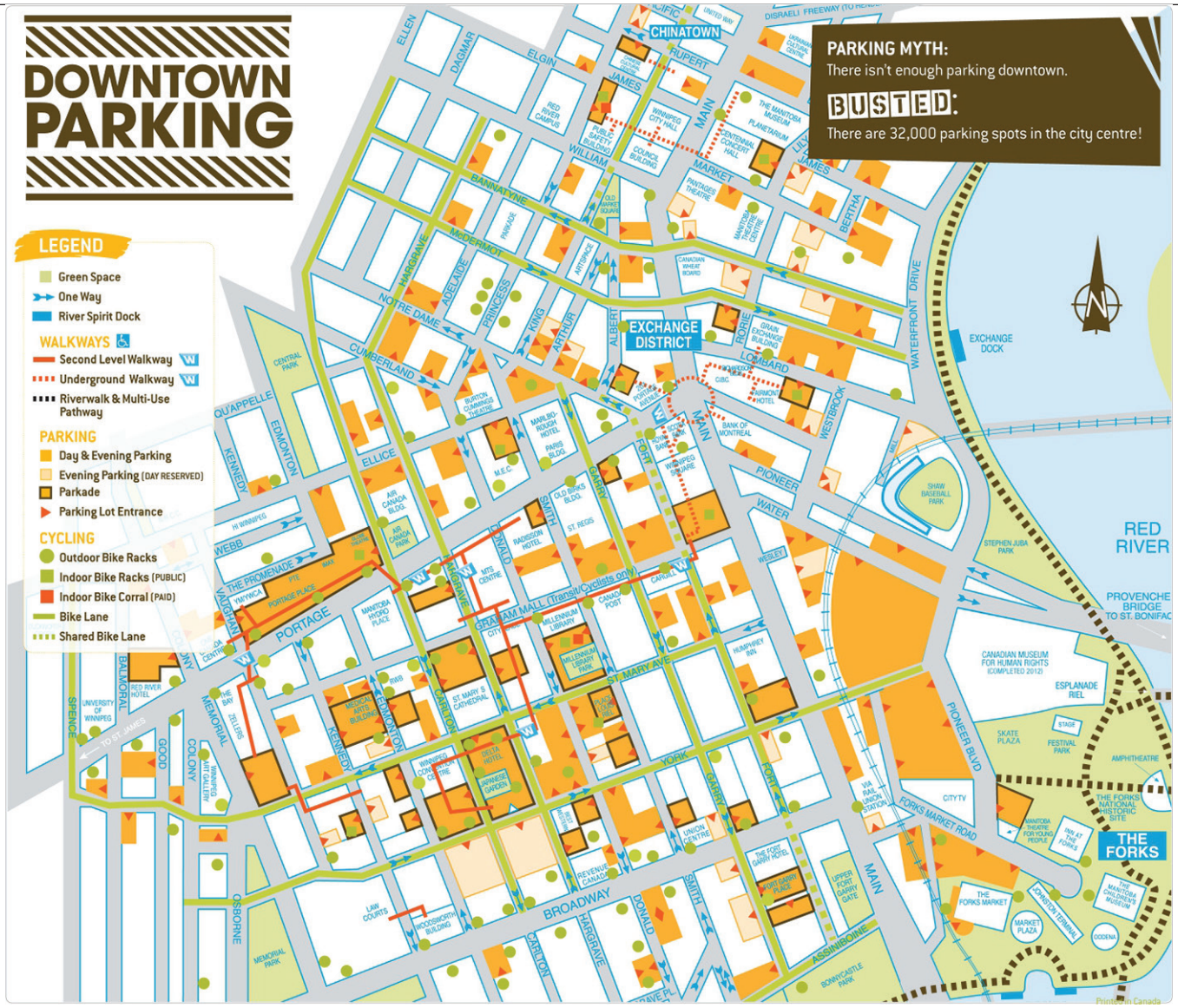

Figure 2: Downtown Winnipeg parking map. (Source: Downtown Winnipeg BIZ 2011A.)

an estimated 17,000 residents[2]. In turn, 94.9 per cent of downtown residents are renters and 75.3 per cent live in apartments of five or more storeys. This population is mostly concentrated in or around the periphery of the study area. Thus, the study area is sparsely populated and dominated by businesses, with some high-rise apartments and a great number of parking structures and surface lots (Downtown Winnipeg BIZ 2012).

The percentage of land allocated to parking in downtown Winnipeg is close to 41 per cent. In turn, the greatest concentration of surface parking lots and structures lies between Broadway Avenue and Graham Mall (south-north) and Smith and Kennedy Street (west and east) (Figure 2).

Parking lots and parkades are operated either by two major agencies: The Winnipeg Parking Authority and Impark (an international parking company) with some public agencies and other small operators. It is estimated that per day, on average, approximately 65,000 vehicles park downtown. Together, parking operators manage about 32,000 off-street parking spaces, of which 2,500 are available for public use (Winnipeg Free Press 2012). In 2008, the Winnipeg Parking Authority operated "5,000 spots on city streets, three city-owned parkades and handful of surface lots" (Winnipeg Free Press 2008). In turn, private operators, including Impark, operate 150 lots in Winnipeg. Aside from the 32,000 off-street parking spaces, there are another 2,000 on-street parking spaces. Ironically, with over 32,000 parking spaces, the public perception is that there is not enough parking available downtown. To remediate this negative perception Downtown Winnipeg Biz and the Winnipeg Parking Authority have, over the years, published numerous pamphlets to extol the benefits of downtown parking and its low cost compared to

[2] Gillies, B., 'Civic parking garage closure tip of the iceberg', *Winnipeg Free Press* 09/12/2012. Winnipeg is one of the more sprawling cities in Canada, with an urban density of 1,400 per square kilometre compared to Ottawa's 1,700 and Montréal's 1,850.

other Canadian cities (Downtown Winnipeg Biz 2011A, 2011B, 2012).

Downtown parking campaigns aim to 'educate' the public on parking availability and 'proper' usage of street, surface and parkade parking. For example, a survey of downtown parking indicated that "almost 60 per cent of business owners use on-street parking for themselves and their employees, thereby reducing the number of scarce and valuable spaces for their customers" (Downtown Winnipeg Biz 2011B). Since there are only 2,000 on-street parking spots, they should be reserved for short-term (customer/consumer) use while surface parking lots and parkades should be used by workers and business owners (long term parking). All of these pamphlets advocate the use of parkades: "putting your vehicle in a parkade is the most comfortable and convenient way to park" (Downtown Winnipeg Biz 2011B). The main reason is that some of the parkades within the study area are also connected to the downtown indoor walkway system. The latter is a series of above-ground walkway corridors (2nd floor) connecting a series of buildings in downtown Winnipeg. Part of this walkway system is found along Portage Avenue and Graham Mall Street where "you are never more than two blocks (less than a 5 minute walk) away from an indoor parkade". (Downtown Winnipeg Biz,2011B)

Parking Structure Typology

Downtown Winnipeg parking structures encompass four different types and styles of parkades: 1) parkades integrated within a building or as an extension; 2) bunker/brutalist parkades; 3) two or more storey flatbed parkades; and 4) rotunda or the "Space Age" parkades. Each category has a different effect on the cohesiveness of the downtown, the streetscape, social and commercial activities, and urban life. Given that the parkades were built over a span of some 60 years, from the 1960s to today, each category incorporates many variations in architectural style, materials and size. In turn, parking structures reflect different periods of the modernist movement from the 'pure' functional and utilitarian phase to the more 'tolerant' phase of employing materials other than cement and glass, along with incorporation of some ornamentation. Each of these types have their advantages and drawbacks. These are discussed following an overview of various types of parking structures.

1) Parkades integrated within a building or as an extension to it.

The integration of parking structures within a building, or as an extension to one, dates back to the 1930s. The latest addition to this type of parkade is the incorporation of stores on their first floor. In downtown Winnipeg, there are many examples of this parkade type varying from commercial buildings (Radisson Hotel, Louis Riel Place), government buildings (Western Canada Lottery), cultural institutions (Royal Winnipeg Ballet) and apartment high-rises.

Five parkade structures integrated into, or as an extension to, a commercial building stand out in their effort to blend into the streetscape.

Figure 3: Radisson Hotel (all the other pictures were taken by the author).

The Radisson Hotel on Portage Avenue (Figure 3) is a classic example of a major downtown hotel incorporating its parking facility within the first five to ten floors of the building (or placing them below street level). It is not immediately obvious that the first eight floors are devoted solely to parking. The access ramp is on the side street. This type of parking structure on a major downtown commercial street has little impact on the streetscape and has the benefit of being architecturally integrated within the design of the building.

In contrast, the parkade of the hotel complex Place Louis Riel consists of a three storey brown brick mega-structure (Figure 4 and 4A). While one side of the parkade has stores facing the street, the entire parking structure is adjacent to a large surface lot. The structure is integrated with the apartment building and also shares the same building material and appearance. Nonetheless, this parkade, half a city block long, looks like a bunker in the middle of a parking lot. Thus, these two hotels provide a study in contrast as to how parkades may affect the streetscape and general urban ambience.

Figure 4 and 4A: Place Louis Riel.

Figure 5: Western Canada Lottery .

The Western Canada Lottery and CTV Head Office (Figures 5 and 6) are two examples of parking structures built as extensions but are architecturally integrated into the building. The Western Canada Lottery parkade extends outward from the hexagonal modern 10 storey edifice. The parkade is a three flatbed parking structure made of the same material as the main building. The broad brown/beige panels covering the parkade constitute a shelf which hides the parkade cement beds. Once again, aside from the entrance on the side, this parking structure gives the impression of being a building in itself as opposed to being a parkade. The hexagonal design of the office building does contrast with the 'bunker' straight line of the parkade. One must point out that, like many tall buildings in downtown Winnipeg, this structure stands out simply because there is no other building of its height surrounding it. In fact, behind this parkade is a surface parking lot. Such relationships seem to be a common feature in the survey area.

The CTV Head Office parkade extension (Figure 6 and 6A) is a five storey parking structure adjacent to the Head Office. CTV Head Office facade has been architecturally integrated to this building through the use of the same material, red brick and glass, which partially hides the grey cement parking deck visible from the side street. The grey cement deck columns and panels recently were painted in different colours on one side, giving a playful and pleasing look. The colours also identify which deck a customer's car is parked on. CTV Head Office design actually incorporates a small public place (trees and benches) in front of

Figure 6 and 6A: CTV head office.

Figure 7 and 7Aa: Royal Winnipeg Ballet.

the parkade. Unfortunately, this public place faces a large surface parking lot across the street and is located on the main bus route through downtown. People lounging in this public place are mainly looking at parked cars or traffic on the busy and noisy thoroughfare.

The Royal Winnipeg Ballet (Figures 7 and 7A) is somewhat unusual as the parkade was integrated within the building but was built as an extension. Architecturally, the building seems to float atop its two-bed parking podium. This parking structure provides a great contrast with the old type of parkade, in particular the 'Bunker/Brutalist' (Figure 8) located across the street. In fact, the Royal Winnipeg Ballet is an island surrounded on all sides by either parkades or surface parking lots.

The next example is a slim elongated edifice composed of three distinct rectangular towers (Figures 8 and 8A). The tower in the foreground is a 20 storey glass building. The middle tower has no windows (a black slab) and the one at the rear is a half glass tower with a curvature sitting atop of an eight to nine storey concrete parkade. Aesthetically, this is the worst example of integration of a parkade extension to a building. The overall effect is that of a bad collage which ruins the aesthetics of the building. It seems that the parkade extension was an afterthought, quickly and cheaply added to satisfy the need for

Figure 8 and 8A: Office Towers parkade.

parking. This incongruous effect is further compounded by the sterility of the adjacent large surface parking lots.

Finally, perhaps the oldest style of this type of parkade is the one extending for a city-block length from The Bay (Figures 9 and 9A). This four storey parkade, with its brick columns as

Figure 9 and 9A: The Bay parkade.

Figure 10: Apartment building integrated parkade.

opposed to cement, is reminiscent of the old type of parking structure with its dated sign advertising "Auto Centre top level of Parkade Complex Car Service". This parkade does not match The Bay's grey stone material and extends the length of a long city block. Commercial activities can only be found on the other side of the street. Furthermore, the whole design is ruined by a pedestrian walkway bridge that joins two buildings across an intersection.

Most parkades in downtown Winnipeg attached to apartment buildings are highly functional but aesthetically disappointing. To illustrate this point, two examples may be cited. The first consists of an integrated parkade within an apartment complex (Figure 10), somewhat similar to the Radisson Hotel, where the first two or four storeys are reserved for parking lots. A grid-like cover hides the view of cars in the parkade. Yet, once again, the presence of an adjacent surface parking lot negates the effort of a parking structure aiming to minimize land use and to aesthetically incorporate a parkade into a commercial building.

The second example is a brick high-rise apartment of more than 15 storeys, seemingly sitting on top of a very large three storey flat-bed cement parkade which occupies half of a city block and extends well beyond the width of the apartment building (Figure 11 and 11A). There are some stores at street level but they are constantly under the shadow of the rooftop of the parkade. This somewhat monolithic complex is aesthetically displeasing, made so by the presence of a huge surface parking lot in front of the building. Any pedestrian would feel lost in a sea of parking lots.

This survey of downtown Winnipeg's commercial buildings that incorporate parkades (within the building, or as an extension) indicate that they were better designed and aesthetically more pleasing than the high-rise apartments' parkades. One the reason is that most of the latter were built and designed in the late 1960s and the 1970s. Thus, they truly reflect the modernist movement of functionality and its favourite material (i.e., cement). The parkades of high-rise apartments also reflect the popularity of the flat-bed cement parkade which dates back to the 1960s. In contrast, many of the commercial buildings with parkades are more recent and represent a new urban vision, one that strives for integration and cohesion. It should be remembered that commercial buildings serve as a symbols and that companies, governments and institutions tend to invest much more in the design of their buildings than do private owners.

Both commercial and residential buildings incorporating a parkade strive to minimize the impact on pedestrian flow and

Figure 11 and 11A: Apartment high-rise parkade and stores.

street activities, either by placing their entrances on side streets or by incorporating stores and other businesses within their parkades. In one case a small public park was incorporated into the design.

2) Bunker/Brutalist parkades

Brutalist architecture (1950 to 1970) is normally associated with multifunctional mega complexes, government buildings and low-rent housing. In Canada, many Canadian universities adopted this style during the 1960s, such as the D.B. Weldon Library at Western Ontario. In turn, Montreal's Place Bonaventure is a famous example of the Brutalist style of a multi-functional

Figure 12: Brutalist style of bunker parkade.

complex. Place Bonaventure encapsulates the fortress-like, blockish style and linear aspects of the Brutalist movement. The predominant building material of Brutalist architecture was either cement or brick. Winnipeg also embraced this style with the Manitoba Theatre Centre or the Manitoba Teachers' Society building. Thus, while Brutalism is associated with buildings, the characteristics of this style (blockish, cement, and linear) also characterized a certain type of parkade, here referred to as the Bunker/Brutalist parkade.

There is only one example of this type of parkade in downtown Winnipeg and it is located across the street from the Winnipeg Royal Ballet (WRB) building. This Bunker-style parkade consists of a large enclosed cement parking structure of five to six storeys (Figure 12). This monolithic cement building covers almost an entire city block. The Royal Winnipeg Ballet's parkade is on the other side of the street, so there is no commercial or social activity within this section of the street. Many of these Bunker parkades have disappeared in larger Canadian cities. They were, and are, the prime target of criticism for those who reject Modernism and its negative impact on city form and cohesiveness. We can also include the previously discussed parking structure of Place Louis Riel within the Bunker/Brutalist parkade category.

3) Two or more storey flatbed parkades

This category and style of parking structure is a very familiar design in many cities. In downtown Winnipeg about half of the study area, between St-Mary and Broadway Avenues (north-south) and Edmonton and Smith Streets (west-east), is occupied by flat-bed parkades (Figure 2). Some of these parkades are linked to a pedestrian walkway system that provides access to some buildings in and around the area (Figures 13 and13A).

This area is an island of parking characterized by the absence of public life and commercial activity. Many flat-bed parkades covers one or two city blocks and, more often than not, there are large surface parking lots adjacent to them. While conducting this survey, the only people seen in this area were drivers getting in and out of their parking spaces. There was a

Figure 13 and 13A: Four-storey flat-bed parkade.

Figure 14 and 14A: Rotunda Parkade Gary Street.

complete absence of pedestrian activity on the street. If there was ever a question that downtown Winnipeg was primarily designed for and influenced by the automobile, walking around this area will dispel any doubts. The feeling is similar to that of wandering around a huge sports stadium's surface parking lot. The term eye-sore cannot begin to describe the overall impact of this area on Winnipeg's downtown.

4) Rotunda or "Space Age" parkades

The Rotunda parkade is a multi-storey circular parking structure. Downtown Winnipeg has two examples of this type. Both are constructed of cement and glass and do have a somewhat whimsical look, since their circular shape contrasts greatly with the linear and rectangular lines of most other modern structures in the city.

The Rotunda on Gary Street (Figure 14 and 14A) on one side is adjacent to commercial buildings in the 1940-1950s architectural style and, on the other side, to a 1980s modern-style building with glass and cement columns. The latter has parking on top of the building which is accessed via the Rotunda parkade. In other words, the last deck of the Rotunda parkade extends to the rooftop of the adjacent building.

The other Rotunda parkade, on Hargrave Street, is part of the City Place shopping and office complex (Figure 15). Historically, this building was part of the old Eaton's building with a later addition of a government office (Manitoba Public Insurance) and of the mall. Both Rotundas' parkades seem mismatched with the recombinant style of architecture and highly rectangular and linear construction that surrounds them.

The entrances to these parking structures impede pedestrians. The Rotunda on Gary Street actually has two parkade entrances while the Rotunda on Hargrave Street has only a single ramp. The advantages of Rotunda, as opposed to flat-bed, parkades, is that they use less land than the other types of parkade and have less impact on the streetscape. Unfortunately, they are not very efficient for getting cars in and out during peak traffic periods.

Discussion

This study of downtown Winnipeg parking facilities assesses how facilities, particularly parking structures affect urban and civil composition. Urban composition refers to the design of settlements with a focus on the built environment and its composition. In turn, civil composition, a term coined by Childs, refers to the "concinnity in which multiple independently-designed parts collectively make urban streets, districts, towns and other settlements" and "the skillful and harmonious adaptation of fitting together of parts to craft a whole" (Childs 2012,17). Lack of concinnity is often associated with urban compositions char-

Figure 15: Rotunda parkade Hargrave Street.

acterized by placelessness, identical and monotonous design such as "identical franchise stores, manufacturing housing, and much infrastructure design" (Childs 2012, 7). Childs (2012,17) claims "great places emerge from the concinnity of incremental acts of design" based on existing built forms and the inclusion of new projects that can inspire future projects. Positive concinnity and its synergy takes into account the various contexts and interdependence of built forms, both old and new. Projects that ignore the context or the style of existing buildings will stand out from their surrounds. This can lead to "excessive independence" where surface parking lots and parkades break down area cohesion with inefficiencies, "such as duplicate parking [precisely the case of downtown Winnipeg's parking landscape], disconnected sidewalks and poorly defined streets" (Childs 2012,18)

The overwhelming presence of parking structures and surface lots in downtown Winnipeg precludes the attainment of concinnity. With most parking structures surrounded by surface parking lots, repetitious landscapes are created and land-use practices that deter possible changes implementation of new designs become entrenched.

An important element in the viability and cohesiveness of a settlement lies in the relationship between social practices and the built form. This relationship has the power to "dispirit or inspire, deter or encourage, show disregard or social investment" (Childs 2012,18). In turn, the cohesiveness and vitality of a built form lies in providing a creative public milieu and a rich sense of place.

There is no doubt that the study area lacks concinnity: its appearance is dictated by the dominant simplistic land-use of vehicle parking. Accordingly the positive and negative aspects of each category of parking structures will be examined.

Winnipeg's parking landscape is slowly changing. The parking structures surveyed revealed some well integrated parkades in downtown Winnipeg that respect their context, reduce the area used for parking, and attempt to enhance life on the street. The Radisson Hotel, Winnipeg Royal Ballet, the CTV Head Office parkades are all examples of parking structures that are architecturally well-integrated into their surrounds and in some cases respect the historical context of the site. In turn, some parkades integrate stores at the street level. This encourages pedestrian traffic and enlivens the street. Nevertheless, the few examples in downtown Winnipeg remain poorly incorporated into the streetscape because they are surrounded by surface parking lots.

Parkades integrated within buildings, more so than those that are extensions or the rotunda-type parkades, are aesthetically more pleasing and reduce the area dedicated to parking because they are built vertically. For some, this type of parking structure (in fact any type of parking) continues to encourage and reinforce the car-built city. However, the Radisson Hotel, and CTV Head Office are better suited to the creation of a more pedestrian-friendly city and help thereby to enhance the city's image. Such parkade styles also have the advantage of being able to incorporate stores into their lower storeys, thereby encouraging commercial life on the street. Surface parking lots are the complete opposite as they create monotonous repetitive landscapes and discourage commercial and social life and pedestrian traffic.

Rotunda parkades, provide visually interesting architecture and give a somewhat 'whimsical' look to the streetscape. Unfortunately rotunda parkades are difficult to integrate into existing buildings but they can provide a stimulating view for the pedestrian.

There is no doubt that downtown Winnipeg's parking landscape has been one of the main causes of the area's lack of vitality, cohesiveness and vibrancy. The negative impacts of parking structures can be grouped under two major categories: 'desert utilitarian streetscape' and 'downtown garage streets'.

Deserted Utilitarian Streetscape

The concentration and overwhelming number of parking structures and surface lots in downtown Winnipeg created of what can be described as 'deserted utilitarian streets". In other words, a streetscape populated mainly by parked cars with minimal commercial or pedestrian activities (Figure 16 and 16A).

The positive impact of any well integrated parking structure in downtown Winnipeg is negated by the presence of adjacent surface parking lots. Without exception, all integrated parkade structures surveyed were adjacent to surface lots. This reinforces the utilitarian and functional aspect of the structures, discourages commercial and pedestrian activities and exacerbates the absence of a sense of place. There are numerous streets completely absent of people (except during peak traffic period) where the presence of parked cars is overwhelming. At night, when parking lots are empty, one truly has a sense of walking in a deserted town, since there are few commercial or social activities evident.

The "deserted utilitarian streetscape" truly reflects the 1960s era car-centred planning mentality that has guided downtown Winnipeg's development since then. Deserted utilitarian streets are an aesthetic blot on the landscape; they create a negative image of the city as a whole. They convey an image of a downtown that is stagnant, lacks vibrancy, and has no genius loci.

Figure 16 and 16A: Desert utilitarian streets.

Figure 17 and 17A: Desert garage streets.

Downtown Garage Streets

Another section of the study area, between Kennedy to Smith Streets (west to east) and Graham Mall Street to Broadway Avenue (north to South) is designated as downtown garage streets (Figure 2). These streets run through one to two city blocks where there are flat-bed parking structures or a parkades (flat-bed) on one side and surface parking lots on the other side.

Walking or driving to and from parking spots are the only activities in areas that consist of huge parking garages, with a few businesses and one or two apartment buildings scattered here and there (Figure 17 and 17A). If downtown Winnipeg was a house, this area would be its garage. The feeling of 'garaging' is further exacerbated when one walks or drives in the back alleys. All one sees are long stretches of flat-bed parkades and surface lots. As with 'deserted utilitarian streets', there is a complete absence of on-street social activity. This highly unattractive streetscape has been designed for cars and there are few, if any, commercial or social activities. This area truly breaks the cohesiveness of the downtown, for garage streets create corridors of bland cement structures. The area is a sea of parked cars during the daytime and is completely empty during the night. Lastly, garage streets also destroy the architectural, commercial, and social purposes of the few buildings aimed at integrating parkades within buildings. This is the case with the Winnipeg Royal Ballet integrated parkade, which is offset by a Bunker/Brutalist style parkade across the street and is part of the corridor of a 'garage street' which extends another two city blocks.

Those parkades that house stores on their first floors are mostly located on 'garage streets' or 'deserted utilitarian streets.' These few businesses are the only ones around and service mostly those who park there or those working or living in the building where the parkade is located.

Both deserted utilitarian streets and garage streets are frequently associated with boredom and the potential for anti-social activity such as tagging, writing graffiti, vandalism, car theft, mugging, begging and harassment. This is the case in the study area which has been plagued for years with a high level of petty crime and gang wars. Jane Jacob's "eyes on the street" concept as part of the necessary ingredient for a vital neighborhood urban life does not apply to the study area. There are no residences on the deserted and garage streets area, which means that there are no residents in and around these street corridors. The 17,000 permanent residents of downtown Winnipeg are mostly located beyond, or at the periphery of, the study area. The desert and garage streets service mainly the transient 65,000 people who shop, study or work downtown. Lewis Mumford claimed that "the right to access every building in the city by private car, in

an age when everyone owns such a vehicle, is actually the right to destroy the city" (Mumford 1961). Mumford's reference to the destruction of the city pivots around the loss of cohesion and concinnity that makes a downtown more than the sum of its parts, something that creates a vibrant energetic commercial, social, and public space.

In the case of downtown Winnipeg, Mumford's claim cannot be ignored or denied. This survey of parking structures encompasses over 40 years of development in Winnipeg. Winnipeg has a slow-growth population and economy, which means that land use changes at a slower pace than in a fast growing metropolis. There are many other reasons for downtown Winnipeg's slow development. The development of regional shopping malls and suburbs in Winnipeg has greatly contributed to the decline and lack of development in the downtown. Nevertheless downtown Winnipeg, was, and is, designed mainly for car use, since almost 40 per cent of land use is for parking.

Parking demands, will continue to grow and unless city policy changes radically. A study of parking in Los Angeles concluded that parking space (and requirements) have ,and continue to, make Los Angeles, " little more than a group of buildings, each a destination in its own right, to be parked at and departed from, and not part of some larger collective whole" (Shoup 2011). The same can be said about downtown Winnipeg's deserted utilitarian streetscape and garage streets which mainly serve a few buildings in the area. Such planning leads to the repetition of similar land use (parking), placelessness, monotony, and complete absence of urban life. Downtown 'deserted streets' and 'garage streets' are dispirited, deter changes, and disregard or discourage social investment.

Conclusion and Recommendations

There is a need to admit there is such a thing as too much parking. This means a radical break with Winnipeg's automobile-friendly culture. While some commitment to the development of better rapid transit exists, new solutions for downtown Winnipeg are necessary. These might include development of underground parking for new commercial developments; encouragement of the development of bicycle paths and new residential developments with built-in or underground parkades.

The city must strive for better designed parkades that take into account the streetscape, context, and local architecture. Designs should encourage vibrant street life. It is important that various elements of city form (e.g., roads, sidewalks, buildings, and benches) are not stand-alone structures and they integrate with each other according to the local context. Urban elements which are not integrated result in a lack of concinnity and cohesiveness. In other words, one has to strive towards an integrated landscape, coordinating urban form and structure. It is ironic that the design and incorporation of parking structures in urban areas in the 1920s and 1940s showed greater respect for the cohesiveness of the city and incorporated local architecture and commercial services to a greater extent than more recent designs.

It is important to maintain public and commercial space around parkades as opposed to surface parking lots. One should think of parking structures as places that can accommodate businesses on the first floor; they are more than simple car parks. Integration of public space, as in the CTV Head Office, can make a significant impact on the streetscape in terms of pedestrian flows. A radical solution would be to transform the numerous surface parking lots into business and residential complexes with integrated parking structures. In the case of downtown Winnipeg, it will not only increase the downtown population, it will also stimulate business and highlight the need for a better public transportation systems. There are some encouraging signs, such as the new Manitoba Hydro building which houses 2,000 employees. This building has no parkade or underground parking. Located between Portage Avenue and the public transit route of Graham Street, it banked on its employees using the transit system, which actually stops at the front door of the building. The city is also planning to replace some of its large surface parking lots with underground or vertical parkades. It is hoped multi-storey flat-bed parkades that can occupy a city block and create inhospitable deserted streets will be avoided at all costs.

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Degree-day snowmelt runoff experiments; Clear Lake Watershed, Riding Mountain National Park

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Abstract

The Temperature Index model or Degree-Day Melt model estimates snowmelt for a time period (one day) as a linear function of temperature (mean daily). Intrinsic to this model is the melt coefficient, the melt factor, degree-day-factor or degree-day ratio (M_f).
The purpose of this study was to empirically determine the degree-day ratios throughout the melt-season for small (< 0.5 ha) open grassland sites in the Clear Lake watershed, Riding Mountain National Park.
A 0.5 ha open relatively flat grassland with full sun exposure was selected for the snowmelt runoff experiments. A 10 m^2 plywood collection platform funneled meltwaters into a collection reservoir. Sample plot runoff was weighed daily. Mean ambient and snowpack temperatures were measured hourly and mean daily values calculated. Degree-days of melt are calculated based on cumulated degree-hours above 0.0 °C for a twenty-four period (degree-hour-days (DHD).
During the 24-day melt season (March 31 to April 23 2011, degree-day ratios and degree-hour-day ratios are variable. The arithmetic mean DD ratio was calculated to be 7.43 °C day^{-1}, a value considerably smaller than the 3.10 mm °C $hour\text{-}day^{-1}$ calculated mean DHD ratio for the same period. Seven-day running mean smoothing produced a melt season mean DD ratio (3.22 mm °C day^{-1}) similar to the seven day smoothing melt season mean DHD ratio (3.38 mm °C $hour\text{-}day^{-1}$). The open site 7-day smoothing M_f values are approximately 19 percent greater than McGuire's 1997 benchmark forested (50%) watershed mean melt ratio of 2.78 mm °C day^{-1}. The Martinec 1960 snowpack density function generated an overall melt factor of 3.06 mm °C day^{-1}; a value similar to McGuire's benchmark standard and the 7-day smoothing M_f values.
For shallow ripe snowpacks containing less than 15.0 cm snow water equivalent, that melt over a relatively short period (less than one month), a single degree-day or degree-hour-day melt ratio appears to be acceptable for the snowpack melt phase. Melt ratios however, must be determined for each cover type.
In Riding Mountain National Park, the arithmetic mean degree-day melt ratio tends to overestimate snowpack depletion. Consequently, a 7-day running mean smoothing function combined with a graphically determined mean for the total melt season is preferred. Alternately, Martinec's 1960 density function based on a mean of weekly snowpack density estimations can be used to estimate the degree-day melt ratio.

Keywords: *snowmelt modelling, degree-day index, temperature index*

Introduction

Snowmelt is a thermodynamic process. Its study should thus consider those factors influencing the transmission of heat to the snowpack: the snowpack radiation heat balance (see Millar 1981, Haan et al. 1982, Bras 1990, Singh 1992). Although energy balance models provide a theoretical background for the applications of snowpack melt equations at specific locales, the estimation of snowmelt-generated runoff from a watershed is more complex.

Grey and O'Neill (1974) found that net radiation was the primary energy source for snowmelt on the Canadian prairies when snow cover is continuous, supplying 93 percent of melt energy. However for discontinuous snow cover, the advection of sensible heat from bare ground towards isolated snow patches provides 44 percent of the melt energy and the net radiation contribution is reduced to 56 per cent. Zuzel and Cox (1975) measured daily values of wind run (velocity times time), air temperature, vapour pressure, net radiation and melt at a continuous snow cover research plot. They found that net radiation, vapour pressure and wind run explained 78 percent of the variation in melt; the autocorrelated air temperature explained 51 percent of variance. Viessman and Lewis (2003) suggested that temperature as an index of melt represents net radiation, sensible and latent heat transfer inputs, and is sensitive to wind. Dingman (1994) supported this argument, indicating that both long-wave radiation and turbulent heat exchanges are approximately linear functions of ambient temperature.

Daily/hourly ambient temperature data is readily available for most watersheds whereas daily radiation, vapour pressures and wind meteorological data may not be available for the watershed of interest. Due to logistics in fulfilling the data requirements for an energy balance approach and the virtual impossibility of collecting spatially representative data in a moderate to large watershed the empirical temperature index or degree-day methodology is incorporated into most snowmelt runoff models e.g. UBC Watershed Model (Quick and Pipes 1977), Snowmelt Runoff Model (Martinec et al. 2008).

The Temperature Index model or Degree-Day Melt model estimates snowmelt for a time period (one day) as a linear function of mean daily temperature (Dingman 1994) and is commonly expressed as:

$$Q = M_f \ (T_a - T_p) + b$$

Where:

Q is the daily melt (m^3) or depth of melt (m);
$\mathbf{T_a}$ is the mean or maximum daily temperature (°C);
$\mathbf{T_p}$ is the temperature (mean daily) of the snowpack (°C);
$\mathbf{T_a - T_p}$ is the degree-day value (DD);
$\mathbf{M_f}$, the slope, is the melt coefficient, melt factor, degree-day factor or degree-day ratio; measured in m, mm or cm of depth per degree-day (m $°C^{-1}$ day^{-1}, mm $°C^{-1}$ day^{-1} or cm $°C^{-1}$ day^{-1});
b, the intercept, is the volume of melt (m^3, cm^{-3} or mm^3) or the depth of melt (m, cm or mm) when $T_a = T_p$. This is often assumed to be zero.

A degree-day (DD), is a measure of the departure of the mean daily temperature from a specified standard; commonly 0°C, one degree-day for each °C of departure above the 0°C standard during one 24 hour period (Lo 1992).

Intrinsic to the degree-day melt model is the determination of the melt coefficient, melt factor, degree-day factor or degree-day ratio (M_f).

Objective

The purpose of this study is to determine empirically the melt coefficients throughout the melt-season for a small (0.5 ha) open grassland site in the Clear Lake watershed, Riding Mountain National Park.

Physical Characteristics of a Snowpack

Cold Content (Q_{cc})

Cold Content (Q_{cc}) is defined as: the heat required per unit area (m^2) to raise a dry snowpack temperature to 0°C (Singh 1992).

$$Q_{cc} = - (C_i \rho_s) [d_s (T_m - T_p)]$$

Generally this heat is generated through the refreezing of diurnal meltwater within the snowpack. Consequently, cold content is also defined as a water equivalent depth of snow (Dw_{cc}) which on melting and refreezing will generate sufficient latent heat per unit area (m^2) to raise a dry snowpack temperature to 0 °C (Singh 1992).

$$Dw_{cc} = - (C_i / L_i) (\rho_s / \rho_w) [d_s (T_m - T_p)]$$

$$Dw_{cc} = - (C_i / L_i) [d_{swe} (T_m - T_p)]$$

Where:

$\mathbf{Q_{cc}}$ = cold content (kJ m^{-2});
$\mathbf{Dw_{cc}}$ = cold content as a water equivalent depth (mm);
$\mathbf{C_i}$ = specific heat capacity of ice = 2.06 kJ kg^{-1} $°C^{-1}$ at 0°C;
$\mathbf{L_i}$ = heat of fusion of ice = 333.7 kJ kg^{-1} at 0°C;
ρ_s = mean snowpack density (kg m^3);
ρ_w = density of water = 1000 kg m^{-3};
$\mathbf{d_s}$ = snowpack depth (m);
$\mathbf{d_{swe}}$ = water-equivalent depth of the snowpack (m);
$\mathbf{T_m}$ = melting temperature of snow = 0°C;
$\mathbf{T_p}$ = mean temperature of the snowpack (°C).

Thermal Quality (β)

Thermal quality (β) is defined as: the ratio of the amount of heat required to produce a given amount of water from the snowpack to the amount of heat required to produce the equivalent amount of water from pure ice at 0°C (Singh 1992).

$$Q_o / Q_i = \beta$$

$$\beta = (L_s / L_i) + (C_i T_p / L_w)$$

$$\beta = (1 - W_a) L_i + (C_i T_p / L_w)$$

Where:

Q_o = cold content + latent heat in the snowpack (kJ m^{-2})
Latent heat in the snowpack = $\rho_s d_s L_s$ (kJ m^{-2});
Q_i = Latent heat in the equivalent volume of ice = $\rho_s d_s L_i$ (kJ m^{-2});
β = Qo / Qi = thermal quality;
L_s = heat of fusion of snow < 333.7 kJ kg^{-1} (dependent on the liquid water content in the snowpack);
L_i = heat of fusion of ice = 333.7 kJ kg^{-1} at 0°C;
L_w = heat of fusion of water = 333.7 kJ kg^{-1} at 0°C;
T_p = the mean temperature of the snowpack (°C);
C_i = specific heat capacity of ice (the snowpack) = 2.06 J kg^{-1} °C at 0°C;
W_a = the liquid water content of the snowpack= $mass_{water}$ / $mass_{snow}$ = zero at temps significantly below freezing.

Liquid Water Holding Capacity (W_{max}) and Liquid Water Content (W_a)

A snowpack is assumed to be homogeneous, has a maximum water holding capacity (W_{max}) and fills from the top to the base (Singh 1992). At temperatures equal to or greater than 0°C, liquid water can exist in the snowpack as free water (hygroscopic water and capillary water) and as fringe or gravitational water. The liquid water holding capacity is the maximum liquid water that can be held in the snowpack against gravitational pull at a specified snowpack density and stage of metamorphism (Singh and Singh 2001). The liquid water content in a snowpack (W_a) is defined as: the weight ratio of the actual mass of liquid-water (hygroscopic, capillary and fringe) present in the snowpack, to the mass of snow in the snowpack.

$$W_a = (mass_{water} / mass_{snow}) = M_w / M_s$$

W_a is commonly expressed as a percentage. i.e. $W_a = (M_w / M_s)$ 100;
M_w = zero at temps significantly below freezing (< -1.0°C).

The difference between the liquid water holding capacity (W_{max}) and the liquid water content (W_a) is referred to as the liquid water deficiency (S_d). Once the liquid water deficiency is satisfied, fringe water drains by gravity through the snowpack. This meltwater may evaporate, infiltrate or run off.

Snowpack Melting Process and Timing

Warming phase

Absorbed radiant energy raises the isothermal mean snowpack temperature to zero; cold content approaches 0.0 kJ kg^{-1}, thermal quality approaches 1.00 and the snowpack liquid water content is zero.

Ripening phase

Absorbed radiant energy melts snow, but meltwater is retained in the snowpack as hygroscopic water, capillary water and fringe water. Mean snowpack cold content approximates 0.0 kJ kg^{-1}, thermal quality equals 1.00 and the liquid water content ranges from approximately 0% to 8% (Singh 1992).

During the warming and ripening phases, heat energy is generated through the refreezing of diurnal meltwater within the snowpack. Specifically, surface meltwaters percolate downward, refreezing in the lower snowpack layers, releasing latent heat and warming the base of the snowpack.

Melting phase

Absorbed radiant energy melts snow. Since the ripe snowpack is at the liquid water holding capacity, meltwater drains through the snowpack. Mean snowpack cold content is 0.0 kJ kg^{-1}, thermal quality equals 1.00 and the liquid water content ranges from approximately 3% to 15%, depending on the snowpack depth, porosity and density, the size, shape and spacing of snow crystals, the presence of ice layers, snowpack channelization and drainage conditions (Singh 1992).

The degree-day snowmelt model

The relationship between degree-days (DDs) and snowmelt runoff has been used in North America for over 80 years (Clyde 1931; Collins 1934). The most fundamental formulation relates snowpack water equivalent loss (melt) during a specified time interval (usually one day – 24 hours) to the sum of positive ambient temperatures during that same time interval (Hock 2003). Today, many hydrological models include DD routines to compute snowmelt and snowmelt runoff; e.g. SSARR (Holtan et al., 1975 and US Army Corps of Engineers 1987), USDAHL (US Army Corps of Engineers 1975), UBC Watershed Model (Quick and Pipes 1977), SLURP (Kite 1998), SRM (Martinec et al., 2008). A fundamental input in these DD melt algorithms is the watershed melt coefficient (M_f), melt factor (M_f) or DD ratio. Melt coefficients and DD ratios are typically recorded in cm $°C^{-1}$ day^{-1}, or mm $°C^{-1}$ day^{-1}.

Linsley (1943) demonstrated that the mean DD ratio was not a constant but increased throughout the melt season; ranging from approximately 0.1 cm $°C^{-1}$ day^{-1} in March to 0.7 cm $°C^{-1}$ day^{-1} by the end of June in the San Joaquin watershed. Rango and Martinec (1995) attributed these changes to an increase in snowpack liquid water content and decreasing albedos.

Weiss and Wilson (1958) acknowledged that DD ratios change seasonally and recognized the influence of cover type on DD ratios, specifically the effect of forest cover. They recommended a range of DD ratios from 0.185 cm $°C^{-1}$ day^{-1} to 0.740 cm $°C^{-1}$ day^{-1} depending on cover type and the time during the ablation season. Granger and Male (1978) observed that the DD ratio increases during the melt season, suggesting that this was due to the effect of radiation during cloud free periods. Bengtsson (1980) in Rango and Martinec (1995) also reported seasonal

increases in DD ratios throughout the melt season at sites in northern Sweden, ranging from 0.3 cm $°C^{-1}$ day^{-1} in March to 0.6 cm $°C^{-1}$ day^{-1} in May.

The US Army Corps of Engineers (1960) developed a table of DD factors (ratios) for use in the deep snowpacks of mountainous watersheds and McKay (1968) employed a series of curves to illustrate the variation in DD factors (ratios) for a shallow prairie snowpack. In 1994 the World Meteorological Organization proposed similar temporal and cover type DD ratios.

Rango and Martinec in their 1995 review of the DD model for snowmelt computations stated that there is no excuse for assuming that the DD ratio is constant throughout the melt season and provided guidance for evaluating variable DD ratios (factors). Dingman (1994) stated that the DD ratio or M_f "varies with latitude, elevation, slope inclination, aspect, forest cover and time of year" and concludes that M_f must be empirically derived for each watershed.

Degree-days (DDs) and degree-hour-days (DHDs)

The mean daily temperature, the arithmetic mean of maximum and minimum daily temperatures, may not generate a recorded DD of melt when overnight cooling offsets above freezing daytime hourly temperatures. Consequently, Garstka et al. (1958) in Rango and Martinec (1995) modified the operational definition of a degree-day, using an average of the daily maximum temperature and zero degrees when the minimum recorded daily temperature was below freezing. Bruce and Clark (1966), Brown and Goodison (1993) and Louie and Hogg (1980) argued that maximum daily temperature should be used to determine DDs in Canada as it consistently yields the best model results.

An alternative approach employs the degree-hour concept. Lo (1992) defined degree-hour as the departure of hourly temperature from a given standard (0.0°C). Degree-hours can be accumulated over a 24 hour period to produce a degree-hour-day (DHD). The DHD is commonly employed in European research (Bagchi 1983). See, for example, Hock (1999).

Snowpack depletion, degree-days and the degree-day ratio

The DD methodology is founded on the linear relationship between the depletion of snowpack mass and daily or hourly temperature. Snowpack depletion generally is evaluated as the reduction in snowpack depth and or snowpack water equivalent depth over a designated time period (commonly one 24 hour day). Relevant examples of studies employing snowpack depletion curves include Martinec 1960, 1975 and 1985, Kane et al. (1997) Alaskan Arctic watershed, and DeWalle et al. (2002) Upper Rio Grande watershed, Colorado. McGuire (1997) employed similar snowpack water equivalent (SWE) depletion measurements at six snowpack survey sites sampling five cover types to determine a mean regional melt ratio (M_f) for a small catchment on the Riding Mountain Uplands, Manitoba.

Degree-days and snowpack density

Martinec (1960) demonstrated that DD ratios (M_f) varied considerably over a 35-day continuous period. However when DD ratios are averaged over a weekly period values become consistent and are linearly related to snowpack density, specifically: M_f (cm $°C^{-1}$ day^{-1}) = 1.1 (ρ_p / ρ_w). In 1980, Kuusisto derived additional snowpack density degree-day factor relationships: DD_f cm $°C^{-1}$ day = 1.04 (ρ_p / ρ_w) - 0.07 for forest cover, DD_f = 1.96 (ρ_p / ρ_w) - 0.239 for open areas. Rango and Martinec (1995) concluded that snowpack density might be a convenient index of DD ratios.

Areal degree-day ratios

Rango and Martinec (1995) stated that hourly, daily or even weekly snowmelt depths cannot be accurately computed by the DD or DHD method and suggest that this is due to hourly radiation variation responsible for temperature variation, overnight refreezing and associated snowpack water detention. However, they suggest that short term (biweekly) means tend to smooth daily variations particularly for regional watershed responses.

Bagchi (1983) states that point -- or site -- calculated DD factors (ratios) vary in both time and space. Consequently, regional or areal DD factors are of doubtful value for routine prediction of snowmelt runoff in the Himalayas. Hock (1999) pointed out that lumped (regional) temperature index models cannot account for the spatial dynamics of the melt process and are incapable of handling the extreme heterogeneity of complex mountainous topography. Rango and Martinec (1995), however, suggested that a regional (watershed) DD ratio generally agrees with point values under the favorable conditions of non-rugged terrain, a large snow accumulation, and a short ablation period, places such as the Arctic tundra and the Canadian prairies.

Summary

Rango and Martinec (1995) argued that the classical Degree-day or Temperature Index Methodology for calculating snowmelt will not be easily replaced by more physically-based theoretical radiation balance models. The methodology is reliable for computing snowmelt depth for periods of greater than one week. However, they emphasized that hourly, daily and even weekly computations of snowmelt depths using the degree-hour method are not accurate. Hock (2003) agreed; the DD methodology works for average conditions at the catchment scale for temporal periods greater than several days. Hock (2003) pointed out that DD factors (ratios) vary directly as a function of time of year, physical surface properties and snowpack characteristics and that DD factors need to be adjusted to each application, hence treated as a calibration parameter.

Methodology

A small (0.5 ha), open, relatively flat grassland was selected for the snowmelt runoff experiments. The site, the "research snowpack lysimeter site," is located immediately north of Riding Mountain National Park Maintenance Compound; UTM E433270, N5611988, Zone 14, NAD83 at an elevation of approximately 627 metres above sea level (ASL) (Figure 1).

A 10 square metre polygon collection platform constructed out of 0.75 inch plywood with 4" by 4" sides was lined with

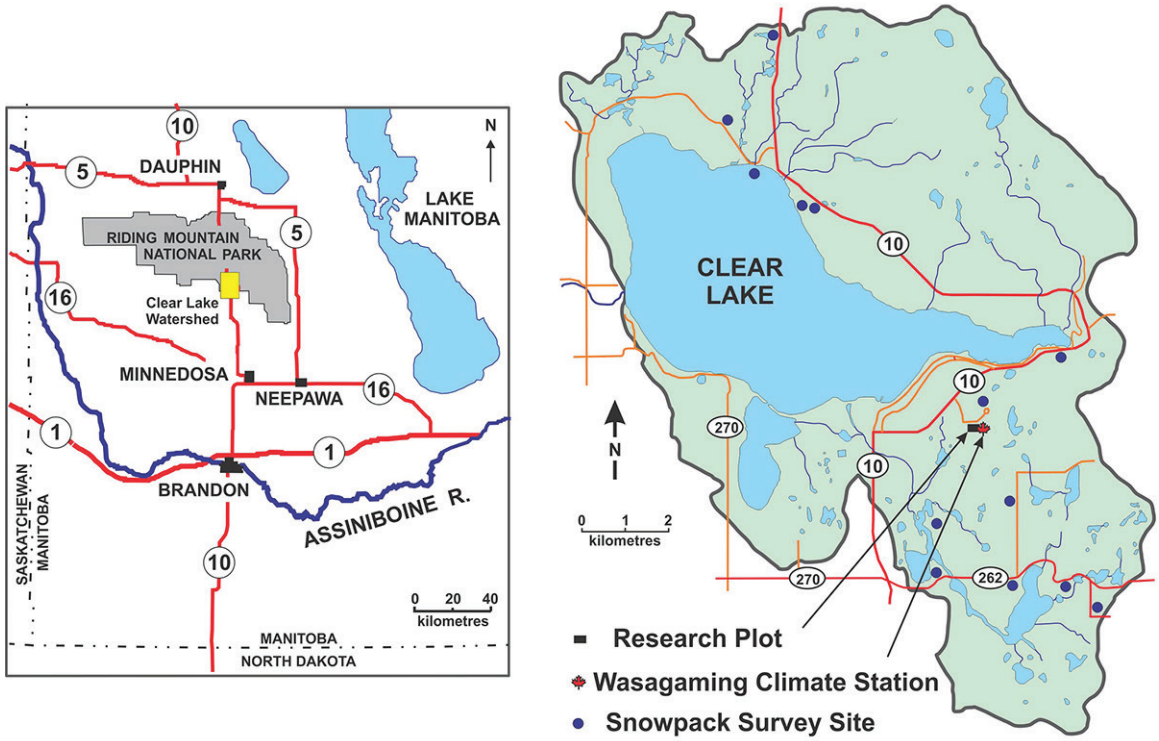

Figure 1: Clear Lake watershed.

high density (10 mm) polypropylene sheeting (Figure 2 and Plate 1). The surveyed slope of the snow lysimeter structure was 2.82° (0.0492) towards the south-southeast (azimuth 145°) and funneled meltwaters into a dugout pit which contained a "cut down" 20 litre pail (approximately 18 L capacity). Runoff was monitored daily; more frequently during warm melt periods. The collection pail (tare weight = 805 g) and runoff were weighed. A unit (1.0 g) of runoff equals 1.0 cm^3 volume. Runoff volumes were converted into snowpack water equivalent (SWE) mm depth of melt over the research plot (depth of melt = runoff volume / plot area).

An Environment Canada climatological data collection site (the Wasagaming Climatological Station) is situated in the Clear Lake watershed approximately 150 m east-southeast (azimuth 120o) of the research plot (Plate 2). The site is located at the Park

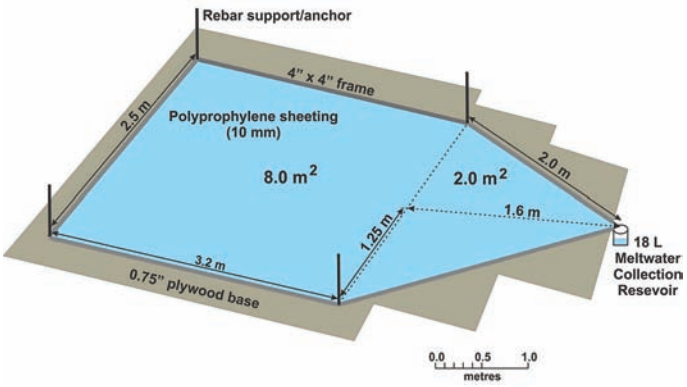

Figure 2: Schematic: snowpack lysimeter.

Maintenance Compound near the townsite of Wasagaming (ID. 5013117); UTM E433381, N5611861, Zone 14, NAD83; 50°39' 18" north, 99°56' 31" west at an elevation of 627.40 ASL. Since 1966 (48 years) meteorological data have been collected at this site. Hourly temperatures are measured and the daily maximum, minimum and mean ambient temperature values recorded. Daily precipitation (mm water equivalent) and depth of snow (cm) are recorded. Other hourly meteorological variables measured include; standard pressure, dew point temperature, relative humidity, wind direction and velocity.

Two Onset U-series TidbiT v2 temperature loggers (3.0 cm by 4.1 cm by 1.7 cm) were placed near the base of the snowpack in mid-February and secured to framing rebar. This durable, waterproof instrument is designed for extended deployment measuring temperatures in rivers and lakes. The Tidbit v2 temperature logger uses an optical USB communications interface (via a compatible shuttle or base station) for launching and downloading recorded data. The instrument measures temperature from -20°C to 70°C with a 0.2°C resolution and accuracy. Snowpack temperatures were measured hourly and mean daily values calculated. Table 1 and Figure 3 summarize the data.

Observations and Results

The 2010-2011 snowpack

Winter snowpack surveys were conducted at the research snowpack lysimeter site and along thirteen established snow survey courses in the Clear Lake Watershed (Figure 1). The snowpack survey courses sample snowpack depth, snow wa-

Plate 1: Snowpack lysimeter open site, Clear Lake watershed.

Plate 2: Wasagaming climatological station, Clear Lake watershed, Riding Mountain National Park, Manitoba.

Table 1: 2011 snowmelt runoff expereimental data.

Ordinal	March	T_{max}	T_{mean}	T_{pack}	Cold	Content	Thermal	DH	Acc DH	DHD	Acc DHD	DD	Acc DD	Melt	Acc Melt	Depth	Melt/DD	Melt/DHD
Date	Date	°C	°C	°C	(kJ m^{-2})	(mm D_{swe})	Quality	(Hours)	(Hours)	(Days)	(Days)	(Days)	(Days)	(g&cm^3)	(g&cm^3)	mm	(M_f)	(M_f)
60	3/1/2011	-19.6	-26.0	-4.2	921.9	2.8	1.03	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
61	3/2/2011	-14.8	-24.7	-4.4	965.9	2.9	1.03	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
62	3/3/2011	-11.8	-16.0	-4.4	965.9	2.9	1.03	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
63	3/4/2011	-11.5	-16.5	-3.6	790.2	2.4	1.02	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
64	3/5/2011	13.7	-17.1	-3.0	658.5	2.0	1.02	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
65	3/6/2011	-11.5	-21.1	-2.9	636.6	1.9	1.02	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
66	3/7/2011	-14.1	-25.3	-3.5	768.3	2.3	1.02	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
67	3/8/2011	-9.8	-18.4	-4.1	900.0	2.7	1.03	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
68	3/9/2011	-6.8	-14.9	-3.7	812.2	2.5	1.02	0.0	0.0	0.00	0.00	0.0	0.0	0	0	0.000	0.000	0.000
69	3/10/2011	1.9	-11.2	-3.3	724.4	2.2	1.02	2.9	2.9	0.12	0.12	0.0	0.0	0	0	0.000	0.000	0.000
70	3/11/2011	0.6	-9.0	-2.3	504.9	1.5	1.01	0.3	3.2	0.01	0.13	0.0	0.0	0	0	0.000	0.000	0.000
71	3/12/2011	-9.1	-15.3	-2.0	439.0	1.3	1.01	0.0	3.2	0.00	0.13	0.0	0.0	0	0	0.000	0.000	0.000
72	3/13/2011	-4.6	-15.4	-2.6	570.7	1.7	1.02	0.0	3.2	0.00	0.13	0.0	0.0	0	0	0.000	0.000	0.000
73	3/14/2011	4.4	-5.6	-2.8	638.2	2.0	1.02	19.3	22.5	0.80	0.94	0.0	0.0	0	0	0.000	0.000	0.000
74	3/15/2011	2.7	-2.3	-1.4	319.1	1.0	1.01	19.2	41.7	0.80	1.74	0.0	0.0	388	388	0.039	0.000	0.049
75	3/16/2011	3.6	-1.9	-0.3	68.4	0.2	1.00	15.6	57.3	0.65	2.39	0.0	0.0	306	694	0.031	0.000	0.047
76	3/17/2011	-0.7	-7.8	0.1	0.0	0.0	1.00	0.0	57.3	0.00	2.39	0.0	0.0	7982	8676	0.798	0.000	0.000
77	3/18/2011	-4.8	-12.8	0.1	0.0	0.0	1.00	0.0	57.3	0.00	2.39	0.0	0.0	0	8676	0.000	0.000	0.000
78	3/19/2011	2.7	-2.9	0.1	0.0	0.0	1.00	3.6	60.9	0.15	2.54	0.0	0.0	0	8676	0.000	0.000	0.000
79	3/20/2011	-0.9	-2.7	0.0	0.0	0.0	1.00	0.0	60.9	0.00	2.54	0.0	0.0	0	8676	0.000	0.000	0.000
80	3/21/2011	-0.3	-1.8	0.0	0.0	0.0	1.00	0.0	60.9	0.00	2.54	0.0	0.0	604	9280	0.060	0.000	0.000
81	3/22/2011	-1.6	-4.5	0.1	0.0	0.0	1.00	0.0	60.9	0.00	2.54	0.0	0.0	0	9280	0.000	0.000	0.000
82	3/23/2011	-4.5	-13.3	-0.1	22.8	0.1	1.00	0.0	60.9	0.00	2.54	0.0	0.0	0	9280	0.000	0.000	0.000
83	3/24/2011	-0.7	-13.7	-0.8	182.3	0.6	1.00	0.0	60.9	0.00	2.54	0.0	0.0	0	9280	0.000	0.000	0.000
84	3/25/2011	-3.1	-14.4	-1.7	387.5	1.2	1.01	0.0	60.9	0.00	2.54	0.0	0.0	534	9814	0.053	0.000	0.000
85	3/26/2011	-1.2	-12.1	-2.3	524.2	1.6	1.01	0.0	60.9	0.00	2.54	0.0	0.0	0	9814	0.000	0.000	0.000
86	3/27/2011	-2.6	-13.5	-2.6	592.6	1.8	1.02	0.0	60.9	0.00	2.54	0.0	0.0	0	9814	0.000	0.000	0.000
87	3/28/2011	-0.7	-10	-2.5	569.8	1.7	1.02	0.0	60.9	0.00	2.54	0.0	0.0	0	9814	0.000	0.000	0.000
88	3/29/2011	-0.7	-10.7	-2.4	744.6	2.2	1.01	0.0	60.9	0.00	2.54	0.0	0.0	0	9814	0.000	0.000	0.000
89	3/30/2011	0.5	-1.8	-1.8	558.5	1.7	1.01	0.7	61.6	0.03	2.57	0.0	0.0	0	9814	0.000	0.000	0.000
90	3/31/2011	3.7	0.7	-0.8	248.2	0.7	1.00	13.4	75.0	0.56	3.13	0.7	0.7	180	9994	0.018	0.026	0.032
Ordinal	April	T_{max}	T_{mean}	T_{pack}	Cold	Content	Thermal	DH	Acc DH	DHD	Acc DHD	DD	Acc DD	Melt	Acc Melt	Depth	Melt/DD	Melt/DHD
Date	Date	°C	°C	°C	kJ m^{-2}	mm D_{swe}	Quality	(Hours)	(Hours)	(Days)	(Days)	(Days)	(Days)	(g&cm^3)	(g&cm^3)	mm	(M_f)	(M_f)
91	4/1/2011	6.8	1.6	-0.1	31.0	0.1	1.00	51.3	126.3	2.14	5.26	1.6	2.3	8539	18533	0.854	0.534	0.399
92	4/2/2011	8.0	-0.6	0.2	0.0	0.0	1.00	60.3	186.6	2.51	7.78	0.0	2.3	6677	25210	0.668	0.000	0.266
93	4/3/2011	2.4	-0.3	0.2	0.0	0.0	1.00	9.3	195.9	0.39	8.16	0.0	2.3	1482	26692	0.148	0.000	0.382
94	4/4/2011	2.3	-4.2	0.2	0.0	0.0	1.00	11.7	207.6	0.49	8.65	0.0	2.3	3924	30616	0.392	0.000	0.805
95	4/5/2011	6.3	-1.7	0.3	0.0	0.0	1.00	40.1	247.7	1.67	10.32	0.0	2.3	24622	55238	2.462	0.000	1.474
96	4/6/2011	5.6	-1.9	0.3	0.0	0.0	1.00	32.3	280.0	1.35	11.67	0.0	2.3	31680	86918	3.168	0.000	2.354
97	4/7/2011	7.8	-0.6	0.3	0.0	0.0	1.00	59.7	339.7	2.49	14.15	0.0	2.3	56430	143348	5.643	0.000	2.269
98	4/8/2011	5.7	-1.2	0.2	0.0	0.0	1.00	43.1	382.8	1.80	15.95	0.0	2.3	40230	183578	4.023	0.000	2.240
99	4/9/2011	5.6	1.6	0.2	0.0	0.0	1.00	52.5	435.3	2.19	18.14	1.6	3.9	68660	252238	6.866	4.291	3.139
100	4/10/2011	12.0	3	0.5	0.0	0.0	1.00	109.9	545.2	4.58	22.72	3.0	6.9	261988	514226	26.199	8.733	5.721
101	4/11/2011	12.9	3.5	0.6	0.0	0.0	1.00	102.3	647.5	4.26	26.98	3.5	10.4	269380	783606	26.938	7.697	6.320
102	4/12/2011	6.5	1.3	0.7	0.0	0.0	1.00	78.4	725.9	3.27	30.25	1.3	11.7	51870	835476	5.187	3.990	1.588
103	4/13/2011	-1.3	-7.1	-0.2	28.8	0.1	1.00	0.0	725.9	0.00	30.25	0.0	11.7	36918	872394	3.692	0.000	0.000
104	4/14/2011	2.0	-5.4	-2.0	287.6	0.8	1.01	5.5	731.4	0.23	30.48	0.0	11.7	23786	896180	2.379	0.000	10.379
105	4/15/2011	2.0	-0.7	-1.3	186.9	0.5	1.01	4.2	735.6	0.18	30.65	0.0	11.7	4420	900600	0.442	0.000	2.526
106	4/16/2011	-0.1	-2.1	-0.3	43.1	0.1	1.00	0.0	735.6	0.00	30.65	0.0	11.7	3480	904080	0.348	0.000	0.000
107	4/17/2011	-1.1	-3.7	-0.7	100.7	0.3	1.00	0.0	735.6	0.00	30.65	0.0	11.7	3210	907290	0.321	0.000	0.000
108	4/18/2011	1.3	-4.2	-0.1	14.4	0.0	1.00	3.5	739.1	0.15	30.80	0.0	11.7	12070	919360	1.207	0.000	8.277
109	4/19/2011	4.3	-4.1	0.3	0.0	0.0	1.00	30.7	769.8	1.28	32.08	0.0	11.7	45760	965120	4.576	0.000	3.577
110	4/20/2011	5.7	-2.3		0.0	0.0	1.00	45.3	815.1	1.89	33.96	0.0	11.7	121690	1086810	12.169	0.000	6.447
111	4/21/2011	8.8	1.5		0.0	0.0	1.00	53.3	868.4	2.22	36.18	1.5	13.2	116020	1202830	11.602	7.735	5.224
112	4/22/2011	7.4	1.7		0.0	0.0	1.00	63.6	932.0	2.65	38.83	1.7	14.9	46760	1249590	4.676	2.751	1.765
113	4/23/2011	10.4	1.9		0.0	0.0	1.00	96.1	1028.1	4.00	42.84	1.9	16.8	7850	1257440	0.785	0.413	0.196
114	4/24/2011	12.1	4.6					117.5	1145.6	4.90	47.73	4.6	21.4					
115	4/25/2011	8.8	4.4					108.5	1254.1	4.52	52.25	4.4	25.8					
116	4/26/2011	16.5	8.1					168.2	1422.3	7.01	59.26	8.1	33.9					
117	4/27/2011	17.4	7.8					183.4	1605.7	7.64	66.90	7.8	41.7					
118	4/28/2011	16.3	7.5					205.1	1810.8	8.55	75.45	7.5	49.2					
119	4/29/2011	11.7	5.9					159.6	1970.4	6.65	82.10	5.9	55.1					
120	4/30/2011	0.0	-4.2					0.0	1970.4	0.00	82.10	0.0	55.1					
Totals								**1028.1**		**42.84**		**16.8**		**1257440**		**125.74**	**36.169**	**65.475**
Mean		**0.4**	**-7.1**	**-1.3**													**4.02**	**2.85**

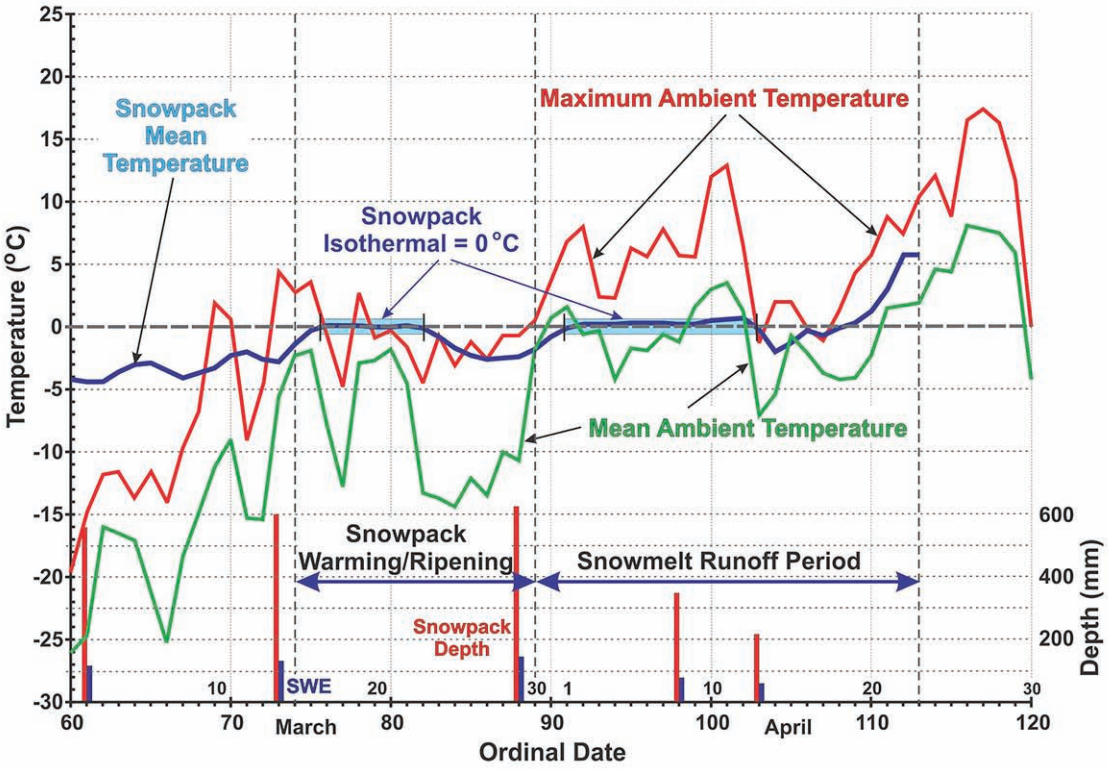

Figure 3: 2011 ambient and snowpack temperatures.

ter equivalent (SWE) depth and snowpack mean density over differing cover types: deciduous, coniferous and mixed forest, open meadows, pastures and cropped fields, aspen woodlots, wetlands and lake ice. Sampling began on November 30, 2010 and continued monthly throughout the winter accumulation period. Final snowpack survey measurements on April 27, 2011, indicated that the snowpack in the Clear Lake watershed had melted in open areas including the research lysimeter site.

The March 29 snowpack represents the maximum measured accumulation of snowfall during the 2010-2011 winter season. Mean snowpack depth in the Clear Lake watershed was 57.1 cm, with a standard deviation of 14.9 cm and a calculated coefficient of variation ($C = \sigma / \mu$) equal to 0.26 (Hofer et al. 2011). The overall mean SWE depth on the Clear Lake watershed was calculated to be 12.6 cm, ± 3.0 cm. Snowpack densities recorded at the survey sites located in the Clear Lake watershed averaged 227 kg m^{-3} ± 41 kg m^{-3} (Hofer et al. 2011). At the snowpack lysimeter site, mean snowpack depth was 61.3 cm, SWE depth 15.0 cm and the snowpack density was calculated to be 245 kg m^{-3}, all values within the standard error of the Clear Lake watershed means.

Snowpack lysimeter results

Table 1 Appendix I summarizes daily temperatures and melt volumes recorded at the research snowpack lysimeter site and the calculated daily snowpack parameters, degree-days, degree-hour-days and degree-day ratios.

Figure 4 illustrates snowpack depth, SWE depth, and the snowpack cold content expressed as a depth measured at the snowpack lysimeter site for specific snowpack survey dates. Figure 8 also illustrates the recorded daily depth of melt hydrograph and snowpack depletion curves from the snowpack lysimeter site.

During the March 10-15 snowpack warming phase (Figure 4), a total of 41.7 degree-hours generated 1.74 DHDs. Absorbed all-wave radiation reduced snowpack cold content from 812.2 kJ m^{-2} calculated for March 9 to 68.4 kJ m^{-2}, the thermal quality of 1.02 calculated for March 9 declined to 1.00 on March 16 and 388 grams (0.04 mm SWE depth) of melt were collected.

The snowpack at the lysimeter site was "ripe" from March 16 to March 24 (Figure 4). Thermal quality was at or less than unity (1.00) and 8589.6 cm^3 of melt drained through the snowpack (0.9 mm SWE depth). A cold snap (March 23-30) cooled the snowpack and cold content increased to 744.6 kJ m^{-2} on March 29, was subsequently reduced to 248.2 kJ m^{-2} on March 30 and by April 2 snowpack cold content was 0.0 kJ m^{-2}. Snowpack thermal quality increased throughout the cold snap to 1.02, declining to unity by March 31. Approximately 534 cm^3 of residual meltwater drained from the snowpack on March 25. No additional melt was recorded during the March 24-30 cold period.

The snowpack melt over the lysimeter site began on March 31, when the first recorded degree-day (DD) generated a continuous melt. From March 31 to April 23, 1083.8 degree-hours generated 45.2 DHDs, and 21.4 recorded DDs; 1,247.63 kg of melt was observed. The 2010-2011 snowpack at the research site was gone by April 24 2011 following 4.2 mm of warm rain between April 21-23.

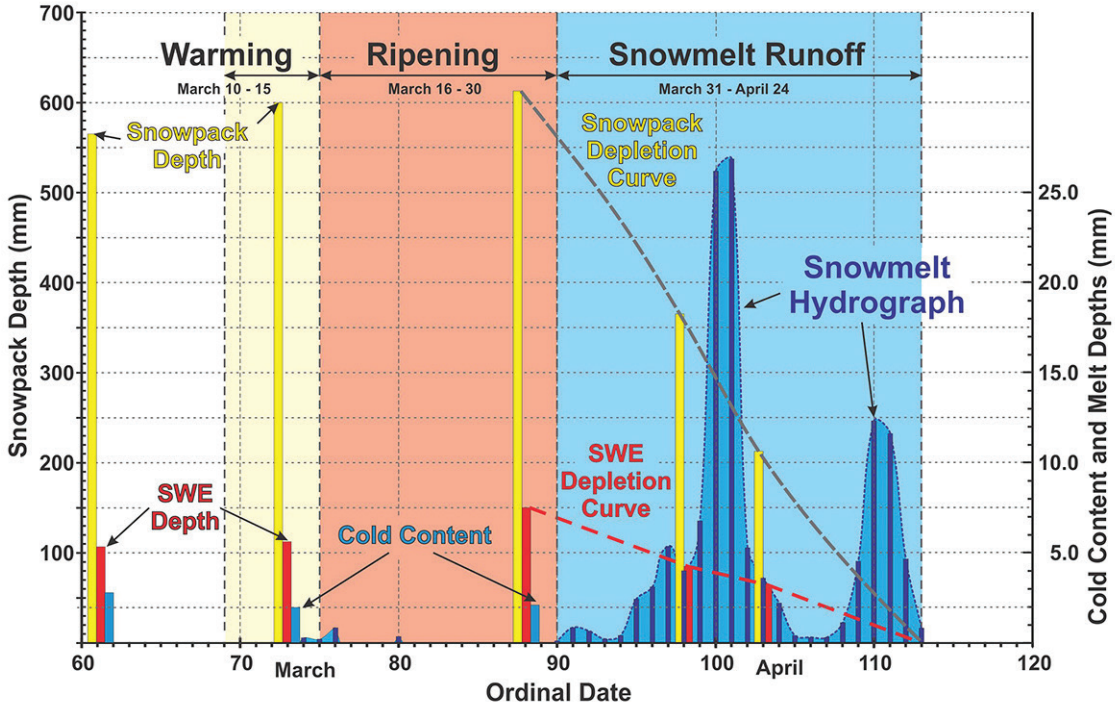

Figure 4: Snowpack, snow water equivalent and melt depths.

Throughout the ablation season (warming, ripening and melting phases) a total of 1028.1 degree-hours generated 42.84 DHDs; 16.8 DDs were recorded and 1,257.44 kg (litres) of melt were measured. That is the SWE of 125.7 mm depth (12.6 cm). Maximum measured SWE depth at the snowpack lysimeter site was 15.0 cm.

Calculation of the Degree-day Ratios

Calculation of degree-day ratios based on empirical data

Table 1 in Appendix 1 includes the calculated daily melt ratios (DD ratios and DHD ratios). The mean DD ratio was 4.02 mm of melt °C^{-1} day^{-1} for the total ablation season March 10-April 23). The maximum calculated DD value was 8.70 mm °C^{-1} day^{-1} and zero DDs were recorded for 36 days of the 45-day ablation season. The comparable DHD data registers a mean DHD ratio of 2.85 mm °C^{-1} hour-day^{-1}, a maximum calculated DHD ratio of 10.40 mm °C^{-1} hour-day^{-1} and zero DHDs for 22 days of the 45-day ablation period.

DD melt ratios (M_f) vary significantly but generally increase throughout the ablation season (Linsley 1943, Weiss and Wilson 1958, McKay 1968, Grange and Male 1978, Rango and Martinec 1995, Hook 1999). Rango and Martinec (1995) suggested weekly or biweekly means can smooth daily variations, giving a regional M_f that generates good results. Consequently, DD ratios have been calculated for the warming/ripening phase (March 10-March 30), the early melt March 31- April 8), mid-melt (April 9 – April 14) and the late melt phase (April 15- April 23). These are summarized in Table 2. Melt ratios in Table 2 are based on the total volume of melt per total accumulated DDs or DHDs.

DD melt ratios for early melt, mid-melt, late melt and total melt exceed 7.0 mm °C^{-1} day^{-1}. DHD ratios range from 1.30 mm °C^{-1} hour-day^{-1} during early melt to 4.90 mm °C^{-1} hour-day^{-1} for the mid-melt period (Table 2). The DHD melt ratio for the warming/ripening season was 0.38 mm °C^{-1} day^{-1}. Mean melt ratios for the ablation season were 7.48 mm °C^{-1} day^{-1} and 2.93 mm °C^{-1} hour-day^{-1} (Table 2).

Figure 5 illustrates the diurnal variation in DD ratios. Figure 6 shows the diurnal variation in DHD ratios, calculated for the research snowpack lysimeter site. The graphs indicate periodic variation in the DD and DHD ratios associated with cold periods but show

Table 2: Calculated melt ratios during the 2011 ablation season.

Phase	Date	Melt Volume g & cm^3	Accumulated Degree-Days	Accumulated Degree-Hour-Days	DD Melt Ratio	DHD Melt Ratio
Warming/Ripening	March 10-30	9814	0	2.56		0.38
Early Melt	March 31 - April 8	173764	2.3	13.40	7.55	1.30
Mid-Melt	April 9 - April 14	712602	9.4	14.53	7.58	4.90
Late Melt	April 15 - April 23	361260	5.1	12.37	7.08	2.92
Total Melt	March 31 - April 23	1247626	16.8	40.30	7.43	3.10
Ablation Season	March 10 - April 23	1257440	16.8	42.86	7.48	2.93

DD Melt Ratio in mm °C^{-1} day^{-1} DHD Melt Ratio in mm °C^{-1} hour-day^{-1}

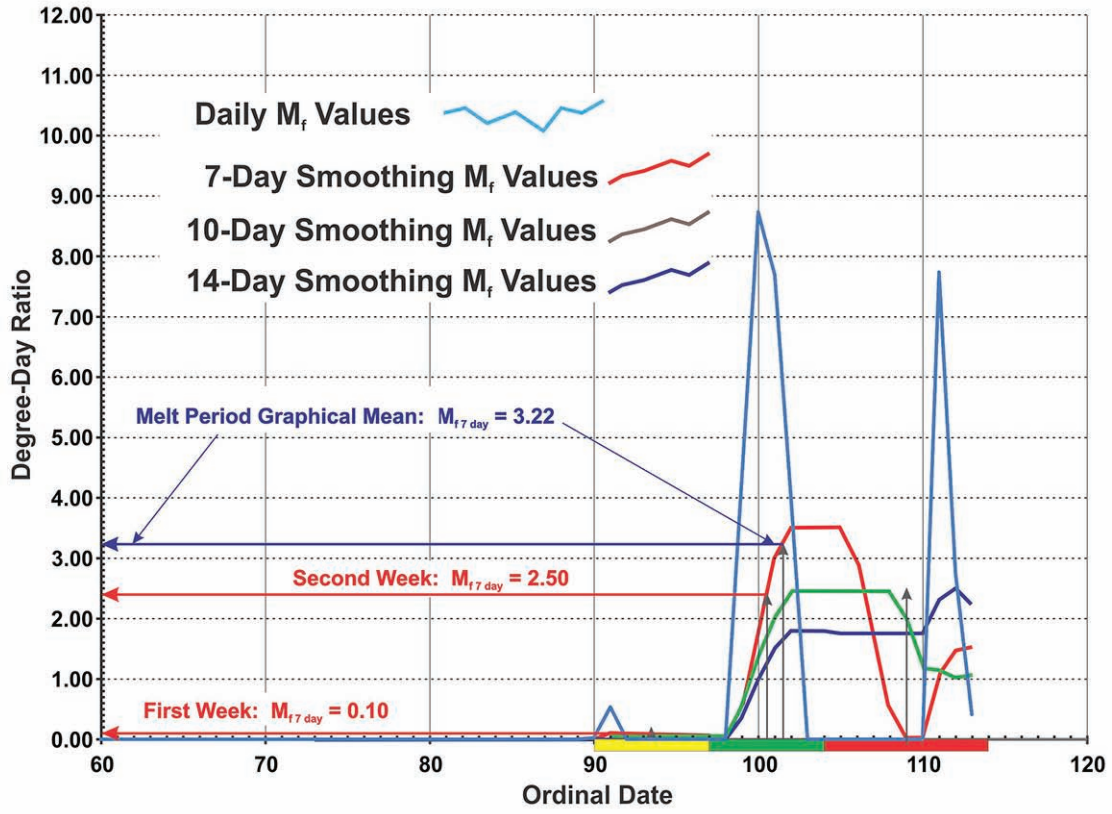

Figure 5: Diurnal variation in degree-day ratios.

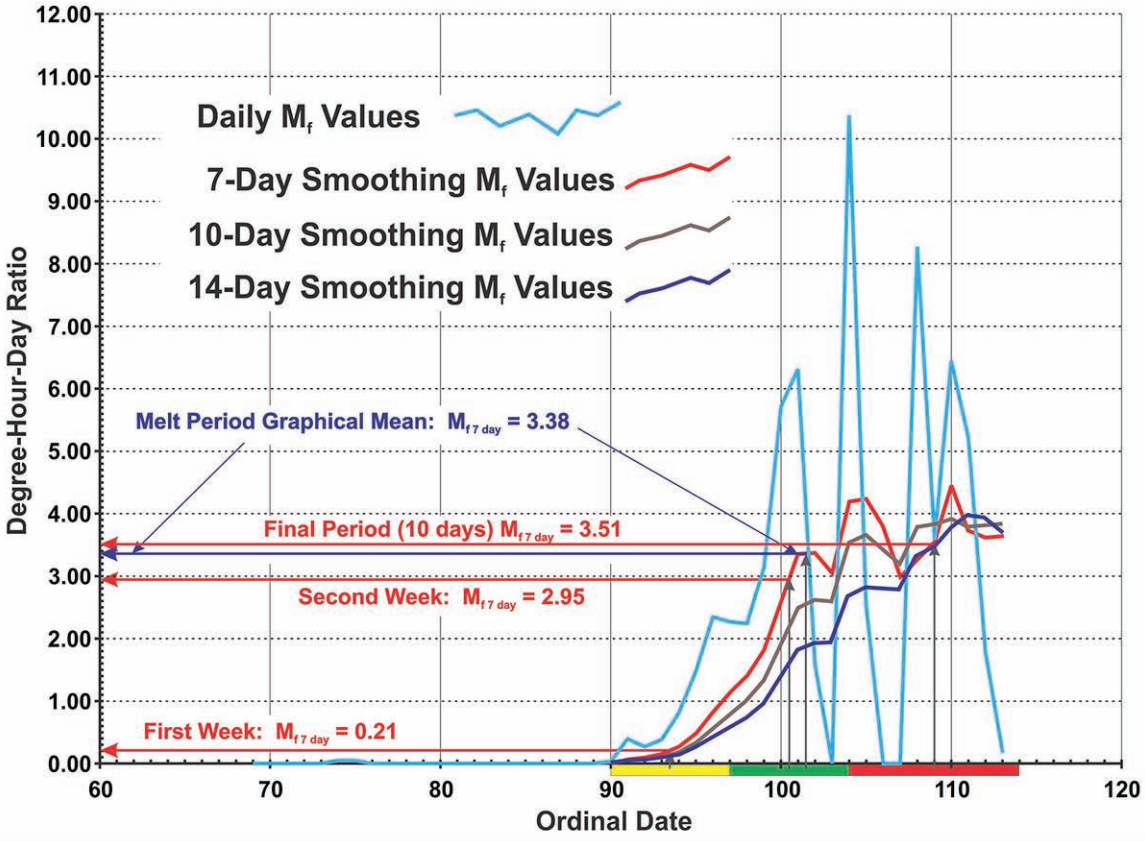

Figure 6: Diurnal variation in degree-hour-day ratios.

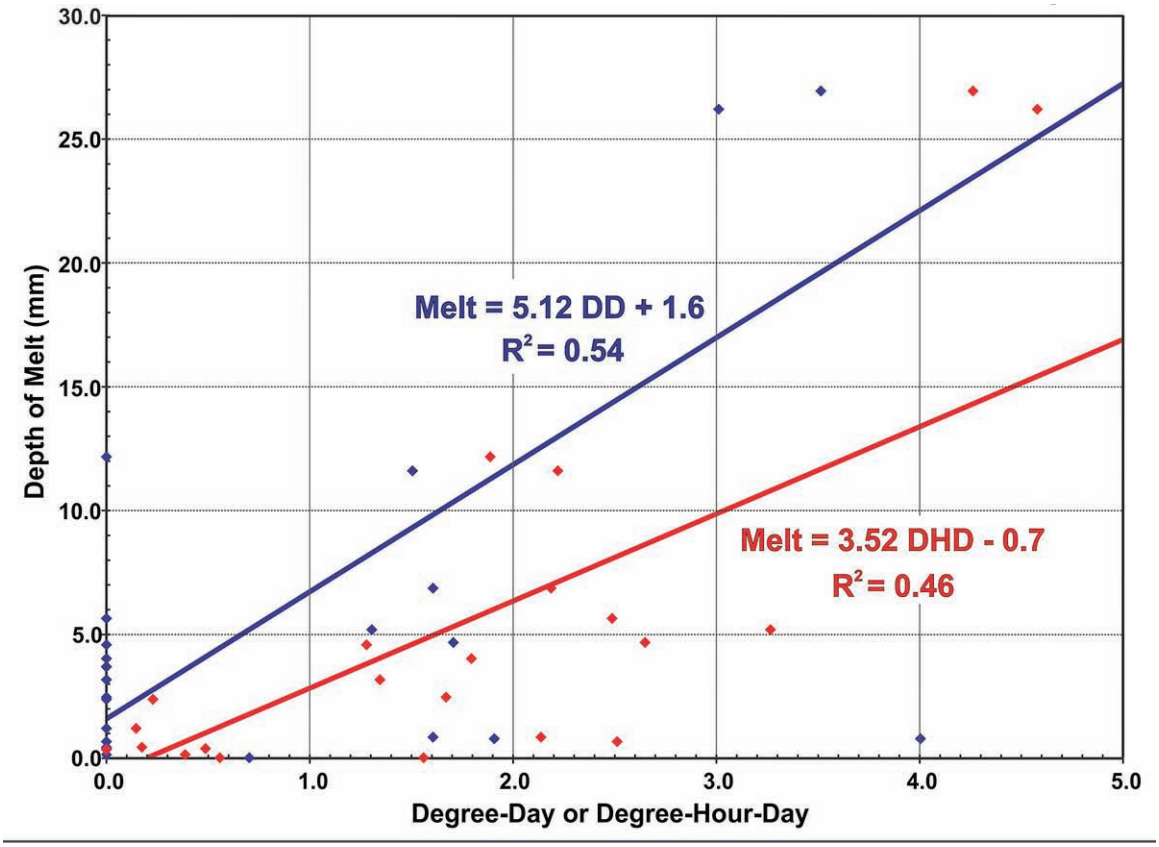

Figure 7: Regression plot for 2011 melt period.

they generally increase through the early and mid-melt periods. A seven-day running mean smoothing function supports this general trend (Figure 5). Weekly means were derived from the plot and are summarized in Table 4. Ten-day and 14-day running mean smoothing functions generate slightly smaller weekly means (Figures 5 and 6). Specific values are included in Table 4 and addressed in the discussion portion of this paper.

Calculation of degree-day ratios based on regression analysis

Linear regression analysis has been employed to determine DD melt ratios despite concerns regarding the general assumptions of the linear regression model, specifically the assumptions of linearity, independence, homoscedasticity and normality of errors. For comparative reasons a linear regression analysis was performed on the DD data and DHD data. Graphical results for the melt season data (March 31-April 23) are illustrated in Figure 7.

There is considerable scatter in the data and the respective regression equations can account for approximately 50 percent of the variation; R2 values are not considered useful for this study. The M_f for DDs was 5.12 mm °C^{-1} day^{-1}; the DHD M_f was 3.52 mm °C^{-1} hour-day^{-1}; both values are comparable to respective empirical mean melt ratio values.

Calculation of degree-day ratios based on snowpack densities

Martinec 1960 and Kuusito 1980 suggest that approximately weekly mean melt ratios are linearly related to snowpack density. Table 3 summarizes snowpack density estimates on various dates and calculated melt ratios based on Martinec (1960) and Kuusito (1980) functions.

Mean snowpack density in the warming phase (March 10-15) is 197 kg m^3; the Martinec (1960) melt factor M_f is calculated to be 2.17 mm °C day^{-1}. The Kuusisto (1980) degree-

Table 3: Snowpack density and melt ratios.

Date	2/28/2011	14/03/2011	29/03/2011	8/4/2011	13/04/2011	20/04/2011
Site	Snowpack Density	ρ_s	ρ_s	ρ_s	ρ_s	ρ_s
Open Meadow	206	204	211	241		
Pasture	210	207	238	296		
Alfalfa	185	190	216	227		
Stubble	197	214	285	293		
Lysimeter Plot	188	180	245	232	307	*307
Mean	**197**	**199**	**239**	**258**	**307**	**307**
Standard Deviation	**11**	**14**	**29**	**34**		
Melt Ratios	**2/28/2011**	**14/03/2011**	**29/03/2011**	**8/4/2011**	**13/04/2011**	**20/04/2011**
M_f (Martinec 1960)	**2.17**	**2.19**	**2.63**	**2.84**	**3.38**	**3.38**
M_f (Kuusisto 1980)	**3.63**	**3.66**	**4.45**	**4.81**	**5.78**	**5.78**

* estimate Snowpack density in kg m^{-3} Melt Ratios in mm °C^{-1} day^{-1}

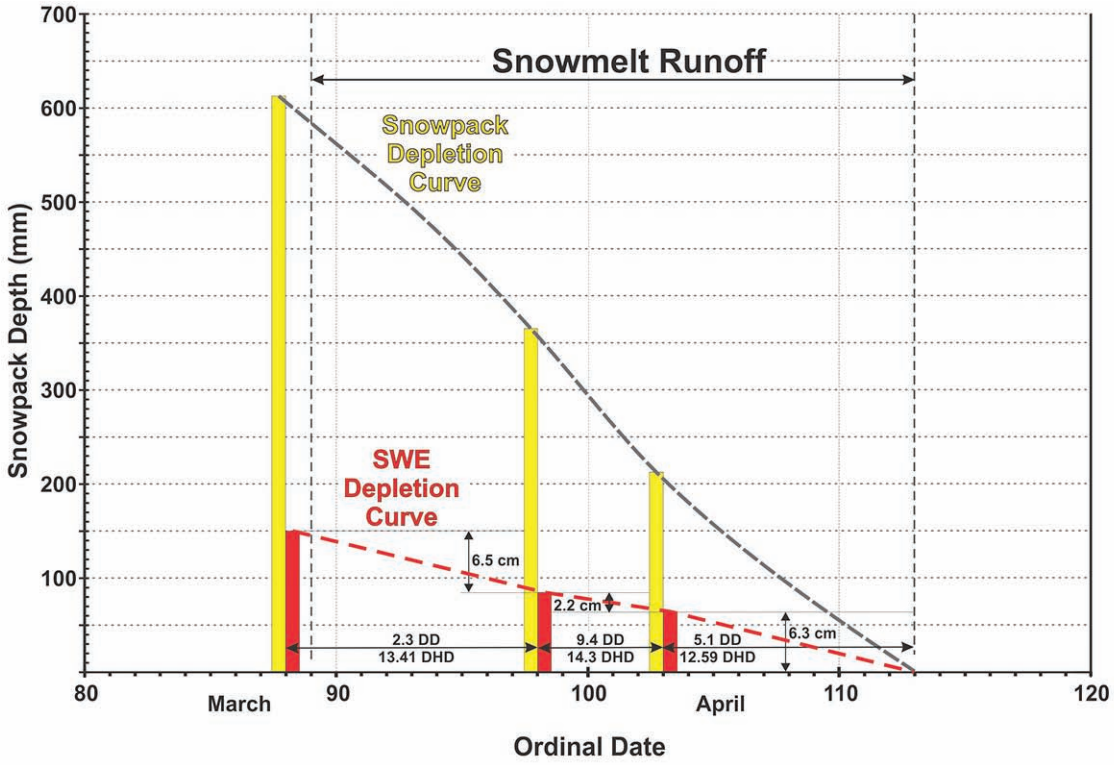

Figure 8: Snowpack and snow water equivalent depletion curves.

day factor DD_f equals 3.63 mm °C day^{-1}. During the ripening phase (March 16-24-30) mean snowpack density is estimated to be (197+239)/2 = 218 kg m^3. M_f is calculated to be 2.39 mm °C day^{-1}; DD_f = 4.03 mm °C day^{-1}. Mean snowpack density in the early melt phase (March 31-April 14) is estimated to be (239+258+307)/3 = 268 kg m^3. M_f = 2.94 mm °C day^{-1}; DD_f = 5.03 mm °C day^{-1}. By the late melt phase (April 15-23) snowpack density had increased to 307 kg m^3; M_f = 3.38 mm °C day^{-1}, DD_f = 5.78 mm °C day^{-1}. Assuming the snowpack density remains at least at 307 kg m^{-3} from April 14 to April 23, mean snowpack density throughout the total melt season is calculated to be 278 kg m^{-3} and respective degree-day melt ratios are M_f = 3.06 mm °C day^{-1}, DD_f = 5.44 mm °C day^{-1}. The Martinec 1960 and Kuusito 1980 snowpack density functions appear to provide reasonable estimates of degree-day melt ratios in the Clear Lake watershed.

Calculation of degree-day ratios based on snowpack depletion

Melt ratios are frequently derived from the SWE depletion over a given period of time (Martinec 1960, McGuire 1997, Kane et al. 1997 and DeWalle et al. 2002). Figure 8 illustrates the snowpack depth and water equivalent depth depletion from March 29 to April 23, 2011.

From March 31 to April 8 (early melt) a 6.5 cm SWE loss was recorded for 2.3 DDs and 13.41 DHDs. The calculated melt ratios for the early melt are 28.26 mm °C day^{-1} and 4.85 mm °C hour-day^{-1}, respectively. For the April 9 to April 14 mid melt period, 2.2 cm SWE melt was recorded during 9.4 DDs and 14.3 DHDs. The calculated melt ratios are 2.34 mm °C day^{-1} and 1.54 mm °C hour-day^{-1}, respectively. The remaining late melt of 6.3 cm SWE occurred over 5.1 DDs and 12.59 DHDs. Melt ratios are calculated to be 12.35 mm °C day^{-1} and 5.00 mm °C hour-day^{-1}, respectively. The overall melt ratios calculated for the total melt season were 15.0 cm SWE loss in 16.8 DDs and 40.31 DHDs; respectively a 8.92 mm °C day^{-1} and 3.72 mm °C hour-day^{-1}.

Short term (approximately weekly) melt ratios derived from snowpack depletion curves are variable and appear to be consistent with DD ratios derived by other methodologies and from empirical data.

Discussion

Table 4 summarizes M_f calculated for the open site lysimeter research plot in this study. The active ablation period began on March 10 and concluded on April 23. Snowpack warming and ripening took place between March 10 and March 30. The melting snowpack phase began on March 31 and has been subdivided into three periods; early melt (March 31 to April 8), mid-melt (April 9 to April 14) and late melt (April 15 to April 23).

During the 24-day melt season (March 31 to April 23), there were nine days for which a DD ratio was calculated and recorded. DD ratios were variable throughout the melt phase ranging from 0.26 mm °C day^{-1} to 8.73 mm °C day^{-1}. The arithmetic mean DD ratio was calculated to be 7.43 mm °C day^{-1} for the total melt phase. The early melt mean DD ratio was 7.55 mm °C day^{-1}, mid-melt, 7.58 mm °C day^{-1} and late melt, 7.08 mm °C day^{-1} (Table 4).

Table 4: Comparison of melt ratios during the 2011 ablation season.

SNOWPACK PHASE	Warming	Ripening	Early Melt	Mid-Melt	Late Melt	Total Melt
DATES	March 10-15	March 16-30	March 31 - April 8	April 9 - April 14	April 15 - April 23	March 31 - April 23
METHODOLOGY	6 days	15 days	9 days	6 days	9 days	24 days
Empirical Data						
Mean Degree-day	***		7.55	7.58	7.08	7.43
7-Day Smoothing			0.10	2.50	***	3.22
10-Day Smoothing			0.08	1.69	1.19	1.69
14-Day Smoothing			0.05	1.25	1.78	2.00
Mean Degree-hour-day	0.38		1.30	4.90	2.92	3.10
7-Day Smoothing			0.21	2.95	3.51	3.38
10-Day Smoothing			0.15	2.29	3.85	2.54
14-Day Smoothing			0.11	1.60	3.48	1.88
Regression						
Degree-day			6.32		1.08	5.12
Degree-hour-day			4.79		1.28	3.52
Snowpack Density Functions						
Martinec 1960	2.17	3.39	2.94		3.38	3.06
Kuusito 1980	3.63	4.03	5.03		5.78	5.44
Snowpack Depletion Curves						
Degree-day			28.26	2.34	12.35	8.93
Degree-hour-day			4.85	1.54	5.00	3.72

DD Melt Ratio in mm $^{o}C^{-1}$ day^{-1}

DHD Melt Ratio in mm $^{o}C^{-1}$ $hour\text{-}day^{-1}$

Mean melt ratio = Total melt volume / accumulated Ddor DHD (for the designated period)

Similar to DD ratios, DHD ratios were variable throughout the snowpack melt phase ranging from 0.32 mm °C hour-day^{-1} to 10.37 mm °C hour-day^{-1}. The arithmetic mean DHD ratio was calculated to be 3.10 °C hour-day^{-1} for the total melt phase, a value considerably smaller than the 7.43 mm °C day^{-1} calculated mean DD ratio for the same period. Likewise, early melt 1.30 mm °C hour-day^{-1}, mid-melt 4.90 mm °C hour-day^{-1} and late melt 2.92 mm °C hour-day^{-1} ratios are less than respective mean DD ratios (Table 4).

Seven-day, 10-day and 14-day running mean smoothing functions have been employed to determine melt ratios for early, mid and late melt periods. Early melt, mid-melt and late melt DD ratios and DHD ratios are summarized in Table 4.

Smoothing results in smaller average melt ratios because below zero temperatures are included in the calculation of running means. Also 14-day smoothing generates smaller means than the 10-day smoothing and both generate smaller mean values than the 7-day running means for respective melt periods (Table 4).

Seven-day smoothing generates a melt season mean DD ratio (3.22 mm °C day^{-1}) similar to the seven-day smoothing melt season mean DHD ratio (3.38 mm °C hour-day^{-1}). The 14-day smoothing functions generate similar DD (2.00 mm °C day^{-1}) and DHD (1.88 mm °C hour-day^{-1}) melt season mean ratios. It should be noted that the 14-day smoothing function melt season ratios are considerably smaller than those generated by seven-day smoothing functions. Ten-day smoothing does not generate a DD ratio similar to the DHD ratio. Considering the overall length of the melt season in the Clear Lake watershed (24 days), seven-day smoothing appears to be the more appropriate averaging procedure. Other snowpack melt ratios have been calculated by least squares regression analysis, the application of the Martinec 1960 and Kuusito 1980 snowpack density functions and the plotting of a snowpack water equivalent depletion curve (Table 4).

Table 5 summarizes relevant regional M_f found in the literature. Melt ratios for the Canadian Prairies appear to be consistent, ranging between 0.6 mm °C day^{-1} and 2.8 mm °C day^{-1} (Clark 1955, Granger and Male 1978, and McGuire 1997).

The McGuire 1997 DD melt ratio (2.78 mm °C day^{-1}) is a weighted average dependent on cover type and the percentage area of the specific cover type in the Clear Lake watershed. Snowpack ablation over the eight cover types common in the watershed is variable. The Clear Lake watershed is approximately 50 percent forest cover. Snowpack over urban lots, agricultural fields, lake ice, wetlands, and small open meadows melts earlier and depletes faster than snowpack under coniferous, deciduous and mixed forest cover. This implies that DD melt ratios over open areas are greater than average while forest cover melt ratios are less than average.

McGuire's (1997) mean DD ratio has been employed in the annual snowpack survey conducted in the Clear Lake watershed. Following melt, the actual recorded DDs, maximum SWE depth and McGuire's DD ratio is used to calculate the date of complete snowpack ablation. This date is then compared to observed data. Fifteen years of comparative analysis suggests that the 2.78 mm °C day^{-1} melt ratio can predict the date of total snowpack ablation in the Clear Lake watershed to within one day.

The research lysimeter open site melt ratios were expected to be slightly greater than the McGuire's 1997 weighted mean watershed ratio. The seven-day smoothing generates average melt season ratios that are approximately 19 percent larger than McGuire's 1997 weighted melt ratio. The DD melt ratio of 3.22

Table 5: Degree-day melt ratios found in the literature.

Clark 1955.	Red River basin, Manitoba	0.9 to 2.7 mm	$^{o}C^{-1}_{mean}\,day^{-1}$
Clark 1955.	North Branch of Thames River basin, Southwestern Ontario	0.3 mm	$^{o}C^{-1}_{mean}\,day^{-1}$
Pysklywee *et al*. 1968.	North Nashwaaksis forested stream basin, St. John River basin, New Brunswick	1.82 mm	$^{o}C^{-1}_{mean}\,day^{-1}$
Granger and Male 1978.	Canadian Prairies	0.6 to 2.8 mm	$^{o}C^{-1}_{mean}\,day^{-1}$
Louie and Hogg 1980.	Canadian Climate Stations	0.91 mm	$^{o}C^{-1}_{max}\,day^{-1}$
McGuire 1997.	Clear Lake Watershed, Manitoba based on snowpack depletion	2.78 mm	$^{o}C^{-1}_{mean}\,day^{-1}$

mm °C day^{-1} is 16% greater and the 3.38 mm °C hour-day^{-1} DHD melt ratio is approximately 22% greater than McGuire's 1997 2.78 mm °C day^{-1}.

Linear regression (DDs versus melt volume), generates M_f of 5.12 mm °C day^{-1}. The DHD versus melt volume regression results in M_f of 3.52 mm °C hour-day^{-1}. Both values are similar to respective arithmetic mean melt ratios (Table 4).

The Martinec 1960 snowpack density function generates a 2.94 mm °C day^{-1} early melt factor, a 3.38 mm °C day^{-1} late melt factor and an overall melt factor of 3.06 mm °C day^{-1}, values which are similar to the benchmark standards, the arithmetic mean DHD Mf and the DHD linear regression M_f (Table 4).

The Kuusito 1980 model however, results in respective melt factors of 5.03 mm °C day^{-1}, 5.78 mm °C day^{-1} and 5.44 mm °C day^{-1}. These values are similar to the arithmetic mean DD M_f and the DD linear regression M_f (Table 4).

The calculated DHD depletion curve results in a melt ratio of 3.72 mm °C hour-day^{-1}, a value similar to the 7-day smoothing DHD melt ratio (3.38 mm °C hour-day^{-1}).

Degree-day methodology rarely provides estimates of runoff for the snowpack warming/ripening phase but the degree-hour-day approach can provide estimates of melt during this pre-melt period.

Summary and Conclusions

This study empirically determined the melt coefficients throughout the melt-season for a small open grassland site in the Clear Lake watershed, Riding Mountain National Park. A 0.5 ha open relatively flat grassland with full sun exposure was selected for the snowmelt runoff experiments. A 10 m^2 plywood collection platform funneled meltwaters into a collection reservoir. Sample plot runoff was weighed daily. Mean ambient and snowpack temperatures were measured hourly and mean daily values calculated. Degree-days of melt are calculated based on cumulated degree-hours above 0.0 °C for a twenty-four period (degree-hour-days (DHD).

The 2011 active ablation period began on March 10 and concluded on April 23. Snowpack warming and ripening took place between March 10 and March 30. The melting snowpack phase began on March 31 and has been subdivided into three periods: early melt (March 31 to April 8), mid-melt (April 9 to April 14) and late melt (April 15 to April 23).

Degree-day and DHD melt ratios were variable throughout the 24-day snowpack melting phase (March 31-April 23). The arithmetic mean DD ratio was calculated to be 7.43 °C day^{-1} for the total melt season, a value considerably greater than the 3.10 mm °C hour-day^{-1} calculated mean DHD for the same period.

Seven-day smoothing generates a melt season mean DD ratio (3.22 mm °C day^{-1}) similar to the seven-day smoothing melt season mean DHD ratio (3.38 mm °C hour-day^{-1}). The open site seven-day smoothing M_f values are approximately 19 percent greater than McGuire's 1997 benchmark forested (50 percent) watershed mean melt ratio of 2.78 mm °C day^{-1}. Ten-day and 14-day smoothing functions were not successful in generating melt season M_f values similar to McGuire's 1997 watershed mean melt ratio.

Other snowpack melt ratios were calculated by least squares regression analysis, the application of snowpack density functions, and the plotting of a snowpack water equivalent depletion curve.

The Martinec 1960 snowpack density function generates a 2.94 mm °C day^{-1} early melt factor, a 3.38 mm °C day^{-1} late melt factor and an overall melt factor of 3.06 mm °C day^{-1}, values that are similar to the McGuire's 1997 benchmark watershed M_f and the seven-day smoothing M_f mean values.

Although the DD methodology rarely provides estimates of runoff for the snowpack warming/ripening phase, the DHD approach can provide estimates of melt during this period.

Conclusions

For shallow ripe snowpacks containing less than 15.0 cm snow water equivalent that melt over a relatively short period (less than one month), a single DD or DHD melt ratio appears to be acceptable for the snowpack melting phase. Melt ratios must be determined for each cover type.

In Riding Mountain National Park, the arithmetic mean degree-day melt ratio tends to overestimate snowpack depletion. Consequently, a seven-day running mean smoothing func-

tion combined with a graphically determined mean for the total melt season is preferred. Alternatively, Martinec's 1960 density function based on a mean of weekly snowpack density estimations can be used to estimate the degree-day melt ratio.

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