Designing the Livable Winter City

by

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Abstract

Winter cities in the U.S. and Canada seem to resemble cities anywhere else in North America, despite their differing climatic needs. Most of a city's built structure ignores the reality of winter, and in its form it makes winter outside less pleasant. This thesis gives some ideas about how to design public outdoor spaces in winter.

To provide a basis for designing, the positive imagery of winter and the climatic concerns that a designer must consider in working with outdoor spaces is discussed. Vernacular buildings and settlement forms often have dealt successfully with these climatic concerns. A discussion about them provides a basis for a history of development in Toronto, Ontario, the city used as a case study. Toronto's climatic planning policy and urban design initiatives are reviewed to show how the city currently operates and where it may be heading as a winter city.

The main body of this investigation is a handbook which is directed at planners, designers, developers, and citizens of Toronto, and concerns the development of outdoor public and semi-public spaces for winter use.

**Thesis Supervisor:** Tunney F. Lee, Professor,
Urban Studies and Planning
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Introduction

Winter is a special time. It evokes strong images at either end of the spectrum for all of us who know it. On the one hand there are cars throwing up slush onto unsuspecting pedestrians, traffic jams, bleak vistas of black and white skyscrapers; on the other there is the beauty of a sun-sparkling snowscape, the silence of a winter's night, and skating on the local pond.

In countries where winter is a fact of existence for the entire nation, these special associations of winter have taken on an even stronger meaning. The winter and wide open spaces of Canada have shaped the psyche of its people. Survival has been a constant theme of Canadian literature, poetry, and art (witness works such as Margaret Atwood's *Survival*, Gilles Vigneault's "Mon Pays" or Lawren Harris's iceberg paintings). It isn't difficult to conjecture that what Canadians survive is winter, for depending on where they live, Canadians endure five to ten months of it.

Canadians are moving away from a "survivor" image of themselves because they have been for some time an urban people. Nonetheless, there is always winter lurking nearby; a connection to the eternally wild. The cities and towns that many Canadians live in do not look too different from cities and towns elsewhere. This could be part of a problem. Here we have a season that dominates the life of a people and it is not reflected in the settings in which they live.
Our winter cities look like cities anywhere in North America. Skyscrapers define the skyline but fail to make a unique statement about the city they are in. Their modernist style looks bleak on a winter day. To build them, we have torn down historic buildings with their rich red, pink or brown colours and their intricate detailing. The effects of modern developments have slipped over into the outside environment; they feel placeless and unconnected.

Now, when we step out of tall buildings, we almost get blown over by a gusty and bone-chilling wind in the winter. As we walk the canyon-like streets, the buildings hide us from the faint warmth of the sun. The speeding cars in the street splash us with salty slush. Driving snow prevents us from seeing. Winter in the city has become something we shun. The warm places are unconnected. Parks are unused, designed as they were for the summer months. Those who can afford it fly south to warm places for a few precious days or weeks in the sun.

Even in the best of winter places, transportation costs more and is more difficult, heating bills are higher, communication is more difficult, individual and family social problems escalate, people spend more time inside, and they do not linger in the public outdoor places.

In recent years more people have become interested in these phenomena. Leaders in northern climates are now expressing an interest in dealing more
effectively with their winter cities. They want to increase tourism and
decrease the exodus of people and jobs to the "sunbelt". Within the last few
years, the Livable Winter City Association has been formed and conferences
have taken place to address these and other issues. Investigation in this area
seems especially timely.

What is a winter city? It has been defined variously by researchers as an
area where "the underheated period of the year (relative to human comfort)
is of such magnitude and duration that it is judged to require significant
intervention by the built environment (in terms of structure and energy
input) to ensure human survival"1 and where "the average January
temperature is 32° F (0° C) or colder".2 Regardless, this takes in a lot of
ground (see Figure 1). It covers most Canadian cities, not to mention cities
in the U.S., U.S.S.R., Europe, and elsewhere. It also covers a lot of types
of winter: snowy winters, slushy winters, icy winters, dark winters, and
sunny winters.

This thesis investigates the problems and opportunities that winter creates in
a city setting. It looks at the implications for the design of outdoor urban
spaces. Why outdoor? I work from the premise that the outdoor spaces,

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1 Boris Culjat, "Climate and the Built Environment in the North" (Phd.
2 William C. Rogers and Jeanne K. Hanson, The Winter City Book, A
21.
more than any other, need to be more effectively treated in the winter city. Recent trends have been towards the enclosure of public space, and it is my contention that developers will ensure the continuation of these trends. The need for investigation lies elsewhere: outside. The need for connection to the outside and to nature increases as we are prevented from using it by factors such as climate. It is therefore incumbent on planners and designers to deal with these issues positively.

In the first section of this investigation, I look at the positive imagery of winter as a step towards discovering how these images might be incorporated into city design. The climatic concerns that must be addressed when dealing with outdoor environments are also introduced, especially those in Toronto, which will act as a case study. Then vernacular building and settlement forms are discussed, in terms of their sensitivity to both climate and context. This provides a background for a history of how Toronto developed and the effect that development had on the way Toronto operates in winter today. Toronto's climate-related planning policy is also reviewed in order to elaborate on the historical situation and indicate where Toronto appears to be heading as a winter city.

The last section of the thesis is a handbook, treated as an entity within itself. It is directed at planners, designers, developers, and the public who are interested in creating outdoor public and semi-public spaces that are usable

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3 Boris Culjat, p. 68.
year-round. While Toronto is the focus of the study, the information provided may be more broadly applicable. The handbook reiterates the climatic concerns of winter and then uses a problem and opportunity format to discuss how outdoor spaces can be made more "livable" in winter.
1 Positive Images of Winter

Current images about winter are often negative: the weather forecaster reports cold and snow as if doom were descending, the newscaster concentrates on the accidents or the power outages, drivers groan when they see the results of the previous night's snowstorm. We need to rethink this attitude, in order to make winter more enjoyable. If we could adopt a positive attitude in our urban development, we would build richer, more lively, more informative and diverse environments. Our settlements would respond better to human needs for warmth and comfort in winter.

Winter is a major part of the existence of most Canadians. We should try to enjoy our reality. While winter sets important limits on our actions, it also provides us with a number of experiential opportunities.

Winter puts us in touch with raw nature in a way that we cannot ignore. Also, like the other seasons, it makes the rhythm of time clear, so that places that are fortunate enough to have demarcated seasons are further tied into nature. We are aware of our growth and the events of our lives as integrally connected to the change in the seasons.

The positive images we have about winter are often related to childhood memories, because our childhood is usually when we participate most fully
in winter (see Figure 2). As children we spend more time out of doors and seem to be more comfortable doing this than adults.  

Snow provides an ideal play accessory for children since it is so pliable and moldable. It becomes a snowball for throwing at people, or a snow fort to hide behind when attacked, or a snowperson to dress up with a carrot and muffler. Soft fluffy piles of new fallen snow can be jumped into or flattened into angels. Packed hard, snow provides a surface for tobogganing, sledding or skiing.

For either adults or children, falling snow can be a beautiful sight as it drifts gently down. Each flake is different, each has a special geometry caused by the constraints of space. After a storm, snow and ice coat the houses and the trees. The world looks simpler, cleaner, and more elemental. Expanses of unbroken snow twinkle and shimmer in the sunlight (see Figure 3).

The sound of snow is special too. Fresh hard packed snow squeaks when walked upon. The wet snow of a snowball thuds as it lands. Hails clatters. Crusty snow crunches as it is broken. Loosely packed snow quiets the surrounding noises.

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Snow creates a sense of isolation that need not be considered a bad thing. When the roads are blocked and the trees bent over with ice, there is a certain cozy feeling about being in a warm, snug house or a warm, snug coat. The clarity and stillness of a winter's night contributes to a sense of isolation, of being alone with the beauty of the sparkling stars.

Ice turns into icicles that children use as swords or as (forbidden) sources of drinking water. Icicles also look beautiful hanging from the edges of snow-covered houses. Ice can be skated or slid upon. In the early spring, when an icebound river breaks up, huge blocks of ice are thrown up onto the riverbanks, providing children with a magical city of adventure.

Winter makes things look different. Houses are revealed from behind the trees. The river can be crossed on foot and new perspectives are possible. In ravines, whole areas that may be impassable and boggy during other seasons can become open to access and their secrets known.

Then there are the winter sports: downhill and cross-country skiing, skating, snowshoeing (although this isn't frequent in the city), and tobogganig, for example. Most of these activities are undertaken in a group or family setting. The fresh cold weather can bring out a certain camaraderie among those who have an affinity for it. Winter sports allow us to socialize at an otherwise isolated time of year, so they are all the more

Figure 3: Idyllic winter scene with expanses of unbroken snow
special for this. During or following these activities, there are wonderful warming liquids, such as hot chocolate, hot cider or mulled wine.

Much of what makes activities that accent the thermal sense special is the contrast between warm and cold. Lisa Heschong points out that people seek extreme environments for recreation, so that, for instance, the Finnish will run from the sauna and roll in the snow:

There are probably two reasons for having the extremes right next to each other. The first is physiological: the availability of extremes ensures we can move from one to the other to maintain a thermal balance. This gives us the safety to enjoy fully both extremes. We can be greatly overheated for a while and then chilled to the bone, all without threatening our health...

The second reason to have thermal extremes close together might be termed aesthetic. The experience of each is made more acute by contrast to the other. 5

Poets and artists often have a magic way of portraying winter scenes in a positive light. In Canada, the Group of Seven helped define a Canadian way of painting and winter which was a common source of inspiration. One might mention the powerful whites, blues, and grays of some of Lawren Harris's iceberg paintings, but there are a number of urban paintings that are more along the lines of inquiry here. His picture entitled

"Old Houses, Toronto, Winter" is shown in black and white here (see Figure 4) but the original shows the wet brown-black of the tree, the clear blue wash of the sky, the creamy yellow stucco, the red of the sills, and the blue of the shutters. The painting shows just how much colour is possible in winter. The snow itself looks luminous. Here, winter does not look bleak at all. The lively colours of the old buildings give us something to aspire to in new development.

Poets clearly have a preference for portraying winter in the country, where it is more pristine, but they do write poems with urban winter themes. Snow is shown as something pure, silent, and light. In a city, it is described by poets as an equalizer: something that hides differences. Here is a poem by Raymond Souster that shows the lazy, floating quality of snow:

Night of Snow
slow-drifting down
drifting shifting and piling over
streets, fences, houses, skyscrapers,
till all the world is swallowed up
by one last fragile shivering
flake of snow.⁶

Figure 4: Lawren Harris's "Old Houses, Toronto, Winter" has bright touches of colour. We need colour in our winter environment and should encourage it in our urban design.

Others write about snow's muffling qualities, and how it can quiet the noise of a city or its "white geometry". These are images that we need to draw upon as we begin to design for a winter city.

We need to "strive for a more intimate, even symbolic, relationship with natural forces". If we could make this relationship explicit, winter might be seen to provide a sense of delight, of wonder at its beauty, its breathtaking coldness, and its control over humans. If winter could be made to be a pleasant and exciting experience in our cities, it would become just as precious a season as the summer is to Canadians and there might be less of a need to escape the city for warmer places. Cities and towns in Austria, Switzerland, and elsewhere have based a successful tourist industry on the special virtues of winter. This could happen in certain North American cities if winter became a focus for further architectural or urban design inquiry. We will examine how this focus might be achieved in the handbook which follows.

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9 Lisa Heschong, p. 56.
2 Practical Concerns of Winter

If our purpose is to create conditions whereby people can be encouraged to use the outdoor winter environment more than they do now, we need to know something about that environment as it exists now. In this section, I will take a brief look at some important climatic variables that should be considered when designing sites for winter use: sun or radiant heat, wind, air temperature, precipitation, and relative humidity. (The latter, although important to human comfort, is difficult to control through design, and is less of an issue in winter than summer. It will be indirectly discussed in connection with wind and precipitation.) I will also talk about climate particular to the case study of Toronto.

The climatic variables mentioned above work together to form the general climate. Humans respond to the climate by altering the environment or themselves to be as comfortable as they can under given circumstances. They don heavy or light clothing as necessary, they modify their activity level and they build their structures to provide climatic comfort. Various attempts have been made to measure the human perception of comfort. One of the most successful has been Victor Olgyay's bioclimatic chart because it reflects graphically the interaction of more than one climatic variable (see Figure 5) to produce comfort or the lack of it. Of course, the idea of comfort varies for different individuals, cultural groups, sexes, and age groups. The chart shown is based on assumptions that a person is in shade in a moderate climatic zone in the U.S. at less than 1000 feet above sea

Figure 5: Schematic of the bioclimatic chart: This chart shows that any winter city falls well outside the comfort zone. Some combination of clothing, activity levels, shelter, or protection must be provided in order to make a winter environment tolerable.
level. The person is wearing light clothes (unlike our winter situation) and is sitting or doing only light work. The comfort zone is in the middle of the chart, where temperatures range approximately from 21° to 26° C and relative humidity is roughly 20-75%.

Since Toronto winter weather quite obviously falls outside the comfort zone, climate modification is required. A combination of radiant heat, clothing, and wind control (relative humidity can often be considered in relation to the wind) can compensate for low air temperatures. The outdoor environment can be manipulated either through natural or built systems for this purpose, as will be discussed in later sections.

Olgyay’s chart was one of the first and most popular bioclimatic charts. Other more recent ones take varying levels of clothing and activity and plot these against a number of climatic parameters. Fanger’s charts, in particular, may useful for a winter situation.⁴

2.1 Macroclimate

Any site or place in the city is subject to macroclimatic conditions, which are the larger climatic influences affecting a country or large region. Since the handbook which follows concerns Toronto, it is useful to describe the

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macroclimate of the city and the province of Ontario. Toronto is located in Southern Ontario on the shore of Lake Ontario (see Figure 6). Southern Ontario's climate is classified as "modified continental", which means that it has dry, cold winters and warm summers. Most of downtown Toronto falls within the Lake Ontario Shore climatic region of Ontario, and the rest of the metropolitan area lies within the Southern Slopes region (see Figure 7). Both areas are affected by the lake itself. Differences are due to the inland and upland location of the Southern Slopes region.

Air Masses and Air Temperature

Variations in air temperature are largely the result of the amount of incoming solar radiation. Temperatures change during the course of a day for this reason. They also change depending on whether or not the sky is overcast or clear, with overcast days showing less variation in general. The direct path of energy from the sun on a clear summer day causes the temperature to be warmer than on a cloudy summer day. However, a cloudy day in winter will be warmer than a clear one, since the clouds reflect heat which would have escaped back to the ground.

In general, three major air masses affect Toronto; cold, dry ones from the north, which dominate in winter; warm, humid ones from the Gulf of

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Mexico, which occur often in the summer, and varying air masses from the west. Storms that are associated with these air masses are more intense and create more cloud cover in winter than in summer. As a result, Toronto records fewer hours of sunshine in winter than summer. In Table 2.1, the main characteristics of the Lake Ontario Shore climate and the South Slopes climate are shown.

The Lake Ontario Shore climatic region probably does not extend as far as it would in the case a rural area. The roughness created by a built-up region limits its effect. Nonetheless, Lake Ontario exerts a strong control for perhaps one half mile inland, and weaker control for a much larger area inland. In fall and early winter, the lake will be much warmer than the land. Air is warmed in passing over the lake, and clouds form downwind over the city. In this area, sunshine is deceased for 1-2 hours/day, but temperatures are warmer than they would be elsewhere. The opposite phenomenon happens in spring and summer, so that sunshine is increased 1/2 to 1 1/2 hours a day over those locations unaffected by the lake, and temperatures are cooler.7

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7 Marshall Macklin Monaghan Ltd., p. 3-14.
Table 2.1  Selected Climate Characteristics for Toronto

<table>
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<th>Climate Region Characteristics:</th>
<th>Lake Ont. Shore</th>
<th>South Slopes</th>
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<tbody>
<tr>
<td>Altitude (ft above sea level)</td>
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<td>Mean Annual Temp. (°F)</td>
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<td>Mean Daily Max. Temp. (°F):</td>
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<tr>
<td>January</td>
<td>29</td>
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<td>April</td>
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<td>52</td>
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<tr>
<td>July</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>October</td>
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<tr>
<td>Mean Daily Min. Temp. (°F):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>13</td>
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<td>July</td>
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<td>October</td>
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<td>July</td>
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<td>Extreme High Temp. (°F)</td>
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<td>Mean Date of Last Frost (Spring)</td>
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<td>Mean Date of First Frost (Fall)</td>
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<td>Mean Ann. Frost Free Period (Days)</td>
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<tr>
<td>End of Growing Season</td>
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</tr>
<tr>
<td>Mean Annual Precipitation (Inches)</td>
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<td>30-38</td>
</tr>
<tr>
<td>Mean Annual Snowfall (Inches)</td>
<td>65</td>
<td>70</td>
</tr>
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Sun

The sun’s energy arrives at the Earth in the form of energy waves. By the time it arrives, much of it has been reflected back to space by the Earth’s atmosphere, but the ability to capture even a small fraction of what is left over can mean a great deal in the colder months. In an urban area like Toronto, further losses occur due to pollution. Toronto receives 15-20% less solar radiation than the neighbouring suburb of Scarborough.\(^8\) Ultraviolet radiation may be lowered by 30% and the duration of sunshine may drop by between 5%-15% due to increased cloud cover caused by pollution.\(^9\)

The theoretical intensity and duration of solar radiation is affected by the latitude because it has a bearing on the angle of the sun’s rays as they hit the ground. The sun’s rays hit at an oblique angle at northern latitudes (see Figure 8). This in turn has a significant effect on air temperatures. Toronto is one of Canada’s most southern cities. However, at Toronto’s latitude (roughly 44°N), the sun still has a relatively low angle of altitude during the winter. This is angle ABC in Figure 8a. Toronto’s December 31 angle of altitude is approximately 22.5° and the June 21st angle is approximately

\(^8\) Marshall Macklin Monaghan Ltd., p. 3-9.
69.5°. The actual amount of sunlight received varies depending on cloud cover and atmospheric turbidity.

In the city, the heat generating buildings, people, and activities, such as transportation, tend to create the urban heat island, especially under clear condition with light winds. Large concentrated urban areas like Toronto show the greatest effect. This may be useful in winter, because outdoor temperatures are raised, but it is not necessarily desirable in summer. The extensive use of natural materials (trees, grass, etc.) will reduce the extreme temperature variations. Plants and trees moderate extreme air temperatures through evapotranspiration, insolation, low albedo, and high conductivity.

**Wind**

The wind is an also important factor to consider at the macro and microclimatic scales. In winter it strongly affects heat loss from warm surfaces and in summer it aids in cooling through convection (the movement of air upwards, away from a heated surface, and its replacement with cooler air below) and evaporation. The wind roses for Toronto show its direction, velocity, and frequency in January, July, and annually (see Figure 9).

The winds in an unobstructed area, such as the country, are governed mainly by the regional (macro-scale) wind. At a certain height, the regional wind is completely unaffected by the surface of the land. At lower levels, this wind swoops down over the land and is slowed by the friction of the

![Wind roses for Toronto](image)
surface. The wind is decreased by a greater or lesser amount depending on the roughness of the land. An urban setting, with its buildings, other structures and trees, creates more drag than open fields or water (see Figure 10).

In urban areas, a light wind will be produced by the urban heat island. This is also a form of convection. The cooler air in this case comes from the suburban or rural areas (see Figure 11).

**Precipitation**

The amounts of snow and other forms of precipitation are shown in Table 2.1. Toronto is fortunate that it is not affected by the snowbelt effect of certain other parts of the Great Lakes. This effect occurs when air is heated as it crosses a major body of warm water, absorbing more moisture than it would over the drier, colder land. As the air passes over the cooler land on the other side of the lake, the air cools and loses its capacity to hold moisture. The moisture falls as snow or other precipitation on the downwind land locations. Toronto is spared when winter winds are from the north and west over land and suffers only minimally when they are southwest, because the unimpeded stretch across Lake Ontario is comparatively short in this direction.

An urban area has an impact on the amount of precipitation and cloudiness, in part because it is usually more polluted. Particulate encourages the

![Figure 10: Wind speed changes with variations in surface roughness. Wind speeds are generally lower in built-up conditions than in the country. The regional wind speed \( z_g \) is the wind that is unaffected by the friction of land. It is therefore attained at a higher height over the city than is the case in the country.](image)

![Figure 11: Urban air circulation in calm conditions](image)
formation of droplets and these quickly turn into precipitation--this is one of the ways the sky is cleansed. As a result of this process, Landsberg indicated that there is 5-10% more total precipitation and 5-10% more cloud cover in cities than in rural, unpolluted locations. He also suggests that there is 5% less snowfall. This occurs because of the urban heat island which allows air to retain more water than in rural areas. The two phenomena in combination lead to an increase of city fog in winter of 100%.10

2.2 Microclimate

Notwithstanding the larger climatic influences, a site will also be affected strongly by microclimatic, or localized (site) modifications of the macroclimate which occur due to topography, cover, ground surface, and structural form.11 In particular, the microclimatic characteristics of an urban area are much different than those of the countryside. Conditions may vary radically from block to block.

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Air Temperature

Wide variations of air temperature may occur on a site due to changing surface types or slope changes. Peak daily temperature is usually achieved two to three hours after solar noon, provided that the sun continues to reach the site. It falls off as the energy lost from the earth begins to surpass the energy received from the sun, usually after sunset. Air temperatures are controlled by conduction, as described below, under Sun/Radiant Heat, and by convection, described previously. On a local level, trees, shrubs, and other plants can moderate extreme air temperatures, but they must be grouped in order to have any significant effect. Air temperatures above large bodies of water also vary less and change more slowly than those over land.

Topography in combination with the lake effect is also important in determining air temperatures. In general, temperatures drop with decreasing altitude. With a lake however, this effect is superceded until 5-6 miles inland. Figure 12 indicates how valley areas in Toronto, other than those near Lake Ontario, shown to the left of the graph, have significant drops in temperature inland. These measurements were taken on a clear winter's


Figure 12: Effect of land formation on temperature distribution: Lake Ontario is the low elevation on the left, where temperatures are quite warm. Temperatures drop significantly 5 and 7 miles inland due to valleys.
night. Tall buildings can affect air temperatures in much the same manner as valleys do, producing cold sinks.

Sun/Radiant Heat

The orientation of a site will affect the amount of sun available. Spaces oriented towards the sun, with no shadowing by obstructions will, of course, receive the maximum available sunlight.

Slope also has an important effect with respect to the sun's intensity, especially at the middle latitudes, such as Toronto's. South facing slopes are warmer and drier because they are closer to perpendicular to the sun. Even small slopes of 5% can change the environment sufficiently in the early spring to cause snow melt when flat areas remain covered. A north facing slope will remain snow covered for longer than flat land since it receives much less radiation.

Albedo (reflectance) properties of building materials, the ground, and snow affect the amount of heat available. Generally light and glossy surfaces such as fresh snow reflect most of the sunlight that hits them and have high albedos. Fresh snow may have an albedo of 0.95 while old snow has albedos closer to 0.40.13 Darker matte surfaces absorb more sunlight.

Albedos for clay soil are 0.20 to 0.30 and for black asphalt, as low as 0.05.\textsuperscript{14}

Absorption into a material from the surface is called conduction. This property is important to this discussion because it represents the earth's ability to warm itself. Materials with high conductivity absorb and emit heat well. Those with low conductivity, such as snow, are good insulators. As Lynch and Hack point out, the conductivity of natural materials will lessen with dryness and density, in the following order: wet sand, ice, concrete, asphalt, still water, dry sand or clay, wet peat, fresh snow, still air.\textsuperscript{15}

The dark, hard materials of cities, such as stone, brick or asphalt, absorb heat quickly, store it in greater quantities and re-radiate it slowly due to their large mass and density. However, because they do not transpire or create shade, and they have a lower moisture content, they create more extreme microclimates than does natural ground cover.

\textsuperscript{14} Kevin Lynch and Gary Hack, p. 49.
\textsuperscript{15} Kevin Lynch and Gary Hack, p. 50.
Wind

In winter, winds will generally lower temperatures and decrease the humidity by evaporation and thereby affect human comfort in outdoor areas. People find that wind speeds greater than 5 m/s (11 mph) are uncomfortable, especially in combination with low air temperatures and limited sunshine.

Urban areas are subject to some unusual wind effects. Tall buildings can bring a regional wind down to the street level (see Figure 13). Streets with buildings of uniform height and regularized setback will funnel wind at increased speed along them. However, the conditions at a particular site are difficult to predict because of the complexity of the urban fabric. As a result, the surest means of determining the effect of a building is to perform a wind tunnel test.

Natural vegetation modifies wind flows depending on its size and density. Plants can channel, divert, block or filter wind, depending on their orientation with respect to the prevailing wind direction (see Figure 14).

Precipitation

Usually the microclimatic concerns with precipitation involve a combination of factors, such as rain and stormwater drainage or retention, or snow and wind. Localized landforms affect how and where water drains or snow
drifting occurs. Snow collects wherever the wind slows and drops its load. This occurs both front and behind barriers such as walls.

Less rain that falls on an urban site is absorbed into the ground than in a rural area because of the large amount of pavement and built-up land. Instead, water that does not evaporate runs overland to drainpipes, sewers, catchbasins, etc. Urban storm drainage becomes a potential problem. Flooding and pollution increase when storm sewage is released into a river or basin. In winter, flooding is rarely a problem. The precipitation is stored in the form of snow, wherever it lands and blows. It must then be collected and moved to locations that do not inconvenience the movement of people and traffic.

Plants reduce drainage and storage needs to a certain extent. In summer, leaves catch rain and roots absorb it, therefore increasing the capacity of the natural system to handle water. In winter, branches and needles hold and store snow, and so modify environments near them.

In summary, climate either facilitates or limits the opportunities available to us outdoors. In a snow storm we may not even venture outside or we only go out if we absolutely must. If the urban environment is inadequately designed or poorly maintained an unpleasant microclimate may result, so that opportunities are limited even in the best winter weather. On the other
hand, climate introduces recreational opportunities such as skating or skiing.

The ideal urban outdoor environment maximizes the ability to be outdoors in winter and to interact with people and the environment. It minimizes the limitations of cold, wind, and ice. In the handbook, I will elaborate on how design methods and ideas can be used to modify the microclimate and hence facilitate outdoor activity.

In recent years, researchers have rediscovered the vernacular built form and its positive qualities. One of the positive qualities is said to be its ability to respond appropriately to the microclimatic concerns just discussed. In the next section, vernacular buildings and settlements are investigated to see what lessons we can learn from them.
3 Vernacular Buildings and Settlements

It is instructive to look at indigenous building forms to reflect on what lessons they provide for a more climate-related way of city building. Indigenous building methods often acknowledge the climate in ingenious ways. The older city forms are now seen to be more sensitive to human comfort and culture than the technological planned city that many of us live in.16 We need to recapture the spirit of these settlements in today's development.

Historically, humans have used the materials available to them in order to protect themselves from the elements. People responded to the world of limited local resources and natural energy by producing vernacular buildings. Adaptation to the climate was, to a large extent, a necessity of survival, so it had a visible effect on architecture and community form, from extremely warm to extremely cold places. The derived solutions resulted from cultural norms and generations of experimentation and adaptation to find what worked best under the constraints faced by the builders. These solutions often became rules of building,17 contradicted at great cost to both the culture and the individual. The vernacular building in hot, dry places,

for example, generally tended to have thick walls, with tiny windows that allowed access to light but minimized heat gain. The community layout was dense, with narrow streets and tall buildings, again to minimize sun on the street and to reduce surface exposure.

In a northern area, like Switzerland, the buildings often had steep gables to handle the heavy snowfall. The Swiss farm, for example, contained all its major functions under a single roof. The barn animals below warmed the people on the second floor, thus conserving and maximizing the use of valuable heat. The Swiss mountain town was, like the Arab settlement, closely packed, in this case for warmth and wind protection. The building heights and densities, though, allowed for solar access.

Since this investigation involves the winter reality of Canada, it is also important to consider vernacular examples from there. The Inuit building methods provide an excellent illustration of resourceful adaptation to a severe climate. The French Canadian settlements exemplify how their built form changed in response to a new climatic situation.

The winter housing the Inuit used, and sometimes use still, was the igloo, made of blocks of fined grained compacted snow. The blocks spiral upwards and slope inwards towards the domed top. Use makes the igloo more leak-proof, for the heat generation inside causes the inner walls to melt

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18 Boris Culjak, p. 41.
slightly and they later refreeze into solid ice. Snow is a wonderful insulator, so the heat inside the igloo is preserved. The entrance allows for graduated introduction to heat or cold (see Figure 15), important for health reasons. Cold sinks down below the seating platform and is drawn out of the entrance area because of pressure differentials created by winds at right angles to the igloo. Inside, on top of the platforms, temperatures of 15° C (60° F) are possible, even when exterior temperatures are -46° C (-50° F). Heat and light are provided by body heat and by burning seal oil. The igloo, then, is a very efficient structure. As Culjat says:

In terms of heat losses, the Eskimo dwellings ... utilize the principles of least surface enclosing the greatest volume, least surface exposed to the cooling effects of the wind, thick walls to retain heat, minimal openings, [and] vertical off-setting of spaces to ensure that warm air is trapped in the living area.19

When several Inuit families spent their winter in the same place, they joined their igloos with galleries. This communal arrangement saved heat (see Figure 16).

In the Province of Quebec historic settlements were densely built, using the same methods as used in France. Over time, the builders made a number of adaptations to the traditional French building forms which better suited the extreme climate that the French Canadians had to deal with. For instance, Ramsey Traquair describes how verandahs began to appear on

19 Boris Culjat, p. 55.
French housing because they furnished protection from the sun in summer and snow in winter. Likewise, the mansard roof was extended to deal with the heavy snowfall. The adaptations eventually created a distinctive French Canadian style of housing. On this subject, Pressman and Zepic have stated:

While the French created settlements which supported community life during the winter season, many British settlers lived in isolation, usually in dwellings built in the middle of their properties, miles from civilization.

In time, the French learned how to cope with (and to enjoy) the cold season; their British counterparts suffered through it. The architecture of Quebec reflects the climate and the building materials of the region.

These exact buildings types and community formations are not appropriate for the twentieth century technological world, because while the climate may remain the same over time, culture is modified by the events of history. However, the principles that underlie the forms can be extracted for the purpose of discovering what constitutes livability in the winter city. The principle of maximizing energy savings for the material used is one important thing we can learn. At the communal and architectural levels,

21 Norman Pressman and Xenia Zepic, p. 42.
22 Boris Culjat, pp. 41, 57.
some elements of this principle are the use of small spaces, minimal
openings, massive materials, access to the sun and multi-use structures, and
the creation of a sense of enclosure. Another principle is that of providing
orientation and a means of identification with a place, as the French did with
their gradual adaptations. Yet another is furnishing better contact with
nature, so that people can live more in concert with it, as the Inuit did.

This leads us to the topic of the case study. How did Toronto evolve and is
its form conducive with the winter weather that it has to face?

3.1 Toronto as a Winter City

Toronto developed as a number of Canadian urban settlements did, as a
planned English settlement beside a military reserve. It was laid out based
on the Roman practices of town-making that the English used as a matter of
expediency in colonial development. The directional grid was, in part, a
reaction to the congested conditions in cities like London. The roads were
wide and the lots spread out.

The grid was filled in and extended gradually throughout the nineteenth
century. It was clearly not the best type of urban form for handling the
winter weather that the little community faced and quite obviously different
from the French Canadian settlement form discussed above.

The British adapted the architectural forms of their home country with fewer concessions to the climate. Their architecture symbolically proclaimed their loyalty to England and their independence from the U.S.A. Yet in Toronto, the architecture and layout of the site was not completely inimical to winter survival. For one thing, the limited extent of the townsit made it traversable in the worst winter conditions. Moreover, it was well connected to its hinterland by way of Yonge Street leading to the north, so the area was a popular one with both urban and rural settlers. Clearly, the urban form was not so disadvantageous that it discouraged development. It worked, however, because this is what the British immigrants and Loyalist settlers were accustomed to.

People weren’t completely miserable either. They quickly adapted or created new sports to entertain themselves during the long winter. In the middle to late 1800’s, sleigh-racing, and later ice-boating, on the frozen Toronto Harbour were popular with the wealthy. Throughout that century and into our own, curling and ice skating were common winter activities (see Figure 17). Later, hockey became Toronto’s and Canada’s most beloved sport.24

Figure 17: Curling on the Don River, in the 1870’s. Curling has remained a very popular sport in Canada, although it is now played almost exclusively on indoor rinks.

The arrival of the streetcar in the 1870's to 1890's and cars in the twentieth century (the major road network extensions occurred in the 1950's) caused the continuing expansion of Toronto. Toronto has long since lost the compact form of its initial settlement. In an era of proliferating development, its easily extendable form has turned into a liability.

In the twentieth century, Toronto, in its planning and architecture, strove to prove itself a member of, first, the Canadian community, and later, the world community. It has continued to derive its architectural form primarily from elsewhere, as has most of the rest of Canada (although this is beginning to change). A core of tall buildings, designed in the International Style, were erected in response to the local desire for broader recognition (see Figure 18). Many of these are quite utilitarian looking and unimaginative. They are rendered grey and unmemorable in snowy, wet weather. No local or Canadian architecture has ever developed that is sensitive to its winter climate. Nor has the urban design profession created a unique local response to the development of public and outdoor spaces, although certainly some good designs exist.

Urban sprawl, tall buildings and wide wind-swept streets have brought some very special problems. Today, Toronto has some public spaces, such as City Hall plaza, that are a delight even in winter, but many areas are not. Crossing the street at St. Clair Avenue and Yonge Street is difficult in a winter blizzard. Neither is it easy or enjoyable to walk across the podium and into any one of the tall buildings at King and Bay Streets. In both

Figure 18: The black, grey, and white skyscrapers that form Toronto's business core.
locations, the wind whips up to speeds that are disconcerting and even dangerous to the pedestrian.

Toronto turns inward in winter. This is partly a cultural response of its citizens which should not be considered a bad thing. However, it is also a physical reaction to unpleasant conditions. Toronto's underground walkway systems link up most of the main office buildings in the financial system and a good part of the Yonge Street and Bloor Street retail districts as well (see Figure 19). People use these connections whenever possible. Use of the commercial streets is therefore severely curtailed. When activity disappears from the street, it seems even colder and less enjoyable.

The downtown parks are also underutilized in winter, perhaps because most of them are too small for the Parks and Recreation Department to program extensively (see Figure 20). Most were not planned with winter in mind. Larger parks, such as Harbourfront, are hard to get to because the pedestrian connections are so cold and windy. The waterfront parks especially suffer from the fierce winds that come off the lake. Other parks, such as Ontario Place, aren't even open in winter.

In general, Toronto has tended to deny the reality of winter, as have a good many other northern cities. Torontonians complain without end about winter weather but few do much about it. They spend much of their time indoors. Jack Royle, a Torontonian, described northerners as having a "cold-climate mentality":

Figure 19: Inside a mall in Toronto's underground walkway system.
Many of us live a kind of half life, indulging ourselves in the good things served up by our northern lands through half the year and pretending the other half away. We turn our backs on the rich diet of joys and sensations offered in our cold and snowy season, thus reducing the quality of our living and our experience. We live in badly designed cities and communities - badly designed in terms of their adaptation to our climate - and decline to insist that our architects and planners can do better by us.  

It is time now to insist on something better, armed as we are with the principles of vernacular buildings and settlements and being willing to further investigate outdoor urban design issues in winter cities. But first, it is necessary to look at the recent planning policy of Toronto to better understand why things got the way they did and what the City has recently decided to do about it.

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4 Climate-Related Policy in Toronto

Toronto's winter problems do not stem from a lack of planning. The city has been planned in one way or another from its outset. The problems are occurring because past planning initiatives did not consider climate as a matter of concern in plan production or in the review and approval of development proposals. This isn't uncommon; climate and contextually-related issues were not a concern in most places in North America until quite recently. It is especially interesting to look at what happened to the pedestrian system as symptomatic of the thinking of planners during the late 1950's and early 1960's. Pedestrian issues are in many ways integrally bound up with issues of climate and human comfort. They were assessed for the first time in Toronto in a 1959 report. It recommended the implementation of a system of mid-block walkways, sidewalk improvements, and grade separated links.26

The first underground shopping centres, the TD Centre and the Richmond Adelaide Centre were built in the period following this report (1964-1967), but the underground concourses produced in connection with them were not envisioned as part of the pedestrian system. A subsequent study in 1969 recommended that the City build on the base provided by the underground

concourses and so create a complete grade-separated pedestrian system. This was how the large underground network was eventually formed (see Figure 21).

In this era of rational planning, the microclimate wasn't even an issue; streamlining traffic was. The idea was that pedestrians should be separated from vehicular traffic; a commendable notion, except that as a total solution, the underground pedestrian route was questionable. The City tried to develop the street level system as well. In particular, since 1959 it has had a policy of providing walkways through the middle of the largest downtown blocks. However, the underground system remained popular and developers now feel they must tie into it if they wish to get retail business. Of course, it does provide complete weather protection but it has effectively caused pedestrian activity at the street level to be reduced. This has had a negative effect on street-level retail uses. Especially in the windswept and dark surface areas along the underground route, the street is almost abandoned in winter. The planners of the day got the result they intended, but began to realize that it was not at all desirable. When an area loses its activity, it loses its vitality and safety too.

Torontonians began to be concerned that their quality of life in the city was slipping away in the late 1960's and early 1970's. This happened all over North America and, of course, had little to do with matters of climate and everything to do with the desire for more control over municipal decision-making and planning. In response to this, and with the help of a new

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Figure 21: Toronto's underground walkway system: This system includes almost 3.5 km (2.2 miles) of walkways which cover a good portion of the financial district and extends over to Yonge Street, the major shopping street in the city. Bloor Street, also a major shopping area, has another smaller series of linkages.
reform council (1972), the nature of planning in Toronto began to change. A holding bylaw was placed on all developments over 45 feet while the City assessed the kind of development that was desirable. About this time, a set of design guidelines were commissioned. *Onbuildingdowntown* was a report to the City of Toronto Planning Board, which was intended to rectify the urban design problems that were occurring. While it covered many topic areas, I will discuss only those that had a bearing on winter climate. To my knowledge, this was the first planning document in Toronto that dealt explicitly with climate-related issues.

One intention of the guidelines was "to expand the use of the natural phenomena of everyday city life in the pattern of downtown building; wind and calm; *sun and shadow*; the changing sky; *the changing seasons*; *snow* and rain and birds; all these instead of the too-frequent bland, uniformly climate-controlled, totally interior spaces of so much downtown city building." 27 (Emphasis mine.)

The guidelines also sought to change the pattern of pedestrian activity from below ground to the street. They suggested that exclusive pedestrian routes should only be encouraged when this would not reduce the activity on street sidewalks. This meant that solutions had to be found for the uninviting

pedestrian environment on the street. In fact, the report was quite strong about this:

With the advent of such extremely large building complexes as the Toronto Dominion Centre and the Commerce Court, the microclimate of the Core Area has become a matter requiring civic regulation. The effect of such large complexes on sun and wind conditions at ground level requires closer scrutiny and guidance than it has had to date. These guidelines propose standards for the measurement of desirable microclimate conditions in the Core Area.28

In looking at microclimate, the study touched on winter conditions a number of times. The sun and shade guidelines, for example, proposed that new buildings allow for good year-round conditions of sun and shade in designated open spaces. Standards detailed the times of day and year when sunlight on an open space should be maximized. The report gave an example of a hotel which blocks the afternoon sun on the City Hall plaza as a condition to be avoided. It also gave examples of good sun traps. A guideline was also proposed for sunlight access to streets. Another guideline suggested that new buildings should not aggravate wind conditions either by increasing wind where it was undesirable or decreasing it where it was wanted. Arcades, awnings, overhangs, and transit waiting shelters were encouraged to protect pedestrians from winter snow and summer sun.

28 Design Guidelines Study Group, p. 15.
One of the stated goals was "to provide sufficient open space in the Core Area and to ensure that where it occurs it can be used by a wide range of people at all times of the year." (Emphasis mine.) In elaborating on the goal, the report stated that people experience the seasons most directly in open spaces but that these spaces are often unused in winter. It pointed out that in High Park, in the early part of the century, the City constructed ice slides and toboggan runs yearly, and could do so again at reasonable cost.

While *Onbuildingdowntown* was fairly explicit about how it might be implemented, and it was approved by the Planning Board, the report was never used in the site plan review process. It was perhaps too ambitious in its grasp. The goals were to be carried out by certain "requirements", although the intent of the goals took precedence over the requirements themselves. Nonetheless, the requirements made most developers nervous. Architects feared that the design process was being dictated, although both architects and developers were involved in consultations to produce the guidelines. The guidelines themselves were quite comprehensive and so they were difficult for either a designer or a reviewer to hold in mind all at one time. Moreover, some of them were nearly impossible to implement. For example, the criterion which requires maximum sun on the street seems to neglect the fact that a lot of overshadowing currently exists, and it may

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29 Design Guidelines Study Group, p.121.
not be worth implementing for the small daily gains of sunlight that can be made.

Another reason for the limited success of the report was that, since it merely consisted of guidelines, it did not have the same legal clout that other downtown plans did. It is to these plans that we now turn.

To understand how some plans have more influence than others in Toronto, it is useful to know the context of planning in Ontario. The Ontario Planning Act (1983) regulates all major regional and municipal planning that occurs in the province. A city must formulate an official plan (OP) if any major development is to take place. Major development constitutes virtually everything outside of severances. Official plans usually consist of generalized land use mapping and policies and objectives for physical development that the municipality intends to achieve over a certain time period, usually about 20 years. Unlike most master plans in the U.S., the official plan in Ontario has some legal status. Once developed, the plan has to be approved by the City Council and the provincial government. Planning must be carried out in accordance with the OP; otherwise an amendment to the OP must be obtained. This is unlike the guidelines described above.

Planning in the downtown area of Toronto is guided by the Toronto Official Plan which contains within it the Central Area Plan. Official plan policies
apply to the entire city and are the most general of all. The Central Area Plan, while still fairly general, applies only in the downtown area.

Toronto's Planning and Development Department calls its local plans "Part II plans". Part II plans of importance in the downtown area are the Harbourfront Plan, which guides development in the 37 hectare (91 acre) federally-owned Harbourfront site; the Central Waterfront Plan, which covers the waterfront area east of Harbourfront; and the Railway Lands Plan, which covers a large tract of undeveloped land between the Central Area and Harbourfront. These plans contain policies which are more location-specific than the OP policies. They guide the development review process and the City's own actions in the area in question. A list of known policies that relate to climate for each of these plans follows.

Official Plan (1981):

- It is the policy of Council that a program of planting, protection and replacement of trees along main roads will be carried out. Shade trees on roads in residence areas will be protected, as far as possible, and additional large shade trees will be planted.

- It is the policy of Council to encourage the retention, development and enhancement of public streets and streetscapes which have a well defined character, scale and enclosure, to ensure they are comfortable [emphasis mine] and convenient and offer varied activities and experience to pedestrians. (A similar policy relates specifically to pedestrian walkways.)
In lands south of Harbour Street between York Street and Yonge Street, appropriate regard [must be] had to microclimatic conditions, such as wind, calm, sun and shade as may be a consequence of any [new] building.30

Central Area Plan (1981 - a part of the Official Plan):

- In enacting regulations and reviewing plans and drawings ... Council will ... consider ... [among other things] arcades and overhangs accommodating pedestrian walkways, transit shelters, access to subway stations and pedestrian connections between developments.

- In order to achieve an improved pedestrian environment at and around street level in the Central Area, Council will seek to ensure satisfactory conditions with respect to wind and calm, and sun and shade. In doing so, Council will seek to alleviate existing problems of high wind velocities and lack of sun in important pedestrian areas caused by the height or the inappropriate spacing or configuration of buildings, and to prevent the worsening of such conditions. In using its powers of regulation and review in implementing this Section, Council will apply objective standards to determine satisfactory conditions.31

The Planning Department's policies for the Central Area also encourage mixed-use development. Although this is not specifically for climate-related purposes, it has had the effect of bringing residential uses back downtown and putting them in close proximity to stores, banks, and offices.

30 City of Toronto Department of Planning and Development, Official Plan (Toronto: 1978).
31 City of Toronto Department of Planning and Development, 1978.
Developments such as Market Square or Queen's Quay mix condominiums or apartments in one building with offices and retail uses. The Eaton's Centre has a mix of stores and offices (see Figure 22), with direct subway access as well. This kind of development makes it possible to minimize outdoor exposure when the weather is bad. On the other hand, they represent a trend towards covering and enclosing malls and the semi-public space within them.

Other relevant policies which are not related to climate but which have implications for comfort in winter include ones to encourage the use of mass transit over private automobiles downtown and the integration of transit terminal facilities. This has the effect of concentrating development in the core, making it a more traversable and interconnected.

**Harbourfront Plan (1982):**

- ...the plans, drawings and the textual commentary ... shall include [among other things] a description of the manner in which the environmental goals of the official plan are to be met, and such description shall include ... a climatic study...32

In the plan, certain guidelines are outlined concerning public open spaces and parks:

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In the design of open spaces, consideration shall be had for their use and appearance in all seasons.

In considering the design of open spaces regard should be had for: avoiding the creation of adverse wind conditions at grade, providing wind protection by building on the north and west edges of open spaces and streets, creating open spaces that exploit winter sun conditions to modify temperatures, using small scale elements, such as walls, plantings and shelters to create localized wind-protected and snow-controlled areas; and providing where possible, sheltered pedestrian routes and entrances to buildings such as covered walkways, arcades, colonnades and courtyards.

Tree planting along the water's edge should be employed, where appropriate, to ... create a comfortable pattern of sun and shade.33

Central Waterfront Plan (1984):

- Council will seek ... to secure improved access to the Central Waterfront by providing pedestrian walkways that are comfortable, convenient and enjoyable, by extending the downtown system of weather-protected walkways.34

Railway Lands Plan (1986):

- Special attention should be paid to the relationship between the ground level of buildings and the level of any adjoining sidewalk or open space by encouraging [among other things] the provision of weather-protected pedestrian ways along buildings edges which are appropriately linked to interior public pedestrian routes.

33 City of Toronto Department of Planning and Development, 1982.
34 City of Toronto Department of Planning and Development, Official Plan Amendment, Part II Plan for the Central Waterfront (Toronto: 1984).
• The location, form and pattern of buildings should permit reasonable sun penetration to parks, publicly accessible open spaces and sidewalks, and should provide protection from adverse wind conditions in these areas.

• An Environmental Report shall contain an assessment of the appropriate means of ensuring satisfactory air quality and climatic conditions, including satisfactory wind conditions at grade.35

Within the Railway Lands Plan, design criteria have been approved by City Council for particular precincts. In the Stadium Precinct, for example, the following criteria related to comfort and climate are included:

• The overall massing strategy of buildings within the precinct should act to frame and articulate adjacent spaces, terminate or frame important vistas and contribute to comfortable urban conditions. (Emphasis mine.)

• Where warranted by anticipated pedestrian flows [development should] provide for comfortable weather protected routes. In the case of the Stadium it is desirable to have a covered pedestrian route encompassing the entire perimeter of the building...36

In addition to the planning policies, the development review process, which covers virtually every sizeable development in Toronto, has requirements that have a bearing on climate. For example, shadow studies are required

for buildings located near public open spaces, and wind studies are also required for buildings over 90 m in height or over three times the height of surrounding structures. Wind conditions must be predicted within a distance of 150 metres of the site.

These policies indicate that Toronto does consider the climate. This is most evident in the more recent planning documents. Requirements are becoming increasingly explicit. While earlier plans called for "satisfactory micro-climatic conditions", later ones have spelled out what "satisfactory" might mean.

However, policies are general, and it is not always clear what constitutes an acceptable environment to the plan reviewers. This creates problems for both developers and the public. Developers do not know what to expect and the public does not know what they can legitimately ask for. The setting of standards makes requirements clearer, but often raise the question of their validity (usually scientific or quasi-scientific) and whether they actually achieve their goals. Standards and requirements are slowly worked out over time as a city gains more experience with procedures such as wind testing. However, if the City planners have required wind tests of areas in Harbourfront, for example, they have not yet achieved their aim. Comfort conditions there remain poor. The program of requiring arcades may have increased protection from snow and rain, but wind protection is minimal. Also, wide sidewalks have been installed for the comfort of pedestrians, but this creates wide streets which funnel winds. Thus, some of the policies
appear to be counter-productive. It is not even certain that even planting evergreens will significantly counter the lake winds. The closing-in of the Queen's Quay with tall towers on the north side has not helped either. However, this may reflect political decisions rather than the established policies, a perennial problem for well-meaning planners, but a reality of the business. Policies themselves do not ensure the success of given objectives. This kind of criticism can be extended from Harbourfront to the rest of the central area. Follow-through on the polices has been limited.

There is still much work to be done before Toronto is truly a livable winter city. However, this is not to say that winter in Toronto is entirely dreary and unpleasant. A lot of positive changes began to occur about the time that the reform government came into power in 1972.

The successes of the City's Urban Design Group are notable in this respect. Some of their initiatives have contributed enormously to improve the aesthetics and comfort of the streetscape. To encourage developers to recreate links between the waterfront and the city, they have placed a demountable glazed canopy along lower Bay Street in front of certain vacant lands. As these lands are developed, the canopy will be replaced with the arcades of the new buildings.

Many of the concrete sidewalks on the major streets, such as Yonge Street, have been replaced with warm-coloured brick pavers. Steel-framed shelters have been provided at convenient locations for street vendors on Yonge
Street (see Figure 23). Plexiglass roofs have been erected over some of the open subway entrances. These efforts are continuing. A City staff member has indicated that the Urban Design Group is taking a more active role in reviewing the architecture of private proposals recently. In the past this was considered beyond their mandate because of the Province's conviction that local planners should not be arbiters of taste. The change in direction is happening because the public is more concerned than ever with the architecture that is produced in Toronto.

Also on the positive side, the City's public services are above average when compared to many municipalities. Snow management in Toronto is excellent. The major streets and sidewalks are plowed, salted, and sanded immediately (although it would be wonderful if an alternative to salt were found). Most transit waiting areas have adequate, if unexciting, shelters and in the downtown area people do not have to wait long for the bus, streetcar or subway.

Other public and private initiatives are commendable as well. The gaudy lights of Yonge Street are a welcome sight in winter. More appropriate, and much more beautiful, are the lights that outline Old City Hall in winter, making it look like a fairy castle (see Figure 24). New City Hall has constant activity in its plaza, because the summer fountain becomes a winter skating rink. There is also a small and popular outdoor skating rink in front of Ryerson Polytechnical Institute.
The Handbook

In order to encourage the City's efforts to get citizens and developers to consider the impact of winter on public open spaces, I have developed "The Livable Winter City Handbook", using Toronto as the basis of example.

The handbook is intended to guide the actions of people who are actually implementing physical changes in the outdoor environment of the city. As such, it does not go into detail about possible policy changes, although these might well be a necessity. In particular, it might be appropriate to build policies concerning the winter environment into the Official Plan, when it is next reviewed. As an example, Sudbury has done this in its most recent OP update. More important though, would be an effort to more thoroughly enforce the policies and guidelines which already exist.

We have reviewed the positive imagery of winter, the spirit of vernacular building and settlement, the concerns of winter, especially as they relate to Toronto, and Toronto's policy and practice related to climate. I have tried to bring this information to bear in the handbook which follows. There is necessarily some repetition in the next section, because it is considered a completely separate entity.

Figure 24: Toronto's Old City Hall at night.
5 The Livable Winter City Handbook

5.1 Introduction

This handbook has been designed as a reference to city planners and designers, design consultants, interest groups, and developers. Its purpose is to give professionals design information to promote the creation of downtown public and semi-public outdoor areas that respond to winter conditions. It uses Toronto as a case study, but may be applicable to other centres that have a temperate climate. The purpose of the handbook is to encourage the fuller use of outdoor spaces and help create a positive image of the city in winter.

5.2 Why is Design for Winter Necessary?

At present, outdoor areas in Toronto's downtown are underutilized in the winters. People tend to use the below-ground indoor connections whenever possible. While this is not a bad thing for those businesses which are located on this level, retailers and businesses at the street level may find that their business decreases in the January to March period. Toronto has tried to convey an international image of itself, and the image fails when people get the idea that the city closes down for the winter months. The lack of activity on the streets is not good for tourism. With a concerted effort of city planners and developers, we can make changes that would turn Toronto into a year-round city, a truly great place to be.
5.3 Who Should Participate?

Clearly, the City has the major role to play in making changes to the downtown that improve the winter environment. It is responsible for the overall economic, environmental, and social health of the downtown. Increased downtown activity helps to stabilize its tax-base, improves safety on its streets, and leads to increased job opportunities for its citizens. It also creates a cycle whereby further social and cultural activity is generated.

The City has special tools at its disposal to facilitate urban design. It can require that winter be considered in the planning process. It can acquire land and finance urban design projects, using its own technical expertise. It is responsible for city parks, streets, and sidewalks--areas where large design impacts can be made. The City is mandated to ensure that citizens have a say in the development process. It can promote activities that involve citizens, such as the organization of a winter festival.

This handbook is geared towards those who will be implementing public urban projects. Less is said about the role of public policy and legislation, although initiatives concerning winter would clearly be useful.

Developers also have an important role to play. Increasingly, there is a move to privatize what once was public space. This is especially true in situations where climate control is desirable. More and more indoor shopping facilities with public walkways and connections to public
transport systems are being provided by private developers in Toronto. These have been useful contributions to the city; however, they lead to an increased separation between outdoor and indoor activities and environments. If not carefully planned, poor design and poor connections with other facilities result. An increased emphasis on thoughtful urban design can lead to a more positive outdoor urban development pattern. Developers and their designers can help the City in undertaking this new initiative, by providing innovative proposals that consider the outdoor winter context.

Neighbourhood groups that review planning proposals can use this information as one input to their considerations. The public is the user of the winter city and may be the best judge of whether the intentions concerning winter design are effective. Groups that are developing new facilities themselves can also use the information in their designs.

5.4 The Study Area

The area under consideration comprises that which is known in Toronto's Official Plan as the Central Area, plus all lands south to the Lake Ontario shoreline including the Railway Lands planning area, the Central Waterfront planning area, and the Harbourfront planning area (see Figure 1). It also includes connections to the larger regional area, through the Rosedale ravine and Toronto Islands. Occasional references are made to locations outside the study area if they help demonstrate a point.
5.5 Potential Activities in Outdoor Public Areas

In planning for the use of outdoor public areas, the goal is usually to maximize public activity and promote interaction. In order to consider how this may be done, it is useful to discuss the kinds of activities that are desirable in different types of outdoor spaces. A categorization of outdoor spaces has been developed because, while there is an overlap of uses in the different spaces, these spaces often have separate primary functions. The chosen categories are plazas and urban spaces, streets and pedestrian ways, parks and connections to the region, and city form/city-wide connections. The last category requires some comment. It refers less to a kind of space than to a general form that promotes the use of the city as a whole in the winter. As such, the activities associated with it are less specific.

In plazas and other urban spaces, people are usually walking to and from work and retail areas in the building associated with the plaza (see Figure 2). In the plaza they may be sitting, watching other people, gossiping, meeting people at landmarks such as sculptures, standing, vending goods, eating (especially if there is an outdoor cafe'), and watching programmed or unprogrammed events such as mimes or musicians. The plaza should not be seen simply as the space required to get that extra density bonus. It should be considered a vital part of the building composition and be designed and programmed on this basis.
On streets and pedestrian ways, activities include driving, walking, strolling, sight-seeing, window shopping, people-watching, sitting on benches, waiting at transit stops, vending goods (see Figure 3), eating, and bicycling. There is a need to separate pedestrian and other traffic to minimize accidents and to have clearly articulated points where pedestrians and traffic necessarily meet (bus stops, pedestrian crossings). On a walkway, pedestrians need to have room to walk in both directions, to walk either quickly or slowly, depending on their purpose, and to avoid street furniture on one side and the building on the other. A report for the City of Toronto on pedestrian movement south of Front Street has recommended 4.5 metres as a minimum on most streets in that area.  

Shirvani states that "the pedestrian element should aid in the interaction of basic urban design elements, should relate strongly to the existing built environment and activity pattern, and should fit in effectively with future change in the city...we have to balance the use of pedestrian elements to support livable, attractive public spaces while at the same time allowing for such related uses as delivery services, access, and individual property requirements."  

In parks or open space areas that connect to the larger region, the most diverse set of activities occurs, under ideal circumstances. In

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addition to all the same kinds of activities that go on in plazas or on streets and walkways, active recreation, such as field sports, swimming, skating, jogging, cross-country skiing, and tobogganing occurs and more passive recreation, such as hiking or naturalist activities go on (see Figure 4). Places like Harbourfront, Ontario Place and Exhibition Place do extensive indoor programming as well. Parks should be clearly connected to the urban area in order to promote active use. They provide an important environmental function in addition to their recreational purposes. For example, a good size group of trees will filter polluted city air and add moisture back into it. Trees and natural ground cover moderate the flow of water over and into the ground.

The city-wide connections that are made should allow the larger activities of access through rapid and private transportation to occur. These are the arterial highways, the subway, the LRT, and the major connections to other forms of transportation, such as buses or streetcars. It also refers to the built form of the major metropolitan area. The major recreational systems, such as the ravine system and the waterfront parks, and the major trails, bike paths, and walkways within them can be included in this definition, but are discussed under parks. The city form should allow for convenient living, work, shopping, entertainment and recreation. Primarily this means that connections between these activities need to be clear and convenient. For example, distances between living, working, and recreating should be short enough to facilitate activity in the winter, not prevent it.

Figure 4: A walkway through one of Toronto's ravines near Spadina Road, outside of the study area.
5.6 Problems and Opportunities of Winter

The major problems for outdoor spaces in winter are winds, lack of sunlight, icy passages underfoot and icicles falling from above, snow storms, slush, and cold temperatures. At the same time the combination of ice, snow, cold and sunshine provide opportunities that are available only in winter and provide us with some of our fondest memories and most interesting experiences. Below, each of these environmental factors will be discussed briefly. This discussion does not permit detailed understanding of climatic concerns. The reader is advised to consult other sources when designing projects. Some general guidance on microclimatic design considerations is given below. More detail is provided in later sections.

In winter there are a number of wind effects which may cause concern (see Figure 5). Winds in Toronto have known to get so bad near certain office towers on Bay Street and along Front Street that guide ropes are occasionally required for pedestrians. If squeezed between two obstructions, the wind will speed up as a result. A good example of this effect is the channelling of wind up a street, the obstructions being the walls of buildings. In Toronto, problems are caused by winter winds from the

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Figure 5: Urban wind effects

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north, west, and southwest which funnel up streets with north and west alignments. The major undesirable wind effect is caused by tall buildings in the vicinity of lower buildings. The regional wind hits the building and most of it is redirected down to the ground level, along local streets and walkways, and into open spaces. The downflow creates vortices in which the wind gusts and eddies.

When wind effects are combined with cold temperatures, a wind chill effect is achieved, where the apparent temperature is much colder than the thermometer reading. Frostbite on exposed or poorly protected skin may result. The temperature also seems colder when there is no radiant energy.

In controlling winds, building orientation, massing, and local topography must be considered. For larger buildings, wind tunnel testing is usually required and can help determine how to manipulate massing and orientation to minimize wind effects. It is preferable to do this at the planning stage, before final design decisions have been made rather than trying to use remedial solutions later.

However, poor existing conditions may plague a new development. These can be ameliorated using arcades or canopies which are specifically designed for this purpose. Alternatively, semi-permeable walls and trellises

can be used (about 50% permeability provides adequate protection). Landscaping with shelterbelts of trees and shrubs is another solution. A medium density shelterbelt provides perhaps the best trade-off between the percentage of wind speed reduction and the amount of area protected (see Figure 6). Vegetation can also be used to guide wind in a specific direction, if this is desired (see Figure 7). Windscreens are most effective if they are located on the north and west sides of the area to be protected.

The radiant energy of the sun is detected in humans by our thermal receptors. While the temperature in an area may remain the same with or without the sun, we always feel warmer when the sun is out. If it is out for any length of time and the air is still, the sun will eventually raise the air temperature. In winter, the sun's rays hit at a low angle with respect to the earth in the northern hemisphere. The sun's energy is spread over a larger area and so it heats less. It is also out for a shorter period of the day than in summer. Sunshine is therefore a precious commodity in the winter. It can make outdoor spaces feel warm even in the coldest weather. At the same time, the sun's rays are more easily obstructed by buildings in winter, so methods must be developed to maximize solar access. Alternatively, substitutes for the sun (radiant heating through fires, infra-red heaters, etc., can be provided. Light and colour also important, although their effects are purely psychological. Studies suggest that bright yellow, for instance, promotes feelings of hope and expectation. On the other hand, people

![Figure 6: The effect of a shelterbelt as a function of its permeability](image-url)
appear to be ambivalent about the colour grey. They tend to be more alert and active when surrounded by warm colours and good lighting.

For design purposes, it is important to orient outdoor spaces towards the sun and arrange vegetation, barriers, and the space in relation to other structures, so that important surfaces are not cast in shadow in the winter. Controlled extensions of the interior environment, such as glazed enclosures, can also benefit from unimpeded access to the winter sun. Arcades should not be so large as to prevent sun from getting under them. Overhead structures, such as trellises and pergolas should be designed to admit the winter sunshine (see Figure 8). Accurate shadow diagrams can help to indicate the site constraints and the possibilities for locating outdoor public areas. For certain developments in Toronto, shadow diagrams are a requirement.

Although evergreens are useful for preventing wind encroachment, they may create unwanted shadowing, especially if they are grouped or lined up. Deciduous trees with thin branches and trunks should be used near surfaces

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that need winter sun and summer shade. Honeylocust and many of the Ashes bud late and drop their leaves early, and so are good for maximizing sun penetration. Oaks may hold onto their leaves all the way through the winter and they are also bulky, so they should be located away for sensitive areas (see Figure 9).

Snow in the street makes transportation more difficult. Commuting times are increased and accidents occur more often. Blowing snow causes poor visibility and may make walking close to impossible at times (see Figure 10). Slush makes for cold and wet feet and salt destroys cars and boots. Dirty snow piles get in our way and seem to be a reminder of what is most objectionable in winter. On the other hand, fluffy white snow has an extraordinary beauty and allows unique kinds of recreation.

Good landscape design permits the convenient removal of snow from places where it is not wanted to storage places or locations where snow is wanted. Vegetation can be used to block snow in its lee and to control the location of snow drifting. Permeable barriers, such as plants or snow fencing, allows the wind to drop snow over a longer distance, with less build-up than does a solid barrier. If a permeable barrier is used, it must therefore be well set back from that area it is protecting.

Many winter car accidents are caused by skidding out of control on ice. Uncleared sidewalks and passageways lead to ice build-up, which in turn causes pedestrian accidents, especially for those, such as the elderly, the
overburdened (mothers with packages and strollers), or handicapped, who are less sure on their feet. Overhead, dripping water is a nuisance and falling ice is a menace. In both these instances, maintenance is the primary concern, however, design can also be used to ensure that ice does not become a menace.

Ice also has special qualities which should be considered. Shot through with sunlight, ice takes on magical translucent qualities. It sparkles with colour. Ice also allows for various types of winter recreation.

Designers will, no doubt, have ideas on how to capitalize on the positive aspects of winter. Here are some additional ideas.

Design for winter does not simply refer to dressing up spaces with holiday decorations, important as these may be. Winter design has the potential for opening up new avenues of thought about urban design. Experimental artists should especially find the possibilities of winter a source of inspiration for their work. For instance, the special geometry of snow (combinations of 120° angles, with three to six sides) could be the basis for ideas. Consider also how snow and ice can be deliberately incorporated into a design. Elements might include locations for temporary (ice) sculpture, or, more useful still, sculpture in combination with water or ice in forms that can be enjoyed in winter as well as summer. Metal frames or large rocks could be the basis for moldable snow sculpture or snow drift pattern-making. Another thing to consider is the use of colourful winter

Figure 10: A winter snow storm makes walking difficult and seeing almost impossible.
vegetation--evergreens and shrubs--in landscaping schemes. Continued experimentation will help a new winter urban design and art aesthetic emerge.

In the next section, the problems and opportunities of these environmental elements are described in relation to the kinds of activities that are desirable in outdoor public and semi-public spaces. Advice on winter design is given in point form. This format raises a problem, and possible ways of mitigating it, or an opportunity and possible ways of reinforcing the opportunity. Since the format allows people to go directly to the subject in which they are interested, there is necessarily some overlap between sections.
5.7 Plazas and Outdoor Urban Spaces

Wind

Problem: • Tall buildings can cause a severe wind effect at the ground level of an outdoor plaza in front of the building. Entrances may be impossible to open. The plaza, if it consists of uninterrupted pavement, allows wind to pick up and the result may be a treacherous, unintended skating rink.

Mitigation: • New tall buildings should not have shear walls extending to the ground which bring regional winds down to this level. Instead, setbacks which step back from the street line can minimize this effect (see Figure 11). Specially designed canopies can divert winds from pedestrian areas. Wind tunnel testing, required by the City for buildings over 30 metres in height, helps determine which building forms minimize wind effects.

• Various wind screen devices, such as rows of evergreens in combination with low shrubbery or permeable walls, can be used to protect the building. Alternatively, protection may be sought for specific areas, such as outdoor restaurants and entrances. Positioning of entrances and outdoor seating must be considered in relation to the wind, using the wind tunnel if necessary. If windy locations must be chosen, permeable walls or lattices can be used upwind (see Figure 12).

Figure 11: If a building is stepped back from its base in the direction of the prevailing winds, the wind is diverted and broken up at each level. The total wind impact at the street level is therefore reduced.
Designers should consider ways to divide a large urban space so that wind speed is reduced. Small level changes are not necessarily effective in stopping wind; usually some kind of wind-diffusing landscaping is required as well.

**Opportunity:** Wind is a fact of the winter existence and it is better to celebrate it than hide from it.

**Reinforcement:** Flags, banners, and wind sculptures (such as the sculpture in Porter Square, Cambridge, Massachusetts, which has huge propellors that are slowly turned by the wind) celebrate the effects of wind (see Figure 13). They also can cut wind speeds.

Wind can be directed into an area, and with the use of specially developed windscreens, beautiful snow drifting patterns can result. An area of the plaza can be set aside, away from pedestrian walkways, for this type of experimental art.

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Sun/Shadow/Colour

Problem: • Tall buildings will often shade their own plazas or those opposite them.

Mitigation: • Public plazas should be located to maximize sunlight and to extend their use in spring and fall. South-facing locations should be chosen, and shadowing studies should consider the effect of surrounding buildings (see Figure 14).

• In designing the space, the designer should endeavor to create a "sun-trap" that receives both direct heat from the sun and reflected or re-radiated heat from masonry or stone surfaces (see Figure 15). It may be possible to use mirrors and heat retaining masonry walls to "scoop" up sunlight from elsewhere and re-direct it into dark areas. This solution is being used in certain Japanese high-rise office buildings with open courtyards. The mirrors are computer-controlled to follow the sun's path. The sun-trap is a good location for seating areas.

• The colour of surfaces and paving materials in a plaza is important. Dark colours absorb and re-radiate heat over a longer period of time than do light colours, so heat is maintained in an area longer. Brick is a popular material

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for this purpose. Concrete can be made darker and more colourful with the addition of oxide pigments. In summer, dark colours become less advantageous because the surface area heats up so effectively. For this reason, areas that are predominantly for summer, daytime use should use light, highly reflective surfaces. If on the other hand an area is used in summer, winter, and the night-time, it may be best to use dark paving materials and a covering of deciduous trees. Deciduous trees reduce summer daytime temperatures while allowing winter solar access.

**Problem:** • With so little sun, and the bleakness of dirty snow and dark pavement, the public plaza that may be interesting in other seasons is dull and anonymous in winter.

• A special effort should be made to detail the facades of new winter city buildings and to provide colours that contrast with the somber winter palette—yellow, orange, red, brick, pink, etc. Older buildings often provide examples of good detailing at the pedestrian level. Their patterns of rhythm and proportions should especially be considered if they surround the new plaza (see Figure 16). The open space can be livened with colourful flags or banners that reflect companies or events that occur within the new building.

**Opportunity:** • Night lights help to brighten the winter scene.

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**Requirements:**

(1) Design new buildings so as to maximize the extent to which direct sunlight reaches designated open spaces, at 9:18 A.M., 12:18 P.M., and 3:18 P.M., on the spring equinox, March 21, and on the autumn equinox, September 21 (E.S.T. and D.S.T.)

On the following three diagrams, Area ABCD is a designated open space.

A range of different building lots have the potential to maximize or minimize sunlight conditions on open space ABCD. Moreover, during the day, the responsibility for maximization or minimization of sun on that space shifts among that range of different building lots.

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**Figure 14:** The suggested wind requirements from Onbuildingdowntown. These were never enforced although the City does require the shadow studies be done near public spaces.
Reinforcement: Well-lit buildings using careful floodlighting, outlining with light bulbs or the judicious use of neon, will provide drama, decrease the darkness of a winter’s night, and make a good advertisement for the activities in the building (see Figure 17). Trees in the plaza can be decked with lights or highlighted with concealed floodlights. Sculpture can be lit or lighting might be intrinsic to the sculpture (e.g., laser sculpture). Low level lighting (i.e., less than a metre high) can effectively be used to light a path or planting.\(^9\)

- Special events can make creative use of lasers or searchlights.

Ice/Water/Steam

Problem: Icy passages across an open space or plaza are dangerous. Icicles from overhangs may fall on hapless victims.

Mitigation: Important pedestrian areas can be heated from beneath with electricity or steam, or reflecting mirrors on particular trouble spots can keep them ice-free. The high costs associated with heating options make it desirable to use the waste heat of buildings or district heating systems, if possible. Active maintenance out of doors is essential. Overhangs should be

be heated to prevent snow build-up, or located so that snow does not fall on pedestrian paths.

- Paving materials should be durable so they can withstand snow removal equipment. Care must be taken in installing the paving stones so that heaving does not occur. It is important to choose materials that minimize the possibility of slipping or ice accumulation in cracks. The designer should consider the possible effects of salt damage and the effects of freeze/thaw cycles.

**Opportunity:** • Winter is the only time that the sculptural elements of ice may be used outdoors.

**Reinforcement:** • Public artwork in the plaza should be chosen with a view to its effectiveness in winter or to take advantage of winter. Ice can be used in temporary sculptural works or dripped over a frame to achieve an icicle effect (i.e., a winter ice sculpture and summer fountain). Clear glazed panels might be used to experiment with frost formations. Steam sculptures, such as those created by Joan Brigham in Boston, provide dramatic images in winter.

**Opportunity:** • Plazas can provide year-round recreational activities, rather than simply programming for the summer months.
Reinforcement: • Skating rinks allow office workers to exercise at noon (see Figure 18). Perhaps sculptural ice slides can be developed.

Snow/Slush

Problem: • Snow collection areas in plazas are ugly and dangerous. Grey snow may last well into spring. Uncleared walkways are wet nuisances (see Figure 19).

Mitigation: • Snow should be cleared of all walkways immediately and stored away from pedestrian and traffic zones. Steps and level changes must especially be cleared promptly. Collection areas should be away from the public eye. Careful drainage and grading should prevent ponding in heavily used parts of the plaza.

Problem: • The monumental plaza may be inappropriate and monotonous in the winter city.

Mitigation: • The designer should consider what the design looks like with a coating of snow. Does it still have vitality? The design should include detail and components of interest that contrast well with snow. Wet stone in simple arrangements, for instance, might make a dramatic statement.

Figure 18: Skaters on the City Hall rink
Temperature

**Opportunity:** Celebrations are especially important when the weather gets colder. Crowding allows for protection from the elements, raises the real and perceived temperatures and helps diminish the isolation that can occur in winter.

**Reinforcement:** The plaza can be planned to accommodate crowds in winter. Programming can allow for special winter activities and perhaps even festivals. A thoughtfully conceived space may permit spontaneous winter "events" to occur, just as they do in summer (e.g., a crowd collecting to listen to a musician who stands under a heated awning). The design might include standing room for a small crowd or the provision of movable chairs (so that people can follow the sun). Displays and craft sales can go on outdoors in warm winter weather.

- Kiosks and areas extended from indoors can sell hot food and drinks to passersby. Restaurants can use glazed, retractable roofs that can be opened on warm spring-like days. They can also allow for visual connections with the outdoors when physical connections are impossible (see Figure 20).

- A progression of temperatures minimizes the jarring change from indoors to outdoors. Such a progression might be as follows: lobby, foyer,

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10 Pressman and Zepic, p. 98.

Figure 19: Heaps of snow at the top of these stairs make them impossible to walk down.
protected and heated arcade or awning, unheated, but covered, walkway, exterior environment.

• A fire has always warmed us both physically and psychologically, just as fountains cool us in the summer. Our plazas provide us with fountains and pools, why not a public hearth (e.g., the flame in City Hall's Peace Garden—see Figure 21)? Fire could also be integrated with fountains or skating rinks (see Figure 22). Surely safe containers for fires can be created. While a gas flame won't really heat much, it will provide colour and perceived warmth.

Figure 20: The restaurant overlooking the sculpture garden gives good visual contact with a natural setting.

Figure 22: An urban park with a combined fountain/skating rink and fire sculpture.

Figure 21: The flame in the Peace Garden in front of City Hall; one of few public uses of fire in Toronto
5.8 Streets and Pedestrian Ways

Wind

**Problem:** Winter winds are channelled down streets that are aligned in a cardinal grid, such as Toronto has. This sometimes makes walking on sidewalks dangerous and it causes people to look for interior routes. The winter city street then lacks activity to brighten it.

**Mitigation:** Planning for wind on the street as well as the site is important. Tests, such as the Bloor Street Study by the City of Toronto, are a step in the right direction. This study was a quantitative assessment of the pedestrian-level winds on Bloor Street, using a wind tunnel and water flume analysis. The study found that the best way to modify winds on the street was to carefully consider the massing of adjacent buildings.

- On streets where conditions are already bad, it may make sense for the City to plant dense rows of evergreens to cut wind, although only in those places which do not affect traffic sight lines (see Figure 23). Evergreens planted in this manner can reduce wind by an average of up to 20 per cent. Conifers are largely intolerant to salt, with the exception of Scotch pine, so careful placement is essential.

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11 Ontario Ministry of Municipal Affairs, p. 44.
• Wind screens such as the semi-circular metal wind lattice in Buffalo, New York, serve a decorative as well as functional purpose. Periodic transit or rest shelters can be provided, perhaps as an adjunct to building's awning.

• Streets that are heavily used by pedestrians should not be wide in the winter city. In northern Europe, the narrow streets of the pre-car era often provide a wind free and pleasant pedestrian environment. Perhaps Toronto should consider the use of its alleys and lanes as new retail development resources.

**Problem:** • Winds increase across parking lots adjacent to the road.

**Mitigation:** • Parking lots need to be screened for aesthetic and environmental reasons. If vegetation is used, screening will reduce summer heat build-up as well.

**Opportunity:** • On regional roads, where pedestrian traffic is not permitted or encouraged, the wind may purposefully be channelled to sweep snow-filled streets. Shelterbelts can also be configured to funnel wind into parking lots with similar results.

**Reinforcement:** • The City staff may wish to study which of its streets are unsuitable for pedestrian use and use tree formations (probably deciduous trees) which funnel wind. This procedure is most useful for
streets with an east-west orientation. Wind tunnel tests might have to be carried out to indicate if the procedure is plausible in a given situation.

**Sun/Shadow/Colour**

**Problem:** Dark streets and sidewalks discourage pedestrian use.

**Mitigation:** If possible, sunlight should reach the street during the middle hours of the winter day. Building design should accommodate the need to retain sunlight on the street during the limited winter day.

- Certain deciduous tree species are better than others for allowing solar access late in the fall and early in the spring by dropping leaves early and budding late. A landscape architect should be consulted. Trees should be planted away from walls or windows requiring sunlight.

- Pedestrian-level lights should be warming colours, such as yellow.

- Lights can be stretched across the street for the winter season rather than simply at Christmas. They should also be in cheering, warm colours or white. Street trees can be lit up too (see Figure 24). Carefully structured lighting will create an ambiance for an area that connotes activity and festivity.

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12 [Ontario Ministry of Municipal Affairs, p. 39.](#)
• Blank walls can be painted with bright colours (see Figure 25).

Ice/Water/Steam

Opportunity: • In Northern European cities, major shopping precincts have electrical or steam heated sidewalks and pedestrian streets.

Reinforcement: • The use of heated sidewalks (perhaps provided by steam from the City’s district heating system or waste heat from buildings) could be considered for the major shopping districts, such as Yonge Street, Bloor Street and Yorkville, and parts of the financial district.

• Sidewalks and pedestrian crossings should have strongly textured surfaces to increase traction--granite is good, as are paving stones, cobblestones, or textured cement. However, the texture should not make walking difficult at other times.

Snow/Slush

Problem: • Snow accumulates on outdoor stairways leading to the subway.

Mitigation: • All exterior entrances to the subways should be covered, as is done at the Dundas subway stop (see Figure 26).
**Problem:** Exterior connections with the interior walkway system are often unclear, so that pedestrians often don't know they have a choice of walking inside or out.

**Mitigation:** Information panels and signs should indicate the interior walkway systems. Entrances and connections should be clearly articulated through design (see Figure 27).

**Problem:** Snow discourages pedestrians from going outside, especially if the pedestrian walkways are not clear.

**Mitigation:** Protective canopies, such as the glazed Bay Street canopy (see Figure 28), arcades, such as in Bern, Switzerland, and awnings can be provided along the street edge to encourage pedestrian use. Protection is most useful if it is part of a continuous system. Such a system could include radiant heating, lighting and music to entice pedestrians onto the winter street.\(^\text{13}\)

- On-going snow clearance is essential, of course, and Toronto is good at doing this on its major shopping streets. Agreements must be reached about how the responsibility for maintenance will be split between public and private groups such as business associations.

\(^\text{13}\) Pressman and Zepic, p.73.
**Opportunity:** • In Sweden, certain cities have pedestrian crossings that are slightly raised rather than being at the road grade. The pedestrian does not have to step into slush when stepping into the road. Another advantage is that the vehicle operator is made more aware of the pedestrian right-of-way and most slow down to pass it.\(^{14}\)

**Reinforcement:** • The City could experiment with the effectiveness of raised crosswalks in the major shopping areas, along Yonge Street and Bloor Street.

**Opportunity:** • Design may be used to help reduce snow build-up on streets.

**Reinforcement:** • Road alignment should maximize solar access. Design can provide adequate snow storage areas (not areas needed for pedestrian circulation!). Feasible locations are sections of extended sidewalk (bulbs or nodes), so long as they do not interfere with crosswalks. The design of seating areas in these nodes should take snow clearance into account.

\(^{14}\) Pressman and Zepic, p. 101.
Experimentation has occurred with snow melting systems that are actually mixed into the road surface, thereby reducing maintenance costs. Electrically heated roads have been used in Norway and Sweden.\(^{15}\)

**Temperature**

**Opportunity:** • Warmth on the street can be made available from sources other than the sun.

**Reinforcement:** • Infra-red heaters could be placed at strategic locations where pedestrians gather, for instance, street corners, major transit waiting areas or the entrances to the subway. Bus shelters could have heaters that are timed to coincide with likely periods of high use, such as rush hour. A push button for short-terms use would save energy. Benches should be provided in these heated areas.\(^{16}\)

\(^{15}\) Pressman and Zepic, p. 68.

\(^{16}\) Ontario Ministry of Municipal Affairs, p. 60.
5.9 Parks/Connections to the Region

Wind

**Problem:** • Cold, windy areas, especially areas where snow drifting occurs, are not used by the public.

**Mitigation:** • While some wide open spaces are needed for summer playing fields, parks should also contain sheltered, vegetated areas. Parks have space that plazas and streets do not, so they can provide for proper shelterbelts. These consist of several rows of evergreen trees and low shrubs (ideally about five rows). It is best to work with a landscape architect to get an effective configuration. Paths should not be shadowed by the shelterbelt; deciduous trees can be used along side the trail itself. Earth berms can also be used for wind protection.

• Temporary winter forms, such as decorative ice walls, could also cut wind, if appropriately placed.

• Trails along the ravines or the waterfront should be laid out so wind is not channelled along them. The direction of the trail can be varied periodically so wind speed does not build up.
Sun/Shadow

**Problem:** • Small inner city parks may be surrounded by large developments which shadow significant areas in the park.

• When the sun sets early, the park and trails lie in darkness much of the day. This can be perceived as dangerous. Short cuts across the park aren’t used.

**Mitigation:** • Development around a inner city park should plan heights and massing so that areas designated for winter, fall and early spring use are not shadowed. New parks are best located where southern exposure is good.

• Lighting up some of the trees in the parks and along paths makes safe walkways through the park. Also, pedestrian level lighting should follow any well-used paths. The lights help to create a festive atmosphere (see Figure 29).

• Access to the regional trail system should be accented with higher levels of illumination, while using lower levels of lighting along the trail itself. Rest areas should also be lit.

**Opportunity:** • The shadows of deciduous trees look lovely against white snow and reminds us that nature still exists, even in the winter city.
Reinforcement: • Even if they don't provide winter wind protection, deciduous trees are essential climate modifiers in other seasons. They can certainly play a role in the winter city. The nicest shadow effect on snow seems to come from a clump of trees, not too tightly packed.

Opportunity: • Fire can act as a replacement to the sun.

Reinforcement: • More open fire pits should be provided in our open spaces or perhaps near skating rinks. Supervision is essential, of course, and it is useful to have sand nearby to put out the fire (see Figure 30). Benches and tables near the pit will permit winter picnicking to occur.

Ice/Water/Steam

Problem: • Ice-covered paths through the park are dangerous.

Mitigation: • Clear the ice and sand the paths. Snow-covered cross-country trails should be maintained to prevent ice build-up.

Opportunity: • Water has special meanings and associations for people and is a manifestation of nature in the city. Its dynamic nature can be illustrated equally well in winter as summer.
Reinforcement: • Parks are a great place to exhibit ice sculptures by local artists. Ice blocks can be provided in conjunction with a local winter carnival. Ice walls or an ice castle can also provide a strong focal point for a carnival.

• The Parks Department could also provide heavy, non-movable blocks of ice in a variety of shapes and positions for children to play on. These blocks would be the winter play equipment. However, signs need to be posted indicating that play must be supervised.

Opportunity: • Ice has always been associated with Canadian winter recreation (see Figure 31).

Reinforcement: • Curling and skating rinks are often provided in City parks and are very popular. More outdoor rinks should be provided in the downtown area. They can be part of a storm retention system, as in Winnipeg.\textsuperscript{17}

• Ice slides can offered in major parks. Examples such as Quebec's "Glissade" and the more modest slide in Lake Placid, New York, are a popular attraction for the family.

Opportunity: • Scandinavians have been famous for their use heated pools

\textsuperscript{17} Pressman and Zepic, p. 92.
and saunas. Water continues to be a valuable source of recreation and relaxation during the wintertime.

Reinforcement: • The City might consider providing some supervised outdoor heated pools, hot tubs and saunas, for the adventurous.

• Waterfront parks allow the use of the water, even in winter. In Vancouver, for instance, a growing Christmas tradition is carolling from boats.18

Snow/Slush

Problem: • Snow builds up on benches, and seating areas often catch the drifting snow (see Figure 32).

Mitigation: • Clear park benches and the ground around them, at least in the sunnier locations.

Problem: • There is a certain bleakness to a coat of snow over a featureless park.

Mitigation: • Parks should be carefully landscaped, with winter in mind.

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Evergreens, bushes with winter berries, and a ground covering with more height than grass (e.g., low shrubs) provide colour and variation. Park structures should be colourful.

Opportunity: • A park is one of the few places in the city with a lot of snow.

Reinforcement: • Certain parts of the park, such as the playing fields, can be used for "snow expression", where children are encouraged to build forts and play snowy games. The Parks Department might consider building some igloos to demonstrate thermal adaption in historic times. Artists can experiment with snow sculpture and colouring the snow. Cleared snow from other parts of the park could be deposited in these areas to provide extra materials.

• Larger parks should support toboggan hills, and winter picnicking areas.

• Some parks in the city should be predominantly winter parks, just as others are predominantly summer parks. Structures could be erected to encourage interesting snow drifting patterns. Large rocks are good for this purpose too. They can also be used as the basis for snow sculpture.

19 Norman Pressman and Xenia Zepic, p. 95.
20 R/UDAT, p. 23.
Temperature

**Problem:** A drop in the temperature heralds the closure of many park facilities, with fewer replacements.

**Mitigation:** Places like Ontario Place should be open in the winter, with special winter programming. Exhibition Park might be used as a major site for a Toronto Winter Carnival. In smaller public parks, concession stands should remain open in winter, selling hot food and drinks. The City should consider licensing a few of these so that mulled wine can be sold.

**Problem:** Even with wind protection, parks and trails may not be used when the weather is cold.

**Mitigation:** Shelters with seating and perhaps radiant heating could be placed along walking routes (see Figure 33). In the larger ravines periodic warm-up huts or cabins are needed, including outdoor fire pits. Clear access can improve use. Trails need to link to main entrance locations and parking lots. They must be clearly marked.

**Problem:** Many public benches are made of metal or concrete, materials that are uncomfortable to sit on when temperatures are low.

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21 R/UDAT, p. 25.
Mitigation: • Any materials that will come in contact with the body should be non-conducting. Wood is one of the "warmest" materials for benches.
5.10 City-Wide Connections/City Form

Wind

Problem: Wide open spaces (roads, parking areas, plazas) create wind channels.

- Single family housing is the most wasteful of space, although less so in the city core than the suburbs.

Mitigation: Development should be compact-medium to high density, without jeopardizing access to sunlight. One way to accomplish this is to mix uses wherever possible (for example, Barton Myer's University of Alberta HUB building in Edmonton). Medium density housing in low- or medium-rise, mixed-use structures provides convenience, while still allowing privacy and outdoor access.

- Shared walls reduce heat loss and increase density. They also reduce wind impact by forming a barrier (e.g., Ralph Erskine's windscreen buildings, used in more northern climates; see Figure 34).

- Infilling of vacant or underutilized parcels needs to be encouraged.

Figure 34: The windscreen building protects the lower density development in its lee.
Sun/Shadow

Problem: • Dense city form promotes the skyscraper, which blocks the sun of neighbouring buildings.

Mitigation: • If buildings step back from the lot line, they can be designed to permit solar access (see Figure 35). Shadow studies should be completed. However, a trade-off between solar access and wind protection needs to be made. In Europe, a popular solution is the medium density, medium rise courtyard development.

- Public and semi-public spaces can be planned where shadowing does not occur and where maximum daily sun exposure is obtained.

Ice/Water/Snow

Opportunity: • City form should allow for access to winter recreational possibilities.

Reinforcement: • Fingers of natural landscapes should be allowed to penetrate the city—as with the ravines—but they should reach further downtown, if possible. Opportunities for providing linear linkages need to be explored.
Temperature

Problem: • Low density development means long travel distances and wasteful use of services and land for transportation purposes. It also decreases the possible warmth of the city and allows cold winds to penetrate the city.

Mitigation: • When designing local road alignments, their length and width should be minimized, where this does not conflict with other objectives.

• Integrated transit terminals, reserved bus lanes during the rush hour, special winter transit schedules, and improved transit information at waiting areas can all minimize the amount of land used for transportation purposes while making the facilities more attractive to users.²²

• Efforts should be continued to provide more comfortable and faster forms of mass transit. A Toronto example is the proposed LRT line on Spadina Avenue.

Opportunity: • Compact forms increase the warmth of the city. Swiss mountain towns could provide a model for city development that is more

²² Norman Pressman and Xenia Zepic, p. 70.
sensitive to winter. The buildings "huddle" together with eves overlapping for warmth (see Figure 36).

**Reinforcement:** • Buildings can be built close together, without gaps. A continuous system of overhead protection for pedestrians could be developed with the cooperation of business associations and the City.

• Mixed-use buildings allow for one stop usage, meaning fewer and shorter trips out into the cold weather.

Figure 36: Bellwald, Switzerland, huddles beneath a blanket of snow.
5.11 Summary

Not all the ideas presented in this handbook have been extensively tested in the field; some have not been implemented at all. But the principles are quite simple and they have been used through the ages, if somewhat unconsciously. At some point we need to stop testing the prototypes and simply get into the spirit of designing for winter in addition to the other seasons. You might ask yourself: what is it that I can do? Here are some ideas.

Planners play a role in influencing and informing the decisions of elected officials. They can keep the question of "winter fitness" in their minds as they review plans. They can remain informed about the emerging research on the subject and pass this information along to elected officials and the public. While this handbook has not concentrated on climate-related policy development, planners should consider what policy might be appropriate for inclusion in the official plan, guidelines, or other policy documents.

Urban designers and architects, whether public or private, should consider the implications of their designs in all seasons, not just the green ones. You might try doing drawings which show your design in winter, to see if the degree of detail, the scale, and so on, are appropriate. Architects should place an emphasis on the context of development. How does it relate to its neighbours? What would the possible connections to other developments be? Does the design make these connections obvious in winter? What are
the spaces like that are left over after the building is sited? As one architect states:

We must shift our main interest toward the city structure where buildings, supply systems, technical apparatus, inventory and biological elements create a landscape of components—a townscape—and a pattern of zones where all the spaces between the [buildings] are at least as important as the rooms inside and where individual buildings are "only" furniture in a town landscape.23

What can a development company do? It can take a lead in the urban design of its projects. With people placing a higher value on quality of life issues today, the appearance, convenience, and comfort that the city environment has becomes increasingly important when choosing jobs and places to live. A forward looking attitude towards urban design is therefore a sound financial investment. Moreover, careful site design could lead to savings in energy and therefore costs.

The people of the city stand to benefit the most from good winter city design. They can provide support for those projects that create better downtown conditions and through their individual actions contribute by making the city a better place to be during the winter. Citizens should make their opinions known about the City's program of public art and urban

design. While we have not discussed the programming of activities, this is one obvious way that winter can be made more enjoyable with broad public input.

The concerted action of planners, designers, developers, and citizens will help to make Toronto a truly livable winter city.
6 Conclusions

This investigation has shown what can be done with public outdoor spaces to extend their use in the winter and thereby help create a more livable downtown area. But the making of a livable winter city requires more than a handbook. The mechanisms must be found to make it a reality. Toronto is well on its way, with the City providing leadership in creating a humane city form, even if it is not directed specifically at dealing with winter issues. In the name of pedestrian comfort, it is moving in this direction, though. Over the past ten years the Planning and Development Department has shown a greater interest in designing and adding new public spaces and downtown parks. It would not be too difficult for the City to change its emphasis slightly to incorporate some of the suggestions made here. The development of only a few projects along these lines could have a marked impact on the microclimate and general livability of parts of the downtown.

Of course, investigations of this sort clearly raise as many questions as they address. One might ask whether it is even desirable that every season be an outdoor season. Perhaps there is a need to maintain the fantasy of a sizzling warm summer against the backdrop of a dull, dreary winter. This investigation, however, takes a view that it is possible to have positive fantasies of both seasons. Certainly, other northern countries in Europe have been more concerned with the livability of their winter cities and this has resulted in more effective and beautiful urban design in their downtown areas. On the other hand, it has not made people long for summer sunshine any less. It simply makes life in the city more enjoyable, year-round.
Other questions concern the workability of some of the suggestions made here. It is difficult to preserve sunlight on streets and sidewalks in the winter, for example. Heated sidewalks are extremely expensive to provide and one has to consider whether the investment is worth it. It may also be difficult to get developers to support experimental art forms that melt shortly after they are erected. However, if requirements about sunlight, sidewalks or the provision of art lead to increased use, desirability, and sales of a development, they would be worth it. Prototype developments will be necessary to demonstrate this.

One might well ask: how can this be implemented? In line with the environmental viewpoint taken here the answer is: slowly.

The City can implement many things through their own urban design program. Modest funds are made available yearly for urban design projects, and occasionally joint funding from other levels of government are possible.37

Developers are required to give 5% of their land (or cash in lieu) to a parks fund. In addition, they must contribute to works that the City completes in association with any development or redevelopment that they undertake. Most of the development of semi-public space by developers falls under the

37 City of Toronto Planning and Development Department, "Public Urban Design", Toronto, n.d., p. 4.
City's development review process, so microclimatic concerns can be raised to some extent in this forum. However, the City is constrained in what can be required of a developer by the limitations of the site plan review legislation of the Ontario Planning Act. Thus, many aspects of an urban design program can be requested, but not required, by a developer. The City achieves much of what it does because of almost constant development pressure which gives the planners a bargaining position with developers.

The City may well have to enforce and define its requirements and standards more carefully to make them more salient. As more becomes known about the usefulness of such tests as wind tunnel analyses, through on-going use and evaluation, standards can be refined to be more effective and possibly less punitive to developers. As City planners are well aware, the key is negotiation and flexibility in the plan review process. Incentives may be required to get developers to consider options other than the enclosed mall and to ensure the provision of specific outdoor amenities.

At the zoning level, it may be appropriate to reconsider the building heights that are being permitted. For example, perhaps high density development should be re-directed away from the financial district, where winter wind problems are the worst, to the Railway Lands. At the same time, it would be important to use development controls carefully to prevent the same situation from occurring there. Alternatively, the City could look into the question of setbacks. In order to prevent wind problems it may be
important to deliberately vary the street wall and minimize open spaces, such as large plazas, where wind speed can accelerate.

Ultimately though, the best way of making livable winter cities a reality is to make changes at every level and in every group. No matter what, the City planners and builders cannot do it all themselves, even if we assume them to completely support this endeavor.

The public needs to actively endorse the livable winter cites concept so that negative attitudes towards winter are changed. We need less griping about winter and more doing something about it; more participation in winter sports, more organizing of neighbourhood barbecues and winter festivals.

Cultural groups could easily use this idea to promote Canadian culture, for celebrating winter is celebrating a part of the Canadian heritage. Artists may find the winter city theme a fertile subject for investigation. Groups such as the Livable Winter Cities Association can help promote the idea through conferences, competitions, and activities.

Private groups or clubs can also be helpful in spreading the concept. Clubs can make outdoor rinks on their properties and make them available to the public, they can help fund parks designed for winter, and so on.
Business associations can be encouraged by the City to consider winter promotions and activities. A simple emphasis on continuing winter maintenance could make an enormous difference to the environment.

Senior levels of government can make funding available for demonstration projects. In Ontario, the next review of the Planning Act should definitely allow for changes that produce more flexibility in urban design and climatic matters. This might include changes to the zoning and site plan control sections of the act. On the artistic front, senior levels of government could provide funds to artists to allow experimentation with winter themes.

The benefits of an active stance towards creating livable cities in all seasons of the year are not limited simply to beauty. The approach has tangible financial impacts as well. A microclimatic approach can save money both inside and outside buildings by saving energy, reducing maintenance, and increasing use. Even small urban design efforts will, in general, improve the property and tax base of the city.38

Thus, developing the livable winter city makes sense financially and in terms of human comfort, social activity, and even cultural development. The choice is ours. It simply depends on what kind of city we wish to live in.

38 City of Toronto Planning and Development Department, n.d., p. 5.
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