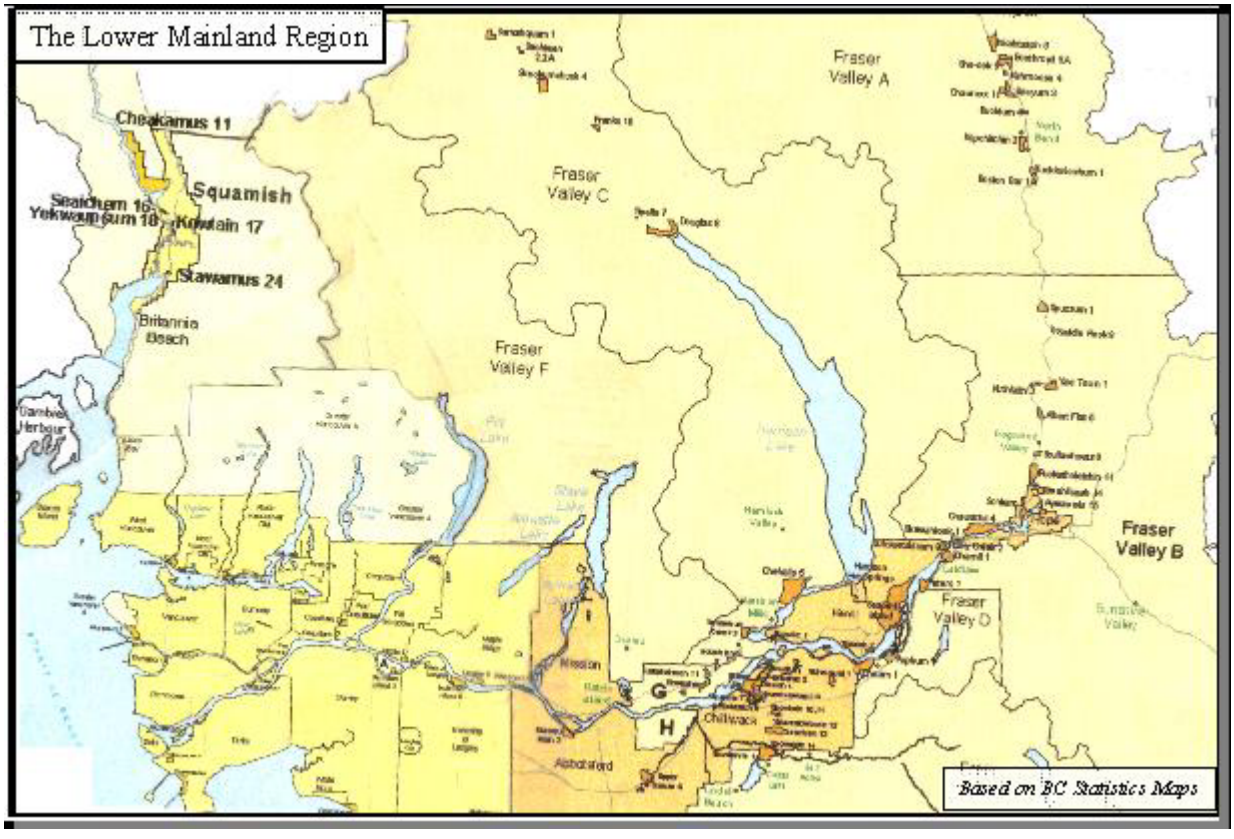
The Context for Change:

Demographics, Life Cycles, Economics, and the Lower Mainland of British Columbia Over the Next Four Decades



URBAN FUTURES
Strategic Research to Manage Change

The Context for Change:
Demographics, Life Cycles, Economics, and the Lower Mainland of British Columbia Over the Next Four Decades

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I. INTRODUCTION

a) The region

The Lower Mainland Region – comprising the south-western corner of Mainland British Columbia between the 49th and 50th parallel, from Howe Sound to the Fraser Canyon - is Canada's third largest metropolitan region. It is home to 2.43 million residents, which is approximately sixty percent of the province's population, and eight percent of the country's. This is a large and diverse region, with a range of natural, physical and social characteristics unmatched in the world. It is also a region that has experienced, and is experiencing, significant change, and one that will continue to do so in the future.

The region that is the focus of this report is larger than the usual definition of the Lower Mainland, in that it includes not only the communities of the Fraser Delta between Harrison and Howe Sound, but also the communities centered on Hope and Squamish. Hope and its adjacent communities are included because they are the gateway to the region, the point at which the region's road and rail based access to the rest of the country, pass. As well, one in six of the labour force participants resident in Hope centered communities who have a usual place of work have it elsewhere in the Lower Mainland, making these communities an integral part of the region's economy and housing stock. As employment opportunities in the eastern half of the region increase, the role that Hope centered communities have in providing homes for the region's workers will increase.

Like the Hope centred communities, the communities centred on Squamish serve as both a gateway to the region and, with the usual place of work of one in six of their resident labour force being in the rest of this region, as an integral cog in the Lower Mainland's economy. In addition, Downtown Squamish is an equivalent distance – both in terms of road distance and travel time - from Downtown Vancouver as is Downtown Aldergrove, further justifying its inclusion into this report's definition of the Lower Mainland region. With the increase in the capacity of the transportation systems along the east side of Howe Sound and the growth of the housing stock in the immediate vicinity of Squamish, as well as at Porteau Cove and Britannia Beach, the role of this area in the region's housing market will also increase.

Thus the region considered here – comprising the Fraser Valley and Greater Vancouver Regional Districts, as well as the Census subdivisions adjacent to and including Squamish - represents a reasonable equivalent of a single functional region, defined by the boundaries of the places of residence of the vast majority of its workers, and the diversity of their places of work. While there are certainly some instances of people traveling on a regular basis from outside of the region to work in it, or from residences in the region to places of work outside it, these are not (yet) defining characteristics of either the origin or destination communities.

b) The future

The projections of this region extend forty years into the future, and are based on examination of data on change in the region over the past forty years. Demography generally determined this time frame: the typical current resident of the region was born just over four decades ago and has, at current mortality rates, a life expectancy of just over four more decades. While data and projections for intermediate dates are presented here, the "forty years back and forty years into the future" time frame provides a reasonable set of boundaries for long term projections, with the boundaries being both directly relevant of the region's typical resident and being wide enough to enable the focus to be on long run patterns of change rather than on short term variations.

c) Predicting change

While there will be many changes in this region over the coming decades, changes in population, labour force and employment will provide the context for the changes that will occur in the other dimensions. The purpose of this report is to present projections of the future population, labour force, and employment in this Lower Mainland region over the 2004 to 2044 period and to present an examination of the factors that will bring about the changes reflected in these projections.

This statement of purpose contains a number of elements that warrant explicit discussion in this introduction. First, fundamental to consideration of any projection is an understanding of both the nature and the purpose of projection. All future oriented statements (projections, forecasts, predictions, warnings, etc.) are conditional statements: they describe what future conditions will be, subject to the assumption that the conditions upon which they are based prevail in the future. Given this conditional nature of projection, understanding the underlying conditions, stated or unstated, is essential to understanding the results.

In the case of projections involving human communities and populations, the future is uncertain. No projection therefore can ever be precisely right, in the sense of exactly describing what will happen on a specific date far in the future: projection must acknowledge that it can never be precisely right - that it can never "tell the future". This raises the question, then, of "Why project if it can never be precisely right?"

The answer is that, while you can never be precisely right, you can reduce the consequences of being wrong by carrying out projections; most importantly, you can avoid being really wrong. What is asked of projections is not that they tell us the score in the Stanley Cup Final ten years from now, but whether or not hockey will be played as a professional sport.

What we must ask of projections is "What do they tell us about the factors that will shape the future? What do they tell us about the degree of uncertainty, and of risk, that the future involves? How can they help us plan for an uncertain future?" The purpose of projection - be it of population, sales of muffins, or the price of real estate - is to help

manage the risks and uncertainty associated with decisions that must be made today about a tomorrow that is, by definition, uncertain.

d) The nature of projections

Projection generally starts with a baseline projection, a statement of what the future will look like if currently observed trends continue, showing the future logical consequences of current behaviour. These are the most direct projections, in that they do not say "this would happen", but rather say "this will happen if this behaviour does not change". This provides two important types of information for risk management. The first is that they demonstrate whether current behaviour can continue (most often it can, but it must be noted that in some cases such a future, while feasible, may not be desirable). While there are many examples of this situation, from labour supply to health care, discussions of the environment generally involve these projection outcomes.

In other cases, projections of current trends show that they cannot logically continue, as they present an impossible future. The incidence of end-state renal disease in the older population in Canada is growing exponentially, something which cannot continue forever.

This leads to the second type of information that baseline projections provide: the need to evaluate the trends upon which the projections are based. When the baseline projection shows that trends cannot continue, it forces us to assess what will change, intentionally or otherwise. In cases where trends that can continue but whose results we don't like, the projection gives us the opportunity to consider what changes might occur to bring about a better future, and how effective these changes might be. And in cases where we are overjoyed with the projected future, from a risk management perspective, we really should ask how likely it is that the underling tends will actually continue in the future, and what the consequences of them not doing so are.

Each of these types of information compels us to prepare additional, non-baseline, projections to access the impact of changes (by design, necessity or happenstance) of the underlying conditions. If we are happy with the results of the baseline projection, other scenarios are still essential to see how sensitive our happiness is to the uncertainly inherent in trends that underlie the projection. By incrementally changing each of these variables (sensitivity analysis), the range of possible futures can be delimited and the critical factors can be identified. Through this exercise, not only can risk be managed, but it can be measured, empirically valued and hedged against.

If we are not happy with the results of the baseline projection, testing changes in the underlying trends identifies how sensitive the future is to intentional changes in behaviour, and gives us a chance to consider the laws of unintended consequences before we have to live with them. This is often a sobering experience, as often even major changes in many of the underlying factors have little impact and the required changes in those that have the biggest impact are often are highly unlikely to occur. For example, only massive behavioural change will offset the demand pressure that aging is going to

put on the health care system, which means that strategies are increasingly looking at economic growth to fund the spending, rather than simply at demand management.

What is important is not whether the numbers in any one projection are "right". What is important is the evaluation of the likelihood of achieving the numbers, the consequences of doing so, and most importantly, the consequences of not achieving them. Don't project and the future is a game of chance where you don't know the rules, the players or the probabilities – projection not only helps prepare for the future, it can help change it.

e) This projection

A single scenario projection is presented in this report, a projection of the number of people (by age and sex) resident in the region over the next forty years, the number of people active in its labour force, and the number of jobs by sector for them to work in. The development of this single projection involved preparing a large number of other projections.

There are two contexts in which these other projections were carried out. The first was to prepare independent projections of employment and labour force (and hence population). When these two independent projections were brought together, they had to be consistent, with consistency measured by the resultant unemployment rate, which had to fall within a reasonable range. At the start of the resolution process, the results of bringing these two projections together was not reasonable, as there were more jobs in the region than there were people to work in them. This compelled a re-evaluation of the projected rate of economic growth, of productivity increases, of change in labour force participation, and of the drivers of demographic change. The result was a projected level of economic growth in the region that, while compatible with long run trends in change, is a third of what has generally been experienced historically in the region. It also results in a projected increase in labour force participation rates, and particularly labour force participation rates in the older population, that is historically unprecedented, but which again is consistent with some of the trends shown in more recent data.

Sensitivity analysis on these variables show that to move in any one direction too far from this trend based scenario will produce, at the point of resolution, unreasonable results. This means that while this projection will most assuredly not be a precise description of the future, the future will lie within a reasonable range of the projection presented in the following pages.

Which brings up the second context for the other scenarios that were carried out. As the presentation in this report describes the components of the projection process and its results, it presents alternative scenarios for some of the critical components of the projection. For example, it considers the difference between the consequences of current birth and death rates and trended rates, showing the sensitivity of the projections to variance in the underlying parameters.

f) Data and rounding

This report contains a multitude of numbers. Some are estimates of historical values and others are projections of future ones. It has become conventional to round numbers so as not to convey as sense of precision. Unfortunately this creates a situation where readers cannot pull out a calculator and do their only analysis based on these numbers. In this report, numbers are not, as such, rounded: the only place rounding is used is to keep number from being so big that they become meaningless. So please take note – the absence of rounding is not to indicate precision in what are obviously estimates and projections, but rather to avoid having to say things like "percentages may not sum to 100 percent due to rounding".

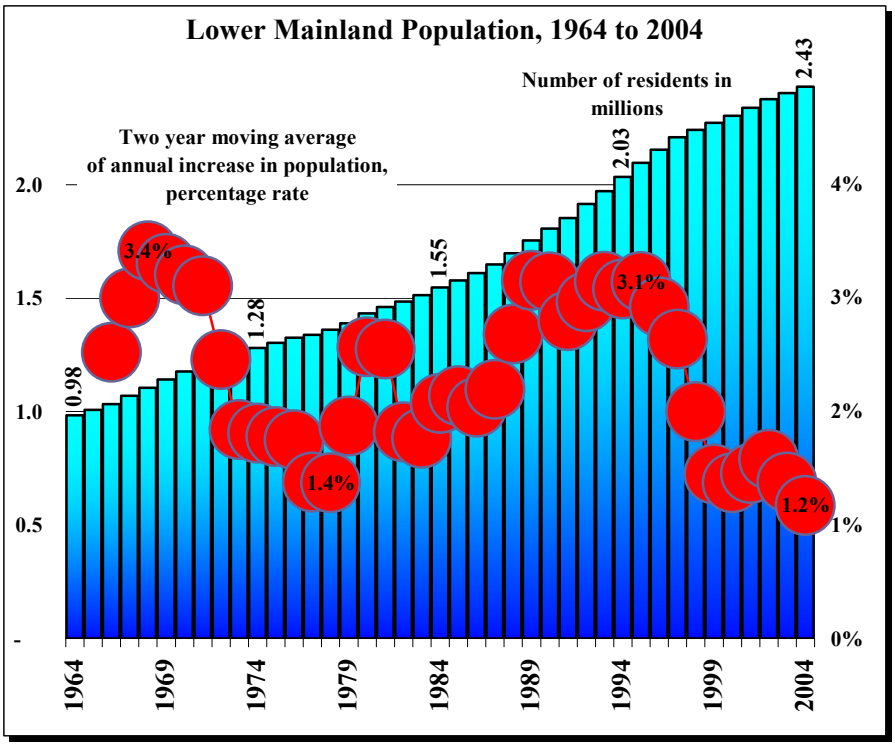
The Appendix to this report contains the numbers behind the story: in it the summary outputs of the projections for the region for between 2004 and 20044, by decade, can be found for the following variables:

- population by age group;
- labour force by age group; and
- employment by industry sector.

II. POPULATION

A. Overview of the Lower Mainland's Demographic History

Figure 1



The population in the Lower Mainland region has increased continually, but not steadily, over the past four decades, from 980,000[1] in 1964 to 2.43 million in 2004, a 147 percent (1.45 million person) increase (Figure 1). The region's population reached one million residents in 1965, 1.5 million in 1983 and two million in 1994.

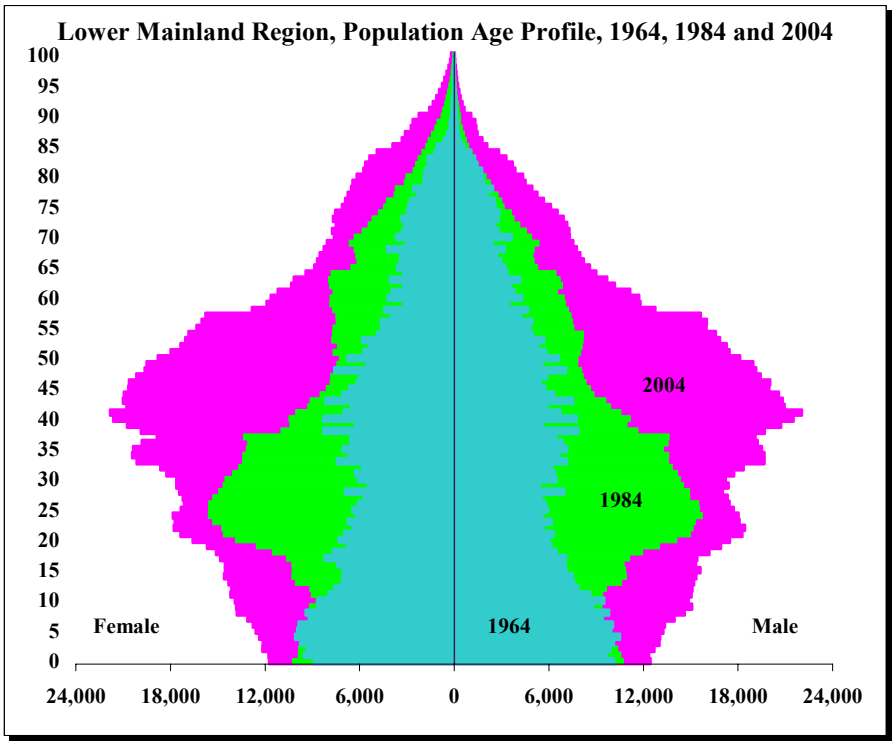
During this four decade period, population change has undergone two major cycles of growth, with annual growth dropping from the 3.4 percent range in the late 1960s to the 1.4 to 1.8 percent range in the early 1980s, before climbing back up to the three percent range in the early 1990s and then falling back to the 1.2 to 1.6 percent range in the early 2000s.

The region experienced its slowest relative growth over the past decade, with the 1994 to 2004 increase of 1.8 percent per year falling below not only the high of 2.8 percent of the 1984 to 1994 decade (which slightly eclipsed the 2.7 percent average of the 1964 to 1974 decade), but also below the 1.9 percent average of the 1974 to 1984 decade. In terms of absolute growth, again the 1984 to 1994 decade was the record setter, with an average of 48,700 persons added to the region's population each year, followed by the most recent decade's 39,700 average, and then by the 1964 to 1974 decade's average of 29,700 additional residents, leaving the 1974 to 1984 decade's average addition of 26,700 persons per year to mark the slowest period of absolute growth.

More profound than the growth of the Lower Mainland's population has been the change in its age composition (Figures 2, 3, and 4). The region's 2004 age profile reflects the cumulative demographic history of the region: it is the net result of the births and deaths in the region and migration to and from it over the past century, and is the base upon which the region's future age profile will be built. The character of this 2004 age profile is one largely determined by the history of births in Canada: this is not to say that

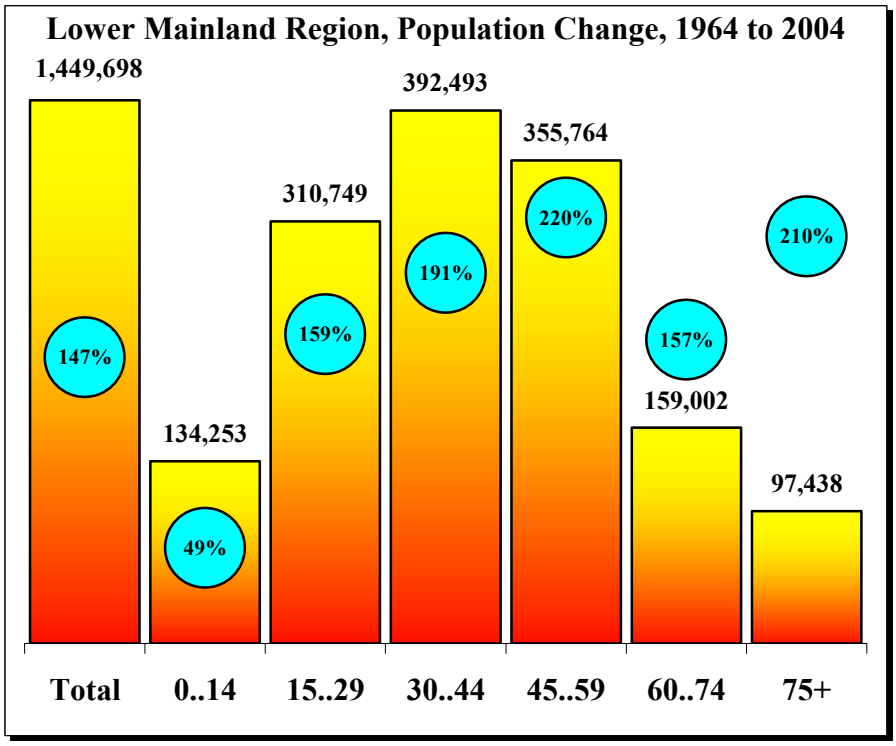
Figure 2

mortality and migration have not played significant roles, but their roles have been to modify a structure still reflective of, and largely shaped by, historical natality.



The region's current age profile is similar to the general pattern found in all of Canada's major regions (Figure 2). This age profile, moving down from the top, is characterized by conical shape in the oldest age groups, with an accelerated widening from age 66 to 58 reflecting the increase in birth rates in Canada during the post-Depression and World War Two period, followed by the marked bulge between 57 and 38 year olds reflecting the cohort born during the post war baby boom of 1947 to 1966, and then by a general narrowing as a result of the declining birth rates in the post 1966 period.

Figure 3

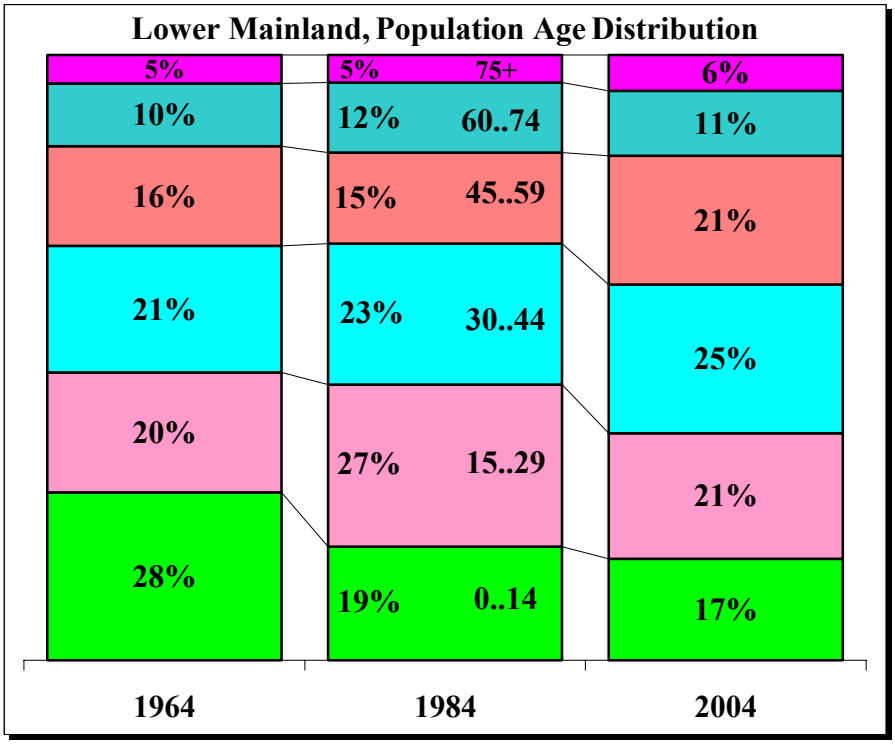


This same pattern, shifted downward by 20 years, can be seen in the region's 1984 age profile (with the 1938 to 1946 cohort aged 46 to 38, and the post war cohort aged 37 to 18) and again in the 1964 profile, with the boomer cohort in the under 18 age group forming a relatively wide base to the age profile.

The aging of the post World War Two cohort, whether they were living in the region in 1964 or migrated to it, has meant that demographic change

has proceeded at a rate much faster than the population has grown. The number of individuals in the under 15 age group in the Lower Mainland increased by 49 percent over the past four decades, one-third of the region's 147 percent overall growth (Figure 3). The number of people in all other age groups increased faster than the regional average, with the 45 to 59 age group increasing by 220 percent, and the 75 plus age group by 210 percent, the result of increasing life expectancies and the aging of the country's population boom in the first decades of the twentieth century.

Figure 4



These different rates of change in the number of people in each age group led to the shift in the age distribution of the region's population as is shown on Figure 4. The biggest change was the decline in the under 15 age group's share of the population between 1964 and 2004, falling from 28 to 17 percent. The 15 to 29 age group's share of the region's total population in 2004 (21 percent) was slightly higher than its 20 percent share in 1964: this, however, represents a decline from its 1984 share of 27 percent, a trend reflecting the aging of the post war boom cohort into, and out of, this age group over the past forty years. All of the older age groups increased in share, with the greatest percentage point increase being the 45 to 59 year old age group's jump from 16 percent of the population in 1964 to 21 percent in 2004.

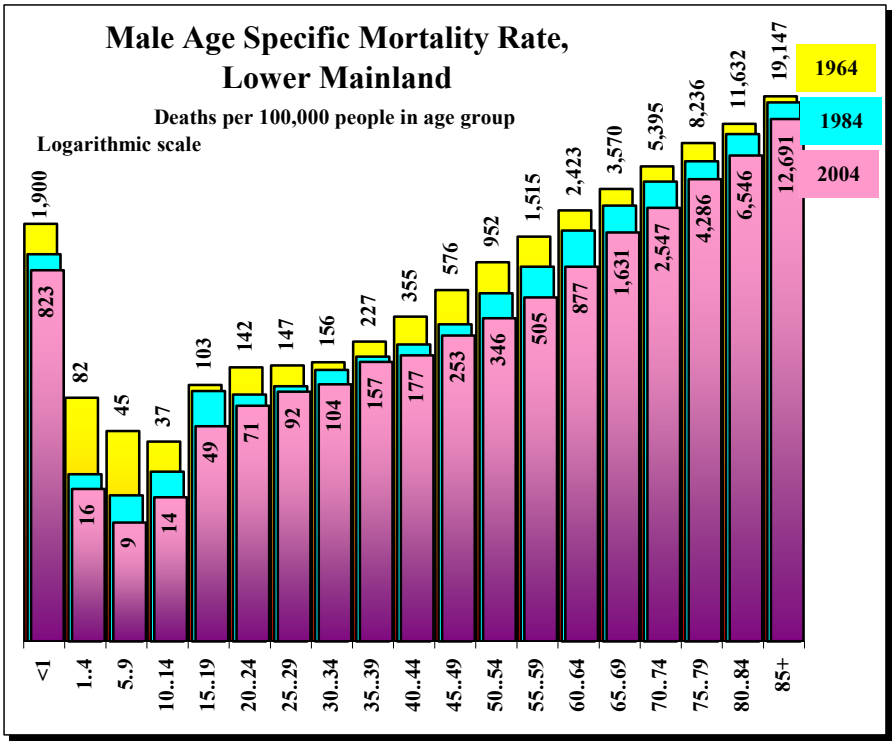
The region's population is currently older than it ever has been, to the extent that the youngest age groups have the smallest share of the population, and the oldest age groups the largest share, on record: it is also the youngest age profile that we can anticipate, at least over the next four decades.

The processes that will determine how the size and composition of the region's population changes in the future will be the ones that did so in the past, but their relative importance will be different. The typical resident of this region – who was 41 years old in 2004 - has a life expectancy of approximately 40 more years. Aging, and its partner, mortality, will therefore be more significant shapers of the region's age profile, and births a less significant one, over the next four decades than they were over the past four.

B. Aging and Mortality in the Lower Mainland

Mortality rates provide the first example of the life cycle patterns that form one of the basic themes of this report. Life cycle patterns are those which are strongly correlated with age: as Figure 5 shows, the number of deaths per 100,000 males declines from the under 1 year of age group to the 5 to 9 age groups, increases sharply between the 10 to 14 and 15 to 19 age groups, and then continues to increase across the remainder of the age groups[2]. This pattern, with some variance, existed in the region in 1964 and 1984, exists in 2004, and is projected to exist in 2024 and 2044 (see Figure 7).

Figure 5



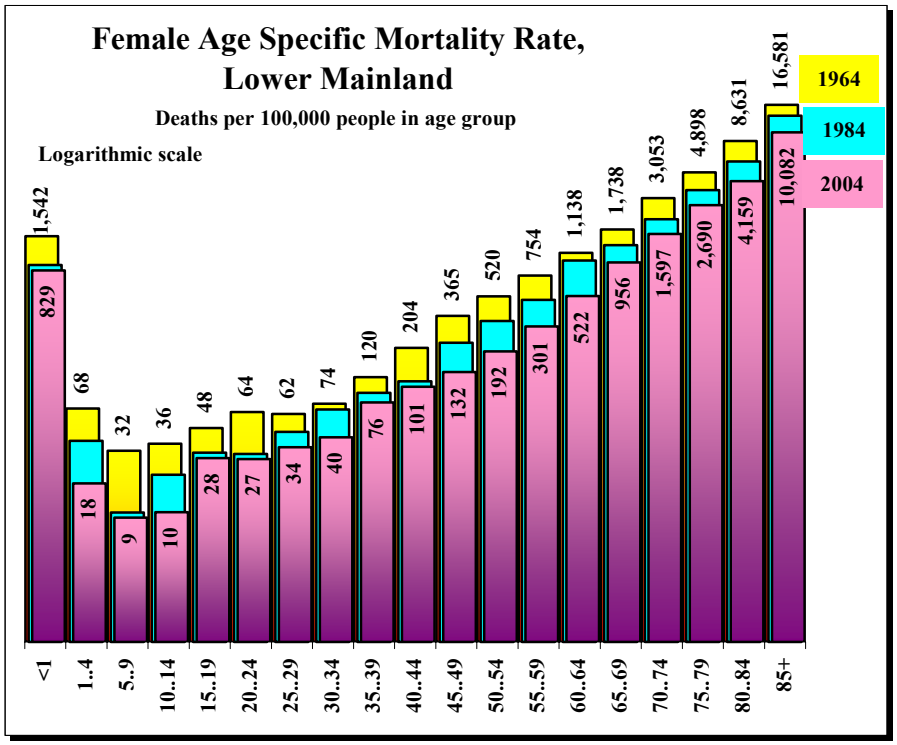
There are five points to note when considering mortality rates in the Lower Mainland. The first is that while mortality is correlated with age, age in itself does not cause mortality: instead, it is the life cycle pattern of diseases, accidents and violence that causes mortality. In population projections, rather than modeling the incidence rates of each cause of mortality, their summary in the form of age specific mortality rates is generally used.

The second point to note is that the values for age specific mortality rates change so much over the life cycle - from 2004's 9 deaths per 100,000 males aged 5 to 9 in the Lower Mainland to the 12,691 deaths per 100,000 people in the 85 plus age group - that it is necessary to plot them on logarithmic scales in order to capture the range (Figure 5).

The third point to consider is that while the age specific mortality rates for males in every age group were historically higher than for their female counterparts, by 2004 this rule had one exception, the 5 to 9 age group, where the mortality rate for females was the same as for males (Figure 6). This reflects a significant decline in mortality rates for 5 to 9 year olds of both sexes over the past decades: in fact, the number of child deaths has been so small over the past decade that the differences in mortality rates for males and females is not statistically significant.

The fourth point to note is that age specific mortality rates for both males and females in each age group have declined significantly, but not evenly, over the past four decades. Generally speaking, the relative decline in mortality rates was a) greater in the younger age groups than it was in the older ones, b) greater for males under the age of twenty and between the ages of 50 and 79 than it was for females in the same age groups, and c) greater for females aged 20 to 49 than it was for males in the same age range.

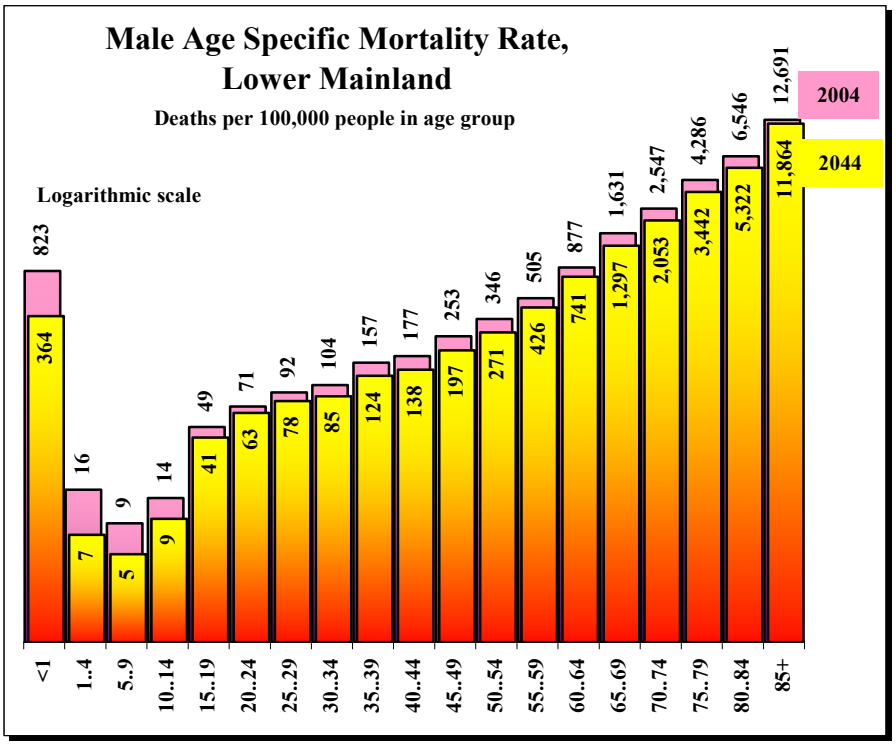
Figure 6



The final point to note is that the decline in age specific mortality rates that occurred between 1964 and 1984 was larger than that which occurred between 1984 and 2004. While population projections require use of mortality rates, this pattern of diminishing marginal change in age specific mortality is best reflected in the by-product of these changes, that being changes in life expectancy. Between 1964 and 1984, male life expectancy at birth (the number of years that, at birth, the average person can anticipate living given the prevailing age specific mortality rates at birth) increased by 5.3 years (7.4 percent), while over the next two decades it still increased, but by only 3.6 years (4.7 percent). Similarly, life expectancy at age 65 (that is, the number of years the average 65 year old could anticipate living given prevailing mortality rates) increased by 2.8 years (3.5 percent) between 1964 and 1984, and by only 1.9 years (2.3 percent) between 1984 and 2004.

This pattern of diminishing marginal change is a common one in many dimensions of human behaviour, from changes in record marathon times to changes in technological innovation in health care: the quicker, larger gains are realized earlier on, with the harder, smaller (and more expensive) ones following. Acknowledgement of this reality, in addition to the trends shown in the data, informed the projections of age specific mortality rates into the future that are used in the trend based projection of the Lower Mainland population presented in this report. The annual age specific mortality rates by single years of age and sex for the Lower Mainland over the past four decades, combined with the trends apparent in the lager provincial and national data, were extended into the future using statistical curve fitting that carried the concept of diminishing returns forward to 2044.

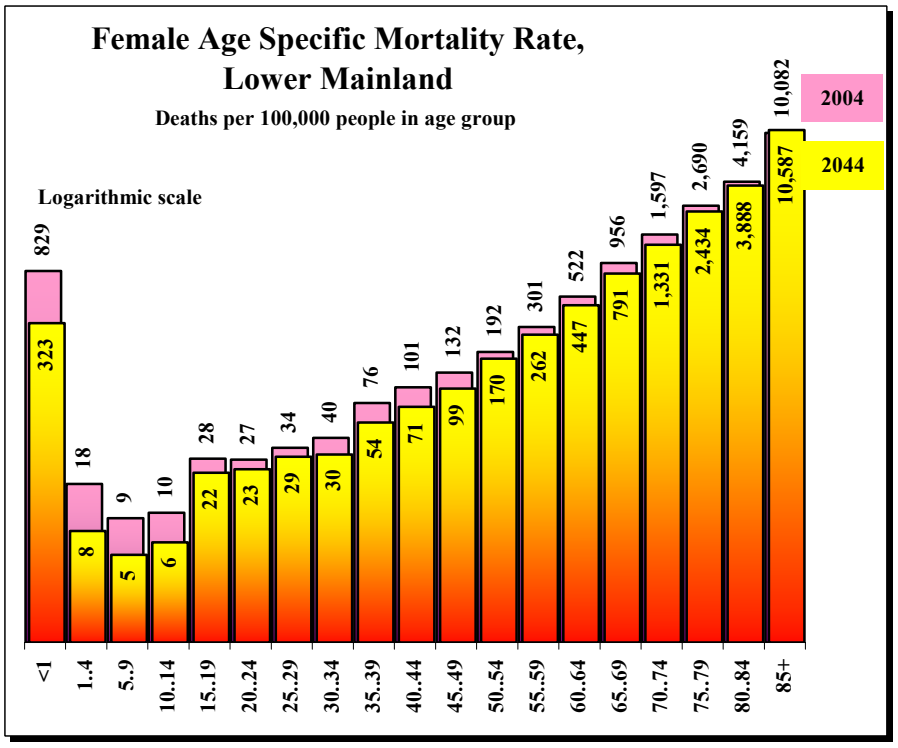
Figure 7



Just as the 1964 to 2004 period was one of continual change in age and sex specific mortality rates, so is the projected future: Figures 7 and 8 show the results of extending trends in mortality rates into the future. They show continued declines in both male and female mortality rates, at a slowing pace, with rates in 2044 being in the range of 25 percent lower than their current levels.

This mathematical extension of past trends into the future at a diminishing rate represents the logical consequences of changes such as those experienced over the past four decades, subject to diminishing returns. For example, to the extent that medical breakthroughs and changes in behaviour that affect life expectancy occurred in the past, similar changes are implicit in the trend based projections for the future.

Figure 8



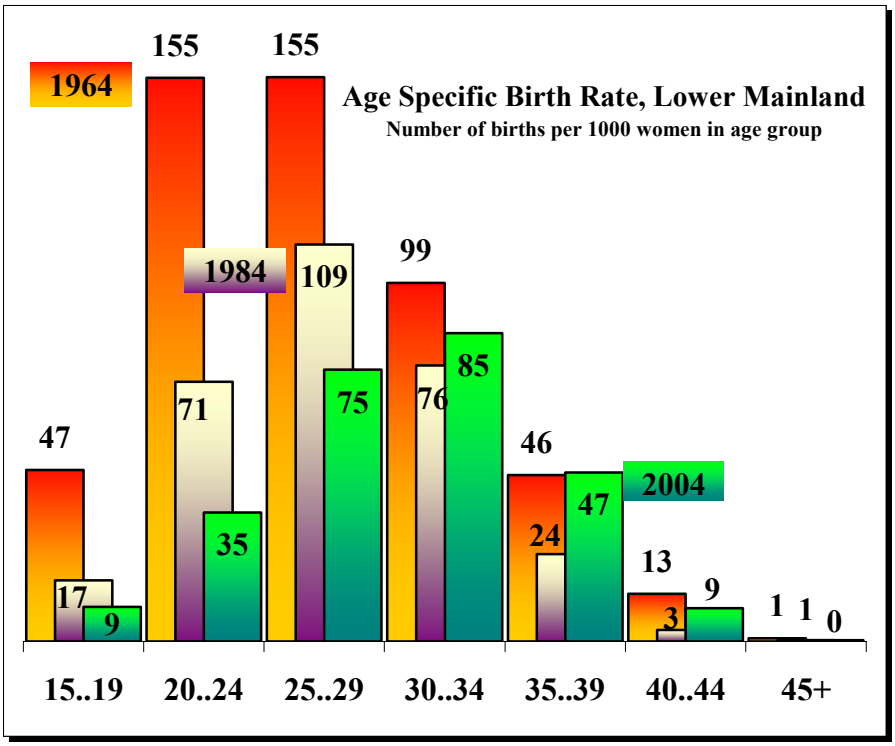
It is likely that the projections presented here are conservative, in that the extension of historical trends brings the greatest relative reductions in mortality to the younger age groups, reflecting the pattern of the past 40 years. Recently, however, much of policy and medical research attention has shifted towards mortality factors affecting the older population.

Having noted this, the largest projected absolute declines in mortality occur in the older age groups.

The degree to which the population projection is affected by trends in age specific mortality rates (in terms of the size and age composition of the region's future population) can be measured through preparing alternative scenarios about the future magnitude of change in mortality rates (sensitivity analysis): before doing so, it is appropriate to consider the life cycle of natality, thereby delimiting the other end of the human life cycle.

C. Births and natality

Figure 9

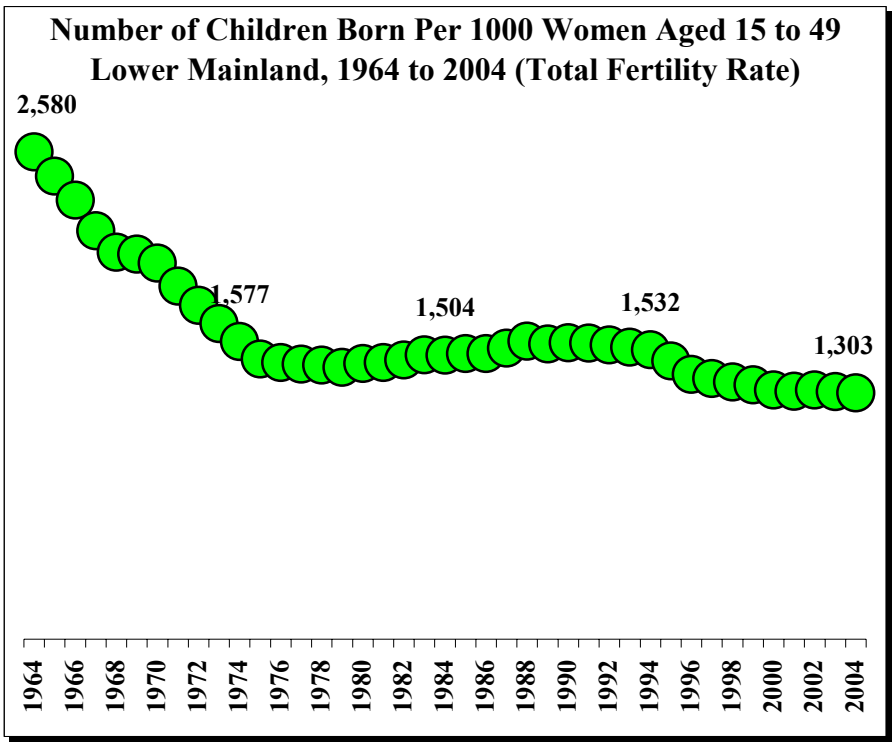


As with death rates, there is both a distinct life cycle pattern to birth rates and significant change in the age specific pattern over the past forty years (Figure 9) [3]. In 1964, there were 155 births per 1000 women in each of the 20 to 24 and 25 to 29 age groups, making these age groups the high birth rate stage of the life cycle. If these age specific rates remained constant, there would be a total of 2580 births per 1000 women as they aged through the childbearing stage of the life cycle: this value is referred to as the total fertility rate, indicating that with these rates there would be an average of 2.58 children born to each woman during her lifetime.

A total fertility rate of 2.1 is referred to as the replacement level birth rate, with the 0.1 accounting for female deaths before childbearing and the 2.0 providing the replacement of two adult parents. All other things equal, with a birth rate above this level a population will grow larger and younger as there are more young people added to the population than there are older people for them to eventually replace. Below 2.1, however, the population will shrink and become increasingly older as there are not sufficient young people added to the population to offset the aging, and eventually mortality, of the parental population.

Between 1964 and 1984 the total fertility rate in the Lower Mainland dropped by more than 40 percent to reach a below the replacement rate level of 1.5 children born per women during her lifetime in 1984 (Figure 10). While birth rates fell in all age groups, the biggest declines were in the youngest age groups, with the rate for women aged 15 to 19 dropping by almost two thirds from 47 to 17 births per 1000 women in this age group and for those aged 20 to 24 dropping by a half, to 71 births per 1000.

Figure 10



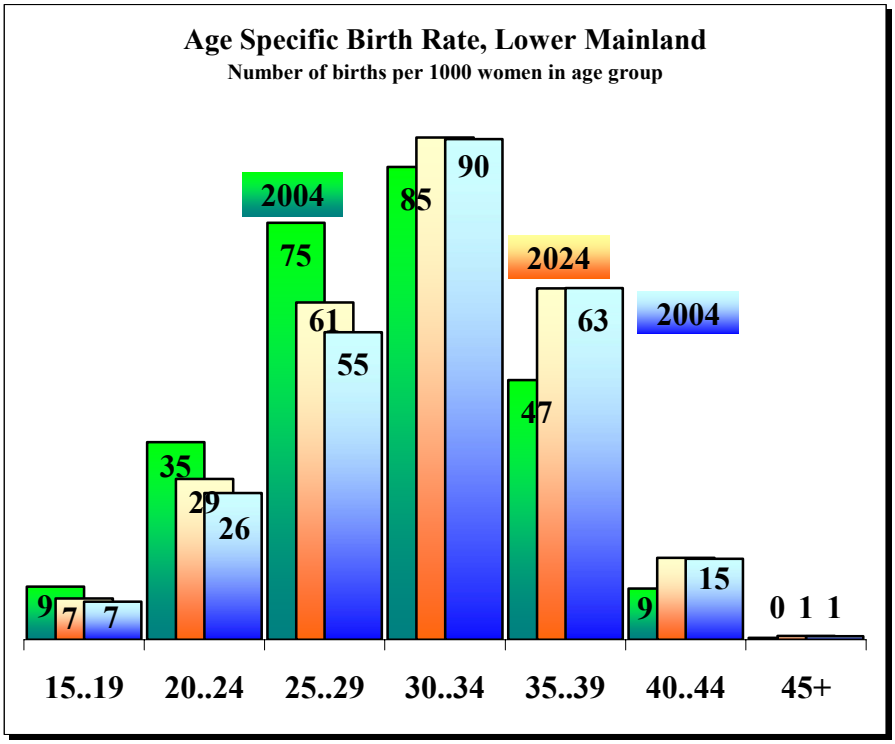
The decline in the propensity to have children continued, albeit at a slower rate, between 1984 and 2004. The decline in the total fertility rate to 1.3 children per woman – a 14 percent decline in the rate over the two decade period – is significant in itself, but is equal to only half of the decline experienced over the preceding twenty years. The most recent decade, however, is not merely an slowing marginal change extension of the preceding one: while birth rates in the younger age groups continued to decline, there were significant increases in the rates in the older age groups. This indicates that some of the decline in the younger age groups in previous years was due to postponing childbearing: the decline in the total fertility rate indicates a declining overall propensity for childbearing.

By 2004, the highest birth rates were seen in the 30 to 34 age group, with the 85 births per 1000 women in this age group being not only the highest rate, but 10 percent above the rate for the same age group in 1984. The 47 births per 1000 women in the 35 to 39 age group was twice 1984's 24 per 1000, while the 35 births per 1000 women aged 20 to 24 in 2004 was half of the same age group's 71 per 1000 rate in 1984.

Postponing has an effect on population growth that is not accounted for in the total fertility rate. All other things equal, with the same total fertility rate, the later in the life cycle that births occur the smaller the numerical contribution of births to the population. As an image, generations are now 30 year age spans rather than the historical 20 years, which means waiting an extra decade for the replacement implied in the replacement level birth rate to arrive.

As with the pattern for mortality rates, diminishing marginal change has occurred in the life cycle of age specific birth rates. Fitting curvilinear trend lines to the annual age specific birth rates for this region from 1964 to 2004, as well as giving due consideration to the patterns of change observed in the provincial and national data, results in patterns of continued decline in the total fertility rate and a continued shifting of births into later childbearing stages of the life cycle. Figure 11 shows two snapshots of this projected pattern of change in rates, with the greatest change occurring in the 2004 to 2024 period (as would be expected with a diminishing change model). This trend based pattern continues the decline evident in the age specific birth rates in the under 30 age groups over the projection period. In addition, it continues the pattern of increases in the 30 plus population but, given the trends evident in the underlying annual data, these increases will essentially be realized during the next two decades.

Figure 11

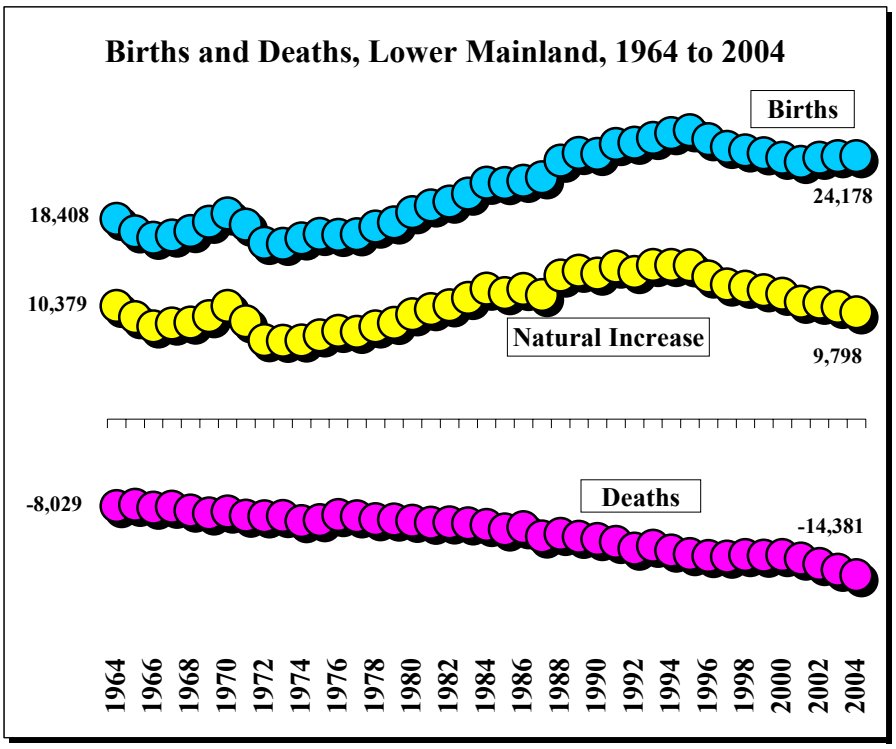


It is the annual pattern of change in age specific birth rates at the single years of age level reflected in the summary five year age group data presented on Figure 11 that are applied in the cohort survival portion of the population model used to prepare the projections for the region.

D. Natural Increase

All other things equal, falling birth rates and death rates in the region would lead to falling annual numbers of birth and deaths. As Figure 12 shows, in spite of these vital rate declines, neither the number of births nor the number of deaths in the region declined over the past forty years, an acknowledgement of the reality that other factors were not constant over this period. A rapidly growing population meant that, while birth rates fell, the annual number of births in the region increased steadily to 1996. With the slowdown in population growth since 1996 the annual number of births has also declined. Similarly, the growth in the population meant that the annual number deaths climbed in spite of falling rates. The aging of the population during this period also played a part: a greater proportion of the population in the older age groups meant a greater number of deaths, and the aging of the baby boomers through the highest-yielding child bearing stages of the life cycle offset some the impact of declining birth rates.

Figure 12



The difference between the annual number of births and of deaths is referred to as natural increase, although it is hard to say what is natural about either birth or death rates, and with a total fertility rate that is well below the replacement level, decrease rather than increase will be the inevitable result. As Figure 12 shows, the contribution of natural increase to population growth in this region has been declining, with the 2004 net addition of 9,798 persons, representing the smallest differential between births and deaths in the past decade. In terms of projections, this is a very useful measure of the contribution made by biology, as opposed to mobility, to population growth.

E. A First Scenario: Natural Increase and Constant Rates

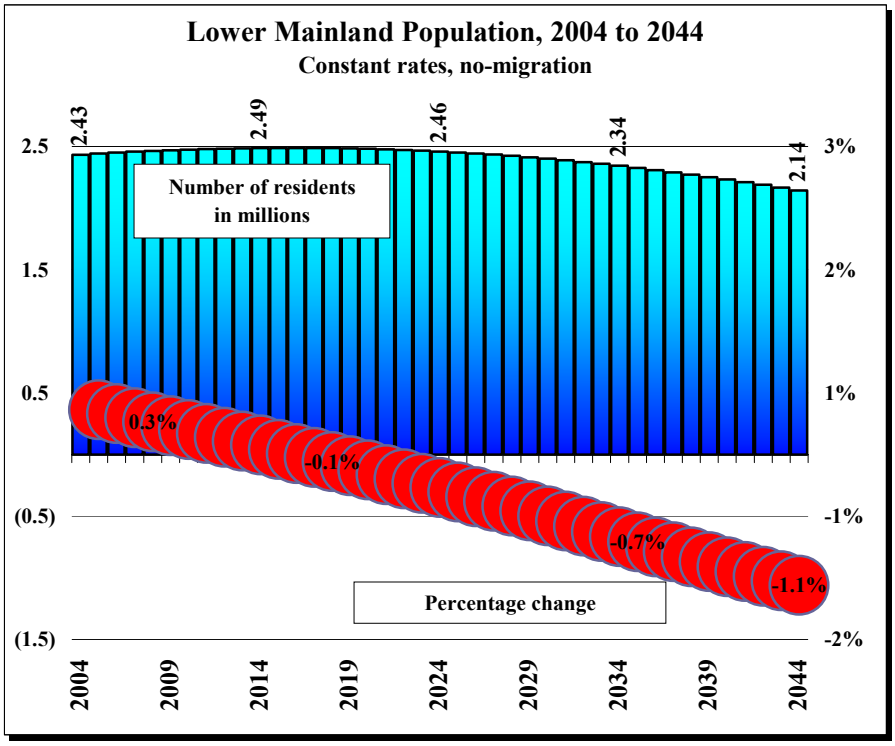
The population projection methodology used here has as its foundation in a single-year of age cohort survival model. The models employed here begin with an initial population broken down by single years of age and sex, and operate by aging this starting population

one year, applying age and sex specific mortality rates to determine the number of people of each age and sex who survive to the next year, applying single years of age birth rates to determine the number of births, thus resulting in some projected number of people in the next year. This process encompasses the projection of natural change in the population based on cohort survival (mortality) and natality. In addition, but outside of the cohort survival model per se, the estimated number of migrants by age and sex are calculated and added to the surviving cohorts to estimate the total population by age and sex in the next year. This population then forms the base for the next annual iteration in the projection process.

The use of mathematical models such as the cohort survival approach in population projection facilitates the measurement of the consequences of uncertainty that projection inherently involves. In mathematical projections such as those presented here, the sensitivity to uncertainty can be measured by establishing a base projection or scenario that describes the future solely in terms of current values for the functional relationships upon which projection models are based.

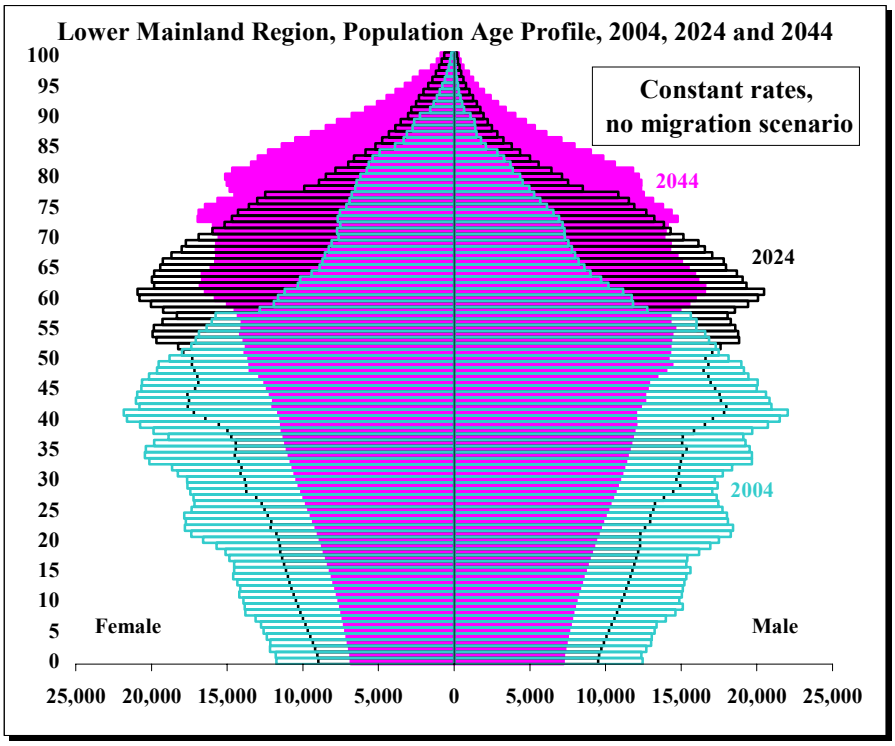
In the case of population projections, such a base projection involves the current age profile of the population and its current birth and death rates. A constant rate, no-migration population projection describes the future of the current resident population on the basis of its current behaviour. As this type of projection involves only birth and death rates, they are often referred to as natural increase projections. Note that preparing such a projection is neither saying that such a situation will occur, or advocates it. Rather, it is establishing a base set of values to which other scenarios can be compared and which will permit the measurement of the impact of different patterns of change in the region's demography.

Figure 13



Given the size and composition of the Lower Mainland's current population and current birth and death rates, and ignoring migration (into or out of the region), cohort survival projections show a long term decline in the total population (Figure 13). Given the region's below the replacement level birth rate, this should come as no surprise: what is surprising is that the decline is both modest and

Figure 14



relatively far in the future. Without migration (in or out), at current birth and death rates the region's population would increase from its current 2.43 million people to 2.49 million in 2016, before declining to 2.14 million in 2044. The reason for the continued growth in the near term even without migration is that the current long life expectancies mean that births will continue to outnumber deaths until 2016 under a constant current rate, no-migration scenario.

Even if held constant at today's level, these long life expectancies would also cause a dramatic aging of the population: of the 2.43 million people currently resident in the Lower Mainland, 58 percent (1.41 million) will be alive – and 40 years older – in 2044. As Figure 14 shows, without migration, the aging of the region's current population will shift the region's age profile up, while the below the replacement level birth rate will significantly shrink its base. The result will be rapid growth in the region's older population, and a significant decline in its younger one.

Figure 15

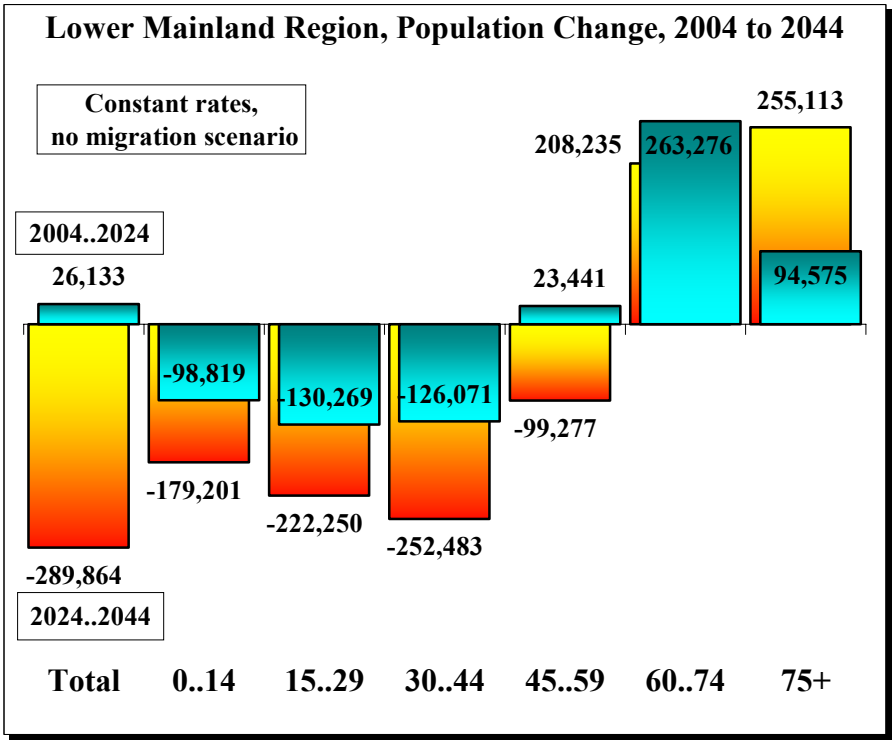
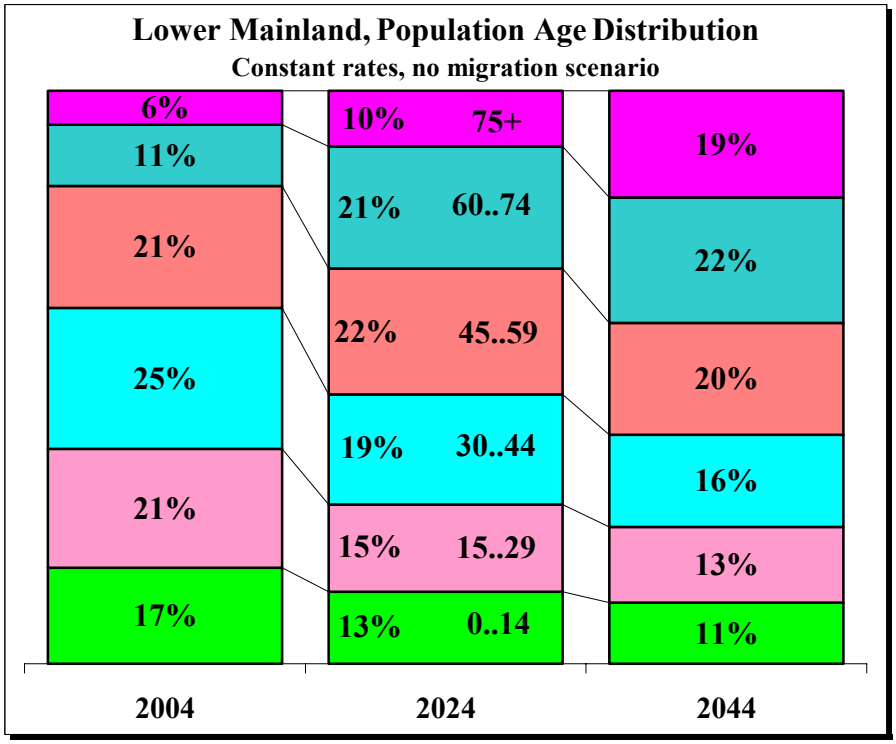


Figure 15 shows that, under these conditions, between 2004 and 2024 the population of the region would increase by 26,133 persons (1.1 percent). This would be

the net result of a 25 percent decline in the number of people under the age of 44 (everyone under the age of 40 in this scenario was born to a resident of the region), and significant increases in the number of people 45 and older (the result of the aging of today's under 50 population). Thus, the net increases of 26,133 people is the balancing of a 355,159 person decline of the under 45 population and a 381,292 person increase in the 45 and older population.

Figure 16



Over the longer term, the 289,864 person (12 percent) decline in the region's population over the 2004 to 2044 period would again be the net effect of a 753,211 person decline, in this case in the zero to 60 population, and a 463,374 person increase in the 60 plus population.

This below the replacement level birth rate and the differential in age group growth rates would result in a more than doubling of the percentage of the region's population that is 60 or older, from today's 17 percent through 31 percent in 2024 to 41 percent in 2044 (Figure 16). Conversely, the under 30 population would fall from today's 38 percent share through 28 percent in 2024 to 24 percent in 2044.

Note that while the magnitude of this shift is strongly influenced by the aging of the current bulge of the region's population in the 38 to 57 age group, given a below the replacement level birth rate, without migration the share of the population in the older age groups would continue to increase, albeit slowly, forever. .

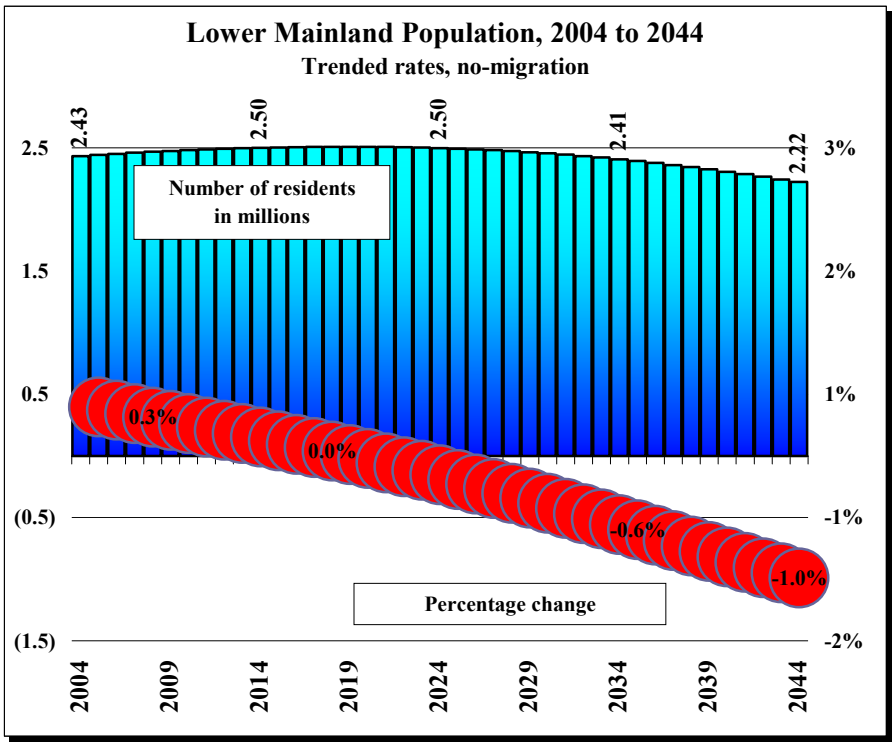
This projection of the future of the region's population without migration given its current age composition and birth and death rates establishes the base for the measurement of the sensitivity of the projection to changes made to make it a more realistic description of the future. The first of these changes is to introduce the projected changes in birth and death rates.

F. A Second Scenario: Natural Increase and Trended Rates

The sensitivity of a population projection to the trending of birth and death rates can be measured by continuing the projection process using the trends in these vital rates discussed in the preceding sections, while again assuming no-migration into or out of the region, and comparing the result to the constant rate, no-migration scenario.

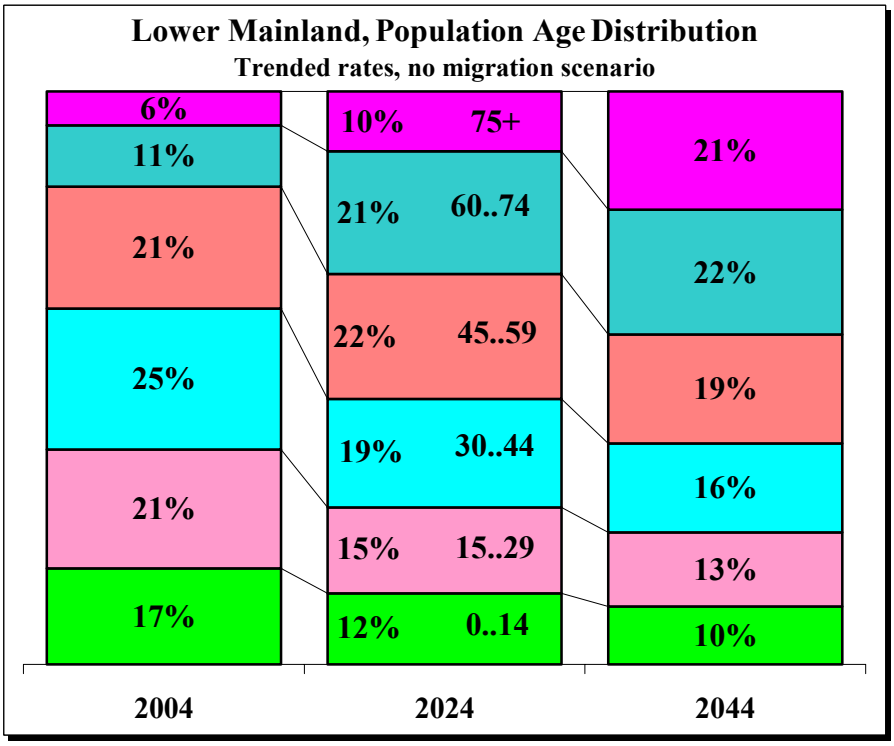
A number of important findings emerge from this comparison. The first is that extending historical patterns into the future subject to continuing diminishing marginal change does not result in a substantially different future population than the constant rates scenario. The differences, while minor, are none the less of importance, as they reveal that following this trended pattern will result in a slightly larger, and older, population in the future than that which would exist if birth and death rates remained constant at their current level. Under this scenario, the region's population would continue to increase until 2019, reaching a peak of 2.50 million people, and would have a 2044 population of 2.22 million people (Figure 17). The reason for this difference compared to the constant rate scenario is that the declines in mortality affect everyone in the population, while the declines in fertility rates affect only women of childbearing age.

Figure 17



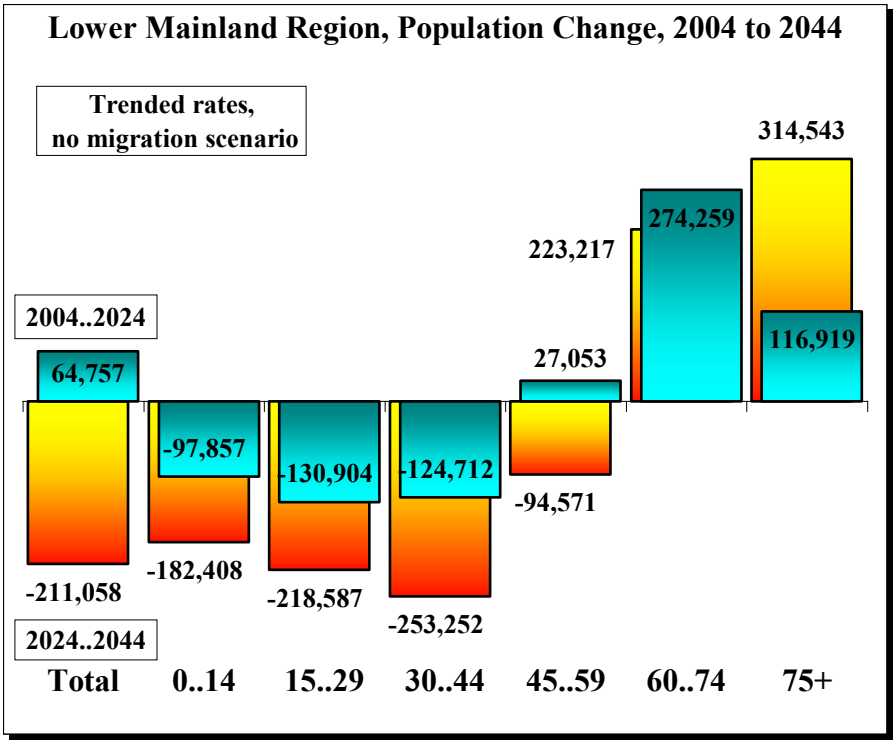
Under this scenario 61 percent (1.49 million people) of today's population would be alive in 2044, compared to the 58 percent from the constant rate scenario. As these people would still be 40 years older, the impact of declining mortality rates is to make the 60 plus population a greater portion of the region's total population (Figure 18). The 60 plus population would account for 43 percent of the total population in 2044, and the under 30 population only 24 percent. On an absolute basis, under the no-migration trended vital rates scenario, the 60 plus population would increase by 391,178 persons over the 2004 to 2024 period, while it would increase by only 357,851 persons assuming today's vital rates remain constant (Figure 19).

Figure 18



Neither of these is a realistic projection of the future 60 plus population in the region, as they deal only with a comparison of the consequences of differing levels of mortality rates. However, together they do show that, implicit in the region's current age profile and vital rates is the reality of a future characterized by the significant aging of its population, with a more than doubling of the relative size of the older population and shrinking of its younger one. Further, they show that trends in birth and death rates will compound this aging. From a strategic planning perspective, these scenarios tell us that every dimension of life in the region that is age related has the potential to change significantly: the degree that they will change will be dependant upon these trends in vital rates, and how they are in turn shaped by the demographic change that will be brought about by migration to and from the region.

Figure 19



G. The three dimensions of migration in the Lower Mainland

As indicated, no-migration, natural increase (or decrease) scenarios are of value in determining the sensitivity of the future population of the region to changes in the vital rates of natality and mortality. However, in themselves they are not realistic projections for a region in which the ability to move – in or out – is not only a privilege but a constitutional right, and where to a large extent the future supply of labour force replacements will be dependant upon net inward migration. To take the next step in preparing long term population projections for the region, this section considers the characteristics of the migratory flows to the Lower Mainland from other parts of the province, the rest of Canada and the rest of the world, and the future implications of extending these historical trends into the future.

The approach to the projection of future migratory flows differs from that applied to births and deaths. In the case of these two vital measures, the dominant factors in determining the annual levels of births and deaths are the region's population with birth and death rates applied to it. While acknowledging that the birth and death rates of migrants may (do) differ from those of residents, the number of migrants in a population in any one year is small, and hence it is the characteristics and behaviour of the stock of residents that will determine the majority of births and deaths in a year.

Migration and particularly in-migration depends to a large degree on the characteristics and behaviour of persons who are resident in other regions. Out-migration, while partially a function of the resident population, is also dependent upon conditions outside of the region. As result, a general approach to migration projections, and the approach utilized here, is to project the level of future migration flows and apply age specific profiles to the flows, rather than to apply migration rates to the region's resident population. These levels and age compositions are then layered into the cohort survival model to produce the trend projections of the regions population.

In doing so, there are three components of migration that must be considered: directly between the region and the rest of the world (immigration and emigration), directly between the region and other provinces (interprovincial migration, which may involve trans-migration - that is, immigration and emigration that occurs elsewhere in the country but which is manifested as interprovincial migration) and intraprovincial migration (people moving between the region and the rest of the province).

a) International migration

Annual migratory flows by individual age groups are often numerically small, and hence subject to significant year to year variation. As a result, it is necessary to use longer term averages to identify general patterns. In the projections presented here, average migration flows by direction and age are based on data for the past decade, a period characterized by both high and low levels of migration.

Figure 20

As with all migratory flows, there is a life cycle pattern to immigration and emigration, the profiles of which are decidedly young: 74 percent of the immigrants, and 70 percent of the emigrants, under the age of 40 (Figure 20)[4]. The peak age groups for both international flows are the 25 to 39 age groups, with relatively few migrants in either direction in the 55 plus age groups (nine percent of the immigration and eight percent of the emigration). Note that the 21 percent of immigration the flow, and the 17 percent of the emigration flow, that are people under the age of 15 is the result of migration of the 25 to 39 parental age group.

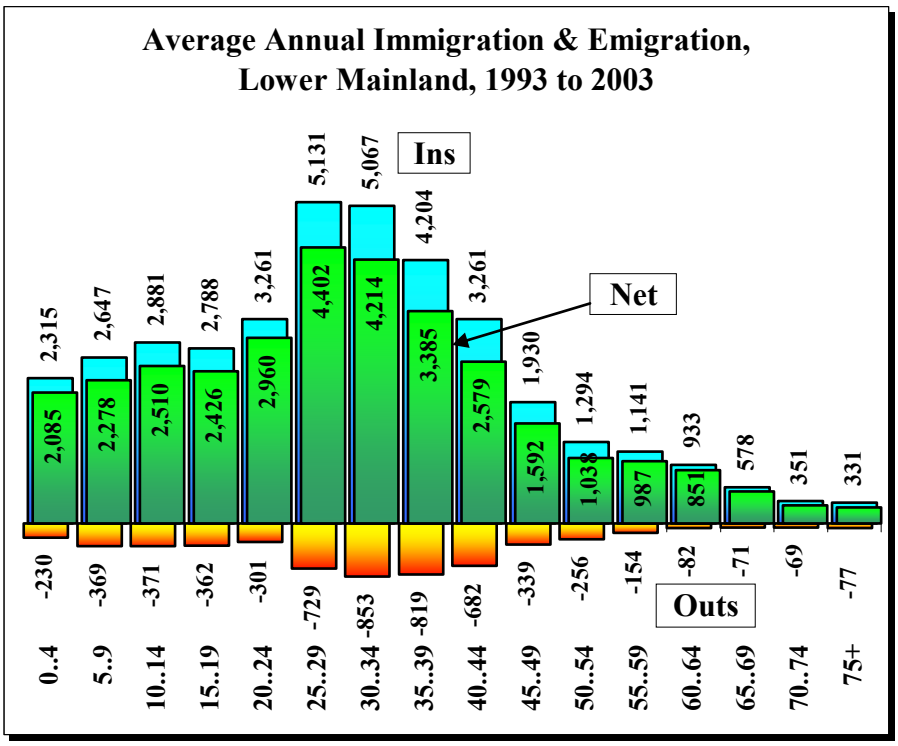
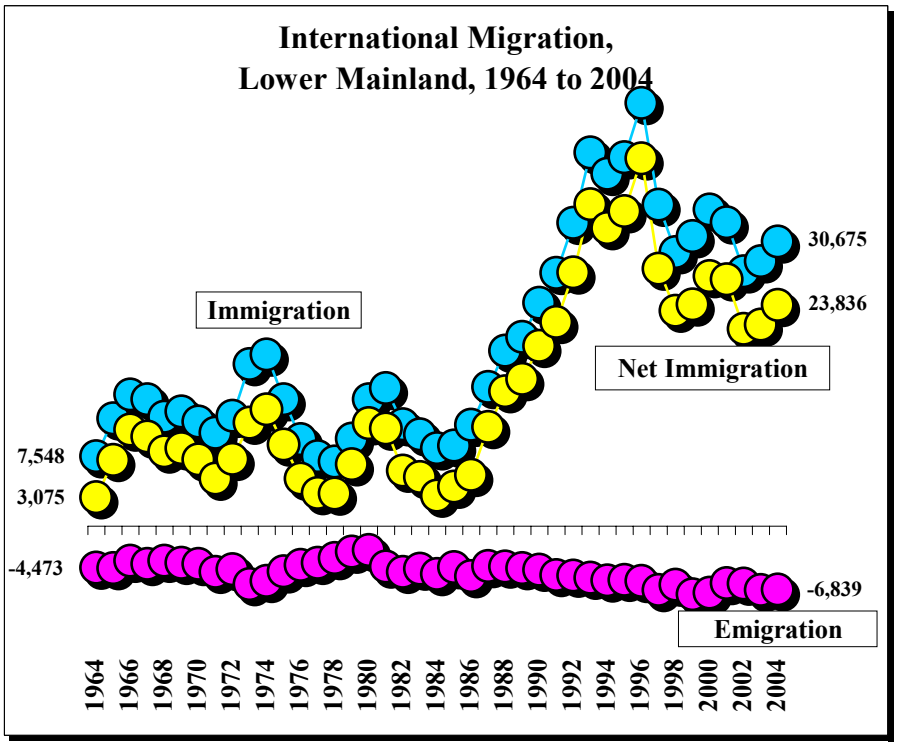


Figure 21

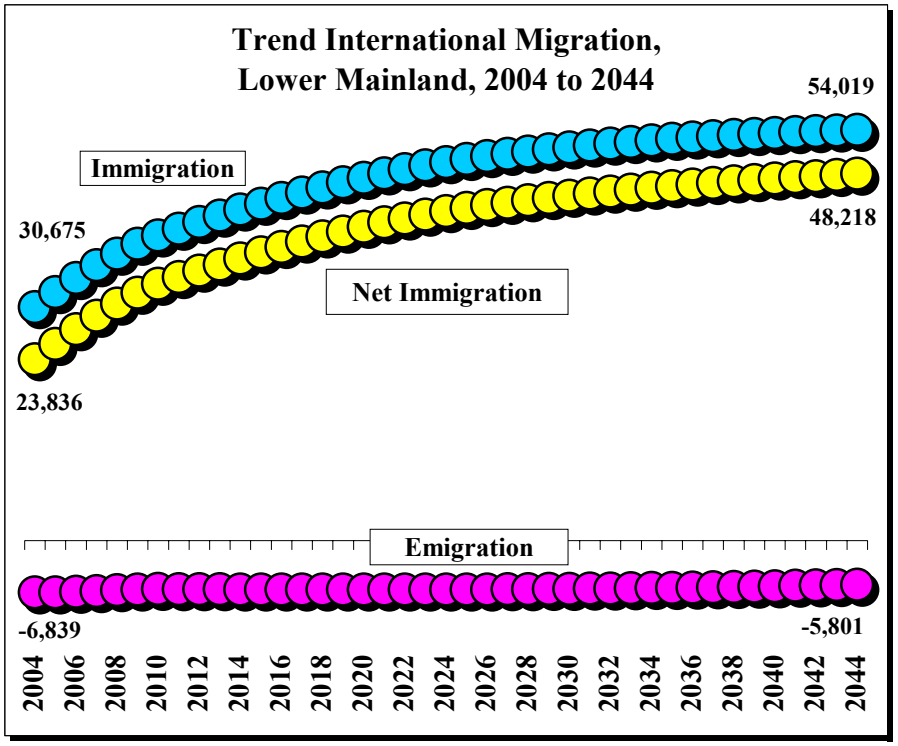
The pattern of international migration to the Lower Mainland is primarily one of immigration, with roughly one emigrant for every four immigrants over the past decade (Figure 21). Immigration to the region over the past decade averaged 34,000 persons per year, an average pulled up by levels of immigration exceeding 45,000 per year in the early 1990s, and down by the past five years averaging 31,000 per year. On a more modest scale, similar change has occurred for emigration, with the past decade's average in the range of 6,500 emigrants from the region, but the past five year's average being in the 6,800 range. The result is that net migration over the past five years was in the range of 24,000 persons per year, a level more in keeping with the late 1980 than the early 1990s.



Three factors were considered in preparing the trend based projections of future levels of immigration and emigration. The first was the general level of international migration that has prevailed in the region over the past decade, the second was the level of net migration experienced at the national level, and this region's (declining) share of the national flow, and the third being the reality that the demography of Canada, like that of the Lower Mainland, has a declining younger population from with to draw future labour force entrants. Combined, these factors indicate a tightening labour supply in the region (and in Canada as a whole) as the bulge in the middle of the current age profiles enters the retirement stage of the life cycle, creating a situation of increasing labour force exit and declining labour force entry. This will result in a situation where increases in labour force participation, labour force productivity, and the working aged population will all be necessary to support the economic growth that Canada will require to provide the social and health care services demanded by its aging populations.

The mathematical basis of the projections of immigration was to trend them towards their levels of the early 1990s over the next decade, and then to link them to a constant share of national immigration flows which were in turn projected to average slightly less than one percent of the national population. In the case of emigration, a similar approach was used, trending from the current rate of emigration towards the lower long run average rate of emigration from the Lower Mainland of two emigrants per 1000 residents. With this approach, immigration to the region is a function of the national level of immigration while emigration is a function of the size of the region's population.

Figure 22

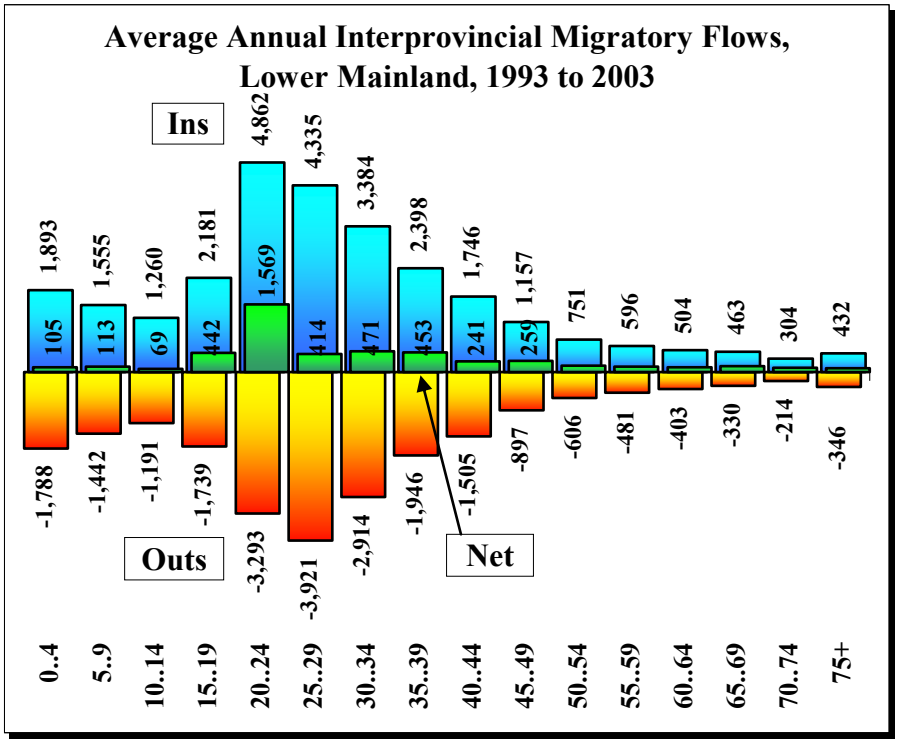


The results of this trend based projection of international migration flows are shown of Figure 22, with immigration increasing from 2004's 30,675 immigrants to 54,019 by 2044. The diminishing rate of increase in immigration that this projection demonstrates is a result of the slowing in growth of the country's population as a whole as it moves to a population growth situation characterized by natural decrease. The math behind a constant incremental growth rate applied to a base that is growing at a slowing rate leads to a projection of the plateauing of the number of immigrants to this region in the 54,000 per year range.

Given the projection of a gradual slowing in the annual number of emigrants from the region from the current 6,839 to 5,801 in 2044, net immigration from the region would grow from its current 23,836 to 48,218 in 2044. Given the young age profile of both immigration and emigration, and the magnitude of net immigration, clearly immigration will slow the aging of the region's population. While the extent to which it could do so can be measured using sensitivity analysis, this will be postponed until after all migration flows have been considered.

b) Interprovincial Migration

Figure 23

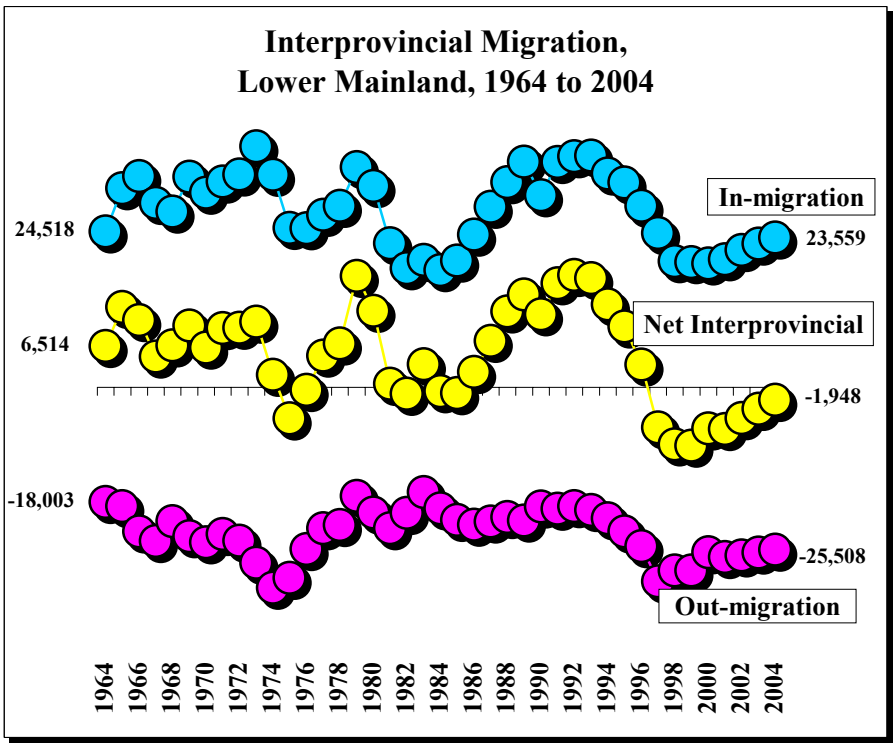


Interprovincial migration involves people changing their place of permanent residence within Canada. In the case of this region, it includes people moving to the Lower Mainland from the other provinces of Canada and those who moved from the Lower Mainland to other provinces. As with international migration, interprovincial migration is dominated by the young (Figure 23). Four out of five interprovincial in-migrants and out-migrants are under the age of 39: compared to three out of four for international flows. As might be anticipated, the interprovincial flows are more concentrated in the young adult age groups, with the 20 to 29 age group being the peak years for interprovincial migration compared to the 25 to 34 peak for the international flows. As with international migration, only 8 percent of interprovincial flows are people aged 55 and older.

Historically, interprovincial migration to the region has generally exceeded out migration, with net interprovincial migration in the range of 7,700 per year over the 1964 to 1994 period, and 11,100 over the 1985 to 1994 period (Figure 24). Over the past decade, however, out migration has exceeded in migration, with net interprovincial migration averaging a loss of 3,500 persons per year. The net outflow of residents of the region to other provinces commenced in 1997, reached a loss of 9,100 people in 1999, and has been gradually shrinking since to reach a net loss of 1,925 in 2004. This narrowing of the gap between interprovincial ins and outs has been the result of both increases of in-

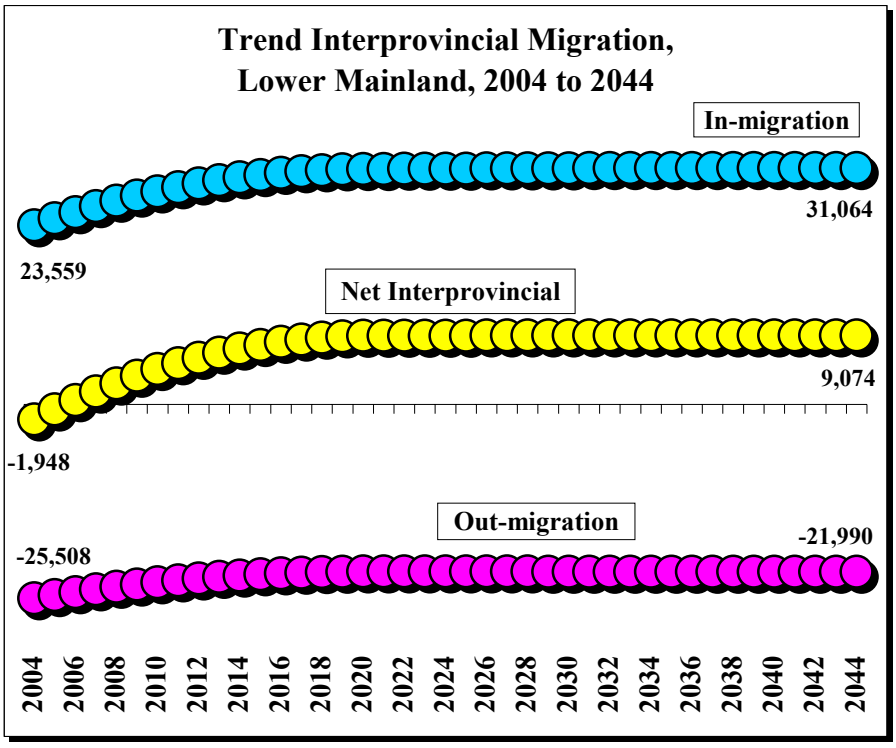
migration and decreases of out-migration: these trends will bring net interprovincial migration into positive territory in 2005.

Figure 24



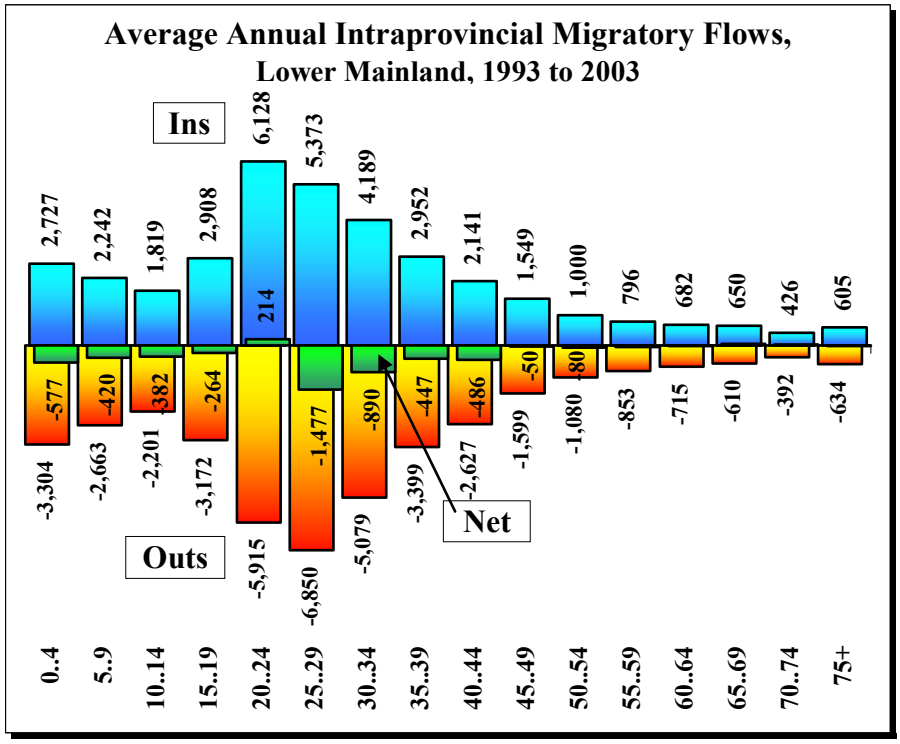
Fitting trend curves to the long run levels of interprovincial in- and out-migration, and using a diminishing marginal change approach acknowledges that the aging of Canada's population is likely to slow the rate of mobility within Canada over the next four decades. It produces projections of the interprovincial flows that bring net interprovincial migration into the range of 9,000 migrants per year by the 2020 (Figure 25). This projected level is above the 1964 to 1993 average of 7,700 per year but below the 1985 to 1994 level of 11,000 per year. The projected levels of interprovincial in- and out-migration, combined with the average age profiles of each flow for the last decade, form the interprovincial migration inputs for the trend based population projection.

Figure 25



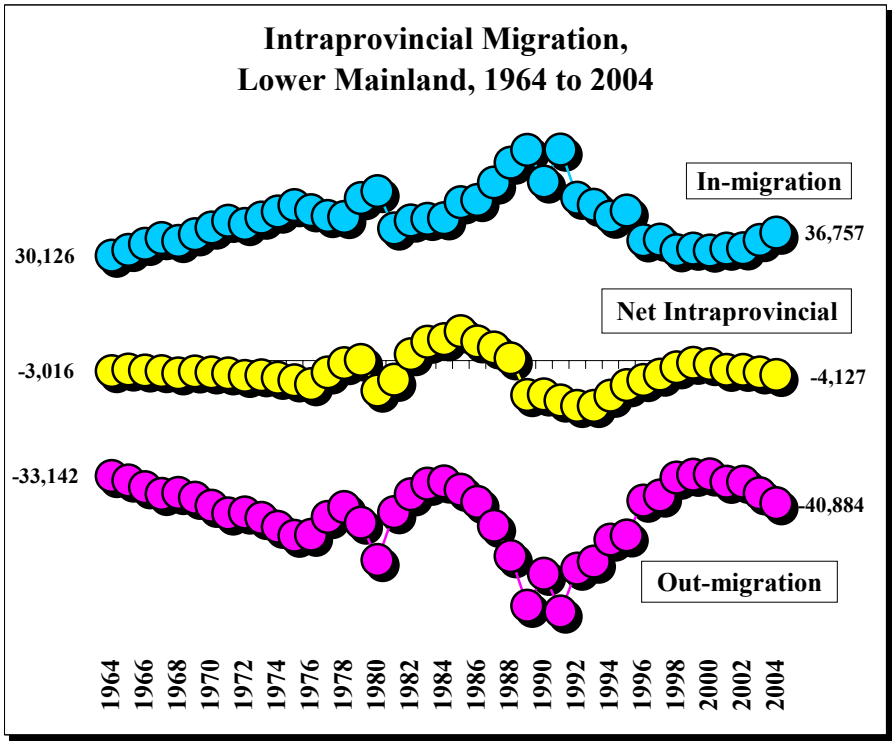
c) Intraprovincial Migration

Figure 26



Intraprovincial migration involves people changing regions of residence within the province. Of the three migration flows it is often the easiest to do and the most difficult to measure. Moving from Princeton to Hope is much less complicated than moving from Princeton to Toronto, and requires much less documentation that can be used to estimate mobility levels. Thus, while what is intended by measures of "intraprovincial" is to identify people changing their place of residence from within this region to other regions in the province, and from other regions to this one, changing boundaries and the rather "soft" data that must be used to estimate these flows results in the data being more of indices than precise measurements. Having said this, the patterns shown in the data generally conform to what is observed on the ground, and the data are essential as inputs to any projection process.

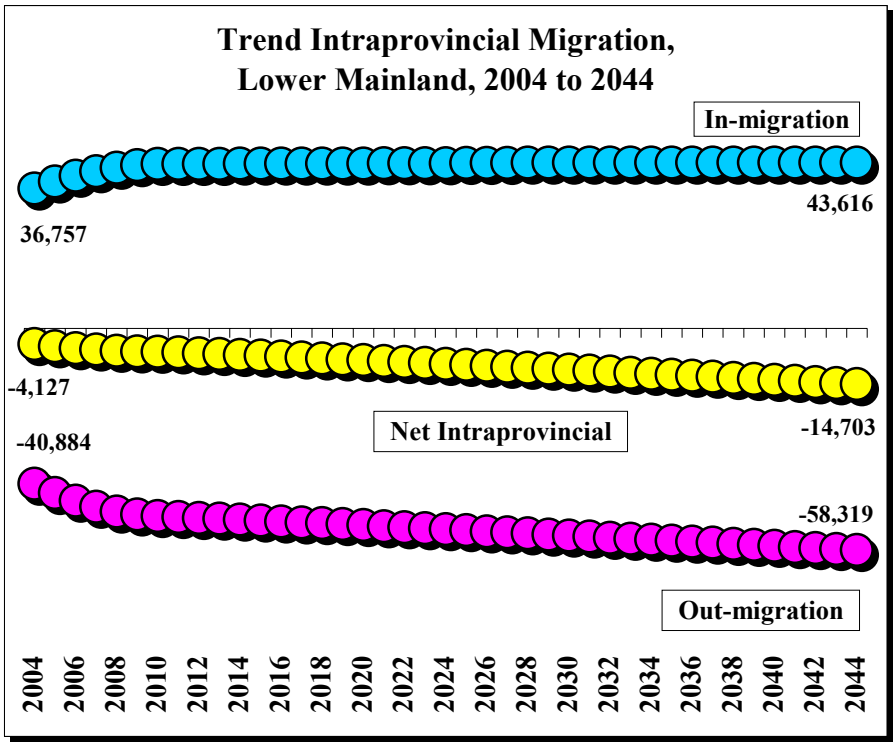
Figure 27



As with the two other migration flows, intraprovincial migration involves a relatively young life cycle pattern, one that closely resembles that of interprovincial migration (Figure 26). Four out of five intraprovincial in- and

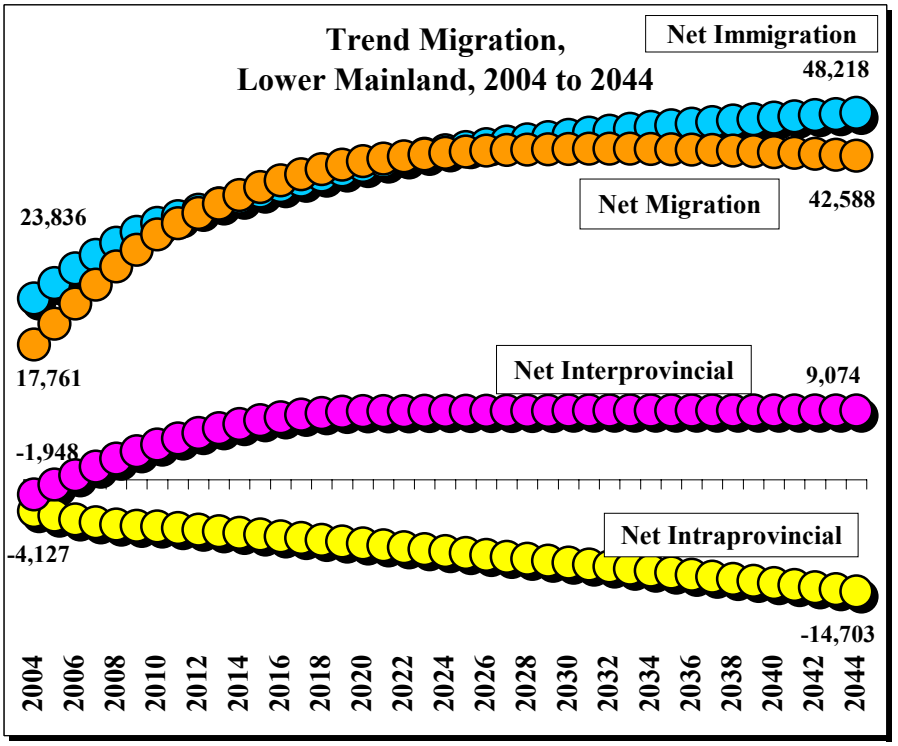
out-migrants are under the age of 40, one out of five is under the age of 20, and only eight percent are 55 years of age and older.

Figure 28



Reflecting the ease of intraprovincial migration, its directional flows are the largest of the three types of migration. They are also the most closely balanced of the flows, averaging a net loss from this region to the rest of the province of 2,400 people per year over the past four decades, 3,900 over the past decade, and 2,800 over the past five years (Figure 27). The record net outflow was the 13,000 person loss from this region to the rest of the province in 1993 and 1994. Over the past two decades there has been a general counter cyclical pattern of intraprovincial migration, with higher levels of out-migration, and lower levels of in-migration when the region's economy has been relatively strong. The two factors that account for these trends are economic opportunities for the young outside of the region and strong housing prices for vendors within the region.

Figure 29



Over the long run, given approaching retirement of a large number of equity-rich home owners in the Lower Mainland, and the improving regional economies of the province, trending based on diminishing marginal change produces projections of increasing future levels of intraprovincial migration in both directions (Figure 28). Combined, these two migratory flows increase

the region's net loss to other parts of the province from the current 4,127 loss per year through the early 1990s' record lows of 13,000 by 2038 to reach the 14,700 level by 2044.

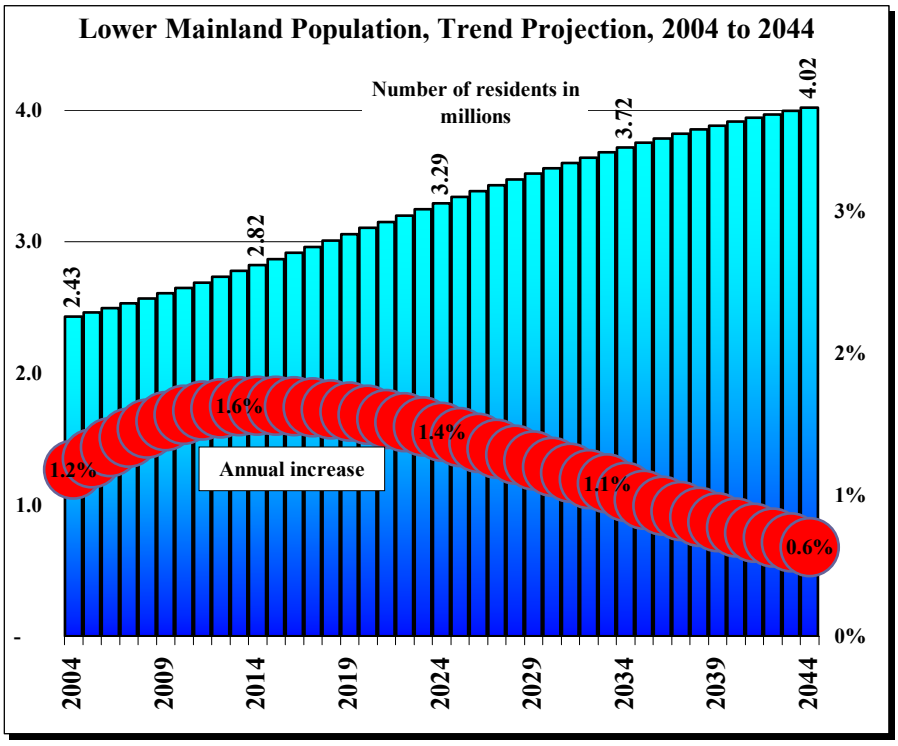
d) Relative future levels of migration

Combined, the trend based projections of all individual migration flows to and from the region results in net migration flow to the region that will increase from its current 17,800 level to pass through its early 1990s levels of 37,000 by 2014, and then flatten out in the range of 42,600 from 2024 to the end of the projection period (Figure 29). While net inter provincial migration is projected to move back to being positive, it will generally be only sufficient to offset the increases projected for net intra-provincial out migration. Thus net immigration will be, as it has been over the past decade, the major component of migratory change in the region in the coming four.

H. A trend based population projection for the Lower Mainland, 2004 to 2044

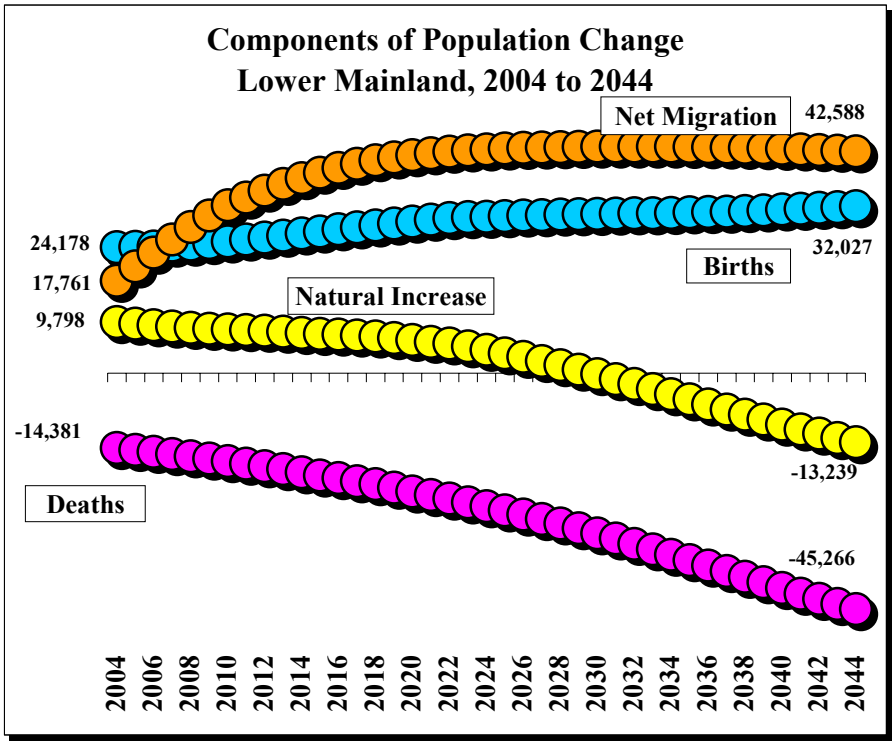
The addition of the projected levels of the six migratory flows, along with their age profiles (by single years of age and sex) to the cohort survival model of aging and trended births and death rates leads to a projection of the Lower Mainland's population increasing from its current 2.43 million people to 3.29 million in 2024 and 4.02 million in 2044 (Figure 30). This projected increase of 861,000 people over the next 20 years, and 727,000 over the following 20, would add 1.59 million people to the region's population.

Figure 30



This projected 65 percent increase in the total population is less than half the 148 percent increase in the region's total population that occurred over the past forty years. The projected absolute increase of an additional 1.59 million people added to the region's population over the next four decades is only slightly larger than the 1.45 million added over the past four. Thus, a scenario for demographic change that involves extending historical trends into the future, while acknowledging patterns of diminishing marginal change, results in a

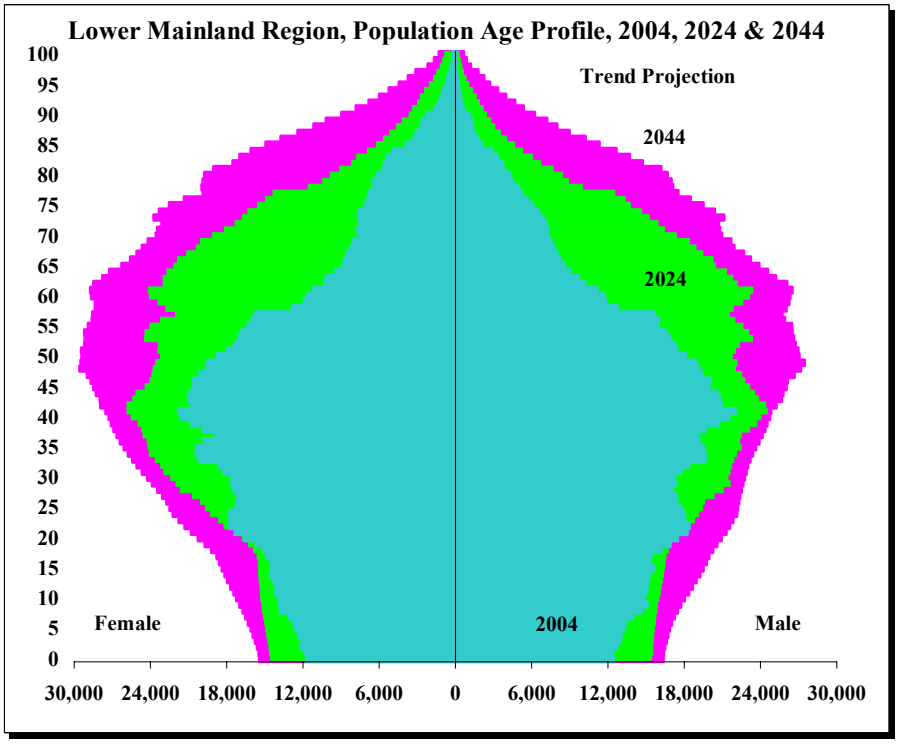
Figure 31



region that will grow relatively slowly, and at about the same rate absolutely, compared to its past experience.

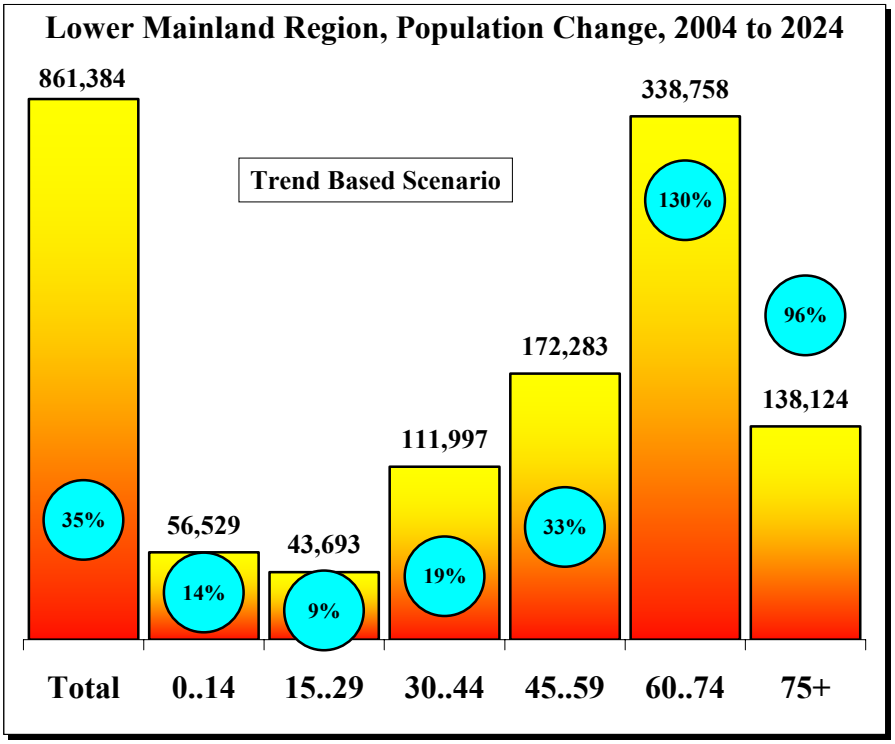
The no-migration scenarios considered earlier show that without migration a below the replacement level birth rate would mean that the region's population would slowly decline. The direct impact of migration is the additional (younger) people it brings to the region: given their age profile, its indirect impact is to increase the number of births, and, later in the life cycle, the number of deaths in the region. As a result, the number of births in the region would increase, from its current 24,200 to 32,000 by 2044, in contrast to the decline to 14,100 in 2044 under the no-migration trended rates scenario (Figure 31). Similarly, the annual number of deaths in the region under the trend rates and migration scenario would increase from their current 14,400 level to 45,300 in 2044, compared to the increase to 36,700 in the comparable no-migration scenario. In spite of this difference, natural increase will nonetheless become natural decrease by 2030, as the number of deaths in the region will still exceed births by 2030, later than the 2019 cross over without migration, but still part of the future.

Figure 32



The most significant consequence of the projected levels and composition of migration to the region is not that it will increase the region's population, but that it will slow – not halt – the aging of the population. As Figure 32 shows, the age profile of the region will

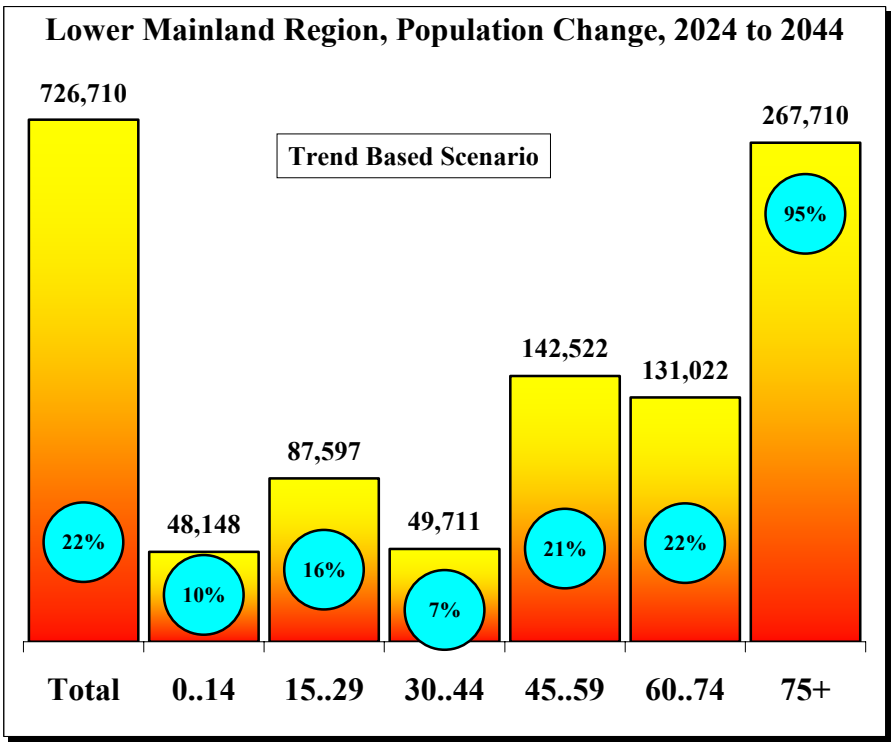
Figure 33



still shift up with the aging of this region's current residents, and of the new comers who move here, given the reality that the below the replacement level birth rate will not be able to expand the base of the age profile faster than aging will expand the top. In passing, note that while the in-migrant population in the future may have a different birth pattern than the region's residents, the trends observed in the pattern of change in birth rates over the past decade capture this migration compositional effect, and hence extend it into the future.

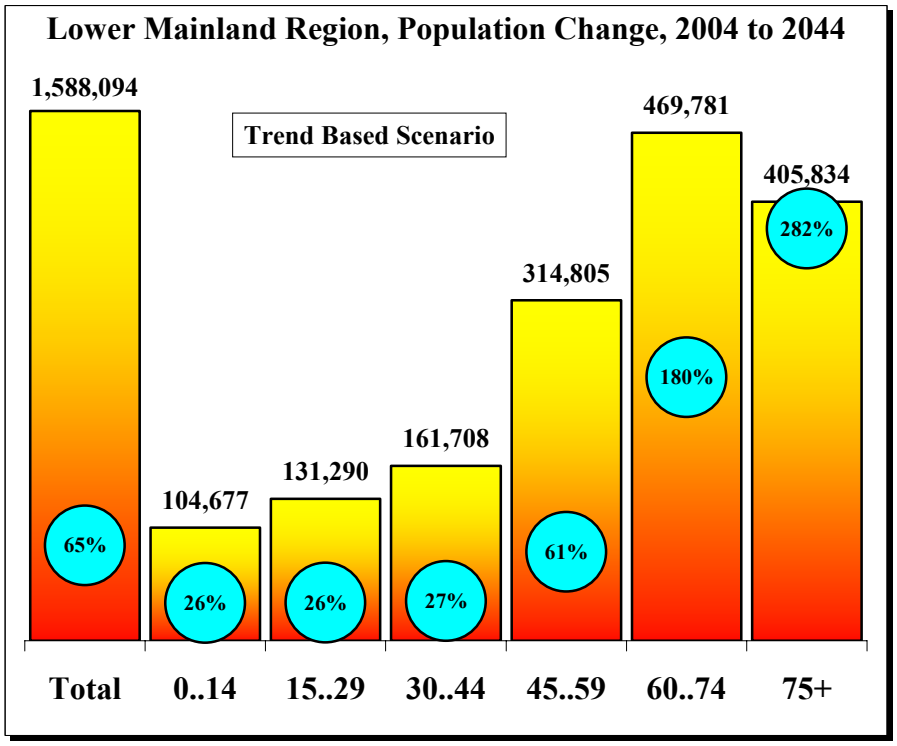
The impact of migration will be felt to the greatest degree in the younger population (Figure 33). In contrast to the 353,473 person (25 percent) decline in the under 45 population of the no-migration trended rates scenario, over the next two decades with migration the under 45 age group would increase by 212,200 people (14 percent). Migration will also contribute to the growth of the older population, with the 60 plus population increasing by 476,900 persons (118 percent) compared to the 391,178 person (97 percent) increase over the 2004 to 2024 period.

Figure 34



The aging of the regions current residents is clearly shown in the 130 percent increase in the 60 to 74 age group over the next two decades, with today's typical resident, a 40 to 45 year old, becoming a 60 to 65 year old over the next two decades.

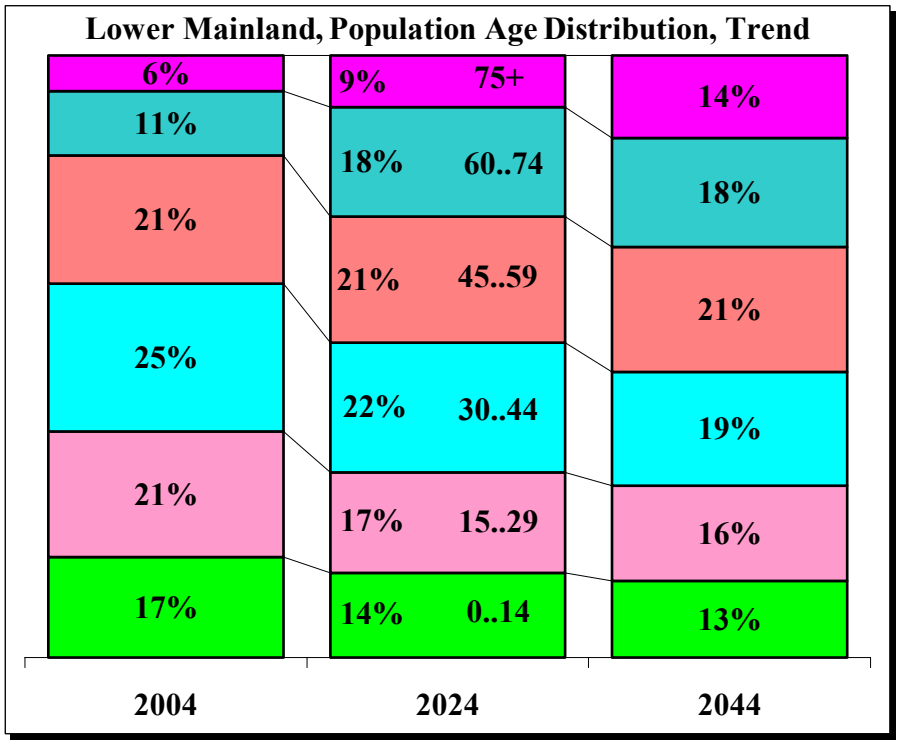
Figure 35



This pattern continues into the next two decades (Figure 34), as today's 40 to 45 year old becomes 2044's 80 to 85 year old. This means that in the post 2024 period, the largest absolute and percentage change will occur in the 75 plus population, as it grows by 267,710 people (95 percent). The smallest relative growth would be seen in the 30 to 44 year old group (at seven percent), while the slowest absolute growth would be seen in the 0 to 14 age cohort, as it grows by 48,148 people.

Overall, under these continuing trends, the next four decades will bring a more than doubling in the number of people aged 60 and older in the region. The largest relative and absolute increases over the whole four decade period will be in the 60 to 74 and the 75 plus age groups, as they add 469,781 (180 percent) and 405,834 (282 percent) individuals, respectively. The smallest absolute and relative increases will be in the youngest age cohorts: the under 14 and 15 to 29 age groups are projected to add 104,677 and 131,290 people (relative growth of 26 percent in both age groups) over the next four decades (Figure 35).

Figure 36



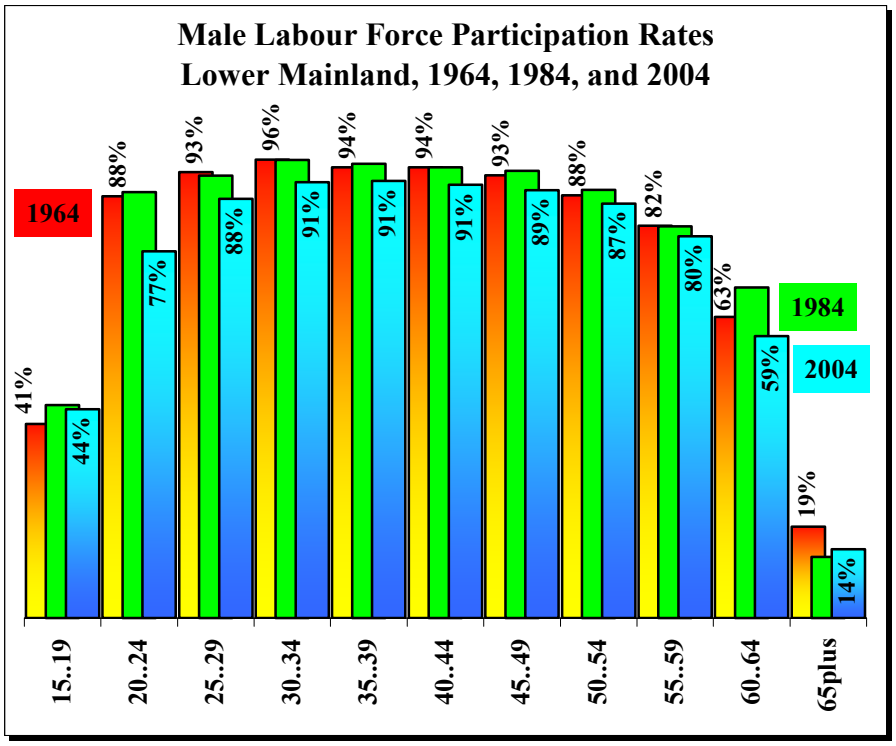
The pattern of demographic change will shift the relative shares of age groups in the region's population (Figure 36). As would be anticipated, the 60 and older age groups will increase their shares, with the 75 plus population more than doubling its share from 6 percent today to 15 percent in 2044, and the 60 to 74 age group's share

increasing from 11 percent to 18 percent. In total, the 60 plus population will account for one third of the region's 2044 population, almost twice its current 17 percent share. Note that the trend projection age profile for 2044 is not only significantly different from today's, but significantly different from the 2004 profile that would result from trending vital rates and no-migration (as shown on Figure 18). All other things equal, but without migration, the 60 plus population of the region in 2044 would account for 43 percent of the region's population rather than the trend 32 percent or the current 17 percent. Conversely, the no-migration scenario would result in an under 45 population of 39 percent, compared to the migration scenario's 48 percent and the current 63 percent share of the younger population.

Migration, therefore, will make the region's population larger than it is today, but will not on its own be sufficient to offset the aging of the region's current residents and the consequences of a below the replacement level birth rate.

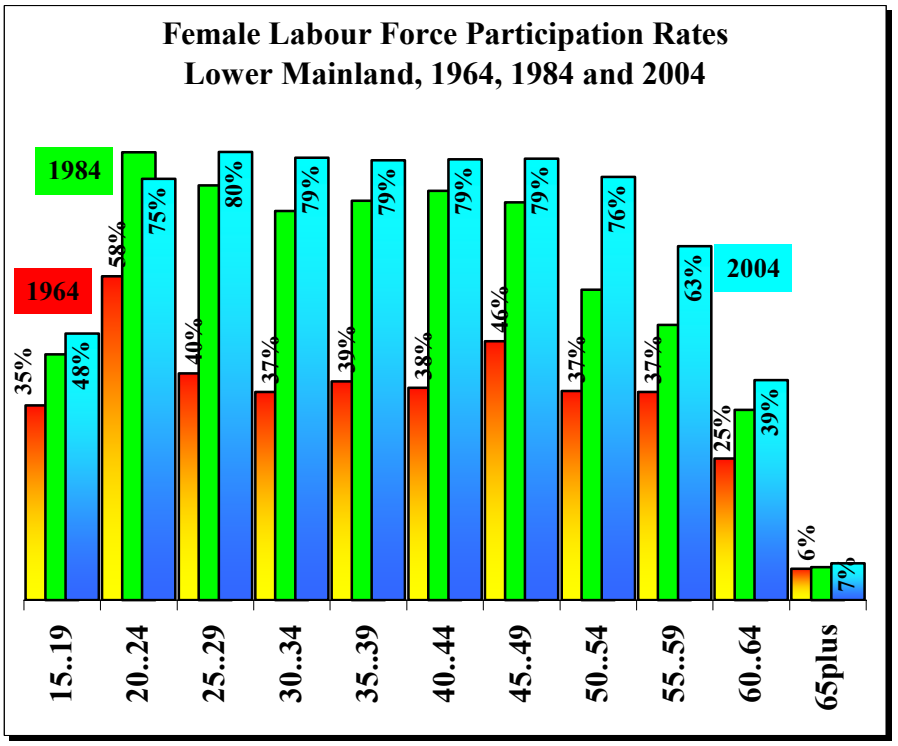
III. LABOUR SUPPLY

Figure 37 **A. The life cycle of labour force participation**



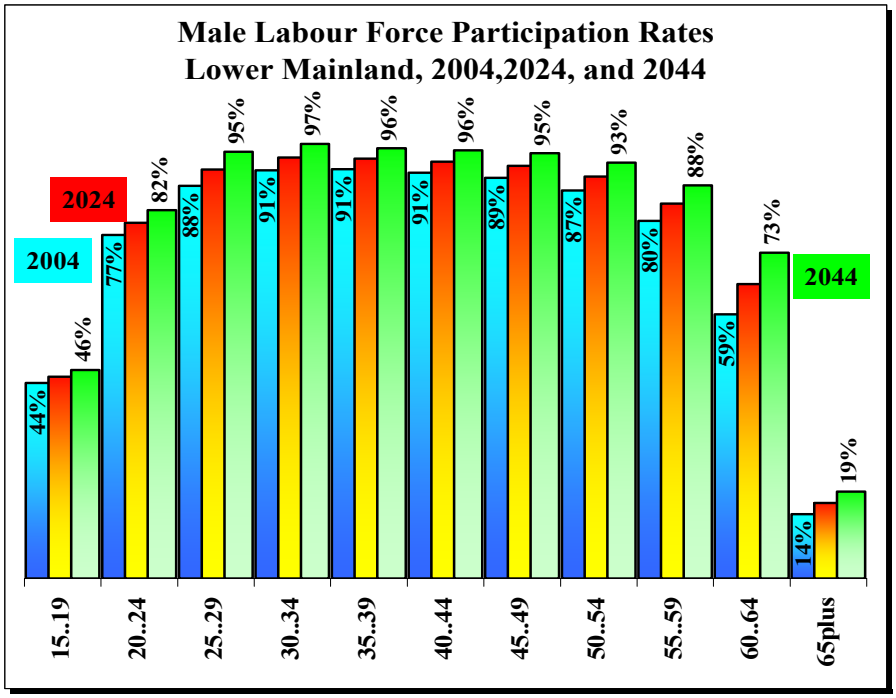
The age specific labour force participation rate is the percentage of people in an age group who are either employed or actively seeking employment. As with the other variables considered in these projections, labour force participation demonstrates a distinct life cycle pattern. Considering the example of male labour force participation rates in 2004 (Figure 37)[5], participation increases steeply from the 44 percent rate in the 15 to 19 age group to reach its highest levels in the 89 to 91 percent range in the 30 to 49 age groups before declining through the early retirement stage to reach 59 percent in 60 to 64 age group, then dropping to its lowest level, the 14 percent rate for the 65 plus population.

Figure 38



The age specific participation rates for females in 2004 (Figure 38) demonstrate a similar pattern, increasing from 47 percent in the 15 to 19 age group to the mid-career plateau in the 79 to 80 percent range before declining through 39 percent in the 60 to 64 age group to a low of 6 percent in the oldest age group.

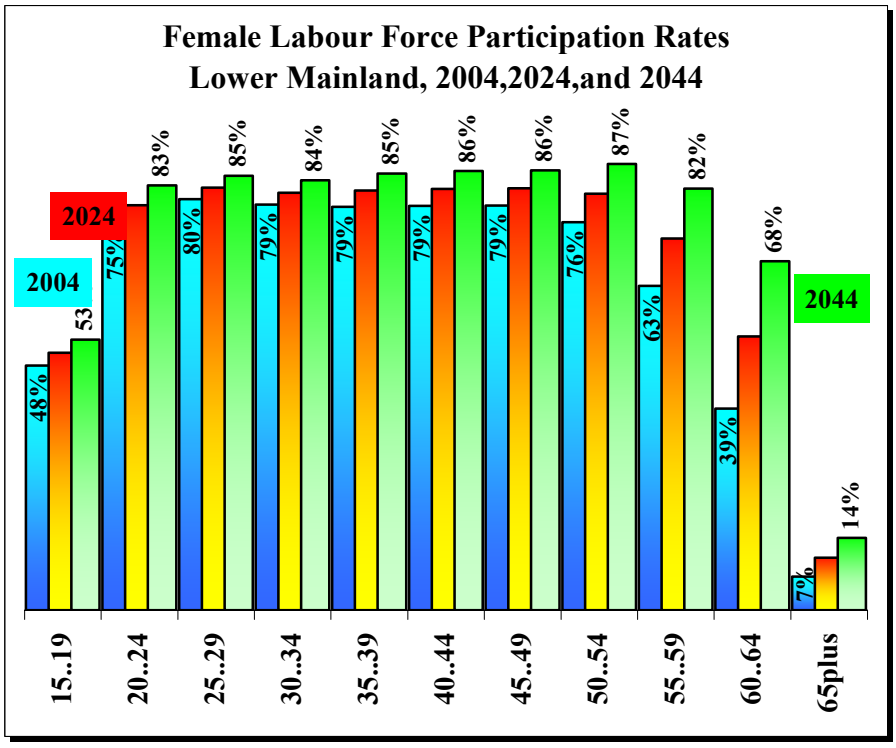
Figure 39



Note that male labour force participation rates are higher than those for females except in the youngest 15 to 19 age group. In the older age groups, the gap between male and female rates is in the range of 10 percentage points, roughly the same as the percentage of females aged 25 to 34 who give birth each year. Also note that even in the male population there is not 100 percent participation in any age group: furthering education, caring for family, illness and disability, incarceration, lack of skills, a sense of futility at ever finding work, life style choices and a range of other factors will always result in less than complete labour force participation.

As with the demographic variables, the life cycle pattern of age (and sex) specific labour force participation has changed significantly over the past four decades. In the case of the male population, the general pattern has been one of modest decline in participation rates, with the 2004 rates for all age groups except the 65 plus population being lower than they were in 1964. As the snapshots of male participation rates on Figure 37 indicate, the annual data show that the path between these two points was not a straight line, with some values in 1984 being higher than they counterparts in 2004.

Figure 40



The pattern of change in female labour force participation was also not in a straight line between 1964 and 2004: in contrast to male rates the path followed was

one of significant increase (Figure 40). In all but the 65 plus age group female labour force participation rates in 2004 were significantly higher than in 1964: in the 20 to 54 age groups, rates doubled over the forty year period, while in the other under 65 age groups they increased by between a third and seventy percent. Note that in the under 50 age groups, most of the increases occurred in the 1964 to 1984 period, reflecting the pattern of diminishing marginal change shown the demographic variables: once rates passed 50 percent, they cannot double again.

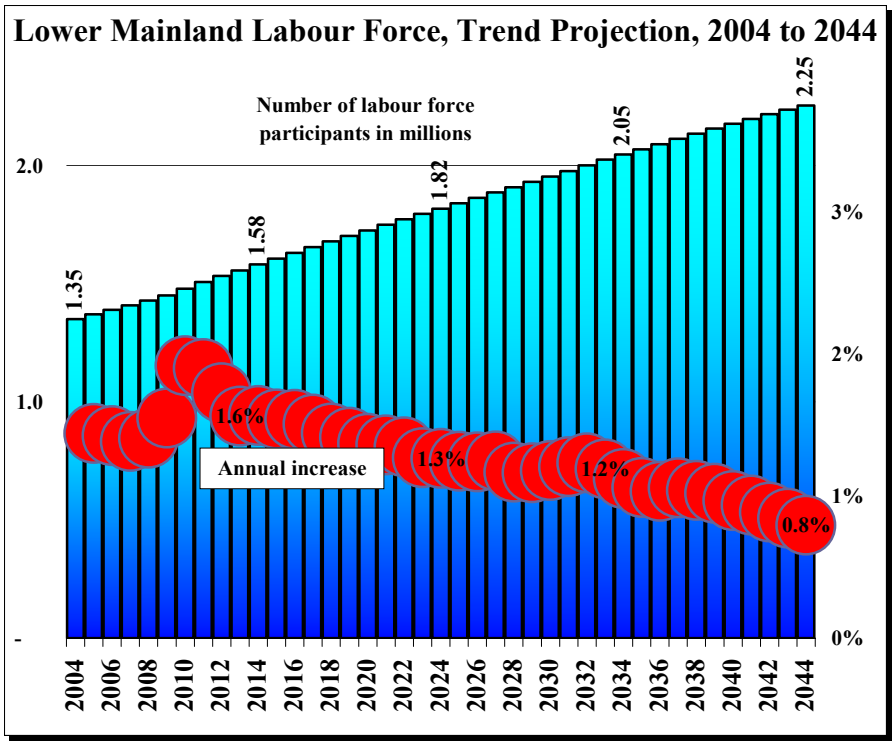
The projection of the future labour force in the region involve a procedure similar to that used for births and deaths, where the age and sex specific participation rates are applied to the population by age and sex to estimate the number of labour force participants in the future. In this projection of labour force participation rates, a trend based approach was used, but with recognition of a tightening national labour market as the boom generation reaches retirement. Both male and female labour force participation rates are projected to increase in the future (Figures 39 and 40). In the case of rates for females this is generally a continuation of the historical pattern, while in the case of male it represents a reversal of the long term pattern. The 2044 rates for males are projected to be back to their 1964 levels in the under 50 population, and slightly above them in the 50 and older population. Rates for females are projected to increase in all age groups, maintaining the historical gap between male and female rates in the prime childbearing years but narrowing it sharply in the older age groups.

There are a number of factors that were considered in preparing these projected participation rates. First, small sample data indicate a recent increase in participation rates in older male age groups, and the 2001 Census indicated an increase in participation for the 65 plus age group. Second, longer life expectancies (and more importantly longer disability free life expectancy) support the hypothesis that people will be able to, will chose to, or may have to, work later in the life cycle. But most significantly, the resolution of labour force and employment projections indicates that population growth alone will not be able to assure a sufficient supply of labour in the future to support the projected economic growth. As is demonstrated in the next major section on employment in the region, in addition to the migration, this region will need to experience increases in both labour force participation and productivity if it is to support even modest economic growth, economic growth that will be essential to support the social and health care services this region currently enjoys.

B. Trend based projection of labour supply in the Lower Mainland

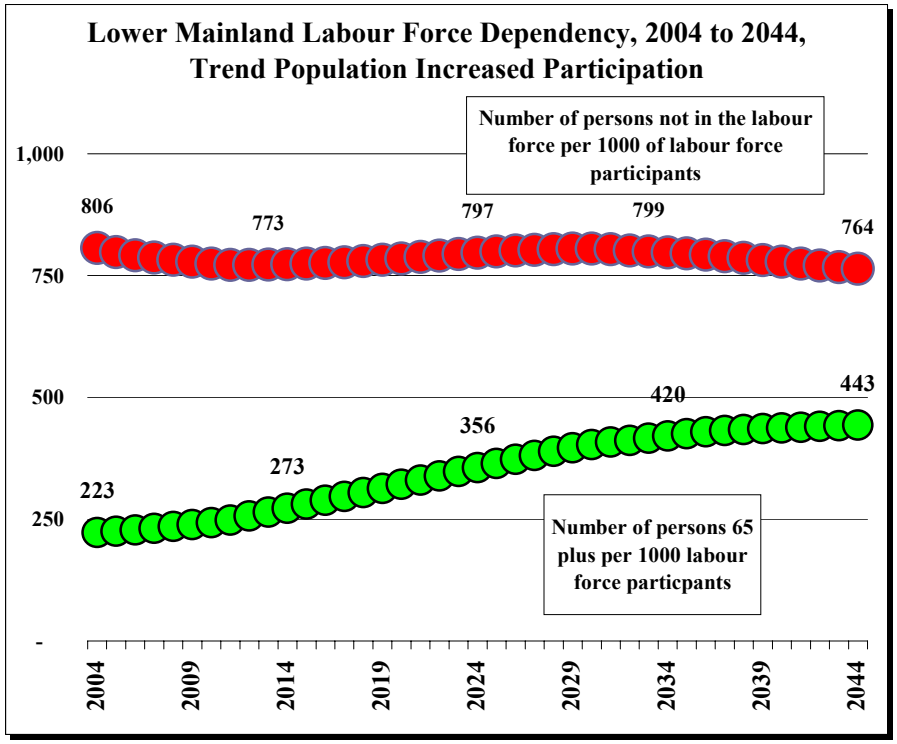
Given the trend population projection and these projected labour force participation rates, it is possible to project labour supply in the region. As Figure 41 shows, the result would be an increase in the region's labour force from its current 1.35 million workers to 2.25 million in 2044 - a 67 percent increase compared to a total population increase of 65 percent.

Figure 41



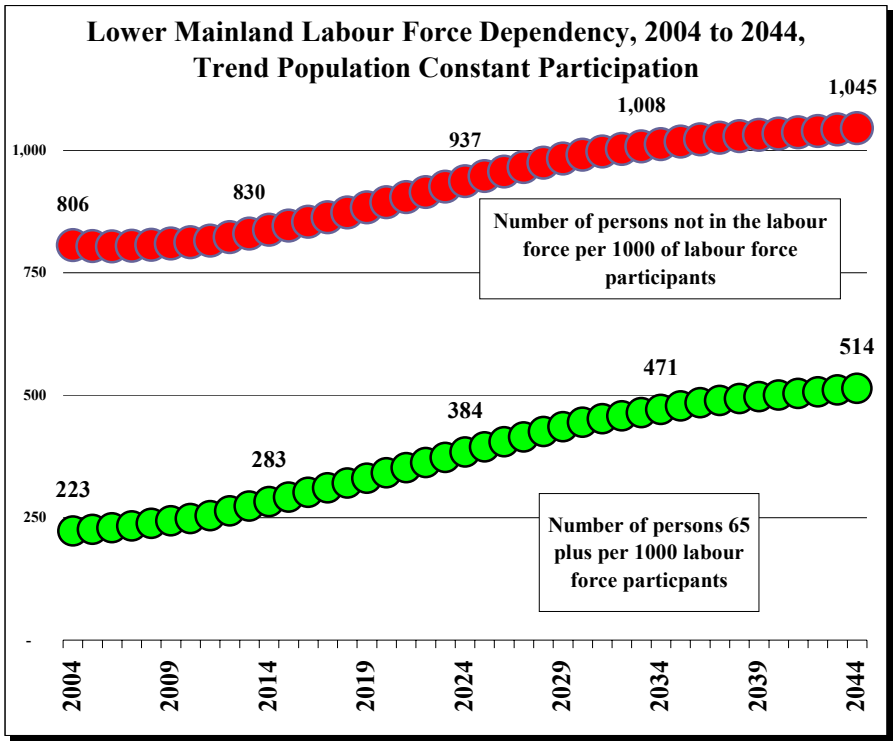
A standard demographic index of the consequences of demographic changes and labour force is the ratio of the number of people 65 plus per 1000 people in the labour force (the elderly to labour force dependency ratio) and the ratio of the number of people not in the labour force to the number of people in the labour force (the overall labour force dependency ratio). As these measures provide, albeit crude, indications of the degree to which the working population provides support, either directly or through taxation funded social expenditures, to the non working population, they are referred to as dependency ratios.

Figure 42



As Figure 42 shows, there are currently 806 people not in the labour force, and 223 persons 65 plus, for every 1000 labour participants. Given the trend population scenario and increased participation rates, the overall labour force dependency ratio would remain relatively constant over the next four decades, while the number of persons 65 plus would almost double. To the extent that the support provided by the labour force to the under 65 population is approximately the same as it is to the 65 and older population, the projected population and labour force would generally be able to maintain current transfers from workers to non-workers. To the extent that there is a greater

Figure 43



relative transfer to the older age group, the contributions required from the working aged population would increase. Note that the difference in paths traced by these two measures is in part the result of the fact that under the increased participation rate scenario, an increasing share of the 65 plus population are in the labour force, something that is not reflected in the ratio of the number of older people to the total labour force.

The role that increasing labour force participation rates play in maintaining a relatively constant overall dependency ratio can be measured by projecting what the ratio of persons not in the labour force to those in it would be without increased participation (Figure 43). With the same population growth and change, but with labour force participation rates remaining at their current level, the ratio of the number of people not in the labour force to the number active in it would increase by 30 percent, from today's 806 to 1,045 in 2044. This is indicative of a 30 percent increase in the contributions required from the labour force to support the current level of transfers to the population that is not in the labour force. The elderly dependency ratio would also increase substantially, growing by 130 percent, from today's 223 persons aged 65 plus per 1000 persons in the labour force to 514 over the next four decades as the region's population ages.

Clearly, increased labour force participation and an increased population of working age, along with increases in the productivity of those working, will be the critical elements of future discussions with respect to funding social policy. The next step in projections is to see if there will be enough jobs for all of these workers, or, interestingly, whether there will be enough workers for the future number of jobs.

IV. EMPLOYMENT

Figure 44 **A. The history of sectoral employment in the Lower Mainland**

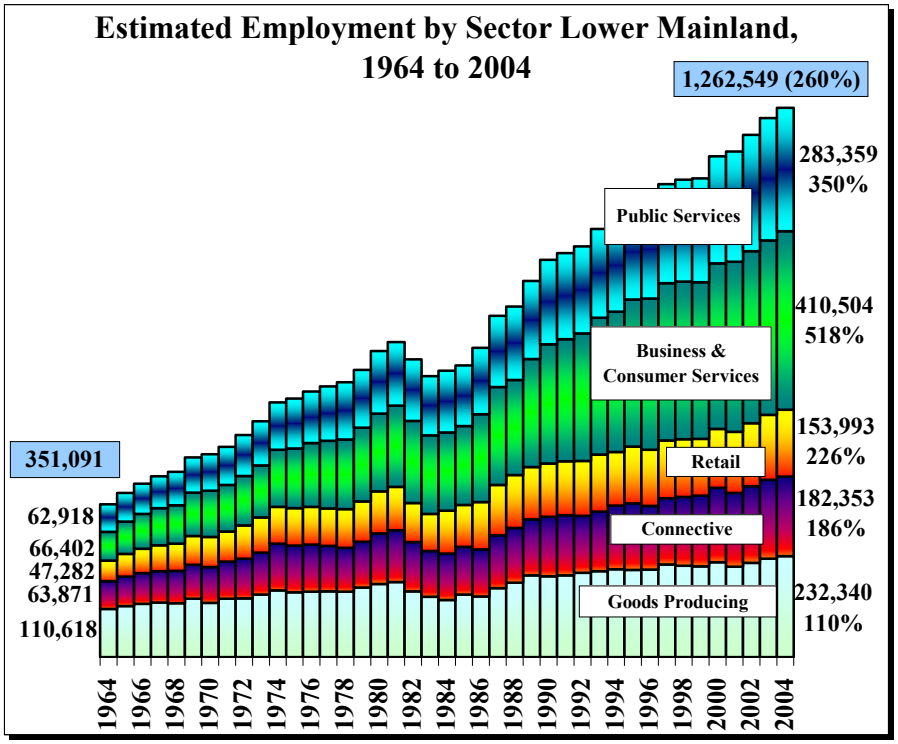
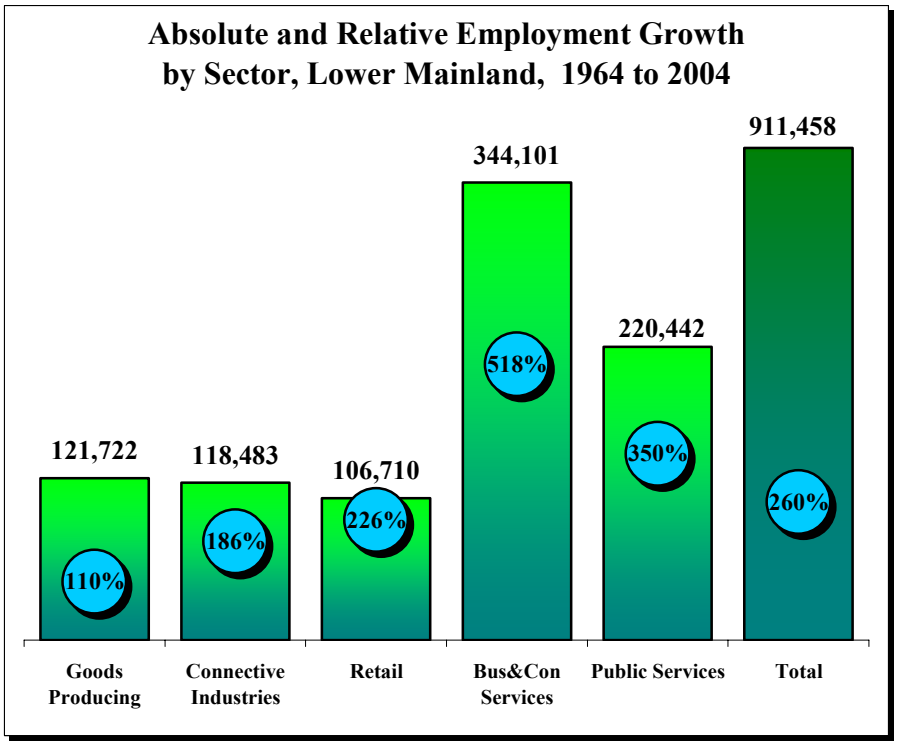


Figure 45



Employment – that is, the number of people working in paid occupations – has increased significantly over the past four decades, from 351,091 workers in 1964 to 1,262,549 in 2004 (Figure 44). This 260 percent (911,458 jobs) increase both facilitated and necessitated increases in labour force and labour force participation rates, over this forty year period.

The analysis and projection of employment discussed here was carried out for 11 individual industry sectors: however, for purposes of presentation these have been grouped into the five major categories outlined in Figure 45[6]. Employment in the Goods Producing industries, which includes primary industry, manufacturing and construction, increased by 98 percent over the past four decades, adding 121,722 employees, 13 percent of the total growth in the Lower Mainland's employment.

Employment in the transportation,

communication, utilities and wholesaling industries (aggregated here into the so-called Connective Industries) increased by 186 percent, and also accounted for 13 percent of the total increase in employment in the region. Employment in the Retail sector increased by 226 percent, with its additional 106,710 employees accounting for 12 percent of regional employment growth. The Business and Consumer Services industries, which include everything from the finance, insurance and real estate industries to personal services such as hair dressing, food services, and accommodation, experienced a 662 percent growth in employment over the past forty years (adding 344,101 employees, or 38 percent of all employment growth) making it the single largest employer by industry aggregate in 2004, with more than one out of every three employees in the region working in this sector. In 1964, this sector was the second smallest in terms of employment, accounting for only 19 percent of total employment, while the Goods Producing industries accounted for one-third of total employment, the largest share of the five industry aggregates.

The Public Services sector, which includes health and welfare, education, and public administration, recorded the second largest absolute and relative growth in the region over the past four decades, increasing by 220,442 employees (350 percent, 24 percent of the total increase) over the past four decades.

B. Projection of sectoral employment: Methodology

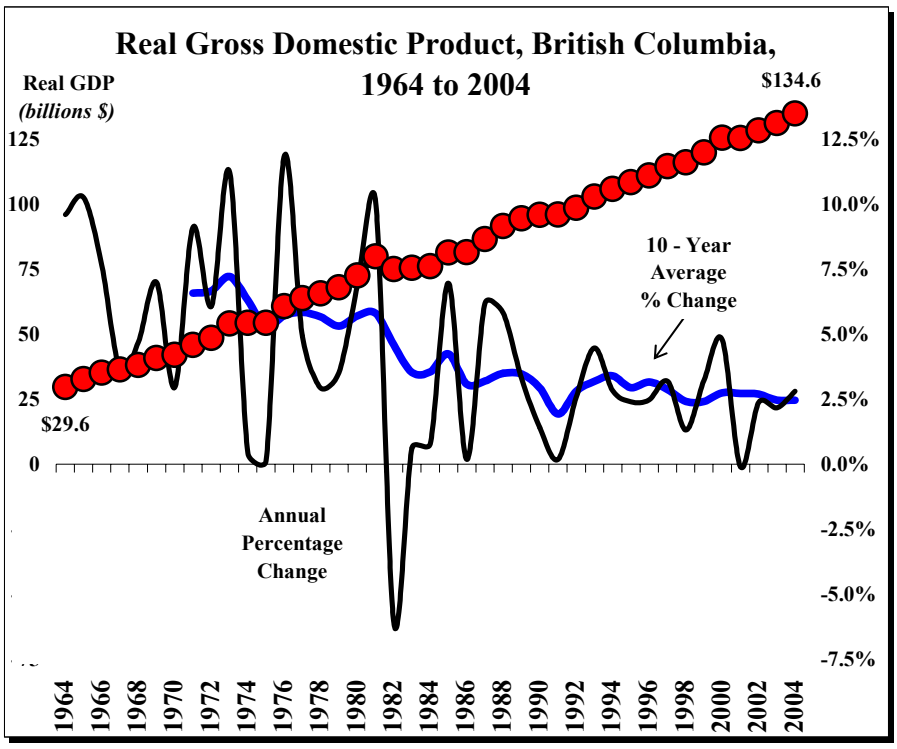
There a number of ways that regional sectoral employment may be projected. One is to assume that there will be some level of unemployment in the future, apply this accompanying unemployment rate to the labour force that is projected to exist in the future and, as such, estimate future employment levels. While such population-driven employment estimates are common, they have two drawbacks in the current context: ***a)*** they do not facilitate estimates of sectoral employment, something that these projections are to address; and ***b)*** they do not require the discipline of resolving the economic future of the region with its demographic counterpart.

Another approach which, for the purposes of this report is prohibitively costly and complex, would be to prepare a detailed employment projection for each industry based on the analysis of the factors of supply, demand, price, and market access that is will be assumed to affect each industry, and then to aggregate these individual sectoral projections to a regional employment projection, perhaps via the utilization of an input/output table. While this represents the most interesting and empirically-rooted approach to employment projections, it is far beyond the resources available for this research.

The approach selected here is to utilize the historical database of employment by industry sector in the Lower Mainland region and link it to a projectable economic variable – the "employment driver" - that generally reflects the external markets to this region. The associated sectoral employment levels (which are based on the historical correlation between employment in each individual sector and the selected "employment driver"

variable) are then independent of the population and labour force projections, but capture the economic climate that is assumed will exist in the future.

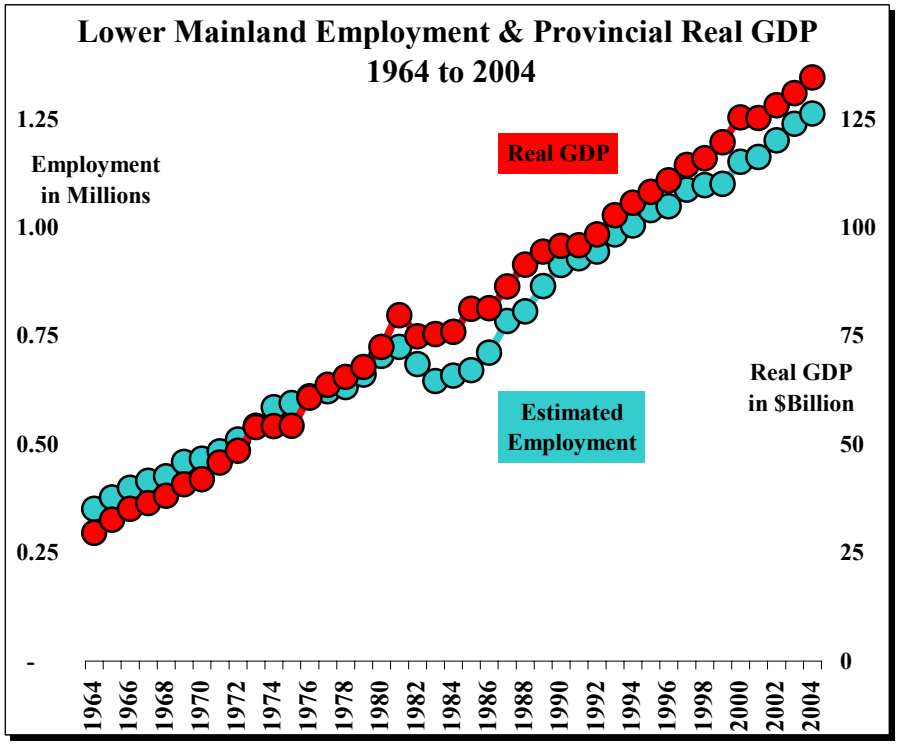
Figure 46



In this case, based on strong evidence that the Lower Mainland's economy, and hence its employment activity, is closely tied to the economic activity taking place throughout the rest of the province of British Columbia the external variable chosen as the "employment driver" was the province's real Gross Domestic Product (real GDP).

British Columbia's real GDP (in constant 1997 dollars) has increased four and a half times over the past forty years, from $29.6 billion in 1964 to $134.6 billion in 2004 (Figure 46)[7]. The path that this growth has followed has been far from smooth, with annual percentage changes fluctuating in both magnitude and in sign. In order to smooth this annual pattern of change, a 10-year moving average has been included, showing the general pattern of decline in real GDP growth over the four decades, from the six percent range in the 1960s to the 2.5 percent range in recent years.

Figure 47



[As an aside, approximately one-quarter of the growth in real GDP in the province over the past four decades resulted from increased productivity (increased output per worker) and three-quarters was driven by an increase in the number of workers.]

The approach to developing a projection model for employment in each of the region's 11 employment sectors was to calculate an equation that historically described the linear relationship between employment (the dependent variable) in each individual sector and provincial real GDP (the independent variable). For purposes of illustration, the relationship between total regional employment and provincial GDP is presented on Figure 47: there is a general correspondence between the pattern of change in real GDP and total employment in the region (this relationship was also born out, to varying degrees, between employment in each of the individual sectors and real GDP). While the historical trend exhibited by each variable shown in Figure 47 has its own set of unique fluctuations, they generally follow the same pattern of change. Through the identification of the correlation between these two variables, an equation describing the change in employment that would result from a one unit change in real GDP can be mapped out. Given the assumption that the identified relationships (correlations) between sectoral employment and real GDP will hold in the future, projections of BC's real GDP can serve as the independent variable used to determine future levels of employment in the region.

The challenge in this regard is to obtain a long term projection of real GDP. Not only are such projections rarely made, but often the historical values are changed when new data are made available. While recognizing this, the observed trend in the 10-year moving average change in provincial real GDP was mathematically extended into the future (again using a diminishing marginal change approach) to estimate the degree of real GDP change that will be experienced over the next four decades (Figure 48). The consequence of the historical pattern of slowing pace of growth in provincial GDP is a long term future that, by 2035, will push provincial GDP below one percent. Given the projected trend in real GDP, and by relating it to its historical degree of correlation with each sector, this allows for the projection of sectoral employment presented in the following section. [Note that sensitivity analysis can again be used to measure the consequences of greater or lesser real GDP growth.]

Figure 48

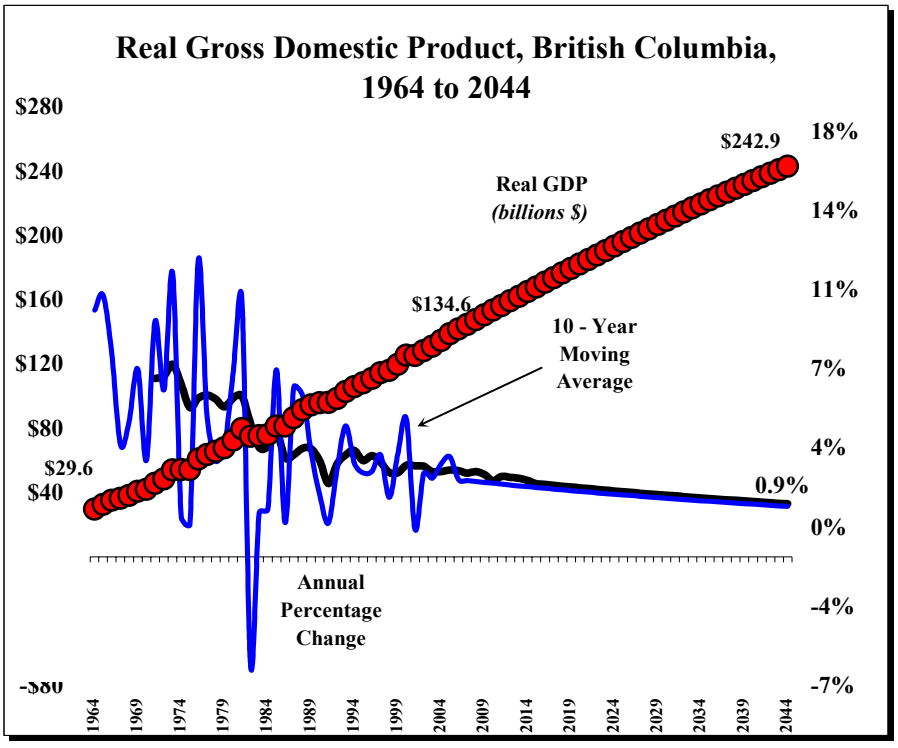
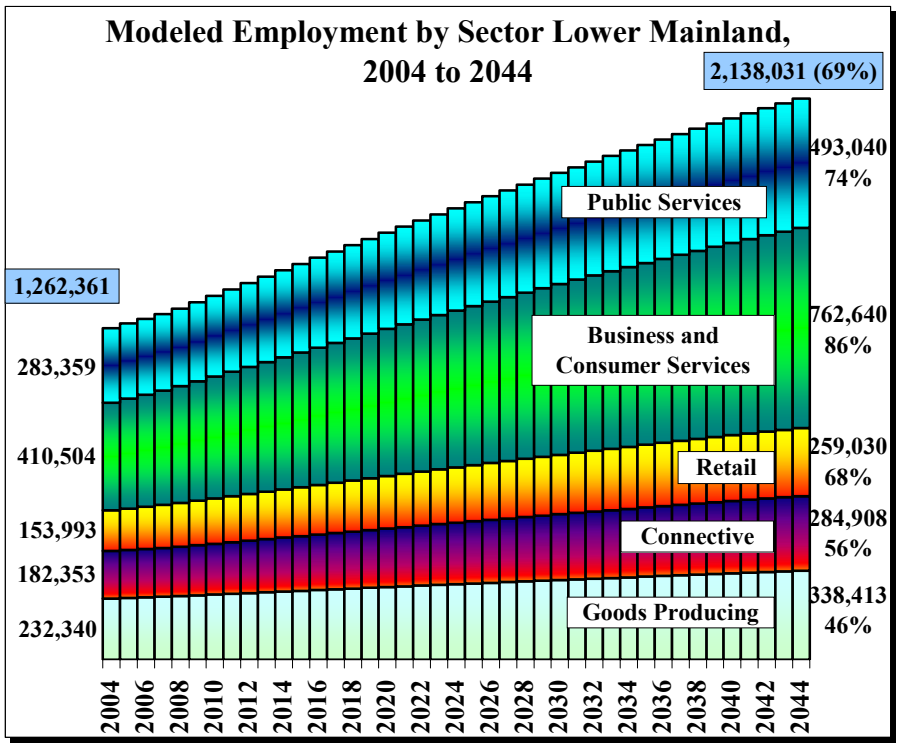


Figure 49

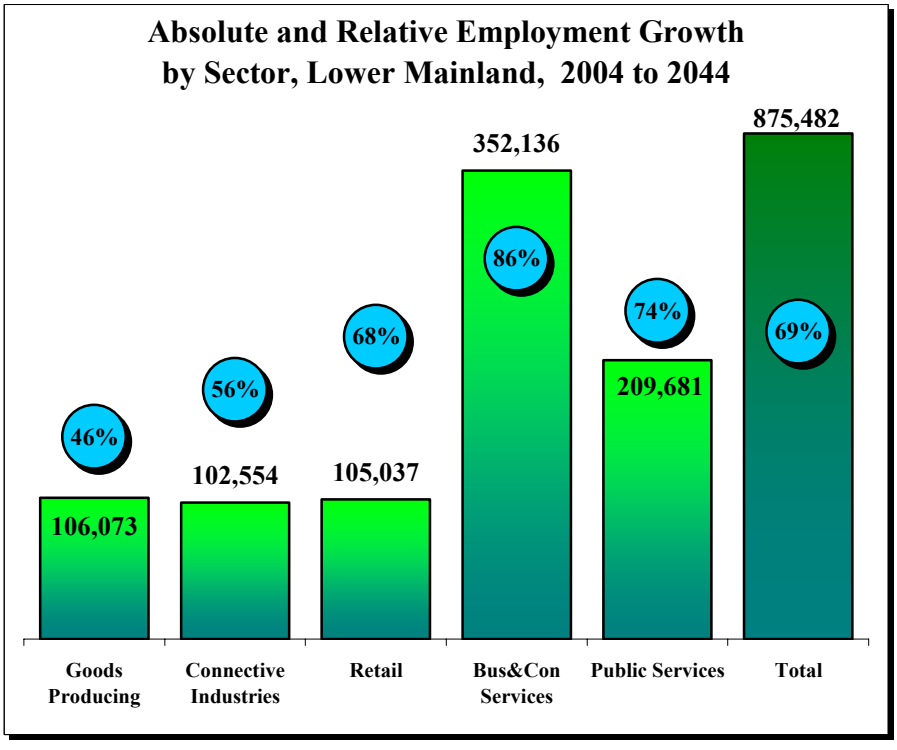


a) Sectoral employment projections

In aggregate, these sectoral employment projections result in a projected total of 2,138,031 workers by 2044, 875,482 (69 percent) more than today (Figure 49). On both an absolute and relative level, this projected growth will be less than the 911,458 (160 percent) increase recorded over the past for decades.

Given the correlative approach used in the projection, and the fact that the Business and Consumer sector has historically been fastest growing sector, it is also projected to be so in the future, increasing by 352,136 workers, or 86 percent between 2004 and 2044 (Figure 50). This would be followed by the 209,681 employee increase (74 percent) in Public Services. The third largest relative increase would be the 68 percent increase in Retail employment, as 105,037 workers are added to this sector, while the third largest absolute increase would be the 106,073 additional workers in the Goods Producing sector. Note that while the goods producing sector may have the third largest absolute increase, it is projected to see slow relative growth when compared to the other sectors, continuing the historical decline in this sector's share of total employment.

Figure 50

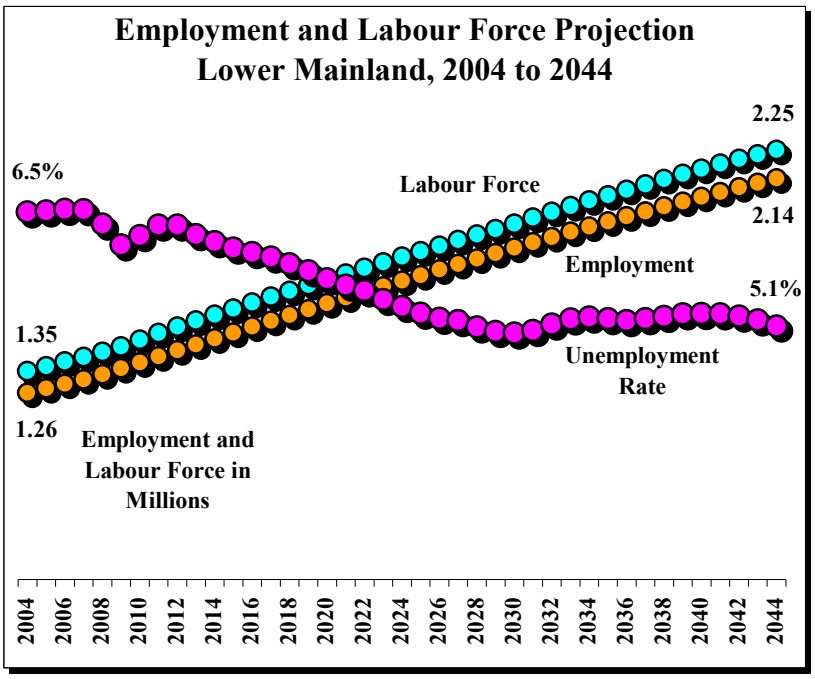


[As another aside, this approach implies that 14 percent of future economic growth would emanate from increased productivity, while 86 percent would come from employment growth, again reflecting the concept of diminishing marginal change – this time, in productivity.]

b) Resolution

At this stage, there are two projections: one of employment and one of labour force, the former based on the sectoral correlation to provincial GDP and the latter on a trend based projection of population. The resolution of these two independent projections provides a robustness test for both series of projections, with the resolution being provided by the unemployment rate, or the difference between the total number of labour force participants and the total number of jobs in the region.

Figure 51



As Figure 51 shows, with projected growth taking the number of today's labour force participants from the current level of 1.35 million to 2.25 million in 2044, and projected employment from 1.26 million today to 2.14 million in 2044, the resulting unemployment rate in the region would decline from its current seven percent to the 5.1 percent range by 2044. This is a reasonable long run unemployment rate, given the reality that job turnover, job search, and structural adjustments will always result in some level of structural unemployment within the economy.

Again, it is important to note here that what is important is not the *precise* projected level of unemployment, but that it falls within a reasonable range of what has been seen historically and what would be expected in the future. That this resolution is derived from what would be considered historically low levels of economic growth and relatively high levels of labour force participation implies a future where the issue of labour supply in the Lower Mainland has the potential to constrain future levels of economic growth.

VII. CONCLUSIONS

The nominal conclusions resulting from the research presented in the preceding pages anticipate the Lower Mainland region seeing its:

- population increase by 65 percent, from 2.43 million residents in 2004 to 4.02 million in 2044;
- labour force increase by 67 percent, from 1.35 million participants in 2004 to 2.25 million in 2044;
- and level of employment increase by 69 percent, from 1.26 million jobs in 2004 to 2.14 million in 2044.

The real substance of the research, however, is much more significant than the numbers presented above would indicate.

Turning our attention first to the issue of the Lower Mainland's future population, the impact that population *change* will have on the region's resources, in both a financial (in terms of social program and health care funding) and physical (in terms of land use planning) sense will be much more relevant than that which will be brought about by population *growth*. In addition to the region's population growing in size over the coming forty years, it will also become significantly older. As a proportion of its total population, the youngest age groups will garner a smaller share of regional population than has ever been seen in the region. Conversely, the older age groups will garner a much larger share than has ever been seen.

In a number of respects, the region's reliance on the components of migration and general increases in the propensities for individuals of all working-ages to be active in the labour force will become much more pronounced than they are today. For one, the significant aging of the population that is expected (virtually guaranteed) to take place over the next four decades will serve to decrease the share of individuals working or looking for work relative to the non-working (retired) population. In this vein, more working age individuals (via increases in participation rates and positive net inflows of working age migrants) will be required to fill the void left by the increasing number of people who will have gone from contributing to our social systems to making debits from them once they are no longer in the work force.

More to the issue of labour supply in the Lower Mainland, the historical trend and future path of real GDP growth in the province of British Columbia portend further pressure being placed on the region's labour force to grow at an adequate pace in order to ensure that the future number of jobs that will exist in the region can be filled. As well, sufficient growth in the region's labour force will be required to ensure that the Lower Mainland's economy can grow and adapt in such a way that it can meet the demands of its growing number of – and increasingly diverse – residents.

Appendix

Vancouver Lower Mainalnd Region, Trend Based Population & Labour force, 2004 to 2044

Population	2004	2014	2024	2034	2044
0..4	123,811	132,289	151,188	156,732	160,775
5..9	136,477	134,150	154,396	167,063	169,079
10..14	146,769	142,657	158,001	177,904	181,879
15..19	154,229	157,526	162,086	183,418	194,830
20..24	177,653	177,773	181,212	196,785	214,316
25..29	173,777	191,684	206,054	210,340	227,803
30..34	187,808	210,976	225,035	229,015	240,570
35..39	198,002	205,623	236,895	252,720	253,832
40..44	212,169	213,998	248,046	263,587	265,285
45..49	198,215	216,482	232,444	264,692	278,893
50..54	174,420	223,816	231,494	266,033	280,417
55..59	145,154	204,271	226,134	242,467	273,284
60..64	104,552	177,595	228,771	236,891	269,654
65..69	82,634	144,406	203,177	224,490	239,394
70..74	73,379	99,072	167,375	214,326	221,297
75..79	60,323	71,463	125,379	175,462	193,307
80..84	45,988	54,988	75,990	127,952	163,469
85..89	23,852	36,120	43,902	77,771	108,300
90 plus	13,732	28,053	36,747	49,591	84,652
Total	**2,432,943**	**2,822,941**	**3,294,327**	**3,717,238**	**4,021,038**
Labour Force (Trend Based Participation Rates)					
Total	**1,350,679**	**1,580,840**	**1,817,391**	**2,047,425**	**2,253,407**

Lower Mainland Employment Projection, 2004 to 2044

	2004	2014	2024	2034	2044
Goods Producing	232,340	259,783	287,644	313,678	338,413
Connective Industries	182,353	205,274	234,125	260,991	284,908
Retail	153,993	183,814	211,064	236,440	259,030
Bus&Con Services	410,504	503,186	597,185	684,715	762,640
Public Services	283,359	331,445	389,990	444,507	493,040
Total	**1,262,549**	**1,483,502**	**1,720,009**	**1,940,330**	**2,138,031**
Unemployment Rate	**6.5%**	**6.2%**	**5.4%**	**5.2%**	**5.1%**

Endnotes

[1] All population figures in this report are estimates derived from Urban Futures population estimation model based on data from Statistics Canada' Censuses of Canada, Statistics Canada's Annual Demographic Statistics, and BC Statistics Population Estimates They have been adjusted for the census undercount, and hence are in the range of 4 percent above the published values from the Census of Canada for the corresponding years.

[2] Historical mortality counts and rates presented in this report are estimates prepared by Urban Futures based on a range of mortality data published or provided by custom tabulations by Statistics Canada, BC Statistics, and BC Vital Statistics. All projections of future mortality rates are based on these historical data and are prepared by Urban Futures.

[3] Historical birth counts and rates presented in this report are estimates prepared by Urban Futures based on data published or provided by custom tabulations by Statistics Canada, BC Statistics, and BC Vital Statistics. Projections of future natality rates are based on these historical data and are prepared by Urban Futures.

[4] The age and sex composition of migratory flows to and from the region, and the historical annual levels of these flows, are estimates prepared by Urban Futures based on a wide range of data published by or provided by custom tabulations by Statistics Canada, Immigration Canada and BC Statistics. Projections of levels of migration are based on these historical data and the evaluation of factors affecting the national and regional labour market and are prepared by Urban Futures.

[5] The historical age and sex specific labour force participation rates are estimates prepared by Urban Futures based on data published by Statistics Canada, HRDC, and BC Statistics. Projections of levels of future labour force participation are based on these historical data and the evaluation of factors affecting the national and regional labour market and are prepared by Urban Futures.

[6] The historical data base on employment is the region is derived from an employment information system maintained by Urban Futures that covers employment in the region over the 1961 to 2004 period. The data inputs for this information system are from a number of Statistics Canada sources, including the Census, the Survey of Employment and Hours, and the Labour Force Survey.

[7] Historical data for BC real GDP is from publications of BC Statistics and Statistics Canada.