QUANTIFYING THE COSTS AND BENEFITS OF ALTERNATIVE GROWTH SCENARIOS

Halifax Regional Municipality, Nova Scotia

FINAL REPORT

This report has been prepared for Halifax Regional Municipality by Stantec Consulting Limited to summarize the approaches applied to allocate residential growth in HRM consistent with four prescribed scenarios and the effects of such allocations on the use and requirement for public and private services within the region. This final report includes economic and environmental analysis of the impacts of alternative growth scenarios as well as a high level health impact assessment.

Prepared by Stantec Consulting in association with Gardner Pinfold Consultants Inc.

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Executive Summary

1.0 INTRODUCTION

The specifications of this assignment required Stantec to assess four regional growth scenarios for HRM. The first scenario was to reflect Regional Municipal Planning Strategy goals for growth in designated urban (Regional Centre), suburban, and rural portions of the region. The second was to reflect continuation of recent trends that have fallen short of the RMPS goals. The third and fourth were to reflect stronger regional goals emphasizing greater concentration of growth in the core of the region. Stantec and its partners, Gardner Pinfold Consultants, were responsible to determine and compare public, private, and social costs and benefits anticipated from these scenarios over the period from 2011 to 2031. Stantec has also woven an assessment of the health impacts of alternative scenarios through the study to identify qualitative outcomes identifiable through the analysis of individual services. The report sets out a framework for Health Impact Assessment for the purpose and follows it to the conclusion of the study.

2.0 SETTLEMENT IN HRM

Population in the area now defined as HRM has shifted erratically since the founding of Halifax in the mid-eighteenth century. Since the 1950s the trend has been strongly toward dispersion of residential population from the urban core. Today, HRM as a whole is one of the most dispersed urban areas in North America, when measured by overall population density within its municipal boundaries. A closer look at the Regional Centre and Suburban Area is more encouraging, as the Regional Centre, in particular, shows high levels of sustainable transportation use. Population quickly dissipates away from the core, however, and costs relative to comparable urban areas in Canada are evident in measures of network length for roadways, and water and wastewater networks servicing the existing Regional Centre and Suburban Area, as opposed to the rural portion of the region.

3.0 SCENARIO CREATION

Altus Economic Consulting prepared comprehensive population, household, and labour force projections for HRM in 2004 that were updated in 2009. Stantec has employed these projections, with adjustments as necessary to account for trends apparent in recently released 2011 Census data. Housing unit additions by type calculated to 2031 based on the Altus projections have been distributed within the Regional Centre, and Suburban and Rural Areas of the region using land suitability assessment in GIS, assigning new housing units progressively to areas defined as most desirable/suitable by the GIS model. Related employment estimates were created by HRM staff using methods developed in the VISUM transportation model employed to assess impacts on the region's transportation network.

4.0 TRANSPORTATION SYSTEMS

There is a complex two-way relationship between road improvements and regional development patterns. Together with other factors, expanded regional roadways facilitate dispersed development, which in turn generates demand for further road capacity both at the regional and local level. This study addresses the latter aspect of this relationship in terms of the influence of development on transportation.

The local road network must be extended with residential development in new areas of HRM. At the same time, additional residential development, depending on its scale and location influences use of the existing road network to degrees that may require strategic improvements. The distribution of development, furthermore, may influence the choice of mode of transportation, the vehicle trips required, and the time required for travel by citizens within the region. Stantec has quantified each of these factors for the four distribution scenarios to assess the influence of development patterns on the cost of transportation in the region.

5.0 WATER AND WASTEWATER SERVICES

Municipal networks for water distribution, as well as for collection and disposal of wastewater and stormwater are normally extended in association with new roads constructed in the Regional Centre and Suburban Area of HRM. In the Rural Area, piped networks are not provided as homes rely on wells and onsite septic disposal, with less expensive ditch and culvert systems for stormwater collection. Stantec has assessed the cost of developing the required systems in each area of HRM and the overall cost of their development for all of HRM.

6.0 OTHER PUBLIC SERVICES

A wide variety of services is provided to citizens through specialized facilities provided by the Municipality and the Province. While the form of facilities and the interaction between them and the citizens they serve varies considerably, their efficiency and adequacy is strongly associated with the distance between facilities and the public. For each distinct service provided, Stantec has calculated the cumulative distance between existing facilities and the new residential development distributed as assumed for each distribution scenario. We have also assessed the future adequacy of several facility networks to determine the potential need for new facilities under future distribution patterns.

7.0 PRIVATE UTILITIES

Several important networked systems are provided to HRM citizens by private companies. Stantec assessed the extension of electricity, telecommunications, and natural gas networks to determine their cost under each distribution scenario. In the case of natural gas, which is being supplied within a limited area of the municipality, Stantec also assessed the potential extent of the future network so as to provide a basis for further estimation of its environmental benefits.

8.0 SUMMARY OF SERVICE IMPACTS

Results of our analysis clearly show the benefits of concentrating new residential development. For nearly all services assessed, the best distribution scenario is Scenario B in which the maximum proportion (50 per cent) of new development is located in the Regional Centre. Of 26 measures ranked, Scenario B provides the best outcome for 22. The scenario ranks second in terms of increased transit use and obtains mixed results in terms of elementary and junior high school enrolment balance. It would however create the most stress on parkland supply of any scenario. Scenario A, which allocates 40 per cent of new development to the Regional Centre, generally ranks second, although it ranks ahead of Scenario B in terms of its positive impact on transit use. The current RMPS objective of locating 25 per cent of new residential development in the Regional Centre with 50 per cent in the Suburban Area and 25 per cent in the Rural Area generally ranks third with exceptions being water and wastewater improvements for which costs would be highest, school over and under enrolment, where it is at least tied for the best outcome for all three levels of schooling, and in terms of increased transit usage, in which it ranks

very slightly behind the Trend Scenario, partly because achievement of the RMPS Goals would encourage more use of active transportation modes. Continuation of the current trend by which only 16 per cent of new residential development has located in the Regional Centre provides the worst outcome in all cases except for transit usage, where it shows 0.1 per cent edge over the RMPS Scenario, and travel time to the Materials Recycling Facility, where it ties the RMPS scenario.

9.0 ENVIRONMENTAL, ECONOMIC AND HEALTH IMPACTS

Assessment of GHG emissions suggests that concentration of development will reduce locally generated greenhouse gas (GHG) emissions to a small degree. Economic assessment of costs to provide and maintain more extensive infrastructure, if sprawl is permitted to continue and for users to employ this infrastructure, suggests very substantial savings available. Between continuation of the current pattern of sprawl and the RMPS Goals, Gardner Pinfold has calculated nearly $700 million in savings can be achieved. Taking into account the densest alternative considered for this study (Scenario B), modelling suggests more than $3 billion in reduced costs. Health impacts were assessed qualitatively and Stantec has concluded that more condensed scenarios provide superior outcomes for six of nine factors considered to be related to community health. Evidence is ambivalent for the other three factors but does not alter the overall conclusions of this study.

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1.0 INTRODUCTION

The adoption of the Regional Municipal Planning Strategy (RMPS) in 2006 was a major step forward for HRM. The RMPS examined the region as a whole and created a framework for its future development. A key element of this framework was precisely stated goals for the distribution of regional growth among three areas shown on **Figure 1.1** within the region as follows:

> The citizens of HRM have indicated through consultation that a balanced approach to growth across the Municipality is the desired approach. To achieve this, approximately 25 per cent of growth will be targeted to occur on the Halifax Peninsula and in downtown Dartmouth, inside the Circumferential Highway (Regional Centre), approximately 50 per cent will occur in the Suburban Area, and the remaining 25 per cent will occur within the Rural Areas. This is consistent with projected housing demand in HRM.

The distribution of growth experienced since adoption of the plan has, however, diverged from this allocation with only 16 per cent of new dwelling units being added in the Regional Centre, while the remaining 84 per cent have been built in Suburban and Rural Areas, suggesting that sprawl has yet to be significantly curbed.

1.1 Project Objectives

HRM is seeking to demonstrate the potential benefits of achieving or exceeding the RMPS goal by comparing the different goals for development within the region. In adherence to the Request for Proposals (RFP) that set out the requirements for this project, Stantec has modelled and assessed the following four scenarios distributing newly developed residential units within the as follows:

1. *Current Regional Plan Growth Goals* – 25% Regional Centre, 50% Suburban, 25% Rural

2. *Actual Observed Growth (Post Regional Plan Adoption)* – 16% Regional Centre, 56% Suburban, and 28% Rural

3. *Hypothetical Growth Scenario A* – 40% Regional Centre, 40% Suburban, 20% Rural

4. *Hypothetical Growth Scenario B* – 50% Regional Centre, 30% Suburban, 20% Rural.

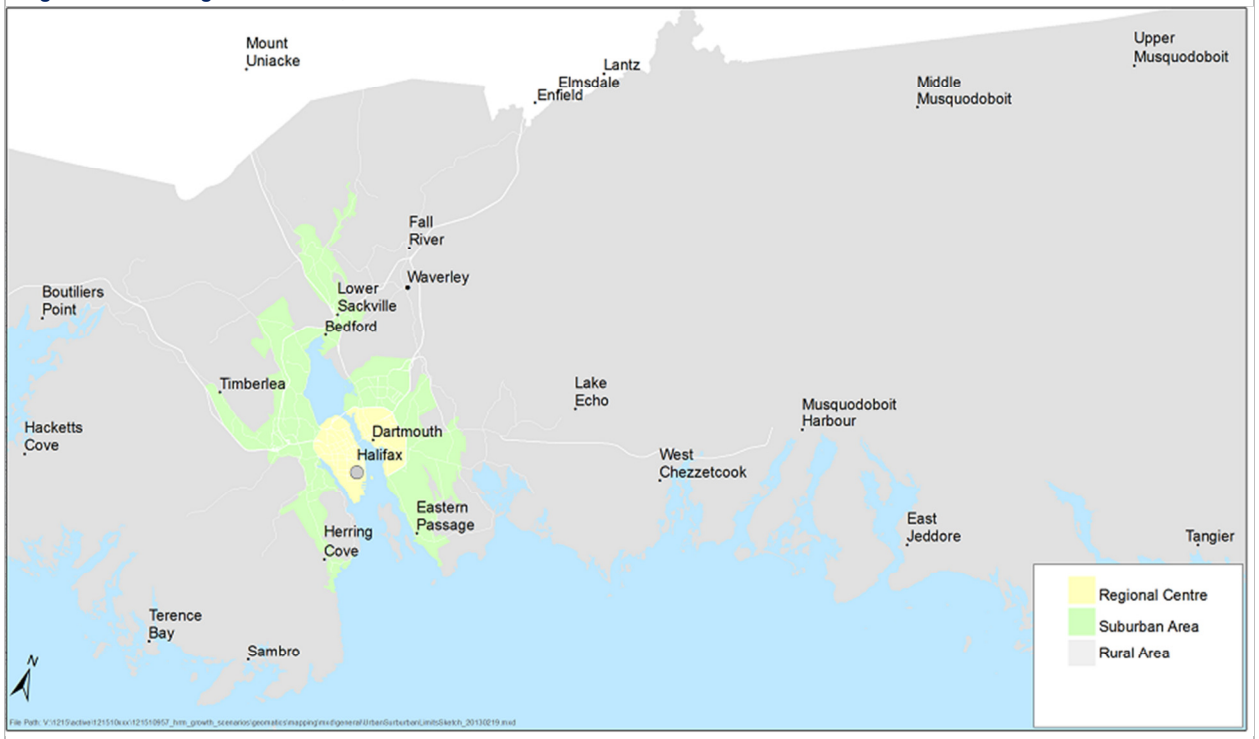
The four scenarios taken together cover the established plan goals (1) and actual experience (2), as well as two potential patterns that reinforce the current RMPS goals and aspire to an even more compact community (3 and 4).

The importance of reducing sprawl is well understood by planners and engineers. Limiting the extent of urban development reduces the length of infrastructure networks and the requirement for attendant elements such as pumping stations and interchanges. Reduced networks, furthermore, mean reduced operating costs given less infrastructure to maintain and less energy consumption for its use (*e.g.*, less pumping of wastewater and substantial reductions in fuel use for commuting). A smaller urban footprint also reduces the intrusion of development and human activity into wildlife habitat, increasing the land available for natural drainage and filtration, stormwater retention, groundwater recharge, flora and fauna, and for

human enjoyment, while increasing access choices and mobility by sustainable transportation modes such as transit, cycling, and walking.

The associated benefits accrue widely. The Municipality can gain by reducing the costs of providing services to its citizens. These benefits can be passed to citizens in the form of reduced taxes and/or enhanced services. Citizens will also gain through reduction of their direct expenditures associated with vehicle acquisition, operation, and maintenance, as well as time. Reduced use of energy for vehicle operation and other purposes also means reduced pollutant and Greenhouse Gas (GHG) emissions, which accrues benefits locally and globally. At the same time, the use of active transportation modes and transit increases levels of physical activity and reduces prospects of obesity. More time, improved access to employment, friends and amenities, a cleaner environment, promotion of physical activity and health, and preservation of natural spaces, furthermore, have lifestyle benefits that are less tangible but ultimately represent the "bottom line" for regional residents.

Figure 1.1 Designated Urban, Suburban and Rural Areas in HRM



Source: HRM, Regional Municipal Planning Strategy

1.2 Project Outputs

The quantification of alternative regional growth scenarios is a complex process. To manage the development and application of our modelling approach, Stantec conducted this assignment in three phases as follows:

- PHASE 1 – Research and Problem Definition
- PHASE 2 – Model Development and Application
- PHASE 3 – Final Assessment and Reporting

Within the phased structure, Stantec delivered the Modelling Approach Report summarizing Phase 1 work for the project. The first report outlined the history and status of settlement patterns in HRM, and the issues to be addressed. It also

described the data that was assembled and the approach to be applied to quantify the features of the four scenarios identified in **Section 1.1**.

In Phase 2, Stantec modelled residential development within the parameters set for each of the four scenarios prescribed by the project RFP. The consultants then estimated the public and private effects of each residential distribution. Development and application of a residential location model was a challenging undertaking given the breadth of considerations defined for this study. It was also challenging to calculate the influence of development on the array of services influenced by residential distribution, given that each has unique features and is subject to differing metrics.

The results of Stantec's assessment of development scenarios were passed to additional Stantec team members with specialized knowledge in the quantification of environmental impacts, and to our sub-consultant economists on this assignment, Gardner Pinfold Consultants, who have quantified and summarized the economic implications. These components have been compiled with the results of work in Phases 1 and 2 in this Final Report along with a Health Impact Assessment that has been woven through the document to identify and assess the social impacts of the alternative growth scenarios.

1.3 Project Approach

Consideration of the effects of development form and settlement patterns has not escaped the attention of regional planners working within what is now HRM. The Halifax-Dartmouth Regional Development Plan of 1975, for example, was fundamentally based on an assessment of land development suitability in the urban core of what is now HRM. Subsequent planning work in the region such as the Land Development Distribution Strategy and the related Mainland North Servicing Strategy addressed the extension of services more explicitly to prioritize and sequence development in specific areas. Later transportation planning work in the 1990s for the City of Halifax and the Metropolitan Authority, which was responsible for regional services such as transit and solid waste management before amalgamation, added similar mapping of roadway infrastructure needs and costs, as well as limited consideration of pollutant output.

In the late 1990s these considerations came together in the Integrated Servicing Strategy (ISS), which assessed the costs of developing a large number of areas in the core of HRM based on their respective transportation, transit, storm, sanitary, and water needs. The approach of the ISS was further refined in the 2002 Brownfield Options Paper, the 2003 Greenfield Areas Servicing Analysis, and the more recent Cost of Servicing Study. The issue of development density was also directly addressed in the very useful 2005 HRM staff study "Settlement Pattern and Form with Service Cost Analysis," which compared the costs of providing municipal services to a full range of residential development patterns.

This previous work provided a substantial and valuable foundation for the current assignment. The central task of this project has been to develop a comprehensive model to quantify accurately the full range of public, private, and social costs influenced by the regional settlement pattern. Most of these factors are reflected in municipal expenditures. Some, however, are the responsibility of senior governments and private companies (*e.g.*, highways, which are the responsibility of the Province, and electricity distribution and communications infrastructure, which are handled by a variety of utilities).

The required modelling exercise has two major elements: distributing development presumed by the prescribed scenarios in a rational manner and developing "cost and impact estimates" – recognizing that not all important effects associated with development can necessarily be monetized. The distribution of development is not simply a matter of allocating the specified proportions of development to the designated Regional Centre, and Suburban and Rural Areas of HRM. The suitability of land for development unquestionably varies within each area and with it the cost of development. Development can furthermore be assumed to be distributed first to the most suitable lands in each area and later to progressively less suitable lands.

Stantec has developed methods for defining the suitability of land using Geographic Information Systems (GIS) and allocating population sequentially in keeping with reasonable assumptions of developer/home buyer behavior that have been previously refined and applied by the company for projects in the US Southwest. At the heart of this methodology is GIS-based land suitability assessment, which is widely employed by planners and developers to evaluate the developability of lands. It has been applied in this project to quantify the development potential of lands in the Regional Centre, and Suburban and Rural Areas of HRM on a property by property basis, taking into account not only vacant lands but also the potential of already developed properties based on comparison of their market value with their presumed highest and best residential use. With reference to the determined distribution of residential units under each scenario, HRM staff developed related employment distributions using methods developed for the Municipality's VISUM transportation model.

With population and households properly assigned for each scenario, Stantec developed a collection of models to calculate the impact of development distribution on infrastructure access and adequacy under each Alternative Scenario defined in the RFP. This data provided the foundation for the modelling of pollutant and GHG impacts by Stantec and economic assessment by Gardner Pinfold Consultants.

As illustrated in **Figure 1.2**, these costs accrue in public, private, and social terms. Public costs, whether incurred by the Municipality, another level of government, or the private sector, can be readily calculated in relation to network length and cost per kilometer of network development. Due consideration must also be given to the provision of supporting facilities where existing facilities such as schools or recreation centres may become redundant in depopulated areas even as new facilities are required in growing areas without such services. These costs may, however, also be reflected in increased travel times to reach existing facilities from more dispersed residential areas. Ultimately, the costs calculated are absorbed by citizens in the form of taxes and/or user fees/prices, with the lion's share the responsibility of HRM residents (recognizing that a portion of costs is covered by the Provincial and Federal Governments, which generate revenue from wider areas).

The services taken into account in modelling the effects of future growth scenarios below are:

Municipal Services

- Water
- Sanitary Sewer
- Stormwater Management
- Roadways, Bikeways, and Trails
- Transit
- Solid Waste Management
- Fire and Emergency
- Police
- Community Facilities and Parks
- Libraries

Provincial Services

- Highways
- Schools
- Health Care

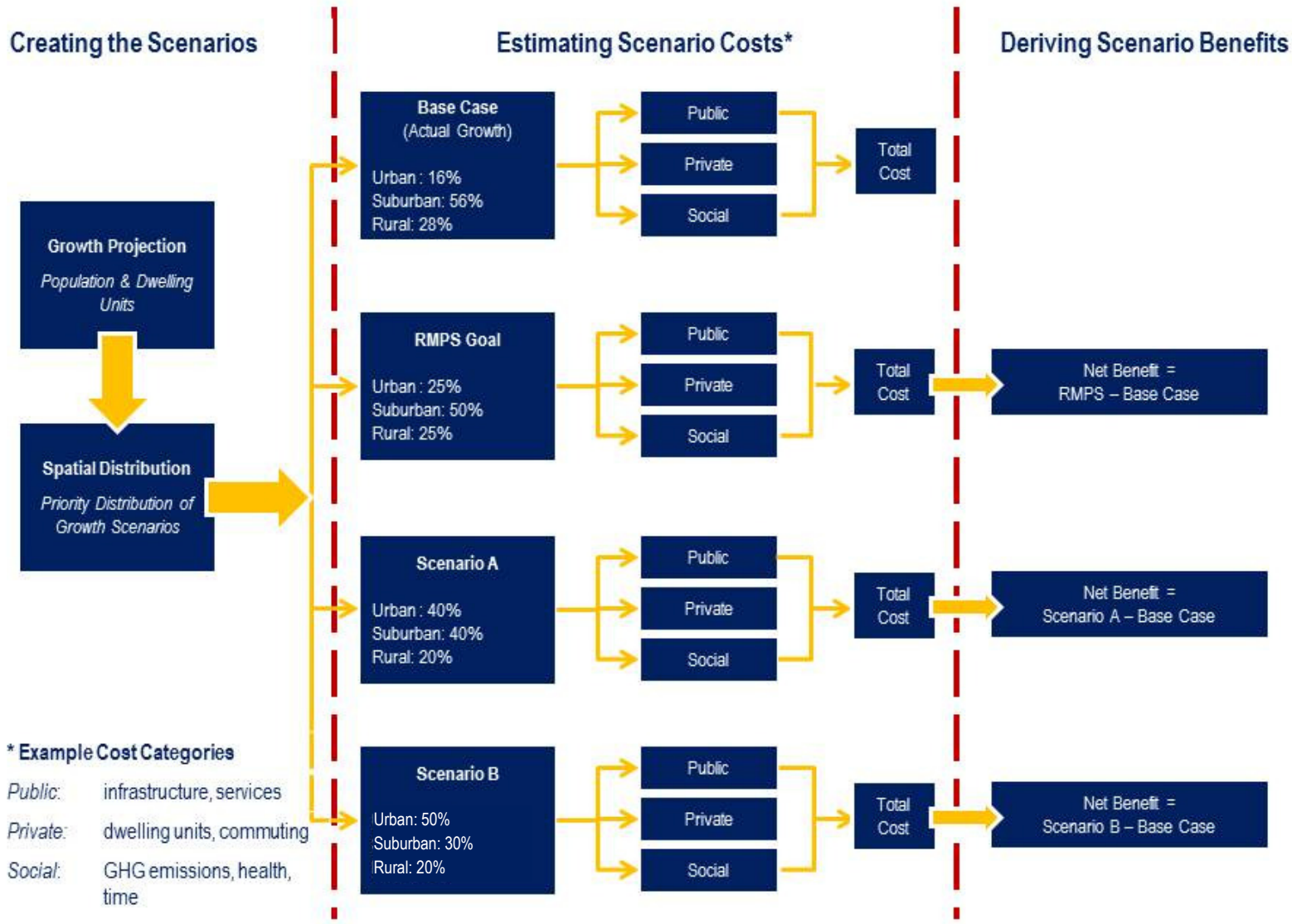
Private Services

- Electrical Utilities
- Communications Infrastructure
- Natural Gas

Taxes and user fees for utilities are not the only costs imposed on consumers under alternative scenarios, however. Modelling work presented below has also taken into account direct private costs associated with extended networks. The most obvious example of these is increased vehicle use, most notably associated with increased commuting distance but also with travel time to other facilities (*e.g.*, schools and recreation facilities). Additional costs will also be incurred for other forms of energy use to the extent that additional network costs may increase rates and/or may influence access to lower cost energy options (*e.g.*, natural gas).

Some social impacts such as pollutant outputs are quantifiable and reliable models are available to calculate these quantities with appropriate estimates of additional energy consumption under each scenario. Other potential impacts to overall quality of life have been assessed using a qualitative Health Impact Assessment (HIA) approach. HIA considers the broad human health impacts of projects or policies, taking a holistic view of health as reflected in the 1948 constitution of the World Health Organization (WHO), which defined health as:

Figure 1.2 Modelling Approach, Quantifying the Costs and Benefits of Alternative Growth Scenarios



> … a state of complete physical, social and mental well-being, and not merely the absence of disease or infirmity."

By assessing a broad range of social, economic, physical, and equity-based determinants of health, the HIA provides an understanding of the broader implications of the four growth scenarios, providing an appropriately holistic evaluation of the benefits of effectively directed development.

1.4 Project Scope and Limitations

The purpose of this study is to compare objectively four future conditions for residential development in HRM. The underlying hypothesis is that by concentrating development in patterns reflected by the RMPS policy or the higher levels of concentration posited by Scenarios A and B, the region can function more economically than it will if the current residential development trend (*i.e.*, the post-RMPS Trend Scenario) is allowed to continue.

The scenarios tested by this study are residential distribution scenarios; that is, they involve locating dwelling units consistent with the prescribed breakdowns outlined in **Subsection 1.1**. The first step to create the necessary scenarios was to determine how much development should be distributed in the envisaged future. In the interest of equitable comparison, the number of dwelling units needed to be the same for each scenario. It was also desirable that the number of units be realistic. For that reason, Stantec adopted projections of population and dwelling units prepared in 2009 for HRM by Altus Consultants to fill the role of "Growth Projections" shown in **Figure 1.2**. The Altus projections were particularly useful for the purposes of this study because they provided related estimates of labour force needed for modelling along with population and housing estimates. They only extended, however, to 2026, so Stantec extrapolated them to the prescribed study horizon of 2031 (see **Section 3.1**).

The four residential distribution scenarios required to address "Spatial Distribution" in **Figure 1.2** were developed by Stantec in GIS. The numbers of dwelling units expected to be located in the Regional Centre, and Suburban and Rural Areas were allocated to those areas and then distributed to properties in those three areas based on assumptions concerning their "developability" (*i.e.*, a combination of considerations taking into account each property's availability, legal potential for development, technical and economic suitability for development, and relative attractiveness as explained in **Section 3.2**, below).

This detailed positioning of new dwelling units and their associated residents facilitated their allocation to Traffic Analysis Zones defined for HRM's regional transportation model (see **Figure 3.4**, below). Non-residential land uses that relate to residential development as well as to each other were located based on assumptions concerning the relationship between these land uses and ongoing residential development previously developed by HRM staff. In short, these assumptions assign the bulk of jobs to existing employment centres taking into account the relative recent growth of local employment centres and recognizing that a portion of business and institutional uses is located with new residential areas. Very generally, this means that work in this study assumes that the current major employment centres in HRM – Downtown Halifax, Burnside/City of Lakes/Dartmouth Crossing, Bayers/Ragged Lakes, and so on – will hold their positions while some new employment will locate with new areas of residential development. This means that employment is somewhat more dispersed in the Trend Scenario versus the more concentrated alternatives but that the foci of non-residential development under all scenarios will remain largely where they are at present.

As outlined in the preceding section, this study assesses a broad range of services. To the best of our knowledge, the scope of its assessments considerably exceeds similar studies of regional development patterns prepared for other communities and regions. Most other studies of which we are aware have focused on linear services, particularly linear services that are typically delivered by local government. These most often include roads, and water and wastewater networks.

As homes are developed, this linear infrastructure extends with them. A road or roads, for example, must usually be built to provide access to a new subdivision. The length of road will depend on the frontage of the homes, which will largely vary in relation to the form of housing and the frontage and lot area requirements of the applicable land use bylaw. In areas within the Regional Service Boundary applied in HRM, the extension of roads is normally accompanied by curbs and sidewalks as well as pipes for water delivery, and wastewater and stormwater removal. In unserviced areas, new roads imply wells, septic systems, ditches, and culverts. Roadway, and water and sewer network requirements were calculated on a per meter basis for each development type. Stantec's property-based allocation of development allowed the consultants to know the frontage of each property to be developed or to estimate frontage based on assumed density in areas that will require subdivision. It also allowed the consultants to identify infill properties that will not require additional infrastructure because they already have frontage on a public roadway with necessary services.

The impacts of development are not, of course, confined to the frontage of the developed property. Homes, for example, generate trips that impact collector and arterial roads across the region. These components of the road and transit systems were assessed using the Municipality's transportation model. The model, like most transportation models, focuses on the impacts of growth and change on the journey-to-work. The afternoon commuting peak is the time at which the road network and the transit system are subject to the highest levels of use. Strains experienced in the afternoon peak are the primary determinants of road upgrading requirements and required transit capacity. Model outputs indicate which segments of the road network will be subject to undue strain from additional development and, therefore, need to be upgraded. The model also indicates the expected proportion of trips absorbed by the transit system, which provides an indication of the potential strains on the existing transit system implying a need for upgrades or, alternatively, where scenarios suggest higher levels of transit use, the potential to reduce subsidy to the system thanks to increased fare revenue.

Water and wastewater systems were assessed using a collection of models of water and wastewater infrastructure created for Halifax Water. Stantec engineers ran these models with inputs based on projections of population and labour force in 2031 distributed as described in relation to the transportation model above. The models assess the ability of infrastructure in each water service area or sewershed to accommodate the requirements or loads anticipated in 2031. As with the transportation model, the water and wastewater models identify components of the system (*i.e.*, pipes, pumps, and treatment facilities) that need to be upgraded.

Models similar to the transportation, water, and wastewater models were not available for other services considered. For each of these services, Stantec created individual models that generally determined the distances of residences from existing facilities that could be summed and compared for each scenario. For some additional linear services (*i.e.*, electricity and communications, and natural gas) needs for network extensions were calculated in a similar manner to local roads and services described above. For schools and libraries, the capacity of existing facilities was compared, respectively, to anticipated school age population and general population to identify facilities that will be subject to over-use or over-enrollment and, in the case of schools, under-enrollment. For parks and open spaces, the existing supply was compared to accepted standards for parkland provision and the cost of addressing deficits where they occurred was calculated.

Measures of additional development, and infrastructure requirements and use were provided to economic consultants Gardner Pinfold Consultants for further estimation of operating costs and economic impacts. The same data was also provided to Stantec environmental staff to calculate the expected generation of greenhouse gases (GHG) and common air pollutants.

Throughout the study further consideration was given to the health impacts of outcomes estimated by each assessment. Health Impact Assessment or HIA is a relatively new discipline expanding the scope of traditional economic and environmental impact assessment to consider the influence of development and policy initiatives on public health. It recognizes that the condition of public health is

closely associated with the environment in which residents live. In the developed world, the critical environmental influences have much less to do with direct health concerns such as exposure to disease than to quality of life issues such as availability and productivity of time and levels of social equity.

The HIA contained in this document was conducted at a high level. It is based on limited direct consultation of stakeholders and no public consultation. Potential health impacts have been identified from secondary sources as explained further below. The HIA should be regarded as a rapid assessment intended to establish and address these impacts in company with more detailed analysis of economic costs and benefits.

The comparison presented below involves the overlay of conditions anticipated in 2031 on observable current conditions, Other than a small number of critical planned transportation network improvements incorporated in the transportation model for this study and specific facility improvements that are now underway (*e.g.*, the Central Library now under construction), future development is assessed against current service provisions.

Assessment, furthermore, is focused on distribution rather than quantity of development. The total number of residential units and related parameters (*i.e.*, population and labour force) are essentially the same for all four scenarios. The amount of solid waste going to landfill, therefore, is not relevant to this study, as it is the same for all scenarios in the absence of reliable data on differences in waste generation for different housing locations. How far waste must travel to landfill is, however, very relevant both in terms of the cost of energy consumed and its environmental consequences.

Currently available models are discrete and are not dynamic. Models such as the transportation model and water and wastewater models used by HRM analyze their respective infrastructure components independently of each other. Unquestionably, whatever development pattern evolves in HRM, the Municipality and senior governments, businesses, and citizens will adapt incrementally to the conditions that transpire. Modelling such adaptation is not however realistic. In addition to the limitations of existing models, determination by the consultants of the future response of HRM's society to four gradually evolving patterns of residential distribution would undermine the objectivity of the analysis set out in the following chapters of this report.

Similarly, potential changes to standards of development were not considered. Certainly, standards can be expected to evolve. In some cases, most notably wastewater collection and treatment future requirements have been identified and are being incorporated in current planning. The practicality of taking these changes into account is challenged by uncertainty and the limitations of available models, as well as by the scope of this study and the resources available for its execution.

Ultimately, the analysis presented following is a cost-benefit analysis, as suggested by the title of this study. To the degree possible, estimated impacts have been monetized. The extension of water services, for example, has been converted to a cost to construct based on typical per meter costs estimated for this study. For some other services costs have been estimated in terms of the inconvenience or cost to the public of accessing services. An example of this condition would be libraries. Rather than estimate the cost to construct libraries needed to maintain current levels of service, we have estimated the cost in travel time for citizens to access the library facilities closest to them. The comparison of alternative scenarios, therefore, is based on the relative costs of accessing the existing library system from new households distributed as expected in each scenario.

This study is a broad, high level assessment. Given that its bottom line is economic costs for HRM society, of which the Municipality is a component, cost estimates presented below are not comparable to more detailed studies of individual services undertaken by HRM. They provide an order of magnitude basis for comparing the four scenarios defined for this study, not a basis for estimating future budget requirements.

The HIA component of this report addresses important factors influenced by the pattern of residential development that cannot be readily monetized. This study has not included a significant consultative component to identify potential health impacts

associated with alternative patterns of residential development. In place of specific input for this study, the consultants have relied on academic literature and a variety of guidebooks dealing with HIA, and the relationship between urban development and public health. Although HIA is a relatively new methodology, practitioners have given substantial attention to the relationship between health and the built environment. This includes a range of academic studies; a variety of fact sheets, toolkits, and manuals; as well as a small number of completed HIA studies dealing with urban and regional planning related topics.

One particularly useful and pertinent publication is the *Healthy Communities Practice Guide* prepared for the Canadian Institute of Planners (CIP), which represents the mainstream view of the Canadian planning community. The Guide directly addresses the health impacts of sprawl as follows (numbering added to original):

> Communities with wide-spread sprawling development encourage vehicle use and vehicle-oriented design which have a multitude of negative impacts on community health:
>
> [1.] increased greenhouse gas emissions and air pollution;
>
> [2.] increased stormwater runoff and water and soil pollution;
>
> [3.] increased risk of danger to pedestrians, cyclists, and drivers;
>
> [4.] decreased options for active or alternative transportation;
>
> [5.] decreased opportunities and safety for outdoor physical activity;
>
> [6.] limited accessibility and mobility for non-drivers and a decrease in social [equity];
>
> [7.] reduced amounts of affordable accommodations close to community resources;
>
> [8.] decreased opportunities for social interaction and a detraction from overall social well-being;
>
> [9.] increased commuting time; and
>
> [10.] reduced neighbourhood safety as a result of limiting the amount of eyes on the street.
>
> To the contrary, communities that are well designed in terms of land use mix, density, and connectivity can contribute to positive community health benefits.

HIA is normally applied to assess the validity of a specific policy initiative in terms of features that contribute to enhanced public health or, alternatively, are detrimental to health. The objective of this study is to assess three alternative "policy approaches," one of which is in place as a central theme of the RMPS, against a baseline condition reflecting the trend experienced despite existing policy. The other two potential policies have been suggested to explore the possibilities of reinforcing existing policy.

Analysis below assesses the influence of each scenario on the 16 services or service groupings listed in **Section 1.3**. The HIA addresses the influence of each scenario in terms of the nine questions posed in **Table 1.1**, which are based on the health impacts listed above from the CIP Guide (see the column headed CIP Ref in **Table 1.1**). For each factor, the influence of each scenario on the service analyzed is discussed and assessed. For GHG emissions, transit use, and some other factors, objective quantitative measures have been generated and provide the basis for ranking. In other cases, rankings have been determined and assigned by the consultants. These latter qualitative rankings are founded on the accompanying discussion. Where possible, this draws on quantitative evidence generated by the analyses of each service or from additional data available from secondary sources.

Table 1.1 Settlement Pattern-related Factors Influencing Health

Factor	CIP Ref	Question
Time Availability	9	Does the scenario increase or decrease the discretionary time available to citizens for productive activity, recreation/leisure, or social interaction?
Alternative Transportation Modes	3, 4	Does the scenario promote the use of transit, and/or active transportation modes?
Physical Activity	5	Does the scenario encourage or discourage physical exercise either by promoting the provision and use of alternative transportation modes or by enhancing access to facilities specifically provided for exercise (*i.e.,* parks and open spaces, arenas, gymnasia, *etc.*)?
GHG/Pollutant Emissions	1	Does the scenario increase or decrease the output of GHGs and/or other pollutant emissions?
Environmental Conservation/ Management	2	Does the scenario increase or decrease the area of land left in its natural state by virtue of the extent of construction involved? *and/or* Does the form of development potentially increase or decrease impacts on the quality of land and water?
Public Safety	3, 10	Does the scenario enhance or diminish public safety in fact or perception?
Housing Affordability	7	Does the scenario facilitate or hinder the provision of housing types that are more affordable and/or reduce the costs associated with owning and operating a home?
Social Equity	6	Does the scenario promote social equity by enhancing the access of disadvantaged groups (*e.g.*, the poor, youth, the elderly, physically and mentally challenged) to needed services, by promoting social cohesion, or by reducing costs?
Social Interaction	8	Does the scenario promote or inhibit interaction among citizens?

2.0 SETTLEMENT IN HRM

HRM is both a typical and a distinctive urban centre in the North American context. It is subject to the same technological trends that have influenced settlement patterns across the continent over more than a century. It is served by modern highways and residents predominantly rely on the automobile to move within the region. Halifax is, on the other hand, the easternmost major urban centre on the continent and has a long history of urban settlement by North American standards. It is also a coastal community with an ocean on one side and deep inlets that significantly interfere with direct movement along the shore, where the majority of the population lives and works. Movement on land also faces impediments from rugged topography and equally harsh geology, which not only influence the ease with which communities can be connected within the region but also impact the ability to build in many areas.

As the largest centre in a relatively sparsely populated and very extensive region, HRM also has a variety of roles to play. It is the capital of Nova Scotia. It is the primary point of entry to and exit from Atlantic Canada. It is an important centre of production and an even more important centre for the delivery and management of goods and services. It is also a major cultural centre that people outside of Atlantic Canada look on as a reflection of the region and people within the region look to as a leader.

2.1 The History of Urban Development in HRM

Halifax is first and foremost a port city. It is, furthermore, a port primarily oriented to the ocean in contrast to many other ports such as Montreal, Chicago, or New York that draw on extensive hinterlands of agriculture, resource extraction, and manufacturing activity. Certainly, Halifax does have a hinterland but in contrast to many other major ports, its small population provides both relatively modest outputs to export and a limited market for imports.

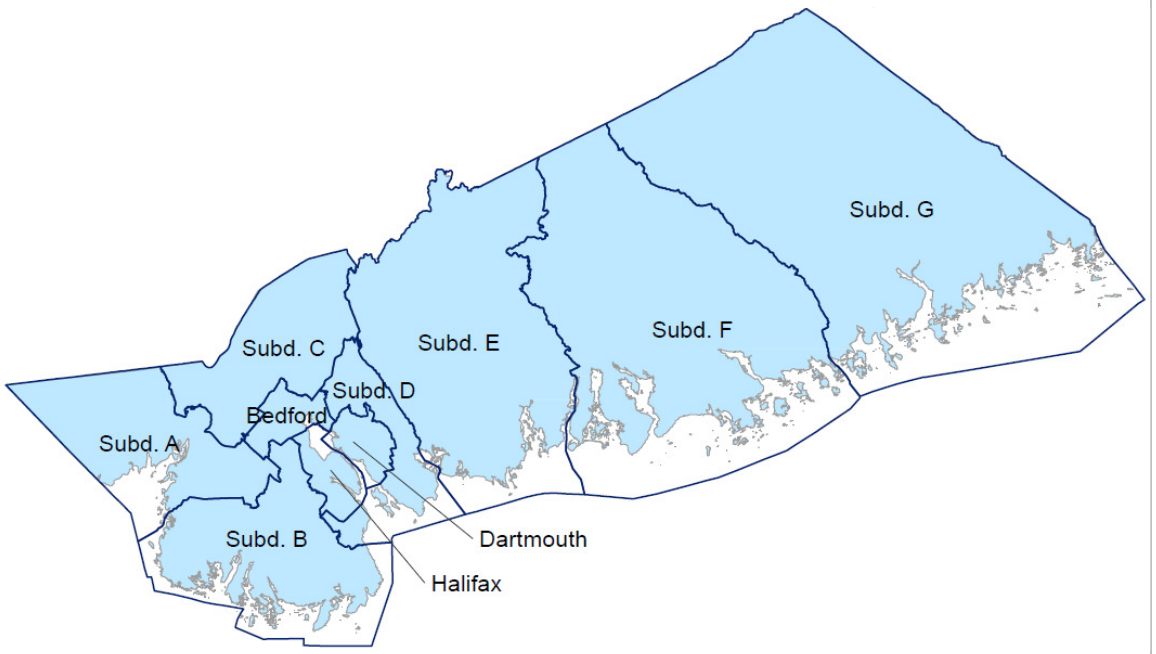
Halifax was settled and built in 1749 because of its strategic location. Its harbour is the second largest in the world and is brilliantly configured to shelter fleets and defend the land. The town and later the city of Halifax famously grew around the Citadel fortress on the Halifax Peninsula.

Settlement did not however stay confined to the Peninsula for long. By the late years of the eighteenth century, during his time in Halifax as Commander-in-Chief of British forces in North America, Prince Edward the Duke of Kent built Prince's Lodge on the shores of Bedford Basin on an estate already established there by the then Lieutenant Governor of Nova Scotia, Sir John Wentworth. Other prominent Nova Scotians, similarly, built homes away from the bustle of the Peninsula such as Uniacke Estate in Mount Uniacke and one-time Premier James William Johnston's Mount Amelia in Dartmouth.

Many common people also lived outside the small urbanized cluster on the harbour. At the first Census following Confederation in 1871, barely half the region's population was located in the City of Halifax, which only received its charter in 1849, and the community of Dartmouth, which was then two years from being recognized as a town. Many rural people lived off the land through farming, fishing, or both, and were spread relatively evenly along coastlines and valleys in what is now HRM

(**Figure 2.1** and **Table 2.1**). Suburban living, though, remained largely a privilege of the rich as it was not practical for most to live in the country and work in the city before the advent of motorized transportation.

Figure 2.1 Halifax Census Subdivisions, 2006



Source: Census of Canada

In the following decades, however, the focus on the urban centre steadily rose, until the 1920s when nearly 70 per cent of the region's population lived in Halifax or Dartmouth. The critical advances that brought about the movement of population into cities were of course related to transportation and communications. The building of railways was one of the primary motivations for Confederation in 1867. Shortly afterward, Alexander Graham Bell invented the telephone and, subsequent to that, a variety of inventors and entrepreneurs invented and marketed the automobile. These inventions combined with improvements in agriculture allowed many people to move off the land to come to cities like Halifax and towns like Dartmouth to pursue new types of careers and enjoy the benefits of access to goods and services, education, and other amenities that could not be easily provided to a dispersed population.

As quickly as technology brought population together at the centre of the region, it began in the 1930s to send it back out. As population surged with the coming of war at the end of the decade, many residents chose to live in the suburbs. Although the City of Halifax, which was still confined to the Peninsula, gained more than 10,000 people from 1931 to 1941, Census Subdivision D, which then included areas such as Spryfield, Fairview, and Rockingham, as well as other areas contiguous with the recognized urban communities, increased its population by 7,099 or nearly 70 per cent.

The 1941 Census was the first in which Halifax and Dartmouth's share of the region's population declined but the trend once established was steady. From 1941 to 1956, the proportion of population in Halifax and Dartmouth shrank from 66.3 per cent to 57.8 per cent.

The share of the two urban communities rebounded in the 1961 Census after the MacDonald Bridge was built. The bridge opened up Dartmouth to workers living in Halifax and its population surged from 21,093 in 1956 to 46,966 in 1961, leading to it becoming a city. Its population increase of 123 per cent was the largest experienced by any urban community in Canada over that period. Halifax, however, lost population for the first time between1956 to 1961, and lost even more from 1961 to 1966 (**Figure 2.2**).

Table 2.1 Population by Census Subdivision, Halifax Region, 1871-2011

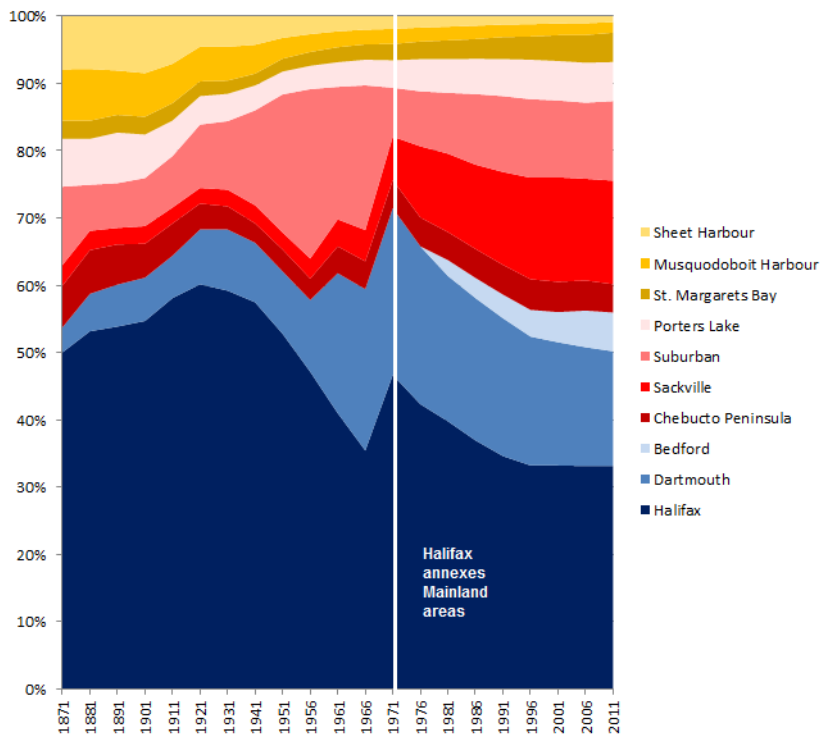
				CSD							
Census	Halifax	Dartmouth	Bedford	A St. Marg-arets Bay	B Chebucto Peninsula	C Sackville	D Suburban	E Porters Lake	F Musquo-doboit Harbour	G Sheet Harbour	Total
1871	29,582	2,191		1,615	3,670	1,811	6,905	4,211	4,497	4,672	59,154
1881	36,100	3,786		1,832	4,409	1,956	4,638	4,642	5,220	5,334	67,917
1891	38,437	4,452		1,884	4,259	1,752	4,737	5,370	4,699	5,768	71,358
1901	40,832	4,806		1,979	3,766	1,956	5,330	4,829	4,835	6,329	74,662
1911	46,619	5,058		2,085	3,845	1,901	6,131	4,240	4,697	5,681	80,257
1921	58,372	7,899		2,131	3,738	2,259	9,143	4,100	5,001	4,410	97,053
1931	59,275	9,100		1,955	3,445	2,478	10,192	4,080	5,042	4,557	100,124
1941	70,488	10,847		2,160	3,531	3,296	17,291	4,541	5,262	5,216	122,632
1951	85,589	15,037		3,120	5,295	4,090	33,303	5,492	5,010	5,237	162,173
1956	93,301	21,093		4,068	6,294	5,930	49,804	6,873	5,248	5,289	197,900
1961	92,511	46,966		5,021	8,994	9,058	44,469	8,257	5,329	5,104	225,709
1966	86,792	58,745		5,607	10,138	11,380	52,654	9,321	5,353	4,907	244,897
1971	122,035*	64,770		6,300	10,969	16,846	18,984**	10,675	5,873	4,971	261,423
1976	117,882	65,331		7,304	11,929	29,466	22,750	13,318	5,795	4,713	278,488
1981	114,594	62,277	6,777	8,058	11,984	33,581	26,052	14,402	5,858	4,513	288,096
1986	113,577	65,038	9,198	9,026	13,220	38,503	32,254	16,080	6,101	4,376	307,372
1991	114,455	67,798	11,618	10,814	14,611	45,667	37,289	18,211	6,130	4,160	330,753
1996	113,910	65,629	13,638	11,833	15,599	51,763	40,001	20,093	6,255	4,125	342,851
2001	119,292	65,741	16,102	13,785	16,153	55,765	41,039	21,046	6,268	3,905	359,111
2006	*123,612*	*65,634*	*20,329*	*15,374*	*16,708*	*56,395*	*42,174*	*22,203*	6,493	3,936	372,858
2011	*128,764*	*69,788*	*20,969*	*15,387*	*18,746*	*58,547*	*43,560*	*24,461*	*6,129*	*3,479*	390,328

* Halifax annexed Mainland Areas, 1969
** Lost Mainland areas to Halifax, 1969

Source: Census of Canada, *italic figures* are Stantec estimates

In addition to Dartmouth, Halifax was losing population to the suburban mainland area to the west of the Peninsula. Mainland communities were in fact growing so rapidly that the County of Halifax, which was responsible for all of the area outside the two cities, had considerable difficulty keeping up. In the late sixties, ratepayers in Rockingham applied to the Public Utilities Board, which was the predecessor to today's Utilities and Review Board, to be annexed to the City of Halifax.

Figure 2.2 Population Shares, HRM, 1871-2011



Source: Census of Canada

They were joined by ratepayers in Spryfield and, in 1969, the Board approved the annexation to Halifax of lands extending from Fernleigh Park in the north to a point in the south just north of Purcell's Cove and extending westward roughly to lands owned by the City's Public Service Commission that were then used to supply municipal water.

Combined with more modest additions to Dartmouth, Halifax's 1969 annexation restored the share of regional population to the two cities. In 1971, they accommodated 71.5 per cent of the people in the region, exceeding the previous peak of 68.3 per cent achieved in 1931.

Table 2.2 HRM Growth by Decade, 1871-2011

Period	Largest Gain	Largest Loss	Regional Population Change	Major Influences
1871-1881	Halifax	Suburban	8,763	
1881-1891	Halifax	Musquodoboit	3,441	
1891-1901	Halifax	Porters Lake	3,304	
1901-1911	Halifax	Sheet Harbour	5,595	
1911-1921	Halifax	Sheet Harbour	16,796	WWI
1921-1931	Dartmouth	Chebucto Pen.	3,071	
1931-1941	Halifax	Chebucto Pen.	22,508	WWII
1941-1951	Suburban	Musquodoboit	39,541	WWII
1951-1956	Suburban	Sheet Harbour	35,727	
1956-1961	Dartmouth	Halifax	27,809	Macdonald Bridge built
1961-1966	Dartmouth	Halifax	19,188	
1966-1971	Halifax	Suburban	16,526	Annexation
1971-1976	Suburban	Halifax	17,065	
1976-1981	Bedford-Sackville	Halifax	9,608	RDP
1981-1986	Suburban	Halifax	19,276	
1986-1991	Sackville	Sheet Harbour	23,381	
1991-1996	Sackville	Dartmouth	12,098	Amalgamation
1996-2001	Halifax	Sheet Harbour	16,260	
2001-2006	Bedford	Sheet Harbour	13,747	
2006-2011	Bedford	Sheet Harbour	17,470	RMPS

Source: Census of Canada

The 1970s, however, saw a resumption of outflow to the suburbs. Dartmouth had been substantially developed and attention turned to the Bedford-Sackville area in Subdivision C, north of the Bedford Basin, which had previously grown moderately. The area, which became considerably more accessible following improvements to the Province's network of freeways, jumped from less than 5 to more than 10 per cent of the region's population between 1966 and 1976 and has continued to increase its share in every census since, despite the loss of Bedford in 1981 when it became a town.

These trends have continued to the present. The former area of the City of Halifax has grown reasonably over the two census periods from 1996 to 2006; however, Dartmouth stagnated, with just 170 additional residents over the ten years. Based on estimates of the CSD populations developed by Stantec from Census Tract counts, the two former cities, as of 2006, accounted for just 50.7 per cent of the region's population or three percentage points less than in 1871, when 53.7 per cent of the region's population lived on the Halifax Peninsula and the area of Dartmouth that became a town in 1873.

The suburban communities in the former Town of Bedford and Census Subdivisions B, C, D, and E, by contrast, have 42.3 per cent of the region's population compared to 28.1 per cent in the distant past when their area included the mainland west of Halifax and substantial portions of what later became the City of Dartmouth. The three outermost areas – St. Margaret's Bay to the west and Musquodoboit Harbour and Sheet Harbour to the east – have fallen from 18.2 per cent just after Confederation to just 6.9 per cent today, although the St. Margaret's Bay area has been growing with increasing momentum since the 1950s and the Musquodoboit Harbour area has stabilized as it has begun to be drawn into the urban commutershed.

Data from the recently released 2011 Census shows that the region added another 17,417 people between 2006 and 2011, which is more than was added in any other census period since the late 1980s. Statistics Canada has not yet released the 2011 populations of HRM Census Tracts; however, an interesting map and table showing percentage population changes in each tract has been posted online. Applying these rates to 2006 Census Tract populations we have estimated populations for 2011. Because the growth percentages provided by Statistics Canada are rounded and some growing Census Tracts were subdivided between 2006 and 2011, these numbers need to be interpreted cautiously (**Table 2.3**). Nevertheless, compiled at the Census Subdivision level, they are reasonably accurate and provide insight to the most recent trends in the region. By our estimate, Bedford again topped the region in terms of percentage population growth (10.8 per cent), although the Suburban Area around the former cities kept pace at 9.4 per cent. Halifax also continued to grow well, adding a similar number of residents as Bedford and the Suburban Area combined. Dartmouth, however, only grew by 1.0 per cent.

Table 2.3 Population by Census Subdivision, Halifax Region, 2001-2011

CSD	2001	2006	% Change	Estimated 2011	% Change
Halifax	119,292	*123,566*	3.6%	129,441	4.8%
Dartmouth	65,741	*65,799*	0.1%	66,461	1.0%
Bedford	16,102	*20,315*	26.2%	22,515	10.8%
St. Margarets Bay	13,785	*15,363*	11.4%	16,407	6.8%
Chebucto Pen.	16,153	*16,696*	3.4%	17,029	2.0%
Sackville	55,765	*56,356*	1.1%	60,099	6.6%
Suburban	41,039	*42,145*	2.7%	46,117	9.4%
Porters Lake	21,046	*22,188*	5.4%	22,649	2.1%
Musquodoboit	6,268	6,493	3.6%	6,129	-5.6%
Sheet Harbour	3,905	3,936	0.8%	3,479	-11.6%
TOTAL	**359,111**	**372,858**	**3.8%**	**390,328**	**4.7%**

Source: Census of Canada

The remaining Suburban Area gained significant population, particularly Sackville and the St. Margarets Bay area. The two eastern subdivisions, which have consistent boundaries traceable back to 1871, and therefore do not have to be estimated, lost substantial numbers, particularly the Sheet Harbour area.

2.2 Settlement in HRM Today

In the United States, the outward movement of urban population is often associated with processes of urban decay and associated "suburban flight" or the phenomenon of middle class and wealthier residents escaping crime and declining property values in older neighbourhoods in the core. The applicability of this model in Canada as well as in many smaller American cities is debatable, however. While Canadian cities certainly have troubled areas, the relationship between urban deterioration and proximity to the urban centre is erratic at best. This is clearly the case in HRM, where substantial areas of the Peninsula and the core of Dartmouth have been consistently strong residential real estate markets.

Many factors contribute to the dispersal of development in HRM, not all of which are driven by the housing market. In particular, research has shown the locations of freeways and schools (both of which are normally planned and financed by the public sector) to be important influences on residential development. Provincial land banking for affordable housing programs was also an important influence in the development of suburban HRM. One important feature of our region relative to inland cities in both Canada and the US is the variability of our topography and the impact of our irregular coastline. The presence of our deep harbour, for example, stalled the development of Dartmouth for more than a century until the Macdonald Bridge was built. Similarly, the rocky land in many areas of the mainland has tended to channel development within specific corridors.

Halifax, as noted, was originally chosen as the primary focus of settlement because it met a variety of military requirements. The drumlin on which the Citadel was built allowed the British to survey the harbour. It also provided soil cover on which it was relatively easy to build the fortress and the structures of the city that was laid out below it. The lands to the west were also probably reasonably productive areas for farming, in contrast to much of the adjacent area that became part of Halifax County, where bedrock is close to the surface and large rock outcrops are frequent.

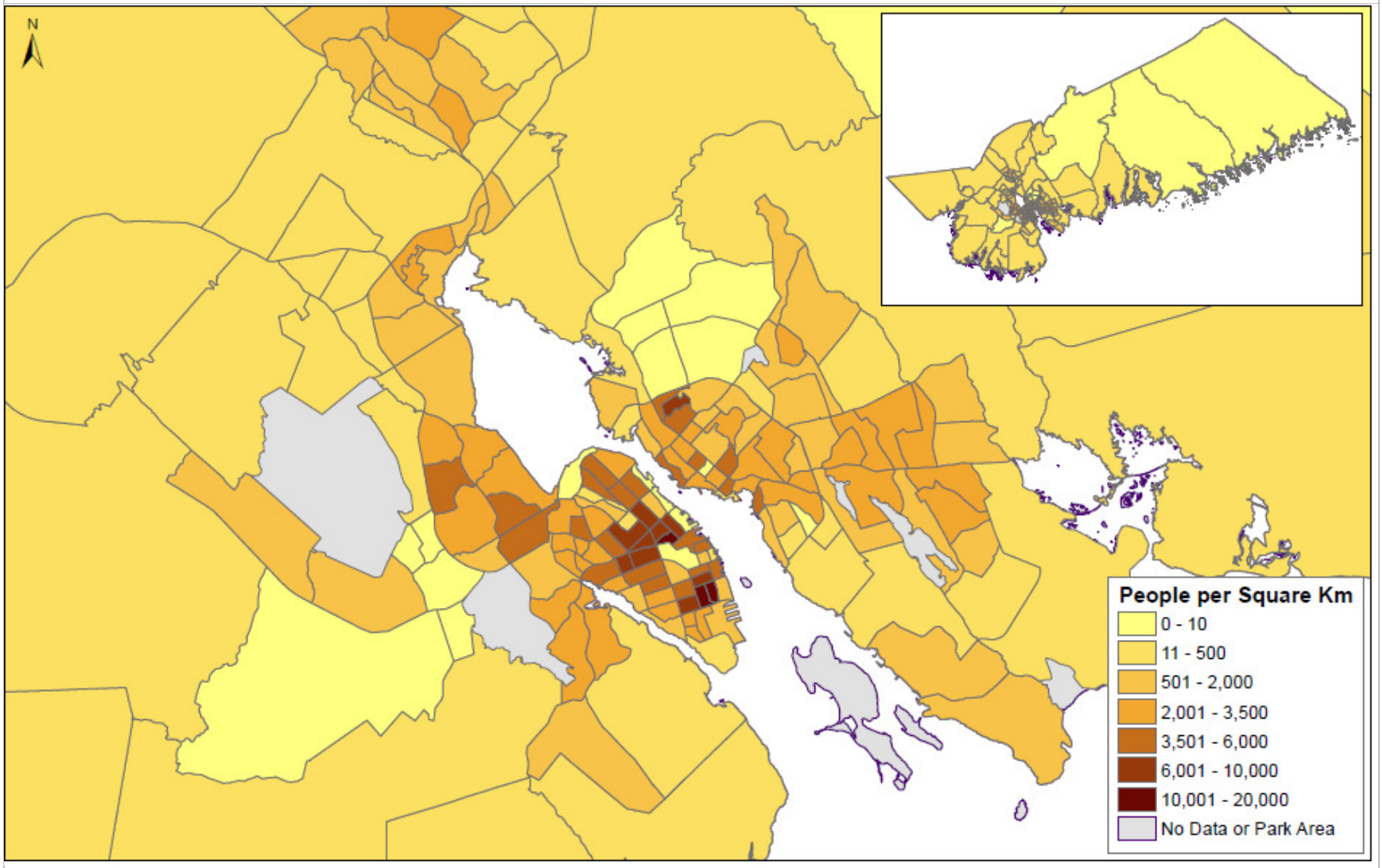
The Peninsula also has features that have sustained its attraction for residential development. The overview of water that was prized by military engineers is also valued by residential developers and homebuyers. The western side of the Peninsula also offers prospects over the Northwest Arm, which was an effective "moat" that allowed the landward defence of the Peninsula to be focused on the isthmus now occupied by the Fairview Overpass and the Armdale Roundabout. Today the inlet is one of the most attractive residential areas in Canada with sloping properties on both sides enjoying waterfrontage and water views over parklands and recreational activity.

The region, in fact, has many areas on the coast, the shores of lakes and rivers, on ridges, and in valleys that provide outstanding residential sites. It also has extensive areas on which construction is challenging, including many that have become subject to restrictions under contemporary planning regulations because of their proximity to coastlines and watercourses, or because of excessive slope.

The region has, in addition, developed in fits and starts. It grew significantly through the two world wars. Like most of Canada, it continued to grow strongly after the Second World War as a result of the Baby Boom, which continued to the mid-1960s. It has slowed since but has remained steady and substantial, averaging about 10,000 additional residents per five-year Census period. Areas on the western Peninsula were still being developed in the 1940s and 50s but development was also proceeding apace in mainland areas such as Spryfield and Fairview. As noted, Dartmouth grew strongly following the completion of the Macdonald Bridge in 1955.

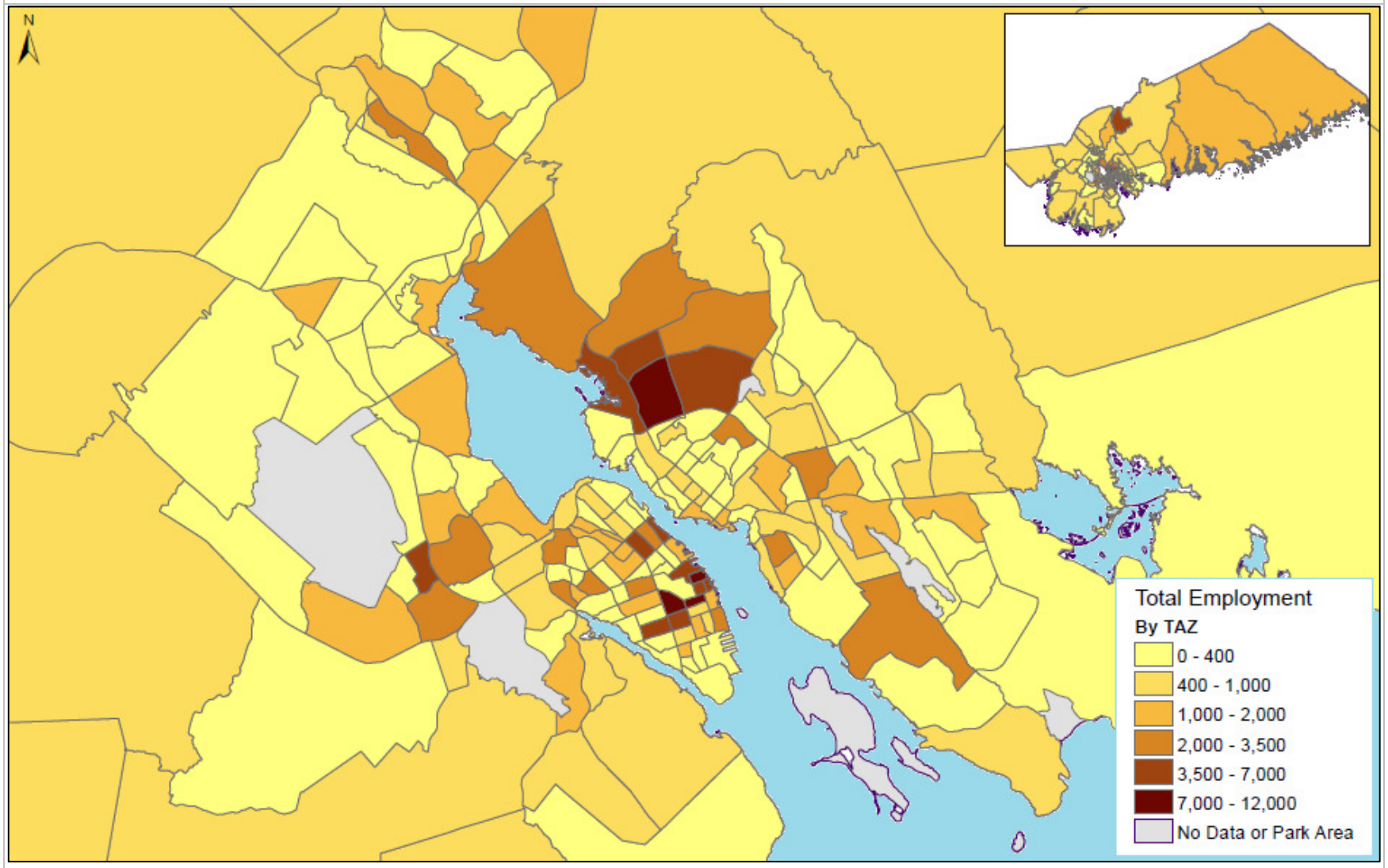
In the following decade, the Province responded to the needs of many growing families by assembling large tracts of land in Lower Sackville and in Cole Harbour, east of Dartmouth, where pockets of deep till facilitated land development. These areas were promoted by the Province's Housing Commission and strongly supported by the 1975 Halifax-Dartmouth Regional Development Plan, which was prepared by the Provincially-created Metropolitan Area Planning Commission to guide development in the urban core of the region and remained in place until the creation of HRM in 1996.

Figure 2.3 Population Density (km²) by Traffic Zone, HRM, 2009



Source: HRM (see **Appendix B**)

Figure 2.4 Employment Density (km²) by Traffic Zone, HRM, 2009



Source: HRM (see **Appendix B**)

2.8 Settlement in HRM

The ambition of planners at the time was to create balanced communities in both Cole Harbour and Lower Sackville with retail areas, employment opportunities, and a full range of public services. To a considerable extent that has happened, although few would deny that both places are bedroom suburbs. Certainly, journey-to-work information from the Census indicates that the considerable majority of residents in both communities commute to workplaces in Halifax and Dartmouth.

HRM is not the most dispersed urban settlement in North America by any means. Statistics Canada and the US Census Bureau both have systems to classify significant urban settlements. Larger urban regions in Canada, including HRM, are called Census Metropolitan Areas (CMAs). Their equivalent in the US is the Metropolitan Statistical Area (MSA). In both cases, an area classified as a CMA or an MSA must surround a core urban area with 50,000 or more population. Most CMAs and MSAs include adjacent municipalities in which the population is considered to interact or be integrated with the core area but HRM is considered to be a CMA on its own. An urban area in Canada must have a population of at least 100,000 to be designated as a CMA but there is no similar requirement for American MSAs.

Canada has 33 CMAs and the US has 323 MSAs with populations of more than 100,000. With a 2011 Census population of 390,328, the Halifax CMA ranked thirteenth among Canadian CMAs and 144th by size on the combined list of 346 Canadian and US urban areas. By the most basic measure of sprawl, the number of people by area or population density, it ranks 232nd in Canada and the United States combined. The closest comparator to HRM among North American urban areas is Beaumont-Port Arthur, which is located on the Gulf of Mexico in Texas near its border with Louisiana. Beaumont-Port Arthur covers a very similar territory to HRM at 5,579.6 km^2 relative to HRM's 5,495.6 km^2. Its 2010 US Census population was 385,090, giving it 69.0 persons/km^2 relative to 71.0 persons/km^2 in HRM. Beaumont-Port Arthur is also a port and, as its hyphenated name implies, includes two significant cities with similar populations to Halifax and Dartmouth (Beaumont's 2010 population was 118,296, while Port Arthur accommodated 53,818).

Assessment of density in HRM needs, however, to be qualified. The very large eastern area of the HRM CMA identified in the Census as Census Subdivisions F and G contains a relatively small proportion of the CMA. In 2006, only 10,429 people or just 2.8 per cent of the region's population lived in CSDs F and G on 2,957.9 km^2 of land or substantially more than half the region's area.

If the Halifax CMA were defined as CSDs A through E only, as it was until 1996, the density of the region would be 150.0 persons/km^2. Under those circumstances, HRM would rank 117th just 0.1 persons/km^2 behind the Portland, Maine, a city very familiar to many Haligonians as it is, interestingly enough, the closest large metropolitan centre in the US to Halifax. Like Halifax, of course, Portland is a port city located on the Gulf of Maine. Portland, however, has less than two-thirds as many residents as Halifax (243,537 in the as opposed to 380,720 in the area of former CSDs A through E) and, obviously, covers a smaller area (1,662 km^2 as opposed to 2,537 km^2 for the five central CSDs of HRM).

The regional settlement pattern, in any case, has more impacts and can be measured in many more ways than by the simplistic calculation of density. **Figures 2.3** and **2.4**, above, respectively show the pattern of population and employment density in the region (excluding the Eastern Shore) in richer detail using the traffic zone framework developed by HRM staff (see **Section 4.2**, and **Figure 4.3**, below). Both maps indicate strong concentration in the urban centre but rapid dissipation outside its boundaries

Statistics Canada and several national professional organizations have compiled a wide range of indicators that allow a detailed assessment of HRM's position. Census of Canada data, an extensive compilation of statistics in the Transportation Association of Canada (TAC) 2010 publication *Urban Transportation Indicators,* and a spreadsheet compilation of 2009 Municipal Water Use Data by Environment Canada, together, provide a variety of measures with which to assess the relative position of HRM among Canadian regions and municipalities that are compiled in **Appendix A** for HRM and six comparable CMAs (St. John's, Saint John, Quebec,

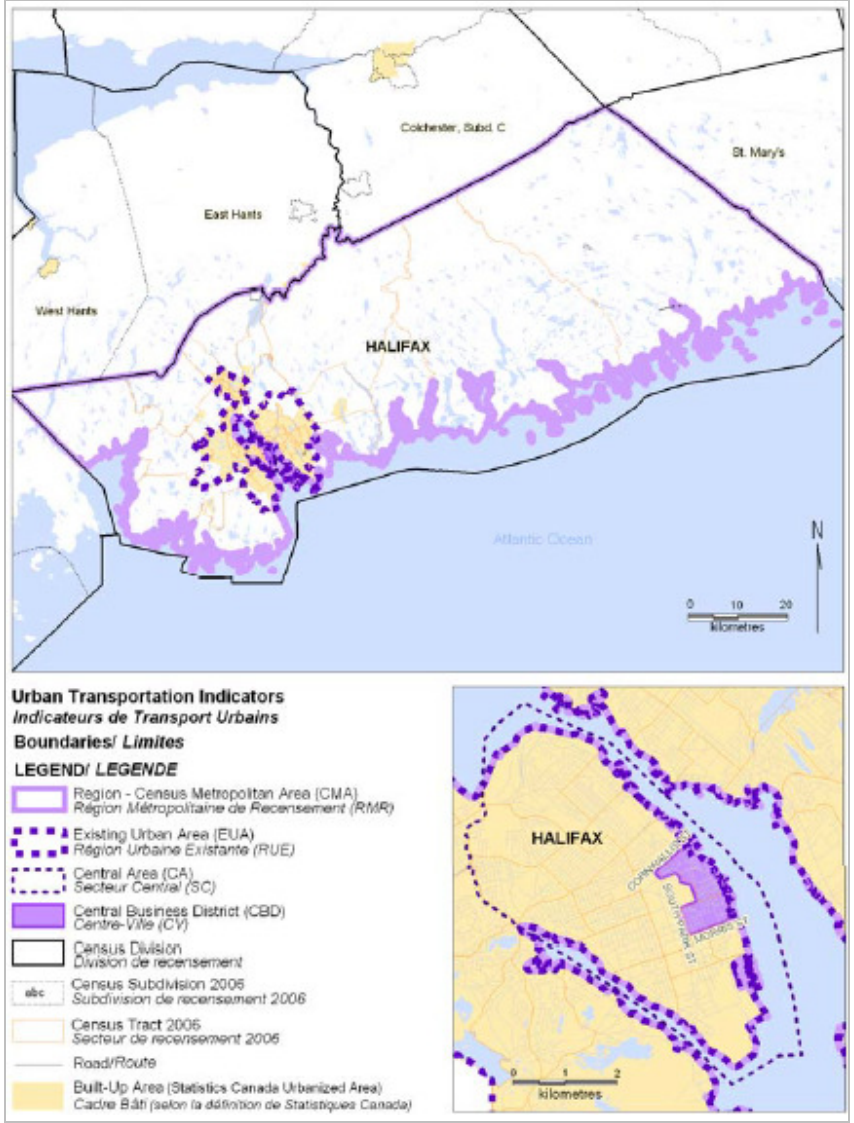
London, Regina, and Victoria) identified and used by the Greater Halifax Partnership as a basis for benchmarking the status of HRM.

These benchmarks suggest a fairly encouraging picture of HRM's position. Admittedly, the region is growing more slowly than its comparators, adding 8.7 per cent to its population from 2001 to 2011 relative to average gains of 10.0 per cent for the group as a whole (or 11.6 per cent for Canada as a whole). It is also fifth among the seven in terms of density based on new 2011 data by which the Halifax CMA has a density of 71.0 persons per km^2.

On the other hand, HRM ranks 20th of 33 CMAs (fourth among the benchmark CMAs) by population density in what the TAC defines as the Existing Urban Area (essentially the Regional Centre and Suburban Area as defined in **Figure 1.1**, above) and has the seventh densest population in its CBD (the area of Downtown Halifax between Cogswell Street and Morris Street, extending west to include the Spring Garden Road area as shown in purple on the detail map with **Figure 2.5**). Among the benchmark regions, its CBD population density is second, following only Quebec City. The Halifax CBD also ranks highly in terms of employment density in the CBD, following only Regina among its benchmarks and ranking seventh among all CMAs. HRM also ranks second to Regina in terms of the combined density of residents and employees in the CBD but has considerably more residents than Regina, suggesting a better integrated downtown area.

TAC statistics compiled for CBDs and "Central Areas" (the Halifax Peninsula in the case of HRM as shown on **Figure 2.5**) also suggest a balanced pattern of development (**Table 2.4**). Among the benchmark regions, the ratio between population and employment in Halifax's Central Area follows only St. John's, which is very intensively developed in its core, and Quebec City, which although renowned for its rich urban environment, barely edges out Halifax.

Figure 2.5 HRM Subdivisions, Transportation Association of Canada



Source: Transportation Association of Canada

Table 2.4 HRM Transportation Indicators, and Rankings for Halifax Among Canadian Census Metropolitan Areas and Census Agglomerations

Indicator	Value	Rank Among CMAs	Rank Among CMAs & CAs	Source
Population Density in EUA (pop/km^2)	858.8	20th densest of 33		TAC
Urban Density in EUA ([pop+emp]/km^2)	1,380.0	19th densest of 33		TAC
Employment Density CBD (emp/km^2)	25,754.4	7th densest of 33		TAC
Population Density in CBD (pop/km^2)	3,947.4	10th densest of 33		TAC
Arterial+Collector Lane-km per 1,000 Capita - EUA	3.73	14th longest of 23		TAC
Median Home-Work Trip Distance (km)	6.5	15th longest of 33	25th longest of 144	2006 Census
Annual Fuel Usage per Capita - EUA (L/Capita)	1,234	23rd most of 33		TAC
% Commuting to Work as Driver in Own Vehicle	65.1%	4th best of 33	7th best of 144	2006 Census
% Commuting to Work by Public Transit	10.1%	7th best of 33	8th most of 144	2006 Census
% Commuting to Work by Active Modes (bike + walk)	11.1%	3rd best of 33	23rd most of 144	2006 Census
Total Transit Expenditures per Capita	$220	9th most of 31		TAC
Average duration of round trip between home and workplace for workers living 1 km or more from their workplace	65	7th longest of 21		Canadian Social Survey 2005
Percentage of employed labour force using sustainable transportation modes	23.0%	6th most of 33	7th most of 144	2006 Census

Positive Measure Concerning Measure

This balance within the central area of Halifax has many benefits. One of the most obvious is the relatively high proportion of people who walk to work. Although only 10.1 per cent of HRM residents walk to work, the percentage ranks 17th among 144 Canadian CMAs and CAs and second among the 33 CMAs. In terms of active transportation (*i.e.*, walking and bicycling combined), the region ranks 23rd among CMAs and CAs, and third among CMAs. While some of Halifax's edge is attributable to a relatively moderate climate, the density of the Regional Centre (*i.e.*, the Peninsula and Dartmouth inside the Circumferential) clearly plays an important part.

Statistics Canada data provided to the consultants by HRM staff indicates that 37 per cent of commuters from the Regional Centre walk or bike to work.

HRM also rates well in terms of transit use. The percentage of HRM commuters using public transit in 2006 ranked eighth among CMAs and CAs, and seventh among the larger CAs. This is despite the fact that the high proportion of Haligonians relying on self-propulsion actually works against transit to a small degree. While 18 per cent of residents in the Regional Centre use transit to get to work, residents of the near suburbs rely on it more, with 22 per cent riding to work on the bus and/or ferry.

While these figures paint a very positive picture of contemporary Halifax, other data suggests that dispersion has considerable influence on the typical daily commute of Haligonians. HRM has 3.73 kilometers of arterial and collector lanes per 1,000 residents within its Existing Urban Area, which places it 14th among 23 CMAs from which TAC collected lane kilometer data. More notably, over half of HRM residents commute more than 6.5 kilometers to work, which places the region 119th of 144 CMAs and CAs and 17th among 33 CMAs. This is reflected in the third highest level of fuel use among the seven comparator regions and the longest time spent on the daily round trip commute by workers living at least one kilometer from their workplace, according to

data collected by Statistics Canada's 2005 General Social Survey and shown in **Table 2.4**.

The water and wastewater situation in HRM presents a similar mixed picture to transportation. As Environment Canada's Municipal Water database is compiled for municipalities as opposed to regions, Stantec developed regional measures by summing totals for individual municipalities within the six benchmark CMAs.

HRM has a reliable water supply administered by Halifax Water that is more than capable of providing for the region's population. Of the six benchmark regions reporting to Environment Canada's Municipal Water Use survey (Victoria did not report), Halifax Water provides by far the largest volume of water to residential users, even though it ranks third among the six regions in terms of residential connections and population served. It also treats all water delivered and is almost entirely free of water quality concerns. Since the completion of the Harbour Solutions project, Halifax Water also treats all wastewater that enters its collection network.

At the same time, the percentage of HRM's population connected to the municipal system (82 per cent) is the lowest of the six reporting regions. At 1,463,400 meters, the system serving HRM nevertheless is the second longest water distribution network among the seven benchmark regions (Victoria reported this measure), following only London (1,918,890 meters), and the third most distribution pipe per person served (4.9 meters versus 7.5 for Saint John and 5.1 meters for St. John's). HRM also shows the greatest percentage water losses from its system (14.9 per cent compared to typical losses in the benchmark group of less than 10 per cent) (see **Appendix A** for further detail).

On the wastewater side, it is reasonable to assume that the length of the collection network compares in a similar manner to the water network, given that a high percentage of water service users are normally connected to piped wastewater collection networks in all jurisdictions. No data is however available to compare the extent of inflow and infiltration in HRM's network relative to other regions.

Also, despite the treatment of all wastewater discharged, it is notable that Halifax Water largely provides primary treatment only. Three other benchmark regions (Quebec, London, and Regina) treat all wastewater that they collect but all three provide secondary and tertiary levels of treatment to significantly larger proportions of their users than HRM. Whereas 15.2 per cent of wastewater generated in HRM is subject to secondary or primary treatment, the other three regions provide at least secondary treatment for nearly all wastewater collected. Regina, in fact, provides tertiary treatment to 99 per cent of its collected wastewater.

2.3 The Implications of HRM's Settlement Pattern

As the preceding section acknowledges, the settlement pattern that has evolved in HRM has definite strengths and weaknesses. The core of the region is reasonably densely developed and notably diverse in its mix of employment with population. The result is an area that is very supportive of sustainable transportation modes and serviceable with piped water and sewer networks.

The balance of the region, however, lacks this diversity and is arguably more dispersed than most urban centred regions in Canada. Preventing further sprawl can avert expenditures to expand infrastructure networks that are already more extensive than the norm in Canada. Drawing the settlement pattern more tightly to decrease the numbers living at distance from the designated Regional Centre would have substantial additional benefits for the region and society at large by reducing commuting time and energy consumption, and increasing the focus on existing service networks for water distribution, wastewater collection, and stormwater management.

Most contemporary analysts would suggest these positive outcomes would not only reduce costs but would also enhance health and well-being by countering the deleterious effects of sprawl summarized by Howard Frumkin, MD, in the article "Urban Sprawl and Public Health," which appeared in the journal *Public Health Reports* in 2002:

> Some of these effects [of sprawl] relate directly to heavy reliance on automobiles: air pollution, automobile crashes, and pedestrian injuries and fatalities. Other effects relate to land use patterns that typify sprawl: sedentary lifestyles, threats to water quantity and quality, and an expansion of the urban heat island effect. Finally, some mental health and social capital effects are mediated by the social dimensions of sprawl.

Dr. Frumkin, who reflects the views of many public health professionals and urban and regional planners, points out the higher levels of automobile use in more dispersed urban regions and by residents in less densely developed neighbourhoods. He notes that automobiles are the primary source of pollution in the United States, as they are in Canada. Reliance on automobiles erodes the numbers of people walking and riding bicycles, which influences health, particularly, the incidence of obesity.

To the extent that sprawl may improve the access of some residents to the natural environment, Dr. Frumkin, acknowledges that it may enhance mental and physical health. He notes however that commuting time and the physical toll that it takes, as well as the frustration that it often engenders are definite negative consequences. He also speculates that the time required for commuting and the impediments to social interaction caused by residential dispersion also exact a toll in terms of the connections between people and their communities.

One area that Dr. Frumkin does not address is the expansion of the urban footprint that is intrinsic to sprawl. Covering more land with buildings, driveways, parking areas, and other impermeable surfaces increases run-off. This may add to the costs of stormwater management and will unquestionably increase the risk of dispersing pollutants associated with urban development to sensitive receptors such as wetlands and watercourses. More generally, increasing the breadth of the area in which humans regularly interact and on which they have impacts decreases the land available for natural and wildlife habitat thereby distorting the natural environment and compromising its function.

Progress toward the goal of increasing development in the Regional Centre has been limited. A clear motivation for the current study was the recognition that the number of dwelling units constructed in the Regional Centre since adoption of the RMPS in 2006 has fallen well short of the plan objective. Census data released as we began work on the project gives even more cause for concern. While Census population numbers suggest that RMPS policy has had a positive influence since 2006, creating modest growth at the centre where the region was previously experiencing modest decline, estimates of 2001, 2006, and 2011 Census population in the Regional Centre, and Suburban and Rural Areas prepared by Stantec suggest there is a long way to go (**Table 2.5**).

The bulk of new residents have settled in the Suburban Area. Substantial additional residents have also chosen rural locations, although the significant decline in the populations of the Musquodoboit and Sheet Harbour areas discussed above, suggests that most of this development is in areas adjacent to the Suburban Area where housing requires onsite servicing and existing facilities are limited. Indeed, the unserviced rural areas have grown faster in percentage terms over both Census periods since 2001 than the Suburban Area. In fact, if CSDs F and G are excluded from percentage growth calculations, the areas designated as Rural by the RMPS increased their population by 9.1 per cent from 2001 to 2006 and by 8.1 per cent from 2006 to 2011.

The full implications of such trends, however, are at best partially understood. The 17,417 people added in HRM over the past five years are a significant number. It is considerably more than live in Truro, Nova Scotia's largest town, which the 2011 Census recorded as having 12,059 residents. HRM, in other words, is settling a very large town within its boundaries every five years. The manner in which these residents are distributed and in which existing residents are redistributed, has critical impacts on the costs of the Municipality and the lifestyles of its citizens. It is the difference between a community that simply happens and one that results from thought and design.

Table 2.5 Population Distribution and Change, Regional Centre, Suburban, and Rural Areas, HRM and CSDs, 2001-2011

	2001	2006	% Change	2011	% Change
HRM	**359,111**	**372,679**	**3.8%**	**390,096**	**4.7%**
Regional Centre	**95,347**	**94,193**	**-1.2%**	**95,989**	**1.9%**
Halifax	61,209	60,628	-0.9%	62,899	3.7%
Dartmouth	34,138	33,565	-1.7%	33,090	-1.4%
Suburban	**175,828**	**183,397**	**4.3%**	**193,674**	**5.6%**
Halifax	57,915	62,981	8.7%	68,060	8.1%
Bedford	16,433	17,178	4.5%	19,269	12.2%
Dartmouth	30,428	30,818	1.3%	32,762	6.3%
A	5,477	5,396	-1.5%	5,358	-0.7%
B	2,456	3,576	45.6%	3,873	8.3%
C	28,403	27,812	-2.1%	28,328	1.9%
D	34,715	35,635	2.6%	36,024	1.1%
Rural	**87,969**	**95,264**	**8.3%**	**101,329**	**6.4%**
Bedford	2,814	3,151	12.0%	3,532	12.1%
Dartmouth	1,160	1,250	7.8%	1,248	-0.2%
A	8,842	9,978	12.8%	11,257	12.8%
B	13,032	13,132	0.8%	13,373	1.8%
C	24,492	28,583	16.7%	32,671	14.3%
D	6,377	6,539	2.5%	6,702	2.5%
E	21,046	22,203	5.5%	22,937	3.3%
F	6,268	6,493	3.6%	6,129	-5.6%
G	3,939	3,936	-0.1%	3,479	-11.6%

Source: Census of Canada (allocations to the Regional Centre, and Suburban and Rural Areas estimated by Stantec)

2.4 Analysing Alternative Settlement Patterns

As we have pointed out above and explore in more detail below, many more services provided by HRM, the Province, and the private sector are affected by the pattern of human settlement. So too are the environment and the lifestyles of citizens. By examining this issue in a structured manner, we have gained a considerably improved understanding of how development in HRM can be better shaped to reduce costs, enhance productivity, protect our natural assets, and ensure our future.

Services are analysed individually in **Chapters 4, 5, 6,** and **7** in terms of the extent and costs of required service networks, the distances to be overcome to access facilities, and/or the investment required to address deficiencies. These measures for the RMPS Scenario, and Scenarios A and B are compared to continuation of the current development trend in HRM to establish the incremental impact of each alternative. These individual measures are integrated in **Chapters 8** and **9**. This includes monetization of time, expenditure, and tax impacts in an economic cost-benefit framework. The Health Impact Assessment or HIA integrated through **Chapters 4, 5, 6,** and **7** addresses critical factors influenced by the pattern of residential development that cannot be readily monetized.

HIA is normally applied to assess the validity of a specific policy initiative in terms of features that contribute to enhanced public health or, alternatively, are detrimental to health. The objective of this study is to assess three alternative "policy approaches," one of which is in place as a central theme of the RMPS, against a baseline condition reflecting the trend experienced despite existing policy. The other two potential policies have been suggested to explore the possibilities of reinforcing existing policy.

It is difficult to identify negative consequences of intensification without a public consultation process. Urban planning literature – particularly literature focused on the health consequences of urban distribution patterns – almost uniformly favours intensification. The primary concern with concentration is crowding, which was at one time a dominant argument for suburbanization. Many of the most severe

consequences of crowding have however been mitigated through the implementation of modern sanitation and improved design.

Not all of the drawbacks of concentration in central urban areas have however been eliminated. Notably, it is more difficult to provide access to informal open space or, particularly, private open space under property owner control in a denser urban setting. Intensification of settlement requires increased reliance on multiple unit residential structures. The replacement of typically large yards associated with single-detached homes in suburban and rural settings with smaller private spaces that accompany rowhousing or the balconies associated with apartment structures is a substantial sacrifice to many, particularly families with young children.

The concentration of urban activity also has negative impacts that are often cited by urban residents. Noise, which is especially bothersome at night, is a frequent feature of mixed use settings, especially in entertainment areas. It is also a more general characteristic of urban areas where traffic is more intense. Although reduced energy use for transportation may mitigate the global consequences of GHG and pollutant emissions, higher levels of traffic and industrial activity in urban areas are associated with increased exposure to localized air pollution.

The World Health Organization (WHO) has stated that suspended particulate matter (*i.e.*, airborne smoke, soot, dust, and liquid droplets from fuel combustion) has major impacts on respiratory health. The WHO has set a standard of 90 micrograms of suspended particulate matter (PM) per cubic meter (µg/m^3) (http://www.worldbank.org/depweb/english/beyond/beyondco/beg_10.pdf, p. 71). In 2006, WHO data indicated that Montreal and Toronto had respective concentrations of 34 and 36 micrograms per cubic meter (µg/m^3). Canadian guidelines are more stringent and detailed, measuring fine particulates at less than 10 microns (PM_{10}) and very fine particulates at less than 2.5 microns ($PM_{2.5}$). The Canadian objective for $PM_{2.5}$ is 30 µg/m^3 for a 24-hour averaging time, by the year 2010.

The most recent HRM data is well within these standards with 6 micrograms of $PM_{2.5}$ and 11 micrograms of PM_{10} in 1996. Both were down considerably from levels recorded for the region in 1985. While local air quality is relatively good in HRM and well within guidelines, greater concentrations in specific areas undoubtedly influence both real and perceived quality of life.

Some may also assert that properly managed development in suburban and rural areas can have less environmental impact than concentrated development in the Regional Centre. Before the implementation of near universal wastewater treatment in HRM, residents with onsite septic systems could have very reasonably contended that wastewater that they generated had less impact on the environment than the raw sewage discharged daily to Halifax Harbour from the piped network serving the region's core. Even now, with only primary treatment in place for most municipally handled wastewater and the potential for overflows in storm events, the position has considerable validity. Suburban and rural development may also be better suited to a variety of other sustainable options such as solar heating, green roofs, and natural stormwater management. An off the grid rural residence with occupants who telecommute (*i.e.*, communicate with their workplace and clients electronically) will arguably have the least environmental impact of any settlement option provided sources of supply for food and other essentials are reasonably accessible.

A more general political argument against policies encouraging concentration is their impact on freedom of choice. While proponents of intensification contend that transportation and taxation policy and even land use planning rules have induced and supported sprawl, most rural and suburban residents perceive their choices as rational decisions based on a weighing of the pros and cons of different settlement options for themselves. Living farther from the centre may provide opportunities to live next to a golf course, to dock a boat, or to be close to a forest. Most importantly, in present circumstances at least, a decision in favour of an outlying residential location allows the purchase of more land for less money. For many, in fact, lower land cost is a critical factor in choosing to live in the suburbs or a rural area, and some members of the development community have strongly contended that regulatory efforts to limit suburban and rural development will impact housing affordability.

The balancing consideration is the overall cost of housing and the broad environmental impact of sprawling development. While individual homeowners may save money on the purchase of their house and property or may be able to obtain what they consider better value for their home investment, they will normally incur additional costs for transportation. Unless they are able to work in their home or nearby, they will commute farther to work, very likely in a single occupant vehicle. Active transportation modes are unlikely to be realistic given the distances to be covered and transit is less likely to be available given the cost of operating bus routes to outlying areas. Other needs and wants, such as school, shopping, and social trips, often also involve longer distances.

Extending services delivered by networks is also affected by distance. Roads, water and wastewater pipes, natural gas lines, and electricity and telephone lines all must cover greater distances to reach fewer people. The costs of extending these networks and maintaining them after their construction consequently rise on a per dwelling and per capita basis, increasing the costs that the Municipality and other utility providers must cover through user fees or taxes.

The costs of additional transportation and services erode and sometimes exceed the gains that suburban and rural residents may achieve through their home purchase. They also often fall on other members of society when an equivalent fee is charged regardless of residential location. The same can be said for environmental influences. While suburban and rural residents may gain easier access to the expansive natural areas that are within HRM, sprawling development by definition infringes on these natural areas and threatens their integrity. Similarly, while these same groups may avoid concentrations of pollution experienced in some parts of the Regional Centre, the overall impact of increased vehicle use is a net increase in HRM's contribution to air pollution, particularly our impact through GHG emissions on climate change.

Analyses following address these questions as objectively as possible, quantifying the consequences wherever data and identifiable relationships will support it. Quantification of impacts supports the calculation of costs and benefits in uniform monetary terms, allowing us to assess the relative impacts of differing settlement patterns on the wide array of services on which citizens rely. In some cases, below, little or no relationship has been found. In most, however, clear and definable consequences have been identified and quantified. The degree of variation most certainly varies from service to service, with some showing moderate gains from concentration of residential settlement, while others show very large benefits. We have also found cases in which relationships are ambiguous and for which costs will likely be higher if development is intensified in the Regional Centre.

Placing all of these costs and benefits in an economic framework allows us to obtain an integrated bottom line that will allow decision-makers to assess the potential of the current RMPS. HIA adds additional elements to this that are less easy to quantify but certainly worthy of consideration in policy development.

3.0 SCENARIO CREATION

As explained in **Chapter 1**, the project terms of reference required Stantec to create four future scenarios for impact assessment. The four scenarios reflect different distributions of households across the three areas of HRM represented in **Figure 1.1**, above. Scenarios are to be developed to the horizon year 2031. The scenarios are all distributive insofar as they assume the same level of growth in the region and essentially the same economic state. They only vary the distribution of dwelling units and related employment with some additional adjustments to the mix of dwelling unit types between scenarios as explained below.

The purpose of the scenarios is to model specific future conditions described in the RFP for this assignment. These conditions are, roughly: continuation of recent trends, which fall substantially short of goals to intensify urban development in the Regional Centre set in the 2006 RMPS; achievement of the RMPS goals; and achievement of aspirations for intensification that reach beyond the metrics established in the RMPS to create an even more intensively concentrated region.

3.1 Projections

In 2004, Clayton Research Associates prepared comprehensive demographic projections for HRM. The projections provided future estimates of labour force, population, and housing. In 2009, Altus Economic Consulting, which acquired Clayton in the interim, updated the projections to take account of 2006 Census data and presented them in the report *Employment, Population and Housing Projections for Halifax Regional Municipality: An Update.* Projections in both cases covered Census years to 2026 and provided Baseline, Low, and High projections.

The projections are well-suited to the purposes of the current study as they provide interrelated measures of growth. Two recent occurrences must however be taken into account in considering their application. First, population data has recently been released from the 2011 Census. Second, Halifax Shipyards has been awarded a $25-billion contract to build combat vessels for the Royal Canadian Navy.

The 2011 Census count for the Halifax CMA is 390,328, which is much closer to Altus's High Scenario estimate of 392,298 for 2011 than its Baseline estimate of 385,255. The shipbuilding contract adds to the higher than expected base. Impact assessment by the Conference Board of Canada suggests that the project will provide an average of 8,500 jobs in Nova Scotia over its course extending to 2030 with a peak of 11,500 about 2020 or 2021. This economic activity can obviously be expected to increase population and housing within HRM. Although the Conference Board work does not provide an estimate of increased resident population stimulated by the contract, it does include an estimate of 420 additional dwelling units annually over the 20-year course of the contract.

Tables 3.1 and **3.2**, respectively, present the key projections from the 2009 Altus report. As can be seen from comparison of the tables, the High Scenario assumes the addition of roughly 23,000 more people to the region's population relative to the Baseline projection (75,620 additional residents versus 52,800). The increase in population is associated with the addition of 46,107 jobs or roughly 15,000 more than are expected under the Baseline Scenario. It will also result in the addition of nearly 20,000 more dwelling units (54,975 versus 35,825), which is the most critical number for the analysis mandated by this assignment.

Table 3.1 Projections Summary, HRM, Baseline Scenario, 2001-2026

	2001	2006	2011	2016	2021	2026	2011-2026
Population (Halifax CMA)							
Population	359,195	372,860	385,255	406,305	425,065	438,115	
Change	16,220	13,665	12,395	21,050	18,760	13,050	52,860
% Change	4.7%	3.8%	3.3%	5.5%	4.6%	3.1%	13.7%
Employment							
Labour Force	196,600	212,860	221,689	237,041	245,056	249,495	27,806
Unemployed	7.2%	6.3%	7.0%	6.0%	5.7%	5.2%	
HRM Employed Labour Force	182,445	199,450	206,171	222,819	231,088	236,521	
Change		17,005	6,721	16,648	8,269	5,433	30,350
% Change		9.3%	3.4%	8.1%	3.7%	2.4%	14.7%
Outside Commuters	8,000	9,300	9,300	9,300	9,300	9,300	0
% Change		16.3%	2.2%	0.0%	0.0%	0.0%	0.0%
Total Commuters	190,482	208,785	215,471	232,119	240,388	245,821	
Change		17,005	6,721	16,648	8,269	5,433	30,350
% Change		8.9%	3.2%	7.7%	3.6%	2.3%	14.1%
Additional Dwelling Units							
Census Period	1996-2001	2001-2006	2006-2011	2011-2016	2016-2021	2021-2026	
Singles & Semis	1,832	880	1,005	1,240	1,355	1,235	19,150
% share	71.1%	41.4%	51.9%	52.5%	52.3%	55.8%	53.5%
Row	45	20	105	125	150	120	1,975
% share	1.7%	0.9%	5.4%	5.3%	5.8%	5.4%	5.5%
Apartments & Other	874	1,160	765	925	1,005	795	13,625
% share	33.9%	54.6%	39.5%	39.2%	38.8%	35.9%	38.0%
Mobile	-174	65	60	70	80	65	1,075
% share	-6.8%	3.1%	3.1%	3.0%	3.1%	2.9%	3.0%
TOTAL Units	**2,577**	**2,125**	**1,935**	**2,360**	**2,590**	**2,215**	**35,825**

Source: Altus Group Economic Consulting, 2009

Table 3.2 Projections Summary, HRM, High Scenario, 2001-2026

	2001	2006	2011	2016	2021	2026	2011-2026
Population (Halifax CMA)							
Population	359,195	372,860	392,260	422,735	448,735	467,880	
Change	16,220	13,665	19,400	30,475	26,000	19,145	75,620
% Change	4.7%	3.8%	5.2%	7.8%	6.2%	4.3%	19.3%
Employment							
Labour Force	196,600	212,860	227,285	248,473	261,975	271,606	44,321
Unemployed	7.2%	6.3%	7.0%	6.0%	5.7%	5.2%	
HRM Employed Labour Force	182,445	199,450	211,376	233,565	247,042	257,483	
Change		17,005	11,926	22,189	13,477	10,441	46,107
% Change		9.3%	6.0%	10.5%	5.8%	4.2%	21.8%
Outside Commuters	8,000	9,300	9,500	9,700	9,900	9,900	400
% Change		16.3%	2.2%	2.1%	2.1%	0.0%	4.2%
Total Commuters	190,482	208,785	220,851	243,240	256,916	267,358	
Change		17,005	12,066	22,389	13,676	10,442	46,507
% Change		8.9%	5.8%	10.1%	5.6%	4.1%	21.1%
Additional Dwelling Units							
Census Period	1996-2001	2001-2006	2006-2011	2011-2016	2016-2021	2021-2026	
Singles & Semis	1,832	880	1,320	1,985	2,135	1,985	30,525
% share	71.1%	41.4%	55.7%	56.5%	55.0%	55.1%	55.5%
Row	45	20	105	145	200	185	2,650
% share	1.7%	0.9%	4.4%	4.1%	5.2%	5.1%	4.8%
Apartments & Other	874	1,160	875	1,280	1,430	1,320	20,150
% share	33.9%	54.6%	36.9%	36.4%	36.9%	36.7%	36.7%
Mobile	-174	65	70	105	115	110	1,650
% share	-6.8%	3.1%	3.0%	3.0%	3.0%	3.1%	3.0%
TOTAL Units	**2,577**	**2,125**	**2,370**	**3,515**	**3,880**	**3,600**	**54,975**

Source: Altus Group Economic Consulting, 2009

Table 3.3 Key Growth Scenario Projection Parameters, HRM, 1996-2031

	1996	2001	2006	2009	2011	2016	2021	2026	2031	Change 2009-2031
Population	342,975	359,195	372,845	384,491	392,255	422,730	448,735	467,880	484,153	
- Change		16,220	13,650	11,646	7,764	30,475	26,005	19,145	16,273	99,660
- % Change		4.7%	3.8%	3.1%	2.0%	7.8%	6.2%	4.3%	3.5%	25.9%
Dwelling Units	131,520	144,435	155,140	161,149	165,155	182,730	202,130	220,130	236,870	
- Change		12,915	10,705	6,009	4,006	17,575	19,400	18,000	16,740	75,720
- % Change		9.8%	7.4%	3.9%	2.5%	10.6%	10.6%	8.9%	7.6%	47.0%
- Singles & Semis	77,000	86,185	90,755	94,271	96,615	107,265	118,940	129,790	139,880	45,609
- Apartments & Other	54,520	58,520	64,385	66,878	68,540	75,465	83,190	90,340	96,990	30,110
% Apartments	41.5%	40.5%	41.5%	41.5%	41.5%	41.3%	41.2%	41.0%	40.9%	39.8%
DU Size	2.61	2.49	2.40	2.39	2.38	2.31	2.22	2.13	2.04	-0.33
Population 15-84		288,810	306,960	319,386	327,670	353,910	373,890	389,420	401,225	81,835
Labour Force		196,600	212,860	221,515	227,285	248,473	261,975	271,605	279,830	58,315
Participation Rate		68.1%	69.3%	69.4%	69.4%	70.2%	70.1%	69.7%	69.7%	0.4%
Unemployment		7.2%	6.3%	7.0%	7.0%	6.0%	5.7%	5.2%	5.2%	-1.8%
Employed		182,445	199,450	206,605	211,375	233,565	247,040	257,480	265,300	58,695
- Change			17,005	7,155	4,770	22,190	13,480	10,440	7,819	
- % Change			9.3%	3.6%	2.3%	10.5%	5.8%	4.2%	3.0%	
Outside Commuters		8,000	9,300	9,420	9,500	9,700	9,900	9,990	9,990	570
All Commuters		190,445	208,750	216,025	220,875	243,265	256,940	267,470	275,290	59,266

To fit with other data and project specifications, furthermore, some estimates of key parameters had to be carried both backward and forward (**Table 3.3**). With respect to moving the projections back, the estimated dwelling units associated with each residential distribution scenario prepared for this project were fed into HRM's VISUM transportation model. The VISUM model baseline has been calibrated with 2009 data; therefore, additional residential units and related growth measures (*i.e.*, population and employment) had to be calculated as additions from 2009. This was done simply by using linear interpolation to find the value of all critical parameters in 2009 shown in **Table 3.3**.

The timeframe for assessment of the scenarios, furthermore, is twenty years from 2011. The Altus projections were consequently extended five years. Required values for 2031 were determined using exponential smoothing, a method of extrapolating time series that places increasing weight on more recent values. Smoothing equations also incorporate a smoothing factor that can be compared to an existing series to determine the curve that best fits the data to be projected. The best fit curve was determined by this method for each quantity required for the 2031 scenario.

3.1.1 Residential Development

Examination of **Tables 3.1** and **3.2** shows an intriguing bump in apartment construction in HRM from 2001 to 2006. This followed an equally interesting surge in single family home building in the preceding five years. The projections prepared by Altus reflect an expectation that future housing demand will largely reflect the profile of housing types identified in the region through the 2006 Census. Their estimates reflect a moderate increase in the proportion of units in apartment structures. This increase in apartments is moderated slightly in the High Scenario because higher levels of growth are expected to be associated with higher levels of family formation and births in the population. Larger families with children can be expected to increase demand for ground level housing.

Given the shares of households specified for evaluation by this assessment, the distribution of additional households will be as represented in **Table 3.4**. In the first two scenarios, 75,721 total units were allocated as 45,609 singles and semis, and 30,112 apartment and other unit types. The distribution of households by structural type was however influenced by the modelling of available land and its attraction for different forms of development as explained in **Section 4.3** below. Because there are relatively few opportunities for single family housing development in the Regional Centre, additional apartment units were assumed to be developed in Scenarios A and B.

While households or dwelling units are the quantity that must be allocated within the region to create the specified scenarios, other related factors clearly influence regional function and performance. A key benefit of adopting the Altus projections of dwelling unit additions is that they were created in the context of comprehensive forecasts of HRM's demographic and economic future that are the cause and to a lesser extent an effect of housing requirements. Along with projections of housing, the Altus report includes related projections of population and labour force by five-year age cohort that are critical to the calculation of features such as future school enrollment and potential traffic congestion.

Table 3.4 Housing Growth Allocation by Area, HRM, High Scenario, 2009-2031

	Current Regional Plan Growth Goals		Observed Growth (Post RMPS Adoption)		Hypothetical Growth Scenario A		Hypothetical Growth Scenario B	
Area	Share	DU	Share	DU	Share	DU	Share	DU
Regional Centre	25%	18,930	16%	12,115	40%	30,288	50%	37,861
Suburban	50%	37,861	56%	42,404	40%	30,288	30%	22,716
Rural	25%	18,930	28%	21,202	20%	15,144	20%	15,144
TOTALS		**75,721**		**75,721**		**75,721**		**75,721**

Table 3.5 provides baseline projections for population by five-year age group taken from the Altus report plus 2009 and 2031 estimates prepared by Stantec. The numbers for 2001, 2006, and 2011 reflect those respective Censuses. As noted, the 2011 Census population (390,328) is slightly less than the 2011 High Scenario projection prepared by Altus (392,255).

The High projection reflects expectations of more robust growth in HRM but it is not extravagant. While the Altus projection suggests the addition of more than 30,000 residents by the time of the next Census count in 2016 as opposed to an increase of roughly 17,500 between 2006 and 2001, it anticipates a gradual decline in growth that is presumably connected to ongoing aging of the local population. The expected population increase from 2026 to 2031 is only 16,265 or less than was actually experienced between 2006 and 2011.

Over the period represented in the table, the projections suggest that the number of youth (14 years and younger), which has been falling slowly but steadily, will recover modestly rising from 59,625 in 2011 to 71,580 in 2031. The share of youth in Halifax's increasing population will however continue to decrease slowly, declining from 15.3 to 14.8 per cent of residents in the region. At the same time, the elderly population is expected to more than double from 51,100 according to the

2011 Census to 104,180 in 2031 or from 13.1 per cent of the region's population to 21.5 per cent.

Table 3.5 Population by Age, HRM, High Scenario, 2001-2031

Age	2001	2006	2009	2011	2016	2021	2026	2031
0-4	19,935	18,210	19,195	*19,855*	*22,025*	*23,220*	*23,065*	*22,935*
5-9	22,370	19,655	18,940	*18,465*	*20,730*	*22,700*	*23,625*	*24,010*
10-14	23,695	22,345	20,995	*20,095*	*19,525*	*21,590*	*23,290*	*24,635*
15-19	22,910	24,360	24,110	*23,940*	*22,565*	*21,645*	*23,320*	*23,275*
20-24	26,565	28,130	29,660	*30,680*	*32,015*	*29,990*	*28,240*	*26,680*
25-29	26,445	26,020	28,535	*30,215*	*34,185*	*34,950*	*32,265*	*31,665*
30-34	27,600	25,850	26,310	*26,615*	*31,950*	*35,535*	*35,790*	*35,890*
35-39	32,860	27,410	26,755	*26,320*	*28,095*	*33,055*	*36,195*	*38,100*
40-44	31,650	32,760	30,035	*28,220*	*27,845*	*29,310*	*33,880*	*36,825*
45-49	28,070	31,575	32,175	*32,575*	*28,545*	*27,965*	*29,235*	*29,370*
50-54	25,530	28,240	30,060	*31,270*	*32,690*	*28,580*	*27,865*	*27,340*
55-59	18,345	25,085	26,670	*27,730*	*31,040*	*32,350*	*28,245*	*27,205*
60-64	13,680	18,255	21,685	*23,975*	*26,785*	*29,945*	*31,175*	*32,035*
65-69	11,845	13,225	15,910	*17,700*	*23,350*	*25,980*	*28,960*	*30,895*
70-74	9,715	11,025	11,745	*12,225*	*16,530*	*21,620*	*24,050*	*25,335*
75-79	8,060	8,565	9,235	*9,680*	*10,920*	*14,560*	*18,945*	*24,205*
80-84	5,535	6,475	6,510	*6,530*	*7,400*	*8,405*	*11,255*	*14,530*
85+	4,385	5,675	5,970	*6,170*	*6,540*	*7,340*	*8,475*	*9,215*
TOTAL	**359,195**	**372,860**	***384,490***	***392,260***	***422,735***	***448,735***	***467,880***	***484,145***

Numbers in *italics* are estimates/projections other numbers are Census Counts

Source: 2001 and 2006 Census of Canada; Stantec Consulting 2009 and 2031 estimates; Altus Group Economic Consulting, 2009, projections for 2011 through 2026

The working age population from 15 to 64 years is also expected to increase in numbers but its share of total population will shrink even more than the youth cohorts. The number of residents between 15 and 64 is expected to grow from 279,610 to 308,385, or by nearly 30,000, between 2011 and 2026 but their share of total population will decline considerably, falling from 71.6 per cent to 63.7 per cent of the total population. The dependency ratio or the ratio between the total of children and senior citizens and the working age population will consequently escalate from a current level of 39.6 to 57.0. This represents a return to a more typical historic level, although dependency ratios were much higher in Canada during the Baby Boom, when they ranged in the 60s and low 70s, as well as in the nineteenth and early twentieth centuries when they were constantly over 60 to as high as 90 in the mid-nineteenth century.

3.1.2 Non-residential Development

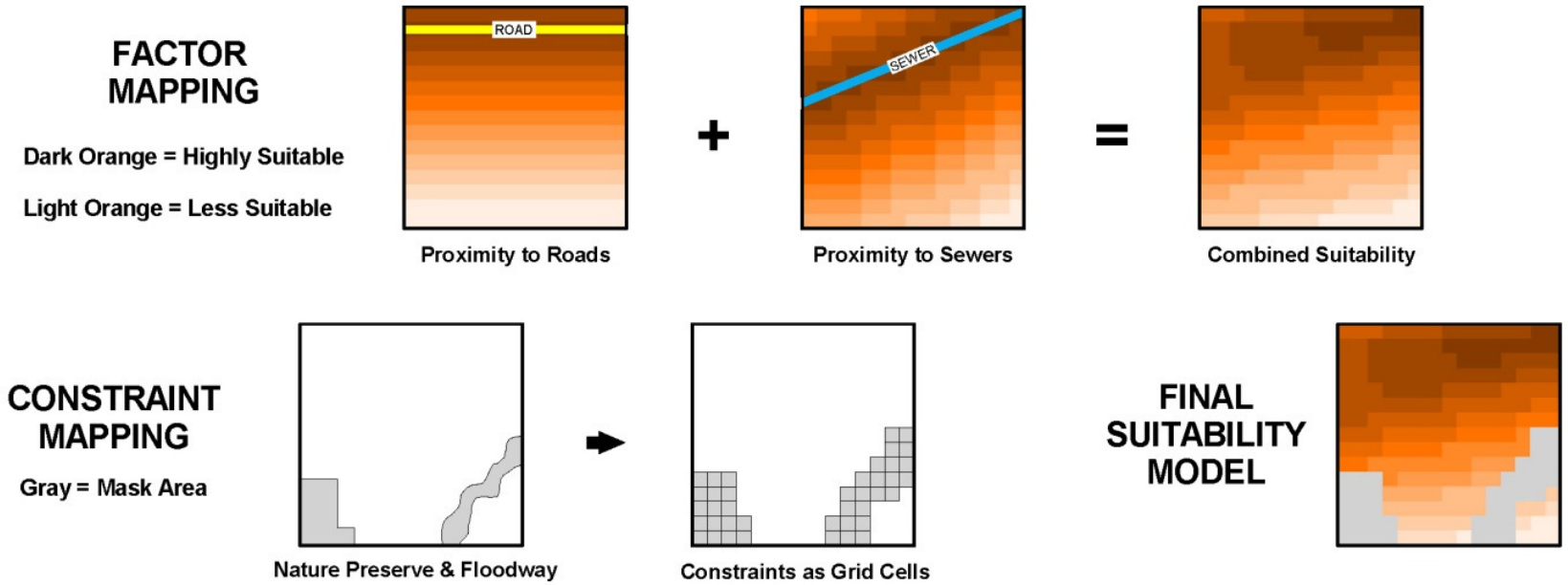
As noted, Altus also calculated labour force demand to 2026 represented by the numbers presented above in **Tables 3.1** and **3.2**. Altus anticipates increased labour force participation in older age groups and marginally lower rates of unemployment, along with the previously discussed modest increase in working age population. These factors, according to Altus, should be sufficient to increase the labour force resident in HRM under the High Scenario by 46,505 from 2011 to 2026. Altus projects the labour force within the municipality in 2026 to be 257,480 to which can be added another 9,900 workers commuting from jurisdictions outside HRM's boundaries such as East and West Hants. The total number of commuters under these circumstances would be 267,358. Stantec's extrapolation to 2031 suggests that the number of internal commuters will grow further to 265,300, which with the addition of a constant 9,900 outside commuters gives a future total of 275,200.

3.2 Creating Residential Distribution Scenarios

The critical issue in developing housing distribution scenarios as required by the RFP was to determine how new housing units would be most likely to be distributed in the Regional Centre, and Suburban and Rural areas under each proposed scenario. To make this determination, Stantec created a housing distribution model in GIS to allocate projected dwelling unit additions to available lands based on an index of their relative attraction/availability for residential development.

As illustrated in **Figure 3.1**, it was applied to all lands in HRM not subject to the following absolute development constraints:

Figure 3.1 Land Suitability Modelling Approach



- Lands with excessive slope (*i.e.*, 15 per cent or greater)
- Watercourses and wetlands including associated buffers and identified floodplains
- Protected watersheds and wellfields
- Designated parklands, open spaces areas, and wilderness protected areas
- HRM Business Parks, Stanfield International and Shearwater Airports (including associated areas in which construction is restricted), and similar areas committed long-term to non-residential land use.
- Lands zoned Conservation, Holding, for Harbour Use, or similar categories that prohibit residential development.

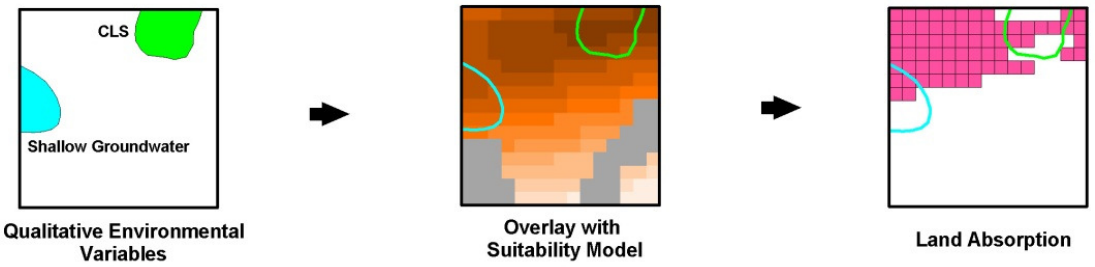
Also excluded were extensive Rural Areas that are more than 300 meters from an existing roadway and, consequently, considered impractical to develop, as well as irregularly shaped properties that cannot reasonably be developed (*i.e.*, largely linear properties that are too narrow in at least one dimension to satisfy lot standards for construction).

The suitability of remaining lands for development was rated on the basis of the following considerations:

- Vacant versus developed land with allowance that developed land may be redeveloped where development potential established by municipal zoning significantly exceeds the current land use
- Land use and number of dwelling units permitted by existing municipal zoning
- Recent new construction in the vicinity based on assessment roll data (*i.e.*, residential units added since 2000)
- Location in areas specified for development (*i.e.*., Bedford West and Morris-Russell Lake, and roughly 20 other areas identified by HRM staff as prime sites for development)
- Location on/overlooking attractive waterfrontage (*i.e.*, excludes waterfrontage in industrial areas)
- Affordability of housing measured by average market value assessment per dwelling unit in the subject Traffic Zone
- Citizen ratings of neighbourhood satisfaction derived by Council district from the 2010 HRM Citizen Survey
- Neighbourhood stability measured by the proportions of residents living in the applicable Census Tract for at least one year and at least five years according to the 2006 Census
- Incidence of crime in the applicable police district based on 2010 crime reporting
- Distance to the closest existing water line (assumed to be in roadway in the Regional Centre and Suburban Area)
- Distance to the closest existing wastewater line (assumed to be in roadway in the Regional Centre and Suburban Area)
- Distance to the closest arterial or collector road
- Distance to nearest highway interchange
- Distance to the closest existing transit stop and to the nearest transit terminal (including ferry terminals)
- Distance to the closest existing community centre/sportsplex/arena and to the closest outdoor sportsfield or ballfield, and to the nearest passive park, wilderness area, or trail.
- Distance to the nearest Halifax Public Libraries branch or to a university or college library
- Distance to nearest elementary, junior high, and high school
- Distance to the nearest hospital or medical centre.

In past applications of this methodology by Stantec, ratings were assigned to grid squares as suggested by the depictions in **Figures 3.1**, above, as well as **Figure 3.2**. HRM, however, is more extensive than any other area to which the method has been applied and the considerations of this study are considerably broader. As a result, the consultants decided to develop and apply indices to individual properties as opposed to collections or portions of properties within arbitrary squares. The resulting approach is not significantly different, although properties are arguably more able to reflect the precise pattern of development.

Figure 3.2 Residential Land Allocation Process



A more significant decision was to incorporate consideration of zoning in the allocation of dwelling units. To do so, the consultants compiled all of the zoning categories applied in HRM based on the comprehensive zoning layer provided from HRM's GIS. The Municipality has more than 150 distinct zone identifiers and some identically named zones have significantly different provisions depending on the planning area in which they are located (21 different land use bylaws are posted on HRM's Planning Web site). Stantec project staff, who are familiar with most of the documents, reviewed them and determined the predominant type of residential development permitted in each zone. Some zones do not allow residential development and therefore augmented the area in the municipality considered to be subject to absolute constraints.

Zones that permit the construction of residential dwelling units were treated in the following ways:

- Properties meeting the minimum lot standard applicable in a zone allowing a fixed number of units were considered capable of supporting that number of units (*e.g.*, a 4,000-square foot property in an R-1 Zone on the Halifax Peninsula is considered capable of accommodating one dwelling unit)

- Properties meeting the minimum lot standard in a zone allowing a variable number of units were considered capable of supporting units in proportion to the area of the property (*e.g.*, an 8,100-square foot property in an R-3 Zone on the Halifax Peninsula is considered capable of accommodating ten dwelling units plus one additional unit for each 760 square feet of additional lot area)

- Areas zoned for comprehensive development (*e.g.*, CDD, RDD, and similar zones) were treated as a whole. The consultants examined each comprehensive development zone and determined the probable density and mix of single and semi-detached, and multi-unit dwellings to be expected in each based on provisions of the applicable zone and their knowledge of current development plans or expectations.

The process also took into consideration the many commercial zones that permit residential development. Properties in some of these zones tend to score lower on residential attraction because they are often removed from schools, and recreational and cultural facilities. There are however relatively few locations that will accommodate multi-unit residential buildings, particularly high-rises, and the development of former commercial lands for residential purposes has been a clear trend in the region, particularly on the Halifax Peninsula, where the C-2 and C-3 Zones permit R-2 and R-3 uses as-of-right.

Some other unique variations were also accounted for, including zones that specifically permit mobile homes or zones such as the DH or Downtown Halifax Zone in which we have assumed only multi-unit residential structures will be built (as opposed to single-detached homes).

Table 3.6 summarizes the capacities of the Regional Centre, and Suburban and Rural Areas to accommodate additional residential dwelling units determined by this method. It is not possible to take into account all of the nuances of development approval available in the "real world" such as the configuration of lots. As noted, properties that are clearly too narrow in one dimension for development were

excluded but for others that are marginally deficient, we assumed that the minor variance process or similar exceptions would allow their development, if they meet the required lot area minimums. Many other policies and procedures are also in place to increase the development capacity of properties, including lot consolidation and rezoning. While these factors will undoubtedly play a part in the actual development of housing within the region they are beyond the capacity of our modelling to predict.

In the modelling process, dwelling units were assigned in accordance with the specifications of each scenario beginning with the Regional Centre, which has the most limited capacity. In all three areas units were first allocated to properties receiving the highest attractiveness ratings and progressed to lands with lower ratings until the number of units required under each scenario was attained. The process did not differentiate between singles and multiples beyond accounting for zoning provisions (*i.e.*, multiple unit dwellings are located only on properties zoned to permit multiple unit development either as-of-right or through an alternative documented development approval process), although it did assign the maximum number of units that each multiple unit property can accommodate immediately.

Table 3.6 Dwelling Unit Capacity by Area, HRM

Area	Property Count	Singles & Semis	Multiple Unit	Total Capacity
Regional Centre	21,850	804	34,161	34,965
Suburban	57,191	31,830	36,947	68,187
Rural	59,956	327,854	18,584	344,439
TOTALS	**138,997**	**360,488**	**89,692**	**447,591**

A critical issue in assigning units to the Regional Centre was the limited availability of sites for singles and semis. As indicated in **Table 3.6**, the Regional Centre can only accommodate 804 new single or semi units. The Regional Centre has many more R-1 sites with dwelling units on them but, while some will undoubtedly be redeveloped in future, they cannot contribute to intensification as existing units can only be replaced one for one.

To provide for the larger number of units assumed for the Regional Centre in Scenarios A and B, therefore, Stantec adjusted the assumptions of Altus concerning the mix of single and semi, and multiple units. Whereas the Altus projections as extended by Stantec to begin in 2009 and end in 2031 assumed a split of roughly 60:40 between dwelling units in singles and semis, and multiple unit structures, Stantec assumed that 50 per cent of all new dwelling units would be in multiple unit buildings under Scenario A and 60 per cent under Scenario B.

Careful readers may also notice that the capacities outlined in **Table 3.6**, above, are sufficient to accommodate the number of units to be allocated to them under the first two growth scenarios, although the Regional Centre is definitely more limited than the other two areas in all cases. Not enough developable or redevelopable land is however available in the Regional Centre under our assumptions to accommodate the proportions of growth anticipated in the Regional Centre under Scenarios A and B. In view of this limitation, the consultants assumed that the addition of one accessory flat or extra unit would be permitted for each existing single detached dwelling in R-1 and R-2 zoned areas within the Regional Centre to facilitate the achievement of the development goals implied by the two most condensed scenarios.

This type of provision has been under consideration by HRM planners as a means to facilitate residential intensification on the Peninsula. In our model, the change increased the potential for multiple unit development in the Regional Centre under Scenario B to 40,531 and total capacity at the centre of the region to 41,335, which is more than adequate to absorb 50 per cent of the dwelling unit growth expected to 2031.

Table 3.7 Housing Growth Allocation by Area, HRM, High Scenario, 2009-2031

	Current Regional Plan Growth Goals				Observed Growth (Post RMPS Adoption)				Hypothetical Growth Scenario A				Hypothetical Growth Scenario B			
Area	Single/ Semis	Multis	Totals	Share	Single/ Semis	Multis	Totals	Share	Single/ Semis	Multis	Totals	Share	Single/ Semis	Multis	Totals	Share
Regional Centre	218	18,712	18,930	25%	74	12,041	12,115	16%	235	30,053	30,288	40%	730	37,131	37,861	50%
Suburban	26,462	11,399	37,861	50%	24,334	18,070	42,404	56%	22,480	7,808	30,288	40%	14,414	8,302	22,716	30%
Rural	18,930	0	18,930	25%	21,202	0	21,202	28%	13,307	1,837	15,144	20%	15,144	0	15,144	20%
TOTALS	**45,610**	**30,111**	**75,721**	**100%**	**45,610**	**30,111**	**75,721**	**100%**	**36,022**	**39,698**	**75,720**	**100%**	**30,288**	**45,433**	**75,721**	**100%**

Units remaining after dealing with the Regional Centre were next assigned to the Suburban Area in the same manner until the number of units specified for the Suburban Area by the scenario in question was reached. As with the Regional Centre, no distinction was made between singles and multiples in the allocation process. If, however, the number of multiple dwelling units expected to be built in the region was reached in the course of satisfying the quota set for the Suburban Area, remaining units would be assigned as singles or semis.

Dwelling units were assigned to the Rural Area after the Suburban Area by the same process with the same qualifications as for the Suburban Area. If the number of multiples was exhausted in the course of allocating units to the preceding two areas or if it was exhausted in the course of allocating units in the Rural Area, the balance of the unit allocation for the Rural Area was taken up by singles and semis.

By the methods described, the consultants arrived at a detailed distribution of residential development for each prescribed growth scenario suitable for calculation of housing costs, commuting and other travel costs, and other consequences of residential location choices. **Appendix C** provides maps of the distributions determined for each of the four scenarios, showing the number of dwelling units assigned to each property.

The process adopted for distributing dwelling units was the same across the four scenarios. The best location for an apartment building in the region (*i.e.*, the property zoned for multiple unit structures that received the highest residential attractiveness score) was the same in all cases as were the second and third best locations, and so on. Variations in the scenarios only come with respect to the point at which the specified number of dwelling units was reached and, in some cases, where the maximum number of dwelling units in multiple unit structures was attained (**Table 3.7**).

For many analytical purposes, population associated with housing distributed in this manner was then summarized by the Traffic Zones shown in **Figure 3.3**. For the VISUM traffic model applied by HRM, municipal staff divided the region into 199 traffic zones, which are classified into Regional Centre (Urban Centre on **Figure 3.3**), Suburban Area, and Rural Commuter West and East Areas (RCW and RCE on **Figure 3.3**), and a residual Rural Area labelled Rural on **Figure 3.3**. **Appendix B** provides 2009 population and employment estimates for the Traffic Zones and indicates the categorization of each zone.

Not shown on either of the two maps in the figure but included in **Appendix B** as Traffic Zones 9998 and 9999 are two further "XRural" Zones to the east of the Musquodoboit River. The external zones are Census Tracts or sub-areas of Census Tracts within HRM created by Statistics Canada of which there are 88 in the region. Statistics Canada provides full profile information for each Census Tract online. Census Tracts have also been reasonably stable over time, so it is possible to assess trends in these sub-areas, provided attention is paid to some adjustments

that have been made as areas have grown and evolved (*i.e.*, primarily subdivision of Census Tracts in the growing Suburban Area). These two external areas combined with the RCW, RCE, and Rural Areas shown on **Figure 3.4** correspond to the RMPS Rural Area designation used throughout this report.

These zones were employed through the VISUM model to determine traffic generation from new dwelling units. They provide a reliable estimate of population in each area drawn from the 2006 Census and updated by HRM staff to 2009 based on population estimates prepared by Environics for the recent review of Council electoral boundaries. The zones were also used to assign other features common to neighbourhoods such as crime rates or serviceability that apply to areas as opposed to individual properties as well as to develop catchment areas for facilities and calculate distances to facilities from new development under each future scenario. In the case of water and sewer assessments, catchment areas were developed based on known conditions and dwelling unit counts for those areas were compiled for each catchment area.

3.3 Distribution of Non-residential Land Uses

The RFP for this assignment did not specify how employment should be distributed in relation to residential location choices. As noted above, allocation of employment to the Traffic Zones was determined by HRM staff as part of the traffic modelling process they undertook in support of this assignment. They had previously developed and refined methods of employment allocation relative to residential population in developing the employment distribution portrayed in **Figure 3.4.**

HRM staff allocated employment to Traffic Zones for each scenario for 2031 in consideration of the distribution of dwelling units by structural type provided by Stantec. The employment allocation method was based on the following assumptions adopted by HRM staff:

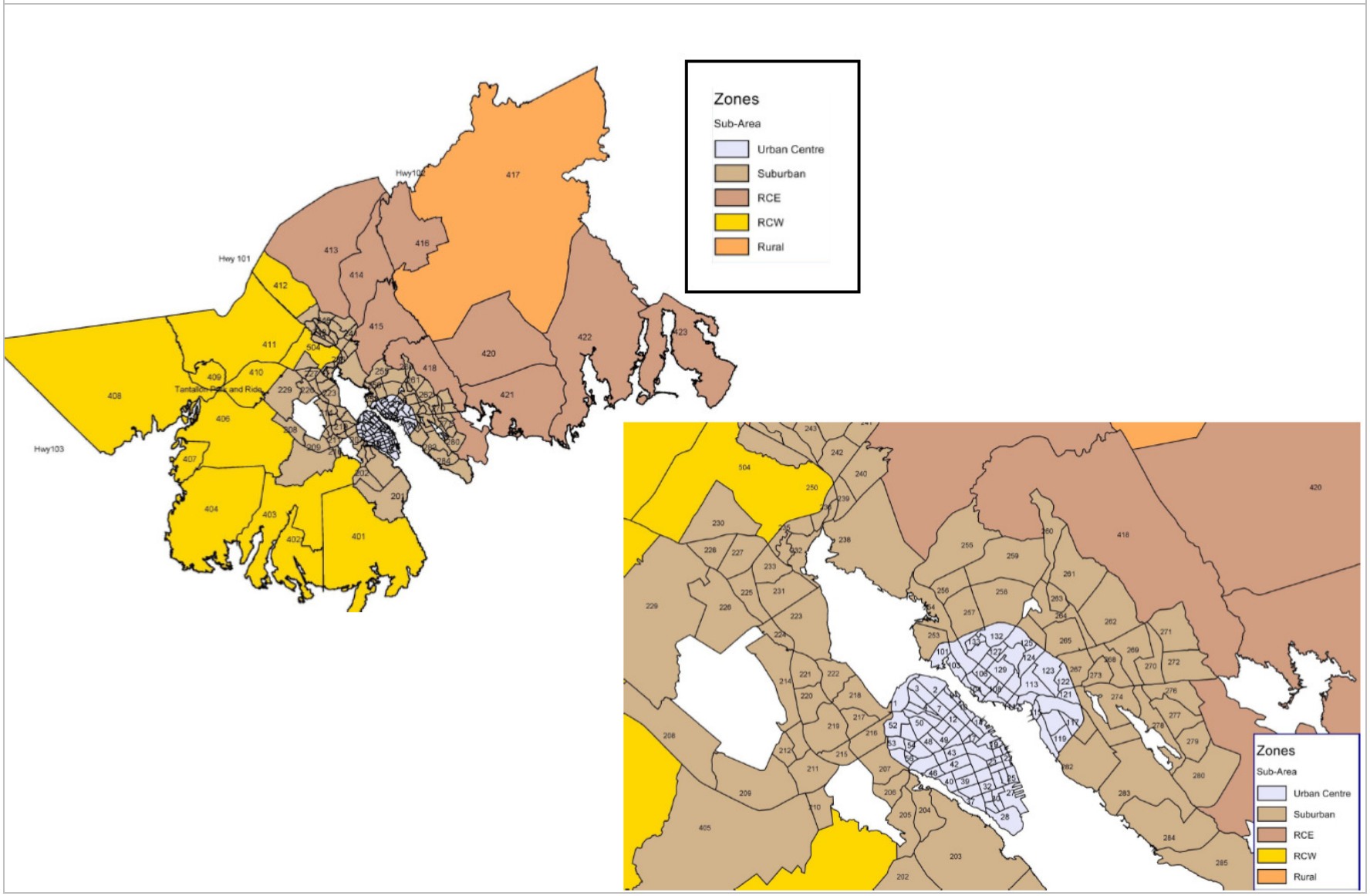
- The allocation of basic employment (*i.e.*, employment in sectors producing goods and services exported to areas outside HRM) is independent of the distribution of residential growth.
- Basic employment growth in a Traffic Zone is a function of building permit activity and existing employment in each Traffic Zone.
- The allocation of non-basic employment (*i.e.*, remaining employment producing goods and services for local needs) is directly related to the distribution of residential growth.

More simply stated, HRM staff assume employment in large offices, institutions, and industries grows in locations where it is already located within the region, while local service businesses are expected to follow the growth of residential areas closely.

HRM staff also took into account the critical impact of the shipbuilding contract on employment location in HRM. While available economic impact assessments do not identify the number of shipbuilding-related jobs that will be located in HRM, it is reasonable to assume that the majority will be here as the main activity will take place on the Halifax waterfront. The Richmond area where the shipyard and Richmond terminals are located can be expected to become a much more significant employment centre. While economic impact reports as well as press releases concerning the contract have been circumspect about ultimate employment in the shipyard, contacts familiar with the project have suggested to Stantec that as many as 4,000 employees may be added to the current complement of 1,200 in the yard. With additional associated jobs attracted to this area, it is reasonable to assume that it may become the workplace of 6,000 or more people.

Table 3.8 summarizes the allocation of additional employment to the Regional Centre, and Suburban and Rural Areas of HRM in 2031. The table suggests that the residential development scenarios significantly influence employment location with more than 5,000 more jobs in the Regional Centre in Scenario B than in the Observed Growth situation in which the current trend of dispersion continues.

Figure 3.3 HRM Traffic Zones, 2006



The overall variation in employment distribution is however more modest than the variation in residential shares, largely because of the assumption that base employment will grow in its current locations. This, in turn, tends to emphasize the Regional Centre where business has traditionally located, allowing that considerable transportation and manufacturing employment as well as large format retailing is now located in suburban centres, most notably in the region's business parks.

Table 3.8 Employment Growth Allocation by Area, HRM, High Scenario, 2009-2031

	Current Regional Plan Growth Goals		Observed Growth (Post RMPS Adoption)		Hypothetical Growth Scenario A		Hypothetical Growth Scenario B	
Area	Emp	Share	Emp	Share	Emp	Share	Emp	Share
Regional Centre	19,569	33%	18,260	31%	22,106	37%	23,922	40%
Suburban	29,501	50%	30,141	51%	27,977	47%	26,217	44%
Rural	10,130	17%	10,798	18%	9,117	15%	9,061	15%
TOTALS	**59,200**	**100%**	**59,199**	**100%**	**59,200**	**100%**	**59,200**	**100%**

3.4 Residential Distribution and Health

Following sections of this report detail the impacts of residential distribution on public and privately provided services. Relative access of HRM's population to these services is a major determinant of community health and is discussed in relation to each service grouping addressed in the next four chapters. Discussions closing each chapter summarize these impacts.

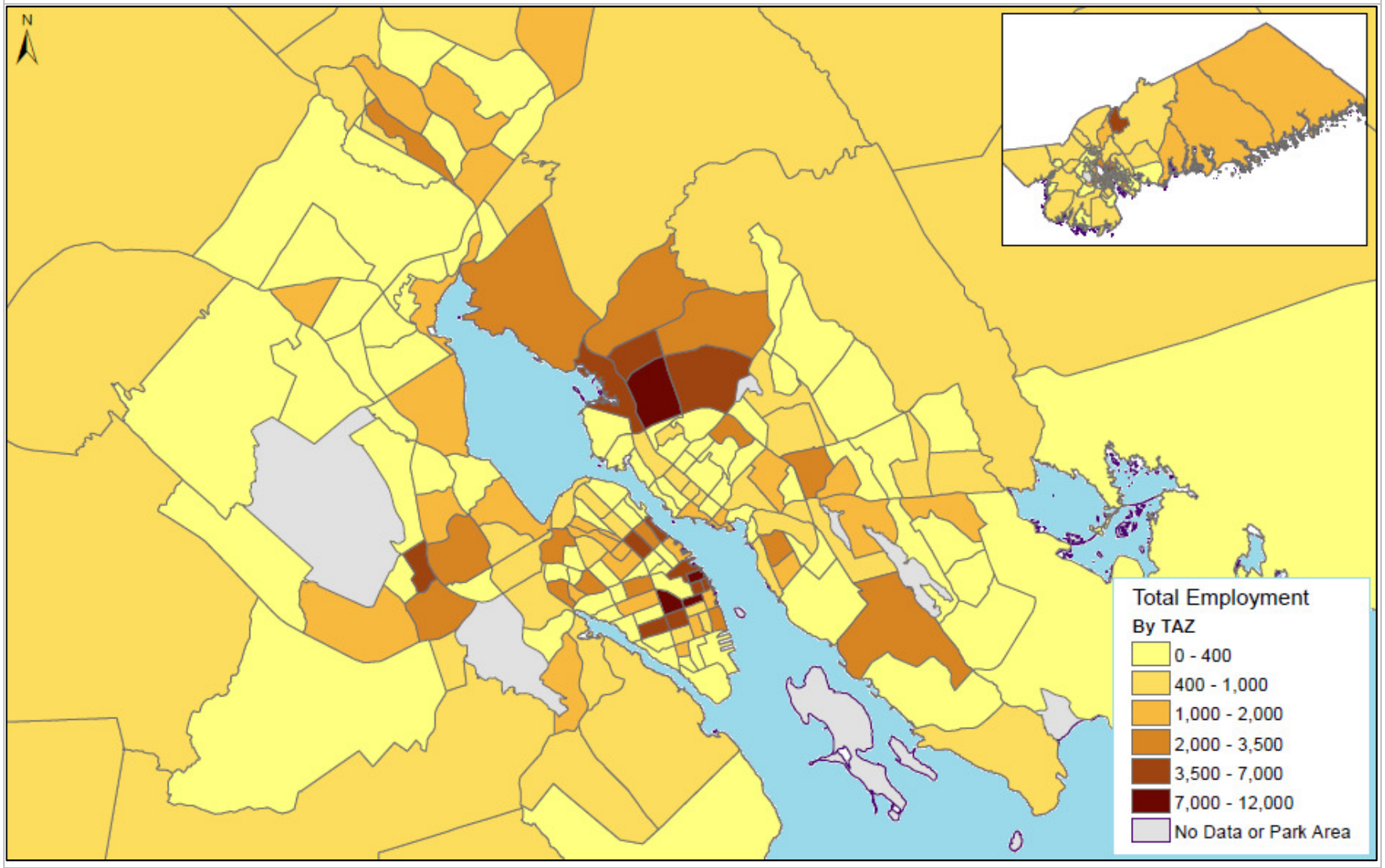
The inherent health implications of the four growth scenarios considered separate from these services largely relate to housing and its affordability. The assumptions supporting scenario creation explained above do not however envisage significant variation in housing arrangements beyond the distribution of units. The Altus projections fix the number of dwelling units and the division between singles and semis, and multi-unit types. As an expedient necessity, we have adjusted the split between these types for Scenarios A and B because it would not be possible to accommodate the dwelling units posited for the Regional Centre without increased reliance on multiple-unit housing.

Housing costs in Halifax are moderate relative to other Canadian and international centres. Halifax placed 175th in a September 2011 compilation of housing affordability in 325 urban markets in Australia, Canada, Hong Kong, Ireland, New Zealand, the United Kingdom , and the United States. The ranking by the think tank Demographia was based on dividing median house price by median household income in each market.

The multiple of income divided by house price in Halifax placed HRM in a many way tie with US and Canadian cities such as Edmonton, Guelph, and Austin, TX. Based on this multiple, HRM falls into the Demographia classification of "Moderately Unaffordable." The only superior classification, however, is "Affordable," which is assigned to markets with multiples of 3.0 or less. The Demographia compilation found 113 metropolitan markets satisfying this criterion, several of which are distressed areas where housing markets have collapsed. The most "Affordable" market is Saginaw, MI, and the top Canadian market is Windsor, ON. The top 100 includes many areas in the US Rust Belt, Florida, and Arizona in which housing prices have fallen markedly. It also, however, includes many apparently sound markets such as Atlanta, Dallas, and Indianapolis in the US, and Charlottetown in Canada.

The issue of determining affordability is contentious in any case. Demographia's rankings are based on price only and take no account of mortgage and other costs. Mortgage costs have fallen to record lows recently. Lower rates have considerably enhanced affordability even as they have played a role in driving up home prices.

Figure 3.4 Total Employment by Traffic Zone, HRM, 2009



Source: HRM (see **Appendix B**)

The Royal Bank of Canada calculates indices of affordability based on ownership costs (*i.e.*, proportion of median pre-tax household income that would be required to service the cost of mortgage payments, property taxes, and utilities) for a 1,200 ft² detached bungalow, a standard 1,500 ft² two-storey home, and a standard 900 ft² condo (excluding maintenance fees) at the going market prices for major Canadian housing markets. Mortgage carrying costs are based on principal and interest payments on a 25-year mortgage loan at a five-year fixed rate after a 25 per cent down payment. Unfortunately, this measure is not available from RBC for Halifax, which is not considered a "Major Market," and can only be inferred from RBC's Atlantic Canada index.

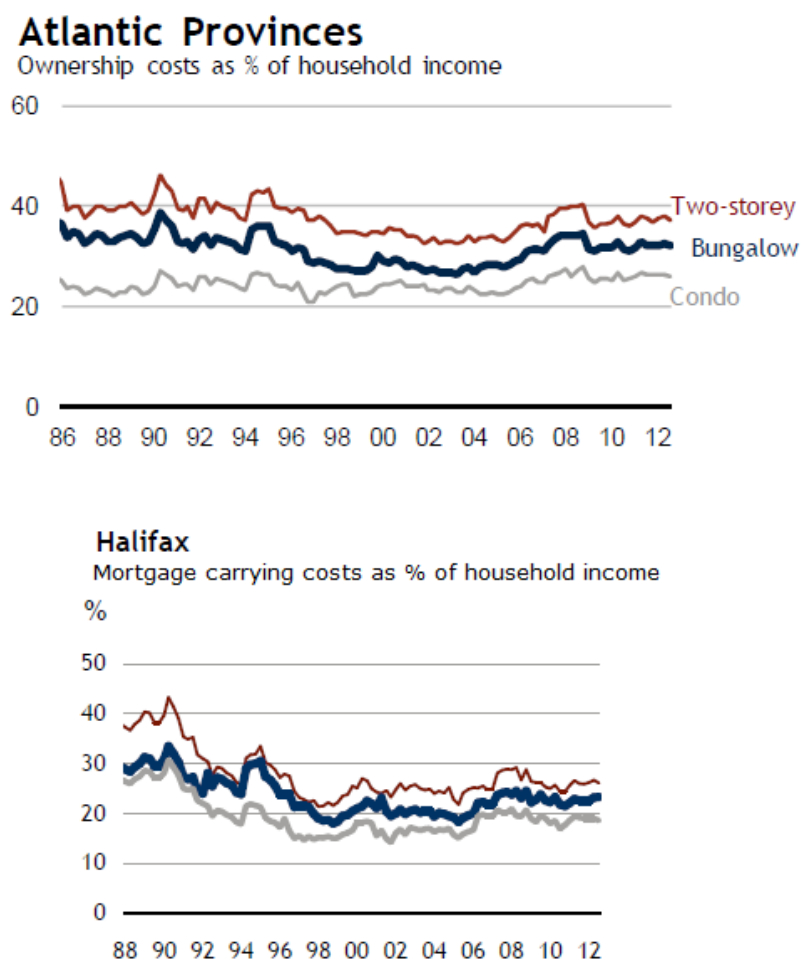
Overall affordability for Atlantic Canada is marginally better than the Canadian average. According to RBC's November 2012 *Housing Trends and Affordability* newsletter, the percentage of income required to own a standard bungalow in Atlantic Canada was just 32.3 per cent of average household income in the region or 76.9 per cent of the Canadian norm (42 per cent of income). Ownership of a two-storey home required 37.3 per cent of income and a standard condo required just 26.0 per cent, which respectively were 78.0 and 92.9 per cent of Canadian norms.

Costs for residents of the region have been stable over an extended period as illustrated in **Figure 3.5** and as characterized by RBC:

> Affordability measures have been quite stable in the past three years in the region, showing no discernible [sic] trends either on the up or down sides. Atlantic Canada's affordability position, therefore, continues to be 'average from a historical perspective and attractive when compared to the majority of other provinces.

Mortgage carrying cost trends for Halifax present a similarly positive picture. As portrayed in **Figure 3.5**, costs have clearly fallen as a percentage of income since the early 1990s in a market that has generally been stable with moderately increasing prices over the period.

Figure 3.5 Housing Affordability Measures, Atlantic Provinces and HRM, Third Quarter, 2012



Source: Royal Bank of Canada, November 2012

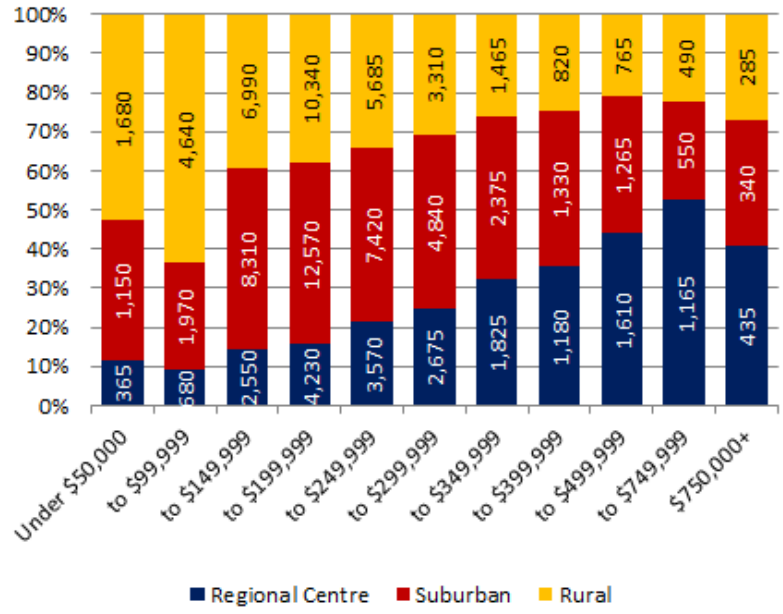
While housing affordability does not therefore appear to be a critical concern for Halifax residents, at least relative to other Canadians and residents of the other urban regions surveyed by Demographia, the influence of residential distribution on continued reasonable affordability may be debated. Demographia's consultants, for example, argue strongly that planning controls and, particularly, restrictions on the availability of land for residential development reduce affordability. Demographia however focuses on detached housing, which we have pointed out cannot be a major component of urban intensification. In this regard, it is important to be reminded, that RBC's index of housing costs takes into account utility costs, which are no doubt reduced for condominiums by their lesser area as well as by shared walls and common spaces. Condominiums, which are clearly more affordable based on the charts in **Figure 3.5**, will have to have a much larger role in HRM if urban concentration is to be achieved on the scale envisioned by Scenarios A and B.

A broader accounting of costs is required in any case. As economists, planners, and real estate agents are well aware, the choice between inner and outer urban locations involves a tradeoff between housing and transportation costs. Data assembled for this project indicate strongly that housing costs diminish steadily from the centre of the region to its periphery. The distribution of average housing values from the 2006 Census (the most recent comprehensive data available) demonstrates clearly higher cost housing is located in the Regional Centre (**Figure 3.6**). The average price of an owned dwelling unit within the Regional Centre in 2006 was $269,192 versus $207,086 in the Suburban Area and $188,352 in the Rural Area.

A counterpoint is however offered by the Center for Neighborhood Technology (CNT), which has developed a housing and transportation (H+T©) affordability index. CNT's Web site (http://htaindex.cnt.org/map/) provides comparative maps of affordability for all areas of the US that allow visitors to compare affordability with and without consideration of transportation – comparisons that invariably show affordable housing in extensive outlying areas based on housing costs alone but only in limited inner areas when transportation costs are added to the equation.

CNT unfortunately does not cover Canadian communities. The balance of this document, however, explores issues that accompany housing location decisions in HRM and goes far beyond just the issue of personal transportation costs. To the extent that concentration implies the choice of different residential types at a regional scale, it will influence health determinants such as environmental conservation and pollutant emissions as smaller more densely developed dwelling units will reduce land coverage and energy consumption. It may also enhance social equity if the overall cost of living can be reduced and access to services improved.

Figure 3.6 Distribution of Housing Values, HRM, 2006



Source: 2006 Census of Canada

4.0 TRANSPORTATION SERVICES

The connection between transportation and the distribution of residential development is an obvious and critical consideration underlying the hypotheses to be tested by this study. Road construction is an essential complement to residential land development. The location of dwelling units furthermore has a direct impact on road use in terms of trip length and duration of vehicle operation. Proponents of Transit Oriented Development, furthermore, argue and have demonstrated that higher density residential forms are more supportive of transit. Similarly, evidence such as the data referenced in **Section 2.2**, on walking and cycling by residents of the Halifax Peninsula suggests that the intensity of residential development can have a major role in shifting residents to the use of active modes of transportation.

4.1 Transportation Services Delivery

Responsibility for transportation services in HRM is shared between the Municipality and the Province of Nova Scotia. HRM is responsible for local, collector, and arterial roads. It is also responsible for sidewalks associated with these roadways as well as for most bicycle paths and many walking trails separate from the road network. Through Metro Transit, furthermore, the Municipality delivers bus and ferry services. The Province is responsible for highways and, through Halifax Harbour Bridges, maintains and operates the Macdonald and MacKay Bridges.

Road Network

Table 4.1 summarizes roadways for which HRM is responsible by type. HRM provides 7.08 lane kilometers of road in the Existing Urban Area defined by TAC on **Figure 2.5**, above, for every 1,000 residents there (estimated at 279,965 people in 2006 by TAC), but only 1.71 lane kilometers for every 1,000 rural residents. It is noteworthy however that the ratio of Provincial roadways to population is much higher in the Rural Area than in the Regional Centre and the Province continues to take responsibility for a large proportion of other rural roads in all classifications. HRM staff have indicated there is a total of 4,347.1 kilometers of road in the municipality including Provincial and private roads.

The Province of Nova Scotia is responsible for the construction and maintenance of highways. Halifax Harbour Bridges, a commission of the Province, is responsible for construction, operation, and maintenance of toll bridges across Halifax Harbour. It currently maintains and operates the three-lane Angus L. Macdonald Bridge and the four-lane A. Murray MacKay Bridge.

The 100 Series highways within HRM are nearly all two-

Table 4.1 Roadways by Classification, Rural and Urban HRM, 2009

TAC Road Classification	Length (2-lane equivalent km)
Rural Roads	
Highways/Expressways	Provincially owned
Arterial	7.7 km
Collector	35.3 km
Local	116.1 km
Lanes and Alleys	Classification not used
All Rural Roads	*159.1 km*
Urban Roads	
Highways/Expressways	Provincially owned
Arterial	404.2 km
Collector	596.7 km
Local	980.3 km
Lanes and Alleys	Classification not used
All Urban Roads	*1,981.2 km*
TOTAL ALL ROADS	**2,140.3 km**

Source: HRM as provided to Transportation Association of Canada

lane divided, limited access freeways. They define the major growth corridors within the region. The major roadways are as follows:

- *Highway 103* – Parallels the coast from the west of Halifax, south of Timberlea/Lakeside/Beechville, through Tantallon to Hubbards.
- *Highway 102/Bicentennial* – Connects Halifax to Truro and areas to its west to the border with New Brunswick. It also carries the bulk of traffic from areas between Truro and HRM and, more significantly for this study, from Bedford-Sackville into western Halifax.
- *Highway 101* – Provides further connection from the 102 north to the boundary between HRM and East Hants from which it continues to the Annapolis Valley. It is the primary carrier of commuters to the urban centre from Windsor, Wolfville, and Kentville, as well as from Upper Sackville.
- *Highway 107* – Intersects with Highway 102 east of Bedford and provides connection from Dartmouth to the Eastern Shore, although it ends at Porter's Lake at which point the more traditional Highway 7, a two-lane, undivided roadway running through communities of the area provides the primary eastward route.
- *Highway 111/Circumferential* – Provides a ring road around the core of Dartmouth through which users can move quickly between major points such as Burnside Industrial Park, Dartmouth Crossing, Portland Street, and Morris-Russell Lake.
- *Highway 118* – Provides a connection between Highway 102 and the Circumferential and secondary access to the eastern portions of Burnside and City of Lakes Business Park, as well as Dartmouth Crossing.

The Province pays for all highway improvements from its capital budget taking into account the availability of funds and the requirements for improvements in other areas under its jurisdiction. It is also responsible for the upkeep of these roadways and associated transportation facilities.

Nova Scotia Transportation and Infrastructure Renewal is planning only two major new roadways for the region:

- *Burnside Bypass* – A major extenison to Highway 107 intended to relieve chronic congestion on Magazine Hill/Windmill Road, which is the primary connection between Burnside/North Dartmouth and Bedford-Sackville.
- *Highway 113* – A connection from Highway 102 to Highway 103 that should reduce volumes on the Bicentennial on the western edge of Halifax as well as on the Hammonds Plains Road, which currently connects Highways 102 and 103, and has been handling increasing volumes of traffic as a result of residential development along much of its length.

Neither improvement is likely to directly facilitate significant residential development. Before reaching Burnside Industrial Park, the Burnside Bypass is planned to run through an area of active quarrying and lands owned by the Department of National Defence on which the military continues to store ordnance. The proposed Highway 113 will largely run through untouched woodland and barrens that have been designated as a Wilderness Protection Area by the Province. While neither will provide access to extensive areas with potential for residential development, both should reduce travel times and thereby enhance the residential attraction of upstream areas (*i.e.*, Sackville in relation to the Burnside Bypass and areas west of Halifax in relation to the 113).

The two harbour bridges also have a leading role in carrying commuter traffic in the region. Both carry substantial volumes between Halifax and Dartmouth: the Macdonald Bridge averaging 48,000 crossings a day and the MacKay 52,000. Halifax Harbour Bridges is exclusively funded through bridge tolls. Capacity on the bridges is strained and the commission has investigated the potential to build a third crossing south of the Macdonald Bridge. It is assumed that a third bridge would join the end of the Circumferential in Woodside to a point on the Halifax Peninsula near

Georges Island. It would be considerably longer than either of the Macdonald and MacKay Bridges. Preliminary studies estimated the cost of construction at more than $1 billion.

The bridges are funded by tolls, which are regulated by the Nova Scotia Utility and Review Board (NSUARB). The cash toll for an automobile is $1 but Halifax Harbour Bridges is encouraging the use of so called "MACPASSes," which are electronic transponders that record each time a user passes through a toll gate. Transponders considerably facilitate the flow of traffic on both bridges. According to the Halifax Harbour Bridges Web site, "[a]pproximately 85 per cent of bridge crossings during the peak travel times of the day are made using MACPASS." MACPASS users pay $0.70 per crossing. Cash charges for vehicles with trailers and commercial vehicles range from $1.25 (automobile towing single axel trailer) to $10.75 (commercial vehicle with eight axels) and are generally discounted about 25 per cent when using a MACPASS. Buses are charged $2.50 cash or $1.25 with a MACPASS.

New municipal roads are normally built by land developers or at their expense through Capital Cost Contributions. The Municipality does however contribute to major transportation facilities that are shared with existing development. The most notable example is highway interchanges, the cost of which is shared by the Province, HRM, and defvelopers. In such cases, the municipal share after taking the Provincial contribution will be based on the expected proportion of traffic volume on the facility that is attributable to the region as a whole as opposed to the specific development. This share is normally determined through traffic modelling.

HRM is also responsible for ongoing operations, maintenance, and renewal, including substantial regular expenses such as cleaning and snow clearing. Road maintenance costs are paid from HRM's general revenues. Costs for renewal and replacement of this infrastructure are funded from general municipal revenue (*i.e.*, property tax, deed transfer tax, and fines, permits, and other fees).

HRM is also responsible for sidewalk renewal and some aspects of their maintenance. On the Halifax Peninsula, property owners are required to clear their own sidewalks, whereas the Municipality plows sidewalks elsewhere. Residents in areas cleared by HRM pay an area rate to cover the cost of the service.

Transit

Transit services are delivered by Metro Transit. The organization operates 63 bus routes as well as ferries that connect Woodside and Downtown Dartmouth to Downtown Halifax across Halifax Harbour.

System ridership, as noted, compares well to other Canadian urban areas, ranking near the top among Canadian urban regions. Services include the following:

- *Conventional Bus* – Metro Transit operates nearly 300 buses on 57 conventional routes run throughout HRM. These routes operate through a network *of* 15 terminals that act as hubs for the system. Average weekday ridership is 101,202.

  There are 13 Park and Ride locations in the HRM, 11 of which are free for transit users. Many of the Park and Ride lots are at capacity. Proposals have been made to expand some lots and build new lots.

- *Urban Express* – Collects walk-on passengers from several stops in the suburbs and provides limited stop service through the Peninsula to downtown Halifax.

- *MetroLink* – MetroLink offers limited stop routes and upgraded buses on routes connecting Portland Hills and Sackville to Downtown Halifax, and Portland Hills to Woodside.

- *Community Transit Bus* – Community Transit buses operate from major transit terminals to the Porter's Lake, Sambro, and Beaver Bank areas. Average daily weekday ridership on these routes is 340.

Table 4.2 Metro Transit Services and Fares, 2011

Fare Category	Adult	Senior & Child	Student
Conventional, Ferry, Access-A-Bus, and Community Transit			
Cash Fare	$2.25	$1.50	$2.25
10 Tickets	$18	$13	$18
MetroPass	$70	$52	$64
Bus or Ferry Transfer	Free	Free	Free
MetroLink Fares			
Cash Fare	$2.75	$2.00	$2.75
MetroLink Pass	$85	N/A	N/A
With ticket, MetroPass, UPass or transfer	+$0.50	+$0.50	+$0.50
MetroX Fares			
Cash Fare	$3.25	$2.50	$3.25
MetroX Pass	$100	N/A	N/A
With ticket, MetroPass, UPass or transfer	$1	$1	$1
With MetroLink pass or transfer	$0.50	$0.50	$0.50

Source: Metro Transit, http://www.halifax.ca/metrotransit/tickets.html

- *MetroX* – MetroX is a network of express routes linking park and ride locations in the outlying rural areas with key destinations in HRM. The first route, which serves Tantallon along the Highway 103 corridor, began service in August 2009.

  In August 2012, the Route 330 Tantallon will become the Route 330 Tantallon/Sheldrake Lake, with some trips stopping at the Sheldrake Lake Park and Ride at Exit 4 on Highway 103. On May 21, 2012, the Route 320 Airport/Fall River was introduced to the Highway 102 corridor, connecting the Halifax Stanfield International Airport and Fall River Park and Ride with the Dartmouth Bridge Terminal and Downtown Halifax, and the Route 370 Porters Lake along the Highway 107 corridor is currently in the planning stages.

- *Access-A-Bus* – The Access-A-Bus service is a shared ride, door-to-door bus service for passengers who are unable to use the conventional bus system. People who have physical or cognitive disabilities can apply to use the service. The service operates within 1,000 meters of urban transit routes. Users outside this area must travel to the service area.

- *Harbour Ferries* – Metro Transit operates two ferries between downtown Halifax and downtown Dartmouth, from 6:30 a.m. to 11:45 p.m., seven days a week. Another ferry runs between downtown Halifax and Woodside, Monday to Friday during peak hours.

  The ferries transport an average 4,318 daily commuters along the twelve-minute crossing and have a maximum capacity of 285 passengers each.

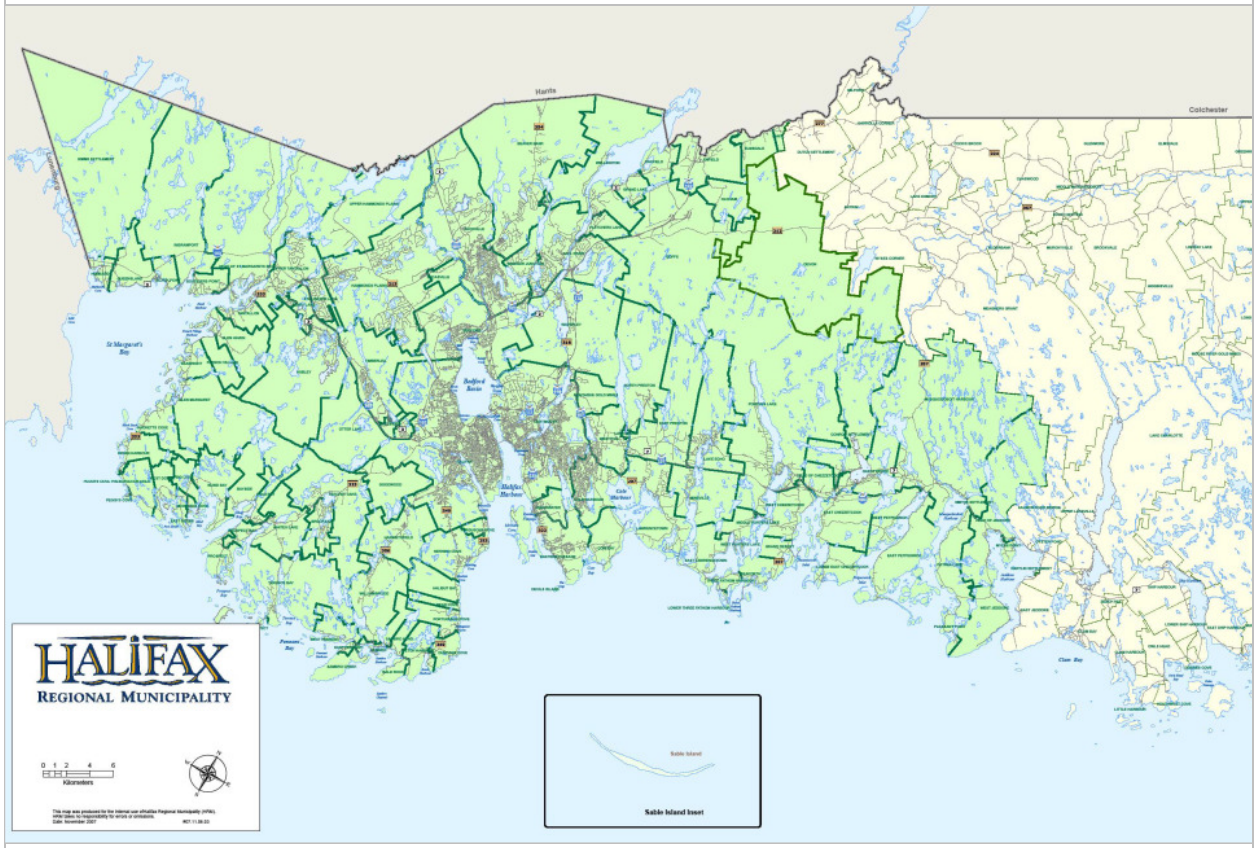
- *Higher Order Transit* – As HRM continues to plan for growth, new investments in transit will be required to address emerging transportation issues. As part of this planning process, investigating new services such as rail, bus rapid transit, and an expanded ferry will continue to be long term priorities for Metro Transit. Developing these options will depend on a number of factors including, the success of Transit Oriented Development in the region and the potential demand.

Transit system users pay a set fare depending on service type (**Table 4.2**, above). Fares, however, do not generally cover the costs of operation. Additional requirements are covered from various sources, including contributions from Gas Tax revenues and a special Transit Tax. Transit Tax levies for residential property owners are as follows:

- 5.1 cents per $100 of assessment for regional transit services such as MetroLink, Metro X, and the ferries, as well as for a share of local transit costs, payable by residents of HRM living within the green area shown on **Figure 4.1**, above.

- 10.5 cents per $100 of assessment for the local transit service paid for by residents within 1 km of a local transit route.

Figure 4.1 HRM Regional Transportation Tax Area, 2011



Source: HRM, http://www.halifax.ca/revenue/tax/documents/RegionalTransportationMap.pdf

Commercial properties are charged rates on their assessment sufficient to cover 49 per cent of the regional residential rate and 40 per cent of the local residential rate. Capital Cost Contribution charges have recently been expanded by HRM to fund transit infrastructure such as terminals, ferries, buses, and bus shelters.

Active Transportation

Halifax, like many communities across Canada, is developing trails and bicycle links to supplement its road network and encourage active transportation modes. In 2006, HRM Council adopted an Active Transportation Plan in principle, and the Municipality is currently implementing many of its recommendations, which cover bicycle routes as well as pedestrian trails and walkways.

The current Trails in HRM Web site indicates there are 157.9 kilometers of trailways in the municipality distributed as shown in **Table 4.3**. Some are the responsibility of HRM but most are managed and maintained by local community groups. According to HRM staff, the Municipality has also developed 100 lane-kilometers of bikeways consisting of 89 kilometers of dedicated bicycle lanes and 11 kilometers of widened curb lane.

The listed facilities are predominantly in Suburban and Rural Areas where most serve recreational uses more than transportation roles. In the Regional Centre and in most of the Suburban Area, the sidewalk network for carrying pedestrians has long been developed, and HRM standards require its extension with new roadways. Specialized connections have however been proposed and are under development, and there is ongoing demand for improved definition of bikeways.

Table 4.3 HRM Trails, 2011

Trail	Community Group Manager	Length (km)
Beechville/Lakeside/Timberlea		
Beechville/Lakeside/Timberlea Trail	Beechville Lakeside Timberlea Trails Assoc.	13
St. Margaret's Bay Rails to Trails	St. Margaret's Bay Area Rails to Trails Assoc.	32
	Sub-total	45
Halifax		
Chain of Lakes Trail	Chain of Lakes Trail Assoc.	7.25
Frog Pond Trail	Halifax Regional Municipality	1.4
Halifax Urban Greenway	Halifax Urban Greenway Assoc.	1
Halifax Waterfront Boardwalk	Halifax Waterfront Development Corp,	3.8
Mainland North Linear	Halifax North West Trails Assoc.	4
McIntosh Run Community Trail	McIntosh Run Watershed Assoc.	1.3
Point Pleasant Park	Halifax Regional Municipality	3.36
Sir Sandford Fleming Park Trail	Halifax Regional Municipality	2.8
	Sub-total	24.91
Bedford-Sackville		
Bedford/Sackville Greenway Connector	Sackville Rivers Assoc.	6
DeWolfe Park Boardwalk	HRM Waterfront Development Corporation	1
First Lake Glen Slauenwhite Trail	Friends of First Lake Society	3.3
	Sub-total	10.3
Dartmouth		
Dartmouth Harbourfront Walkway	Dartmouth Harbourfront Trails Assoc.	3
Portland Lakes Trail	Portland Estates & Hills Residents Assoc.	2.2
Shubie Park Greenway Corridor	Shubenacadie Canal Commission	18.5
	Sub-total	23.7
Cole Harbour		
Cole Harbour Heritage Park	Cole Harbour Parks and Trails Assoc.	22.5
Salt Marsh Trail	Cole Harbour Parks and Trails Assoc.	6.5
	Sub-total	29
Eastern Shore		
Atlantic View Trail	Atlantic View Trails Assoc.	10
Musquodoboit Trailway	Musquodoboit Trailways Assoc.	15
	Sub-total	25
	TOTAL	**157.91**

Source: HRM, http://www.halifax.ca/rec/walking.html

4.2 Impacts on Transportation Services

New development, particularly greenfield subdivision development, frequently requires construction of new local roads, which are paid for by developers. Stantec assumed new roads would be required for properties to be developed with any combination of single family and apartment development requiring five or more structures. The length of new roadway was estimated in GIS based on the size of the property to be developed and the percentage of its area required (*e.g.*, if a property was to be developed to half of its estimated capacity under a specific scenario, it was assumed that only 50 per cent of its road network would be built).

Stantec assumed 125 meters of road per developed hectare of land in the Regional Centre and the Suburban Area where municipal services are provided and 62.5 meters per hectare in the Rural Area, where development on onsite services requires more generous spacing. Estimates were based on examination of existing HRM road networks in GIS (*i.e.*, road network was measured within several 100 hectare squares overlaid on existing HRM neighbourhoods to establish the approximate range of road densities in recently developed Suburban and Rural greenfield areas, and the rounded mean was adopted with consideration of available literature on the topic). Costs of this road construction were estimated based on $3,500 per meter for roads in the Regional Centre and the Suburban Area, and $3,250 per meter for roads in the Rural Area. By this methodology, Stantec arrived at the estimates presented in **Table 4.4**.

As one might expect, the addition of dwelling units within the Regional Centre requires minimal construction of new roads. On the Halifax Peninsula and inside the Dartmouth Circumferential, road networks are already thoroughly developed so that only a few properties do not have frontage on an existing road. The higher density of residential development in the Regional Centre, furthermore, means that relatively modest road lengths serve large numbers of residences.. One good example is Kings Wharf, which will add hundreds of new units on extensions to King and Prince

Streets in downtown Dartmouth that, at most, add two to three blocks to each street.

Elsewhere in the region, new development will more often than not require much more extensive networks of new roadways to access and service extensive tracts of land. The total cost of these roadways is estimated to range from roughly $1.1 billion under Scenario B to more than $1.7 billion if current trends continue – a difference of nearly 35 per cent between the best and worst cases (**Table 4.4**).

Table 4.4 New Roads Required to Access New Dwelling Units, HRM, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre				
Single/Multi DUs	0/1000	0/1000	0/1000	0/1018
Length (km)	0.5	0.5	0.5	0.5
Cost ($000s)	$1,750	$1,750	$1,750	$1,750
Suburban				
Single/Multi DUs	18832/3122	17230/5591	15983/2635	10008/2635
Length (km)	221.8	191.0	181.8	95.3
Cost ($000s)	$776,283	$668,413	$636,169	$333,441
Rural				
Single/Multi DUs	15308/0	17387/0	11984/0	11984/0
Length (km)	306.9	355.5	248.2	248.2
Cost ($000s)	$920,804	$1,066,361	$744,638	$744,638
TOTAL				
Single/Multi DUs	34140/4122	34617/6591	27967/3635	21992/3653
Length (km)	529.2	546.9	430.5	344.0
Cost ($000s)	**$1,698,837**	**$1,736,524**	**$1,382,557**	**$1,079,829**
% of Trend	*97.8%*	*100.0%*	*79.6%*	*62.2%*

Although, the capital cost of building these roads as well as accompanying sidewalks, walkways, and pedestrian connections is largely absorbed by the responsible developers, their long-term maintenance will normally become the responsibility of the Municipality. New local roads also involve the construction of water and sewer networks in serviced areas (*i.e.*, all development in HRM classified as being in the Regional Centre or Suburban Area) as well the extension of electrical and communications networks. Following construction, HRM will, in most cases, be responsible for cleaning and snow clearing, as well as periodic repair and renewal. Some aspects of maintenance will increase for existing roadways subject to additional use but this increment is modest relative to the ongoing needs of a completely new road link.

In addition to the need for road frontage on which to build new dwelling units, the arrangement of residential development influences the need for travel within the region. HRM staff determined the impacts of development under each of the four scenarios on the broader network of collector and arterial roads using the VISUM model noted at various points above. The model provides measures of total drive time hours and distance at the PM peak under each scenario as well as the splits between automobile, transit, and pedestrian and cycling trips (pedestrian and cycling trips include individuals working at home) in each case. For testing of 2031 scenarios, HRM staff assumed following consultation with Stantec that the currently planned Bayers Road widening, Burnside Bypass, and Highway 113 connection would be in place and these were considered to be part of the network. No changes to the transit system were included in the 2031 models.

Modelling results suggest significant gains from concentration of new development (**Table 4.5**). The number of trips inevitably increases from the 2009 Baseline under all scenarios because of the significant increase in population expected to 2031; however, all three of the more concentrated scenarios are estimated to achieve shorter vehicle trip times than continuation of the Post RMPS Trend with benefits increasing progressively from the RMPS Goals Scenario through Scenario A and, finally, Scenario B. More significantly, the total increase in the distance covered by vehicle (*i.e.*, automobile) trips over the 2009 Baseline is better in all of the more

concentrated scenarios. In Scenario B it is less than 63.3 per cent of the increase expected if current trends are allowed to continue. The increase in automobile trips, furthermore, is estimated at 17.1 per cent less between continuation of current trends for Scenarios A and B.

Table 4.5 Transportation Model Estimates, HRM, 2031 Scenarios

Measure	2009 Baseline	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Network Summary					
Vehicle-Hours	24,926	31,745	33,443	30,581	29,038
% of Baseline		*127.4%*	*134.2%*	*122.7%*	*116.5%*
% of Trend		*94.9%*	*100.0%*	*91.4%*	*86.8%*
Vehicle-km	879,510	1,073,352	1,118,371	1,065,543	1,030,784
% of Baseline		*122.0%*	*127.2%*	*121.2%*	*117.2%*
% of Trend		*96.0%*	*100.0%*	*95.3%*	*92.2%*
Home-based Work Trips					
Automobile	36,350	45,371	45,635	44,139	44,051
% of Total	*76.6%*	*76.3%*	*76.7%*	*74.2%*	*74.0%*
% of Trend		*99.4%*	*100.0%*	*96.7%*	*96.5%*
Transit	5,760	7,352	7,354	7,564	7,472
% of Total	*12.1%*	*12.4%*	*12.4%*	*12.7%*	*12.6%*
% of Trend		*100.0%*	*100.0%*	*102.9%*	*101.6%*
Pedestrian/Cycle	5,338	6,769	6,503	7,789	7,969
% of Total	*11.3%*	*11.4%*	*10.9%*	*13.1%*	*13.4%*
% of Trend		*104.1%*	*100.0%*	*119.8%*	*122.5%*
TOTAL TRIPS	**47,448**	**59,492**	**59,492**	**59,492**	**59,492**
Avg. Trip Time	31.5	32.0	33.7	30.8	29.3

Source: HRM

Modal split in favour of transit is predicted to rise moderately relative to the 2009 baseline. To some extent this underestimates future benefits. Transit system routes are held constant by assumptions in the VISUM model as it is not possible to know how the transit system will be configured in 2031. As a result, new areas of development are not served or are less well served than in the baseline condition, even under Scenarios A and B. Over time, regardless of the pattern of development, the transit system will adapt to reach potential users. The relatively higher percentages estimated to use transit in the more intensified scenarios, however, suggest that less adaptation of the existing system will be required under those conditions as residents will be more concentrated in the existing serviced area. A more concentrated settlement pattern would also be expected to be characterized by Transit Oriented Development (*i.e.*, higher density development located on or near major transportation corridors) that could support system restructuring that would likely stimulate further increases in ridership; however, the detailed service reconfiguration required to address this potential is beyond the scope of this study.

The benefits of concentration are even more dramatic in terms of the estimated need for road network improvements under the four scenarios. Necessary road network improvements are identified by the model as those sections of arterial and major collector roads where the volume-to-capacity ratio is greater than or equal to 1.10 under the expected future condition. As can be seen from examination of the second column “Increase” in **Table 4.6**, the 16.90 kilometers of additional road network improvements required under Scenario B to accommodate residential growth are just less than 60 per cent of the 28.18 additional kilometers estimated to be required if current trends continue. Based on a cost of $4,000 per meter for urban arterial roadways, the costs of arterial upgrades range from $159 million under current trends to just $115 million if Scenario B can be achieved. With an additional $2,000 per meter for typical land acquisition costs, the overall expenditure for upgrades increases to $240 million under the Trend Scenario versus $172 million for Scenario B, a difference of approximately $68 million or roughly 40 per cent more money.

Table 4.6 Required Network Improvements, HRM Roadways, 2031 Scenarios

Scenario	2009 Baseline	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Required Improvements (km)	11.81	35.28	39.99	33.06	28.72
Net Increase		23.47	28.18	21.25	16.9
Incremental Cost ($000s)		$141,120	$159,960	$132,240	$114,880
Including Land ($000s)		**$211,680**	**$239,940**	**$198,360**	**$172,320**
% of Trend		*88.2%*	*100.0%*	*82.7%*	*71.8%*

Provincial roadways were explicitly considered in the modelling process; however, a critical component of the regional transportation network that was not directly assessed in the VISUM model is the harbour bridges. As stated above, Halifax Harbour Bridges has discussed the potential need for a third harbour crossing should volumes using the bridges continue to increase. While the model does not measure trip increases against bridge capacity, it does include a screenline indicating the total number of vehicle crossings anticipated across the harbour. Although the more condensed scenarios should reduce overall trip generation as discussed, they place larger proportions of population close to the harbour's edge. The two influences bring harbour sceenline counts fairly close together for all four scenarios measured by anticipated vehicles per hour in the afternoon or PM peak period:

- RMPS Goals – 8,600 vph
- Post-RMPS Trend – 8,400 vph
- Scenario A – 8,600 vph
- Scenario B – 8,700 vph.

All distributions result in moderate increases over the baseline count for 2009 (8,300 vph). The distribution expected if current trends continue is expected to generate the least flow and Scenario B would result in the most. The difference is slight, however, with a 3.6 per cent difference between the best and worst cases. The results suggest that none of the scenarios considered will either necessitate the construction of an additional harbour crossing or avoid it. Moreover, the analysis did not consider the potential for new or improved ferry services to divert some of this additional cross-harbour demand. This and related questions would have to be studied in detail before any final decision could be made on the case for constructing a third harbour crossing.

4.3 Transportation and Health

The health implications of transportation choices are probably the most wide-ranging of any service considered by this study. As noted by Dr. Frumkin cited in **Section 2.3**, transportation affects health on at least three levels:

- Generation of air pollutants and greenhouse gases through burning of fossil fuels
- Injuries and fatalities resulting from travel
- The impact on health of using automobiles as opposed to active modes.

The operation of vehicles using fossil fuels is a major source of air pollution including generation of GHGs. Increased vehicle use required in more dispersed scenarios directly adds to the quantity of detrimental emissions associated with the activity of HRM residents. The scale of associated emissions is calculable using common models and is outlined for the four distribution scenarios considered by this study in **Section 9.1**, below.

Intensification of development also reduces road construction requirements as demonstrated above. Roads and related sidewalks are largely impervious surfaces from which substantial runoff is generated. Stormwater from roads and sidewalks,

furthermore, frequently carries pollutants including hydrocarbons, salt, and particulates directly or through stormwater networks. **Table 4.7** summarizes road network and sidewalk improvements associated with each residential distribution scenario based on an assumed average asphalt road surface width of 15 meters for arterial roads summarized in **Table 4.6**, above, and 7.5 meters for subdivision roads (*i.e.*, local and collector streets) summarized in **Table 4.4.** Sidewalks are assumed to accompany subdivision roads in the Regional Centre and Suburban Area with an average width of 1.5 meters assuming sidewalks on one side of all roads. Sidewalks are not anticipated with major network improvements on the assumption that arterial roads requiring widening already have sidewalks (*i.e.*, sidewalks will likely be replaced but will represent no net addition) and new arterial roads will generally not have sidewalks.

The differences among the scenarios are substantial. Achievement of Scenario B could avoid the creation of 166.6 hectares of asphalt in the region, a reduction of nearly 38 percentage points. Drive accesses and parking areas at homes and associated with non-residential properties in a more car dependent condition would augment this coverage, although it is difficult to say to what degree given the variety of factors influencing parking provisions.

Table 4.7 Road Network and Sidewalk Coverage (Ha), 2031 Scenarios

Measure	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Total Required Roadway	564.5	586.9	463.5	372.7
Road Area	397.0	410.3	322.9	258.0
Sidewalk Area	33.3	28.7	27.3	14.4
TOTAL AREA	**430.3**	**439.0**	**350.2**	**272.4**
% of Trend	*98.0%*	*100.0%*	*79.8%*	*62.1%*

The health impacts of resultant increases in run-off would largely be experienced in diminished water quality, particularly in inland streams and lakes, which do not have the volume to absorb contaminated inflows. Haligonians are largely protected from drinking water effects because municipal water sources are isolated from areas of potential new development and/or subject to strict land use controls. Run-off from developed land can however impact fish and wildlife habitat disrupting eco-systems and, thereby, affecting hunting, fishing, and the experience of nature available to local residents.

While the notion of urban intensification, with its implications of crowding, may convey a sense of danger, it is not borne out by available data. The most recent posted data on traffic accidents in Nova Scotia reveals strikingly the relative security of urban transportation versus rural components of the road network (**Table 4.8**). The so called rural network, which for the purposes of defining collision sites includes "primary and secondary highways, as well as local roads with a speed limit at the collision site exceeding 60 km/h," generates significantly more serious accidents than the urban network, which consists of "metropolitan roads and streets and other urban areas and a speed limit at the collision site of 60 km/h or less." This split is reflected in data for collisions in HRM in 2006 (the most recent year for which statistics have been published), which rank it tenth among Nova Scotia's 17 counties based on collisions per capita resulting in injury or death, despite the region being the most urbanized area of the province and having the highest level of traffic activity. HRM ranks first by collisions resulting in property damage, however.

Table 4.8 Accidents by Urban and Rural Road Classifications, Nova Scotia, 2006

Place of Occurrence	Property Damage	Personal Injury	Fatal	Total
Urban	5,462	1,794	21	7,277
Rural	2,081	1,173	58	3,312
Not Stated	1,818	513	0	2,331
TOTALS	**9,361**	**3,480**	**79**	**12,920**

Source: NSTIR, Highway Engineering Services, Road Safety, *2006 Motor Vehicle Collision Statistics*

Data from the same source also suggests safety benefits from use of alternative modes. As **Table 4.9** shows, the vast majority of transportation related injuries and

deaths occur in self-driven motorized vehicles, which include motorcycles and mopeds. By contrast, in 2006, only a small number of injuries and no fatalities occurred on transit buses, although 15 bicycle riders and pedestrians were killed. The number of transit and bicycle/pedestrian fatalities is reasonably consistent with records for previous years, which indicate that a single death occurred on a transit bus in Nova Scotia in each of 2003 and 2004, and that pedestrian/bicyclist deaths have ranged from 16 in 2004 to as low as 8 in 2000.

Table 4.9 Serious Accidents by Mode of Travel, Nova Scotia, 2006

Mode	Commuters	Personal Injury	Fatality	Share of Injuries/ Share of Commuters	Share of Fatalities/ Share of Commuters
Car, truck, van, other motorized	343,345	5,130	103	106.8%	102.4%
Public transit	23,965	10	0	3.0%	0.0%
Walk or bicycle	35,645	27[1]	15	N/A	143.7%
TOTALS	**402,955**	**5,140**	**118**		

[1] Serious injuries only

Source: NSTIR, Highway Engineering Services, Road Safety, *2006 Motor Vehicle Collision Statistics* (Commuter data from 2006 Census of Canada)

To compare the relative safety of transportation modes, Stantec divided the share of injuries and fatalities for each mode in Nova Scotia, by the percentage of commuters in the province using each mode. A coefficient of more than 100 per cent resulting from this calculation indicates a higher share of accidents than would be expected based on the use of a particular mode, while a coefficient of less than 100 per cent indicates a relatively safer mode of travel.

While this is a crude measure considering that accidents are recorded in relation to all types of trips, it does give an order of magnitude feel for relative safety and, particularly, the safety of public transit in comparison to the alternatives. It also indicates that active modes are less safe than their energy consuming alternatives based on a significantly higher level of fatalities. Data on pedestrian injuries only record "serious injuries" and cannot be directly compared to the "personal injury" numbers recorded for other modes. On the other hand, serious injuries to pedestrians and bicyclists varied from 9 to 14 per cent of all recorded serious injuries to road users in Nova Scotia, which suggests a coefficient between 100 and 160 per cent given the proportion of commuters who walked or biked in 2006 (*i.e.*, 8.8 per cent).

To the extent that the concentration of residential development facilitates the use of transit, it clearly promotes a safer as well as a more sustainable transportation mode. The evidence with respect to active modes is more difficult to decipher. With markedly higher accident rates among pedestrians and bicyclists, some might conclude that it would be desirable to encourage them to use safer options. Pedestrian commuters and bicyclists have however argued for some time that the issue is with facilities rather than modal choice, a position to which HRM like many other municipalities has responded with a growing network of trails and bike lanes as outlined in **Section 4.1**.

These facilities are not easier to provide in the Regional Centre given more limited road right of ways and higher land costs; however, they are considerably more effective in terms of the number of users benefitting from their provision relative to their required length, a characteristic that they share with other networked services addressed by this study. Some research also suggests that increased presence of walkers and cyclists reduces the risk of accidents with vehicles, as drivers appear to show more care on roadways with more vulnerable users.

Maintenance of transportation options is also a major social equity issue. Vehicle ownership is beyond the means of some residents and vehicle operation is beyond the legal or physical capacity of others such as youth, some health challenged people, and many older seniors. A viable transit system and active transportation options provide essential alternatives that facilitate greater participation of these groups in society. To the extent that the settlement pattern can reduce travel distances and thereby lower vehicle operating costs, facilitates transit use, and/or enhances the viability of active transportation choices, it can improve the prospects

of full social participation for these groups. Traffic modelling data indicates that the more condensed scenarios can produce all three benefits.

Use of transit and active modes in this context has additional benefits for physical health. Automobile use is closely associated with the sedentary North American lifestyle deplored by many health professionals. Lack of exercise in the opinion of most is a critical cause of obesity, which is correlated with heart disease and several other common detrimental health conditions. Increasing the proportion of population walking and bicycling to work or just to transit stops offers significant benefits to those able adopt these modes. With a relatively benign climate, HRM residents can maximize the benefits of settlement patterns that encourage greater levels of active transportation and transit use for non-work as well as commuting trips.

5.0 WATER AND WASTEWATER SERVICES

Piped water and wastewater services are typically extended in conjunction with the development of local roads in serviced areas, which correspond to the Regional Centre and Suburban Area defined in the RMPS. The relative density of development in serviced areas is clearly a critical factor in the extent of water and wastewater networks required to service development.

Piped services are not normally provided to the Rural Area of the municipality, which is outside the Regional Development Boundary, which coincides with the Suburban or Urban Settlement Boundary shown in **Figure 1.1** above. Rural housing is typically developed on well and septic systems or, occasionally, on small-scale local sewage collection and treatment systems. It does not directly require the extension of pipes but is accompanied by other concerns. The potential for failure of on-site systems or privately managed community treatment systems raises the specter of undertaking remedial measures, including potentially installing piped systems after the fact, which is usually very expensive, particularly where initial development is dispersed.

5.1 Water and Wastewater Service Delivery

Water is provided to residents within the Regional Centre and Suburban Area of HRM by Halifax Water, which is a commission wholly owned by the Municipality. Halifax Water was formed from the combination of several municipal water utilities at the time of amalgamation. It was originally responsible for water services only but assumed responsibility for HRM's wastewater collection and treatment infrastructure starting in 2007. Halifax Water also took on responsibility for HRM stormwater assets within the core boundary in 2007.

Water service is generally provided with piped wastewater collection in HRM; however, Kingswood in Hammonds Plains; some areas bordering Lower Sackville such as Fall River/Monarch Estates/Waverley; and some areas to the east of the former City of Dartmouth have water only.

Halifax Water is self-funded through water rates approved by the NSUARB. All water customers are metered and pay a per litre charge for water that they use. The current charge for water service is $0.413 per m^3.

For residences connected to the wastewater system, the current charge for discharge to the wastewater collection network is $1.169 per m^3, which also covers Halifax Water stormwater services. The volume to which the charge is applied is the metered water consumed. Base rates that set a minimum charge for all users also apply and vary in relation to the size of the subject meter. Rates applicable from January 2011 ranged from a minimum of $34.32 per quarter for 15 mm meters to $274.59 for 50 mm meters.

Water

The main source of water for the core of the region is the Pockwock Lake system northwest of Halifax, which provides just less than 70 per cent of Halifax Water's production capacity (**Table 5.1**). Halifax Water also draws water from the Lake Major watershed in east Dartmouth, the Lake Bennery watershed west of Stanfield International Airport, and a variety of smaller watersheds that serve subareas of the municipality such as Five Island Lake, Miller Lake, Collins Park, Middle Musquodoboit, Bomont, and Silver Sands.

Water distribution is accomplished through a 1,307-kilometer network of mains. The production capacity of the system is considerable. According to Halifax Water's 2010 Annual Report, the system is capable of producing 222,700 m^3 per day, which is sufficient to supply roughly twice the requirements of the current service population of 345,000, not including fire flows.

Table 5.1 Sources of Supply and Safe Yield, Halifax Water

Watershed	Areas (Ha)	Safe Yield (m^3/day)
Pockwock Lake	5,661	145,500
Chain Lake	206	4,500
Lake Major	6,944	65,900
Lake Lamont/Topsail	346	4,500
Bennery Lake	644	2,300
TOTALS	**13,801**	**222,700**

Source: Halifax Water, *Fourteenth Annual Report*, March 31, 2010

Wastewater

Any wastewater discharged through a central municipal wastewater system in HRM is treated. The Regional Centre and most of the Suburban Area are served by six treatment plants discharging to a marine environment, three of which comprise the Halifax Harbour Solutions project (*i.e.*,Halifax, Dartmouth, and Herring Cove). The remaining Wastewater Treatment Facilities (WWTFs) discharging to marine receiving waters are Belmont, Eastern Passage, and Mill Cove (**Table 5.2**). The plants have a combined treatment capacity of 298,300 m^3, which dwarfs the 7,636 m^3 handled by nine inland plants serving various suburban communities (Aerotech, Beechville/Lakeside/Timberlea, Frame, Lockview/MacPherson, Middle Musquodoboit, North Preston, Springfield Lake, Uplands Park, and Wellington).

The three harbour facilities currently provide advanced primary treatment; however, federal regulations will require these facilities to be upgraded to secondary treatment by 2031.

The "capital overview" in Halifax Water's 2011-12 to 2016-17 Business Plan provides rounded estimates of the length of the wastewater collection network, suggesting there are approximately 1,300 kilometers of wastewater pipe in the serviced areas (1,000 kilometers of sanitary sewers and 300 kilometers of combined sewers).

HRM and/or Halifax Water have had to extend services or takeover systems in several communities in HRM originally developed with on-site services or small cluster servicing schemes. Significant investments have been made either by the property owners in relation to the service extensions through the Local Improvement Charge process or by Halifax Water as the new system operator in the case of the assumption of neglected or failing systems.

Stormwater Management

The stormwater collection network is estimated in Halifax Water's Business Plan to comprise 700 kilometers of storm sewer and the previously noted 300 kilometers of combined sewer (by definition, combined sewers provide both sanitary and stormwater conveyance). As also noted above, stormwater costs, including renewal and replacement, are covered through the wastewater rate. Halifax Water also maintains ditches in the core service area.

Stormwater systems for new developments are typically constructed in conjunction with water and wastewater systems, and roads. Some components – most notably retaining structures and wetland restoration – are however separate and significant.

Table 5.2 Wastewater Treatment Facilities, Halifax Water

Facilities	Process	Design Capacity (m^3/day)	Area Served	Receiving Water
Halifax	Enhanced Primary - UV	139,900	Halifax	Halifax Harbour
Dartmouth	Enhanced Primary - UV	83,800	Dartmouth	Halifax Harbour
Herring Cove	Enhanced Primary - UV	28,500	Halifax-Herring Cove	Halifax Harbour (Outer)
Mill Cove	Secondary - UV/Pure oxygen activated sludge	28,400	Bedford-Sackville-Beaverbank	Bedford Basin
Eastern Passage	Primary – Chlorine [1, 2]	17,700	Cole Harbour/Eastern Passage	Halifax Harbour
Beechville-Lakeside-Timberlea (BLT)	Enhanced Primary - Chlorine / RBC	4,540	Beechville/Lakeside/Timberlea	Nine Mile River
Aerotech	Tertiary - UV/SBR	1,400	Aerotech Park-Airport	Johnson River
Springfield Lake	Secondary - Chlorine/Activated sludge	543	Springfield Lake	Springfield Lake
Lockview-MacPherson (Fall River)	Tertiary - UV/Activated sludge & post filtration	454.5	Lockview-MacPherson Road	Lake Fletcher
North Preston	Tertiary - UV/SBR and engineered wetland	345	North Preston	Winder Lake
Middle Musquodoboit	Secondary - U.V RBC	114	Middle Musquodoboit	Musquodoboit River
Uplands Park	Tertiary - UV/Trickling filter and wetland	91	Uplands Park Subdivision	Sandy Lake
Wellington	Secondary - Chlorine /Activated sludge [3]	68	Wellington Subdivision	Grand Lake
Frame	Secondary - Chlorine/Activated sludge	80	Frame Subdivision	Lake William

RBC = Rotating Biological Contactor; SBR = Sequencing Batch reactor; UV = Ultra Violet

1. Eastern Passage Wastewater Treatment Facility (WWTF) is currently being upgraded to a secondary treatment facility.
2. Includes Belmont WWTF that will be decommissioned following the Eastern Passage WWTF upgrade.
3. Wellington WWTF is currently being upgraded to a tertiary treatment facility with enhanced nutrient removal.

Source: Halifax Water, *Fourteenth Annual Report*, March 31, 2010

Provision of Services

Services can be extended to new users as new areas are developed within the existing service area defined by the Regional Development Boundary. Development on the edges of the boundary normally requires an application to alter the boundary that generally must be supported by evidence that the water or wastewater system can accommodate additional users. This must take into account the adequacy of local water/wastewater infrastructure to meet relevant service standards and regulatory compliance requirements. HRM does not encourage the development of property with water service without complementary municipal wastewater provisions.

Whether areas of new development are within the Service Boundary or require that the boundary be extended to accommodate them, the cost of constructing local water and wastewater pipe networks is borne directly by the developer or through HRM's Local Improvement Charge process. Developers of new subdivisions are required to submit a concept plan accounting for all service provisions required for their proposed development. They are required to build all required components of the water delivery and wastewater collection systems on their property and upgrade any off-site infrastructure required to facilitate their development.

In master plan areas, for both water and wastewater servicing, over-sized infrastructure may be required to benefit all landowners within the plan area. The

oversized components of the water and wastewater systems are used to develop the Capital Cost Contribution (CCC) charge that will be applicable on a per acre basis to all of the lands in the master plan area.

Residents who live outside serviced boundaries generally rely on wells and on-site septic systems. On-site servicing presents an ongoing risk to the homeowner related to potential well contamination, water supply capacity concerns, water quality concerns, and failing septic systems. The resolutions for problems of this type may include:

Water

- Drilling new wells where property can accommodate them
- Trucking in water
- Extending water services
- Creating new municipal water supplies

Wastewater

- Replacing failing septic system where feasible
- Trucking away sewage
- Extending sewer services
- Developing new municipal wastewater treatment facilities.

All of these solutions tend to be costly with the extension of piped services being particularly expensive to implement in areas that have been developed at low densities required to support on-site services. The cost risk for these resolutions is borne by the property owner but the financing of piped services, central water supplies, and treatment plants can be accomplished through a Local Improvement Charge process, which can spread out the costs in smaller amounts over several years.

The impact of development on the municipal water and wastewater system is related to population served, calculated area to be serviced, the extension of infrastructure to service the development, additional supply and treatment capacity, and pressure constraints in the water system. Water and wastewater infrastructure is extended in roughly direct proportion to construction of new roadways for greenfield development. Infill in established areas may have occurred on existing infrastructure where no changes in density are proposed. Infill requiring an increase in density must be analyzed to ensure no impacts on the existing system, customers, and the environment. In some cases, infill development will trigger local infrastructure improvements that would be required at the developer's cost. New connections in established areas will, in fact, reduce the cost of water per unit of development by increasing the number of users covering the costs of this shared capital. .

5.2 Impacts on Water and Wastewater Services

For greenfield development, Stantec estimates the installed costs of water and wastewater pipe at $1,500 per meter and $1,250 per meter respectively. Both cost figures are based on the installed cost of piping for typical residential development provided by Halifax Water. The commision's numbers included factors for risk, overhead, and taxes (*i.e.*, HST), and apply to all new roadways in the Regional Centre and Suburban Area. The construction of related underground network infrastructure, which is generally required for stormwater collection and disposal in the Regional Centre and Suburban Area, is similarly estimated at another $1,500 per meter.

As noted, piped water and sewer services are not provided to most developments in the Rural Area. Individual property owners, however, must pay to install wells and septic systems. While there are large variations in the cost of obtaining adequate water supply from wells in different parts of HRM, Stantec estimates the installed cost of a typical 300-foot deep well at roughly $6,500 with an additional $2,000 for pumping equipment, and $1,250 for other required components and work. Roughly, 50 per cent of rural wells also require water treatment at approximately $1,500 per well. The total cost per property is therefore estimated at $10,500 (*i.e.*, $6,500 + $2,000 + $1,250 + ($1,500* 0.5) = $10,500). Apartment structures larger than 20 units may require an additional well or wells but no apartment structures on this scale are anticipated in the Rural Area.

Typical septic fields for single family homes and small multi-unit structures cost approximately $10,000 in HRM. Roughly 15 per cent of properties may require more expensive options that will normally increase the costs into the $15,000 to $20,000

range giving an average cost of roughly $11,000 (*i.e.*, ($10,000*0.85) + ($17,500*0.15) = $11,125, which we have rounded down).

Replacement of a septic field may cost about half of the original installation cost (*i.e.*, approximately $5,000, considering that elements of the original infrastructure can normally be preserved). The cost of replacing a contaminated well will often equal its original installation. In both cases, replacement may be more difficult than the original installation given that the first location for both can be presumed to have been the best available option. In some circumstances, if the property is too small or affected by some other condition or limitation (*e.g.*, extensive contamination or less suitable soils) or if multiple properties in one area are affected, development of piped systems may be necessary.

In rural areas, stormwater collection is typically accomplished through ditches and culverts, which are considerably more economical than underground pipes at, perhaps, $250 per meter of new road accounting for both sides of the roadway.

Table 5.3 provides a summary of costs for water, wastewater, and stormwater management in the Regional Centre, and Suburban and Rural Areas. All costs are essentially private as developers pay for local water, wastewater, and stormwater piping as explained above, and individual property owners are responsible for provision of their onsite services in the Rural Area. The differences in costs are large with nearly $495 million separating the Trend Scenario and Scenario B. A substantial portion of the costs accounted (ranging from 31.6 to more than 45 per cent of the total cost depending on the scenario) is in the provision of on-site services in the Rural Area. Differences in provision of piped water and sewer are however more significant, ranging from $833.6 million under the RMPS Scenario down to $359.3 million under Scenario B.

Scenario B could save nearly $360 million, with the bulk of savings coming from the ability to avoid new water, wastewater, and stormwater piping in the Regional Centre, where the bulk of new development would be directed in Scenario B. Estimates for Scenario B, in fact, suggest that it would cost more than 40 per cent less than continuation of the current pattern of development.

Table 5.3 Water, Wastewater, and Stormwater Linear Infrastructure for New Dwelling Units, HRM, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre				
Single/Multi DUs	0/1,000	0/1,000	0/1,000	0/1,018
New Road (km)	0.5	0.5	0.5	0.5
Cost ($000s)	$1,875	$1,875	$1,875	$1,875
Suburban				
Single/Multi DUs	18,832/3,122	17,230/5,591	15,983/2,635	10,008/2,635
New Road (km)	221.8	191.0	181.8	95.3
Cost ($000s)	$831,750	$716,250	$681,750	$357,375
Rural				
Single/Multi DUs	15,557/0	21,564/0	12,723/0	12,723/0
New Road (km)	86.6	98.0	79.0	79.0
Costs ($000s)				
Ditch and Culvert	$21,650	$24,500	$19,750	$19,750
On-site services	$406,995	$455,843	$325,596	$325,596
TOTAL				
Single/Multi DUs	34,140/4,122	34,617/6,591	27,967/3,635	21,992/3,653
Length (km)	529.2	546.9	430.5	344.0
Cost ($000s)	**$1,262,270**	**$1,198,468**	**$1,028,971**	**$704,596**
% of Trend	*105.3%*	*100.0%*	*85.9%*	*58.8%*

Table 5.3 does not provide the whole story, however. As with the transportation network, the volumes of water and sewage that must be moved within the respective networks increases as development proceeds. Existing pipes may have to be upgraded as new development is added to provide more supply in the case of water and to accommodate more sewage in the case of the wastewater network. Pumping and treatment infrastructure may also have to be improved to handle additional flows.

For the water network, Stantec determined the specific pressure zones associated with each water source or pumping station in the existing Halifax Water system. For each pressure zone, Stantec then estimated existing (2009) population and employment, and anticipated growth to 2031 in each pressure zone under the four distribution scenarios. Increased demand associated with growth impacts pump capacity across the system. Stantec obtained the firm capacity of each pumping station in the system from the hydraulic model provided by Halifax Water. These capacities were compared to projected demands associated with each scenario to determine required pump upgrades. The Infrastructure Replacement Unit Rates Water Systems value for water pumping stations from the 2012 Halifax Water Integrated Resource Plan was applied to determine future pumping costs presented in **Table 5.4**. The unit cost per million litres pumped per day based on the Integrated Resource Plan is $240,134.

Unlike network costs presented in **Table 5.3**, the differences between the various growth scenarios do not have an appreciable impact on overall pumping costs. The projected costs associated with servicing the four scenarios are very similar, varying from $33.5 million for Scenario B to $34.4 million for the RMPS Scenario. Although Scenario B represents a savings of more than12 percentage points relative to continuation of current trends, the overall difference is just $931,000.

To assess wastewater collection systems, Halifax Water provided Stantec with 15 computer models representing major serviced sewersheds in HRM. As with the water analysis, Stantec staff allocated population and employment estimates for 2031 to each sewershed. Stantec then calculated anticipated flows within each sewershed. As flow increases were determined to be nominal in eight of the 15 models (all serving smaller suburban and rural communities), the eight were set aside and models for the following seven areas were assessed under each of the growth scenarios:

- Burnside
- Dartmouth
- Eastern Passage
- Halifax
- Herring Cove
- Mill Cove
- Timberlea.

Table 5.4 Estimated Cost ($000s) of Water Pumping Improvements, HRM, 2031 Scenarios

Pump Station/ Facility	2009 Baseline	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Lake Major	$541	$5,688	$6,005	$6,181	$5,904
Beaver Bank	$53	$136	$105	$91	$82
Bedford South	$2,708	$2,949	$2,952	$2,944	$2,837
Bedford Village	$2,447	$2,858	$2,835	$2,744	$2,596
Crestview	$2,707	$2,956	$2,959	$2,952	$2,829
Eaglewood	$2,625	$2,627	$2,627	$2,626	$2,626
Highway 7	$2,230	$2,355	$2,381	$2,337	$2,350
Lieblin Park	$1,854	$1,865	$1,889	$1,862	$1,858
Mount Edward	$2,748	$2,928	$2,931	$2,930	$2,930
North Preston	$801	$1,437	$1,471	$1,288	$1,262
Upper Sackville	$2,783	$2,821	$2,816	$2,809	$2,794
Rockmanor	$0	$0	$0	$0	$0
Silverside	$2,594	$2,621	$2,621	$2,623	$2,622
Upper Hammonds	$2,670	$2,793	$2,819	$2,775	$2,788
TOTALS	**$26,760**	**$34,033**	**$34,410**	**$34,164**	**$33,479**
Change from Base		$7,273	$7,651	$7,404	$6,719
% of Trend		*95.1%*	*100.0%*	*96.8%*	*87.8%*

Table 5.5 summarizes the costs estimated for additional pumping required under each scenario to deal with sewage generation from increased population in 2031. The high level assessment involved identifying pipes where the modelled flow was estimated to be above the gravity full flow capacity (often referred to as q/Q). Cost estimates assumed a pipe increase of one size would be required if q/Q was between 0.95 and 1.25. An increase of two pipe sizes was assumed where the q/Q value surpassed 1.25.

Table 5.5 Estimated Cost ($000s) of Wastewater Pumping Improvements, HRM, 2031 Scenarios

Model	2009 Baseline	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Aerotech	N/A	N/A	N/A	N/A	N/A
Burnside	$980	$980	$980	$980	$980
Dartmouth	$10,330	$17,910	$17,910	$17,910	$17,670
Eastern Passage	$22,580	$22,580	$26,550	$26,550	$28,610
Fall River	N/A	N/A	N/A	N/A	N/A
Frame	N/A	N/A	N/A	N/A	N/A
Halifax	$7,620	$31,890	$29,970	$34,250	$34,250
Herring Cove	$14,530	$18,250	$18,280	$17,860	$15,490
Middle Musquodoboit	N/A	N/A	N/A	N/A	N/A
Mill Cove	$5,350	$5,540	$5,540	$5,540	$5,540
North Preston*	$2,600	$2,600	$2,600	$2,600	$2,600
Springfield Lake*	$6,910	$6,910	$6,910	$6,910	$6,910
Timberlea	$3,690	$5,400	$5,540	$5,160	$8,710
Uplands Park	N/A	N/A	N/A	N/A	N/A
Wellington	N/A	N/A	N/A	N/A	N/A
TOTALS	**$74,590**	**$112,060**	**$114,280**	**$117,760**	**$120,760**
Change from Base		*$37,470*	*$39,690*	*$43,170*	*$46,170*
% of Trend		*94.4%*	*100.0%*	*108.8%*	*116.3%*

* Improvements are not growth related and are carried from existing conditions through all four growth scenarios considered.

Cost estimates, in this case, are more ambivalent toward concentration. The least expensive scenario is the current RMPS policy. It is marginally better than continuing with the current trend. Scenario B, however, is the most costly alternative, resulting in $6.5 million more in capital expenditure than the Trend Scenario.

The final aspect of the wastewater system considered was treatment. Costs of plant upgrades were based on per $/m^3/day for each Wastewater Treatment Facility (WWTF) as provided by Halifax Water as follows:

- Halifax WWTF (Primary Treatment) - $755/m^3/d
- Dartmouth WWTF (Primary Treatment) - $1,495/m^3/d
- Herring Cove WWTF (Primary Treatment) - $650/m^3/d
- Middle Musquodoboit WWTF (Secondary) - $22,456/m^3/d
- North Preston WWTF (Tertiary) - $2,819/m^3/d
- Uplands Park WWTF (Tertiary) - $2,720/m^3/d
- Wellington WWTF (Secondary) - $20,000/m^3/d
- Frame WWTF (Secondary) - $30,222/m^3/d
- Springfield Lake WWTF (Secondary) - $2,895/m^3/d
- Mill Cove WWTF (Secondary) - $1,531/m^3/d
- Eastern Passage WWTF (Primary) - $940/m^3/d
- Aerotech WWTF (Tertiary) - $9,901/m^3/d.

Estimated treatment cost increases were lowest in the most concentrated scenarios. The least expensive was Scenario B and the most expensive was the RMPS Scenario, which is estimated to cost nearly $10 million more.

Table 5.6 Estimated Cost ($000s) of Wastewater Treatment Upgrades, HRM, 2031 Scenarios

Model	2009 Baseline	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Aerotech*	*$63,830*	*$63,830*	*$63,830*	*$63,830*	*$63,830*
Burnside*	N/A	N/A	N/A	N/A	N/A
Dartmouth	$100,250	$113,790	$114,170	$115,230	$115,540
Eastern Passage*	$22,830	$29,600	$28,800	$23,000	$25,950
Fall River	N/A	N/A	N/A	N/A	N/A
Frame*	*$7,720*	*$7,720*	*$7,720*	*$7,720*	*$7,720*
Halifax	$76,680	$114,200	$110,740	$119,740	$123,390
Herring Cove	$37,530	$38,040	$38,170	$37,950	$37,600
Middle Musquodoboit*	*$20,720*	*$20,720*	*$20,720*	*$20,720*	*$20,720*
Mill Cove	$28,480	$57,540	$56,940	$51,190	$46,200
North Preston	N/A	N/A	N/A	N/A	N/A
Springfield Lake	N/A	N/A	N/A	N/A	N/A
Timberlea	$9,810	$13,950	$13,240	$13,470	$9,810
Uplands Park	N/A	N/A	N/A	N/A	N/A
Wellington*	*$740*	*$740*	*$740*	*$740*	*$740*
TOTALS	**$368,590**	**$460,130**	**$455,070**	**$453,590**	**$451,500**
Change from Base		*$91,540*	*$86,480*	*$85,000*	*$82,910*
% of Trend		*105.9%*	*100.0%*	*98.3%*	*95.9%*

* Improvements are not growth related and are carried from existing conditions through all four growth scenarios considered.

Overall, compilation of all development-related costs for water, wastewater, and stormwater services favours Scenarios A and B (**Table 5.7**). Savings between Scenario B and continuation of the current trend total more than $490 million. The larger portion of savings is attributable to reduced costs of pipes and related infrastructure in the serviced areas of the region (*i.e.*, the Regional Centre and Suburban Area). Approximately $135 million is however gained in the Rural Area by reducing the considerable expenditures for on-site services implied by the Trend Scenario.

Table 5.7 Estimated Cost ($000s) of All Water, Wastewater, and Stormwater Improvements, HRM, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre and Suburban Services ($000s)				
New Pipes	$833,625	$718,125	$683,625	$359,250
Pipe Upgrades	$204,300	$217,180	$217,690	$217,860
Water Pumping	$7,273	$7,651	$7,404	$6,719
Wastewater Pumping	$37,470	$39,690	$43,170	$46,170
Wastewater Treatment	$91,540	$86,480	$85,000	$82,910
Urban Totals	**$1,174,208**	**$1,069,126**	**$1,036,889**	**$712,909**
Rural Services ($000s)				
Ditch and Culvert	$21,650	$24,500	$19,750	$19,750
On-site Services	$406,995	$455,843	$325,596	$325,596
Rural Totals	**$428,645**	**$480,343**	**$345,346**	**$345,346**
TOTALS	**$1,602,853**	**$1,549,469**	**$1,382,235**	**$1,058,255**
% of Trend	**103.4%**	**100.0%**	**89.2%**	**68.3%**

5.3 Water and Wastewater and Health

Provision of clean water and environmentally sound disposal of wastewater are vital to the maintenance of public health. The development of water and wastewater networks in the nineteenth century was critical to the control of typhoid, cholera, and other once common water borne diseases. HRM is fortunate to have access to

clean and abundant sources of water. With the completion of the Harbour Solutions, the Municipality made an important step to reduce the environmental impacts and health dangers associated with wastewater disposal.

Prior to the institution of a comprehensive wastewater treatment system for the urban core of HRM, it might have been reasonably contended that rural development with on-site septic disposal was superior to development connected to portions of the municipal network that discharged untreated effluent to Halifax Harbour through multiple outfalls. Even today, 85 per cent of the sewage discharged from HRM facilities is subject to primary treatment only, meaning that effluent continues to contain dissolved and suspended organic matter.

Both wastewater system types are subject to operational shortcomings that may have consequences for health. In some rain events, wastewater networks may overflow and discharge untreated sewage. Portions of the network where sanitary and storm sewers are combined are particularly prone to do so. Halifax Water is pursuing a Stormwater Infiltration Reduction program to reduce this threat. Pumping stations, treatment plants, and other components of the system may also fail, possibly for extended periods as happened with the Cornwallis Street Wastewater Treatment Plant shortly after it was commissioned.

Onsite septic systems, on the other hand, inevitably fail. The design life of a typical septic disposal system is 20 to 30 years. Even with proper maintenance, the accumulated discharge of sewage will eventually clog the absorption field requiring its replacement. If maintenance is poor, system life will be reduced to less than the expected design life. Leaking and improperly treated waste can encourage the spread of dysentery and hepatitis, and provide breeding areas for mosquitoes and flies. Chemical products commonly disposed into household waste systems may also be detrimental to plants and wildlife exposed to this leachate. Contaminants can also foul wells on the same or adjacent properties endangering their occupants.

The influence of residential settlement patterns on the health impacts of water and wastewater systems is therefore ambiguous. Location of larger proportions of residents in the Regional Centre and Suburban Area will increase the use of piped water and wastewater systems, and will reduce costs per connection where existing capacity is available. Many of the drawbacks of inflow and infiltration, and overflow will be averted for new development. All new systems in HRM separate storm and sanitary flows, and new pipe is much less likely to have breaks or leaks. New systems, in general, will be better managed than the old given higher and more consistent standards than in the past and considerable improvements in record keeping. Improved maintenance and monitoring as well as public education programs provided by Halifax Water also promise improvement.

Onsite systems in the Rural Area are also being improved through enhanced regulation and public education, as well as greater emphasis on responsibility of individual property owners. Small-scale community collection and treatment systems are being refined to support higher density development in rural areas and as a lower cost solution to area contamination.

Ultimately – and with some qualification – municipal water and wastewater systems provide more secure and reliable management of water and wastewater. While municipal systems are subject to breakdowns like private systems, they are also subject to more stringent oversight. Municipal systems, as discussed, also have a longer life and are perpetually renewable. They are also an essential support to urban development and, as such, a necessary condition to obtain the benefits from concentration documented for other services addressed by this study.

6.0 OTHER PUBLIC SERVICES

In addition to networked services discussed in the preceding two chapters, HRM and the Province are responsible for a variety of services that are delivered from designated facilities. In the case of services like solid waste management,, and fire and emergency services, facilities provide a framework from which services are provided to homes and businesses. Services such as schools and community and cultural services, on the other hand, are normally accessed directly by users on a daily or less frequent basis dependent on interests, family characteristics, and other variables.

In both cases, the distances between facilities and the users that they serve are critical. The distance between a new subdivision and the landfill in Otter Lake is a leading influence on the charge levied to HRM by the responsible waste hauler. For other services extreme separation from facilities may compromise public safety such as when fire stations are beyond reasonable response times; or it may influence public satisfaction such as when parks, libraries, and school are beyond distances that residents consider reasonable.

In general, it is desirable to minimize distance between residents and the facilities that serve them and/or which they use. In some cases, where facilities are lacking or deemed to be inadequate in relation to accepted standards, it may require the construction of new facilities even as existing facilities sit under-used. In the following, we have measured by the most practical means available the distance and/or travel time separating new development from existing facilities in HRM. In some cases where standards or capacities are available, we have also assessed the adequacy of existing provisions under each distribution scenario.

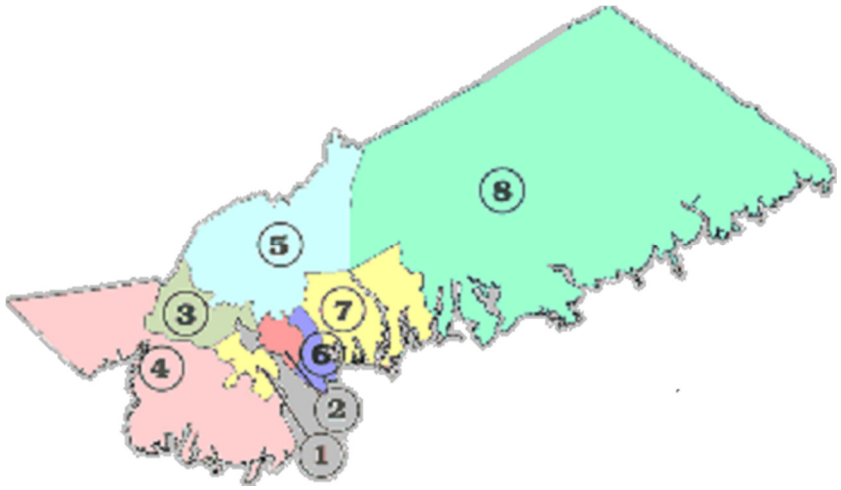
These measures are raw and are intended to provide a basis for comparing the stresses created by differing patterns of development. They do not, for example, take into account the potential frequency of trips from new residences to particular facility types. Any speculation concerning the adequacy of facilities, furthermore, requires detailed study of the specific circumstances of facilities and communities, and alternatives available for satisfying public needs and wants.

6.1 Solid Waste Management

HRM has a sophisticated solid waste management system featuring extensive source separation. Non-organic waste from throughout the municipality is disposed to the Otter Lake Waste Processing and Disposal Facility south of Timberlea/ Lakeside/Beechville, which was commissioned in 1999.

Solid waste management is overseen by the Solid Waste Resources Division within HRM's Department of Transportation and Public Works but there is considerable involvement of private companies. Mirror NS manages the Otter Lake operation under a six-year contract initiated in 2010. Residential collection for eight distinct areas of the municipality is contracted with eight separate private providers serving areas shown in **Figure 6.1**. Several other aspects of the system are also contracted as described following. The infrastructure for waste diversion as well as disposal is extensive and is distributed across the region as summarized in **Table 6.1**.

Figure 6.1 Solid Waste Collection Areas, HRM, 2011



#	Area	Hauler
1	Former City of Halifax	Waste Management
2	Former City of Dartmouth	Waste Management
3	Bedford, Hammond Plains, Pockwock & area	Miller Waste
4	Beechville/Lakeside/Timberlea, Prospect & West	Waste Management
5	Sackville, Fall River, Dutch Settlement & area	Miller Waste
6	Cole Harbour/Westphal, Eastern Passage & area	Waste Management
7	Porters Lake, Chezzetcook, Preston & area	Leo J. Beazley
8	Elderbank, Musquodoboit, & all Eastern Shore	Eastern Shore Cartage

Source: HRM, http://www.halifax.ca/wrms/collection.html#hauler

Otter Lake is the site of the landfill, which is state of the art. HRM's waste resource management approach seeks to divert substantial portions of the waste stream from the landfill to minimize the environmental impacts of landfilling and to prolong the life of the Otter Lake facility. Homeowners are limited to three bags of garbage per collection week (garbage collection is provided on alternate weeks). They are also expected to separate recyclables (*i.e.*, paper, cardboard, plastics, and containers), which are collected weekly, and compostables, which are collected on weeks opposing garbage collection except in the summer when they are collected weekly. Many residents compost in their own yards.

Recyclables are handled by HRM's Materials Recycling Facility (MRF) in Bayers Lake Business Park. Compostables are delivered to Miller Composting at 80 Gloria McCluskey Avenue in Burnside or New Era Technologies at 61 Evergreen Place in Ragged Lake. Homeowners can take household hazardous wastes (*i.e.*, paints and oil products) to the Household Hazardous Waste Depot, which is co-located with the MRF in Bayers Lake. Paints and recyclables can also be dropped off by homeowners to Enviro-Depots distributed throughout HRM.

HRM generally does not collect solid waste from commercial properties or from residential properties comprising more than six units. Businesses, institutions, and apartment owners are required to comply with the same source separation requirements as homeowners but must make arrangements for collection and disposal through private haulers. Private companies taking materials to landfill are charged tipping fees ($125/tonne for material weighing 100 kg or more) that they pass on to customers. They are also required to take compostables to one of the compost facilities. Both compost sites charge haulers $75/tonne.

Haulers take waste directly to the appropriate regional facility except in District 8. Waste from within District 8 is taken to transfer stations in Sheet Harbour at 21611 Highway 7 and in Middle Musquodoboit at 249 Sibley Road, where it is consolidated and trucked to larger HRM facilities. All bagged garbage is taken to the landfill at Otter Lake and recyclables go to the MRF in Bayers Lake. Compostables from the western portion of the municipality (Areas 1, 3, and 4) go to Ragged Lake, while compostables from Collection Areas 2, 6, 7, and 8 go to Burnside. Most compostable material from Collection Area 5 also goes to Burnside, although some Area 5 material regularly goes to Ragged Lake to balance composting plant capacities.

6.2 Other Public Services

Additional components of the municipal solid waste management system include Construction and Demolition (C&D) waste disposal sites operated by Halifax C & D Recycling Ltd. at 16 Mills Drive in Goodwood, not far from Otter Lake, and 188 Ross Road in Westphal, as well as by RDM Recycling at 1275 Old Sambro Road in Harrietsfield. A tire recycling facility has also been proposed for Goodwood. All C&D and tire recycling facilities are operated by private companies as are the composting facilities. All of the facilities generate revenue through tipping fees paid either directly by commercial and institutional users or by the Municipality.

Solid waste management costs are only partially covered by tipping fees. The balance of costs is covered from general revenue. The system also recovers about $3 million annually from refundables. Solid waste hauling costs vary in relation to distance to Otter Lake. Areas in the eastern part of the municipality, in particular, incur higher costs. Small businesses in outlying areas of HRM where private hauling is considered uneconomic are exempted from requirements to arrange their own solid waste disposal. HRM treats them in essentially the same manner as small residential properties. The Municipality collects their waste directly and disposes it on their behalf.

Table 6.1 HRM Solid Waste Management Facilities, 2011

Facility	Address	Community	Fees
Otter Lake Landfill	Exit 3, Hwy. 103, 200 Otter Lake Dr.	Timberlea	$5 up to 100 kg or $125/tonne
Materials Recycling Facility (MRF)	20 Horseshoe Lake Dr., Bayers Lake	Halifax	No charge
Household Hazardous Waste Depot	20 Horseshoe Lake Dr., Bayers Lake	Halifax	No charge
Compost Facilities			
Miller Composting	80 Gloria McCluskey Av., Burnside	Dartmouth	$75/tonne
New Era Technologies	61 Evergreen Pl., Ragged Lake	Halifax	$75/tonne
Enviro-Depots			
Beaver Redemption & Recycling	374B Herring Cove Rd	Halifax	No charge/payment for refundables
Bluenose Bottle Exchange	99 Woodlawn Rd.	Dartmouth	No charge/payment for refundables
Bluewater Recycling Inc.	957 Prospect Rd.	Goodwood	No charge/payment for refundables
Bluewater Recycling Inc.	23 Bluewater Rd.	Bedford	No charge/payment for refundables
Burnside Recycling	66 Simmonds Dr., Burnside	Dartmouth	No charge/payment for refundables
Canadian Recycling Ltd.	365 Portland St.	Dartmouth	No charge/payment for refundables
Clifton Recycling Centre	2651 Clifton St.	Halifax	No charge/payment for refundables
E.T. Bottle Exchange	12 Rosedale Dr.	Dartmouth	No charge/payment for refundables
Eastern Shore Cartage	23557 Hwy. 7	Sheet Harbour	No charge/payment for refundables
Faders Bottle Exchange	15 Sackville Cross Rd.	Lower Sackville	No charge/payment for refundables
Friends Depot	8134 Hwy. 3	Ingramport	No charge/payment for refundables
Green Tree Recycling Ltd.	5321 Hwy. 7	Porter's Lake	No charge/payment for refundables
Green Tree Recycling Ltd.	933 Cobequid Rd.	Lower Sackville	No charge/payment for refundables
John Ross & Sons Ltd.	171 Chain Lake Dr.	Halifax	No charge/payment for refundables
Karen's Recycling Ltd	807 Main St. (Hwy. 7)	Dartmouth	No charge/payment for refundables
Matt's Bottle Exchange	124 Cow Bay Rd.	Eastern Passage	No charge/payment for refundables
Preston Recycling	1977 Hwy. 7	East Preston	No charge/payment for refundables
Sackville Bottle Exchange	446 Sackville Dr.	Lower Sackville	No charge/payment for refundables
Tanner's Transfer	6393 Bayne St.	Halifax	No charge/payment for refundables
The Recycle Market	11470 Hwy. 7	Lake Charlotte	No charge/payment for refundables
Timberlea Bottle Exchange	2352 St. Margaret's Bay Rd.	Timberlea	No charge/payment for refundables
Youth L.I.V.E. Recycling	947 Mitchell St.	Halifax	No charge/payment for refundables

Source: HRM, www.halifax.ca

The costs of new residential development for the solid waste management system are largely a function of the distance of new development from the facilities to which solid waste, recyclables, and compostables must be delivered. These trips differ from trips made to other facilities, such as schools or community centres by individuals, which originate at home and normally return to the home. They are made by public and private haulers as part of collection routes.

As such, the consultants decided that it would be best to measure the travel involved collectively from originating traffic zones to the traffic zones in which the processing facilities are located. In other words, travel from each traffic zone to the Otter Lake Landfill taken from an origin-destination matrix provided by HRM staff was weighted by the number of new units and new non-residential properties (measured based on a ratio of estimated employment to business establishments in each traffic zone) in the particular zone and summed for the Regional Centre, and Suburban and Rural Areas taking into account the interim stage required for materials from the Musquodoboit Harbour and Sheet Harbour areas. The same was done for the MRF and the two composting sites. Stantec also developed estimates for multiple unit structures separate from single and semi-detached dwellings recognizing that hauling is a private responsibility in the first case and a municipal responsibility in the second case.

The results of these analyses are provided in **Table 6.2.** Total savings are similar for the landfill, composting facilities, and the MRF, which are all located near the centre of the region and mostly in the Bayers Lake/Otter Lake area west of Halifax. The more concentrated scenarios reflect less distance to travel with Scenario B providing the greatest savings. The degree of benefit is however fairly moderate with savings for Scenario B relative to the Trend Scenario ranging from nearly 6 per cent for compostables to more than 8 per cent for recyclables. Savings to the Municipality are however particularly significant. Time required for travel between solid waste facilities and single and semi-detached dwellings for which HRM is responsible vary by nearly 40 per cent between the Trend Scenario and the highest level of concentration represented by Scenario B.

Table 6.2 Total Travel Time in Hours from New Development to Existing Waste Management Facilities, 2031 Scenarios

Waste Stream	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Singles and Semis				
Landfill	19,585	20,655	15,363	12,606
% of Trend	*94.8%*	*100.0%*	*74.4%*	*61.0%*
Compost	23,663	24,251	18,988	16,268
% of Trend	*97.6%*	*100.0%*	*78.3%*	*67.1%*
MRF	19,226	20,389	15,150	12,501
% of Trend	*94.3%*	*100.0%*	*74.3%*	*61.3%*
Multiple Units				
Landfill	9,327	9,252	11,711	13,969
% of Trend	*100.8%*	*100.0%*	*126.6%*	*151.0%*
Compost	10,885	10,885	13,575	16,017
% of Trend	*100.0%*	*100.0%*	*124.7%*	*147.2%*
MRF	8,530	8,524	10,783	12,901
% of Trend	*100.1%*	*100.0%*	*126.5%*	*151.3%*
Businesses				
Landfill	19,637	19,727	19,474	19,406
% of Trend	*99.5%*	*100.0%*	*98.7%*	*98.4%*
Compost	20,967	21,085	20,586	20,593
% of Trend	*99.4%*	*100.0%*	*97.6%*	*97.7%*
MRF	18,756	18,905	18,433	18,426
% of Trend	*99.2%*	*100.0%*	*97.5%*	*97.5%*
TOTALS				
Landfill	48,549	49,634	46,548	45,981
% of Trend	*97.8%*	*100.0%*	*93.8%*	*92.6%*
Compost	55,515	56,221	53,149	52,878
% of Trend	*98.7%*	*100.0%*	*94.5%*	*94.1%*
MRF	46,512	47,818	44,366	43,828
% of Trend	*97.3%*	*100.0%*	*92.8%*	*91.7%*

These results need to be qualified, given that the number of single and semi-detached units is necessarily fewer in Scenarios A and B because concentration of dwelling units in the Regional Centre in both cases requires heavier emphasis on apartments. Comparisons of times per single-detached and semi unit show the same value for the RMPS scenario (*i.e.*, 94.3 per cent) but reduced benefits for Scenarios A and B, which show travel time per dwelling unit equal to 89.5 and 92.3 per cent of the Trend Scenario (as compared to 74.3 per cent and 61.3 per cent under Singles and Semis in **Table 6.2**).

The higher proportion of apartment units in Scenarios A and B, concomitantly, has a substantial influence on the travel time expected for private haulers in those cases. The RMPS scenario is essentially the same as continuation of current trends but Scenarios A and B require coverage of considerably more distance. When travel per unit is taken into account, however, differences all but disappear, with the RMPS scenario requiring 100.1 per cent of the distance per unit served; Scenario A, 100.6 per cent; and Scenario B, 100.3 per cent.

Overall, savings in travel time favour the more concentrated scenarios: the RMPS Scenario requires 97.1 per cent as much travel time as the Trend, while Scenario B is estimated at 91.1 per cent and Scenario A at 89.7 per cent. These benefits accrue almost entirely to the Municipality, however, as the distances to be covered by private haulers appear likely to increase modestly in the more concentrated scenarios.

Recycling depots yield less equivocal results, as shown in **Table 6.3**. With multiple depots located to serve dispersed communities within HRM, the travel reductions available through locating population in the core of the region are not as great. They are however comparable to other multi-facility services discussed below, inasmuch as facilities in more heavily populated areas are inherently closer to more users and thereby reduce travel distance and related time requirements.

Table 6.3 Total Travel Time in Hours from New Development to Existing Recycling Depots, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre	1,115	642	1,891	2,465
Suburban	3,711	4,067	2,758	1,966
Rural	3,250	3,511	2,719	2,719
TOTALS	**8,076**	**8,221**	**7,369**	**7,149**
% of Trend	*98.2%*	*100.0%*	*89.6%*	*87.0%*

6.2 Fire and Emergency

A total of 57 fire stations are distributed within HRM. Seventeen serving the Regional Centre and Suburban Area plus a new station serving the Tantallon area are managed by HRM's Fire and Emergency Services. The remaining 40 stations serve rural communities. They are operated by volunteer departments, several of which are responsible for two or three stations. Some suburban stations have composite staffing under which a small number of professional firefighters work with volunteers.

In addition to being important to the safety and security of residents, fire stations are often important as community centres, particularly in rural communities where they are sometimes the only public buildings. Proximity is valued by residents and business owners to whom fire stations represent security. Property owners usually react strongly to suggestions of station closure, but fire station location is probably not explicitly considered in most residential location decisions.

Fire and Emergency Services are funded from the Municipality's general revenues. While volunteer departments often fund raise in their communities, the contributions are generally modest relative to department needs. System needs are impacted by density. Lower response standards are accepted in Rural Areas and areas of higher density require hydrant service. Also, areas with high-rise structures require specialized equipment such as ladder trucks.

To assess the provision of fire services to new development under each scenario, Stantec measured the travel time from each Traffic Zone with newly developed property to the closest fire station. These distances were weighted by the number of new dwelling units and estimated non-residential structures in the relevant Traffic Zone and summed for each of the Regional Centre, and Suburban and Rural Areas to determine total distance travelled from new development within each area to the closest existing station. Comparison of these measures among the three areas gives a rough measure of relative levels of service.

As summarized in **Table 6.4**, Scenario B will potentially decrease travel time by more than 10 per cent relative to continuation of the recent residential distribution trend. In the more condensed scenarios, travel time in the Suburban and Rural areas is reduced because there are fewer new units in both areas and the units added in both are in superior locations.

Table 6.4 Total Travel Time in Hours from Existing Fire Stations to New Development, 2031

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre	1,568	1,111	2,193	2,725
Suburban	5,152	5,566	4,744	4,015
Rural	3,818	4,414	3,317	3,224
TOTALS	**10,537**	**11,091**	**10,253**	**9,964**
% of Trend	*95.0%*	*100.0%*	*92.4%*	*89.8%*

6.3 Police

Police services are provided to HRM by the Halifax Police Force and the Royal Canadian Mounted Police Force (RCMP). The Halifax Police are responsible for the areas of the former cities of Halifax and Dartmouth, which they divide into the following three precincts denoted by abbreviations on **Figure 6.2**:

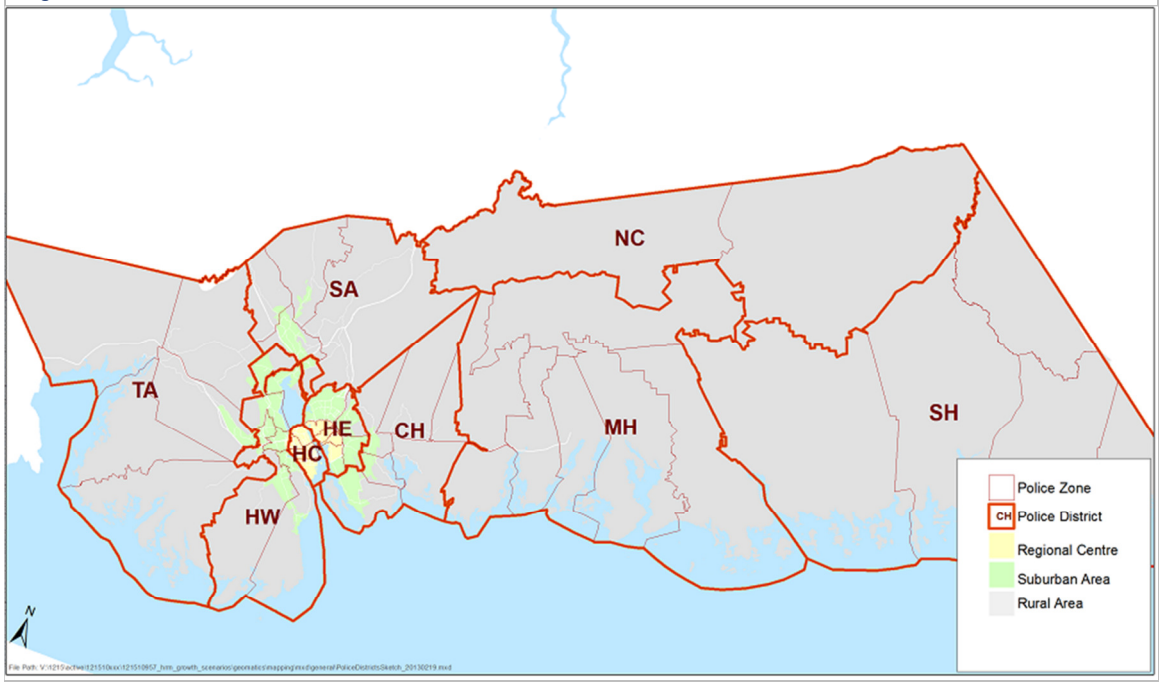
- *East* (**HE**) – the former City of Dartmouth
- *Central* (**HC**)– Halifax Peninsula
- *West* (**HW**) – Bedford, the Mainland area of former city of Halifax, and areas south and west of Halifax, including the Sambro Loop.

The police maintain regional headquarters at 1975 Gottingen Street on the edge of Halifax's Downtown. They also operate divisional offices for each of the three community precincts and a community office that serves the Spryfield area within the West precinct.

The RCMP is contracted by HRM to provide staff for six precincts distributed across the area of the former County of Halifax with which the force had a contract before amalgamation. The precincts are based on Council polling districts, which have recently been amended as a result of the reduction of Council's size from 23 to 16 members. The precincts currently comprise:

- *Tantallon* (**TA**) – Districts 22 and 23 encompassing areas west of the Halifax Mainland to the western boundary of the Municipality including Timberlea and St. Margarets
- *Cole Harbour* (**CH**) – Districts 3, 4, and 8 east of the Dartmouth core, including Woodside, Eastern Passage, Cole Harbour, Preston, and Chezzetcook
- *Lower Sackville* (**SA**) – Districts 2, 19, and 20 including Bedford as well as Sackville
- *North Central* (**NC**)– Robert L. Stanfield International Airport
- *Musquodoboit Harbour* (**MH**) – Districts 1 and 3 east of Dartmouth including the Prestons, Chezzetcook, the Musquodoboit Valley, and along the Eastern Shore to the vicinity of Lake Charlotte
- *Sheet Harbour* (**SH**) – District 1 taking in the Musquodoboit Valley and areas from the vicinity of Lake Charlotte to the eastern boundary of the municipality.

Figure 6.2 Police Precincts and Zones, HRM, 2012



Police services are largely funded from municipal general revenues. The RCMP provides its services to the Municipality on a contract arrangement based on the number of officers provided. RCMP costs are shared with the Province of Nova Scotia, which covers 30 per cent of the contract, leaving HRM to pay roughly $105,000 annually per officer. The Province also provides approximately $3 million in additional support through its "Boots on the Streets" program. Fines and fees supplement these sources but are modest relative to overall costs.

Stantec assessed the distances from new development to existing police stations in a similar manner to our assessment of fire and emergency services, and obtained similar results (indicating stations are more accessible to residents of the Regional Centre). HRM staff, however, pointed out that most police services are delivered through patrols dedicated to the zones mapped within each Police District on **Figure 6.2**.

Patrols effectively cover all of HRM. At Stantec's request, the Halifax Police Department provided data on police calls within each zone for 2009. These were compared to population and employment data for Traffic Zones derived from the VISUM traffic model. The data showed a high correlation between police calls and the number of people living and employed in each police zone (regression analysis indicated more than 70 per cent of the variation in police calls by zone was explained by these two factors together). Further statistical analysis determined that there was no significant statistical difference between police calls per capita in the Regional Centre, and the Suburban and Rural Areas. Given this information, the consultants concluded that while the location of police calls would change moderately under different residential distribution scenarios, the cost of servicing those calls would be unlikely to change greatly given that all areas are patrolled and only gross changes in the number of calls would require increasing the level of patrols.

6.4 Community Facilities and Parks

HRM provides a wide array of parks and recreation facilities for residents. **Table 6.5** summarizes key facilities by areas/services designated by the Municipality. In total, HRM recreation facilities deliver 8,296 programs. In 2009, these programs attracted 57,089 registrants (6.88 per program) who received 82,017 hours of programmed services (1.44 hours per registrant).

Recreation facilities are overseen by 55 management staff (managers, coordinators, and administrative support personnel) but rely heavily on more than 1,200 part-time and seasonal employees for program delivery.

The system also makes extensive use of community organizations and volunteers. According to an overview of the system provided in the short report *Community Development – Community Recreation Services, 2009 Highlights*, there are 28 facilities in the HRM system that are owned by the Municipality but "managed and operated by not-for-profit volunteer groups." The same document notes that "more than 250 volunteers are directly managing community centres." A further important component of the system is schools, which are discussed below in **Subsection 6.6** in relation to their central role as educational centres. Schools provided venues for 100,205 hours of HRM programming in 2009.

Table 6.5 HRM Community Recreation Services by Area, 2009

Area	Major Facilities	Programs	Registration	Hours	Staffing
Mainland South and Chebucto	Capt. Wm. Spry Centre, St. Mary's Boat Club, Chocolate Lake Centre	523	5,692	6,869	8
Mainland North and Western	Northcliffe Rec Centre, Lakeside Centre, St. Andrews Rec Centre, Hubbards Rec Centre	769	8,871	9,387	8
Bedford, Sackville, and Fall River	Lebrun Centre, Acadia Centre, Basinview Drive Community School, Gordon Snow Centre	772	8,708	9,093	8
Cole Harbour, Eastern Shore, and Valley	North Preston Community Centre, Cole Harbour Activity Centre and Recreation Office, 7900 Hwy 7 (Musquodoboit Harbour), Sheet Harbour Office and Fitness Centre	855	8,694	8,748	9.5
Halifax Peninsula	Needham Centre, George Dixon Centre, Bloomfield Centre, Isleville Art Studio, Larry O'Connell, Central Commons Centre	441	4,743	10,063	8
Aquatic Facilities	Northcliffe Pool, Needham Pool, Spryfield Wave Pool	4,031	11,842	24,807	5
Outdoor Recreation	Adventure Earth Centre	351	3,470	5,146	2.5
Dartmouth and Eastern Passage	Findlay Centre, Tallahassee Community School	554	5,069	7,904	6
	TOTALS	**8,296**	**57,089**	**82,017**	**55**

Source HRM, *Community Development – Community Recreation Services, 2009 Highlights*

The private sector is also a provider of recreation services, marketing recreational opportunities such as bowling alleys, pool rooms, weight rooms, and health clubs. Review of the Canada 411 telephone directory indicates there are eight bowling centres, 18 pool rooms, and 42 fitness centres in HRM, including several co-located with HRM facilities. The community also benefits from not for profit operations such as the Central and Community Ys.

The region also has many parks and open spaces reflecting a long tradition of reserving lands for public use that began with the establishment of the Halifax Commons and Point Pleasant Park by the community's military founders. In addition to the indoor facilities addressed in **Table 6.5**, HRM now has:

- 23 supervised beaches
- 175 ball parks
- 325 playgrounds
- 130 sports fields
- 7 skateboard parks and 4 BMX dirt jump sites.

In total, including the sports facilities and playgrounds listed, the municipality has more than 1,200 parks. These include large historic parks such as Point Pleasant, the Commons in both Halifax and Dartmouth, and Fleming Park on the Northwest Arm. They also include newer facilities that provide regional scale active sports facilities such as the Mainland North Common in Halifax, Beazley Field in Dartmouth, and the all-weather turf fields off Commodore Drive in City of Lakes Business Park.

The region furthermore has an impressive network of regional parks that are mostly arrayed at the edges of its urbanized core. These include designated Federal and Provincial parks, as well as parks that are primarily the responsibility of HRM. Seven were well-established at the time the RMPS was adopted in 2006 and another six were under consideration for designation (**Table 6.6**). All six additional locations are also on the edges of the urban core, where most would have significant influence on the path of future urban development if they were formally approved as parks.

In most cases, subdividers are required to dedicate 10 per cent of the land they develop for future municipal parkland, pursuant to municipal policy. At the discretion of the Municipality, they may substitute cash-in-lieu or equivalent in kind contributions such as improvements to parkland or installation of playground equipment.

HRM partners managing recreation facilities are expected to breakeven. Although the Municipality provides subsidies and assistance to operators that cannot make ends meet, the overall costs of such supplements are minor. Outdoor parks and facilities for which user charges cannot be levied, on the other hand, are paid for through general revenues. This would include most passive parks and open spaces.

A critical issue for new development in the region is access to community facilities. As with fire and police services discussed above, the availability of arenas and community centres is a critical consideration for many households making residential location decisions. More so than fire and police protection, residents may well demand these facilities for developing areas where they are not present. While the variety of community facility types and the standards for their provision are too complex to allow a full assessment of their adequacy under different growth scenarios, assessment of the travel time to the nearest identifiable HRM community facility (not including parks and open spaces) does give a measure of the likely strains on the recreation services delivery system in each case.

Table 6.6 Regional Parks, HRM, 2006

Existing Regional Parks	Responsible Agency	Community
Admirals Cove Park	HRM	Bedford
Canal Lakes Park	HRM/Shubencadie Canal Commission	Dartmouth
Cole Harbour-Lawrencetown Coastal Heritage Park	HRM/DNR	Cole Harbour
Hemlock Ravine Park	HRM/DNR	Halifax
Long Lake Provincial Park	DNR	Halifax
McNab's Island Provincial Park	DNR/Parks Canada	Halifax Harbour
Sandy Lake Park	HRM	Hammonds Plains
Additional Regional Parks		
Blue Mountain-Birch Cove Lakes Park	DNR/HRM	Halifax
Feely Lake	DNR	Beaverbank
Jacks Lake Park	HRM	Bedford
Porters Lake Park	DNR	Porters Lake
Second Lake Provincial Park	DNR	Sackville
Western Common Wilderness Area	HRM	Halifax

Source: HRM, *Regional Municipal Planning Strategy*, 2006, p. 23

Stantec, consequently, determined the travel time from each new residential development unit under each scenario to the nearest designated recreational facility (**Table 6.7**). As with recycling depots and fire services, the total travel time recorded for each scenario shows clear benefits with increased intensification from the RMPS Goals through to Scenario B. The latter scenario offers an improvement in overall travel time of about 14 per cent over continuation of the current trend.

Table 6.7 Total Travel Time in Hours from New Development to Nearest Community Facilities, 2031				
Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre	963	517	1,575	2,096
Suburban	3,287	3,686	2,895	2,194
Rural	2,845	3,437	2,334	2,272
TOTALS	**7,095**	**7,640**	**6,804**	**6,562**
% of Trend	*92.9%*	*100.0%*	*89.1%*	*85.9%*

Some concern has lately been expressed with the adequacy of park provisions in major cities such as Toronto where efforts to intensify have recently been successful. To assess park provisions under each 2031 distribution scenario Stantec summarized the area of existing parks classified as Neighbourhood, Community, District, and Regional in each of the Regional Centre, and Suburban and Rural Areas and divided the areas in each category to obtain a measure of each type of parkland per 1,000 residents for comparison to the following standards developed by the Ontario Ministry of Culture:

- Neighbourhood Park (ranging from 0 to 10 Ha) – 1.0 Ha per 1,000
- Community Park (from 2 to 50 Ha) – 1.0 Ha per 1,000
- City/District Park (from 12.5 to 100 Ha) – 5.0 Ha per 1,000
- Regional Park (12.5 to 500 Ha) – 4.0 to 10.0 Ha per 1,000

Table 6.8 presents the results of this analysis demonstrating the generous supply of parkland in HRM. Even with population growth expected to 2031, the region boasts substantially more park space than the generally accepted total park standard of 5 to 10 hectares per 1,000 residents. On the other hand, the supply of Neighbourhood and District Parks is currently deficient in most areas and all categories of parks are deficient in the Regional Centre. These deficiencies, which are highlighted in red in the table, will be exacerbated by future growth and particularly so under Scenarios A and B, which will place increased numbers in the core of the region.

The quantity of land required to bring park provisions up to standards is the same for all four scenarios given that HRM's population is assumed to be the same in all cases (*i.e.*, taken as a whole 484,153 residents require the same quantity of park). The scenarios vary in relation to the location in which parklands are needed and, arguably, the extent of need in the Regional Centre. It will likely be more expensive and certainly more difficult to acquire recreational land in the Regional Centre than in the Urban and Suburban Areas. The need is also greater in the Regional Centre, which has a modest share of Regional Park area and no Provincial parkland.

Given that Regional and Provincial Parks serve the region as a whole and are well supplied in relation to the Ontario standards, the focus is on Neighbourhood, Community, and District Parks. **Table 6.8** represents park acquisitions required to bring the Regional Centre, and Suburban and Rural areas up to standards. As there is a substantial surplus of parkland classified as Community Park by criteria applied for this study, but significant shortfalls in Neighbourhood and District spaces, Stantec assumed that surplus Community parkland could cover shortfalls in the other two categories where it was available. This substantially reduced the net parkland requirement in the Suburban Area and eliminated any need for additional parkland in the Rural Area.

The more concentrated scenarios require considerably more parkland acquisition under these circumstances. The total of 390 acres of park required under Scenario B is 90 per cent more than would be required if current trends continue. This effect is further exacerbated by higher costs for land in the Regional Centre. Examination of listings of land for sale within the Regional Centre at the time of writing found ten current offerings for building lots ranging from $119,000 within the Circumferential to $550,000 in South End Halifax. The median price, which applied to property in both the North End of the Halifax Peninsula and in various locations in Dartmouth, was

Table 6.8 Park Provisions in Ha per 1,000 Residents, HRM, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Neighbourhood Parks				
Regional Centre	0.13	0.14	0.11	0.10
Suburban	0.26	0.26	0.27	0.30
Rural	0.80	0.77	0.85	0.83
TOTAL	**0.36**	**0.36**	**0.36**	**0.36**
Community Parks				
Regional Centre	0.80	0.87	0.69	0.63
Suburban	1.60	1.57	1.67	1.80
Rural	4.57	4.40	4.89	4.78
TOTALS	**2.15**	**2.15**	**2.15**	**2.15**
District Parks				
Regional Centre	0.41	0.44	0.36	0.32
Suburban	0.99	0.97	1.03	1.11
Rural	1.03	0.99	1.10	1.08
TOTALS	**0.86**	**0.86**	**0.86**	**0.86**
Regional Parks				
Regional Centre	1.14	1.24	0.99	0.90
Suburban	1.96	1.93	2.05	2.20
Rural	17.03	16.38	18.20	17.81
TOTALS	**5.55**	**5.55**	**5.56**	**5.56**
Provincial Parks				
Regional Centre	0.00	0.00	0.00	0.00
Suburban	0.48	0.47	0.51	0.54
Rural	35.31	33.97	37.73	36.93
TOTALS	**9.13**	**9.13**	**9.14**	**9.14**
ALL PARK TYPES				
Regional Centre	2.47	2.69	2.15	1.96
Suburban	5.30	5.20	5.54	5.95
Rural	58.75	56.51	62.77	61.43
TOTAL	**18.06**	**18.05**	**18.07**	**18.08**

$130,000 for lots roughly averaging 5,000 square feet. Bulk land, if it were available, might reasonably be assumed to cost at least $1.5 million per hectare.

Land in the Suburban Area is also highly valued. Serviced lots are available from as little as $15,000 in one instance on a well-used arterial road to a more typical $70,000 or $80,000 in many outlying locations and $650,000 for waterfrontage on the Northwest Arm. Typical lot prices are not significantly different from the Regional Centre with the median at approximately $110,000 but for lots that are usually about twice the size of their counterparts in the urban core (*i.e.*, approximately 10,000 square feet). Unsubdivided bulk land is more readily available than in the Regional Centre but hardly common. A small number of examples suggest prices between $40,000 and $60,000 per acre or about $125,000 per hectare.

Applying these very rough land acquisition costs to the estimated requirements presented in **Table 6.9** suggests substantial differences between the concentrated and dispersed scenarios. Specifically, the required cost of land acquisition under Scenario B is estimated at nearly six times more than under the Trend Scenario. While a portion of this cost in the Suburban and Rural Areas will be covered by either direct contributions of land as required through the subdivision process or through cash-in-lieu, subdivision will be a minor factor in redevelopment in the Regional Centre, where most developments will be multiple unit dwellings on individual lots, which will not trigger the subdivision parkland dedication requirements..

Development from vacant land to basic parkland (*i.e.*, cleared and grassed, with basic walking areas) is conservatively estimated at an additional $5 per square foot. While the value of improvements is greatest for Scenario B, consideration of improvements reduces the difference between the Trend Scenario and the more condensed alternatives. Nevertheless, the difference in total cost (*i.e.*, land acquisition plus improvements) is estimated to be more than 3.5 times greater in Scenario B than under established conditions.

It is also questionable whether it is feasible or necessary to satisfy the Ontario guidelines. The requirement of 332.5 hectares calculated for the Regional Centre

based on the Ontario specifications is nearly twice the current supply of parkland in the area (177.8 hectares) and represents nearly 10 per cent of the total land area on the Halifax Peninsula and inside the Circumferential Highway (*i.e.*, 3,473 hectares). It should also be recognized that the Regional Centre has many more enclosed recreational facilities than the Suburban and Rural Areas, and they are much more accessible to residents as demonstrated in **Table 6.7**, above.

Table 6.9 Net Park Requirements (Ha), HRM, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre				
Neighbourhood	16.4	6.7	34.3	47.5
Community	13.3	6.7	34.3	47.5
District	81.6	33.1	171.1	237.5
Net requirement	**111.3**	**46.5**	**239.7**	**332.5**
Suburban				
Neighbourhood	52.7	57.4	42.3	26.5
Community	191.0	186.1	201.2	217.0
District	262.8	287.2	211.9	132.8
Net requirement	**124.5**	**158.5**	**53.0**	**57.7**
Rural				
Neighbourhood	13.4	18.2	5.7	8.3
Community	517.2	495.1	507.6	505.1
District	153.9	178.0	115.4	128.1
Net requirement	**0**	**0**	**0**	**0**
All parks (Ha)	235.8	205.0	292.7	390.0
Costs ($000s)				
Land	$182,512.5	$89,562.5	$366,175.0	$505,962.5
Improvements	$126,906.4	$110,330.0	$157,529.7	$209,896.1
TOTAL	**$309,418.9**	**$199,892.5**	**$523,704.7**	**$715,858.6**
% of Trend	*154.8%*	*100.0%*	*262.0%*	*358.1%*

Nevertheless, existing parklands in the Regional Centre will be subject to stress if development is intensified there. Securing additional land or intensifying the development of existing parks to accommodate more users will undoubtedly be a requirement if intensification is successfully pursued in the future.

6.5 Libraries

Halifax Public Libraries (HPL) operates 14 branch libraries across HRM listed in **Table 6.10**. A new central library is being built at the corner of Spring Garden Road and Queen Street in downtown Halifax. It will replace the existing Spring Garden Road Main Branch Library as well as the administrative offices of HPL that are now largely housed in conjunction with the Dartmouth Branch Library in Alderney Gate in downtown Dartmouth.

Remaining branches are distributed somewhat unevenly. The Keshen-Goodman Library in Mainland North was built within the past decade. It is an outstanding facility that is heavily used by the surrounding residential population. The Woodlawn Branch was also replaced in recent years.

The remaining facilities are marginally older. Several branches are located in community centres such as the Captain William Spry Centre in Spryfield and Cole Harbour Place, where they enhance the attraction of those important facilities. Others such as J. D. Shatford in Hubbards or the Musquodoboit Harbour and Sheet Harbour Branches are in older structures and house smaller collections but are valued features of the communities in question. HRM citizens also have access to the substantial university and college library collections available at various sites on the Dalhousie, NSCAD, and St. Mary's University campuses on the Peninsula, the Mount St. Vincent University Campus in Rockingham on the Bedford Highway, and Nova Scotia Community College sites in both Halifax and Dartmouth.

Table 6.10 provides a complete list of libraries with key features and ratings taken from HPL's 2004 facilities master plan. The Woodlawn Branch library has since been upgraded and expanded to 16,000 square feet, which would raise its service rating to 0.63 square feet per capita or very close to the preferred service standard. A new central library, which will replace the Spring Garden Road Main Branch Library on a site adjacent to the former library as well as absorb administrative

Table 6.10 Halifax Public Libraries, Branches with Floor Area and Service Standards, 2004

Branch	Address	Community	Area (ft²)	2001 Pop.	Standard (.07)*	Standard
Alderney Gate	60 Alderney Drive	Dartmouth	32,510	29,345	1.10	A+
Bedford	15 Dartmouth Road	Bedford	5,949	17,420	0.34	-C/U
Captain William Spry	16 Sussex Street	Spryfield	10,160	26,935	0.37	-C/U
Cole Harbour	51 Forest Hills Pkwy.	Cole Harbour	10,008	36,935	0.27	-C/U
Dartmouth North	105 Highfield Park Drive	Dartmouth	2,152	7,445	0.29	-C/U
Halifax North Memorial	2285 Gottingen Street	Halifax	12,400	8,960	1.34	A+
J.D. Shatford	10353 St. Margaret's Bay Road	Hubbards	2,700	1,555	1.73	B
Keshen-Goodman	330 Lacewood Drive	Halifax	25,000	48,050	0.52	C
Mobile Library	636 Sackville Drive	Lower Sackville	N/A	37,533	N/A	N/A
Musquodoboit Harbour	Village Plaza, 7900 Hwy. 7	Musquodoboit Harbour	3,900	4,840	0.80	A+
Sackville	636 Sackville Drive	Lower Sackville	13,500	41,860	0.32	-C/U
Sheet Harbour	Blue Water Business Centre, 22756 Hwy. 7	Sheet Harbour	2,964	3,215	0.92	B+
Spring Garden Road Memorial	5381 Spring Garden Road	Halifax	29,000	51,610	0.56	-C/U
Tantallon	3646 Hammonds Plains Road	Upper Tantallon	12,064	15,640	0.77	A+
Woodlawn	31 Eisener Boulevard	Dartmouth	4,000	25,530	0.16	-C/U
		TOTAL	**175,403**	**359,183**	**166,307**	

* Standard:

- Level 'A' is the highest level of service corresponding to roughly 0.7 square feet per capita.
- Level 'B' is a lower standard, generally between 0.5 and 0.6 square feet per capita.
- Level 'C' is the lowest service level corresponding to 0.4 to 0.5 square feet per capita.
- Level 'U' indicates "under serviced."

Source: Terrain Group, *Needs Assessment and Master Facilities Plan – Halifax Public Libraries*, July 2004

As with parks and community facilities, development within HRM impacts the library system in terms of the accessibility of library branches to new residences and in terms of the adequacy of the existing system to meet increasing needs. To address the first issue, Stantec calculated the sum of travel times between new dwelling units in each branch catchment area defined by HPL and the existing branch buildings. As with preceding analyses, the sum of travel time was the least in the more concentrated scenarios. In the case of Scenario B, the total of distances from new development was 23 per cent less than under the Trend Scenario. Scenario A was second best and the RMPS scenario was third best (**Table 6.11**).

A critical effect of development on libraries is the increased population housed in new residences that individual branches must serve. With more population, branches must deal with more borrowers and their standard of service will come under pressure.

To develop an estimate of this future impact, Stantec estimated the population of each branch catchment area in 2031 and calculated the service standard at that time based on the area of the library serving each area (*i.e.*, the areas provided in **Table 6.10**, above, with the exception of the Woodlawn and Central libraries, which

will have 16,000 and 72,315 square feet respectively). We have calculated the future standard for each library catchment area under the four distribution scenarios.

Table 6.11 Halifax Public Libraries, Total Travel Time in Hours from New Development to Existing Branches, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre	1,008	557	1,662	2,218
Suburb	5,369	5,974	4,497	3,415
Rural	4,939	5,730	3,766	3,766
TOTALS	**11,317**	**12,262**	**9,926**	**9,399**
% of Trend	*92.3%*	*100.0%*	*80.9%*	*76.7%*

Given fixed library space and identical total populations under each scenario, the overall level of service provided by existing libraries stays constant at level C. With more population, in fact, pressure on the overall system will increase. The influences of distribution, however, are very modest. Under each scenario seven library areas would continue to be underserved (U) (**Table 6.12**). Under three of the four scenarios, including continuation of the current trend, five libraries will be at level A. The only scenario that falls below that level is Scenario B, under which four libraries are anticipated to operate at level A. Under Scenario B, however, three libraries should operate at level B giving it seven at A or B, the most of any scenario except Scenario A, which also has seven (five at A and two at B). All scenarios, however, have seven branches operating at acceptable levels (*i.e.*, C or better).

Table 6.12 Halifax Public Libraries, Prospective Service Population and Standard by Existing and Planned (2012) Branches, 2031 Scenarios

Branch	Library Area (ft²)	RMPS Goals			Post RMPS Trend			Scenario A			Scenario B		
		Population	Standard		Population	Standard		Population	Standard		Population	Standard	
Alderney Gate	32,510	45,202	0.72	A	44,007	0.74	A	49,331	0.66	B	53,654	0.61	B
Bedford	5,949	44,836	0.13	U	44,257	0.13	U	40,347	0.15	U	37,517	0.16	U
Captain William Spry	10,016	32,880	0.30	U	34,360	0.29	U	31,939	0.31	U	28,002	0.36	U
Cole Harbour	10,008	37,233	0.27	U	37,124	0.27	U	37,016	0.27	U	37,083	0.27	U
Dartmouth North	2,152	7,002	0.31	U	6,678	0.32	U	7,958	0.27	U	8,210	0.26	U
Halifax North	12,400	6,910	1.79	A	6,677	1.86	A	7,594	1.63	A	8,192	1.51	A
JD Shatford	2,700	3,744	0.72	A	3,750	0.72	A	3,743	0.72	A	3,743	0.72	A
Keshen Goodman	25,000	74,900	0.33	U	76,100	0.33	U	71,730	0.35	U	70,922	0.35	U
Mobile Library*	N/A	48,248	N/A		50,109	N/A		45,608	N/A		45,458	N/A	
Musquodoboit Harbour	3,900	8,614	0.45	C	9,555	0.41	C	7,731	0.50	B	7,797	0.50	B
Sackville	13,500	51,279	0.26	U	50,763	0.27	U	47,191	0.29	U	46,998	0.29	U
Sheet Harbour	2,964	1,323	2.24	A	1,327	2.23	A	1,288	2.30	A	1,290	2.30	A
Spring Garden Road	72,315	62,837	1.15	A	56,514	1.28	A	74,546	0.97	A	81,079	0.89	A
Tantallon	12,064	34,217	0.35	U	36,432	0.33	U	33,257	0.36	U	33,807	0.36	U
Woodlawn	16,000	24,921	0.64	B	26,493	0.60	B	24,867	0.64	B	20,392	0.78	A
TOTAL	**221,478**	**484,145**	**0.46**	**C**	**484,145**	**0.46**	**C**	**484,145**	**0.46**	**C**	**484,145**	**0.46**	**C**

The libraries attaining acceptable levels of service are the same in all four cases, although the grades vary among the scenarios. The differences favour Scenario B and, to a lesser extent, Scenario A, but are very modest.

6.6 Schools

The Province provides for schools through the Department of Education. Halifax schools are managed locally through the Halifax Regional School Board (HRSB). The Board manages 139 public schools in HRM offering grades from primary through 12 in elementary, junior high school, and high school facilities. Of these, 59 offer French immersion. Another five schools are administered by the Conseil Scolaire Acadien Provincial (CSAP) and offer programs for Francophone students.

Schools are built by the Province. In the recent past, the HRSB decommissioned two high schools on the Halifax Peninsula and replaced them with Citadel High School. The Board also built a new Sir John A. MacDonald High School west of Halifax and the new Porters Lake Elementary School in Porters Lake. The CSAP recently added Ecole Beaubassin in the Royale Hemlocks area in Halifax west of Bedford Highway and assumed responsibility for the former Lakeview Elementary School, which served English language students in Porters Lake before the construction of the new school there.

HRSB undertook a major master planning process in 2007-2008, which assessed the quality of and need for schools across the HRSB. Through the process, which was called Imagine Our Schools, consultants evaluated the physical condition and future service need for each school in the system. The resulting reports provide extensive data on each school in the system including current enrollment and capacity, and, for roughly half of the schools, ratings of the quality of program delivery. The process also identified areas of need in the system and areas where schools were recommended for closure. Several schools have been closed as a result. The major area of need is Eastern Passage where residents have pressed for a new high school.

School costs are paid for from general Provincial tax revenue and from mandatory municipal contributions to the HRSB under the *Education Act*. This mandatory education contribution is set by the Province of Nova Scotia and is based on HRM's share of the "Uniform Assessment," which is essentially a measure of relative taxing power based in the case of HRM on the taxable assessment available within the municipalities relative to other local governments in Nova Scotia.

The quality and proximity of local schools is a critical consideration in the selection of residential location for most families with children. Schools are often touted in real estate advertising and parents will typically defend the preservation of existing schools if they consider them to be good. Parents will also press strongly for improvement or replacement of schools that they consider deficient.

The school system, furthermore, is organized roughly on three levels: elementary covering grades primary through 6; junior high covering grades 7 through 9; and high school for grades 9 through 12. Each level has its own network of schools with related catchment areas. Catchment areas generally increase in size for the more senior levels. Students have the option of travelling to schools outside their catchment area to access programs such as French immersion or simply to attend schools they consider superior but doing so is not the norm as attendance at a closer school serving the catchment areas in which a student is located is normally much more convenient.

Residential development raises two critical questions for schools. First, as with other facility types discussed, is access in terms of the distance that new residents must cover to get to specific types of schools. Second is the absorption of new students into existing facilities. In some cases, particularly in the Regional Centre but sometimes also in outlying Rural Areas, schools are under enrolled and have considerable excess capacity. In developing suburban areas, however, schools are often distant and may well be incapable of accommodating substantially increased numbers of students.

Development impacts on schools were therefore assessed in two different ways for the three levels at which schools are provided. First, the travel time from new dwelling units in each school catchment area was measured and summed. Second, Stantec estimated future enrollment in the catchment areas of each HRM public school (*i.e.*, all schools at the elementary, junior high, and high school levels) based on the percentage of 2009 population represented in each grade in the Regional Centre, and Suburban and Rural Areas determined from information available in the2009-10 edition of the Nova Scotia Department of Education's annual *Directory of Schools*. The estimated students in each Traffic Zone were then allocated to school catchment areas defined by the HRSB. For each distribution scenario, Stantec then added the number of students of specific ages in different dwelling unit types calculated using student generation factors currently employed by HRSB. These calculations provided total anticipated 2031 enrollments for each scenario that were compared to available capacity based on statistics available in the *Directory of Schools*. Schools in the CSAP were not taken into consideration as they are an option that students from very large catchment areas are free to choose.

Analysis of travel times to schools generated results similar to previous assessments of facility accessibility by travel time or distance. Taking into account all levels of schools, the sum of times for access was least in Scenario B and most in the Trend Scenario, with Scenario A ranking second and the RMPS Scenario third (**Table 6.13**).

Table 6.13 Total Travel Time in Hours from New Development to Schools by Level, HRM, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Elementary	6,935	7,394	6,296	6,084
Junior High School	8,409	8,717	7,521	7,423
High School	14,783	15,542	12,729	12,190
TOTAL	**30,127**	**31,653**	**26,546**	**25,697**
% of Trend	*95.2%*	*100.0%*	*83.9%*	*81.2%*

While travel time to schools is important as a measure of convenience and safety, and is similar to travel to work in terms of its influence on energy consumption, the distribution of students relative to school capacity is often seen as critical. It is very difficult to keep school enrollments in balance at the best of times as neighbourhoods tend to age in place and new schools are required in developing areas that previously had little or no population. Recently, the long-term decline in the number of children in HRM has created a need to consider school closures in many areas of the region even as new schools are built elsewhere.

Parents are often concerned if their local school is under enrolled and, therefore, considered to be a candidate for closure because the existing school is more often than not closer to their residence than any likely new location and because of the general concern of parents for the stability of their children's learning environment. Parents are probably even more concerned if the school their children attend is over enrolled and the education of their children is compromised by overcrowded classrooms and/or limited access to specialized facilities such as laboratories or gymnasiums. From the perspective of the provider, issues of over enrollment are probably more significant, as they imply a requirement to build new schools at considerable expense.

The evidence provided by the calculations for this study is however equivocal. Stantec classified future enrollments at less than 50 per cent of capacity as under capacity and those at greater than 110 per cent as over capacity. The total number of schools under and over capacity under each scenario varies between just 51 (Scenario A) and 55 (Trend Scenario and Scenario B) (**Table 6.14**). The best in terms of minimizing the number of schools over capacity is the RMPS Scenario (24 schools of all types over capacity), while Scenario B places the most pressure on existing schools (33 over capacity). The results are however very sensitive. If, for example, the criterion for over capacity was raised from 110 per cent to 130 per, the RMPS Scenario would become the superior choice (16 schools over capacity), although Scenario B would remain the worst (22 schools over capacity).

The more significant differences are with respect to the location of schools that are under and over capacity. While the correspondence of school catchment areas used by Halifax Regional School Board to the Regional Centre, Suburban, and Rural boundaries used for this study is imperfect, it is not surprising to find that under Scenario B eight schools in the Regional Centre would be over capacity, versus five to as few as one under the other three scenarios. On the other hand, ten suburban schools and six rural schools would be over capacity if trends continue but only six suburban schools and four rural schools would be over capacity under Scenario B.

The analysis, also, necessarily assumes a fixed system in which no new schools are built or existing schools are enlarged. New high schools are being planned for Eastern Passage and Bedford, which will reduce capacity concerns at the senior level in the Suburban Area but we do not yet know the number of students that either of these schools will be able to accept. Students furthermore are more flexible than we have been able to assume. Students within HRM are permitted to attend any HRSB school appropriate to their grade level that has room for them and many do in fact attend schools outside their catchment area of residence. This policy allows some students to remove themselves from situations of overcrowding and probably assists in balancing utilization within the system. Decisions to attend out-of-catchment schools, however, are

Table 6.14 HRSB Schools by Level, Under and Over Enrollment, HRM, 2031 Scenarios

	2011		RMPS Goals		Post RMPS Trend		Scenario A		Scenario B	
Area	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over
Elementary Schools (91 schools in 2011)										
Regional Centre	6	1	3	1	5	1	1	2	1	6
Suburban	2	7	6	9	5	10	5	10	4	8
Rural	4	4	9	8	9	9	9	7	9	9
TOTALS	**12**	**12**	**18**	**18**	**19**	**20**	**15**	**19**	**14**	**23**
%	*13.0%*	*13.0%*	*19.6%*	*19.6%*	*20.7%*	*20.7%*	*21.7%*	*21.7%*	*16.3%*	*20.7%*
Junior High Schools (38 schools in 2011)										
Regional Centre	2	0	2	0	0	2	0	2	0	2
Suburban	1	2	4	3	4	2	4	4	5	5
Rural	2	0	1	1	1	1	1	1	2	1
TOTALS	**5**	**2**	**7**	**4**	**5**	**5**	**5**	**7**	**7**	**8**
%	*13.2%*	*5.3%*	*18.4%*	*10.5%*	*13.2%*	*13.2%*	*13.2%*	*13.2%*	*13.2%*	*18.4%*
High Schools (15 schools in 2011)										
Regional Centre	0	0	0	0	0	0	0	1	0	1
Suburban	0	1	1	2	1	2	1	1	0	1
Rural	1	1	2	0	2	1	2	0	1	0
TOTALS	**1**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**1**	**2**
%	*6.7%*	*13.3%*	*20.0%*	*13.3%*	*20.0%*	*20.0%*	*20.0%*	*20.0%*	*20.0%*	*13.3%*
ALL SCHOOLS (145 schools in 2011)										
Regional Centre	8	1	5	1	5	3	1	5	1	9
Suburban	3	10	11	14	10	14	10	15	9	14
Rural	7	5	12	9	12	11	12	8	12	10
TOTALS	**18**	**16**	**28**	**24**	**27**	**28**	**23**	**28**	**22**	**33**
%	*12.4%*	*11.0%*	*19.3%*	*16.6%*	*18.6%*	*19.3%*	*15.9%*	*19.3%*	*15.2%*	*22.8%*

complex and unpredictable as they can relate to personal issues such as the student's previous attendance at a school with which they are familiar or the location of a school on a parent's route to work.

6.7 Health Care

In many respects, health care facilities are a counterpoint to concerns with school enrollment. Heath care is consuming an increasing proportion of the Provincial budget as population ages. The primary provider of health care services in HRM is the Capital District Health Authority (CDHA). A second important organization is the IWK Health Centre, which operates the Grace Maternity and IWK Childrens Hospitals. Hospital services are heavily concentrated on the Halifax Peninsula south of Quinpool Road, where the Infirmary and Victoria General Hospitals are combined with several other hospitals operated by CDHA as well as the IWK facilities and Dalhousie Medical and Nursing Schools to create the most substantial concentration of health care facilities in Atlantic Canada (see **Table 6.15**). The area is a major employment centre and provides for higher order medical needs across not only Nova Scotia but most of Atlantic Canada.

In addition to the major concentration on the Halifax Peninsula, Dartmouth General Hospital and the Cobequid Medical Centre respectively serve the Dartmouth and Bedford-Sackville areas. Smaller hospitals in Musquodoboit Harbour, Middle Musquodoboit, and Sheet Harbour serve outlying eastern areas of the municipality. The hospital system, furthermore, is supplemented by 30 to 40 medical centres and clinics, as well as many doctors in private practice, offering supplementary services and specialties. While many of these offices are located near the various hospitals, many also provide medical services to local markets throughout the region and are, no doubt, a desirable feature of individual neighbourhoods in which they are located.

Table 6.16 summarizes travel time from new dwelling units to existing health facilities in HRM. As health facilities tend to be more centralized than the other services examined, with the exception of the major solid waste management facilities, the difference between concentrated and dispersed scenarios is wide, with a spread of more than 25 per cent between continuation of the current trend and Scenario B in which half of new development would be concentrated in the Regional Centre.

Table 6.15 Hospitals and Major Health Care Facilities, HRM, 2012

Facility	Address	Community
Bayers Road Centre	7071 Bayers Rd	Halifax
Cobequid Community Health Centre	40 Freer Ln	Lower Sackville
Community Wellness Centre	16 Dentith Rd	Halifax
Dartmouth General Hospital	325 Pleasant St	Dartmouth
East Coast Forensic Hospital	88 Gloria McCluskey Av	Dartmouth
Eastern Shore Memorial Hospital	22637 Hwy 7	Sheet Harbour
Hants Community Hospital	89 Payzant Dr	Windsor
IWK Health Centre	5850/5980 University Av	Halifax
Musquodoboit Valley Memorial Hospital	492 Archibald Brook Rd	Middle Musquodoboit
Nova Scotia Environmental Health Centre	3064 Hwy 2	Fall River
Nova Scotia Hospital	300 Pleasant St	Dartmouth
Public Health	7 Mellor Av, Unit 5	Dartmouth
QEII - Abbie J. Lane Memorial Building	5909 Veterans' Memorial Ln	Halifax
QEII - Bethune Building	1276 South Park St	Halifax
QEII - Camp Hill Veterans' Memorial	5955 Veterans Memorial Ln.	Halifax
QEII - Centennial Building	1276 South Park St	Halifax
QEII - Centre for Clinical Research	1276 South Park St	Halifax
QEII - Dickson Building	1276 South Park St	Halifax
QEII - Halifax Infirmary	1796 Summer St	Halifax
QEII - MacKenzie Building	1276 South Park St	Halifax
QEII - Nova Scotia Réhabilitation Centre	1341 Summer St	Halifax
QEII - Victoria Building	1276 South Park St	Halifax
Twin Oaks Memorial Hospital	7702 Hwy 7	Musquodoboit Harbour

Table 6.16 Total Travel Time in Hours from New Development to Existing Health Facilities, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre	877	499	1,554	2,097
Suburb	3,830	4,230	3,214	2,473
Rural	6,517	7,820	4,589	4,589
TOTAL	**11,225**	**12,549**	**9,357**	**9,158**
% of Trend	*89.4%*	*100.0%*	*74.6%*	*73.0%*

6.8 Impacts on Other Public Services

All of the services considered in this chapter can be regarded as facilities-based in contrast to the network delivered services discussed in **Chapters 4, 5,** and **7**. While the outcomes of analyses of facilities access measured in terms of travel time generally show seemingly moderate differences ranging from less than 10 per cent to approximately 25 per cent between the best, usually most concentrated scenarios and continuation of current trends, they are cumulative and sum to substantial impacts in terms of user time, vehicle operating costs, pollutant output, and other effects.

Differences in travel times and distances are generally largest where facilities are few in number and more centralized. As more facilities are added accessibility increases; however, so also do the costs of building and operating facilities. While it is frequently hypothesized that better management of population distribution will reduce the need to add new facilities, the examples for which we have been able to provide a high level assessment in this study are at best inconclusive. Facilities already serve the whole of HRM and it is very difficult to redistribute population within the region without compromising utilization in some area.

While concentration of population in the Regional Centre will from all appearances enhance the use of facilities at the core of the region, it will erode utilization of facilities elsewhere with consequences for capital needs and general disruption that are probably very similar. It may also place excessive pressure on facilities in the core, although it may be argued that it is easier to reallocate users in the core where facilities are more numerous and the distances to alternative sites are considerably less. On the whole, however, we are inclined to regard the issue of facility utilization as unresolved and in need of a detailed and original study that might take into account second and third best alternatives before concluding that one residential distribution strategy is likely to be more beneficial than another.

6.9 Other Public Services and Health

The broad range of services considered in this chapter has varied health impacts. Some have clear and direct effects on the health and safety of the population; most notably, fire and emergency, police, and medical services, access to which enhances real and perceived security, as well as reducing the consequences of accidents, violence, and other physical risks. Others such as community facilities, parks, libraries, and schools influence the physical, mental, and emotional health of the population able to access them.

All of these services, as we have noted, are facilities-based. Although it is not possible to define differences in time and distance with the same precision that the VISUM model provides for assessing the journey to work, the relationships between distances from new housing to public facilities are clearly parallel. For every service considered in this study, the total distance between service population and existing facilities decreases with the relative degree of residential concentration.

Reduced travel distance to community facilities has the same basic health benefits as reduced distance to work: facility users spend less time on travel and consume less energy, thereby reducing detrimental emissions. Shorter distances allow users to substitute transit, walking, and cycling for automobile use, further reducing emissions, while simultaneously increasing physical activity and its positive influence on health, and employing inherently safer modes of travel.

Most of the services discussed in this chapter make important contributions to quality of life. The solid waste collection, recycling, and disposal system is as critical

to the health of community members as the water and wastewater systems managed by Halifax Water. The influence of residential distribution on the effectiveness of these services in minimizing health impacts is however minimal. Waste is collected from all residents of HRM, albeit on varied terms depending on building type and location. Its ultimate destinations are essentially the same regardless of origin with impacts on transportation requirements outlined above but little variation in consequences at handling and disposal locations, absent any data indicating that different residential uses have significantly different waste generation rates.

The remaining services, however, have important effects beyond transportation access. Fire and emergency services, policing, and health services provide important assurances of security and well-being. Parks and recreation facilities, libraries, and schools are critical cultural facilities that typically provide gyms and rooms for fitness and meetings that contribute to physical as well as intellectual development of the public. These facilities, which are also found in many fire halls and in some private businesses, furthermore, play an important role bringing community members together and, thereby, facilitating group action.

The safety of the public is best assured when fire and police services are available rapidly in response to an event. Similarly, in relation to these and other events, it is desirable to be able to deliver individuals with injuries or extreme health issues as quickly as possible to appropriate health care facilities. It is clearly easiest to satisfy this condition in the Regional Centre where multiple facilities including major regional facilities (*i.e.*, fire and police administration and major hospitals) are located.

Some may argue that protective services must be provided at a higher level in the Regional Centre because of the higher level of risks there. Certainly more crimes occur in the Regional Centre than in the Suburban Area, although the crime rate per capita is not much different between the Regional Centre and the eastern portion of the Rural Area (*i.e.*, Musquodoboit Harbour and Sheet Harbour) based on calculations by Stantec of crimes per capita handled by the respective detachments shown in **Table 6.17**.

A similar situation prevails for fire. Risks are greater in the Regional Centre where buildings are more substantial and are located closer together but data do not suggest a dramatic difference in the number of events related to density. HRM Fire and Emergency Services has handled over 11,000 calls in each of the three most recent years for which data has been posted (*i.e.*, 2008-2009 through 2010-2011).

The department deals with fires, health incidents, vehicle accidents, and a variety of other interventions. No geographic breakdown of these responses is readily available; however, a list of major structure fires, which are the most serious responses with which the department deals, includes addresses and dates allowing Stantec to compile the summary contained in **Table 6.18**. The data shows modest year to year variations in fire numbers and very similar rates of occurrence between the Regional Centre and the Rural Area but roughly 50 per cent fewer occurrences in the Suburban Area.

Age of buildings, mixture of lands uses, and socioeconomic status of residents, as well as many other factors play a part in the relatively safer conditions in the Suburban Area. Intensification of development may address some of these considerations in and of itself. It would decrease the age of building stock in the Regional Centre and increase the residential component of land use. Some would argue further that increasing the residential component in the Regional Centre would inherently increase security.

As with provision of parks, provision of protective services needs to be geared to need as the settlement pattern progresses. Unlike parks, we have no reason to presume that an increase in levels of protective services is needed in the Regional Centre. A great benefit of settlement in the core urban area is the prevalence of police, and fire and emergency facilities in many locations such that no resident is an unreasonable distance from assistance when they may require it.

Table 6.17 Crimes by Type by Police Detachment, HRM, 2011

Crime	Central	West	East	Cole Harbour	Lower Sackville	North Central	Tantallon	Musquo-dobit Hbr	Sheet Harbour	Total
Assaults	795	575	928	181	266	16	86	47	23	2,917
Break & Enter	542	454	618	156	234	13	150	51	46	2,264
Impaired Driving	215	128	154	109	122	-	85	24	7	844
MVA – Property	1,635	1,417	1,457	493	944	46	376	122	38	6,528
MVA -- Injury	270	246	218	84	163	12	83	33	6	1,115
Robberies	122	75	106	19	22	-	3	1	-	348
Sex Offense	135	59	91	27	54	1	17	8	1	393
Vehicle Thefts	143	144	235	53	59	3	33	11	3	684
Weapons	338	289	436	133	159	9	96	32	5	1,497
TOTAL	**4,195**	3,387	**4,243**	**1,255**	**2,023**	100	**929**	**329**	**129**	**16,590**
Est. Population	62,899	77,282	67,100	65,663	82,905	N/A	24,639	6,129	3,479	390,096
Persons per Offence	*15.0*	*22.8*	*15.8*	*52.3*	*41.0*	*N/A*[1]	*26.5*	*18.6*	*27.0*	*23.5*

[1] Crime recorded in the North Central detachment are included with Lower Sackville for the purpose of calculating crime incidence

Source: Halifax Police, 2011Census of Canada, Stantec calculations

Table 6.18 Major Structure Fires by Area of Occurrence, HRM, 2009-2012

Area	Jan-Jly, 2012	2011	2010	Sep-Dec, 2009	Total	2011 Population per Fire
Regional Centre	7	20	22	4	53	1,811
Suburban	14	24	20	7	65	2,980
Rural	14	15	22	7	58	1,747
TOTALS	**35**	**59**	**64**	**18**	**176**	**2,222**

Source: HRM Fire and Emergency Services

Residents of the Regional Centre also have the benefit of ready access to medical services to reinforce the benefit of access to fire and police assistance. Whether for routine medical care or in emergency situations, Regional Centre residents generally close to a wide range of medical care services, although there are certainly Suburban and Rural areas that have very convenient access to local clinics and hospitals without concern for the relative congestion in the urban core (*e.g.*, Lower Sackville near Cobequid Medical Centre, and Musquodoboit Harbour and Sheet Harbour).

Improved access to schools, libraries, and recreation centres enhances the intellectual, cultural, and physical health of community members. The ability of residents to improve themselves can lead to increased employability and earning power, which have further positive repercussions for the larger community. The Regional Centre clearly offers easiest access to the widest range of these facilities. The synergy of these facilities co-located with post-secondary institutions and other

cultural centres at the core of the region is, in fact, regularly cited as a critical benefit to its residents.

Recreation facilities, and parks and open spaces are clearly provided to enhance physical health and well-being. Recreation centres and, to a lesser extent parks, are also frequently employed as supplementary venues for education and education-related events.

Proximity to these facilities promotes their regular use. Once again, individuals who locate in the Regional Centre have access to a considerable number and variety of facilities. On the other hand, as noted, substantial increases in the Regional Centre population will strain the current supply of parkland. If intensification is pursued, particularly at the levels anticipated by Scenarios A and B, provision of adequate parkland will be a key challenge exacerbated by the need to use available land for residential development.

7.0 PRIVATE UTILITIES

The three utilities provided privately in HRM are electricity, communications, and the relatively new service of natural gas. While electrical and communications services are provided more or less as a matter of course to all but the most remote developments in HRM, their costs are influenced by sprawl in the same way as water and wastewater services. Natural gas is currently very selectively distributed. Its significance is as a potentially more cost effective energy alternative that may also reduce GHG and pollutant outputs relative to typical alternatives available in Nova Scotia.

7.1 Electricity

Electrical power is provided throughout HRM by Nova Scotia Power, a private monopoly. Electrical rates are set through the NSUARB. Electricity is almost universally available in HRM. It is used for nearly all lighting and most appliance operation. It also tends to be favoured for home heating, in spite of higher operating costs, because of low capital costs for installation.

Nova Scotia Power generates its electricity primarily from fossil fuels consisting of coal, petroleum coke, heavy fuel oil, natural gas, and diesel. Some of the energy is produced from renewables consisting of hydro, tidal, wind, and biomass. The three largest units at the Tufts Cove generating plant in Dartmouth can be fueled by either heavy fuel oil or natural gas and the newest two are natural gas only.

The electricity transmission system across HRM is considered flexible and robust as alternative supply sources are available and disruption of a single transmission line or generating unit would not typically lead to a power loss to local consumers. Similarly, distribution infrastructure within the region's urban core is resilient given auxiliary units installed for almost all main feeders connecting consumers to sub-stations. Conversely, Rural Areas of HRM lack contingency systems as the area's diminished load density increases costs to the distribution system.

Power is provided to property in two forms. Most residential property (*i.e.*, singles, semis, and small apartment buildings) receive single-phase power, which is sufficient to run all typical domestic appliances. Multi-unit apartment structures and commercial properties are normally serviced with three-phase power. Three-phase power is better suited to powering large electrical motors and industrial equipment used by business and in large residential properties. Three-phase power is more expensive to provide but it allows this larger scale equipment to operate more efficiently than single-phase equivalents.

Nova Scotia Power allows a 92-meter credit distance from distribution poles, after which the new construction owner or developer will be charged for any poles or wires required. Typically, at spans over 40 meters, distribution poles will be needed to connect to structures. There is no charge for installing poles unless rock needs to be cut or trees need to be trimmed around secondary lines.

Recent experience with ice and wind storms, as well as aesthetic concerns, have led to pressure to transfer aboveground networks (*i.e.*, poles and cables) to subterranean systems. Underground utilities can ameliorate streetscape aesthetics, grid reliability, and decrease municipal tree trimming costs, as well as damage to

Table 7.1 Cost of New Electrical and Communications Service Extensions ($000s) Required to Access New Dwelling Units, HRM, 2031 Scenarios												
	RMPS Goals			Post RMPS Trend			Scenario A			Scenario B		
Area	Phase 3	Phase 1	Total	Phase 3	Phase 1	Total	Phase 3	Phase 1	Total	Phase 3	Phase 1	Total
Regional Centre	$36	$0	$36	$36	$0	$36	$36	$0	$37	$37	$0	$37
Suburban	$3,573	$4,673	$8,246	$5,698	$3,674	$9,372	$3,330	$3,334	$6,664	$3,230	$2,079	$5,309
Rural	$666	$12,327	$12,993	$78	$13,965	$14,044	$613	$9,220	$9,833	$423	$9,643	$10,067
TOTAL	**$4,275**	**$17,000**	**$21,275**	**$5,813**	**$17,639**	**$23,451**	**$3,979**	**$12,554**	**$16,533**	**$3,690**	**$11,723**	**$15,412**
% of Trend	*73.6%*	*96.4%*	*90.7%*	*100.0%*	*100.0%*	*100.0%*	*68.5%*	*71.2%*	*70.5%*	*63.5%*	*66.5%*	*65.7%*

property. The study *Underground Utilities Feasibility Study for Halifax Regional Municipality* produced for HRM by Kinectrics Inc., however, determined that the costs of such infrastructure – for cable and telephone as well as power – were prohibitive, and exceeded the quantifiable benefits by a margin of 5 to 15 times.

To estimate electrical service costs, Stantec assumed aboveground installation of single phase power at $40 per meter and three-phase power at $60 per meter. Results are presented in **Table 7.1**, showing, once again, significant benefits to concentration of development with Scenario B reducing the cost of extending the power network by roughly 38 per cent over continuation of the current development trend. Numbers in the table also include a $10 per meter cost for associated communications upgrades as explained further at the close of **Section 7.2**.

7.2 Communications

Communications infrastructure has undergone considerable change in recent decades. Traditionally, telephone lines accompanied electricity to homes in the region. They still do; however, they are now accompanied by cable lines for television and computers. Network dependent communications, furthermore, are being increasingly supplemented, if not replaced, by wireless communications. Cellphones and related devices are consequently stimulating the development of cell towers that, while not physically connected to each other, must be distributed to all developed areas within HRM.

HRM has a fully-digital telecommunications system with a robust broadband network and end-to-end redundant fibre networks provided by two full-service telephone providers: Bell Aliant and Eastlink. According to Bell Aliant, residential phone lines for new construction cost $130 for complete installation (includes $95 for technician and $35 for 'Dmarc' demarcation point). If the existing network is nearby, the utility provider will cover costs within 160 meters from the nearest pole to the main floor of the building. Eastlink charges a one-time $10 fee covering the first 300 feet of any aerial line from an existing pole to a new home.

Utilities do not have set rates for underground installation, because underground services are not yet common. Eastlink, for example, only installs lines aboveground in the Maritimes. Buried cable, however, has been estimated to cost approximately $41 per meter within HRM not including installation costs, which would be the responsibility of the developer /property owner. The costs for cable service are approximately $2 per meter; however, these charges are typically included as part of the costs of installation covered by the utility.

While aerial services (*e.g.*, cell towers) represent the most significant infrastructure expense in the telecommunications sector within Canadian municipalities, fibre network expansion is on the rise given the faster connectivity associated with the technology, high definition television signals, and voice over a consolidated connection. Costs for lines such as fibre networks would need to be verified by the utility. Also, if the building is not pre-wired (though it usually will be), there is a charge per jack by the utility service provider.

The major cost of extending the communications network is the provision of necessary poles, which are generally shared with the electricity network and accounted for in our calculations for electricity extensions. There is an approximate cost of $10 per meter for wire and other connection hardware required specifically for the communications network and that has been incorporated in the costs calculated in **Table 7.1**, above.

7.3 Natural Gas

Natural gas is a relatively new utility for Haligonians. It became available when a lateral was built from the Maritimes and Northeast Pipeline to Nova Scotia Power's Tufts Cove facility, which brought natural gas to the urban core of HRM in 2003. Natural gas is available to urban areas in Halifax and Dartmouth through Nova Scotia distributor Heritage Natural Gas. As economical delivery of natural gas to residential users depends significantly on the density of households, it is unlikely that natural gas networks will ever be extended beyond the urban and, possibly, Suburban Area of the municipality. Beyond the piped gas network, natural gas can be delivered by large trucks where warranted by demand.

Heritage is encouraging connections and expanding its local network; however, progress is slow. Costs for natural gas are marginally lower than for other fuel sources measured by gigajoule (GJ) equivalents (**Table 7.2**). Rates are set by application to the NSUARB, which also approves extensions of gas delivery network. Critically from the perspective of the social consequences of development, natural gas also generates less GHG and pollutant outputs than other options.

Staff with Heritage Gas consulted by Stantec indicated that there is no assurance that service will be extended throughout the Regional Centre even by 2031. They indicated that service is typically extended to areas where large commercial loads are available. Heritage will typically assess potential loads *en route* when determining its route to connect to large commercial customers. Consequently, the current natural gas network reflects the arterial and collector road network where commercial development and high density residential development are concentrated and areas of adjacent commercial development and high density residential development (*e.g.*, Highfield Park next to Burnside in Dartmouth and the south end of Barrington Street adjacent to the Port of Halifax). Heritage is also interested in extending natural gas to greenfield areas where installation of gas lines can be coordinated with the overall development process (*e.g.*, Bedford West). The only service within the Rural Area of HRM is at the Airport where residential development is restricted.

Table 7.2 Fuel Type Cost Comparison, 2011

Fuel	Rate Class		
	5,000 GJ/ year	5,001-50,000 GJ/ year	50,001 GJ/ year or more
Natural gas ($ per GJ)	$12.44	$6.88	$5.61
Oil ($ per 26.1 litre)	$12.84	$6.99	$6.16
Propane ($ per 39.2 litre)	$12.82	$7.02	$5.64
Electricity ($ /277.78 kwh)	$12.78	$6.94	$5.56

Source: Heritage Natural Gas, http://www.heritagegas.com/business/commercial-rates.html

Predicting future natural gas provision is difficult given that lines are being extended on a one-by-one basis. Changes to the regulatory regime or to the price of natural gas relative to other energy alternatives could influence the scope of the system and the pace of its expansion; however, it is clear that natural gas is only viable in areas of higher density. It was therefore assumed that natural gas will be available only within the Regional Centre and Suburban Area of HRM. Within the Regional Centre, Stantec assumed natural gas will be available to new development on streets

already served by natural gas and for which natural gas extensions are planned based on mapping posted on the Heritage Natural Gas Web site, along all arterial and collector roadways within the Regional Centre, and within 300 meters of existing and assumed connections. In the Suburban Area, connections were assumed to be available on existing and proposed lines and within 300 meters of such lines, as well as throughout areas to which service is committed such as Bedford West, Royale Hemlocks, and Morris-Russell Lake. Finally, we assumed greenfield areas with more than 250 dwelling units could have natural gas but discounted potential connections by 50 per cent to recognize that not all developers will be interested in the opportunity.

The extension of natural gas networks, like publicly provided piped networks discussed above, is proportional to length. Natural gas networks being extended in built up areas, however, have an additional cost because existing roads must be opened and other challenges must be dealt with. Heritage Gas provided general numbers for various areas in which the company is currently extending services. Stantec has rounded these to the numbers presented in **Table 7.3**.

Table 7.3 Natural Gas Network Development Costs (per meter)

	Developed	Greenfield
Regional Centre		
Halifax	$405	N/A
Dartmouth	$290	N/A
Suburban Area		
Halifax West	$325	$165
Bedford West/South	$305	$175
Dartmouth	$290	$155

Source: Heritage Gas, adjusted by Stantec

Applying the criteria outlined above, Stantec estimated that natural gas could be provided under each scenario to the numbers of dwelling units shown in **Table 7.4**.

Applying the rough cost factors provided in **Table 7.3**, above, Stantec also estimated the costs provided in **Table 7.4**. Total costs are higher in the more condensed scenarios but considerably more units are serviced (costs per unit are the same for all four scenarios). The additional costs of servicing additional units should however be mitigated by lower fuel costs for these consumers as well as lower GHG and pollutant output associated with the use of natural gas relative to other home heating alternatives.

Table 7.4 Dwelling Units Served by Natural Gas with Estimated Costs ($000s), HRM, 2031 Scenarios

Area	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Regional Centre				
Dwelling Units	18,313	11,863	28,717	35,744
Cost ($000s)	$6,719.9	$4,296.3	$10,657.0	$13,138.9
Suburban				
Dwelling Units	18,313	11,863	28,717	35,744
Cost ($000s)	$7,031.3	$7,215.8	$6,769.5	$7,416.3
Rural				
Dwelling Units	0	0	0	0
Cost ($000s)	$0	$0	$0	$0
TOTAL				
Dwelling Units	**43,583**	**39,917**	**50,201**	**55,276**
% of Trend	*109.2%*	*100.0%*	*125.8%*	*138.5%*
Cost ($000s)	**$14,831.0**	**$10,230.6**	**$14,971.9**	**$17,182.3**
% of Trend	*109.4%*	*100.0%*	*120.8%*	*126.3%*

7.4 Impacts on Private Utilities

The private services considered in this chapter generally emulate the networked public services addressed in **Chapters 4** and **5**. All private utilities discussed will benefit from the encouragement of residential concentration relative to the

alternative of continued dispersion of growth, as concentration will reduce the length of required distribution networks in all cases and, in the case of natural gas, will increase access to a beneficial service.

Given that rates for all of the utilities presented are significantly influenced by the cost of the infrastructure to provide them, reductions in network length should have benefits in terms of lower charges to consumers. Lower rates will free income for other purposes and, as such, enhance quality of life.

7.5 Private Utilities and Health

While the private utilities assessed in this chapter have much in common with networked public facilities, their influence on human health is more limited.

Certainly, the availability of electricity and communications technology has quality of life and cultural benefits for users. They likely also enhance safety and security. Very few homes will not however have access to both in some form regardless of their location within HRM.

No significant energy is consumed in the transmission of electricity, communications signals, or natural gas. Substitution of natural gas for alternative fossil fuels will reduce pollutant outputs with related health benefits and reduce the risk of oil spills and resultant contamination of sites and watercourses. It can also enhance quality of life to the extent that its cost is lower than alternatives and, thereby, allows consumers to allocate savings to other purposes.

8.0 SUMMARY OF SERVICE IMPACTS

Results presented in the four preceding chapters demonstrate the benefits of concentrating new residential development. Dwelling units served, distances to be covered, and capital costs for infrastructure required vary anywhere from 10 to nearly 40 per cent between continuation of existing trends and the optimal development scenario (**Table 8.1**).

For nearly all services assessed, the best distribution scenario is Scenario B in which the largest proportion (50 per cent) of new development is located in the Regional Centre. Of 26 measures listed in **Table 8.1**, Scenario B provides the best outcome in 22, denoted in blue in the "Percentage of Trend or Rank" column. The scenario ranks second in terms of increased transit use, denoted by red numbers and obtains mixed results in terms of elementary and junior high school enrolment balance. Scenario A, which allocates 40 per cent of new development to the Regional Centre, generally ranks second, although it ranks ahead of Scenario B in terms of its positive impact on transit use. The current RMPS objective of locating 25 per cent of new residential development in the Regional Centre with 50 per cent in the Suburban Area and 25 per cent in the Rural Area most often ranks third (denoted by gold numbers), with exceptions being water and wastewater improvements for which costs would be highest, and school over and under enrolment, where it is at least tied for the best outcome for all three levels of schooling. Continuation of the current trend by which only 16 per cent of new residential development has located in the Regional Centre provides the worst outcome in all cases except for wastewater improvements where it ranks ahead of the RMPS Scenario by 3.4 per cent. It also ties the RMPS Scenario on measures of time required for private compost haulage and its suitability for existing library catchment areas.

Parkland requirements stand out for reversing this general ordering. It will cost significantly less to bring park supply up to grade under the Trend Scenario relative to the three alternatives considered. The other three scenarios will cost significantly more given the pressure that they will create for park supplies in the Regional Centre where land costs are the highest. This, as noted, should be balanced by the better access to recreation opportunities available in community facilities under the more condensed scenarios (see **Table 6.7**, above), as well as the more intensive development of existing parklands in the Regional Centre and Suburban Areas (*i.e.*, provision of park furniture and active facilities, as opposed to undeveloped open space).

8.1 Scope of Analysis

While the scope of our analysis is broader and more detailed than any other we have seen, it is not exhaustive. Even within the public sector we cannot purport to have covered all services. Both the Province and HRM maintain customer service centres, for one example, at which citizens can pay bills, obtain permits, obtain information, and otherwise conduct various types of business with each government. Individual departments also maintain offices, depots, and facilities (*e.g.*, transportation depots where salt and equipment is stored for road maintenance) of various types that are often located in relation to development and influenced by its distribution and the extent of infrastructure created to serve it.

Table 8.1 Summary of Scenario Comparisons, HRM, 2031 Scenarios

Service	Measure				Percentage of Trend or Rank			
	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Water, Wastewater, and Stormwater								
- All improvements ($000s)	$1,602,853	$1,549,469	$1,382,235	$1,058,255	103.4%	100.0%	89.2%	68.3%
Transportation								
- Local Road Construction ($000s)	$1,698,837	$1,736,524	$1,382,557	$1,079,829	97.8%	100.0%	79.6%	62.2%
- Regional Road Improvements ($000s)	$211,680	$239,940	$198,360	$172,320	88.2%	100.0%	82.7%	71.8%
- Additional Vehicle Trip Time (hours)	31,745	33,443	30,581	29,038	94.9%	100.0%	91.4%	86.8%
- Additional Vehicle Trips Distance (km)	1,073,352	1,118,371	1,065,543	1,030,784	96.0%	100.0%	95.3%	92.2%
- Transit Use Change (work trips from 2009)	1,009	743	2,029	2,209	135.8%	100.0%	273.1%	297.3%
- Active Transportation Change (work trips from 2009)	9,530	9,255	9,828	9,970	103.0%	100.0%	106.2%	107.7%
Other Public Services								
Solid Waste Management								
- Municipal Solid Waste Haulage (hours)	19,585	20,655	15,363	12,606	94.8%	100.0%	74.4%	61.0%
- Private Solid Waste Haulage (hours)	9,327	9,252	11,711	13,969	100.8%	100.0%	126.6%	151.0%
- Municipal Compost Haulage (hours travel)	23,663	24,251	18,988	16,268	97.6%	100.0%	78.3%	67.1%
- Private Compost Haulage (hours travel)	10,885	10,885	13,575	16,017	100.0%	100.0%	124.7%	147.2%
- Municipal Recyclables Haulage (hours travel)	19,226	20,389	15,150	12,501	94.3%	100.0%	74.3%	61.3%
- Private Recyclables Haulage (hours travel)	8,530	8,524	10,783	12,901	100.1%	100.0%	126.5%	151.3%
- Recycling Depots (hours travel)	8,076	8,221	7,369	7,149	98.2%	100.0%	89.6%	87.0%
Fire and Emergency (hours travel)	7,095	7,640	6,804	6,562	92.9%	100.0%	89.1%	85.9%
Police	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Community Facilities and Parks								
- Community Facilities (hours travel)	7,095	7,640	6,804	6,562	92.9%	100.0%	89.1%	85.9%
- Parkland Supply ($000s to address shortfalls)	$309,418.9	$199,892.5	$523,704.7	$715,858.6	154.8%	100.0%	262.0%	358.1%
Libraries								
- User Travel Distance (km to branches)	11,317	12,262	9,926	9,399	92.3%	100.0%	80.9%	76.7%
- Catchments Classified A/B/C/U	5/1/1/7	5/1/1/7	4/3/0/7	5/2/0/7	3	3	2	1
Schools								
- User Travel Time (hours to all school types)	30,127	31,653	26,546	25,697	95.2%	100.0%	83.9%	81.2%
- Elementary (% under/over capacity)	18/18	19/20	15/19	14/23	3 1	4 3	2 2	1 4
- Junior High School (% under/over capacity)	7/4	5/5	5/7	7/8	3 1	1 2	1 3	3 4
- High School (% under/over capacity)	3/2	3/3	3/2	1/2	2 1	2 4	2 1	1 1
Health Care (hours travel)	11,225	12,549	9,357	9,158	89.4%	100.0%	74.6%	73.0%
Private Utilities								
Electricity and Communications ($000s)	$21,275	$23,451	$16,533	$15,412	90.7%	100.0%	70.5%	65.7%
Natural Gas (potential DUs connected)	43,583	39,917	50,201	55,276	109.2%	100.0%	125.8%	138.5%

Similarly, just as privately provided network services respond to the pattern of development in much the same way as publicly supplied networks, a much broader array of private sector services is provided from stores and offices that are a significant feature of the Regional Centre. As with other services discussed, the degree of benefit derived from concentration of residential development will be proportionate to the degree to which the facilities to be accessed are themselves concentrated. The cost of going to a junior hockey game, for example, is lowest for residents living near to the Metro Centre in downtown Halifax and very substantial for residents of Hubbards and Sheet Harbour at the extreme ends of HRM. Attendance at hockey games in one of HRM's many arenas, however, is substantially less costly because the dispersion of arenas enhances access, although there are still normally many more residents in close proximity to arenas in urban neighbourhoods than in rural communities.

Much the same can be said for the goods and services regularly needed and accessed by citizens. Convenience stores and fast food restaurants are generally dispersed, although their frequency dissipates as urbanization falls off. Higher order goods and services are however almost exclusively concentrated in the Regional Centre and Suburban Area, and the cost of accessing them from less densely settled outlying areas is commensurately higher. It is reasonable to assume that these needs and the costs in travel, time, and money to access them exceed the public services and private utilities discussed and analysed here.

While it would not be impossible to assess the accessibility of such services or to even determine the potential cost of their adaptation under different growth scenarios, the array of analyses required would likely be overwhelming and would, in our opinion, only serve to reinforce the lessons conveyed by the assessment outlined above.

8.2 Limitations

The preceding analyses of the impact of development on services in HRM have been carried out at a high level for the purposes of comparing the four alternative scenarios specified in the RFP for this study. The quantities calculated and the cost factors applied were estimated by the consultants based on professional experience and/or consultation with other expert professionals. They are nevertheless generalized numbers reflecting available data and/or average conditions within HRM.

The quantity of new roads required, for example, is based on the size of the property to be developed rather than any attempt to layout roads to serve the presumed development. Similarly, the installation of water and sewer networks can vary considerably in different areas of HRM depending on soil cover, topography, access, ownership, and other factors. With thousands of properties to consider in this analysis, these details were not taken into account. The cost factors applied are, in our opinion, reasonable estimates of averages within the region recognizing that they are applied across large areas (*i.e.*, the designated Regional Centre, and Suburban and Rural Areas) in which the full range of extremes will be encountered.

No aspect of the foregoing work should however be considered to provide a sound basis for planning infrastructure development or estimating its ultimate cost. Its sole purpose is to illustrate the magnitude of costs and the influence on costs of the four scenarios assessed.

8.3 A Note on Revenue Sources

Development not only generates costs for public sector agencies. It is also a critical source of revenue. Sometimes revenues resulting from development are direct charges for services as in the example of water rates charged by Halifax Water, tolls levied by Halifax Harbour Bridges, or the approved fees charged by Heritage Gas for natural gas. In other cases, development enlarges government revenue through taxes or fees that bear a relationship to services required by property but are much less closely tied to any measure of consumption. The most notable of these is the property tax, which is the primary source of municipal revenue and a source from which the Province draws to pay a portion of the costs of schools. Less significant but clearly tied to development are processing fees for planning applications, building permit fees for construction, and the deed transfer tax, which applies to all real estate transactions.

Summaries of service impacts, above, generally include an outline of funding sources. Although most services draw entirely or to a significant degree on municipal general revenues (*i.e.*, primarily property taxes but also charges such as the deed transfer tax), some also draw on specific revenue sources. In the case of transit, the special transit tax is notable in addition to the important contribution of fare revenue. In most other cases, charges are levied directly on users based on their quantity of consumption (*e.g.*, water and transit rides) or admission to facilities (*e.g.*, recreation services). **Table 8.2** summarizes services discussed above and key revenue sources for capital and operating needs.

It is also important to be aware that taxes are levied differentially across the region. Largely to recognize differences in service levels, HRM has adopted three taxation areas portrayed in **Figure 8.1** to govern the levy of property taxes. These areas are identified as Urban, Suburban, and Rural tax areas. They bear some resemblance to the Regional Centre, and Suburban and Rural planning areas assessed by this study but are not the same. As examination of the figure reveals, for example, Urban tax rates apply to most areas defined as "Suburban" for planning purposes and the Suburban tax areas cover areas abutting the Urban tax areas that are nearly all categorized as Rural for planning purposes.

Table 8.2 Revenue Sources by Service, HRM, 2011-12

Service	Capital	Operating
Municipal		
Roads and Sidewalks	Capital Cost Contribution	General revenue
Transit	Fares, transit tax, Capital Cost Contribution	Fares, Transit Tax
Water	Water rate, Capital Cost Contribution, Local Improvement Charges	Water rate ($0.413 per m^3)
Wastewater	Wastewater rate and Capital Cost Contribution, Local Improvement Charges	Wastewater rate ($1.169 per m^3)
Stormwater	Wastewater rate and Capital Cost Contribution, Local Improvement Charges	Wastewater rate and Capital Cost Contribution
Solid Waste Management	Tipping fees, general revenue	Tipping fees, general revenue
Fire and Emergency	General revenue	General revenue
Police	General revenue	General revenue
Community Facilities and Parks	General revenue, subdivision dedication	Admission/registration fees, general revenue
Libraries	General revenue	General revenue
Provincial		
Highways	General revenue	General revenue
Harbour Bridges	Tolls	Tolls
Schools	General revenue, mandatory municipal contribution	General revenue, mandatory municipal contribution
Private		
Electricity	User fees	User fees
Communications	User fees	User fees
Natural Gas	User fees	User fees

8.4 Summary of Service Impacts

Figure 8.1 HRM Taxation Structure Areas

Source: HRM, http://www.halifax.ca/revenue/taxbill/documents/HRM_urban_suburban_may2009.pdf

Each area is subject to different "general" residential and commercial tax rates on assessment. Although the variations in rates shown are modest, they are overlaid in many locations by other area rates for special services (see **Table 8.3**).

Table 8.3 HRM General Property Tax Rates by Area, 2012-13

Area	Residential Rate	Commercial Rate	Services Provided
Urban	$0.661	$3.084	Policing, Solid Waste, Recreation Programs, Planning, Libraries, Sports Fields, Playgrounds, Administration, Fire Suppression, Street lighting, Recreational and Community Facilities (HRM share of capital and operating costs), Crosswalk Guards..
Suburban	$0.645	$3.084	Policing, Solid Waste, Recreation Programs, Planning, Libraries, Sports Fields, Playgrounds, Administration, Fire Suppression, Street lighting, Recreational and Community Facilities (HRM share of capital and operating costs), Crosswalk Guards.
Rural	$0.639	$2.733	Policing, Solid Waste, Recreation Programs, Planning, Libraries, Sports Fields, Playgrounds, Administration, Fire Suppression, Street lighting, Recreational and Community Facilities (HRM share of capital costs)."

Source: HRM, http://www.halifax.ca/revenue/taxbill/rates.html#GR

The Municipality levies too many area rates to list here. Some cover large areas like the transit tax area illustrated in **Figure 4.1**, above. Another example is the Fire Protection Rate, which largely overlays the Regional Centre and Suburban Area of HRM but also includes the Goffs area south of Stanfield International Airport, which is classified as Rural. These areas all benefit from the availability of fire hydrants,

which are not provided in most Rural Areas. Another example is the Sidewalk Snowplowing Area rate, which applies to the Regional Centre and Suburban Area (not including the Goffs area) but excludes the Halifax Peninsula where property owners are required to clear their own sidewalks (in front of more densely developed properties that typically have less frontage).

In addition to these "wide area" rates, there are also many rates applicable to specific communities that pay for local improvements and facilities. A good example is Beaver Bank where residents pay rates of $0.425 per $100 of assessment to cover sewer improvements in their area discussed under "Wastewater" in **Section 5.1**, above, and $0.352 for related water improvements. They also pay $0.070 for the costs of the Beaver Bank Recreation Centre. Some on Beaver Bank Road from Meadow Drive to Danny Drive, furthermore, are paying $0.0831 over three years to cover the capital cost of recently installed sidewalks.

Many similar rates are applied in other communities, mostly in the outer Suburban and Rural Areas of HRM to pay for varied facilities and services. Harrietsfield and Hatchet Lake pay for crossing guards, 30 communities in addition to Beaver Bank pay for local recreation facilities, five pay for private road maintenance, and nine in addition to the area of Beaver Bank pay local improvement charges for sidewalks and roadway improvements. Residents in the southeastern corner of the municipality around Sheet Harbour pay $11.84 per property to support the capital and operating costs of streetscape improvements in Sheet Harbour.

Commercial property owners in some areas designated as business improvement districts (*e.g.*, Downtown Halifax, Spring Garden Road, Quinpool Road, North End Halifax, Downtown Dartmouth, and Dartmouth Main Street) pay additional taxes to support local business improvement organizations. Businesses are also subject to many of the same area rates as residential property owners. Unlike the general rates, which are much higher for commercial properties than for residential properties, area rates charged against commercial properties, where they apply, are levied at the same rates as on residential properties. The sole exception is the fire protection charge, which is $0.69 for commercial property or three times the rate applied to residential property in recognition of the greater risk and potential consequences of fire for commercial property.

This considerable array of rates, charges, and fees is intended to recover many of the costs related to development. Its design is however erratic and the influences it places on decisions to develop land, purchase real estate, and distribute both residential population and economic activity are uncertain.

9.0 ENVIRONMENTAL, ECONOMIC AND HEALTH IMPACTS

The foregoing sections demonstrate that the distribution of housing within the region has consequences. Sprawl has costs in terms of additional expenditures to build infrastructure and to service it after construction, additional travel in terms of distance and time, and reduced access owing to distance and time.

The implications of alternative distribution scenarios do not stop there though. Additional expenditures that could be avoided imply a loss of discretionary income. Money that could be spent on entertainment, education, or other purposes must be committed to paying a higher price for a house that incorporates the cost of infrastructure paid for by the developer through development charges, water rates, taxes, or other fees required to pay for the associated services. Travelling farther and/or longer consumes energy, which is a further cost and an impact on the environment, and requires time that could be used more productively or for leisure, which in the long-term may also increase productivity. Saving money; enhancing choices and productivity; reducing energy consumption, and with it pollution all, furthermore have benefits in terms of the health and well-being of the community.

These economic, environmental, and health impacts are in many respects the bottom line consequences of distribution decisions. The following sections deal with each separately, although there is overlap in each case and the health impact assessment, to a degree, integrates all three.

9.1 Environmental Impacts

As part of this study, Stantec estimated the potential HRM community greenhouse gas (GHG) emissions and air contaminant emissions in 2031 resulting from each of the four distribution scenarios. It should be noted that the GHG and other air contaminant emissions in the residential, commercial, industrial, and community waste sectors are identical in all four scenarios. Only transportation emissions vary as the distribution of the population in HRM is different in each scenario.

Greenhouse gas emission estimates (presented as tonnes of carbon dioxide equivalents (CO_2e are based on best practice guidance and use the *Inventory Quantification Support Spreadsheet* developed by the International Council for Local Environmental Initiatives (ICLEI).

Emission estimates of nitrogen oxides (NOx), sulphur oxides (SOx), volatile organic compounds (VOCs) and total particulate matter (TPM) in 2031 are calculated for the economic and waste management sectors using data in the National Pollutant Release Inventory (NPRI) published by Environment Canada. The estimation of non-GHG air emissions for the transportation sector was completed using Transport Canada's Urban Transportation Emission Calculator.

Inputs used to estimate emissions include energy use by the residential, commercial, and industrial sectors as well as annual disposed waste and vehicle kilometers travelled for each scenario. Energy use and waste data available from 2009 was used to extrapolate values for 2031 according to the population growth estimates reported in this study. The transportation inputs were based on data from the 2031 projections reported above in **Table 3.3**.

Table 9.1 presents GHG and other contaminant emission estimates by sector (excluding transportation). Environmental benefits will be in the form of reduced CO_2 emissions, which are greenhouse gases regarded as being a critical cause of global climate change, and other air pollutants. Air pollutants include nitrogen oxide and nitrogen dioxide, which are collectively known as NO_x; sulphur dioxide or SO_x; volatile organic compounds or VOCs; and total particulate matter or TPM. Total Particulate Matter is airborne particulate matter with an upper size limit of approximately 100 micrometers (µm) in aerodynamic equivalent diameter.

Table 9.1 GHG and Pollutant Emissions (tonnes) Residential, Commercial, Industrial, and Community Waste Sectors, HRM, 2031 Scenarios

Sector	GHGs	SO_x	NO_x	VOCs	TPM
Residential	2,173,431	20,847	4,249	4,424	3,405
Commercial	2,428,869	18,461	3,420	27	455
Industrial	1,729,512	18,630	4,923	2,972	6,933
Community Waste	126,000	0	0	202	30
TOTALS	**6,457,812**	**57,938**	**12,593**	**7,625**	**10,823**

The number of residential units added is the same in each scenario assessed and variations in unit type are very modest (slightly more apartment units were assumed in Scenarios A and B in order to accommodate the required number of units within the Regional Centre), although their distribution obviously varies considerably. Comparable data is not available on use of natural gas as a residential energy source relative to typical alternatives, so the consulting team was unable to develop an estimate of the potential benefit of improved access to natural gas in more concentrated scenarios, although there would definitely be a benefit.

This limited influence of residential distribution on energy use applies even more strongly to the non-residential sectors considered. Labour force numbers are constant for all four scenarios and the distribution of employment is very similar with variations largely in relation to the portion of the commercial sector that serves local residential markets. There is also no basis for assuming that residential distribution will significantly alter community waste generation rates. Differences are therefore concentrated in the transportation sector where previous analyses indicate that the variations in residential distribution will result in significant differences in distances travelled and hours of vehicle operation.

Table 9.2 reports GHG and air contaminant emissions estimates for the transportation sector only. Transportation is a minor component of overall generation but variations in GHG and other air emissions output from transportation are consistent with preceding analyses, suggesting that emissions generation will decline with increasing degrees of concentration and could be reduced by roughly 7 percentage points between continuation of the established development trend and the greatest degree of concentration considered under Scenario B.

Table 9.2 Greenhouse Gas Emissions (tonnes), Transportation Sector, HRM, 2031 Scenarios

Pollutant	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
GHGs (t CO_2e)	1,115,540	1,150,292	1,091,213	1,070,362
Sulfur Oxides (SOx)	426.45	439.74	417.15	409.18
Nitrogen Oxides (NOx)	13.47	13.89	13.17	12.92
Volatile Organic Compounds (VOCs)	566.21	583.85	553.86	543.28
Total Particulate Matter (TPM)	54.55	56.25	53.36	52.34
%Trend (all emissions)	*97.0%*	*100.0%*	*94.9%*	*93.1%*

9.2 Economic Impacts

To further explore previous modelling results, including estimates of capital costs for some aspects of development (*e.g.*, roads, water, and wastewater), Gardner Pinfold Consultants assessed the full scope of their implications, particularly with respect to operations and maintenance costs associated with added infrastructure, increased service delivery costs, and key additional expenses borne by residents.

It must be recognized that the costs are focused on the new residential developments, and do not include spillover effects to existing residential homes even though these may be affected in some of the same ways (*e.g.,* traffic congestion). Similarly, effects to workplaces are beyond this analysis, although they would be equally affected by traffic patterns that influence work-related travel and other expenses. Overall, therefore, the costing presented is considered conservative but clearly indicative of the direction of impacts expected with each scenario.

Municipal revenues through property assessments are examined to appreciate the implications of each scenario for the ability of HRM to cover new costs as they arise. Finally, some concluding remarks tie-in other important scenario differences that are difficult to quantify despite their prominence in planning dialogues.

9.2.1 Costs

The cumulative totals for all cost items from 2009 to 2031 are shown by scenario for each cost item in the first four columns of **Table 9.3**. The last four columns show the differences between costs for the RMPS relative to all other scenarios. The differences are of greatest interest, and the grand totals for costs under each scenario are found at the bottom of the table.

To produce the table results, year by year costs for each scenario were worked out based on the annual projected population and dwelling growth from 2009 to 2031 (see **Table 3.3**, above). Capital expenditures for such items as roads, and water and wastewater were allocated each year, and the associated activity costs for transportation and service delivery were assumed to begin in the same year for each infrastructure type. Operations and maintenance costs related to capital infrastructure (*e.g.*, maintenance of water and wastewater networks) are set to begin in the year after installation since the first year should be largely free of such costs. In a few cases "costs" are shown as negative values (*e.g.*, active transportation replaces vehicle use, and conversion to natural gas replaces home heating oil).

Unless otherwise noted, cost estimates are drawn from HRM staff and reports, or are based on Stantec and Gardner Pinfold research of Halifax-based costs. All values are represented in 2011 dollars using Halifax consumer price indices from Statistics Canada to convert from historical to current values. To aid with the interpretation of results, none of the projected costs were adjusted for inflation, nor are they discounted as is often done in benefit-cost analysis.

The top three cost categories that drive the differences between scenarios are transportation (*e.g.*, travel time, travel costs, road construction and capital), water and wastewater capital and operation, and, finally, health and environment (*e.g.*, GHG emissions, traffic accidents, and other transport-related environmental costs). For the Municipality, the three main cost drivers are local and regional road capital, water and wastewater capital, and combined services for solid waste, police, and fire protection.

Achieving the RMPS Goals rather than continuing on the Post RMPS Trend yields savings across nearly all cost categories. The total savings with RMPS Goals to 2031 are about $669 million. Scenarios A and B represent potential savings of $1.7 billion and $3.1 billion, respectively, compared to the Post RMPS Trend.

These differences to 2031 shared across the new dwelling units would represent an $8,845 cost savings ($385/year) for the RMPS Goals, a $22,841 savings ($993/year) for Scenario A, and a $31,645 savings ($1,376/year) for Scenario B.

Table 9.3 Summary of Scenario Costs ($000s), HRM, 2009-2031

Service	Cumulative Costs to 2031				Differences from Post RMPS Trend			
	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Water, Wastewater, and Stormwater								
- Municipal System Capital	$1,602,853	$1,549,469	$1,382,235	$1,058,255	$53,384	$0	-$167,234	-$491,214
- Municipal System O&M	$124,708	$120,554	$107,543	$82,336	$4,153	$0	-$13,011	-$38,218
- Private Water and Septic O&M	$57,733	$80,025	$47,215	$47,215	-$22,292	$0	-$32,809	-$32,809
Transportation Services								
- Local Road Capital	$1,698,837	$1,736,524	$1,382,557	$1,079,829	-$37,687	$0	-$353,967	-$656,695
- Local Road O&M	$514,672	$531,886	$418,681	$334,556	-$17,214	$0	-$113,204	-$197,330
- Regional Road Capital	$211,680	$239,940	$198,360	$172,320	-$28,260	$0	-$41,580	-$67,620
- Regional Road O&M	$45,651	$54,813	$41,333	$32,872	-$9,161	$0	-$13,479	-$21,941
- Additional Peak Trip Time	$1,809,114	$2,259,602	$1,500,300	$1,090,934	-$450,488	$0	-$759,303	-$1,168,668
- Additional Peak Trip Distance	$971,176	$1,196,728	$932,052	$757,904	-$225,552	$0	-$264,676	-$438,823
- Additional Transit Use	$29,324	$22,259	$55,934	$54,926	$7,064	$0	$33,675	$32,667
- Active Transportation	-$19,765	-$18,469	-$21,170	-$21,840	-$1,297	$0	-$2,702	-$3,371
Solid Waste Management								
- Added Solid Waste O&M	$184,704	$185,429	$183,495	$183,014	-$724	$0	-$1,934	-$2,415
- Recycling Depots Travel Distance	$42,625	$43,390	$38,893	$37,732	-$765	$0	-$4,497	-$5,658
Fire and Emergency								
- Added Service	$232,510	$239,899	$220,194	$214,981	-$7,389	$0	-$19,705	-$24,918
Police								
- Added Service	$249,169	$256,819	$236,418	$231,785	-$7,650	$0	-$20,401	-$25,034
Community Facilities and Parks								
- Added Users Travel Time	$11,359	$12,231	$10,893	$10,506	-$873	$0	-$1,338	-$1,726
- Added Users Travel Distance	$3,748	$4,036	$3,595	$3,467	-$288	$0	-$442	-$570
- Parkland Supply	$309,400	$199,900	$523,700	$715,900	$109,500	$0	$323,800	$516,000

Cont. …

Table 9.3 Summary of Scenario Costs ($000s), HRM, 2009-2031 (cont.)

Service	Cumulative Costs to 2031				Differences from RMPS			
	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Libraries								
- Added Users Travel Time	$29,616	$32,089	$25,976	$24,597	-$2,473	$0	-$6,113	-$7,492
- Added Users Travel Distance	$9,773	$10,590	$8,572	$8,117	-$816	$0	-$2,017	-$2,472
Schools								
- User Travel Distance	$262,365	$275,654	$231,179	$223,785	-$13,289	$0	-$44,475	-$51,869
Health and Environment								
- Added User Distance	$249,194	$307,068	$239,155	$194,470	-$57,874	$0	-$67,913	-$112,598
- GHG Emissions	$2,655,633	$2,738,363	$2,597,721	$2,548,083	-$82,730	$0	-$140,642	-$190,280
- Other Health & Environment	$135,924	$167,492	$130,448	$106,075	-$31,568	$0	-$37,043	-$61,417
Private Utilities								
- Electric/Communication Capital	$21,275	$23,451	$16,533	$15,412	-$2,176	$0	-$6,918	-$8,039
- Electric/Communication O&M	$13,068	$14,405	$10,155	$9,467	-$1,337	$0	-$4,249	-$4,938
- Natural Gas Capital	$14,831	$10,231	$14,972	$17,182	$4,600	$0	$4,741	$6,952
- Natural Gas O&M	$3,037	$2,095	$3,065	$3,518	$942	$0	$971	$1,423
- Natural Gas vs. Alternatives	-$15,254	-$13,971	-$17,570	-$19,347	-$1,283	$0	-$3,599	-$5,376
Residential Construction								
- Singles and Semis	$14,992,187	$14,912,586	$14,270,092	$13,593,575	$79,601	$0	-$642,495	-$1,319,011
- Multiple unit	$3,953,867	$3,879,691	$4,552,707	$5,197,157	$74,176	$0	$673,016	$1,317,466
TOTAL COSTS	**$30,405,014**	**$31,074,778**	**$29,345,232**	**$28,008,785**	**-$669,764**	**$0**	**-$1,729,546**	**-$3,065,993**

9.2.2 Revenues

Residential construction cost estimates in the last rows of **Table 9.3** are based on the average value of assessments for new dwellings over the last five years, distinguished by type (singles and semis *v.* multiple unit) and by area of HRM (Regional Centre, and Suburban and Rural Areas). Since assessment values trail market values, the estimates are somewhat understated for costs of construction but are accurate for determining HRM property-based tax revenues. The average assessed values are applied to the projected development by type and area of HRM. Finally, 2012-13 approved general tax rates were applied to the appropriate assessment bases. This does not include a variety of area rates and therefore understates revenues somewhat.

Similar to the cost estimates, revenues to HRM were worked out annually based on the development expected to occur each year. The cumulative totals for all

revenues from 2009 to 2031 are shown by scenario for dwelling types in **Table 9.4,** with differences between the costs expected if the ongoing trend continues and all other scenarios shown beneath each type.

Relative to the Trend since the adoption of the RMPS, adherence to RMPS Goals would yield $14 million more property tax revenue over the 2009 to 2031 period ($0.6 million/year), while Scenario A will produce $113 million less revenue (-$5 million/year), and Scenario B will yield $203 million less (-$9 million/year). The lower revenues found for Scenarios A and B are attributable to the greater number of apartment units associated with those scenarios. Apartment dwelling units normally have lower assessed values associated than single and semi units.

Table 9.4 Summary of Municipal Revenues ($000s) by Scenario, HRM, 2009-2031

Dwelling Unit Type	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Singles and Semis	$1,088,552	$1,079,812	$865,955	$714,617
Difference from trend	$8,741	$0	-$213,856	-$365,195
Apartments and Other	$292,795	$287,253	$388,015	$449,175
Difference from trend	*$5,542*	*$0*	*$100,761*	*$161,922*
TOTAL REVENUES	**$1,381,347**	**$1,367,065**	**$1,253,970**	**$1,163,791**
Difference from trend	*$14,282*	*$0*	*-$113,095*	*-$203,274*

The larger driving factor is still the costs, even considering just the Municipality's perspective. As can be seen from **Table 9.5,** overall municipal costs estimated to deal with new development substantially exceeded expected revenues by a factor of at least two under all four scenarios. These costs produce net losses (municipal revenues minus costs), ranging from just over a billion dollars for Scenario A to nearly $2 billion for the Trend Scenario. New residential developments, in other words, do not pay their way and are subsidized by the existing tax base and by new commercial development that they complement and support.

The net savings for each scenario relative to the trend over the 2009 to 2031 period is $66 million for the RMPS Scenario, $337 million for Scenario A, and $715 million for Scenario B.

Table 9.5 Summary of Net Municipal Impacts ($000s) by Scenario, HRM, 2009-2031

Category	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B
Costs	$3,243,263	$3,294,595	$2,844,354	$2,375,832
Revenues	$1,381,347	$1,367,065	$1,253,970	$1,163,791
Revenues - Costs	-$1,861,916	-$1,927,530	-$1,590,384	-$1,212,041
Difference from trend	*$65,614*	*$0*	*$337,146*	*$715,489*

9.3 Health Impact Assessment

Table 9.6 summarizes the health impacts associated with each scenario with reference to questions posed in **Table 1.1**, above. Assessments are qualitative, based on the discussions closing **Chapters 3, 4, 5, 6,** and **7**. More concentrated scenarios are most highly rated (indicated by **+** as opposed to **-** signs) for six of the nine questions echoing the propositions put forward by the Canadian Institute of Planners (see **Section 1.4**).

Benefits from concentration of development include decreased time required for commuting and to access community facilities and services; and less vehicle operation and related fuel consumption. Shorter travel distances and times also enhance the feasibility of employing active modes and transit to complete these trips, increasing the amount of purposeful walking and cycling, and the health benefits that accrue from both. Both the reduction of the length of automobile trips taken and the displacement of automobile trips by transit and active modes, furthermore, reduces air pollution and diminishes its detrimental impacts on health.

The ability to reach developed areas from existing facilities should also enhance public security, particularly with respect to fire protection and health care, facilities for which are more numerous and closer together in the Regional Centre. The influence of residential development on police protection and crime is more difficult to establish. Crime is certainly more prevalent in more densely developed areas of the region but seems to be more strongly associated with the presence of non-residential than residential development in those locations. Arguably, increasing the residential component of development in these areas will assist to control crime; however, evidence to prove such an outcome is not readily available.

Police protection is one of several areas in which the influence of residential development is difficult to define. With reference to **Table 9.6**, we have concluded that we cannot comfortably declare concentration of development to necessarily be superior to the alternatives with respect to environmental conservation, housing affordability, and social interaction. In each case, clear benefits from intensification are qualified by valid counterarguments. In the case of environmental conservation and management, for example, concentration of population in the Regional Centre should definitely reduce the footprint of urban development. One benefit of intensification that we have been able to quantify is the area of roads that will be required under each of the four scenarios.

Our calculations presented in **Table 4.7**, above, suggest that the area of new roads and sidewalks will be close to 40 per cent less under Scenario B than if current trends continue. The avoidance of more than 50 hectares of concrete and pavement is a certain benefit of concentration of development. The substitution of apartment structures for single-detached homes should augment this, although there are many variables traded off in the construction of each type. The counterpoint is that less dense development allows more natural absorption of runoff, particularly in rural areas where it is not necessary to channel most stormwater to specific outfalls.

A similar balancing of views prevails for housing. Certainly, increased focus on rowhousing and apartment development in Scenarios A and B shifts emphasis to housing that is cheaper to produce. On the other hand, the increased reliance on multiple-unit housing is not a condition of either of the most concentrated scenarios but more of an essential compromise to deal with the limited availability of land in those cases. As we have discussed, furthermore, land costs are significantly higher in the Regional Centre relative to the Suburban and Rural Areas and will have an unavoidable impact on the cost of housing. The mitigating benefit of reduced transportation costs is important but has been covered in this framework by Time Availability and access to Alternative Transportation modes.

Social interaction is even more nebulous. While concentration of population in the Regional Centre offers many benefits to its residents in terms of contact with larger numbers, access to cultural facilities, and ability to participate more fully in regional governance, suburban and rural communities offer similar benefits through different avenues. The smaller scale of communities in the Rural Area, for example, allows residents to know each other more comprehensively than is likely in an urban setting. Rural residents are also necessarily more engaged in the delivery of services in their community as distance from the centre of municipal administration and the scale of services required, requires their involvement in the delivery of services such as fire protection and recreation. Suburban residents can probably be regarded as falling between these two extremes, with better access to the facilities and services of the Regional Centre and to sub-centres within the Suburban Area that emulate the features of the downtowns and commercial and cultural areas on the Halifax Peninsula and the traditional centre of Dartmouth, as well as engagement in local service delivery. In the Suburban Area the frequent bridge to social interaction is children who predominate in subdivisions primarily composed of single-detached homes.

We are, however, convinced that intensification in the Regional Centre can have significant benefits for social equity. Most significantly enhancement of alternative transportation modes is a critical benefit to disadvantaged citizens who lack the income or are otherwise limited in their ability to make use of a private automobile.

Table 9.6 Health Impacts by Scenario

Factor	Question	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B	Assessment
Time Availability	Does the scenario increase or decrease the discretionary time available to citizens for productive activity, recreation/leisure, or social interaction?	+	-	++	+++	All alternatives to the existing trend will increase time availability. The leading cause of increased time is reduced commuting time for vehicle users, although time should also be saved through reduced travel to community facilities.
Alternative Transportation Modes	Does the scenario promote the use of transit, and/or active transportation modes?	+	-	++	++	Transit use is expected to be maximized in Scenario A but active transportation will be maximized in Scenario B.
Physical Activity	Does the scenario encourage or discourage physical exercise either by promoting the provision and use of alternative transportation modes or by enhancing access to facilities specifically provided for exercise (*i.e.*, parks and open spaces, arenas, gymnasia, *etc.*)?	+	-	++/-	++/-	Use of transit and active modes together increase physical activity and both are best supported by Scenarios A and B. Indoor community facilities should also be significantly more accessible in Scenarios A and B; however, the availability of adequate parks and open spaces in the Regional Centre is a definite concern.
GHG/Pollutant Emissions	Does the scenario increase or decrease the output of GHGs and/or other pollutant emissions?	+	-	++	+++	Calculations of GHG and other emissions demonstrate that emissions will be lowest in Scenario B, followed in order by Scenario A, the RMPS Goals Scenario, and the Post-RMPS Trend.
Environmental Conservation/ Management	Does the scenario increase or decrease the area of land left in its natural state by virtue of the extent of construction involved? *and/or* Does the form of development potentially increase or decrease impacts on the quality of land and water?	+/-	+/-	+/-	+/-	More concentrated scenarios should reduce the footprint of urban development, although it is difficult to establish the overall extent. Reduced coverage associated with multiple-unit as opposed to lower density single-detached development should also reduce total run-off. More concentrated scenarios, on the other hand, will focus run-off in a confined area within which stormwater and wastewater management can be expected to be more challenging.

Cont. …

Table 9.6 Health Impacts by Scenario (cont.)

Factor	Question	RMPS Goals	Post RMPS Trend	Scenario A	Scenario B	Assessment
Public Safety	Does the scenario enhance or diminish public safety in fact or perception?	+	-	++	+++	The potential for serious traffic accidents is minimized in urban areas particularly when transit is used, thereby favouring Scenarios A and B. Inadequate pedestrian and bicycle facilities in these areas may however increase the risk associated with active modes. The distances between new residents and existing police, fire, and health facilities is also minimized in Scenarios A and B.
Housing Affordability	Does the scenario facilitate or hinder the provision of housing types that are more affordable and/or reduce the costs associated with ownership and operation of housing accommodation?	+/-	+/-	+/-	+/-	Scenarios A and B imply greater reliance on multiple-unit housing types, which are typically less expensive to supply. At the same time, however, the more concentrated scenarios require construction on more expensive land in the Regional Centre (acknowledging that these costs are often offset by higher transportation costs for outlying residents). Emphasis on multiple-unit housing also reduces the potential for equity building through owner construction and improvement.
Social Equity	Does the scenario promote social equity by enhancing the access of disadvantaged groups (*e.g.*, the poor, youth, the elderly, physically and mentally challenged) to needed services or by reducing the costs of such access?	+	-	++	++	More concentrated scenarios should enhance the availability of transit and/or lower its cost, which is a critical benefit to disadvantaged groups with limited access to private vehicles as well as other groups with health or other limitations that restrict their ability to operate personal vehicles. Reduced distances to employment and shopping opportunities, schools, and other community facilities also benefit these groups relative to society as a whole.
Social Interaction	Does the scenario promote or inhibit interaction among citizens?	+/-	+/-	+/-	+/-	Proximity to schools and other community facilities in the more concentrated scenarios should promote social interaction and cohesion; however, volunteerism and community focus provide similar benefits in outlying communities.

9.3.1 Health Impact Mitigation

Scenarios have been assessed against existing trends in HRM. In general, more concentrated scenarios are expected to require less adaptation of existing infrastructure than continuation of the current tendency to urban sprawl. Analysis further suggests that less adaptation will be required the greater the degree to residential development can be concentrated.

Achievement of the goals in the present RMPS or of the higher levels of intensification suggested by Scenario A or B will require measures to mitigate the effects of concentration. The most critical is likely to be the provision of affordable housing within a more limited geographic area. Several initiatives can assist to lower the cost of higher density housing. Facilitating the approval of multiple unit structures in the Regional Centre is certainly one available approach and is probably essential to the feasibility of any intensification strategy. HRM can also require that a suitable proportion of units in multiple unit buildings meet affordability criteria. Also, where good transit service is available, minimum parking requirements can be reduced to lower construction costs and landlords can be encouraged to “de-couple” parking from rents. “De-coupling” enables residents who do not need as much, or any parking, to pay less than those who do.

A critical benefit of intensification should be the facilitation of alternative modes of transportation. Exploitation of the potential bestowed by concentration of residential development will however require appropriate facilities to ensure the safety of users. HRM is implementing a transit plan, and is pursuing programs to develop trails and bicycle routes that are well underway. Further enhancements in all three areas will probably be required to complement residential intensification.

As noted above, also, parks in the Regional Centre will be placed under stress by increased population. Trails systems within the Regional Centre can play a dual role by addressing a portion of the need for outdoor recreational space as well as supporting active transportation goals. In the relatively few situations in the Regional Centre where subdivision of land is involved, open space can also be provided through ongoing dedication of land in conjunction with development as well as through retention of institutional lands for public purposes. It may however be difficult to supply park areas within the Regional Centre at rates commensurate with traditional standards. Adaptation may require more intensive use of existing parklands and/or substitution of indoor recreation facilities, which are well supplied in the Regional Centre not only by the Municipality but also through universities, non-profit organizations, and private providers.

Water supply and wastewater disposal through municipal systems, while generally having a positive influence on public health are not without their issues. Water supplies on which thousands rely must be properly protected. Again, HRM has adopted suitable measures to do so but they must be maintained without compromise. Similarly, while the implementation of comprehensive wastewater treatment by the Municipality is a major step to addressing a critical consequence of sewage collection and disposal, further upgrading of treatment to secondary and tertiary levels will be desirable as increased intensification is achieved not only because of the increased volumes of wastewater generated but because of the increased exposure of the population to the receiving water bodies. These enhancements, in any case, are being mandated by rising standards recommended by the Canadian Council of Ministers of the Environment.

Intensification also has its limits. Less than half of the current residential population of HRM is located in the Regional Centre. Even achievement of Scenario B, in which 50 per cent of new development is assumed to go to the Regional Centre, will not place the majority of residents in the urban core. It will consequently continue to be essential for HRM with the assistance of senior governments, to support the development of the Suburban and Rural Areas with consideration of their sustainability. Measures such as telecommuting, commuter and community transit, improved onsite well and septic system management, open space subdivisions, and the development of accessible community sub-centres for local commercial uses are just a few of myriad initiatives that can reduce energy consumption, enhance environmental protection, and enhance the quality of life in these areas of HRM..

APPENDIX A BENCHMARK INDICATORS

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
Population in 2011	390,328	196,966	127,761	765,706	474,786	210,556	344,615	2,510,718
Population in 2006	372,858	181,113	122,389	715,515	457,720	194,971	330,088	2,374,654
Population in 2001	359,183	172,918	122,678	686,569	435,600	192,800	311,902	2,281,650
2001 to 2011 population change (%)	8.7%	13.9%	4.1%	11.5%	9.0%	9.2%	10.5%	10.0%
2006 to 2011 population change (%)	4.7%	8.8%	4.4%	7.0%	3.7%	8.0%	4.4%	5.7%
2001 to 2006 population change (%)	3.8%	4.7%	-0.2%	4.2%	5.1%	1.1%	5.8%	4.1%
Total private dwellings	166,757	75,860	53,583	332,306	198,144	84,998	155,224	1,066,872
Private dwellings occupied by usual residents	155,138	70,663	49,107	316,533	184,946	80,323	145,388	1,002,098
Population density/km^2 (2011)	71.0	244.8	38.0	233.7	178.1	61.8	495.6	127.4
Land area (km^2)	5,496	805	3,360	3,277	2,665	3,408	695	19,705
Age characteristics								
Total population (2006)	372,855	181,115	122,390	715,515	457,720	194,970	330,090	2,374,655
0 to 4 years	4.9%	5.1%	5.1%	4.6%	5.3%	5.5%	4.2%	4.9%
5 to 9 years	5.3%	5.3%	5.6%	4.8%	5.7%	5.8%	4.5%	5.2%
10 to 14 years	6.0%	5.7%	6.7%	5.8%	6.7%	6.6%	5.3%	6.0%
15 to 19 years	6.5%	6.7%	6.9%	5.8%	7.0%	7.5%	6.0%	6.4%
20 to 24 years	7.5%	7.8%	6.2%	6.8%	7.4%	8.1%	6.9%	7.2%
25 to 29 years	7.0%	7.2%	5.8%	7.3%	6.6%	7.2%	6.1%	6.8%
30 to 34 years	6.9%	7.1%	6.3%	6.2%	6.3%	6.3%	5.8%	6.4%
35 to 39 years	7.4%	7.5%	6.6%	6.3%	6.8%	6.3%	6.5%	6.7%
40 to 44 years	8.8%	8.4%	8.3%	7.9%	8.1%	7.9%	7.5%	8.1%
45 to 49 years	8.5%	8.2%	8.4%	8.5%	8.0%	8.1%	8.1%	8.3%
50 to 54 years	7.6%	7.7%	7.9%	8.2%	7.1%	7.4%	8.1%	7.7%
55 to 59 years	6.7%	6.7%	7.0%	7.5%	6.3%	6.0%	7.6%	7.0%
60 to 64 years	4.9%	5.1%	5.3%	6.0%	4.8%	4.2%	5.5%	5.3%
65 to 69 years	3.5%	3.5%	3.9%	4.2%	3.7%	3.4%	4.1%	3.9%
70 to 74 years	3.0%	2.7%	3.2%	3.5%	3.2%	3.0%	3.8%	3.3%
75 to 79 years	2.3%	2.2%	2.7%	2.9%	2.8%	2.7%	3.6%	2.8%
80 to 84 years	1.7%	1.6%	2.1%	2.1%	2.3%	2.1%	3.3%	2.2%
85 years and over	1.5%	1.4%	2.0%	1.7%	1.7%	1.9%	3.1%	1.9%
Median age of the population	39.0	38.4	40.5	41.7	38.6	37.5	43.1	
% of the population aged 15 and over	83.9%	83.8%	82.6%	84.9%	82.3%	82.1%	85.9%	83.9%
Occupied private dwelling characteristics								
Total private dwellings occupied by usual residents	155,125	70,660	49,120	316,650	184,950	80,320	145,430	1,002,255
Single-detached houses - as a % of total occupied private	51.6%	54.3%	60.3%	41.4%	55.5%	68.6%	42.5%	49.8%

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
dwellings								
Semi-detached houses - as a % of total occupied private dwellings	6.9%	5.7%	2.2%	5.1%	4.1%	2.5%	3.8%	4.7%
Row houses - as a % of total occupied private dwellings	3.5%	8.7%	3.9%	2.2%	10.5%	4.5%	6.0%	5.2%
Apartments, duplex - as a % of total occupied private dwellings 14	4.0%	21.4%	7.3%	6.4%	2.9%	1.3%	13.5%	7.1%
Apartments in buildings with fewer than five storeys - as a % of total occupied private dwellings 14	22.1%	8.3%	19.6%	37.6%	10.8%	17.5%	27.6%	24.2%
Apartments in buildings with five or more storeys - as a % of total occupied private dwellings	9.6%	0.8%	3.5%	5.9%	15.7%	4.9%	5.2%	7.6%
Other dwellings - as a % of total occupied private dwellings 15	2.4%	0.8%	3.3%	1.3%	0.5%	0.6%	1.3%	1.3%
% of owned dwellings	64.0%	71.5%	70.0%	58.6%	65.9%	70.1%	64.7%	64.1%
% of rented dwellings	36.0%	28.5%	30.0%	41.4%	34.0%	29.9%	35.2%	35.9%
% of dwellings constructed before 1986	65.4%	64.2%	77.7%	69.6%	72.0%	80.6%	72.9%	70.8%
% of dwellings constructed between 1986 and 2006	34.6%	35.8%	22.3%	30.4%	28.0%	19.4%	27.1%	29.2%
Dwellings requiring major repair - as a % of total occupied private dwellings	6.8%	5.5%	8.9%	6.2%	6.2%	7.8%	5.9%	6.5%
Average number of rooms per dwelling	6.6%	7.3%	6.8%	5.6%	6.8%	6.6%	6.2%	6.3%
Dwellings with more than one person per room - as a % of total occupied private dwellings	0.5%	0.2%	0.3%	0.5%	0.9%	0.9%	0.7%	0.6%
Average value of owned dwelling ($)	$212,942	$164,374	$139,978	$159,861	$215,743	$157,617	$487,350	$225,072
Mobility status - Place of residence 1 year ago								
Total population 1 year and over								
Lived at the same address 1 year ago	85.0%	86.4%	86.7%	88.0%	85.0%	83.8%	82.8%	
Lived within the same province or territory 1 year ago, but changed addresses within the same census subdivision (municipality)	10.8%	8.0%	8.3%	8.0%	10.1%	11.9%	10.2%	
Lived within the same province or territory 1 year ago, but changed addresses from another census subdivision (municipality) within the same province or territory	1.3%	3.3%	3.1%	3.4%	3.7%	2.3%	4.1%	
Lived in a different province or territory 1 year ago	2.2%	1.8%	1.4%	0.2%	0.4%	1.4%	1.8%	
Lived in a different country 1 year ago	0.7%	0.5%		0.4%	0.8%	0.6%	1.1%	
Mobility status - Place of residence 5 years ago								
Total population 5 years and over	351,015	170,065	114,580	671,200	428,130	181,830	311,060	2,227,880
Lived at the same address 5 years ago	59.1%	62.3%	63.9%	62.1%	56.0%	58.6%	53.1%	59.0%

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
Lived within the same province or territory 5 years ago, but changed addresses within the same census subdivision (municipality)	27.3%	20.7%	21.4%	23.8%	27.4%	27.3%	25.0%	25.1%
Lived within the same province or territory 5 years ago, but changed addresses from another census subdivision (municipality) within the same province or territory	3.8%	9.9%	9.1%	11.9%	11.7%	8.3%	12.2%	10.0%
Lived in a different province or territory 5 years ago	7.5%	5.8%	4.0%	0.8%	1.4%	3.9%	6.4%	3.6%
Lived in a different country 5 years ago	2.3%	1.3%	1.6%	1.4%	3.5%	1.9%	3.4%	2.3%
Place of work status								
Total employed labour force 15 years and over	199,550	88,130	59,030	383,460	235,425	106,425	175,055	1,247,075
Worked at home	6.1%	4.6%	4.7%	5.5%	6.3%	5.1%	9.0%	6.1%
Worked outside Canada	0.5%	0.6%	0.2%	0.2%	0.4%	0.2%	0.5%	0.4%
No fixed workplace address	9.7%	8.5%	9.5%	7.2%	8.7%	8.5%	11.4%	8.8%
Worked at usual place	83.7%	86.3%	85.6%	87.1%	84.5%	86.1%	79.1%	84.7%
Worked in census subdivision (municipality) of residence	81.5%	48.9%	49.8%	62.4%	64.7%	75.4%	26.3%	60.4%
Worked in a different census subdivision (municipality) within the census division (county) of residence	0.0%	35.8%	8.0%	5.5%	9.5%	8.9%	51.1%	14.3%
Worked in a different census division (county)	1.3%	0.5%	27.2%	19.0%	10.1%	1.1%	1.2%	9.5%
Worked in a different province	0.9%	1.2%	0.6%	0.2%	0.2%	0.7%	0.5%	0.5%
Transportation Indicators								
Population in Region	372,858	181,113	122,389	715,515	457,720	194,971	330,088	2,374,654.0
Population in Existing Urban Area (EUA)	279,965	153,085	88,352	643,833	341,987	179,246	303,488	1,989,956.0
Population in CBD	4,500	5,644	1,901	22,525	4,849	635	7,001	47,055.0
Employment in EUA	169,910	79,935	47,375	343,185	165,780	94,470	152,040	1,052,695.0
Employment in CBD	29,360	9,785	7,975	52,425	24,545	15,760	30,040	169,890.0
EUA Land Area (km2)	326	234	238	761	207	119	284	2,169.0
CBD Land Area (km2)	1.1	1.6	0.8	4.5	1.9	0.5	1.9	12.3
Land Use Characteristics								
Population Density in EUA (pop/km^2)	858.8	654.2	371.2	846.0	1,652.1	1,506.3	1,068.6	917.5
Urban Denstiy in EUA ([pop+emp] /km^2)	1,380.0	995.8	570.3	1,297.0	2,453.0	2,300.1	1,604.0	1,402.8
Employment Density CBD (emp/km^2)	25,754.4	6,003.1	9,608.4	11,780.9	12,850.8	30,902.0	16,150.5	13,812.2
Population Density in CBD (pop/km^2)	3,947.4	3,462.6	2,290.4	5,061.8	2,538.7	1,245.1	3,764.0	3,825.6
Employment to Population Ratio – EUA	0.61	0.52	0.54	0.53	0.48	0.53	0.50	0.53
Employment to Population Ratio - Central Area	1.37	0.96	1.73	1.35	1.98	5.08	1.84	
Employment to Population Ratio - CBD	6.52	1.73	4.20	2.33	5.06	24.82	4.29	3.61

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
Transportation Supply								
Arterial+Collector Lane-km per 1,000 capita - EUA	3.73	3.10	-	2.20	5.35	3.62	3.12	3.51
Expwy Lane-km per 1,000 capita - EUA	2.09	-	-	1.12	0.17	1.17	0.57	0.92
HOV Lane-km per 1,000 capita – EUA	0.00	-	-	0.072	-	-	-	-
On-Street Bike Route-km per 1,000 capita - EUA	0.350	-	-	0.354	0.015	0.05	0.306	-
On-Street Bike Route-km per Road Lane-km - EUA	-	-	-	0.041	0.007	0.004	0.053	-
On-Street Bike Route-km (excl. signed) per Road Lane-km – EUA	-	-	-	0.033	0.001	0.004	0.027	-
Off-Street Bike Route-km per Land Area - EUA	-	-	-	-	0.169	0.218	0.165	-
Light-Duty Vehicles per Capita – EUA	0.49	0.53	0.62	0.6	0.66	0.69	0.65	0.61
AM Peak Period Transit Seat-km per Capita - EUA	-	0.33	-	-	-	-	-	-
24-h Transit Seat-km per Capita - EUA	-	2.56	-	-	4.11	-	5.44	-
Parking Spaces per CBD Employee	0.18	0.1	-	-	-	0.09	0.11	-
Transportation Demand								
Mode of Journey to Work (2006 Census of Canada)								
Car, truck or van as driver	65.1%	74.4%	75.1%	74.9%	75.5%	79.6%	64.9%	72.5%
Car, truck or van as passenger	10.6%	13.8%	11.2%	5.4%	9.1%	8.1%	6.8%	8.2%
Total - Sustainable transportation	23.0%	9.7%	12.0%	19.0%	14.4%	11.4%	26.3%	18.1%
Public transit	11.9%	2.9%	4.4%	10.2%	6.7%	4.2%	10.2%	8.5%
Walked	10.1%	6.6%	7.3%	7.3%	6.1%	5.8%	10.4%	7.8%
Bicycle	1.0%	0.3%	0.3%	1.4%	1.6%	1.4%	5.6%	1.8%
Other	1.3%	2.1%	1.7%	0.7%	0.9%	0.9%	2.0%	1.2%
AM Peak Period Mode Shares to CBD:								
Transit Modes	-	-	-	27%	-	-	25%	-
Auto (Driver+Passenger)	-	-	-	59%	-	-	58%	-
Non-Motorized	-	-	8%	12%	-	-	16%	-
AM Peak Period Mode Shares to/from/within EUA:								
Transit Modes	-	-	-	19%	9%	-	10%	-
Auto (Driver+Passenger)	-	-	-	69%	78%	-	72%	-
Non-Motorized	-	-	9%	11%	9%	-	17%	-
24-hr Mode Shares to/from/w within EUA:								
Transit Modes	-	-	-	12%	7%	-	7%	-
Auto (Driver+Passenger)	-	-	-	74%	83%	-	78%	-
Non-Motorized	-	-	5%	13%	7%	-	14%	-
Auto Occupancies								
AM Peak Period Trips to CBD	-	-	-	1.27	-	-	1.23	-

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
AM Peak Period Trips to/from/within EUA	-	-	-	1.22	1.12	-	1.39	-
24-hr Trips to/from/within EUA	-	-	-	1.25	1.13	-	1.32	-
Daily Trips per capita – EUA	-	-	-	2.79	1.84	-	3.83	-
Annual Transit Trips per capita – EUA	64.77	20.64	27.58	70.83	54.71	36.76	75.00	58.99
Average-Day Vehicle-km per capita - EUA	-	-	-	-	-	-	23.62	-
Transportation System Performance								
Median Home-Work Trip Distance (km) - CMA	6.5	5.5	6.9	6.9	5.6	4.6	4.6	-
Annual Injuries and Fatalities per 1,000 capita - EUA	-	5.3	-	5.7	-	7.7	-	-
Annual Fuel Usage per capita - EUA (L/capita)	1,234	1,001	1,357	1,019	1,343	949	702	1,064
Daily Fuel Usage per Person-Trip - EUA (L)	-	-	-	1.0	2.0	-	0.5	-
Transportation Costs and Finance								-
Total Road Expenditures per capita	-	-	-	$330	-	-	-	-
Total Transit Expenditures per capita	$220	$92	$98	$164	$156	$146	$269	$175
Transit Farebox Revenue/Operating and Maintenance Budget	55%	43%	51%	41%	58%	22%	42%	
FTE staff dedicated to bike/pedestrian projects per 1-million capita	-	-	-	-	4.4	-	-	-
Average duration of round trip between home and workplace for workers living 1 km or more from their workplace, Cdn Social Survey 2005	65	47	-	57	55	48	59	-
Commuting Distance								
Less than 5 km	40.7%	45.8%	40.2%	36.9%	44.9%	55.4%	52.8%	43.5%
5 to 9.9 km	25.7%	26.9%	19.4%	30.6%	29.1%	33.2%	24.6%	28.2%
10 to 14.9 km	12.4%	14.8%	11.5%	17.6%	8.8%	3.7%	9.9%	12.4%
15 to 24.9 km	14.2%	7.8%	18.4%	9.3%	7.9%	2.9%	8.0%	9.4%
25 km or more	7.0%	4.6%	10.4%	5.6%	9.3%	4.8%	4.8%	6.5%
Water and Wastewater Indicators								
Jurisdictional population. In some cases jurisdictions have been merged into regions for survey administration purposes; in that case it is the combined population of the jurisdictions forming the region. population estimates used for each Jurisdictions based on Statistics Canada population estimates for census subdivisions on July 1, 2009.	397,866	261,611	124,972	739,946	433,079	208,429	362,365	2,528,268
Jurisdictional population for the 2006 survey cycle	372,679	179,819	120,895	711,009	405,952	193,195	19,225	2,002,774
Jurisdictional population for the 2004 survey cycle	379,711	179,369	124,869	707,752	410,284	196,670	18,633	2,017,288

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
Number of distinct water distribution systems in the jurisdiction, as determined by 1) physical separation, 2) water pricing variations (ex. volumetric versus flat), and 3) jurisdictional (municipal-level) boundaries.	8	4	8	14	3	3	1	41
Number of water treatment facilities in the jurisdiction	8	4	7	17	2	6	-	44
Number of sewer systems in the jurisdiction	14	7	10	23	3	3	7	67
% municipal population that is served by a water system.	82.0%	94.2%	63.0%	96.2%	99.8%	98.1%	-	92.4%
% municipal population that obtains water from private (household) wells.	17.0%	5.8%	37.0%	3.8%	0.2%	1.9%	-	7.4%
% municipal population that is served trucked water.	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-	0.2%
Responding population for the question on population served water services. This is the total population of the municipalities that submitted data on population served water services.	397,866	248,752	108,616	723,960	419,659	198,400	-	2,097,253
% municipal population that is served by a sewer system.	82.0%	94.1%	83.3%	94.5%	99.0%	97.5%	-	92.7%
% municipal population that obtains water from private (household) septic system.	18.0%	5.9%	16.7%	5.5%	1.0%	1.8%	-	7.2%
% municipal population that is served sewage haulage (holding tank and sewage trucking).	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	-	0.1%
Responding population for the question on population served wastewater services. This is the total population of the municipalities that submitted data on population served wastewater services.	397,866	248,752	108,616	714,031	417,571	202,292	-	2,089,128
% population served water that is also served water treatment.	100.0%	100.0%	96.7%	100.0%	99.7%	100.0%	0.0%	99.8%
Responding population for the question on population served water treatment. This is the population served water on systems for which the municipality submitted data on population served water treatment.	301,080	219,176	73,278	645,672	407,369	192,912	340,000	2,179,487
Total annual volume of water (in cubic meters) distributed by the water distribution system(s) of the municipality, excluding any water transferred to system(s) outside of the municipality.	49,452,123	37,397,161	43,060,321	102,662,584	52,904,881	27,556,080	-	313,033,149
Annual volume of water (in cubic meters) distributed by the water distribution system(s) of the municipality to residential customers, excluding any water transferred to system(s) outside of the municipality. Calculated by	31,903,597	7,146,108	15,785,800	5,714,024	22,122,542	14,880,283	-	97,552,354

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
multiplying the TotalAnnualVol_M3 by the % water used by the residential (single-family and multi-family) sector.								
Total water use per capita, in litres per capita per day. Calculated by dividing total annual volume (m^3) by the population served water for each Responding water system, and converting to litres per day.	446.4	534.9	1,611.0	426.5	359.3	391.3	-	470.3
Responding population for the question on total water use per capita. This is the population served water on systems for which the municipality submitted data on total water use per capita.	301,080	191,550	73,229	646,457	406,786	192,912	-	1,812,013
Residential water use per capita, in litres per capita per day. Calculated by dividing annual Residential Water Use (m^3) by the population served water for each Responding water system, and converting to litres per day.	290.3	176.1	590.6	170.5	149.0	211.3	-	224.9
Responding population for the question on residential water use per capita. This is the population served water on systems for which the municipality submitted data on residential water use per capita.	301,080	111,190	73,229	137,980	406,786	192,912	-	1,223,176
2006 total water use per capita (in litres per capita per day)	437.9	303.65	609.3	543.5	424.1	401.9	-	437.6
2004 total water use per capita (in litres per capita per day)	455.3	303.22	4,493.5	521.2	427.9	401.9	-	673.1
2006 residential water use per capita (in litres per capita per day)	286.3	224.70	86.0	268.3	176.5	160.8	-	210.3
2004 residential water use per capita (in litres per capita per day)	296.0	224.27	534.0	269.8	178.4	160.8	-	240.3
2001 residential water use per capita (in litres per capita per day)	320.1	761.17	509.0	288.5	182.7	184.8	-	300.9
1999 residential water use per capita (in litres per capita per day)	246.5	646.82	557.5	151.3	182.7	196.0	-	261.6
% of serviced single-family homes that have water meters	100.0%	0.0%	8.3%	31.6%	100.0%	100.0%	100.0%	66.6%
Responding population for the question on single-family water metering. This is the population served water on systems for which the municipality submitted data on single-family water metering.	301,080	219,244	73,281	646,382	407,369	194,216	340,000	2,181,571
Total Number of single-family households connected to a water distribution system	74,532	38,036	14,352	107,579	98,050	100	-	332,649
% of serviced multi-family buildings that have water meters	100.0%	0.0%	99.1%	31.6%	100.0%	100.0%	100.0%	69.6%

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
Responding population for the question on multi-family water metering. This is the population served water on systems for which the municipality submitted data on multi-family water metering.	300,000	219,244	72,701	646,382	407,369	194,216	340,000	2,179,911
% of serviced small office/stores (1" or 25 mm connection) that have water meters	100.0%	91.7%	98.8%	80.9%	100.0%	100.0%	100.0%	97.3%
Responding population for the question on commercial water metering. This is the population served water on systems for which the municipality submitted data on commercial water metering.	300,530	216,978	72,951	137,905	407,369	194,216	340,000	1,669,948
% of distributed water used by the residential sector (single-family and multi-family combined).	64.5%	74.5%	39.8%	48.6%	42.3%	40.4%	#DIV/0!	51.1%
% of distributed water used by the commercial/institutional/municipal sector.	15.6%	11.6%	28.6%	29.8%	37.6%	44.7%	#DIV/0!	29.4%
% of distributed water used by the industrial/agricultural sector.	5.0%	9.0%	18.0%	6.9%	13.3%	5.0%	#DIV/0!	9.1%
% of distributed water that is unaccounted for, for whatever reason (leakage, system flushing, unknown).	14.9%	5.0%	13.6%	14.7%	6.8%	10.0%	#DIV/0!	10.4%
Responding population for the question on sectoral water use. This is the population served water on systems for which the municipality submitted data on sectoral water use.	301,080	111,190	73,229	137,195	406,786	180,835	-	1,210,314
Number of water sources in this municipality which are from surface water bodies ("Lake", "River", "Reservoir", "Creek", "Wetlands".)	6	6	4	7	8	1	1	33
Number of water sources in this municipality which are from groundwater sources ("Aquifer").	2	-	6	-	-	-	-	8
% of the population served water for which the water originates from a surface water source.	99.9%	100.0%	93.0%	100.0%	100.0%	100.0%	-	99.7%
% of the population served water for which the water originates from a ground water source.	0.1%	0.0%	7.0%	0.0%	0.0%	0.0%	0.0%	0.3%
Responding population for the question on water sources (by population). This is the population served water on systems for which the municipality submitted data on water sources	301,080	219,244	72,979	645,015	412,507	192,912	340,000	2,183,736
Total annual volume of distributed water (in cubic meters) that came from surface water sources	49,039,421	37,397,161	42,052,256	102,662,584	52,904,881	27,556,080	-	311,612,383

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
Total annual volume of distributed water (in cubic meters) that came from ground water sources	16,222	-	967,387	-	-	-	-	983,609
% of the volume of water used that originates from a surface water source.	100.0%	100.0%	93.6%	100.0%	100.0%	100.0%	-	99.1%
Responding population for the question on water sources (by volume). This is the population served water on systems for which the municipality submitted data on water sources	301,080	191,550	72,979	645,015	408,523	192,912	-	1,812,059
Number of water distribution systems that the respondent indicated had a problem with water quality in 2007, 2008 or 2009	1	-	4	-	1	-	-	6
% population served water on a distribution system that the respondent indicated had a problem with water quality in 2007, 2008 or 2009	30	-	62,541	-	3,984	-	-	66,555
Responding population for the question on water quality problems. This is the population served water on systems for which the municipality submitted data on water quality problems.	301,080	193,816	73,281	137,999	369,171	-	-	1,075,346
Number of water distribution systems that the respondent indicated had a microbiological problem with water quality in 2007, 2008 or 2009	-	-	2	-	1	-	-	3
Population served water on a distribution system that the respondent indicated had a microbiological problem with water quality in 2007, 2008 or 2009	-	-	57,404	-	3,984	-	-	61,388
Number of water distribution systems that the respondent indicated had a chemical problem with water quality in 2007, 2008 or 2009	-	-	-	-	-	-	-	-
% population served water on a distribution system that the respondent indicated had a chemical problem with water quality in 2007, 2008 or 2009	-	-	-	-	-	-	-	-
Number of water distribution systems that the respondent indicated had an aesthetic problem with water quality in 2007, 2008 or 2009	-	-	1	-	-	-	-	1
% population served water on a distribution system that the respondent indicated had an aesthetic problem with water quality in 2007, 2008 or 2009	-	-	4,859	-	-	-	-	4,859
Number of water distribution systems that the respondent	1	-	1	-	-	-	-	2

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
indicated had a radiological problem with water quality in 2007, 2008 or 2009								
Population served water on a distribution system that the respondent indicated had a radiological problem with water quality in 2007, 2008 or 2009	30	-	278	-	-	-	-	308
Responding population for the question on Number of water quality problem days. This is the population served water on systems for which the municipality submitted data on Number of water quality problem days.	30	-	62,243	-	-	-	-	62,273
Number of water distribution systems that the respondent indicated had a problem with water supply (water quantity) in 2007, 2008 or 2009.	1	2	1	2	-	-	-	6
Population served water on a distribution system that the respondent indicated had a problem with water supply (water quantity) in 2007, 2008 or 2009	150	191,550	57,384	637,740	-	-	-	886,824
Responding population for the question on water supply (water quantity) problems. This is the population served water on systems for which the municipality submitted data on water supply (water quantity) problems.	301,080	193,816	73,281	646,477	365,187	-	-	1,579,839
Responding population for the question on number of water supply problem days. This is the population served water on systems for which the municipality submitted data on Number of water supply problem days.	150	11,550	57,384	129,263	-	-	-	198,347
Total meters of water mains of all water distribution systems	1,463,400	720,000	550,000	139,220	1,918,890	900,000	126,000	5,817,510
Responding population for the question on length of water mains. This is the population served water on systems for which the municipality submitted data on length of water mains.	301,080	141,400	73,281	643,889	407,369	192,912	340,000	2,099,930
Meters of water mains per population served	4.9	5.1	7.5	0.2	4.7	4.7	0.4	2.8
% water mains between 0 and 25 years of age in 2009.	31.6%	23.8%	7.2%	14.6%	41.2%	5.0%	-	26.9%
% water mains between 26 and 50 years of age in 2009.	36.4%	34.9%	16.1%	18.2%	35.3%	20.0%	-	30.8%
% water mains between 51 and 75 years of age in 2009.	17.0%	27.2%	34.0%	43.2%	14.7%	50.0%	-	25.0%
% water mains between 76 and 100 years of age in 2009.	8.5%	11.6%	31.3%	24.1%	5.5%	25.0%	-	13.1%
% water mains over 100 years of age in 2009.	6.5%	2.5%	11.3%	0.0%	3.3%	0.0%	-	4.2%
	43.80	46.34	69.76	56.67	36.54	61.25	-	47.3

Indicator	Halifax (CMA)	St. John's (CMA)	Saint John (CMA)	Quebec (CMA)	London (CMA)	Regina (CMA)	Victoria (CMA)	TOTAL
Responding population for the question on age of water mains. This is the population served water on systems for which the municipality submitted data on age of water mains.	301,080	216,978	73,281	643,889	407,369	192,912	-	1,835,508
% population served sewers that is served wastewater treatment (beyond preliminary-only treatment)	100.0%	50.5%	56.8%	100.0%	100.0%	100.0%	0.0%	92.4%
% population served sewers that is served no wastewater treatment or preliminary-only treatment.	0.0%	49.5%	43.2%	0.0%	0.0%	0.0%	-	7.6%
% population served sewers that is served primary wastewater treatment.	84.9%	50.5%	0.6%	0.6%	0.0%	0.0%	-	20.7%
% population served sewers that is served secondary-WSP (waste stabilization ponds) wastewater treatment.	0.0%	0.0%	21.7%	7.7%	0.2%	1.0%	-	3.8%
% population served sewers that is served secondary-mechanical wastewater treatment.	11.0%	0.0%	34.6%	61.1%	54.5%	0.0%	-	36.4%
% population served sewers that is served tertiary wastewater treatment.	4.2%	0.0%	0.0%	30.6%	45.3%	99.0%	0.0%	31.5%
Responding population for the question on level of wastewater treatment. This is the population served water on systems for which the municipality submitted data on level of wastewater treatment.	325,852	211,943	84,737	637,437	415,574	195,350	352,219	2,223,111

APPENDIX B 2009 TRAFFIC ZONE DATA

TAZ	Sub-Area	Census Tract	2009 Population Estimate	Dwelling Units	Total Employees	Retail Employees	Service Employees	Other Employees
1	Regional Centre	22	7	4	661	119	403	138
2	Regional Centre	22	1,926	926	301	54	184	63
3	Regional Centre	22	1,737	984	555	100	339	116
4	Regional Centre	22	1,587	831	296	53	181	62
5	Regional Centre	22	3	2	1,869	337	1,141	391
6	Regional Centre	22	313	188	1,261	227	770	264
7	Regional Centre	21	1,681	847	685	105	351	229
8	Regional Centre	21	1,648	798	30	5	15	10
9	Regional Centre	21	-	-	183	28	94	61
10	Regional Centre	20	-	-	5,718	309	3,144	2,264
11	Regional Centre	20	274	99	2,124	115	1,168	841
12	Regional Centre	20	2,561	956	5,734	310	3,153	2,271
13	Regional Centre	20	3	2	1,607	87	884	636
14	Regional Centre	10	-	-	1,621	56	784	781
15	Regional Centre	10	2,198	1,066	278	10	135	134
16	Regional Centre	10	1,351	744	258	9	125	124
17	Regional Centre	10	1,603	1,000	149	5	72	72
18	Regional Centre	9	1,177	632	4,398	256	3,786	355
19	Regional Centre	9	711	455	10,332	603	8,895	835
20	Regional Centre	9	156	86	6,558	382	5,646	530
21	Regional Centre	9	8	5	4,535	264	3,904	366
22	Regional Centre	8	859	535	1,761	103	1,331	327
23	Regional Centre	8	610	358	10,940	639	8,268	2,032
24	Regional Centre	8	1,323	763	728	43	550	135
25	Regional Centre	4.01	504	317	2,201	190	1,966	46
26	Regional Centre	4.01	3,091	1,979	687	59	614	14
27	Regional Centre	3	734	371	264	12	246	6
28	Regional Centre	3	346	137	47	2	44	1
29	Regional Centre	3	419	161	-	-	-	-
30	Regional Centre	3	813	365	47	2	44	1
31	Regional Centre	3	375	153	1,740	77	1,626	37
32	Regional Centre	4.02	2,416	1,378	671	49	594	28

TAZ	Sub-Area	Census Tract	2009 Population Estimate	Dwelling Units	Total Employees	Retail Employees	Service Employees	Other Employees
33	Regional Centre	4.02	2,273	1,455	1,218	89	1,078	51
34	Regional Centre	7	1,203	802	5,268	38	5,118	113
35	Regional Centre	7	633	330	11,540	83	11,210	247
36	Regional Centre	7	-	-	343	2	333	7
37	Regional Centre	5	712	269	48	5	38	5
38	Regional Centre	5	1,130	424	16	2	13	2
39	Regional Centre	6	773	368	5,687	42	5,641	5
40	Regional Centre	6	598	207	132	1	131	-
41	Regional Centre	6	1,932	964	252	2	250	-
42	Regional Centre	12	2,639	1,091	1,415	250	1,119	47
43	Regional Centre	11	3,215	1,502	2,003	286	1,577	140
44	Regional Centre	11	1,327	646	283	40	223	20
45	Regional Centre	11	1,311	535	264	38	208	19
46	Regional Centre	13	539	209	22	4	18	1
47	Regional Centre	13	2,130	927	179	30	140	8
48	Regional Centre	19	1,737	836	196	44	142	10
49	Regional Centre	19	3,383	1,744	1,363	303	987	73
50	Regional Centre	23	1,548	724	552	22	491	39
51	Regional Centre	23	1,372	522	89	4	79	6
52	Regional Centre	23	1,426	784	3,125	127	2,779	219
53	Regional Centre	18	1,030	529	231	83	141	7
54	Regional Centre	18	313	145	34	12	21	1
55	Regional Centre	18	780	356	2,342	839	1,436	67
56	Regional Centre	18	362	215	1,308	469	802	37
57	Regional Centre	18	1,156	727	2,107	755	1,292	60
101	Regional Centre	112	87	45	40	4	31	5
102	Regional Centre	112	1,508	789	780	84	596	100
103	Regional Centre	112	416	217	42	4	32	5
104	Regional Centre	111	1,094	657	4	-	2	2
105	Regional Centre	111	1,249	628	176	20	82	73
106	Regional Centre	111	863	427	970	112	455	403
107	Regional Centre	110	656	309	585	63	478	44

TAZ	Sub-Area	Census Tract	2009 Population Estimate	Dwelling Units	Total Employees	Retail Employees	Service Employees	Other Employees
108	Regional Centre	110	-	-	624	68	510	47
109	Regional Centre	110	482	381	195	21	159	15
110	Regional Centre	110	533	262	1,398	151	1,141	105
111	Regional Centre	102	3	2	1,575	84	1,457	34
112	Regional Centre	102	727	444	1,624	87	1,502	35
113	Regional Centre	102	2,805	1,336	663	35	613	14
114	Regional Centre	102	884	433	290	16	269	6
115	Regional Centre	101	1,023	586	8	1	6	1
116	Regional Centre	101	2,455	1,180	959	96	711	152
117	Regional Centre	101	-	-	46	5	34	7
118	Regional Centre	100	989	441	2,572	126	2,207	239
119	Regional Centre	100	171	51	1,859	91	1,595	173
120	Regional Centre	100	375	152	642	31	551	60
121	Regional Centre	103	994	453	717	258	416	43
122	Regional Centre	103	519	232	384	138	223	23
123	Regional Centre	103	2,938	1,250	1,105	398	642	66
124	Regional Centre	108	1,037	557	71	48	21	1
125	Regional Centre	108	609	310	2,428	1,652	728	48
126	Regional Centre	108	1,936	839	188	128	57	4
127	Regional Centre	108	518	215	-	-	-	-
128	Regional Centre	109	1,659	979	90	2	85	3
129	Regional Centre	109	926	382	133	4	124	5
130	Regional Centre	109	780	367	86	2	81	3
131	Regional Centre	114	2,501	1,511	204	19	120	65
132	Regional Centre	114	1,128	513	155	15	91	49
133	Regional Centre	114	2,276	1,186	638	60	376	202
134	Regional Centre	114	1,023	592	96	9	56	30
201	Suburban	120	2,405	869	316	9	272	35
202	Suburban	1	3,793	1,521	783	27	683	73
203	Suburban	2	5,511	2,357	877	30	810	36
204	Suburban	14	4,291	2,027	539	50	466	23
205	Suburban	15	4,868	2,390	1,538	367	817	353

TAZ	Sub-Area	Census Tract	2009 Population Estimate	Dwelling Units	Total Employees	Retail Employees	Service Employees	Other Employees
206	Suburban	16	3,252	1,423	352	13	339	-
207	Suburban	17	2,647	1,179	841	-	841	-
208	Suburban	142.01	5,559	1,951	158	6	138	14
209	Suburban	142.02	3,711	1,489	1,732	630	693	409
210	Suburban	142.02	-	-	619	225	248	146
211	Suburban	142.02	14	6	3,178	1,156	1,272	750
212	Suburban	142.02	-	-	-	-	-	-
213	Suburban	142.02	-	-	3,692	1,343	1,478	871
214	Suburban	142.02	101	43	112	41	45	26
215	Suburban	24	701	437	-	-	-	-
216	Suburban	24	4,976	2,378	582	32	462	88
217	Suburban	25.01	4,733	2,137	762	9	730	22
218	Suburban	25.02	5,025	2,514	1,423	201	1,207	14
219	Suburban	25.03	7,739	4,054	2,242	994	1,224	23
220	Suburban	26.01	8,021	3,554	1,081	46	1,029	6
221	Suburban	26.01	3,482	1,408	226	10	216	1
222	Suburban	26.02	3,407	1,523	381	43	296	41
223	Suburban	27	5,253	2,574	1,092	98	912	82
224	Suburban	27	39	21	29	3	24	2
225	Suburban	132.06	28	10	-	-	-	-
226	Suburban	132.06	75	27	394	29	141	224
227	Suburban	132.06	80	29	17	1	6	10
228	Suburban	132.06	284	103	1,288	96	461	730
229	Suburban	132.06	3,600	1,143	41	3	15	23
230	Suburban	132.06	107	42	145	11	52	82
231	Suburban	123.04	3,793	1,561	17	2	13	2
232	Suburban	123.04	2,098	909	1,909	186	1,506	217
233	Suburban	123.06	1,279	504	239	58	180	-
234	Suburban	123.06	1,645	643	56	14	42	-
235	Suburban	123.05	2,433	970	145	30	113	2
236	Suburban	123.05	1,027	448	54	11	42	1
237	Suburban	123.05	209	94	1,705	357	1,321	26

TAZ	Sub-Area	Census Tract	2009 Population Estimate	Dwelling Units	Total Employees	Retail Employees	Service Employees	Other Employees
238	Suburban	123.02	2,689	949	2,367	316	1,194	857
239	Suburban	123.02	1,430	543	213	28	107	77
240	Suburban	123.02	296	104	456	61	230	165
241	Suburban	131.04	593	190	204	12	165	27
242	Suburban	131.04	18	6	1,044	63	844	137
243	Suburban	131.04	2,778	1,068	382	23	309	50
244	Suburban	131.05	3,801	1,322	1,624	22	1,340	263
245	Suburban	131.05	93	30	-	-	-	-
246	Suburban	131.01	5,389	1,926	108	-	108	-
247	Suburban	131.02	4,594	1,812	1,746	657	1,017	72
248	Suburban	131.03	2,631	995	2,275	891	1,283	102
249	Suburban	131.03	785	347	615	241	347	27
250	Suburban	131.03	790	325	28	11	16	1
251	Suburban	131.03	1,914	708	437	171	246	20
252	Suburban	132.03	5,269	1,874	553	105	448	-
253	Suburban	113	662	261	-	-	-	-
254	Suburban	113	49	19	4,706	486	2,983	1,238
255	Suburban	114	10	5	2,857	269	1,682	906
256	Suburban	114	8	3	4,774	450	2,811	1,514
257	Suburban	114	10	5	7,075	667	4,166	2,243
258	Suburban	114	-	-	5,285	498	3,112	1,676
259	Suburban	114	5	2	3,028	285	1,783	960
260	Suburban	106.02	1,026	379	-	-	-	-
261	Suburban	106.02	1,968	671	194	4	187	3
262	Suburban	106.02	498	185	122	2	118	2
263	Suburban	106.02	1,959	712	72	1	69	1
264	Suburban	106.01	3,771	1,538	661	264	364	33
265	Suburban	107	3,186	1,346	733	21	669	43
266	Suburban	108	94	48	-	-	-	-
267	Suburban	104.01	2,110	907	2,896	411	2,437	48
268	Suburban	105.01	3,278	1,334	280	-	234	46
269	Suburban	105.02	4,938	1,814	309	23	71	215

TAZ	Sub-Area	Census Tract	2009 Population Estimate	Dwelling Units	Total Employees	Retail Employees	Service Employees	Other Employees
270	Suburban	122.01	3,531	1,368	884	353	518	12
271	Suburban	122.02	3,587	1,252	339	31	287	21
272	Suburban	122.02	4,348	1,655	681	63	576	43
273	Suburban	104.02	2,036	811	1,235	353	718	164
274	Suburban	104.02	4,668	1,836	1,041	297	605	138
275	Suburban	104.02	1,509	613	441	126	256	59
276	Suburban	121.02	3,510	1,329	1,214	241	876	98
277	Suburban	121.08	4,046	1,241	158	36	109	12
278	Suburban	121.07	1,853	632	-	-	-	-
279	Suburban	121.07	2,697	860	230	19	211	-
280	Suburban	121.07	552	188	-	-	-	-
281	Suburban	100	157	66	247	12	212	23
282	Suburban	100	1,500	583	206	10	177	19
283	Suburban	121.05	1,017	297	2,555	240	118	2,197
284	Suburban	121.05	3,580	1,442	348	33	16	299
285	Suburban	121.06	5,736	2,031	927	30	897	-
401	Rural	140	4,508	1,714	407	6	318	82
402	Rural	140	2,214	821	82	1	64	17
403	Rural	141	5,497	2,021	632	107	320	205
404	Rural	141	1,692	721	518	87	262	168
405	Suburban	142.02	-	-	65	24	26	15
406	Rural	143.02	5,431	1,995	568	473	-	94
407	Rural	143.01	949	416	25	8	16	1
408	Rural	143.01	3,199	1,364	777	249	504	24
409	Rural	143.01	1,448	466	10	3	7	-
410	Rural	132.05	4,039	1,326	642	132	348	162
411	Rural	132.05	5,930	2,055	529	109	287	133
412	Rural	132.04	5,408	1,861	424	-	352	72
413	Rural	130.01	8,259	2,954	517	6	467	45
414	Rural	130.02	8,476	2,943	1,207	211	877	119
415	Rural	123.01	2,215	841	848	-	637	211
416	Rural	152	1,264	464	3,707	231	2,391	1,086

TAZ	Sub-Area	Census Tract	2009 Population Estimate	Dwelling Units	Total Employees	Retail Employees	Service Employees	Other Employees
417	Rural	152	3,109	1,160	402	25	260	118
418	Rural	122.03	3,493	1,326	819	174	441	204
419	Rural	121.03	1,984	704	79	11	62	6
420	Rural	150.01	6,971	2,523	525	-	525	-
421	Rural	150.02	6,308	2,322	223	-	159	63
422	Rural	151	6,011	2,375	1,114	253	716	145
423	Rural	153	2,652	1,127	1,760	272	1,138	351
504	Rural	132.06	511	201				
9998	Rural	153						
9999	Rural	154						
Tantallon Park and Ride			8	3				
Sackville Park and Ride			2	1				

APPENDIX C RESIDENTIAL DISTRIBUTION MAPS

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