The Submission of

William M. Mercer Limited

to

The Royal Commission on Workers’ Compensation in British Columbia

Part B: Asset/Liability Study

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EXECUTIVE SUMMARY

This report presents the results of the asset/liability study for the Royal Commission on Workers’ Compensation in British Columbia. The purpose of the study was to assist the Commission consider alternative asset mix strategies which reflect a range of future economic conditions, the size and nature of the liabilities, and the funding position of the Workers’ Compensation system.

The study is based on an analytical framework that links the funding and investment policies using “value at risk” principles. The central theme of this framework is that conservatively (i.e. well) funded systems can adopt higher equity allocations in the asset mix.

Achieving a well funded position and adopting higher equity content results in lower expected future costs for contributors, while protecting the benefit security needs of claimants.

The study was conducted in the context of financial market conditions at the end of 1997, and considers a likely range of changes that may occur in the future with respect to the level of inflation expectations, real interest rates and economic growth using a scenario risk model.

In addition, the impact of some extreme economic conditions was examined to stress test our findings.

We also examined the alternative asset mix strategies using the efficient frontier to assess the return to risk characteristics.

Our findings are that
♦ The Workers’ Compensation system is well funded;
♦ The Board can add more equity to the asset mix. This will increase the liabilities on a risk adjusted basis, but lower long-term expected costs;
♦ Over the long term, the liability structure will grow with increases in the average covered wage;
♦ For claims incurred to a specific date, the duration of the system’s real interest rate risk is about equal to a real return bond with a 10-year term to maturity;
♦ Equities will likely protect the system against real interest rate risk and real wage growth over the long-term, although imperfectly; and

♦ Additional diversification of equity holdings outside Canada could improve the risk/return expectations.

In this context, the current funding target and investment policy do a very good job, but the mechanism that links funding and investment policy could be fine-tuned. This would improve the transparency of how costs are allocated over time. Within a risk adjusted framework, equity content may be increased, providing lower long-term expected costs while protecting the benefit security needs of workers within the required standards of prudence.

Considerations for Revising the Investment Policy

♦ Equity content may be increased from 50% currently, to a range varying from 50-70%, provided the appropriate funding target is maintained;

♦ The foreign equity component may be increased from 20% currently, to a range varying from 20-40%, depending on the level of equity content;

♦ The proportion of U.S. to foreign equity may be reduced from 75% currently, to a range varying from 50-75%;

♦ The fixed income portfolio may continue to be invested in nominal bonds with an average term to maturity about equal to the Universe Index; and

♦ The cash component may be reduced from 10% currently to 5% or less. The reduction may be invested in real return bonds.
INTRODUCTION AND OVERVIEW

A. SCOPE AND LIMITATIONS OF THE STUDY

The purpose of this study is to analyze and illustrate the impact of investment policy decisions in a framework that links funding and investment policy. The linkage requires that liabilities be valued using current market interest rates and adjusted for investment policy risk. In this context, we have included estimates of liability values at different discount rates. These estimates are sufficient to indicate the direction and order of magnitude of changes to the balance sheet and annual costs, in response to changes in the interest rate.

We have not attempted to achieve the degree of accuracy of a bona fide actuarial valuation of the liabilities. An actuarial valuation would consider experience and demographic factors beyond the scope of our study. For these reasons, our estimates should not be used for purposes other than this report.

To the extent that the Board wishes to adopt the approaches described in this report, we recommend that our estimates be verified by an actuarial valuation.

B. BACKGROUND

The Workers’ Compensation Board (WCB) administers the Accident Fund (the Fund) maintained to pay compensation, outlays, and expenses (referred to in aggregate as benefits) to workers and their dependants in accordance with the terms of the Workers’ Compensation Act (the Act).

The WCB is responsible for:
- monitoring the Fund’s financial condition,
- periodically valuing the assets and liabilities of the Fund,
- establishing investment policy, and
- establishing funding policy.

The major investment policy decisions include
- the portions of the Fund invested in equities and fixed income securities,
- for the equity portion, the amounts to be invested in Canadian and foreign securities, and for the foreign portion, the amounts to be invested in U.S. and non-North American equity,
- for the fixed income portion, the economic structure (real or nominal) and term structure (duration), and
- the role of speciality asset classes.

The funding policy consists of determining the level of annual assessments needed to:
- capitalize the value of future benefits in respect of injuries that occur during the year,
- ensure there are sufficient funds to provide for benefits incurred in prior years, and
♦ provide for additional benefits imposed by special circumstances, including legislative change, with the costs being recognized over a period of one or more years.

The annual cost is determined by:
♦ the benefits paid (which in turn are governed by the Act),
♦ experienced rates of injury, recovery, and longevity,
♦ the economic environment, in particular, prevailing levels of inflation, salary growth, interest rates, and capital market returns,
♦ the Fund’s investment performance, and
♦ the pattern of cost allocations to annual time periods determined by the funding policy.

The benefits paid to workers are not directly affected by the system’s financial condition and the performance of the Fund’s investments.

C. FUNDING AND INVESTMENT POLICY LINKS

The scenario risk study is based on a proposed framework that links funding and investment on a risk adjusted basis. This framework is not currently used by the WCB, but could be implemented along the lines described in this report. One of the benefits would be to increase the transparency of the allocation of costs among different generations of contributors.

The link between the funding and investment policies may be described by reference to the following amounts:

The Economic Liability

The economic value of the liabilities at a particular point in time, is the present value of expected future benefits using the market yield on a Government of Canada bond with a term structure (i.e. duration) and economic structure (i.e. real or nominal) comparable to the liabilities. This yield is referred to as the economic discount rate. We have estimated the current economic discount rate to be about 3.8%.
The Funding Target

The funding target is the amount that the Fund should have at any point in time, consisting of the economic liability plus a reserve (risk margin) for investment policy risk. The funding target is also referred to as the “risk adjusted liability”. Because experience and the rate of return earned on investments is uncertain, the Fund’s assets will rarely be at this target level. We have estimated the investment risk margin to be 35% of the economic liability, times the proportion of the fund invested in equities. If the investment policy contains no equity content, the funding target is equal to the economic liability. If the investment policy allocates 100% of the Fund to equities, the funding target is 135% of the economic liability.

The Economic Assessment

The economic value of the annual assessment for expected future benefits relating to injuries incurred during the year is calculated in the same way as the economic liability described above.

The Expected Annual Cost

The expected annual cost consists of:

♦ the economic assessment, plus
♦ interest at the economic discount rate (plus expected inflation) on the funding target, less
♦ the expected investment policy return on the funding target.

The expected annual cost is therefore determined primarily by:

♦ the current market yield (economic discount rate)
♦ the investment policy risk margin (used to determine the funding target)
♦ the expected return from the investment policy asset mix
The Current Annual Cost

The current annual cost consists of:

♦ the expected annual cost, plus
♦ the expected return on, and amortization of, the difference between the market value of assets and the funding target, plus
♦ amortization of the risk margin on the economic assessment reduced by benefits expected to be paid during the year (this amount is referred to as the “maturity cost”).

The current annual cost is equal to the expected annual cost if:

♦ assets are equal to the funding target, and
♦ benefits paid are equal to economic assessment (i.e. the system is “mature”).

D. THE CONCERNS OF CONTRIBUTORS

The funding policy assigns cost (i.e. the capitalized value of future benefits) to the year an injury is incurred. To the extent this is achieved, the allocation of costs relative to the risks borne by different generations of contributors is equitable.

In this context, the implications of conservative and aggressive investment policies are reviewed as follows.

A conservative investment policy minimizes the risk of future deficits by investing in fixed income assets which closely track (i.e. match) the Fund’s economic liabilities. The Fund may be maintained about equal to the economic liabilities without exposing future generations of contributors to the risk of funding an investment loss on funds contributed for injuries incurred in past years. At the same time, the long-run costs of the plan are likely to be high, as the investment returns on fixed income assets will be relatively low in most economic environments.

An aggressive investment strategy, consisting of significant equity content, provides poor tracking of the economic liabilities in the short term. If the Fund is maintained close to the economic liability value, investment losses that emerge will need to be funded by future generations of contributors. This can be remedied by maintaining the Fund at a sufficient level so that the emergence of a deficit has a very low probability. An aggressive investment policy with significant equity content together with a higher funding target can provide reasonable protection against the Fund falling below the economic liability. A high equity content investment policy is economically attractive to the extent that the additional investment returns exceed the cost of maintaining a higher funding target and are available to provide lower long-term costs.

E. A SUMMARY OF KEY ASSET AND LIABILITY VALUES AT DECEMBER 31, 1997

The financial position of assets and liabilities recorded in the (draft) Actuarial Report as at December 31, 1997 was determined using actuarial assumptions and methods that anticipate future long-term “average market” condition. This approach is widely used and has the advantages of:
producing consistent results over multi-year periods, and
stable annual costs

The assumptions and methods typically do not change dramatically from year to year when the “average market” approach is used.

A scenario risk analysis depends on asset and liability values that vary directly with current financial market conditions. This approach is more appropriate for asset/liability management. The “marked to market” liability values for this study were derived from the reported financial data using estimation techniques. A comparison of the reported and derived values is as follows:

<table>
<thead>
<tr>
<th>$Millions at December 31, 1997</th>
<th>Reported</th>
<th>Derived</th>
<th>Risk Adjusted Funding Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liability Valuation Method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Market</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount Rate</td>
<td>3%</td>
<td>3.8%</td>
<td>3.8% 3.8%</td>
</tr>
<tr>
<td>Investment Risk Margin</td>
<td>Implicit</td>
<td>Nil</td>
<td>17.5% 24.5%</td>
</tr>
<tr>
<td>Liabilities</td>
<td>$6,192</td>
<td>$5,792</td>
<td>$6,806 $7,211</td>
</tr>
<tr>
<td>Asset Valuation Method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoothened Market Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>$6,270*</td>
<td>$7,386</td>
<td></td>
</tr>
<tr>
<td>Funding Excess (i.e. Surplus)</td>
<td>$78</td>
<td>$1,594</td>
<td>$580 $175</td>
</tr>
<tr>
<td>1997 Assessment** (Expected Annual Cost)</td>
<td>$971</td>
<td>$927</td>
<td>$832 $782</td>
</tr>
</tbody>
</table>

* Note 1 Realized and unrealized capital gains are smoothed over 5 years.

**Note 2 Represents the long-term expectation, prior to the expected investment return on, and the amortization of the current funding excess, and the risk margin on changes to the liability.
F. UTILIZING SURPLUS

The table on page 7 indicates that the term “surplus” needs to be treated with some caution. The measurement of surplus depends on the methods and assumptions used to value assets and liabilities. In this report, we use the term surplus (or deficit) to mean the difference between the market value of assets and the risk adjusted liabilities (i.e. funding target). Recall that surplus and deficits will emerge because experience and investment returns are uncertain, and hence the market value of assets will rarely be equal to the funding target. However, the risk margin included in the funding target will ensure that the market value of assets will almost always exceed the economic liability value.

The following figures illustrate how surplus may be utilized:

<table>
<thead>
<tr>
<th>Investment Policy</th>
<th>100% Fixed Income</th>
<th>70% Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liability (Risk Adjusted)</td>
<td>5,792</td>
<td>7,211</td>
</tr>
<tr>
<td>Assets (at MV)</td>
<td>7,386</td>
<td>7,386</td>
</tr>
<tr>
<td>Surplus</td>
<td>1,594</td>
<td>175</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annual Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Annual Cost</td>
<td>927</td>
</tr>
<tr>
<td>Amortization of Surplus over 15 Years</td>
<td>(163)</td>
</tr>
<tr>
<td>Current Annual Cost for next 15 Years</td>
<td>764</td>
</tr>
</tbody>
</table>

| Theoretical Assets Value after 15 Years | 5,792 | 7,211 |
| Current Annual Cost After 15 Years | 927 | 782 |

The first column assumes that the investment policy is revised to 100% fixed income assets that “match” the term and economic structure of the claim obligations. In this case, there is no requirement for a risk margin and the funding target is set equal to the economic liability, resulting in a surplus of $1,594 million. The surplus could be amortized over 15 years in equal instalments of principal and interest (at 7%), to reduce the ongoing annual cost to $764 million.
A 70% equity investment policy achieves the same annual cost over the next 15 years but in a different manner. With equities, the surplus is reduced because a risk margin is included in the liabilities. However, the expected annual cost ($782 million) is lower than for the 100% fixed income policy because additional investment returns on the fund are anticipated. Although (in theory) both investment policies produce the same annual cost for the next 15 years, the position of the system will be very different once current surplus has been fully amortized.

After 15 years, in theory, the assets would be equal to the funding target under both approaches, and annual costs will no longer be reduced by the amortization of surplus. After 15 years, the Fund would be substantially less, and the annual costs higher, for the 100% fixed income policy. If the future generation of contributors wished to add equities to the asset mix, an additional levy would be needed to bring the assets up to the appropriate funding target.

In summary, assets in excess of the economic liabilities represent “capital” that can be:

♦ used to fund additional benefits
♦ refunded to the current generation of contributors, or
♦ deployed as risk capital to cover equity risk

The decision on how surplus is utilized has a material consequence on the financial position and ongoing costs of the system that will eventually be ceded to future generations of stakeholders.
G. SCENARIO RISK ANALYSIS

This study utilizes an approach called scenario risk analysis. The purpose of a scenario risk analysis is to estimate the impact of changes in the economic environment on the balance sheet position and ongoing costs of the Workers’ Compensation system. We are primarily concerned with changes in three macroeconomic factors:

♦ real interest rates,
♦ expected inflation, and
♦ economic growth.

Graphs showing the historical trends for these factors for the period 1924-97 are provided in Appendix D. Historical data for these factors, and related historical capital market returns for T-Bills, long Canada bonds, and Canadian and foreign equities are shown in Appendix A. The historical trends and data include estimated yields and returns for Canadian real return bonds before they became available to investors at the end of 1991. The estimates for the period from 1924-91 were derived using Mercer’s interest rate model.

Appendix B illustrates typical future scenarios for the next 10 years. These scenarios are typically used to project assets and liabilities on a year by year basis into the future.

Projections can model the dynamics of demographic and economic change; for example, the impact of

♦ changes in average age, and
♦ average benefit levels as new claims based on higher salaries enter the system.

Scenario risk analysis, the approach used in this study, provides a simpler alternative to projection studies. This is achieved by limiting the study to current point in time estimates of the liabilities and assets. The information provided by scenario risk analysis is particularly relevant for two key investment decisions:

♦ the allocation between fixed income and equities (Section III), and
♦ fixed income policy (Section II)
The scenario risk model considers all 9 combinations of the following real interest rates and inflation environments:

<table>
<thead>
<tr>
<th></th>
<th>RRB Yield</th>
<th>Expected Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>3.00%</td>
<td>0.50%</td>
</tr>
<tr>
<td>Current</td>
<td>4.15%</td>
<td>1.90%</td>
</tr>
<tr>
<td>High</td>
<td>4.75%</td>
<td>3.50%</td>
</tr>
</tbody>
</table>

This would cover most of the scenarios shown in Appendix B. We also assume that economic growth varies inversely with real interest rates as follows:

<table>
<thead>
<tr>
<th></th>
<th>RRB Yield</th>
<th>Real GDP Per Employed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.00%</td>
<td>2.40%</td>
</tr>
<tr>
<td></td>
<td>4.15%</td>
<td>1.00%</td>
</tr>
<tr>
<td></td>
<td>4.75%</td>
<td>0.25%</td>
</tr>
</tbody>
</table>

Section V considers some more extreme conditions (stress test) consisting of higher inflation and the combination of lower real interest rates with low economic growth.

We have analyzed the current investment policy and five alternative mixes (Mixes 1 - 5) using the fixed income yield curve at December 31, 1997 as illustrated below:

**Summary of Alternative Asset Mixes**

<table>
<thead>
<tr>
<th>CURRENT YIELD CURVE DEC. 31, 1997</th>
<th>EXPECTED TOTAL RETURN CURRENT SCENARIO</th>
<th>CURRENT POLICY MIX</th>
<th>ASSET MIXES</th>
<th>ASSET MIXES</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.00%</td>
<td>4.06%</td>
<td>10%</td>
<td>45%</td>
<td>5%</td>
</tr>
<tr>
<td>5.35%</td>
<td>5.42%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>5.65%</td>
<td>5.73%</td>
<td>40%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>6.05%</td>
<td>6.14%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>4.15%</td>
<td>6.14%</td>
<td>0%</td>
<td>0%</td>
<td>55%</td>
</tr>
<tr>
<td>REAL ESTATE</td>
<td>7.53%</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>EQUITY</td>
<td>8.58%</td>
<td>45%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
<td></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

EXPECTED TOTAL RETURN: 6.93%

5.21% 5.87% 7.04% 7.32% 7.61%

Diversification in foreign equities is considered in Section IV. For this purpose, we have used traditional mean/variance analysis (i.e. the efficient frontier).
SECTION I. LIABILITIES

A. Considerations for Reform

♦ Liability values that reflect economic and risk adjusted costs improve the transparency of cost allocations over time.

B. Findings

1. The economic structure (i.e. real or nominal) and term structure (duration) of the liabilities is approximately matched by a real return bond having a 10-year term to maturity.

In November, 1997, the Government of Canada began issuing real return bonds (RRBs). There are now 2 issues outstanding, with the first issue maturing on December 31, 2021 and the second issue maturing on December 1, 2026. RRBs have an annual coupon rate of 4.25% applied to a principal amount that changes with the Consumer Price Index (CPI). The coupon is payable semi-annually on June 1 and December 1.

The real yield on RRBs constitutes a market-related discount rate for valuing inflation protected obligations such as Workers’ Compensation claims because the stream of future coupons and the principal at maturity are indexed to inflation. The Worker’s Compensation liability has about the same sensitivity to changes in real yields as an RRB with a 10-year term to maturity. On December 31, 1997, the real yield on RRBs maturing in 2021 and 2026 was about 4.15%. The estimated real yield for an RRB with a 10-year term to maturity was obtained by subtracting the yield differential between long and mid-term nominal bonds (i.e. about 0.40% on December 31, 1997) and annualizing. This resulted in an annualized real discount rate of 3.80% as at December 31, 1997.
A similar approach was followed for determining the appropriate real discount rate for valuing Workers’ Compensation liabilities in other scenarios. The following chart shows economic liabilities based on market related real discount rates for various RRB yield and inflation environments. Although Workers’ Compensation claims are indexed to inflation, the economic liabilities are determined by the real yields available on RRBs, not expected inflation.

<table>
<thead>
<tr>
<th>RRB (%)</th>
<th>3.00%</th>
<th>4.15%</th>
<th>4.75%</th>
<th>5.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Liabilities ($000,000)</td>
<td>6,403</td>
<td>5,792</td>
<td>5,508</td>
<td>5,508</td>
</tr>
</tbody>
</table>

2. The reserve for equity risk is about 35% times the proportion of the fund invested in equities.

The annual standard deviation of the balance sheet position (surplus or deficit) of the system, assuming 100% investment in Canadian equities was estimated as follows:

- The volatility of the liabilities is assumed to be about equal to a 10-year term real return bond. The standard deviation of real returns is estimated to be 7.5%.
- The standard deviation of real equity returns is estimated to be 15.5%
- A first approximation for the standard deviation of the surplus (or deficit) position is 17.2% (i.e. the square root of \(7.5^2 + 15.5^2\)).

This estimate could be fine-tuned further to include the impact of correlation between equity and liability returns, and the diversification effect of investing in foreign equities. Both factors would tend to reduce balance sheet volatility. On the other hand, some conservatism appears appropriate because standard deviations are time varying (i.e. uncertain) and 10-year term real return bonds is not actually available for investment.

On this basis, we are using this first approximation for the study. A typical “value at risk” approach establishes a risk margin equal to 2 times the balance sheet standard deviation, or about 35% (i.e. 2 x 17.2% rounded up). Maintaining a 35% margin reduces the probability of
a deficit to 2.5%, or about 1 year in 40. The margin for an investment policy with less than 100% equity investments is reduced proportionally, as shown in the following table:

<table>
<thead>
<tr>
<th>Equity Content</th>
<th>Risk Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>35%</td>
</tr>
<tr>
<td>70%</td>
<td>24.5%</td>
</tr>
<tr>
<td>60%</td>
<td>21.0%</td>
</tr>
<tr>
<td>50%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Risk adjusted liabilities are determined by both the real yield environment and the equity content of the investment policy as shown on the following graph:
SECTION II.  FIXED INCOME

A.  Considerations For Reform

♦  In the absence of 10-year term real return bonds, practical fixed income strategies may incorporate T-Bills, nominal bonds and 25 - 30 year term real return bonds.

♦  Investment in nominal bonds rather than T-Bills provides a trade-off between higher expected returns and exposure to inflation risk.

B.  Discussion

This part of the study considers two 100% fixed income strategies (i.e. Mixes 1 and 2). We do not suggest or anticipate that the Fund will be invested in 100% fixed income securities. Rather, the purpose of this approach is to identify strategies that minimize risk by matching the term (i.e. duration) and economic (i.e. real vs. nominal) structure of the liabilities. This will provide information on the economic cost of minimizing investment risk as well as guidance for structuring the fixed income portion of the investment policy. When equities are considered in Section III, we use the concept of substituting equities for the various fixed income components of Mix 2.
C. Findings

Our findings are summarized as follows:

1. **The economic structure (i.e. real or nominal) and term structure (duration) would be approximately matched with a real return bond having a 10-year term to maturity. A reasonable proxy consists of 45% T-Bills and 55% RRBs having a 25-30 year term to maturity.**

The following graph illustrates that the surplus position of a 45% T-Bill/55% RRB policy is sensitive to real yields, but independent of inflation expectations. This T-Bill/RRB combination is considered to be a matching asset to the term and economic structure of the liabilities.
2. A reasonable alternative fixed income strategy consists of

- **5%** T-Bills
- **40%** Scotia Capital Market Universe Bonds (SCMU)
- **55%** RRB’s

Historically, T-Bills have provided lower returns than nominal bonds and therefore impose an “opportunity cost”. This can be mitigated by allocating 40% to bonds having an average term to maturity of about 9-10-years.

The addition of nominal bonds creates an exposure to inflation risk as indicated by the following surplus profile:

Adding nominal bonds to the asset mix worsens the balance sheet position as inflation expectation rise, and improves the balance sheet position if we experience further declines in the level of inflation expectations. A perspective on historical inflation expectations is provided in Appendix D.
3. The economic compensation for exposure to inflation risk is the higher expected returns on nominal bonds compared to T-Bills.

The impact of higher expected returns is illustrated by comparing the expected (long-term) annual costs for Mix 1 (45% T-Bill/55% RRB) and Mix 2 (5% T-Bill, 40% SCMU bonds/55% RRBs) policies as shown on the following graphs:

**Expected Annual Cost - Mix 1**

**Expected Annual Cost - Mix 2**
A. Considerations for Reform

♦ The system is well funded,
♦ Equity content may increased from 50% currently, to up to 70% of the fund, provided the appropriate funding target is maintained,
♦ Higher equity content will reduce the expected long-term costs of the system, especially in lower real interest rate environments.

B. Findings

1. The current funding target is sufficient for equity content up to about 70% of the fund.

In its 1997 annual report, the WCB has committed to a funding target of 110-115% of the current liabilities (i.e. discounted at 3%). This compares to the risk adjusted framework used for this study as follows:

<table>
<thead>
<tr>
<th></th>
<th>WCB Current Liability/ Funding Target</th>
<th>Risk Adjusted Funding Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,192</td>
<td>5,792 (No Equity)</td>
<td></td>
</tr>
<tr>
<td>6,811 (110%)</td>
<td>6,806 (50% Equity)</td>
<td></td>
</tr>
<tr>
<td>7,120 (115%)</td>
<td>7,211 (70% Equity)</td>
<td></td>
</tr>
</tbody>
</table>

As shown, the WCB’s funding targets are very similar to the risk adjusted funding targets developed in this report. By this criteria, the system is conservatively funded.
2. A reasonable approach for determining a 50% equity content policy is to substitute equities for RRBs.

Equities are generally considered to be a “real” asset class, and therefore should cover the real interest rate risk inherent in the liability structure. In particular, equities should protect the balance sheet against a reduction in long-term real interest rates, but it will do so imperfectly, particularly in the short term. Asset Mix 3 is obtained by substituting 50% equities for RRBs in Mix 2. Mix 3 is very similar to the Current Policy and has a very similar “surplus profile” as the economic environmental changes as shown below:
As expected, Mix 3 and the Current Policy also have very similar expected (long-term) annual cost profiles as shown below:
3. **Equity content in excess of 50% may be achieved by reducing the allocation to SCM Universe bonds.**

Given the exposure to real interest rate risk inherent in the liabilities, it would appear reasonable to retain some investments in RRBs. It is recognized that the total market for RRBs in Canada is about $11 billion. As a practical matter, the allocation to RRBs is probably limited to 10% or less of the Fund.

A reasonable approach to achieve equity content in excess of 50% of the Fund would be to substitute equities for nominal bonds. This has the advantage of reducing the exposure to inflation risk posed by nominal bonds. Although equities are also adversely affected by inflation, the risk is over shorter time horizons. Over the long term, equities have provided a good hedge against inflation.
Mixes 4 and 5 have 60% and 70% equity content, respectively. The surplus profiles are shown below. The lower surplus for Mix 5 is due, for the most part, to the higher risk margin added to the liabilities as equity content increases.

**Balance Sheet Risk - Mix 4 (60% Equity)**

**Balance Sheet Risk - Mix 5 (70% Equity)**
The advantage of higher equity content is the lower expected costs as illustrated below.
SECTION IV. EQUITY DIVERSIFICATION

A. Considerations for Reform

♦ The allocation to foreign equities may be increased from 20% of the total fund to an amount varying between 20% and 40%

♦ The proportion of U.S. equities to the total foreign allocation may be revised from 75% currently, to an amount varying between 50 and 65%

B. Efficient Frontier Analysis

The equity portfolio of the fund stands to derive considerable benefit from diversification into global markets.

We have used mean/variance optimization to identify efficient portfolios of Canadian, U.S. and non-North American equities. This type of analysis requires the following expectational inputs (i.e. capital market assumption) for each asset class:

♦ rates of return,
♦ standard deviations of return volatility, and
♦ correlations of returns for all possible pairings of the asset classes.

A summary of the inputs and historical data is provided in Appendix B.

Using these inputs, the optimization model identifies a set of “efficient” portfolios (i.e. the efficient frontier) that optimize the trade-off between return and volatility. Conceptually, the portfolios comprising the efficient frontier either:

♦ maximize the expected return for a fixed level of volatility, or
♦ minimize volatility for a given level of return.

The Sharpe ratio represents the excess return over T-Bills, per unit of risk. Portfolios with high Sharpe ratios provide the most attractive return to risk trade-offs. The efficient frontier and statistics for the current and alternative asset mix policies are shown below.
No Foreign Risk Premium

<table>
<thead>
<tr>
<th>Asset Classes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>91-Day T-Bills</td>
<td>84</td>
<td>23</td>
<td>16</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SCM Universe Bonds</td>
<td>11</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>SOM Long Term Bonds</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Real Return Bonds</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Canadian Equity</td>
<td>0</td>
<td>24</td>
<td>26</td>
<td>28</td>
<td>31</td>
<td>40</td>
</tr>
<tr>
<td>U.S. Equity</td>
<td>0</td>
<td>11</td>
<td>13</td>
<td>16</td>
<td>21</td>
<td>43</td>
</tr>
<tr>
<td>EAFE Equity</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Real Estate</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Expected Return</strong></td>
<td>2.62</td>
<td>4.90</td>
<td>5.18</td>
<td>5.47</td>
<td>5.90</td>
<td>6.75</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>2.53</td>
<td>7.60</td>
<td>8.41</td>
<td>9.23</td>
<td>10.46</td>
<td>13.95</td>
</tr>
<tr>
<td><strong>Sharpe Ratio</strong></td>
<td>0.15</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.32</td>
</tr>
<tr>
<td>Total Fixed Income</td>
<td>95</td>
<td>51</td>
<td>46</td>
<td>40</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Total Equity</td>
<td>5</td>
<td>50</td>
<td>54</td>
<td>60</td>
<td>70</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: Maximum real estate is 5%.
C. Findings

Our findings are as follows:

1. The current policy provides an efficient return to risk trade-off. Additional equity content will enhance the expected real return within an acceptable level of risk.

   The Sharpe ratio for the current policy is .34. Alternative mixes with higher equity content, and substantial foreign diversification achieve, at most, a .01 improvement in the Sharpe ratio, to .35. Thus the primary reason for increasing equity content is to enhance the expected return. An additional 10% equity content would enhance the expected return by about 0.25-0.30%. The related increase in volatility is acceptable in the context of the system’s conservative funding target.

2. Diversifying 20 - 40% (Mixes 3 - 5) of the total fund into foreign equities provides attractive return to risk trade-offs, along with the higher return expectations.

   One approach for choosing the total equity content is to assume the Canadian, U.S. and EAFE equity all have equal return expectations. In this manner, foreign content would be based solely on risk and correlation characteristics. Our study indicated that the optimum foreign content on this basis depends on total equity content as follows:

<table>
<thead>
<tr>
<th>Total Equity Content</th>
<th>Optimal Foreign Equity (% of Total Fund)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>21%</td>
</tr>
<tr>
<td>60%</td>
<td>27%</td>
</tr>
<tr>
<td>70%</td>
<td>34%</td>
</tr>
</tbody>
</table>

   A somewhat higher foreign content is justifiable if foreign equities are expected to outperform Canadian stocks.

   For example, a higher foreign equity content may be justified if risk premiums over Canadian equity (1% for U.S., 1.5% for EAFE) are expected.

   This suggests increasing the upper end of the range somewhat, to say, 40%.
The Royal Commission on Workers’ Compensation in British Columbia
Asset/Liability Study

Efficient Frontier

Foreign Risk Premium
(U.S. = 1%, EAFE = 1.5%)

<table>
<thead>
<tr>
<th>Asset Classes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Current IPP</th>
<th>Mix 1</th>
<th>Mix 2</th>
<th>Mix 3</th>
<th>Mix 4</th>
<th>Mix 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>91-Day T-Bills</td>
<td>84</td>
<td>34</td>
<td>27</td>
<td>24</td>
<td>14</td>
<td>0</td>
<td>10</td>
<td>45</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>SCM Universe Bonds</td>
<td>11</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>0</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SOM Long Term Bonds</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>55</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Real Return Bonds</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Canadian Equity</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>U.S. Equity</td>
<td>0</td>
<td>20</td>
<td>25</td>
<td>27</td>
<td>34</td>
<td>0</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>EAFE Equity</td>
<td>0</td>
<td>17</td>
<td>19</td>
<td>20</td>
<td>23</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Real Estate</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

| Expected Return      | 2.62 | 1.54 | 5.53 | 5.73 | 6.31 | 8.25 | 5.37        | 3.35 | 4.05 | 5.47 | 5.88 | 6.21 |
| Standard Deviation   | 2.53 | 7.29 | 8.21 | 8.67 | 10.6 | 19.00 | 8.42        | 6.17 | 8.23 | 8.73 | 9.41 | 10.21 |
| Sharpe Ratio         | 0.15 | 0.40 | 0.40 | 0.40 | 0.40 | 0.32 | 0.37        | 0.18 | 0.22 | 0.37 | 0.39 | 0.39 |

| Total Fixed Income   | 95   | 51   | 44   | 41   | 31   | 0    | 50          | 100  | 100  | 50   | 40   | 30   |
| Total Equity         | 5    | 49   | 56   | 59   | 69   | 100  | 50          | 0    | 0    | 50   | 60   | 70   |

Note: Maximum real estate is 5%.
3. The proportion of U.S. to total foreign equities may vary from 50%-75%.

The proportion of U.S. equity to total foreign (i.e. U.S. + EAFE) using various approaches is summarized below:

<table>
<thead>
<tr>
<th>Market Capitalization</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficient Frontier</td>
<td></td>
</tr>
<tr>
<td>→ No risk premium</td>
<td>52-62%</td>
</tr>
<tr>
<td>→ Risk premium* 1% for U.S., 1.5% EAFE</td>
<td>54-60%</td>
</tr>
</tbody>
</table>

* over the expected real return for Canadian equities

Given the broader set of North American investment opportunities available in the U.S., a reasonable upper limit would be 75%.

4. Specialty Asset Classes

We have continued to include a 5% allocation to real estate, consistent with the current policy, and confirmed by the efficient frontier analysis. Current real estate holdings are less than 2% of the Fund.

Efficient frontier analysis generally indicates that the return to risk profile of the fund can be enhanced by small allocations to small cap and emerging market equities and commodity linked securities. These asset classes (including real estate) typically provide either:

- higher expected returns (with commensurate higher risk), and/or
- lower total fund volatility due to their diversification properties.

Since the performance of these asset classes displays some trending behaviour, allocations are typically made on a strategic basis, rather than being specifically included in the policy asset mix benchmark. This allows a more effective response as specific asset classes move in and out of favour. Typically, allocations (including real estate) to these asset classes in aggregate may vary between 0 to 15% of the fund. As a practical matter, even small allocations necessitate a commitment for the time and resources needed to provide the focused analytical and oversight activities relating to these asset classes.
SECTION V. STRESS TESTS ON EQUITY CONTENT

So far, our analysis has considered economic environments within the following ranges:

<table>
<thead>
<tr>
<th>Economic Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Inflation</td>
<td>0.50 - 3.50%</td>
</tr>
<tr>
<td>Real Interest Rates</td>
<td>3.00 - 4.75%</td>
</tr>
<tr>
<td>Economic Growth</td>
<td>2.40 - 0.25%</td>
</tr>
</tbody>
</table>

Recall that economic growth varied inversely with real interest rates. This means that equities do well when real interests decline. We now introduce some adverse scenarios that consider:

♦ high inflation and deflation, and
♦ the combination of low real interest rates and no economic growth.
Equities are expected to perform poorly in all these environments. We now compare the balance sheet profiles of Mix 5 (70% equity) and the Current Policy (50% equity):
As expected, the 70% equity policy has a higher downside risk compared to the Current Policy, given the sensitivity of equity prices to adverse economic conditions. As a matter of interest, the combination of 1% deflation, 2.50% real interest rates, and no economic growth (the lower left hand corner) is similar to the Japanese economy during the 1990’s.

The impact of adverse economic conditions on a 70% equity policy would depend on how long they persist. If public policy response is successful at stimulating a recovery within a short period (say 2-4 years), the amortization mechanism of the funding policy would likely be sufficient for the system to cope. On the other hand, persistent adverse conditions over longer periods (as appears to be the case in Japan) would expose the system to much more pressure if the equity content is 70%, compared to the Current Policy.

How well did the risk margin protect the system? Let’s review the worst case scenario in the lower left hand corner for Mix 5. We have assumed that benefits are not reduced Consumer Prices are falling 1% a year (i.e. 1% deflation). The balance sheet position is:

<table>
<thead>
<tr>
<th></th>
<th>$Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets at Market Value</td>
<td>$7,467</td>
</tr>
<tr>
<td>Risk Adjusted Liability</td>
<td>$9,168</td>
</tr>
<tr>
<td>Deficit</td>
<td>$1,701</td>
</tr>
</tbody>
</table>

However, the economic liabilities are $7,364 (9168 ÷ 1.245). There are still sufficient assets to provide all accrued obligations but annual costs will rise to replenish the risk margin that was depleted.

It is recognized that claim experience may also worsen during economic dislocation. We have not attempted to include this in our analysis.

With this background, some of the considerations for determining the appropriate equity content include:

♦ Equities provide higher investment returns, and lower costs under most economic environments, and especially over longer time horizons. Equities are also good long-term hedges against inflation and real wage growth (i.e. see Appendix A-1). Both factors are sources of liability growth over time.

♦ The volatility of equity return may adversely affect annual costs and benefit security. However, the greater volatility risk can be mitigated by setting appropriate risk margins (funding targets) and amortization periods within the funding policy,
Higher equity content does expose the system to greater risk of loss during extreme economic environments, even though the probability of such occurrences is remote, and the risk margin appears to provide adequate protection for the system.

The trade-offs involved in determining the appropriate equity content will vary with the risk tolerances of the stakeholders.
## Historical Economic Data

### Economic Environment

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of Years</th>
<th>Consumer Price Index</th>
<th>Real GDP per Employed</th>
<th>Real Wage Growth</th>
<th>RRB* Yields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom</td>
<td>1924-28</td>
<td>5</td>
<td>0.3</td>
<td>3.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Depression</td>
<td>1929-32</td>
<td>4</td>
<td>(5.5)</td>
<td>(4.6)</td>
<td>2.7</td>
</tr>
<tr>
<td>Recovery</td>
<td>1933-38</td>
<td>6</td>
<td>0.7</td>
<td>3.2</td>
<td>1.5</td>
</tr>
<tr>
<td>War</td>
<td>1939-45</td>
<td>7</td>
<td>2.6</td>
<td>7.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Reconstruction</td>
<td>1946-51</td>
<td>6</td>
<td>7.8</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>High Growth</td>
<td>1952-56</td>
<td>5</td>
<td>0.5</td>
<td>6.4</td>
<td>4.4</td>
</tr>
<tr>
<td>Stable Growth</td>
<td>1957-65</td>
<td>9</td>
<td>1.8</td>
<td>2.2</td>
<td>2.1</td>
</tr>
<tr>
<td>Inflation Pressure</td>
<td>1965-74</td>
<td>9</td>
<td>5.4</td>
<td>2.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Stagflation</td>
<td>1975-82</td>
<td>8</td>
<td>9.4</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Tight Money</td>
<td>1983-91</td>
<td>9</td>
<td>4.3</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Fiscal Restraint</td>
<td>1992-97</td>
<td>6</td>
<td>1.4</td>
<td>0.8</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Real Returns

<table>
<thead>
<tr>
<th>91-Day T-bills</th>
<th>Canada Long Bonds</th>
<th>Canadian Equities</th>
<th>U.S. Equities ($Cdn) *</th>
<th>Non-North American Equities ($Cdn) *</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.4</td>
<td>9.8</td>
<td>8.7</td>
<td>5.7</td>
<td>-</td>
</tr>
<tr>
<td>3.7</td>
<td>(4.2)</td>
<td>(2.4)</td>
<td>6.7</td>
<td>5.4 +</td>
</tr>
<tr>
<td>1.4</td>
<td>1.1</td>
<td>0.0</td>
<td>4.8</td>
<td>5.4 +</td>
</tr>
<tr>
<td>4.5</td>
<td>4.1</td>
<td>5.7</td>
<td>7.7</td>
<td>12.4 + 11.0 +</td>
</tr>
<tr>
<td>2.7</td>
<td>1.5</td>
<td>6.7</td>
<td>12.4 + 11.0 +</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>4.1</td>
<td>5.7</td>
<td>7.7</td>
<td>12.4 + 11.0 +</td>
</tr>
<tr>
<td>3.2</td>
<td>2.8</td>
<td>7.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Real Return Bond (RRB) yields and returns simulated prior to 1992, using Mercer's Interest Rate Model
Best performing Canadian Asset Class
Indicates Foreign Equities overperforming/underperforming Canadian Equities

### Historical Periods

- **Depression**: 1924-1933
- **War**: 1939-1946
- **Recovery**: 1946-1952
- **High Growth**: 1952-1957
- **Stable Growth**: 1957-1965
- **Inflation Pressure**: 1965-1974
- **Stagflation**: 1975-1982
- **Tight Money**: 1983-1991
- **Fiscal Restraint**: 1992-1997
Historical Economic Data
Eras During the Last 41 Years

1957-65: Stable Growth
The explosive growth of the early 1950’s subsides to an era of steady and comfortable economic growth, low inflation and low interest rates. Wage earners and shareholders both thrive under these ideal conditions. Equity returns look extremely attractive compared to fixed income investments.

1966-74: Inflation Pressures
The expanding economy is faced with increasing capital demands to expand social programs and provide schooling and jobs for the first wave of baby boomers reaching adulthood. The US finances expanding social programs, the Vietnam War, and the space program. Rising inflation pressures and rising real interest rates culminate with the oil crisis and the 1973-74 bear market which reprices equities for a high real interest rate environment. Cash looks attractive on a risk adjusted basis compared to stocks and bonds.

1975-82: Stagflation
The affects of the oil crisis lead to a period of persistent high inflation. Combined with higher real interest rates, this ushers in a long period of sharply lower economic growth which we are still dealing with today. Equities provide an effective hedge against inflation while bonds continue to depreciate in inflation adjusted terms.

1983-91: Tight Money
In an effort to reduce inflation pressures, the Bank of Canada maintains short term real interest rates at historically high levels. Falling inflation expectations boost bond returns as nominal interest rates begin a slow, choppy decline. But rising government deficits and debt keep real interest rates on long bonds at historically high levels.

1992-97: Fiscal Restraint
Increasing recognition and response to government deficit and debt issues facilitates the easing of monetary policy. Inflation falls to 1957-65 levels and reduced inflation expectations spur spectacular bond and stock performance. The first signs of declining real interest rates and recovering economic growth begin to appear.
Future Economic Scenarios

Scenario Analysis (Quantitative Economic Model)

Determine equilibrium states for:
- inflation
- real interest rates for RRBs
- productivity growth

Equilibrium State for 3 economic drivers
(Canadian only)

Translate into market information
(Canadian only)

Determine rates of return
(Canadian only)

Determine rates of return
(Canadian & Foreign)

Determine:
- interest rates
- wage growth
- equity risk premium

Compare current & equilibrium interest rates to determine expected capital gains/losses for each asset class

Determine risk premiums for specialty/foreign asset classes

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Mercer Investment Consulting

Appendix B-1
# Future Economic Scenarios

## 10-Year Economic Scenarios

### Annual Compound Growth/Returns

<table>
<thead>
<tr>
<th>STRESS A</th>
<th>Deflation</th>
<th>B</th>
<th>Low Inflation</th>
<th>C</th>
<th>Low Inflation</th>
<th>D</th>
<th>Current</th>
<th>E</th>
<th>Moderate Inflation</th>
<th>F</th>
<th>Recurring Inflation</th>
<th>G</th>
<th>Stagflation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reccession</td>
<td></td>
<td>Slow Growth</td>
<td></td>
<td>Robust Growth</td>
<td></td>
<td>Expectations</td>
<td></td>
<td>Moderate Growth</td>
<td></td>
<td>Slow Growth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Secular Growth

- **Inflation**
  - (1.00)
- **Productivity**
  - (0.75)
- **Real Wages**
  - (0.25)

### Total Return

- **RRB**
  - 4.50
- **T-Bills**
  - 2.25
- **SCMU Bonds**
  - 6.25
- **Long Canada Bond**
  - 4.75
- **TSE 300**
  - 5.75

### Equity Risk Premium

- (1.50)
- **Nil**
- 3.50
- (2.50)
- (3.75)
- (2.50)
- (2.50)

### Real Return

- **RRB**
  - 5.50
- **T-Bill**
  - 3.25
- **SCMU**
  - 6.25
- **Long Canada Bond**
  - 7.25
- **TSE 300**
  - 5.75

### Assumed Scenario Equilibrium

- **Inflation**
  - (Same as C)
  - 1%
  - (Same as F)
  - 0%
- **RRB Yield**
  - 4.25%
- **Productivity**
  - 0.75%

* SCMs long bonds are assumed to return 0.25% more than long Canada bonds

**December 31, 1997 Starting Point**
## Capital Market Assumption

For the Efficient Frontier

### Historical Risk/Return for All Asset Classes

(Canadian & Foreign)

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Total Return Index</th>
<th>Time Period</th>
<th>Historical Real Returns (%)</th>
<th>Expected Real Return</th>
<th>Expected Risk</th>
<th>Historical Risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>History #</td>
<td>25 Years</td>
<td>10 Years</td>
<td>History #</td>
</tr>
<tr>
<td>Cash</td>
<td>SCM 91-Day T-Bills</td>
<td>1957-1997</td>
<td>2.64</td>
<td>3.32</td>
<td>4.96</td>
<td>2.25</td>
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<tr>
<td>Real Return Bonds</td>
<td>N/A</td>
<td>1957-1997</td>
<td>4.25</td>
<td>10.00</td>
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<tr>
<td>Canadian Bonds</td>
<td>SCM Universe Bond</td>
<td>1980-1997</td>
<td>8.00</td>
<td>N/A</td>
<td>8.64</td>
<td>4.00</td>
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<tr>
<td>Canadian Bonds</td>
<td>SCM Long Term Bond</td>
<td>1957-1997</td>
<td>4.44</td>
<td>5.98</td>
<td>10.72</td>
<td>4.25</td>
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<tr>
<td>U.S. Equities</td>
<td>S&amp;P 500</td>
<td>1960-1997</td>
<td>8.84</td>
<td>9.52</td>
<td>15.72</td>
<td>6.75</td>
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<tr>
<td>EAFE Equities</td>
<td>MSCI EAFE</td>
<td>1970-1997</td>
<td>9.16</td>
<td>8.92</td>
<td>6.00</td>
<td>6.75</td>
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<tr>
<td>Real Estate</td>
<td>CIA Real Estate Returns</td>
<td>1973-1997</td>
<td>5.05</td>
<td>5.05</td>
<td>2.48</td>
<td>5.75</td>
</tr>
</tbody>
</table>

# - History covers total time period shown.
Capital Market Assumptions for the Efficient Frontier

Historical Correlations

1973-1997

Real Returns

<table>
<thead>
<tr>
<th></th>
<th>Cash</th>
<th>RRBs</th>
<th>Bonds</th>
<th>Long Bonds</th>
<th>Canadian Equities</th>
<th>U.S. Equities</th>
<th>EAFE Equities</th>
<th>Real Estate</th>
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<tbody>
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<td>Cash</td>
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<td>U.S. Equities</td>
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<td>0.58</td>
<td>0.66</td>
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<tr>
<td>EAFE</td>
<td>0.13</td>
<td>0.30</td>
<td>0.25</td>
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<td>0.57</td>
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<td>-0.17</td>
<td>-0.28</td>
<td>-0.09</td>
<td>1.00</td>
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</tbody>
</table>

Note: Correlations for Real Return Bonds are based on expectations.
Economic Trends

Historical CPI, Nominal LCB Yields and Modeled RRB Yields

Year

Percentage (%)

Historical Consumer Price Index
Nominal Canada Long Bond Yield
Modelled Real Return Bond Yield
Actual Real Return Bond Yield
Economic Trends

Actual Inflation vs. the Expected Inflation Component of Long Bond Yields (Estimated)

Year


Percentage (%)

20%  15%  10%  5%  0%  -5%  -10%  -15%  -20%

Historical Consumer Price Index — Expected Inflation
Economic Trends

Productivity, Real Wages and Modelled RRB Yields

Real GDP per employed  ---- Real Wages  ---- Modelled Real Return Bond Yield