

Implementation of a Map-Based  
Heat Vulnerability Assessment and  
Decision Support System

**User Manual for Heat Vulnerability  
Mapping Tool**

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Prepared on behalf and with the support of  
Toronto Public Health

## Map-Based Heat Vulnerability Assessment

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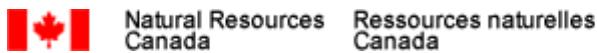
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For more information about Natural Resources Canada's Regional Adaptation Collaboratives Program, please visit [http://adaptation.nrcan.gc.ca/collab/index\\_e.php](http://adaptation.nrcan.gc.ca/collab/index_e.php)

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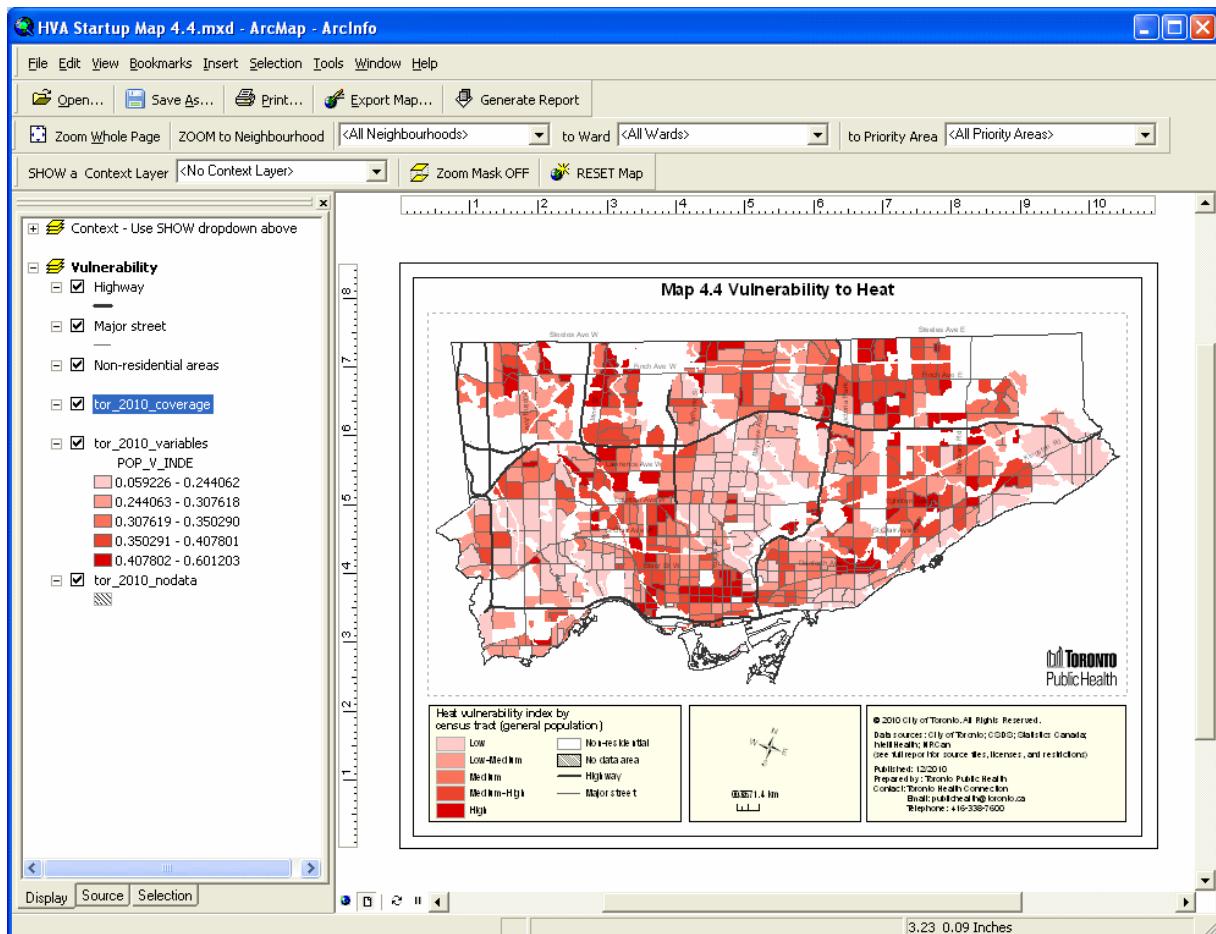
## 1. Introduction

In 2010/11, Toronto Public Health developed a refined heat vulnerability index and implemented a spatially explicit heat vulnerability assessment approach. This approach consists of (1) a methodology and decision support maps contained in the final project report; (2) the geographic information systems (GIS) project and mapping tools described in this user manual; and (3) a separate data maintenance and update protocol. Interaction with the GIS project and mapping tools provides extended functionality beyond static maps to Toronto Public Health. This will enable Toronto Public Health staff to produce custom maps for individual stakeholders to support effective hot weather preparation and response in Toronto. For example, high-resolution map images, custom map overlays, or detailed views of target neighbourhoods can be achieved. The access to the GIS project files also allows Toronto Public Health to export the vulnerability indices as GIS layers that can be shared with stakeholders, thereby addressing the expressed desire to combine the heat vulnerability assessment with existing data and existing tools.

Section 2 of this user manual provides an overview of the map handling, map zooming, map drawing, and reporting functionality. This is followed by a sample walk-through for creating a heat vulnerability report for the South Parkdale neighbourhood in Toronto in Section 3. Furthermore, Section 4 describes the cartographic design and map layout of the pre-processed decision support maps, while Section 5 outlines the software development and deployment approach for the implementation of the mapping tools.

## 2. Overview of Functionality

The general principle underlying the design of the mapping tools is to streamline the user interface for data exploration and map production by public health analysts and decision-makers. The goal is to simplify the user's interaction with the map and data as much as practical, so that users, who are experts in hot weather response but not in GIS, could easily access the information and use the tools. Consultation with Toronto Public Health determined that the appropriate software platform in terms of functionality and availability to users would be the ArcMap application within ArcGIS 9.3. ArcGIS is a full-featured GIS and mapping product, but more importantly in this context, it provides extensive possibilities for customizing its graphical user interface using the Visual Basic for Applications (VBA) scripting environment.



**Fig. 1: Heat Vulnerability Mapping Tool upon starting ArcMap**

ArcMap natively provides two main interface components to map users: a top panel containing a series of menus and toolbars above the mapping window, and a side panel containing the “table of contents” along the left hand side (see Fig. 1). In the Heat Vulnerability Mapping Tool interface, upon startup, both components are customized so that only the interface elements needed for heat vulnerability maps are visible. In the top panel there are four sections, from top to bottom:

1. Main menus
2. Map Handling toolbar
3. Map Zooming toolbar
4. Map Drawing toolbar

These are identified in Fig. 2. The main menus remain unchanged with their standard ArcMap functionality. They give the user access to most ArcMap functions via dropdown menus. The three additional toolbars were created for the Heat Vulnerability Mapping Tool. Subsequent sections provide details about each toolbar's functionality.



**Fig. 2: Detail of standard main menus and custom toolbars added to Mapping Tool interface**

Additional ArcMap user interface components are not visible on startup, but may be added to the interface if required. For example, ArcMap does provide a large number of toolbars for additional functionality. These may be added using the View->Toolbars menu function. ArcMap toolbars that experienced GIS users may find useful include:

- Standard, for handling map documents (open, save, etc.)
- Tools, for map navigation and querying (zoom, identify, etc.)
- Layout, for navigation in map layout view
- Draw, for editing the map layout

Similarly for the side panel “table of contents”, full functionality is available for experienced GIS users who wish to turn map layers on or off, and access the data behind them. However this is not necessary for users who only wish to use the basic visualization and reporting tools provided in the Heat Vulnerability Mapping Tool.

Conversely, to remove any or all of the customized toolbars, the user can navigate to the View->Toolbars menu function, find the custom toolbars with labels starting with “TPH”, and uncheck them.

## 2.1 Map Handling Toolbar



This toolbar includes buttons to open, save, print, and export the decision support maps from the map series included with the final project report. It also includes a button to generate a report on a selected neighbourhood.

### 2.1.1 Opening a Map

Clicking the “Open...” button takes you to the MapProjectFiles directory (Fig. 3). You can then navigate to the subdirectory and specific heat vulnerability map file, which you wish to open. Map documents are stored with the ArcMap file extension \*.mxd.

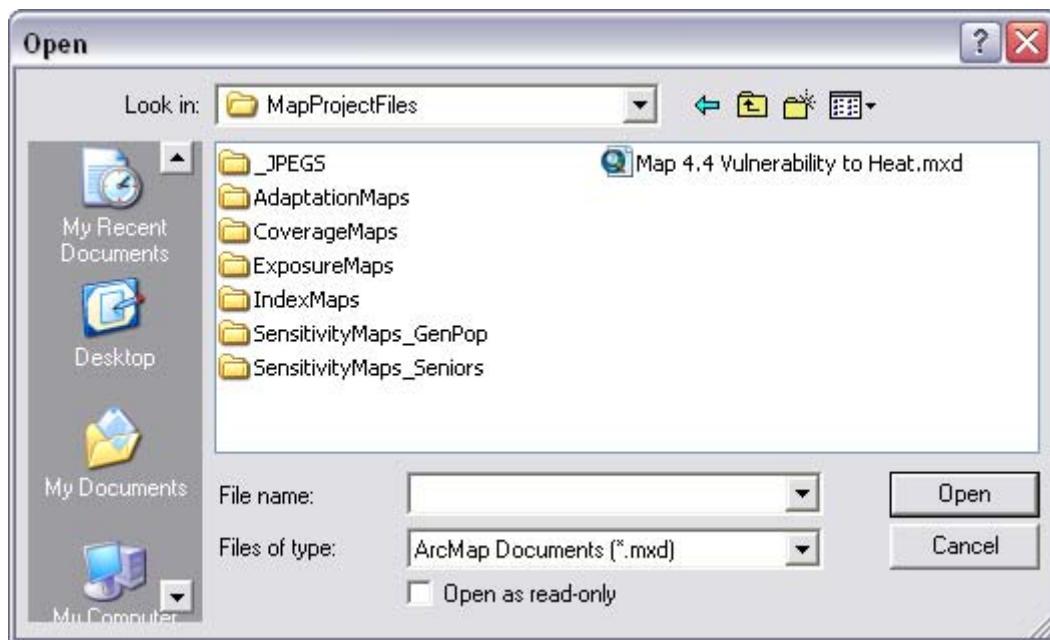


Fig. 3: Open map function

### 2.1.2 Saving the Map as a New Document

Clicking the “Save as...” button takes you to the directory, in which you most recently saved a file. It is recommended that map files made for specific purposes be saved within a local or personal directory, such as My Documents\My HVA Maps.

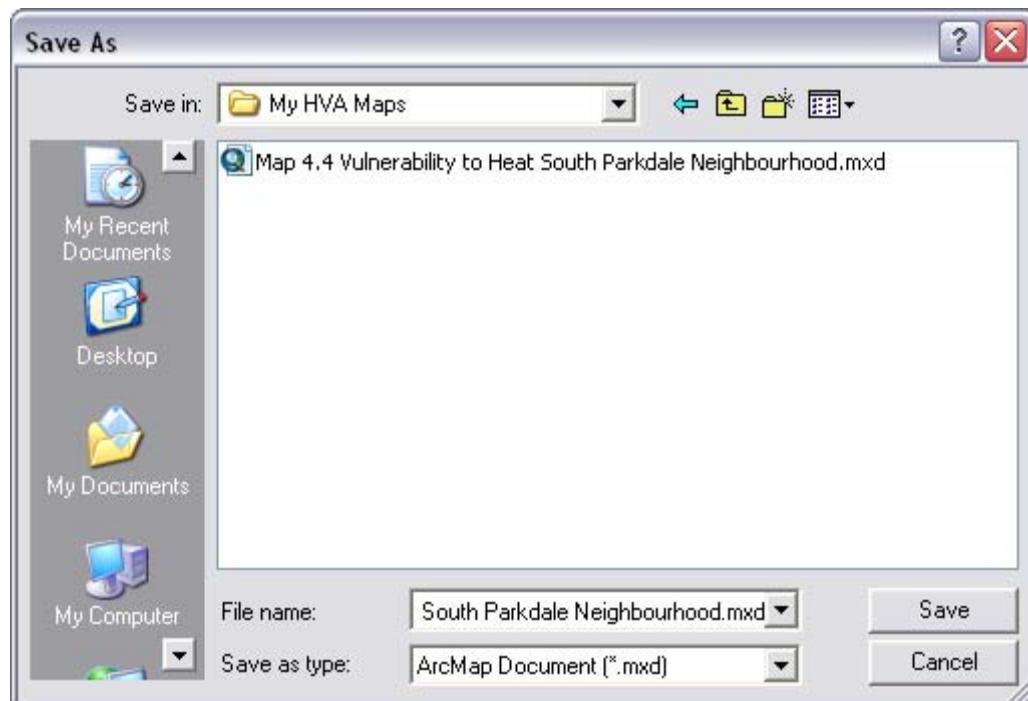
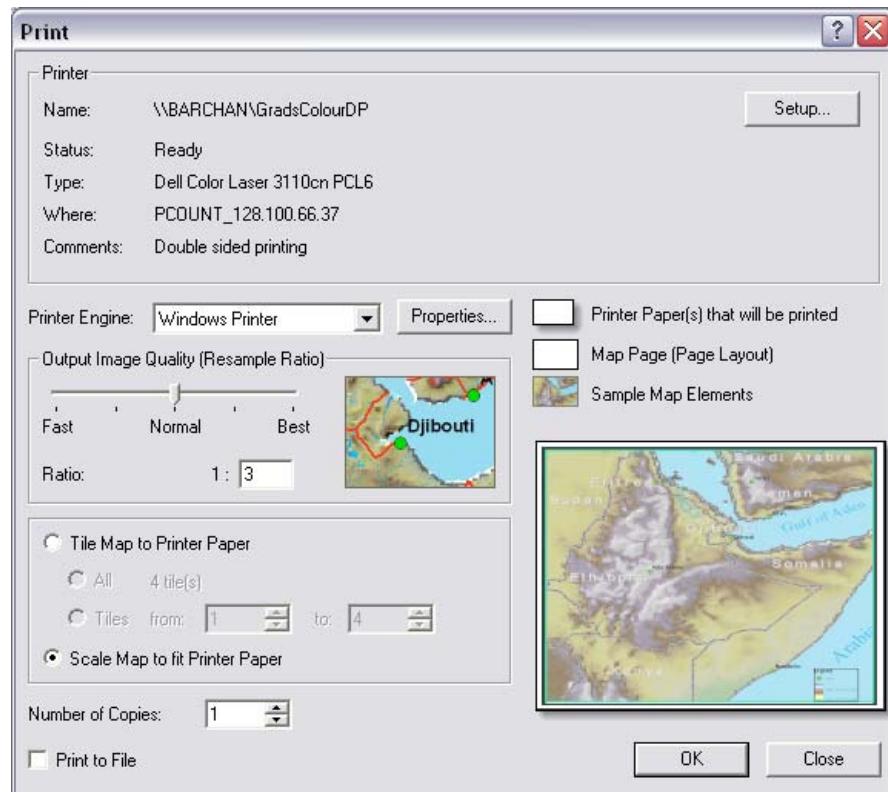


Fig. 4: Save as function

### 2.1.3 Printing the Map

Clicking the “Print...” button brings up ArcMap’s standard print function, which prints the current map layout view. The “Print” and “Print and Page Setup” window will vary according to your available printers, but the latter should look similar to Fig. 5. You may have to click the radio button “Scale Map to Fit Printer Paper”. The printer page must be set up as Letter and Landscape; if it is not, you may have to click on the printer “Properties” button below to access the “Print and Page Setup” window to set these.



**Fig. 5: Print function (ArcMap standard)**

#### 2.1.4 Exporting the Map as an Image or PDF file

Clicking the “Export Map...” button brings up ArcMap’s standard Export Map function, which will generate a “snapshot” of the current ArcMap page layout. You will be able to choose which file format to generate (see Fig. 6). Use this function to export an image file to be used as an illustration within a document or slideshow (e.g. Word or Powerpoint). Recommended image file formats include the compressed formats PNG, GIF, or JPG, or the uncompressed TIFF format. This function may also be used to export the map layout to a Portable Document Format (PDF) file, which can be distributed by email or printed as a handout.

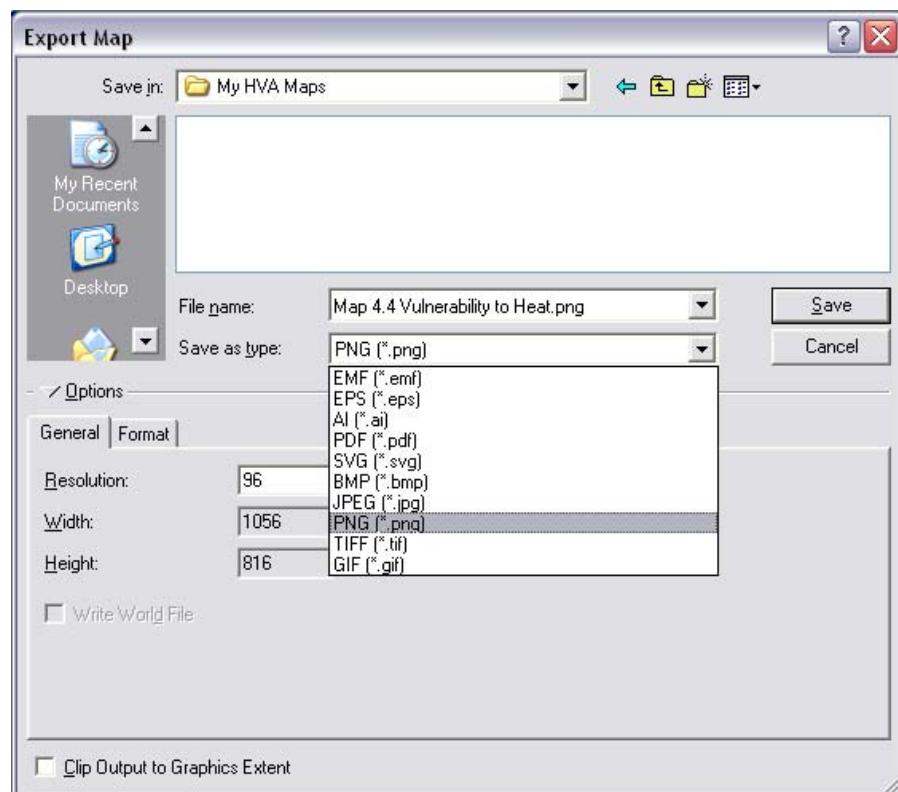


Fig. 6: Export Map function

### 2.1.5 Generating a Report

The “Generate Report” button will create a report summarizing the area and data that have been selected. This report is generated in a Web page format suitable for printing and archiving. It is designed to be used in conjunction with the “Zoom to” functions to focus on a specific area such as a City neighbourhood, ward, priority area, or postcode region, and summarize the data on vulnerable populations within the Census tracts of that area. The resulting one-page report includes the map and a summary table. The table sums the count values for eleven variables for the general population and seven variables for seniors within the selected Census tracts.

Upon clicking the button, you will be presented with three message prompts requiring a response before the page will be generated:

Prompt	Default
1. Map Export Path?	c:\temp\ArcMapExport.jpg
2. Report Export Path?	c:\temp\ArcMapSelectionReport.html
3. Report Title?	TPH - Heat Vulnerability - Neighbourhood Report - [date]

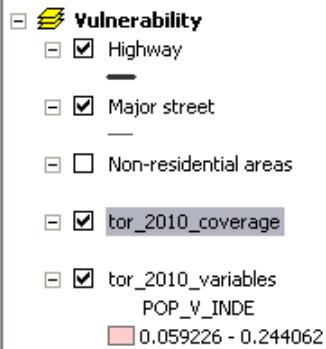
In all cases a default is provided so that you can just click “OK”. Or, you can change these settings to save and name the files as you wish. After collecting your responses, Internet Explorer will open with the report in Web page format. An example of a report is provided in Section 3. After the report is generated and displayed, you can use the Internet Explorer menu (File->Save as...) to save the Web page file to your personal directory.

Reference tables with City-wide totals as well as average and median counts per neighbourhood, ward, priority area, and postcode regions are provided in Appendix A.

#### Troubleshooting “Generate Report”:

As mentioned, the tool is designed mainly for generating reports after the “Zoom to” function is run, which also selects the Census tracts in the target area. If that has not been done, you may get the message “There were no selected features found in the report”. The report will be created, but with no data filled into the table.

There is an unusual circumstance which could interrupt this smooth process. This issue occurs when the correct data layer for generating the report is not highlighted. The total count data for the table come from the map layer “tor\_2010\_coverage”. This layer must be highlighted in the table of contents panel on the left side of the map (see Fig. 7a). This is the default upon start-up, but if you have clicked on another layer you may have highlighted it accidentally. In this case upon clicking “Generate Report” an error message will come up (“Error: Object variable or With block variable not set”). To fix this, click on the tor\_2010\_coverage layer once to highlight it as shown in Fig. 7, and then click “Generate Report” again.

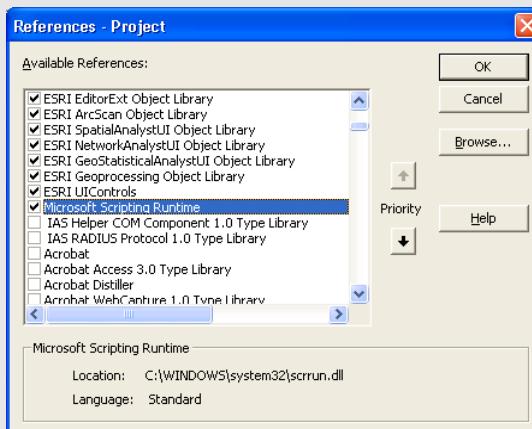


**Fig. 7a: Highlighted layer for “Generate Report”**

An additional issue may arise when the Heat Vulnerability Mapping Tool is used on a computer that has a different Microsoft Windows setup than the development computer. Because the generate report function creates a file, it needs access to the Windows operating system. For this, the tool’s program code needs to reference the “Microsoft Scripting Runtime” library.

If clicking the “Generate Report” button results in an error message that refers to an “automation” or “reference” problem, or a “library not found” error, then this library may not be correctly installed. To remedy the situation, select Tools-Macros-Visual Basic Editor, or hit ALT+F11 in ArcMap, to open the Microsoft Visual Basic window. From this window’s menu bar, select Tools-References... to open the list of program libraries used. If “Microsoft Scripting Runtime” is unchecked, click its checkbox. If it is entirely missing from the list, use the Browse... button to find the file “scrrun.dll” in the folder C:\Windows\system32, which will add this library to the list. In both cases, close the Visual Basic window and use File-Save in ArcMap’s main window to store the modified map project file.

Alternatively, if the reference to “Microsoft Scripting Runtime” appears to be correct (checked, not marked as “missing”), then uncheck it, close the Visual Basic window, save the map file, and close ArcMap. Then, re-open ArcMap with the same map and follow the steps above to find and check the “Microsoft Scripting Runtime” library. A screenshot of the references list with the Scripting library activated is shown below.



**Fig. 7b: Visual Basic references list with the Scripting library activated**

## 2.2 Map Zooming Toolbar



This toolbar contains a button and three dropdown menus to zoom to detailed map views, and to reset the map layout.

### 2.2.1 Zooming to the Whole Page

Clicking this button runs the standard ArcMap function “Zoom Whole Page”, which reverts the map layout view to showing the page layout fitted to the current window size. This function may be needed after repeatedly zooming to different city neighbourhoods or other areas, which affects the page layout.

**Tip:**

If the map on your screen slipped out of place, try using the “Zoom Whole Page” button to reset the map page back to a centred, fitted position.

### 2.2.2 Zooming to City Neighbourhood, Ward, or Priority Area

The “Zoom to” tools assist with focusing on an area. There are three sets of areas, as defined by the City of Toronto: neighbourhoods, wards and priority investment areas. Use these drop-down “combination box” tools to select one of these areas by name. Doing so will zoom the map extent to the area and select the Census tracts within it. It will also highlight its extent by masking the surrounding Census tracts (see illustration in Section 3). At this point, you can use the “Generate Report” tool as outlined above. If you wish to see the zoomed area without masking out the surrounding Census tracts, use the “Zoom mask OFF” tool on the Map Drawing Toolbar as explained below.

### 2.2.3 Zooming to Ipsos-Reid Postal Code Region



The Ipsos-Reid Postal code regions are aggregations of Canada Post forward-sortation areas (three-digit postal code areas) used for reporting survey data. An additional “Zoom to” combination box tool was created for these areas. Since these regions are less commonly used than the city-defined areas listed above, this toolbar is not included in the start-up default interface for the Mapping Tool. It can be added below the other toolbars by using the main menu function “View->Toolbars->TPH – IPSOS REID zoomto”. This dropdown works just like the other “Zoom to” tools.

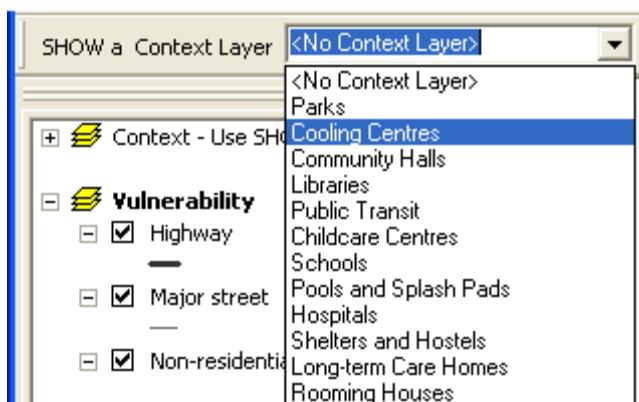
## 2.3 Map Drawing Toolbar



This toolbar combines buttons that modify the data layers shown in the map, or how they are shown.

### 2.3.1 Showing an Additional Layer with Adaptation or Context Information

The “SHOW a Context Layer” tool has been designed to add a single adaptation or context layer as an overlay onto the current map. On startup, these layers are hidden in the table of contents to encourage their access through this tool, as can be seen in Fig. 8. Clicking on the black triangle on the right of the tool name triggers a drop-down menu of the 12 available adaptation and context layers. Clicking on one of these turns it on, and simultaneously turns off any other context overlay.



**Fig. 8: Adaptation/Context overlay tool**

For those users who are familiar with GIS and wish to use the full ArcMap interface, the full set of adaptation and context layers can be opened in the table of contents and its checkboxes and other tools used.

### 2.3.2 Showing/Hiding Vulnerability of Surrounding Neighbourhoods

As described above, when one of the “Zoom to” tools is invoked, it highlights the selected area by masking the surrounding area. To remove this mask, in order to see the surrounding Census tracts symbolized for exposure, sensitivity, or vulnerability (depending on the map at hand), click the “Zoom Mask OFF” button. This tool will reveal the shades of red in the surrounding area. To revert to the masked view of the map, use the “Zoom to” tool again.

### 2.3.3 Resetting the Map

Click on the “RESET Map” button to zoom out to the full extent of the City of Toronto, and turn off any of the context and adaptation layers that may have been turned on. This effectively returns the map to its default startup state.

**Tip:**

If the map on your screen appears to be “mixed up”, try using the “RESET Map” button to reset the map extent and map layers to their original status.

### **3. Sample Usage – Heat Vulnerability Report for South Parkdale Neighbourhood**

In this section, a series of steps have been assembled as an example of using the customized user interface, to serve as an introduction to the Heat Vulnerability Mapping Tools. We will generate a heat vulnerability report for the South Parkdale neighbourhood.

#### **3.1 Opening the Heat Vulnerability Mapping Tools**

Navigate to the startup directory for the Heat Vulnerability Maps. This will normally be something like ..\username\TPH 2011\HVA\_Deliverables\MapProjectFiles. Within this directory, select and open the HVA Startup mapfile:

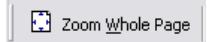
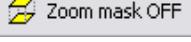
HVA Startup Map 4.4 Vulnerability to Heat.mxd.

#### **3.2 Opening an Existing Decision Support Map**

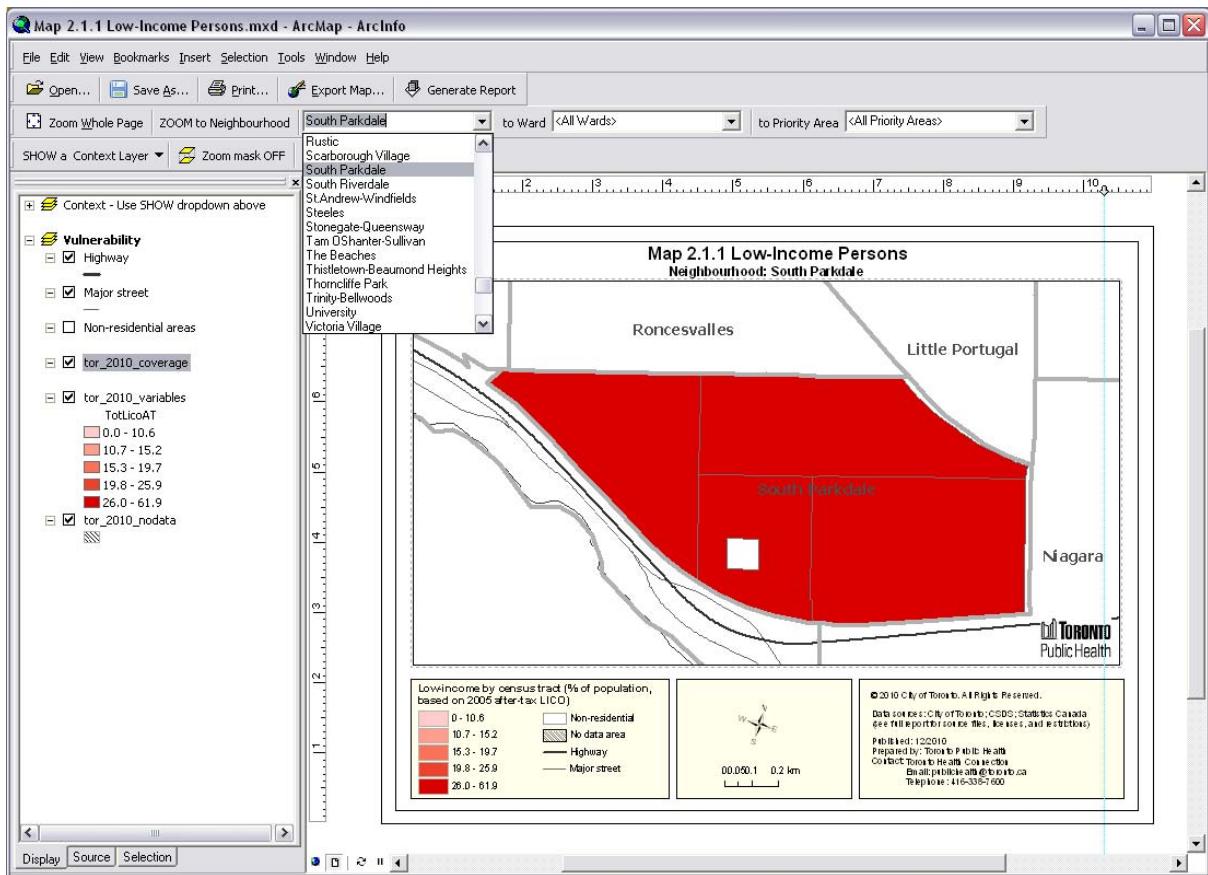
On the Map Handling Toolbar, click the  Open... button, and using the standard ArcMap “Open” window, navigate to the specific map you wish to view. All of the Exposure, Sensitivity, Index, and Coverage maps developed for this project have the customized Heat Vulnerability Mapping Tools incorporated into them. As an example, navigate to the following map document and open it:

..\MapProjectFiles\SensitivityMaps\_GenPop\Map 2.1.1 Low-Income Persons.mxd

#### **3.3 Zooming to an Area of Interest – The South Parkdale Neighbourhood**

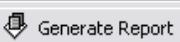
If your map page looks small, click on the  Zoom Whole Page button. Then use the “ZOOM to Neighbourhood” combination box dropdown to select “South Parkdale”. The selection process and the resulting map should look like Fig. 9 below. The map is zoomed to the area of South Parkdale, the map title now reflects this, the neighbourhoods around it are labelled, and the surrounding area is masked to highlight the area of interest. If you want to see what the percentages of the population with low incomes are in the surrounding census tracts, you can click the  Zoom mask OFF button to reveal them. You can try this now, and then refresh the highlighted view by zooming to South Parkdale again.

## Map-Based Heat Vulnerability Assessment



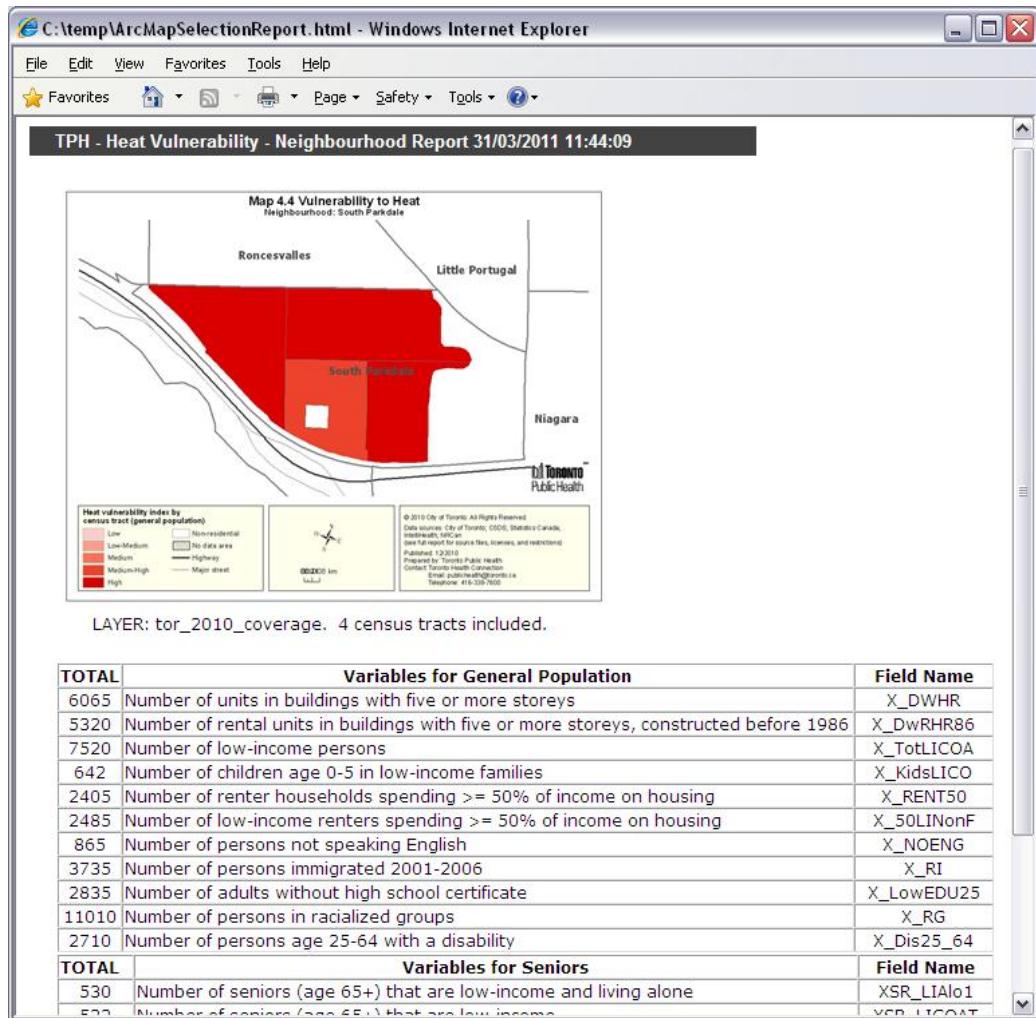
**Fig. 9: Zoom to South Parkdale neighbourhood**

### 3.4 Generating a Report on the Census Tracts in South Parkdale

Click on the  **Generate Report** button to create the summary report containing the map and table for South Parkdale. You will be requested to supply the “Map Export Path”, “Report Export Path”, and “Report Title”. For now, leave the default for the first two requests, but change the title to something like “TPH South Parkdale Summary Report” – with the automated date and time left as they appear, and click OK. An Internet Explorer browser window will then open containing the summary report, which should appear much like Figure 10, below.

The report reproduces the map page layout as it appears in ArcMap, reports that there are four Census tracts included in the South Parkdale neighbourhood, and the table provides count data totalled up for those four Census tracts for each of the 18 reporting variables. To compare the tabulated data with City-wide totals and neighbourhood averages and medians, refer to the neighbourhood reference table in Appendix A.

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**Fig. 10: South Parkdale summary report**

### 3.5 Saving the Generated Report

If you wish to save the report for future usage, use the Internet Explorer menu “File->Save as” to save it in your own directory under a new name, such as:

..../username/My Documents/Report-SouthParkdale.mht

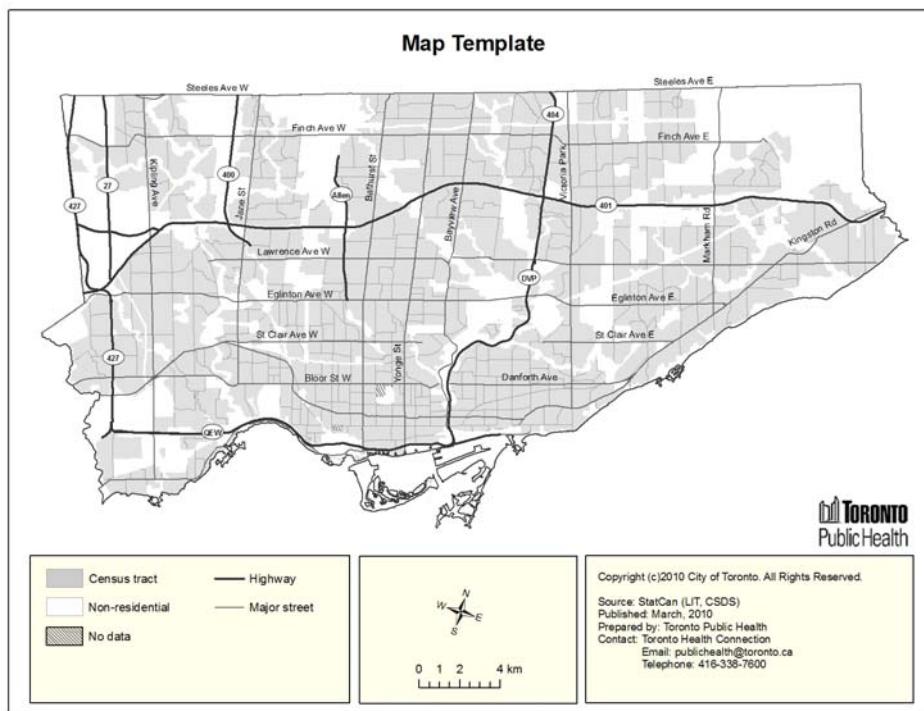
It is recommended to save it as a Web archive single file (\*.mht file), but it may also be saved as a complete Web page (.htm file with named directory attached), but not as a Web page (HTML only.) This will ensure that the map image is saved along with the report. These files may then be opened in the browser of your choice (Firefox, Chrome, etc.), while the automatic opening of the report upon generating is currently limited to Internet Explorer. Various utilities are available to convert the Web page into more portable file formats such as PDF for printing or digital sharing.

## 4. Cartographic Design and Map Layout

This section describes the project's cartographic design principles and the map layout, in which the decision support maps are provided. This information is reported for those users who may wish to modify the existing maps.

### 4.1 Map Template and General Mapping Principles

Fig. 11 shows the ArcMap template used for thematic mapping of exposure and sensitivity indicators as well as composite heat vulnerability indices. The Universal Transverse Mercator (UTM) Zone 17N projection was applied to all maps in this report. Note that the orientation of the map has been rotated by -16° according to City of Toronto mapping guidelines.



**Fig. 11: Template for decision support maps**

Highways and selected major streets are provided for orientation. Stakeholders suggested displaying more street names, linking the maps to postal codes, and adding railroad lines for orientation. However, this information would affect the legibility of the thematic symbols and therefore should not be included at this time. In an interactive desktop or online tool, the suggested layers could be included and the decision to display them left with the end-user. A layer with non-residential areas was used when mapping population, dwellings, and some exposure variables. Areas with “no data” are displayed with a distinctive line hatch pattern.

It is important to note that the legends for all decision support maps were customized. Therefore, the legends are not connected to the map layers. If a layer's symbology or underlying data change, new legend items for this layer need to be created and arranged manually.

The thematic maps were numbered according to the components of the conceptual framework for the heat vulnerability assessment:

1. Maps of exposure indicators
2. Maps of sensitivity indicators
  - 2.1. General population sensitivity
  - 2.2. Seniors sensitivity
3. Adaptation and context maps (transparencies/overlays)
4. Maps of potential vulnerability (composite indices)
5. Coverage maps (count symbol overlays)
  - 5.1. Overlay of exposure counts
  - 5.2. Overlay of general population sensitivity counts
  - 5.3. Overlay of seniors' sensitivity counts

## 4.2 Thematic Colour Scheme and Classification Method

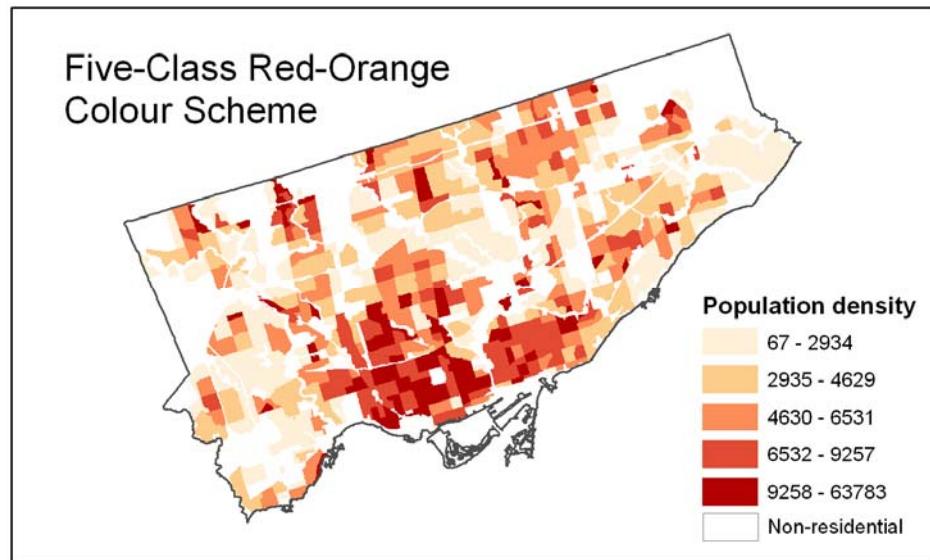
The decision support maps were designed as choropleth maps, where shades of colour fill the polygons representing enumeration units, i.e. Census tracts. Lightness is the primary visual variable that determines the effectiveness of a choropleth map. The logical progression of values along the number line should be matched with a progression of lightness levels. A sequential colour scheme with a logical progression from light to dark in a given colour hue (e.g. red) also enables greyscale printing and photocopying of colour maps, as requested by hot weather response plan stakeholders. Subordinate changes in colour hue and saturation can further support a map's effectiveness.

Following the above guidelines, the advice from some stakeholders to use a diverging colour scheme with two hues, e.g. blue and red, could not be heeded. Similarly light or dark shades of the two hues could not be distinguished in greyscale print, requiring separate map series to be produced for greyscale printing. In addition, neighbourhoods shown in blue or green for lower temperatures and lower vulnerability levels could be misinterpreted as being cool or not vulnerable at all, due to typical associations with these colours.

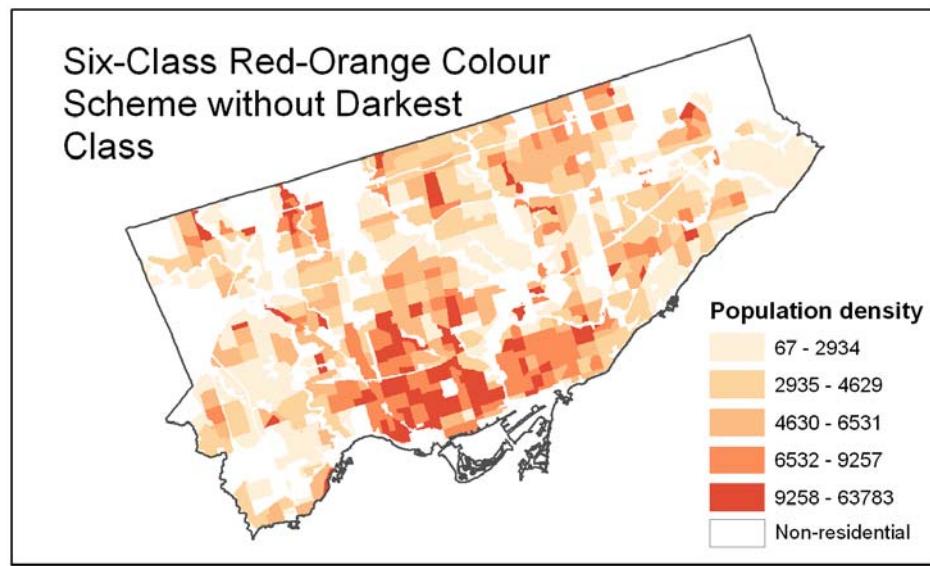
To avoid stigmatization of high-risk neighbourhoods, Toronto Public Health requested the consideration of colour hues other than red for the most vulnerable areas. An online tool, ColorBrewer (<http://www.colorbrewer2.org>) that guides map authors in selecting appropriate colour schemes for thematic mapping, was used to determine suitable colour schemes. The tool considers the number of data classes, the nature of the data being mapped (qualitative vs. quantitative; bi-polar), and the intended display environment for the map (i.e. print, photocopy, projection) in recommending suitable colour schemes. ColorBrewer also provides the numerical specifications for the selected scheme in RGB, CMYK, and HEX for users to import into commercial GIS software.

Generally, red or orange were identified as the best colours to map exposure, sensitivity and potential vulnerability due to their association with heat. Blue and green tones were dismissed because of their association with coolness, and the need to use the darker, more intense end of the colour scheme for the areas of greater interest, i.e. the most vulnerable areas. A blue-purple and a purple-red colour scheme from ColorBrewer were explored, but found to be not

photocopy friendly. Three red or orange colour schemes were tested in more detail to determine the best scheme for the decision support maps.



**Fig. 12:** Five-class sequential red-orange colour scheme from ColorBrewer



**Fig. 13:** Six-class sequential red-orange colour scheme from ColorBrewer without the darkest class

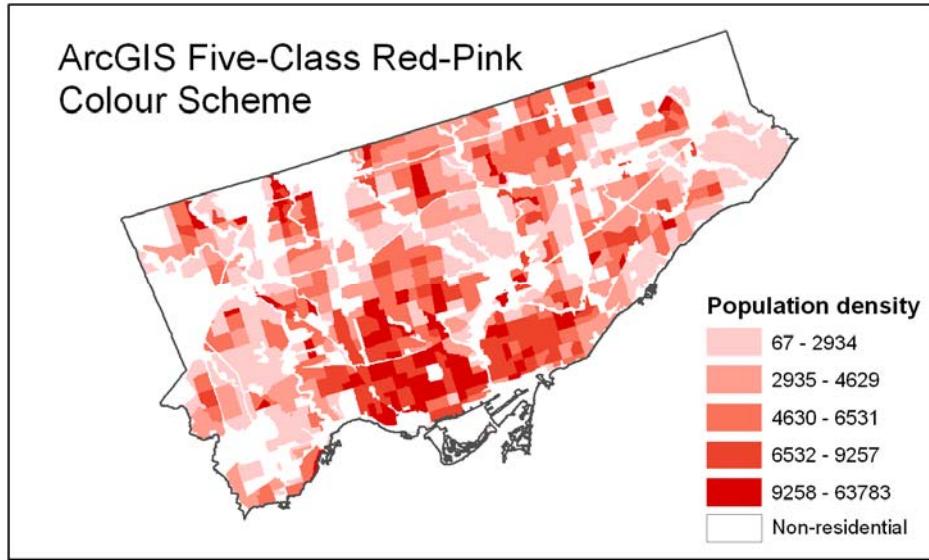


Fig. 14: Five-class sequential red-pink colour scheme from ArcMap 9.3

The selection of a colour scheme was ultimately based on visual separability between data classes and the ability to easily distinguish map overlays. The five-class sequential red-pink colour scheme from ArcMap 9.3 (Fig. 14) was selected because it produced the best results on a computer monitor and in print. In the five-class sequential red-orange colour scheme from ColorBrewer (Fig. 12), the lightest colour was too similar to the white depicting non-residential areas. In the six-class sequential red-orange scheme from ColorBrewer, from which the five lightest classes were considered (Fig. 13), the second and third lightest colours were difficult to distinguish on a computer monitor and in print. Another experiment was made by using a green colour scheme for variables related to green space (while keeping the red-pink scheme for all other variables). However, for consistency among the maps, it was decided to use the red colour scheme on all maps, and to always use dark red for high-risk values in any variable.

Indicators and indices were classified for mapping using the quintiles classification method, which separates the data values into five classes of the same number of objects (Census tracts). Some stakeholders suggested simplifying the information on the vulnerability maps by including only three classes, and assigning actions (recommended interventions) to each of them. Cartographically, a number of 5-7 classes is generally recommended. It would also be difficult to assign a specific action to each class because the same maps may be used by stakeholders with very different mandates and resources, e.g. a community health centre on the one hand, and Toronto Public Health on the other. However, Toronto Public Health could develop guidelines on how to use the maps to support hot weather response.

For the coverage maps, counts of at-risk population groups were mapped using proportional symbols. The Census tracts with the highest counts were mapped in order to identify large

counts of at-risk groups that fall inside or outside of high-vulnerability census tracts. The cut-off point for mapping counts was set at 50% of the total count of the at-risk population (when the total count mapped equalled 50% of the total count, no further Census tract counts were mapped). In this way only the census tracts with the largest number of the at-risk groups are included. This approach shows if large numbers of particular at-risk groups fall outside of the identified high-vulnerability census tracts so that strategies targeted to this group can also include these areas. Raw-count variables must never be mapped using choropleths, but proportional symbols are an appropriate representation technique that is independent of the size of enumeration units. Circles were chosen as the symbols, since they are neutral and generally fit well into corresponding polygon areas (Census tracts). Hollow circles are recommended because they keep the underlying vulnerability index legible. The circles were classified into quintiles and overlaid on top of the choropleth map layer with the potential vulnerability index values. Ranges of circle sizes were described in the map legend.

## 5. Implementation of the Decision Support Functionality

The Heat Vulnerability Mapping Tool is implemented in Visual Basic for Applications (VBA). The VBA program code is included in each of the decision support maps (\*.mxd files). The implementation also required the addition of the zoom neighbourhood boundaries and the adaptation and context overlay datasets in each map document.

**Tip:**

The decision support maps should be installed in a read-only directory, so that upon closing, they will revert to the startup settings. If you wish to save a revised map, for example, zoomed to a certain area, you should do so in a personal directory. In this way, the Heat Vulnerability Mapping Tool is maintained in its original working state for your future usage, or for other users.

## 6. Appendix A – Reference Tables

<b>Variable</b>	<b>City</b>	<b>Neighbourhoods</b>	
Description	Total	Average	Median
Units in buildings with 5+ storeys	377475	2696	1915
Rented units in buildings with 5+ storeys constructed before 1986	218760	1563	1093
Low income persons (2005, after tax LICO)	475563	3397	2664
Children age 0-5 in low-income families	50530	361	226
Renter households spending >= 50% of income on housing	100545	718	628
Low-income renters spending >= 50% of income on housing	100665	719	608
Persons not speaking English	132105	944	650
Persons immigrated 2001-2006	266810	1906	1533
Adults without high school certificate	310795	2220	1848
Persons in racialized groups	1158545	8275	5760
Persons age 25-64 with a disability	230500	1646	1400
Low income and living alone among seniors (age 65+)	39220	280	248
Low income among seniors (age 65+)	40599	290	244
Senior families spending >= 30% on housing	27095	194	165
Unattached seniors spending >= 30% on housing	50265	359	300
Seniors not speaking English	53470	382	240
Unattached seniors with a disability	54695	391	343
Seniors age 65-74 with a disability	74135	530	470

<b>Variable</b>	<b>City</b>	<b>Wards</b>	
Description	Total	Average	Median
Units in buildings with 5+ storeys	377475	8206	7705
Rented units in buildings with 5+ storeys constructed before 1986	218760	4756	4443
Low income persons (2005, after tax LICO)	475563	10338	11343
Children age 0-5 in low-income families	50530	1098	988
Renter households spending >= 50% of income on housing	100545	2186	1960
Low-income renters spending >= 50% of income on housing	100665	2188	1930
Persons not speaking English	132105	2872	2575
Persons immigrated 2001-2006	266810	5800	5110
Adults without high school certificate	310795	6756	6613
Persons in racialized groups	1158545	25186	23258
Persons age 25-64 with a disability	230500	5011	5115
Low income and living alone among seniors (age 65+)	39220	853	838
Low income among seniors (age 65+)	40599	883	844
Senior families spending >= 30% on housing	27095	589	545
Unattached seniors spending >= 30% on housing	50265	1093	1065
Seniors not speaking English	53470	1162	968
Unattached seniors with a disability	54695	1189	1198
Seniors age 65-74 with a disability	74135	1612	1693

## Map-Based Heat Vulnerability Assessment

<b>Variable</b>	<b>City</b>	<b>Postcode Regions</b>	
Description	Total	Average	Median
Units in buildings with 5+ storeys	377475	26963	25168
Rented units in buildings with 5+ storeys constructed before 1986	218760	15626	13530
Low income persons (2005, after tax LICO)	475563	33969	29787
Children age 0-5 in low-income families	50530	3609	3498
Renter households spending >= 50% of income on housing	100545	7182	5840
Low-income renters spending >= 50% of income on housing	100665	7190	6103
Persons not speaking English	132105	9436	9048
Persons immigrated 2001-2006	266810	19058	16198
Adults without high school certificate	310795	22200	20300
Persons in racialized groups	1158545	82753	75515
Persons age 25-64 with a disability	230500	16464	14153
Low income and living alone among seniors (age 65+)	39220	2801	2628
Low income among seniors (age 65+)	40599	2900	2669
Senior families spending >= 30% on housing	27095	1935	1635
Unattached seniors spending >= 30% on housing	50265	3590	3588
Seniors not speaking English	53470	3819	3638
Unattached seniors with a disability	54695	3907	3803
Seniors age 65-74 with a disability	74135	5295	5280

<b>Variable</b>	<b>Priority Areas</b>		
Description	Total	Average	Median
Units in buildings with 5+ storeys	79745	6134	5660
Rented units in buildings with 5+ storeys constructed before 1986	47335	3641	3265
Low income persons (2005, after tax LICO)	115570	8890	7490
Children age 0-5 in low-income families	16230	1248	1280
Renter households spending >= 50% of income on housing	17075	1313	1310
Low-income renters spending >= 50% of income on housing	17470	1344	1250
Persons not speaking English	33825	2602	1705
Persons immigrated 2001-2006	69590	5353	4580
Adults without high school certificate	74425	5725	4905
Persons in racialized groups	319995	24615	18580
Persons age 25-64 with a disability	47210	3632	2890
Low income and living alone among seniors (age 65+)	8055	620	580
Low income among seniors (age 65+)	8988	691	637
Senior families spending >= 30% on housing	6185	476	450
Unattached seniors spending >= 30% on housing	9390	722	640
Seniors not speaking English	13010	1001	685
Unattached seniors with a disability	9465	728	730
Seniors age 65-74 with a disability	15700	1208	1070