Crime and Justice Research Paper Series

Neighbourhood characteristics and the distribution of crime in Winnipeg

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Robin Fitzgerald, Michael Wisener and Josée Savoie, *Statistics Canada*

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Abstract

This research paper explores the spatial distribution of crime and various social, economic and physical neighbourhood characteristics in the City of Winnipeg. Analysis is based on police-reported crime data from the 2001 Incident-based Uniform Crime Reporting Survey (UCR2), the 2001 Census of Population, and City of Winnipeg land-use data.

In general, results support previous research suggesting that crime is not randomly distributed within cities, but is associated with the distribution of other factors related to the population and land-uses of the city. In particular, crime in Winnipeg in 2001 was concentrated in the city centre, representing a relatively small proportion of the total geographic area of the city.

Results point to significant differences in the characteristics of high- and low-crime neighbourhoods. For instance, high-crime neighbourhoods were characterized by reduced access to socio-economic resources, decreased residential stability, increased population density and land-use patterns that may increase opportunity for crime.

After taking into account all other factors, the level of socio-economic disadvantage of the residential population in a neighbourhood was most strongly associated with the highest neighbourhood rates of both violent and property crime.

Background

This demonstration study represents Statistics Canada's first examination of crime data using Geographic Information System (GIS) technology. The study, funded by the National Crime Prevention Centre at Public Safety and Emergency Preparedness Canada, examines crime patterns in the City of Winnipeg in 2001. Results lend support to the notion that crime is not randomly distributed within cities but is associated with the distribution of other factors related to the population and land-uses of the city.

A recognition that crime is not evenly dispersed across cities, but is often concentrated within particular areas has been the focus of ecological studies of crime since the 1940s. Using data from the 2001 Census of Population, the 2001 Incident-based Uniform Crime Reporting Survey (UCR2) and City of Winnipeg zoning data, this study describes and explains spatial patterns of crime using social, economic and physical neighbourhood characteristics. Questions addressed include: How are police-reported crimes distributed across city neighbourhoods? Is the rate of crime in a neighbourhood associated with factors that are specific to that neighbourhood such as particular population, housing, land-use or socio-economic characteristics?

The study addresses these questions through a combination of statistical analyses and maps. Crime maps are important tools for the development and implementation of crime reduction strategies, and are used in this report to provide a visual representation of areas of concentrated crime and characteristics related to that concentration.

It should be kept in mind that this study makes use of police-reported data, which provides one particular view of the nature and extent of crime. Specifically, police-reported data measure only those crimes that are known to the police. Many factors can influence the police-reported crime rate, including the willingness of the public to report crimes to the police; reporting by police to the UCR Survey; and changes in legislation, policies or enforcement practices.

According to the 1999 General Social Survey (GSS) on Victimization, 59% of incidents at the national level in Canada were not reported to the police (Besserer and Trainor 2000). While population-based surveys such as the GSS collect information directly from individuals about their experiences of criminal victimization regardless of whether the crime was reported to the police, these data are currently not available at the urban and sub-urban levels in Canada.

The Census of Population is conducted by Statistics Canada every 5 years, and most recently in 2001. In order to achieve the highest degree of compatibility between neighbourhood characteristics derived from the Census and crime information, this study is based on police and Census data from the year 2001.

The focus of this study is to examine factors related to the geographic location of reported criminal incidents, and does not address issues related to the residential location of either offenders or victims. Consequently, conclusions cannot be drawn about the connection between the location of criminal incidents and the residences of either accused individuals or victims.

How is this report organized?

There are four parts in this report. The first part provides a description of the data sources, variables and methods used for analyzing spatial data. The results of the analysis are presented in the second part, and part three presents a discussion of the major findings and some of the limitations of this demonstration study. Finally, the fourth part of the report includes appendices providing greater detail of the distribution of specific crimes, and selected crime and census data for the highest-need neighbourhoods in Winnipeg.

Methodology

Data sources

The Incident-based Uniform Crime Reporting Survey (UCR2)

The incident-based UCR2 survey captures detailed information on individual criminal incidents reported to police, including characteristics of victims, accused persons and incidents. The Winnipeg Police Service has been reporting to the UCR2 since 2000.

The UCR2 Survey allows for a maximum of four offences committed during the same criminal incident to be recorded in the data base. The selected offences are classified according to their level of seriousness, which is related to the maximum sentence that can be imposed under the *Criminal Code.*

Analyses of broad offence categories (e.g., total offences against the person, total property offences, total drug-related offences and total other *Criminal Code* offences) undertaken in this study are based on the most serious offence in each incident. This coincides with the crime rates published annually by the CCJS, which are based on the most serious offence in each police-reported incident. In classifying offences this way, a higher priority is given to violent offences than to non-violent offences. As a result, less serious offences may be under-represented when only the most serious offence is considered.

The majority of analyses undertaken in this study are based on broad categories of crime such as violent and property crime, which are based on a count of the most serious offence. However, in some analyses individual offence types are examined. In these cases, all incidents in which the offence was reported are included. For example, Table 1 provides information on selected individual offence types including theft under $5,000, theft over $5,000, car theft, shoplifting, break and enter, drug offences, mischief, arson, prostitution, robbery, common assault, sexual assault, homicide and serious assault. For these specific offence types, all incidents in which the offence was reported are included, regardless of the seriousness of the ranking given to the offence in the incident. This method provides a more complete representation of the distribution of individual offence types.

This study includes most *Criminal Code* offences, but excludes offences under other Federal, Provincial and Municipal statutes with the exception of the *Controlled Drug and Substances Act.* Also excluded are *Criminal Code* offences for which there is either no expected pattern of spatial distribution or a lack of information about the actual location of the offence. For example, administrative offences including bail violation, failure to appear and breach of probation are typically reported at court locations; threatening or harassing phone calls are often reported at the receiving end of the call; and impaired driving offences may be more likely to

be related to the location of apprehension (for example, apprehensions resulting from road-side stop programs). In total, roughly 7,000 offences were excluded.

The Census of Population

On May 15, 2001, Statistics Canada conducted the Census of Population to develop a statistical portrait of Canada and its people. The Census of Population provides the population and dwelling counts not only for Canada but also for each province and territory, and for smaller geographic units such as cities or districts within cities. The Census also provides information about Canada's demographic, social and economic characteristics.

The detailed socio-economic data used in this study is derived from the long form of the Census, which is based on a 20% sample of households. These data exclude the institutional population, which includes individuals living in hospitals, nursing homes, prisons and other institutions.

City of Winnipeg Zoning Data

Zoning data from the City of Winnipeg's Planning, Property and Development Department were used to calculate the proportion of the area within neighbourhoods designated as either commercial, multiple-family residential or single-family residential land-use zones. Individual zoning parcels defined by City by-laws[1] were aggregated to the neighbourhood level in order to calculate proportions.

Zoning data were also included for parcels in the downtown core. In these areas in particular, zoning types were frequently overlapping such that the same parcel of land could be zoned as commercial and residential (e.g., multiple-family) in cases where buildings served mixed purposes. Since historical data are not available, the zoning data used in this study are based on current (2003-04) information from the City of Winnipeg.

Description of variables

Crime variables

While selected individual offence types are displayed in tables and maps, analyses exploring the relationship between crime and neighbourhood characteristics are limited to the broad offence categories of violent and property crime to maximize the number of incidents being considered.

For this report, rates of both violent and property crime are calculated based on the "population at risk" rather than the residential population alone (see **Text Box 2** for an explanation of this calculation). Violent crime includes homicide, attempted murder, sexual assault, assault, violations resulting in the deprivation of freedom, robbery, extortion, criminal harassment, explosives causing death or bodily harm, uttering threats and other violent violation. Property crime includes arson, break and enter, theft under $5,000, theft $5,000 and over, possessing stolen goods, fraud and mischief.

2001 Census of Population variables

Socio-economic disadvantage variables

Socio-economic disadvantage was derived from the set of five variables listed below. Boyle and Lipman (2002) found this composite variable to be linked to delinquent or problem behaviour in a Canadian sample of children and youth. Moreover, inequality of socio-economic resources across US cities has been demonstrated to be strongly associated with the spatial distribution of crime (Morenoff, Sampson and Raudenbush 2001).

Based on the approach taken by Boyle and Lipman (2002), the five socio-economic disadvantage variables were standardized to have a mean of 0 and a standard deviation of 1 (z-score). The Disadvantage Score was calculated by taking an unweighted average of the five standardized variables. The variables are highly correlated and yield an Alpha coefficient of 0.81 which reflects a high degree of internal consistency between the variables, and suggests that the variables successfully measure the same concept.

- Percent of population receiving government transfer payments including Employment Insurance; Old Age Security including Guaranteed Income Supplement and Spousal Allowance; Net Federal Supplements; Canada and Quebec Pension Plan benefits; Child Tax Benefit; New Brunswick, Quebec, Alberta and British Columbia Family Allowance; Goods and Services Tax Credit; Workers' Compensation; Social Assistance; and provincial/territorial Refundable Tax Credits.

- Percent of neighbourhood population aged 20 years and older without a secondary school certificate.

- Percent of neighbourhood population in private households with low income in 2000. Low income refers to private households who spend 20% more of their disposable income than the average private household on food, shelter and clothing. Statistics Canada's low-income cut-offs (LICOs) are income thresholds that vary according to family and community size. Although LICOs are often referred to as poverty lines, they have no official status as such.

- Neighbourhood unemployment rate for population aged 15 and older participating in the labour force.

- Median household income in $1,000s or the dollar amount above and below which half the cases fall, the 50th percentile.

Population characteristic variables

- Males aged 15-24 years as a percentage of the total neighbourhood population. This age group represents the highest risk age group for offending (see Figure 2). In Winnipeg in 2001 about 35% of all identified accused were males aged 15-24 years who were responsible for 26% of reported violent offences and 43% of property crimes.

- Percent of neighbourhood population aged 65 years and over. Results from the General Social Survey on Victimization suggest that Canadian rates of criminal victimization among the elderly are relatively low compared to the population as a whole, though they report feeling less safe (Besserer and Trainor 2000).

- Percentage of the neighbourhood population immigrating to Canada between 1991 and 2001. Initially, immigration may hinder integration into society; however this condition decreases with the length of residence in the country (Breton 2003). Recent immigrants may be more likely to face reduced social participation and consequently reduced social capital or the benefits gained from relationships within the community. Numerous studies have demonstrated links between reduced levels of social participation and increased levels of crime (Morenoff et al. 2001; Sampson, Raudenbush & Earls 1997; Sampson 1997).

- Percentage of Aboriginal identity population living in the neighbourhood. Included are those persons who reported identifying with at least one Aboriginal group, that is, "North American Indian", "Métis" or "Inuit (Eskimo)", and/or who reported being a Treaty Indian or a Registered Indian, as defined by the Indian Act of Canada, and/or who reported they were members of an Indian Band or First Nation. The Aboriginal population in Canada is over represented with respect to victimization and offending. For instance, about 35% of Aboriginal people reported being the victim of at least one crime in 12 months preceding the 1999 General Social Survey on Victimization, in comparison to about 26% for non-Aboriginal people (Statistics Canada 2001a). In 1998-99 Aboriginal peoples aged 18 and over represented about 2% of the 18 and over population, but about 17% of admission to provincial/territorial custody and the same proportion to federal custody (Thomas 2000).

- Percentage of female lone-parent families among economic families living in private households.[2] Although the after-tax income of female lone-parent families is increasing in Canada, these families continue to be among the lowest earners (Statistics Canada 2001c), and consequently may be concentrated in more disadvantaged areas of the city. Additionally, an increase in labour force participation among female lone-parents from 65% in 1995 to 82% in 2001 may be tied to the notion of decreased guardianship or supervision in neighbourhoods, which has been associated with higher crime rates (Cohen and Felson 1979).

- Percentage of population in a neighbourhood living at another residence one year prior to the Census. Residential mobility has been associated with higher crime rates through reduced guardianship or social involvement that frequent movers exhibit. For instance, studies of American cities indicate that streets where neighbours knew each other or felt responsible for their community had significantly lower rates of violent crime than those where social interaction was lower (Block 1979; Sampson 1993).

Dwelling characteristic variables

- Percentage of dwellings built before 1961. In combination with other variables related to signs of physical decay within urban neighbourhoods the age of buildings may be associated with higher crime rates through a perception of increased physical disorder (Kelling & Coles 1998).

- Percentage of dwellings in need of major repairs. Refers to whether, in the judgement of the respondent, the dwelling requires any repairs (excluding desirable remodelling or additions). Major repairs refer to the repair of defective plumbing or electrical wiring, structural repairs to walls, floors or ceilings, etc. This variable may similarly be associated

with higher crime rates through the perception of increased physical disorder in the neighbourhood (Kelling & Coles 1998).

- Percentage of households spending more than 30% of total household income on shelter, including both owner-occupied and tenant occupied households. This is a measure of housing affordability. The 30% figure is based on research indicating that when the shelter costs of low income households exceed 30% of their incomes, their consumption of other life necessities is reduced. Shelter expenses include payments for electricity, oil, gas, coal, wood or other fuels, water and other municipal services, mortgage payments, property taxes, condominium fees and rent. Decreased housing affordability within a neighbourhood is another indicator of socio-economic disadvantage.

- Percentage of owner-occupied dwellings in the neighbourhood. Collective dwellings are excluded from both the numerator and denominator. Greater proportions of owner-occupied housing in a neighbourhood may increase residential stability, social involvement among neighbours and a collective commitment to the neighbourhood.

City land-use variables

- Commercial zoning – the proportion of square area within a neighbourhood zoned for commercial land-use. Types of land-use falling under commercial zoning include stores, supermarkets, discount stores, furniture stores, banks, hotels, beverage hotels (licensed off-sales beer vendors), motels, restaurants, service garages, service stations, auto dealers, car washes, residential/commercial split properties and commercial offices.

- Multiple-family residential zoning – the proportion of square area within a neighbourhood zoned for multiple-family, two-family (duplex) or transitional dwellings which include short- and longer-term subsidized housing for those in need.

- Single-family residential zoning – the proportion of square area within a neighbourhood zoned for single-family dwellings.

Methods

What is Geocoding?

Geocoding is the process of matching a particular address with a geographic location on the Earth's surface. In this study the address corresponds to the location of the incident reported to the police and aggregated to the *block-face* level, or to one side of a city block between two consecutive intersections. This is done through matching records in two databases, one containing a list of addresses, the other containing information about a street network and the address range within a given block. The geocoding tool will match the address with its unique position along the street network. Since the street network is *geo-referenced*, or located in geographic space with reference to a coordinate system, longitude and latitude values—or X and Y values—can be generated for each crime incident. X and Y values in the crime incident database provide the spatial component that allows for points to be mapped, relative to the street or neighbourhood in which they occurred.

While the UCR2 does not currently collect information on the geographic location of crime incidents, for the purposes of this study these data were provided by the Winnipeg Police Service (WPS) for each of the approximately 73,000 incidents reported in 2001.[3] The WPS collects the street address of each reported incident. This information was resolved by the WPS to a set of geographical coordinates (X and Y) for each address. These coordinates were rolled up to the mid-point of a *block-face*, and intersection data were compiled.

Mapping techniques

Two methods of displaying crime and other information are used in this study. First, data are displayed as a total for each NCA (see **Text Box 1** for NCA description), and second, the pattern of points (individual criminal incidents) is displayed across the City of Winnipeg to indicate the location of high density crime locations or "hot spots".

Text Box 1: Neighbourhood Characterization Areas

The 230 'neighbourhoods' in this study reflect Neighbourhood Characterization Areas (NCAs) (Map 1). The NCA boundaries were formally adopted in the 1980s by the Community Data Network (CDN), a consortium of government and non-government agencies in Winnipeg. The boundaries are based on the collective knowledge of many local agencies that helped to establish these and other geographies including the inner city.

Map 1

Neighbourhood characterization area (NCA) boundaries, Winnipeg, 2001

Winnipeg NCA

Downtown area
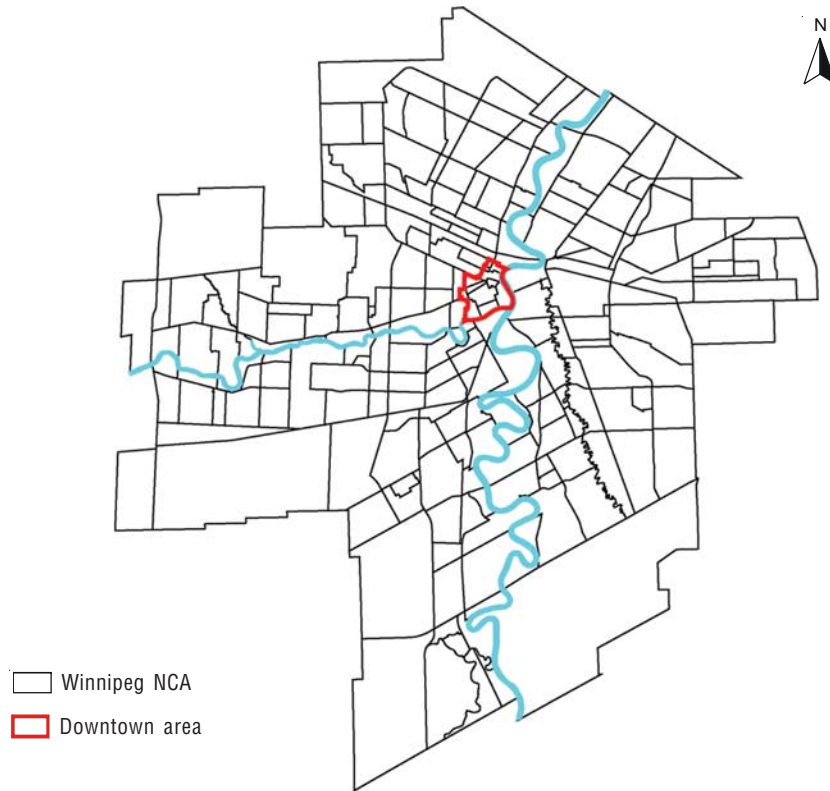
Boundaries were defined based on information about housing and existing neighbourhoods, natural conditions such as rivers and streams, transportation routes (rail lines and major roadways), and land usage (residential, commercial and industrial). NCAs are typically smaller and more demographically and socio-economically homogeneous than Statistics Canada's neighbourhood level geographies (i.e., Census Tracts) and more accurately match boundaries used by the City and other agencies to direct programs. The smaller size of the NCA units makes them a critical geography for many Winnipeg groups and they have effectively become the standard for assessing neighbourhood issues.

Map 2

A comparison of NCA and Census Tract boundaries, West Broadway and Armstrong Point, Winnipeg, 2001

Census Tract 15

West Broadway

Armstrong Point

Disadvantage by Winnipeg NCA

High

Low

Winnipeg NCA
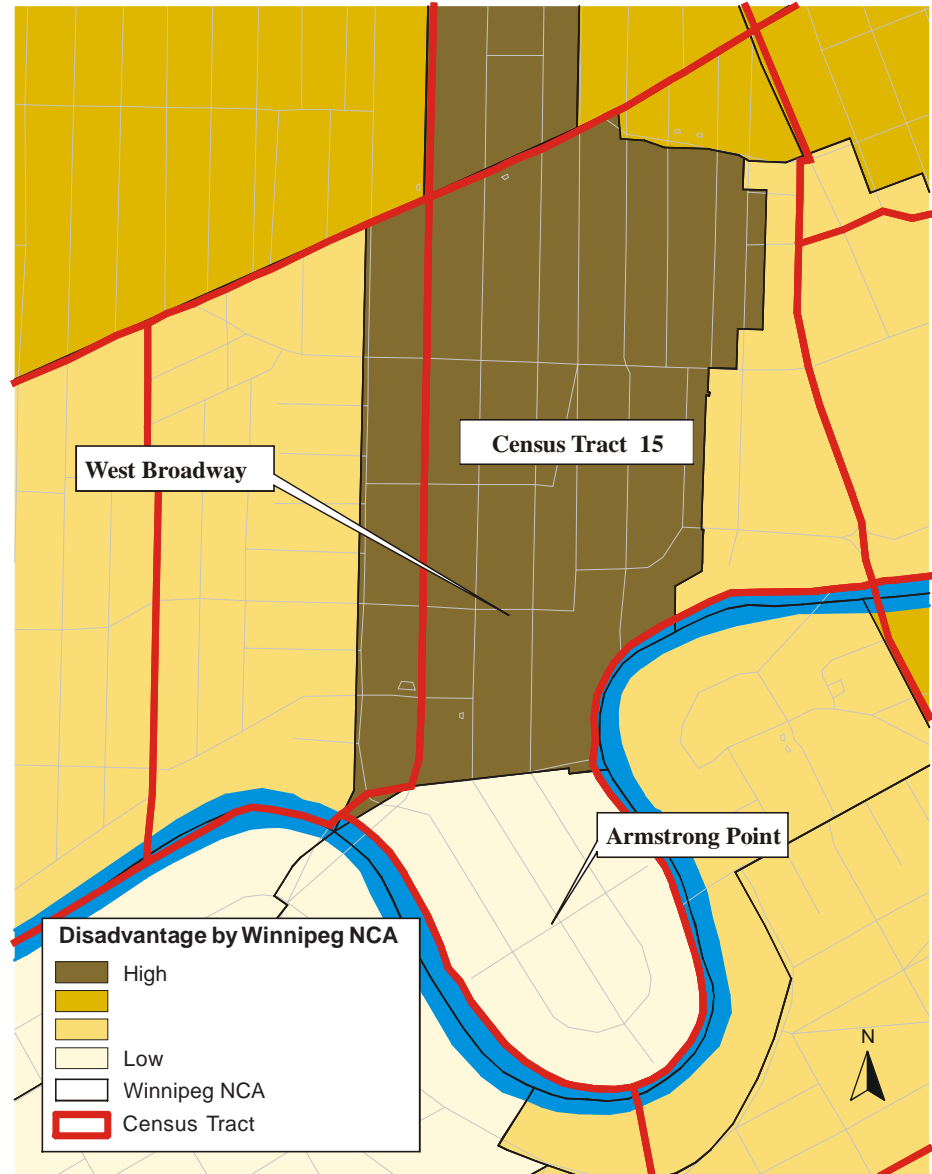
Census Tract

Source: Statistics Canada, 2001 Census.

The choice of neighbourhood boundaries can change the understanding of the distribution of neighbourhood characteristics. Map 2 shows the greater specificity of NCA boundaries than Census Tract boundaries. In this example, Census Tract 15 encompasses two NCAs, Armstrong Point and West Broadway, with different levels of socio-economic disadvantage.

Mapping NCAs

By combining the crime incident codes with an X and Y value, point distributions were generated for specific crime types, time of incidents, and other data from the UCR database. Using the Geographic Information System (GIS), point data were overlaid on top of NCAs. Crime incidents were then calculated as a total for each NCA.

Mapping "hot spots": Kernel analysis

Kernel analysis is an alternative method of making sense of the spatial distribution of crime data. The method makes it possible to examine crime incident point data across neighbourhood boundaries and to see natural distributions and the location of concentrations of incidents. The goal of kernel analysis is to estimate how the density of events varies across a study area based on a point pattern. Kernel estimation was originally developed to estimate probability density from a sample of observations (Bailey and Gatrell 1995). When applied to spatial data, kernel analysis creates a smooth map of density values in which the density at each location reflects the concentration of points in a given area.

In kernel estimation, a grid is overlaid on the study area. Distances are measured from the centre of a grid cell to each observation that falls within a predefined region of influence known as a bandwidth. The grid cell size for single kernel estimation in this study was about 110 meters squared. Each observation contributes to the density value of that grid cell based on its distance from the centre. Nearby observations are given more weight in the density calculation than those farther away.

The product of the kernel estimation method is a simple matrix of dots (raster image) displaying contours of varying density. Contour loops define the boundaries of hot spot areas. Hot spots may be irregular in shape, and they are not limited by neighbourhood or other boundaries. This method of analysis was applied using Environmental Systems Research Institute (ESRI) Spatial Analyst software.

The dual kernel method is also used in this study in order to examine the distribution of two variables simultaneously (for example crime and population at risk).[4] The dual kernel method was applied using CrimeStat 2.0 spatial statistics modelling software.

Findings

Winnipeg in context

In 2001, the Winnipeg Census Metropolitan Area (CMA), with a population of 671,274, ranked eighth in terms of size among the 25 CMAs in Canada.[5] The 2001 population was up 0.6% from 1996 (667,093), a rate of change that was similar to the average percentage change (0.7%) over the same period for the 25 CMAs. In 2001, the Winnipeg CMA represented approximately 60% of the population of the province of Manitoba.

The City of Winnipeg, which is the focus of this demonstration study, falls within the larger CMA boundary and covers approximately 475 square kilometres, with a perimeter of 130 kilometres encompassing 230 neighbourhoods or Neighbourhood Characterization Areas (see definition in **Text Box 1**). The population of the study area in 2001 was 610,455. The area is served entirely by the Winnipeg Police Service, which employed a force of 1,127 officers operating out of 6 police stations and 8 community-based policing service centres.

Zoning in Winnipeg is composed of roughly 19% single-family, 5.3% multiple-family and other types of residential; 3% commercial; 13% industrial; 7% parks and recreation areas; 35% agricultural and rural residential district; 0.5% downtown residential (primarily multiple-family); and 0.5% downtown non-residential (primarily commercial). This zoning accounts for roughly 83% of the 475 square kilometres within the study area boundary. The remaining 17% is associated with spaces such as street right of ways, rivers and other natural features.

Since the mid 1990's, the CMA of Winnipeg has reported crime rates among the highest in the country. In 2001, the CMA ranked 4th behind Regina, Saskatoon and Vancouver. Figure 1 compares Winnipeg's crime rate to the overall rate in Canada from 1991 to 2002. While both rates were generally declining in the 1990s, the drop was been less dramatic in Winnipeg, and beginning in 1999, Winnipeg experienced three years of increase prior to 2002.

Categories of offences considered in this study include: violent, property, drug, prostitution, offensive weapons, and gaming and betting offences. In 2001, the Winnipeg Police Service reported over 66,000 of these incidents, the vast majority of which were property crimes (83%), followed by violent (15%), and other offences (2%) including prostitution, drugs, offensive weapons and gaming and betting. These results are similar to the distribution of offences in Canada overall in 2001 (79%, 17% and 4%), as well as the results reported by other police services in the West including Calgary, Edmonton and Regina.

Figure 1

Crime rate Winnipeg and Canada, 1991 to 2002

Rate per 100,000 population[1]   Rate per 100,000 population[1]
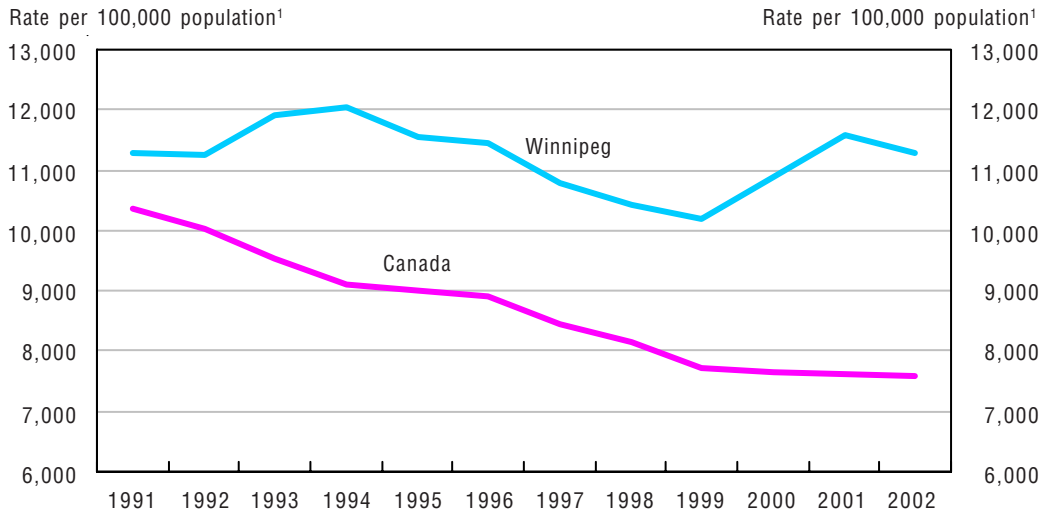
1. Rates based on count of total *Criminal Code* incidents excluding traffic offences.
Sources: Statistics Canada, 1991-2002 UCR; Statistics Canada, 2001 Census.

For about one-quarter or nearly 16,000 incidents one or more accused persons were identified. Among accused persons, most were adult males (57%), women accounted for 14%, with male (20%) and female (7%) youth aged 12-17 years, and children under the age of 12 (2%) accounting for the remainder. The peak offending years among accused identified by the police in Winnipeg were 15 to 19 (Figure 2) and this is similar to the peak ages overall in Canada.

Figure 2

Age distribution of accused, Winnipeg, 2001

Number of accused persons[1]

Number of accused persons[1]

Age of accused
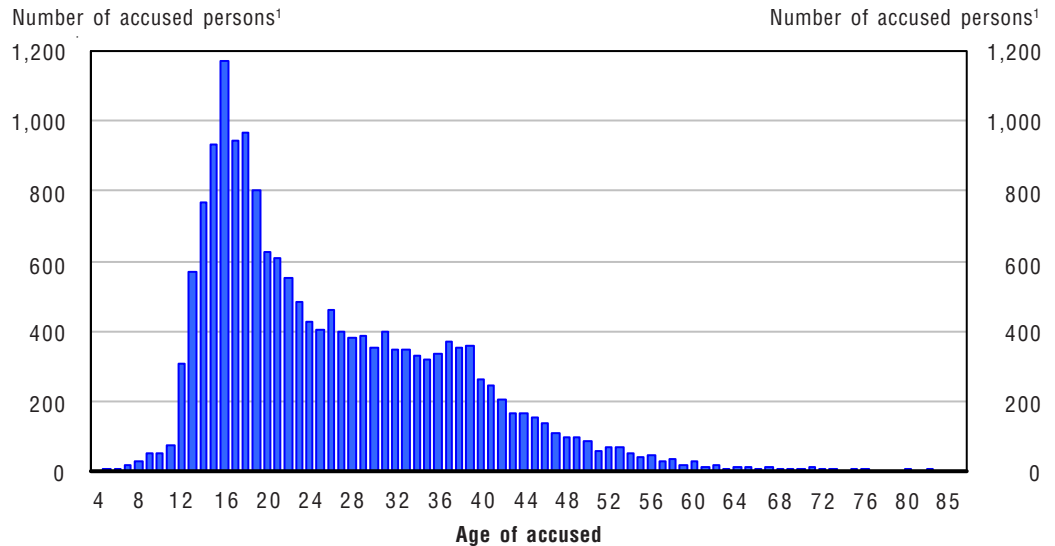
1. Based on 17,227 accused persons aged 4 to 87 years, about 16,000 incidents for which one or more accused persons were identified.

Source: *Statistics Canada, 2001 UCR2.*

How is crime distributed across Winnipeg neighbourhoods?

While reported incidents were located in 228 of the 230 NCAs, a closer look at the distribution of incidents reveals that reported crime is not evenly distributed across the city. Maps 3 and 4 show spatial distributions by NCAs for violent and property crimes, where dark blue represents the highest crime NCAs.[6] About 30% of reported violent crime incidents in 2001 occurred in 3% of NCAs, and 30% of reported property crime incidents occurred in 7% of NCAs.[7]

Map 3

Distribution of violent crime incidents by NCA, Winnipeg, 2001

Distribution
- 220 to 433
- 117 to 219
- 39 to 116
- 1 to 38
- Downtown Area
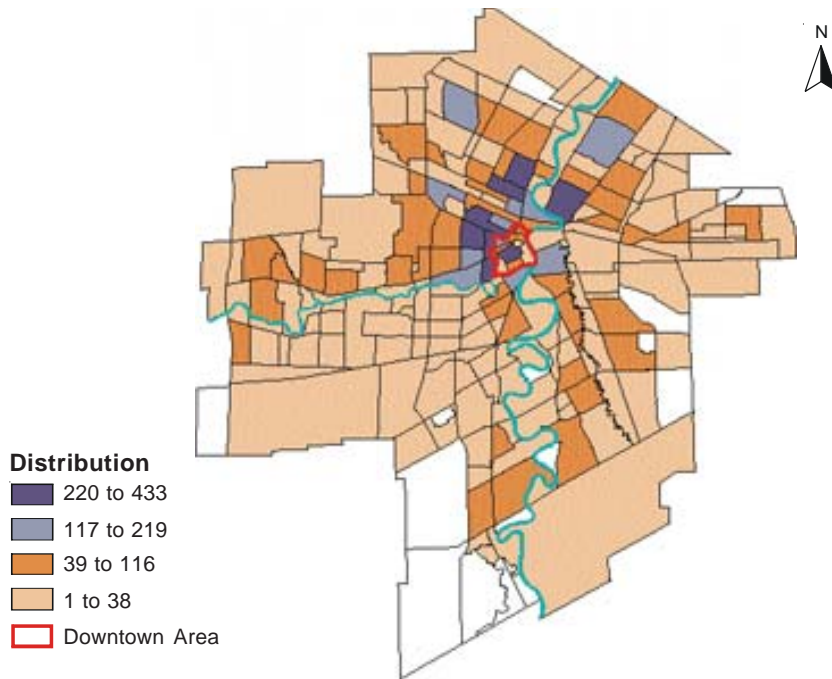
Based on 9,727 violent crime incidents.
Source: Statistics Canada, 2001 UCR2.

Map 4

Distribution of property crime incidents by NCA, Winnipeg, 2001

Distribution
- 706 to 1,334
- 360 to 705
- 138 to 359
- 1 to 137
- Downtown Area
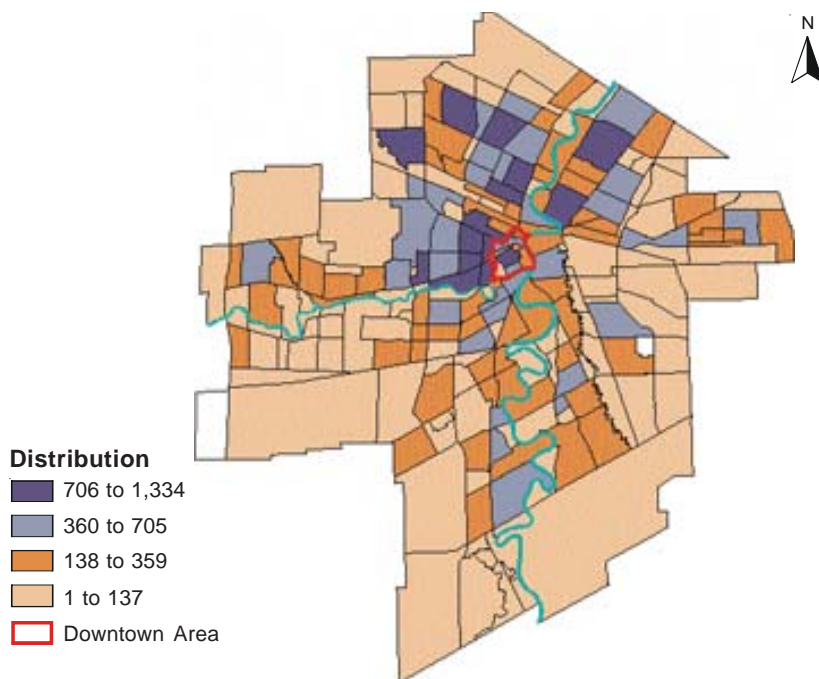
Based on 54,775 property crime incidents.
Source: Statistics Canada, 2001 UCR2.

The concentration of crime within cities in relatively few areas has been noted in other studies (Sherman, Gartin and Buerger 1989; Brantingham and Brantingham 1982). In Winnipeg, much of the reported crime in 2001 was clustered in neighbourhoods that are in the core and north of the core. One method of visualizing this is to examine the density of reported incidents per square kilometre. Map 5 displays densities within 2 kilometre concentric rings moving out from the geographic centre of the city. Roughly 1,100 incidents per square kilometre were reported in the core area indicated by the darkest colour. Moving out from the core, the density of reported incidents drops dramatically to 431, 259 and 151 incidents per square kilometre in each successive concentric ring.

Map 5

Concentration of incidents, density per square kilometre, Winnipeg, 2001
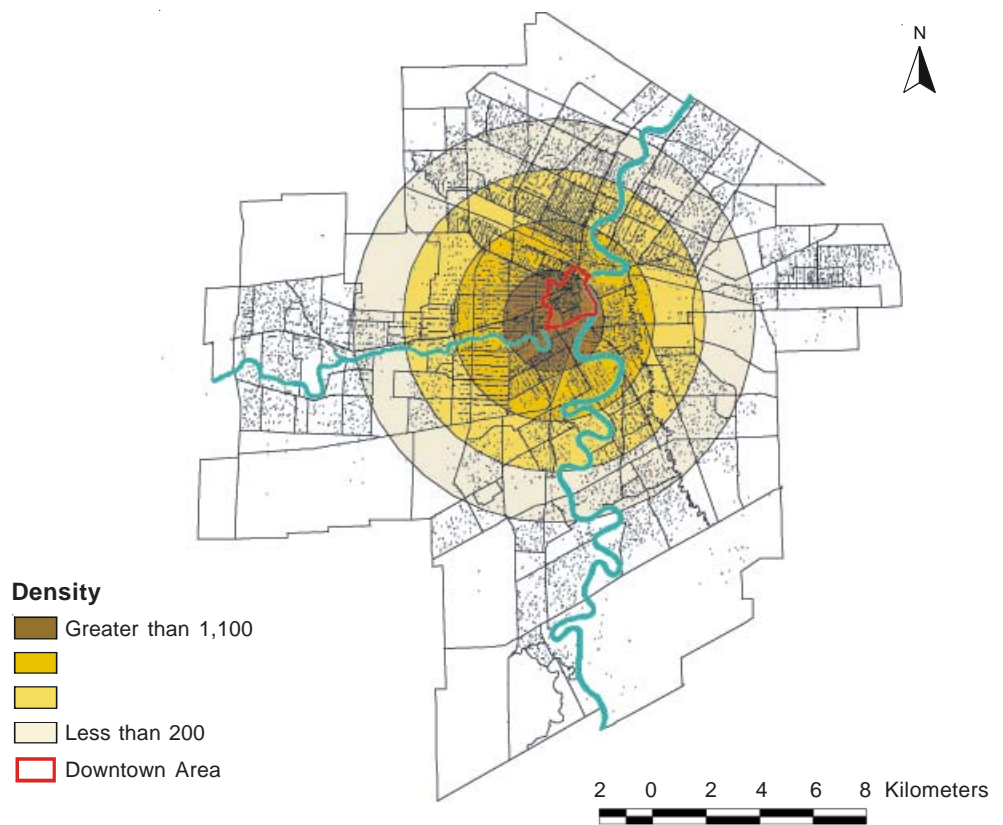
Based on 66,038 crime incidents.
Source: Statistics Canada, 2001 UCR2.

The location of clusters of violent and property incidents or "hot spots" (indicated by the darkest red colour) are displayed in Maps 6 and 7. The first map displays more clearly that those areas with the highest relative densities of violent crime are in the urban core and to the north. Although this is also true for property crime, there is a wider distribution of concentration spread further from the core. Hot spots outside of the city centre are located in major shopping areas of the city. Maps showing the location of hot spots within the City for selected individual offence types are shown in **Appendix A**.

Map 6

Kernel density distribution of violent crime incidents, Winnipeg, 2001
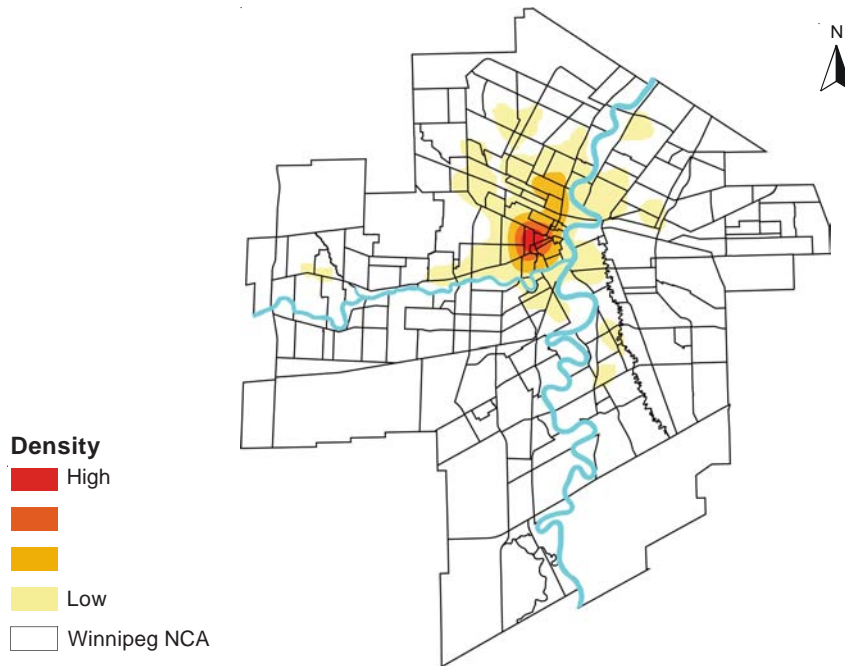
Based on 9,727 violent crime incidents.
Source: Statistics Canada, 2001 UCR2.

Map 7

Kernel density distribution of property crime incidents, Winnipeg, 2001
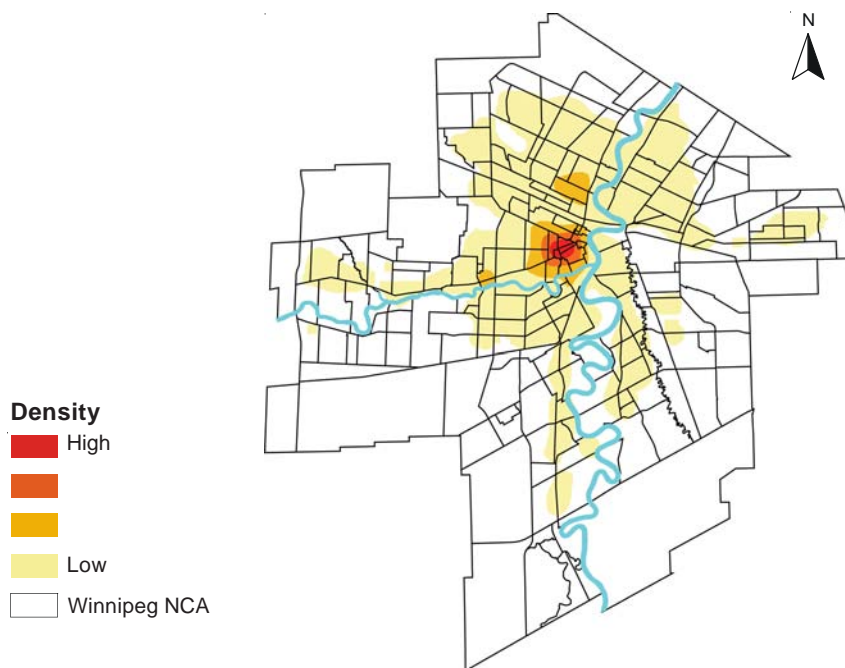
Based on 54,775 property crime incidents.
Source: Statistics Canada, 2001 UCR2.

Text Box 2: What is the population at risk? Calculating crime rates in small geographic areas

The typical approach to calculating crime rates is to look at the distribution of incidents per residential population in a given area. While this approach works well at a city, provincial or national level, difficulty arises when the spatial areas of interest are small, for example neighbourhoods, with correspondingly small residential populations.

The distribution of criminal incidents across urban areas is often concentrated in or near the city centre, where residential populations are relatively low, but where there are otherwise high concentrations of people either working or spending time in other ways. Rates based on residential population alone will artificially inflate the crime rates in these urban core neighbourhoods since the total population at risk in these areas has not been taken into account (See for example, Oberwittler, and Wiesenhütter. 2002.

While information about the true population at risk does not currently exist in any precise form, alternative approaches to calculating crime rates for small geographic areas have been proposed by Oberwittler (in press) and Wikstrom (1991). These include combining the residential population with different counts of population such as the number of people entering a given neighbourhood on public transit (Oberwittler in press) or the number of people working in a given neighbourhood (Wikstrom 1991). Rates based on these combined populations more closely approximate the total number of people at risk of experiencing crime. While it could be argued that these rates are more appropriate for understanding the distribution of violent crimes that require a victim, they may also serve as an improved measure for property crime since a count of residents and workers provides a better approximation of the numbers of dwellings and businesses that may be the targets of property crime.

Table 1 compares results for rates based on two different measures of the 'population at risk' in Winnipeg neighbourhoods which are used as the denominator in the calculation of rates: residential population alone and residential plus the employed labour force population.

1. Using the residential population for each NCA there are on average 148 incidents per 1,000 residents. At a minimum, neighbourhoods experience 15 incidents per 1,000 residents, whereas the highest rate is just less than 4,400 incidents per 1,000 residents. When only violent offences are considered, the highest rate was 235 incidents per 1,000 residents as compared to property offences alone where the highest rate was about 4,100 incidents per 1,000 residents.

2. The employed labour force population for each NCA is taken from the 2001 Census and refers to the number of people whose regular place of work is within the boundaries of the NCA. This figure was added to the residential population for each NCA to approximate the 'population at risk'. Based on this measure, the neighbourhood average decreases to about 70 incidents per 1,000 persons at risk, while the highest rate is 348. The highest rates for violent (88) and property crime (229) are also reduced.

To more accurately gauge risk of crime within NCAs, subsequent multivariate analyses in this paper will include crime rates based on the population at risk using residential and employed labour force combined.

Table 1

Count and rate of police-reported crime incidents in Winnipeg neighbourhoods, 2001

Offences	Count of incidents[1]				Rate of incidents per 1,000 residential population[2]			Rate of incidents per 1,000 residential and employed population[2]		
	Total all NCAs	NCA average	NCA minimum	NCA maximum	NCA average	NCA minimum	NCA maximum	NCA average	NCA minimum	NCA maximum
Total incidents[4]	66,038	287	0	1,821	148	15	4,379	72	14	348
Total violent incidents[4]	9,727	42	0	433	19	0	235	11	0	88
Total property incidents[4]	54,775	238	0	1,334	125	15	4,124	60	12	229
Drug incidents[4]	899	4	0	42	2	0	63	1	0	9
Other[3, 4]	637	3	0	105	1	0	28	1	0	22
Selected offences										
Arson[5]	494	2	0	36	1	0	10	1	0	5
Assault level 1[5]	4,429	19	0	194	8	0	103	5	0	40
B&E[5]	7,646	33	0	249	14	0	208	9	0	35
Car theft[5]	10,699	47	0	373	20	0	475	12	0	48
Drug incidents[5]	1,322	6	0	59	3	0	75	1	0	12
Homicide and assault 2 and 3[5]	1,773	8	0	105	4	0	55	2	0	19
Mischief[5]	17,323	75	0	531	38	0	1,160	19	0	79
Prostitution[5]	252	1	0	103	0	0	27	0	0	22
Robbery[5]	1,677	7	0	100	4	0	55	2	0	21
All sexual offences[5]	660	3	0	52	1	0	20	1	0	6
Shoplifting[5]	2,331	10	0	275	10	0	1,131	2	0	50
Theft under without car theft[5]	34,809	151	0	1,180	96	3	4,007	37	2	171
Theft over without car theft[5]	1,845	8	0	56	4	0	89	2	0	12

1. Total count based on 230 Neighbourhood Characterization Areas (NCAs).
2. Rate based on the 175 NCAs where the total residential population was over 250 people.
3. Includes Prostitution, Offensive Weapons, Gaming and Betting.
4. Includes most serious violation in each incident only.
5. Includes all recorded violations in each incident.

Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

Map 8 displays the combination of the distribution of property incidents and residential population alone; while Map 9 shows the combination of property incidents with the 'population at risk' which includes both the residential and employed populations in each NCA (see Text Box 2).[8] These maps point to important differences in the distribution of reported criminal activity across the City. In particular, when the broader measure of population at risk is used, the density distribution is widened to more areas beyond the city centre. This difference is even more evident when examining the distribution of violent crime (Maps 10 and 11).

Map 8

Kernel density distribution of property incidents and residential population, Winnipeg, 2001
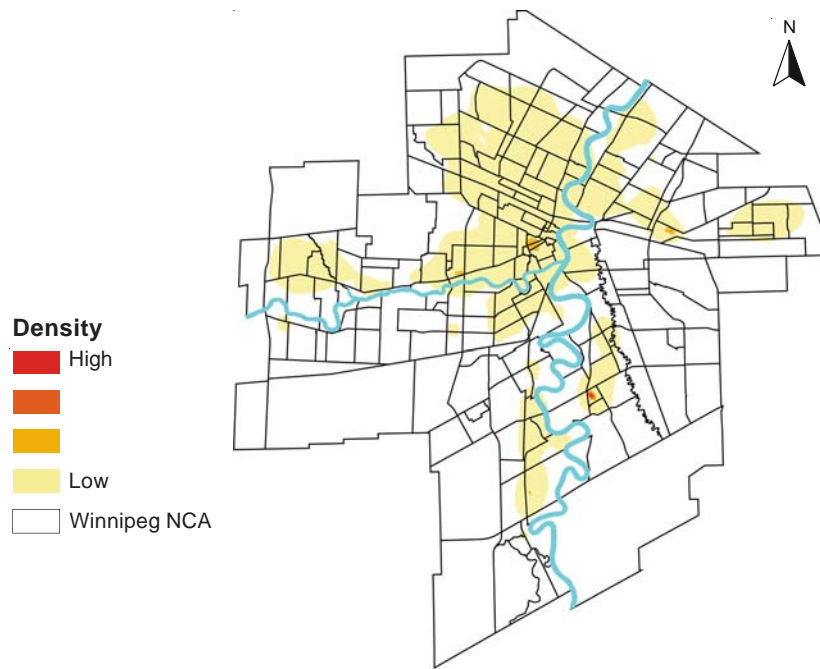
Based on 54,775 property crime incidents.
Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

Map 9

Kernel density distribution of property incidents and population at risk (combined residential and employed population), Winnipeg, 2001
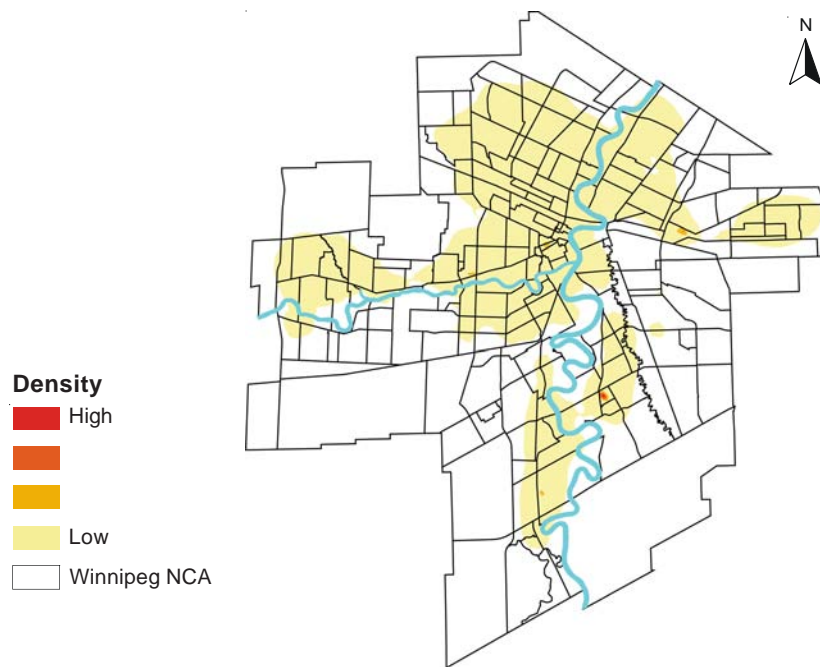
Based on 54,775 property crime incidents.
Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

Map 10

Kernel density distribution of violent incidents and residential population, Winnipeg, 2001

Based on 9,727 violent crime incidents.
Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

Map 11

Kernel density distribution of violent incidents and population at risk (combined residential and employed population), Winnipeg, 2001
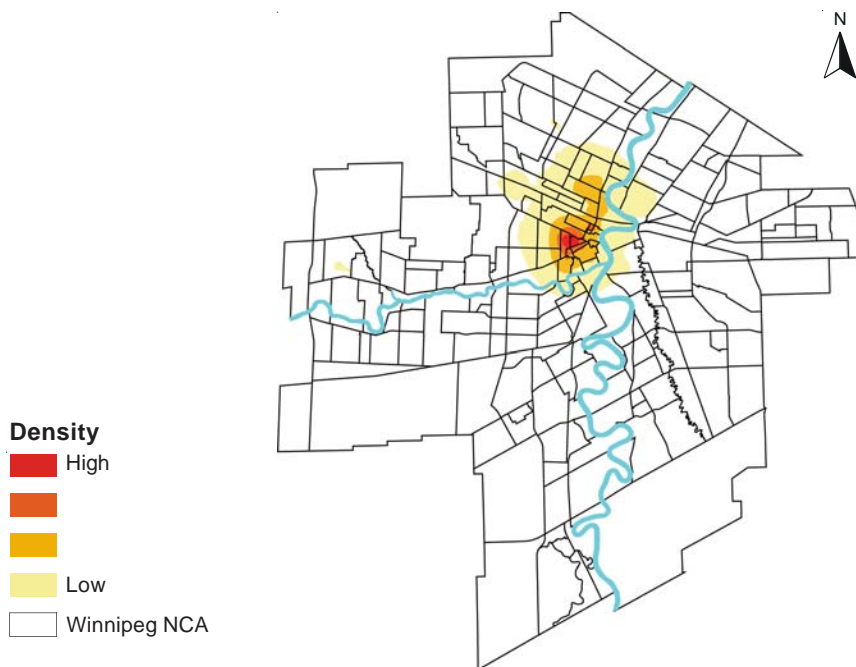
Based on 9,727 violent crime incidents.
Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

How does the spatial pattern of incidents change by time of day?

In combination with the location of crime, the time of occurrence is particularly important from the perspective of a crime reduction strategy. Although criminal incidents can occur at any time, research indicates that different types of crimes are concentrated at certain times of the day (Assuncao, Beato and Silva. 2002.

As an example, distributions of reported incidents of robbery by time of day for all reported incidents in 2001 are shown in Figure 3. Since criminal offences may occur over an extended period of time, the UCR2 survey collects both the reported starting time of the offence and the reported completion time. Columns in the figure below represent the reported completion time of the incidents. A pattern emerges for robbery offences with the fewest incidents occurring in the morning hours and the peak occurring in the evening before midnight.

Figure 3

Robbery incidents by time of day, Winnipeg, 2001[1]
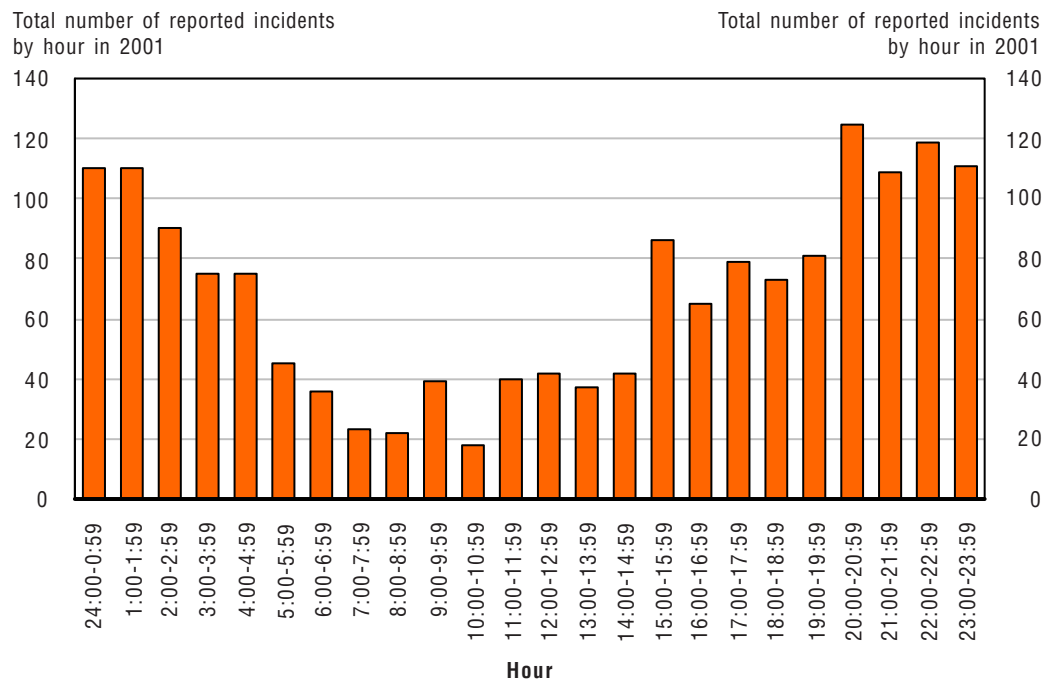
1. Includes 1,652 reported robbery incidents where the time of the incident was known.
Source: Statistics Canada, 2001 UCR2.

Maps 12 through 14 show the distribution of robbery incident hot spots at three points during the day: morning (7:00 to 9:00); evening (20:00 to 22:00) and night (1:00 to 3:00). In 2001, 4% of reported robberies occurred between 7:00 and 9:00 AM, 14% between 8:00 and 10:00 PM and 12% between 1:00 and 3:00 AM. The spatial distributions differ depending on the time of day, with variation in both the amount of crime and also in the location of the highest crime density areas or 'hot spots' identified by the darkest red colour.

Map 12

Kernel density distribution of morning robbery incidents, 7:00-9:00 AM, Winnipeg, 2001
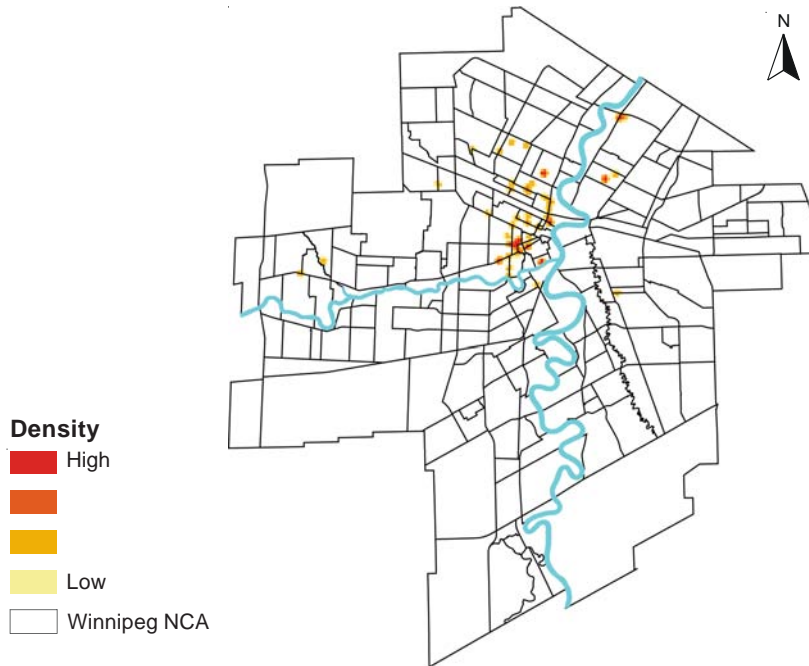
Based on 52 robbery incidents occurring from 7:00-9:00 AM in 2001.
Source: Statistics Canada, 2001 UCR2.

Map 13

Kernel density distribution of evening robbery incidents, 8:00-10:00 PM, Winnipeg, 2001
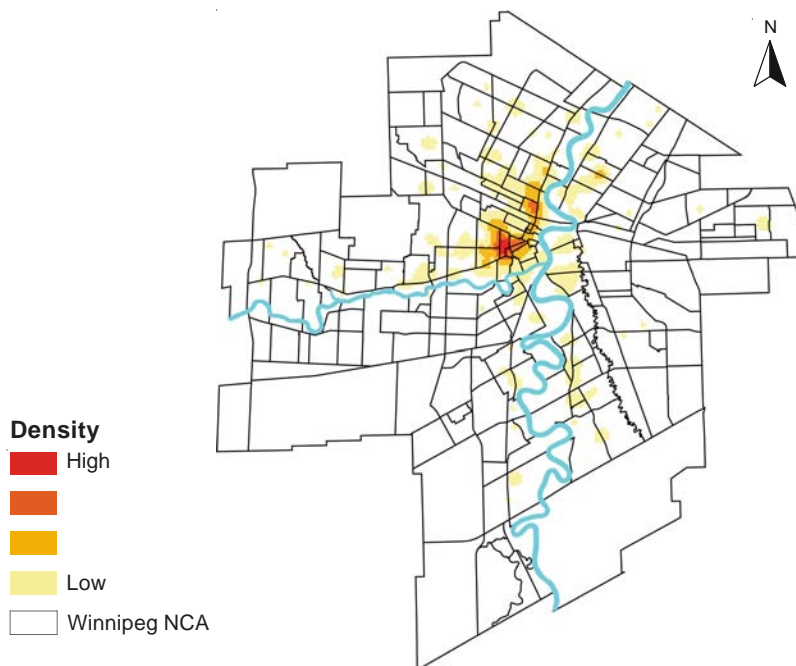
Based on 254 robbery incidents occurring from 8:00-10:00 PM in 2001.
Source: Statistics Canada, 2001 UCR2.

Map 14

Kernel density distribution of night time robbery incidents, 1:00-3:00 AM, Winnipeg, 2001

Based on 220 robbery incidents occurring from 1:00-3:00 AM in 2001.
Source: Statistics Canada, 2001 UCR2.

Neighbourhood characteristics and crime within neighbourhoods[9]

Since the 1940s (Shaw and McKay 1942) numerous studies have documented the relationship between neighbourhood characteristics and rates of crime. These studies however, have differed with respect to their emphasis on the importance of factors such as low income, residential mobility, ethno-cultural composition, opportunities for criminal behaviour, collective efficacy (or the level of trust and reciprocity in a neighbourhood), and social disorganization (or a decrease in the influence of social rules over behaviour) (Cohen and Felson 1979; Brantingham & Brantingahm 1982; Roncek & Maier 1991; Sampson and Lauritsen 1994; Sampson et al. 1997; Oberwittler in press).

This section explores the relationship between many of these factors and 2001 rates of violent and property crime within Winnipeg NCAs. The analysis makes use of total violent and property crime rates rather than rates for individual offence types to maximize the number of incidents being considered. The analysis is based on Neighbourhood Characterization Areas with residential populations greater than 250 people. Statistics Canada suppresses income data for geographies below this level for reasons of confidentiality and data quality.[10] As a result, only 175 of the 230 Neighbourhood Characterization Areas are included.

Characteristics considered in this analysis have been derived from the 2001 Census and City of Winnipeg zoning data and are outlined in the *Description of Variables* section above.

Descriptive results: a comparison of high- and low-crime neighbourhoods

To examine the relationship between violent and property crime rates and selected neighbourhood characteristics, the 175 NCAs are divided into two groups for each crime type. The first group contains NCAs falling into the highest 25% of property and violent crime rates, and the second group contains the remaining 75% of NCAs.[11]

Before controlling for other factors, there are significant differences in selected characteristics when neighbourhoods with higher rates of crime are compared to their lower crime rate counterparts. These differences in crime rates are consistent across a number of neighbourhood residential characteristics, zoning and dwelling characteristics and socio-economic characteristics for both violent and property crimes.

For instance, Figure 4 shows that when compared to the other group, NCAs with the highest violent crime rates had, on average, significantly greater percentages of residential mobility or people who did not reside at the same address one year prior to the 2001 Census compared to lower violent crime NCAs (22% and 13%, respectively); greater percentages of recent immigrants arriving to Canada between 1991 and 2001 (29% and 18%, respectively); greater percentages of Aboriginal residents (19% and 5%, respectively),[12] and greater percentages of female lone-parent families (24% and 12%, respectively). Similar differences were found with respect to property crimes (Figure 5).

Figure 4

Population characteristics in neighbourhoods with high and lower rates of violent crime, Winnipeg, 2001

Mean percentages for high and lower violent crime rate NCAs[1,2]

1. High-crime = NCAs falling into the highest 25% of violent crime rate neighbourhoods; lower-crime = remaining 75%. Rate per 1,000 residential and employed population.
2. Differences between high-crime and lower-crime means are statistically significant at: $p<0.001$.

N = 175 Neighbourhood Characterization Areas
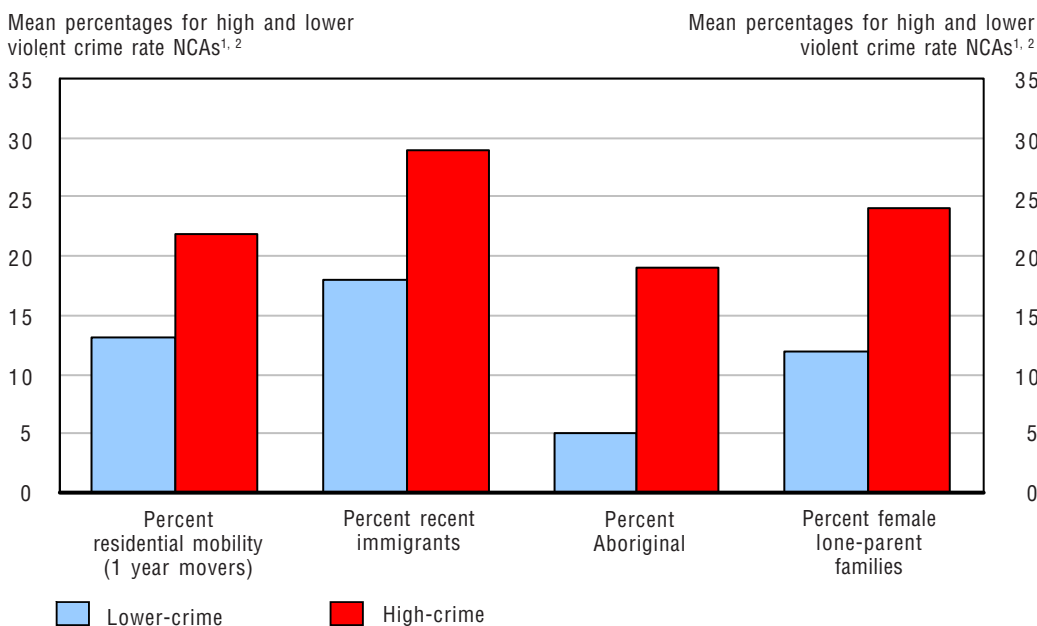
Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

Figure 5

Population characteristics in neighbourhoods with high and lower rates of property crime, Winnipeg, 2001

Mean percentages for high and lower property crime rate NCAs[1,2]

Mean percentages for high and lower property crime rate NCAs[1,2]

Lower-crime   High-crime

1. High-crime = NCAs falling into the highest 25% of property crime rate neighbourhoods; lower-crime = remaining 75%. Rate per 1,000 residential and employed population.
2. Differences between high-crime and lower-crime means are statistically significant at: p<0.001.

N = 175 Neighbourhood Characterization Areas

Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

With respect to land-use characteristics, neighbourhoods with the highest rate of violent crime had significantly greater proportions of commercial zoning than lower crime neighbourhoods (15% and 5%, respectively); greater proportions of multiple-family residential zoning (30% and 8%, respectively); and lower levels of single-family zoning (18% and 38%, respectively) (Figure 6). On average, a greater proportion of housing in high violent crime rate areas was in need of major repairs (12% and 8%, respectively) and was older, built before 1961 (60% and 36%, respectively). There were also lower proportions of owner-occupied dwellings in high violent crime NCAs (43% and 76%, respectively), and greater proportions of unaffordable housing represented by households spending more than 30% of their income on shelter (30% and 17%, respectively). These differences in land-use and housing characteristics were similar for property crime (Figure 7).

Figure 6

Land-use and housing characteristics in neighbourhoods with high and lower rates of violent crime, Winnipeg, 2001

Mean percentages for high and lower
violent crime rate NCAs[1, 2]

Mean percentages for high and lower
violent crime rate NCAs[1, 2]

☐ Lower-crime   ☐ High-crime

1. High-crime = NCAs falling into the highest 25% of violent crime rate neighbourhoods; lower-crime = remaining 75%. Rate per 1,000 residential and employed population.
2. Differences between high-crime and lower-crime means are statistically significant at: p<0.001.

N = 175 Neighbourhood Characterization Areas

Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

Figure 7

Land-use and housing characteristics in neighbourhoods with high and lower rates of property crime, Winnipeg, 2001

Mean percentages for high and lower property crime rate NCAs[1,2]

Mean percentages for high and lower property crime rate NCAs[1,2]

Lower-crime   High-crime

1. High-crime = NCAs falling into the highest 25% of property crime rate neighbourhoods; lower-crime = remaining 75%. Rate per 1,000 residential and employed population.
2. Differences between high-crime and lower-crime means are statistically significant at: p<0.001.

N = 175 Neighbourhood Characterization Areas
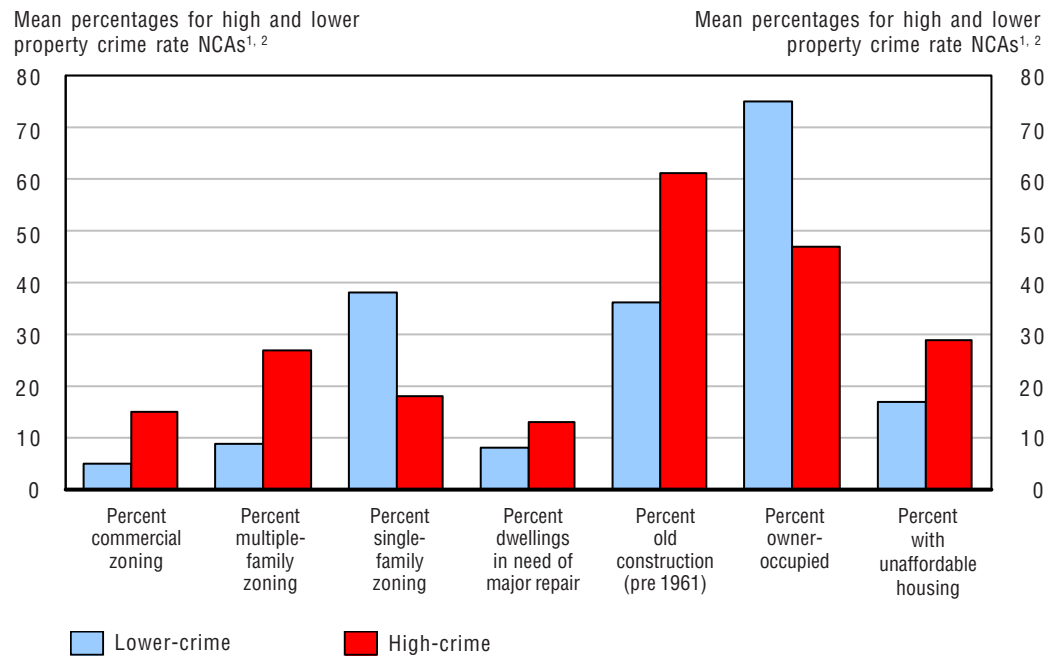
Sources: *Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.*

Finally, Figure 8 points to the presence of concentrated socio-economic disadvantage in higher violent crime rate neighbourhoods, evidenced by significantly greater percentages of population receiving government transfers (23% and 11%, respectively), without completion of high school (27% and 18%, respectively), with incomes below the low income cut-off (39% and 13%, respectively) and unemployed (9% and 5%, respectively). In addition, these neighbourhoods have significantly lower median household incomes when compared to neighbourhoods with lower violent crime rates ($28,000 and $57,000, respectively). Figure 9 indicates similar results for property crime rates.

Figure 8

Socio-economic characteristics in neighbourhoods with high and lower rates of violent crime, Winnipeg, 2001

Mean percentages and dollar amounts for high and lower violent crime rate NCAs[1,2]

Mean percentages and dollar amounts for high and lower violent crime rate NCAs[1,2]

Lower-crime ▢   High-crime ■

1. High-crime = NCAs falling into the highest 25% of violent crime rate neighbourhoods; lower-crime = remaining 75%. Rate per 1,000 residential and employed population.
2. Differences between high-crime and lower-crime means are statistically significant at: p<0.001.
3. Median household income in $1,000s.

N = 175 Neighbourhood Characterization Areas

Sources: *Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.*

Figure 9

Socio-economic characteristics in neighbourhoods with high and lower rates of property crime, Winnipeg, 2001

Mean percentages and dollar amounts for high and lower property crime rate NCAs[1, 2]

Mean percentages and dollar amounts for high and lower property crime rate NCAs[1, 2]

Lower-crime ■   High-crime ■

1. High-crime = NCAs falling into the highest 25% of property crime rate neighbourhoods; lower-crime = remaining 75%. Rate per 1,000 residential and employed population.
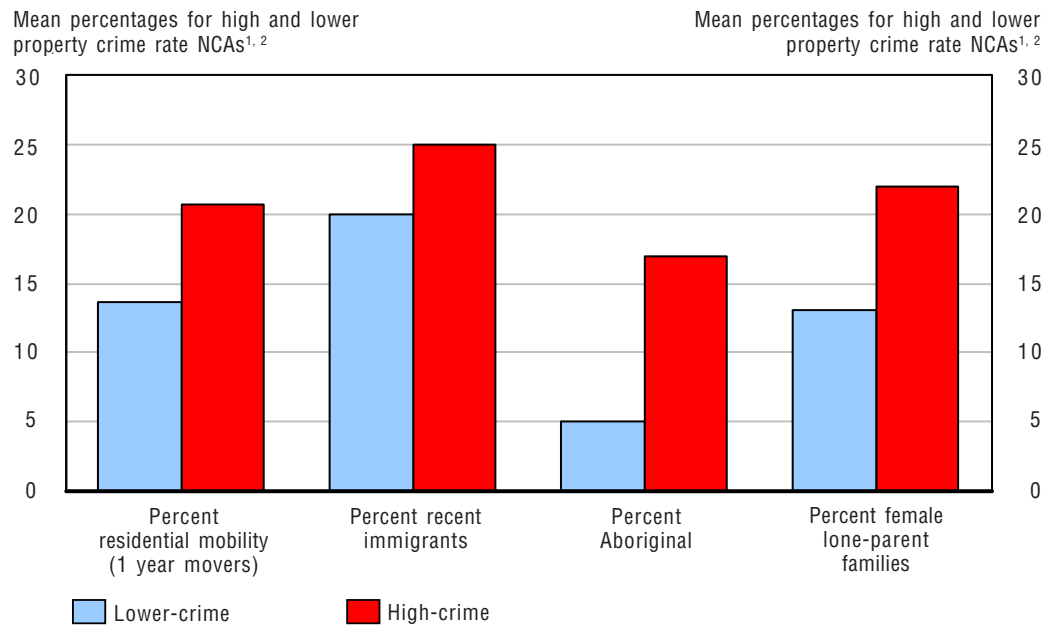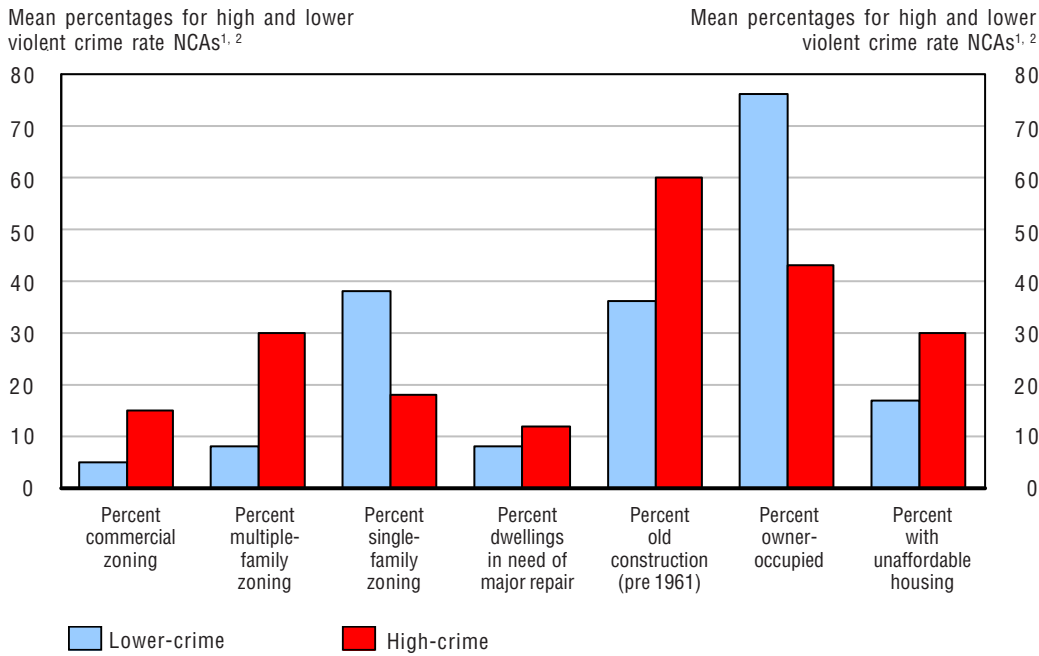2. Differences between high-crime and lower-crime means are statistically significant at: $p < 0.001$.
3. Median household income in $1,000s.
N = 175 Neighbourhood Characterization Areas
Sources: *Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.*

As would be expected, results for the composite socio-economic disadvantage variable (based on the combination of the 5 variables, see definition in ***Description of Variables*** section) indicate a similar pattern in which the highest crime neighbourhoods have the highest levels of disadvantage.[13]

There were, however, no significant neighbourhood differences for some of the factors that were analyzed including the proportion of males in the high risk age group (15-24 years) and the proportion of older adults aged 64 and over.

Multivariate Results

When considered individually, the neighbourhood characteristics discussed above are associated with violent and property crime rates in neighbourhoods. However, the extent of this association can vary when multiple characteristics are considered together. Multivariate analysis in this section is used to examine the interrelationships among variables and to observe how they relate to the level of crime after taking other factors into account.[14]

Many of the neighbourhood characteristics in this study are highly correlated with each other or convey essentially the same information. This multicollinearity between factors stems from the strong association among many of the structural factors that are individually linked to crime (Land, McCall & Cohen 1990).

To avoid the problem of multicollinearity, which may distort the results, highly correlated variables were eliminated from the analysis. For instance, Table 2 shows that the proportion of lone-parent families (r=.81), Aboriginal population (r=.82), owner-occupied dwellings (r=.73) and unaffordable housing (r=.76) are all highly correlated with socio-economic disadvantage and consequently were removed from the multivariate analysis.[15] As has been mentioned earlier in this report, the 'socio-economic disadvantage' variable is a composite of five related factors which reflect the level of social and economic resources available to individuals. Although the additional highly correlated variables listed here were not included as part of the composite 'disadvantage' variable, they are also strongly associated with the concept. In fact it could be argued that their effect on crime is a result of their strong connection to disadvantage.

As one might expect, Table 2 also indicates that the proportion of single-family residential zoning is highly correlated with multiple-family residential zoning (r=-.72). Typically, single-family zoning increases as the proportion of multiple-family zoning decreases. In order to achieve the most parsimonious results, multiple-family zoning was maintained for the multivariate analysis, since previous research has demonstrated links between the cost and density of housing and concentrated crime (South & Crowder 1997). Finally, results indicate a strong correlation between the proportion of older homes (built before 1961) and the proportion of dwellings in need of major repair (r=.75). In this case, housing built before 1961 was dropped from the multivariate analysis, primarily because the state of repair of housing is considered to be an important factor associated with increased social disorder and consequently higher crime rates (Kelling & Coles 1998).

Table 2

Bivariate correlations of independent variables, Winnipeg neighbourhoods, 2001[2]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Socio-economic disadvantage[1]	1.00													
2 Percent males aged 15 to 24	-0.11	1.00												
3 Percent dwellings in need of major repair	0.31**	-0.14	1.00											
4 Percent commercial zoning	0.36**	-0.06	-0.05	1.00										
5 Percent multiple-family zoning	0.55**	-0.09	0.06	0.58**	1.00									
6 Percent population aged over 64 years	0.24**	-0.42**	-0.01	0.25**	0.21**	1.00								
7 Percent recent immigrants, 1991 to 2001	0.32**	0.07	0.06	0.32**	0.38**	-0.16*	1.00							
8 Percent recent movers (past year different address)	0.60**	0.05	0.21**	0.52**	0.54**	-0.02	0.49**	1.00						
9 Percent owner-occupied households	-0.73**	0.10	-0.13	-0.60**	-0.68**	-0.31**	-0.42**	-0.77**	1.00					
10 Percent lone-parent mother families	0.81**	0.11	0.36**	0.22**	0.41**	-0.01	0.31**	0.53**	-0.61**	1.00				
11 Percent Aboriginal population	0.82**	0.02	0.29**	0.20**	0.48**	-0.08	0.28**	0.53**	-0.50**	0.77**	1.00			
12 Percent households spending 30% or more on shelter	0.76**	-0.06	0.13	0.57**	0.64**	0.34**	0.28**	0.66**	-0.83**	0.62**	0.54**	1.00		
13 Percent single-family zoning	-0.43**	0.03	0.07	-0.44**	-0.72**	-0.10	-0.34**	-0.53**	0.54**	-0.29**	-0.39**	-0.53**	1.00	
14 Percent housing built before 1961	0.28**	-0.18*	0.75**	-0.07	0.07	0.04	0.08	0.16*	-0.07	0.30**	0.27**	0.06	0.06	1.00

* $p < 0.05$

** $p < 0.01$

1. Composite variable.

2. Based on the 175 NCAs where the total residential population was over 250 people.

Sources: *Statistics Canada, 2001 Census; City of Winnipeg, 2004 Zoning Data.*

To assess the relative contribution of neighbourhood characteristics to the explanation of crime, the set of variables was regressed separately on violent and property crime rates (Table 3). The adjusted r-square values indicate that the 8 remaining explanatory variables account for a very high percentage of the variation in violent crime (76%) and property crime (66%). The estimated regression coefficients provide an indication of the relative contribution of each variable after controlling for the other variables in the model.[16]

Socio-economic disadvantage makes the largest relative contribution to the explanation of both violent (b=0.78) and property (b=0.54) crime rates, after adjusting for, or holding constant, the other explanatory variables. In both models, as the level of socio-economic disadvantage increases, so do the violent and property crime rates. Disadvantage is followed in importance by the relative contribution of the condition of housing in the neighbourhood, indicated by the proportion of dwellings in need of major repairs (b=0.25 and b=0.40). As the proportion of dwellings in need of major repair increases, so do the violent and property crime rates net of the other variables in the model.

Other variables that made smaller, though statistically significant, contributions to an increase in violent crime rates after adjusting for other variables include an increase in the percentage of multiple-family zoning (b=0.14), an increase in the percentage of commercial zoning (b=0.12), a decrease in the proportion of older adults aged over 64 years (b=-0.12) and an increase in the high risk victim/offender population of males aged 15-24 (b=0.10). Neither the proportion of immigrants in the neighbourhood, nor the proportion of residents living at a different address in the previous year made significant contributions to the explanation of the violent crime rate after controlling for the other variables in the model.

With respect to property crime, the percentage of commercial zoning (b=0.25) followed socio-economic disadvantage and dwellings in need of repair in terms of relative importance, and was the only other variable to make a significant contribution to the explanation of the property crime rate. Net of the other variables, an increase in the proportion of commercial zoning in a neighbourhood was related to increases in the property crime rate.

Table 3

OLS-multiple regression models for violent and property crime rates[1], Winnipeg neighbourhoods, 2001

Neighbourhood characteristics[2]	Unstandardized regression coefficients	
	Violent crime rate[4]	Property crime rate[4]
	b	b
Percent males aged 15 to 24	0.10*	0.08
Percent population aged over 64 years	-0.12*	0.05
Percent recent immigrants, 1991 to 2001	0.09	0.01
Percent recent movers (past year different address)	-0.11	-0.11
Percent dwellings in need of major repair	0.25***	0.40***
Percent commercial-zoning	0.12*	0.25***
Percent multiple family-zoning	0.14**	0.04
Socio-economic disadvantage[3]	0.78***	0.54***
Adjusted R-squared	0.76	0.66

* $p<0.05$
** $p<0.01$
*** $p<0.001$

1. Police-reported violent and property crime rates per residential and employed population (log transformed). Based on the 175 NCAs where the total residential population was over 250 people.
2. Variables are standardized: z-scores.
3. Composite variable.
4. Regression models include intercept.

Sources: Statistics Canada, 2001, UCR2; Statistics Canada, 2001 Census; City of Winnipeg, 2004 Zoning Data.

Discussion

This report has presented information from a Statistics Canada pilot study of the spatial distribution of crime in a Canadian city using a combination of statistical analyses and crime mapping based on Geographic Information System (GIS) technology. Results from the examination of 2001 Winnipeg data are in agreement with those from other studies indicating that crime is not randomly distributed across cities, but rather is concentrated in certain areas that are associated with other factors related to the population and land-uses of the city.

Maps of the distribution of police-reported criminal incidents in this report show a concentration in the core of the city representing a relatively small geographic area. For example, about 1,100 incidents per square kilometre were reported within a 2 kilometre radius of the geographic centre of the city. However, between 6 and 8 kilometres from the centre, the density of reported incidents drops dramatically to 151 incidents per square kilometre.

There are some differences in the degree of concentration of violent and property crime. About 30% of reported violent crime incidents in 2001 occurred in 3% of neighbourhoods, and although there is a wider distribution of property crime incidents, about 30% of reported property crime occurred in just 7% of neighbourhoods.

Before controlling for other factors, results point to significant differences in selected characteristics when neighbourhoods with the highest rates of crime are compared to their lower crime rate counterparts. Differences in crime rates are consistent across a number of neighbourhood residential characteristics, land-use and dwelling characteristics and socio-economic characteristics for both violent and property crimes.

These bivariate results suggest that higher levels of crime occur in areas with reduced access to social and economic resources. For example, these neighbourhoods are characterized by populations that are more economically disadvantaged, less educated, more likely to have higher numbers of female single-parent families, Aboriginal residents and/or recent immigrants. The neighbourhoods also tend to exhibit lower levels of residential stability, to be more crowded and to have greater proportions of multiple-family dwellings which are often in need of repair.

It was demonstrated in this study that many of these individual factors are closely related. Thus, when the variables were held constant through the use of a multivariate technique, a few key factors were shown to be most highly related to both property and violent crime rates.

After controlling for other variables, socio-economic disadvantage had the greatest significant association with violent and property crime. The strong association between concentrated disadvantage and crime has been demonstrated frequently in

other research. For example, Sampson and Raudenbush (1999) have argued that the relationship between disadvantage and crime is in fact so strong that other "symptoms" of high-crime neighbourhoods actually stem from the socio-economic disadvantage.

Disadvantage was followed in importance by the relative contribution of the condition of housing in the neighbourhood, indicated by the proportion of dwellings in need of major repair. This factor is an indication of lower community affiliation, a lower sense of community responsibility leading to a disconnection from identification with and interest in neighbours and neighbourhood (Sampson and Raudenbush 1999).

Land-use types also contributed to the explanation of crime. With respect to violent crime, this was particularly the case for multiple-family zoning, and to a lesser extent was also valid for commercial zoning which included, among other businesses, restaurants, beverage hotels and retail establishments. The results for property crime were somewhat different. In this case, commercial zoning was the only land-use type that proved to be significant.

Opportunities for crime increase when neighbourhood land-use patterns are conducive to crime (Hayslett-McCall 2002). Land-uses that have been associated with crime include mixed patterns of residential, commercial, industrial, and vacant lands within neighbourhoods, as well as the presence of particular establishments, such as shopping malls. Land-use patterns can influence crime by inhibiting the social control or guardianship capacity of residents in a neighbourhood or by being a focal point for particular types of activities (e.g., consuming alcohol at a bar, selling/using drugs in abandoned structures) (Hayslett-McCall 2002).

This study has demonstrated that high-crime neighbourhoods exhibit distinct characteristics that are quite different from low-crime neighbourhoods. They are characterized by residential populations with smaller shares of social and economic resources, and by land-use patterns that may increase opportunities for crime to be committed.

These results suggest that effective community level interventions would include programs and policies that improve the socio-economic conditions of residents including housing and take into account the implications of land-use zoning. Moreover, the high level of geographic concentration found in this study suggests that there may be some benefit to targeting strategies to the particular needs of neighbourhoods or smaller areas within a city.

Limitations and opportunities

Work undertaken in the Winnipeg demonstration study was limited to a single year of data. Consequently it was not possible to examine change in neighbourhood crime rates and associated characteristics. Temporal data provides the opportunity to examine the causal ordering of different factors. For instance, studies of American cities suggest that high crime leads to depopulation which in turn leads to an increase in socio-economic disadvantage in urban core areas. Understanding factors related to change over time is also important for the development of prevention and reduction strategies and for the evaluation of existing programs. Future work should consider multiple years of data and consequently change over time.

While this study provided information about the location of the criminal incidents, no data were available on the location of either accused or victim residences. Information about travel-to-crime patterns, or the distances offenders travel to commit crimes, can be used to shape appropriate crime reduction strategies. While it is often assumed that offenders travel distances to commit crime, and that a considerable amount of crime is committed by the same high-volume offenders travelling to different parts of the city, evidence from the UK suggests that most offender movements are relatively short and travel associated with crime is driven by opportunities presenting themselves during normal routines rather than plans to offend. To test these results in the Canadian context, accused address information could be examined.

Some initial work was undertaken in the Winnipeg demonstration study to examine factors that distinguish neighbourhoods with lower levels of crime despite having characteristics typically associated with high-crime neighbourhoods. The characteristics and locations of these neighbourhoods are of particular interest from an intervention perspective since they may possess certain protective attributes. However, the very strong relationship between crime and disadvantage in Winnipeg meant that the small numbers of these low-crime/higher-disadvantage neighbourhoods yielded unreliable results. Consequently, it was not possible to describe the attributes of these neighbourhoods. More work in this area could be undertaken in other Canadian cities.

Finally, analyses of the spatial distribution of crime are particularly affected by the availability of data. This study relied on the Census of Population and City of Winnipeg zoning data to describe the relationship between location and crime. While this information contributes to an understanding of crime patterns in cities, there are other factors that could be related to the people who flow in and out of a neighbourhood over the course of a day, the locations of specific land-use types (e.g., bars and nightclubs), the location and delivery of various justice and non-justice services and most importantly about individuals' attitudes and perceptions regarding their own neighbourhood, their trust in others and their willingness to participate. Improved understanding of factors associated with crime distribution requires access to data sets from a variety of sources.

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Appendices

Appendix A: Maps of distribution of selected Census variables

Map 15

Kernel density distribution of drug incidents, Winnipeg, 2001

Based on 1,322 drug crime incidents.
Source : Statistics Canada, 2001 UCR2.

Map 16

Kernel density distribution of arson incidents, Winnipeg, 2001
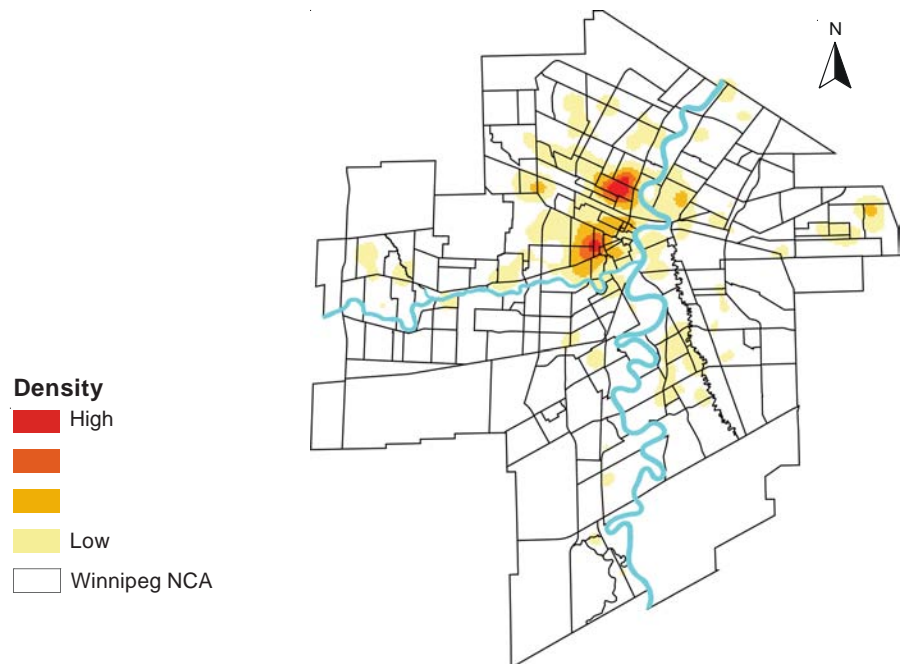
Based on 494 arson incidents.
Source : Statistics Canada, 2001 UCR2.

Map 17

Kernel density distribution of common assault incidents, Winnipeg, 2001

Density
High

Low
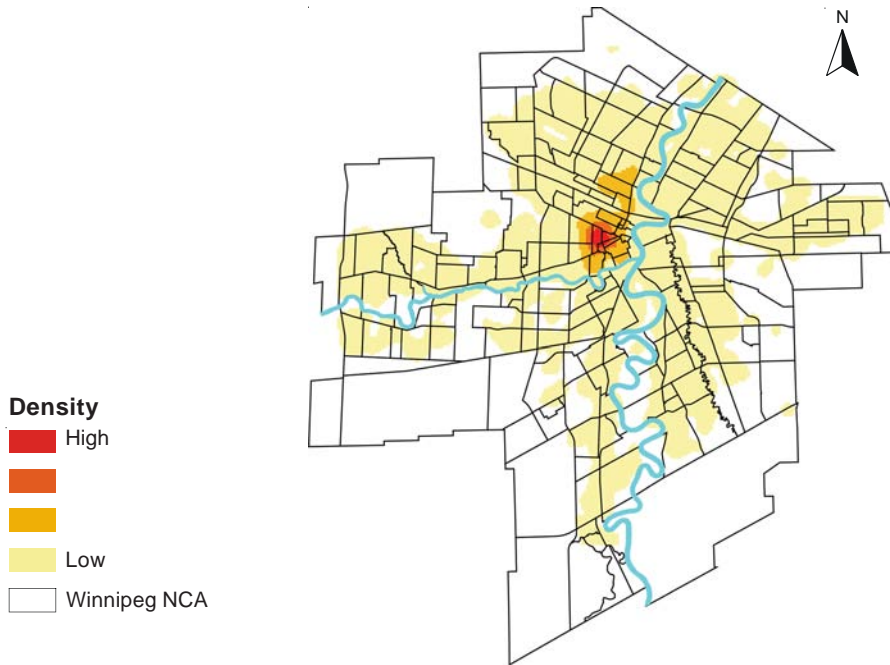
Winnipeg NCA

Based on 4,429 common assault (assault level 1) incidents.
Source: Statistics Canada, 2001 UCR2.

Map 18

Kernel density distribution of break and enter incidents, Winnipeg, 2001

Density
High

Low
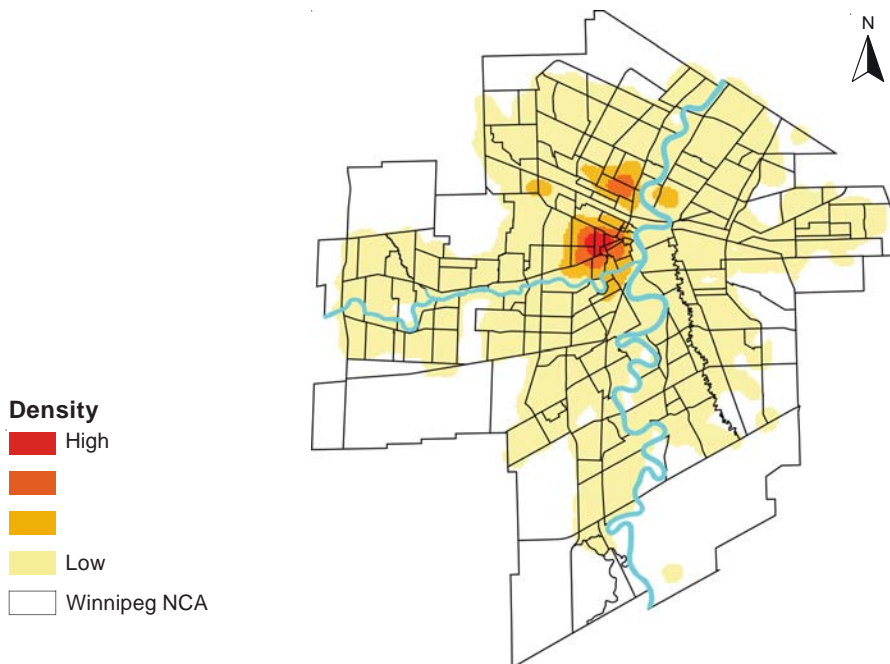
Winnipeg NCA

Based on 7,646 break and enter incidents.
Source: Statistics Canada, 2001 UCR2.

Map 19

Kernel density distribution of car theft incidents, Winnipeg, 2001

Density
- High
- Low
- Winnipeg NCA
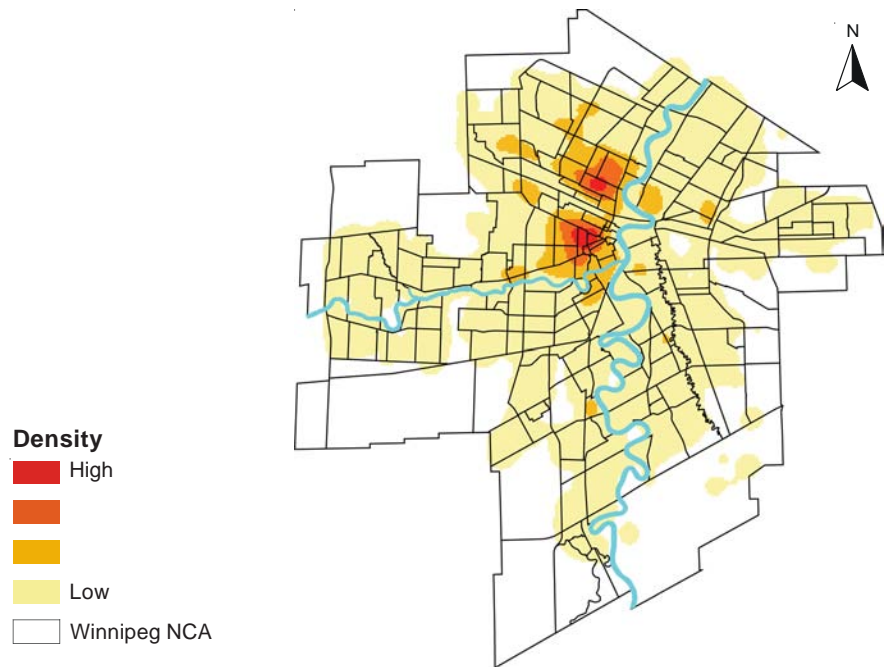
Based on 10,699 car theft incidents.
Source: Statistics Canada, 2001 UCR2.

Map 20

Kernel density distribution of homicide and serious assault incidents, Winnipeg, 2001

Density
- High
- Low
- Winnipeg NCA
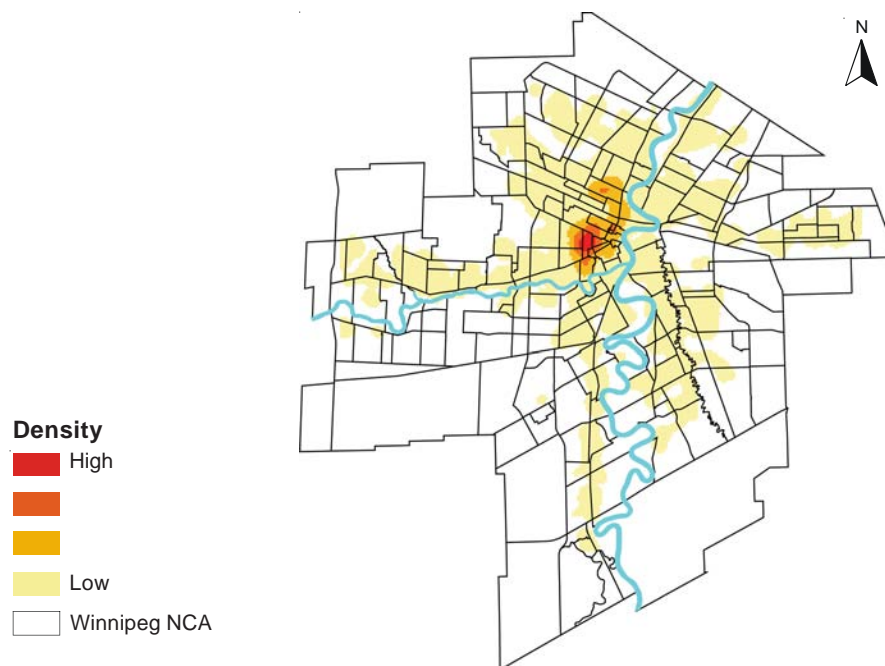
Based on 1,773 homicide and serious assault incidents (assault levels 2 and 3) incidents.
Source: Statistics Canada, 2001 UCR2.

Map 21

Kernel density distribution of mischief incidents, Winnipeg, 2001

Density
High

Low
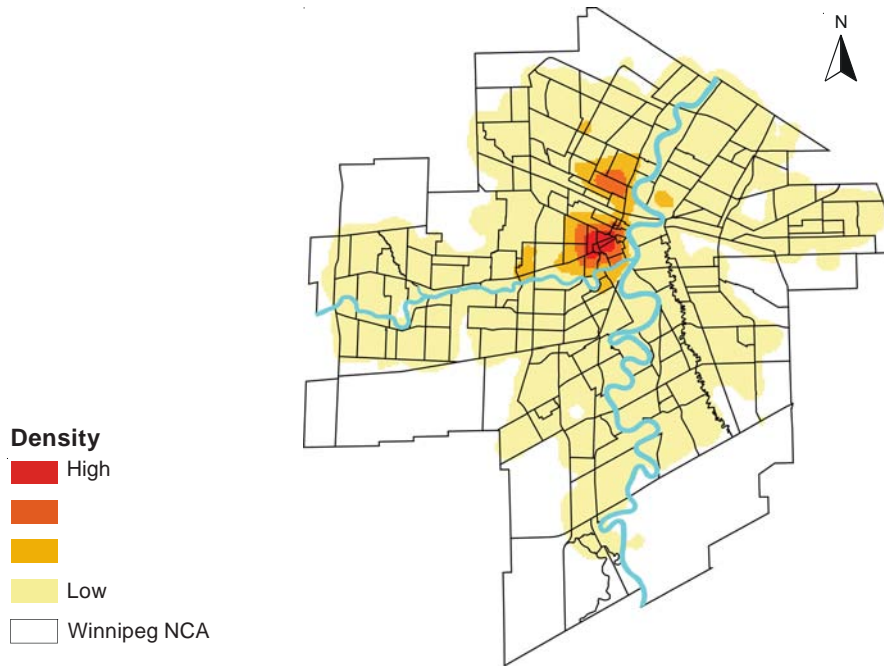
Winnipeg NCA

Based on 17,323 mischief incidents.
Source: Statistics Canada, 2001 UCR2.

Map 22

Kernel density distribution of prostitution incidents, Winnipeg, 2001

Density
High

Low
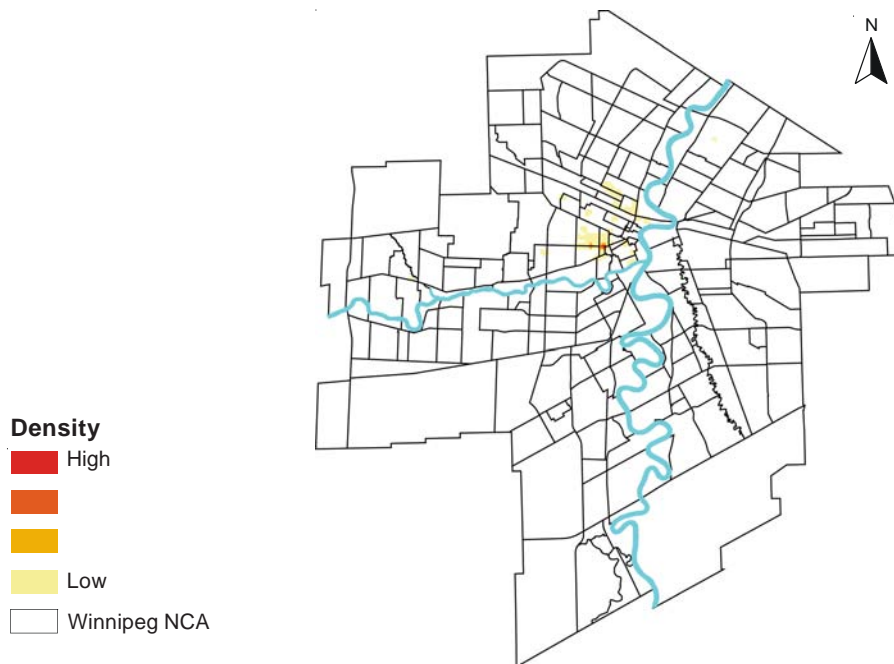
Winnipeg NCA

Based on 252 prostitution incidents.
Source: Statistics Canada, 2001 UCR2.

Map 23

Kernel density distribution of robbery incidents, Winnipeg, 2001

Density

High

Low
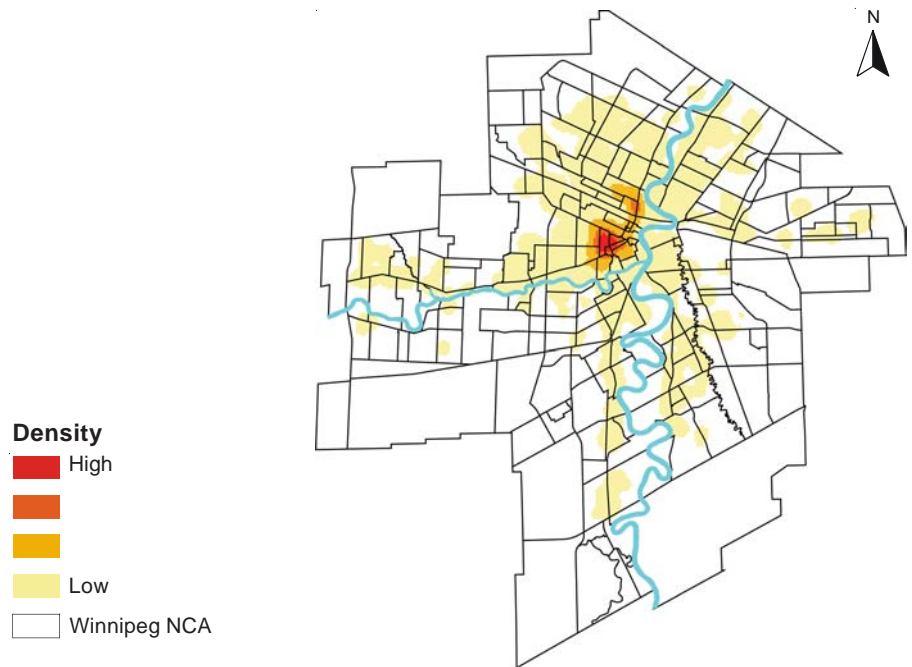
Winnipeg NCA

Based on 1,677 robbery incidents.
Source: Statistics Canada, 2001 UCR2.

Map 24

Kernel density distribution of sexual offence incidents, Winnipeg, 2001

Density

High

Low
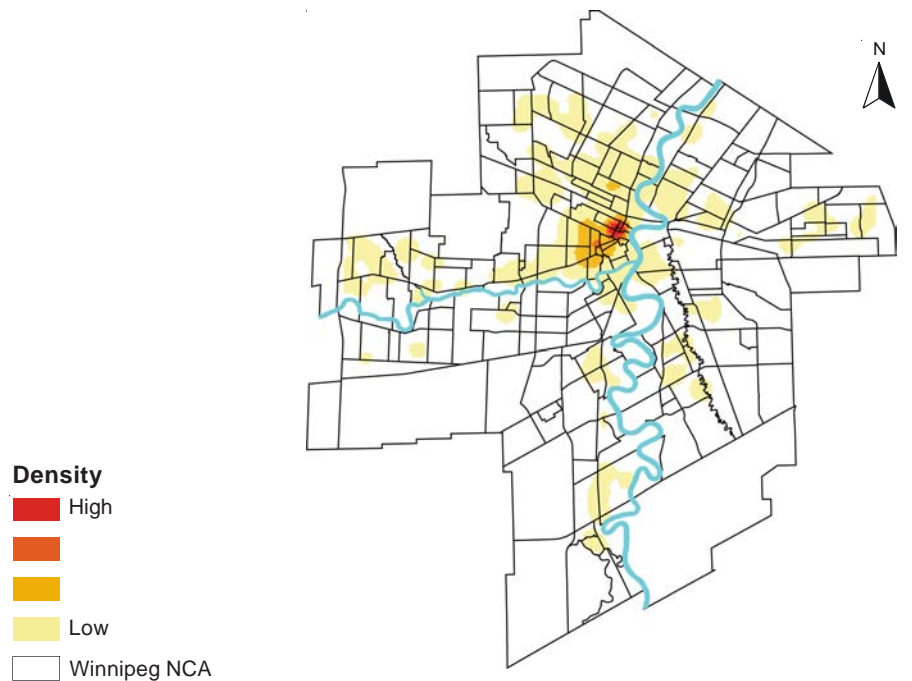
Winnipeg NCA

Based on 660 sexual offences incidents.
Source: Statistics Canada, 2001 UCR2.

Map 25

Kernel density distribution of shoplifting incidents, Winnipeg, 2001
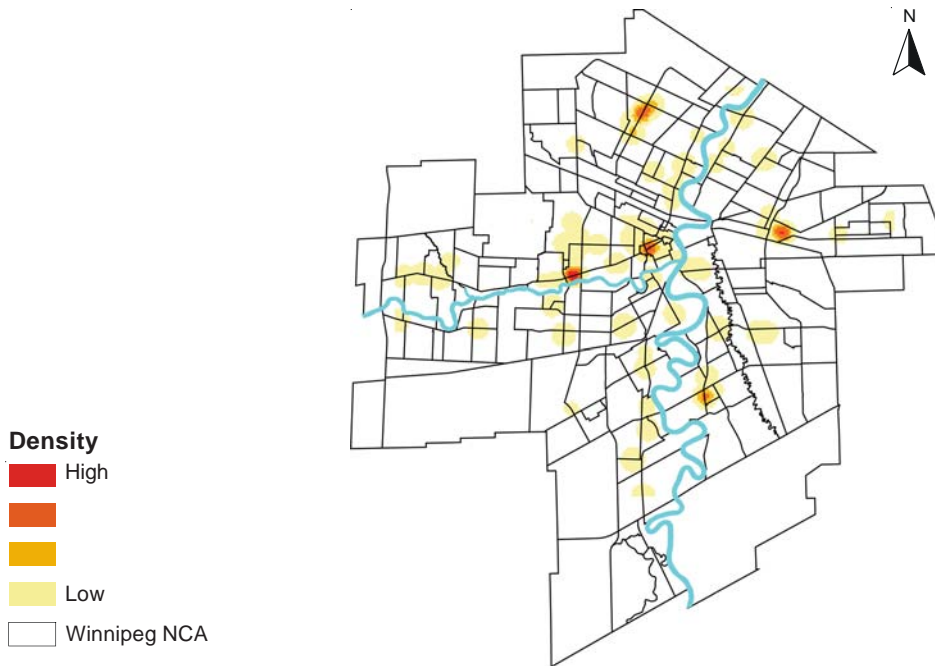
Based on 2,331 shoplifting incidents.
Source: Statistics Canada, 2001 UCR2.

Map 26

Kernel density distribution of theft $5,000 and under incidents, Winnipeg, 2001
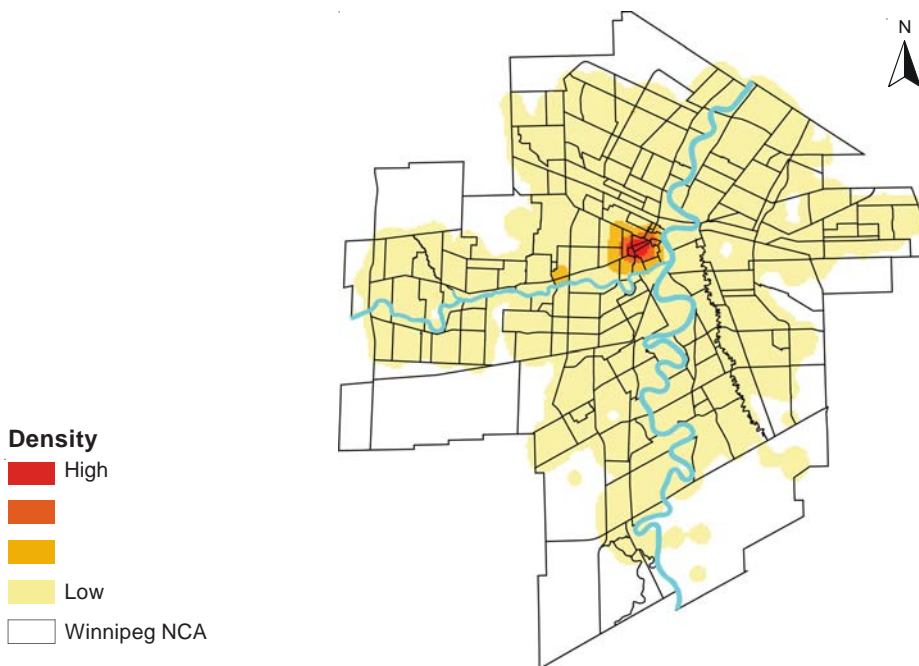
Based on 34,809 theft $5,000 and under incidents (excludes car theft).
Source: Statistics Canada, 2001 UCR2.

Map 27

Kernel density distribution of theft over $5,000, Winnipeg, 2001

Density
- High
- Low
- Winnipeg NCA
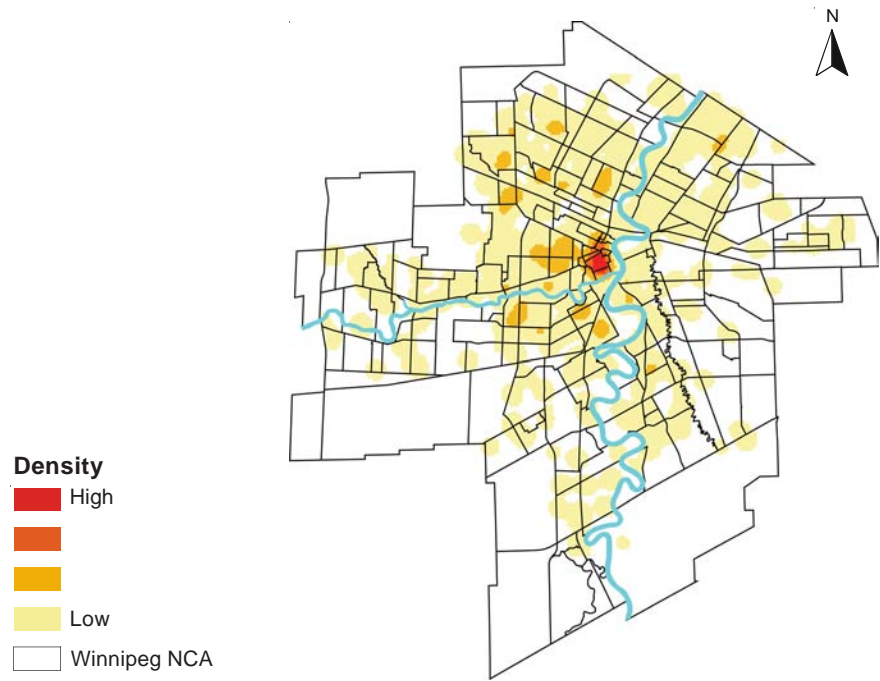
Based on 1,845 theft over $5,000 incidents (excludes car theft).
Source: *Statistics Canada, 2001 UCR2.*

Appendix B:

High-need neighbourhoods

In this appendix, selected crime (Table 4) and population characteristics (Table 5) are reported for the 30 *highest-need* NCAs, and as an average across the 175 Winnipeg NCAs examined in this study. *High-need NCAs were* selected based on their socio-economic disadvantage ranking.

Socio-economic disadvantage is a composite variable derived from five neighbourhood characteristics including percent receiving government transfer payments, percent aged 20 years and older without a secondary school certificate, percent in private households with low income in 2000, unemployment rate for population aged 15 and older, and median household income in $1,000s. Separate results for each of the 5 socio-economic disadvantage variables are reported in Table 5. Details regarding the creation of the socio-economic disadvantage variable are provided in the *Description of variables* section earlier in this report.

Table 4

Selected offence types for highest-need Neighbourhood Characterization Areas, Winnipeg, 2001

Neighbourhood Characterization Area	Total incidents[3]		Total violent crime[3]		Total property crime[3]		Common assault 1[4]		Break and enter[4]		Car theft[4]	
	Count	Rate[1]	Count	Rate[1]	Count	Rate[1]	Count	Rate[1]	Count	Rate[1]	Count	Rate[1]
Average for Winnipeg (175 NCAs)[2]	346	72	52	11	286	60	26	5	40	9	58	12
Highest-need NCAs[5]												
Lord Selkirk Park	523	203	176	68	308	119	68	26	48	19	62	24
Logan-C.P.R.	263	76	49	14	203	59	12	3	33	10	43	12
Dufferin	431	204	109	52	305	145	53	25	60	28	93	44
Centennial	505	153	190	58	296	90	101	31	63	19	58	18
William Whyte	1,816	270	433	64	1,320	196	194	29	234	35	322	48
North Point Douglas	577	140	155	38	392	95	63	15	63	15	79	19
Spence	1,638	348	413	88	1,078	229	188	40	159	34	176	37
West Broadway	1,333	177	327	43	963	128	150	20	163	22	138	18
Central Park	813	179	219	48	565	124	109	24	82	18	113	25
Polo Park	1,235	179	58	8	1,163	168	29	4	41	6	134	19
China Town	148	133	46	41	97	87	14	13	11	10	17	15
Alpine Place	267	71	52	14	213	56	26	7	25	7	65	17
Daniel McIntyre	1,821	165	402	36	1,309	118	182	16	249	23	279	25
St. Matthews	1,105	144	207	27	871	114	79	10	193	25	157	20
Weston	819	125	181	28	620	95	97	15	117	18	164	25
Luxton	300	102	51	17	246	84	30	10	29	10	63	22
South Portage	1,656	72	282	12	1,334	58	121	5	123	5	91	4
St. John's	1,628	187	318	36	1,269	145	156	18	223	26	373	43
Burrows-Keewatin	381	118	77	24	300	93	40	12	21	7	100	31
Talbot-Grey	238	98	34	14	199	82	19	8	39	16	38	16
West Alexander	1,345	80	312	19	995	59	152	9	118	7	223	13
Burrows Central	785	155	110	22	659	130	47	9	108	21	193	38
Chalmers	1,355	111	284	23	1,049	86	146	12	185	15	248	20
Valhalla	106	33	14	4	90	28	4	1	11	3	19	6
Lavalee	120	73	25	15	94	57	12	7	22	13	30	18
Central St. Boniface	813	63	169	13	628	49	70	5	92	7	102	8
Colony	364	151	52	22	298	123	22	9	18	7	18	7
Brooklands	474	165	88	31	375	130	47	16	90	31	96	33
Dufresne	47	103	9	20	35	77	3	7	7	15	10	22
Mynarski	116	81	17	12	96	67	7	5	17	12	20	14

x   suppressed to meet the confidentiality requirements of the *Statistics Act.*

1. Rates per 1,000 residential and employed population.

2. Winnipeg figures based on the 175 neighbourhoods where the total residential population was over 250 people.

3. Includes most serious violation in each incident only.

4. Includes all recorded violations in each incident.

5. Highest-need neighbourhoods based on ranking for the socio-economic disadvantage score.

Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

Table 4 – concluded

Selected offence types for highest-need Neighbourhood Characterization Areas, Winnipeg, 2001

Neighbourhood Characterization Area	Drug offences[4]		Homicide and serious assault 2 and 3[4]		Mischief[4]		Robbery[4]		Theft under $5,000[4]	
	Count	Rate[1]	Count	Rate[1]	Count	Rate[1]	Count	Rate[1]	Count	Rate[1]
Average for Winnipeg (175 NCAs)[2]	10	1	12	2	93	19	11	2	179	37
Highest-need NCAs[5]										
Lord Selkirk Park	13	5	43	17	110	43	55	21	158	61
Logan-C.P.R.	11	3	16	5	56	16	17	5	134	39
Dufferin	14	7	20	9	106	50	17	8	110	52
Centennial	19	6	44	13	116	35	24	7	140	43
William Whyte	51	8	105	16	531	79	84	12	516	77
North Point Douglas	27	7	40	10	178	43	35	9	152	37
Spence	56	12	88	19	337	72	100	21	806	171
West Broadway	47	6	71	9	348	46	60	8	652	86
Central Park	38	8	41	9	177	39	50	11	398	87
Polo Park	9	1	6	1	327	47	8	1	1,130	163
China Town	7	6	19	17	29	26	10	9	59	53
Alpine Place	x	x	7	2	56	15	3	1	148	39
Daniel McIntyre	50	5	94	8	409	37	70	6	825	75
St. Matthews	15	2	35	5	258	34	47	6	527	69
Weston	19	3	35	5	201	31	22	3	323	49
Luxton	5	2	7	2	62	21	4	1	145	50
South Portage	37	2	40	2	340	15	56	2	1,180	51
St. John's	59	7	68	8	466	53	39	4	487	56
Burrows-Keewatin	3	1	17	5	126	39	5	2	100	31
Talbot-Grey	6	2	6	2	78	32	x	x	104	43
West Alexander	33	2	75	4	268	16	47	3	707	42
Burrows Central	18	4	20	4	231	46	30	6	278	55
Chalmers	22	2	55	5	358	29	40	3	550	45
Valhalla	3	1	3	1	33	10	x	x	56	18
Lavalee	x	x	6	4	35	21	3	2	29	18
Central St. Boniface	20	2	26	2	163	13	39	3	501	39
Colony	8	3	9	4	89	37	10	4	347	144
Brooklands	10	3	21	7	89	31	12	4	259	90
Dufresne	4	9	x	x	9	20	x	x	25	55
Mynarski	3	2	x	x	38	26	7	5	39	27

x   suppressed to meet the confidentiality requirements of the *Statistics Act*.

1.   Rates per 1,000 residential and employed population.

2.   Winnipeg figures based on the 175 neighbourhoods where the total residential population was over 250 people.

3.   Includes most serious violation in each incident only.

4.   Includes all recorded violations in each incident.

5.   Highest-need neighbourhoods based on ranking for the socio-economic disadvantage score.

Sources: Statistics Canada, 2001 UCR2; Statistics Canada, 2001 Census.

Table 5

Selected Census characteristics for highest-need Neighbourhood Characterization Areas, Winnipeg, 2001

Neighbourhood Characterization Area (NCA)	Population receiving gov't transfers	Population without high school certi-ficate	Population below low income cut-off	Uem-ployed popu-lation aged 15 and over	Median house-hold income (in $1,000s)	Recent immi-grant popu-lation	Abori-ginal popu-lation	Female lone-parent families	Recent movers (past year different address)	Housing built before 1961	Dwell-ings in need of major repairs	House-holds spending 30% or more on shelter
					%							
Average percentage for Winnipeg (175 NCAs)[1]	14	20	20	6	49.6	21	8	15	15	42	9	20
Highest-need NCAs[2]												
Lord Selkirk Park	60	35	83	22	14.7	14	54	41	32	25	7	29
Logan-C.P.R.	33	26	46	32	15.8	27	22	38	23	46	x	44
Dufferin	41	38	62	15	17.5	19	40	34	22	73	13	37
Centennial	38	30	65	17	16.0	33	49	42	32	59	13	35
William Whyte	34	35	54	16	20.0	32	40	28	22	81	20	40
North Point Douglas	26	31	53	18	21.7	13	39	32	25	75	15	40
Spence	33	25	63	14	16.5	43	32	33	29	76	11	42
West Broadway	27	20	65	14	16.1	35	27	34	39	70	12	51
Central Park	29	21	67	11	14.9	57	24	43	27	33	7	46
Polo Park	26	31	48	12	21.6	14	13	40	40	7	21	52
China Town	36	16	64	9	18.9	58	6	13	16	18	5	38
Alpine Place	30	32	39	7	24.9	50	8	24	16	10	5	39
Daniel McIntyre	25	26	38	12	27.1	35	21	25	20	83	14	29
St. Matthews	24	28	41	10	27.2	31	16	26	25	83	18	34
Weston	23	33	40	9	30.3	41	24	26	17	80	13	27
Luxton	17	33	38	13	36.8	31	25	23	19	93	16	29
South Portage	20	21	48	11	18.3	32	14	12	40	23	5	40
St. John's	20	33	41	8	26.7	23	29	30	23	86	27	34
Burrows-Keewatin	24	31	36	9	33.4	36	32	30	18	38	6	15
Talbot-Grey	18	41	31	8	34.7	21	16	23	15	82	16	20
West Alexander	23	21	47	10	25.3	45	24	30	27	73	14	25
Burrows Central	24	31	41	6	27.9	29	19	24	16	87	22	26
Chalmers	17	31	36	10	31.0	39	16	27	21	67	14	29
Valhalla	27	31	27	7	29.6	8	x	12	20	5	2	36
Lavalee	19	27	43	7	28.2	56	20	29	21	33	10	29
Central St. Boniface	25	21	36	7	24.3	20	12	23	21	48	11	36
Colony	21	20	41	8	21.5	35	18	19	36	23	5	45
Brooklands	19	24	32	10	31.3	29	19	17	16	81	20	21
Dufresne	18	40	39	x	27.9	x	18	8	15	83	12	27
Mynarski	24	31	28	5	30.2	31	11	19	23	63	9	21

x   suppressed to meet the confidentiality requirements of the *Statistics Act.*

1.   Winnipeg figures based on the 175 neighbourhoods where the total residential population was over 250 people.

2.   Highest-need neighbourhoods based on ranking for the socio-economic disadvantage score.

Source: *Statistics Canada, 2001 Census.*

Endnotes

1. Zoning parcels are defined in the City of Winnipeg by-laws 4800/88 and 6400/94 and subsequent amendments.

2. Economic family is defined as a group of two or more persons who live in the same dwelling and are related to each other by blood, marriage, common-law or adoption.

3. In 2001, the 73,111 incidents were reported to the Winnipeg Police Service, and it was possible to geocode the vast majority (99.6% or 72,860) of these incidents.

4. For the purposes of this analysis the centroid, or spatial midpoint of the NCA, is used when examining the distribution of Census variables. The centroid provides the location (X and Y) information for each area while the value of the Census variable (e.g., socio-economic disadvantage) provides the intensity estimate (Z).

5. These population figures are based on the Statistics Canada Census Metropolitan Area (CMA) population for Winnipeg, and are used for national comparative purposes. The CMA boundary includes adjacent municipalities situated around the urban core and is consequently larger than the study area which covers 230 NCAs within the municipality of Winnipeg; consequently population figures for the study area are lower, totalling 610,455 residents in 2001.

6. Information in maps in this report is typically displayed in 4 categories or classes. Classes are based on natural groupings of data values. Arcmap identifies break points by looking for groupings and patterns inherent in the data. The features are divided into classes whose boundaries are set where there are relatively large jumps in the data values.

7. The highest reported violent crime neighbourhoods in 2001 were Spence, William Whyte, Daniel Mcintyre, West Broadway, St. John's, West Alexander, Chalmers and South Portage, and the highest reported property crime neighbourhoods were South Portage, William Whyte, Daniel Mcintyre, St. John's, Polo Park, Spence, Chalmers, West Alexander, Rossmere-A, West Broadway, Wolseley, St. Matthews, Tyndall Park, Garden City, The Maples and Regent.

8. The dual kernel method is used in these maps in order to examine the distribution of two variables simultaneously.

9. Findings in this study are not intended to suggest that certain neighbourhood characteristics are the cause of crime, but rather they suggest that these factors are associated with or co-occur with higher crime rates in neighbourhoods.

10. For reasons of confidentiality and reliability, Statistics Canada requires that when using individual, family or household income data, the population size for any Canadian geographic area being considered must be least 250 people who are residing in at least 40 private households.

11. Dichotomous variables are used only for the descriptive or bivariate analysis. The multivariate analysis that follows this section is based on continuous dependent variables: violent and property crime rates.

12. The 2001Aboriginal identity population accounted for 8.4% of the Winnipeg Census Metropolitan Area population, 13.6% of Manitoba's population and 3.3% of Canada's population.

13. Average disadvantage scores for high- and low-crime NCAs were -0.3 and 1.0, respectively, and for property crime, -0.3 an 0.8, respectively.

14. Ordinary least squares (OLS) regression is used in this study to examine the distribution of violent and property crime rates as a function of the set of explanatory factors. This method requires a continuous or quantitative outcome variable which is normally distributed, in this case crime rate. Since the distribution of crime rates is often skewed with a small proportion of neighbourhoods accounting for a larger proportion of reported incidents, it was necessary to log transform the crime variables.

15. The correlation between two variables reflects the degree to which the variables are related. The most common measure of correlation is the Pearson's correlation (r) which reflects the degree of linear relationship between two variables. It ranges from +1 to -1. A correlation of +1 means that there is a perfect positive linear relationship between variables, while a correlation of -1 means that there is a perfect negative relationship.

16. Since the independent variables are initially transformed into z-scores, the unstandardized regression coefficients provide a means of assessing the relative importance of the different predictor variables in the multiple regression models. The coefficients indicate the expected change, in standard deviation units, of the dependent variable per one standard deviation unit increase in the independent variable, after controlling for the other variables. The maximum possible values are +1 and -1, with coefficient values closer to 0 indicating a weaker contribution to the explanation of the dependent variable.

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