Actuarial Report 30th

on the Canada Pension Plan

as at 31 December 2018

Canada

27 November 2019

The Honourable William F. Morneau, P.C., M.P.
Minister of Finance
House of Commons
Ottawa, Canada
K1A 0A6

Dear Minister:

In accordance with section 115 of the *Canada Pension Plan*, which provides that an actuarial report shall be prepared every three years for purposes of the financial state review by the Minister of Finance and the ministers of the Crown from the provinces, I am pleased to submit the Thirtieth Actuarial Report on the Canada Pension Plan, prepared as at 31 December 2018.

Yours sincerely,

Assia Billig, FCIA, FSA, PhD
Chief Actuary

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Main Findings 30th CPP Actuarial Report		
	BASE CPP	**ADDITIONAL CPP**
Contributions	➢ Legislated contribution rate of 9.9% for year 2019 and thereafter.	➢ Legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter, respectively.
	➢ The number of CPP contributors expected to grow from 14.5 million in 2019 to 18.4 million in 2050.	
	➢ Contributions expected to increase from $52 billion in 2019 to $165 billion in 2050.	➢ Contributions expected to increase from $1.6 billion in 2019 to $43 billion in 2050.
	➢ Contributions projected to be higher than expenditures up to the year 2021 inclusive.	➢ Contributions projected to be higher than expenditures up to the year 2057 inclusive.
Expenditures	➢ The number of retirement beneficiaries expected to increase from 5.6 million in 2019 to 9.9 million in 2050.	➢ The number of retirement beneficiaries expected to increase from 0.2 million in 2019 to 8.9 million in 2050.
	➢ Total expenditures projected to grow from $49 billion in 2019 to $188 billion in 2050.	➢ Total expenditures projected to grow from $0.1 billion in 2019 to $28 billion in 2050.
Assets	➢ Total assets projected to grow from $372 billion at the end of 2018 to $688 billion by 2030 and $1.7 trillion by 2050.	➢ Total assets projected to grow from $0 billion at the end of 2018 to $191 billion by 2030 and $1.3 trillion by 2050.
	➢ In 2050, investment income is projected to represent 37% of revenues.	➢ In 2050, investment income is projected to represent 61% of revenues.
Minimum Contribution Rates needed to sustain the CPP	➢ The minimum contribution rate is 9.75% of contributory earnings for years 2022 to 2033 and 9.72% for years 2034 and thereafter.	➢ The first additional minimum contribution rate as a percentage of first additional contributory earnings is 1.49% in 2022 and 1.98% for years 2023 and thereafter.
		➢ The second additional minimum contribution rate as a percentage of second additional contributory earnings is 7.92% for years 2024 and thereafter.
	➢ **The respective legislated contribution rates are higher than the minimum contribution rates needed to sustain the Plan, and thus are sufficient to finance both the base and additional CPP over the long term.**	

1.2 Introduction

This is the 30th Actuarial Report on the Canada Pension Plan since the inception of the Canada Pension Plan (CPP or the Plan) in 1966. The valuation date is 31 December 2018. This report has been prepared in compliance with the timing and information requirements of the *Canada Pension Plan*. Section 113.1 of the *Canada Pension Plan* provides that the Minister of Finance and ministers of the Crown from the provinces shall review the financial state of the CPP once every three years and may consequently make recommendations to change the benefits or contribution rates, or both. Section 113.1 identifies the factors the ministers consider in their review, including information to be provided by the Chief Actuary.

As of 1 January 2019, the CPP has two components: the base and additional Plans. The CPP consisted only of the base Plan (or base CPP) prior to 2019, and this component continues. The additional Plan (or additional CPP) is the new enhancement to the CPP as of 2019. An important purpose of the report is to inform contributors and beneficiaries of the current and projected financial states of the base and additional CPP. The report provides information to evaluate the base and additional Plans' financial sustainability over a long period, assuming that the legislation remains unchanged. Such information should facilitate a better understanding of the financial states of the base and additional Plans and the factors that influence costs, and thus contribute to an informed public discussion of issues related to the finances of the two components of the CPP.

The previous triennial report was the 27th Actuarial Report on the Canada Pension Plan as at 31 December 2015, which was tabled in the House of Commons on 27 September 2016.

The *Canada Pension Plan* was subject to a series of amendments since the 27th CPP Actuarial Report but prior to 31 December 2018 pursuant to the adoption of Bills C-26, C-74, and C-86. These Bills are described further in Appendix A of this report. The 28th CPP Actuarial Report was prepared to show the estimates for the Plan in respect of the introduction of the additional Plan (Bill C-26). The 29th CPP Actuarial Report was prepared to show the effect of Bill C-74 on the long-term financial states of the base and additional Plans. There was no supplemental actuarial report in respect of Bill C-86 since the cost impacts on the CPP were deemed to be small to negligible.

Under Bill C-97 – *Budget Implementation Act, 2019, No. 1*, the application for a CPP retirement pension is waived upon reaching age 70, effective 1 January 2020. Bill C-97 was introduced in 2019 and received Royal Assent on 21 June 2019. This amendment is considered to be a subsequent event for the purpose of this report, since it became known to the Chief Actuary after the valuation date but before the report date and was determined to have an effect on the financial state of the CPP.

In addition, amendments to the regulations regarding the calculation of the CPP contribution rates were proposed in 2018 to clarify the determination of full funding rates and introduce the calculation of the additional CPP minimum contribution rates. These regulations as well as proposed regulations regarding the sustainability of the additional CPP, namely the *Calculation of*

Contribution Rates Regulations, 2018 and the *Additional Canada Pension Plan Sustainability Regulations*[1] are awaiting formal consent by the provinces.

This 30th CPP Actuarial Report takes into account all the above listed amendments and proposed regulations as well as the subsequent event of the amendment under Bill C-97. Further, this CPP Actuarial Report takes into account the updated population estimates from Statistics Canada that became available in January 2019. This is also considered to be a subsequent event for the purpose of this report.

1.3   Independent Peer Review Process

As part of its policy of ensuring that it provides sound and relevant actuarial advice to Members of Parliament and to the Canadian population, as was done for previous reports, the Office of the Chief Actuary (OCA) has commissioned an external peer review[2] of this actuarial report on the CPP.

The external peer review is intended to ensure that the actuarial reports meet high professional standards, and are based on reasonable methods and assumptions. Over the years, peer review recommendations have been carefully considered and many of them implemented.

1.4   Scope of the Report

Section 2 presents a general overview of the methodology used in preparing the actuarial estimates included in this report, which are based on the best-estimate assumptions described in section 3. The results for the base Plan and additional Plan are presented separately in sections 4 and 5, respectively, and include for each component the projections of the revenues, expenditures, and assets over more than the next 75 years. Section 6 provides the reconciliation of the results for the base Plan with those of the 27th CPP Actuarial Report as well as the reconciliation of the results for the additional Plan with those of the 28th CPP Actuarial Report. Section 7 presents a general conclusion about the financial states of the base and additional Plans, and section 8 provides the actuarial opinion.

The various appendices provide a summary of the Plan provisions, a description of the data, assumptions and methodology employed, supplemental information on the financing of the CPP, detailed reconciliations of the results with previous reports, the uncertainty of results, and acknowledgements of data providers and staff who contributed to this report.

1.5   Uncertainty of Results

This actuarial report on the Canada Pension Plan presents projections of its revenues and expenditures for both of its components, the base and additional CPP, over a long period of time. Both the length of the projection period and the number of assumptions required ensure that

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[1] The *Calculation of Contribution Rates Regulations, 2018* and the *Additional Canada Pension Plan Sustainability Regulations* were published in the Canada Gazette, Part l, Vol. 152, No. 42 on October 20, 2018. Both Regulations are awaiting formal provincial approval.
[2] More information on the CPP independent peer review process and past reviews can be found at http://www.osfi-bsif.gc.ca/Eng/oca-bac/ipr-rip/Pages/default.aspx

actual future experience will not develop precisely in accordance with the best-estimate projections.

To measure the sensitivity of the long-term projected financial position of the base and additional Plans to future changes in the demographic, economic, and investment environments, a variety of sensitivity tests were performed. The tests and results are presented in detail in Appendix E of this report.

These tests show that the minimum contribution rate (MCR) of the base CPP as well as the first and second additional minimum contribution rates (FAMCR and SAMCR) of the additional Plan would deviate significantly compared to their best estimates, if other than best-estimate assumptions were realized.

Real rates of return on investments, the future evolution of mortality, and future economic growth are among the important factors that could result in the minimum contribution rates being higher than the respective legislated rates. The following table highlights some of the impacts of these factors on the MCR of the base CPP and the FAMCR and SAMCR of the additional Plan.

Highlights of Uncertainty of Results[1]	
Base CPP	**Additional CPP**
Rate of Return	

The 30th CPP Actuarial Report is based on an assumed nominal average 75-year rate of return of 5.95% for the base CPP and 5.38% for the additional CPP.

A decrease of 1% in the assumed nominal average annual 75-year rate of return would result in:

➢ The MCR increasing to 10.62%, which is 9% higher than the MCR under the best-estimate assumptions.	➢ the FAMCR increasing to 2.69% and the SAMCR increasing to 10.76%, which is 36% higher than the AMCRs under the best-estimate assumptions.

An increase of 1% in the assumed nominal average annual 75-year rate of return would result in:

➢ The MCR decreasing to 8.82%, which is 9% lower than the MCR under the best-estimate assumptions.	➢ the FAMCR decreasing to 1.49% and the SAMCR decreasing to 5.96%, which is 25% lower than the AMCRs under the best-estimate assumptions.

Given that the additional CPP relies more heavily on investment earnings as a source of revenues than the base CPP, the AMCRs are more sensitive to changes in the rate of return assumption than the MCR.

(1) Unless specified otherwise, the MCR quoted in the table is for years 2034 and thereafter, the FAMCR is for years 2023 and thereafter, and the SAMCR is for years 2024 and thereafter.

Highlights of Uncertainty of Results[1]

Base CPP	Additional CPP

Rate of Return Intervaluation Experience

For the 30th CPP Actuarial Report, the assumed cumulative nominal rates of return over the inter-valuation period 2019-2021 are 16.3% for the base CPP and 8.1% for the additional CPP.

➢ If the actual cumulative nominal rate of return over the inter-valuation period 2019-2021 is 6.3% (i.e. 10 percentage points lower than the best-estimate assumption), the MCR for the years 2025 to 2033, determined at the next actuarial valuation, would be the same as the legislated contribution rate of 9.9%.	➢ As the additional Plan assets are relatively low over the inter-valuation period 2019-2021, it is very unlikely that short-term investment experience would cause the AMCRs to fall outside the "no action" ranges prescribed by the proposed *Additional Canada Pension Plan Sustainability Regulations.*

Mortality

The 30th CPP Actuarial Report is based on the assumption that mortality will continue to improve but at a slower pace than over the last few decades.

If mortality were to improve faster than assumed with life expectancies at age 65 for males and females being about 2.4 years higher by 2050 compared to the best estimates, this would result in:

➢ the MCR increasing to 10.06%.	➢ the FAMCR and SAMCR increasing to 2.15% and 8.60%, respectively.

If mortality is assumed to stay at the same level as in 2019, i.e. with no future improvements, this would result in:

➢ the MCR decreasing to 9.03% (a difference of 0.69%)	➢ the FAMCR and SAMCR decreasing respectively to 1.72% and 6.88% (differences of 0.26% / 1.04%)

These differences represent the annual costs of increasing longevity for the base and additional Plans.

Economic Growth

The 30th CPP Actuarial Report is based on the assumption of moderate and sustainable economic growth.

If lower economic growth is assumed with total employment earnings in 2035 being 13% lower compared to the best estimate, this would result in:

➢ the MCR increasing to 10.67%.	➢ the FAMCR and SAMCR decreasing respectively to 1.80% and 7.20%.

If higher economic growth is assumed with total employment earnings in 2035 being 15% higher compared to the best estimate, this would result in:

➢ the MCR decreasing to 8.80%.	➢ the FAMCR and SAMCR increasing respectively to 2.21% and 8.84%.

The impacts are in the opposite direction for the base and additional Plans due to the different financing approaches of the two components of the CPP. The base CPP relies more heavily on contributions as a source of revenues than the additional CPP.

(1) Unless specified otherwise, the MCR quoted in the table is for years 2034 and thereafter, the FAMCR is for years 2023 and thereafter, and the SAMCR is for years 2024 and thereafter.

1.6   Conclusion

The actuarial projections of the financial states of the base and additional Plans presented in this report reveal the following.

Base CPP

This report confirms that the legislated contribution rate of 9.9% is sufficient to finance the base CPP over the long term. Under the legislated contribution rate, contributions to the base Plan are projected to be higher than expenditures over the period 2019 to 2021, with a portion of investment income thereafter required to pay for expenditures. Total assets of the base Plan are expected to increase significantly over the next decade and then to continue increasing, but at a slower pace. Under the legislated contribution rate of 9.9%, base CPP assets are projected to accumulate to $688 billion by the end of 2030 and $1.7 trillion by 2050, while the ratio of assets to the following year's expenditures is projected to remain relatively stable at a level of 7.6 over the period 2021 to 2031, then grow to 8.8 in 2050 and continue increasing over the projection period.

The MCR of the base CPP is 9.75% for years 2022 to 2033 and 9.72% for the year 2034 and thereafter, which is lower than the legislated contribution rate of 9.9%. Thus, despite the projected substantial increase in benefits paid as a result of an aging population, the legislated rate exceeds the MCR, and the base Plan is expected to be able to meet its obligations throughout the projection period.

Since the MCR of the base CPP is below the legislated contribution rate of 9.9%, the insufficient rates provisions in subsections 113.1(11.05) to 113.1(11.15) of the *Canada Pension Plan* do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated contribution rate will remain at 9.9% for the year 2019 and thereafter.

Additional CPP

This report confirms that the legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter, respectively, result in projected contributions and investment income that are sufficient to fully pay the projected expenditures of the additional CPP over the long term. Under the legislated additional contribution rates, contributions to the additional Plan are projected to be higher than expenditures up to the year 2057 inclusive, with a portion of investment income thereafter required to pay for expenditures. As such, total assets of the additional Plan are expected to increase rapidly over the first several decades. Under the legislated additional contribution rates, additional CPP assets are projected to grow to $191 billion by the end of 2030 and to $1.3 trillion by 2050, while the ratio of assets to the following year's expenditures is projected to increase rapidly until 2025 and then decrease to a level of about 26 by 2080.

The FAMCR is 1.98% for the year 2023 and thereafter, and the SAMCR is 7.92% for the year 2024 and thereafter, which are lower than the respective legislated additional contribution rates.

In accordance with the *Additional Canada Pension Plan Sustainability Regulations*, the AMCRs are sufficiently close to the legislated additional contribution rates such that no immediate action is required to address the differences. Therefore, in the absence of specific action by the federal and provincial governments, the legislated additional contribution rates will remain at their scheduled values.

Base and Additional CPP

To measure the sensitivity of the financial projections of each of the base and additional Plans to future changes in the demographic, economic, and investment environments, a variety of sensitivity tests were performed. Analyses of different asset allocations, the impacts of varying investment experience, and sensitivity tests on key assumptions show that the minimum contribution rates of the base and additional CPP could deviate significantly from their best-estimate values if other than best-estimate assumptions were to be realized, as shown in Appendix E of this report.

The projected financial states of the base and additional Plans presented in this report are based on the assumed demographic, economic, and investment outlooks over the long term. Given the length of the projection period and the number of assumptions required, it is unlikely that the actual experience will develop precisely in accordance with the assumptions. Therefore, it remains important to assess the financial states of the two components on a regular basis by producing periodic actuarial valuation reports. For this purpose, as required by the *Canada Pension Plan*, the next such actuarial valuation will be as at 31 December 2021.

2   Methodology

As of 1 January 2019, the CPP has two components: the base and additional Plans. The base Plan was the CPP prior to 2019, and this component continues. The additional Plan is the new enhancement to the CPP as of 2019. When not qualified, the term CPP or the Plan used in this report refers to the entire CPP, that is, to both its components.

The actuarial examination of the CPP involves projections of the revenues and expenditures of both components over a long period of time, so that the future impact of historical and projected trends in demographic and economic factors can be properly assessed. The actuarial estimates in this report are based on the provisions of the *Canada Pension Plan* as at 31 December 2018,[1] data regarding the starting point for the projections, and best-estimate assumptions regarding future demographic, economic, and investment experience.

The revenues of the base and additional Plans include both contributions and investment income. The projection of contributions begins with a projection of the working-age population. This requires assumptions regarding demographic factors such as fertility, migration, and mortality. Total contributory earnings for each component of the Plan are derived by applying labour force participation and job creation rates to the projected population and by projecting future employment earnings. This requires assumptions about various factors such as wage increases, an earnings distribution, and unemployment rates. Contributions for each of the components of the CPP are obtained by applying the respective component's contribution rate(s) to the respective contributory earnings. Investment income is projected on the basis of the existing portfolio of assets (for the base CPP), projected net cash flows (contributions less expenditures), and the assumptions regarding the future asset mix and rates of return on investments net of investment expenses. Since the assumptions regarding the future asset mix differ between the base and additional Plans, the resulting assumptions regarding investment income differ as well.

Expenditures for each component of the Plan consist of the benefits paid out and operating expenses. Newly emerging benefits are projected by applying assumptions regarding retirement, disability, and death to the populations eligible for benefits, together with the benefit provisions and the earnings histories of participants (actual and projected). The projection of total benefits, which includes the continuation of benefits already in pay at the valuation date, requires further assumptions. Operating expenses, excluding Canada Pension Plan Investment Board (CPPIB) operating expenses, are projected by considering the historical and projected relationship between expenses and total employment earnings, while CPPIB operating expenses are considered in the determination of the rates of return.

The assumptions and results presented in the following sections make it possible to measure the financial states of the base and additional CPP separately in each projection year and to calculate the minimum contribution rates. For the base Plan, the minimum contribution rate (MCR) is the

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[1] The amendment to the *Canada Pension Plan* under Bill C-97 – *Budget Implementation Act, 2019, No. 1* (application for a CPP retirement pension is waived upon reaching age 70, effective 1 January 2020) was also taken into account for this report, since it was determined to be a subsequent event with a material effect on the financial states of the base and additional CPP as at the valuation date.

sum of two types of rates. The first of these excludes the full funding provision for increased or new benefits, and is referred to as the "steady-state" contribution rate. The second type of rate that makes up the MCR is the full funding rate for increased or new benefits.

For the additional CPP, there are two additional minimum contribution rates (AMCRs), the first additional minimum contribution rate (FAMCR) and the second additional minimum contribution rate (SAMCR). The FAMCR is applicable to contributory earnings below the Year's Maximum Pensionable Earnings (YMPE) and the SAMCR is applicable to earnings between the YMPE and the Year's Additional Maximum Pensionable Earnings (YAMPE).

Details of the methodology used to determine the MCR and AMCRs are presented in Appendix C.

A wide variety of factors influence both the current and projected financial state of the components of the CPP. Accordingly, the results shown in this report differ from those shown in previous reports. Likewise, future actuarial examinations will reveal results that differ from the projections included in this report.

3   Best-Estimate Assumptions

3.1   Introduction

The information required by statute, which is presented in sections 4 and 5 of this report, necessitates making numerous assumptions regarding future demographic, economic, and investment trends. The projections included in this report cover a long period of time (over 75 years), and the assumptions are determined by examining historical long-term and short-term trends and applying judgment as to the extent these trends will continue in the future. These assumptions reflect the Chief Actuary's best judgment and are referred to in this report as the best-estimate assumptions. The assumptions were chosen to be independently reasonable and appropriate in the aggregate, taking into account certain interrelationships between them.

The assumptions were developed taking into account two subsequent events, that is, events that became known to the Chief Actuary after the valuation date, but before the report date, that were deemed to have an effect on the financial states of the base or additional CPP as at the valuation date. The first subsequent event is the amendment to the Plan under Bill C-97 – *Budget Implementation Act, 2019, No. 1*, which received Royal Assent on 21 June 2019 (application for a CPP retirement pension is waived upon reaching age 70, effective 1 January 2020). This amendment is further described in Appendices A and B of this report. The second subsequent event is the use of updated population estimates (for years 2018 and prior) from Statistics Canada that became available in January 2019.

The Chief Actuary held a seminar in September 2018 on the long-term demographic, economic, and investment outlook for Canada to obtain opinions from a wide range of individuals with relevant expertise. Five experts in the fields of demographics, economics, investments, and foresight were invited to present their views. Among the participants at the seminar were representatives from the OCA, federal departments including Statistics Canada, Employment and Social Development Canada (ESDC), and the Department of Finance, representatives from provincial and territorial governments, as well as representatives from Retraite Québec, the CPPIB, and other organizations. Representatives of the OCA also attended a seminar on the demographic, economic and financial outlook for 2018-2068 held by Retraite Québec in November 2018. Various presentation materials from both seminars are available on OSFI's Web site.

Table 1 presents a summary of the most important assumptions used in this report compared with those used in the previous triennial report. The assumptions are described in more detail in Appendix B of this report.

Table 1	Best-Estimate Assumptions			
Canada	30th Report (as at 31 December 2018)		27th Report [1] (as at 31 December 2015)	
Total Fertility Rate	1.62 (2027+)		1.65 (2019+)	
Mortality	Statistics Canada Life Tables (CLT 3-year average table: 2014 – 2016) with assumed future improvements		Canadian Human Mortality Database (CHMD 2011) with assumed future improvements	
Canadian Life Expectancy	Males	Females	Males	Females
at birth in 2019	86.9 years	89.9 years	87.0 years	89.9 years
at age 65 in 2019	21.4 years	23.9 years	21.5 years	23.9 years
Net Migration Rate	0.62% of population (for 2021+)		0.62% of population (for 2016+)	
Participation Rate (age group 18-69)	79.2%	(2035)	79.1% [2]	(2035)
Employment Rate (age group 18-69)	74.4%	(2035)	74.4% [2]	(2035)
Unemployment Rate (ages 15+)	6.2%	(2030+)	6.2%	(2025+)
Rate of Increase in Prices	2.0%	(2019+)	2.0%	(2017+)
Real Wage Increase	1.0%	(2025+)	1.1%	(2025+)
Real Rate of Return (average 2019-2093)	Base CPP Assets	4.0%	4.0% [3]	
	Additional CPP Assets	3.4%	3.6% [4]	
Retirement Rates for Cohort at Age 60	Males	27.0% (2021+)	Males	34.0% (2016+)
	Females	29.5% (2021+)	Females	38.0% (2016+)
CPP Disability Incidence Rates (per 1,000 eligible)	Males	2.95 (2019+)	Males	3.17 (2020+) [5]
	Females	3.65 (2019+)	Females	3.72 (2020+) [5]

(1) The 27th CPP Actuarial Report as at 31 December 2015 was the previous triennial report. The 28th and 29th CPP Actuarial Reports are supplemental reports which use the same assumptions and methods as the 27th CPP Actuarial Report, adjusted as necessary to reflect the amendments to the Plan in respect of Part 1 of Bill C-26 and Division 19 of Part 6 of Bill C-74 .

(2) The assumed labour force participation and employment rates of the 27th CPP Actuarial Report for the age group 18-69. These differ from the assumed rates for the age group 15-69 shown in Table 1 of the 27th CPP Actuarial Report.

(3) The expected 75-year average real rate of return over the period 2016-2090 on the base CPP assets was determined to be 3.9% under the 27th CPP Actuarial Report. Under that report, the expected 75-year average real rate of return over the period 2019-2093 is 4.0%.

(4) The expected 75-year (2019-2093) average real rate of return on the additional CPP assets was determined under the 28th and 29th CPP Actuarial Reports.

(5) The ultimate disability incidence rates assumption of the 27th CPP Actuarial Report has been adjusted based on the 2018 eligible population in order to compare with the assumption for this 30th CPP Actuarial Report on the same basis.

3.2   Demographic Assumptions

The population projections start with the Canada and Québec populations on 1 July 2018, to which are applied fertility, migration, and mortality assumptions. The relevant population for the Canada Pension Plan is the population of Canada less that of Québec and is obtained by subtracting the projected results for Québec from those for Canada. The population projections are essential in determining the future number of CPP contributors and beneficiaries.

3.2.1   Fertility

The first cause of the aging of the Canadian population is the decline in the total fertility rate that occurred during the last 50 years. The total fertility rate in Canada decreased rapidly from a level

of about 4.0 children per woman in the late 1950s to 1.6 by the mid-1980s. The total fertility rate rose slightly in the early 1990s, but then declined to a level of 1.5 by the late 1990s. Canada is one of many industrialized countries that saw their fertility rates increase starting in the 2000s. By 2008, the total fertility rate for Canada reached 1.68. However, in some industrialized countries, including Canada, the total fertility rate has decreased since 2008, which could be attributable to the most recent economic downturn experienced. As of 2017, the total fertility rate for Canada stood at 1.55.[1]

Similar to Canada, the total fertility rate in Québec fell from a high of about 4.0 children per woman in the 1950s; however, the Québec rate fell to a greater degree, reaching 1.4 by the mid-1980s. The Québec rate then recovered somewhat in the early 1990s to over 1.6 and subsequently declined to below 1.5 by the late 1990s. There was a significant increase in the Québec rate in the 2000s, with the rate reaching 1.74 in 2008. However, similar to Canada's fertility rate, the fertility rate for Québec has been decreasing in recent years and stood at 1.60[1] in 2017.

The overall decrease in the total fertility rate over the last 50 years occurred as a result of changes in a variety of social, medical, and economic factors. Although there have been periods of growth in the total fertility rates in recent decades, it is unlikely that the rates will return to historical levels in the absence of significant societal changes.

The assumed age-specific fertility rates lead to an assumed total fertility rate for Canada that will increase from its 2017 level of 1.55 children per woman to an ultimate level of 1.62 in 2027. The assumed age-specific fertility rates for Québec lead to a total fertility rate for the province that will increase from its 2017 level of 1.60 to an ultimate level of 1.65 in 2027.

3.2.2   Mortality

Another element that has contributed to the aging of the population is the significant reduction in the age-specific mortality rates. This can be measured by the increase in life expectancy at age 65, which directly affects how long retirement benefits will be paid to beneficiaries. Male life expectancy (without future mortality improvements, i.e. reductions in mortality) at age 65 increased by 42% between 1966 and 2015, rising from 13.6 to 19.3 years. For women, life expectancy at age 65 (without future improvements) increased by 31%, from 16.9 to 22.1 years over the same period. Although the overall gains in life expectancy at age 65 since 1966 are similar for males and females (between 5 and 6 years), about 65% of the increase occurred after 1991 for males, while for females, only about 45% of the increase occurred in that period.

Mortality improvements are expected to continue in the future, but at a slower pace than most recently observed over the 15-year period ending in 2015. Further, it is assumed that ultimately, mortality improvement rates for males will decrease to the same level as for females. The analysis of the Canadian experience over the period 1925 to 2015, including the recent slowdown trends

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[1] The fertility rate of 1.55 for Canada and 1.60 for Québec are adjusted values provided by Statistics Canada as part of a special tabulation that accounts for its revised population estimates released in January 2019.

observed in mortality improvement rates for Old Age Security (OAS) beneficiaries[1], was combined with an analysis of the possible drivers of future mortality improvements.

The 15-year average mortality improvement rates by age and sex for the period ending in 2015 are the starting point for the projected annual mortality improvement rates from 2016 onward. For ages 65 and over, the annual mortality improvement rates for 2016 to 2017 were estimated using the trends derived from the administrative data on OAS beneficiaries, representing 98% of the general population.

Starting from 2015 (2017 for ages 65 and over), the rates are assumed to gradually reduce to their ultimate levels in 2035, which are for both sexes 0.8% per year for ages below 90, 0.5% for ages 90 to 94, and 0.2% for ages 95 and above. Considering future mortality improvements, life expectancy at age 65 in 2019 is projected to be 21.4 years for males, and 23.9 years for females. This represents a decrease of 0.1 years in life expectancy at age 65 in 2019 for males and no change for females, relative to the 27th CPP Actuarial Report projections.

To project CPP benefits, the mortality rates for CPP retirement, survivor, and disability beneficiaries reflect actual experience for those segments of the population. Specific mortality experience for CPP beneficiaries is discussed further in Appendix B of this report.

3.2.3 Net Migration

Net migration corresponds to the number of immigrants less the number of emigrants, plus the number of returning Canadians and the net increase in the number of non-permanent residents.

The net migration rate is expected to decrease from its current (2018) level of 1.11% of the population to 0.86% in 2019, 0.73% in 2020, and reach an ultimate level of 0.62% of the population for the year 2021 and thereafter. The ultimate net migration rate of 0.62% corresponds to the average experience observed over the last 10 years, excluding the net increase in non-permanent residents during that period. For the Québec population, the 2021 ultimate net migration rate assumption corresponds to the 10-year average historical experience for the province of 0.43%, excluding the net increase in non-permanents residents.

3.2.4 Population Projections

Table 2 shows the population of Canada less Québec for three age groups (0-19, 20-64 and 65 and over) throughout the projection period. The ratio of the number of people aged 20-64 to those aged 65 and over is a measure that approximates the ratio of the number of working-age people to retirees. Because of the aging population, this ratio is projected to drop from 3.6 in 2019 to about half its value or 1.9 in 2095.

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[1] More details are provided in the OCA's September 2018 OAS Program Mortality Experience Fact Sheet, which can be found at http://www.osfi-bsif.gc.ca/Eng/oca-bac/fs-fr/Pages/oas_pme_2018.aspx

Table 2	Population of Canada less Québec (thousands)				
Year	Total	Age 0-19	Age 20-64	Age 65 and Over	Ratio of 20-64 to 65 and Over
2019	29,025	6,351	17,707	4,967	3.6
2020	29,354	6,368	17,821	5,165	3.5
2021	29,657	6,389	17,903	5,365	3.3
2022	29,963	6,428	17,965	5,570	3.2
2023	30,272	6,479	18,013	5,780	3.1
2024	30,583	6,533	18,059	5,991	3.0
2025	30,896	6,596	18,092	6,208	2.9
2030	32,432	6,860	18,320	7,251	2.5
2035	33,841	7,096	18,825	7,921	2.4
2040	35,094	7,286	19,428	8,380	2.3
2045	36,227	7,382	20,121	8,724	2.3
2050	37,302	7,458	20,686	9,158	2.3
2055	38,381	7,609	21,099	9,674	2.2
2060	39,516	7,839	21,390	10,286	2.1
2065	40,716	8,093	21,716	10,907	2.0
2075	43,164	8,525	22,937	11,702	2.0
2085	45,555	8,892	24,291	12,372	2.0
2095	48,097	9,381	25,459	13,257	1.9

3.3   Economic and Investment Assumptions

The main economic assumptions for the Canada Pension Plan are: labour force participation rates, job creation rates, unemployment rates, the rate of increase in prices, and real increases in average employment earnings. For asset projections, further assumptions on real rates of return on invested assets are required.

One of the key elements underlying the best-estimate economic assumptions relates to the continued trend toward longer working lives. Older workers are expected to exit the workforce at a later age, which could alleviate the impact of the aging of the population on future labour force growth. However, despite the expected later exit ages, labour force growth is projected to weaken as the working-age population expands at a slower pace and baby boomers exit the labour force. As a result, labour shortages together with projected improvements in productivity growth are assumed to create upward pressure on real wages until 2025.

3.3.1   Labour Force

Employment levels vary with the rate of unemployment, and reflect trends in increased workforce participation by women, longer periods of formal education among young adults, as well as changing retirement patterns of older workers.

As the population ages, older age groups with lower labour force participation increase in size. As a result, the labour force participation rate for Canadians aged 15 and over is expected to decline

from 65.2% in 2019 to 63.0% in 2035. A more useful measure of the working-age population is the participation rate of those aged 18 to 69, which is expected to increase from 76.0% in 2019 to 79.2% in 2035.

The increase in the participation rate for those aged 18 to 69 is mainly due to an assumed increase in participation rates for those aged 55 and over as a result of an expected continued trend toward longer working lives. Furthermore, labour shortages create attractive employment opportunities that will continue to exert upward pressure on the participation rates for all age groups. It is also expected that future participation rates will increase with the aging of cohorts that have a stronger labour force attachment compared to previous cohorts due to higher education attainment. The cohort effect of stronger labour force attachment of women is expected to continue but at a much slower pace than in the past, resulting in a gradual narrowing of the gap between the age-specific participation rates of men and women.

As a result, the participation rates for females are projected to increase slightly more than for males. Overall, the male participation rate of those aged 18 to 69 is expected to increase from 79.8% in 2019 to 82.8% in 2035, while the female participation rate for the same age group is expected to increase from 72.1% in 2019 to 75.6% in 2035. Thereafter, the 2035 gap of 7.2% between males and females in this age group is expected to vary between 7.0% and 7.2%.

The job creation rate (i.e. the change in the number of persons employed) in Canada was on average 1.6% from 1976 to 2018 based on available employment data, and it is assumed that the rate will be 1.1% in 2019. The job creation rate assumption is determined on the basis of expected moderate economic growth and an unemployment rate for Canada, ages 15 and over, that is expected to increase from 5.8% in 2018 to 5.9% in 2019 and then reach an ultimate level of 6.2% by 2030. The assumed job creation rate for Canada, ages 15 and over, is on average about 0.7% from 2019 to 2025 and 0.6% from 2025 to 2030, which is slightly lower than the labour force growth rate. It is assumed that, starting in 2030, the job creation rate will follow the labour force growth rate, with both averaging 0.7% per year between 2030 and 2035, and 0.5% per year thereafter. The aging of the population is the main reason behind the expected slower long-term growth in the labour force and job creation rate.

3.3.2   Price Increases

Price increases, as measured by changes in the Consumer Price Index (CPI), tend to fluctuate from year to year. In Canada, increases in prices (inflation) was 2.3% in 2018.

In 2016, the Bank of Canada and the Government renewed their commitment to keep inflation between 1% and 3% until the end of 2021. The Senior Deputy Governor of the Bank of Canada indicated in November 2018 that the Bank was undergoing an extensive review of its monetary policy framework. A number of variants to replace the inflation target are being explored. The Bank is also looking at a possible dual mandate of targeting inflation as well as GDP growth or

employment[1]. Nevertheless, given the success of the 2% inflation target, it is considered very likely that the Bank will renew its inflation target commitment or that the target will at least constitute an important part of the Bank's future mandate.

Price increase forecasts from various economists indicate an average increase in prices of 2.0% from 2019 to 2040. To reflect these forecasts and the expectation that the Bank of Canada will renew its inflation target, the price increase assumption is set at 2.0% for 2019 and thereafter.

3.3.3 Real Wage Increases

Wage increases affect the financial state of the Canada Pension Plan in two ways. In the short term, an increase in the average wage translates into higher contribution income, with little immediate impact on benefits. Over the long term, higher average wages produce higher benefits.

The difference between nominal wage increases and inflation represents increases in the real wage, which is also referred to in this report as the real wage increase. There are five main factors that influence increases in the real wage, namely general productivity, the extent to which changes in productivity are shared between labour and capital, changes in the compensation structure offered to employees, changes in the average number of hours worked, and changes in labour's terms of trade[2].

The real wage increase is projected to gradually rise from 0.3% in 2019 to an ultimate value of 1.0% by 2025. The ultimate real wage increase assumption is developed taking into account the relationships described above, historical trends, labour shortages, and other changes in the labour market. The ultimate real wage increase assumption combined with the ultimate price increase assumption results in an assumed annual increase in average nominal wages of 3.0% in 2025 and thereafter.

The assumptions regarding the increase in average real annual employment earnings and job creation rates result in projected average annual real increases in total Canadian employment earnings of about 1.6% for the period 2018 to 2035. After 2035, this decreases to about 1.5% on average over the remainder of the projection period, reflecting the assumed 1.0% real increase in annual wages and projected average 0.5% annual growth in the working-age population.

Given historical trends and the long-term relationship between increases in the average annual employment earnings and the YMPE, it is assumed that the nominal wage increase assumption is also applicable to the increases in the YMPE from one year to the next.

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[1] Bank of Canada, Toward 2021: Reviewing the Monetary Policy Framework, November 20, 2018.
https://www.bankofcanada.ca/2018/11/choosing-best-monetary-policy-framework-canada/

[2] Labour's terms of trade measure how shifts in the prices of goods produced by workers (measured by the Gross Domestic Product (GDP) deflator) compare to shifts in the prices of goods consumed by workers (CPI).

3.3.4 Real Rates of Return on Investments

Real rates of return on investments are the excess of the nominal rates of return over price increases and are required for the projection of revenue arising from investment income. A real rate of return is assumed for each year in the projection period and for each of the main asset categories in which the base and additional CPP assets are invested. The assumed long-term real rates of return on base and additional CPP assets take into account the assumed asset mixes of investments, as well as the assumed real rates of return for all categories of CPP assets. The real rates of return on investments are net of all investment expenses, including CPPIB operating expenses. The 75-year average real rate of return on the base CPP assets is assumed to be 3.95%. The additional CPP, which is assumed to have a different asset mix than the base CPP, has an expected 75-year average real rate of return of 3.38%.

For the period 2019 to 2028, the assumed annual real rates of return are lower than the assumed ultimate real rates of return in 2029 due to lower expected bond returns during the period. The average real rates of return over the period 2019-2028 for the base and additional CPP are respectively 3.6% and 2.1%. The ultimate real rates of return for the base and additional CPP are respectively 4.0% and 3.6%. Table 3 summarizes the main economic assumptions over the projection period.

Table 3	Economic Assumptions (percentages)								
	Real Increase Average Annual Earnings	Real Increase Average Weekly Earnings (YMPE)	Price Increase	Labour Force (Canada)				Real Rates of Return on Investments	
Year				Participation Rate (Ages 15+)	Job Creation Rate (Ages 15+)	Unemployment Rate	Labour Force Annual Increase	Base CPP	Additional CPP
2019	0.3	0.3	2.0	65.2	1.1	5.9	1.1	2.9	(0.7) [1]
2020	0.5	0.5	2.0	65.1	0.8	5.9	0.8	2.8	0.4
2021	0.6	0.6	2.0	64.9	0.7	5.9	0.7	3.8	2.3
2022	0.7	0.7	2.0	64.7	0.7	6.0	0.7	3.6	2.4
2023	0.8	0.8	2.0	64.5	0.7	6.0	0.7	3.7	2.5
2024	0.9	0.9	2.0	64.3	0.6	6.0	0.7	3.7	2.6
2025	1.0	1.0	2.0	64.1	0.6	6.1	0.7	3.6	2.7
2030	1.0	1.0	2.0	63.2	0.6	6.2	0.6	4.0	3.6
2035	1.0	1.0	2.0	63.0	0.7	6.2	0.7	4.0	3.6
2040	1.0	1.0	2.0	62.5	0.6	6.2	0.6	4.0	3.6
2045	1.0	1.0	2.0	62.2	0.5	6.2	0.5	4.0	3.6
2050	1.0	1.0	2.0	61.9	0.4	6.2	0.4	4.0	3.6
2055	1.0	1.0	2.0	61.5	0.3	6.2	0.3	4.0	3.6
2060	1.0	1.0	2.0	61.0	0.3	6.2	0.3	4.0	3.6
2065	1.0	1.0	2.0	60.5	0.4	6.2	0.4	4.0	3.6
2075	1.0	1.0	2.0	60.2	0.5	6.2	0.5	4.0	3.6
2085	1.0	1.0	2.0	60.1	0.5	6.2	0.5	4.0	3.6
2095	1.0	1.0	2.0	59.8	0.4	6.2	0.4	4.0	3.6

(1) The initial real rate of return on the additional CPP's assets is assumed to be negative due to the assumed implementation expenses of the CPPIB of $9 million and the assumed increase in bond yields which results in a negative return for bonds in 2019.

3.4   Other Assumptions

This report is based on several other key assumptions, such as retirement benefit take-up rates and disability incidence rates.

3.4.1   Retirement Benefit Take-up Rates

The retirement benefit take-up rates are determined on a cohort basis. The sex-distinct retirement benefit take-up rate for any given age and year from age 60 and above corresponds to the number of emerging (new) retirement beneficiaries divided by the total number of people eligible for retirement benefits for the given sex, age, and year. The unreduced pension age under the Canada Pension Plan is 65. However, since 1987 a person can choose to receive a reduced retirement pension as early as age 60. This provision has had the effect of lowering the average age at pension take-up. In 1986, the average age at pension take-up was 65.2, compared to an average age of 62.5 over the decade ending in 2018.

In 2012, there was a significant increase observed in the retirement benefit take-up rates at age 60 for the cohort reaching age 60 that year. The retirement benefit take-up rates at age 60 in 2012 were 41% and 43% for males and females, respectively, compared to the corresponding rates of 32% and 35% in 2011. The observed increase in the retirement benefit take-up rates at age 60 in 2012 may have resulted from two provisions of the *Economic Recovery Act (stimulus)*. First, the work cessation test to receive the pension early (prior to age 65) was removed in 2012. As such, starting in 2012, individuals may receive a CPP retirement pension without having to stop working or materially reduce their earnings. The removal of the work cessation test may have thus led at least in part to the observed increase in take-up rates at age 60 in 2012. Second, greater reductions in early retirement pensions were scheduled to be phased in over a five-year period, starting in 2012. The anticipation of greater adjustments may have also contributed toward the observed increase in retirement benefit take-up rates at age 60 in 2012.

After 2012, the age 60 retirement benefit take-up rates have continually decreased as the higher actuarial adjustments were phased in and the effect of the removal of the work cessation test diminished. For cohorts reaching age 60 in 2018, the retirement benefit take-up rates are 27.9% for males and 30.6% for females, which are the lowest such rates since 1992.

The retirement take-up rates at age 60 observed for 2018 are assumed to further decrease over the next three years such that, for cohorts reaching age 60 in 2021 and thereafter, the retirement benefit take-up rates are assumed to be 27.0% for males and 29.5% for females. For cohorts reaching age 65 in 2026 and thereafter, the retirement benefit take-up rates are 46.4% for both sexes. These rates result in a projected average age at retirement pension take-up in 2030 of 63.5 for males and 63.3 for females. The same retirement take–up rates apply to the additional CPP.

3.4.2   Disability Incidence Rates - Disability Pension

The sex-distinct disability incidence rate in respect of the disability pension at any given age is the number of new disability beneficiaries divided by the total number of people eligible for the

disability pension at that age. The disability incidence rates for the base Plan are the same as for the additional Plan.

Based on the experience over the period from 2003 to 2018, the overall incidence rates for the year 2019 and thereafter are assumed to remain constant at the values in 2018, which are 2.95 per thousand eligible for males and 3.65 per thousand eligible for females.

The assumptions for the disability incidence rates in respect of the disability pension recognize that current disability incidence rates are significantly below the levels experienced from the mid-1970s to mid-1990s for males and during the early 1980s and early to mid-1990s for females. It is also recognized that incidence rates for both sexes have been relatively stable since 1997 as a result of administrative changes made to the disability program.

4   Results - Base CPP

4.1   Overview

The key observations and findings of the actuarial projections of the financial state of the base Canada Pension Plan presented in this report are as follows.

➢ With the legislated contribution rate of 9.9%, contributions to the base CPP are projected to be more than sufficient to cover the expenditures over the period 2019 to 2021. Thereafter, a portion of investment income is required to make up the difference between contributions and expenditures. Between 2030 and 2050, it is projected that about 22% of investment income will be required to pay for expenditures. In 2095, it is projected that 37% of investment income will be required to cover expenditures.

➢ With the legislated contribution rate of 9.9%, total assets of the base Plan are expected to increase significantly over the next decade and then will continue increasing, but at a slower pace. Total assets are expected to grow from $372 billion at the end of 2018 to $688 billion by the end of 2030. Assets are then projected to reach $1.7 trillion by 2050 and $9.9 trillion by 2095. The ratio of assets to the following year's expenditures is projected to remain relatively stable at a level of 7.6 over the period 2021 to 2031 and then grow thereafter to values of 8.8 in 2050 and 9.5 in 2095.

➢ With the legislated contribution rate of 9.9%, investment income of the base Plan, which is expected to represent 26% of revenues (i.e. contributions and investment income) in 2019, is projected to represent 37% of revenues in 2050 and 42% of revenues by 2095. This illustrates the importance of investment income as a source of revenues for the base Plan.

➢ The minimum contribution rate (MCR) to sustain the base Plan is 9.75% of contributory earnings for years 2022 to 2033 and 9.72% for the year 2034 and thereafter. The legislated contribution rate of 9.9% applies to the first three years after the valuation year, that is, to the current triennial review period of 2019-2021.

➢ The MCR consists of two separate components. First, the steady-state contribution rate, which is the lowest rate that results in the projected ratio of the assets to the following year's expenditures of the base Plan remaining generally constant over the long term, before consideration of any full funding of increased or new benefits, is 9.71% for the year 2022 and thereafter. The second component is the full funding rate that is required to fully fund the recent amendments made to the *Canada Pension Plan* under Bill C-74 – *Budget Implementation Act, 2018, No. 1*. The full funding rate is 0.04% for years 2022 to 2033 and 0.01% for the year 2034 and thereafter.

➢ Under the MCR, the ratio of assets to the following year's expenditures is projected to decrease slightly from 7.6 in 2022 to 7.5 in 2031 and to be the same fifty years later in 2081.

➢ The MCR determined for this report is lower than the MCR of 9.79% determined under the 27th CPP Actuarial Report. Experience over the period 2016 to 2018 was better than expected overall, especially regarding investment returns, leading to a decrease in the MCR. This decrease is partially offset by changes in assumptions. As well, the amendments under Bills C-74 and C-97

have the effects of increasing the MCR. The net result of all changes since the 27th CPP Actuarial Report is an overall absolute decrease in the MCR of 0.07% for the year 2034 and thereafter.

➢ Although the pay-as-you-go rate is expected to increase over time from 9.4% in 2019 to 12.5% by 2095 due to the retirement of the baby boom generation and the projected continued aging of the population, the legislated contribution rate of 9.9% is sufficient to finance the base Plan over the long term. The pay-as-you-go rate is the contribution rate that would need to be paid if there were no assets.

➢ The number of contributors to the CPP is expected to grow from 14.5 million in 2019 to 18.4 million in 2050 and 23.1 million by 2095. Under the legislated contribution rate of 9.9%, base CPP contributions are expected to increase from $51.7 billion in 2019 to $165.5 billion in 2050 and to continue increasing thereafter.

➢ The number of base CPP retirement beneficiaries is expected to increase from 5.6 million in 2019 to 9.9 million in 2050 and to continue increasing thereafter.

➢ There continues to be more female than male base CPP retirement beneficiaries, and by 2050 there is expected to be approximately 750,000 (or 16%) more female than male retirement beneficiaries. Thereafter, the relative difference is projected to fall.

➢ Total expenditures of the base Plan are expected to grow rapidly from approximately $49.3 billion in 2019 to $86.8 billion in 2030. Thereafter, total expenditures are projected to grow at a slower pace, reaching $187.9 billion in 2050 and $1.0 trillion by 2095.

4.2 Contributions

Projected contributions are the product of the contribution rate, the number of contributors, and the average contributory earnings. The contribution rate for the base CPP is set by law and is 9.9%. As of 1 January 2019, all contributors to the base CPP also contribute to the additional CPP.

Table 4 presents the projected number of CPP contributors, including CPP retirement beneficiaries who are working (i.e. "working beneficiaries"), their base CPP contributory earnings and contributions. The number of contributors by age and sex is directly linked to the assumed labour force participation rates applied to the projected working-age population and the job creation rates. Hence, the demographic and economic assumptions have a great influence on the expected level of contributions. In this report, the number of CPP contributors is expected to increase continuously throughout the projection period, but at a generally decreasing pace, from 14.5 million in 2019 to 18.4 million in 2050 and 23.1 million by 2095. The future increase in the number of contributors is limited due to the projected lower growth in the working-age population and labour force.

The growth in base CPP contributory earnings, which are derived by subtracting the Year's Basic Exemption (YBE) from pensionable earnings (up to the YMPE) is linked to the growth in average employment earnings through the assumption regarding annual increases in wages and is affected by the freeze on the YBE since 1998.

Contributions to the base CPP are expected to increase from $51.7 billion in 2019 to $165.5 billion in 2050 and to continue increasing thereafter, as shown in Table 4. The projected YMPE is also shown, which is assumed to increase according to the nominal wage increase assumption. The YMPE is projected to increase from $57,400 in 2019 to $67,100 in 2025 and $140,500 by 2050.

Since the legislated contribution rate is constant at 9.9% for the year 2019 and thereafter, contributions to the base CPP increase at the same rate as total contributory earnings over the projection period.

Table 4	Contributions - Base CPP				
Year	Contribution Rate (%)	YMPE ($)	Number of Contributors (thousands)	Contributory Earnings ($ million)	Contributions ($ million)
2019	9.9	57,400	14,528	521,967	51,675
2020	9.9	58,700	14,712	542,126	53,670
2021	9.9	60,200	14,869	563,194	55,756
2022	9.9	61,800	15,026	585,498	57,964
2023	9.9	63,400	15,152	607,349	60,128
2024	9.9	65,200	15,274	630,884	62,458
2025	9.9	67,100	15,391	655,541	64,899
2030	9.9	77,800	15,935	791,884	78,397
2035	9.9	90,200	16,599	960,579	95,097
2040	9.9	104,600	17,201	1,157,737	114,616
2045	9.9	121,200	17,854	1,394,863	138,091
2050	9.9	140,500	18,422	1,671,351	165,464
2055	9.9	162,900	18,855	1,987,685	196,781
2060	9.9	188,900	19,214	2,353,547	233,001
2065	9.9	219,000	19,606	2,789,376	276,148
2075	9.9	294,300	20,741	3,973,597	393,386
2085	9.9	395,500	21,989	5,669,320	561,263
2095	9.9	531,600	23,126	8,026,025	794,577

4.3   Expenditures

The projected number of base CPP beneficiaries by type of benefit is given in Table 5, while Table 6 presents information for male and female beneficiaries separately. The number of retirement, disability, and survivor beneficiaries increases throughout the projection period. In particular, the number of retirement beneficiaries is expected to increase from 5.6 million in 2019 to 7.9 million by 2030 or by 42% due to the aging of the population and retirement of the baby boomers. By 2050, the number of retirement beneficiaries is projected to be 9.9 million. Female retirement beneficiaries continue to outnumber their male counterparts, and by 2050 there is projected to be 750,000 or 16% more female than male beneficiaries. Over the same period, the number of disability and survivor beneficiaries is projected to increase but at a much slower pace than for retirement beneficiaries.

Table 5	Beneficiaries - Base CPP [1] (thousands)				
Year	Retirement [2],[3],[4],[5]	Disability [4],[6]	Survivor [5],[6]	Children	Death [7]
2019	5,561	404	1,292	218	159
2020	5,807	408	1,313	224	163
2021	6,017	412	1,335	230	167
2022	6,234	415	1,357	237	172
2023	6,461	417	1,380	244	176
2024	6,688	420	1,403	249	181
2025	6,913	421	1,427	254	186
2030	7,893	423	1,559	280	216
2035	8,555	448	1,703	309	252
2040	9,024	485	1,841	337	288
2045	9,442	526	1,952	356	317
2050	9,926	554	2,029	360	338
2055	10,492	570	2,074	359	351
2060	11,122	573	2,099	358	357
2065	11,686	574	2,128	364	363
2075	12,554	618	2,256	383	395
2085	13,316	671	2,395	397	433
2095	14,269	705	2,432	408	447

(1) Numbers of beneficiaries by sex in Table 6 may not sum to total numbers of beneficiaries shown in Table 5 due to rounding.
(2) The number given for retirement beneficiaries includes working beneficiaries.
(3) The number given for retirement beneficiaries does not take into account that the retirement pension can be shared between spouses.
(4) A beneficiary who receives concurrently a retirement and post-retirement disability benefit is counted in each of the retirement and disability benefit categories.
(5) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(6) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.
(7) This is the number of deceased contributors whose estate is entitled to a death benefit during the given year.

Table 6	Beneficiaries by Sex - Base CPP [1] (thousands)							
	Males				Females			
Year	Retirement[2],[3],[4],[5]	Disability[4],[6]	Survivor[5],[6]	Death[7]	Retirement[2],[3],[4],[5]	Disability[4],[6]	Survivor[5],[6]	Death[7]
2019	2,688	183	251	95	2,872	221	1,042	65
2020	2,797	184	259	97	3,010	224	1,054	67
2021	2,894	185	268	98	3,124	227	1,067	69
2022	2,993	186	277	100	3,241	229	1,080	71
2023	3,098	187	285	103	3,364	231	1,094	74
2024	3,202	187	294	105	3,486	232	1,109	76
2025	3,305	187	303	107	3,608	234	1,124	79
2030	3,747	186	346	122	4,147	238	1,213	95
2035	4,023	194	386	139	4,533	253	1,317	113
2040	4,200	210	416	154	4,824	274	1,424	133
2045	4,364	229	436	166	5,078	296	1,516	151
2050	4,588	243	446	174	5,338	311	1,582	164
2055	4,881	250	452	178	5,611	321	1,622	173
2060	5,224	249	458	180	5,898	324	1,641	177
2065	5,525	247	467	183	6,161	327	1,662	179
2075	5,950	267	489	201	6,604	352	1,767	194
2085	6,316	290	500	220	7,000	381	1,895	213
2095	6,789	305	501	224	7,480	400	1,931	222

(1) Numbers of beneficiaries by sex in Table 6 may not sum to total numbers of beneficiaries shown in Table 5 due to rounding.
(2) The number given for retirement beneficiaries includes working beneficiaries.
(3) The number given for retirement beneficiaries does not take into account that the retirement pension can be shared between spouses.
(4) A beneficiary who receives concurrently a retirement and post-retirement disability benefit is counted in each of the retirement and disability benefit categories.
(5) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(6) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.
(7) This is the number of deceased contributors entitled to a death benefit during the given year.

Table 7 shows the amount of projected base CPP expenditures by type. Total expenditures of the base Plan are expected to grow rapidly from approximately $49.3 billion in 2019 to $86.8 billion in 2030. Thereafter, total expenditures are projected to grow at a slower pace, reaching $187.9 billion in 2050. Table 8 shows the same information but in millions of 2019 constant dollars.

Table 9 shows the projected base CPP expenditures by type expressed as a percentage of contributory earnings. These are referred to as the pay-as-you-go (or "PayGo") rates. A pay-as-you-go rate corresponds to the contribution rate that would need to be paid if there were no assets. Although the total pay-as-you-go rate is expected to increase significantly from 9.4% in 2019 to 12.5% by the end of the projection period, the legislated contribution rate of 9.9% is sufficient to finance the base Plan over the projection period.

Table 7	Expenditures - Base CPP ($ million)						
Year	Retirement [1]	Disability [2]	Survivor	Children	Death	Operating Expenses [3]	Total
2019	38,541	4,363	4,802	528	398	659	49,291
2020	41,228	4,498	4,899	554	408	683	52,270
2021	43,665	4,630	5,002	582	418	707	55,004
2022	46,369	4,756	5,109	611	429	733	58,007
2023	49,249	4,876	5,222	642	441	759	61,188
2024	52,295	5,007	5,342	669	453	786	64,551
2025	55,472	5,131	5,472	696	466	814	68,052
2026	58,730	5,257	5,614	724	479	843	71,648
2027	62,031	5,385	5,769	753	493	874	75,305
2028	65,391	5,513	5,938	784	508	905	79,039
2029	68,811	5,655	6,123	816	524	937	82,867
2030	72,245	5,820	6,326	850	540	971	86,752
2031	75,652	6,021	6,546	885	557	1,006	90,667
2032	79,012	6,248	6,785	920	574	1,043	94,583
2033	82,362	6,494	7,040	957	593	1,081	98,526
2034	85,757	6,755	7,313	996	611	1,121	102,553
2035	89,223	7,029	7,603	1,038	629	1,163	106,684
2036	92,768	7,314	7,909	1,080	647	1,204	110,922
2037	96,357	7,625	8,231	1,122	665	1,247	115,248
2038	99,979	7,962	8,568	1,166	684	1,293	119,651
2039	103,674	8,322	8,920	1,210	701	1,340	124,167
2040	107,497	8,693	9,285	1,254	718	1,388	128,835
2041	111,464	9,080	9,662	1,296	734	1,439	133,676
2042	115,578	9,483	10,050	1,338	750	1,492	138,691
2043	119,867	9,900	10,448	1,378	765	1,547	143,907
2044	124,366	10,327	10,858	1,418	780	1,605	149,353
2045	129,101	10,757	11,276	1,456	792	1,663	155,045
2046	134,106	11,189	11,702	1,491	804	1,724	161,016
2047	139,395	11,622	12,135	1,525	816	1,787	167,279
2048	144,971	12,056	12,575	1,559	826	1,851	173,838
2049	150,859	12,495	13,021	1,592	836	1,917	180,720
2050	157,090	12,932	13,472	1,624	844	1,984	187,948
2055	193,653	15,126	15,781	1,783	876	2,349	229,568
2060	240,078	17,272	18,239	1,969	891	2,769	281,218
2065	294,776	19,706	21,144	2,209	905	3,267	342,009
2070	355,890	23,218	24,885	2,505	937	3,874	411,310
2075	427,008	27,465	29,737	2,837	987	4,619	492,653
2080	510,241	32,551	35,628	3,196	1,040	5,509	588,165
2085	609,556	38,607	42,324	3,578	1,083	6,563	701,711
2090	731,717	45,267	49,594	3,997	1,108	7,804	839,487
2095	881,259	52,698	57,461	4,482	1,116	9,264	1,006,280

(1) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(2) Disability expenditures include expenditures related to post-retirement disability benefits for disabled retirement beneficiaries.
(3) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

Table 8   Expenditures - Base CPP [1]
(millions of 2019 constant dollars)

Year	Retirement [2]	Disability [3]	Survivor	Children	Death	Operating Expenses [4]	Total
2019	38,541	4,363	4,802	528	398	659	49,291
2020	40,419	4,410	4,803	543	400	670	51,245
2021	41,969	4,450	4,808	559	402	680	52,868
2022	43,694	4,482	4,814	576	404	691	54,661
2023	45,499	4,504	4,824	593	407	701	56,528
2024	47,365	4,535	4,838	606	410	712	58,466
2025	49,258	4,556	4,859	618	414	723	60,428
2026	51,128	4,576	4,888	630	417	734	62,373
2027	52,943	4,596	4,924	643	421	746	64,272
2028	54,716	4,613	4,969	656	425	757	66,136
2029	56,449	4,639	5,023	670	430	769	67,980
2030	58,104	4,681	5,088	684	435	781	69,772
2031	59,651	4,748	5,162	698	439	793	71,490
2032	61,079	4,830	5,245	712	444	806	73,116
2033	62,420	4,921	5,335	725	449	819	74,671
2034	63,718	5,019	5,433	740	454	833	76,198
2035	64,994	5,120	5,538	756	458	847	77,714
2036	66,251	5,224	5,648	771	462	860	79,216
2037	67,465	5,339	5,763	786	466	873	80,692
2038	68,628	5,465	5,882	800	469	887	82,132
2039	69,770	5,600	6,003	814	472	902	83,561
2040	70,924	5,735	6,126	827	474	916	85,002
2041	72,099	5,873	6,250	839	475	931	86,467
2042	73,294	6,014	6,373	848	476	946	87,952
2043	74,524	6,155	6,496	857	476	962	89,470
2044	75,805	6,295	6,618	864	475	978	91,035
2045	77,148	6,428	6,739	870	474	994	92,652
2046	78,568	6,555	6,856	874	471	1,010	94,333
2047	80,065	6,675	6,970	876	468	1,026	96,081
2048	81,635	6,789	7,081	878	465	1,042	97,890
2049	83,285	6,898	7,188	879	461	1,058	99,770
2050	85,025	6,999	7,292	879	457	1,074	101,726
2055	94,933	7,415	7,736	874	429	1,152	112,540
2060	106,597	7,669	8,098	874	396	1,230	124,864
2065	118,545	7,925	8,503	889	364	1,314	137,540
2070	129,630	8,457	9,064	912	341	1,411	149,817
2075	140,873	9,061	9,810	936	326	1,524	162,529
2080	152,463	9,726	10,646	955	311	1,646	175,747
2085	164,969	10,449	11,455	968	293	1,776	189,910
2090	179,362	11,096	12,157	980	271	1,913	205,779
2095	195,655	11,700	12,757	995	248	2,057	223,412

[1] For a given year, the value in 2019 constant dollars is equal to the corresponding value in current dollars divided by the cumulative projected increases in prices since 2019.
[2] Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
[3] Disability expenditures include expenditures related to post-retirement disability benefits for disabled retirement beneficiaries.
[4] Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

Table 9	Expenditures as Percentage of Contributory Earnings - Base CPP (pay-as-you-go rates) (%)						
Year	Retirement [1]	Disability [2]	Survivor	Children	Death	Operating Expenses [3]	Total
2019	7.38	0.84	0.92	0.10	0.08	0.13	9.44
2020	7.60	0.83	0.90	0.10	0.08	0.13	9.64
2021	7.75	0.82	0.89	0.10	0.07	0.13	9.77
2022	7.92	0.81	0.87	0.10	0.07	0.13	9.91
2023	8.11	0.80	0.86	0.11	0.07	0.12	10.07
2024	8.29	0.79	0.85	0.11	0.07	0.12	10.23
2025	8.46	0.78	0.83	0.11	0.07	0.12	10.38
2026	8.63	0.77	0.82	0.11	0.07	0.12	10.53
2027	8.77	0.76	0.82	0.11	0.07	0.12	10.65
2028	8.91	0.75	0.81	0.11	0.07	0.12	10.77
2029	9.03	0.74	0.80	0.11	0.07	0.12	10.87
2030	9.12	0.73	0.80	0.11	0.07	0.12	10.96
2031	9.20	0.73	0.80	0.11	0.07	0.12	11.02
2032	9.24	0.73	0.79	0.11	0.07	0.12	11.06
2033	9.27	0.73	0.79	0.11	0.07	0.12	11.09
2034	9.28	0.73	0.79	0.11	0.07	0.12	11.10
2035	9.29	0.73	0.79	0.11	0.07	0.12	11.11
2036	9.31	0.73	0.79	0.11	0.06	0.12	11.13
2037	9.31	0.74	0.80	0.11	0.06	0.12	11.14
2038	9.31	0.74	0.80	0.11	0.06	0.12	11.14
2039	9.30	0.75	0.80	0.11	0.06	0.12	11.14
2040	9.29	0.75	0.80	0.11	0.06	0.12	11.13
2041	9.28	0.76	0.80	0.11	0.06	0.12	11.13
2042	9.27	0.76	0.81	0.11	0.06	0.12	11.12
2043	9.25	0.76	0.81	0.11	0.06	0.12	11.11
2044	9.25	0.77	0.81	0.11	0.06	0.12	11.11
2045	9.26	0.77	0.81	0.10	0.06	0.12	11.12
2046	9.26	0.77	0.81	0.10	0.06	0.12	11.12
2047	9.29	0.77	0.81	0.10	0.05	0.12	11.14
2048	9.31	0.77	0.81	0.10	0.05	0.12	11.17
2049	9.35	0.77	0.81	0.10	0.05	0.12	11.20
2050	9.40	0.77	0.81	0.10	0.05	0.12	11.25
2055	9.74	0.76	0.79	0.09	0.04	0.12	11.55
2060	10.20	0.73	0.77	0.08	0.04	0.12	11.95
2065	10.57	0.71	0.76	0.08	0.03	0.12	12.26
2070	10.71	0.70	0.75	0.08	0.03	0.12	12.37
2075	10.75	0.69	0.75	0.07	0.02	0.12	12.40
2080	10.74	0.69	0.75	0.07	0.02	0.12	12.38
2085	10.75	0.68	0.75	0.06	0.02	0.12	12.38
2090	10.84	0.67	0.73	0.06	0.02	0.12	12.44
2095	10.98	0.66	0.72	0.06	0.01	0.12	12.54

(1) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(2) Disability expenditures include expenditures related to post-retirement disability benefits for disabled retirement beneficiaries.
(3) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

4.4 Financial Projections with Legislated Contribution Rate

4.4.1 Market Value of Assets as at 31 December 2018

Prior to 2001, CPP assets were valued at cost because they were traditionally limited to short-term investments and 20-year non-marketable bonds in the form of loans to the provinces. With the creation of the CPP Investment Board (CPPIB) in 1997, excess cash flows (contributions less Plan expenditures) not needed to pay benefits are invested in the capital markets as of 1999. Those assets, as is usually the case for private pension plans, are valued at market. The market value of base CPP assets is $371.7 billion as at 31 December 2018.

4.4.2 Projected Financial State

Table 10 presents historical results of the base CPP while Table 11 and Table 12 present the projected financial state of the base CPP using the legislated contribution rate of 9.9% in current dollars and in 2019 constant dollars, respectively. The projected financial state of the base CPP using the minimum contribution rate of 9.75% for years 2022-2033, and 9.72% for 2034 and thereafter is discussed in the next section 4.5.

Base CPP assets are projected to increase significantly over the next decade and then to continue increasing, but at a slower pace. As shown in Table 11, base CPP assets are projected to increase from $371.7 billion in 2018 to $687.6 billion in 2030 and to $1,718.2 billion by 2050.

The substantially better than expected investment experience of the base Plan over the previous three years and thus higher than expected level of base CPP assets as at the end of 2018 leads to projected base CPP assets that are significantly higher than projected under the previous triennial actuarial report (the 27th CPP Actuarial Report as at 31 December 2015).

Table 10   Historical Results - Base CPP

Year	PayGo Rate (%)	Contribution Rate (%)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flow ($ million)	Net Investment Income [2] ($ million)	Assets at 31 Dec. [1] ($ million)	Yield/ Return [2] (%)	Assets/ Expenditures Ratio
1966	0.05	3.6	531	8	523	2	525	0.7	52.5
1970	0.45	3.6	773	97	676	193	3,596	6.2	24.1
1975	1.42	3.6	1,426	561	865	607	9,359	7.2	11.5
1980	2.72	3.6	2,604	1,965	639	1,466	18,433	8.7	7.6
1985	4.31	3.6	4,032	4,826	(794)	3,113	31,130	10.8	5.7
1986	4.20	3.6	4,721	5,503	(782)	3,395	33,743	10.9	4.7
1987	5.02	3.8	5,393	7,130	(1,737)	3,654	35,660	10.9	4.3
1988	5.41	4.0	6,113	8,272	(2,159)	3,886	37,387	11.0	4.0
1989	5.89	4.2	6,694	9,391	(2,697)	4,162	38,852	11.3	3.7
1990	5.82	4.4	7,889	10,438	(2,549)	4,386	40,689	11.4	3.5
1991	6.31	4.6	8,396	11,518	(3,122)	4,476	42,043	11.2	3.2
1992	7.07	4.8	8,883	13,076	(4,193)	4,497	42,347	11.0	3.0
1993	7.79	5.0	9,166	14,273	(5,107)	4,480	41,720	10.9	2.7
1994	8.33	5.2	9,585	15,362	(5,777)	4,403	40,346	11.0	2.5
1995	7.91	5.4	10,911	15,986	(5,075)	4,412	39,683	11.3	2.4
1996	8.71	5.6	10,757	16,723	(5,966)	4,177	37,894	11.0	2.2
1997	8.67	6.0	12,165	17,570	(5,405)	3,971	36,460	10.8	2.0
1998	8.11	6.4	14,473	18,338	(3,865)	3,938	36,535	10.9	1.9
1999	8.23	7.0	16,052	18,877	(2,825)	764	42,783	1.7	2.2
2000	7.69	7.8	19,977	19,683	294	4,446	47,523	9.9	2.3
2001	7.85	8.6	22,469	20,515	1,954	3,154	52,631	6.2	2.4
2002	8.16	9.4	24,955	21,666	3,289	187	56,107	0.3	2.5
2003	8.19	9.9	27,454	22,716	4,738	6,769	67,614	11.1	2.8
2004	8.29	9.9	28,459	23,833	4,626	6,475	78,715	8.9	3.2
2005	8.37	9.9	29,539	24,976	4,563	11,083	94,361	13.2	3.6
2006	8.33	9.9	31,000	26,080	4,920	14,300	113,581	14.4	4.1
2007	8.15	9.9	33,621	27,691	5,930	3,269	122,780	2.7	4.2
2008	8.03	9.9	36,053	29,259	6,794	(18,350)	111,224	-14.2	3.6
2009	8.16	9.9	37,492	30,901	6,591	9,021	126,836	7.6	4.0
2010	8.83	9.9	35,885	32,023	3,862	11,804	142,502	8.9	4.2
2011	8.73	9.9	38,202	33,691	4,511	8,057	155,070	5.4	4.3
2012	8.84	9.9	40,682	36,321	4,361	15,664	175,095	9.7	4.7
2013	8.73	9.9	42,632	37,575	5,057	23,887	204,039	13.2	5.3
2014	8.70	9.9	44,181	38,808	5,373	32,136	241,548	15.2	5.9
2015	8.79	9.9	46,026	40,883	5,143	38,667	285,358	15.6	6.7
2016	9.06	9.9	46,492	42,561	3,931	12,244	301,533	4.2	6.8
2017	9.17	9.9	48,139	44,596	3,543	35,257	340,333	11.4	7.3
2018	9.30	9.9	49,594	46,591	3,003	28,364	371,700	8.2	7.5

(1)   Results for years 1966 to 1998 are on a cost basis, while results for years 1999 to 2018 are presented on a market value basis. If assets were shown at market value at the end of 1998, total assets would be $44,864 million instead of $36,535 million.

(2)   Rates of return and Investment Income are net of all investment expenses of the CPPIB for the year 1999 and thereafter.

Table 11 Financial Projections - Base CPP, 9.9% Legislated Contribution Rate

Year	PayGo Rate (%)	Contribution Rate (%)	Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flow ($ million)	Net Investment Income [1] ($ million)	Assets at 31 Dec. ($ million)	Net Rate of Return [1] (%)	Assets/ Expenditures Ratio
2019	9.44	9.9	521,967	51,675	49,291	2,383	18,335	392,419	4.85	7.5
2020	9.64	9.9	542,126	53,670	52,270	1,400	19,307	413,126	4.85	7.5
2021	9.77	9.9	563,194	55,756	55,004	752	24,159	438,037	5.77	7.6
2022	9.91	9.9	585,498	57,964	58,007	(42)	24,929	462,924	5.62	7.6
2023	10.07	9.9	607,349	60,128	61,188	(1,061)	26,648	488,511	5.69	7.6
2024	10.23	9.9	630,884	62,458	64,551	(2,093)	28,367	514,785	5.74	7.6
2025	10.38	9.9	655,541	64,899	68,052	(3,153)	29,315	540,947	5.64	7.6
2026	10.53	9.9	680,630	67,382	71,648	(4,265)	31,113	567,795	5.70	7.5
2027	10.65	9.9	707,105	70,003	75,305	(5,301)	34,283	596,776	5.99	7.6
2028	10.77	9.9	734,162	72,682	79,039	(6,357)	35,149	625,568	5.85	7.5
2029	10.87	9.9	762,391	75,477	82,867	(7,390)	37,993	656,171	6.03	7.6
2030	10.96	9.9	791,884	78,397	86,752	(8,356)	39,826	687,641	6.03	7.6
2031	11.02	9.9	822,419	81,419	90,667	(9,248)	41,704	720,098	6.03	7.6
2032	11.06	9.9	854,840	84,629	94,583	(9,954)	43,649	753,793	6.03	7.7
2033	11.09	9.9	888,788	87,990	98,526	(10,536)	45,673	788,929	6.03	7.7
2034	11.10	9.9	924,146	91,490	102,553	(11,062)	47,768	825,636	6.02	7.7
2035	11.11	9.9	960,579	95,097	106,684	(11,587)	49,959	864,008	6.02	7.8
2036	11.13	9.9	996,622	98,666	110,922	(12,256)	52,249	904,001	6.02	7.8
2037	11.14	9.9	1,034,670	102,432	115,248	(12,815)	54,639	945,824	6.01	7.9
2038	11.14	9.9	1,074,381	106,364	119,651	(13,287)	57,141	989,679	6.01	8.0
2039	11.14	9.9	1,114,968	110,382	124,167	(13,785)	59,782	1,035,676	6.01	8.0
2040	11.13	9.9	1,157,737	114,616	128,835	(14,219)	62,550	1,084,006	6.01	8.1
2041	11.13	9.9	1,201,584	118,957	133,676	(14,719)	65,463	1,134,750	6.01	8.2
2042	11.12	9.9	1,247,334	123,486	138,691	(15,205)	68,538	1,188,083	6.01	8.3
2043	11.11	9.9	1,295,428	128,247	143,907	(15,659)	71,775	1,244,199	6.01	8.3
2044	11.11	9.9	1,344,464	133,102	149,353	(16,251)	75,166	1,303,114	6.01	8.4
2045	11.12	9.9	1,394,863	138,091	155,045	(16,954)	78,719	1,364,879	6.01	8.5
2046	11.12	9.9	1,447,496	143,302	161,016	(17,714)	82,443	1,429,608	6.01	8.5
2047	11.14	9.9	1,501,085	148,607	167,279	(18,671)	86,341	1,497,277	6.01	8.6
2048	11.17	9.9	1,556,720	154,115	173,838	(19,723)	90,414	1,567,968	6.01	8.7
2049	11.20	9.9	1,613,094	159,696	180,720	(21,023)	94,662	1,641,607	6.01	8.7
2050	11.25	9.9	1,671,351	165,464	187,948	(22,484)	99,085	1,718,208	6.01	8.8
2055	11.55	9.9	1,987,685	196,781	229,568	(32,788)	123,788	2,145,008	6.01	9.0
2060	11.95	9.9	2,353,547	233,001	281,218	(48,217)	152,558	2,640,210	6.01	9.0
2065	12.26	9.9	2,789,376	276,148	342,009	(65,861)	185,432	3,205,873	6.01	9.0
2070	12.37	9.9	3,324,016	329,078	411,310	(82,232)	223,716	3,866,645	6.01	9.1
2075	12.40	9.9	3,973,597	393,386	492,653	(99,266)	269,472	4,657,652	6.01	9.1
2080	12.38	9.9	4,749,801	470,230	588,165	(117,934)	324,797	5,615,242	6.01	9.2
2085	12.38	9.9	5,669,320	561,263	701,711	(140,448)	392,136	6,781,144	6.01	9.3
2090	12.44	9.9	6,750,680	668,317	839,487	(171,170)	473,590	8,189,811	6.01	9.4
2095	12.54	9.9	8,026,025	794,577	1,006,280	(211,703)	570,803	9,869,059	6.01	9.5

(1) Rates of Return and Investment Income are net of all investment expenses.

**Table 12   Financial Projections – Base CPP, 9.9% Legislated Contribution Rate [1]
(millions of 2019 constant dollars)**

Year	PayGo Rate (%)	Contribution Rate (%)	Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flow ($ million)	Net Investment Income [2] ($ million)	Assets at 31 Dec. ($ million)
2019	9.44	9.9	521,967	51,675	49,291	2,383	18,335	392,419
2020	9.64	9.9	531,496	52,618	51,245	1,373	18,928	405,025
2021	9.77	9.9	541,324	53,591	52,868	723	23,221	421,027
2022	9.91	9.9	551,728	54,621	54,661	(40)	23,492	436,224
2023	10.07	9.9	561,096	55,549	56,528	(980)	24,618	451,309
2024	10.23	9.9	571,411	56,570	58,466	(1,896)	25,693	466,257
2025	10.38	9.9	582,102	57,628	60,428	(2,800)	26,031	480,346
2026	10.53	9.9	592,530	58,660	62,373	(3,713)	27,086	494,300
2027	10.65	9.9	603,508	59,747	64,272	(4,525)	29,260	509,343
2028	10.77	9.9	614,314	60,817	66,136	(5,319)	29,411	523,448
2029	10.87	9.9	625,426	61,917	67,980	(6,062)	31,168	538,289
2030	10.96	9.9	636,883	63,051	69,772	(6,720)	32,030	553,044
2031	11.02	9.9	648,471	64,199	71,490	(7,292)	32,883	567,792
2032	11.06	9.9	660,819	65,421	73,116	(7,694)	33,742	582,706
2033	11.09	9.9	673,590	66,685	74,671	(7,985)	34,614	597,910
2034	11.10	9.9	686,654	67,979	76,198	(8,219)	35,493	613,459
2035	11.11	9.9	699,729	69,273	77,714	(8,440)	36,393	629,383
2036	11.13	9.9	711,750	70,463	79,216	(8,753)	37,314	645,604
2037	11.14	9.9	724,434	71,719	80,692	(8,973)	38,256	662,228
2038	11.14	9.9	737,489	73,011	82,132	(9,121)	39,224	679,346
2039	11.14	9.9	750,342	74,284	83,561	(9,277)	40,232	696,980
2040	11.13	9.9	763,847	75,621	85,002	(9,381)	41,269	715,201
2041	11.13	9.9	777,232	76,946	86,467	(9,521)	42,344	734,001
2042	11.12	9.9	791,004	78,309	87,952	(9,642)	43,464	753,430
2043	11.11	9.9	805,395	79,734	89,470	(9,736)	44,624	773,545
2044	11.11	9.9	819,493	81,130	91,035	(9,905)	45,816	794,288
2045	11.12	9.9	833,541	82,521	92,652	(10,131)	47,041	815,623
2046	11.12	9.9	848,033	83,955	94,333	(10,378)	48,300	837,553
2047	11.14	9.9	862,185	85,356	96,081	(10,724)	49,592	859,998
2048	11.17	9.9	876,608	86,784	97,890	(11,106)	50,913	882,942
2049	11.20	9.9	890,542	88,164	99,770	(11,606)	52,260	906,284
2050	11.25	9.9	904,612	89,557	101,726	(12,169)	53,629	929,973
2055	11.55	9.9	974,409	96,467	112,540	(16,073)	60,684	1,051,532
2060	11.95	9.9	1,044,999	103,455	124,864	(21,409)	67,737	1,172,280
2065	12.26	9.9	1,121,758	111,054	137,540	(26,486)	74,572	1,289,254
2070	12.37	9.9	1,210,750	119,864	149,817	(29,953)	81,487	1,408,398
2075	12.40	9.9	1,310,914	129,780	162,529	(32,749)	88,900	1,536,588
2080	12.38	9.9	1,419,270	140,508	175,747	(35,239)	97,051	1,677,869
2085	12.38	9.9	1,534,333	151,899	189,910	(38,011)	106,127	1,835,235
2090	12.44	9.9	1,654,761	163,821	205,779	(41,958)	116,089	2,007,528
2095	12.54	9.9	1,781,917	176,410	223,412	(47,002)	126,728	2,191,103

[1] For a given year, the value in 2019 constant dollars is equal to the corresponding value in current dollars divided by the cumulative projected increases in prices since 2019.

[2] Investment Income is net of all investment expenses.

Over the period 2019 to 2021, contributions are projected to exceed expenditures for the base CPP. Thereafter, a small but increasing portion of investment income is required to cover the shortfall. This causes the total revenues (contributions and investment income) to continue to be higher than expenditures but to a lesser extent over the long term, which causes the assets to grow at a slower pace.

Table 13 shows in more detail the sources of the revenues required to cover the expenditures, from which several observations can be made:

➢ During the period 2019 to 2021, contributions are more than sufficient to cover expenditures.

➢ From 2022 onward, a portion of investment income is required to fund net cash outflows. It is project that in 2050, 23% of investment income is required to pay for expenditures.

➢ Investment income, which is expected to represent 26% of revenues in 2019, is further projected to represent 34% of revenues in 2030 and 37% of revenues by 2050. This clearly illustrates the importance of investment income as a source of revenues for the base Plan.

| Table 13 | | Sources of Revenues and Funding of Expenditures - Base CPP, 9.9% Legislated Contribution Rate ($ million) | | | | | |

Year	Contributions	Net Investment Income [1]	Total Revenues	Net Investment Income as % of Revenues (%)	Expenditures	Expenditures as % of Revenues (%)	% of Net Investment Income Needed to Pay Expenditures (%)
2019	51,675	18,335	70,010	26.2	49,291	70.4	0.0
2020	53,670	19,307	72,977	26.5	52,270	71.6	0.0
2021	55,756	24,159	79,915	30.2	55,004	68.8	0.0
2022	57,964	24,929	82,894	30.1	58,007	70.0	0.2
2023	60,128	26,648	86,775	30.7	61,188	70.5	4.0
2024	62,458	28,367	90,825	31.2	64,551	71.1	7.4
2025	64,899	29,315	94,214	31.1	68,052	72.2	10.8
2026	67,382	31,113	98,495	31.6	71,648	72.7	13.7
2027	70,003	34,283	104,286	32.9	75,305	72.2	15.5
2028	72,682	35,149	107,831	32.6	79,039	73.3	18.1
2029	75,477	37,993	113,470	33.5	82,867	73.0	19.5
2030	78,397	39,826	118,222	33.7	86,752	73.4	21.0
2031	81,419	41,704	123,124	33.9	90,667	73.6	22.2
2032	84,629	43,649	128,278	34.0	94,583	73.7	22.8
2033	87,990	45,673	133,663	34.2	98,526	73.7	23.1
2034	91,490	47,768	139,259	34.3	102,553	73.6	23.2
2035	95,097	49,959	145,057	34.4	106,684	73.5	23.2
2036	98,666	52,249	150,915	34.6	110,922	73.5	23.5
2037	102,432	54,639	157,071	34.8	115,248	73.4	23.5
2038	106,364	57,141	163,505	34.9	119,651	73.2	23.3
2039	110,382	59,782	170,164	35.1	124,167	73.0	23.1
2040	114,616	62,550	177,166	35.3	128,835	72.7	22.7
2041	118,957	65,463	184,420	35.5	133,676	72.5	22.5
2042	123,486	68,538	192,024	35.7	138,691	72.2	22.2
2043	128,247	71,775	200,023	35.9	143,907	71.9	21.8
2044	133,102	75,166	208,268	36.1	149,353	71.7	21.6
2045	138,091	78,719	216,810	36.3	155,045	71.5	21.5
2046	143,302	82,443	225,745	36.5	161,016	71.3	21.5
2047	148,607	86,341	234,948	36.7	167,279	71.2	21.6
2048	154,115	90,414	244,529	37.0	173,838	71.1	21.8
2049	159,696	94,662	254,359	37.2	180,720	71.0	22.2
2050	165,464	99,085	264,549	37.5	187,948	71.0	22.7
2055	196,781	123,788	320,569	38.6	229,568	71.6	26.5
2060	233,001	152,558	385,559	39.6	281,218	72.9	31.6
2065	276,148	185,432	461,580	40.2	342,009	74.1	35.5
2070	329,078	223,716	552,794	40.5	411,310	74.4	36.8
2075	393,386	269,472	662,858	40.7	492,653	74.3	36.8
2080	470,230	324,797	795,027	40.9	588,165	74.0	36.3
2085	561,263	392,136	953,399	41.1	701,711	73.6	35.8
2090	668,317	473,590	1,141,907	41.5	839,487	73.5	36.1
2095	794,577	570,803	1,365,379	41.8	1,006,280	73.7	37.1

(1)   Investment income is net of all investment expenses.

Chart 1 shows historical and projected revenues and expenditures of the base CPP for the period 2000 to 2050.

Chart 1   Revenues and Expenditures - Base CPP, 9.9% legislated contribution rate (billions of 2019 constant dollars)
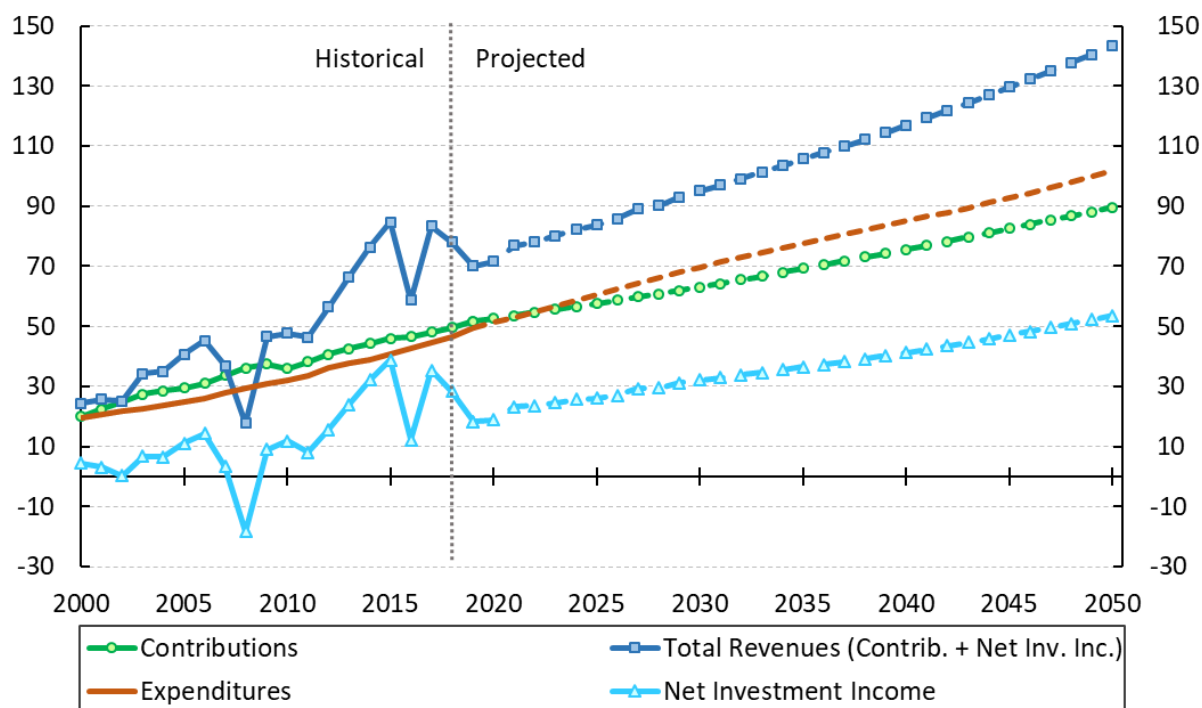
4.5   Financial Projections with Minimum Contribution Rate

The results presented in Table 14 are based on the best-estimate assumptions, but use the MCR of 9.75% for 2022-2033 and 9.72% thereafter as opposed to the legislated contribution rate of 9.9% for 2022 and thereafter. The financial projections of the base Plan under the legislated rate of 9.9% were previously presented in Table 11. Under the MCR, the ratio of assets to the following year's expenditures is projected to decrease slightly from 7.6 in 2022 to 7.5 in 2031 and to be the same fifty years later in 2081.

In the case that the MCR, as determined by an actuarial report, exceeds the legislated rate, the insufficient rates provisions of the CPP statute may result in adjustments to the base CPP legislated contribution rate and, perhaps, benefits in pay if the federal and provincial governments make no recommendation to either increase the legislated rate or maintain it. In respect of this 30th CPP Actuarial Report, the MCR is less than the legislated rate of 9.9%, and thus the insufficient rates provisions do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated contribution rate will remain at 9.9% for the year 2019 and thereafter.

Table 14   Financial Projections - Base CPP, Minimum Contribution Rate of 9.75% 2022-2033, 9.72% 2034+

Year	PayGo Rate (%)	Contribution Rate (%)	Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flow ($ million)	Net Investment Income [1] ($ million)	Assets at 31 Dec. ($ million)	Assets/ Expenditures Ratio
2019	9.44	9.90	521,967	51,675	49,291	2,383	18,335	392,419	7.5
2020	9.64	9.90	542,126	53,670	52,270	1,400	19,307	413,126	7.5
2021	9.77	9.90	563,194	55,756	55,004	752	24,159	438,037	7.6
2022	9.91	9.75	585,498	57,086	58,007	(920)	24,902	462,019	7.6
2023	10.07	9.75	607,349	59,216	61,188	(1,972)	26,568	486,615	7.5
2024	10.23	9.75	630,884	61,511	64,551	(3,040)	28,228	511,803	7.5
2025	10.38	9.75	655,541	63,915	68,052	(4,136)	29,117	536,784	7.5
2026	10.53	9.75	680,630	66,361	71,648	(5,286)	30,844	562,342	7.5
2027	10.65	9.75	707,105	68,943	75,305	(6,362)	33,922	589,902	7.5
2028	10.77	9.75	734,162	71,581	79,039	(7,458)	34,712	617,156	7.4
2029	10.87	9.75	762,391	74,333	82,867	(8,534)	37,449	646,071	7.4
2030	10.96	9.75	791,884	77,209	86,752	(9,544)	39,179	675,706	7.5
2031	11.02	9.75	822,419	80,186	90,667	(10,481)	40,945	706,170	7.5
2032	11.06	9.75	854,840	83,347	94,583	(11,236)	42,769	737,703	7.5
2033	11.09	9.75	888,788	86,657	98,526	(11,869)	44,661	770,495	7.5
2034	11.10	9.72	924,146	89,827	102,553	(12,726)	46,605	804,374	7.5
2035	11.11	9.72	960,579	93,368	106,684	(13,316)	48,623	839,681	7.6
2036	11.13	9.72	996,622	96,872	110,922	(14,050)	50,727	876,358	7.6
2037	11.14	9.72	1,034,670	100,570	115,248	(14,678)	52,915	914,595	7.6
2038	11.14	9.72	1,074,381	104,430	119,651	(15,221)	55,199	954,573	7.7
2039	11.14	9.72	1,114,968	108,375	124,167	(15,792)	57,605	996,386	7.7
2040	11.13	9.72	1,157,737	112,532	128,835	(16,303)	60,118	1,040,201	7.8
2041	11.13	9.72	1,201,584	116,794	133,676	(16,882)	62,758	1,086,077	7.8
2042	11.12	9.72	1,247,334	121,241	138,691	(17,450)	65,537	1,134,163	7.9
2043	11.11	9.72	1,295,428	125,916	143,907	(17,991)	68,456	1,184,628	7.9
2044	11.11	9.72	1,344,464	130,682	149,353	(18,671)	71,504	1,237,461	8.0
2045	11.12	9.72	1,394,863	135,581	155,045	(19,465)	74,688	1,292,684	8.0
2046	11.12	9.72	1,447,496	140,697	161,016	(20,320)	78,016	1,350,380	8.1
2047	11.14	9.72	1,501,085	145,905	167,279	(21,373)	81,487	1,410,494	8.1
2048	11.17	9.72	1,556,720	151,313	173,838	(22,525)	85,103	1,473,072	8.2
2049	11.20	9.72	1,613,094	156,793	180,720	(23,927)	88,860	1,538,005	8.2
2050	11.25	9.72	1,671,351	162,455	187,948	(25,492)	92,756	1,605,269	8.2
2055	11.55	9.72	1,987,685	193,203	229,568	(36,365)	114,202	1,974,373	8.3
2060	11.95	9.72	2,353,547	228,765	281,218	(52,454)	138,402	2,388,719	8.2
2065	12.26	9.72	2,789,376	271,127	342,009	(70,881)	164,915	2,841,877	8.0
2070	12.37	9.72	3,324,016	323,094	411,310	(88,216)	194,388	3,346,858	7.8
2075	12.40	9.72	3,973,597	386,234	492,653	(106,419)	227,986	3,922,967	7.7
2080	12.38	9.72	4,749,801	461,681	588,165	(126,484)	266,597	4,585,240	7.5
2085	12.38	9.72	5,669,320	551,058	701,711	(150,653)	311,042	5,346,716	7.4
2090	12.44	9.72	6,750,680	656,166	839,487	(183,321)	361,230	6,203,247	7.1
2095	12.54	9.72	8,026,025	780,130	1,006,280	(226,150)	415,863	7,130,703	6.8

(1)   Investment Income is net of all investment expenses.

Table 15 shows the progression of the MCR over time under the best-estimate assumptions of this report.

As shown in Table 15, the MCR is relatively stable over the periods considered. If the best-estimate assumptions of this report are realized, the MCR will increase between 0.01% and 0.05% for each of the next four reports and will remain below the legislated contribution rate of 9.9%. Thus, the current legislated contribution rate is projected to be sufficient over subsequent reports as long as the best-estimate assumptions remain the same and base Plan experience does not deviate materially from the assumptions.

Table 15   Progression of Minimum Contribution Rate over Time – Base CPP

Valuation Year [1]	Steady-State Target Years [2]	Steady-State Target A/E Ratio [3]	Steady-State Contribution Rate [4]	Full Funding Rate [5]		Minimum Contribution Rate (MCR) [6]		Average PayGo Rate Over Target Years Period
				Prior to 2034	2034+	Prior to 2034	2034+	
2018	2031 and 2081	7.5	9.71%	0.04%	0.01%	9.75%	9.72%	11.7
2021	2034 and 2084	7.6	9.71%	0.04%	0.01%	9.75%	9.72%	11.8
2024	2037 and 2087	7.8	9.73%	0.04%	0.01%	9.77%	9.74%	11.9
2027	2040 and 2090	8.0	9.74%	0.05%	0.01%	9.79%	9.75%	11.9
2030	2043 and 2093	8.2	9.78%	N/A	N/A [7]	N/A	9.78%	12.0

(1)   Reports are prepared as at 31 December of the valuation year.

(2)   Target years refer to the beginning and end of the 50-year interval over which the steady-state contribution rate is determined. This rate is the lowest level rate that results in the assets/expenditures (A/E) ratio being the same in the two target years. For a given triennial review period of the Plan, the target years are 13 and 63 years after the valuation year. For this report, the valuation year is 2018 and thus the target years are 2031 and 2081.

(3)   The steady-state target A/E ratio is the ratio obtained in the target years relating to the determination of the corresponding steady-state contribution rate. Where the ratios in the target years do not match exactly, the ratio presented pertains to the first target year.

(4)   The steady-state contribution rate determined by a valuation is effective following the corresponding triennial review period. That is, for the current valuation as at 31 December 2018, the corresponding triennial review period is 2019-2021, and the steady-state rate applies from 2022 onward.

(5)   The full funding rate, in respect of amendments to the *Canada Pension Plan* that introduce or increase benefits, is determined by a valuation such that the rate is effective following the corresponding triennial review period, or as at the effective date of the amendments if later. For the current valuation, the full funding rate is in respect of the amendments to the CPP statute under Bill C-74 (*Budget Implementation Act, 2018, No. 1*), and the rate applies from 2022 onward. The full funding rates prior to 2034 shown in the table increase over time due to rounding of the rates as per the regulations.

(6)   The minimum contribution rate equals the sum of the rounded steady-state contribution rate and the rounded full funding rate.

(7)   The full funding rate for the 2030 valuation applies for the year 2034 and onward and as such consists only of the permanent rate with the temporary rate no longer applying, since the amortization of benefit improvements under Bill C-74 in respect of past Plan participation ends in 2033. The permanent full funding rate is determined to be 0.01%, which falls below the de minimis rate of 0.02% as set out in the regulations. As such, the rate is deemed to equal 0%, the benefit improvements of Bill C-74 in respect of future Plan participation are financed entirely by the steady-state contribution rate, and the MCR for 2034 and onward equals the steady-state contribution rate.

5   Results – Additional CPP

5.1   Overview

The key observations and findings of the actuarial projections of the financial state of the additional CPP presented in this report are as follows.

➢   With the legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter, respectively, contributions to the additional CPP are projected to be higher than expenditures up to the year 2057 inclusive.

➢   With the legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter, total assets are expected to increase rapidly over the first several decades as contributions are projected to exceed expenditures. The additional CPP assets are projected to grow from $1.5 billion at the end of 2019 to $68 billion by 2025, $191 billion by 2030, $1.3 trillion by 2050, and $9.8 trillion by 2095. The ratio of assets to the following year's expenditures is projected to increase rapidly until 2025 and then decrease after that, reaching a level of about 26 by 2075 and remaining at that level for the years following up to 2095.

➢   Due to the financing approach of the additional Plan, investment income will become the major source of revenues of the additional Plan. With the legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter, investment income is projected to represent about 70% of revenues (i.e. contributions and investment income) of the additional CPP by 2075.

➢   The first additional minimum contribution rate (FAMCR) applicable to pensionable earnings between the YBE and YMPE is 1.49% in 2022 and 1.98% for the year 2023 and thereafter. The second additional minimum contribution rate (SAMCR) applicable to pensionable earnings above the YMPE up to the YAMPE is 7.92% for the year 2024 and thereafter. The phased-in legislated first additional contribution rates of 0.3%, 0.6%, and 1.0% applies respectively to the first three years after the valuation year, that is, to the current triennial review period of 2019-2021.

➢   Under the FAMCR of 1.98% for 2023 and thereafter and the SAMCR of 7.92% for 2024 and thereafter, the additional CPP open group assets represent 107% of its open group actuarial obligations as at 1 January 2019, and the ratio of invested assets to expenditures stabilizes at a value of 25 for the target years 2088 and 2098.

➢   Although demographic experience over 2016 to 2018 was better than anticipated and acted to lower the AMCRs, changes in assumptions, especially those related to the CPPIB investment policy, and the amendments under Bills C-74 and C-97 have more than offset the decrease. As a result, the net result of all changes since the 28th CPP Actuarial Report is an overall absolute increase in the FAMCR of 0.05% and corresponding increase in the SAMCR of 0.20%.

➢ Demographic changes affecting the base CPP, particularly the aging of the population, will also affect the additional Plan, but to a lesser extent than the base Plan due to the different financing approaches of the base and additional Plans.

➢ The number of contributors to the additional CPP is the same as to the base CPP, since an individual cannot contribute to the additional Plan without also contributing to the base Plan. Under the legislated first and second additional contribution rates of 2.0% and 8.0%, respectively, additional contributions are expected to increase from $1.6 billion in 2019 to $17 billion in 2025, $43 billion in 2050, and to continue increasing thereafter.

➢ The number of beneficiaries of additional retirement benefits is expected to increase from 0.2 million in 2019 to 1.8 million in 2025, 8.9 million in 2050, and to continue increasing thereafter.

➢ Total additional CPP expenditures are expected to steadily grow over time as the additional Plan matures and individuals accrue benefits. Total additional CPP expenditures are projected to increase from approximately $85 million in 2020 to $1.7 billion in 2030, $28 billion in 2050, and $359 billion by 2095.

5.2   Contributions

Projected additional contributions are the product of the additional contribution rates, the number of contributors, and the average first and second additional contributory earnings. The first and second additional contribution rates for the additional CPP are set by law and are 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter. The first additional contribution rate is phased in over the period 2019 to 2023 as: 0.3%, 0.6%, 1.0%, 1.5%, and 2.0%, and the second tier of the additional Plan starts in 2024.

Table 16 presents the projected number of contributors to the additional CPP, including retirement beneficiaries who receive additional retirement benefits and are working (working beneficiaries), their additional contributory earnings, and additional contributions.

As all contributors to the additional Plan are contributors to the base Plan, the number of contributors to the additional Plan is linked to the same assumed labour force participation rates applied to the working-age population and the job creation rates as for the base Plan.

The additional contributory earnings relating to the first tier of the additional CPP are the same as the base CPP contributory earnings (pensionable earnings between the YBE and YMPE). As such, the projected total first additional contributory earnings shown in Table 16 are the same as the projected total base CPP contributory earnings shown in Table 4.

The second additional contributory earnings relating to pensionable earnings above the YMPE up to the YAMPE are based on the assumed annual increases in wages and the assumed proportion of individuals with pensionable earnings between the YMPE and YAMPE.

As shown in Table 16, total contributions to the additional CPP are expected to be $1.6 billion in 2019 and then are projected to increase to about $12.1 billion in 2023 following the phase-in of the first additional contribution rate. The total additional contributions are projected to reach $17.0 billion by 2025, following the full phase-in of the additional CPP. Thereafter, total contributions to the additional Plan continue to increase, reaching $43.0 billion by 2050.

The projected YMPE and YAMPE are also shown, which are assumed to increase with the nominal wage increase assumption, with the YAMPE equal to 107% of the YMPE in 2024 and 114% of the YMPE from 2025 onward (rounded down to the nearest $100). The YAMPE is projected to be $69,700 initially in 2024 and to then increase to $160,100 by 2050.

After the end of the phase-in period in 2025, the first and second additional contributions to the additional CPP increase at the same rate as the first and second additional contributory earnings, respectively, throughout the projection period. This growth is reflected in the projected total additional contributions.

Table 16   Contributions - Additional CPP

Year	First Additional Contribution Rate (%)	Second Additional Contribution Rate (%)	YMPE ($)	YAMPE ($)	Number of Contributors (thousands)	First Additional Contributory Earnings ($ million)	Second Additional Contributory Earnings ($ million)	Additional Contributions ($ million)
2019	0.3	–	57,400	–	14,528	521,967	–	1,566
2020	0.6	–	58,700	–	14,712	542,126	–	3,253
2021	1.0	–	60,200	–	14,869	563,194	–	5,632
2022	1.5	–	61,800	–	15,026	585,498	–	8,782
2023	2.0	–	63,400	–	15,152	607,349	–	12,147
2024	2.0	8.0	65,200	69,700	15,274	630,884	24,189	14,553
2025	2.0	8.0	67,100	76,400	15,391	655,541	48,363	16,980
2030	2.0	8.0	77,800	88,600	15,935	791,884	57,959	20,474
2035	2.0	8.0	90,200	102,800	16,599	960,579	70,032	24,814
2040	2.0	8.0	104,600	119,200	17,201	1,157,737	83,697	29,851
2045	2.0	8.0	121,200	138,100	17,854	1,394,863	100,221	35,915
2050	2.0	8.0	140,500	160,100	18,422	1,671,351	119,475	42,985
2055	2.0	8.0	162,900	185,700	18,855	1,987,685	141,782	51,096
2060	2.0	8.0	188,900	215,300	19,214	2,353,547	166,935	60,426
2065	2.0	8.0	219,000	249,600	19,606	2,789,376	197,054	71,552
2075	2.0	8.0	294,300	335,500	20,741	3,973,597	279,401	101,824
2085	2.0	8.0	395,500	450,800	21,989	5,669,320	396,260	145,087
2095	2.0	8.0	531,600	606,000	23,126	8,026,025	559,448	205,276

5.3 Expenditures

Under the additional CPP, there are only earnings-related benefits. There are no flat-rate components to the additional disability and survivor benefits, and no additional flat-rate children's or death benefits.

The projected number of additional CPP beneficiaries by type of benefit is given in Table 17, while Table 18 presents information for male and female beneficiaries separately. The number of additional retirement beneficiaries increases over time as the number of contributors reaching age 60 (earliest retirement age) and over with at least one valid contribution to the additional CPP increases. The total number of retirement beneficiaries receiving additional retirement benefits is projected to increase from 182,000 in 2019 to 8.9 million by 2050.

The total number of disability and survivor beneficiaries receiving additional benefits increases over time as well. Since eligibility to these benefits is harmonized between the base and additional CPP, all new disability and survivor beneficiaries of the base CPP will also be entitled to additional benefits as long as they (in the case of disability beneficiaries) and their deceased partners (in the case of survivor beneficiaries) had made at least one contribution to the additional Plan. The total number of disability beneficiaries receiving additional benefits is projected to increase from 23,000 in 2019 to 541,000 in 2050. The total number of survivor beneficiaries receiving additional benefits is projected to increase from 15,000 to 1.6 million in 2050.

As the number of additional CPP retirement, disability, and survivor beneficiaries eventually becomes the same as those for the base CPP, the difference between female and male beneficiaries will likewise become equal.

Table 19 shows the amount of projected additional CPP expenditures by type. Projected additional benefit expenditures are low over the first few years of the additional Plan as additional benefits start to accrue. In 2019 and 2020, total expenditures are largely attributable to the operating expenses of the additional Plan. As higher additional benefits become payable to a greater number of beneficiaries, projected additional expenditures increase to reach $447 million in 2025 and $28 billion by 2050. Table 20 presents the same information but in 2019 constant dollars.

Table 17	Beneficiaries - Additional CPP [1] (thousands)		
Year	Retirement [2],[3],[4]	Disability [5]	Survivor [4],[5]
2019	182	23	15
2020	409	50	33
2021	655	76	55
2022	917	102	78
2023	1,198	128	103
2024	1,490	153	131
2025	1,789	177	160
2030	3,290	276	343
2035	4,842	363	597
2040	6,310	438	912
2045	7,673	501	1,248
2050	8,935	541	1,552
2055	10,031	563	1,783
2060	10,950	567	1,943
2065	11,638	569	2,055
2075	12,553	614	2,245
2085	13,316	665	2,394
2095	14,269	699	2,432

(1) Numbers of beneficiaries by sex in Table 18 may not sum to total numbers of beneficiaries shown in Table 17 due to rounding.
(2) The number given for retirement beneficiaries includes working beneficiaries.
(3) The number given for retirement beneficiaries does not take into account that the retirement pension (base and additional benefits) can be shared between spouses.
(4) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(5) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.

Table 18   **Beneficiaries by Sex – Additional CPP [1]**
(thousands)

Year	Males			Females		
	Retirement[2],[3],[4]	Disability[5]	Survivor[4],[5]	Retirement[2],[3],[4]	Disability[5]	Survivor[4],[5]
2019	95	12	5	87	12	10
2020	215	25	11	195	25	22
2021	343	38	18	312	38	36
2022	479	51	26	438	52	52
2023	624	63	34	574	65	69
2024	774	75	44	716	79	87
2025	927	86	53	863	92	107
2030	1,679	128	110	1,611	148	232
2035	2,414	162	183	2,428	200	414
2040	3,081	193	260	3,229	245	652
2045	3,682	220	328	3,991	281	920
2050	4,239	237	380	4,696	304	1,172
2055	4,736	246	415	5,295	317	1,368
2060	5,177	246	440	5,773	322	1,503
2065	5,514	244	459	6,124	325	1,596
2075	5,950	264	488	6,603	350	1,757
2085	6,316	287	500	7,000	378	1,894
2095	6,789	302	501	7,480	398	1,931

(1)   Numbers of beneficiaries by sex in Table 18 may not sum to total numbers of beneficiaries shown in Table 17 due to rounding.
(2)   The number given for retirement beneficiaries includes working beneficiaries.
(3)   The number given for retirement beneficiaries does not take into account that the retirement pension (base and additional benefits) can be shared between spouses.
(4)   A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(5)   A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.

Table 19	Expenditures - Additional CPP ($ million)				
Year	Retirement [1]	Disability	Survivor	Operating Expenses [2]	Total
2019	1	0	0	92	92
2020	9	0	0	76	85
2021	28	1	0	79	108
2022	64	3	1	81	149
2023	123	6	2	84	216
2024	216	12	3	87	318
2025	332	20	5	90	447
2026	475	31	8	94	608
2027	658	46	12	97	812
2028	884	64	17	101	1,066
2029	1,154	87	24	104	1,369
2030	1,464	112	32	108	1,717
2031	1,821	142	42	112	2,117
2032	2,232	175	54	116	2,577
2033	2,704	213	69	120	3,107
2034	3,246	256	87	125	3,713
2035	3,856	303	108	129	4,395
2036	4,534	354	132	134	5,153
2037	5,281	409	160	139	5,988
2038	6,099	469	192	144	6,903
2039	6,997	534	228	149	7,908
2040	7,988	604	270	154	9,016
2041	9,080	678	317	160	10,236
2042	10,281	757	370	166	11,574
2043	11,600	841	431	172	13,043
2044	13,050	930	498	178	14,656
2045	14,643	1,022	574	185	16,424
2046	16,392	1,118	659	192	18,361
2047	18,306	1,217	752	199	20,474
2048	20,390	1,319	857	206	22,772
2049	22,656	1,424	972	213	25,265
2050	25,117	1,531	1,098	220	27,967
2055	40,585	2,075	1,929	261	44,849
2060	61,753	2,568	3,144	308	67,772
2065	87,235	3,015	4,822	363	95,435
2070	114,901	3,610	7,039	430	125,981
2075	145,843	4,363	9,858	513	160,577
2080	180,661	5,281	13,261	612	199,815
2085	220,416	6,396	17,127	729	244,669
2090	267,394	7,640	21,260	867	297,162
2095	323,451	9,036	25,523	1,029	359,038

(1) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(2) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

Table 20   Expenditures – Additional CPP [1]
(millions of 2019 constant dollars)

Year	Retirement [2]	Disability	Survivor	Operating Expenses [3]	Total
2019	1	0	0	92	92
2020	9	0	0	75	83
2021	27	1	0	76	104
2022	60	3	1	76	140
2023	114	6	2	78	200
2024	196	11	3	79	288
2025	295	18	4	80	397
2026	414	27	7	82	529
2027	562	39	10	83	693
2028	740	54	14	85	892
2029	947	71	20	85	1,123
2030	1,177	90	26	87	1,381
2031	1,436	112	33	88	1,669
2032	1,725	135	42	90	1,992
2033	2,049	161	52	91	2,355
2034	2,412	190	65	93	2,759
2035	2,809	221	79	94	3,202
2036	3,238	253	94	96	3,680
2037	3,698	286	112	97	4,193
2038	4,187	322	132	99	4,738
2039	4,709	359	153	100	5,322
2040	5,270	399	178	102	5,949
2041	5,873	439	205	103	6,621
2042	6,520	480	235	105	7,340
2043	7,212	523	268	107	8,109
2044	7,954	567	304	108	8,933
2045	8,750	611	343	111	9,815
2046	9,603	655	386	112	10,757
2047	10,515	699	432	114	11,760
2048	11,482	743	483	116	12,823
2049	12,508	786	537	118	13,948
2050	13,594	829	594	119	15,137
2055	19,896	1,017	946	128	21,986
2060	27,419	1,140	1,396	137	30,091
2065	35,082	1,212	1,939	146	38,380
2070	41,852	1,315	2,564	157	45,888
2075	48,114	1,439	3,252	169	52,975
2080	53,983	1,578	3,962	183	59,706
2085	59,653	1,731	4,635	197	66,217
2090	65,545	1,873	5,211	213	72,842
2095	71,812	2,006	5,667	228	79,713

(1) For a given year, the value in 2019 constant dollars is equal to the corresponding value in current dollars divided by the cumulative projected increases in prices since 2019.

(2) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.

(3) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

5.4 Financial Projections with Legislated Additional Contribution Rates

Table 21 and Table 22 present the projected financial state of the additional CPP using the legislated first and second additional contribution rates of 2.0% and 8.0% in current dollars and in 2019 constant dollars, respectively. The projected financial state of the additional CPP using the FAMCR and SAMCR of 1.98% and 7.92%, respectively is discussed in the next section 5.5.

Under the legislated additional contribution rates, additional contributions are projected to be higher than additional expenditures up to the year 2057 inclusive. Over that period, the additional assets are projected to grow rapidly, from $1.5 billion at the end of 2019 to $68 billion by 2025, $191 billion by 2030, and $1,284 billion by 2050.

In comparison with Table 11, additional CPP assets are projected to be 75% of base CPP assets by 2050, and this percentage is expected to further increase to 99% by 2095. The substantially better than expected investment experience of the base Plan over the previous three years and thus higher than expected level of base CPP assets as at the end of 2018, together with the decrease in the assumed best-estimate rates of return on the additional CPP assets, lead to projected base CPP assets exceeding the additional CPP assets over the entire projection period.

Table 21   Financial Projections - Additional CPP, 2.0%, 8.0% Legislated First and Second Additional Contribution Rates

Year	First / Second Additional Contribution Rates (1) (%)	First Additional Contributory Earnings ($ million)	Second Additional Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flow ($ million)	Net Investment Income (2) ($ million)	Assets at 31 Dec. ($ million)	Net Rate of Return (2) (%)	Assets/ Expenditures Ratio
2019	0.3	521,967	0	1,566	92	1,474	11	1,485	1.31	17.4
2020	0.6	542,126	0	3,253	85	3,167	77	4,729	2.36	43.7
2021	1.0	563,194	0	5,632	108	5,524	333	10,586	4.27	70.9
2022	1.5	585,498	0	8,782	149	8,633	673	19,893	4.37	92.2
2023	2.0	607,349	0	12,147	216	11,931	1,188	33,012	4.48	103.9
2024	2.0 / 8.0	630,884	24,189	14,553	318	14,235	1,877	49,124	4.59	109.9
2025	2.0 / 8.0	655,541	48,363	16,980	447	16,533	2,735	68,392	4.69	112.5
2026	2.0 / 8.0	680,630	50,231	17,631	608	17,023	3,731	89,146	4.79	109.8
2027	2.0 / 8.0	707,105	52,104	18,310	812	17,498	5,219	111,863	5.28	105.0
2028	2.0 / 8.0	734,162	54,076	19,009	1,066	17,944	6,445	136,252	5.29	99.5
2029	2.0 / 8.0	762,391	56,025	19,730	1,369	18,361	8,175	162,788	5.58	94.8
2030	2.0 / 8.0	791,884	57,959	20,474	1,717	18,758	9,670	191,216	5.58	90.3
2031	2.0 / 8.0	822,419	60,505	21,289	2,117	19,172	11,270	221,658	5.58	86.0
2032	2.0 / 8.0	854,840	62,590	22,104	2,577	19,527	12,982	254,167	5.58	81.8
2033	2.0 / 8.0	888,788	64,684	22,950	3,107	19,844	14,808	288,819	5.58	77.8
2034	2.0 / 8.0	924,146	67,288	23,866	3,713	20,153	16,754	325,726	5.58	74.1
2035	2.0 / 8.0	960,579	70,032	24,814	4,395	20,419	18,825	364,970	5.58	70.8
2036	2.0 / 8.0	996,622	72,662	25,745	5,153	20,592	21,024	406,586	5.58	67.9
2037	2.0 / 8.0	1,034,670	74,830	26,680	5,988	20,692	23,353	450,631	5.58	65.3
2038	2.0 / 8.0	1,074,381	78,070	27,733	6,903	20,830	25,820	497,281	5.58	62.9
2039	2.0 / 8.0	1,114,968	80,924	28,773	7,908	20,865	28,429	546,575	5.58	60.6
2040	2.0 / 8.0	1,157,737	83,697	29,851	9,016	20,834	31,184	598,593	5.58	58.5
2041	2.0 / 8.0	1,201,584	86,618	30,961	10,236	20,725	34,089	653,407	5.58	56.5
2042	2.0 / 8.0	1,247,334	90,125	32,157	11,574	20,582	37,150	711,139	5.58	54.5
2043	2.0 / 8.0	1,295,428	93,564	33,394	13,043	20,350	40,371	771,861	5.58	52.7
2044	2.0 / 8.0	1,344,464	96,618	34,619	14,656	19,963	43,756	835,580	5.58	50.9
2045	2.0 / 8.0	1,394,863	100,221	35,915	16,424	19,491	47,306	902,377	5.58	49.1
2046	2.0 / 8.0	1,447,496	103,743	37,249	18,361	18,889	51,024	972,290	5.58	47.5
2047	2.0 / 8.0	1,501,085	107,966	38,659	20,474	18,185	54,914	1,045,3	5.58	45.9
2048	2.0 / 8.0	1,556,720	111,554	40,059	22,772	17,287	58,977	1,121,6	5.58	44.4
2049	2.0 / 8.0	1,613,094	115,289	41,485	25,265	16,220	63,213	1,201,0	5.58	42.9
2050	2.0 / 8.0	1,671,351	119,475	42,985	27,967	15,018	67,622	1,283,7	5.58	41.6
2055	2.0 / 8.0	1,987,685	141,782	51,096	44,849	6,247	92,278	1,744,7	5.58	35.6
2060	2.0 / 8.0	2,353,547	166,935	60,426	67,772	(7,347)	121,178	2,283,3	5.58	31.3
2065	2.0 / 8.0	2,789,376	197,054	71,552	95,435	(23,883)	154,354	2,901,1	5.58	28.6
2070	2.0 / 8.0	3,324,016	234,030	85,203	125,981	(40,778)	192,670	3,615,6	5.58	27.3
2075	2.0 / 8.0	3,973,597	279,401	101,824	160,577	(58,753)	237,549	4,453,5	5.58	26.5
2080	2.0 / 8.0	4,749,801	332,684	121,611	199,815	(78,204)	290,620	5,445,3	5.58	26.1
2085	2.0 / 8.0	5,669,320	396,260	145,087	244,669	(99,581)	353,940	6,629,7	5.58	26.1
2090	2.0 / 8.0	6,750,680	470,912	172,687	297,162	(124,475)	429,898	8,050,9	5.58	26.1
2095	2.0 / 8.0	8,026,025	559,448	205,276	359,038	(153,762)	521,174	9,759,1	5.58	26.2

(1) The legislated second additional contribution rate is applicable from the year 2024 onward.
(2) Rates of Return and Investment Income are net of all investment expenses.

Table 22   **Financial Projections - Additional CPP, 2.0%, 8.0% Legislated First and Second Additional Contribution Rates (millions of 2019 constant dollars)[1]**

Year	First / Second Additional Contribution Rates [2] (%)	First Additional Contributory Earnings ($ million)	Second Additional Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flow ($ million)	Net Investment Income [3] ($ million)	Assets at 31 Dec. ($ million)
2019	0.3	521,967	0	1,566	92	1,474	11	1,485
2020	0.6	531,496	0	3,189	84	3,105	76	4,636
2021	1.0	541,324	0	5,413	104	5,309	320	10,175
2022	1.5	551,728	0	8,276	141	8,135	634	18,745
2023	2.0	561,096	0	11,222	199	11,023	1,098	30,498
2024	2.0 / 8.0	571,411	21,909	13,181	288	12,893	1,700	44,493
2025	2.0 / 8.0	582,102	42,945	15,078	397	14,681	2,429	60,730
2026	2.0 / 8.0	592,530	43,729	15,349	529	14,820	3,248	77,607
2027	2.0 / 8.0	603,508	44,471	15,628	693	14,935	4,454	95,474
2028	2.0 / 8.0	614,314	45,249	15,906	892	15,014	5,393	114,009
2029	2.0 / 8.0	625,426	45,960	16,185	1,123	15,063	6,707	133,543
2030	2.0 / 8.0	636,883	46,614	16,467	1,381	15,086	7,777	153,788
2031	2.0 / 8.0	648,471	47,708	16,786	1,669	15,117	8,887	174,776
2032	2.0 / 8.0	660,819	48,384	17,087	1,992	15,095	10,036	196,479
2033	2.0 / 8.0	673,590	49,022	17,394	2,354	15,039	11,223	218,889
2034	2.0 / 8.0	686,654	49,996	17,733	2,759	14,974	12,449	242,019
2035	2.0 / 8.0	699,729	51,015	18,076	3,202	14,874	13,713	265,861
2036	2.0 / 8.0	711,750	51,892	18,386	3,680	14,706	15,015	290,369
2037	2.0 / 8.0	724,434	52,393	18,680	4,193	14,488	16,351	315,514
2038	2.0 / 8.0	737,489	53,589	19,037	4,738	14,299	17,723	341,349
2039	2.0 / 8.0	750,342	54,460	19,364	5,322	14,041	19,132	367,829
2040	2.0 / 8.0	763,847	55,221	19,695	5,949	13,746	20,574	394,937
2041	2.0 / 8.0	777,232	56,028	20,027	6,621	13,406	22,050	422,649
2042	2.0 / 8.0	791,004	57,153	20,392	7,340	13,052	23,559	450,973
2043	2.0 / 8.0	805,395	58,171	20,762	8,109	12,652	25,100	479,883
2044	2.0 / 8.0	819,493	58,892	21,101	8,933	12,168	26,671	509,312
2045	2.0 / 8.0	833,541	59,890	21,462	9,814	11,648	28,269	539,242
2046	2.0 / 8.0	848,033	60,779	21,823	10,757	11,066	29,893	569,628
2047	2.0 / 8.0	862,185	62,013	22,205	11,760	10,445	31,541	600,445
2048	2.0 / 8.0	876,608	62,817	22,558	12,823	9,735	33,211	631,617
2049	2.0 / 8.0	890,542	63,648	22,903	13,948	8,955	34,898	663,084
2050	2.0 / 8.0	904,612	64,665	23,265	15,137	8,129	36,600	694,811
2055	2.0 / 8.0	974,409	69,505	25,049	21,986	3,062	45,237	855,322
2060	2.0 / 8.0	1,044,999	74,121	26,830	30,092	(3,262)	53,804	1,013,837
2065	2.0 / 8.0	1,121,758	79,246	28,775	38,380	(9,605)	62,074	1,166,692
2070	2.0 / 8.0	1,210,750	85,244	31,034	45,888	(14,853)	70,179	1,316,985
2075	2.0 / 8.0	1,310,914	92,176	33,592	52,975	(19,383)	78,369	1,469,261
2080	2.0 / 8.0	1,419,270	99,408	36,338	59,706	(23,368)	86,839	1,627,114
2085	2.0 / 8.0	1,534,333	107,243	39,266	66,217	(26,950)	95,790	1,794,263
2090	2.0 / 8.0	1,654,761	115,432	42,330	72,842	(30,512)	105,379	1,973,496
2095	2.0 / 8.0	1,781,917	124,207	45,575	79,713	(34,138)	115,710	2,166,712

(1)   For a given year, the value in 2019 constant dollars is equal to the corresponding value in current dollars divided by the cumulative projected increases in prices since 2019.

(2)   The legislated second additional contribution rate is applicable from the year 2024 onward.

(3)   Investment Income is net of all investment expenses.

Table 23 shows the sources of the revenues (contributions and investment income) required to cover the additional CPP expenditures. With the growth in the additional assets, the importance of the investment income increases rapidly. By 2075, investment income is projected to represent about 70% of revenues of the additional CPP. The importance of investment income as a source of revenues is directly related to the financing approach of the additional CPP.

A strong reliance of the additional CPP on investment income as a source of revenues results in the additional contribution rates being much more sensitive to financial market environments than is the case for the base CPP. The sensitivity of the base and additional CPP to investment experience is examined in Appendix E of this report.

Chart 2 shows projected revenues and expenditures of the additional CPP for the period 2019 to 2069.

Chart 2   Revenues and Expenditures - Additional CPP, 2.0%/8.0% legislated contribution rates (billions of 2019 constant dollars)
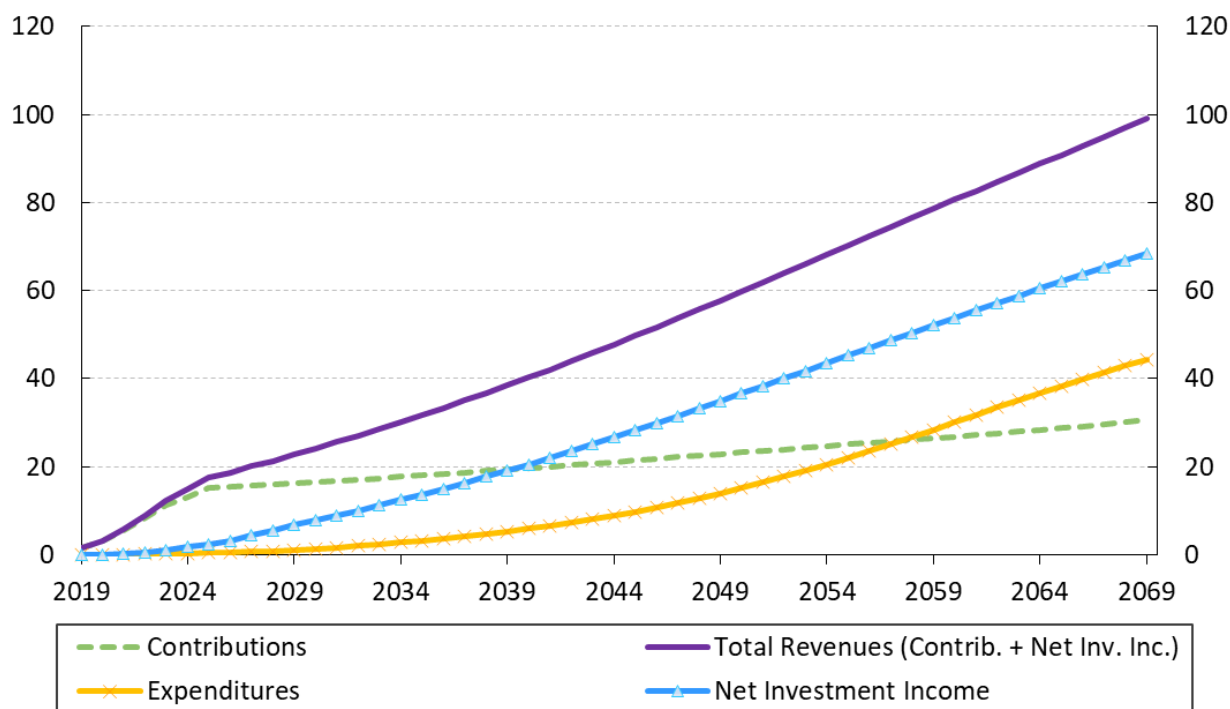
Table 23 also shows the projected additional CPP expenditures as a percentage of total additional revenues. This percentage is projected to increase as the additional Plan matures from about 2% in 2022 to 10% in 2035. It continues to grow but at decreasing pace, and stabilizes at about 49% by 2095.

Table 23 **Sources of Revenues - Additional CPP**
($ million)

Year	Contributions	Net Investment Income [1]	Total Revenues	Net Investment Income as % of Revenues (%)	Expenditures	Expenditures as % of Revenues (%)	% of Net Investment Income Needed to Pay Expenditures (%)
2019	1,566	11	1,577	0.7	92	5.8	0.0
2020	3,253	77	3,330	2.3	85	2.6	0.0
2021	5,632	333	5,965	5.6	108	1.8	0.0
2022	8,782	673	9,456	7.1	149	1.6	0.0
2023	12,147	1,188	13,335	8.9	216	1.6	0.0
2024	14,553	1,877	16,430	11.4	318	1.9	0.0
2025	16,980	2,735	19,715	13.9	447	2.3	0.0
2026	17,631	3,731	21,362	17.5	608	2.8	0.0
2027	18,310	5,219	23,529	22.2	812	3.5	0.0
2028	19,009	6,445	25,455	25.3	1,066	4.2	0.0
2029	19,730	8,175	27,905	29.3	1,369	4.9	0.0
2030	20,474	9,670	30,144	32.1	1,717	5.7	0.0
2031	21,289	11,270	32,559	34.6	2,117	6.5	0.0
2032	22,104	12,982	35,086	37.0	2,577	7.3	0.0
2033	22,950	14,808	37,759	39.2	3,107	8.2	0.0
2034	23,866	16,754	40,620	41.2	3,713	9.1	0.0
2035	24,814	18,825	43,639	43.1	4,395	10.1	0.0
2036	25,745	21,024	46,769	45.0	5,153	11.0	0.0
2037	26,680	23,353	50,033	46.7	5,988	12.0	0.0
2038	27,733	25,820	53,553	48.2	6,903	12.9	0.0
2039	28,773	28,429	57,202	49.7	7,908	13.8	0.0
2040	29,851	31,184	61,034	51.1	9,016	14.8	0.0
2041	30,961	34,089	65,050	52.4	10,236	15.7	0.0
2042	32,157	37,150	69,307	53.6	11,574	16.7	0.0
2043	33,394	40,371	73,765	54.7	13,043	17.7	0.0
2044	34,619	43,756	78,375	55.8	14,656	18.7	0.0
2045	35,915	47,306	83,221	56.8	16,424	19.7	0.0
2046	37,249	51,024	88,274	57.8	18,361	20.8	0.0
2047	38,659	54,914	93,573	58.7	20,474	21.9	0.0
2048	40,059	58,977	99,036	59.6	22,772	23.0	0.0
2049	41,485	63,213	104,698	60.4	25,265	24.1	0.0
2050	42,985	67,622	110,607	61.1	27,967	25.3	0.0
2055	51,096	92,278	143,374	64.4	44,849	31.3	0.0
2060	60,426	121,178	181,604	66.7	67,772	37.3	6.1
2065	71,552	154,354	225,906	68.3	95,435	42.2	15.5
2070	85,203	192,670	277,873	69.3	125,981	45.3	21.2
2075	101,824	237,549	339,373	70.0	160,577	47.3	24.7
2080	121,611	290,620	412,230	70.5	199,815	48.5	26.9
2085	145,087	353,940	499,027	70.9	244,669	49.0	28.1
2090	172,687	429,898	602,585	71.3	297,162	49.3	29.0
2095	205,276	521,174	726,450	71.7	359,038	49.4	29.5

(1) Investment Income is net of all investment expenses.

5.5 Financial Projections with Additional Minimum Contribution Rates

The results presented in Table 24 are based on the best-estimate assumptions, but use the FAMCR of 1.98% for 2023 and thereafter and SAMCR of 7.92% for 2024 and thereafter as opposed to the legislated first and second additional contribution rates of 2.0% and 8.0%, respectively. The financial projections of the additional Plan under the legislated rates were previously presented in Table 21. Under the AMCRs, the additional CPP open group assets represent 107% of its open group actuarial obligations as at 1 January 2019, and the ratio of invested assets to expenditures stabilizes at a value of 25 for the target years 2088 and 2098.

Table 25 shows the progression of the additional minimum contribution rates over time under the best-estimate assumptions of this report. As shown in Table 25, If the best-estimate assumptions of this report are realized, the FAMCR and SAMCR will remain at about 1.98% and 7.92%, respectively for each of the next four reports, which are below and very close to the legislated additional contribution rates of 2.0% and 8.0%. Thus, the current legislated additional contribution rates are projected to be sufficient over subsequent reports as long as the best-estimate assumptions remain the same and additional Plan experience does not deviate materially from the assumptions.

In the event that the AMCRs, as determined under a CPP actuarial report, deviate to a certain extent from their respective legislated additional rates and the federal and provincial Ministers of Finance do not reach an agreement on how to address such deviation, certain provisions of the *Additional Canada Pension Plan Sustainability Regulations* would be activated. The deviation in the rates is quantified in the regulations with respect to both the magnitude (absolute basis points difference between the legislated rates and AMCRs) and duration of time that a deviation exists. In such case, adjustments would be made to current and future benefits and possibly to the contribution rates. In respect of this 30th CPP Actuarial Report, the AMCRs do not deviate materially from their respective legislated rates, and thus the provisions under the sustainability regulations do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated additional contribution rates will remain as scheduled.

Table 24   Financial Projections - Additional CPP, First and Second Additional Minimum Contribution Rates of 1.98% / 7.92%

Year	First / Second Additional Contribution Rates [1] (%)	First Additional Contributory Earnings ($ million)	Second Additional Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flow ($ million)	Net Investment Income [2] ($ million)	Assets at 31 Dec. ($ million)	Assets/ Expenditures Ratio
2019	0.30	521,967	0	1,566	92	1,474	11	1,485	17.4
2020	0.60	542,126	0	3,253	85	3,167	77	4,729	43.7
2021	1.00	563,194	0	5,632	108	5,524	333	10,586	70.9
2022	1.49	585,498	0	8,724	149	8,575	672	19,833	92.0
2023	1.98	607,349	0	12,026	216	11,810	1,182	32,825	103.3
2024	1.98 / 7.92	630,884	24,189	14,407	318	14,089	1,865	48,779	109.1
2025	1.98 / 7.92	655,541	48,363	16,810	447	16,363	2,714	67,857	111.6
2026	1.98 / 7.92	680,630	50,231	17,455	608	16,847	3,701	88,404	108.9
2027	1.98 / 7.92	707,105	52,104	18,127	812	17,315	5,174	110,893	104.0
2028	1.98 / 7.92	734,162	54,076	18,819	1,066	17,753	6,388	135,035	98.7
2029	1.98 / 7.92	762,391	56,025	19,533	1,369	18,164	8,101	161,300	94.0
2030	1.98 / 7.92	791,884	57,959	20,270	1,717	18,553	9,580	189,434	89.5
2031	1.98 / 7.92	822,419	60,505	21,076	2,117	18,959	11,164	219,557	85.2
2032	1.98 / 7.92	854,840	62,590	21,883	2,577	19,306	12,858	251,721	81.0
2033	1.98 / 7.92	888,788	64,684	22,721	3,107	19,614	14,665	286,000	77.0
2034	1.98 / 7.92	924,146	67,288	23,627	3,713	19,914	16,590	322,504	73.4
2035	1.98 / 7.92	960,579	70,032	24,566	4,395	20,171	18,638	361,312	70.1
2036	1.98 / 7.92	996,622	72,662	25,488	5,153	20,335	20,812	402,459	67.2
2037	1.98 / 7.92	1,034,670	74,830	26,413	5,988	20,425	23,115	445,999	64.6
2038	1.98 / 7.92	1,074,381	78,070	27,456	6,903	20,553	25,553	492,105	62.2
2039	1.98 / 7.92	1,114,968	80,924	28,486	7,908	20,577	28,131	540,813	60.0
2040	1.98 / 7.92	1,157,737	83,697	29,552	9,016	20,536	30,853	592,202	57.9
2041	1.98 / 7.92	1,201,584	86,618	30,652	10,236	20,416	33,723	646,340	55.8
2042	1.98 / 7.92	1,247,334	90,125	31,835	11,574	20,261	36,746	703,347	53.9
2043	1.98 / 7.92	1,295,428	93,564	33,060	13,043	20,016	39,926	763,290	52.1
2044	1.98 / 7.92	1,344,464	96,618	34,273	14,656	19,617	43,267	826,174	50.3
2045	1.98 / 7.92	1,394,863	100,221	35,556	16,424	19,132	46,770	892,076	48.6
2046	1.98 / 7.92	1,447,496	103,743	36,877	18,361	18,516	50,438	961,030	46.9
2047	1.98 / 7.92	1,501,085	107,966	38,272	20,474	17,798	54,274	1,033,102	45.4
2048	1.98 / 7.92	1,556,720	111,554	39,658	22,772	16,886	58,279	1,108,268	43.9
2049	1.98 / 7.92	1,613,094	115,289	41,070	25,265	15,805	62,453	1,186,526	42.4
2050	1.98 / 7.92	1,671,351	119,475	42,555	27,967	14,588	66,796	1,267,911	41.0
2055	1.98 / 7.92	1,987,685	141,782	50,585	44,849	5,736	91,049	1,721,272	35.2
2060	1.98 / 7.92	2,353,547	166,935	59,821	67,772	(7,951)	119,392	2,249,304	30.8
2065	1.98 / 7.92	2,789,376	197,054	70,836	95,435	(24,599)	151,807	2,852,585	28.2
2070	1.98 / 7.92	3,324,016	234,030	84,351	125,981	(41,630)	189,085	3,547,455	26.8
2075	1.98 / 7.92	3,973,597	279,401	100,806	160,577	(59,771)	232,557	4,358,630	25.9
2080	1.98 / 7.92	4,749,801	332,684	120,395	199,815	(79,420)	283,724	5,314,323	25.5
2085	1.98 / 7.92	5,669,320	396,260	143,636	244,669	(101,032)	344,480	6,450,056	25.3
2088	1.98 / 7.92	6,297,356	440,079	159,542	275,127	(115,585)	386,433	7,234,526	25.3
2090	1.98 / 7.92	6,750,680	470,912	170,960	297,162	(126,202)	416,994	7,805,978	25.3
2095	1.98 / 7.92	8,026,025	559,448	203,224	359,038	(155,815)	503,659	9,426,798	25.3
2098	1.98 / 7.92	8,905,491	620,187	225,448	401,345	(175,898)	563,654	10,549,067	25.3

(1)   The second additional minimum contribution rate is applicable from the year 2024 onward.

(2)   Investment Income is net of all investment expenses.

Table 25   Progression of Additional Minimum Contribution Rates over Time

Valuation Year (1)	Target Years (2)	Target A/E Ratio (3)	Additional Minimum Contribution Rates	Years Additional Minimum Contribution Rates Applicable (4)	Assets as a % of Obligations on an Open Group Basis (5)
2018	2088 and 2098	25.2	1.98%/7.92%	2023+, 2024+	106.8%
2021	2088 and 2098	25.2	1.98%/7.92%	2025+	106.4%
2024	2088 and 2098	25.2	1.97%/7.88%	2028+	105.6%
2027	2088 and 2098	25.2	1.97%/7.88%	2031+	105.3%
2030	2088 and 2098	25.3	1.97%/7.88%	2034+	105.1%

(1)   Reports are prepared as at 31 December of the valuation year.

(2)   Target years refer to the beginning and end of the 10-year interval that are used to determine the FAMCR and SAMCR. These rates are the lowest level rates that result in the assets/expenditures (A/E) ratio being the same in the two target years. For a given triennial review period of the Plan, the target years are 53 and 63 years after the valuation year, but occurring no earlier than 2088 and 2098. For this and all reports with valuation years before 2036, the target years are 2088 to 2098. The AMCRs must also satisfy a full funding condition as described in note (5) below.

(3)   The target A/E ratio is the ratio obtained in the target years relating to the determination of the corresponding AMCRs.

(4)   The FAMCR equals 1.49% for the year 2022. The legislated first additional contribution rate applies to the current triennial review period 2019-2021. More generally, the legislated first and second additional contribution rates apply for each triennial review period following a valuation year.

(5)   The AMCRs must satisfy the condition that the present value of projected additional expenditures equals the projected additional assets and present value of projected additional contributions. In other words, the total assets must equal 100% of the obligations of the additional Plan. As shown, this condition is projected to be met over successive valuations, under the best-estimate assumptions of this report.

6 Reconciliation with Previous Triennial Report

6.1 Base CPP

6.1.1 Introduction

The results presented in this report differ from those previously projected for a variety of reasons. Differences between the actual experience for 2016 through 2018 and that projected in the 27th CPP Actuarial Report are addressed in section 6.1.2 below. Since historical results provide the starting point for the projections shown in this report, these historical differences between actual and projected experience have an effect on the projections. The impact of experience since the last triennial valuation of the base Plan (that is, the experience update from the period 2016-2018) and changes in the assumptions and methodology on the base CPP minimum contribution rate are addressed in section 6.1.3. Detailed reconciliations of the projected pay-as-you-go rates and the minimum contribution rate are presented in Appendix D.

6.1.2 Experience Update – 31 December 2015 to 31 December 2018

The major components of the change in the base CPP assets from 31 December 2015 to 31 December 2018 are summarized in Table 26.

Contributions during the period 2016 to 2018 were about $234 million lower than expected, mainly as a result of lower than anticipated growth in total employment earnings. This represents a deviation from the expected results of about -0.2%.

Expenditures during the period were $1.9 billion lower than expected. This represents a deviation from the expected results of about -1.4%. The difference between actual and expected expenditures is due to over-projections of retirement benefits (lower take-up of retirement benefits at age 60 than expected), disability benefits (lower disability incidence rates than expected), survivor benefits and operating expenses that outweigh under-projections of death and children benefits. The details by type of expenditure are given in Table 27.

Due to the strong investment performance over the period (actual average annual nominal rate of return of 7.9% compared to the anticipated 3.9%), investment income was $39.3 billion higher than expected. This represents a deviation from the expected results of about 107%. As a result, the change in assets was $86 billion or 90% higher than expected over the period. The resulting assets as at 31 December 2018 are about $41 billion or 12% higher than projected under the 27th CPP Actuarial Report.

Table 26   **Change in Assets - 31 December 2015 to 31 December 2018 - Base CPP [1]**
(cost accrual basis, $ million)

	Actual	Expected [2]	Difference Actual – Expected	% Change Difference/ Expected
Assets at 31 December 2015	285,358	285,358	-	-
+ Contributions	144,226	144,460	(234)	(0.2)%
- Expenditures	133,748	135,680	(1,932)	(1.4)%
+ Investment Income	75,865	36,583	39,282	107.4%
Change in Assets	86,342	45,363	40,979	90.3%
Assets at 31 December 2018	371,700	330,721	40,979	12.4%

(1)   Components may not sum to totals due to rounding.
(2)   Expected contributions, expenditures, and investment income shown are as per the projections of the 27th CPP Actuarial Report as at 31 December 2015.

Table 27   **Summary of Expenditures – 2016 to 2018 – Base CPP [1]**
($ million)

	Actual	Expected [2]	Difference Actual – Expected	% Change Difference/ Expected
Retirement	103,628	105,107	(1,479)	(1.4)%
Disability	12,248	12,554	(306)	(2.5)%
Survivors	13,420	13,559	(139)	(1.0)%
Children	1,569	1,534	35	2.2%
Death	1,079	1,020	59	5.5%
Operating Expenses	1,804	1,906	(102)	(5.7)%
Total Expenditures	133,748	135,680	(1,932)	(1.4)%

(1)   Components may not sum to totals due to rounding.
(2)   Expected expenditures shown are as per the projections of the 27th CPP Actuarial Report as at 31 December 2015.

6.1.3   Changes in the Minimum Contribution Rate

Table 28 presents the main elements of change in the base Plan MCR since the 27th CPP Actuarial Report and shows an overall decrease in the rate. The cost impacts of the amendments introduced under Bill C-74 – *Budget Implementation Act, 2018, No. 1* were determined in the 29th CPP Actuarial Report. It was determined under that report that the amendments had the effect of triggering the full funding provision of the CPP statute and introducing full funding rates, which increased the MCR. Bill C-97 – *Budget Implementation Act, 2019, No. 1*, which waives the application for the retirement pension upon reaching age 70, also had the effect of increasing the MCR. Since Bill C-97 does not involve a benefit improvement, it does not trigger the full funding provision of the CPP statute.

Experience over the period 2016 to 2018 was better than anticipated overall, especially regarding investment income, which lowers the MCR. Changes made to the demographic assumptions also act to lower the MCR. However, these reductions in the rate are partially offset by lower assumed real wage increases, changes to the assumed retirement take-up rates, assumed disability incidence rates, and investment assumptions. A more detailed reconciliation of changes in the MCR is provided in Table 106 in Appendix D of this report.

Table 28 **Reconciliation of Changes in Minimum Contribution Rate** [1]
(% of base CPP contributory earnings)

	Steady-State Rate	Full Funding Rates		MCR	
		2019-2033	2034+	2019-2033	2034+
27th CPP Actuarial Report - After Rounding	9.79	0.00	0.00	9.79	9.79
27th CPP Actuarial Report - Before Rounding	9.795	0.000	0.000	9.795	9.795
Legislated Amendments:					
28th CPP Actuarial Report (Bill C-26) [2]	0.000	0.000	0.000	0.000	0.000
29th CPP Actuarial Report (Bill C-74) [3]	0.000	0.035	0.007	0.035	0.007
Bill C-97 [4]	0.009	0.000	0.000	0.009	0.009
Total Amendments	0.009	0.034	0.007	0.044	0.016
Improvements in Methodology	0.000	0.001	0.000	0.001	0.000
Experience (2016 to 2018)	(0.233)	0.000	0.000	(0.233)	(0.233)
Changes in Demographic Assumptions	(0.061)	0.001	0.001	(0.060)	(0.060)
Changes in Benefit Assumptions	0.080	(0.001)	(0.001)	0.080	0.080
Changes in Economic Assumptions	0.094	0.000	0.000	0.094	0.094
Changes in Investment Assumptions	0.027	0.000	0.000	0.027	0.027
Change in Funding Target from 2028-2078 to 2031-2081	(0.002)	0.000	0.000	(0.002)	(0.002)
Rate before Rounding	9.708	0.035	0.007	9.743	9.715
Rounded Rate, in Accordance with the proposed Calculation of Contribution Rates Regulations, 2018 [5]	9.71	0.04	0.01	9.75	9.72
30th CPP Actuarial Report	9.71	0.04	0.01	9.75	9.72

(1)   Components may not sum to totals due to rounding.

(2)   The supplemental 28th CPP Actuarial Report provides the financial estimates of the introduction of the additional CPP under Bill C-26 (*An Act to Amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act*).

(3)   The 29th CPP Actuarial Report supplementing the 27th and 28th CPP Actuarial Reports as at 31 December 2015 provides the estimated financial impacts of the amendments of Bill C-74 (*Budget Implementation Act, 2018, No. 1*) on the base and additional CPP. A description of the amendments is also provided in Appendix A of this 30th CPP Actuarial Report.

(4)   Bill C-97 (*Budget Implementation Act, 2019, No. 1)* waives the application for a CPP retirement pension upon reaching age 70. As the amendment is not a benefit improvement, the full funding provision was not invoked.

(5)   The *Calculation of Contribution Rates Regulations, 2018* and the *Additional Canada Pension Plan Sustainability Regulations* were published in the Canada Gazette, Part l, Vol. 152, No. 42 on October 20, 2018. Both Regulations are awaiting formal provincial approval.

6.2   Additional CPP

6.2.1   Introduction

The results presented in this report differ from those previously projected for a variety of reasons. Differences between the actual experience for 2016 through 2018 and that first projected in the 28th CPP Actuarial Report and then the 29th CPP Actuarial Report provide a different starting point for the additional CPP projections shown in this report. The impact of a different starting point (that is, experience since the last triennial valuation of the base Plan) and changes in the assumptions and methodology on the additional minimum contribution rates relative to the 28th and 29th CPP Actuarial Reports are addressed in section 6.2.2. Detailed reconciliations of the first and second additional minimum contribution rates are presented in Appendix D.

6.2.2   Changes in the Additional Minimum Contribution Rates

Table 29 presents the main elements of change in the first and second additional minimum contribution rates (FAMCR, SAMCR) and shows an overall increase in the rates. The cost impacts of the amendments determined in the 29th CPP Actuarial Report had the effect of increasing the AMCRs.

Although demographic experience over 2016 to 2018 was better than anticipated and acted to lower the AMCRs, changes in assumptions, especially those related to the assets allocation, and the amendments under Bills C-74 and C-97 have more than offset the decrease. As a result, the net result of all changes since the 28th CPP Actuarial Report is an overall absolute increase in the FAMCR of 0.05% and corresponding increase in the SAMCR of 0.20%. A more detailed reconciliation of changes in the AMCRs is provided in Table 107 in Appendix D of this report.

Table 29 **Reconciliation of Changes in Additional Minimum Contribution Rates** [1]
(% of additional CPP contributory earnings)

	First Additional Minimum Contribution Rate	Second Additional Minimum Contribution Rate
28th CPP Actuarial Report [2] - After Rounding	1.93	7.72 [3]
28th CPP Actuarial Report - Before Rounding	1.925	7.700 [3]
Legislated Amendments:		
29th CPP Actuarial Report (Bill C-74) [4]	0.059	0.236
Bill C-97 [5]	0.000	0.000
Total Amendments	0.059 [6]	0.236 [6]
Improvements in Methodology	(0.001)	(0.003)
Starting Demographic and Economic Environment (2016 to 2018) [7]	(0.005)	(0.020)
Changes in Demographic Assumptions	(0.007)	(0.028)
Changes in Benefit Assumptions	(0.021)	(0.082)
Changes in Economic Assumptions	(0.009)	(0.034)
Changes in Investment Assumptions	0.035	0.138
Rate before Rounding	1.977	7.907
Rounded Rates, in Accordance with the proposed Calculation of Contribution Rates Regulations, 2018 [8]	1.98	7.92
30th CPP Actuarial Report	1.98	7.92

(1) Components may not sum to totals due to rounding.

(2) The supplemental 28th CPP Actuarial Report provides the financial estimates of the introduction of the additional CPP under Bill C-26 (*An Act to Amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act*).

(3) At the time of the 28th and 29th CPP Actuarial Reports, there were no regulations regarding the calculation and rounding of the AMCRs. For the given two reports, the rounded SAMCRs were determined as four times the rounded FAMCRs. The same relationship holds between the unrounded total and changes in the rates, but may not appear as such in the table because of separate rounding of the rates.

(4) The 29th CPP Actuarial Report supplementing the 27th and 28th CPP Actuarial Reports as at 31 December 2015 provides the estimated financial impacts of the amendments of Bill C-74 (*Budget Implementation Act, 2018, No. 1*). A description of the amendments is also provided in Appendix A of this 30th CPP Actuarial Report.

(5) Bill C-97 (*Budget Implementation Act, 2019, No. 1*) waives the application for a CPP retirement pension upon reaching age 70. As the amendment is not a benefit improvement, the full funding provision was not invoked.

(6) The effects of the total amendments on the FAMCR and SAMCR on the basis of the final assumptions for the 30th CPP Actuarial Report are 0.055% and 0.218% of additional CPP contributory earnings, respectively.

(7) The difference between the actual and projected demographic and economic experience of the CPP over the period 2016-2018 affect the starting point of the projections for the additional Plan as at 1 January 2019.

(8) The *Calculation of Contribution Rates Regulations, 2018* and the *Additional Canada Pension Plan Sustainability Regulations* were published in the Canada Gazette, Part l, Vol. 152, No. 42 on October 20, 2018. Both Regulations are awaiting formal provincial approval.

7   Conclusion

The actuarial projections of the financial states of the base and additional Plans presented in this report reveal the following.

Base CPP

This report confirms that the legislated contribution rate of 9.9% is sufficient to finance the base CPP over the long term. Under the legislated contribution rate, contributions to the base Plan are projected to be higher than expenditures over the period 2019 to 2021, with a portion of investment income thereafter required to pay for expenditures.

Total assets of the base Plan are expected to increase significantly over the next decade and then to continue increasing, but at a slower pace. Under the legislated contribution rate of 9.9%, base CPP assets are projected to accumulate to $688 billion by the end of 2030 and $1.7 trillion by 2050, while the ratio of assets to the following year's expenditures is projected to remain relatively stable at a level of 7.6 over the period 2021 to 2031 and then grow to 8.8 in 2050 and continue increasing over the projection period.

The MCR of the base CPP is 9.75% for years 2022 to 2033 and 9.72% for the year 2034 and thereafter, which is lower than the legislated contribution rate of 9.9%. Thus, despite the projected substantial increase in benefits paid as a result of an aging population, the legislated rate exceeds the MCR, and the base Plan is expected to be able to meet its obligations throughout the projection period.

Since the MCR of the base CPP is below the legislated contribution rate of 9.9%, the insufficient rates provisions of the *Canada Pension Plan* do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated contribution rate will remain at 9.9% for the year 2019 and thereafter.

Additional CPP

This report confirms that the legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter result in projected contributions and investment income that are sufficient to fully pay the projected expenditures of the additional CPP over the long term. Under the legislated additional contribution rates, contributions to the additional Plan are projected to be higher than expenditures up to the year 2057 inclusive, with a portion of investment income thereafter required to pay for expenditures.

Total assets of the additional Plan are expected to increase rapidly over the first several decades as contributions are projected to exceed expenditures. Under the legislated additional contribution rates, additional CPP assets are projected to grow to $191 billion by the end of 2030 and to $1.3 trillion in 2050, while the ratio of assets to the following year's expenditures is projected to increase rapidly until 2025 and then decrease after that, reaching a level of about 26 by 2080.

The FAMCR is 1.98% for the year 2023 and thereafter, and the SAMCR is 7.92% for the year 2024 and thereafter. The AMCRs are lower than the legislated additional contribution rates.

In accordance with the *Additional Canada Pension Plan Sustainability Regulations,* the AMCRs are sufficiently close to the legislated additional contribution rates such that no immediate action is required to address the differences. Therefore, in the absence of specific action by the federal and provincial governments, the legislated additional contribution rates will remain at their scheduled values.

Base and Additional CPP

To measure the sensitivity of the long-term projected financial position of both the base and additional Plans to future changes in the demographic, economic, and investment environments, a variety of sensitivity tests were performed. Analyses of different asset allocations, the impacts of varying investment experience, and sensitivity tests on key assumptions show that the minimum contribution rates of the base and additional CPP could deviate significantly from their best-estimate values if other than best-estimate assumptions were to be realized. More details are provided in Appendix E.

The projected financial states of the base and additional Plans presented in this report are based on the assumed demographic, economic, and investment outlooks over the long term. Given the length of the projection period and the number of assumptions required, it is unlikely that the actual experience will develop precisely in accordance with the assumptions. Therefore, it remains important to assess the financial states of the two components on a regular basis by producing periodic actuarial valuation reports. For this purpose, as required by the *Canada Pension Plan*, the next such actuarial valuation will be as at 31 December 2021.

8   Actuarial Opinion

In our opinion, considering that this 30th Actuarial Report on the Canada Pension Plan as at 31 December 2018 was prepared pursuant to the *Canada Pension Plan*:

➢ the data on which this report is based are sufficient and reliable for the purposes of this report;

➢ the assumptions used are, individually and in aggregate, reasonable and appropriate for the purposes of this report; and

➢ the methods employed are appropriate for the purposes of this report.

Based on the results of this valuation, we hereby certify that:

➢ the minimum contribution rate required to finance the base CPP is 9.75% for years 2022 to 2033 and 9.72% for the year 2034 and thereafter.

➢ the additional minimum contribution rates that result in projected contributions being sufficient, along with projected investment income, to fully pay projected expenditures of the additional CPP are determined to be:

   ▪ first additional minimum contribution rate: 1.49% for the year 2022 and 1.98% for the year 2023 and thereafter, and

   ▪ second additional minimum contribution rate: 7.92% for the year 2024 and thereafter.

This report has been prepared, and our opinions given, in accordance with accepted actuarial practice in Canada, in particular, the General Standards and the Practice-Specific Standards for Social Security Programs of the Standards of Practice of the Canadian Institute of Actuaries.

As of the date of the signing of this report, we have not learned of any events, other than the events already accounted for in this report, that would have a material impact on the financial states of the base and additional CPP as at 31 December 2018.

_____   _____
Assia Billig, FCIA, FSA   Michel Montambeault, FCIA, FSA
Chief Actuary   Senior Actuary

Ottawa, Canada

27 November 2019

Appendix A – Summary of Plan Provisions

A.1   Introduction

The *Canada Pension Plan* came into force on 1 January 1966. Since its inception, the CPP has been amended several times, the most recent occasions as a result of the following:

Part 1 of Bill C-26 – *An Act to amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act* (introduction of the additional CPP) which received Royal Assent on 15 December 2016.

Division 19 of Part 6 of Bill C-74 – Budget Implementation Act, 2018, No. 1 (removal of age-related reductions in survivor benefits, introduction of child-rearing and disability drop-ins for the additional CPP, introduction of the post-retirement disability benefit for the base CPP, change in base CPP death benefit to flat-rate $2,500, authorization of making of sustainability regulations for the additional CPP) which received Royal Assent on 21 June 2018.

Division 2 of Part 4 of Bill C-86 – Budget Implementation Act, 2018, No. 2 (technical amendment regarding calculation of child-rearing drop-in amount under the additional CPP) which received Royal Assent on 13 December 2018[1].

Division 6 of Part 4 of Bill C-97 – *Budget Implementation Act, 2019, No. 1* (application for CPP retirement pension is waived upon reaching age 70, effective 1 January 2020, as well as administrative amendments regarding overpayments of salaries and wages) which received Royal Assent on 21 June 2019.

The details of the cost impacts of the first two Bills listed above can be found respectively in the 28th Actuarial Report supplementing the 27th Actuarial Report on the Canada Pension Plan as at 31 December 2015, and the 29th Actuarial Report supplementing the 27th and 28th Actuarial Reports on the Canada Pension Plan as at 31 December 2015. There was no actuarial report in respect of the amendments under the third Bill listed above (Bill C-86) since the cost impact on the CPP was deemed small to negligible. As for the fourth Bill listed above (Bill C-97), it is considered to be a subsequent event for the purpose of this report, since it became known to the Chief Actuary after the valuation date but before the report date and was determined to have an effect on the financial state of the CPP.

In addition, amendments to the regulations regarding the calculation of the CPP contribution rates were proposed in 2018 to clarify the determination of full funding rates and introduce the calculation of the additional CPP minimum contribution rates. These regulations as well as proposed regulations regarding the sustainability of the additional CPP, namely the *Calculation of Contribution Rates Regulations, 2018* and the *Additional Canada Pension Plan Sustainability Regulations* are awaiting formal consent by the provinces.

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[1] At the time of the signing of this report, the amendment is still in the process of getting formal provincial approval through Orders in Council.

Effective January 1, 2019, an enhancement of the CPP (the additional CPP) is implemented, such that the CPP consists of two components: the base CPP and additional CPP.

This Appendix presents a summary of the provisions of the Plan inclusive of all amendments. The legislation shall prevail if there is a discrepancy between it and this summary.

A.2   Participation

The CPP includes virtually all members of the labour force in Canada, including both employees and self-employed persons between the ages of 18 and 70 with employment earnings, other than those covered by the Québec Pension Plan (QPP). The main exceptions are persons with annual earnings lower than $3,500 (the Year's Basic Exemption, defined below), members of certain religious groups, and other persons who qualify under excepted employment. It should be noted that the CPP covers all members of the Canadian Forces and the Royal Canadian Mounted Police, including those residing in the province of Québec. The persons to whom a CPP disability benefit is payable are not required to contribute.

A.3   Definitions

A.3.1   Base and Additional CPP

The base CPP or base Plan refers to that part of the CPP other than the part relating to the additional CPP. Prior to 1 January 2019, the CPP consisted only of the base Plan.

The additional CPP or additional Plan refers to the enhancement to the CPP introduced in *An Act to Amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act*. The additional CPP is implemented as of 1 January 2019. The additional CPP has two (first and second) parts, and the corresponding first and second additional contribution rates and pensionable earnings on which contributions are made will be phased in over the seven-year period 2019 to 2025, described below.

As of 1 January 2019, the CPP comprises the base and additional Plans.

A.3.2   Year's Maximum Pensionable Earnings (YMPE) and Year's Additional Maximum Pensionable Earnings (YAMPE)

The YMPE for a calendar year is the limit to which employment and self-employment earnings are subject to contributions and first additional contributions for purposes of the base Plan and additional Plan, respectively. The YMPE increases each year to the extent warranted by the percentage increase, as at 30 June of the preceding year, in the 12-month average of the average weekly earnings of the Industrial Aggregate (as published by Statistics Canada). If the amount so calculated is not a multiple of $100, the next lower multiple of $100 is used. The YMPE is set at $57,400 in 2019.

The YAMPE for a calendar year is the limit to which employment and self-employment earnings

are subject to second additional contributions above the YMPE for the purposes of the additional Plan. The YAMPE will be introduced in the year 2024. The YAMPE will first be set at 107% of the YMPE in 2024, and then at 114% of the YMPE in 2025 and thereafter. The YAMPE is thus set to increase in tandem with the YMPE after 2025. If the YAMPE so calculated is not a multiple of $100, the next lower multiple of $100 is used.

In this report, the YMPE and YAMPE in the year 2025 are projected to be $67,100 and $76,400. respectively.

A.3.3   Year's Basic Exemption (YBE)

The YBE for a calendar year is the minimum employment earnings required to participate in the Plan. As well, contributions are waived on earnings up to the YBE. The YBE is $3,500 in 2019.

A.3.4   Contributory Period and Additional Contributory Periods of the CPP

The contributory period is in respect of the base CPP and is the number of months from attainment of age 18 or from 1 January 1966, if later, to the earliest of the month in which the contributor dies, the month before the one in which the retirement pension commences and the month before the one in which the contributor reaches 70 years of age, less the number of months during which the contributor received a CPP or QPP disability benefit (including the three-month waiting period), or during which the contributor had at least one eligible child under seven years of age and had earnings for that year lower than the YBE. The contributory period excludes periods on or after 1 January 2012 during which beneficiaries contribute while in receipt of a retirement pension.

The first additional contributory period in respect of the additional CPP is the number of months from attainment of age 18 or from 1 January 2019, if later, to the earliest of the month in which the contributor dies, the month before the one in which the retirement pension commences and the month before the one in which the contributor reaches 70 years of age.

The second additional contributory period in respect of the additional CPP is the number of months from attainment of age 18 or from 1 January 2024, if later, to the earliest of the month in which the contributor dies, the month before the one in which the retirement pension commences and the month before the one in which the contributor reaches 70 years of age.

A.3.5   Pension Index

The Pension Index for a given calendar year is equal to the Consumer Price Index averaged over the 12-month period ending with October of the preceding year; however, the Pension Index of a given year may not be less than the previous year's Pension Index.

A.4   Contribution Rate and Additional Contribution Rates of the CPP

In respect of the base CPP, from 1966 to 1986, the annual contribution rate applicable to contributory earnings was 1.8% for employees (and the same amount for their employers) and

3.6% in respect of self-employed earnings. This combined employer-employee contribution rate of 3.6% was subject to an annual increase of 0.2 percentage points from 1987 to 1996, attaining 5.6% in the last year of that period. From 1997 to 2003, the combined employer-employee contribution rate for the base CPP then increased in steps to reach a rate of 9.9% by 2003, with no subsequent increases scheduled thereafter.

The first additional contribution rate of the additional CPP applies to earnings between the YBE and the YMPE. The first additional combined employer-employee contribution rate will be phased in over the 5-year period 2019 to 2023 and will be equal to 2.0% from the year 2023 onward. The first additional contribution rate during the phase-in period from 2019 to 2023 is shown in Table 30.

The second additional contribution rate of the additional CPP applies to earnings between the YMPE and YAMPE and will be applied starting in the year 2024. The second additional combined employer-employee contribution rate is equal to 8.0% for the year 2024 and thereafter.

Employees and employers pay equal shares of the base and additional contribution rates of the CPP, and the self-employed pay the full rates.

Table 30 shows the legislated contribution rates for the CPP.

Table 30	Legislated Contribution Rates (self-employed and combined employer-employee) (%)		
	Pensionable Earnings above YBE up to YMPE		Pensionable Earnings above YMPE up to YAMPE
Year	Base Contribution Rate	First Additional Contribution Rate	Second Additional Contribution Rate
2003-2018	9.9	–	–
2019	9.9	0.3	–
2020	9.9	0.6	–
2021	9.9	1.0	–
2022	9.9	1.5	–
2023	9.9	2.0	–
2024+	9.9	2.0	8.0

The CPP statute gives the federal and provincial ministers of finance the authority to make changes to the Plan's contribution rates through regulation, in connection with a triennial review. However, year-over-year rate increases cannot exceed 0.2 percentage points; beyond that, legislation is required.

For the base Plan, if a triennial CPP actuarial report projects a minimum contribution rate in excess of the scheduled (legislated) rate and the finance ministers do not make a recommendation to either increase the legislated rate or maintain it, the insufficient rates provisions of the *Canada Pension Plan* would apply. The base CPP contribution rate would then be increased in stages and a possible temporary freeze on inflation adjustments to benefits in pay would apply.

For the additional Plan, if a triennial CPP actuarial report projects that the minimum additional contribution rates deviate to a certain extent from their respective legislated additional rates and the finance ministers do not agree on how to address the deviation, then sustainability Regulations in respect of the additional Plan would provide the actions to take: changes to benefits and possibly the additional contributions rates. The proposed sustainability Regulations – the *Additional Canada Pension Plan Sustainability Regulations*, were pre-published in the Canada Gazette, Part I, Volume 152, Issue No. 42, October 20, 2018. The technical aspects of the methodology used to develop the Regulations are described in detail in the *Technical Paper on the Additional Canada Pension Plan Regulations: Actuarial Study No. 20*, published by the Office of the Chief Actuary in November 2018.

A.5   Retirement Pension

A.5.1   Eligibility Requirements

A person aged 60 or over becomes eligible for a base CPP retirement pension, provided contributions have been made during at least one calendar year. Further, an individual must apply for a retirement pension in order to receive it. However, as of 1 January 2020, the requirement to apply is waived for an eligible person if he or she is aged 70 or older and is in receipt of another benefit from the CPP, OAS program, or a provincial plan and/or had an income tax return filed in respect of the year before the year in which the waiver is granted.

Prior to 2012, a work cessation test applied in order for a retirement pension to become payable before age 65. This test required individuals who applied to take their CPP retirement benefit early (i.e. before age 65) to either stop working or materially reduce their earnings both in the month immediately preceding and the month of benefit take-up. The month following the start of pension payment, an individual could return to work and/or earn more without affecting the eligibility for or amount of the benefit. However, no further contributions to the CPP were allowed once benefits started being paid. There was no work cessation test for those aged 65 or older.

Since 1 January 2012, the work cessation test no longer applies, and individuals younger than 65 who choose to work in Canada outside of Québec while receiving a CPP or QPP retirement pension are required, along with their employers, to contribute to the CPP. Working beneficiaries aged 65 or older are given the option of continuing to contribute to the Plan; however, employers of those opting to do so are also required to contribute. The contributions from working beneficiaries are applied only toward providing post-retirement benefits from the base and additional CPP and do not affect eligibility for other CPP benefits. Upon attaining age 70, contributions are no longer permitted under the Plan.

The eligibility requirements for the additional retirement benefit are those of the base CPP. That is, a contributor is deemed to be eligible for the additional CPP retirement benefit if they are eligible for the base CPP retirement benefit.

A.5.2   Amount of Pension

The initial amount of the monthly retirement pension payable to a contributor under the CPP is equal to the sum of his or her retirement benefits payable under the base and additional Plans.

Base CPP

The initial monthly retirement pension payable under the base Plan is based on the contributor's entire history of pensionable earnings during the contributory period. The retirement pension under the base Plan is equal to 25% of the average of the YMPE for the year of retirement and the four previous years, referred to as the Maximum Pensionable Earnings Average (MPEA), adjusted to take into account the contributor's pensionable earnings. For this purpose, the contributor's pensionable earnings for any given month are indexed by the ratio of the MPEA for the year of retirement to the YMPE for the year to which the given month belongs.

Some periods with low pensionable earnings may be excluded from the calculation of benefits by reason of pensions commencing after age 65, disability, child-rearing for a child less than seven years of age, and the general drop-out provision.

The general drop-out provision allows for a number of years with low or zero earnings to be dropped from the calculation of the retirement benefit. For example, for someone who took his/her retirement benefit at age 65 in 2019, the provision allows for 17% of the number of months with the lowest earnings (up to a maximum of about eight years) to be dropped from the calculation of the benefit. The general drop-out percentage was 15% from 1966 to 2011, 16% in 2012 and 2013, and has been 17% since 2014. As a result, the maximum number of years of low or zero earnings that may be dropped from the calculation of the retirement benefit for those contributors who take their benefit at age 65 has increased from about seven to eight years. The actual drop-out percentage that applies is based on the year of benefit take-up. The increase in the general drop-out provision increases the retirement pension, as well as the CPP disability and survivor pensions, since the determination of these benefits depends on the retirement pension.

The maximum retirement benefit payable under the base CPP at age 65 in 2019 is $13,855 per year or $1,154.58 per month.

Additional CPP

The calculation of the additional CPP retirement benefit is based on the first and second additional monthly pensionable earnings. The first additional monthly pensionable earnings are equal to the total of the highest 480 months or the total number of months, if lower, in the first additional contributory period of monthly adjusted pensionable earnings up to the YMPE divided by 480. Similarly, the second additional monthly pensionable earnings are equal to the total of the highest 480 or total number of months, if lower, in the second additional contributory period of monthly adjusted pensionable earnings between the YMPE and the YAMPE divided by 480. These calculations provide for a monthly accrual of 1/480 of the total additional retirement benefit.

The additional monthly retirement benefit is calculated as the sum of 8.33% of the first additional monthly pensionable earnings and 33.33% of the second additional monthly pensionable earnings.

The pensionable earnings used for the calculation of additional retirement benefits are adjusted to the date of retirement in the same way as for the base CPP, that is, indexing by the ratio of the MPEA to the YMPE as described above. Further, to account for the lower first additional contribution rates during the first four years of the phase-in period (from 2019 to 2022), the first additional monthly pensionable earnings are multiplied by 0.15 in 2019, 0.30 in 2020, 0.50 in 2021, and 0.75 in 2022.

Unlike the base CPP, there are no drop-out provisions for the additional Plan. However, there are "drop-in" provisions for the additional CPP to protect the additional benefits from periods of low pensionable earnings resulting from disability or child-rearing for a child less than seven years of age.

Specifically, for individuals who become disabled after 1 January 2019, an imputed income will be assigned to those disability periods of low or zero earnings for the purpose of calculating the additional CPP retirement (and survivor) benefits. The drop-in amount will be equal to 70 per cent of an individual's average earnings in the six years prior to the onset of the disability.

The disability drop-in amount is calculated based on months of earnings after 2018 and prior to the onset of disability. If, however, there are fewer than 72 months (6 years) of such earnings, then the drop-in will be calculated based on the actual number of earnings months after 2018, prior to the onset of disability.

For parents of children under the age of seven on or after 1 January 2019, an imputed income will be assigned to child-rearing periods of low or zero earnings on or after 1 January 2019 for the purpose of calculating additional CPP benefits. The drop-in amount is equal to the parent's average earnings during the five years prior to the birth or adoption of the child if that amount is higher than their actual earnings during the period the child was younger than age seven.

The child-rearing drop-in amount is calculated based on months of earnings after 2018 and prior to birth or adoption of a child. If, however, there are fewer than 60 such months (5 years), then the drop-in is calculated based on the actual number of earnings months, but not lower than 36. If there are less than 36 such months of earnings, the drop-in will be calculated using imputed earnings of 40% of the YMPE for the number of months missing from the minimum of 36.

Additional CPP retirement benefits will initially be low in the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of contributions. Contributions made over time to the additional CPP allow individuals to accrue partial additional benefits. Full additional retirement benefits are accrued after about 40 years of making contributions.

The projected maximum additional retirement benefits are shown in Table 31. An individual, with pensionable earnings at or above the YAMPE, who contributed to the additional Plan for at least 40 years starting in the year 2025 or later, would receive the maximum additional retirement benefit payable of $7,202 per year or $600 per month, in 2019 wage-adjusted dollars[1]. Table 31 accounts for the phase-in period of the additional Plan from 2019 to 2025. The maximum additional CPP retirement benefit represents an increase of 52% over the maximum base CPP retirement pension.

Table 31	Projected Maximum Additional CPP Retirement Benefit		
Pensionable Earnings at or above YMPE before 2024, YAMPE thereafter			
All amounts in 2019 wage-adjusted dollars			
Maximum Basic CPP Retirement Benefit in 2019: $13,855 per year ($1,155 per month)			
Start Retirement Pension at Age 65 on January 1	Number of Years of Contributions to	Additional CPP Retirement Benefit	
Year	Additional CPP [1]	Annual	Monthly
2024	5	$312	$26
2029	10	$1,180	$98
2044	25	$3,881	$323
2065	46 [2]	$7,202	$600

(1)   All years starting from 2019 to year before retirement.
(2)   40 years of contributions at the maximum.

A.5.3   Adjustment for Early or Postponed Retirement Benefit

The CPP retirement pension is subject to an actuarial adjustment that depends on the year and contributor's age at commencement of the pension. As the initial monthly retirement pension is the sum of the retirement benefits under the base and additional Plans, the actuarial adjustment is applied to each component's benefit.

The retirement pension is permanently adjusted downward or upward by a factor for each month between age 65 and the age when the pension commences or, if earlier, age 70. Prior to 2011, the adjustment factor for both pre-65 and post-65 pension take-up was 0.5% per month. Starting in 2011, the adjustment factors were changed. For contributors who take their retirement benefit early (before age 65), the adjustment factor gradually increased to 0.6% per month over the five-year period 2012 to 2016. For those who take their benefit after age 65, the factor gradually increased to 0.7% per month over the three-year period 2011 to 2013. Table 32 shows the legislated pension adjustment factors for the CPP.

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[1] For a given year, the value in 2019 wage-adjusted dollars is equal to the corresponding value in current dollars divided by the cumulative projected increase in nominal wage since 2019.

Table 32	Legislated Pension Adjustment Factors (percentages)	
Effective date	Pre-65 Downward Monthly Adjustment Factor	Post-65 Upward Monthly Adjustment Factor
Pre-2011	0.50	0.50
1 January 2011	0.50	0.57
1 January 2012	0.52	0.64
1 January 2013	0.54	0.70
1 January 2014	0.56	0.70
1 January 2015	0.58	0.70
1 January 2016	0.60	0.70

The downward pension adjustment factor of 0.6% per month, applicable for the year 2016 and thereafter, results in a pension that is reduced by 36% for pension take-up at age 60. The upward factor of 0.7% per month, applicable for 2013 and thereafter, results in a pension increased by 42% for pension take-up at age 70.

In accordance with subsection 115(1.11) of the *Canada Pension Plan*, the Chief Actuary shall calculate the pension adjustment factors and specify them in every third triennial CPP actuarial report prepared, starting with the Actuarial Report on the Canada Pension Plan as at 31 December 2015. The Chief Actuary may also, if deems it necessary, specify the factors in any supplemental CPP actuarial report after 2015.

In accordance with the legislation, the first CPP actuarial report to specify the pension adjustment factors was the 27th CPP Actuarial Report as at 31 December 2015, which was tabled in the House of Commons on 27 September 2016. The methodology used to calculate the factors is described in the study: "Canada Pension Plan Actuarial Adjustment Factors as specified in the 27th Actuarial Report on the Canada Pension as at 31 December 2015 – Actuarial Study No. 18", which was published by the OCA in April 2017.

A.5.4   Working Beneficiaries – Post-Retirement Benefit

Prior to 2012, those who received a CPP retirement pension and then returned to work (i.e. working beneficiaries) did not pay contributions and therefore did not continue to build their CPP pension. Commencing 1 January 2012, individuals under the age of 65 who receive either a CPP or QPP retirement pension and continue to work in Canada outside of Québec are required, along with their employers, to contribute to the Plan. Working beneficiaries aged 65 to 69 are not required to contribute, but are given the option to do so. Employers of those working beneficiaries opting to contribute are also required to contribute.

The contributions paid by working beneficiaries provide for a post-retirement benefit. The total post-retirement benefit is equal to the sum of the benefits earned during retirement under the base and additional Plans.

The post-retirement benefit is earned at a rate of 1/40 of the maximum retirement pension per year of post-retirement contributions and is adjusted for the applicable earnings level and age of the contributor.

For both the base and additional CPP, contributions paid by working beneficiaries toward accruing the post-retirement benefit do not affect eligibility for other CPP benefits, except the post-retirement disability benefit described below. Pensionable earnings and additional pensionable earnings of working beneficiaries do not qualify for credit splitting.

A post-retirement benefit becomes payable the year following the year in which contributions are made, and multiple post-retirement benefits may accumulate over time. The total pension payable resulting from the combination of the retirement pension and post-retirement benefit may be greater than the maximum CPP or QPP pension payable. As for the CPP retirement pension, the post-retirement benefit is payable for a beneficiary's lifetime.

The maximum base CPP post-retirement benefit at age 65 in 2019 for a working beneficiary who started their retirement pension at age 64 is $346.38 per year or $28.86 per month.

The projected maximum additional CPP post-retirement benefit at age 65 in 2026 and thereafter, for a working beneficiary who started their retirement pension at age 64, is $179.90 per year or $15 per month, in 2019 wage-adjusted dollars.

A.6 Disability Pension

A.6.1 Eligibility Requirements

A person is considered disabled if he or she is suffering from a severe and prolonged mental or physical disability. A disability is considered severe if by reason of it the person is regularly incapable of pursuing any substantially gainful occupation; a disability is considered prolonged if it is likely to be long-continuing and of indefinite duration or likely to result in death.

A person who becomes disabled prior to age 65 and is not receiving a CPP retirement pension is eligible for a disability pension provided that contributions have been made, at the time of disablement, for at least four of the previous six calendar years, counting years included wholly or partly in the contributory period. Contributions must be on earnings that are not less than 10% of the YMPE rounded, if necessary, to the next lower multiple of $100. Since 2008, contributors with 25 or more years of contributions to the Plan can meet the eligibility requirement with contributions in three of the last six years.

The eligibility requirements for the additional disability benefit are those of the base CPP. That is, a contributor is deemed to be eligible for the additional CPP disability benefit if they are eligible for the base CPP disability benefit.

A.6.2 Amount of Pension

The initial amount of the monthly disability pension payable is the sum of the disability benefits payable under the base and additional Plans.

The initial base CPP monthly disability benefit is the sum of a flat-rate portion payable ($496.36 per month in 2019) depending only on the year in which the benefit is payable and an earnings-related portion equal to 75% of the base CPP retirement pension that would be payable at the onset of disability if the contributory period ended on that date and no actuarial adjustment applied.

The initial amount of the additional CPP monthly disability benefit is strictly earnings-related and is equal to 75% of the additional retirement pension that would be payable at the onset of disability if the first and second additional contributory periods ended on that date and no actuarial adjustment applied.

The automatic conversion of the CPP disability benefit into a retirement pension at age 65 is determined by base and additional pensionable earnings at the time of disablement, price-indexed to age 65. In other words, the indexing from the time of disablement to age 65, which determines the initial rate of the CPP retirement pension, is in line with increases in prices rather than wages.

The maximum base CPP disability benefit payable in 2019 is $16,347.60 per year or $1,362.30 per month.

Additional CPP disability benefits will initially be low in the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of contributions.

The projected maximum additional CPP disability benefits, in 2019 wage-adjusted dollars, are shown in Table 33. The table accounts for the phase-in period of the additional Plan from 2019 to 2025. The maximum additional disability benefit payable is $5,402 per year or $450 per month, in 2019 wage-adjusted dollars.

Table 33	Projected Maximum Additional CPP Disability Benefit		
Pre-Disability Pensionable Earnings at or above YMPE before 2024, YAMPE thereafter			
All amounts in 2019 wage-adjusted dollars			
As at January 1	Number of Years of Contributions to	Additional CPP Disability Benefit	
Year	Additional CPP [1]	Annual	Monthly
2024	5	$234	$19
2029	10	$885	$74
2044	25	$2,910	$243
2065+	46 [2]	$5,402	$450

(1) All years starting from 2019 to year before disability.
(2) 40 years of contributions at the maximum.

A.6.3 Post-Retirement Disability Benefit (Base CPP only)

Effective 1 January 2019, disability protection is provided for base CPP retirement pension recipients under age 65. Prior to 2019, base CPP retirement beneficiaries who were deemed disabled after the start of the retirement pension could not receive the CPP disability benefit, even if they were still under age 65 and otherwise met eligibility requirements. As of

1 January 2019, a post-retirement disability benefit equal to the flat-rate amount ($496.36 per month in 2019) will be payable under the base CPP to retirement beneficiaries who are deemed disabled while under age 65. Such eligible disabled retirement beneficiaries will receive the post-retirement disability benefit in addition to their retirement pension, and the dependent children of disabled retirees will receive children's benefits.

The post-retirement disability benefit pertains only to the base Plan. There is no additional post-retirement disability benefit payable under the additional Plan.

A.7 Survivor's Pension

A.7.1 Eligibility Requirements

A legal spouse, a separated legal spouse not cohabiting with a common-law partner, or a common-law partner of a deceased contributor, is eligible for a survivor's benefit if the following conditions are met as at the date of the contributor's death:

➢ The deceased contributor must have made contributions during the lesser of ten calendar years, or one-third of the number of years included wholly or partly in his or her contributory period, but not for less than three years.

➢ If the surviving spouse is the separated legal spouse of the deceased contributor, there must be no cohabiting common-law partner of the contributor at the time of death. If the survivor is the common-law partner of the deceased contributor, the couple must have cohabited for not less than one year immediately before the death of the contributor. If the common-law partner is of the same sex as the deceased contributor, the death must have occurred on or after 17 April 1985.

➢ Prior to 2019, the surviving spouse or common-law partner must have had dependent children, been disabled, or been at least 35 years of age. As of 1 January 2019, these conditions no longer apply.

The eligibility requirements for the additional survivor's benefit are those of the base CPP. That is, a legal spouse, a separated legal spouse not cohabiting with a common-law partner, or a common-law partner of a deceased contributor, is eligible for a survivor's additional benefit if he/she is eligible for the base CPP survivor's benefit.

A.7.2   Amount of Pension

The initial amount of the monthly survivor's pension payable under the CPP is equal to the sum of the survivor's benefits payable under the base and additional Plans.

Prior to 2019, survivors who were not disabled and did not have dependent children had their survivor's pension reduced by 10 per cent for each year they were under the age of 45 when their spouse or common-law partner died. This reduction lasted until age 65, when the survivor's pension was then recalculated. This meant that survivors under the age of 35 who were not disabled and did not have dependent children did not receive a survivor's pension until age 65.

As of 1 January 2019, reductions are no longer applied to the survivor's pension for survivors under age 45 who are neither disabled nor have dependent children. A surviving spouse and common-law partner of any CPP contributor who has made sufficient contributions will receive an unreduced survivor's pension.

The amount of the pension changes depends on whether the survivor is younger or older than age 65 as described below. Additional survivor's benefits regardless of age will initially be low in the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of additional contributions previously made by the deceased contributor.

A.7.2.1   New Survivor under Age 65

The initial monthly survivor's pension payable until the surviving spouse or common-law partner attains age 65 is the sum of a base CPP flat-rate benefit and base and additional CPP earnings-related benefits. There is no additional CPP flat-rate benefit.

The base CPP flat-rate survivor's benefit depends only on the year in which the survivor's benefit is payable ($193.66 per month in 2019).

The earnings-related benefits payable under the base and additional CPP depend initially only on the contributor's record of pensionable and additional pensionable earnings, respectively as at the date of death. The initial earnings-related survivor's benefit is equal to 37.5% of either the retirement pension of the deceased contributor if he or she had been receiving a pension, or the retirement pension that would have been payable to the deceased contributor if the contributory and additional contributory periods had ended at the time of death, with no actuarial adjustment in either case.

The maximum base CPP earnings-related survivor's benefit for new survivors under age 65 is $432.97 per month in 2019.

The projected maximum additional CPP survivor's benefits, in 2019 wage-adjusted dollars, are shown in Table 34. The table accounts for the phase-in period of the additional Plan from 2019 to 2025. The maximum additional survivor's benefit payable for survivors younger than age 65 is $2,701 per year or $225 per month, in 2019 wage-adjusted dollars.

Table 34   Projected Maximum Additional CPP Survivor's Benefit, Survivor under Age 65

Prior Earnings of Deceased Contributor at or above YMPE before 2024, YAMPE thereafter
All amounts in 2019 wage-adjusted dollars

As at January 1 Year	Number of Years of Prior Contributions by Deceased Contributor to Additional CPP [1]	Additional CPP Survivor's Benefit	
		Annual	Monthly
2024	5	$117	$10
2029	10	$442	$37
2044	25	$1,455	$121
2065+	46 [2]	$2,701	$225

(1)   All years starting from 2019.
(2)   40 years of contributions at the maximum.

A.7.2.2   Survivor Age 65 or Over

At age 65, or upon becoming widowed at a later age, an eligible surviving spouse or common-law partner is entitled to a monthly survivor's benefit equal to 60% of either the retirement pension of the deceased contributor if he or she had been receiving a pension, or the retirement pension that would have been payable to the deceased contributor if the contributory and additional contributory periods had ended at the time of death, with no actuarial adjustment in either case.

The maximum base CPP earnings-related survivor's benefit for new survivors aged 65 or older is $692.75 per month in 2019.

The projected additional CPP survivor's benefits, in 2019 wage-adjusted dollars, are shown in Table 35. The table accounts for the phase-in period of the additional Plan from 2019 to 2025. The maximum additional survivor's benefit payable for survivors aged 65 or older is $4,321 per year or $360 per month, in 2019 wage-adjusted dollars.

Table 35   Projected Maximum Additional CPP Survivor's Benefit, Survivor Age 65 or Over

Prior Earnings of Deceased Contributor at or above YMPE before 2024, YAMPE thereafter
All amounts in 2019 wage-adjusted dollars

As at January 1 Year	Number of Years of Prior Contributions by Deceased Contributor to Additional CPP [1]	Additional CPP Survivor's Benefit	
		Annual	Monthly
2024	5	$187	$16
2029	10	$708	$59
2044	25	$2,328	$194
2065+	46 [2]	$4,321	$360

(1)   All years starting from 2019.
(2)   40 years of contributions at the maximum.

A.8   Death Benefit (Base CPP only)

A lump sum benefit is payable to the estate of a deceased contributor if the eligibility rules for the survivor's benefit are met. Prior to 2019, the amount of the death benefit was equal to six times the monthly amount of the CPP retirement pension accrued or payable in the year of death,

adjusted to exclude any actuarial adjustments, and subject to a maximum of ten percent of the YMPE for the year of death prior to 1998, and $2,500 thereafter. As of 1 January 2019, the death benefit equals the flat-rate amount of $2,500. The death benefit pertains only to the base CPP.

There is no additional CPP death benefit.

A.9 Child's Benefits (Base CPP only)

Each child under age 18 and each full-time student aged 18 to 25 who is dependent on a contributor eligible for a CPP disability benefit (the disability pension or post-retirement disability benefit) or who was dependent on a deceased contributor who satisfied the requirements for a survivor's pension is entitled to a flat-rate monthly benefit ($250.27 in 2019). Furthermore a child may receive more than one child's benefit simultaneously. The child's benefits pertain only to the base CPP.

There are no additional CPP child's benefits.

A.10 Combined Benefits

The combined benefits rules of the CPP regarding the simultaneous payment of disability and survivor's pensions or retirement and survivor's pensions are complex and involve calculations and comparisons of various amounts.

For combined benefits under the base CPP, if there are two flat-rate components, then the beneficiary receives the larger one. For the earnings-related components, the beneficiary receives the larger one and 60% of the smaller one. As well, the total combined earnings-related component is limited to the maximum retirement pension at age 65 for combined survivor-retirement benefits and to the maximum disability pension for combined survivor-disability benefits. In the case of combined survivor-retirement benefits where the retirement pension is taken early (before age 65), the final retirement amount is actuarially adjusted.

The combined benefits under the additional CPP follow the same rules as for the base CPP, except that there are no flat rate benefits payable, and the limits on the earnings-related amounts do not apply.

A.11 Inflation Adjustments

All monthly CPP benefits are indexed annually in accordance with inflation, as measured by the Pension Index. Benefits are multiplied on 1 January of each calendar year by the ratio of the Pension Index applicable for that calendar year to the Pension Index for the preceding year. As the Pension Index for a year is at least equal to the value of the previous year's Pension Index, benefits are either held constant or increased from one year to the next.

A.12   Credit Splitting

Pensionable and additional pensionable earnings may be split between separated or divorced couples (legal spouses or common-law partners) for each month the couple lived together. Pensionable earnings (of the base CPP) are used to establish eligibility for CPP benefits, and both pensionable and additional pensionable earnings are used to calculate the amounts of benefits.

Contributors may obtain a credit split even if they have remarried. However, pensionable and additional pensionable earnings cannot be split for any year in which the total earnings of the former couple do not exceed twice the YBE. Credit splitting also does not apply for any period of cohabitation during which a former spouse or common-law partner received a CPP retirement pension.

A.13   Pension Sharing

Couples (legal spouses or common-law partners) in an ongoing relationship may voluntarily (at the request of one of them) share their CPP retirement pensions corresponding to the number of years during which they cohabited. This applies provided both spouses have reached the minimum age requirement to receive a retirement pension. Sharing is possible even if only one of the spouses has participated in the Plan. Pension sharing ceases upon separation, divorce, or death.

Appendix B – Data, Assumptions and Methodology

B.1   Introduction

This section describes the data, assumptions and methodology that underlie the financial projections in the Results sections of this report.

Future cash flows for the base and additional Plans are projected over a long period of time, i.e. over more than 75 years, and depend on assumptions such as those regarding fertility, mortality, migration, labour force participation, job creation, unemployment, inflation, employment earnings, and investment returns. These assumptions form the basis for the projections of future income and expenditures of both components of the CPP.

Over the years, the cumulative difference between revenues from contributions and investment income and the expenditures of the base and additional CPP generate the respective accumulated assets. The ratio of the end-of-year assets to the following year's expenditures (the A/E ratio) is then calculated for each component of the Plan.

For the base CPP, the A/E ratio is used to determine the steady-state contribution rate, which is the lowest contribution rate that, in the long term, would generally stabilize the A/E ratio. The steady-state contribution rate is determined in this way before the consideration of any full funding requirement for increased or new benefits. The full funding rate is determined independently of the steady-state rate. It is added to the steady-state rate to produce the minimum contribution rate.

For the additional CPP, the A/E ratio combined with a funding ratio of at least 100% on an open-group basis are used to determine the first and second additional minimum contribution rates before the consideration of any full funding requirement for increased or new benefits. The A/E ratio is also used to determine the permanent increase in the additional minimum contribution rates to fully fund any increased or new benefits. A temporary increase in the additional minimum contribution rates to fully amortize any past costs resulting from increased benefits would be determined separately.

Although the demographic, economic, and investment assumptions have been developed using available information, the resulting estimates should be interpreted with caution. These estimates are not intended to be predictions, but rather projections of the future financial states of the base and additional CPP.

B.2   Data

Table 36 lists the sources of data used for this report categorized by major assumptions. The most recent years of data are also listed.

Table 36   Data Sources

Major Assumptions	Source of Data	Last experience year
Population [1]		
Fertility	Statistics Canada, Institut de la statistique du Québec	2017
Migration	Statistics Canada	2018
Mortality	Statistics Canada Life Tables	2015
Initial population	Statistics Canada	2018
Economic		
CPI	Statistics Canada	2018
Real Wage Increases	Statistics Canada	2018
	Records of Earnings file from Service Canada	2017
Labour Force (participation, employment, and unemployment rates)	Statistics Canada	2018
Total Earnings and Contributory Earnings	Records of Earnings file from Service Canada	2017
Contributions	Service Canada	2017
	Canada Revenue Agency	2017
Benefits	Administration data from Service Canada	2018
Assets and Investment	CPPIB	2018
	Canadian Institute of Actuaries' Report on Canadian Economic Statistics 1924-2017, Final Release May 2018	
Operating Expenses	ESDC and CPPIB	2018

(1)   Population estimates as at July 2018 based on the 2016 census were published by Statistics Canada in January 2019 and were used although this was subsequent to the valuation date.

In addition to the data sources listed above, other data and reference sources were consulted for the development of the assumptions used in this report. These other sources include the Actuarial Valuation Report on the Québec Pension Plan as at 31 December 2015, which was used to set the assumed incidence rates in respect of the new post-retirement disability benefit, and mortality data from the United Kingdom and United States, which were used for comparison purposes.

B.3   Demographic Assumptions

Both the historical and projected populations of Canada less Québec are required for the calculation of future CPP contributions and benefits of the relevant cohorts of contributors and beneficiaries.

The populations of Canada and Québec as at 1 July 2018 are used as a starting point. The populations are then projected by age and sex from one year to the next by adding births and net migrants and subtracting deaths. Applying the fertility, migration, and mortality assumptions to the starting population develops the annual numbers of births, net migrants, and deaths. The relevant population for the CPP, which is the population of Canada less Québec, is obtained by subtracting the projected population of Québec from the projected population of Canada.

The population covered by the CPP pertains to Canada less Québec, but includes all members of the Canadian Forces (CF) and the Royal Canadian Mounted Police (RCMP). The approach used above to determine the CPP population does not make an explicit allowance for the members of

the CF or RCMP residing in Québec or outside Canada. However, provision for this group is made implicitly through the development of the number of people with earnings and the proportion of contributors as described in section B.5 of this Appendix.

B.3.1   Initial Population as at 1 July 2018

The starting point for the demographic projections is based on the most recent Statistics Canada population estimates as at 1 July 2018 for Canada and Québec, by age and sex. The estimates are based on the 2016 Census. The estimates are adjusted by ungrouping ages 100 and older into individual ages using the observed distribution of Old Age Security program beneficiaries by age for ages 100 and older.

B.3.2   Fertility Rates

There are two definitions for the fertility rate: the total fertility rate and the cohort fertility rate. The total fertility rate corresponds to the average number of children born in a given calendar year. Specifically, it is the sum of fertility rates by age group for women aged 15 to 49. In comparison, the cohort fertility rate is the average number of children born to a woman in her lifetime, for women born in a specific year. It gives an idea of trends and variations between different generations over time.

Fertility rates are affected by many factors, including social attitudes, reproductive technologies, and economic conditions. It is assumed for this report that the most recent economic downturn has caused a temporary downward effect on total fertility rates, with couples choosing to postpone having any or more children until economic conditions improve. This effect was taken into consideration along with historical trends in age-specific fertility rates over the last 15 years.

The total fertility rate in Canada has declined significantly since the baby boom period, when the rate peaked at nearly 4.0 per woman in the late 1950s. The baby bust period that followed in the mid-1960s initiated a decline in total fertility rates, resulting in a record low of 1.6 children per woman by the mid-1980s. The total fertility rate rose slightly in the early 1990s, but then generally declined to a level of 1.5 by the late 1990s. Canada is one of many industrialized countries that saw their total fertility rates increase starting in the 2000s. By 2008, the total fertility rate for Canada had reached 1.68. However, in some industrialized countries, including Canada, the total fertility rate has decreased since 2008, which could be attributable to the economic downturn experienced in recent years. In 2017, the total fertility rate for Canada was 1.55.[1]

Similar to Canada, the total fertility rate in Québec fell from a high of 4.0 per woman in the 1950s; however, the Québec rate fell to a greater degree, reaching 1.4 by the mid-1980s. The Québec rate then recovered somewhat in the early 1990s to over 1.6 and subsequently declined to below 1.5 by the late 1990s. There was a significant increase in the Québec rate after the year 2000, with the rate reaching 1.74 by 2008. In 2006, the Québec rate exceeded Canada's level for the

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[1] The fertility rate of 1.55 for Canada and 1.60 for Québec are adjusted values provided by Statistics Canada as part of a special tabulation that accounts for its revised population estimates released in January 2019.

first time since 1958. However, similar to Canada's fertility rate, the fertility rate for Québec has been decreasing in recent years. In 2017, the total fertility rate for Québec was 1.60.

To determine the ultimate total fertility rate for Canada, the historical fertility rate of each age group was studied and projected independently. As a result, it is assumed that the total fertility rate from 2027 onward for Canada will be 1.62 children per woman, which is lower than the ultimate rate of 1.65 assumed for the 27th CPP Actuarial Report. The ultimate rate corresponds to the average experience over the last 15 years, which captures the pre- and post-recession trends.

For Québec, the historical fertility rate and the difference between Canada's and Québec's fertility rates for each age group were analyzed. It is assumed that the difference in the rates will decrease until 2027 and remain stable thereafter. As a result, the total fertility rate from 2027 onward for Québec is assumed to be 1.65 children per woman, which is lower than the assumed ultimate rate of 1.68 in the 27th CPP Actuarial Report.

Although the historical total fertility rates, based on age-group rates, are used to set the assumption for the future, it is nonetheless useful and informative to consider the historical progression of the cohort fertility rates. Over time, the cohort fertility rates will converge to the total fertility rate assumption as shown in Table 37. Historically, the cohort fertility rates in Canada and Québec have steadily declined for the last 50 years. For females born in 1941, who reached the end of their childbearing years (turned age 49) in 1990, the cohort rates were 2.61 and 2.28 for Canada and Québec, respectively. However, for females reaching the end of their childbearing years in 2017 (born in 1968), the Canada and Québec cohort fertility rates were 1.78 and 1.70, respectively.

Table 37	Cohort Fertility Rates by Age and Year of Birth (Canada)							
Year of Birth of Woman [1]	Annual Fertility Rates by Age and Year of Birth (per 1,000 women)							Cohort Fertility Rate per Woman [2]
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
1960	31.3	91.3	117.5	86.1	32.6	6.2	0.4	1.83
1965	26.0	76.8	121.2	84.9	36.4	7.9	0.5	1.77
1970	22.7	76.5	104.7	91.3	48.5	10.6	0.8	1.78
1975	25.6	64.6	97.9	106.1	53.4	11.7	0.9	1.80
1980	20.0	54.2	101.9	107.7	57.0	13.9	1.0	1.78
1985	14.9	52.6	96.3	107.8	64.2	16.2	1.0	1.77
1990	13.9	44.6	87.0	114.1	71.5	16.2	1.0	1.74
1995	12.1	37.0	84.8	120.4	71.5	16.2	1.0	1.71
2000	7.7	32.3	82.5	120.4	71.5	16.2	1.0	1.66
2005	6.2	27.6	82.5	120.4	71.5	16.2	1.0	1.63
2006	5.9	27.6	82.5	120.4	71.5	16.2	1.0	1.63
2007	5.5	27.6	82.5	120.4	71.5	16.2	1.0	1.62
2008	5.2	27.6	82.5	120.4	71.5	16.2	1.0	1.62
2009	4.9	27.6	82.5	120.4	71.5	16.2	1.0	1.62
2010+	4.6	27.6	82.5	120.4	71.5	16.2	1.0	1.62

(1) Ranges for years of birth correspond to the oldest to youngest ages for an age group. For example, in the first row of the table, 1960 is the year of birth for those aged 19, 24, 29, etc., 1961 is the year of birth for those aged 18, 23, 28, etc., and so forth.

(2) Fertility rates below and to the right of the stepwise line are projected.

Table 38 below shows the assumed fertility rate of each age group and the resulting assumed total fertility rate by calendar year.

Table 38	Fertility Rates for Canada							
	Annual Fertility Rates by Age Group (per 1,000 women)							
Year	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total
2019	7.1	35.1	86.1	110.3	59.9	12.6	0.8	1.56
2020	6.8	34.2	85.7	111.6	61.3	13.0	0.9	1.57
2021	6.5	33.2	85.2	112.8	62.8	13.5	0.9	1.57
2022	6.2	32.3	84.8	114.1	64.2	13.9	0.9	1.58
2023	5.9	31.4	84.3	115.4	65.7	14.4	0.9	1.59
2024	5.5	30.4	83.9	116.6	67.1	14.8	0.9	1.60
2025	5.2	29.5	83.4	117.9	68.6	15.3	1.0	1.60
2026	4.9	28.5	83.0	119.2	70.0	15.7	1.0	1.61
2027+	4.6	27.6	82.5	120.4	71.5	16.2	1.0	1.62

Chart 3 shows the historical and projected total and cohort fertility rates for Canada.

Chart 3   Historical and Projected Total and Cohort Fertility Rates for Canada[1]
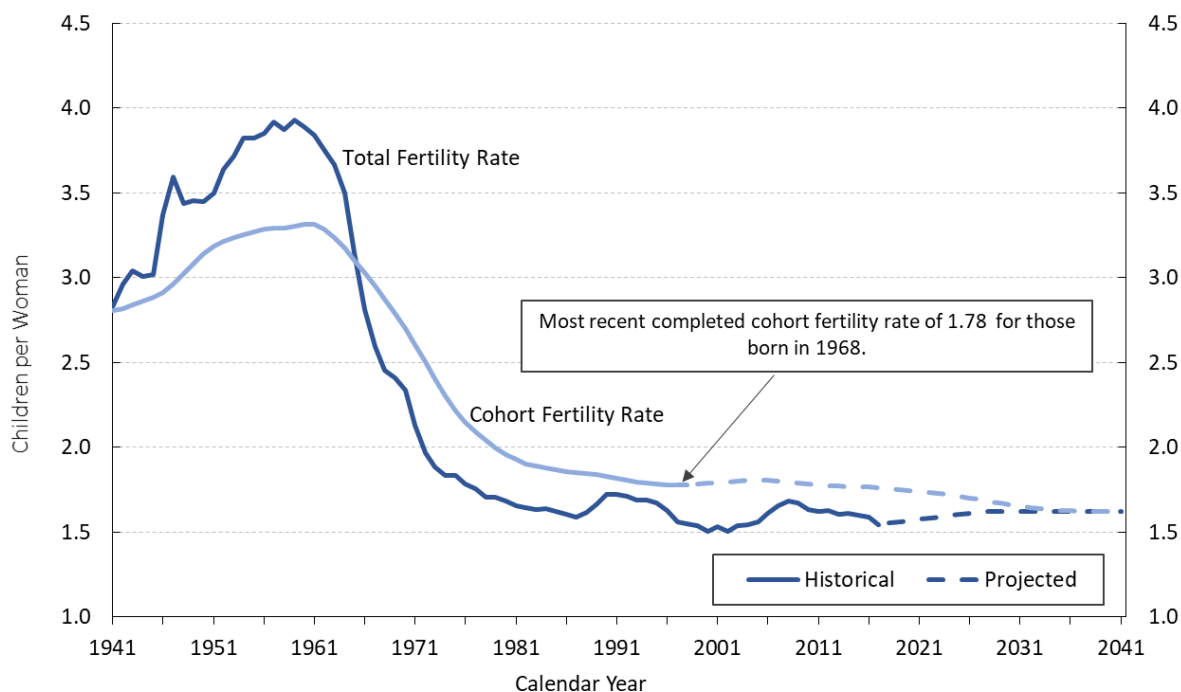
(1)   Cohort fertility rates are based on the age of a woman being 30 in a given calendar year. For instance, the cohort fertility rate for the year 2016 pertains to women born in 1986.

Finally, in accordance with the average experience over the last 10, 20, and 30 years, the assumed ratio of male to female newborns is 1.053, which is essentially the same as for the 27th CPP Actuarial Report.

B.3.3 Mortality

For this report, the mortality rate projections start from the year 2015 mortality rates of Statistics Canada (CLT 2014-2016 Tables). According to Statistics Canada, life expectancies at birth in 2015 without any assumed future improvements in mortality (i.e. reductions in mortality) for males and females in Canada were 79.9 and 84.0 years, respectively, compared to 80.5 and 84.3 years projected under the 27th CPP Actuarial Report. At age 65 in 2015, life expectancies were 19.3 and 22.1 years according to Statistics Canada Tables compared to 19.7 and 22.3 years projected under the 27th CPP Actuarial Report for males and females, respectively.

The average annual mortality improvement rates experienced in Canada over the 15-year period from 2000 to 2015 by age and sex were used as the basis for projecting annual mortality improvement rates from 2016 onward. For ages 65 and over, the annual mortality improvement rates for 2016 to 2017 were projected using the trends derived from the administrative data on Old Age Security (OAS) program beneficiaries, representing 98% of the general population. Improvement rates by age and sex for years 2016 to 2034 (2018 to 2034 for ages 65 and over) were determined by cubical interpolation between:

➢ the improvement rates of year 2015 (2017 for ages 65 and over), and

➢ the ultimate improvement rates described below in respect of the period 2035 and thereafter.

For the year 2035 and thereafter for Canada, the ultimate annual rates of mortality improvement vary by age only and not by sex or calendar year. The ultimate mortality improvement rates are derived using a combination of backward- and forward-looking approaches. The analysis of the Canadian experience over the period from 1925 to 2015, including the recent slowdown trends observed in mortality improvement rates for OAS beneficiaries, was combined with an analysis of the possible drivers of future mortality improvements. Mortality improvement rates for males at most ages are currently higher than those for females but are assumed to decrease to the same level as female rates from 2035 onward. The mortality improvement rates for Québec are assumed to be the same as for Canada from 2018 onward.

The ultimate rate for both sexes for ages 0 to 89 is set at 0.8% per year from 2035 onward for Canada and Québec. For ages above 89, the ultimate improvement rate is set to reduce from 0.5% for the age group 90-94 to 0.2% for those aged 95 and older.

Table 39 shows the initial (2016-2017), intermediate (2018-2034) and ultimate (2035+) assumed annual mortality improvement rates for Canada. The mortality improvement rates shown for 2016-2017 and 2018-2034 represent the average rates over these periods.

Table 39	Annual Mortality Improvement Rates for Canada (percentages)					
	Males			Females		
Age	2016-2017 [1]	2018-2034 [1]	2035+	2016-2017 [1]	2018-2034 [1]	2035+
0	1.1	1.0	0.8	0.7	0.8	0.8
1-14	3.3	2.0	0.8	1.6	1.2	0.8
15-44	1.9	1.3	0.8	1.0	0.9	0.8
45-64	1.9	1.4	0.8	1.4	1.1	0.8
65-74	2.3	1.5	0.8	1.6	1.2	0.8
75-84	2.3	1.5	0.8	1.6	1.2	0.8
85-89	2.1	1.5	0.8	1.8	1.3	0.8
90-94	1.5	1.1	0.5	1.4	1.0	0.5
95+	0.5	0.4	0.2	0.5	0.4	0.2

(1)   The mortality improvement rates shown for 2016-2017 and 2018-2034 represent average rates over these periods.

The resulting projected mortality rates in Table 40 indicate a continuous decrease in mortality rates over the long term. For example, the mortality rate at age 65 for males is expected to decrease from about 10 deaths per thousand people in 2019 to 6 deaths per thousand people by 2075. The gap in mortality rates between males and females at each age is also expected to decrease over the projection period.

Table 40	Mortality Rates for Canada (annual deaths per 1,000 people)						
	Males				Females		
Age	2019	2025	2050	2075	2019	2025	2050	2075
0	4.56	4.28	3.48	2.84	4.13	3.95	3.23	2.64
10	0.08	0.07	0.05	0.04	0.08	0.07	0.06	0.05
20	0.56	0.48	0.37	0.31	0.27	0.26	0.21	0.17
30	0.86	0.80	0.65	0.53	0.41	0.39	0.32	0.26
40	1.18	1.08	0.87	0.71	0.73	0.67	0.54	0.44
50	2.79	2.56	2.06	1.69	1.89	1.78	1.45	1.19
60	6.51	5.77	4.58	3.75	4.28	3.90	3.13	2.56
65	10.34	9.18	7.29	5.96	6.81	6.21	4.98	4.08
70	16.77	14.98	11.92	9.75	11.19	10.30	8.31	6.80
75	27.47	24.54	19.53	15.98	18.78	17.34	14.00	11.45
80	45.68	40.77	32.44	26.54	32.13	29.52	23.78	19.45
85	77.33	69.10	55.02	45.01	56.24	51.15	41.03	33.57
90	134.88	122.24	101.81	87.15	102.53	93.70	78.33	67.05
100	341.45	330.34	305.88	285.33	298.22	287.87	266.29	248.40

Chart 4 and Chart 5 show the historical and projected life expectancies at birth and age 65, respectively since the Plan's inception in 1966, based on each given year's mortality rates (i.e. without future mortality improvements). Table 41 shows the projected Canadian life expectancies at various ages for the specified calendar years, also based on each given year's mortality rates (without future improvements). Table 42 is similar to Table 41, the only difference being that it takes into account the assumed mortality improvements after the specified calendar years (with future improvements).

Given the continuing trend in increased longevity, Table 42 is considered to be more realistic than Table 41, especially for the older ages. At the same time, the extended length of the projection period increases the uncertainty of the results presented in Table 42 for younger ages.

From 2019 to 2075, Canadian life expectancy at age 65 (with assumed future mortality improvements) is projected to grow from 21.4 to 24.7 years for males and from 23.9 to 26.8 years for females, as shown in Table 42. The yearly increase in life expectancies at age 65 in the early years of the projection reflects the significant increase observed over the last decades. Thereafter, there is a projected slowdown in the increase in life expectancies consistent with the lower rate of improvement in mortality assumed for 2035 and thereafter.

Chart 4   Life Expectancies at Birth for Canada, without improvements after the year shown[1]
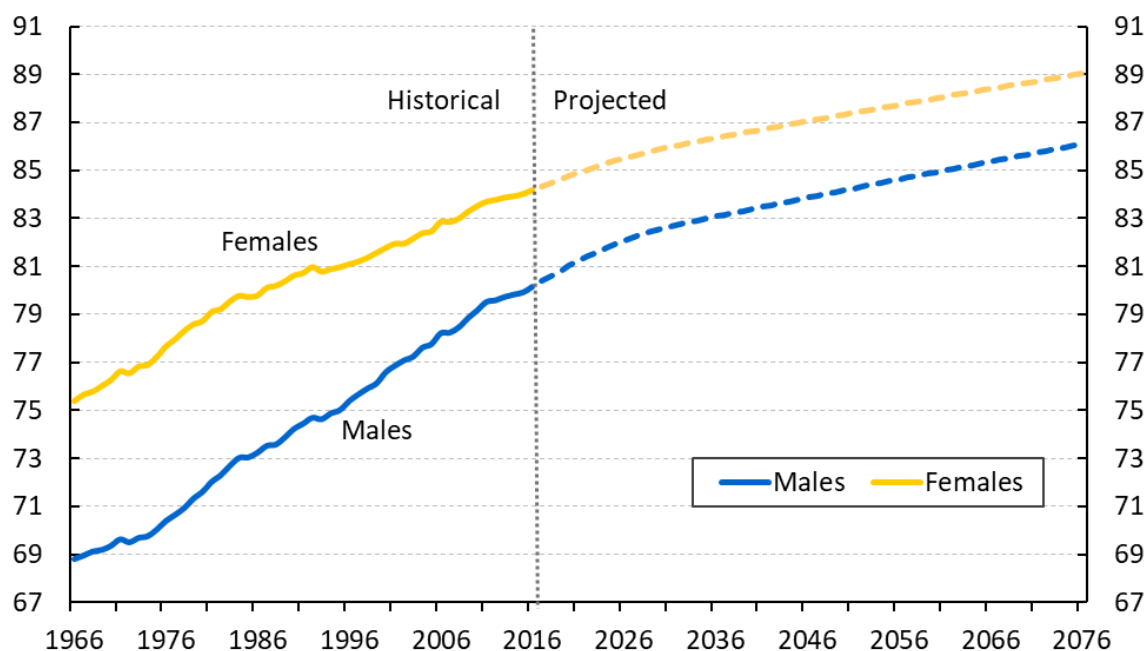
(1)   These are calendar year life expectancies based on the mortality rates of the given attained year.

Chart 5   Life Expectancies at Age 65 for Canada, without improvements after the year shown[1]
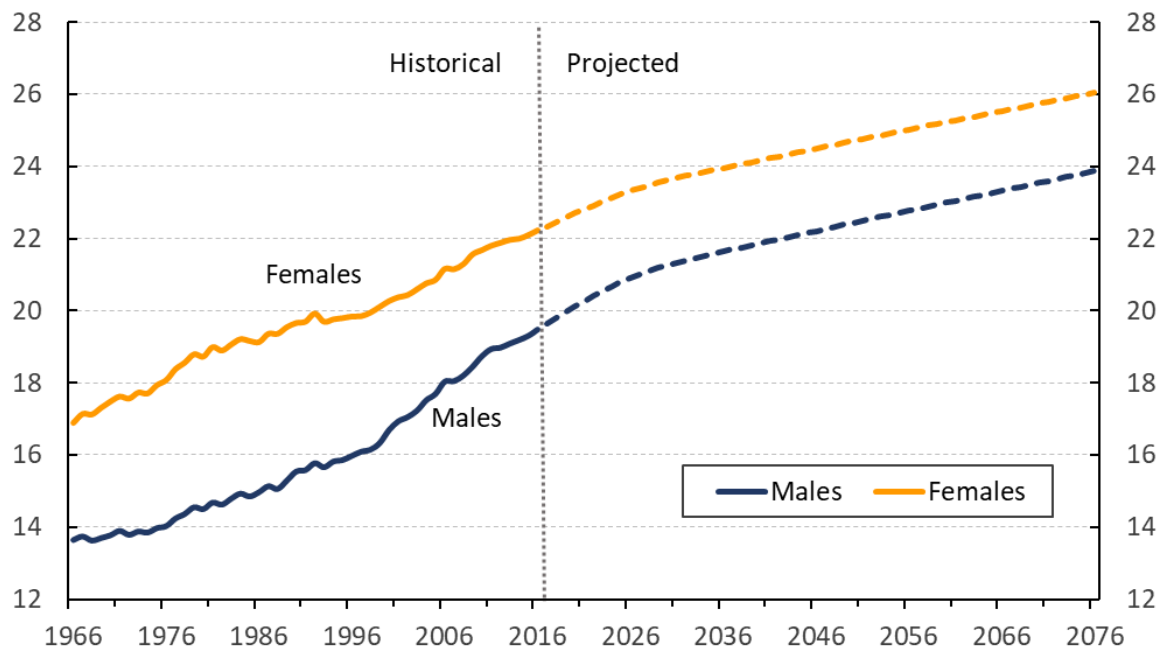
(1)   These are calendar year life expectancies based on the mortality rates of the given attained year.

Table 41   Life Expectancies for Canada, without improvements after the year shown [1]

Age	Males				Females			
	2019	2025	2050	2075	2019	2025	2050	2075
0	80.8	81.9	84.2	86.0	84.6	85.4	87.3	89.0
10	71.3	72.4	74.5	76.3	75.0	75.8	77.7	79.3
20	61.4	62.5	64.6	66.4	65.2	65.9	67.8	69.3
30	51.8	52.9	54.9	56.7	55.4	56.1	57.9	59.5
40	42.3	43.3	45.3	47.0	45.6	46.4	48.1	49.6
50	32.9	33.9	35.8	37.4	36.1	36.8	38.5	40.0
60	24.1	25.0	26.8	28.2	26.9	27.6	29.2	30.6
65	20.0	20.8	22.4	23.8	22.6	23.2	24.7	26.0
70	16.1	16.9	18.3	19.6	18.4	19.0	20.4	21.6
75	12.6	13.2	14.5	15.7	14.6	15.1	16.3	17.4
80	9.4	10.0	11.1	12.0	11.1	11.6	12.6	13.5
85	6.8	7.2	8.0	8.7	8.0	8.4	9.2	9.9
90	4.6	4.9	5.4	5.9	5.5	5.8	6.3	6.8
100	2.2	2.2	2.4	2.5	2.5	2.5	2.7	2.8

(1)   These are calendar year life expectancies based on the mortality rates of the given attained year.

Table 42   Life Expectancies for Canada, with improvements after the year shown [1]

Age	Males				Females			
	2019	2025	2050	2075	2019	2025	2050	2075
0	86.9	87.4	89.1	90.7	89.9	90.3	91.8	93.2
10	76.7	77.1	78.8	80.4	79.8	80.1	81.6	83.0
20	66.1	66.5	68.3	69.9	69.2	69.6	71.1	72.5
30	55.7	56.2	57.9	59.6	58.8	59.2	60.7	62.1
40	45.5	45.9	47.6	49.2	48.4	48.8	50.3	51.8
50	35.4	35.9	37.5	39.1	38.3	38.7	40.2	41.6
60	25.9	26.3	27.9	29.3	28.5	28.9	30.3	31.7
65	21.4	21.8	23.3	24.7	23.9	24.2	25.6	26.8
70	17.2	17.6	19.0	20.2	19.4	19.8	21.0	22.2
75	13.4	13.8	15.0	16.1	15.3	15.7	16.8	17.9
80	10.0	10.4	11.4	12.3	11.6	11.9	12.9	13.8
85	7.1	7.4	8.2	8.9	8.3	8.6	9.4	10.1
90	4.7	5.0	5.5	5.9	5.6	5.9	6.4	6.8
100	2.2	2.2	2.4	2.5	2.5	2.5	2.7	2.8

(1)   These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

B.3.4   Net Migration

The net migration rate refers to the net effect of the number of immigrants less the number of emigrants, plus the number of returning Canadians and the net increase in the number of non-permanent residents.

Immigration and emigration are generally recognized as being volatile parameters of future population growth since they are subject to a variety of demographic, economic, social, and political factors. During the period from 1972 to 2018, annual immigration to Canada varied between 84,000 and 320,000, annual emigration from Canada fluctuated between 40,000 and 97,000, and the annual number of returning Canadians fluctuated between 14,000 and 41,000.

Over the same period, the annual net increase in the number of non-permanent residents fluctuated between -71,000 and 166,000. Since 2014, the federal government has introduced several modifications to the Temporary Foreign Workers Program making it more difficult for employers to hire temporary foreign workers. The federal government also improved its monitoring of the Temporary Foreign Workers Program in 2018. It is expected that these changes will moderate the increase in the number of non-permanent residents.

However, in the most recent years, the largest group of non-permanent residents has been international students, accounting for almost half of non-permanent residents. It is expected that the number of foreign students will stabilize over the next three years. Given the government's policies and the expected stabilization of the number of foreign students, the annual net increase in the number of non-permanent residents is projected to fall gradually to reach zero in 2021 and to remain at that level thereafter.

The actual 2018 net migration rate of 1.11% is assumed to decrease to 0.86% in 2019, 0.73% in 2020, and 0.62% in 2021, and to remain at that level thereafter. The ultimate net migration rate of 0.62% corresponds to the average rate experienced over the ten-year period 2009-2018, excluding the net increase in non-permanent residents during that period. The assumed short-term net migration rate is higher than the ultimate rate of 0.62%, due to starting from a higher rate in 2018, the federal government's short-term targets, and the assumed gradual decrease to zero for the net increase in the number of non-permanent residents from 2019 through 2021. Chart 6 shows the net migration experience since 1972 and the projected rates.

Chart 6   Net Migration Rate (Canada)
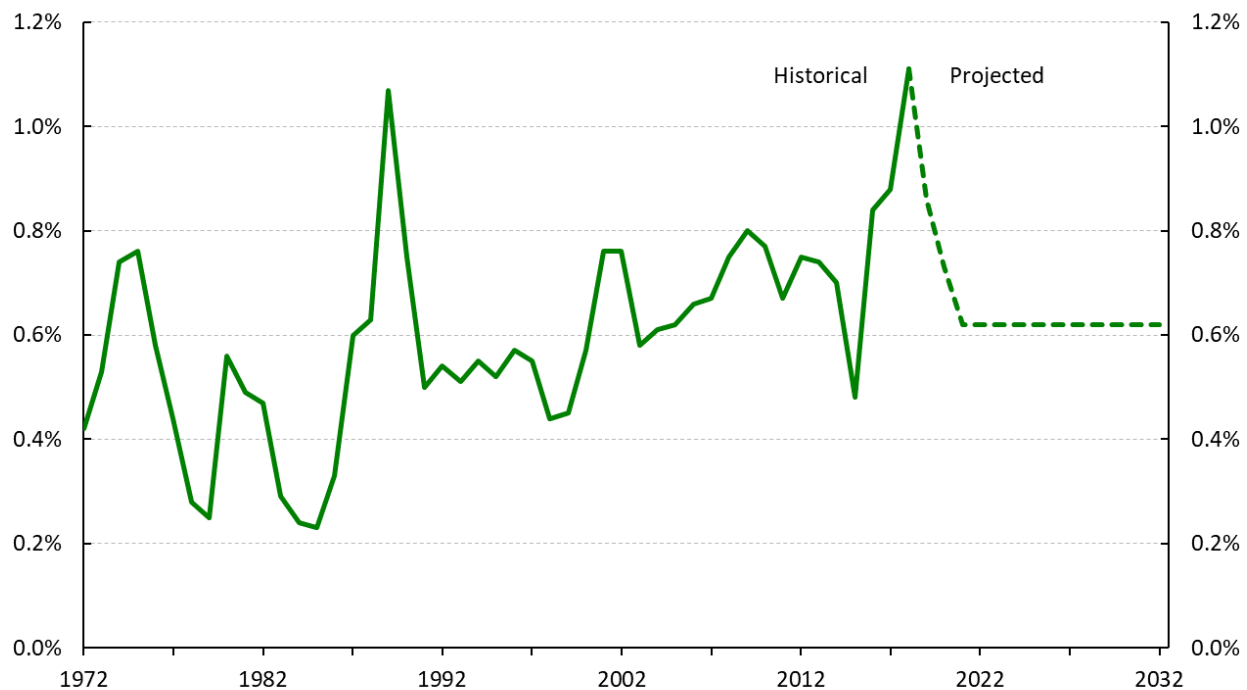
To project Québec's population, the same migration components of immigration, emigration and returning Canadians are considered. An additional component consisting of the net interprovincial emigration for Québec is also included. It is assumed that the 2018 net migration rate of 0.91% for Québec will decrease gradually to reach an ultimate level of 0.43% in 2021, assuming a decline in the net increase of non-permanent residents to zero by that year. The ultimate net migration rate for Québec of 0.43% corresponds to the average experience over the last 10 years, excluding the net increase in non-permanent residents.

For both Canada and Québec, the distributions of immigrants, emigrants, and returning Canadians by age and sex used for the demographic projections were derived from Statistics Canada data averaged over the period 2009 to 2018.

B.3.5   Projected Population and its Characteristics

The historical and projected evolution of the Canada less Québec population age distribution since the inception of the Plan is shown in Chart 7. One can easily observe that the triangular shape of the 1960s has become more rectangular over time. This is projected to continue and indicates an aging population. The effects of the baby boom, baby bust, and echo generations can be seen. The chart also reveals that the number of people aged 85 and over is expected to increase dramatically over the coming decades.

Chart 7   Age Distribution of the Population of Canada less Québec
(thousands)

1966

2018

2025

2050

Baby Boomers
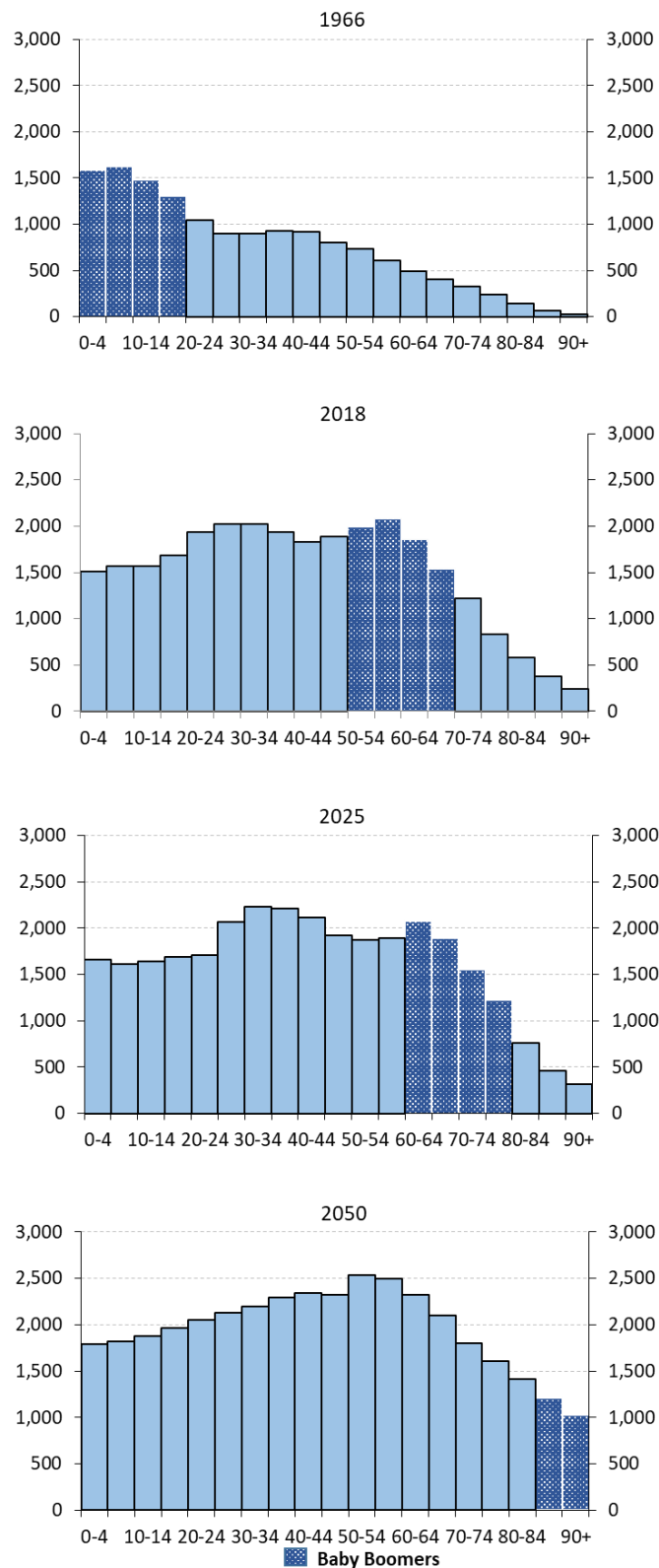
The population of Canada as at 1 July 2018 is 37.1 million, while the population of Canada less Québec is 28.7 million. Table 43 and Table 44 present the projected populations of Canada and Canada less Québec as at 1 July for selected age groups and years, while Chart 8 shows the evolution of the population of Canada less Québec, split by ages groups 0 to 19, 20 to 64, and 65 and above, from 1975 to 2095. Table 45 shows the variations in the relative proportions of various age groups for Canada less Québec throughout the projection period.

The proportion of people aged 65 and over for Canada less Québec is expected to increase significantly from 17.1% of the total population in 2019 to 27.6% by 2095. The number of people aged 65 and older as a proportion of the number of people aged 20 to 64 also increases over the same period, from 28.0% in 2019 to 52.1% by 2095. This proportion affects the ratio of benefits to contributions under the CPP.

Table 43	Population of Canada by Age (thousands)						
Year	0-17	18-69	70+	0-19	20-64	65+	Total
2019	7,235	25,757	4,507	8,115	22,780	6,604	37,499
2020	7,292	25,912	4,694	8,144	22,892	6,862	37,899
2021	7,346	26,028	4,885	8,175	22,961	7,122	38,259
2022	7,405	26,138	5,079	8,226	23,005	7,390	38,621
2023	7,471	26,232	5,283	8,292	23,031	7,663	38,986
2024	7,536	26,315	5,500	8,361	23,054	7,937	39,351
2025	7,594	26,395	5,728	8,437	23,065	8,215	39,717
2030	7,838	26,762	6,901	8,726	23,248	9,528	41,502
2035	8,061	27,063	7,984	8,957	23,828	10,323	43,108
2040	8,212	27,764	8,536	9,157	24,520	10,836	44,512
2045	8,274	28,667	8,828	9,265	25,258	11,245	45,769
2050	8,362	29,517	9,069	9,357	25,864	11,727	46,948
2055	8,544	30,140	9,440	9,534	26,308	12,282	48,124
2060	8,785	30,632	9,946	9,790	26,585	12,988	49,362
2065	9,028	31,020	10,633	10,059	26,954	13,669	50,682
2075	9,418	32,370	11,592	10,513	28,332	14,535	53,381
2085	9,779	34,013	12,223	10,919	29,777	15,320	56,016
2095	10,271	35,591	12,952	11,452	31,036	16,326	58,814

Table 44	Population of Canada less Québec by Age (thousands)						
Year	0-17	18-69	70+	0-19	20-64	65+	Total
2019	5,646	19,995	3,383	6,351	17,707	4,967	29,025
2020	5,688	20,140	3,525	6,368	17,821	5,165	29,354
2021	5,729	20,259	3,670	6,389	17,903	5,365	29,657
2022	5,773	20,372	3,818	6,428	17,965	5,570	29,963
2023	5,826	20,471	3,975	6,479	18,013	5,780	30,272
2024	5,881	20,560	4,142	6,533	18,059	5,991	30,583
2025	5,932	20,646	4,318	6,596	18,092	6,208	30,896
2030	6,168	21,038	5,226	6,860	18,320	7,251	32,432
2035	6,394	21,356	6,092	7,096	18,825	7,921	33,841
2040	6,536	21,986	6,571	7,286	19,428	8,380	35,094
2045	6,589	22,785	6,852	7,382	20,121	8,724	36,227
2050	6,660	23,585	7,058	7,458	20,686	9,158	37,302
2055	6,814	24,172	7,394	7,609	21,099	9,674	38,381
2060	7,035	24,622	7,859	7,839	21,390	10,286	39,516
2065	7,267	25,004	8,445	8,093	21,716	10,907	40,716
2075	7,637	26,192	9,335	8,525	22,937	11,702	43,164
2085	7,961	27,727	9,868	8,892	24,291	12,372	45,555
2095	8,414	29,188	10,495	9,381	25,459	13,257	48,097

Chart 8   Population of Canada less Québec
(millions)
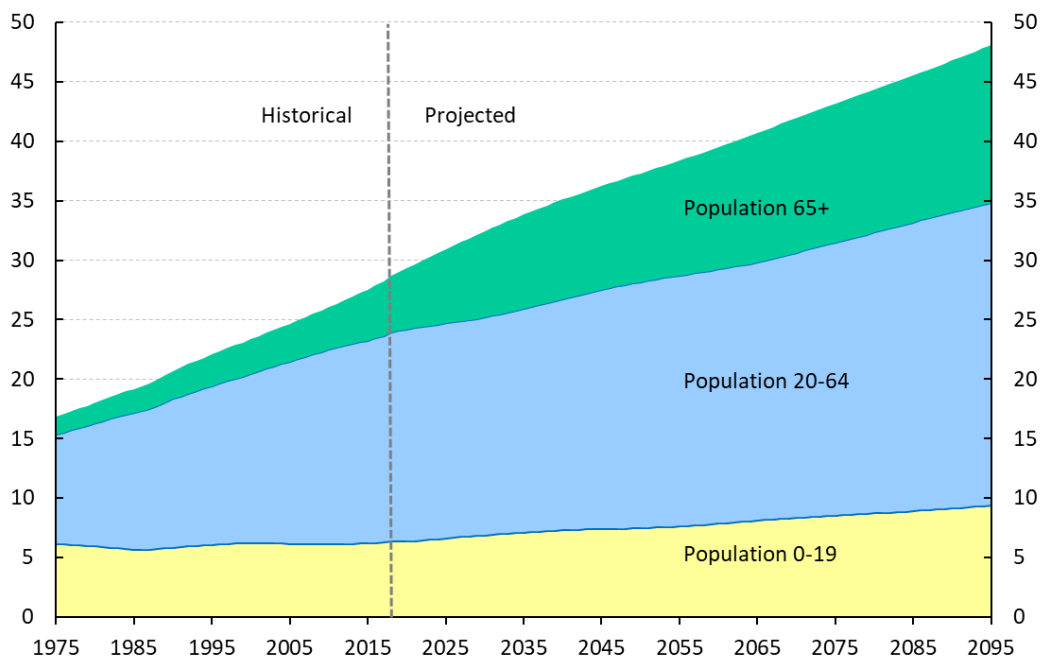
Table 45   Analysis of Population of Canada less Québec by Age

Year	% of Total Population [1]			% of Total Population [1]			Age 65 + as % of Age
	0-17	18-69	70+	0-19	20-64	65+	20-64
2019	19.5	68.9	11.7	21.9	61.0	17.1	28.0
2020	19.4	68.6	12.0	21.7	60.7	17.6	29.0
2021	19.3	68.3	12.4	21.5	60.4	18.1	30.0
2022	19.3	68.0	12.7	21.5	60.0	18.6	31.0
2023	19.2	67.6	13.1	21.4	59.5	19.1	32.1
2024	19.2	67.2	13.5	21.4	59.0	19.6	33.2
2025	19.2	66.8	14.0	21.3	58.6	20.1	34.3
2030	19.0	64.9	16.1	21.2	56.5	22.4	39.6
2035	18.9	63.1	18.0	21.0	55.6	23.4	42.1
2040	18.6	62.7	18.7	20.8	55.4	23.9	43.1
2045	18.2	62.9	18.9	20.4	55.5	24.1	43.4
2050	17.9	63.2	18.9	20.0	55.5	24.5	44.3
2055	17.8	63.0	19.3	19.8	55.0	25.2	45.8
2060	17.8	62.3	19.9	19.8	54.1	26.0	48.1
2065	17.8	61.4	20.7	19.9	53.3	26.8	50.2
2075	17.7	60.7	21.6	19.7	53.1	27.1	51.0
2085	17.5	60.9	21.7	19.5	53.3	27.2	50.9
2095	17.5	60.7	21.8	19.5	52.9	27.6	52.1

(1)   Sum of components may not equal to 100% due to rounding

Table 46 shows the projected components of population growth, which is defined as the projected number of births plus net migrants less the projected number of deaths for Canada less Québec from 2019 to 2095, and Chart 9 presents these figures graphically. For Canada less Québec, the number of births is projected to exceed deaths until 2041. Thereafter, all population growth is expected to come from migration.

Over the period 2019 to 2025, the population of Canada less Québec is projected to grow by about 1.0% per year. The annual growth slows to about 0.7% between the late 2030s and early 2040s and to 0.6% thereafter. The population of Canada less Québec is expected to reach 48.1 million by 2095.

Table 46   Births, Net Migrants, and Deaths for Canada less Québec (thousands)

Year	Population 1st July	Births	Net Migrants	Deaths	Change in Population	Annual Percentage Change		
						20-64	65+	Total
						(%)	(%)	(%)
2019	29,025	303	260	207	356	0.9	3.9	1.2
2020	29,354	312	228	210	329	0.6	4.0	1.1
2021	29,657	317	200	214	303	0.5	3.9	1.0
2022	29,963	322	202	217	306	0.3	3.8	1.0
2023	30,272	326	204	221	309	0.3	3.8	1.0
2024	30,583	330	206	226	311	0.3	3.6	1.0
2025	30,896	334	208	230	312	0.2	3.6	1.0
2030	32,432	340	218	259	300	0.3	2.7	0.9
2035	33,841	336	227	294	269	0.5	1.6	0.8
2040	35,094	336	236	333	239	0.7	0.9	0.7
2045	36,227	344	243	367	220	0.7	0.8	0.6
2050	37,302	355	250	392	213	0.5	1.1	0.6
2055	38,381	369	257	408	219	0.3	1.2	0.6
2060	39,516	382	264	414	233	0.2	1.3	0.6
2065	40,716	390	272	418	244	0.4	1.1	0.6
2075	43,164	402	288	448	242	0.5	0.7	0.6
2085	45,555	426	304	488	241	0.5	0.6	0.5
2095	48,097	451	320	502	269	0.5	0.8	0.6

Chart 9   Projected Components of Population Growth for Canada less Québec (thousands)
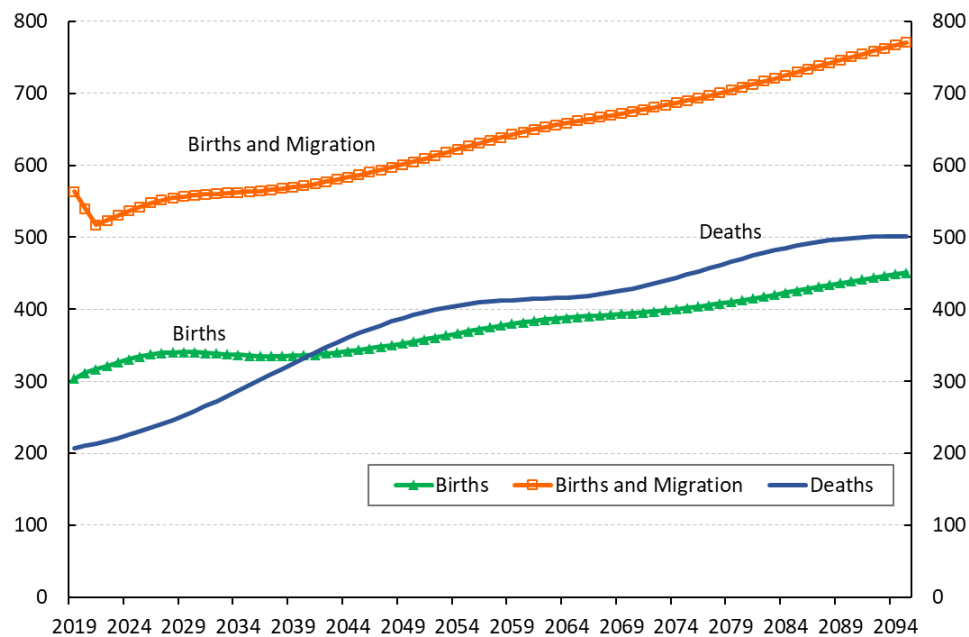
B.4 Economic Assumptions

The list of assumptions required to project the various economic indices, as well as CPP contributions and expenditures is quite extensive. The following sections cover the more important assumptions.

The economic outlook rests on the assumed evolution of the labour market, that is, labour force participation, employment, unemployment, inflation, and the increase in average employment earnings. Rates of return on CPP assets reflect the financial markets and are part of the investment assumptions described in section B.6 of this Appendix. All of these factors must be considered together and form part of an overall economic perspective.

B.4.1 Economic Perspective

The future revenues and expenditures of the CPP depend on many economic factors. It is important to define the individual economic assumptions in the context of a long-term overall economic perspective. For this report, it is assumed that, despite an uncertain economic outlook for major economies, a moderate and sustainable growth in the Canadian economy will persist throughout the projection period.

The actuarial examination of the CPP involves the projection of its revenues and expenditures over a long period of time. Although best judgment is used regarding future economic trends, it is nonetheless difficult to anticipate all economic changes that may occur during the projection period. There will always be some degree of uncertainty. The projected aging of the population combined with the continued retirement of the baby boom generation over the next few decades will certainly create significant social and economic changes. It is possible that the evolution of the working-age population, especially the active population, will be quite different from what has been historically observed and what has been assumed for the purpose of this report.

B.4.2 Labour Market

Chart 10 shows the main components of the labour market that are used to determine the number of earners and contributors by age, sex, and calendar year.

Chart 10   Components of the Labour Market

```
                        ┌──────────────────────┐
                        │   Total Population    │
                        └──────────────────────┘
                                   │
           ┌───────────────────────────────────────────────┐
┌────────────────────────────┐              ┌──────────────────────────┐
│ Population aged 15 and over │              │  Population aged 0 to 14 │
└────────────────────────────┘              └──────────────────────────┘
           │
    ┌──────────────┐
┌──────────────────────┐      ┌──────────────┐
│  Active Population*   │      │   Inactive   │
│   (Labour Force)      │      └──────────────┘
└──────────────────────┘
    │
┌────────────┐
┌────────────┐  ┌────────────┐
│  Employed  │  │ Unemploye  │
└────────────┘  └────────────┘
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*   An active person is one who is in the labour force, meaning that the person is either employed or is looking for employment (unemployed). A person is said to be inactive in all other cases.
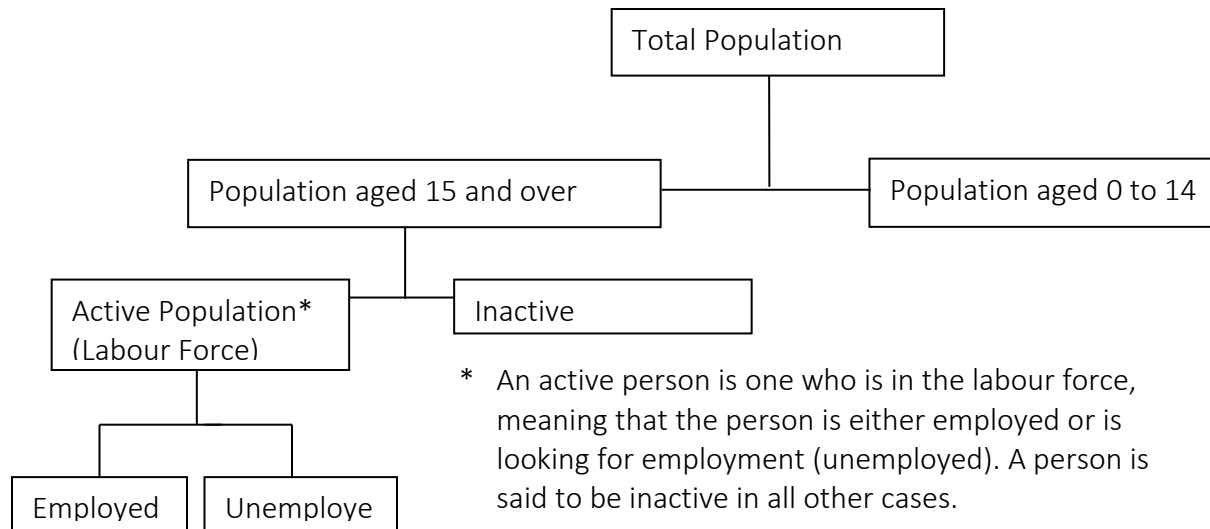
The number of earners is based on the number of employed and is defined as the number of persons who had earnings during a given calendar year. The earners become contributors if they have earnings during the year above the Year's Basic Exemption (YBE) and they are between the ages of 18 and 70.

The proportion of earners and contributors assumptions (described in this section and section B.5.1) rely on the projected active population given in this report. The projected effect of working beneficiaries is reflected in all these assumptions.

B.4.2.1   Active Population (Canada)

The overall labour force participation rates in Canada (the active population expressed as a proportion of the population aged 15 and over) from 1976 to 2018 clearly show a narrowing of the gap between male and female rates. Although the increase in participation rates of females aged 18 to 69 has slowed down since the mid-2000s, the increase was significant over the previous decades. Furthermore, participation rates for those aged 55 and older have increased significantly over the last decade for both men and women.

In 1976, overall male participation (ages 15 and over) was about 78% compared to only 46% for females, which represents a gap of 32%. This gap has narrowed to 8.3% in 2018 (participation rates of 69.6% for males, 61.3% for females). It is assumed that females will continue to narrow the gap in participation rates but at a slower pace, with the gap gradually reducing to about 8.1% by 2035 (67.1% for males vs. 59.0% for females). In addition, over the next two decades, it is assumed that the participation of males and females aged 55 to 69 will continue to increase.

Table 47 to Table 49 provide projections of the active and employed populations and associated participation, employment, and unemployment rates for Canada.

Table 47   Active population (Canada, ages 15 and over) (thousands)

Year	Population [1]			Active Population			Employed		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
2019	15,155	15,568	30,723	10,533	9,505	20,038	9,862	8,994	18,856
2020	15,318	15,736	31,054	10,630	9,575	20,205	9,954	9,059	19,013
2021	15,464	15,890	31,354	10,712	9,635	20,347	10,028	9,113	19,141
2022	15,615	16,048	31,663	10,795	9,696	20,491	10,102	9,167	19,270
2023	15,769	16,211	31,980	10,875	9,757	20,632	10,174	9,222	19,396
2024	15,924	16,373	32,297	10,954	9,818	20,772	10,246	9,276	19,522
2025	16,077	16,534	32,611	11,031	9,877	20,907	10,314	9,328	19,642
2030	16,799	17,298	34,097	11,339	10,215	21,554	10,586	9,632	20,218
2035	17,450	17,994	35,444	11,706	10,615	22,321	10,928	10,009	20,937
2040	18,077	18,664	36,741	12,052	10,919	22,970	11,250	10,296	21,546
2045	18,653	19,287	37,940	12,393	11,221	23,614	11,567	10,582	22,149
2050	19,163	19,831	38,994	12,676	11,478	24,153	11,831	10,825	22,656
2055	19,642	20,323	39,965	12,894	11,686	24,580	12,035	11,021	23,056
2060	20,140	20,821	40,960	13,093	11,883	24,976	12,221	11,206	23,427
2065	20,678	21,358	42,036	13,333	12,113	25,446	12,446	11,423	23,869
2075	21,824	22,540	44,364	14,003	12,702	26,705	13,071	11,978	25,050
2085	22,923	23,706	46,629	14,700	13,320	28,019	13,721	12,561	26,282
2095	24,063	24,876	48,939	15,365	13,909	29,274	14,343	13,117	27,459

(1)   Adjusted to the basis used by Statistics Canada in its Labour Force Survey.

Table 48   Labour Force Participation, Employment and Unemployment (Canada, ages 15 and over) (percentages)

Year	Labour Force Participation Rate			Employment Rate			Unemployment Rate		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
2019	69.5	61.1	65.2	65.1	57.8	61.4	6.4	5.4	5.9
2020	69.4	60.8	65.1	65.0	57.6	61.2	6.4	5.4	5.9
2021	69.3	60.6	64.9	64.8	57.4	61.0	6.4	5.4	5.9
2022	69.1	60.4	64.7	64.7	57.1	60.9	6.4	5.5	6.0
2023	69.0	60.2	64.5	64.5	56.9	60.7	6.4	5.5	6.0
2024	68.8	60.0	64.3	64.3	56.7	60.4	6.5	5.5	6.0
2025	68.6	59.7	64.1	64.2	56.4	60.2	6.5	5.6	6.1
2030	67.5	59.1	63.2	63.0	55.7	59.3	6.6	5.7	6.2
2035	67.1	59.0	63.0	62.6	55.6	59.1	6.6	5.7	6.2
2040	66.7	58.5	62.5	62.2	55.2	58.6	6.7	5.7	6.2
2045	66.4	58.2	62.2	62.0	54.9	58.4	6.7	5.7	6.2
2050	66.1	57.9	61.9	61.7	54.6	58.1	6.7	5.7	6.2
2055	65.6	57.5	61.5	61.3	54.2	57.7	6.7	5.7	6.2
2060	65.0	57.1	61.0	60.7	53.8	57.2	6.7	5.7	6.2
2065	64.5	56.7	60.5	60.2	53.5	56.8	6.7	5.7	6.2
2075	64.2	56.4	60.2	59.9	53.1	56.5	6.7	5.7	6.2
2085	64.1	56.2	60.1	59.9	53.0	56.4	6.7	5.7	6.2
2095	63.9	55.9	59.8	59.6	52.7	56.1	6.7	5.7	6.2

Table 49   Labour Force Participation Rates (Canada) (percentages)

Age Group	Males				Females			
	2019	2025	2035	2050	2019	2025	2035	2050
15-19	48.8	50.0	52.0	52.0	50.9	52.0	54.0	54.0
20-24	76.1	79.0	80.0	80.0	74.2	76.0	78.0	78.0
25-29	89.3	91.0	92.0	92.0	83.7	84.0	87.0	87.0
30-34	92.4	93.0	94.0	94.0	81.7	83.0	85.0	85.0
35-39	92.7	94.0	94.0	94.0	82.6	84.0	86.0	86.0
40-44	92.9	93.0	94.0	94.0	84.8	86.0	87.0	87.0
45-49	90.9	93.0	93.0	93.0	85.1	86.0	87.0	87.0
50-54	88.2	90.0	91.0	91.0	82.4	83.0	85.0	85.0
55-59	80.0	82.0	84.0	84.0	71.7	73.0	76.0	76.0
60-64	62.5	63.0	65.0	65.0	50.9	52.0	54.0	54.0
65-69	31.9	34.0	35.0	35.0	21.8	22.0	24.0	24.0
70 and Over	11.2	12.0	13.0	13.0	5.5	6.0	6.5	6.5
55-69	60.4	59.6	61.8	62.9	50.1	48.7	51.8	52.4
55 and Over	43.0	40.3	37.0	38.7	32.7	30.1	27.8	28.6
18-69	79.8	81.0	82.8	82.0	72.1	72.7	75.6	74.9
15 and Over	69.5	68.6	67.1	66.1	61.1	59.7	59.0	57.9

Given that participation rates start to decline mostly after age 50, the aging of the population will exert downward pressure on the overall labour force participation rate in Canada. If current participation rates by age and sex were to apply throughout the projection period, the effect of population aging alone would cause the overall participation rate from Table 48 to fall from 65.2% in 2019 to 59.3% in 2050, instead of 61.9% as projected under the best-estimate assumptions. However, it is expected that a number of factors will contribute toward partially offsetting the decline that results from population aging.

The main assumption underlying the future overall participation rate is a significant increase in participation rates for age groups 55 and over as a result of an expected continued trend toward longer working lives. The participation rates for those aged 55 to 59 are assumed to increase from 80.0% to 84.0% for males and from 71.7% to 76.0% for females over the period 2018 to 2050. Over the same period, the participation rates for those aged 60 to 64 are assumed to increase from 62.5% to 65.0% and from 50.9% to 54.0% for males and females, respectively, and the participation rates for those aged 65 to 69 are assumed to increase from 31.9% to 35.0% and from 21.8% to 24.0% for males and females, respectively.

Chart 11 shows the historical and projected participation rates for the three age groups 55 to 59, 60 to 64, and 65 to 69. Government policies aimed at increasing participation rates of older workers, the removal of the work cessation test to receive the CPP retirement pension prior to age 65, the increase in life expectancy, and possible insufficient retirement savings are assumed to encourage older workers to delay their retirement and exit the labour force at a later age.

Chart 11   Labour Force Participation Rates (Canada)
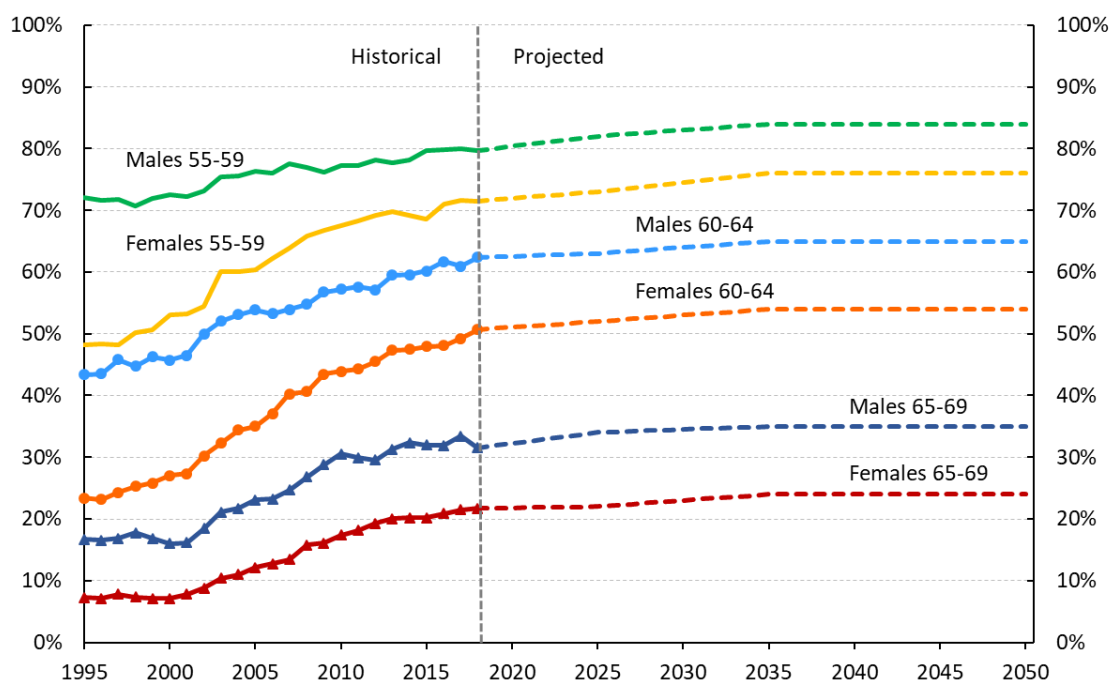
However, despite the assumed future increase in participation rates of older workers and a reliance on skilled immigrant workers, it is still expected that there will be moderate labour shortages in the future as the working-age population expands at a slower pace and as baby boomers continue to retire and exit the labour force. The participation rates for all age groups are expected to increase due to the attractive employment opportunities resulting from labour shortages.

It is also expected that future participation rates will increase with the aging of current young cohorts that have a stronger labour force attachment compared to previous cohorts. The stronger labour force attachment of later cohorts is attributable to different reasons, including higher attained education. The aging of more educated workers with higher labour force attachment, and the exit from the workforce of less educated older workers is expected to create upward pressure on participation rates. Over the shorter term, the participation rates of younger age groups are assumed to gradually increase to their pre-recession levels. Finally, although historical increases in participation rates for women are not expected to continue in the future, their participation rates are expected to increase faster than the participation rates for men.

Based on the foregoing, the participation rates of both men and women are expected to increase over the projection period from their 2018 levels for all age groups, especially for those aged 55 and over. Nonetheless, these increases in participation rates are not sufficient to offset the decrease in the overall participation rate (ages 15 and over) due to the demographic shift.

For the purpose of projecting the participation rates, the projection period has been divided into three periods: 2019 to 2025, 2025 to 2035, and from 2035 onward. From 2019 to 2025, and from 2025 to 2035, the projected participation rates are based on the expected impact of the abovementioned factors through time for each age group and sex. From 2035 onward, the participation rates are held constant. This long-term assumption combined with a slow growth in the working-age population, results in a low rate of growth of approximately 0.5% for the Canadian active population (that is, the labour force) after 2035.

B.4.2.2 Employment (Canada)

In Canada, the annual job creation rate (i.e. the change in the number of persons employed) has been on average about 1.6% since 1976. However, this rate has varied over the years. It is assumed that the job creation rate will be 1.1% in 2019 corresponding to the unemployment rate of 5.9%, based on the most recent experience and various economic forecasts. It is further assumed that over the short term, the job creation rate will be slightly lower than the labour force growth rate, so that the unemployment rate slowly increases from its 2019 level of 5.9% to 6.2% by 2030.

Over the long term, the job creation rate is assumed to be the same as the labour force growth of 0.5%. This results in the projected unemployment rate of 6.2%, which is in line with various economic forecasts and reflects moderate economic growth.

The assumed ultimate unemployment rate of 6.2% is the same as for the 27th CPP Actuarial Report but is assumed to be reached by year 2030 instead of 2025.

Table 50 shows the projected number of employed persons, aged 18 to 69, in Canada.

Table 50	Employment of Population (Canada, ages 18 to 69)					
	Population		Employed		Employment Rate	
Year	Males	Females	Males	Females	Males	Females
	(thousands)		(thousands)		(%)	
2019	12,911	12,846	9,440	8,648	73.1	67.3
2020	12,987	12,925	9,521	8,709	73.3	67.4
2021	13,042	12,985	9,585	8,756	73.5	67.4
2022	13,095	13,043	9,645	8,801	73.7	67.5
2023	13,140	13,092	9,700	8,844	73.8	67.6
2024	13,180	13,135	9,753	8,886	74.0	67.6
2025	13,218	13,177	9,802	8,924	74.2	67.7
2030	13,392	13,370	9,987	9,179	74.6	68.6
2035	13,537	13,526	10,243	9,506	75.7	70.3
2040	13,890	13,874	10,519	9,761	75.7	70.4
2045	14,349	14,318	10,814	10,026	75.4	70.0
2050	14,780	14,737	11,067	10,260	74.9	69.6
2055	15,087	15,054	11,249	10,445	74.6	69.4
2060	15,315	15,317	11,397	10,612	74.4	69.3
2065	15,482	15,538	11,571	10,802	74.7	69.5
2075	16,150	16,220	12,122	11,310	75.1	69.7
2085	16,988	17,025	12,730	11,860	74.9	69.7
2095	17,776	17,815	13,298	12,381	74.8	69.5

B.4.2.3   Labour Market (Canada less Québec)

Given that the CPP covers contributors in all provinces except Québec, labour market assumptions were developed for Québec, and the results for Canada less Québec were derived. Table 51 and Table 52 show the projected active population, number of employed, and labour force participation rates for Canada less Québec.

Table 51	Active Population (Canada less Québec, ages 15 and over) (thousands)								
	Population [1]			Active Population			Employed		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2019	11,653	12,012	23,664	8,148	7,356	15,504	7,628	6,951	14,580
2020	11,788	12,153	23,941	8,234	7,423	15,657	7,712	7,016	14,729
2021	11,910	12,285	24,195	8,310	7,482	15,792	7,782	7,071	14,854
2022	12,036	12,419	24,455	8,385	7,543	15,928	7,852	7,126	14,979
2023	12,164	12,557	24,721	8,459	7,602	16,061	7,920	7,181	15,101
2024	12,293	12,693	24,986	8,531	7,661	16,192	7,987	7,235	15,222
2025	12,419	12,829	25,248	8,601	7,718	16,318	8,051	7,287	15,338
2030	13,023	13,474	26,497	8,879	8,030	16,909	8,305	7,574	15,879
2035	13,583	14,079	27,662	9,198	8,390	17,587	8,603	7,913	16,516
2040	14,136	14,675	28,810	9,507	8,665	18,172	8,891	8,173	17,065
2045	14,655	15,240	29,895	9,821	8,944	18,765	9,183	8,438	17,621
2050	15,124	15,744	30,869	10,087	9,186	19,273	9,432	8,666	18,098
2055	15,563	16,204	31,767	10,294	9,383	19,677	9,625	8,852	18,477
2060	16,012	16,661	32,674	10,479	9,565	20,044	9,798	9,023	18,821
2065	16,493	17,148	33,641	10,693	9,770	20,464	9,999	9,216	19,215
2075	17,524	18,214	35,738	11,293	10,308	21,602	10,559	9,723	20,282
2085	18,521	19,277	37,798	11,938	10,886	22,823	11,161	10,268	21,429
2095	19,546	20,340	39,886	12,548	11,430	23,978	11,731	10,781	22,513

(1)   Adjusted to the basis used by Statistics Canada in its Labour Force Survey.

Table 52	Labour Force Participation Rates (Canada less Québec) (percentages)							
	Males				Females			
Age Group	2019	2025	2035	2050	2019	2025	2035	2050
15-19	48.0	49.1	51.4	51.5	49.2	51.1	53.4	53.5
20-24	75.4	78.2	79.1	79.2	73.3	75.0	77.1	77.2
25-29	88.8	90.7	91.7	91.7	82.7	83.2	87.0	87.0
30-34	92.7	93.0	94.0	94.0	80.7	82.2	84.5	84.5
35-39	93.0	94.0	94.0	94.0	81.7	83.2	85.5	85.5
40-44	92.7	92.7	94.0	94.0	83.3	84.9	86.2	86.2
45-49	91.0	93.3	93.0	93.0	84.3	85.1	86.2	86.3
50-54	88.3	90.0	91.0	91.0	81.5	82.2	84.5	84.5
55-59	79.7	82.0	84.3	84.3	71.9	73.3	77.2	77.0
60-64	63.4	63.9	65.9	65.8	53.0	54.1	56.1	56.0
65-69	33.8	36.2	36.7	36.7	23.4	23.6	25.9	25.8
70 and Over	11.9	12.7	13.6	13.6	6.1	6.7	7.0	6.9
55-69	61.3	60.8	62.6	63.8	51.5	50.3	53.4	54.1
55 and Over	43.9	41.5	38.0	39.8	34.0	31.6	29.2	29.9
18-69	80.0	81.3	83.1	82.2	71.9	72.6	75.7	75.0
15 and Over	69.9	69.3	67.7	66.7	61.2	60.2	59.6	58.3

B.4.2.4   Number of Earners (Canada less Québec)

The number of earners for any given year, namely anyone who had employment earnings during the year, is always more than the employed population and sometimes even close to the labour force because it includes all individuals who had earnings at any time during the year, whereas the employed population only indicates the average number of employed in any given year.

The projected number of earners is obtained by a regression based on a highly correlated historical relationship between the number of employed persons and the number of earners over the period 1976 to 2016. Table 53 shows the projected average number of employed persons and the projected number and proportion of earners (relative to the population) aged 18 to 69, for Canada less Québec. The projected number and proportion of earners shown in Table 53 pertain to all earners, including those who are CPP retirement beneficiaries. The effect of CPP retirement beneficiaries with earnings, that is, working beneficiaries, is discussed more in detail in section B.7.6 of this Appendix.

Table 53	Employment of Population (Canada less Québec, ages 18 to 69)							
	Population		Employed		Earners		Proportion of Earners (earners as % of population)	
Year	Males	Females	Males	Females	Males	Females	Males	Females
	(thousands)		(thousands)		(thousands)		(%)	
2019	9,995	10,001	7,296	6,678	8,166	7,563	81.7	75.6
2020	10,066	10,074	7,372	6,739	8,264	7,641	82.1	75.8
2021	10,122	10,136	7,434	6,789	8,346	7,707	82.5	76.0
2022	10,177	10,196	7,494	6,836	8,426	7,771	82.8	76.2
2023	10,224	10,247	7,549	6,881	8,487	7,822	83.0	76.3
2024	10,267	10,293	7,602	6,925	8,544	7,872	83.2	76.5
2025	10,308	10,338	7,651	6,966	8,597	7,918	83.4	76.6
2030	10,493	10,545	7,836	7,216	8,792	8,195	83.8	77.7
2035	10,645	10,711	8,062	7,513	9,026	8,519	84.8	79.5
2040	10,961	11,025	8,310	7,744	9,298	8,776	84.8	79.6
2045	11,368	11,418	8,580	7,988	9,616	9,063	84.6	79.4
2050	11,774	11,811	8,819	8,208	9,898	9,321	84.1	78.9
2055	12,063	12,110	8,993	8,384	10,104	9,525	83.8	78.7
2060	12,272	12,351	9,132	8,538	10,262	9,701	83.6	78.5
2065	12,439	12,565	9,288	8,708	10,425	9,887	83.8	78.7
2075	13,022	13,169	9,779	9,171	10,966	10,406	84.2	79.0
2085	13,800	13,926	10,343	9,685	11,602	10,992	84.1	78.9
2095	14,528	14,660	10,867	10,168	12,189	11,540	83.9	78.7

B.4.3   Annual Increase in Prices (Inflation Rate)

The increase in prices (inflation rate) assumption is needed to determine the Pension Index for any given calendar year. It is also used in the determination of the annual nominal increase in average employment earnings, the YMPE, YAMPE, and the nominal rates of return on investments.

Price increases, as measured by changes in the CPI, tend to fluctuate from year to year. Over the last 50 years, the trend was generally upward through the early 1980s and then downward until the introduction of the inflation-control targets in the early 1990s, at which point inflation began to stabilize. The average annual increases in the CPI over the 50, 20 and 10-year periods ending in 2018 were 3.7%, 1.9% and 1.6%, respectively.

In 2016, the Bank of Canada and the Government renewed their commitment to keep the inflation rate within a control range of 1% to 3%, with a target of 2%, until the end of 2021. The Senior Deputy Governor of the Bank of Canada indicated in November 2018 that the Bank was undergoing an extensive review of its monetary policy framework. A number of variants to replace the inflation target are being explored. The Bank is also looking at a possible dual mandate of targeting inflation as well as GDP growth or employment[1]. Nevertheless, given the success of the 2% inflation target, it is considered very likely that the Bank will renew its inflation target commitment or at least that it will constitute an important part of its future mandate.

In Canada, inflation was 2.3% in 2018. Price increase forecasts from various economists indicate an average increase in prices of 2.0% for the period 2019 to 2040. To reflect these forecasts and the expectation that the Bank of Canada will renew its inflation target, the price increase assumption is set at 2.0% for the year 2019 and thereafter. The assumption of 2.0% is equal to the assumption for the 27th CPP Actuarial Report.

B.4.4   Real Wage Increases

The real wage increase can be measured using the difference between the increase in the nominal average wage and the CPI. In this case, the nominal average wage is defined as the ratio of the total nominal earnings to total civilian employment in the Canadian economy as a whole.

The real wage increase is related to the growth in total labour productivity as follows:

Real Wage Increase =   Growth in Labour Productivity +
Growth in Compensation Ratio +
Growth in Earnings Ratio +
Growth in Average Hours Worked +
Growth in Price Differential.

Historically, the nominal average wage increase has been similar to the nominal average annual employment earnings ("AAE") increase, and therefore it is assumed that they can be used interchangeably.

The assumed increase in AAE is used to project the total employment earnings of CPP contributors, while the assumed increase in Average Weekly Earnings (AWE) is used to project the increase in the YMPE from one year to the next. The difference between real increases in the AWE and the AAE (net of inflation) has been relatively small over the period from 1966 to 2017,

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[1] Bank of Canada, Toward 2021: Reviewing the Monetary Policy Framework, November 20, 2018.
https://www.bankofcanada.ca/2018/11/choosing-best-monetary-policy-framework-canada/

that is, a difference of approximately 0.01% per year. For several years in the 1980s and the 1990s, this difference was more pronounced; however, the real increases in AAE and AWE have shown a tendency to converge toward each other over time. Taking these factors into consideration, the real increases in AWE and AAE are assumed to be the same for the year 2018 and thereafter.

In addition to the factors included in the equation above, labour demand has a significant impact on real wage increases. Real wages are subject to downward pressure as the demand for workers decreases. On the other hand, one could expect upward pressure on wages if the size of the labour force fails to keep pace with a growing economy.

Labour productivity in the above equation is defined as the ratio of the real Gross Domestic Product (GDP) to total hours worked in the Canadian economy. The average annual growth in labour productivity was 1.59% for the 55-year period ending in 2017, 1.18% for the 25-year period and 0.83% for the 15-year period ending in 2017. Long-term productivity is expected to increase as a result of labour shortages and the federal government's policies aimed at enhancing productivity growth. At the same time, increasing labour force participation rates of older workers and a reliance on immigration for future labour force growth are expected to moderate the labour shortage and its impact on productivity. Labour productivity growth of 1.10% is assumed for the long term.

The compensation ratio is the ratio of the total compensation received by workers to the nominal GDP. Changes in the compensation ratio reflect the extent to which changes in productivity are shared between labour and capital. The compensation ratio has decreased on average by 0.11% per year for the 55-year period ending in 2017 with a more significant decrease between 1992 and 2005 (an average decrease of 0.7% per year). Over the last 25 and 15 years periods ending in 2017 the compensation ratio has decreased on average by 0.28% and 0.06% respectively. It is assumed that there will be no change in the compensation ratio over the long term.

The earnings ratio is the ratio of total workers' earnings to total compensation. The total workers' earnings is defined as the sum of total wages, salary disbursements, and total self-employment earnings. Changes in the earnings ratio reflect changes in the compensation structure offered to employees. The historical decline in the earnings ratio of 0.20% per year from 1962 to 2017 has been primarily due to the faster growth in supplementary labour income, such as employer contributions to pension plans, health benefit plans, the CPP, and the Employment Insurance program, compared to earnings. Given that a significant portion of the historical decrease in the earnings ratio can be explained by the increase in CPP contributions resulting from the increase in the contribution rate from 3.6% in 1986 to 9.9% in 2003, the earnings ratio is not expected to decline as fast as it has in the past. However, the increase in CPP contributions resulting from the new additional Plan as of 2019 is expected to reduce the earnings ratio. As well, as a result of the aging of the population, it is expected that the cost of pension plans and health programs will continue to increase in the future and exert downward pressure on the earnings ratio. Based on the foregoing, it is assumed that the long-term earnings ratio will decline by 0.05% per year.

The average hours worked is defined as the ratio of total hours worked to total employment in the Canadian economy. The average annual growth rate for average hours worked was -0.34% over the 55-year period ending in 2017. There was a significant decrease in the average hours worked between 1965 and 1983, with an average annual decrease over that period of 0.7% per year. Despite short-term fluctuations, the average hours worked stabilized after 1983, with an average decrease of 0.1% per year between 1984 and 2017. In the future, the assumed steady increases in productivity and the higher participation rates of older workers, who generally work fewer hours, could continue to apply negative pressure on the average hours worked. It is assumed that in the long term, the average hours worked will decline by 0.05% per year.

Finally, the price differential or "labour's terms of trade" is the ratio of the GDP deflator (defined as the ratio of nominal to real GDP) to the CPI. Including this ratio is necessary because labour productivity is expressed in real terms by using real GDP, while current dollar earnings are converted to real earnings using the CPI. The average annual growth in the price differential was 0.09% between 1962 and 2017. However, during this period, the price differential experienced significant fluctuations. It increased at an average rate of 1.2% per year between 1962 and 1976 and decreased at an average rate of 0.6% per year between 1977 and 2002. In more recent years, the decline has reversed, such that between 2002 and 2017 the price differential increased by 0.27% per year. This recent trend is partially due to Canada's improving international terms of trade. However, it is not clear for how long such growth could be sustained. It is assumed that the long-term price differential will remain stable in the long term.

The result of the foregoing discussion is that the assumed real wage increase is 1.0% per year over the long term. Table 54 summarizes the historical information and the assumptions described above.

Table 54	Real Wage Increase and Related Components [1]			
	1962-2017 Average	1992-2017 Average	2002-2017 Average	Ultimate Assumption
Labour Productivity Growth	1.59%	1.18%	0.83%	1.10%
+ Compensation Ratio Growth	-0.11%	-0.28%	-0.06%	0.00%
+ Earnings Ratio Growth	-0.20%	-0.16%	-0.20%	-0.05%
+ Average Hours Worked Growth	-0.34%	-0.14%	-0.23%	-0.05%
+ Price Differential Growth	0.09%	0.11%	0.27%	0.00%
Real Wage Increase	1.01%	0.71%	0.62%	1.00%

(1)   Components may not sum to totals due to rounding.

The average annual and weekly earnings are assumed to increase at the same pace, with real wage increases projected to gradually rise from 0.3% in 2019 to an ultimate value of 1.0% by 2025. This is consistent with the assumed moderate economic growth implicitly reflected in the assumption on the unemployment rate. Table 55 shows the assumptions regarding the annual increases in prices, real AAE, and real AWE.

Table 55	Inflation, Real AAE and AWE Increases (percentages)		
Year	Price Increases	Real Increases Average Annual Earnings (AAE)	Real Increases Average Weekly Earnings (AWE), (YMPE)
2019	2.00	0.30	0.30
2020	2.00	0.50	0.50
2021	2.00	0.60	0.60
2022	2.00	0.70	0.70
2023	2.00	0.80	0.80
2024	2.00	0.90	0.90
2025+	2.00	1.00	1.00

B.4.5   Average Annual Earnings, Total Earnings and Pensionable Earnings

Average annual earnings are projected by taking into account past and expected structural demographic changes as well as the narrowing of the gap between average female and male employment earnings. As part of these projections, the average annual earnings of working beneficiaries are also taken into account. The ratio of female to male average employment earnings stood at about 48% in 1966 and was 77% in 2016. This ratio is projected to increase to 87% by 2050. Table 56 shows the projected average annual earnings by age group and sex for selected years.

Table 56	Average Annual Earnings (Canada less Québec, ages 18 to 69) (dollars)					
	Males			Females		
Age Group	2019	2025	2050	2019	2025	2050
20-24	25,846	30,075	61,591	20,258	23,825	50,496
25-29	44,244	51,062	103,998	35,588	41,953	90,667
30-34	55,543	63,714	129,120	41,748	49,413	108,629
35-39	61,039	69,958	141,756	46,682	55,195	121,068
40-44	64,083	73,441	148,753	50,454	59,526	129,746
45-49	64,536	74,037	149,917	51,306	60,592	131,624
50-54	63,468	73,022	147,590	50,578	59,656	129,528
55-59	59,500	68,070	137,803	46,803	55,502	120,720
60-64	49,783	58,389	117,678	38,209	46,587	101,832
65-69	34,631	42,604	85,623	26,085	31,831	72,712
All Ages	51,890	60,424	122,682	40,792	48,657	106,230

Total earnings are the product of average earnings and the number of earners. Table 57 shows the projected average earnings and number of earners for each sex, the resulting total earnings, and the annual percentage increase in total earnings for Canada less Québec. The ultimate annual increase in total earnings is set to reach about 3.5%. This nominal increase comprises an ultimate inflation rate of 2.0%, real wage growth of 1.0%, and population growth for the age group 18 to 69 of 0.5%.

	Average Annual Earnings		Earners		Total	Annual Increase in Total Earnings
Year	Males	Females	Males	Females	Earnings	
	($)	($)	(thousands)	(thousands)	($ million)	(%)
2019	51,890	40,792	8,166	7,563	732,277	3.7
2020	53,083	41,915	8,264	7,641	758,974	3.6
2021	54,359	43,110	8,346	7,707	785,928	3.6
2022	55,729	44,373	8,426	7,771	814,427	3.6
2023	57,192	45,717	8,487	7,822	842,988	3.5
2024	58,756	47,143	8,544	7,872	873,092	3.6
2025	60,424	48,657	8,597	7,918	904,728	3.6
2030	69,551	57,026	8,792	8,195	1,078,761	3.6
2035	80,084	66,778	9,026	8,519	1,291,680	3.7
2040	92,247	78,042	9,298	8,776	1,542,660	3.6
2045	106,348	91,088	9,616	9,063	1,848,125	3.7
2050	122,682	106,230	9,898	9,321	2,204,546	3.5
2055	141,631	123,788	10,104	9,525	2,610,127	3.4
2060	163,620	144,135	10,262	9,701	3,077,219	3.3
2065	189,187	167,650	10,425	9,887	3,629,902	3.4
2075	253,853	225,736	10,966	10,406	5,132,621	3.6
2085	341,129	303,368	11,602	10,992	7,292,564	3.5
2095	458,501	407,629	12,189	11,540	10,293,046	3.5

Table 57   Total Earnings (Canada less Québec, ages 18 to 69)

Average pensionable earnings in respect of the base CPP are computed by removing from average annual earnings the earnings of those earning less than the YBE and the portion of earnings in excess of the YMPE. Such removal is made using distributions of earners and earnings, which are based on individual earnings statistics. These distributions were determined using earnings statistics from 2014 to 2016 and are assumed to remain constant in the future. The average pensionable earnings by age, sex, and calendar year correspond to the average portion of individual employment earnings below the YMPE for a cohort of earners earning more than the YBE.

For the additional CPP, the same methodology as mentioned above applies but the average portion of individual employment earnings used goes up to the YAMPE. In 2019, the YMPE and YBE are respectively $57,400 and $3,500. The YAMPE is set at 107% of the YMPE in 2024 ($69,700 as projected in this report), and at 114% of the YMPE in 2025 ($76,400 as projected in this report) and thereafter, as per the CPP statute. The YMPE and the YAMPE are increased annually based on the average industrial aggregate wage in Canada as published by Statistics Canada. The projected average pensionable earnings by age and sex for selected years up to the YMPE and YAMPE are shown in Table 58 and Table 59, respectively.

Table 58	Average Pensionable Earnings up to YMPE (Canada less Québec) (dollars)					
	Males			Females		
Age Group	2019	2025	2050	2019	2025	2050
20-24	26,557	30,588	60,579	21,975	25,458	51,496
25-29	38,742	44,761	90,536	34,096	39,709	82,288
30-34	43,772	50,620	103,102	37,232	43,455	90,715
35-39	45,585	52,779	107,917	39,385	45,982	96,002
40-44	46,394	53,749	110,094	41,029	47,897	99,998
45-49	46,487	53,867	110,335	41,563	48,567	101,431
50-54	46,186	53,563	109,482	41,361	48,312	100,791
55-59	44,352	51,251	104,147	39,477	46,148	95,777
60-64	41,380	47,928	96,031	36,273	42,746	87,750
65-69	37,374	43,457	86,529	31,185	36,190	75,094
All Ages	41,330	48,167	97,515	36,181	42,438	87,902
YMPE	57,400	67,100	140,500	57,400	67,100	140,500

Table 59	Average Pensionable Earnings up to YAMPE (Canada less Québec) (dollars)					
	Males			Females		
Age Group	2019	2025	2050	2019	2025	2050
20-24	-	31,328	61,976	-	25,762	52,140
25-29	-	47,285	95,454	-	41,363	85,971
30-34	-	54,448	110,683	-	45,910	96,254
35-39	-	57,229	116,818	-	48,944	102,583
40-44	-	58,514	119,675	-	51,187	107,222
45-49	-	58,676	119,978	-	51,907	108,750
50-54	-	58,266	118,898	-	51,554	107,908
55-59	-	55,528	112,650	-	49,084	102,212
60-64	-	51,683	103,391	-	45,169	93,027
65-69	-	46,886	93,307	-	38,120	79,702
All Ages	-	51,869	104,877	-	44,905	93,343
YAMPE	-	76,400	160,100	-	76,400	160,100

The ratios of average pensionable earnings for males and females as a percentage of the YMPE and the YAMPE are slowly decreasing over time. This is due to the freezing of the YBE which has the effect that, over time, fewer and fewer workers are exempt from participating in the CPP. This, in turn, has the effect of increasing the number of earners with low earnings participating in the Plan. The ratio reduces over time for males mainly due to this YBE effect. The ratio also reduces for females, but to a smaller extent and thus is relatively stable as the YBE effect is mostly offset by the increase in their average pensionable earnings.

B.5 Contributions

Contributions are determined by multiplying together the number of contributors, average contributory earnings, and the contribution rate.

B.5.1 Proportion of Contributors

In order to be considered a contributor to the CPP in any given calendar year, one must have employment earnings exceeding the YBE. Accordingly, the proportion of contributors (in respect of the population) is determined by multiplying the proportion of all earners by the proportion of earners earning more than the YBE. This last proportion is determined for each age, sex, and calendar year by expressing the YBE as a percentage of average employment earnings and using distributions of earners and their earnings. The proportion of contributors is adjusted to reflect working beneficiaries. Table 60 presents the proportion of contributors by selected age groups and years for males and females.

Table 60	Proportion of Contributors to the CPP, by Age Group (percentages)					
	Males			Females		
Age Group	2019	2025	2050	2019	2025	2050
20-24	76.3	81.1	84.2	75.7	78.6	84.1
25-29	86.4	87.7	91.2	80.4	81.7	88.1
30-34	88.7	90.3	92.5	78.8	81.6	86.6
35-39	88.3	91.1	92.2	78.5	82.4	86.6
40-44	87.1	88.0	89.8	79.5	80.8	84.2
45-49	86.5	89.4	90.8	80.8	82.0	85.3
50-54	82.8	84.9	86.7	77.9	79.4	83.1
55-59	74.9	78.6	81.6	67.9	71.0	75.9
60-64	59.0	61.6	65.7	49.4	51.4	56.3
65-69	24.6	29.1	31.6	17.4	19.5	23.1
All Ages	76.1	78.3	80.8	69.2	70.8	75.5

B.5.2 Average Contributory Earnings

Average contributory earnings, which include contributory earnings of working beneficiaries, are determined for each age, sex, and year by subtracting the YBE from the average pensionable earnings shown in Table 58 and Table 59. The resulting average contributory earnings by age group and sex for selected years up to the YMPE and YAMPE are shown in Table 61 and Table 62, respectively.

Table 61 Average Contributory Earnings for Pensionable Earnings up to YMPE (dollars)

Age Group	Males 2019	Males 2025	Males 2050	Females 2019	Females 2025	Females 2050
20-24	23,057	27,088	57,079	18,475	21,958	47,996
25-29	35,242	41,261	87,036	30,596	36,209	78,788
30-34	40,272	47,120	99,602	33,732	39,955	87,215
35-39	42,085	49,279	104,417	35,885	42,482	92,502
40-44	42,894	50,249	106,594	37,529	44,397	96,498
45-49	42,987	50,367	106,835	38,063	45,067	97,931
50-54	42,686	50,063	105,982	37,861	44,812	97,291
55-59	40,852	47,751	100,647	35,977	42,648	92,277
60-64	37,880	44,428	92,531	32,773	39,246	84,250
65-69	33,874	39,957	83,029	27,685	32,690	71,594
All Ages	37,830	44,667	94,015	32,681	38,938	84,402
YMPE	57,400	67,100	140,500	57,400	67,100	140,500

Table 62 Average Contributory Earnings for Pensionable Earnings up to YAMPE (dollars)

Age Group	Males 2019	Males 2025	Males 2050	Females 2019	Females 2025	Females 2050
20-24	–	27,828	58,476	–	22,262	48,640
25-29	–	43,785	91,954	–	37,863	82,471
30-34	–	50,948	107,183	–	42,410	92,754
35-39	–	53,729	113,318	–	45,444	99,083
40-44	–	55,014	116,175	–	47,687	103,722
45-49	–	55,176	116,478	–	48,407	105,250
50-54	–	54,766	115,398	–	48,054	104,408
55-59	–	52,028	109,150	–	45,584	98,712
60-64	–	48,183	99,891	–	41,669	89,527
65-69	–	43,386	89,807	–	34,620	76,202
All Ages	–	48,369	101,377	–	41,405	89,843
YAMPE	–	76,400	160,100	–	76,400	160,100

B.5.3 Total Contributory Earnings

Contributory earnings for each given age, sex, and year are calculated as the product of the proportion of contributors, average contributory earnings, and the corresponding population. Total contributory earnings for each year are obtained by summing contributory earnings for each age and sex in that year.

Total contributory earnings are then adjusted upward to take into account the non-refundable portion of employer contributions arising generally in respect of (1) employees with multiple employers during a given year, (2) employees earning less than the YBE during a given year, including those who only work part of a year. The amount of non-refundable employer

contributions increases total CPP contributions, which translates into higher underlying contributory earnings. As such, contributory earnings are adjusted only for the purpose of determining the correct amount of contributions.

The records of earnings from Service Canada, statistics on contributors from the "The CPP & OAS Stats Book 2018", published by Employment and Social Development Canada, and information from the Canada Revenue Agency on base CPP contribution refunds were used to project the adjustment for contributory earnings up to the YMPE and YAMPE. The adjustment for earnings up to YMPE is projected to be 1.56% in 2019 and decreases to 1.50% over the projection period to account for the YBE being frozen at $3,500. The adjustment for earnings up to YAMPE is projected to be 1.50% in 2024 and decreases to 1.45% over the projection period also to account for the YBE being frozen at $3,500.

These adjustments reflect the change in the administration of overcontributions with the introduction of the additional CPP. Specifically, as of 2019, both employer and employee overcontributions will be applied first to maximizing contributors' benefits under the base Plan. Any overcontributions remaining will then be applied toward maximizing benefits under the additional Plan. If there are still overcontributions remaining once maximizing benefits under both components of the CPP, a contribution refund will be issued to the contributor and the employer non-refundable portion would be allocated between the Canada Pension Plan Account and the Additional Canada Pension Plan Account.

Annual contributions are equal to the product of adjusted contributory earnings and the contribution rate. The contribution rates are set by law. For the base Plan, the legislated contribution has been 9.9% since 2003. For the additional Plan, the legislated first additional contribution rate is 2.0% as of 2023 (phased in starting in 2019) and the legislated second additional contribution rate is 8.0% as of 2024. Table 63 and Table 64 present the projected components of total unadjusted contributory earnings, the total adjusted contributory earnings, as well as the projected YMPE and YAMPE, for pensionable earnings up to the YMPE and YAMPE, respectively.

Table 63   Total Adjusted Contributory Earnings for Pensionable Earnings up to YMPE

| Year | Unadjusted Average Contributory Earnings | | YMPE | Contributors | | Total Adjusted Contributory Earnings | Annual Increase in Total Adjusted Contributory Earnings |
| | Males | Females | | Males | Females | | |
	($)	($)	($)	(thousands)	(thousands)	($ million)	(%)
2019	37,830	32,681	57,400	7,608	6,920	521,967	4.3
2020	38,764	33,553	58,700	7,710	7,003	542,126	3.9
2021	39,820	34,518	60,200	7,795	7,074	563,194	3.9
2022	40,939	35,537	61,800	7,880	7,146	585,498	4.0
2023	42,084	36,588	63,400	7,946	7,206	607,349	3.7
2024	43,341	37,731	65,200	8,010	7,264	630,884	3.9
2025	44,667	38,938	67,100	8,071	7,320	655,541	3.9
2030	51,983	45,634	77,800	8,299	7,636	791,884	3.9
2035	60,368	53,381	90,200	8,586	8,013	960,579	3.9
2040	70,028	62,293	104,600	8,889	8,313	1,157,737	3.8
2045	81,104	72,510	121,200	9,224	8,631	1,394,863	3.7
2050	94,015	84,402	140,500	9,510	8,912	1,671,351	3.6
2055	109,079	98,265	162,900	9,719	9,136	1,987,685	3.4
2060	126,605	114,364	188,900	9,883	9,332	2,353,547	3.4
2065	146,936	132,989	219,000	10,065	9,542	2,789,376	3.5
2075	197,779	179,204	294,300	10,643	10,098	3,973,597	3.6
2085	266,224	241,114	395,500	11,285	10,703	5,669,320	3.6
2095	358,483	324,448	531,600	11,867	11,259	8,026,025	3.5

Table 64   Total Adjusted Contributory Earnings for Pensionable Earnings up to YAMPE

| Year [1] | Unadjusted Average Contributory Earnings | | YAMPE | Contributors | | Total Adjusted Contributory Earnings | Annual Increase in Total Adjusted Contributory Earnings |
| | Males | Females | | Males | Females | | |
	($)	($)	($)	(thousands)	(thousands)	($ million)	(%)
2024	45,208	38,994	69,700	8,010	7,264	655,074	N/A
2025	48,369	41,405	76,400	8,071	7,320	703,904	7.5
2030	56,236	48,538	88,600	8,299	7,636	849,843	3.8
2035	65,265	56,800	102,800	8,586	8,013	1,030,611	4.0
2040	75,632	66,286	119,200	8,889	8,313	1,241,434	3.8
2045	87,518	77,172	138,100	9,224	8,631	1,495,083	3.7
2050	101,377	89,843	160,100	9,510	8,912	1,790,826	3.6
2055	117,571	104,625	185,700	9,719	9,136	2,129,468	3.5
2060	136,379	121,759	215,300	9,883	9,332	2,520,482	3.4
2065	158,208	141,587	249,600	10,065	9,542	2,986,430	3.5
2075	212,859	190,761	335,500	10,643	10,098	4,252,999	3.7
2085	286,402	256,572	450,800	11,285	10,703	6,065,581	3.6
2095	385,589	345,180	606,000	11,867	11,259	8,585,473	3.5

(1) The years shown start in 2024 since it is the first year the YAMPE applies.

B.6 Investment Assumptions

The total assets of the CPP at the end of any given year throughout the projection period are simply determined by adding together the total assets at the end of the previous year, projected investment income and contribution revenues of the given year, and then subtracting the projected benefits and operating expenses of the given year.

B.6.1 Net Assets as at 31 December 2018

The following discusses only the assets of the base CPP as at 31 December 2018, since the additional CPP starts in 2019 and thus has no assets as at 31 December 2018.

The actual value of the base CPP assets on a market-value accrual basis as at 31 December 2018 was $371,700 million. This is the sum of the CPP Account ($188 million) and the CPPIB invested assets ($368,490 million) for a total of $368,678 million before being adjusted by the amounts receivable minus amounts payable.

The CPP Account was established in respect of the base Plan to record the contributions, interest, pensions, other benefits, and operating expenses. It also records the amounts transferred to and received from the CPPIB. The receivables include the contributions due but not yet deposited into the CPP Account, benefit overpayments, and net transfers between the CPP and the QPP for dual contributors. The amounts payable include operating expenses, pensions and other benefits, as well as amounts due to the CRA. Benefit and operating expenditures are described in detail in sections B.7 and B.8, respectively of this appendix.

Table 65 reconciles the assets of the base CPP as at 31 December 2018.

Table 65	Net Assets as at 31 December 2018 - Base CPP ($ million)	
CPP Account		188
CPPIB Invested Assets		368,490
Subtotal CPP Account and CPPIB Invested Assets		368,678
Plus Amounts Receivable		
Contributions		3,263
Benefit Overpayments		72
Net Transfers Due from QPP		126
Minus Amounts Payable		
Operating Expenses		6
Pensions and Other Benefits		204
Amounts Due to the Canada Revenue Agency		229
Net Base CPP Assets		371,700

B.6.2   Investment Strategy and Two-Pool Structure

The CPPIB invests funds according to its own investment policies that take into account the needs of contributors and beneficiaries, as well as financial market constraints. For the purpose of this 30[th] CPP Actuarial Report, the CPPIB investments have been grouped into three broad categories:

➢   Equities, consisting of public and private equities;

➢   Fixed income securities, consisting of nominal fixed income (marketable bonds and non-marketable bonds), credit, and cash; and

➢   Real assets.

The foundation of the CPPIB's investment strategy is a two-asset portfolio called the "reference portfolio". This portfolio sets how much risk the CPPIB is willing to take in accordance with its mandate. The reference portfolio comprises a global equity benchmark and a Canadian government nominal bonds benchmark. The higher the equity share, the higher the associated risk. Since the previous triennial actuarial valuation, the CPPIB has progressively shifted its asset allocation toward a reference portfolio consisting of 85% global equity and 15% Canadian government nominal bonds[1].

Recognizing the distinct natures of the base and additional CPP, the CPPIB Board approved two different reference portfolios applicable for each component of the Plan. The reference portfolio applicable to the base CPP is maintained at 85% global equity and 15% Canadian government nominal bonds, whereas, the reference portfolio applicable to the additional CPP consists of 50% global equity and 50% Canadian government nominal bonds.

In order to invest the base and additional CPP funds according to their respective reference portfolios, the CPPIB designed a two-pool investment structure. The base CPP's actual assets as of 31 December 2018 constitute the Core pool and are invested according to the base CPP's investment policy. The additional CPP assets are invested in two pools: the Core pool and the Supplementary pool. The Supplementary pool solely comprises fixed income securities. The share of the additional CPP's assets invested in each of the Core and Supplementary pools is determined such that the overall level of risk of the additional CPP is consistent with its reference portfolio. Chart 12 presents a schematic of the two-pool investment structure for the CPP invested assets.

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[1] The Reference Portfolio consisted of 72% equity and 28% fixed income during Fiscal year 2015-2016.

Chart 12   Illustrative Two-Pool Investment Structure of the CPP
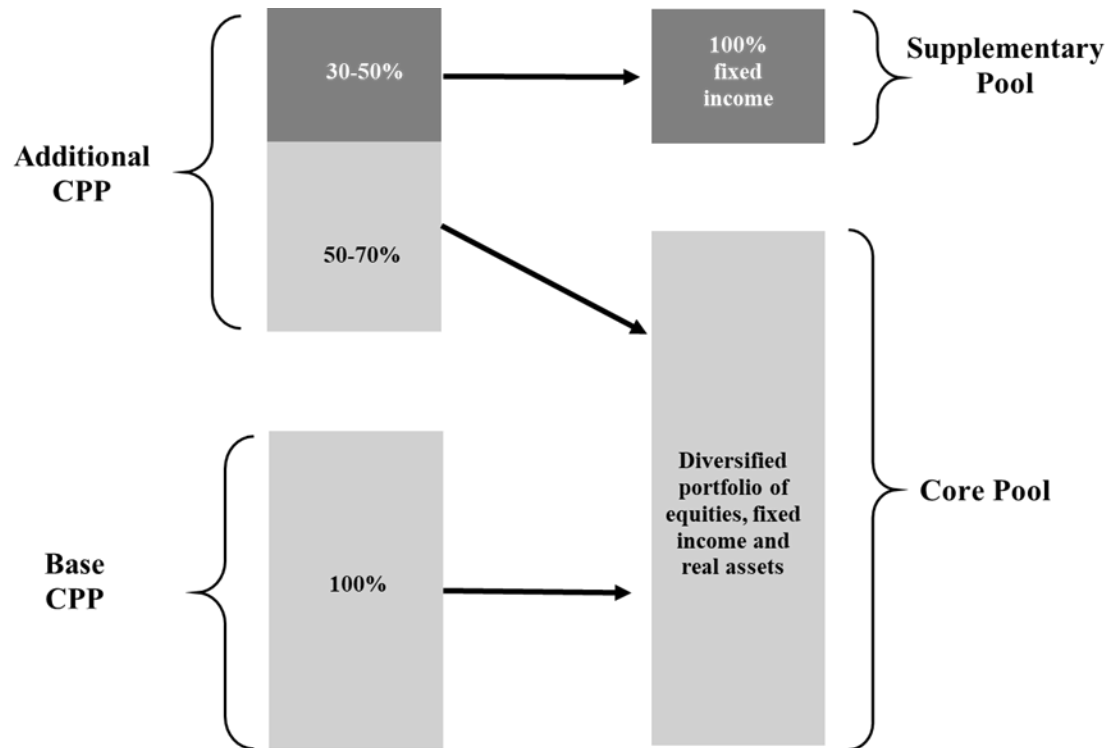
The CPPIB diversifies its holdings and thus sources of returns, while respecting the risk level of its reference portfolios. As a result, the base and additional CPP assets are invested in more than two types of assets. The portfolios capturing that diversification are called the strategic portfolios. The CPPIB uses the strategic portfolios to express its long-term goal for allocating assets by asset classes and geographic regions. In its 2018 and 2019 Annual Reports, the CPPIB signaled its intention to increase the CPP Fund's exposure to emerging markets.[1] This intention is reflected in all assumptions presented in this section.

As at 31 December 2018, the asset mix of the base CPP consisted of 56% equities, 18% fixed income securities, and 26% real assets. Table 66 further categorizes the actual assets under CPPIB management into the asset classes identified at the beginning of this section, which correspond to the strategic portfolio's asset classes.

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[1] President's message, CPPIB 2018 Annual Report.

Table 66 **Base CPP (Core Pool) Initial Asset Mix as at 31 December 2018 (percentages)**

Equity		Fixed Income Securities				
Public Equities	Private Equities	Marketable Bonds	Non-Marketable Bonds	Credit	Cash	Real Assets
32	24	17	6	9	-14 [1]	26

(1) A negative allocation to cash represents financial leverage. This indicates that funds are borrowed in order to increase the amounts invested in the other asset classes. Leverage is profitable when the return obtained by investing in the other asset classes is greater than the cost of borrowing.

B.6.3   Investment Income

In general, investment income from a given asset within a portfolio is the product of the market value of that asset and its projected nominal rate of return (which is obtained by adding the applicable projected real rate of return, as described in section B.6.4 below, to the projected inflation rate).

The investment income of the CPP is based on the assumed real rate of return applicable to each type of asset, projected inflation, and the projected asset mix and cash flows. In addition, the assumed real rate of return at the portfolio level includes an allowance for rebalancing and diversification (discussed in section B.6.5). Investment income is also adjusted downward to recognize investment expenses (discussed in section B.6.6).

B.6.4   Real Rates of Return

Real rates of return are required for the projection of revenue arising from investment income. They are assumed for each year of the projection period and for each of the main asset classes in which CPP assets are invested. All real rates of return described in this section are shown before reduction for assumed investment expenses.

The real rates of return were developed by looking at historical returns (expressed in Canadian dollars) and adjusting the returns upward or downward to reflect expectations that differ from the past. Both public market data and customized benchmarks prepared by the CPPIB were used to analyze the historical experience.

Future currency variations will impact the real rates of return over the projection period, creating gains and losses. However, as the projection period is over 75 years, these gains and losses are expected to offset each other over time. Thus, it is assumed that currency variations will not have an impact on the real rates of return.

The future outlook is based on the assumption that, over the short-to-medium term, federal bond yields are expected to increase, as their current levels are low by historical standards. The speed of that increase, however, is uncertain. The demand for long-term sovereign bonds, in Canada and abroad, remains strong, and central banks of developed economies are moving cautiously to increase interest rates. Nevertheless, the 75-year time horizon of this report warrants a long-term

approach that is expected to be generally consistent with the historical long-term averages of federal bond yields.

B.6.4.1 Fixed Income Securities

As at 31 December 2018, the CPPIB had 18% of its portfolio invested in fixed income securities, split between nominal fixed income, credit, and cash. Nominal fixed income can be further divided into a non-marketable bond portfolio composed of bonds with various terms to maturity, representing loans made to the provinces, and a marketable bond portfolio consisting of federal and provincial bonds. Starting 1 January 2019, the CPPIB will invest part of the additional CPP's contributions in a Supplementary pool composed of fixed income securities.

Non-Marketable Bond Portfolio and Rollover Rates (Loans to Provinces, Core Pool)

The non-marketable bond portfolio at the end of 2018 represented 6% of all CPP assets. The provinces are allowed to roll over at maturity for a further 20-year term any bonds that were purchased prior to the 1997 CPP amendments (that came into effect on 1 January 1998). In lieu of exercising their statutory rollover right, an agreement between the provinces and the CPPIB permits each province to repay a bond and contract a replacement bond or bonds for a term of at least five years, with a total principal amount not exceeding the principal amount of the maturing bond and total successive terms of not more than 30 years. During the 20-year period 1999 to 2018, 68% of provincial bonds available for rollover were rolled over at or before maturity. The rollover proportion increases to 99% when considering the five-year period from 2014 to 2018, and to 100% when considering the three-year period 2016 to 2018. Using this rollover experience, it is assumed that the rollover rate will be 98% for 2019 and thereafter. The last non-marketable bond is expected to mature in 2043.

On the basis of the average short-, medium-, and long-term experience of the spread between the annual yields on federal and provincial bonds, the current outlook of the economy, and data on rollovers since 1999, a spread over the federal yield was determined for each province. The initial spreads on rollover bonds are set at the actual market spreads at the end of 2018 for provincial bonds issued by the given province. The ultimate spreads, applicable from 2029, are set at the average spreads of provincial bonds issued by a given province during the period of 2000 to 2018, excluding 2008 and 2009. Spreads during the global financial crisis (2008-2009) were abnormally high and were thus ignored in the determination of the ultimate spreads. The weighted long-term average spread for all provinces is approximately 70 basis points. The ultimate annual long-term real federal bonds yield is assumed to be 2.6%, as discussed in the following section. Therefore, an ultimate annual real yield of approximately 3.3% for provincial rollover bonds is assumed for 2029 and thereafter.

The real rate of return of the non-marketable bond portfolio is calculated by taking into consideration any coupon payments made throughout the year, as well as the change in the market value of the portfolio due to changes in the assumed yield rates and in the term to maturity of each bond. Coupons paid and redemption values of bonds at maturity are assumed to be reinvested in the marketable bond portfolio.

Marketable Bond Portfolio (Core Pool)

As the non-marketable bond portfolio matures over the next three decades, it is assumed that the proceeds will be invested in marketable bonds and that the marketable bond portfolio will consist of federal and provincial bonds in varying proportions. The initial asset mix of the marketable bond portfolio is estimated from the CPPIB's 31 December 2018 financial statements. In addition to Canadian federal and provincial bonds, the CPPIB's marketable bond portfolio also includes an allocation to foreign sovereign bonds. For the purpose of this report, it was assumed that foreign sovereign bonds would be mostly from developed economies and that they could be approximated by Canadian federal bonds. Hence, the starting composition of the marketable bond portfolio is assumed to be 85% federal and 15% provincial bonds. For the previous triennial CPP actuarial report, corporate bonds were included as a part of the marketable bonds portfolio. For this report, it is assumed that corporate bond holdings of the CPPIB are part of the credit asset class.

It is assumed that the CPPIB will purchase a variety of federal and provincial bonds in proportions consistent with the CPPIB's investment strategy. It is also assumed that maturing non-marketable bonds will be mostly reinvested in provincial bonds. It is thus assumed that the ultimate marketable bond mix applicable for 2029 and thereafter will be composed of 60% federal and 40% provincial bonds.

The real yield on long-term federal bonds as at 31 December 2018 is about 0.2% and is assumed to gradually increase to 2.6% by 2029 and remain at that level thereafter (the same ultimate value but by 2025 in the previous valuation). The real yields for federal bonds of shorter maturities, as well as for provincial bonds are based on the real yield on long-term federal bonds adjusted based on historical spreads. The initial spreads over the real yield on federal long-term bonds are based on spreads prevailing as at 31 December 2018 and reflect the current economic environment.

Since the long-term federal bond yield is assumed to increase between 2019 and 2029 and only stabilize at the end of 2029, bond returns are quite low for the first ten years of the projection. The assumed average maturity of federal and provincial bonds are estimated based on the CPPIB's holdings as at 31 December 2018 and are assumed to remain constant throughout the projection period. The average maturity is set at 7.0 years for federal bonds and 13.5 years for provincial bonds. The assumed average ultimate real rates of return for federal and provincial bonds of various maturities are 1.9% and 2.7% respectively. The assumed real rate of return of the marketable bond portfolio, once bond yields have stabilized, is lower than the corresponding assumed real rate of return of the previous actuarial report because corporate bonds are now considered part of the credit asset class (2.2% instead of 2.7% before investment expenses).

Supplementary Pool

The Supplementary pool is expected to be composed mainly of high-quality fixed income securities such that the mix of Core pool and Supplementary pool assets provides the desired risk profile for the additional CPP. For the purpose of this report, the composition of the Supplementary pool is assumed to be similar to the ultimate composition of the marketable bond portfolio. Therefore, the pool is assumed to be composed of 60% federal and 40% provincial bonds. However, it is assumed that the Supplementary pool will have a higher proportion of long-term bonds compared to the marketable bond portfolio. Therefore, the ultimate average maturity of the Supplementary pool's bonds is assumed to be 11.0 years compared to 9.6 years for the Core pool marketable bond portfolio. Due to this higher allocation to long-term bonds, the ultimate real rate of return for the Supplementary pool is slightly higher at 2.3% (compared to a real rate of return of 2.2% for Core pool marketable bonds). Similar to the Core pool marketable bonds portfolio, the real rates of return of the Supplementary pool are expected to be low over the first few projection years due to the projected increase in yields.

Credit

The credit asset class includes investments in corporate bonds, private debt, and private real estate debt. At the end of 2018, the CPPIB had approximately 9% of its net assets invested in this asset class. For the purpose of this report, the expected real rate of return on credit is assumed to correspond to the return on a diversified portfolio of corporate bonds, adjusted to reflect the risk of the CPPIB's actual holdings. Such adjustments include an assumed increased exposure to emerging markets. The returns on the diversified portfolio of corporate bonds are derived from projected corporate yields, which are themselves obtained by adding a credit spread to the projected yields of a diversified portfolio of Canadian federal bonds. It is assumed that the credit spread between a diversified portfolio of corporate bonds and federal bonds will ultimately be 1.0%. The expected real rate of return of the credit portfolio is low during the first projection years, as the increase in federal bond yields (and the corresponding low returns) is expected to counter the effect of other factors such as credit spreads and increased emerging market exposure. The ultimate real rate of return is assumed to be 2.9% from 2029 onward.

CPP Account, Additional CPP Account, and Cash

The CPP Account is established in the accounts of Canada to record the transactions of the base Plan and amounts transferred to and from the CPPIB in respect of the base Plan. Historically, the CPP Account, held by the federal Department of Finance, consisted of an operating balance and short-term investments. The assets of the CPP Account not needed to meet immediate base Plan payments were transferred to the CPPIB in monthly installments between September 2004 and August 2005. As such, the balance in the CPP Account is now minimal, serving only as a flow-through account with investments solely in short-term securities.

The Additional CPP Account is a new account established in the accounts of Canada. Similar to the CPP Account, the Additional CPP Account is a flow-through account that records the transactions

of the additional Plan and amounts transferred to and from the CPPIB in respect of the additional Plan.

The CPPIB uses financial leverage as part of its investment strategy. Financial leverage in the context of portfolio management consists of borrowing money to invest in additional assets with the expectation that the borrowing cost will be less than the return on the assets purchased. As at 31 December 2018, CPPIB's external debt and financing liability represented about 14% of its net assets. While previous actuarial reports did not explicitly recognize the leverage component of the CPPIB's investment strategy, for the purpose of this report, it was decided that the amount of leverage increased to a level that warrants explicit recognition of it in the asset allocation. The borrowing cost related to financial leverage is assumed to correspond to the expected real rate of return on cash. The initial assumed real rate of return on cash is low, reflecting the current environment, with a smooth transition assumed from the initial to the ultimate assumption of 1.0% for 2029 and thereafter.

B.6.4.2   Equity

The CPPIB assets invested in equities are currently diversified among public and private equities and across various geographies. In the derivation of the real rates of return for these equity investments, consideration was given to the long-term equity risk premium, which includes dividends and market value fluctuations. No distinction is made between realized and unrealized capital gains. Custom equity benchmarks provided by the CPPIB were considered in the derivation of real rates of return for equities.

Public equities

Public equities comprise developed and emerging markets publicly traded equities. Consistent with the assumption that risk taken must be rewarded, equity real rates of returns are developed by adding an equity risk premium to the expected real rate of return on cash[1]. The historical equity risk premium over cash worldwide for the 119-year and 50-year periods ending in 2018 were 4.2% and 4.0% respectively[2]. It is assumed that historical equity risk premiums were higher due to several non-repeatable factors (mainly diversification and globalization). As a result, the long-term expected equity risk premium is assumed to be lower than what was realized in the past 119 years. However, for developed markets, the equity risk premium is assumed to be higher in the first eight years of the projection, reflecting assumed low cash returns over the same period, before reaching an assumed ultimate rate of 3.1%. The equity risk premium for emerging market equities is expected to be 90 basis points higher than for developed market equities, reflecting the additional risk inherent with investments in emerging countries.

It is assumed that the exposure to emerging market public equities will increase. As a result, the expected return on public equities is assumed to increase over the projection period, as the

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[1] In the previous triennial valuation, the equity risk premium was expressed relative to long-term federal bonds. It also included an allocation for rebalancing and diversification.
[2] Source: Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Investment Returns Yearbook 2019.

equity risk premium is assumed to be greater for emerging market equities than for developed market equities. The real rate of return on public equities is assumed to be 3.9% at the start of the projection period and to reach 4.3% by 2025.

Private equities

Compared to public equities, private equities are less liquid and their management necessitates a higher degree of expertise. Private equities may also provide investors the opportunity to invest at an earlier stage in the development of a company, which translates into additional risk and greater potential returns. As a result, the return structure of private equities is different compared to public equities. Private equities are expected to generate an additional return in exchange for additional risk.

In general, private investments have grown in popularity over the last decade. This increase in demand has not necessarily been matched by an increase in supply. Valuations are high and a significant amount of capital is waiting to be allocated at attractive prices. As more and more investors around the globe compete for private placements, it is assumed that the additional return from investing in private equities compared to public equities will decrease. The real rate of return on private equities is assumed to be 5.7% at the start of the projection period and to gradually decrease to 4.9% by 2025.

B.6.4.3   Real Assets

Real assets such as real estate, infrastructure, and natural resources are considered to share some characteristics of fixed income and equities, as well as to have some unique features related to their specific nature (such as illiquidity). The expected real rate of return on real assets is thus influenced by these features. In addition, the ultimate real rate of return on real assets assumes a greater exposure to emerging markets than as at 31 December 2018. Combined with a low expected real rate of return on fixed income at the start of the projection period, the real rate of return on real assets is expected to increase steadily from its assumed initial value of 1.6% in 2019 to reach an ultimate value of 4.1% in 2029.

B.6.4.4   Summary of Real Rates of Return by Asset Type

Table 67 summarizes the assumed real rates of return by asset type throughout the projection period, before reduction for investment expenses. Compared to the previous triennial report, the rates of return by asset type are presented with no allocation for rebalancing and diversification (discussed in section B.6.5). The rebalancing and diversification allocation is presented at the portfolio level in Table 68 for the base CPP and Table 69 for the additional CPP.

It is important to recognize that rates of return for most assets are volatile. The real rates of return presented in Table 67 represent expected trends and assumed levels of returns to be obtained over a long horizon. As such, limited emphasis should be put on individual projection years.

Table 67   Real Rates of Return by Asset Type (before investment expenses) (percentages)

| Year | Equity | | Fixed Income Securities | | | | | Real Assets |
	Public Equities	Private Equities	Marketable Bonds	Non-Marketable Bonds	Supplementary Pool	Credit	Cash	
2019	3.9	5.7	-2.1	-2.2	-3.0	0.2	-0.4	1.6
2020	4.0	5.5	-2.1	-2.0	-3.1	0.3	0.0	1.7
2021	4.1	5.3	0.2	0.9	0.1	1.6	0.4	3.0
2022	4.2	5.2	0.3	0.6	0.2	1.7	0.5	3.1
2023	4.2	5.1	0.5	1.0	0.4	1.9	0.6	3.2
2024	4.3	5.0	0.6	1.1	0.6	2.0	0.7	3.3
2025	4.3	4.9	0.8	1.2	0.7	2.1	0.8	3.5
2026	4.3	4.9	1.0	1.5	0.9	2.2	0.9	3.5
2027	4.3	4.9	1.7	2.5	1.7	2.6	1.0	3.9
2028	4.3	4.9	1.7	2.4	1.8	2.7	1.0	3.9
2029	4.3	4.9	2.2	3.2	2.3	2.9	1.0	4.1
2030	4.3	4.9	2.2	3.3	2.3	2.9	1.0	4.1
2035	4.3	4.9	2.2	2.7	2.3	2.9	1.0	4.1
2040	4.3	4.9	2.2	1.8	2.3	2.9	1.0	4.1
2045	4.3	4.9	2.2	0.0	2.3	2.9	1.0	4.1

B.6.5   Asset Allocation and Expected Portfolio Rates of Return

This report provides a projection of over 75 years. As such, a long-term asset mix assumption is required, both for the base and additional CPP. As the base CPP matures and the Plan's participants age, the ratio of contributors to beneficiaries will decrease, and the proportion of investment income required to pay benefits will increase. Starting in 2022, it is expected that contributions will be insufficient to cover all expenditures, and that a portion of investment income will be required to cover expenditures. The portion of investment income required to pay expenditures will be small at the beginning but will increase over time, reaching 22.7% in 2050 and 36.1% in 2090 (see Table 13 in Section 4 of the report). Therefore, the importance of reliable investment income will grow over time for the base CPP. The additional CPP will rely even more on investment income due to the difference in its financing approach compared to the base CPP. Deviations in the additional CPP portfolio's rate of return will greatly impact the sustainability of that plan as a result of the higher reliance of the additional Plan on investment income. Given the long horizon of this report, it is important to consider how much investment risk is appropriate for the base and additional CPP over the long term, bearing in mind how each part is affected by investment returns.

For both the base and additional Plans, the expected portfolio real rates of return include an allowance for rebalancing and diversification of the assets. This allowance takes into account the beneficial effect of periodically rebalancing a diversified portfolio, thereby selling assets that have appreciated in relative value and buying assets that have declined in relative value. In other words, the expected geometric return of a portfolio is greater than the weighted average of the expected return of its components. The size of the allowance depends on the asset mix and the risk characteristics of the individual assets.

Base CPP

It is assumed that the level of risk of the base CPP investment portfolio will decrease over time. Consistent with the CPPIB's current reference portfolio for the base CPP, a level of risk equivalent to that of a reference portfolio of about 85% equity and 15% fixed income is assumed initially. The volatility of the initial base CPP portfolio, as measured by the one-year standard deviation of return, is estimated at 13.4% annually[1]. Thereafter, it is projected that the annual standard deviation of the rates of return will gradually decrease to 10.7%, equivalent to a hypothetical reference portfolio of about 70% equity and 30% fixed income. The decrease in portfolio risk is assumed to progress in three-year steps reflecting the triennial review of the CPP. Hence, the asset mix is projected to progress from its initial allocation (CPP assets as at 31 December 2018) to a portfolio constructed to match the level of risk of a hypothetical reference portfolio of 70% equity and 30% fixed income. Table 68 presents the projected asset allocation, the expected volatility of the portfolio, and the expected portfolio real rates of return before investment expenses.

Due to the three-year steps progression of the asset mix, the total portfolio real rates of return do not move in a linear fashion. The expected real rates of return tend to decrease each time the level of risk of the portfolio decrease towards its ultimate level. At the same time, expected returns on fixed income are expected to gradually increase up to their ultimate values once yields stabilize. The net effect is a general increasing trend in total portfolio real rates of return with periodic adjustments corresponding to periodic portfolio risk recalibration.

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[1] Although CPPIB's current base CPP reference portfolio is 85% equity and 15% fixed income with an estimated one-year standard deviation of 14%, it's actual portfolio as at 31 December 2018 corresponds to a hypothetical reference portfolio of 82% equity and 18% fixed income with an estimated one-year standard deviation of 13.4%.

| Year | Equity | | Fixed Income Securities | | | | Real Assets | Expected One-Year standard deviation | Total Real Rate of Return [1],[2] |
	Public Equities	Private Equities	Marketable Bonds	Non-Marketable Bonds	Credit	Cash			
2019	32	24	17	6	9	-14	26	13.4	3.05
2020	32	24	18	5	9	-14	26	13.3	3.05
2021	32	24	18	5	9	-14	26	13.3	3.97
2022	29	22	19	4	9	-9	26	12.4	3.82
2023	29	22	19	4	9	-9	26	12.4	3.89
2024	29	22	20	3	9	-9	26	12.4	3.94
2025	26	21	20	3	10	-5	26	11.5	3.84
2026	26	21	20	2	10	-5	26	11.6	3.90
2027	26	21	20	2	10	-5	26	11.6	4.19
2028	23	19	20	2	10	0	26	10.7	4.05
2029	23	19	20	2	10	0	26	10.7	4.23
2030	23	19	20	2	10	0	26	10.7	4.23
2035	23	19	21	1	10	0	26	10.7	4.22
2040	23	19	22	0	10	0	26	10.7	4.21
2045	23	19	22	0	10	0	26	10.7	4.21

Table 68 — Asset Mix, Portfolio Risk and Expected Rates of Return (before investment expenses) Base CPP (%)

(1) The assumed total real rate of return is shown before reduction for investment expenses. The assumed total real rate of return net of expenses is obtained by reducing the total real rate of return by 20 basis points.

(2) The assumed total real rate of return includes an allocation for rebalancing and diversification. At the portfolio level, this allocation is assumed to add 0.45% to the rate of return annually over the projection period.

Additional CPP

The additional CPP assets are invested in both the Core and Supplementary pools. The share of the additional CPP assets invested in each pool is selected in order to match the desired level of risk of the additional CPP's reference portfolio. To increase the total portfolio risk of the additional CPP, a higher allocation to the Core pool would be selected, and vice-versa if a lower level of risk was desired.

It is assumed that the level of risk of the additional CPP will be kept constant over the projection period at a level corresponding to the current CPPIB reference portfolio of about 50% equity and 50% fixed income. During the first few projection years, this level of risk is obtained by investing 55% of the additional CPP's assets in the Core pool and 45% in the Supplementary pool. Because the level of risk of the Core pool's investment returns is expected to decrease gradually, a higher share of the additional CPP's assets is expected to be allocated to the Core pool to maintain the additional CPP's portfolio volatility at 6.6%. As shown in Table 69, 66% of the additional CPP's assets are assumed to be allocated to the Core pool for the year 2028 and thereafter.

			Expected One-	
Year	Core Pool Allocation	Supplementary Pool Allocation	Year standard deviation	Total Real Rate of Return [1],[2]
2019	55	45	6.6	0.55
2020	55	45	6.6	0.49
2021	55	45	6.6	2.40
2022	58	42	6.6	2.50
2023	58	42	6.6	2.61
2024	58	42	6.6	2.72
2025	62	38	6.6	2.82
2026	62	38	6.6	2.92
2027	62	38	6.6	3.41
2028	66	34	6.6	3.42
2029	66	34	6.6	3.71
2030	66	34	6.6	3.71

Table 69 — Asset Mix, Portfolio Risk and Expected Rates of Return (before investment expenses) Additional CPP (%)

(1) The assumed total real rate of return is shown before reduction for investment expenses. For all years except 2019, the assumed total real rate of return net of expenses is obtained by reducing the total real rate of return by 13 basis points.

(2) The assumed total real rate of return includes an allocation for rebalancing and diversification. At the portfolio level, this allocation is assumed to add 0.45% to the rate of return annually over the projection period.

B.6.6 Investment Expenses

Over the last three calendar years, CPPIB's total investment expenses consisting of operating expenses, transaction costs, and investment management fees have averaged 0.95% of assets. The majority of those investment expenses were incurred through active management decisions. Considering how total investment expenses evolved over the last decade, it is assumed that, going forward, CPPIB investment expenses related to the Core pool will be 1.00% of the corresponding assets.

The active management objective is to generate returns in excess of those of the CPP reference portfolios, after reduction for the additional expenses incurred from active management. Thus, the additional returns from a successful active management program should equal at least the cost incurred to pursue active management. For the purpose of this report, it is assumed that the additional returns generated by active management will equal the additional expenses incurred from active management. Those expenses are assumed to be 0.8% for the Core pool (and thus the base CPP), which is the difference between the assumed total investment expenses of 1.0% and the investment expenses of 0.2% that would be incurred from passive management of the portfolio, given that part of the portfolio is invested in private equity and real assets. The assumed investment expenses from passive management of 0.2% represent $756 million and $1,040 million in years 2019 and 2025, respectively.

The investment expenses of the additional CPP will depend on how much of the fund is invested in the Core pool versus the Supplementary pool, and the investment expenses associated with each of these pools. The investment expenses of the Core pool were discussed above and are expected to be 0.8% and 0.2% of net assets from active and passive management, respectively. Taking into account the CPPIB's existing infrastructures, the investment expenses of the Supplementary pool (comprising solely fixed income) are assumed to be zero both from an active and passive management point of view. Therefore, the overall investment expenses related to the additional CPP are assumed to be equal to the share of the additional CPP invested in the Core pool multiplied by the assumed investment expenses of the Core pool. Because 66% of the additional CPP assets are expected to be invested in the Core pool ultimately, the investment expenses are assumed to be 0.53% and 0.13% from active and passive management, respectively. For simplicity, this cost is assumed to be constant over the projection period (except for 2019).

For the year 2019, the additional CPP investment expenses are adjusted to reflect the implementation costs incurred by the CPPIB before 2019. Total start-up costs represent $9 million or -1.1% in terms of the adjustment to the annual rate of return.

The following section shows the overall rate of return on CPP assets net of investment expenses for the base and additional CPP.

B.6.7   Overall Rate of Return on Base and Additional CPP Assets

The best-estimate rates of return on total assets for each of the base and additional Plans are derived from the weighted average assumed rates of return on all types of assets, using the assumed asset mix proportions as weights. The best-estimate rates of return are further adjusted to incorporate an allocation for rebalancing and diversification. In addition, the best-estimate rates of return are increased to reflect additional returns due to active management and reduced to reflect all investment expenses. The ultimate net rates of return are shown in Table 70.

Table 70	Overall Rate of Return on base and additional CPP Assets (percentages)				
		Base CPP		Additional CPP	
		Nominal	Real	Nominal	Real
Weighted Average Rate of Return (before investment expenses)		6.21	4.21	5.71	3.71
Additional Rate of Return due to Active Management		0.80	0.80	0.53	0.53
Total Weighted Average Rates of Return before Investment Expenses		7.01	5.01	6.24	4.24
Expected Investment Expenses					
Expenses due to Passive Management		-0.20	-0.20	-0.13	-0.13
Additional Expenses due to Active Management		-0.80	-0.80	-0.53	-0.53
Total Expected Investment Expenses		-1.00	-1.00	-0.66	-0.66
Ultimate Rate of Return after Investment Expenses		6.01	4.01	5.58	3.58

The resulting nominal and real rates of return for select projection years are shown in Table 71. The projected nominal returns are the sum of the assumed levels of inflation and real returns. The projected average annual real rate of return over the next 75 years is 3.95% for the base CPP and 3.38% for the additional CPP.

Table 71	Annual Rates of Return on CPP Assets (percentages)				
		Base CPP		Additional CPP	
Year		Nominal	Real	Nominal	Real
2019		4.85	2.85	1.31	-0.69 [1]
2020		4.85	2.85	2.36	0.36
2021		5.77	3.77	4.27	2.27
2022		5.62	3.62	4.37	2.37
2023		5.69	3.69	4.48	2.48
2030+		6.01	4.01	5.58	3.58
Average over:					
2019-2023		5.35	3.35	3.35	1.35
2019-2028		5.57	3.57	4.14	2.14
2019-2093		5.95	3.95	5.38	3.38

(1) The 2019 real rate of return on the additional CPP assets is assumed to be negative due to the CPPIB's implementation expenses (assumed to be $9 million) and the assumed increase in bond yields.

The 75-year (2019-2093) average annual real rate of return on investments for the base CPP is 0.03% lower compared to the previous triennial valuation. This decrease is mainly due to lower expected returns on fixed income over that period compared to the previous valuation, mitigated

by a different asset mix that would otherwise produce slightly higher returns during the first ten projection years.

For the additional CPP, the 75-year (2019-2093) average annual rate of return on investments decreases by 0.17% compared to the assumption of the 28th CPP Actuarial Report. This decrease is mainly attributed to a different fixed income composition and lower assumed initial rates of return over the first ten projection years.

B.7 Benefit Expenditures

B.7.1 Benefits Payable as at 31 December 2018 and Projecting Benefits

The number of base CPP beneficiaries in pay and average monthly benefits payable as at 31 December 2018 are shown in Table 72.

Table 72 Benefits Payable as at 31 December 2018 – Base CPP				
	Number of Beneficiaries in pay		Average Monthly Benefit	
Benefit Type	Males	Females	Males	Females
	(thousands)		($)	($)
Retirement	2,517	2,704	680	481
Post-retirement Benefit	692	568	37	30
Survivor				
- Aged less than 65	50	164	359	421
- Aged 65 and over	168	736	121	360
Disability	152	185	959	883
	Number of Beneficiaries in pay		Average Monthly Benefit	
Benefit Type	Males and Females		Males and Females	
	(thousands)		($)	
Orphan	58		244	
Disabled Contributor's Child	77		244	

The approach used in this report to project future benefits paid is based on macrosimulation, which means that the projections rely on grouped data. The amount of benefit expenditures is determined by taking into account the administrative agreement between the CPP and the QPP for beneficiaries who had contributed to both plans.

The retirement, survivor, disability, and children's benefit expenditures for each year following the year of benefit take-up for a given age, sex, and cohort is computed as the product of:

➢ benefit expenditures in the year of take-up (described later in this Appendix);

➢ the probability of survival from the age at benefit take-up to the attained age;

➢ the rules regarding combined retirement and survivor benefits and combined disability and survivor benefits, as applicable; and

➢ the Pension Index, which recognizes the annual inflation adjustment to benefits each 1 January following benefit emergence.

The amounts of the benefits payable during any given calendar year are then obtained by simply summing the annual expenditures applicable for the year as described above, in respect of all age and sex cohorts having emerged in the given and all previous calendar years. The projected number of beneficiaries and amounts of benefit expenditures for the base and additional Plans are shown in various tables in the Results sections 4 and 5 of this report.

All projections of base CPP benefits start from the year 1966 instead of the beginning of the current projection period (2019). This is done for the following reasons:

➢ The valuation methodology can be validated for the historical period up to the valuation year (1966 to 2018) by comparing the projected values (contributions, benefits, beneficiaries, etc.) with actual experience. Based on this comparison, calibration factors are obtained which are then used for the projections of the different types of benefit. For example, the calibration factors for retirement benefit experience for those starting their pension between ages 60 and 65 are 0.97 for males and 0.96 for females.

➢ The projection of benefits already in pay as at the valuation date (31 December 2018) is fully integrated with the projection of benefits emerging after that date thus ensuring full consistency between past experience and the future.

Since the additional Plan is a new component of the CPP as of 1 January 2019, there are no additional benefits in pay as at the valuation date. As such, the same calibration factors developed for the base Plan benefits are assumed to apply to the additional Plan projected benefits except in the case of the additional retirement benefits, where microsimulation was used to estimate the calibration factors. As experience develops for the additional Plan, more precise calibration factors for each type of benefit will be determined separately for that CPP component.

B.7.2   Benefit Eligibility Rates

As described in Appendix A (Summary of Plan Provisions) of this report, eligibility for benefits varies according to the type of benefit. The eligibility rules for the survivor benefit are the same as for the death benefit. The eligibility rules for base CPP benefits determine eligibility for additional CPP benefits.

Benefit eligibility rates (as a percentage of Canada less Québec population) for retirement, disability, and death/survivor benefits are projected using regression formulae that were developed to closely reproduce historical eligibility rates observed from CPP records of earnings data provided by ESDC over the period 1966 to 2016. The projected eligibility rates take into account the applicable eligibility rules for each type of benefit, the proportion of contributors, and the length of the contributory period for existing and future earners.

The disability and survivor benefit eligibility rates developed as above must be adjusted to project the earnings-related portion of these two types of benefits. Table 73 shows the resulting eligibility rates for the various benefit types by sex and age for selected years.

The retirement eligibility rates for some ages and years are greater than 100% due to individuals who contributed to the CPP and then left the country with no further information available as to their status. Since these individuals are not counted in the population, the retirement eligibility rates can be higher than 100%.

| Table 73 | **Benefit Eligibility Rates by Type of Benefit (percentages)** |

	Retirement Benefit Eligibility Rate at Age 65		Survivor/Death Benefit Eligibility Rate at Age 65	
Year	Males	Females	Males	Females
2019	105.5	101.4	100.0	73.7
2020	105.0	101.2	100.0	74.6
2021	104.6	101.1	99.9	75.5
2022	104.2	101.0	99.8	76.3
2023	103.8	100.9	99.7	77.0
2024	103.3	100.8	99.6	77.6
2025	102.9	100.7	99.4	78.2
2030	101.1	99.7	98.2	80.4
2035	100.1	99.3	97.4	81.6
2040	100.9	100.2	96.9	82.4
2045	101.7	101.0	96.7	83.1
2050	101.6	100.9	96.8	83.6
2055	102.5	101.8	97.1	84.2
2060	102.6	101.9	97.6	84.7
2065	102.4	101.8	97.9	85.1
2075	103.0	102.4	98.5	85.8
2085	103.8	103.3	99.0	86.5
2095	103.8	103.4	99.3	86.9

	Survivor/Death Benefit Eligibility Rate at Ages 20-64		Disability Benefit Eligibility Rate at Ages 20-64 [1]		Post-Retirement Disability Benefit Eligibility Rate at Ages 60-64 [2]	
Year	Males	Females	Males	Females	Males	Females
2019	81.0	72.4	73.7	66.4	52.4	45.1
2020	81.2	72.8	74.3	67.2	53.1	45.8
2021	81.0	72.8	74.9	67.7	53.8	46.3
2022	81.1	73.1	75.4	68.1	55.0	47.2
2023	81.5	73.5	76.2	68.8	55.4	47.6
2024	82.5	74.2	77.0	69.4	55.3	47.6
2025	82.7	74.5	77.4	69.7	55.6	47.8
2030	83.8	75.9	78.9	71.7	57.4	49.7
2035	85.2	77.3	79.9	73.5	58.6	50.9
2040	86.2	78.2	80.5	74.5	59.7	52.1
2045	86.9	78.9	80.2	74.5	59.9	52.5
2050	87.5	79.3	80.1	74.7	59.9	52.6
2055	87.9	79.8	80.2	74.9	60.1	53.0
2060	88.2	80.2	80.5	75.2	59.9	53.0
2065	88.6	80.7	81.2	75.8	60.5	53.3
2075	89.1	81.3	81.5	76.3	60.9	53.9
2085	89.5	81.7	81.5	76.5	61.0	53.9
2095	89.8	82.1	81.7	76.7	61.0	54.0

(1) These are eligibility rates for the disability benefit prior to starting the retirement pension, i.e. for the disability pension only, excluding eligibility for the post-retirement disability benefit. Eligibility for the post-retirement disability benefit is shown separately in the table.
(2) Applies to base CPP only.

B.7.3 Adjustments to Proportion of Contributors and Pensionable Earnings for Benefit Computation Purposes

The effect of credit-splitting of pensionable earnings between spouses or common-law partners in the event of divorce or separation is accounted for by adjusting the projected proportion of contributors and average pensionable earnings of the respective spouses or common-law partners.

The average pensionable earnings used to determine the initial amounts of the retirement pensions are also adjusted to exclude the earnings of working beneficiaries. Table 74 presents the resulting adjusted proportion of contributors. The average pensionable earnings up to the YMPE and the YAMPE for benefit computation purposes appear in Table 75 and Table 76, respectively.

Table 74	Proportion of Contributors to CPP (adjusted for benefit computation purposes) (percentages)[1]					
	Males			Females		
Age Group	2019	2025	2050	2019	2025	2050
20-24	77.4	81.9	85.0	77.7	81.0	85.5
25-29	88.0	89.2	92.4	84.3	85.4	90.5
30-34	90.6	92.0	93.9	83.9	86.1	89.9
35-39	90.3	92.7	93.6	83.3	86.5	89.7
40-44	89.0	89.9	91.5	83.4	84.5	87.3
45-49	88.2	90.8	92.0	83.7	84.9	87.6
50-54	84.5	86.4	88.2	80.3	81.7	85.0
55-59	76.5	80.0	82.9	70.1	73.1	77.7
60-64	60.1	62.6	66.8	50.9	52.9	57.7
65-69	24.6	29.1	31.6	17.4	19.5	23.1
All Ages	75.0	76.7	78.9	69.9	71.1	75.0

(1) The proportion of contributors shown excludes working beneficiaries.

Table 75   **Average Pensionable Earnings up to YMPE (adjusted for benefit computation purposes)[1]**
(dollars)

Age Group	Males			Females		
	2019	2025	2050	2019	2025	2050
20-24	26,034	30,038	59,730	21,662	25,114	51,136
25-29	37,289	43,181	88,258	33,370	38,919	81,370
30-34	41,515	48,260	99,310	36,453	42,728	89,760
35-39	43,344	50,552	104,156	38,504	45,264	94,917
40-44	44,457	51,633	106,447	40,132	46,914	98,308
45-49	44,852	52,159	107,411	40,821	47,790	100,084
50-54	44,696	51,966	106,737	40,629	47,522	99,410
55-59	42,945	49,790	101,652	38,693	45,323	94,373
60-64	41,379	47,853	96,441	36,855	43,147	88,731
65-69	37,977	44,362	88,423	32,722	38,004	77,990
All Ages	39,910	46,668	95,163	35,604	41,857	87,046
YMPE	57,400	67,100	140,500	57,400	67,100	140,500

(1)   Average pensionable earnings shown exclude the earnings of working beneficiaries.

Table 76   **Average Pensionable Earnings up to YAMPE (adjusted for benefit computation purposes) [1]**
(dollars)

Age Group	Males			Females		
	2019 [2]	2025	2050	2019 [2]	2025	2050
20-24	–	30,756	61,091	–	25,436	51,809
25-29	–	45,575	92,994	–	40,600	85,087
30-34	–	51,832	106,499	–	45,260	95,392
35-39	–	54,727	112,614	–	48,307	101,599
40-44	–	56,128	115,582	–	50,248	105,578
45-49	–	56,744	116,681	–	51,170	107,444
50-54	–	56,468	115,821	–	50,781	106,534
55-59	–	53,906	109,891	–	48,253	100,781
60-64	–	51,817	104,293	–	45,944	94,799
65-69	–	48,344	96,341	–	40,800	84,092
All Ages	–	50,233	102,334	–	44,409	92,623
YAMPE		76,400	160,100		76,400	160,100

(1)   Average pensionable earnings shown exclude the earnings of working beneficiaries.
(2)   Average pensionable earnings up to the YAMPE are not shown for the year 2019, since the YAMPE is only applicable starting in 2024.

B.7.4   Average Earnings-Related Benefits

Base CPP

To determine base CPP benefits, the valuation model first calculates an average earnings-related benefit for all individuals born in a given calendar year, for each sex, and all relevant ages. This average earnings-related benefit is dependent on four main components:

➢ Average pensionable earnings, adjusted for benefit computation purposes, relative to the YMPE;

➢ Average proportion of contributors adjusted for benefit computation purposes;

➢ 25% of the MPEA for the attained year; and

➢ the number of years in the elapsed contributory period at the attained age.

The base CPP average earnings-related benefit is then further adjusted to take into account certain provisions of the CPP statute as applicable:

➢ Disability exclusion: the period during which an individual received a CPP disability pension is excluded from the contributory period;

➢ Child-rearing provision (exclusion): the period during which an individual was caring for a child younger than age 7 is excluded from the contributory period if earnings during the child-rearing period were sufficiently low;

➢ Post-65 drop-out: earnings of contributors over age 65, who are not yet retirement beneficiaries, may replace earnings before age 65 if those earnings are lower;

➢ General drop-out provision (exclusion): 17% of the lowest earnings months up to a maximum of about 8 years may be dropped from the contributory period.

Table 77 shows the resulting projected average earnings-related benefit for the base CPP as a percentage of the maximum base CPP benefit at ages 60 and 65 by sex and year of birth for various cohorts of contributors. The average base CPP earnings-related benefit for males at age 65 as a percentage of the maximum is about 10 to 15 percentage points lower than at age 60 due to the fact that males who take their benefit at age 65 have a longer contributory period (producing lower career average earnings) and an historical lower earnings profile than those who take an early benefit at age 60. For females, the difference between age 60 and 65 is less pronounced for older cohorts of contributors but increases for younger cohorts.

The earnings-related benefits for males as a percentage of the maximum are expected to generally decrease over time because of the lower participation and pensionable earnings (as a proportion of the YMPE) of younger contributors in the early years of their contributory period. For females, this decline is offset by the expected higher earnings of future female cohorts. As a result, the gap between the male and female average base CPP earnings-related benefits is expected to decrease over time.

Table 77	Average Earnings-Related Benefit as Percentage of Maximum Benefit - Base CPP			
	Average Earnings-Related Benefit (%)			
	Males		Females	
Year of Birth	Age 60	Age 65	Age 60	Age 65
1950	79	65	59	52
1951	79	65	59	52
1952	80	65	62	52
1953	79	64	62	52
1954	79	65	62	53
1955	79	64	63	53
1960	75	65	61	54
1965	72	62	60	53
1970	71	61	61	54
1980	73	62	63	55
1990	73	62	65	56
2000	73	62	66	57
2010	73	62	67	58
2020	73	62	67	58

Additional CPP

For the additional CPP, the valuation model also calculates an average earnings-related benefit based on contributors' highest earnings over forty years for all persons of a birth cohort for each calendar year, sex, and all relevant ages. This average earnings-related additional benefit is dependent on four main components:

➢ average additional pensionable earnings adjusted for benefits purposes relative to the YMPE;

➢ average proportion of contributors adjusted for benefit computation purposes;

➢ 8.33% of the MPEA plus 33.33% of 14% of the MPEA for the attained year; and

➢ the fixed contributory period of 40 years.

The additional CPP average earnings-related benefit is further adjusted to take into account certain provisions of the CPP statute as applicable:

➢ Disability drop-in: individuals who become disabled in 2019 or later will have imputed income assigned to those disability periods; and

➢ Child-rearing provision (drop-in): an imputed income may be assigned to periods of caring for children younger than age 7 on or after 1 January 2019.

The average additional earnings-related benefit is used in the calculation of the total emerging additional earnings-related benefit expenditures for a given calendar year, for each sex, and all relevant ages.

Table 78 shows the resulting projected average additional earnings-related benefits as a percentage of the maximum additional benefit at ages 60 and 65 by sex and year of birth for various cohorts of contributors. The maximum additional benefit is the maximum benefit for both parts of the additional CPP, that is, below the YMPE, and from the YMPE up to YAMPE combined together.

The average additional earnings-related benefit for males at age 65 as a percentage of the maximum is about 3 to 5 percentage points higher than at age 60 due to the longer contributory periods, which is beneficial in the context of the additional CPP fixed forty years contributory period. For females, the difference between age 60 and 65 is less pronounced.

The additional earnings-related benefits as a percentage of the maximum are expected to increase over time for both males and females, since contributory periods are projected to increase relative to the fixed forty years. For later birth cohorts, it is projected that the gap between male and female average earnings-related benefits will stay about the same over time.

Table 78	Average Additional Earnings-Related Benefit as Percentage of Maximum Additional Benefit - Additional CPP			
	Average Earnings-Related Benefit (%)			
	Males		Females	
Year of Birth	Age 60	Age 65	Age 60	Age 65
1965	5	9	4	7
1970	10	15	8	12
1980	25	28	21	24
1985	31	35	26	29
1990	37	41	31	34
2000	45	48	39	41
2010	45	48	39	42
2020	45	48	40	42

B.7.5   Retirement Pension Expenditures

Retirement expenditures result from retirement pensions paid under the base and additional CPP. The retirement pensions paid under both components of the CPP are earnings-related. The total retirement pension payable is the sum of the base and additional pension amounts.

Retirement Pension

New retirement expenditures are determined for each age 60 and older, sex, and calendar year of emergence starting from 1967. Total new retirement benefits are calculated as the product of:

➢ the population;

➢ the retirement pension eligibility rate;

➢ the retirement pension take-up rate;

> ➢ the actuarial adjustment factor for early or late pension take-up; and

> ➢ the average earnings-related benefit previously described.

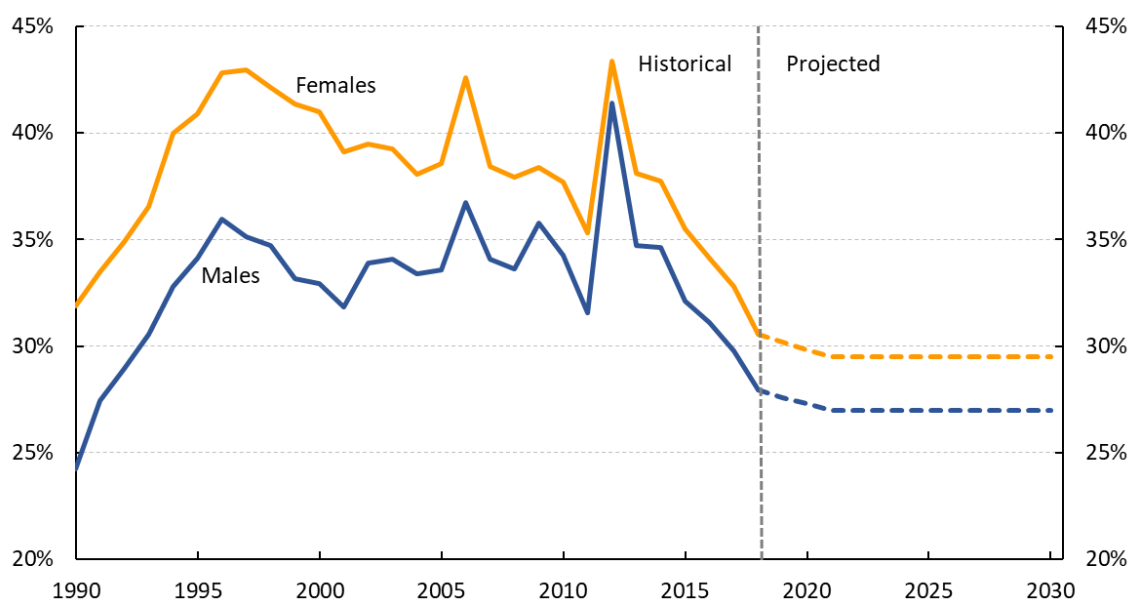## Retirement Benefit Take-up Rates

The retirement benefit take-up rates (or more simply retirement take-up rates) by age, sex, and calendar year are determined by taking into account the assumed future work patterns of earners aged 60 and over and the corresponding CPP experience from 1967 to 2018. The assumed rates correspond to the ratio of the number of emerging retirement beneficiaries to the product of the population and the retirement benefit eligibility rate (i.e. the ratio of the number of new retirement beneficiaries to the eligible population).

The unreduced pension age under the Canada Pension Plan is 65. Since 1987, a person can choose to receive a reduced retirement pension as early as age 60. This provision has had the effect of lowering the average age at pension take-up. In 1986, the average age at pension take-up was 65.2, compared to about 62.5 over the decade ending in 2018.

Chart 13 presents the evolution of the retirement take-up rates at age 60 for males and females respectively. In 2012, there was a significant increase observed in the retirement take-up rates at age 60 for the cohort reaching age 60 that year. The retirement take-up rates at age 60 in 2012 were 41% and 43% for males and females, respectively, compared to the corresponding rates of 32% and 35% in 2011. The observed increase in the retirement take-up rates at age 60 in 2012 may have resulted from two provisions of the *Economic Recovery Act (stimulus)* of 2009:

1. The work cessation test to receive the pension early (prior to age 65) was removed in 2012, so that starting that year, individuals no longer needed to lower their earnings to take an early CPP retirement pension.

2. Greater reductions in early retirement pensions were scheduled to be phased in over a five-year period, starting in 2012.

After 2012, the age 60 retirement take-up rates gradually decreased to below their pre-2012 levels as the higher actuarial adjustments were phased in, the effect of the removal of the work cessation test diminished and individuals stayed longer in the workforce. For cohorts reaching age 60 in 2018, the retirement take-up rates are 27.9% and 30.6% for males and females, respectively, which are the lowest rates since 1992. Take-up rates at age 60 are assumed to further decrease over the next three years such that for cohorts reaching age 60 in 2021 and thereafter, the retirement take-up rates are assumed to be 27.0% for males and 29.5% for females.

Chart 13   Historical and Projected Retirement Pension Take-up Rates at age 60

The retirement take-up rates for ages 61 to 64 and 66 to 69 for the year 2019 and thereafter are determined using the observed averages over the last three years ending in 2018. To reflect the waiving of the requirement for an application for the retirement pension upon reaching age 70, as provided under Bill C-97 – *Budget Implementation Act, 2019, No. 1[1]*, the retirement take-up rate for age 70 is set to equal the average of the last three years of the total retirement take-up rates of ages 70 and over.

The retirement take-up rates at age 65 are derived such that the sum of the retirement rates for each cohort is 100%. The resulting rates at age 65 are determined to be 46.4% in 2026 and thereafter, for both sexes. Table 79 shows the projected retirement take-up rates by age for both males and females.

The assumed retirement take-up rates result in a projected average age at retirement pension take-up of 63.4 years. This compares to an average retirement take-up age of 62.4 years in 2012.

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[1] *The Budget Implementation Act, 2019, No. 1* received Royal Assent on 21 June 2019. Under the CPP statute, formal provincial consent by way of Orders in Council are not required for the waiving of the retirement pension application upon reaching age 70.

Table 79	Retirement Pension Take-up Rates (2021+) (percentages)	
	Cohort aged 60 in 2021+	
Age	Males	Females
60	27.0	29.5
61	4.8	5.0
62	4.0	4.2
63	3.6	3.5
64	7.0	6.7
65	46.4	46.4
66	1.8	1.3
67	1.3	0.9
68	0.9	0.6
69	1.2	0.7
70	2.0	1.2
Total	100.0	100.0

Projected New Retirement Pensions

Table 80 shows the projected number of new retirement beneficiaries and their projected average base and additional monthly retirement pensions by sex. New additional average retirement pensions are quite low in the early years due to the lower benefit accrual rates during the phase-in period and the few years of additional contributions. These averages are projected to grow rapidly as the number of years of contributions to the additional CPP increases.

Table 80   New Retirement Beneficiaries and Pensions

Base CPP

Year	Number of New Retirement Beneficiairies			Average Monthly Retirement Pension		
	Males	Females	Total	Males	Females	Total
				($)	($)	($)
2019	171,927	176,473	348,400	685	552	617
2020	196,774	209,673	406,447	647	500	571
2021	186,475	189,640	376,115	706	576	640
2022	191,680	195,064	386,745	721	591	655
2023	199,503	203,018	402,521	735	606	670
2024	201,344	205,604	406,948	764	632	697
2025	202,770	207,260	410,030	780	649	714
2030	193,331	199,477	392,808	881	753	816
2035	181,811	191,715	373,526	1,015	878	945
2040	184,507	197,431	381,937	1,181	1,030	1,103
2045	204,566	215,582	420,148	1,368	1,202	1,283
2050	229,679	235,201	464,881	1,591	1,414	1,501
2055	249,669	250,634	500,303	1,849	1,661	1,755
2060	254,814	255,530	510,344	2,154	1,946	2,050
2065	241,553	249,530	491,082	2,517	2,284	2,399
2075	246,442	258,334	504,776	3,356	3,081	3,215
2085	269,008	278,334	547,342	4,500	4,149	4,321
2095	286,277	297,839	584,116	6,068	5,603	5,831

Additional CPP

Year	Number of New Retirement Beneficiairies			Average Monthly Retirement Pension		
	Males	Females	Total	Males	Females	Total
				($)	($)	($)
2019	95,400	86,973	182,373	0	0	0
2020	119,942	108,055	227,997	2	1	2
2021	130,312	118,654	248,965	3	3	3
2022	139,245	127,688	266,934	6	5	6
2023	149,684	138,075	287,759	9	8	9
2024	156,366	145,526	301,892	15	13	14
2025	160,972	150,744	311,715	21	18	20
2030	169,216	166,161	335,377	66	54	60
2035	181,338	191,382	372,721	130	107	118
2040	184,507	197,431	381,937	212	176	193
2045	204,566	215,582	420,148	318	264	290
2050	229,679	235,201	464,881	451	375	412
2055	249,669	250,634	500,303	615	512	563
2060	254,814	255,530	510,344	799	668	734
2065	241,553	249,530	491,082	955	803	878
2075	246,442	258,334	504,776	1,270	1,088	1,177
2085	269,008	278,334	547,342	1,700	1,469	1,583
2095	286,277	297,839	584,116	2,299	1,990	2,142

Retirement Beneficiaries Mortality

Projections of retirement pensions in pay require applying survival probabilities to current and new retirement beneficiaries. The mortality rates of CPP retirement beneficiaries used in the projections vary by age, sex, calendar year, and level of emerging pension. The mortality rates were developed based on CPP retirement beneficiaries' mortality experience for the year 2015 and the mortality improvement assumptions for the general population in this report. The resulting projected mortality rates and life expectancies of retirement beneficiaries are shown in Table 81, Table 82, and Table 83.

Table 81	Mortality Rates of Retirement Beneficiaries [1] (annual deaths per 1,000)							
	Males				Females			
Age	2019	2025	2050	2075	2019	2025	2050	2075
60	5.5	4.8	3.8	3.1	2.8	2.6	2.1	1.7
65	11.0	9.7	7.7	6.3	6.6	6.0	4.8	3.9
70	16.4	14.6	11.6	9.5	11.3	10.4	8.4	6.9
75	27.0	24.1	19.2	15.7	18.4	17.0	13.8	11.3
80	45.4	40.5	32.3	26.4	32.0	29.4	23.7	19.4
85	82.1	73.4	58.4	47.8	58.3	53.0	42.5	34.8
90	146.3	132.6	110.4	94.5	107.0	97.8	81.7	69.9

(1) The projected mortality rates of retirement beneficiaries vary by level of emerging pension.

Table 82	Life Expectancies of Retirement Beneficiaries, with improvements after the year shown [1],[2]							
	Males				Females			
Age	2019	2025	2050	2075	2019	2025	2050	2075
60	25.7	26.2	27.7	29.2	28.5	28.9	30.3	31.6
65	21.2	21.6	23.1	24.5	23.7	24.1	25.5	26.7
70	17.0	17.5	18.8	20.0	19.3	19.7	20.9	22.1
75	13.2	13.6	14.7	15.9	15.2	15.5	16.7	17.7
80	9.7	10.1	11.1	12.0	11.4	11.7	12.7	13.6
85	6.8	7.1	7.9	8.6	8.1	8.4	9.2	9.9
90	4.5	4.8	5.3	5.7	5.5	5.7	6.2	6.7

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

(2) The projected life expectancies of retirement beneficiaries result from their projected mortality rates, which vary by level of emerging pension as shown in Table 83.

Table 83	Life Expectancies of Retirement Beneficiaries by Level of Base CPP Pension (2019), with future improvements [1]							
	CPP Level of Pension as % of Maximum							
	Males				Females			
Age	< 37.5%	37.5-75%	75-95%	95-100%	< 37.5%	37.5-75%	75-95%	95-100%
60	24.3	24.8	25.9	26.7	27.8	28.5	29.3	29.5
65	20.3	20.5	21.2	22.0	23.2	23.7	24.5	24.6
70	16.4	16.4	17.0	17.6	18.9	19.3	19.9	20.0
75	12.7	12.7	13.2	13.5	14.9	15.2	15.7	15.7
80	9.4	9.4	9.7	9.9	11.2	11.4	11.8	11.8
85	6.5	6.5	6.8	6.8	8.0	8.1	8.4	8.4
90	4.4	4.4	4.5	4.5	5.4	5.5	5.6	5.6

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

B.7.6   Post-Retirement Benefit Expenditures

Post-retirement benefits are paid to retirement beneficiaries who continue to work and contribute to the Plan. Post-retirement benefits are payable under both the base and additional CPP.

Working retirement beneficiaries younger than 65 are required along with their employers to contribute, whereas contributions are voluntary once reaching age 65 (up to age 69). Employers of those working beneficiaries opting to contribute are required to also contribute. The post-retirement contributions paid in a year are applied toward providing post-retirement benefits in the following years. Post-retirement benefits are described in more details in Appendix A – Summary of Plan Provisions.

Table 84 presents the assumed share of CPP retirement beneficiaries who work and contribute to the CPP in the year of and years following pension take-up, by age and sex.

The assumption corresponding to the year of retirement pension take-up is kept constant after 2025, to reflect the phase-in of the additional CPP. In the year of retirement, contributions are first applied toward maximizing the base and additional retirement pensions, with remaining contributions then applied toward a post-retirement benefit. The contributions to the additional Plan increase over the phase-in period both due to the increase in the contribution rate and the introduction of the YAMPE over two years. This affects the proportion of working beneficiaries who contribute in the year of pension take-up. This proportion is assumed to remain constant once the phase-in is complete in 2025.

The assumption for the proportion of CPP retirement beneficiaries who are contributors after the year of retirement pension take-up is kept constant for the entire projection period.

The figures in the table reflect that not all working beneficiaries contribute to the CPP, due to the following:

➢ having earnings less than the YBE, and

➢ opting out of contributing between the ages 65 and 69.

Table 84	Proportion of CPP Retirement Beneficiaries who are Contributors (percentages)			
	Year of Retirement Pension Take-Up (2025+)		After Year of Retirement Pension Take-Up	
Age	Males	Females	Males	Females
60	45	30	0	0
61	55	40	70	58
62	50	40	48	40
63	55	40	47	35
64	75	55	42	30
65	24	19	40	30
66	47	47	27	20
67	47	43	20	15
68	43	38	15	10
69	36	28	9	6

In order to project the contributions that will result from working beneficiaries, assumptions are required with respect to their average contributory earnings (i.e., average earnings between the YBE and YAMPE on which contributions are made). For both males and females, the average contributory earnings of working beneficiaries for years after the year of retirement pension take-up are assumed to be between 20% and 35% lower than the contributory earnings of contributors who are not beneficiaries, depending on the age and sex. The resulting average annual contributory earnings of working beneficiaries up to the YMPE and YAMPE are presented respectively in Table 85 and Table 86.

Table 85	Average Contributory Earnings of Working Beneficiaries up to the YMPE (dollars)				
	Below Age 65			Age 65 and Above	
Year	Males	Females		Males	Females
2019	32,480	25,627		31,419	24,587
2020	33,295	26,350		32,184	25,268
2021	34,233	27,214		33,040	26,010
2022	35,190	28,154		33,934	26,711
2023	36,157	29,156		34,856	27,449
2024	37,257	30,250		35,876	28,297
2025	38,394	31,364		36,940	29,217
2030	44,050	36,605		42,545	34,331
2035	49,646	41,449		48,294	39,286
2040	57,227	48,112		55,680	45,686
2045	66,932	56,826		65,112	53,936
2050	78,892	67,720		76,566	64,043
2055	92,491	79,992		89,489	75,461
2060	107,833	93,792		104,196	88,364
2065	124,212	108,303		120,147	102,262
2075	165,288	144,159		160,253	136,834
2085	223,206	194,732		216,039	184,837
2095	302,284	263,853		292,180	250,243

Table 86	Average Contributory Earnings of Working Beneficiaries up to the YAMPE (dollars)				
	Below Age 65			Age 65 and Above	
Year [1]	Males	Females		Males	Females
2024	38,481	30,618		37,242	28,944
2025	40,785	32,133		39,753	30,470
2030	46,702	37,481		45,715	35,856
2035	52,374	42,155		51,736	40,927
2040	60,260	48,872		59,583	47,597
2045	70,536	57,889		69,692	56,359
2050	83,346	69,342		82,062	67,165
2055	97,880	82,196		96,006	79,337
2060	114,184	96,557		111,810	93,013
2065	131,357	111,383		128,820	107,573
2075	174,380	147,850		171,575	143,773
2085	235,516	199,845		231,254	194,267
2095	319,287	271,243		312,914	263,192

(1) The years shown start in 2024 since it is the first year the YAMPE applies.

Around 450,000 working beneficiaries started to contribute in 2012, generating about an extra $1.0 billion in contributions that year. The number of working beneficiaries who contribute grew to about 562,000 in 2016 with corresponding contributions representing about $1.5 billion.

The corresponding post-retirement benefits started to be payable the year after contributions were made. In 2013, post-retirement benefits totaled about $63 million for contributions made in 2012. In 2017, post-retirement benefits amounted to $410 million based on contributions made in 2016 and before.

Table 87 shows the projected number of working beneficiaries with their contributions and resulting post-retirement benefits by year. Contributions and benefits are split between the base and additional CPP. Total contributions from working beneficiaries are projected to be about $1.7 billion in 2019 and $6.8 billion in 2050. Total post-retirement benefits payable are projected to be about $637 million in 2019 and $8.4 billion in 2050.

The projected number of working beneficiaries who contribute, their earnings, and contributions are reflected in all other tables in this report that present contributors, earnings, and contributions projections, unless otherwise indicated. Similarly, the post-retirement benefits are presented in combination with retirement benefits as total retirement expenditures in all other tables in this report where expenditures are shown by type of benefit, unless otherwise indicated.

Table 87	Working Beneficiaries – Contributors, Contributions, and Post-Retirement Benefits				
	Number of Contributing Working Beneficiaries	Base CPP		Additional CPP	
Year		Contributions	Post-Retirement Benefits	Contributions	Post-Retirement Benefits
	(thousands)	($ million)	($ million)	($ million)	($ million)
2019	588	1,613	637	49	0
2020	603	1,695	760	103	6
2021	618	1,788	891	181	18
2022	633	1,884	1,032	286	39
2023	649	1,987	1,184	401	72
2024	665	2,101	1,331	476	123
2025	678	2,212	1,486	553	174
2030	661	2,497	2,342	623	499
2035	626	2,688	3,224	661	883
2040	641	3,181	4,091	779	1,294
2045	707	4,116	4,995	1,011	1,757
2050	793	5,451	6,087	1,351	2,312
2055	857	6,915	7,513	1,724	2,979
2060	892	8,402	9,364	2,100	3,782
2065	864	9,401	11,601	2,344	4,719
2075	876	12,694	16,768	3,143	6,843
2085	945	18,473	23,683	4,575	9,666
2095	1,019	26,944	34,046	6,692	13,907

B.7.7   Disability Benefit Expenditures

Disability expenditures result from disability benefits paid under the base and additional CPP.

Under the base CPP, disability benefits consist of the disability pension and the post-retirement disability benefit. The base CPP disability pension consists of both a flat-rate and earnings-related benefit. The post-retirement disability benefit is equal to the flat-rate benefit.

Under the additional CPP, disability benefits consist only of the additional disability pension which is an earnings-related benefit. Eligibility for the additional disability pension follows from eligibility for the base disability pension. There is no post-retirement disability benefit payable under the additional CPP.

Disability Pension

New disability pension expenditures are determined by age and sex for each year starting in 1970 as the product of:
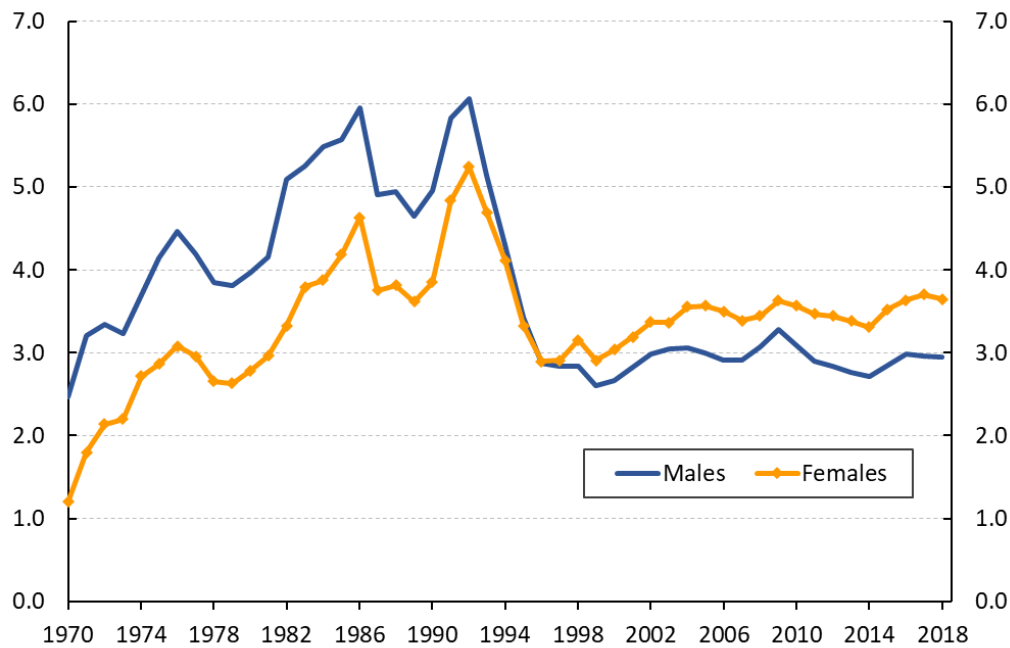
➢   the population;

➢   the disability eligibility rate;

➢   the disability incidence rate; and

➢   the annual amount of the benefit.

The value of the emerging earnings-related benefits by age and sex is equal to the sum of 75% of the average retirement earnings-related benefits for the base and additional Plans.

Disability Incidence Rates

Chart 14 shows the historical disability incidence rates for the CPP disability pension, and Table 88 provides the assumed ultimate disability incidence rates for the disability pension (base and additional CPP) and the assumed disability incidence rates for the post-retirement disability benefit (base CPP).

Chart 14   Historical Disability Incidence Rates
(per 1,000 eligible)

It can be seen from Chart 14 that the incidence of new CPP disability cases (i.e. the number of new cases as a proportion of the eligible population) generally increased from 1970 to the early 1990s. The annual rate of change in incidence rates was particularly acute between 1989 and the recession of the early 1990s. After reaching a peak in 1992, disability incidence rates then declined rapidly during the 1990s and have remained relatively stable since the early 2000s up to recently.

The decline after 1992 reflects the economic recovery that occurred following the 1990-91 recession. As well, beginning in 1994, the CPP administration initiated a range of measures designed to effectively manage the growing pressure on the disability program.

The above trends and the facts that the overall female incidence rate has been higher than the overall male incidence rate since 1996, with the female-male differential generally increasing over the period 2009 to 2015, were taken into account when setting the ultimate assumption for the aggregate disability incidence rates. The estimated rates for years 2016 to 2018, based on available data from Service Canada, were also taken into account.

Based on the above, the aggregate (all ages combined using the 2018 population for weights) incidence rates for the disability pension for 2019 and thereafter are projected to remain constant at the values in 2018 of 2.95 and 3.65 per thousand eligible males and females, respectively. These projected aggregate rates are then distributed by age in accordance with the 2018 eligible population for each sex.

Post-retirement Disability Benefit Incidence Rates

Since no CPP data were yet available as at the time of this report to develop the assumption for the incidence of disability among CPP early retirees, data from the Québec Pension Plan (QPP), which has a similar provision, have been used. Once CPP data become available, it will be used to develop this assumption for future CPP actuarial reports.

Under the QPP, there is a provision for an "additional amount for disability" payable to retirement beneficiaries younger than 65. Effective 2013, QPP retirement beneficiaries younger than 65 who are deemed disabled after the first six months of their retirement pension start date may be eligible to receive the additional amount for disability, which is added to their retirement pension. The additional amount equals the flat-rate portion of the QPP disability benefit. The additional amount ceases to be paid once an individual turns 65.

Given that the eligibility requirements for a disability benefit are similar under the CPP and QPP, and that the QPP additional amount for disability is similar to the CPP post-retirement disability benefit, the assumption for the disability incidence rates in respect of the QPP additional amount for disability were used, as given in Table 36 of the Actuarial Valuation Report on the QPP as at 31 December 2015. These incidence rates are shown in Table 88. The incidence rates are applicable to the population of in-pay retirement beneficiaries aged 61 to 64, that is, excluding new beneficiaries who emerge during the year.

Table 88	Ultimate Disability Incidence Rates (2019+) [1] (per 1,000 eligible)			
	Disability Pension		Post-retirement Disability Benefit [2]	
Age	Males	Females	Males	Females
25	0.32	0.30	–	–
30	0.64	0.86	–	–
35	1.00	1.69	–	–
40	1.52	2.44	–	–
45	2.15	3.32	–	–
50	3.56	5.06	–	–
55	6.45	7.40	–	–
60	9.16	9.12	–	–
61	9.14	9.07	2.90	2.20
62	9.11	9.03	5.60	5.20
63	9.09	8.98	8.30	6.10
64	9.06	8.93	8.50	4.60
All Ages	2.95	3.65	6.23	4.64

(1) The disability incidence rates shown are adjusted by the eligible population in 2018.
(2) The assumed incidence rates for the post-retirement disability benefit are set equal to those assumed in the Actuarial Valuation of the Québec Pension Plan as at 31 December 2015, as shown in Table 36 of that report.

Projected New Disability Benefits

Table 89 shows the projected number of new disability beneficiaries for the disability pension and post-retirement disability benefit, and Table 90 shows the projected average new disability benefits for the base disability pension, additional disability pension, and base post-retirement disability benefit by sex and year.

Table 89   **New Disability Beneficiaries**

Base CPP
Number of Beneficiaries

	Disability Pension			Post-retirement Disability Benefit			ALL Disability Benefits		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2019	19,148	21,276	40,424	1,648	1,229	2,877 [1]	20,796	22,504	43,301
2020	19,348	21,541	40,888	923	646	1,569	20,271	22,186	42,458
2021	19,511	21,748	41,259	928	647	1,575	20,439	22,395	42,834
2022	19,589	21,854	41,443	946	659	1,605	20,536	22,512	43,048
2023	19,731	22,054	41,785	960	670	1,630	20,691	22,724	43,415
2024	19,856	22,261	42,117	967	675	1,642	20,823	22,936	43,759
2025	19,905	22,376	42,281	978	684	1,662	20,883	23,060	43,943
2030	20,152	23,148	43,300	891	634	1,525	21,043	23,782	44,825
2035	21,242	24,691	45,933	895	652	1,547	22,136	25,343	47,480
2040	22,896	26,377	49,272	918	685	1,604	23,814	27,062	50,876
2045	24,456	27,711	52,167	1,047	770	1,817	25,503	28,481	53,984
2050	25,404	28,558	53,962	1,158	828	1,986	26,563	29,385	55,948
2055	25,638	28,973	54,611	1,268	892	2,160	26,907	29,865	56,772
2060	25,284	29,162	54,446	1,300	913	2,213	26,584	30,075	56,660
2065	25,459	29,760	55,219	1,201	878	2,079	26,660	30,638	57,298
2075	27,303	31,768	59,071	1,268	934	2,202	28,571	32,702	61,273
2085	29,288	33,900	63,188	1,393	1,012	2,406	30,681	34,912	65,594
2095	30,462	35,356	65,818	1,478	1,082	2,560	31,940	36,438	68,378

Additional CPP
Number of Beneficiaries

	Disability Pension			Post-retirement Disability Benefit			ALL Disability Benefits		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2019	12,089	11,675	23,764	–	–	–	12,089	11,675	23,764
2020	14,071	13,798	27,869	–	–	–	14,071	13,798	27,869
2021	15,150	15,113	30,262	–	–	–	15,150	15,113	30,262
2022	15,975	16,120	32,094	–	–	–	15,975	16,120	32,094
2023	16,775	17,110	33,885	–	–	–	16,775	17,110	33,885
2024	17,631	18,164	35,795	–	–	–	17,631	18,164	35,795
2025	18,032	18,774	36,806	–	–	–	18,032	18,774	36,806
2030	19,218	21,160	40,378	–	–	–	19,218	21,160	40,378
2035	21,242	24,691	45,933	–	–	–	21,242	24,691	45,933
2040	22,896	26,377	49,272	–	–	–	22,896	26,377	49,272
2045	24,456	27,711	52,167	–	–	–	24,456	27,711	52,167
2050	25,404	28,558	53,962	–	–	–	25,404	28,558	53,962
2055	25,638	28,973	54,611	–	–	–	25,638	28,973	54,611
2060	25,284	29,162	54,446	–	–	–	25,284	29,162	54,446
2065	25,459	29,760	55,219	–	–	–	25,459	29,760	55,219
2075	27,303	31,768	59,071	–	–	–	27,303	31,768	59,071
2085	29,288	33,900	63,188	–	–	–	29,288	33,900	63,188
2095	30,462	35,356	65,818	–	–	–	30,462	35,356	65,818

(1)   The projected higher number of new base CPP PRDB beneficiaries in 2019 than in 2020 is attributable to retirement beneficiaries who were acteady disabled reior to 2019 who could apply to receive the PRDB as of 2019.

	Base CPP			Additional CPP			Base CPP
	Average Monthly Disability Pension			Average Monthly Disability Pension			Post-retirement
Year	Males	Females	Total	Males	Females	Total	Disability Benefit
2019	995	932	962	0	0	0	496
2020	1,031	962	995	2	1	1	506
2021	1,049	981	1,014	4	3	3	516
2022	1,069	1,003	1,035	7	6	7	527
2023	1,092	1,027	1,058	12	10	11	537
2024	1,117	1,052	1,082	18	16	17	548
2025	1,143	1,078	1,109	26	22	24	559
2030	1,297	1,228	1,260	77	64	70	617
2035	1,476	1,401	1,436	134	111	122	681
2040	1,680	1,599	1,637	204	167	185	752
2045	1,906	1,822	1,862	287	234	258	831
2050	2,161	2,074	2,115	379	307	341	917
2055	2,448	2,360	2,402	476	384	427	1,013
2060	2,780	2,689	2,732	567	457	508	1,118
2065	3,168	3,065	3,113	651	530	586	1,234
2075	4,102	3,976	4,035	875	719	791	1,505
2085	5,316	5,158	5,232	1,179	974	1,069	1,834
2095	6,910	6,704	6,800	1,581	1,308	1,434	2,236

Table 90 — New Disability Pensions and Post Retirement Disability Benefits (dollars)

Disability Benefit Termination Rates

All emerging disability benefits (disability pensions and post-retirement disability benefits) are projected by age and sex for each future year until termination of disability (due to recovery, death, or attainment of age 65). The projected disability termination rates presented in Table 91 apply by age, sex, and duration of disability (i.e. the period of being in receipt of a disability benefit) on an attained calendar year basis. The average graduated experience over the 15-year period 2003 to 2017 is used to produce base year rates for 2016. The base year termination rates are then projected for 2019 and thereafter for males and females, by age of disability onset, and duration of disability using assumed recovery and mortality improvement rates.

Recovery improvement rates are assumed to trend to an ultimate level of 0% by 2023 (i.e. recovery rates are assumed to be constant after 2023), and mortality improvement rates of disability beneficiaries are assumed to trend to an ultimate level of 0.8% by the same year.

Table 91   Disability Termination Rates in 2019 and 2035 [1]
(per 1,000 people)

2019

	Males						Females					
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year
Age												
30	42	51	62	47	42	27	38	51	50	42	37	27
40	42	55	48	36	31	21	33	51	45	30	23	18
50	63	70	52	38	32	24	44	59	44	30	22	16
60	73	75	56	45	42	0	53	59	40	28	28	0

2035

	Males						Females					
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year
Age												
30	39	49	60	45	40	26	35	48	49	40	36	27
40	38	52	46	34	29	19	30	47	43	29	22	17
50	56	64	48	35	30	21	39	55	41	28	20	15
60	65	67	51	41	37	0	47	53	36	25	25	0

(1)   Assumed termination rates for all disability benefits (disability pension and post-retirement disability benefit).

B.7.8   Survivor Pension Expenditures

Survivor expenditures result from survivor's benefits paid under the base and additional CPP. Under both components of the CPP, the survivor's pension changes form at age 65.

Under the base CPP, the survivor's pension payable to individuals younger than 65 consists of a flat-rate and earnings-related benefit. At ages 65 and older, the pension payable is earnings-related. The additional survivor's pension payable takes the same form as the base survivor's pension, except that the additional survivor's pension is strictly earnings-related with no flat-rate benefit payable.

New Survivor's Pension

New survivor pension expenditures are determined by age and sex for each year starting in 1968 as the product of:

➢   the number of deaths in the population;

➢   the probability of being married or in common-law union at the time of death;

➢   the survivor eligibility rate;

➢   the husband and wife age distribution;

➢   the annual amount of the benefit (flat-rate and average earnings-related benefits); and

➢   if applicable, the appropriate factor taking into account the base CPP earnings-related benefit limits that apply to combined survivor-disability and combined survivor-retirement pensions.

For each age and sex, the actual proportions of contributors married or in a common-law relationship at the time of death are determined from benefit statistics. The smoothed averages from recent experience over the years 2005 to 2017, with further adjustments for younger and older ages, are used to determine the assumed proportions for future years. On the basis of the trends shown over the period 2005 to 2017, the proportions are extrapolated to 2020 and kept constant thereafter. These proportions account for benefits payable to same-sex couples. Values are shown in Table 92.

Table 92	Proportion of Contributors Married or in Common-Law Relationship at Time of Death (percentages)	
Age	Males	Females
20	2	1
30	16	20
40	44	54
50	54	60
60	58	58
70	65	52
80	68	35
90	52	12

The value of the emerging earnings-related survivor benefit is equal to 37.5% or 60% of the average retirement earnings-related benefit, depending on whether the surviving spouse or common-law partner is under age 65 or aged 65 or older, respectively. It is further adjusted to account for the fact that eligibility rules are more stringent for survivor benefits than for retirement benefits.

The projected number of new survivor beneficiaries by age (below 65, and 65 and older) is shown in Table 93. The projected average monthly survivor pensions of emerging (new) benefits for the base and additional CPP by age and sex are shown in Table 94.

Table 93	New Survivor Beneficiaries

Base CPP
Number of New Survivor Beneficiaries

	Under 65			65 and Over			All Ages		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2019	8,403	41,201	49,604 [1]	15,290	43,610	58,899	23,692	84,811	108,503
2020	5,410	16,366	21,776	16,003	44,904	60,907	21,412	61,270	82,683
2021	5,370	16,282	21,652	16,569	46,107	62,675	21,939	62,389	84,328
2022	5,332	16,179	21,511	17,145	47,385	64,530	22,477	63,565	86,042
2023	5,297	16,105	21,402	17,735	48,747	66,482	23,032	64,852	87,884
2024	5,279	16,106	21,385	18,341	50,197	68,538	23,621	66,303	89,923
2025	5,244	16,034	21,278	18,950	51,730	70,680	24,194	67,764	91,958
2030	5,128	15,673	20,801	21,981	60,578	82,559	27,110	76,251	103,360
2035	5,142	15,401	20,543	24,597	70,266	94,863	29,739	85,667	115,407
2040	5,218	15,308	20,525	26,355	78,287	104,641	31,573	93,594	125,167
2045	5,287	15,460	20,748	27,293	83,328	110,621	32,580	98,788	131,368
2050	5,286	15,751	21,037	27,679	85,895	113,574	32,965	101,646	134,611
2055	5,209	15,916	21,125	27,957	86,678	114,635	33,166	102,594	135,760
2060	5,086	15,834	20,921	28,415	87,258	115,673	33,501	103,092	136,594
2065	4,976	15,508	20,485	29,045	89,867	118,912	34,021	105,376	139,397
2075	4,873	14,805	19,678	30,192	99,900	130,092	35,065	114,705	149,770
2085	4,799	14,506	19,304	30,379	105,844	136,222	35,177	120,349	155,527
2095	4,655	14,269	18,924	30,294	104,995	135,289	34,949	119,264	154,213

Additional CPP
Number of New Survivor Beneficiaries

	Under 65			65 and Over			All Ages		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2019	2,871	8,061	10,932	2,065	1,697	3,761	4,936	9,758	14,694
2020	3,384	9,759	13,143	2,958	2,785	5,743	6,342	12,544	18,887
2021	3,644	10,496	14,140	3,584	3,665	7,249	7,228	14,161	21,389
2022	3,832	11,032	14,865	4,200	4,647	8,847	8,032	15,679	23,712
2023	3,994	11,494	15,488	4,843	5,758	10,600	8,837	17,252	26,089
2024	4,171	12,012	16,183	5,532	7,021	12,553	9,704	19,033	28,736
2025	4,259	12,283	16,541	6,250	8,424	14,675	10,509	20,707	31,216
2030	4,571	13,209	17,780	10,414	17,976	28,390	14,985	31,185	46,170
2035	5,095	14,567	19,662	15,712	32,480	48,192	20,808	47,047	67,854
2040	5,204	14,960	20,164	20,137	49,158	69,294	25,341	64,118	89,459
2045	5,285	15,331	20,616	23,423	64,805	88,228	28,708	80,136	108,844
2050	5,286	15,712	20,998	25,661	75,416	101,077	30,947	91,129	122,076
2055	5,209	15,908	21,118	27,029	81,682	108,711	32,238	97,591	129,828
2060	5,086	15,834	20,920	28,081	85,606	113,687	33,168	101,439	134,607
2065	4,976	15,508	20,485	28,961	89,534	118,495	33,937	105,042	138,979
2075	4,873	14,805	19,678	30,191	99,900	130,091	35,065	114,705	149,769
2085	4,799	14,506	19,304	30,379	105,844	136,222	35,177	120,349	155,527
2095	4,655	14,269	18,924	30,294	104,995	135,289	34,949	119,264	154,213

(1) The projected number of new base CPP survivors for the year 2019 is higher than for other years as a result of the introduction of Bill C-74, which enables survivors younger than 35 years old who were previously ineligible for a survivor's pension to become eligible starting 1 January 2019.

Table 94	New Survivor Pensions (dollars)

Base CPP
Average New Monthly Survivor's Pension

	Under 65			65 and Over		
Year	Males	Females	Total	Males	Females	Total
2019	417	390	395	152	354	302
2020	388	465	446	154	354	302
2021	396	473	454	157	355	302
2022	406	482	463	161	357	305
2023	416	492	473	167	361	309
2024	426	502	483	174	366	314
2025	437	513	494	182	372	321
2030	497	573	554	229	413	364
2035	568	646	626	285	469	421
2040	649	733	712	347	536	488
2045	740	834	810	415	611	563
2050	844	948	922	489	697	646
2055	962	1078	1049	572	793	739
2060	1098	1224	1193	668	907	848
2065	1251	1391	1357	782	1046	981
2075	1,631	1,812	1,767	1,071	1,402	1,325
2085	2,124	2,364	2,304	1,462	1,884	1,790
2095	2,767	3,082	3,005	1,983	2,527	2,405

Additional CPP
Average New Monthly Survivor's Pension

	Under 65			65 and Over		
Year	Males	Females	Total	Males	Females	Total
2019	0	0	0	0	0	0
2020	1	1	1	0	0	0
2021	1	1	1	1	1	1
2022	3	3	3	1	1	1
2023	4	4	4	2	1	2
2024	6	7	7	3	2	2
2025	9	9	9	4	2	3
2030	26	28	28	10	7	8
2035	46	51	50	18	14	16
2040	72	83	80	31	25	27
2045	101	122	117	51	44	46
2050	135	170	162	81	75	76
2055	171	226	212	123	124	124
2060	209	285	266	179	196	192
2065	246	343	320	247	290	280
2075	336	475	441	415	532	505
2085	455	643	596	622	838	790
2095	612	864	802	871	1,183	1,113

Survivor Beneficiaries Mortality

All survivor pensions emerging by year, age, and sex of the surviving spouse or common-law partner are projected to each subsequent year using the assumed survivor mortality rates, which reflect the higher mortality of widows and widowers compared to that of the general population. The assumed survivor mortality rates are developed based on survivor beneficiaries' mortality experience over the period 1966 to 2017 and the mortality improvement assumptions for the general population in this report. Table 95 and Table 96 show the projected mortality rates of survivor beneficiaries and the resulting projected life expectancies of survivor beneficiaries by age and sex, respectively.

Table 95	Mortality Rates of Survivor Beneficiaries (annual deaths per 1,000)							
	Males				Females			
Age	2019	2025	2050	2075	2019	2025	2050	2075
60	8.8	7.8	6.2	5.1	6.1	5.5	4.5	3.6
65	13.6	12.0	9.5	7.8	9.3	8.5	6.8	5.6
70	21.3	19.0	15.1	12.4	14.4	13.3	10.7	8.8
75	33.6	30.0	23.9	19.6	22.4	20.7	16.7	13.7
80	54.2	48.4	38.5	31.5	35.8	32.9	26.5	21.7
85	89.1	79.6	63.4	51.9	60.2	54.8	43.9	35.9
90	151.5	137.3	114.3	97.8	107.5	98.3	82.1	70.2

Table 96	Life Expectancies of Survivor Beneficiaries, with improvements after the year shown [1]							
	Males				Females			
Age	2019	2025	2050	2075	2019	2025	2050	2075
60	24.2	24.7	26.4	27.9	27.3	27.7	29.3	30.7
65	19.9	20.4	21.9	23.4	22.8	23.2	24.7	26.0
70	16.0	16.4	17.8	19.1	18.7	19.0	20.4	21.6
75	12.4	12.8	14.0	15.2	14.8	15.1	16.3	17.4
80	9.2	9.6	10.6	11.6	11.2	11.6	12.5	13.5
85	6.5	6.8	7.6	8.3	8.1	8.4	9.2	9.9
90	4.4	4.6	5.1	5.5	5.5	5.7	6.2	6.7

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

B.7.9 Death Benefit Expenditures

Death benefits are flat-rate amounts that are payable only under the base CPP. There are no death benefits under the additional Plan.

The amount of lump sum death benefits payable each year is determined by age and sex as the product of:

➢ the number of deaths at ages 18 and over in the population;

➢ the survivor eligibility rate; and

➢ the amount of death benefit determined by the year of death:

- As of 1 January 2019, a flat-rate payment of $2,500, regardless of the earnings history of the deceased contributor.
- Before 2019, 50% of the average annual earnings-related benefit capped at 10% of the YMPE for the year of death prior to 1998 and at $2,500 therefater.

Table 97 shows the projected number of death benefits.

Table 97	Number of Death Benefits		
Year	Males	Females	Total
2019	94,809	64,589	159,398
2020	96,620	66,770	163,391
2021	98,463	68,982	167,445
2022	100,433	71,307	171,740
2023	102,650	73,758	176,407
2024	105,017	76,368	181,385
2025	107,423	79,065	186,488
2030	121,685	94,688	216,373
2035	138,522	113,405	251,927
2040	154,423	133,203	287,625
2045	166,248	151,061	317,309
2050	173,792	164,330	338,122
2055	178,081	172,713	350,794
2060	180,067	176,634	356,701
2065	183,273	179,291	362,564
2075	201,004	194,077	395,082
2085	220,068	213,415	433,484
2095	224,387	222,440	446,827

B.7.10 Children's Benefit Expenditures

Children's benefits are flat-rate amounts that are payable only under the base CPP. There are no children's benefits under the additional Plan. The amount of the benefit payable to orphans and to children of disabled contributors is the same.

The number of disabled contributor's child and orphan benefits emerging each year starting in 1970 and 1968, respectively, are determined by the projected number of children of new disability and/or survivor beneficiaries, based on the assumed fertility rates. The resulting number of emerging child beneficiaries by age, sex, and calendar year are thereafter projected from one year to the next, incorporating the following reasons for termination of benefits:

➢ attainment of age 25 by the child;

➢ ceasing full-time attendance at school while over age 18; and

➢ regarding disabled contributor's child benefits only, termination (by reason of recovery, death, or attainment of age 65) of the parent's disability benefits.

As of 1 January 2019, eligible children of early retirees who are deemed disabled and meet disability eligibility requirements receive the children's benefit.

Table 98 shows the projected number of new children's benefits by type and year.

Table 98	New Children's Benefits		
Year	Disabled Contributor's Child [1]	Orphans	Total
2019	13,883	7,957	21,840
2020	14,332	8,036	22,368
2021	14,819	8,069	22,889
2022	15,249	8,132	23,381
2023	15,793	8,235	24,028
2024	16,217	8,355	24,572
2025	16,559	8,407	24,966
2030	18,249	8,814	27,063
2035	20,109	9,332	29,441
2040	21,763	9,780	31,543
2045	22,710	9,946	32,656
2050	23,051	9,795	32,847
2055	23,140	9,505	32,645
2060	23,490	9,277	32,767
2065	24,250	9,155	33,404
2075	25,971	9,043	35,015
2085	27,323	8,807	36,131
2095	28,638	8,532	37,170

(1) Includes benefits payable to children of disabled retirees receiving the post-retirement disability benefit.

B.8 Operating Expenses

Base CPP

The operating expenses of the base CPP have historically arisen from different sources including ESDC, the CRA, Public Services and Procurement Canada, the Office of the Superintendent of Financial Institutions Canada, the Department of Finance Canada, and the CPPIB, where the majority of the operating expenses are attributable to ESDC and the CRA. For the purpose of this report, operating expenses of the CPPIB are included in the investment expenses assumptions for the base CPP. In the calendar year 2018, operating expenses for the base Plan from all sources other than the CPPIB amounted to about $636 million.

Base on recent experience from 2009 to 2018, the annual operating expenses of the base CPP (excluding the CPPIB) were on average 0.092% of total annual employment earnings. ESDC and the CRA provided preliminary estimates of their operating expenses for fiscal years 2019-2020 to 2021-2022. Based on both the average experience of the last 10 years and the preliminary

estimates of ESDC and the CRA, it is assumed that the base CPP operating expenses will represent 0.090% of total annual earnings for 2019 and thereafter.

The total employment earnings basis used in the determination of the assumption and projection of operating expenses include earnings from working beneficiaries.

Table 99 shows the projected total operating expenses of the base CPP as a percentage of total earnings.

Table 99	Operating Expenses – Base CPP [1]		
Year	Operating Expenses ($ million)	Total Earnings [2] ($ million)	Operating Expenses as % of Total Earnings (%)
2019	659	732,277	0.09
2020	683	758,974	0.09
2021	707	785,928	0.09
2022	733	814,427	0.09
2023	759	842,988	0.09
2024	786	873,092	0.09
2025	814	904,728	0.09
2030	971	1,078,761	0.09
2035	1163	1,291,680	0.09
2040	1388	1,542,660	0.09
2045	1663	1,848,125	0.09
2050	1984	2,204,546	0.09
2055	2349	2,610,127	0.09
2060	2769	3,077,219	0.09
2065	3267	3,629,902	0.09
2075	4,619	5,132,621	0.09
2085	6,563	7,292,564	0.09
2095	9,264	10,293,046	0.09

(1) CPPIB operating expenses are not included in base Plan operating expenses, but are accounted for separately in the investment expenses assumption.
(2) Total earnings used to project operating expenses include earnings from working beneficiaries

Additional CPP

The operating expenses of the additional CPP arise from the same sources as the base CPP. For the purpose of this report, operating expenses of the CPPIB are included in the investment expenses assumptions for the additional CPP.

As ESDC and the CRA are responsible for the majority of the CPP operating expenses, the short-term projections of the additional CPP operating expenses are based on preliminary estimates provided by the two organizations for fiscal years 2019-2020 to 2021-2022. Operating expenses incurred in calendar years 2017 and 2018 represent the start-up costs of the additional Plan. For the purpose of this report, it is assumed that the operating expenses for these two years will be

charged to the Additional Canada Pension Plan Account in calendar year 2019, along with the expenses incurred in that year. The total amount of the operating expenses in calendar year 2019 is estimated to be $92 million.

Over the long term, it is assumed that the operating expenses of the additional CPP will be significantly lower than for the base CPP due to the use of the existing CPP infrastructure. It is projected that the additional CPP operating expenses will represent 0.01% of total annual earnings for 2024 and thereafter.

Table 100 shows the projected operating expenses of the additional CPP as a percentage of total earnings. As more information on the additional CPP operating expenses becomes available, these estimates will be revised in future actuarial reports.

Table 100	Operating Expenses - Additional CPP [1]		
Year	Operating Expenses [2] ($ million)	Total Earnings [3] ($ million)	Operating Expenses as % of Total Earnings (%)
2019	92	732,277	0.01
2020	76	758,974	0.01
2021	79	785,928	0.01
2022	81	814,427	0.01
2023	84	842,988	0.01
2024	87	873,092	0.01
2025	90	904,728	0.01
2030	108	1,078,761	0.01
2035	129	1,291,680	0.01
2040	154	1,542,660	0.01
2045	185	1,848,125	0.01
2050	220	2,204,546	0.01
2055	261	2,610,127	0.01
2060	308	3,077,219	0.01
2065	363	3,629,902	0.01
2075	513	5,132,621	0.01
2085	729	7,292,564	0.01
2095	1,029	10,293,046	0.01

(1)   CPPIB operating expenses are not included in additional Plan operating expenses, but are accounted for separately in the investment expenses assumption.

(2)   It is assumed that operating expenses incurred in calendar years preceding 2019 will be charged to the Additional CPP Account in the calendar year 2019, along with the expenses incurred in that year.

(3)   Total earnings used to project operating expenses include earnings from working beneficiaries.

Appendix C   – Financing the Canada Pension Plan

C.1   Historical and Legislative Background

The retirement system in Canada has been designed as a three-tier system. First, the Old Age Security (OAS) program provides a minimum floor benefit based on age and residence in Canada. Second, the CPP and QPP cover most individuals with employment earnings. Finally, individuals may be covered by registered pension plans (RPPs) as well as pooled registered pension plans (PRPPs), and can invest in individual registered retirement savings plans (RRSPs) and tax-free saving accounts (TFSAs) to supplement their retirement income.

Each tier is financed using a different approach: the OAS program is financed through general tax revenues on a pay-as-you-go basis, the CPP and QPP each consist of base and additional plans, which are respectively partially and fully funded based on contributions on employment earnings, and RPPs, PRPPs, RRSPs, and TFSAs are intended to be fully funded. The variety in both the sources and methods of financing enables the Canadian retirement income system to be more resilient to changes in demographic, economic, and investment conditions compared to systems that are less varied in their provision of retirement income.

The CPP was initially established as a pay-as-you-go plan with a small reserve fund worth about two years of benefits. At the time of the Plan's inception, demographic, economic, and investment conditions were characterized by a younger population (higher fertility rates and lower life expectancies), rapid growth in wages and labour force participation, and low rates of return on investments. These conditions made prefunding the scheme unattractive and pay-as-you-go financing more appropriate. Growth in total earnings of the workforce and thus contributions were sufficient to cover growing expenditures without requiring large increases in the contribution rate. The Plan's assets were invested primarily in long-term non-marketable securities of provincial governments at lower than market rates, thus providing the provinces with a relatively inexpensive source of capital to develop needed infrastructure.

However, changing conditions over time, including lower birth rates, increased life expectancies, and lower real wage growth led to increasing Plan costs. These factors, in combination with higher market returns, made fuller funding more attractive and appropriate. By the mid-1980s, the net cash flow (contributions less expenditures) had turned negative and part of the Plan's investment income was required to meet the shortfall. The shortfall continued to grow, which eventually caused the assets of the reserve fund to start to fall by the mid-1990s.

In the December 1993 (15th) Actuarial Report on the CPP, the Chief Actuary projected that the pay-as-you-go contribution rate (expenditures as a percentage of contributory earnings) would increase to 14.2% by 2030. It was further projected that if changes were not made to the Plan, the reserve fund would be exhausted by 2015. The Chief Actuary identified five factors responsible for the increasing costs of the Plan, namely: lower birth rates, higher life expectancies than projected, the effect of the early 1990s recession on the proportions of earners and average employment earnings, benefit enrichments, and increased numbers of Canadians claiming disability benefits for longer periods.

In response to these developments, amendments were made in 1998 to gradually increase the level of CPP funding by increasing contribution rates over the short term, reducing the growth of benefits over the long term, and investing net cash flows in the private markets through the CPPIB to achieve higher rates of return. It was also decided that any future increases to benefits or additions of new benefits under the Plan should be fully funded. The reform package agreed to by the federal and provincial governments in 1997 thus included significant changes to the Plan's financing provisions:

➢ The introduction of _steady-state funding_ to replace pay-as-you-go financing in order to build a reserve of assets and stabilize the ratio of assets to expenditures over time. Investment income on this pool of assets is projected to help pay benefits as the large cohort of baby boomers retires. This refers to paragraph 113.1(4)(c) of the _Canada Pension Plan_.

➢ The introduction of _full funding_ that requires that changes to the CPP that increase benefits or add new benefits be fully funded, i.e. that their costs be paid as the benefits are earned and that any costs associated with benefits that have already been earned but not paid for must be amortized and paid for over a defined period of time consistent with common actuarial practice. This refers to paragraph 113.1(4)(e) of the _Canada Pension Plan_.

Both of the financing objectives (steady-state and full funding) were introduced to improve fairness across generations and improve the financial long-term sustainability of the base Plan. The move to steady-state funding eases some of the contribution burden on future generations, while under full funding each generation that will receive benefit enrichments is more likely to pay for such enrichments in full so that the associated costs are not passed on to future generations.

The steady-state and any full funding contribution rates in respect of the base CPP are determined by the Chief Actuary in accordance with paragraphs 115(1.1)(c) and (e) of the _Canada Pension Plan_ and the prescribed regulations (discussed below).

With the challenge facing younger generations of securing adequate retirement savings at a time when fewer can expect to work in jobs that will include a workplace pension plan, the federal and provincial governments agreed in 2016 to expand the CPP by creating the additional CPP.

The full funding of the additional CPP is a result of the 1997 reforms to the Plan, specifically the requirement to fully fund any increased or new benefits. In accordance with paragraph 113.1(4)(d) of the _Canada Pension Plan_, the additional retirement, survivor, and disability benefits provided by the additional Plan are to be financed by additional contribution rates that (i) are no lower than the lowest constant rates that can be maintained over the foreseeable future, and (ii) result in projected revenues (contributions and investment income) that are sufficient to fully pay the projected expenditures of the additional CPP over the long term.

The rates referred to in paragraph 113.1(4)(d) of the CPP statute are the first and second additional minimum contribution rates (FAMCR, SAMCR), which apply, respectively, to the first and second tier of the additional CPP. The AMCRs are determined by the Chief Actuary in

accordance with paragraphs 115(1.1)(d) and (e) of the *Canada Pension Plan* and the prescribed regulations (discussed below). The AMCRs are calculated before and after accounting for any future increase in benefits or new benefits in accordance with the full funding requirements of paragraph 113.1(4)(e) of the CPP statute.

The regulations regarding the calculation of contribution rates for the base CPP were amended in 2018 to clarify the calculation and application of the de minimis rule (described below) and to set out the calculation of the additional minimum contribution rates for the additional CPP. These regulations are the *Calculation of Contribution Rates Regulations, 2018*.

C.2   Calculation of Base and Additional Minimum Contribution Rates

Base CPP

The financing objective of the base Plan is stated in the CPP statute in terms of the steady-state contribution rate and full funding rate for any increased or new benefits. The minimum contribution rate for the base CPP is the sum of the steady-state contribution rate and full funding rate as described below.

C.2.1   Steady-State Contribution Rate

The steady-state contribution rate calculation is specifically defined in the *Calculation of Contribution Rates Regulations, 2018* as the lowest level contribution rate, applicable after the end of the review period, to the nearest 0.01% that results in the projected assets/expenditures (A/E) ratio of the base Plan being the same in the 10^{th} and 60^{th} years following the end of the review period. For this report, the end of the review period is 2021. Therefore, the steady-state contribution rate is applicable for 2022 and thereafter and the relevant years for the determination of the steady-state contribution rate are 2031 and 2081. The corresponding A/E for those years is determined to be 7.5, and the steady-state contribution rate, which is rounded to the nearest 0.01%, is determined to be 9.71% for the year 2022 and thereafter for this report.

The steady-state contribution rate is calculated separately from the full funding rate for any increased or new benefits.

C.2.2   Full Funding Rate of Increased or New Benefits

Subparagraph 115(1.1)(c)(ii) and paragraph 115(1.1)(f) of the CPP statute require the Chief Actuary to specify, in the report, a contribution rate in respect of any increased or new benefits for the base CPP in accordance with the requirements of paragraph 113.1(4)(e). The amendments to the *Canada Pension Plan* introduced under Bill C-74 (*Budget Implementation Act, 2018, No. 1*), which received Royal Assent on 21 June 2018, include amendments in respect of the base CPP that required the application of 113.1(4)(e). The amendments under Bill C-74 are described in Appendix A – Summary of Plan Provisions of this report and in the 29^{th} CPP Actuarial Report.

The amendments under Bill C-74 represent the second time that the full funding requirement was invoked for the base Plan. The first time was in respect of the 2008 amendments (enhanced eligibility for disability benefits for long-term contributors). The temporary and permanent full funding contribution rate calculations for the base CPP are defined in the *Calculation of Contribution Rates Regulations, 2018*.

According to the *Calculation of Contribution Rates Regulations, 2018*, if the full funding rate before rounding is less than 0.02%, then the full funding rate is deemed to be zero. This is referred to as the "de minimis" rule. The full funding rate in respect of the 2008 amendments was first determined in the 22nd CPP Actuarial Report. Since the 26th CPP Actuarial Report, the full funding rate has been determined to be below 0.02% and thus deemed to be zero in accordance with the de minimis rule. As such, the improvement in benefits from the 2008 amendments is financed entirely by the steady-state contribution rate.

The 29th Actuarial Report supplementing the 27th and 28th Actuarial Reports on the Canada Pension Plan as at 31 December 2015 shows the effects of the amendments under Bill C-74 on the long-term financial states of the base and additional CPP. The effect of the amendments on the base and additional CPP were re-evaluated for this 30th CPP Actuarial Report.

On the basis of this report, the full funding rates for the base CPP were determined as follows.

Temporary Full Funding Rate

Since amended base CPP survivor, disability, and death benefits that will come into pay after 1 January 2019 are based on contributors' CPP participation both before and after the effective date of the proposed amendments, there is a portion of the projected increase in liabilities that relates to Plan participation prior to the effective date. The increase in liabilities for Plan participation prior to 2019 is determined as at the year following the triennial review period, or as at the effective date of the amendments if later. The triennial review period in respect of this report is 2019 to 2021. As such, this increase in liabilities is calculated as the present value as at 1 January 2022 of the projected increase in base CPP expenditures relating to Plan participation prior to 2019 and is estimated at $1.6 billion.

The net accumulated assets in respect of the past unfunded liabilities are determined at the end of year 2021 based on the:

➢ projected increase in expenditures relating to Plan participation prior to 2019 over the years 2019 to 2021, and

➢ contributions calculated using the temporary full funding rate of the previous (29th) report over the same period.

These net accumulated assets are equal to -$93 million[1] as at 31 December 2021.

The temporary full funding contribution rate in respect of the increase in liabilities is determined to be 0.0281%. The temporary full funding rate is equal to the ratio of:

➢ the difference of the increase in liabilities and the net accumulated assets to

➢ the present value as at 1 January 2022 of contributory earnings over the period 2022 through 2033.

The amortization of the past unfunded liabilities was initially over the 15-year period 2019-2033 in the 29th CPP Actuarial Report. As the valuation date of this 30th CPP Actuarial Report is three years later than the valuation date of the 29th Report, the amortization period is reduced by three years to the 12-year period 2022-2033. The amortization period under both reports is consistent with common actuarial practice, as provided in the legislation.

Permanent Full Funding Rate

As for past participation, the increase in liabilities for Plan participation on or after 1 January 2019 is determined as at the year following the triennial review period, or as at the effective date of the amendments if later.

As such, the increased liabilities due to the base CPP amendments in respect of participation on or after 1 January 2019 is determined as at 1 January 2022 and are estimated to be $1.9 billion, and the corresponding net accumulated assets are estimated to be $80 million as at 31 December 2021. The difference between these liabilities and assets is fully funded with a permanent contribution rate of 0.0071%.

The sum of the temporary and permanent full funding rates for the years 2022-2033 is 0.0351% (0.0281% plus 0.0071%) and 0.0071% for 2034 and thereafter. The rounded full funding rate is 0.04% for years 2022 to 2033 and 0.01% for the year 2034 and thereafter. The calculations and results are summarized in Table 101.

The Chief Actuary will review the full funding rates on a periodic basis to account for actual experience and any change in assumptions.

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[1] The negative accumulation of assets net of expenditures over the period 2019-2021 in respect of Plan participation prior to 2019 results from the progression of the expenditures relative to the contributions over time. The accumulated assets are reduced further by applying a rounded full funding rate in accordance with regulations instead of an unrounded rate.

Table 101	Full Funding Rates in Respect of the Amendments to the Base CPP		
Present Value of Contributory Earnings (2022-2033) as at 1 Jan. 2022	(A) [1]	($ billion)	6,186
Increase in Liability after 2021 due to Participation prior to Effective Date (1 Jan. 2019) as at 1 Jan. 2022	(B) [2]	($ million)	1,642
Net Accumulated Assets over Period 2019-2021 for Service prior to 2019 as at 31 Dec. 2021	(C) [3]	($ million)	-93 [4]
Temporary Full Funding Rate (2022-2033)	(D) = (B-C)/(A)		0.0281%
Present Value of Contributory Earnings (2022+) as at 1 Jan. 2022	(E) [1]	($ billion)	25,387
Increase in Liability after 2021 due to Participation on or after Effective Date (1 Jan. 2019) as at 1 Jan. 2022	(F) [2]	($ million)	1,871
Net Accumulated Assets over Period 2019-2021 for Future Service from 2019 Onward as at 31 Dec. 2021	(G) [3]	($ million)	80
Permanent Full Funding Rate (2022+)	(H) = (F-G)/(E)		0.0071%
Permanent and Temporary Rate (2022-2033)	(I) = (D) + (H)		0.0351%
Permanent and Temporary Rate, after Rounding as per Regulations	(I), (H) after rounding applied as per Regulations		0.04%, 2022-2033 0.01%, 2034+

(1) Present values based on contributory earnings as projected under this report and using a discount rate equal to the assumed overall rate of return on base CPP assets.

(2) Increase in liabilities resulting from increase in benefits due to participation prior to the effective date (B) and on or after the effective date (F), using a discount rate equal to the assumed overall rate of return on base CPP assets.

(3) Represents accumulation of assets net of expenditures over the period 2019-2021 in respect of amendments for participation prior to the effective date (C) and on or after the effective date (G), using the full funding rates determined under the 29th CPP Actuarial Report.

(4) The negative accumulation of assets net of expenditures over the period 2019-2021 in respect of Plan participation prior to 2019 results from the progression of the expenditures relative to the contributions over time. The accumulated assets are reduced further by applying a rounded full funding rate in accordance with regulations instead of an unrounded rate.

C.2.3   Minimum Contribution Rate

The minimum contribution rate (MCR) is the sum of the rounded steady-state contribution rate and the rounded full funding rate. For this report, the MCR is determined to be 9.75% for years 2022 to 2033 and 9.72% for 2034 and thereafter. This compares to the MCR under the 29th CPP Actuarial Report of 9.82% for years 2022 to 2033 and 9.80% for 2034 and thereafter. The MCR will be recalculated for the next triennial actuarial report to be prepared as at 31 December 2021. It may also be recalculated at any other date to reflect the cost impact of any other proposed amendments to the CPP statute.

As the MCR determined for this 30th CPP Actuarial Report is less than the legislated contribution rate of 9.9%, the insufficient rates provisions in subsections 113.1(11.05) to (11.15) of the CPP statute do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated contribution rate will remain at 9.9% for the year 2019 and thereafter.

Additional CPP

C.2.4   Additional Minimum Contribution Rates

The financing objective of the additional Plan is stated in the CPP statute in terms of the AMCRs (FAMCR and SAMCR) that must be determined before and after taking into account the full funding of any increased or new additional benefits.

The AMCRs are defined specifically in the *Calculation of Contribution Rates Regulations, 2018* as the lowest level contribution rates, applicable after the end of the review period, to the nearest 0.0001 percentage points, such that the following conditions are met:

➢ the present value of projected additional open group obligations are at least equal to the projected additional assets and present value of projected additional contributions (open group assets);

➢ the projected assets/expenditures (A/E) ratio of the additional Plan is the same in the 50^{th} and 60^{th} years following the end of the review period, but no earlier than in the years 2088 and 2098, respectively; and

➢ the SAMCR equals the FAMCR multiplied by the ratio of the earnings replacement rate of the second tier of the additional Plan to the replacement rate of the first tier (33.33% / 8.33%, which equals 4).

In regard to the first condition above, an open group is defined as one that includes all current and future participants of a plan, where the plan is considered to be ongoing into the future, that is, over an extended time horizon. This means that future contributions of current and new participants and their associated benefits are included in order to determine whether current assets and future contributions will be sufficient to pay for all future expenditures.

The requirement of the first condition to use an open group approach satisfies the requirement of "sufficiency" of the AMCRs formulated in subparagraph 113.1(4)(d)(ii) of the *Canada Pension Plan*. Since the open group methodology is based on projections of future income and expenditures, the requirement of the additional CPP open group assets to be at least 100% of its open group actuarial obligations ensures that, at the valuation date, the projected additional contributions and investment income are sufficient to cover the projected additional expenditures over the long term.

To determine the open group assets of the additional Plan, future additional contributions (using additional minimum contribution rates) of current and future contributors are projected using the best-estimate assumptions of this report. In order to determine their present value, the projected additional contributions are discounted using the assumed nominal rate of return on the additional CPP assets. This present value is added to the invested assets of the additional Plan to obtain the total open group assets.

To determine the actuarial obligations of the additional Plan on an open group basis, future additional expenditures with respect to current and future additional CPP participants are projected using the best-estimate assumptions of this report. The open group actuarial obligations is then the present value of these projected additional expenditures discounted using the assumed nominal rate of return on additional CPP assets.

The requirement of the second condition to match the A/E ratios in the 50[th] and 60[th] years following the end of the review period satisfies the requirement of "stability" of the AMCRs formulated in subparagraph 113.1(4)(d)(i) of the *Canada Pension Plan*. The matching of the A/E ratios and thus stabilization of the ratios over the long term is aimed at ensuring the adequacy of projected contributions and investment income to cover projected expenditures at any point in time without projecting changes in the AMCRs. For this report, the stabilization years for the A/E ratio are 2088 and 2098, and the corresponding A/E ratio for those years is equal to about 25.

The current triennial review period of the CPP is 2019 to 2021, which is part of the initial phase-in period of the additional CPP. During the review period, the legislated first additional contribution rate applies: 0.3% for the year 2019, 0.6% for 2020, and 1.0% for 2021.

The FAMCR is applicable for 2022 and thereafter, and the SAMCR is applicable for 2024 and thereafter (2024 being the first year of the second tier of the additional CPP). The FAMCR and SAMCR are rounded to the nearest 0.01%, and are determined for this report to be 1.98% for 2023 and thereafter and 7.92% for 2024 and thereafter, respectively. The FAMCR for 2022 is 1.49%, which is 1.98% multiplied by a factor of 0.75 during the phase-in period of the additional Plan.

Table 102 shows that the AMCRs satisfy the first condition above. The table shows that, as at 1 January 2019, the additional CPP open group assets are projected to be 106.8% of the open group actuarial obligations. There are no invested additional CPP assets as at 1 January 2019, and the total open group assets are equal to the present value of future additional contributions of current participants and future participants of the Plan. Since there are no benefits in pay as at 1 January 2019, the open group actuarial obligations are equal to the present value of future additional benefits for current and future participants of the CPP.

The AMCRs are determined in respect of the additional Plan as it is defined as at its commencement date, 1 January 2019, and include the benefit enhancements under Bill C-74.

Table 102	Additional CPP Balance Sheet (Open Group Basis) (1.98%/7.92% first/second additional minimum contribution rates, $ billion)
	As at 1 January 2019 [1]
Assets	
Current Assets	0.0
Future Contributions	733.0
Total Assets (a)	733.0
Actuarial Obligations (b) [2]	686.6
Asset Excess (Shortfall) (a) – (b)	46.4
Assets as percentage of Obligations (a)/(b)	106.8%

(1) Commencement date of the additional CPP.
(2) Obligations include operating expenses.

As the AMCRs determined for this report do not deviate materially from the legislated additional contribution rates, the default provisions of the *Additional Canada Pension Plan Sustainability Regulations* do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated first additional contribution rate will remain at 1.5% for 2022 and 2.0% for 2023 and thereafter, and the legislated second additional contribution rate will remain at 8.0% for 2024 and thereafter.

C.3   Evolution of Assets to Expenditures Ratios

An important measure of the base and additional Plans' financial states is the ratio of assets at the end of one year to the expenditures of the next year (the A/E ratio).

Base CPP

As can be seen in Chart 15, under the legislated contribution rate of 9.9%, the A/E ratio for the base Plan is projected to remain relatively stable at a level of about 7.6 over the period 2019 to the early 2030s. Thereafter, it continues to rise overall to a value of 9.5 in 2095.

As the legislated rate of 9.9% is greater than the MCR of 9.75% for years 2022-2033 and 9.72% thereafter, the A/E ratios under the legislated rate are higher than the ratios under the MCR. The A/E ratios under the MCR for years 2022 and thereafter are shown in Chart 15 for comparison. The ratios under the MCR in years 2031 and 2081 are nearly equal, at a value of about 7.5, as indicated in the chart. This is because the years 2031 and 2081 are the target years for the steady-state contribution rate of 9.71%, under which the A/E ratios are equal for those years at a value 7.5.

The projected initial slowdown in the growth of the A/E ratio until the early 2030s under the legislated rate of 9.9% is caused by the retirement of the baby boom generation, which increases the cash outflows of the Plan. The existence of a large pool of assets enables the base Plan to absorb the increased outflow and maintain the contribution rate at 9.9%.

Chart 15   Assets/Expenditures Ratio – Base CPP
(legislated and minimum contribution rates)
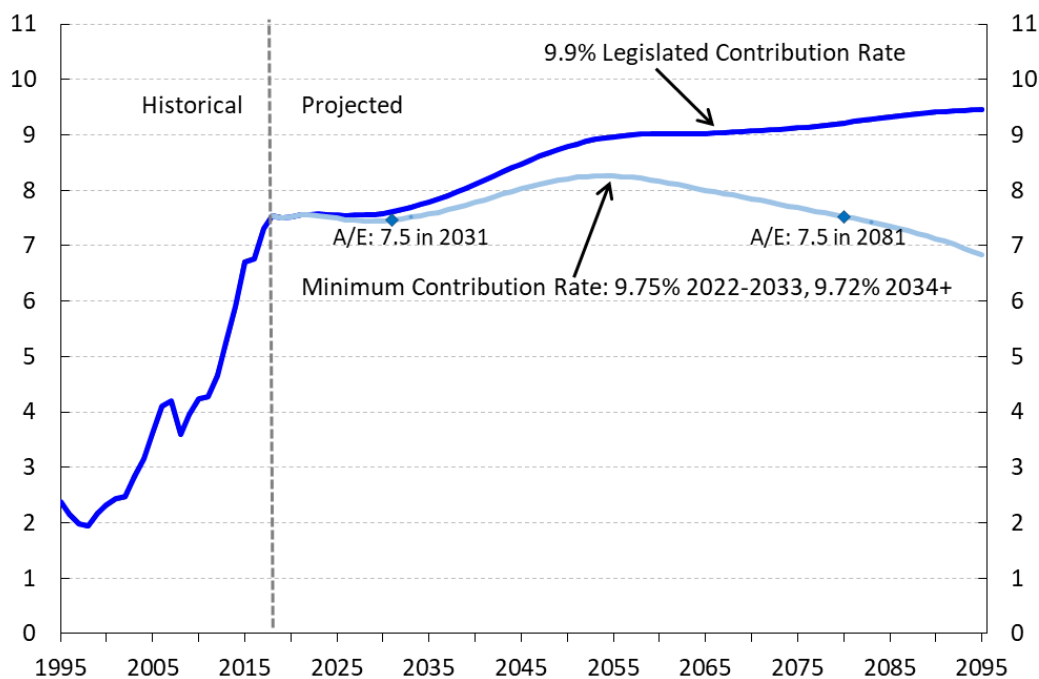
Additional CPP

As shown in Chart 16, under the legislated additional contribution rates of 2.0% and 8.0%, the A/E ratio of the additional CPP is projected to increase significantly during the early years of the additional Plan and remain high as assets rapidly accumulate and benefit expenditures are low. As the additional Plan matures and benefit expenditures increase, the A/E ratio decreases and stabilizes at a level of about 26 by 2075. The A/E ratio under the AMCRs, also shown in Chart 16, is projected to be slightly lower than under the legislated rates, since the AMCRs are close to the legislated rates. The target years of 2088 and 2098, which are used in the determination of the AMCRs, are marked in the chart, and the corresponding A/E ratio is 25.

Chart 16   Assets/Expenditures Ratio – Additional CPP
(legislated and additional minimum contribution rates)
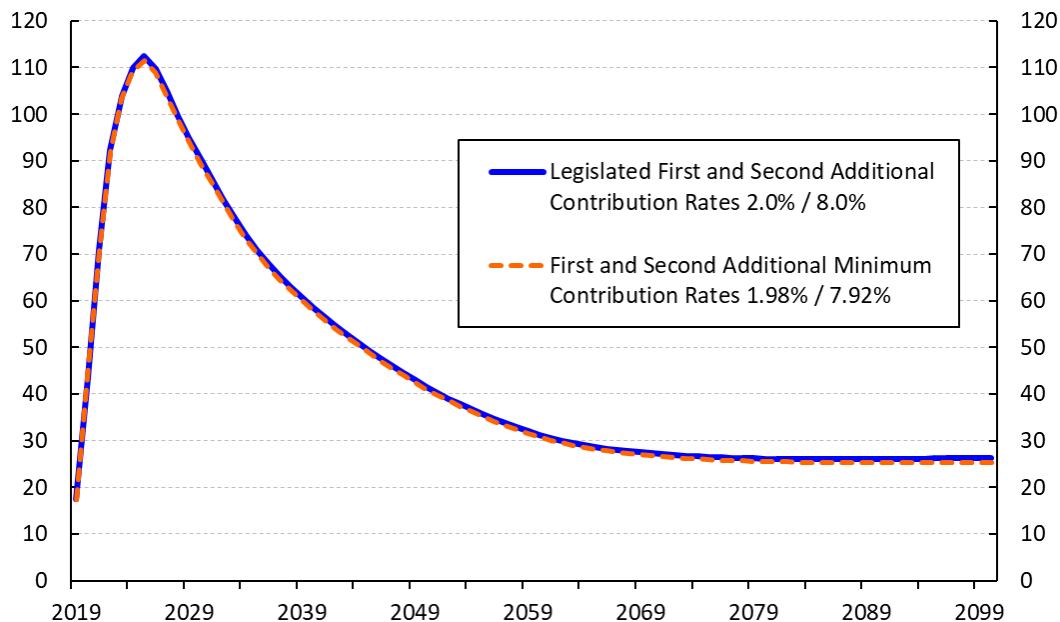
C.4   Open Group Balance Sheets under the Legislated Contribution Rates

The base and additional CPP balance sheets presented in this section are prepared using an open group approach and the legislated contribution rates of each component. The open group methodology is described earlier, in section C.2.4 of this Appendix.

The choice of the methodology used to produce a social security system's balance sheet is mainly determined by the system's financing approach. Partially funded plans like the base CPP represent a social contract where, in any given year, current contributors allow the use of their contributions to pay current beneficiaries' benefits. This social contract creates claims for current and past contributors to contributions of future contributors. As such, the proper assessment of the financial sustainability of partially funded plans by means of their balance sheets should reflect these claims. The open group approach does account explicitly for these claims by considering the benefits and contributions of both the current and future plan participants. In comparison, the closed group methodology does not reflect these claims since only current participants are considered.

As discussed in section C.2.4, using an open group approach is required for the financial projections of the additional CPP in order to meet the "sufficiency" requirement of subparagraph 113.1(4)(d)(ii) of the CPP statute. This in turn ensures that, at the valuation date, the projected additional contributions and investment income under the AMCRs are sufficient to cover the projected additional expenditures over the long term.

Base CPP

The actuarial position of the base Plan as at 31 December 2018 and 31 December 2030 under the open group approach and the legislated contribution rate of 9.9% is presented in Table 103. The open group actuarial assets and obligations of the base CPP are determined similarly as for the additional CPP, as described earlier in section C.2.4, but using the base CPP projected contributions and expenditures and the expected rate of return on base CPP assets as a discount rate. To obtain the asset excess (shortfall) of the base CPP, the base Plan's actuarial obligations are deducted from the open group assets at the valuation date.

Table 103	Base CPP Balance Sheet (Open Group Basis) (9.9% legislated contribution rate, $ billion)	
	As at 31 December 2018	As at 31 December 2030
Assets		
Current Assets	371.7	687.6
Future Contributions	2,319.4	3,439.2
Total Assets (a)	2,691.1	4,126.9
Actuarial Obligations (b) [1]	2,674.4	4,107.1
Asset Excess (Shortfall) (a) − (b)	16.7	19.7
Assets as percentage of Obligations (a)/(b)	100.6%	100.5%

(1)   Obligations include operating expenses.

The CPP is intended to be long-term and enduring in nature, a fact that is reinforced by the federal, provincial, and territorial governments' joint stewardship through the established strong governance and accountability framework of the Plan. It therefore follows that if the base Plan's financial sustainability is to be measured based on its asset excess or shortfall, it should be done on an open group basis that reflects the partially funded nature of the base Plan, that is, its reliance on both future contributions and invested assets as means of financing its future expenditures. The inclusion of future contributions and benefits with respect to both current and future participants in the assessment of the base Plan's financial state confirms that the base Plan is able to meet its financial obligations over the long term.[1]

Although the key legislatively prescribed financial measure for evaluating the base Plan is the minimum contribution rate, specifically, its adequacy and stability over time, other indicators such as the open group balance sheet should be used in combination with the MCR to assess the sustainability of the base Plan.

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[1] As at 31 December 2018, under the closed group approach, the actuarial obligations of the base Plan are equal to $1,257.1 billion, the assets are $371.7 billion, and the assets shortfall is equal to $885.4 billion.

Additional CPP

The prescribed regulations set out the determination of the ratio of the actuarial assets to obligations of the additional Plan on an open group basis in order to determine the AMCRs.[1] In this section, the open group additional CPP balance sheet is prepared under the legislated additional contribution rates.

The actuarial position of the additional Plan as at 1 January 2019 under the open group approach and additional minimum contribution rates is presented in Table 102. The figures shown in Table 102 differ from those shown in Table 104, since different contribution rates are used. The legislated additional contribution rates are used for Table 104, whereas the AMCRs are used for Table 102.

To obtain the asset excess (shortfall) of the additional Plan, the additional Plan's actuarial obligations are deducted from the open group assets at the valuation date. As shown in Table 104, the ratio of the additional Plan's assets to its obligations using the legislated additional contribution rates is determined for this report to be 107.8% as at 1 January 2019 and 106.4% as at 31 December 2030.

Table 104	Additional CPP Balance Sheet (Open Group Basis) (2.0%/8.0% legislated first/second additional contribution rates, $ billion)	
	As at 1 January 2019 [1]	As at 31 December 2030
Assets		
Current Assets	0.0	191.2
Future Contributions	740.3	1,054.2
Total Assets (a)	740.3	1,245.4
Actuarial Obligations (b) [2]	686.6	1,170.6
Asset Excess (Shortfall) (a) − (b)	53.7	74.8
Assets as percentage of Obligations (a)/(b)	107.8%	106.4%

(1) Commencement date of the additional CPP.
(2) Obligations include operating expenses.

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[1] As at 31 December 2018, under the closed group approach, the actuarial obligations, assets, and assets excess/shortfall of the additional Plan are all $0.

Appendix D – Detailed Reconciliations with Previous Report

D.1 Base CPP

The results presented in this report differ from those previously projected for a variety of reasons. Differences between the actual experience for 2016 through 2018 and that projected in the 27th CPP Actuarial Report for the same period were addressed in the Reconciliation with Previous Triennial Reports – Base CPP section 6.1 of this report. Since historical results provide the starting point for the projections shown in this report, these differences have an effect on the projections. This section provides more details on the impact of the experience update and changes in the assumptions and methodology.

The pay-as-you-go rate, which is the ratio of expenditures to contributory earnings in a given year, is an important measure of the cost of the base CPP and corresponds to the contribution rate that would need to be paid if there were no assets. One way of understanding the differences between the best-estimate projections in this report and those presented in the 27th CPP Actuarial Report is to look at the effects of various factors on the pay-as-you-go rates. The most significant effects are identified in the reconciliation presented in Table 105 and the discussion below.

A series of amendments (as described in Appendix A) between the 27th CPP Actuarial Report and the 30th CPP Actuarial Report had the effect of increasing the pay-as-you-go rates and of introducing full funding rates, which are combined with the steady-state rate to obtain the minimum contribution rate (MCR) for the base CPP.

The experience update had the effect of reducing the pay-as-you-go rates in the short and medium term due to better than anticipated demographic and benefits experience compared to the 27th CPP Actuarial Report. The impacts on the pay-as-you-go rates from the experience over the period 2016 to 2018 are shown in Table 105. In particular:

➢ The starting population (July 2018) was higher and younger than expected due to higher than expected migration being partially offset by a lower than expected number of births and higher than expected number of deaths. The higher and younger starting population for the projections of this 30th CPP Actuarial Report decreases the pay-as-you-go rates over the projection period.

➢ Overall lower than expected benefit expenditures, which resulted from an over-projection of retirement benefits (lower retirement benefit take-up rate at age 60 compared to expected), disability benefits (lower disability incidence rate compared to expected), and survivor benefits and operating expenses outweighing an under-projection of children and death benefits leads to a decrease in the pay-as-you-go rates over the near to medium term.

➢ Lower than anticipated growth in total employment earnings increases the pay-as-you-go rates. This partially offsets the decrease due to the demographic experience and benefit expenditures experience over the near to medium term.

Changes made to the key best-estimate assumptions since the previous triennial report were outlined in Table 1 of section 3 of this report. The effects of these changes on the pay-as-you-rates are also shown in Table 105 and are summarized below.

➢ The assumed total fertility rates are lower than those assumed in the previous triennial report, and as such, increase the pay-as-you-go rates in the long term.

➢ The initial lower mortality improvement rates assumed for this report decrease the pay-as-you-go rates in the short term, because beneficiaries are expected to initially receive their benefits over a shorter period of time.

➢ The assumed level of net migration is higher at the beginning of the projection period than in the previous triennial report, and this decreases the pay-as-you-go rates, because the higher growth in total contributory earnings outweighs the ultimate increase in benefit expenditures.

➢ The higher assumed labour force participation and employment rates decrease the pay-as-you-go rates, although the effect diminishes and reverses with time as the higher employment translates into higher benefit entitlements.

➢ The change in the real wage increase assumption causes the pay-as-you-go rates to rise due to the lower increase in contributory earnings compared to the previous triennial report.

➢ Changes in retirement benefit-related assumptions increase the pay-as-you-go rates in the medium term, but decrease them in the long term, due to the fact that the change in the assumed benefit take up rate is more than offset by the change in the assumed distribution by level of pension.

➢ The changes to the disability benefit assumptions increase the pay-as-you-go rates over the projection period mainly due to a change in the age distribution of incidence rates.

Some other assumptions, which are described in Appendix B, were also changed. Overall, the changes in these other assumptions had the effect of slightly increasing the projected pay-as-you-go rates over the projection period.

Factors that lead to changes in the pay-as-you-go rates do not always have comparable effects on the MCR. Furthermore, while the investment experience and assumptions have no effect on the pay-as-you-go rates, they may have a significant impact on the MCR. Investment income was 107% higher than anticipated over the period 2016 to 2018 due to the strong performance of financial markets over that period. This results in an absolute decrease of 0.16% in the MCR, as shown in Table 106.

Regarding the real rate of return assumptions, changes compared to the previous triennial report include a new set of asset classes and a different initial asset mix, which together result in a higher real rate of return over the short term. The new asset classes are introduced to better reflect the CPPIB's investment strategy in respect of the base CPP, and the assumed relative allocation to these asset classes has an impact on the portfolio's expected return. The real rate of return at the start of the projection period is initially lower in the first two years and then higher

over the next four years, when compared with the previous triennial report, to reflect the CPPIB's starting asset allocation. Over the long term, the ultimate level of risk of the portfolio assumed for this report is slightly lower than the one assumed under the previous triennial report, therefore the ultimate real rate of return for this report is slightly lower as well.

A reconciliation of the change in the MCR of 9.79% as presented in the 27th CPP Actuarial Report to the MCR of 9.75% for years 2022 to 2033 and 9.72% thereafter determined for this report is provided in Table 106.

A progression of the MCR over time based on steady-state contribution rate target years of future triennial valuation reports and using the best-estimate assumptions of this report is shown in Table 15 of the Results – Base CPP section of this report. As shown in that table, the MCR is projected to remain relatively stable over time.

Table 105	Reconciliation of Changes in Pay-As-You-Go Rates - Base CPP [1] (% of contributory earnings)			
	2019	2030	2060	2095
27th CPP Actuarial Report	9.61	11.00	11.74	12.16
I. Legislated Amendments:				
28th CPP Actuarial Report (Bill C-26)[2]	0.00	0.00	0.00	0.00
29th CPP Actuarial Report (Bill C-74) [3]	0.03	0.02	0.01	0.01
Bill C-97[4]	0.00	0.02	0.00	0.00
Subtotal:	0.03	0.03	0.02	0.01
II. Improvements in Methodology	0.00	0.00	0.00	0.00
III. Experience Update (2016-2018)				
Demographic	-0.04	-0.15	-0.16	-0.07
Economic	0.22	0.11	0.04	0.01
Benefits	-0.24	-0.13	0.06	0.07
Subtotal:	-0.07	-0.17	-0.06	0.01
IV. Changes in Assumptions				
Fertility	0.00	0.00	0.09	0.10
Mortality	-0.04	-0.05	0.00	0.00
Net Migration	-0.01	-0.07	-0.13	-0.03
Labour Market	-0.13	-0.09	0.00	0.07
Price Increases	0.00	0.01	0.00	0.00
Real Wage Increase	0.04	0.23	0.21	0.21
Retirement	-0.01	0.04	0.06	-0.03
Disability	0.00	0.01	0.02	0.02
Other Assumptions	0.01	0.01	0.00	0.01
Subtotal:	-0.13	0.09	0.25	0.36
Total of I to IV	-0.17	-0.04	0.21	0.38
30th CPP Actuarial Report	9.44	10.96	11.95	12.54

(1) Components may not sum to totals due to rounding.

(2) The supplemental 28th CPP Actuarial Report provides the financial estimates of the introduction of the additional CPP under Bill C-26 (*An Act to Amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act*).

(3) The 29th CPP Actuarial Report supplementing the 27th and 28th CPP Actuarial Reports as at 31 December 2015 provides the estimated financial impacts of the amendments of Bill C-74 (*Budget Implementation Act, 2018, No. 1*) on the base and additional CPP. A description of the amendments is also provided in Appendix A of this 30th CPP Actuarial Report.

(4) Bill C-97 (*Budget Implementation Act, 2019, No. 1*), which received Royal Assent on June 21, 2019, waives the application for a CPP retirement pension upon reaching age 70.

Table 106 Reconciliation of Changes in Minimum Contribution Rate - Base CPP [1],[2]
(% of contributory earnings)

	Steady-State Rate	Full Funding 2022-2033	Full Funding 2034+	MCR 2022-2033	MCR 2034+
27th CPP Actuarial Report - After Rounding	9.79	0.00	0.00	9.79	9.79
27th CPP Actuarial Report - Before Rounding	9.795	0.000	0.000	9.795	9.795
I. Legislated Amendments:					
28th CPP Actuarial Report (Bill C-26) [3]	0.000	0.000	0.000	0.000	0.000
29th CPP Actuarial Report (Bill C-74) [4]	0.000	0.035	0.007	0.035	0.007
Bill C-97 [5]	0.009	0.000	0.000	0.009	0.009
Subtotal:	0.009	0.034	0.007	0.044	0.016
II. Improvements in Methodology	0.000	0.001	0.000	0.001	0.000
II. Experience Update (2016-2018)					
Demographic	-0.088	0.001	0.000	-0.087	-0.088
Economic	0.056	0.000	0.000	0.057	0.056
Benefits	-0.038	-0.001	0.000	-0.040	-0.038
Investments	-0.163	0.000	0.000	-0.163	-0.163
Subtotal:	-0.233	0.000	0.000	-0.233	-0.232
IV. Changes in Assumptions					
Fertility	0.040	0.000	0.000	0.040	0.040
Mortality	-0.028	0.001	0.001	-0.027	-0.028
Net Migration	-0.073	0.000	0.000	-0.073	-0.073
Labour Market	-0.016	-0.001	0.000	-0.017	-0.017
Price Increases	0.000	0.001	0.000	0.001	0.000
Real Wage Increase	0.110	0.000	0.000	0.110	0.110
Real Rates of Return	0.027	0.000	0.000	0.027	0.027
Retirement	0.061	0.000	0.000	0.061	0.061
Disability	0.013	0.000	0.000	0.013	0.013
Other Assumptions	0.005	-0.001	-0.001	0.004	0.004
Subtotal:	0.138	0.000	0.000	0.138	0.138
V. Others (Change in Funding Targets from 2028-2078 to 2031-2081)	-0.002	0.000	0.000	-0.002	-0.002
Total of I to V	-0.087	0.035	0.007	-0.051	-0.080
Rates before Rounding	9.708	0.035	0.007	9.743	9.715
Rounded Rate, in Accordance with the proposed Calculation of Contribution Rates Regulations, 2018 [6]	9.71	0.04	0.01	9.75	9.72
30th CPP Actuarial Report	9.71	0.04	0.01	9.75	9.72

(1) Components may not sum to totals due to rounding.

(2) For each triennial CPP actuarial report, the MCR is determined for all years following the three-year review period in which the report is prepared, with the legislated contribution rate applied during the review period. For the 27th CPP Actuarial Report, the MCR was determined for the year 2019 and thereafter, with the legislated rate of 9.9% applied for the 2016-2018 review period. For the 30th CPP Actuarial Report, the MCR is determined for 2022 onward, with 9.9% applied for 2019-2021.

(3) The supplemental 28th CPP Actuarial Report provides the financial estimates of the introduction of the additional CPP under Bill C-26 (*An Act to Amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act*).

(4) The 29th CPP Actuarial Report supplementing the 27th and 28th CPP Actuarial Reports as at 31 December 2015 provides the estimated financial impacts of the amendments of Bill C-74 (*Budget Implementation Act, 2018, No. 1*) on the base and additional CPP. A description of the amendments is also provided in Appendix A of this 30th CPP Actuarial Report.

(5) Bill C-97 (*Budget Implementation Act, 2019, No. 1*), which received Royal Assent on June 21, 2019, waives the application for a CPP retirement pension upon reaching age 70. As the amendment introduced under Bill C-97 is not a benefit improvement, the full funding provision was not invoked.

(6) The *Calculation of Contribution Rates Regulations, 2018* and the *Additional Canada Pension Plan Sustainability Regulations* were published in the Canada Gazette, Part l, Vol. 152, No. 42 on October 20, 2018. Both Regulations are awaiting formal provincial approval.

D.2   Additional CPP

The results presented in this report differ from those previously projected for a variety of reasons. Since historical results provide the starting point for the projections shown in this report, these historical differences between actual and projected experience have an effect on the projections. The impact of the experience update in respect of the starting environment for the additional Plan and changes in the assumptions and methodology relative to the 28th and 29th CPP Actuarial Reports that have significantly changed the projected results for this report are addressed in this section.

The first and second additional minimum contribution rates (FAMCR, SAMCR) are important measures of the cost of the additional CPP. One way of understanding the differences between the best-estimate projections in this report and those presented in the 28th and 29th CPP Actuarial Reports is to look at the effects of various factors on the AMCRs. The most significant effects are identified in the reconciliation presented in Table 107 and the discussion below.

The 28th CPP Actuarial Report was prepared to provide cost estimates regarding the introduction of the additional CPP, and the 29th CPP Actuarial Report was produced to measure the cost impacts of the legislated amendments introduced under Division 19 of Part 6 of Bill C-74. The amendment to the CPP under Bill C-97 was also taken into account. Overall, the amendments had the effect of increasing the AMCRs.

The experience update had the effect of reducing the AMCRs due to better than anticipated demographic experience compared to the 28th CPP Actuarial Report. The impacts on the AMCRs from the experience over the period 2016 to 2018 are shown in Table 107. In particular:

➢ the starting population (July 2018) was higher and younger than expected due to higher than expected migration being partially offset by lower than expected number of births and higher than expected number of deaths. The higher and younger starting population for the projections of this Report decreases the AMCRs.

Changes made to the key best-estimate assumptions since the previous triennial report were outlined in Table 1 of section 3 of this report. The main effects of these changes on the AMCRs are also shown in Table 107 and are summarized below.

➢ The initial lower mortality improvement rates assumed for this report decrease the AMCRs, because beneficiaries are expected to initially receive their additional benefits over a shorter period of time.

➢ The higher assumed labour force participation and employment rates increase the AMCRs. The AMCRs increase instead of decreasing as for the base Plan MCR due to the different financing approaches of the two components of the CPP. The higher employed population results in eventual higher benefit expenditures, which, for the additional benefits, must be fully funded under the additional Plan.

➢ The change in the real wage increase assumption causes the AMCRs to decrease due to the lower increase in contributory earnings compared to the previous triennial report. The AMCRs decrease instead of increasing as for the base Plan MCR for the same reason cited in the bullet point above in respect of the assumed labour force participation and employment rates.

➢ Changes in retirement benefit-related assumptions decrease the AMCRs.

As well, the investment assumptions have a significant impact on the AMCRs. Regarding the real rates of return assumptions, changes compared to the 28th CPP Actuarial Report include a new set of asset classes and a different initial asset mix to reflect the CPPIB's investment strategy in respect of the additional CPP. The assumed relative allocation to these asset classes along with, in particular, assumed lower real rates of return for bonds result in a lower portfolio real rate of return over the projection period.

As mentioned for the base CPP, some other assumptions were also changed. Overall, the changes in these other assumptions had the effect of slightly decreasing the AMCRs.

A reconciliation of the change in the FAMCR of 1.93% and SAMCR of 7.72%, as presented in the 28th CPP Actuarial Report, to the FAMCR of 1.98% and SAMCR of 7.92% for this report is provided in Table 107.

Table 107	Reconciliation of Changes in Additional Minimum Contribution Rates [1],[2] (% of additional CPP contributory earnings)		
		First Additional Minimum Contribution Rate	Second Additional Minimum Contribution Rate
28th CPP Actuarial Report [2] - After Rounding		1.930	7.720 [3]
28th CPP Actuarial Report - Before Rounding		1.925	7.700 [3]
I. Legislated Amendments:			
29th CPP Actuarial Report (Bill C-74) [4]		0.059	0.236
Bill C-97 [5]		0.000	0.000
Subtotal:		0.059 [6]	0.236 [6]
II. Improvements in Methodology		-0.001	-0.003
III. Starting Environment (2016-2018) [7]			
Demographic		-0.006	-0.025
Economic		0.001	0.005
Benefits		0.000	0.000
Investments		0.000	0.000
Subtotal:		-0.005	-0.020
IV. Changes in Assumptions			
Fertility		0.001	0.005
Mortality		-0.001	-0.005
Net Migration		-0.007	-0.028
Labour Market		0.022	0.088
Price Increases		0.000	0.001
Real Wage Increase		-0.031	-0.124
Real Rates of Return		0.035	0.138
Retirement		-0.017	-0.068
Disability		0.000	-0.001
Other Assumptions		-0.003	-0.013
Subtotal:		-0.002	-0.006
Total of I to IV		0.052	0.207
Rates before Rounding		1.977	7.907
Rounded Rates, in Accordance with the proposed Calculation of Contribution Rates Regulations, 2018 [8]		1.980	7.920
30th CPP Actuarial Report		1.980	7.920

(1) Components may not sum to totals due to rounding.

(2) The supplemental 28th CPP Actuarial Report provides the financial estimates of the introduction of the additional CPP under Bill C-26 (*An Act to Amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act).*

(3) At the time of the 28th and 29th CPP Actuarial Reports, there were no regulations regarding the calculation and rounding of the AMCRs. For the given two reports, the rounded SAMCRs were determined as four times the rounded FAMCRs. The same relationship holds between the unrounded total and changes in the rates, but may not appear as such in the table because of separate rounding of the rates.

(4) The 29th CPP Actuarial Report supplementing the 27th and 28th CPP Actuarial Reports as at 31 December 2015 provides the estimated financial impacts of the amendments of Bill C-74 (*Budget Implementation Act, 2018, No. 1*). A description of the amendments is also provided in Appendix A of this 30th CPP Actuarial Report.

(5) Bill C-97 (*Budget Implementation Act, 2019, No. 1*) waives the application for a CPP retirement pension upon reaching age 70. As the amendment is not a benefit improvement, the full funding provision was not invoked.

(6) The effects of the total amendments on the first and second additional minimum contribution rates on the basis of the final assumptions for the 30th CPP Actuarial Report are 0.055% and 0.218% of additional CPP contributory earnings, respectively.

(7) The difference between the actual and projected demographic and economic experience of the CPP over the period 2016-2018 affect the starting point of the projections for the additional Plan as at 1 January 2019.

(8) The *Calculation of Contribution Rates Regulations, 2018* and the *Additional Canada Pension Plan Sustainability Regulations* were published in the Canada Gazette, Part l, Vol. 152, No. 42 on October 20, 2018. Both Regulations are awaiting formal provincial approval.

Appendix E   – Uncertainty of Results

E.1   Introduction

This actuarial report on the Canada Pension Plan is based on the projection of its revenues and expenditures for both of its components, the base and additional CPP, over a long period of time. The information required by statute, which is presented in the Results sections 4 and 5 of this report, has been derived using best-estimate assumptions regarding future demographic, economic, and investment trends. Both the length of the projection period and the number of assumptions required ensure that actual future experience will not develop precisely in accordance with the best-estimate projections. The objective of this section of the report is to illustrate the sensitivity of the long-term projected financial states of the base and additional Plans to changes in the future demographic, economic, and investment outlooks.

The future revenues and expenditures, or income and outgo of the CPP, both for the base and additional Plans, depend on many demographic, economic, and investment factors, including fertility, mortality, migration, the labour force, average earnings, inflation, retirement patterns, disability incidence rates, and investment returns. On the other hand, future demographic, economic, and investment environments are affected by both domestic and global forces, such as climate change, how globalization or protectionism influence world economic growth, geopolitical situations, etc. The income will depend on how all these factors change the size and composition of the working-age population and the level and distribution of earnings. Similarly, the outgo will depend on how these factors change the size and composition of the beneficiary population and the general level of benefits. Although both the base and additional CPP are affected by the aforementioned factors, the degree to which the two components of the CPP are affected differs.

For the additional CPP, there is a stronger link between contributions paid by individuals and the benefits they will receive. As a result, while some assumptions regarding factors such as fertility, migration, and labour force participation affect the cash flows and amount of assets of the additional Plan, they, in general, do not have a major impact on the first and second additional minimum contribution rates (FAMCR, SAMCR). In comparison, these assumptions could have a significant impact on the minimum contribution rate (MCR) of the base CPP. Other assumptions have a more significant impact on the AMCRs for the additional CPP, the real rate of return is such an example. This again is attributable to the different financing approaches of the base and additional CPP.

Section E.2 examines the sensitivity of the base and additional CPP to different asset allocations. Four alternative investment portfolios are described for each component of the Plan, along with the volatility of each portfolio and the resulting impact on the minimum contribution rates of the base and additional CPP. The impacts of financial market volatility on the financial states of the two components of the CPP are explored in section E.3. In that section, investment scenarios are described that result in the minimum contribution rate of the base CPP reaching its legislated rate and the additional minimum contribution rates falling outside specified ranges.

Section E.4 next presents sensitivity tests on individual long-term assumptions derived based on a combination of judgment and stochastic modeling techniques. Finally, sections E.5 and E.6 build on the individual sensitivity tests performed in section E.4 by combining various assumptions of the individual tests to create scenarios of higher and lower long-term economic growth and younger and older populations. The combination of the individual sensitivity test assumptions is not meant to necessarily create probable scenarios, but rather to show the possible impacts from different economic environments and overall compositions of the population relative to the best-estimate scenarios.

E.2   Sensitivity to Investment Policy

The CPPIB was created in 1997 with the object, as stated in the *Canada Pension Plan Investment Board Act*, "to invest its assets with a view to achieving a maximum rate of return, without undue risk of loss, having regard to the factors that may affect the funding of the Canada Pension Plan and the ability of the Canada Pension Plan to meet its financial obligations on any given business day". The assets of the CPP are invested by the CPPIB through a diversified portfolio.

Historically, equities have shown greater volatility than fixed income instruments (such as bonds), volatility being a measure of the magnitude of fluctuation in returns. Similarly, long-term bonds have historically shown greater volatility than shorter fixed income instruments. For instance, in the fifty, twenty-five, and ten years ending in 2017, the volatility (standard deviation) of Canadian equity returns (indicated by the S&P/TSX Total Return Index) was 16.4%, 16.5%, and 18.9%, respectively, as given in the most recent Canadian Institute of Actuaries' "Report on Canadian Economic Statistics 1924 – 2017". This compares with the volatility of returns of long-term federal bonds (10+ years) of 10.4%, 9.6%, and 8.9% and with the volatility of returns of medium-term federal bonds (5-10 years) of 7.6%, 6.7%, and 6.0% over the same periods. Higher volatility of a security's returns implies a greater risk, since the range of possible outcomes of returns widens. Hence, equities are viewed as being more risky than bonds and long-term bonds are viewed as being more risky than medium- or short-term bonds.

Historically, the higher volatility of equities compared to bonds has been rewarded with higher returns. This describes the key risk-reward relationship, whereby investors seek a higher level of return over the long term, or an equity risk premium, in exchange for assuming a higher level of risk. Nevertheless, over the short term, the potential for lower returns exists along with that for higher returns due to the higher level of volatility.

Investing in a greater proportion of equities requires assuming a higher level of risk and hence the possibility of realizing a wider range of returns. Conversely, investing in lower risk fixed income instruments will tend to produce lower returns.

To express the desired risk target of its investment portfolio, the CPPIB uses a simple two-asset class (fixed income and equity) portfolio called the "reference portfolio". The greater the proportion of equities in the reference portfolio, the greater the risk target. However, actual investments for the base and additional CPP are not limited to fixed income and equity. For the

purpose of this report, six asset classes are considered.

Starting from 31 December 2018, the CPP assets are invested through a two-pool investment structure as described in the CPPIB's 2018 annual report. The base CPP is invested solely in the Core pool, which initially consists of the CPP's assets as at 31 December 2018. The additional CPP is invested in a combination of the Core and Supplementary pools. The Supplementary pool is invested solely in fixed-income securities. Appendix B presents more information on the two-pool structure and the best-estimate assumptions regarding the assets allocation of the CPP.

In summary, the assets of the base and additional CPP are assumed to continue to be invested over the long term through a two-pool structure in a variety of assets with specific investment risk targets defined by their respective reference portfolios.

Base CPP

Table 108 shows the estimated impact that various investment portfolios would have on the assumed base CPP's real rate of return and MCR, as well as the volatility present in each portfolio. Notwithstanding the ultimate asset mixes shown below, for each portfolio the fixed income component includes the same amount of non-marketable provincial bonds as the best-estimate portfolio. To facilitate the comparison of the different investment portfolios, the level of risk of each portfolio is presented both in terms of a hypothetical reference portfolio and the expected one-year standard deviation.

Table 108	Sensitivity of the Base CPP Minimum Contribution Rate to the Investment Policy (percentages)									
	Hypothetical Reference Portfolio [1]		Ultimate Portfolio Asset Mix [2]					Expected 75-Year Average Real Rate of Return	Expected One-Year Standard Deviation	Minimum Contribution Rate [4]
Portfolio	Equity	Debt	Public Equity	Private Equity	Nominal Fixed Income	Credit	Real Assets			
1	30	70	8	6	57	23	6	2.8	3.6	10.71
2	50	50	14	12	41	19	14	3.3	6.6	10.29
B.E.	70	30	23	19	22	10	26	4.0	10.7	9.72
3	85	15	31	27	9	5	28	4.3	14.0	9.41
4 [3]	100	0	100	0	0	0	0	4.5	16.8	9.17

(1) The hypothetical reference portfolio translates a certain amount of risk (one-year standard deviation of returns) into a two-asset portfolio composed of equity and debt. The higher the equity allocation, the higher the risk. Various portfolio can be constructed to match a certain level of risk. A portfolio with a level of risk of a 50-50 hypothetical reference portfolio may not be composed exactly of 50% equity-like assets.

(2) For all portfolios, the cash allocation is assumed ultimately to be zero.

(3) The Nominal Fixed Income allocation is not zero until 2043 due to the presence of non-marketable provincial bonds.

(4) The minimum contribution rate in this table refers to the rate applicable for 2034 and thereafter.

For the base CPP, the current CPPIB reference portfolio consists of 85% equity and 15% fixed income. Based on the best-estimate assumptions of this 30th CPP Actuarial Report, such reference portfolio has an ultimate one-year standard deviation of 14.0%[1]. The assumed best-estimate portfolio of the base CPP has an ultimate level of risk corresponding to a hypothetical reference portfolio of 70% equity and 30% fixed income. The best-estimate portfolio produces an expected average annual real rate of return of 3.95% over the next 75 years, with an estimated one-year standard deviation of 10.7%.

Portfolio 1 is assumed to have a large allocation of assets to low-volatility asset classes such as fixed income and credit. The fixed income asset class is assumed to have a high proportion of short-term bonds with a corresponding low standard deviation of returns. As a result, Portfolio 1 is projected to have a low expected volatility (one-year standard deviation of 3.6%). This portfolio also results in a low expected return of 2.8% over the 75-year projection period and in a MCR of 10.71%. Portfolio 2 has a higher allocation to risky assets and thus presents a higher expected real rate of return. However, under Portfolio 2, like Portfolio 1, the MCR is higher than the legislated rate of 9.9%.

Portfolios 3 and 4 are considered to be more risky than the best-estimate portfolio due to their higher share of variable income securities. As a result, the expected real rates of return are higher and accompanied by greater volatility. While both portfolios are expected to produce returns that result in the MCR being below the legislated contribution rate of 9.9%, such portfolios have a greater likelihood of earning poor investment returns.

Table 109 presents the estimated likelihood of experiencing a significant investment loss during a three-year period. For each portfolio, it is assumed that the best-estimate assumptions are realized up to the beginning of 2031, after which the assets are reallocated according to the asset mix of the portfolios presented in Table 108. For the three-year period that follows (2031-2033)[2], a stochastic approach is used to simulate the distribution of real rates of return, assuming that the rate of return on each underlying portfolio asset is normally distributed[3]. Next, the number of scenarios that result in a cumulative nominal return of less than -10% or -20% (i.e. assets at the end of the three-year period represent less than 80% to 90% of starting assets) is divided by the total number of scenarios to obtain the probability of such an event.

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[1] Although CPPIB's current base CPP reference portfolio is 85% equity and 15% fixed income, it's actual portfolio as at 31 December 2018 corresponds to a hypothetical reference portfolio of 82% equity and 18% fixed income with an estimated one-year standard deviation of 13.4%.

[2] The three-year period 2031-2033 was chosen since it is the first triennial review period after the best-estimate ultimate investment assumptions are reached.

[3] A normal distribution was assumed for simplicity as it adequately reflects most investment return outcomes. However, extreme investment returns may not be well characterized by such a statistical distribution.

Table 109	Impact of Investment Strategy on Probability of Significant Loss (percentages)				
Portfolio	Probability of 10% Nominal Cumulative Loss in Portfolio (2031-2033)	Impact of 10% Loss on MCR at 31 December 2033	Probability of 20% Nominal Cumulative Loss in Portfolio (2031-2033)	Impact of 20% Loss on MCR at 31 December 2033
1	0 [1]		0 [1]	
2	0.7		0.1	
B.E.	5.7	+ 0.51	1.5	+ 0.69
3	10.5		4.4	
4	13.8		7.0	

(1) The probability rounds to zero but is not exactly zero.

Under all scenarios, a -10% cumulative nominal return during the 2031 to 2033 period would increase the MCR determined from the actuarial valuation in 2033 by 0.51%, assuming that best-estimate assumptions of this report are used before 2031. Should the cumulative nominal return be -20%, the MCR would increase by 0.69%. Portfolios 1 and 2 present a near zero percent chance of significant losses over three years. However, these portfolios would result in an MCR higher than the legislated rate over the long term.

Portfolios 3 and 4 have a greater proportion of variable income securities compared to the best-estimate portfolio and thus a higher volatility. As such, these portfolios are expected to result in significant losses more often than the best-estimate portfolio. Over the period 2031 to 2033, the probability of experiencing a -10% cumulative nominal return is about double (10.5% vs 5.7%) for Portfolio 3 compared to the best-estimate portfolio. Under Portfolio 4, a -20% cumulative nominal return is more likely than a -10% cumulative nominal return under the best-estimate portfolio. Thus, the upside of investing in a risky portfolio is associated with a higher probability of poor investment returns occurring.

Additional CPP

For the additional CPP, investment income will ultimately represent about 70% of total revenues (contributions plus investment income). Based on the CPPIB's two-pool investment structure, the additional CPP is invested in both the Core and Supplementary pools, with CPPIB's initial asset allocation of 55% in the Core pool and 45% in the Supplementary pool. This corresponds to a hypothetical reference portfolio of about 50% equity and 50% fixed income (see Appendix B for further details on the base and additional CPP assets allocation). Based on the assumptions of this report, the best-estimate portfolio of the additional CPP is assumed to have a one-year standard deviation of 6.6%.

Since it is assumed that the level of risk of the Core pool investment portfolio will decrease over time, a higher share of the additional CPP's assets is expected to be allocated to the Core pool to maintain the overall additional CPP's level of risk in line with its reference portfolio. The best-estimate portfolio is assumed to be invested 66% in the Core pool and 34% in the Supplementary pool starting in 2028 (which corresponds to a hypothetical reference portfolio of 50% equity and

50% fixed income). The proportion invested in each pool throughout the projection period is such that the expected volatility of the additional CPP best-estimate portfolio remains constant.

Table 110 illustrates how different allocations to the Core and Supplementary pools affect the expected return on the additional CPP assets, the volatility (one-year standard deviation) of returns, and the first additional minimum contribution rate (FAMCR). As the second additional minimum contribution rate (SAMCR) is four times the value of the FAMCR, the table shows only the FAMCR. The asset mix of the Core and Supplementary pools is assumed to correspond to the best-estimate assumptions derived for this report. To facilitate the comparison of the different investment portfolios, the level of risk of each portfolio is presented both in terms of a hypothetical reference portfolio and the expected one-year standard deviation.

Table 110	Investment Policy Impact on First Additional Minimum Contribution Rate (percentages)						
	Hypothetical Reference Portfolio		Ultimate Portfolio Asset Mix		Expected 75-Year Average Real Rate of Return	Expected One-Year Standard Deviation	First Additional Minimum Contribution Rate (FAMCR)[2]
Portfolio	Equity	Debt	Core Pool	Supplementary Pool [1]			
1A	0	100	0	100	2.0	3.9	2.95
2A	35	65	50	50	3.1	4.8	2.14
B.E.	50	50	66	34	3.4	6.6	1.98
3A	60	40	85	15	3.7	8.9	1.84
4A	70	30	100	0	4.0	10.7	1.73

(1) The Supplementary pool is assumed to consist entirely of fixed income securities.
(2) The FAMCR in this table refers to the rate applicable for 2023 and thereafter. The SAMCR is equal to four times the FAMCR.

Portfolio 1A is invested solely in the Supplementary pool, and as such, a low return is expected. As a result, the FAMCR of 2.95% is significantly higher than the legislated rate of 2.0%. The expected volatility of this portfolio is low, but not much lower than portfolio 2A. Portfolio 2A is expected to produce a higher real rate of return over time while maintaining a low volatility. However, Portfolio 2A's expected real rate of return is still not enough to maintain the FAMCR at a level close to its legislated rate.

Portfolios 3A and 4A have higher allocations to the Core pool than the best-estimate portfolio. As a result, their expected rates of return are higher and so are their volatilities. These portfolios produce lower AMCRs, but they also increase the probabilities that the additional CPP will be in a substantial deficit or surplus situation as a result of investment experience as discussed below.

Investment experience could cause the AMCRs to deviate from their legislated rates of 2.0% and 8.0% into various ranges, each with different required courses of action in the event that the provincial and federal Finance Ministers do not reach an agreement on a course of action to take (as prescribed by the *Additional Canada Pension Plan Sustainability Regulations*).

Given that the additional CPP assets are expected to grow rapidly over the next decades, investment experience is expected to eventually become one of the main drivers behind additional Plan surpluses or deficits. The impact of investment experience on the AMCRs will

therefore become more pronounced in terms of the values of the AMCRs and the degree of variability in these values. To illustrate this, Table 111 presents the probability distribution of the FAMCR at 31 December 2048 resulting from investment experience during the immediately preceding three-year period 2046 to 2048 under the various portfolios shown in Table 110. It is assumed that best-estimate assumptions are realized before 31 December 2045 and that they remain in place for the actuarial valuation as at 31 December 2048.

As can be seen from Table 111, Portfolios 3A and 4A increase the probability relative to the best-estimate portfolio of the FAMCR falling in a "Warning" range (ranges B or D) or "Immediate Action" range (ranges A or E), as determined as at 31 December 2048. However, while the AMCRs based on portfolios 1A and 2A fall mainly in range C, the given portfolios produce long term AMCR's above the legislated values, as shown in Table 110.

Table 111	Probabilities of FAMCR being within Specified Ranges as at 31 December 2048 Given Various Portfolios at Previous Valuation Date [1] (percentages)					
	Range [2]	Best Estimate (B.E.)	Portfolio 1A	Portfolio 2A	Portfolio 3A	Portfolio 4A
A	less than or equal to 1.69%	3	0	0	8	13
B	1.70% to 1.79%	10	1	3	13	13
C	1.80% to 2.10%	80	96	94	67	57
D	2.11% to 2.20%	6	3	3	9	11
E	greater than or equal to 2.21%	1	0	0	3	5

(1) If all best-estimate assumptions from this report are realized, the FAMCR determined at the immediately preceding triennial report (31 December 2045) is projected to be 1.95%.

(2) Ranges A and E identify when immediate actions would be required as per the *Additional Canada Pension Plan Sustainability Regulations*. In this case, adjustments to benefits and possibly the contribution rates would take place. If the FAMCR falls in ranges B or D, no action is initially required. However, if the rate remains in the same range for a second consecutive valuation, then immediate actions would be required. Ranges B and D are considered "Warning" ranges. No action is required if the FAMCR falls in range C. The technical analysis of the the Regulations are described in detail in the *Technical Paper on the Additional Canada Pension Plan Regulations: Actuarial Study No. 20*, published by the Office of the Chief Actuary in November 2018.

E.3 Risk of MCR Reaching Legislated Rate and AMCRs Exceeding Specified Ranges due to Investment Experience

The sensitivity of the base Plan MCR and additional Plan AMCRs to investment environments and financial market shocks can be further illustrated by developing scenarios that would result in the MCR reaching the legislated contribution rate of 9.9% and the AMCRs falling in a range that requires corrective action.

The first such scenario examines a range of short-term returns in the future which could cause the base CPP MCR to increase to its legislated value, and the AMCRs to fall into ranges that trigger default actions defined by the *Additional Canada Pension Plan Sustainability Regulations.*

If the actual cumulative nominal rate of return over the inter-valuation period 2019-2021 is 6.3% (10 percentage points lower than the best-estimate assumption), the MCR for the years 2025 to 2033, determined at the next actuarial valuation, would be the same as the legislated

contribution rate of 9.9%. The probability of such return being realized is 30%.

If instead, the actual cumulative nominal rate of return over the inter-valuation period 2031 to 2033 is 12.8% (6.4 percentage points lower than the best-estimate assumption), this would cause the base Plan MCR to increase to its legislated level at the next actuarial valuation in 2033, assuming that all best-estimate assumptions were realized up to 2031. The probability of experiencing cumulative nominal rates of return lower than 12.8% over the period 2031 to 2033 is estimated to be 36%.

For the additional CPP, the AMCRs are allowed to deviate from their legislated contribution rates. As per the *Additional Canada Pension Plan Sustainability Regulations*, the FAMCR may fall between 1.7% and 2.2% without requiring immediate action from 2024 to 2038. From 2039 onward, this "No Action Required" range is reduced to between 1.8% and 2.1% and corresponds to range C of Table 111. The corresponding ranges for the SAMCR are those of the FAMCR with the boundary values multiplied by four.

It is very unlikely that the investment experience during the period 2024 to 2038 would cause the FAMCR to fall below 1.7% or rise above 2.2%. For example, annual nominal returns lower than -17.8% or higher than 24.8% during each year of the intervaluation period 2031 to 2033 would cause the FAMCR to rise above 2.2% or fall below 1.7%, respectively. The probability of such returns occurring is almost zero.

If the period of 2046 to 2048 is considered, the probability of the FAMCR falling outside the 1.8% to 2.1% range due to investment experience during that period increases to 20%, as shown in Table 111. That is because the returns needed for the FAMCR to reach 1.8% or 2.1% are less extreme. Annual nominal returns of 9.9% or higher during each year of the three-year period would result in an FAMCR of 1.8% or lower. The FAMCR could reach 2.1% in 2048 if annual nominal returns of 0.1% or lower are experienced for each of the three years, and 2.2% if annual nominal returns are lower than -3.7% for the same period.

The second scenario is a permanent change in the expected rates of return. For the base CPP, it is estimated that if the assumed real rate of return is 17 basis points lower than the best-estimate assumption (i.e. a 75-year average real rate of return of 3.78% versus the best estimate of 3.95%), the MCR would increase to the level of the legislated rate of 9.9%.

For the additional CPP, a decrease of 3 basis points in the expected real rate of return (i.e. a 75-year average real rate of return of 3.35% versus the best estimate of 3.38%) would increase the FAMCR and SAMCR from 1.98% and 7.92% to 2.00% and 8.00% respectively. The FAMCR would increase to between 2.10% and 2.20% should the expected real rate of return decrease by 20 to 35 basis points (i.e. a 75-year average real rate of return between 3.18% and 3.03%, respectively). If instead the expected real rate of return is increased by 33 to 53 basis points (i.e. a 75-year average real rate of return between 3.71% and 3.91%, respectively), the FAMCR would decrease to between 1.80% and 1.70%.

E.4 Individual Sensitivity Tests

The key best-estimate assumptions used for the projections in this report are described in Appendix B. Individual sensitivity tests have been performed that consist of projecting the financial states of the base and additional CPP using alternative assumptions to illustrate a reasonable range of how experience could vary from the best-estimate projections.

The tests for the fertility rate, mortality improvement rates, and real wage increase use purely deterministic models based on judgment, while the other individual assumption sensitivity tests are developed using a combination of judgment and stochastic modeling techniques. All of the tests are described in the sections below.

Stochastic modeling techniques estimate the probability distribution of an outcome for each selected assumption, and these distributions are used to quantify a range of possible outcomes. Where stochastic tests are used, the fluctuation in each variable other than the rate of return on investments is projected by using standard time-series modeling, a method designed to make inferences based on historical data. The fluctuation in the rate of return on investments is based on a normal distribution[1] of returns and is projected using assumed correlations between asset classes, standard deviations, and expected returns for each asset class.

With the time series approach, a variable is modeled by an equation that captures a relationship between current and prior years' values of the variable. A year-by-year random variation consistent with the variation observed in the historical period is then introduced. Parameters for the equations are estimated using historical data for periods that range between 36 years and 49 years. Each time-series equation is designed such that, in the absence of random variation, the expected value of the variable is equal to the value assumed under the best-estimate assumption.

For the stochastically analyzed assumptions, a minimum of 10,000 outcomes are generated for each year in the projection period. Although the yearly outcome of each variable will fluctuate, it is the average outcome over the projection period that will determine the financial states of the base and additional Plans. Therefore, an 80% confidence interval is calculated for the cumulative average of each assumption to determine, with 80% probability, the range of possible outcomes over the entire projection period (until 2095). If a shorter projection period were to be considered, such as ten or fifteen years, one could expect the average 80% confidence interval to be wider since the outcomes will not have had enough time to stabilize. The upper and lower values of the 80% confidence interval are used as the lower-cost and higher-cost assumptions, or vice versa depending on the assumption, for these individual sensitivity tests.

The results should be interpreted with caution and a full understanding of the inherent limitations of stochastic modeling. Results are very sensitive to model specifications, degrees of interdependence among variables, and the historical periods used for the estimates of the parameters. For some variables, using the variations exhibited in relatively recent or earlier historical periods may not provide a realistic representation of the potential variation for the

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[1] A normal distribution was assumed for simplicity as it adequately reflects most investment return outcomes.

future. The historical periods chosen for most variables are relatively homogeneous and do not include substantial shifts. The time-series modeling reflects what occurred in these historical periods. As a result, the variation indicated in this section should be viewed as the minimum plausible variation for the future. Structural shifts, as predicted by many experts and as seen in prior centuries, are not reflected in the current models. Rather, the projection models or time series are adjusted to reflect the best judgment over a long period.

The sensitivity tests were performed by varying most of the key assumptions individually in a manner consistent with the results of the stochastic analysis or by judgment and by keeping the remaining assumptions at their best-estimate levels. Each sensitivity test was categorized as either a lower-cost scenario or a higher-cost scenario. In the lower-cost scenarios for the base and additional CPP, the alternative assumptions have the effect of reducing the base minimum contribution rate and additional minimum contribution rates. Conversely, the assumptions for the higher-cost scenarios for each component of the CPP increase the minimum rates.

It is possible that a lower-cost scenario for the base CPP may be a higher-cost scenario for the additional CPP, and vice versa. This is the case, for example, for the tests regarding the real wage increase, described below. The opposite effects for the base and additional CPP are attributable to the different financing approaches of the two components.

The alternative assumptions selected are intended to represent a wide range of potential long-term experience. However, the individual results cannot simply be combined, because a change in any one particular assumption may have an impact on other assumptions to various degrees.

Table 112 summarizes the alternative assumptions used in the individual sensitivity tests. It is followed by a brief discussion of each assumption and the impact that the variation in each assumption has on the results.

Table 112	Individual Sensitivity Test Assumptions							
	Canada	Lower Cost		Best-Estimate		Higher Cost	
1	Total Fertility Rate [1], [2]	1.92		1.62		1.32	
2	Mortality: [2]						
	Canadian Life Expectancy	Males	21.0	Males	23.3	Males	25.8
	At Age 65 in 2050 with Future Improvements	Females	23.4	Females	25.6	Females	28.0
3	Net Migration Rate [1]	0.68%		0.62%		0.57%	
4	Rate of Increase in Prices	2.6%		2.0%		1.5%	
5	Real Wage Increase [2]						
	Base CPP	1.7%		1.0%		0.3%	
	Additional CPP	0.3%		1.0%		1.7%	
6	75-Year Average Real Rate of Return						
	Base CPP	5.55%		3.95%		2.35%	
	Additional CPP	4.28%		3.38%		2.48%	
7	CPP Disability Incidence Rates [1]	Males	2.10	Males	2.95	Males	3.75
	(per 1,000 eligible)	Females	2.80	Females	3.65	Females	4.50

(1)   These tests do not significantly impact the AMCRs.
(2)   For these tests, a deterministic instead of a stochastic approach was used to derive the lower- and higher-cost estimates.

E.4.1   Fertility Rate

This test is presented only for the base CPP since there is no significant impact on the additional CPP.

The best-estimate assumption for the total fertility rate for Canada is that it will increase slightly from its 2017 level of 1.55 to an ultimate level of 1.62 in 2027. A deterministic approach based on the experience of countries somewhat similar to Canada was used to generate the lower- and higher-cost scenarios over the 75-year projection period.

It was projected that the average total fertility rate throughout the 75-year projection period will be in the range 1.32 to 1.92, which corresponds to the lowest and highest fertility rates experienced in recent years by the Group of 7 (G7) countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States).

The lower-cost assumption for the base CPP has the total fertility rate increasing to an ultimate level of 1.92 in 2027, which is lower than the national population replacement rate. This is similar to the recent total fertility rate of France. The total fertility rate for Canada has not been above 1.92 since 1972. Under this scenario, the population grows to a level in 2050 that is 5.5% higher than under the best-estimate assumption. In addition, a higher ultimate total fertility rate leads to a slightly younger population. Under this scenario the base Plan MCR for years 2034 and thereafter decreases to 9.43%.

The higher-cost assumption for the base CPP has the total fertility rate decreasing to an ultimate level of 1.32 in 2027. This is similar to the recent total fertility rate of Italy. Under this scenario, the population grows much more slowly, to a level in 2050 that is 5.5% lower than under the best-estimate assumption. A lower ultimate total fertility rate leads to a slightly older population. Under this scenario, the base Plan MCR for years 2034 and thereafter increases to 10.03%.

E.4.2   Mortality Rates

The calendar year life expectancies (without assumed future mortality improvements) at age 65 in 2019 are 20.0 years for males and 22.6 years for females. The best-estimate scenario provides for future mortality improvements (i.e. reductions in mortality rates), such that the cohort life expectancy at age 65 in 2019 is projected to be 21.4 years for males and 23.9 years for females (which are 1.4 years and 1.3 years higher, respectively, than the calendar year life expectancies). In 2050, the best-estimate cohort life expectancy at age 65 is projected to be 23.3 years for males and 25.6 years for females.

The best-estimate ultimate values of the mortality improvement rates are reached in 2035 and are 0.8% per year for ages below 90, 0.5% for ages 90 to 94, and 0.2% for ages 95 and above. The following two sensitivity tests represent alternatives for the assumed mortality improvement rates.

Under the lower-cost scenario, mortality is assumed to improve at a slower rate than under the best-estimate scenario, reflecting that the assumed level of mortality improvements might not be sustainable. The ultimate values of the mortality improvement rates are gradually reduced to 0% for all ages in 2035. As a result, life expectancies decrease. In 2050, the cohort life expectancy at age 65 decreases to 21.0 years for males and 23.4 years for females, or 2.3 and 2.2 years lower for males and females, respectively, compared to the best-estimate scenario. Lower life expectancies lead to the population growing to a level in 2050 that is 1.4% lower than under the best-estimate scenario. Lower mortality improvements lead to a slightly younger population.

Under the lower-cost scenario the base Plan MCR for years 2034 and thereafter decreases to 9.38% while the FAMCR and SAMCR of the additional Plan decrease to 1.80% and 7.20%, respectively.

Under the higher-cost scenario, mortality is assumed to improve at a faster pace than under the best-estimate scenario. The ultimate values of the mortality improvement rates are doubled compared to their best-estimate values and correspond to 1.6%, 1.0%, and 0.4% for the age groups below 90, 90 to 94, and 95 and above, respectively. As a result, life expectancies increase relative to the best-estimate scenario. In 2050, the cohort life expectancy at age 65 increases to 25.8 years for males and 28.0 years for females, or 2.5 and 2.4 years higher for males and females, respectively compared to the best-estimate scenario. Higher life expectancies lead to the population growing to a level in 2050 that is 1.4% higher than under the best-estimate scenario. Higher mortality improvements lead to a slightly older population.

Under the higher-cost scenario the base Plan MCR for years 2034 and thereafter increases to 10.06% while the FAMCR and SAMCR of the additional Plan increase to 2.15% and 8.60%, respectively. Table 113 presents the life expectancies that would result in 2050 from the different rates of mortality improvement.

Table 113	Life Expectancy in 2050 under Alternative Assumptions [1] (Canada)			
		Lower Cost	Best Estimate	Higher Cost
At Birth	Males	82.2	89.1	95.4
	Females	85.6	91.8	97.4
At Age 65	Males	21.0	23.3	25.8
	Females	23.4	25.6	28.0

(1) These are cohort life expectancies that take into account future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

If no future mortality improvements are assumed at all after 2015, projected life expectancies would remain at their 2015 calendar year values for all future years, which would cause the minimum contribution rates of the base and additional Plans to decrease. The MCR of the base CPP would decrease from its best-estimate value of 9.72% to 9.03% for the year 2034 and thereafter, and the FAMCR and SAMCR of the additional Plan would decrease, respectively from their best estimates of 1.98% and 7.92% to 1.72% and 6.88%. The differences of 0.69% for the MCR and 0.26% / 1.04% for the FAMCR / SAMCR from their best estimates represent the annual costs of increasing longevity for the base and additional Plans.

E.4.3   Net Migration Rate

This test is presented only for the base CPP since there is no significant impact on the additional CPP.

Under the best-estimate assumption, the net migration rate is expected to decrease from its current (2018) level of 1.11% of the population to 0.86% in 2019, 0.73% in 2020, and reach an ultimate level of 0.62% of the population in 2021.

A stochastic approach was used to generate lower- and higher-cost scenarios over the 75-year projection period based on the net migration experience of the last 47 years (1972 to 2018) excluding the net increase in the number of non-permanent residents. It is projected that average net migration throughout the entire projection period will be in the range of 0.57% to 0.68% of the population with 80% probability. If a 15-year projection period were considered, then the average net migration would be in the range of 0.53% to 0.73% of the population.

The lower-cost assumption for the base Plan has net migration reaching a level of 0.68% of the population in 2021 and remaining at that level thereafter. This is close to the average net migration rate over the three-year period ending in 2018, excluding the net increase in non-permanent residents. Under this scenario, the population grows to a level in 2050 that is 2.2% higher than under the best-estimate assumption. This scenario results in a slightly younger population.

The higher-cost assumption for the base Plan has net migration reaching a level of 0.57% of the population in 2021 and remaining at that level thereafter. This is close to the average net migration rate experienced during the 1990s, excluding the net increase in non-permanent residents. Under this scenario, the population grows more slowly, to a level in 2050 that is 1.8% lower than under the best-estimate assumption. This scenario results in a slightly older population.

Under the base CPP lower-cost scenario (higher migration) the MCR for years 2034 and thereafter decreases to 9.63% while under the base CPP higher-cost scenario (low migration) the MCR increases to 9.80%.

E.4.4   Price Increases

Higher price increases result in lower minimum contribution rates for both the base and additional CPP. For the base Plan, although a higher rate of increase in prices produces higher base CPP expenditures, these increases in costs are outweighed by higher nominal contributory earnings and thus, higher contributions along with higher investment income from higher nominal returns. The same holds for the additional Plan.

Conversely, lower price increases results in higher minimum contribution rates for each component of the CPP, with a larger effect observed for the base Plan.

For the best-estimate projections, the annual rate of price increase is assumed to be 2.0% in 2019 and to remain at that level thereafter.

Based on the overall inflation rate experience over the last 36 years (1983 to 2018), a stochastic approach was used to generate lower- and higher-cost scenarios over the 75-year projection period. The Bank of Canada has been successful in its inflation targeting policies, implemented in the early 1990s, that have resulted in price increases being mostly contained in the 1% to 3% target range with little volatility. Although central banks might not always be able to control inflation, recent monetary policies in Canada and around the world make it unlikely that very high price increase periods such as the ones after the Second World War and in the 1970s will reoccur. Therefore, the chosen experience period covers periods of both moderately high and low inflation but excludes periods of extremely high inflation seen in earlier years. It was projected that the average annual rate of price increase during the 75-year projection period will be in the range 1.5% to 2.6% with 80% probability. Instead, if a 15-year projection period is considered, the average annual rate of price increase will be in the range 1.1% to 2.9%.

For the lower-cost scenario, the annual rate of price increase is assumed to rise to 2.6% in 2019 and remain at that level thereafter. This level of inflation is comparable to the average of the 1960s and over the last three decades. Under this scenario the base Plan MCR for years 2034 and thereafter decreases to 9.57% while the FAMCR and SAMCR of the additional CPP decrease to 1.96% and 7.84%, respectively.

For the higher-cost scenario, the annual rate of price increase is assumed to be 1.5% in 2019 and remain at that level thereafter. This level of inflation is comparable to the average of the mid-to-late 1990s. Under this scenario the base Plan MCR for years 2034 and thereafter increases to 9.86% while the FAMCR and SAMCR of the additional CPP increase to 1.99% and 7.96%, respectively.

E.4.5   Real Wage Increase

Wage increases affect the financial balance of the base and additional CPP in two ways. In the short-term, an increase in the average wage translates into higher contribution income with little immediate impact on benefits. Over the longer term, higher average wages produce higher benefits. Higher real wages have the effect of decreasing the MCR of the base CPP. However, higher real wages result in the AMCRs increasing for the additional Plan. Conversely, lower real wages increase the MCR of the base CPP, but decrease the AMCRs of the additional Plan.The reason for the opposite effects is due to the different financing approaches of the two CPP components that creates a stronger link between contributions and expenditures for the additional Plan. As there is no change in the assumed level of price increases, there is a greater relative impact on the AMCRs compared to the MCR from a change in real wages.

An ultimate real wage increase of 1.0% has been assumed for the year 2025 and thereafter for the best-estimate projections.

A deterministic approach was used to generate the lower- and higher-cost scenarios over the 75-year projection period. The historical economic cycles (recession/expansion) from 1962 to 2017 were analyzed. During those years, a strong expansionary period occurred during 1984-88 with high average real wage growth of 1.7%.This high value was used as the assumption for the real wage increases for one set of scenarios. For a low assumed value of real wage increases for another set of scenarios, the post-2008 recession experience from 2010 to 2017 was considered. The years 2010 to 2017 experienced to various degrees both positive and negative real wage increases, and reflect an appropriate measure of recent possible values. During that period, the average real wage increase was 0.3%.

For the lower-cost scenario for the base Plan and higher-cost scenario for the additional Plan, the assumed real wage increase rises to an ultimate level of 1.7% in 2025. For the higher-cost scenario for the base Plan and lower-cost scenario for the additional Plan, the assumed real wage is 0.3% for 2019 and thereafter.

Under the base CPP lower-cost scenario (higher real wage) the MCR for years 2034 and thereafter decreases to 9.29% while under the base CPP higher-cost scenario (lower real wage) the MCR increases to 10.15%.

Under the additional CPP lower-cost scenario (lower real wage) the FAMCR and SAMCR decrease to 1.78% and 7.12%, respectively while under the additional CPP higher-cost scenario (higher real wage) the FAMCR and SAMCR increase to 2.22% and 8.88%, respectively.

E.4.6   Rate of Return on Investments

Base CPP

For the base CPP, the 75-year average annual real rate of return on investments is projected to be 3.95% under the best-estimate assumptions. Using the assumed asset mix of this report and based on assumed correlations and standard deviations of returns by asset classes, a stochastic approach was used to generate the lower- and higher-cost scenarios over the 75-year projection period. It was projected that the average annual real rate of return for the base Plan over the 75-year projection period will be in the range 2.35% to 5.55% with 80% probability. Instead, if a 15-year projection period is considered, then the average annual real rate of return will be in the range -0.24% to 7.58%.

Under the lower-cost scenario for the base Plan, the average annual real rate of return on investments is assumed to be 1.60% higher than under the best-estimate assumptions, averaging 5.55% over the next 75 years. Under this scenario the base Plan MCR for years 2034 and thereafter decreases to 8.28%.

For the higher-cost scenario, the average annual real rate of return on investments is assumed to be 1.60% lower than under the best-estimate assumptions, averaging 2.35% over the next 75 years. Under this scenario the base Plan MCR for years 2034 and thereafter increases to 11.16%.

Furthermore, a decrease of 1% in the assumed nominal average 75-year rate of return would result in the base Plan MCR increasing to 10.62%, which is 9% higher than under the best-estimate assumptions. An increase of 1% in the assumed nominal average 75-year rate of return would result in the base Plan MCR decreasing to 8.82%, which is 9% lower than under the best-estimate assumptions.

Additional CPP

The additional CPP has a different assumed investment portfolio, and thus the range of investment outcomes is different. With 80% probability, the average annual real rate of return during the 75-year projection period is projected to be in the range of 2.48% to 4.28%, compared to the best-estimate of 3.38%. This range (180 basis points) is narrower compared to the base CPP (320 basis points), reflecting the different risk profile of the two CPP components. If a 15-year projection period is considered, the average annual real rate of return will be in the range of 0.56% to 4.84% for the additional CPP.

Under the lower-cost scenario for the additional Plan, the average annual real rate of return on investments is assumed to be 90 basis points higher than under the best-estimate assumptions for the projection period, averaging 4.28% over the next 75 years. Under this scenario the FAMCR and SAMCR of the additional CPP decrease to 1.53% and 6.12%, respectively.

For the higher-cost scenario, the annual real rate of return on investments is assumed to be 90 basis points lower than under the best-estimate assumptions for the projection period, averaging 2.48% over the next 75 years. Under this scenario the FAMCR and SAMCR of the additional CPP increase to 2.60% and 10.40%, respectively.

Furthermore, a decrease of 1% in the assumed nominal average 75-year rate of return would result in the FAMCR and SAMCR increasing to 2.69% and 10.76% respectively, which is 36% higher than under the best-estimate assumptions. An increase of 1% in the assumed nominal average 75-year rate of return would result in the FAMCR and SAMRC decreasing to 1.49% and 5.96% respectively, which is 25% lower than under the best-estimate assumptions. Given that the additional CPP relies more heavily on investment earnings as a source of revenues than the base CPP, the AMCRs are more sensitive to changes in the rate of return assumption than the MCR.

E.4.7   Disability Incidence Rates

These sensitivity tests regarding the assumed disability incidence rates are presented only for the base CPP since there is no significant impact on the additional CPP.

In addition, sensitivity tests for the assumed disability incidence rates were performed in respect of the disability pension only, since there are no experience data yet regarding the new base CPP post-retirement disability benefit. As experience data develop over time regarding the post-retirement disability benefit, corresponding sensitivity tests will be considered for future actuarial reports.

The best-estimate projections for the disability pension assume that disability incidence rates will remain at their values in 2018. The assumed aggregate rate of incidence for the disability pension for the year 2019 and thereafter is 2.95 new disability beneficiaries per year among 1,000 eligible workers for males and 3.65 per thousand for females, on average.

Based on the overall disability incidence rate experience of the last 49 years (1970 to 2018), a stochastic approach was used to generate lower- and higher-cost scenarios over the 75-year projection period for the Plan. It was projected that the average annual disability incidence rates for males over the 75-year projection period will be in the range 2.10 to 3.75 per 1,000 eligible workers with 80% probability. For females, the range of disability incidence rates is 2.80 to 4.50 per 1,000 eligible workers.

For the lower-cost scenario for the base Plan, disability incidence rates are assumed to be constant from 2019 onward at values of 2.10 per thousand for males and 2.80 per thousand for females. Other than since 2011 for male incidence rates, neither male nor female incidence rates have been below 3.0 since the early 1970s (on a year 2018 eligible population-adjusted basis for comparison purposes). Under this scenario the base Plan MCR for years 2034 and thereafter decreases to 9.52%.

For the higher-cost scenario for the base Plan, disability incidence rates are assumed to be constant from 2019 onward at values of 3.75 per thousand for males and 4.50 per thousand for females. The rates are lower than the high levels experienced in the early 1970s to mid-1990s for males and in the early 1980s to mid-1990s for females (on a year 2018 eligible population-adjusted basis for comparison purposes). Under this scenario the base Plan MCR for years 2034 and thereafter increases to 9.91%.

E.4.8   Results

Base CPP

Under each scenario, the contribution rate was projected to follow the current legislated rate of 9.9% through 2021, and a new minimum contribution rate (MCR) for the base Plan was determined for 2022 and thereafter. Table 114 summarizes the base Plan MCR and pay-as-you-go rates under each of the scenarios.

Table 114   Sensitivity of Base CPP Minimum Contribution Rate (percentages)

Assumption		Scenario	Minimum Contribution Rate [1]	Change in MCR relative to Best Estimate	Pay-As-You-Go Rates	
					2025	2060
		Best Estimate	9.72	0.00	10.38	11.95
1	Total Fertility Rate	Lower Cost	9.43	-0.29	10.38	11.24
		Higher Cost	10.03	0.31	10.38	12.75
2	Mortality Rates	Lower Cost	9.38	-0.34	10.38	11.50
		Higher Cost	10.06	0.34	10.38	12.41
3	Net Migration Rate	Lower Cost	9.63	-0.09	10.35	11.71
		Higher Cost	9.80	0.08	10.41	12.16
4	Price Increases	Lower Cost	9.57	-0.15	10.29	11.74
		Higher Cost	9.86	0.14	10.30	12.14
5	Real Wage Increases	Lower Cost	9.29	-0.43	10.15	10.72
		Higher Cost	10.15	0.43	10.64	13.39
6	Real Rate of Return on Investments	Lower Cost	8.28	-1.44	10.38	11.95
		Higher Cost	11.16	1.44	10.38	11.95
7	Disability Incidence Rates	Lower Cost	9.52	-0.20	10.26	11.72
		Higher Cost	9.91	0.19	10.50	12.17

(1)   The minimum contribution rate in this table refers to the rate applicable for 2034 and thereafter.

As shown in Table 114, under the alternative long-term assumptions, the valuation results for the base CPP vary to a greater extent for some assumptions compared to others. The assumed alternative assumptions for mortality improvement rates result in a wide range of the MCR. If mortality improvement rates under a higher-cost scenario are assumed to improve to double their best-estimate ultimate values by 2035, then the MCR for the year 2034 and thereafter would increase to 10.06%. If instead mortality improvement rates under a lower-cost scenario are assumed to reduce to an ultimate value of 0% in 2035, the MCR would decrease to 9.38%.

Under the alternative economic assumptions, the real wage increase leads to a wider range in the resulting MCR compared to price increases. If an ultimate real wage increase of 1.7% is assumed for 2025 and thereafter, the MCR would decrease to 9.29%. However, if an ultimate real wage increase of 0.3% is assumed for 2019 and thereafter, the MCR would increase to 10.15%.

Of all the alternative assumptions tested, the real rate of return on investments showed the greatest effect on the MCR. Real rates of return can fluctuate greatly from year to year and can have a significant impact on the base Plan MCR. If an average annual real rate of return over the next 75 years is assumed to be 5.55%, then the MCR decreases to 8.28%. However, if the average annual real rate of return over the next 75 years is assumed to be 2.35%, the MCR increases to 11.16%.

Unlike the MCR, the pay-as-you-go rates are not affected by the assumed rates of returns on investments. For all other assumptions, the MCR and pay-as-you-go rates do tend to move in the same direction.

Table 115 shows the projected impact on the ratio of the assets to the following year's expenditures under each of the alternative sets of assumptions if the current legislated contribution rate of 9.9% for the base CPP continues to apply for the year 2019 and thereafter.

Table 115	Sensitivity of Base CPP Assets/Expenditures Ratio (9.9% legislated contribution rate)			
		Asset/Expenditure Ratio		
Assumption	Scenario	2025	2060	2095
	Best Estimate	7.6	9.0	9.5
1 Total Fertility Rate	Lower Cost	7.6	9.6	14.3
	Higher Cost	7.6	8.4	4.1
2 Mortality Rates	Lower Cost	7.6	10.2	16.0
	Higher Cost	7.6	8.0	4.3
3 Net Migration Rate	Lower Cost	7.6	9.4	10.7
	Higher Cost	7.5	8.7	8.3
4 Price Increases	Lower Cost	7.6	9.8	11.7
	Higher Cost	7.5	8.4	7.4
5 Real Wage Increase	Lower Cost	7.6	10.8	14.2
	Higher Cost	7.5	6.9	1.9
6 Real Rate of Return on Investments	Lower Cost	8.4	19.8	58.9
	Higher Cost	6.8	3.5	N/A [1]
7 Disability Incidence Rates	Lower Cost	7.7	10.2	12.7
	Higher Cost	7.4	7.9	6.4

(1)   Assets depleted by 2081.

Additional CPP

As for the base Plan, under each scenario, the contribution rates for the additional Plan were projected to follow the current schedule of legislated rates through 2021, and new first and second additional minimum contribution rates (FAMCR, SAMCR) were determined for 2022 and thereafter, and 2024 and thereafter, respectively. Table 116 summarizes the additional Plan AMCRs under each of the scenarios.

	Assumption	Scenario	First Additional Minimum Contribution Rate (FAMCR) [1]	Second Additional Minimum Contribution Rate (SAMCR) [2]	Change in AMCRs relative to Best Estimate
		Best Estimate	1.98	7.92	–
1	Total Fertility Rate [3]	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A
2	Mortality Rates	Lower Cost	1.80	7.20	-0.18/-0.72
		Higher Cost	2.15	8.60	0.17/0.68
3	Net Migration Rate [3]	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A
4	Price Increases	Lower Cost	1.96	7.84	-0.02/-0.08
		Higher Cost	1.99	7.96	0.01/0.04
5	Real Wage Increases	Lower Cost	1.78	7.12	-0.20/-0.80
		Higher Cost	2.22	8.88	0.24/0.96
6	Real Rate of Return on Investments	Lower Cost	1.53	6.12	-0.45/-1.80
		Higher Cost	2.60	10.40	0.62/2.48
7	Disability Incidence Rates [3]	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A

Table 116   Sensitivity of Additional CPP Minimum Contribution Rates (percentages)

(1)   The first additional minimum contribution rate in this table refers to the rate applicable for 2023 and thereafter.
(2)   The second additional minimum contribution rate in this table refers to the rate applicable for 2024 and thereafter.
(3)   These tests do not significantly impact the AMCRs.

As shown in Table 116, and similar to the base CPP, under alternative long-term assumptions, the valuation results for the additional CPP vary to a greater extent for some assumptions compared to others. Like for the base CPP, the assumed alternative mortality improvement rates result in a wide range of the minimum rates for the additional Plan. If mortality improvement rates under a higher-cost scenario are assumed to improve to double their best-estimate ultimate values by 2035, then the FAMCR for the year 2023 and thereafter and SAMCR for the year 2024 and thereafter would increase to 2.15% and 8.60%, respectively. If instead mortality improvement rates under a lower-cost scenario are assumed to reduce to an ultimate value of 0% in 2035, the FAMCR and SAMCR would decrease to 1.80% and 7.20%, respectively.

Under the alternative economic assumptions, the real wage increase results in a wider range of the AMCRs compared to price increases. Further, the impact on the AMCRs is in the opposite direction to that on the base MCR. If an ultimate real wage increase of 0.3% is assumed for 2019 and thereafter, the FAMCR and SAMCR would decrease to 1.78% and 7.12%, respectively. If instead an ultimate real wage increase of 1.7% is assumed for 2025 and thereafter, the FAMCR and SAMCR would increase to 2.22% and 8.88%, respectively.

The alternative assumptions for the real rate of return on investments showed the greatest impact on the AMCRs of all the alternative assumptions tested. The additional CPP relies to a greater extent on investment income compared to the base CPP, and as such, the AMCRs are quite sensitive to changes in future rates of return. If an average annual real rate of return of 4.28% is assumed for the 75-year projection period, the FAMCR decreases to 1.53% and the

SAMCR to 6.12%. On the other hand, if an average annual real rate of return of 2.48% is assumed over the period, the FAMCR increases to 2.60% and the SAMCR to 10.40%.

Table 117 shows the projected impact on the ratio of the assets to the following year's expenditures under each of the alternative sets of assumptions if the legislated first additional contribution rate of 2.0% from 2023 onward and the legislated second additional contribution rate of 8.0% from 2024 onward apply for the additional CPP.

Table 117	Sensitivity of Additional CPP Assets/Expenditures Ratio [1] (2.0%, 8.0% legislated additional contribution rates)				
				Asset/Expenditure Ratio	
	Assumption	Scenario	2025	2060	2095
		Best Estimate	112.5	31.3	26.2
1	Total Fertility Rate [2]	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A
2	Mortality Rates	Lower Cost	112.5	32.5	32.9
		Higher Cost	112.5	30.3	21.3
3	Net Migration Rate [2]	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A
4	Price Increases	Lower Cost	113.5	31.8	27.1
		Higher Cost	111.7	30.8	25.3
5	Real Wage Increase	Lower Cost	112.4	33.5	34.9
		Higher Cost	112.6	29.4	20.3
6	Real Rate of Return on Investments	Lower Cost	114.9	39.5	52.6
		Higher Cost	110.1	24.9	11.2
7	Disability Incidence Rates [2]	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A

(1) The legislated first additional contribution rate is 1.50% in the year 2022 as per the phase-in schedule of the rate.
(2) These tests do not significantly impact the AMCRs.

It should be noted that for both the base and additional Plans, once the lower- and higher-cost assumptions reach their ultimate values, they are held constant for the rest of the 75-year projection period and the components of the CPP are assumed to remain in their current forms. This may not be realistic. As new demographic and economic trends in society emerge, it may be necessary to update the base and additional CPP in order to reflect a new demographic or economic reality with the objective of maintaining affordability and intergenerational equity.

E.5   Higher and Lower Economic Growth

The current local and global economic environments pose a series of challenges for Canada to sustain consistent economic growth. Persistent low interest rates, slow productivity growth, as well as demographic pressures from an aging population could adversely affect the Canadian economy. While under the best-estimate scenario, moderate and sustainable economic growth is assumed, different scenarios of higher and lower economic growth were considered. These alternative economic growth scenarios comprise combinations of individual assumptions according to two cases. For the first case, alternative changes pertaining only to the labour market are considered. The second case builds on the first with alternative assumptions for the real wage increase also considered.

In respect of the labour market, employment levels are reflected in the actuarial projection model through the assumptions made regarding the level of labour force participation and job creation rates by year, age and sex. These rates vary not only with the rate of unemployment, but also reflect trends in increased workforce participation by women, longer periods of formal education among young adults, and trends in the retirement patterns of older workers.

Under the best-estimate scenario, the job creation rate assumption is determined on the basis of expected moderate economic growth and an unemployment rate that is expected to gradually increase from its 2018 level of 5.8% to an ultimate rate of 6.2% by 2030. Furthermore, the participation rates for all age groups are expected to increase due to the attractive employment opportunities resulting from labour shortages and the aging of cohorts with stronger labour attachments, especially for women and individuals with higher education attainment. The assumed increase in participation rates of those aged 55 and over is even more significant, given that it is also affected by the expected continued trend toward delayed retirement. Under the best-estimate scenario, the participation rate of those aged 18 to 69 for Canada is expected to increase from 75.9% in 2018 to 79.2% in 2035.

For cohorts reaching age 60 in 2021 and thereafter, the retirement benefit take-up rates at age 60 are assumed to be 27.0% and 29.5% in 2021 and thereafter for males and females, respectively, and the take-up rates at age 65 are assumed to be 46.4% in 2021 and thereafter for both males and females. These rates result in a projected average age at retirement pension take-up of 63.2 years in 2040.

The best-estimate assumption for the real-wage increase is that it reaches an ultimate level of 1.0% by the year 2025. The ultimate real-wage increase assumption together with the price increase assumption of 2.0% leads to an ultimate nominal-wage increase of 3.0% for 2025 and thereafter.

A deterministic model (instead of a stochastic model) was used to generate the higher and lower economic growth scenarios for these assumptions, since a stochastic model would not accurately reflect the assumed future trends in labour force participation, unemployment, and real wage increases. The labour shortages and the trend toward delayed retirement are unlike any labour situation experienced in the past, and thus the historical data do not reflect any substantial shifts like the one being projected. Therefore, it was decided to use judgment in determining the higher and lower economic growth assumptions for the participation rates, unemployment and retirement pension take-up rates, and real wage increases.

E.5.1   Higher Economic Growth

Under the higher economic growth scenario, for the labour market, the job creation rate is robust resulting in a lower unemployment level, higher labour force participation rates, and later retirement pension take-up due to the availability of employment and unwillingness to incur early retirement penalties. In addition to the assumed labour market changes, the real-wage increase is assumed to be higher than the best estimate.

For this higher economic growth scenario, the job creation rate is assumed to increase at a faster pace than under the best-estimate scenario, resulting in an unemployment rate of 4.2% in 2030 and thereafter. In addition, the assumed ultimate participation rates in 2035 are set to increase to higher levels than the best estimates. Furthermore, the assumed ultimate gap between male and female participation rates in 2035 for those aged 18 to 69 is set equal to 3.8% as opposed to 7.3% under the best-estimate scenario. This results in an overall participation rate of 84.6% for those aged 18 to 69 in 2035.

The lower unemployment rate and higher participation rate are assumed to encourage individuals to ask for their CPP retirement pension at a later age. Therefore, by 2038, retirement pension take-up rates at age 60 are assumed to gradually decrease to levels that are 20 percentage points lower than the best estimates, i.e. to 7.0% and 9.5% for males and females, respectively. This results in an increase in the projected average age at retirement pension take-up, from 63.2 years to 64.2 years in 2040. The proportions of working beneficiaries were adjusted to reflect the shift in retirement pension take-up to later ages.

Finally, for the second case where in addition to the assumed changes in the labour market, the real wage increase is also changed, it is assumed to be 1.7% as opposed to 1.0% under the best-estimate scenario. Under this second case, the higher economic growth scenario results in total employment earnings in 2035 being 15% higher compared to the best estimate.

E.5.2   Lower Economic Growth

Under the lower economic growth scenario, for the labour market, the job creation rate increases at a slower pace, resulting in a higher unemployment level and lower labour force participation rates. Insufficient employment opportunities are likely to cause individuals to ask for their CPP retirement pension at an earlier age regardless of the early retirement reduction. In addition to the assumed labour market changes, the real wage increase is assumed to be lower than the best estimate.

For this lower economic growth scenario, the job creation rate is assumed to increase at a slower pace than the best estimate, resulting in an unemployment rate of 8.2% in 2030 and thereafter. In addition, male and female participation rates are assumed to remain constant at their 2018 levels. This results in an overall participation rate of 76.2% for those aged 18 to 69 in 2035.

The higher unemployment rate and lower participation rate are assumed to encourage individuals to ask for their CPP retirement pension at an earlier age. Therefore, retirement pension take-up rates at age 60 are assumed to gradually increase to levels in 2035 that are 20 percentage points higher than the best estimates, i.e. to 47.0% and 49.5% for males and females, respectively. This results in a decrease in the projected average age at retirement pension take-up from 63.2 years to 62.3 years in 2040. The proportions of working beneficiaries were adjusted to reflect the shift in retirement pension take-up to earlier ages.

Finally, for the second case where in addition to the assumed changes in the labour market, the real wage increase assumption is also changed, it is assumed to be 0.3% compared to 1.0% under the best-estimate scenario. Under this second case, the lower economic growth scenario results in total employment earnings in 2035 being 13% lower compared to the best estimate.

E.5.3   Results

Table 118 presents a summary of the assumptions used in the sensitivity analysis of economic growth and the resulting minimum contribution rates under the first case where only labour market changes are assumed and the second case where, in addition, real-wage increase changes are also assumed.

Under the first case, where only changes to the labour market assumptions are considered, the base Plan MCR is 9.16% under the higher economic growth scenario and 10.19% under the lower economic growth scenario compared to the best-estimate scenario. For the additional Plan, the AMCRs likewise decrease under assumed higher economic growth and increase under lower economic growth compared to their best estimates but the impacts are less pronounced. The FAMCR and SAMCR are 1.95% and 7.80%, respectively under the higher economic growth scenario, and 1.99% and 7.96%, respectively under the lower economic growth scenario.

Under the second case, where changes to the assumed real-wage increase are also considered, the base Plan MCR is 8.80% under the higher economic growth scenario and 10.67% under the lower economic growth scenario. The impact on the additional Plan AMCRs is opposite to that for the base Plan MCR in this case. Under the higher economic growth scenario, the FAMCR and SAMCR increase respectively to 2.21% and 8.84%, while under the lower economic growth scenario, the FAMCR and SAMCR decrease respectively to 1.80% and 7.20%. The AMCRs move in the opposite direction compared to the base Plan MCR due to the differing effects of the real wage increase assumption on the base and additional Plans, which is attributable to their different financing approaches.

Table 118   Higher and Lower Economic Growth Sensitivity Tests

Canada	Higher Economic Growth	Best-Estimate	Lower Economic Growth
Case #1: Changes to Labour Market Only			
Participation Rate (age group 18-69) (2035)	84.6%	79.2%	76.2%
Unemployment Rate (2030)	4.2%	6.2%	8.2%
Average CPP Retirement Benefit Take-up Age (2040)	64.2 years	63.2 years	62.3 years
Minimum Contribution Rate (MCR) [1]	9.16%	9.72%	10.19%
Additional Minimum Contribution Rates (AMCRs) [2]	1.95% / 7.80%	1.98% / 7.92%	1.99% / 7.96%
Case #2: Changes to Labour Market and Real Wage Increase			
Participation Rate (age group 18-69) (2035)	84.6%	79.2%	76.2%
Unemployment Rate (2030)	4.2%	6.2%	8.2%
Average CPP Retirement Benefit Take-up Age (2040)	64.2 years	63.2 years	62.3 years
Real Wage Increase	1.7% (2025)	1.0% (2025)	0.3% (2019)
Minimum Contribution Rate (MCR) [1]	8.80%	9.72%	10.67%
Additional Minimum Contribution Rates (AMCRs) [2]	2.21% / 8.84%	1.98% / 7.92%	1.80% / 7.20%

(1)   The MCR in this table refers to the rate applicable for 2034 and thereafter.

(2)   The AMCRs in this table refer to the FAMCR and SAMCR applicable, respectively, for 2023 and thereafter and 2024 and thereafter.

E.6   Younger and Older Populations

Demographic and labour force assumptions are modified in this section with the purpose of projecting younger and older populations compared to the best estimate. However, these alternative populations do not necessarily reflect probable scenarios. Using the demographic assumptions of the individual sensitivity tests, two alternative scenarios were examined. The first scenario is classified as the younger population scenario, since the ratio of retirees to workers is lower than under the best-estimate assumptions. The second scenario has a ratio of retirees to workers that is higher than the best estimate and is referred to as the older population scenario. Once the two populations were created, the labour force participation rates were modified to align with the new populations.

The demographic assumptions anticipated in these scenarios were determined using the lower- and higher-cost assumptions of the base CPP regarding fertility, mortality, and migration rates, as well as the labour force participation rates pertaining to the higher and lower economic growth scenarios described in the preceding section.

The choice of assumptions will always remain subjective to a certain extent and one could always argue that the range of possible projected outcomes presented herein is not realistic. However, one must keep in mind that these alternative scenarios are only presented to provide a reasonable range of possible future outcomes for the cost of the base and additional Plans.

E.6.1   Younger Population

Under the younger population scenario, it is assumed that the ultimate total fertility rate is 1.92 per woman for both Canada and Québec. Mortality improvement rates are assumed to increase at a much slower pace than under the best-estimate scenario. The result is that life expectancies at age 65 decrease from their projected best estimates by 2.3 and 2.4 years for males and females, respectively, by 2050. Finally, net migration to Canada is assumed to reach a level of 0.68% of the population in the year 2021.

The combination of these younger population assumptions results in a dependency ratio of those aged 65 and over to the working-age population (20-64) of about 0.40 (or 2.5 workers per retiree) for Canada less Québec in 2050. This is 9% lower than under the best-estimate scenario where the ratio reaches a level of 0.44 (or 2.3 workers per retiree) in 2050. Under this younger population scenario, the population grows more rapidly, to a level in 2050 that is 7.7% higher compared to the best-estimate scenario.

It is assumed that, under a younger demographic scenario, labour shortages would be less severe. As a result, it is assumed that labour force participation rates would be lower, especially at the younger and older ages.

E.6.2   Older Population

Under the older population scenario, it is assumed that the ultimate total fertility rate is 1.32 per woman for both Canada and Québec. Mortality improvement rates are assumed to increase at a faster pace than under the best-estimate scenario. The result is that life expectancies at age 65 increase from their projected best-estimate levels by 2.5 and 2.4 years for males and females, respectively, by 2050. Finally, net migration to Canada is assumed to fall to a level of 0.57% of the population in the year 2021.

The combination of these older population assumptions results in a dependency ratio of those aged 65 and over to the working-age population (20-64) of about 0.48 (or 2.1 workers per retiree) for Canada less Québec in 2050. This is 9% higher than under the best-estimate scenario where the dependency ratio reaches a level of 0.44 (or 2.3 workers per retiree) in 2050. Under this older population scenario, the population grows more slowly, to a level in 2050 that is 4.7% lower compared to the best-estimate scenario.

It is assumed that, under an older demographic scenario, labour shortages would be more severe. For this purpose, it is assumed that labour force participation rates would be higher, especially at the older ages.

E.6.3   Results

Table 119 presents a summary of the assumptions used in this sensitivity analysis and the resulting minimum contribution rates. The base Plan MCR is 9.30% under the younger population scenario and 9.99% under the older population scenario. The additional Plan AMCRs move in the

same direction as the base Plan MCR. Under the younger population scenario, and FAMCR and SAMCR decrease respectively to 1.81% and 7.24%, while under the older population scenario, the FAMCR and SAMCR increase respectively to 2.10% and 8.40%.

Table 119	Younger and Older Populations Sensitivity Test Assumptions		
Canada	Younger Population	Best-Estimate	Older Population
Total Fertility Rate	1.92	1.62	1.32
Mortality: Canadian Life Expectancy at Age 65 in 2050 with Future Improvements	Males 21.0 Females 23.4	Males 23.3 Females 25.6	Males 25.8 Females 28.0
Net Migration Rate	0.68%	0.62%	0.57%
Labour Force Participation Rate (age group 18-69)	76.2% (2035)	79.2% (2035)	84.6% (2035)
Minimum Contribution Rate [1]	9.30%	9.71%	9.99%
Additional Minimum Contribution Rates[2]	1.81% / 7.24%	1.98% / 7.92%	2.10% / 8.40%

(1)   The minimum contribution rate in this table refers to the rate applicable for 2034 and thereafter.

(2)   The additional minimum contribution rates in this table refer to the FAMCR and SAMCR applicable, respectively, for 2023 and thereafter and 2024 and thereafter.

Appendix F   – Acknowledgements

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