

Population Projection

Methodology and Assumptions

Introduction

Population projections for Alberta and each of its 19 census divisions are available for the period of 2018 to 2046 by sex and single year of age. Three growth scenarios have been prepared. The medium growth scenario represents the most likely case, and is the reference scenario over the projection period. The high growth scenario anticipates higher levels of fertility and migration, as well as lower mortality rates, leading to a higher population. The low scenario considers lower fertility and migration, resulting in lower population growth over the projection period (Figure 1). A glossary of demographic terms can be found in Appendix 2.

These projections represent a plausible progression of the population based on the current population base and assumptions regarding future demographic developments. The first decade of the projections incorporates a forecast component consistent with that used in developing the economic outlook for the Alberta Budget. The latter part of the projection follows a standard demographic approach in which assumptions reflect historical trends. This approach provides planners and researchers with a more relevant tool, since Alberta's population growth can show considerable volatility due to economic cycles.

Methodology and Assumptions

Component Cohort Survival Method

OSI uses the cohort component method to project the future size and age/sex characteristics of the

population. This method is essentially a demographic accounting system. It starts with the base-year population distributed by single year of age and sex. Everyone is aged year-by-year, then fertility, mortality and migration assumptions are applied to the base population to project the number of births, deaths, and migrants in subsequent years. Fertility and mortality rates are applied to the population after half the projected number of migrants for the year have been included in the population. This gives some (but not all, or none) migrants a risk of dying or giving birth. Finally, the three components (births, deaths and migration) are either added to or subtracted from the base population to obtain the projected population. The population is broken down by sex and single year of age up to the age group of 90 years and over.

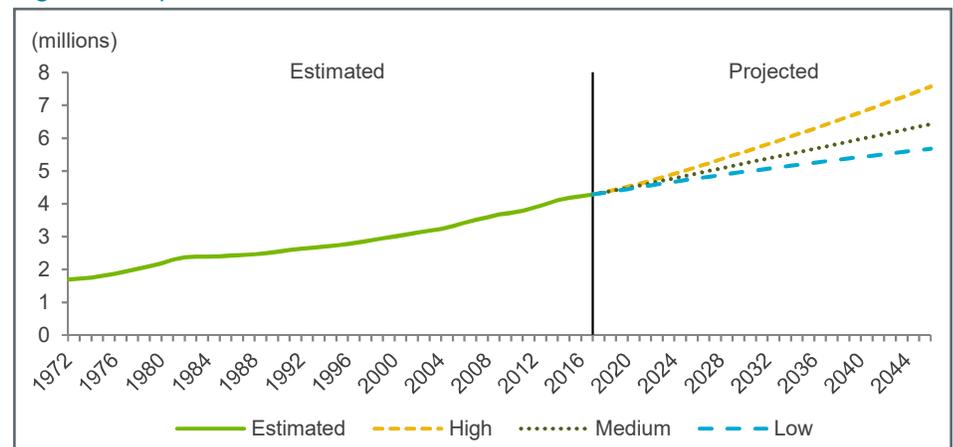
The population of Alberta is projected separately from its sub-provincial regions. The component methodology is applied to each of the 19 census divisions (CDs) in Alberta to ensure consistency and comparability. Furthermore, unique sets of assumptions are made for each CD to account for regional differences. The sum of the CD projections by age and sex cannot exceed the Alberta total; in this way the Alberta level projections function as a control total for the smaller areas. Two-way raking is used to ensure that the population and components of growth by CDs add up to the Alberta total by age and sex.

The Base Population

The base population of the projection model is Statistics Canada's postcensal estimates of the population in Alberta and its 19 CDs as of July 1, 2017 (Figure 2). These estimates are based on the 2011 Census, adjusted for net undercoverage and incompletely enumerated Indian Reserves.

Note that Statistics Canada's population estimates only include the resident population, as defined by the census. Residents must usually be living in

Figure 1: Population of Alberta, 1972-2046



Sources: Statistics Canada and Alberta Treasury Board and Finance

a specific area to be considered a resident of that area. ‘Usual residents’ includes non-permanent residents (NPRs)¹, but does not include “mobile” or “shadow” populations, since these people retain a usual residence elsewhere (either outside of Alberta or in a different census division).

Statistics Canada revises the components of population annually to provide the best possible estimates. These revisions impact some CDs more than others and, coupled with changes to the projection assumptions, can result in higher or lower projected populations in 2046.

Revised estimates provide a new starting point for the population

¹ NPRs are those temporarily residing in Canada with a study, work or minister’s permit, or as a refugee claimant, and family members living with them.

by age and sex and can have a significant impact on the projected growth and age structure. Since assumptions for several components of growth are based on historical trends, revisions can alter the trajectory of future growth by introducing change to historical patterns. Estimates for the total population in each CD can be found in Appendix 1.

Component Assumptions

In general, the assumptions for fertility and mortality are based on detailed analyses of historical trends. Migration assumptions are based on historical trends and assumptions regarding economic drivers of migration, such as job creation and industry development. This section presents a more detailed discussion of the historical trends and assumptions for each of the components of growth (see Figure 3).

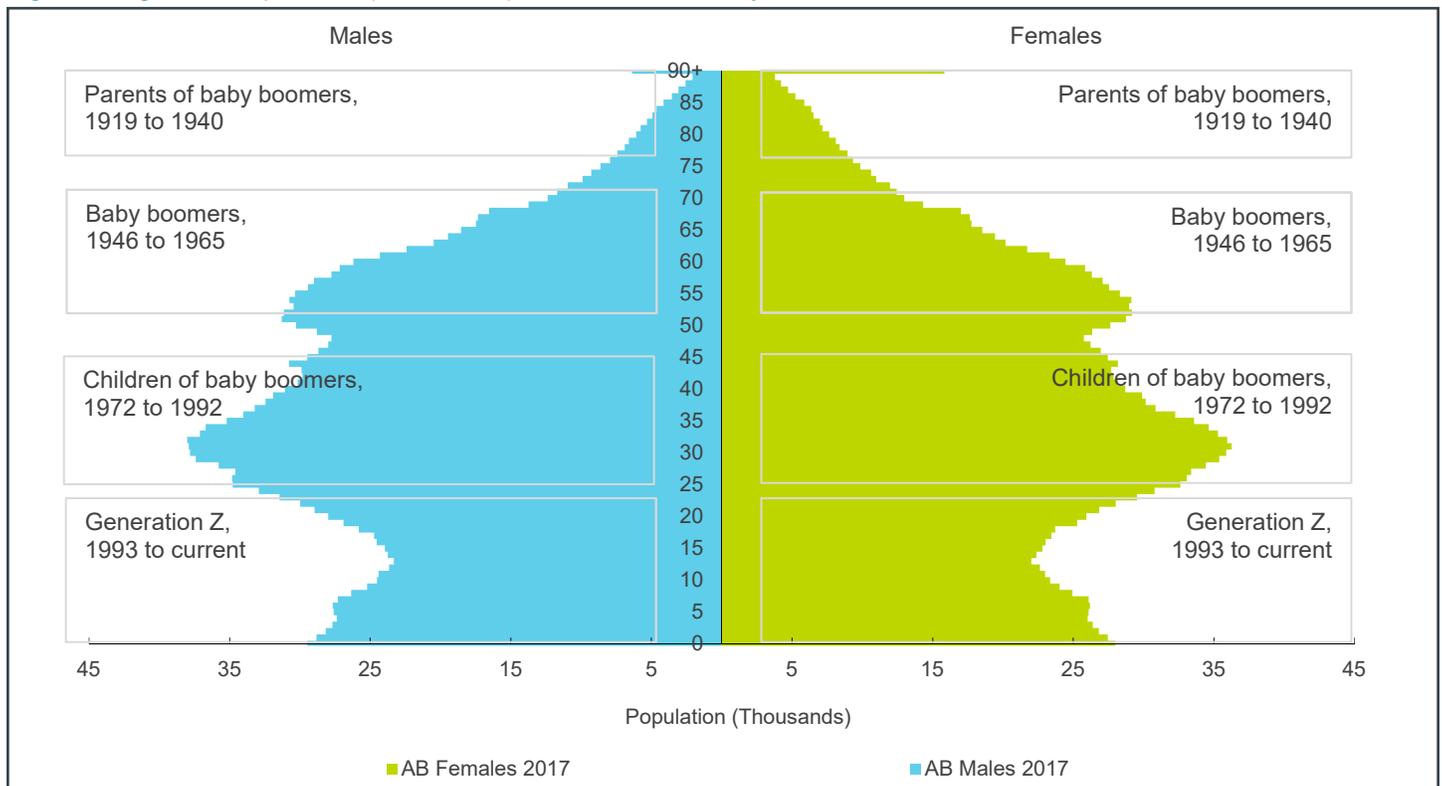
Fertility Assumptions

The projected number of births for a given year are generated by applying age-specific fertility rates to the population of women in the reproductive ages (15 to 49).

Alberta

Alberta’s total fertility rate (TFR) dropped below the population replacement level of 2.1 children per woman of childbearing age by the mid 1970s (Figure 4). Fertility has ranged from a baby boom high of 4.4 children in 1959 and 1960 to a low of 1.7 in 2002, but since the late 1970s, it has remained relatively stable, when viewed in the larger historical context. Alberta’s TFR was 1.7 in 2017.

Figure 2: Age/Sex Population (Thousands) of Alberta as of July 1, 2017



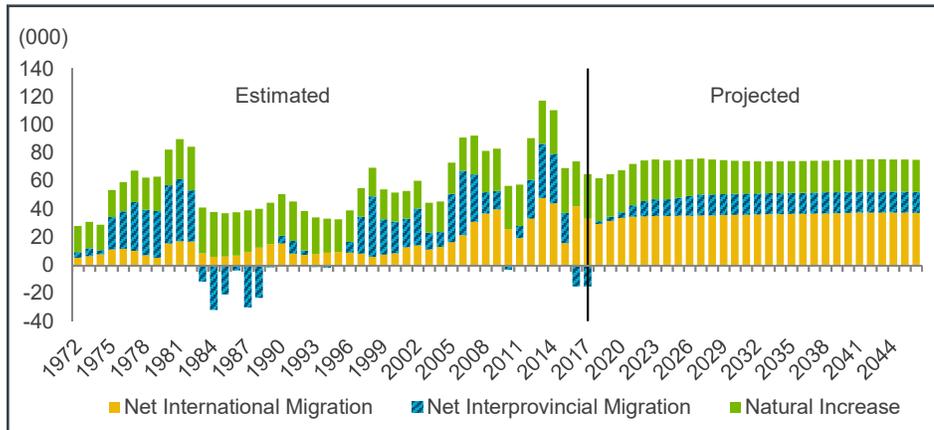
Sources: Statistics Canada and Alberta Treasury Board and Finance

Note: Information boxes indicate generations in 2017.

Under the medium scenario, the TFR is assumed to stabilize at 1.7. In the low scenario, the total fertility rate is projected to drop and stabilize at about 1.6, which is equal to the long-term average total fertility rate (2000-2016) for

Canada. Under the high scenario, the total fertility rate is assumed to rise gradually and stabilize at just under replacement level.

Figure 3: Components of Growth, Alberta, 1972-2046 (medium scenario)



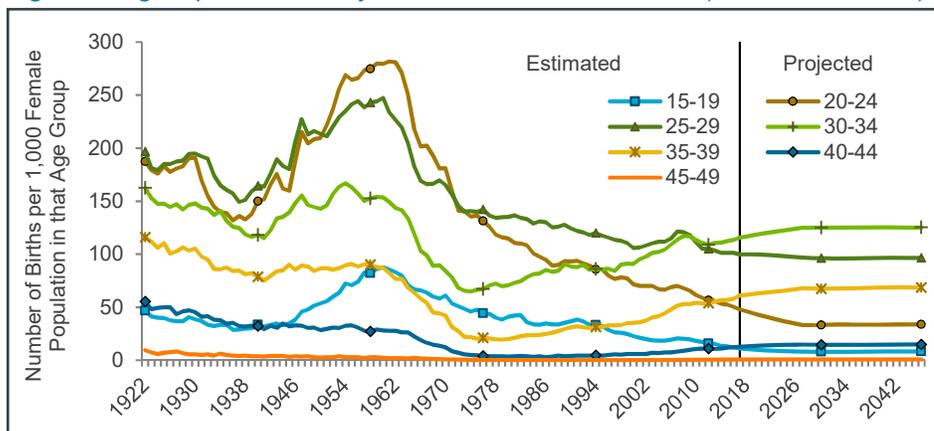
Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 4: Total Fertility Rate, Alberta, 1922-2046



Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 5: Age-Specific Fertility Rates, Alberta, 1922-2046 (medium scenario)



Sources: Statistics Canada, Alberta Vital Statistics and Alberta Treasury Board and Finance

Analysis of age-specific trends in fertility show a long-term shift in the ages that women in Alberta are having children (Figure 5). More women are delaying childbearing and having their first child in their late 20s or early 30s, resulting in a drop in the fertility rates of young women and an increase in the fertility of older women. This trend is projected to continue over the next decade, and then stabilize for the remainder of the projection period.

Regional

There is considerable variation in the fertility rates among census divisions within the province. The TFR in 2017 ranged from highs of 3.4 in CD 17 (Slave Lake) and 2.8 in CD 3 (Pincher Creek) to 1.4 in CD 15 (Banff). Fertility was above replacement in all but six census divisions in 2017. Lower fertility areas included the three census divisions in the Edmonton-Calgary Corridor (CDs 6, 8, 11), CD 15 (Banff), CD 1 (Medicine Hat) and CD 2 (Lethbridge) (Table 1).

Variability in regional fertility is likely related to multiple factors, including income levels, educational attainment, employment opportunities, and the proportion of Indigenous people in the population. For instance, since major urban centers such as Calgary and Edmonton tend to have more educational and career opportunities than other areas of Alberta, women living in and moving to these areas tend to reproduce later in life and have fewer children when compared with women in rural areas of the province.

Indigenous people tend to have higher fertility rates and larger family sizes, resulting in higher fertility rates in areas where they account for a

greater proportion of the overall population, such as CD 3 (Pincher Creek), CD 12 (Cold Lake), CD 17 (Slave Lake) and CD 18 (Grande Cache).

In addition to the variation in overall fertility, there are also marked differences in the age patterns of fertility. The estimated median age of women who had a birth in 2017 ranged from a low of 27.0 years in CD 17 (Slave Lake) to a high of 32.3 in CD 15 (Banff) (Table 1). Assumptions were developed for each region according to their own specific character, based on historical data, in order to maintain these regional differences.

Mortality Assumptions

The projected number of deaths are a result of the application of age- and sex-specific mortality rates to the population in each year.

Alberta

In 2017 life expectancy at birth for males was 79.0 years, up from 70.9 in 1976. Female life expectancy in 2017 was 83.4 years, compared to 77.9 in 1976. Many of the large historical gains in life expectancy resulted from improvements in infant and child mortality. With the low mortality currently observed at these ages, future gains in life expectancy will likely be more concentrated at older ages (Figures 6 and 7). Projected age-specific mortality rates were derived using a method based on the Lee-Carter model (1992).²

² Lee, Ronald D. and Lawrence Carter. 1992. "Modeling and forecasting the time series of U.S. mortality." Journal of the American Statistical Association 87 (419) (September): 659-671.

Table 1: Alberta and Census Divisions, TFR and Median Age of Births, 2017

Census Division	Major City/Town	TFR	Median Age of Births
CD1	Medicine Hat	2.04	29.5
CD2	Lethbridge	1.92	29.3
CD3	Pincher Creek	2.81	28.6
CD4	Hanna	2.70	30.1
CD5	Drumheller	2.35	29.1
CD6	Calgary	1.53	32.1
CD7	Stettler	2.56	28.8
CD8	Red Deer	1.88	29.7
CD9	Rocky Mountain House	2.57	28.2
CD10	Camrose	2.17	29.4
CD11	Edmonton	1.58	31.1
CD12	Cold Lake	2.52	28.7
CD13	Whitecourt	2.60	29.2
CD14	Edson	2.39	29.6
CD15	Banff	1.39	32.3
CD16	Wood Buffalo	2.37	30.5
CD17	Slave Lake	3.36	27.0
CD18	Grande Cache	2.69	28.2
CD19	Grande Prairie	2.16	29.3
Alberta		1.73	30.9

Sources: Statistics Canada, Alberta Vital Statistics and Alberta Treasury Board and Finance

This model essentially breaks down the age-specific mortality rate (ASMR) into three components: an age-specific constant term, a time-varying mortality index, and an age-specific component that measures how fast mortality at each age varies when the mortality index changes. With the projected mortality index, ASMRs can be calculated for future periods.

Two sets of mortality assumptions (low/medium and high) were developed. Under both scenarios, life expectancy at birth in Alberta is expected to continue its upward trend in the future. Under the low/medium scenario, life expectancy at birth for females is expected to gain 3.7 years from its 2017 level to 87.1 by 2046, while it would increase by 4.5 years to 83.5 for males. The high scenario introduces a higher growth profile, wherein life expectancy at birth for females would reach 89.9 years in 2046 for a gain of 6.5 years. Compared to 2017, males would add 8.3 more years to their life expectancy for a total of 87.3 years by the end of the projection period under the high scenario (Figure 8).

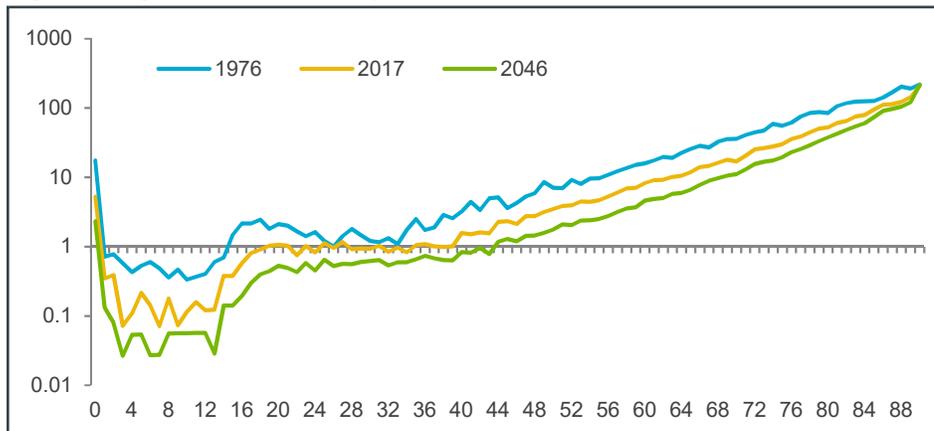
Under both scenarios, male life expectancy at birth is assumed to grow at a faster pace than female life expectancy. This is consistent with recent historical trends where males have experienced larger gains than females. Therefore, the sex differential will continue to shrink over the projection period, falling from about 4.4 years in 2017 to 3.6 and 2.6 years in 2046, under the medium/low and high projections, respectively (Figure 8).

Regional

The Lee-Carter method was used to calculate projected mortality rates. This method requires a large number of events to ensure reliable results, and as such, was used only at the Alberta level to produce the "mortality change factor". The factor takes into account year-to-year

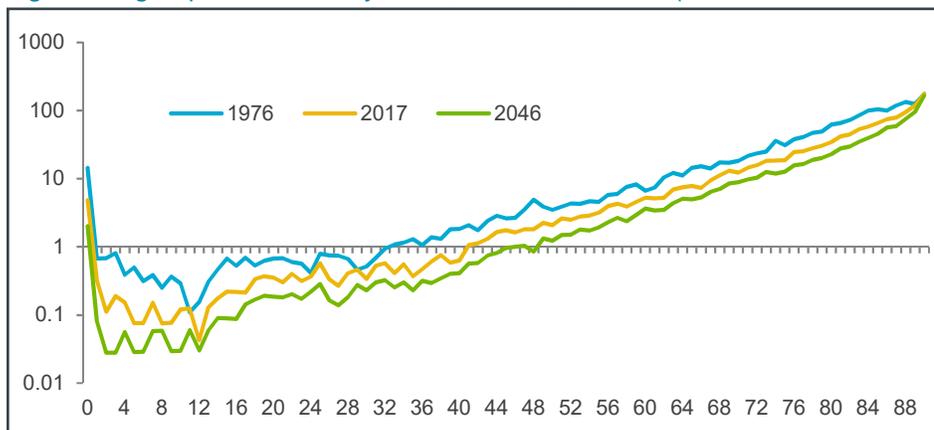
changes in Alberta's mortality by age and sex and was applied to historical mortality by age and sex for each CD to produce region-specific projected ASMRs.

Figure 6: Age Specific Mortality Rates, Males, Alberta (medium/low scenario)



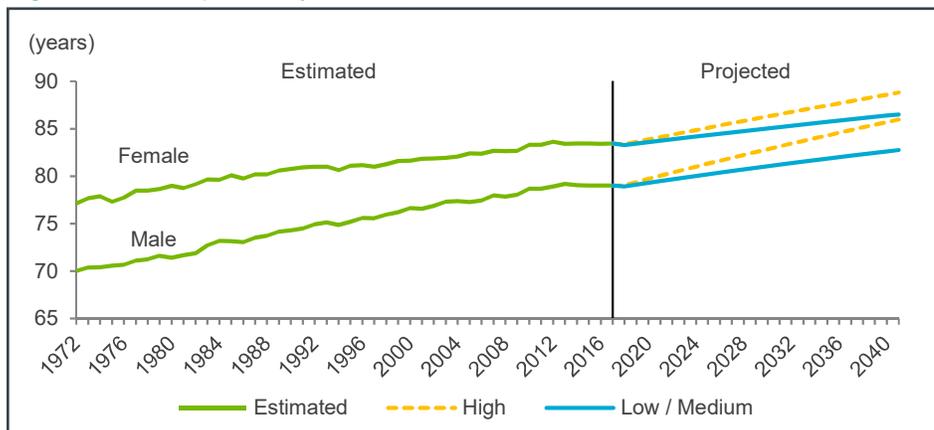
Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 7: Age Specific Mortality Rates, Females, Alberta (medium/low scenario)



Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 8: Life Expectancy at Birth, Alberta 1972-2046



Sources: Statistics Canada and Alberta Treasury Board and Finance

For each CD, ASMRs are calculated from the area's historical data by averaging multiple years of data to the extent required to stabilize the trend. Final projected ASMRs are calculated by multiplying the Alberta-level mortality change rates (from the Lee-Carter model) by these CD-specific ASMRs for females and males.

Migration Assumptions

The projected number of net migrants are a result of separate projections of international (movement from outside the country), interprovincial (movement between provinces and territories) and intraprovincial (movement between CDs) migration. Assumptions about the age and sex distributions of net migrants were developed for each region based on its own characteristics as indicated in historical data.

International Migration

International migration is highly dependent on the Government of Canada's immigration policies and increasingly on the Albertan economy. After hitting a low of 6.0% in 1998, Alberta's share of Canada's immigrants had been increasing, mainly due to the province's strong economy and labour market. In 2016, a record 17.9% of immigrants moving to Canada settled in Alberta. In the following year, the share fell to 16.2% and immigration to Alberta is expected to continue to soften in 2018 before picking up, as a result of economic changes across the country. Despite the softening, immigration levels are expected to continue to remain higher than the historical average, as Canada targets increasing immigration levels over the next three years. Based on historical trends, three immigration scenarios have been developed to capture uncertainty and change within immigration policy. Over the projection period, Alberta is expected to receive close to 1.24 million immigrants in the medium scenario, while under the high and low scenarios, Alberta

is expected to welcome around 1.59 million, and almost 0.93 million people, respectively.

Net emigration (i.e., emigrants minus returned emigrants plus net temporary emigrants) is assumed to increase gradually, as the number of in-migrants increases and the province’s population expands.

Non-permanent residents (NPRs) are heavily dependent on Federal government policies, as well as economic conditions. Due to Federal changes in the Temporary Foreign Worker (TFW) program and the recession, net outflows of NPRs had been seen over the past three years. Net outflows are projected to continue over the next three years, but should be more muted and gradually taper off. Over the long term, the flow of NPRs is expected to return to a more balanced condition, wherein inflows would be completely offset by outflows.

Due to service industries related to tourism, CD 15 (Banff /Jasper) is an area that historically draws a large number of NPRs. Therefore, this area is expected to be heavily impacted by the net outflows of NPRs. Other areas expected to bear the brunt of the changes include CD 16 (Wood Buffalo), CD 6 (Calgary), CD 11 (Edmonton) and CD 2 (Lethbridge).

Overall, net international migration under the medium scenario is expected to be lower than recent years, as immigration softened from the highs of the past few years and outflows of NPRs and moderate emigration rates continue. In the high scenario, immigration is projected to be strong enough to lift net international migration higher than the historical average, while net international migration in the low scenario will remain well below the levels of the last ten years (Figure 9). Between now and 2046, Alberta is expected to receive close to 1.04 million net international migrants under the medium scenario. Under the high and low scenarios about 1.38 million and 0.73 million net international migrants are projected to move to Alberta, respectively.

Interprovincial Migration

Net interprovincial migration is strongly driven by Alberta’s labour market conditions and its performance relative to other provinces. In 2015-2016, low oil prices weighed on energy investment in Alberta, slowed employment growth and wages, and increased unemployment. Net interprovincial migration

dropped sharply and turned negative in 2016 and 2017. However, these net outflows are very small compared to the net gain of over 120,000 new residents between 2011 and 2015.

Alberta has since turned a corner and posted a strong economic recovery in 2017. Since the interprovincial migration component reacts with a lag, Alberta is forecasted to see a small net positive in 2018, despite the economic recovery being well underway. As Alberta’s economic situation continues to improve, net interprovincial migration is forecasted to slowly return to its long term historical trend (Figure 10).

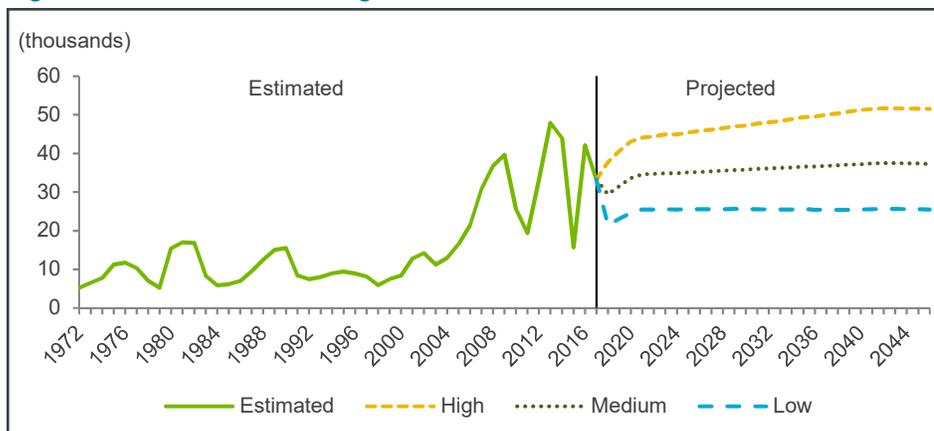
Based on year-to-date estimates, net interprovincial migration is expected to rise from around -30,000 over the past two years to 2,000 in 2018. Thereafter, interprovincial migration is expected to gradually recover as economic growth continues. The long term average for the medium projection is about 15,000 net interprovincial migrants annually. The high and low scenarios project about 23,700 and 7,900 yearly interprovincial migrants, respectively (Figure 10).

The regions expected to see the greatest net inflows of interprovincial migrants are CD 6 (Calgary), CD 8 (Red Deer), CD 11 (Edmonton), CD16 (Wood Buffalo) and CD 19 (Grande Prairie).

Intraprovincial Migration

The projected number of people moving between CDs is developed using long term averages. Net intraprovincial migration has no impact on Alberta’s overall population growth, so only one scenario has been developed for this projection. Historically, CD 6 (Calgary) and CD 11 (Edmonton) have welcomed a large number of intraprovincial migrants, as has CD 8 (Red Deer). CD 5 (Drumheller) has also, on average, gained a positive number of net intraprovincial migrants. All other

Figure 9: Net International Migration to Alberta, 1972-2046



Sources: Statistics Canada and Alberta Treasury Board and Finance

census divisions tend to lose population to other areas of the province on a net basis. In particular, CD 16 (Wood Buffalo) historically has sent large amounts of people elsewhere in the province, along with CD 17 (Slave Lake). Over the next 28 years, almost eight in ten net intraprovincial migrants within Alberta are expected to move to the two largest urban centers, Calgary and Edmonton, for employment and educational opportunities.

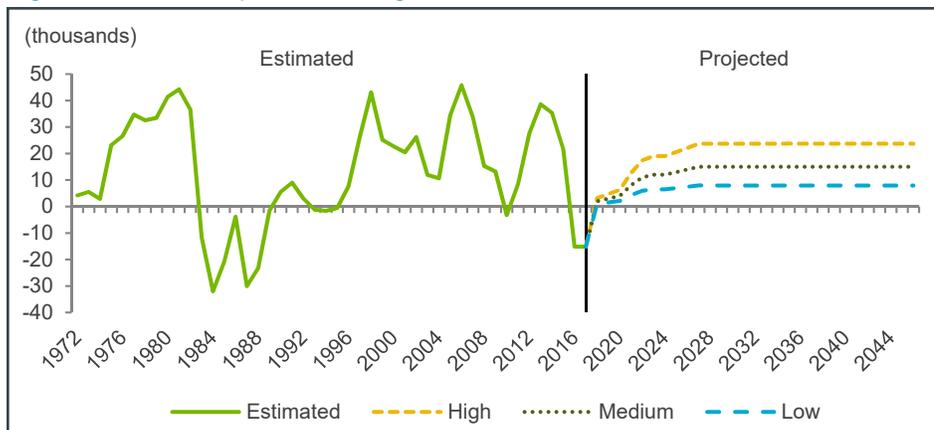
Total Net Migration

Combining all migration components, total net migration is expected to increase from the low of 2017, rising to about 31,400 in 2018 under the medium scenario (Figure 11). A modest increase is projected in 2018, as net inflows of interprovincial migrants continue to improve to their long term historical trend. Following that, total net migration should increase, returning to its long term historical trend.

Regions with more employment and educational opportunities tend to attract more migrants. Of the almost 1.42 million net migrants moving to Alberta over the next 29 years, 86% are expected to settle in the two major urban centers (i.e., CD 6 (Calgary) and CD 11 (Edmonton)).

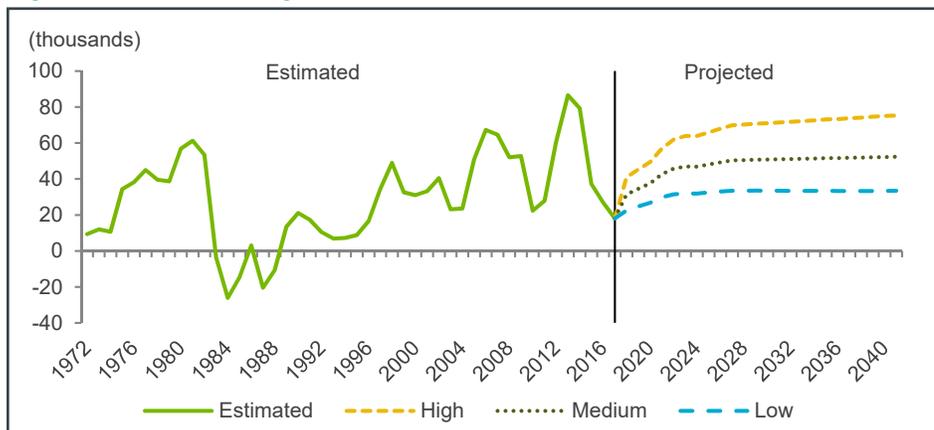
During the recession, areas with substantial oil sands development, such as CD 16 (Wood Buffalo) and CD 12 (Cold Lake), were particularly hit hard, resulting in large net outflows of migrants. Although the province is recovering, these regions are expected to see a few more years of net out-migration. CD 12, a region that historically loses net migrants, will return to a more moderate level of loss over the long term. CD 16 is forecast to experience moderating losses compared to the previous year’s projections due to improving economic conditions and construction activity generated from the Fort McMurray fire in May 2016. Investment confidence in the region is improving. As new pipelines come online over the medium term, investment is expected to increase with new projects adding to growth in oil sands investment and boosting construction in the region. Net migration is expected to increase in the medium term because of the activity that these projects should generate. In the long term, CD 16 is expected to return to a more moderate level of positive net migration. Given uncertainties in the oil sands resources and continued fire-related developments, volatility in migration flows is expected for CD 16.

Figure 10: Net Interprovincial Migration to Alberta, 1972-2046



Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 11: Total Net Migration to Alberta, 1972-2046



Sources: Statistics Canada and Alberta Treasury Board and Finance

Areas which service the oil and gas sector, such as CD 19 (Grande Prairie) and CD 8 (Red Deer), saw their migration impacted in the past two years. These regions should see their migration recover fairly quickly since they service other sectors, and because of improvements in gas and conventional drilling. CD 19, a service area for both Alberta and British Columbia, is expected to see higher long-term net inflows of migrants. CD 8’s proximity to the province’s large urban centers, as well as drilling increases, are expected to continue to bolster the region’s growth.

Population growth in this region is forecast to increase over last year's as it returns to stronger growth over the projection period.

Home to a large number of oil companies' Alberta headquarters, CD 6 (Calgary) was hard hit by the global oil price shock with declines in employment, as companies tried to reduce costs. In 2016 and 2017, CD 6 saw net outflows of interprovincial migrants. However, growth in that region was buffered by strong immigration levels, and net migration remained positive. In 2018, CD 6's net migration is expected to begin its recovery as net interprovincial turns positive.

Employment in the majority of industries in CD11 (Edmonton) was not hit as hard as CD 6 during the recession. However, as major construction projects began wrapping up, net migration to CD 11 slowed. As CD 6 begins to recover, its net migration is expected to pick up while CD 11's softens slightly. Growth due to migration is expected to be higher in CD 6 than in CD 11 over the entire projection period, partly due to the propensity of immigrants to move to CD 6. Over the long term, these two regions will return to their projected long term net inflows of migrants.

Lethbridge was designated as the province's newest census metropolitan area (CMA) in the 2016 Census, as it hit a size and density that puts it in the company of other metropolitan areas in the country. Given its diversified economy, CD 2 (Lethbridge) weathered the economic storm better and remained one of the few regions in the province to see net migration inflows over the recession. While migration to the rest of the province slowly recovers, CD 2 is expected to see migration levels in line with its long term historical average throughout the projection period.

For more information on the [Population Projections](#) see:

Population Projections, Alberta and Census Divisions, 2018-2046.

Provides some discussion and details of the provincial and regional projected populations.

Data for Alberta Population Projections.

Includes estimated (1996-2017) and projected (2018-2046) population of Alberta and its 19 Census Divisions by single year of age and sex as well as selected summary statistics.

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Appendices

Appendix 1: Census Divisions and Their Respective Populations as of July 1, 2017

Census Division	Major City/Town	2017
Alberta		4,286,134
CD1	Medicine Hat	84,532
CD2	Lethbridge	176,735
CD3	Pincher Creek	40,624
CD4	Hanna	9,587
CD5	Drumheller	57,454
CD6	Calgary	1,597,701
CD7	Stettler	40,796
CD8	Red Deer	216,815
CD9	Rocky Mountain House	21,869
CD10	Camrose	98,776
CD11	Edmonton	1,451,849
CD12	Cold Lake	72,928
CD13	Whitecourt	69,397
CD14	Edson	29,445
CD15	Banff	40,826
CD16	Wood Buffalo	72,155
CD17	Slave Lake	66,351
CD18	Grande Cache	14,533
CD19	Grande Prairie	123,761

Source: Statistics Canada

Appendix 2: Glossary of Demographic Terms

Age Specific Fertility Rate	Number of births per 1,000 women of a specific age within the childbearing age range, normally age 15 to 49 years.
Baby Boomer Period	Period following World War II (1946–1965), marked by an important increase in fertility rates and in the absolute number of births.
Components of Population Growth	Births, deaths and migration are components that alter the size of the total population and its composition by age and sex.
Emigrant	Canadian citizen or immigrant who left Canada to settle permanently in another country.
Immigrant	Person who has been permitted by immigration authorities to live in Canada permanently.
International Migration	Movement of persons between Canada and other countries.
Interprovincial Migration	Movement from one province/territory to another resulting in a permanent change in residence. A person who takes up residence in another province is an out-migrant with reference to the province of origin and an in-migrant with reference to the province of destination.
Intraprovincial Migration	Movement within the province from one Census Division to another resulting in a permanent change in residence.
Median Age	Age “x”, such that exactly one half of the population is older than “x” and the other half is younger than “x”.
Migration	Permanent change of residence from one geographical unit to another.
Mortality Rate	The number of deaths per 1,000 individuals in a defined population for a particular time period.
Natural Increase	Population change resulting from only the births and deaths within that population.
Net International Migration	Equal to: immigrants – emigrants + returning emigrants – temporary emigrants + net non-permanent residents
Net Interprovincial Migration	Difference between in-migrants and out-migrants for a given province or territory.
Net Migration	Difference between in-migration and out-migration for a given area and period of time.
Net Non-Permanent Residents	Variation in the number non-permanent residents between two dates.
Net Temporary Emigrants	Variation in the number of temporary emigrants between two dates.
Net Undercoverage	Difference between the number of persons who were covered by the census but who were not enumerated (i.e. undercoverage) and the number of persons who were enumerated when they should not have been or who were enumerated more than once (i.e. overcoverage).
Non-Permanent Residents	Persons from another country who had an employment authorization, a student authorization, or a Minister’s permit, or who were refugees claimant, and family members living with them.
Population Growth	Total change in the population of a given geographic unit in a given period, resulting from fertility (births), mortality (deaths) and migration.
Population Projection	An estimate of a future population derived from calculations made on certain assumptions of fertility (births), mortality (deaths) and migration.
Population Pyramid	A chart which shows the distribution of a population by age and sex.
Replacement Level (Fertility)	Mean number of births per woman necessary to assure the long-term replacement of a population for a given mortality level. Currently, the replacement level in Canada and most other developed countries is about 2.1 children per woman.
Returning Emigrants	Canadian citizens or landed immigrants who have emigrated from the country and subsequently returned to Canada to re-establish a permanent residence.
Shadow Population	Individuals who reside in one region on a temporary basis, while their primary residence is located somewhere else. They are enumerated by the census as residents of the jurisdictions where their primary residence is located.
Temporary Emigrant	Canadian citizen or immigrant who left Canada to settle temporarily in a foreign country.
Total Fertility Rate	The sum of age-specific fertility rates during a given year. The TFR indicates the average number of children that a generation of women would have if, over the course of their reproductive life, they had fertility rates identical to those of the year considered.
Two-Way Raking	An adjustment method (also known as the “Deming method”) where proportions are distributed to ensure that the age and sex of the census divisions equal the province’s total population.

Sources: Statistics Canada and Alberta Treasury Board and Finance