

ASSET ALLOCATION STUDY  
for the

City of Springfield Police Officers' &  
Fire Fighters' Retirement Fund

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## **SUMMARY**

Milliman, Inc. has conducted this analysis for the City of Springfield Police Officers' & Fire Fighters' Retirement Fund. We believe an asset allocation study should be conducted every three to five years. Asset allocation is the most important investment decision made by an institutional investor. Research supports this belief: studies have found that asset allocation accounted for more than 90% of the variance in quarterly returns for a typical pension fund.

This asset allocation study presents a number of alternative asset mixes for the Retirement Fund's consideration, which have been developed based on our estimates of asset class returns, risks and correlations. We present several mixes that would be appropriate depending on the Board's risk tolerance. This report does not address allocation of sub-categories within U.S. equities, International Equities, U.S. fixed or other asset classes. These will be addressed separately.

We find that the Retirement Fund's current asset mix is efficient in that it offers a high expected return for the given level of risk but it is not optimal, as it is not as well-diversified as possible nor is it expected to achieve the required 7.5% (net of fees) actuarial interest rate.

### **The Model**

Our proprietary model integrates the Fund's liabilities into an asset allocation framework, considering volatility of assets in combination with liabilities - total plan risk - as well as standard deviations of asset class returns. The model solves for asset mixes which provide the lowest possible total plan risk for a given level of return. The use of the concept of total plan risk results in asset mixes which best fund the Plan's liabilities. For example, an optimization based only on asset returns would select a portfolio of 100% short-term Treasury Bills as the lowest risk portfolio, but T-bills do not represent the lowest risk mix due to the duration mismatch between T-bills and the Fund's liabilities. We have calculated the duration of the liabilities to be 13.3 years. The present value of the liabilities, due to their long duration, changes dramatically with changes in interest rates, while the present value of T-bills does not, due to their short duration. A portfolio comprised mostly of bonds with a similar duration to the liabilities - and therefore a similar sensitivity to changes in interest rates - would better fund the liabilities and provide a lower funding risk, or total plan risk.

### **Inputs to the Model**

Expected returns, standard deviations and correlations have been projected for each asset class, as well as correlations and the volatility for the Fund's liabilities. Our projections incorporate historical data, Milliman's proprietary research, and projections by outside sources. We evaluate our model inputs as a whole to insure their reasonableness. We look at the risk-return characteristics of each asset class relative to the other asset classes as a check on our inputs and our view of the relative attractiveness of the asset classes.

To develop appropriate risks and correlations for the liabilities, we consider the Fund's projected benefit obligations for active and retired members as provided by the Fund's actuary, Michael Zwiener of Milliman's St. Louis office. We have calculated the duration of these projected benefit payment streams. The longer the duration, the more sensitive the liabilities are to changes in interest rates. We also assess the sensitivity of the Fund's liabilities to changes in inflation and real interest rates. Based on this analysis, we are able to predict how the liabilities will react to various changes in economic conditions. We then project the standard deviation and correlation of the liabilities with each of the asset classes.

## **The Output**

Using our optimization program, we generated an efficient frontier of asset mixes. Each asset mix on the efficient frontier is optimal on a risk/reward basis, meaning that the highest return is achieved for any given level of risk. The asset mixes range from a low risk/low return mix to a high risk/high return mix. The lowest risk mix has the lowest plan funding variability due to the high correlation with the liabilities. The highest risk mix has the highest expected return but also has the greatest uncertainty in return and liability funding.

## **Selecting an Appropriate, Optimal Asset Mix**

All of the asset mixes on the efficient frontier are optimal for their particular level of risk. Other possible asset class combinations are so close to the frontier as to be essentially equivalent, and could also be suitable. The risk tolerance of the Board and the implications of possible mixes' impact on the funding status are the dominant factors in selecting the appropriate, optimal asset mix. To assist in this decision, we present and assess the sensitivity of the Fund's funded status relative to changes in the assumed inflation rate and the assumed real rate of return. For each asset mix on the efficient frontier, we will consider the implications for achieving desired rates of return over both a short-term (1 year), medium-term (5 year) and a long-term (13.3 year) time horizon, the latter of which is the estimated duration of the Fund's liabilities. Specifically, we focus on the answers to the following two questions:

- 1) What dollar level of future returns are likely to be achieved by each mix, and how uncertain is that level of returns?
- 2) What is the likelihood that the actuarially-assumed rate of return will be achieved by each asset mix?

In addition to the Board's risk tolerance and the implications for achieving required returns, adopting a new asset allocation target requires taking into account the Fund's current asset allocation and the costs of changing the asset mix. The expected cost of implementing a new asset mix must be considered relative to the expected benefit.

## Asset Allocation and Plan Funding Uncertainty

Changes in economic conditions, especially inflation and interest rates, directly affect the costs of funding the Retirement Fund's liabilities. Asset allocation is effective if it provides an asset mix which generates reasonable returns for the Retirement Fund, while at the same time guards against high levels of funding uncertainty. In particular, an appropriate asset mix should guard against significant increases in liabilities that are unmatched by increases in assets. Two scenarios help illustrate this point.

A major concern is a *decrease* in the level of inflation. If a decrease in inflation is not accompanied by an increase in inflation-adjusted returns from the Fund's investments, an increase in contributions would likely be required.<sup>1</sup> Partial protection against this outcome is provided by an asset mix with allocations to longer-term bonds and equities. Long-term bonds, common stocks and other interest rate sensitive assets will have relatively superior returns during periods of falling inflation rates, thereby providing protection against an asset liability mismatch and lowering total plan funding volatility. Other asset classes such as cash equivalents and short-term fixed income securities do not provide such protection.

In the case of *rising* inflation and higher interest rates, the current value of the Fund's projected benefit payments will decline, and contribution rates could be lowered, assuming benefit payments are discounted at a higher rate and salaries and cost of living adjustments are not increased for higher inflation. Thus, a decline in the principal (market) value of longer-term assets may be acceptable under such circumstances. Of course, it is preferable to avoid this if possible. Real assets, such as real estate and other non-financial assets, can provide some protection from unanticipated inflation.

Therefore, it is desirable to have an asset mix that can effectively cope with different economic environments and varying levels of inflation. Our asset allocation model incorporates plan liabilities to provide the lowest possible total plan risk (variation of the difference between assets and liabilities) for a given return. The inclusion of Plan liabilities in the analysis results in asset mixes which better fund the Plan's liabilities and maintain a competitive rate of return.

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<sup>1</sup> A lower inflation rate decreases the nominal value of future benefit payments due to lower salary growth. However, assuming the assets' real rate of return remains unchanged, assets can be expected to grow at a commensurately slower rate. As a result, the discount rate will be lower. The result is an increase in present value of liabilities which typically more than offsets the effect of lower nominal payments.

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## **Liability Analysis**

The first section of this *Asset Allocation Study* is an analysis of the Retirement Fund's liabilities. In addition to calculating the present value of the Fund's liabilities<sup>2</sup>, we evaluate the timing of liabilities, and assess the sensitivity of these liabilities to changes in projection assumptions. Finally, we investigate how the value of the liabilities will vary based on key assumptions, the most important of which is the inflation rate.

The projected benefit payments used in this study are provided by the Retirement Fund's actuary. The actuary provided annual benefit payment projections covering the next 100 years (our charts display the first 50 years as the discounted values become insignificant after this time). All the payment projections take into account the Plan's liability characteristics, including membership demographics, salary statistics, benefit payments, years of service and actuarial membership survival assumptions. Finally, the actuary provided similar liability projections under an alternative inflation scenario.

## **Asset Allocation Alternatives**

The second section of the *Study* describes the expected returns, volatility, and relationships between the different asset classes in which the Retirement Fund currently invests as well as new asset classes. The outcome of this research combined with the liability analysis is an "efficient frontier" of asset mixes, a set of asset mixes which provide the highest expected return for a given level of plan funding uncertainty. These mixes range from a low-return, low-uncertainty mix, to a high-return, high-uncertainty mix. The optimality of these mixes is based on the assumption that the Retirement Fund's investment managers are capable of approximating the expected risks and returns of their respective asset classes, and that the relationships (correlations) between these asset classes do not significantly change over the next three to five years. Once we determined the initial efficient frontier, we expanded the number of alternative mixes shown in the range which is most appropriate for the Retirement Fund, given the return objectives, risk tolerance and current asset mix of the Fund.

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<sup>2</sup> We use the projected future actuarial liability instead of projected future benefit payments in our asset allocation study. This actuarial liability represents the retirement benefits which have been earned as of today. This is the obligation which must be planned for and funded with today's assets. For example, consider a new Retirement Fund member: his projected benefits will be paid from employer contributions made in the future; current assets need only provide for a tiny fraction of those benefits. Specifically, current assets need to provide for the portion of benefits which he has earned from her current creditable service. Conversely, consider a retired member of the Plan: he has already earned all of his retirement benefits with past years of creditable service, thus, his actuarial liability and future benefit payments are the same. Also, the calculation of accrued benefits does incorporate future salary growth.

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## Conclusion

We conclude from our analysis that the current asset mix is an efficient allocation, but that it will not deliver an adequate return in light of the actuarial interest rate of 7.5% (net of fees). We propose the adoption of Mix 5 (below) which offers a modestly greater expected return with a slightly higher level of risk. We also present Mixes 4 and 6 as alternatives.

The City of Springfield Police Officers' & Fire Fighters' Retirement Fund's Current Asset Mix, Recommended Mix and Alternative Asset Mixes are detailed below.

<u>Asset Class</u>	<u>Current Mix</u>	<u>Alternative "Mix 4"</u>	<u>Recommended "Mix 5"</u>	<u>Alternative "Mix 6"</u>	<u>Proposed Asset Range of Mix 5</u>
Large/Mid Cap Equities	41%	43%	44%	45%	39-49%
Small Cap Equities	10	11	11	11	8-14%
Int'l Equities	0	8	9	10	6-12%
Fixed Income	49	36	32	29	28-36%
Real Estate	0	2	4	5	0-6%
Cash & Equivalents	0	0	0	0	0-1%
Expected Return, %/yr	6.9	7.4	7.5	7.6	
Total Plan Risk, %/yr	29.2	30.1	30.3	30.5	
Standard Deviation, %/yr	11.1	12.7	13.0	13.2	

The Recommended Mix (Mix 5) has a higher overall allocation to equities than the current mix, 64% versus 51%. However, it is better diversified, with new allocations to International Equity and Real Estate. The allocation to Large Capitalization Equities is modestly higher in Mix 5 than currently and the allocation to Small Capitalization Equities is marginally higher. The amount allocated to Fixed Income is significantly reduced in Mix 5, by 17%. The Recommended Mix has a greater expected return than the current mix with a slightly higher standard deviation and total plan risk.

The increased risk is necessary to achieve the greater expected annual return of 7.5% vs. the expected return of 6.9% given the current investments.

## LIABILITY ANALYSIS

### Overview

Our analysis of the liabilities is based on projections from the Retirement Fund's actuary. Their projection of benefits to members incorporates numerous assumptions regarding future salaries, mortality rates, termination rates, disability rates, the inflation rate and asset returns, etc. General inflation was projected at 2.75% per year by the actuary, while earnings on assets (used to discount future liabilities) were projected at 7.5% per year.

At our request, the St. Louis office of Milliman projected the payments to current Fund members related to past and projected service, excluding benefits to be paid to future members (not yet hired Fund members). Keeping our focus on present members' benefits matches our focus on the present assets. This does not limit the value of this study; future studies will find similar member demographics and reach similar conclusions.

Our process, which incorporates the Fund's liabilities, estimates the volatility of the liabilities and their correlation with each of the proposed asset classes. Appropriate estimates of these variables allow us to determine asset mixes that best fund the Fund's liabilities. Total plan risk can be reduced by selecting assets which behave like the liabilities through fluctuations in financial markets and therefore offset their volatility.

For the baseline projection case, we used an inflation rate of 2.75% per year, and a real return of 4.75% per year, resulting in a discount rate of 7.5%, as provided by the actuary.

## Analysis of Retired Plan Members

Our liability analysis begins with a review of retired Fund members. All promised benefits payable to this group have already been accrued, so projected benefits are quite predictable. Terminated vested members are also included in this analysis.

We calculate the present value of projected benefits to retired members to be \$172.4 million, after discounting the benefits at a 7.5% annual rate.

Figure 1 shows graphically the benefit payment projections for retired members. Actual benefits paid to current retirees begin declining rapidly due to mortality after 20 years. Discounted benefits – the present value of benefits – decline immediately at an average rate of 12% per year, as the 7.5% discount rate and mortality assumptions decrease the present value of benefits, and will have fallen to half their value in roughly 11 years. 40 years into the future, the discounted benefits to current retirees are relatively insignificant. The average benefit is paid 10.5 years in the future.<sup>3</sup> This gives an indication of the sensitivity of the present value of these liabilities to changes in interest rates. For example, with a 1% decrease in interest rates will have a corresponding 10.5% increase in the value of retired member benefit liabilities.

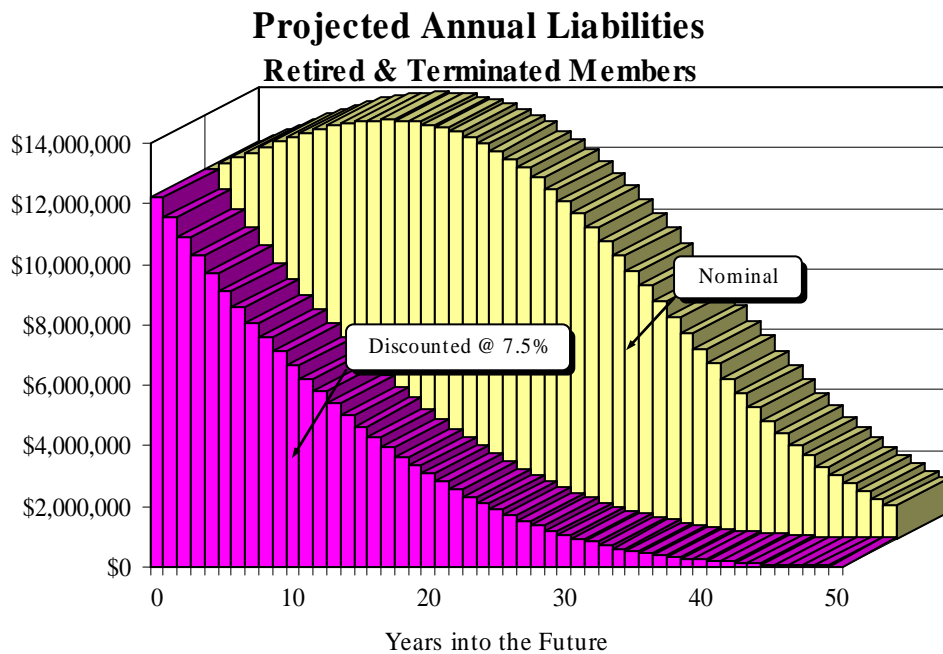


Figure 1

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<sup>3</sup> In computing the average payment, we weight discounted payments by the number of years in the future. This is identical to the computation of a Macaulay bond duration.

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We have also investigated the impact of a lower inflation rate – 1.75% instead of the 2.75% baseline assumption. We held the real return at 4.75%, so the discount rate dropped from 7.5% to 6.5% in this sensitivity test. Decreasing the inflation rate by 1% causes the present value of the retired members’ liabilities to increase 10.75% to \$190.9 million. The present value increases under this scenario because the cash flows remain unchanged but the discount rate has decreased by 1%.

We further investigated the impact of a lower real rate of return: decreasing this rate expands the cost of funding future payments by decreasing the discount rate. By decreasing the projected real rate of return from 4.75% to 3.75% per year, the discount rate falls to 6.5%. While actual payments to retirees are unchanged, this causes the present value of benefits to rise 10.75% to \$190.9 million. This impact is the same as the effect of the 1% change in the inflation assumption noted earlier because the cash flows to the retired members are largely determined.

### Analysis of Active Plan Members

In contrast to retired member benefits, active members will earn a large fraction of their projected benefits in the future. Further, only the portion of expected benefits to current members for which the Normal Cost under the actuarial method is expected to have provided – the “Projected Benefit Obligation” – are accrued to the Plan. Future contributions will provide for benefits related to future employment and salaries.

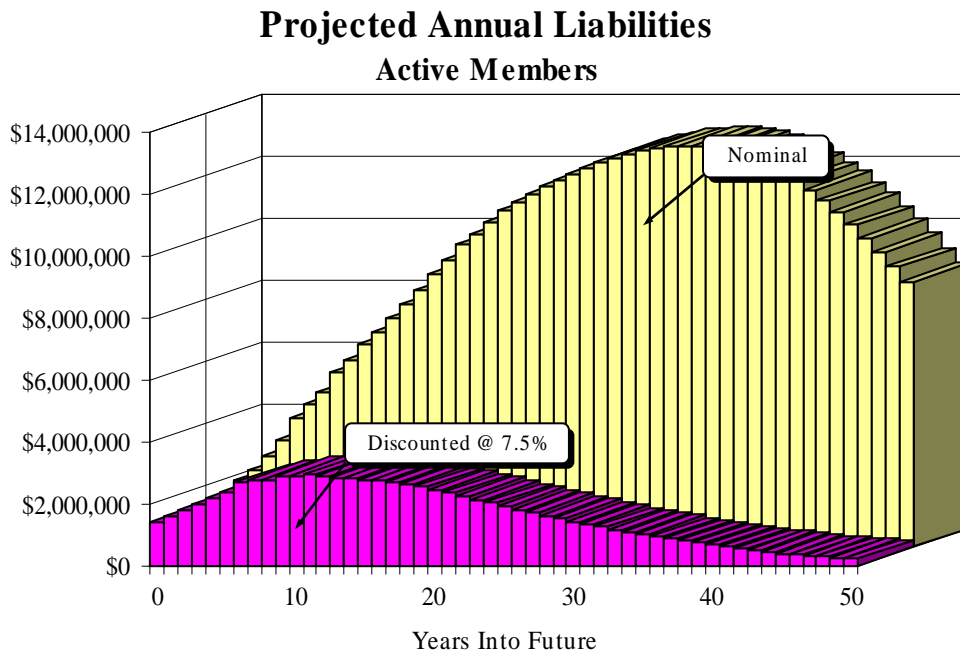


Figure 2

As with current retirees, discounting active members' liabilities shifts the impact of the distribution towards the present and reduces it substantially, since payments far into the future have a much lower present value than future value. The peak in discounted liabilities occurs 11 years in the future and these liabilities become insignificant 50 years in the future (please see Figure 2). The present value of the estimated benefits to active members is \$87.6 million and the average payment (duration) is 18.8 years in the future.

As we did with the retired members, we prepared a sensitivity analysis for active members considering changes in inflation and the real rate of return. We decreased the inflation assumption by 1%, to 1.75% from 2.75%. Lower inflation decreases final salaries – and therefore, benefits – due to the diminishing salaries over many years. However, to maintain a constant “real” rate of return the discount rate is also decreased, which increases the present value of the benefits. Our lower-inflation scenario resulted in a present value of \$100.4 million, 14.6% higher than the baseline. The decreases resulting from lower inflation are more than offset by the increases resulting from the lower discount rate, so the benefits are more expensive to fund.

Changes in real returns have greater impact than changes in the inflation rate: if we decrease the assumed real rate of return from 4.75% to 3.75% while maintaining our 2.75% inflation assumption, the liabilities' present value increases 20.1% to \$105.2 million. Because inflation is constant instead of decreasing, future salaries are not lower; while the discount rate decreases due to the change in the real rate of return.

## Analysis of All Members — Retired and Active

Combining retired and active together, all members' benefits have an estimated \$260.0 million present value (discounted by the 7.5% baseline assumption), with a calculated duration of 13.3 years.

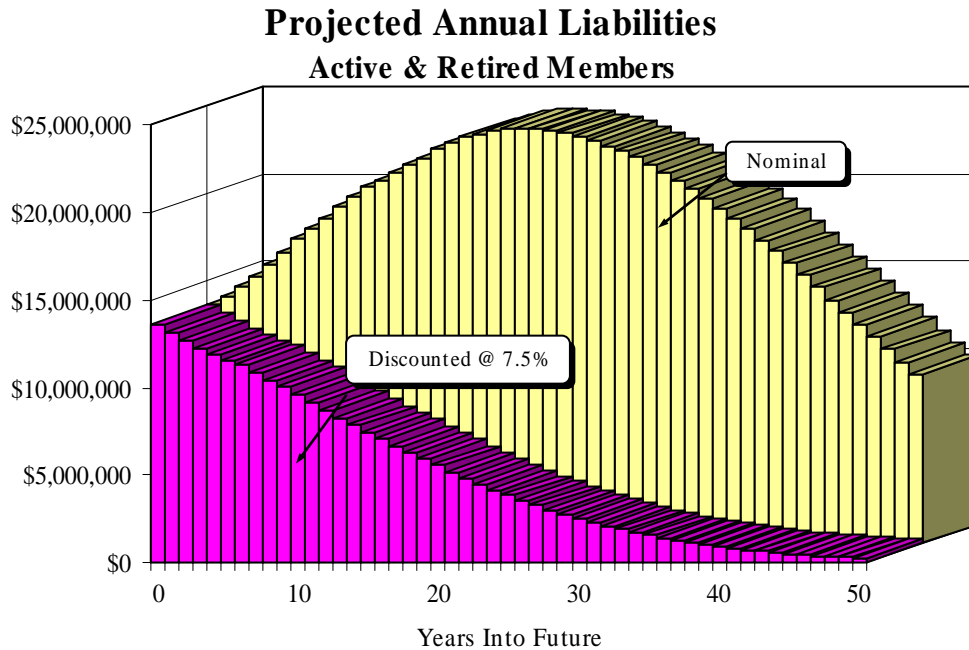


Figure 3

As stated previously, the relatively long duration of the Fund's liabilities makes them sensitive to changes in the inflation rate and real rates of return. Absent a change in expected real returns, a 1% decrease in the inflation assumption increases the present value of liabilities to \$291.4 million, a 12.1% increase. Decreasing the real return assumption from 4.75% to 3.75% without an offsetting change in inflation increases the present value of liabilities by 13.9% to \$296.2 million.

## **Funding Ratio Implications**

In our analysis, we consider the funding ratio – the value of the liabilities relative to the assets. When liabilities are larger than assets, the assets must increase at a higher rate than the liabilities to maintain the same dollar funded status. For example, if liabilities are \$100 and assets are \$80 and the liabilities increase 10% to \$110, the assets must increase 12.5% to \$90 to maintain the same \$20 under-funded status; the same is true for negative returns. The Fund's assets as of December 31, 2005 were \$131.7 million, less than the projected present value of the liabilities of \$260.0 million. We adjusted the liability volatility estimate upward to reflect this ratio of assets to liabilities.

## **Liabilities Summary**

We undertook a study of the Fund's liabilities to consider the time-horizon of payments and the sensitivity of the liabilities to factors that can also cause asset values to vary.

Payments to all current members are expected to be paid on average 13.3 years into the future. These payments have characteristics similar to a long-term bond. This 13.3 year duration indicates that the value of the Fund's liabilities is exposed to substantial volatility from changes in the assumed discount rate: a 1% decrease in inflation causes an increase of 12.1% in the liabilities' present value, while a 1% decrease in the real return causes a more substantial increase of 13.9% in the value of the liabilities.

The liability characteristics developed in this section are used in the following section to develop the relationship of the liabilities with the asset classes.

## ASSET ALLOCATION ALTERNATIVES

### Introduction

If it were possible to create an asset mix that matched the liabilities' uncertainties in all respects, there would be no uncertainty about funding – the Fund could project future funding ratios exactly, based on contribution levels. It is actually possible to build a dedicated long bond portfolio which would fund projected benefit payments virtually exactly. However, we do not believe the Fund should pursue this “riskless” goal, for the following reasons:

- No asset or combination of assets can exactly match the sensitivity of the Fund's liabilities because projected benefits are only estimates, and are subject to revision. A bond portfolio with a 13.3 year duration would come close and is similar to our low risk Mix 1 (as shown on page 15), but using such a portfolio would concentrate the Fund in a small fraction of available investment-grade assets. We feel this would be an undiversified portfolio and would be an unwise asset mix. In addition, this mix generates a low expected return.
- By selecting assets, especially domestic or international stocks, with different patterns of variability, the Fund is likely to be able to get a much higher return from its assets. This is anticipated to be preferred to a less volatile, lower-return mix.
- Liability matching is not the only goal of asset allocation. Very long duration bond portfolios exhibit high absolute volatility which could prove damaging to a fund in the short-term even though matching the liabilities.

For these reasons we use the total U.S. bond market rather than only very long duration bonds as our U.S. fixed income asset class, and believe that a higher return portfolio with a mix of different asset classes is preferable to an all bond portfolio/asset mix.

In this section of the asset allocation study we construct asset mixes which are optimal – the highest expected return for a given amount of uncertainty – incorporating inflation and other sources of uncertainty. The lowest-risk mix best matches the characteristics of the liabilities and thus has the lowest total plan risk; higher-return mixes show additional uncertainty.

## Asset Categories

This study incorporates two new asset classes not currently included in the Retirement Fund's portfolio. We have included international equities and real estate as possible enhancements to the Fund's current asset structure.

To study these asset categories, we selected a representative index for each that captures both the characteristics of the category and is well defined. The asset classes and relevant indexes are listed below:

- (1) Large/Mid Capitalization Equities (Standard & Poor's 500 Index)
- (2) Small Capitalization Equities (Russell 2000 Index)
- (3) International Equities (MSCI EAFE Index)
- (4) Domestic Fixed Income (Lehman Aggregate Bond Index)
- (5) Real Estate (National Association of Real Estate Investment Trusts Index)
- (6) Cash and Equivalents (91-day Treasury Bills); and
- (7) Plan Liabilities as developed in the *Liability Analysis* section of this report, shown as a negative asset, which other assets serve to offset.

## Expected Returns and Uncertainty

Our model uses the expected annual return and the uncertainty of returns (standard deviation) for each asset class. Below are our projections for each asset class:

<u>Asset Class</u>	<u>Expected Return</u>	<u>Expected Std Dev</u>
Large/Mid Cap Equities	8.60%	19.00%
Small Capitalization Equities	9.30	23.00
International Equities	8.90	21.00
Domestic Fixed Income	5.00	6.50
Real Estate	7.30	14.00
Cash and Equivalents	3.50	1.50
Liabilities	N/A	33.49 <sup>4</sup>

Derivation of the asset class estimates is described in the *Appendix A - Basis for Capital Market Assumptions* (page 24). The liabilities' uncertainty was derived from their characteristics, primarily, the sensitivity of benefit payments to changes in interest rates (duration).

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$$^4 \text{LiabilityVolatility} = \left( \frac{\text{LiabilityDuration}}{\text{BondMarketDuration}} \right) \times (\text{BondVolatility}) \times \left( \frac{\text{PlanLiabilities}}{\text{PlanAssets}} \right)$$

The liability duration and plan liabilities are derived from the data provided by the Fund's actuary. The bond market duration is the current duration of the Lehman Aggregate Index. The Bond Volatility measure is taken from our expected standard deviation of the asset class. Finally, Plan Assets are the most recent quarterly market value of plan assets.

The projections reflect our assessment of returns and risks over a minimum of the next three to five years, and we believe they also approximate how investors in aggregate expect these assets to perform.

## Correlations

The following “correlation matrix” indicates the extent to which we project an increase (or decrease) in the value of one asset class will match an increase (or decrease) in the value of another. For example, the boldface “**0.850**” suggests that roughly 85% of expected increases or decreases in large capitalization stock returns will correspond to similar movements in small capitalization stocks.

Code	Large/		Int'l	Dom	Real	Cash	Liab.
	Mid Cap	Sm Cap					
	Equity	Equity	Equity	Bonds	Estate		
Lg/Mid Cap Eq	****						
Small Cap Eq	<b>.850</b>	****	.				
Int'l Equities	.750	.700	****				
Domestic Bond	.300	.150	.150	****			
Real Estate	.200	.250	.050	.150	****		
Cash	.100	.100	.100	.200	.350	****	
Liabilities	.300	.220	.210	.950	.160	.300	****

The correlations used in this study take into consideration their recent historical values as shown in *Appendix A – Basis for Capital Market Assumptions*, *Appendix B - Asset Class Correlations* and *Appendix C – Asset Class Risk*. Correlations to the liabilities are derived by analyzing the sensitivities in the previous section.

Since the present value of pension liabilities is determined most importantly by interest rates, the correlation of bonds to liabilities is high: 95%. Equity values are more sensitive to the changes in perceived real returns. Some of the equity volatilities are also due to changing interest rates, as shown by their correlation to bonds. Additionally, equity returns significantly depend on investor perceptions of future economic growth, which has limited impact on the Fund’s liabilities. International equities have a modest positive correlation to the liabilities through their similarity to domestic equity returns.

## Constraints

A minimum allocation of 25% was specified for domestic fixed income. A maximum allocation of 10% was specified for Real Estate. These constraints were put in place to limit the model to allocations that we felt were reasonable for the Retirement Fund to consider.

### Optimal Asset Mixes for Given Risk Levels: Broad Risk/Reward Range

Component	Limits		Asset Mix Alternatives (Percent)										Current Mix
	min	max	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>	<i>VI</i>	<b><i>VII</i></b>	<b><i>VIII</i></b>	<b><i>IX</i></b>	<i>X</i>	
Lg/Mid Eq	0%	100%	0%	10%	18%	24%	31%	36%	<b>40%</b>	<b>44%</b>	<b>41%</b>	0%	41%
Sm Eq	0	100	0	0	2	5	7	9	<b>11</b>	<b>11</b>	<b>20</b>	75	10
Int'l Eq	0	100	0	0	0	0	0	3	<b>6</b>	<b>9</b>	<b>13</b>	0	0
Dom Fixed	25	100	100	90	91	71	62	52	<b>43</b>	<b>32</b>	<b>25</b>	25	49
Real Estate	0	10	0	0	0	0	0	0	<b>0</b>	<b>4</b>	<b>1</b>	0	0
Cash	0	100	0	0	0	0	0	0	<b>0</b>	<b>0</b>	<b>0</b>	0	0
Return, %/yr			5.0	5.4	5.7	6.1	6.4	6.8	<b>7.2</b>	<b>7.5</b>	<b>7.9</b>	8.2	6.9
Total Plan Risk, %/yr			27.4	27.5	27.7	28.0	28.5	29.0	<b>29.6</b>	<b>30.3</b>	<b>31.2</b>	32.8	29.2
Std Dev, %/yr			6.5	6.7	7.2	8.2	9.3	10.5	<b>11.9</b>	<b>13.0</b>	<b>14.6</b>	17.6	11.1

Mixes I–X in the above Broad Asset Mix Range table make up the range of optimal portfolio asset mixes—the efficient frontier. Each of the ten mixes offers the highest possible expected return for a given level of funding uncertainty—total plan risk. The range between Mixes VII–IX, shown in bold, are the range of asset mix alternatives that will be subsequently analyzed in the Narrowed Asset Mix Range on page 17.

The mixes range from Mix I, the most conservative (lowest risk, lowest expected return) to Mix X, the most aggressive (highest risk, highest expected return). The least-uncertain asset mix, Mix I, is comprised of investment grade bonds, whose characteristics most closely resemble the liabilities'; the highest-return mix is comprised mostly of small cap equities, the asset class with the second-highest expected return and risk (had we left fixed income securities unconstrained, mix X would be comprised of 100% small cap equities). The most-uncertain mix, Mix X, has substantially more uncertainty in future funding costs, but a 3.2% per year higher expected return than Mix I. The Current Mix is most similar in terms of expected risk and return levels to Mix VI above, but has no allocation to international equity or real estate. The Current Mix has an expected return of 6.9% while and Mix VI has an expected return of 6.8%, but the absolute level of volatility and total plan risk of the Current Mix is higher than Mix VI, the result of a less efficient (less diversified) asset mix posture.

Even Mix I, the lowest-uncertainty mix, shows an expected 27.4% per year total plan risk, because the Plan liabilities are much more volatile—due to their long duration—than the best-match asset mix. This duration variability can be understood by considering what would occur if interest rates suddenly and unexpectedly declined 1% from current levels, with no change in inflation expectations. One would expect the fixed income asset class to increase in value, by approximately 5% (based upon its average five year duration), and expect higher equity market returns. The present value of liabilities would increase about 13.3%, due to their higher sensitivity (longer duration).

With a reduced actuarial discount rate, the Fund would become less well funded despite healthy increases in the value of its investment portfolio. Whatever change in rates actually occurs, its impact will be magnified by the greater duration of the liabilities versus the assets.

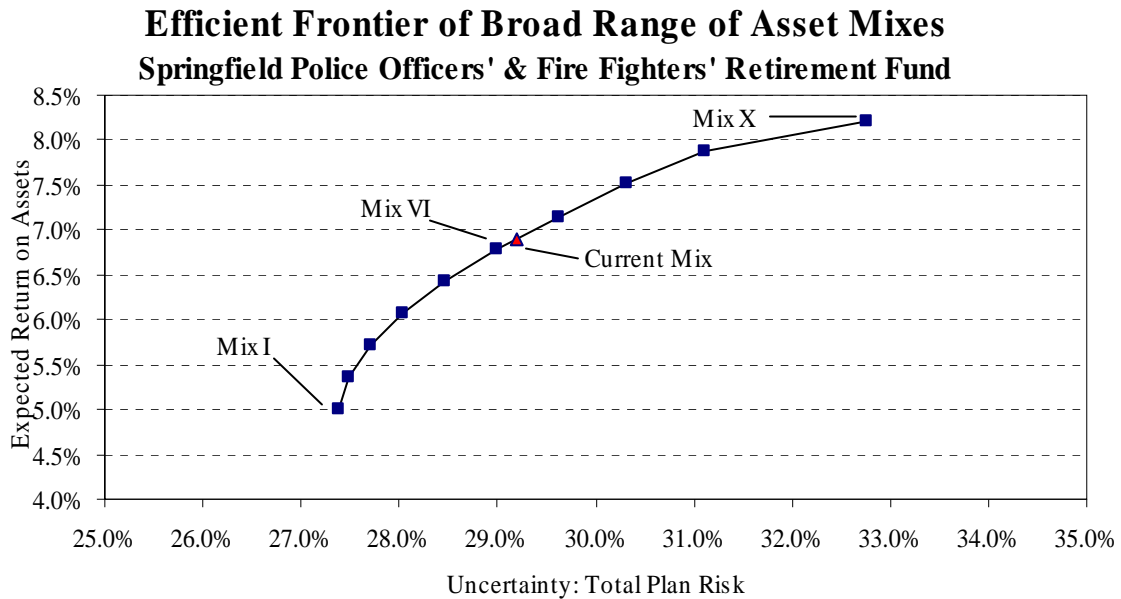


Figure 4

In Figure 4 above, the 10 “optimal” broad range of asset mixes are displayed on a risk/return graph, together with the current asset mix as of December 31, 2005. Based on this analysis, the current target lies nearly on the efficient frontier, but is less diversified. Movement along the efficient frontier toward higher returning asset mixes is preferred from a funding standpoint. We will focus on asset mixes within the risk-return range specified by Mixes VII-IX in the next section of the report. These are the mixes that are projected to generate returns reasonably close to the actuarial interest rate and provide a well-diversified asset mix.

While the output of our model specifies ten optimal asset mixes, there are a large number of efficient asset mixes. Between each risk-reward point in the above table there are many slightly different efficient risk/reward asset mix portfolios. Because Mixes I-VI and Mix X seem inappropriate, we derived additional efficient mixes within the risk and return ranges of Mixes VII-IX. These results are shown below:

**Optimal Asset Mixes for Given Risk Levels: Narrowed Risk/Reward Range**

Component	Limits		Asset Mix Alternatives (Percent)										Current
	min	max	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>Mix</u>
Lg/Mid Eq	0%	100%	40%	41%	42%	43%	44%	45%	46%	43%	39%	32%	41%
Sm Eq	0	100	10	11	11	11	11	11	11	16	22	43	10
Int'l Eq	0	100	6	7	8	8	9	10	11	12	14	0	0
Dom Fixed	25	100	44	42	39	36	32	29	26	25	25	25	49
Real Estate	0	10	0	0	1	2	4	5	7	1	0	0	0
Cash	0	100	0	0	0	0	0	0	0	0	0	0	0
Return, %/yr			7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	6.9
Total Plan Risk, %/yr			29.5	29.7	29.9	30.1	30.3	30.5	30.7	30.9	31.2	31.6	29.2
Std Dev, %/yr			11.7	12.1	12.4	12.7	13.0	13.2	13.5	14.1	14.9	15.8	11.1

Within this more narrowed view of asset mix alternatives, Mix 1 which is the lowest return-lowest risk mix has an expected return of 7.1% and a funding uncertainty of 29.5%. This mix has an expected return below the Retirement Fund's actuarial interest rate of 7.5% (net of fees). The highest return-highest risk mix has an expected return of 8.0% (above the actuarial interest rate) and a net funding risk level of 31.6%. This mix, 10, has more uncertainty in satisfying future funding requirements, but 0.9% per year higher expected return than Mix 1. These asset mix alternatives in the narrowed asset mix table provide more appropriate options for the Retirement Fund, given the return objectives described above, the risk tolerance implied by the Fund's current (actual) asset mix, and the risk/return posture of the actual current asset mix of the Fund.

## Efficient Frontier of Narrow Range of Asset Mixes Springfield Police Officers' & Fire Fighters' Retirement Fund

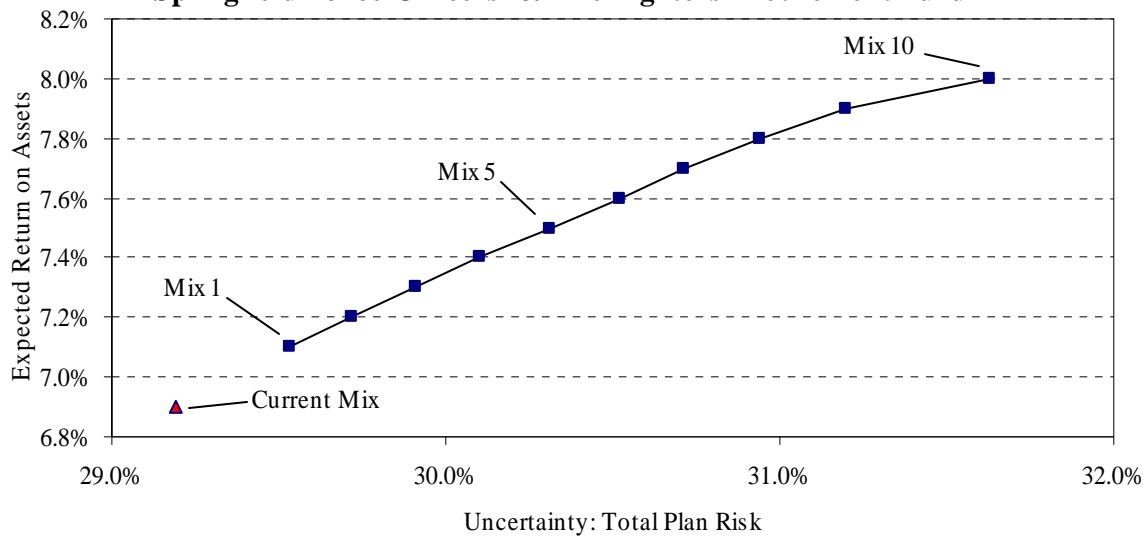


Figure 5

In Figure 5 above, the 10 “optimal” asset mixes are displayed on a risk/return graph, together with the current mix (as of December 31, 2005). Based on this analysis, the current mix falls near the efficient frontier but is quite conservative, as well as less diversified. Movement along the efficient frontier toward higher returning asset mixes is preferred from a risk/return standpoint. We will focus on Mixes 4, 5 and 6 in the next section of the report because these are the mixes that are projected to generate returns that are nearest to the actuarial interest rate and will provide a well-diversified asset mix.

### Asset Allocation Summary

Using the expected return, risk and correlation numbers developed in this section, we identified the efficient frontier for the City of Springfield Police Officers' & Fire Fighters' Retirement Fund, taking into account Plan liabilities. We determined that the current mix of the Plan is approximately efficient, offering nearly the maximum expected return given the level of uncertainty versus the liabilities, but is not expected to deliver the actuarial interest rate assumption of 7.5% (net of fees). We present a number of possible mixes for the Retirement Fund's consideration.

Any investment choice has inherent uncertainty about its future performance. In the next section of this report, we consider trade-offs between the returns and uncertainty.

## IMPLICATIONS FOR ACHIEVING THE ACTUARIAL INTEREST RATE

The prior section presented alternate asset mix choices. This section considers how the choice of one of those mixes will impact the Fund’s achievement of the actuarial interest rate.

Figure 5, previously shown on page 18, compared the annual expected return to the estimated funding uncertainty (net standard deviation) for the 10 narrowed efficient asset mixes. There are two questions that should be addressed at this time:

- 1) *What dollar level of future returns are likely to be achieved by each mix, and how uncertain is that level?*
- 2) *What is the likelihood that the actuarial-assumed rate of return will be achieved by each mix?*

Figure 6, below, portrays the expected return and range of expected returns. Mix 1 has an expected return of 7.1% per year, with an asset risk level of  $\pm 11.7\%$  per year. This mix has approximately a 49% chance of beating the 7.5% (net of fees) actuarial hurdle rate assumption over the next one year period. Mix 10 has an expected return of 8.0% per year, with an uncertainty of  $\pm 15.8\%$ . This indicates approximately a 51% chance of exceeding the assumed 7.5% actuarial hurdle rate over the next year. Mix 5 has approximately a 50% chance of achieving a return equal to, or greater than, 7.5% over the next year.

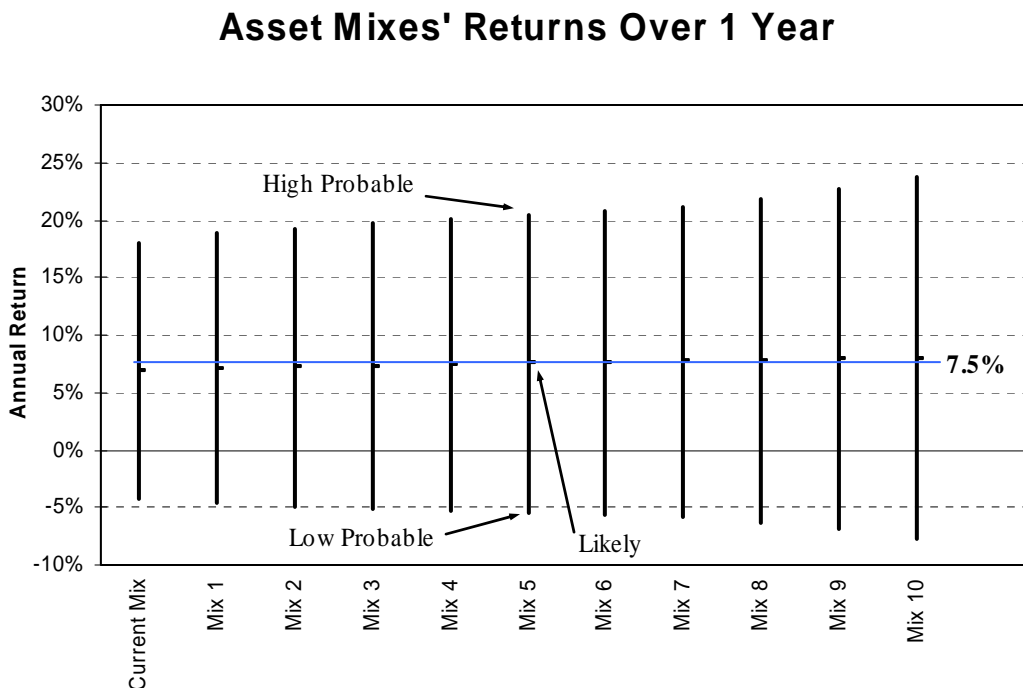


Figure 6

For each mix, the point labeled “Likely” represents the mean expected return over the stated time period. The “High Probable” and “Low Probable” scenarios represent a one standard deviation difference from the mean expected return. There is a one-in-six (about 17%) chance the return will be higher than the “High Probable” or lower than the “Low Probable” return in a given year.

Alternatively, the Retirement Fund can consider the Asset Mixes in light of the extra dollars earned vs. the 7.5% (net of fees) actuarial rate of return. Figure 7 below displays this information for a one-year period. For Mix 1, the assets’ expected return would be below the baseline (\$9.9 million), since it has an expected return of 7.1%, below the 7.5% (net of fees) actuarial interest rate. Its uncertainty range is the expected level plus or minus \$15.4 million (11.7% of \$131.7 million). The “uncertainty range” is displayed on the graph as the line between the “low probable” and “high probable” points. There is approximately a 67% probability that the return over the next one year will lie within this “uncertainty range.” Although no “absolute worst case” can be defined, a range roughly twice the size of the indicated range would cover more than 95% of the likely outcomes; 2.5% of any outcomes would result in a lower return and 2.5% would be even more favorable.

### Asset Mixes' Dollar Returns Over 1 Year

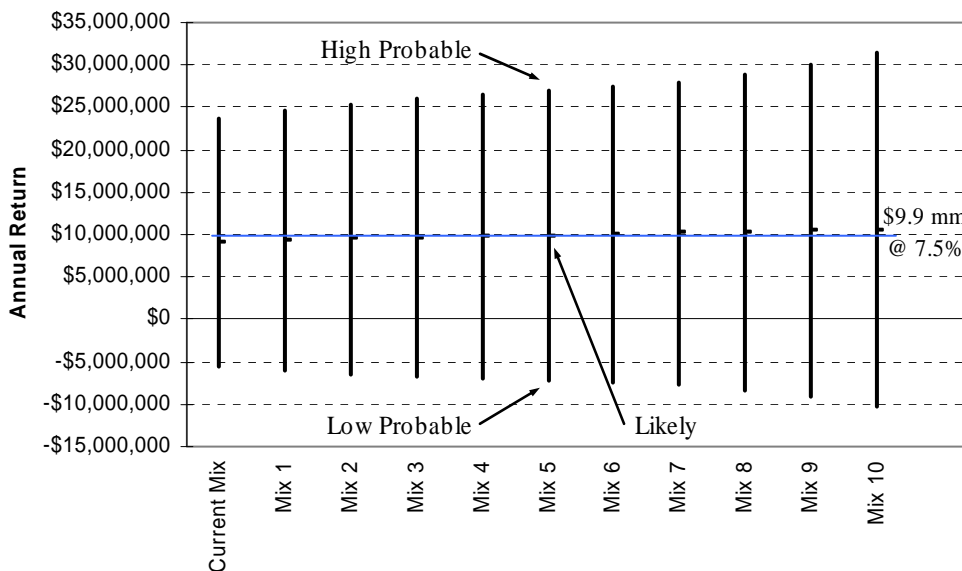


Figure 7

Mix 5 has an expected return of \$9.9 million, matching the actuarial assumption, and has an uncertainty range of \$34.1 million (the difference between the “low probable” and the “high probable”). Mix 4 has an expected return \$131 thousand below the baseline and an uncertainty range of \$33.4 million. Mix 6 has an expected return \$131 thousand above the baseline, and an uncertainty range of \$34.9 million. Again, these figures represent the dollars earned above or below the Fund’s return target rate, 7.5%, for a one year period.

## Longer-term Perspective

In addition to the one-year period, we examined the expected returns and variance of returns over a five year time period. As shown in the Figure 8 below, the expected range of returns is narrower than the range over the one year period. The expected return of each mix has a slightly lower probability of achieving the actuarial rate of return over the five year period versus the one year period.

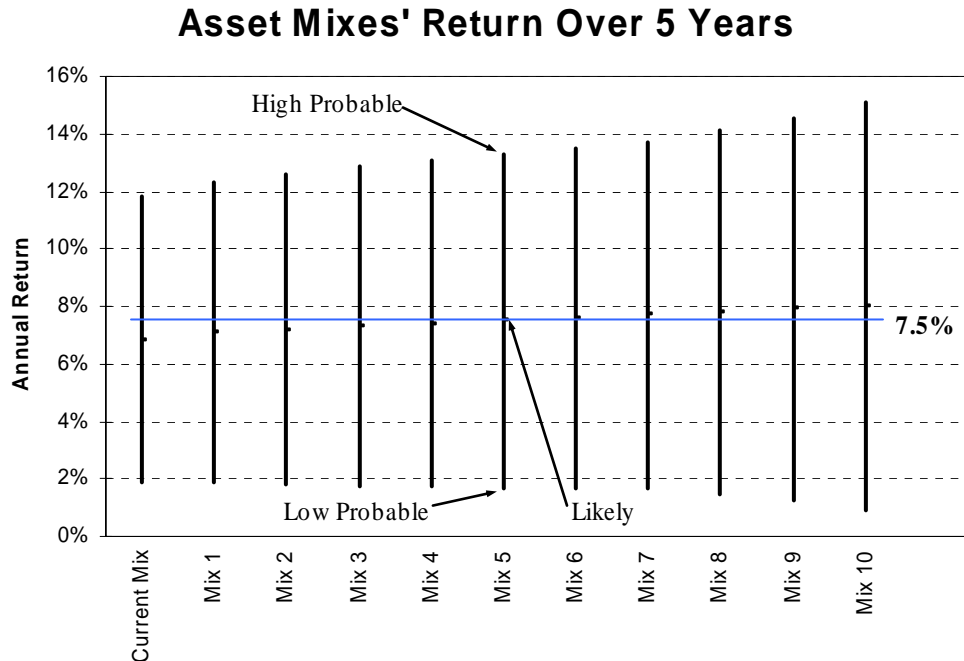


Figure 8

The uncertainties appear “reduced”. Utilizing a longer time horizon tends to somewhat mitigate the short-term effects of risk, making the more aggressive mixes look considerably more attractive than in the one-year chart (the uncertainties are reduced further using a 13.3 year horizon in Figure 9). The likelihood of Mix 5 beating the 7.5% target over the 5 year period remains at 50%, as its expected return matches the actuarial interest rate. The more aggressive mixes, with expected returns above the actuarial interest rate, are shown as more likely to exceed the 7.5% target, with Mix 6 having a 51% chance of exceeding the target.

We also examined the expected returns and variance of returns over a much longer time period. We believe that a reference point for reviewing policy decisions is the time it takes to pay off the average liability—the “duration” of the Fund’s liabilities. We analyze this planning horizon as it corresponds to actual benefits, rather than either the quarter-by-quarter perspective of the capital markets or the actuary’s long-term perspective. In the liability section of this report, we reported the estimated duration at 13.3 years. Looking at the longer horizon smoothes out short-term fluctuations.

### Asset Mixes' Return Over 13.3 Years

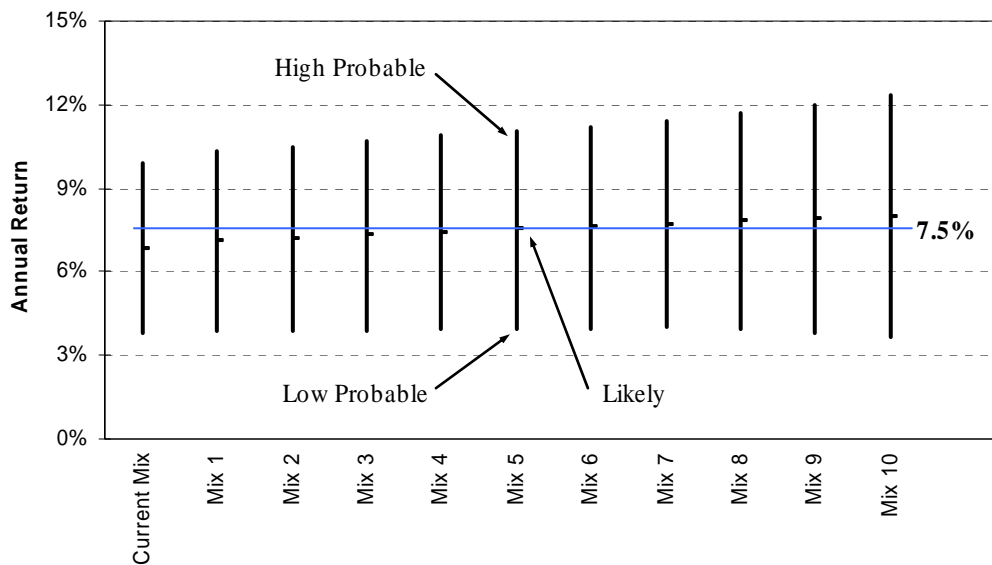


Figure 9

Figure 9 (above) shows how the expected range of returns narrows when variability is spread over the 13.3 year liability horizon. The uncertainties appear substantially “reduced”. Utilizing a longer time horizon tends to somewhat mitigate the short-term effects of risk, making the more aggressive mixes look considerably more attractive than in the one-year chart. The likelihood of Mix 5 beating the 7.5% target over the 13.3 year period remains at 50%. The more aggressive mixes, with expected returns above the actuarial interest rate, are shown as more likely to exceed the 7.5% target, with Mix 6 having a 51% chance of exceeding the target, and Mix 7 having a 52% probability of beating the return hurdle.

## RECOMMENDATION AND CONCLUSION

A case could be made why the Retirement Fund might wish to adopt several of the proposed asset mixes discussed in our report. However, the proposed Mix 5 and alternative Mixes 4 and 6 provide excellent diversification, and provide a relatively moderate level of risk. Mix 5 has assets which match up better with the liabilities. Mix 4 and Mix 6 can add incremental returns to the current mix, while still representing a diversified mix of assets.

We propose the adoption of Mix 5 which offers a reasonable return and is better diversified than the current asset mix.

The Retirement Fund's Current Mix, Proposed Mix and Proposed Asset Ranges are detailed below.

<u>Asset Class</u>	<u>Current Target</u>	<u>Recommended "Mix 5"</u>	<u>Proposed Asset Range for Mix 5</u>
Large/Mid Cap Equities	41%	44%	40-50%
Small Cap Equities	10	11	8-14%
Int'l Equities	0	9	6-12%
Fixed Income	49	32	30-36%
Real Estate	0	4	0-6%
Cash & Equivalents	0	0	0-1%
Expected Return, %/yr	6.9	7.5	
Total Plan Risk, %/yr	29.2	30.3	
Standard Deviation, %/yr	11.1	13.0	

## APPENDIX A – BASIS FOR CAPITAL MARKET ASSUMPTIONS

**Domestic (Large/Mid Cap) Stocks:** Expected returns for stocks are derived from analyses of historic returns, forecasts of the S&P 500 Common Stock Index performance, and the expected economic environment. Return expectations are based on an analysis of historical results, consensus expectation and our proprietary analysis. Risk (the annual standard deviation of returns for stocks) is estimated based on historical data over different time periods.

**Small Cap Stocks:** Expected returns and risk (standard deviation) are estimated for the Russell 2000 using an approach similar to that described above for domestic large/mid cap stocks. Also, the expected capital market line relationship between large/mid and small stocks is analyzed.

**International Stocks:** Expected returns and risk (standard deviation) are estimated for the Morgan Stanley Capital International Europe, Australia and Far East Index on a U.S. Dollar basis.

**Domestic Fixed Income:** Expected returns and risk (standard deviation) for bonds are projected for the Lehman Aggregate Bond Index. The current yield to maturity of the Lehman Aggregate Index is a primary component of expected returns. Risk is based on historical experience.

**Real Estate:** Expected returns and risk (standard deviation) are estimated using historical returns for public estate investment trusts. Historical data was analyzed using the NAREIT Equity Index.

**Cash & Equivalents:** Expected returns and risk (standard deviation) for 91-day Treasury Bills was estimated using historical data.

**Comparative Historical Returns, Standard Deviations and Correlations**  
*As of December 31, 2005*

<b>Historical Returns:</b>	<b>Lg/Mid Cap</b>	<b>Small Cap</b>	<b>Int'l Stock<sup>1</sup></b>	<b>Bonds<sup>2</sup></b>	<b>Real Estate<sup>3</sup></b>	<b>Cash</b>
5-Yr	0.5	8.2	4.9	5.9	19.1	2.2
7-Yr	1.8	8.3	4.9	5.7	16.2	3.1
10-Yr	9.1	9.3	6.2	6.2	14.4	3.7
20-Yr	11.9	10.3	10.0	7.9	12.3	4.8
1926-2005	10.4	12.6	11.2	5.9	13.4	3.7
<b>Historical Risk:</b>	<b>Lg/Mid Cap</b>	<b>Small Cap</b>	<b>Int'l Stock</b>	<b>Bonds</b>	<b>Real Estate</b>	<b>Cash</b>
5-Yr	19.9	26.6	22.3	3.7	14.7	0.6
7-Yr	18.5	24.8	20.3	3.6	14.6	0.9
10-Yr	18.7	24.3	20.1	3.6	14.8	0.9
20-Yr	17.5	24.0	20.8	4.6	14.5	1.0
1926-2005	20.2	32.9	22.1	8.5	16.7	3.1
<b>5-Yr Correlations:</b>	<b>Lg/Mid Cap</b>	<b>Small Cap</b>	<b>Int'l Stock</b>	<b>Bonds</b>	<b>Real Estate</b>	<b>Cash</b>
Lg/Mid Cap	1.00	0.94	0.90	-0.59	0.58	-0.31
Small Cap	0.94	1.00	0.87	-0.52	0.71	-0.21
Int'l Stock	0.90	0.87	1.00	-0.52	0.63	-0.39
Bonds	-0.59	-0.52	-0.52	1.00	0.02	0.17
Real Estate	0.58	0.71	0.63	0.02	1.00	-0.12
Cash	-0.31	-0.21	-0.39	0.17	-0.12	1.00
<b>7-Yr Correlations:</b>	<b>Lg/Mid Cap</b>	<b>Small Cap</b>	<b>Int'l Stock</b>	<b>Bonds</b>	<b>Real Estate</b>	<b>Cash</b>
Lg/Mid Cap	1.00	0.92	0.86	-0.61	0.44	-0.17
Small Cap	0.92	1.00	0.82	-0.51	0.61	-0.14
Int'l Stock	0.86	0.82	1.00	-0.53	0.40	-0.27
Bonds	-0.61	-0.51	-0.53	1.00	0.10	0.15
Real Estate	0.44	0.61	0.40	0.10	1.00	-0.12
Cash	-0.17	-0.14	-0.27	0.15	-0.12	1.00
<b>10-Yr Correlations:</b>	<b>Lg/Mid Cap</b>	<b>Small Cap</b>	<b>Int'l Stock</b>	<b>Bonds</b>	<b>Real Estate</b>	<b>Cash</b>
Lg/Mid Cap	1.00	0.89	0.85	-0.44	0.36	0.03
Small Cap	0.89	1.00	0.82	-0.41	0.58	-0.09
Int'l Stock	0.85	0.82	1.00	-0.47	0.32	-0.18
Bonds	-0.44	-0.41	-0.47	1.00	0.08	0.17
Real Estate	0.36	0.58	0.32	0.08	1.00	-0.12
Cash	0.03	-0.09	-0.18	0.17	-0.12	1.00
<b>20-Yr Correlations:</b>	<b>Lg/Mid Cap</b>	<b>Small Cap</b>	<b>Int'l Stock</b>	<b>Bonds</b>	<b>Real Estate</b>	<b>Cash</b>
Lg/Mid Cap	1.00	0.88	0.72	-0.08	0.48	0.10
Small Cap	0.88	1.00	0.65	-0.12	0.65	-0.06
Int'l Stock	0.72	0.65	1.00	-0.03	0.44	-0.05
Bonds	-0.08	-0.12	-0.03	1.00	0.19	0.25
Real Estate	0.48	0.65	0.44	0.19	1.00	-0.15
Cash	0.10	-0.06	-0.05	0.25	-0.15	1.00
<b>1926-2005 Correlations:</b>	<b>Lg/Mid Cap</b>	<b>Small Cap</b>	<b>Int'l Stock<sup>1</sup></b>	<b>Bonds<sup>2</sup></b>	<b>Real Estate<sup>3</sup></b>	<b>Cash</b>
Lg/Mid Cap	1.00	0.79	0.59	0.19	0.46	-0.03
Small Cap	0.79	1.00	0.42	0.08	0.76	-0.10
Int'l Stock	0.59	0.42	1.00	0.09	-	-0.11
Bonds	0.19	0.08	0.09	1.00	0.29	0.21
Real Estate	0.46	0.76	-	0.29	1.00	-0.06
Cash	-0.03	-0.10	-0.11	0.21	-0.06	1.00

<sup>1</sup>Long-term returns for International Equities extend back to 1970.

<sup>2</sup>Long-duration corporate bonds have been used as a proxy for fixed income in the 1926-2005 period.

<sup>3</sup>Long-term returns for Real Estate Investment Trust Equities extend back to 1972.

**Comparative Expected Returns, Standard Deviations, Correlations  
And Historical Returns  
As of December 31, 2005**

	<b>Ibbotson Historical 1926-2005</b>	<b>UBS 3-Year Estimate</b>	<b>Vestek 5-Year Estimate</b>	<b>Milliman 5-Year Estimate</b>
<b>Domestic Equity (Lg Cap)</b>				
Return	10.4	11.2	10.2	8.60
Risk	20.2	15.0	16.7	19.00
Correlation				
Small Cap	0.8	-	0.8	0.85
International Equity	0.6	-	-	0.75
Domestic Bonds	0.2	-	0.1	0.30
Real Estate	0.5	-	-	0.20
Treasury Bills	0.0	-	0.0	0.10
<b>Domestic Equity (Sm Cap)</b>				
Return	14.9	-	10.8	9.30
Risk	22.8	-	18.3	23.00
Correlation				
International Equity	0.4	-	-	0.70
Domestic Bonds	0.1	-	0.1	0.15
Real Estate	0.8	-	-	0.25
Treasury Bills	-0.1	-	-0.1	0.10
<b>International Equity</b>				
Return	11.2	4.8	-	8.90
Risk	22.1	13.9	-	21.00
Correlation				
Domestic Bonds	0.1	-	-	0.15
Real Estate	-	-	-	0.05
Treasury Bills	-0.1	-	-	0.10

- *Ibbotson does not provide quarterly data. Data shown is as of December 31, 2005.*
- *Long-duration corporate bonds are used as the Ibbotson domestic bond proxy.*
- *Historical data on international equities goes back to 1970.*
- *Historical data on real estate goes back to 1972.*

**Comparative Expected Returns, Standard Deviations, Correlations  
And Historical Returns (cont.)**

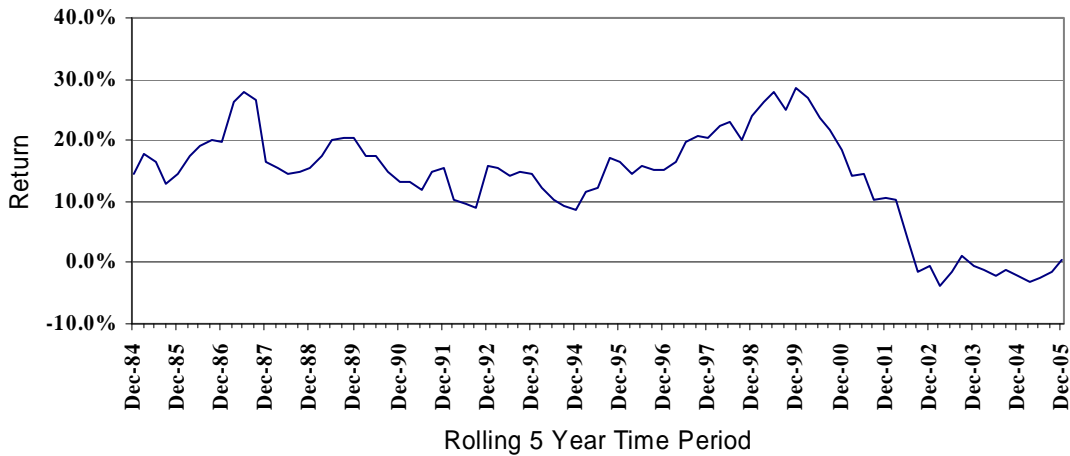
*As of December 31, 2005*

	<b>Ibbotson Historical 1926-2005</b>	<b>UBS 3-Year Estimate</b>	<b>Vestek 5-Year Estimate</b>	<b>Milliman 5-Year Estimate</b>
<b>Domestic Bonds</b>				
Return	5.9	3.8	5.9	5.00
Risk	8.5	4.4	7.9	6.50
Correlation				
Real Estate	0.3	-	-	0.15
Treasury Bills	0.5	-	0.1	0.20
<b>Real Estate</b>				
Return	13.4	3.0	-	7.30
Risk	16.7	10.0	-	14.00
Correlation				
Treasury Bills	-0.1	-	-	0.35
<b>Treasury Bills</b>				
Return	3.7	4.7	4.4	3.50
Risk	3.1	0.5	0.6	1.50

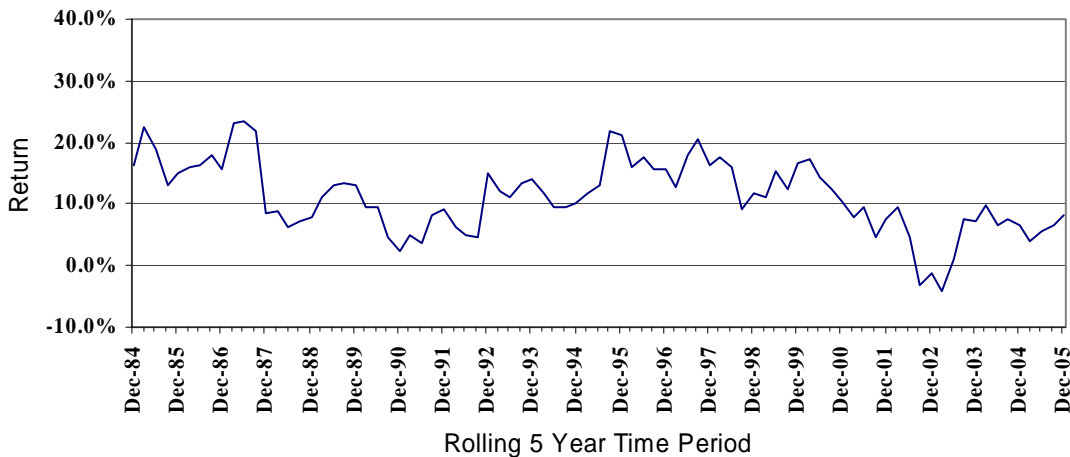
### ***Rolling Five-Year Performance***

We calculated the cumulative annualized returns of each asset class over multiple rolling 5-year time periods. For example, for stocks, we had data spanning over twenty years. We calculated a five-year return for the beginning of this period. This time period started with first quarter 1980 and went through fourth quarter 1984. Then the next quarter's return for the S&P 500 was added to the respective time series and the oldest quarterly return was dropped. The stock return over this new five-year time period was then calculated. This procedure was repeated through the latest five-year period covering first quarter 2001 through fourth quarter 2005.

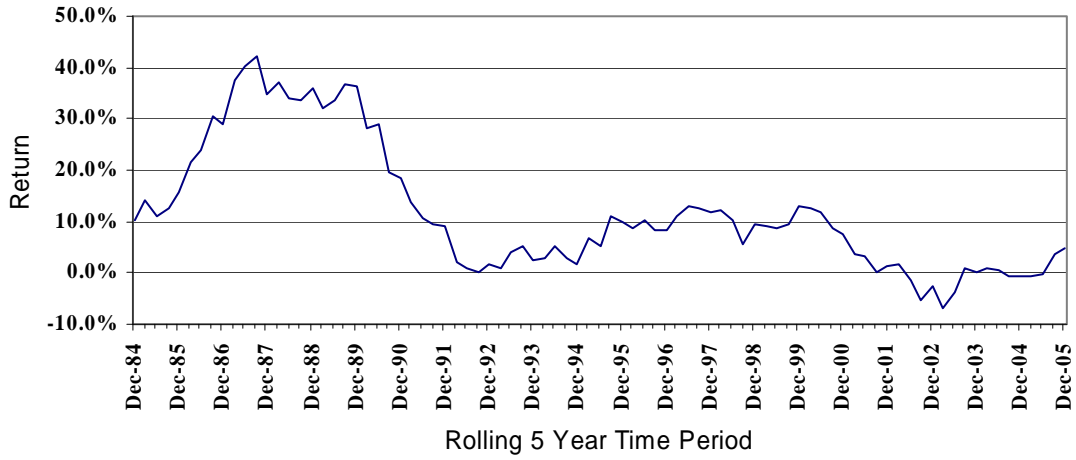
#### **S&P 500 Rolling 5-Yr Return**



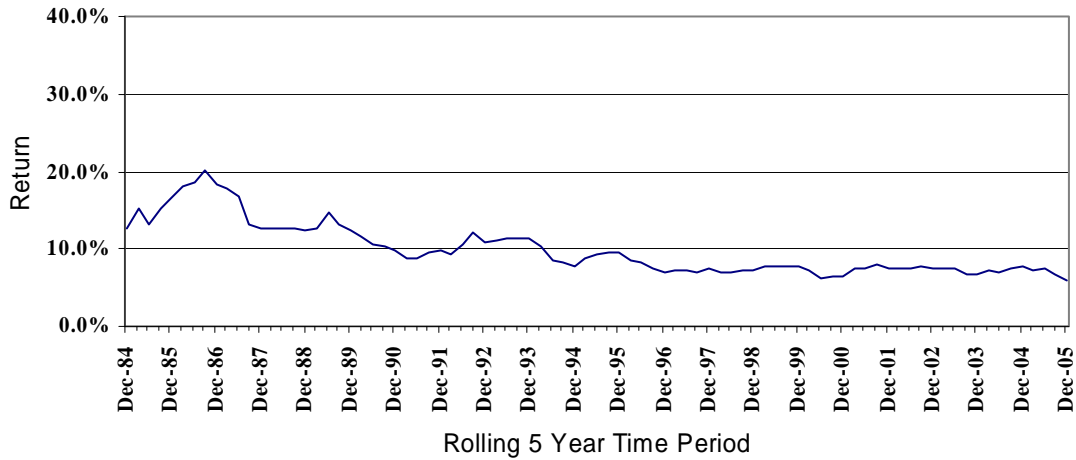
#### **Russell 2000 Rolling 5-Yr Return**



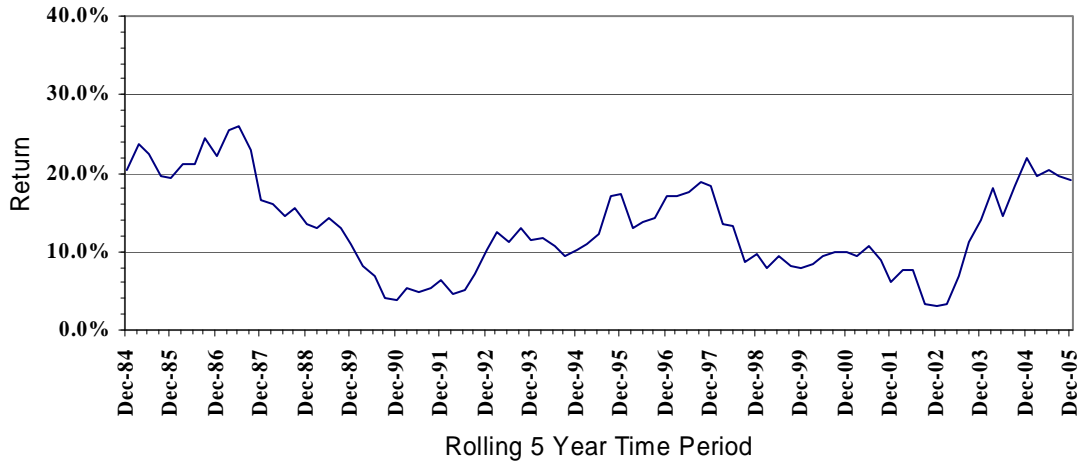
### MSCI EAFE Rolling 5-Yr Return



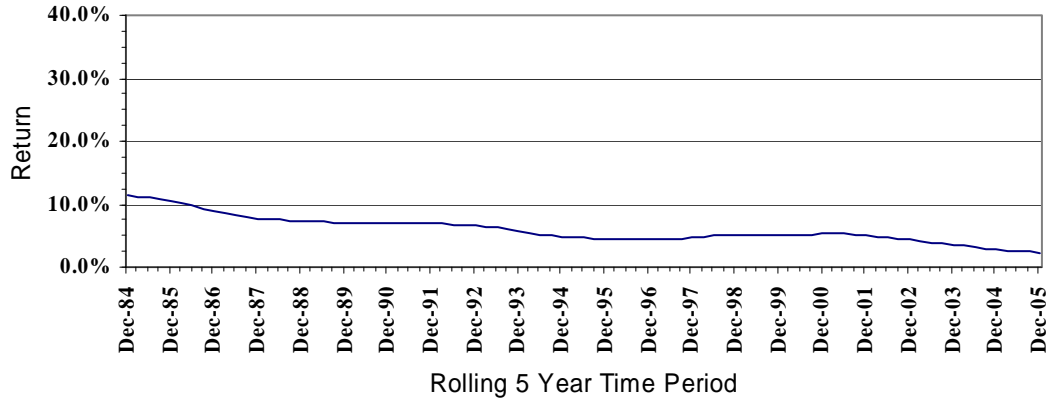
### Lehman Aggregate Rolling 5-Yr Return



## NAREIT Equity Rolling 5-Yr Return



## 91 Day T-Bill Rolling 5-Yr Return



## **APPENDIX B – ASSET CLASS CORRELATIONS**

As part of our research effort on the assumptions used in the asset allocation review, we review the correlation trends between bonds and the other asset classes. The correlation between bonds and other asset classes are particularly critical. Bonds are the asset class which is most highly correlated with plan liabilities, and thus are somewhat representative of the correlation between the liabilities and the asset classes. The correlation between the assets and the liabilities is central to the asset allocation process. These historical correlations are explored below.

### *Procedure Used to Calculate Correlations*

The procedure to generate correlations with liabilities involved several steps. We calculated the correlation between two asset classes over multiple rolling time periods. For example, for bonds and stocks, we had data spanning over twenty years. We then calculated a five-year correlation at the beginning of this period. This time period started with first quarter 1980 and went through fourth quarter 1984. Then the next quarter's return for stocks and bonds was added to the respective time series and the oldest quarterly return was dropped. The correlation coefficient was calculated on the stock and bond returns over this new five-year time period. This procedure was repeated through the latest five-year period covering first quarter 2001 through fourth quarter 2005.

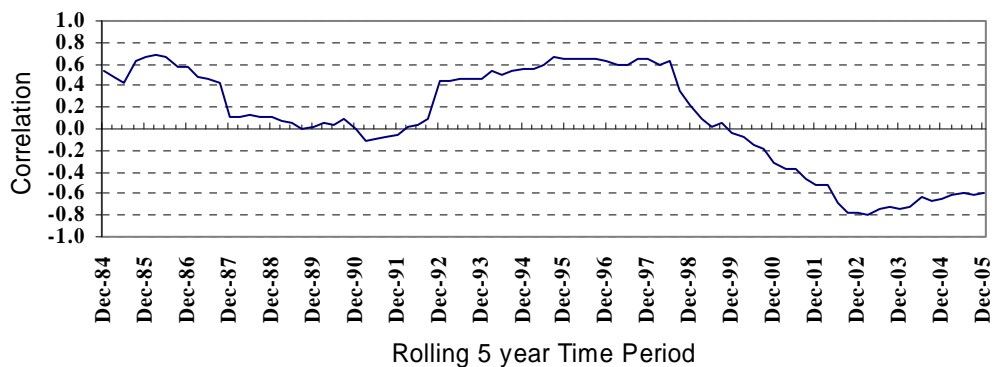
We also examined the relationship between bond indices of varying duration. The liabilities are similar to a bond portfolio in their response to changes in inflation and interest rates. Thus, by supplementing the work presented below with a close examination of the relationships between bond indices of varying duration we were able to gather valuable information regarding key relationships. Specifically, the connection between the liabilities and the asset classes as well as between long-term bonds and other asset classes. In general, we found that bond portfolios of varying duration were consistently very highly correlated over time. We also found that the closer the duration of two bond portfolios are, the higher the correlation tends to be.

### *Bonds and Large/Mid Capitalization Equities*

The underlying indexes used to calculate the correlations between bonds and large/mid capitalization stocks were the Lehman Aggregate Bond Index and the S&P 500. Rolling five-year correlations were calculated for as long as the data was available. Please see the graph below.

Prior to the stock market crash in the fourth quarter of 1987, the correlations between bonds and large cap stocks tended to be between +0.35 and +0.70. Over the next 5 years, while the fourth quarter 1987 stock return is included in the calculations, the correlation between stocks and bonds falls dramatically. After the fourth quarter of 1987 stock returns are dropped from the rolling five-year data, the correlation between bonds and stocks rises to a level comparable to its previous range of +0.35 to +0.70. However, the correlation then dropped again in 1997 and has since exceeded the previous negative levels of 1989-1990. This data suggests that the relationship between bonds and large cap stocks can vary dramatically, but is likely to be within the range of -0.30 and +0.40 when markets are in equilibrium.

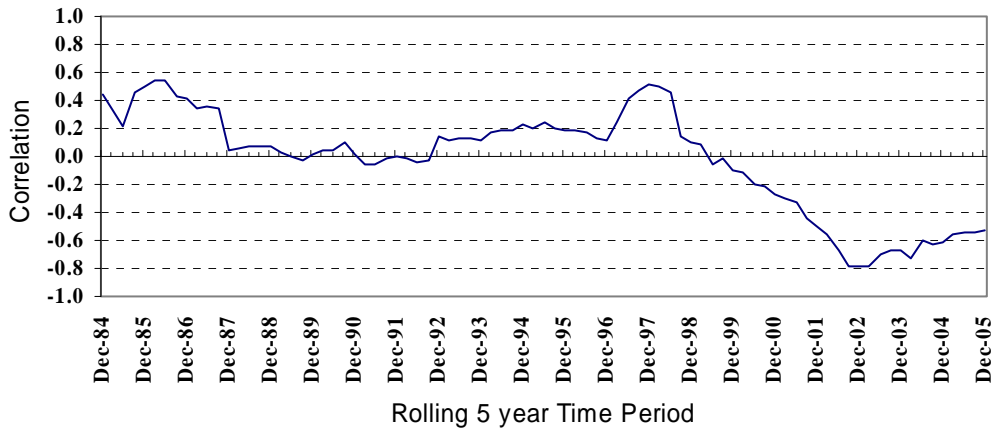
### **Rolling 5-Yr Correlation** Lehman Aggregate & S&P 500



## *Bonds and Small Capitalization Equities*

The time series used for small capitalization stocks is the Russell 2000. This stock index is the bottom 2,000 stocks of the top 3,000 exchange-traded and OTC stocks ranked by market capitalization. These rankings are determined once a year on May 31<sup>st</sup>. This index is representative of stocks with market capitalizations generally below \$3 billion. Generally speaking, the correlation between bonds and small cap stocks is lower than the correlation between bonds and large cap stocks. This is borne out by the graph between bonds and small cap stocks. Notice a general resemblance between this graph and the previous graph between bonds and large/mid cap stocks, although these correlations have tended to be lower throughout the time period, and show a greater stability than the correlation between large cap stocks and bonds. Over a majority of the time periods shown the correlation between small cap stocks and bonds has been between -0.05 and +0.40. However, over the most recent four years, the correlations have been rising from a low point of -0.80 in late 2002 to the current level of approximately -0.55 in the fourth quarter of 2005. Going forward, we expect the correlation between small stocks and bonds to continue in its historically normal range, between -0.40 and +0.30.

**Rolling 5-Yr Correlation**  
Lehman Aggregate & Russell 2000

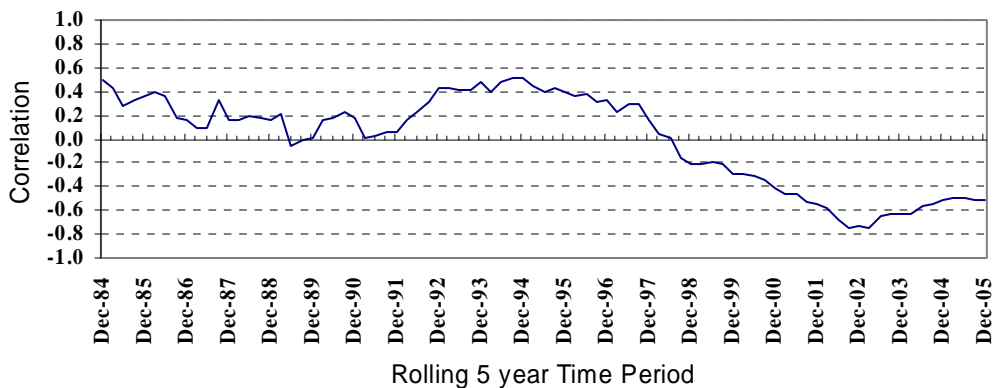


## Bonds and International Equities

International equities are represented by the Morgan Stanley Capital International (MSCI), Europe, Australasia & Far East (EAFE) Index. While there are some shortcomings of this index, it is representative of stocks that can be purchased in the developed equity markets outside of the United States. Efforts to improve the index have resulted in the addition of several countries to the EAFE Index, as well as free-float adjustments in 2002.

There was a pronounced downward trend in the correlation from 1984 through mid-1990, with the correlation turning negative in late 1989 and early 1990. Since mid-1990, the correlation increased dramatically from a low of approximately -0.10 to a high of nearly +0.60 in mid-1993. Subsequently, there has been another steady downward trend, with the correlation dropping to approximately -0.75 in first quarter 2003 before rising to the current level of -0.50. Although the correlation of bonds with international stocks has been varied, for the most part it has ranged between -0.60 and +0.40. It is our expectation that a correlation range between -0.40 and +0.25 is likely going forward.

### Rolling 5-Yr Correlation Lehman Aggregate & MSCIEAFE



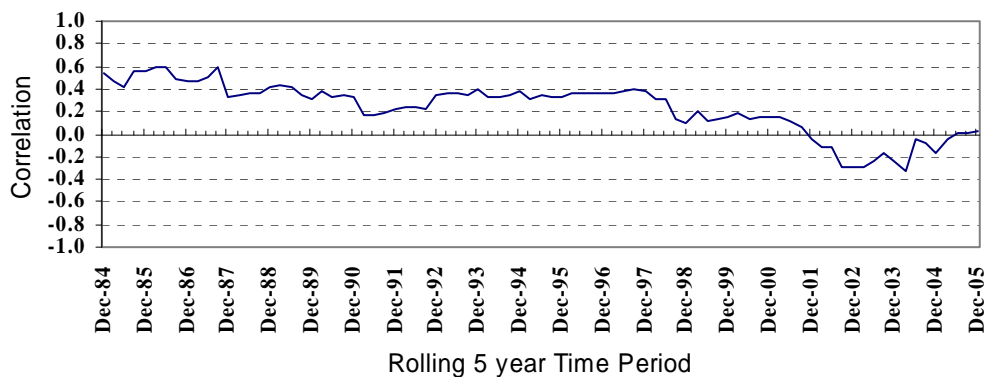
## *Bonds and Real Estate*

The time series used for real estate performance is the NAREIT Equity Index. This is a nationwide index tracking the Equity REIT and publicly traded real estate industry.

The correlation of bonds with real estate has been volatile. During the late 1990s the correlation declined from +0.40 to a low of -0.30 in late 2003. By the end of 2003, the correlation began rising again to a level of approximately zero at the end of 2005.

Because real estate returns are comprised of income and price appreciation/depreciation components, there are certain similarities to bond returns. Real estate investments are expected to be dominated by the income component in the coming years, with relatively minimal price appreciation. Bond returns are also expected to be dominated by income (coupon) payments with relatively minor price appreciation. As a result of this relatively similar performance expectation, albeit with bonds yielding less than real estate, we are anticipating the correlation of bonds with real estate to be somewhat positive, ranging from 0.00 to +0.20.

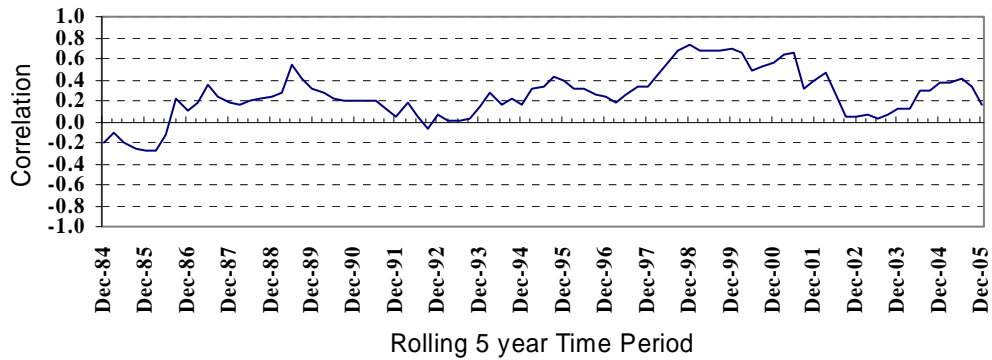
### **Rolling 5-Yr Correlation** Lehman Aggregate & NAREIT Equity



## Bonds and 91-Day Treasury Bills

Until recently, bonds and 91-day Treasury Bills have historically been relatively uncorrelated, except for a brief period in late 1988 and early 1989. However, in 1996 the correlations began to rise gradually and leveled off at approximately +0.60 from fourth quarter 1997 through mid-2000. After this period, the correlations fell sharply over the next two years before rising again to their current level of approximately +0.20. We expect that the correlation between bonds and Treasury bills is likely to be between +0.00 and +0.40 over the next three to five years.

### Rolling 5-Yr Correlation Lehman Aggregate & 91 Day T-Bills



## **APPENDIX C – ASSET CLASS RISK**

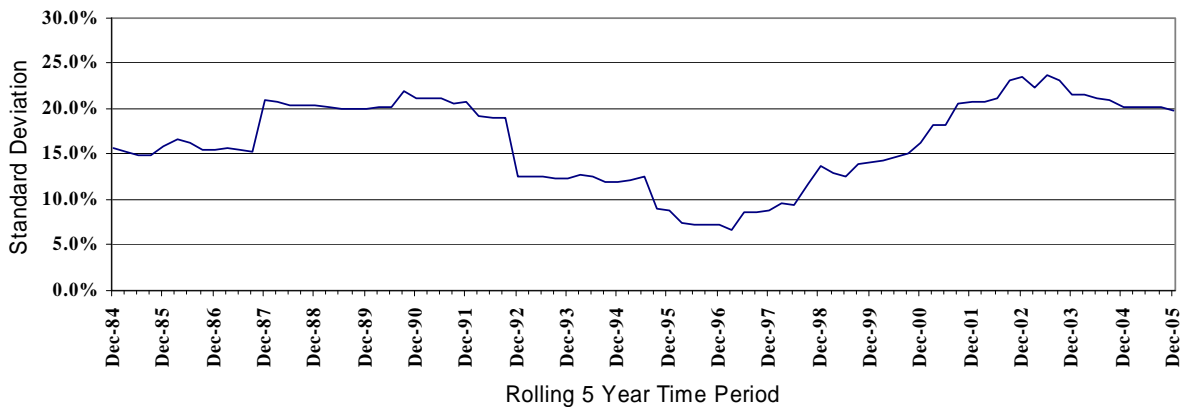
Due to more volatile correlations between the asset classes, we felt it was appropriate to review the historical levels of volatility as well. We calculated the risk of each asset class, as represented by the standard deviation, using the same rolling five-year methodology that was used for calculating the correlation coefficients. If possible, we calculated the rolling standard deviation of each asset class over the last twenty-year period. For example, for large/mid cap stocks, the first time period for the rolling five-year risk started with first quarter 1980 through fourth quarter 1984. Then the next quarter's return for stocks was added to the respective time series and the oldest quarterly return was dropped. The standard deviation of the returns of the asset class was calculated over this new five-year time period. This procedure was repeated through the latest five-year period covering first quarter 2001 through fourth quarter 2005. The results and our future expectations are listed on the following pages.

### *Large Capitalization Equities*

The underlying index used to calculate the standard deviation of large and mid capitalization stocks was the S&P 500. Rolling five-year standard deviations were calculated for as long as the data was available.

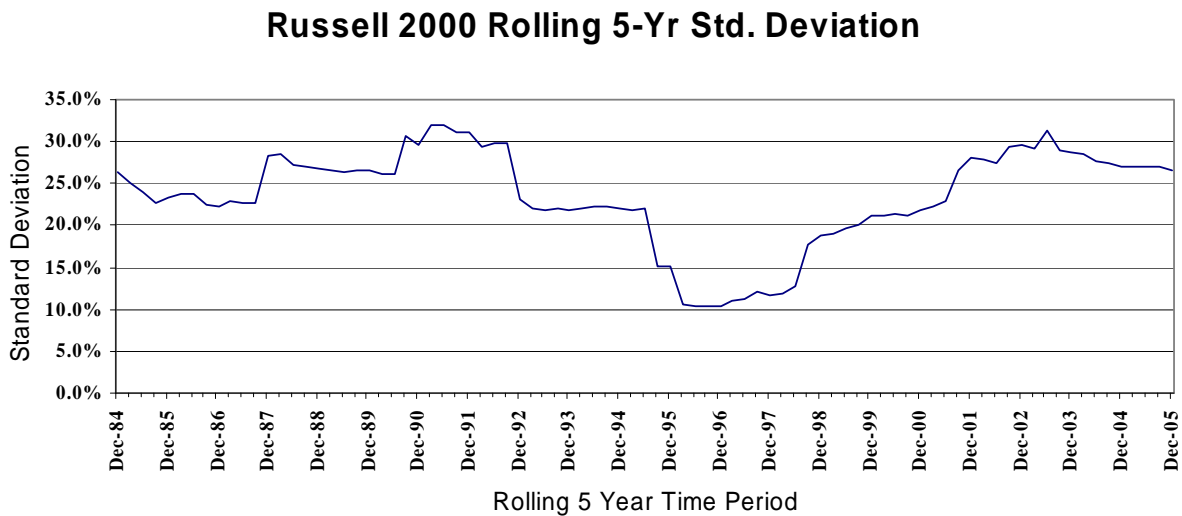
Prior to the stock market crash in the fourth quarter of 1987, the standard deviation of large/mid cap stocks tended to center around 15%. Over the next 5 years, while the fourth quarter 1998 stock return is included in the calculations, the standard deviation rises to between 20% and 23%. After the fourth quarter of 1987 stock return is dropped from the rolling four-year data, the risk level drops and remains below 15% throughout most of the 1990's. However, starting in 1997 there is an upward trend, with the ending risk level at approximately 20%. We expect the risk to be between 18% and 23% over the next five years.

**S&P 500 Rolling 5-Yr Std. Deviation**



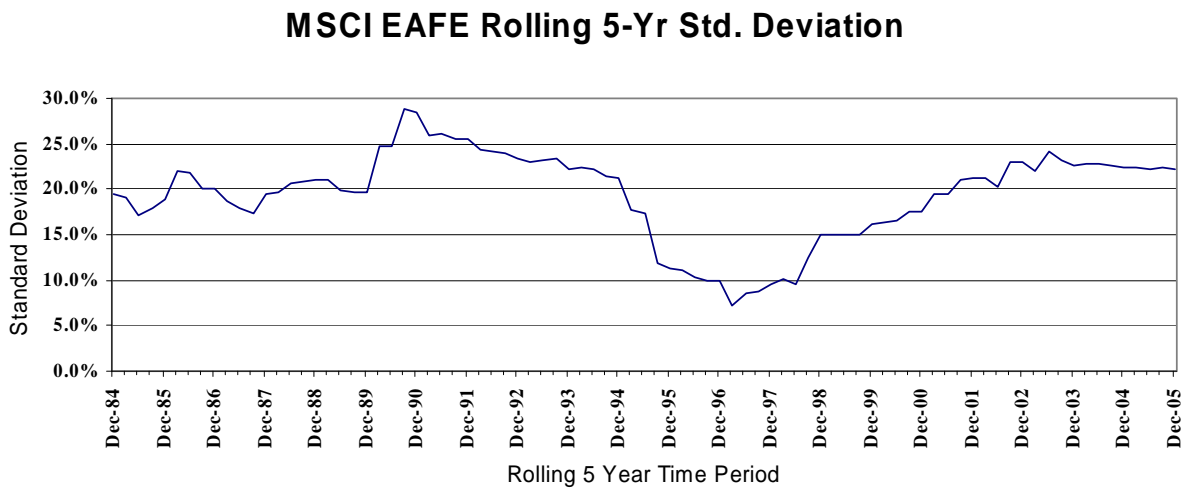
### *Small Capitalization Equities*

The time series used for small capitalization stocks is the Russell 2000. For the most part, the standard deviation of small cap stocks has been greater than that of large/mid cap stocks. The rolling standard deviation has consistently been 20% or higher, although from 1995 through 1998 it dropped to below 15%. Going forward, we expect the standard deviation of small cap stocks to be between 23% and 28%.



*International Equities*

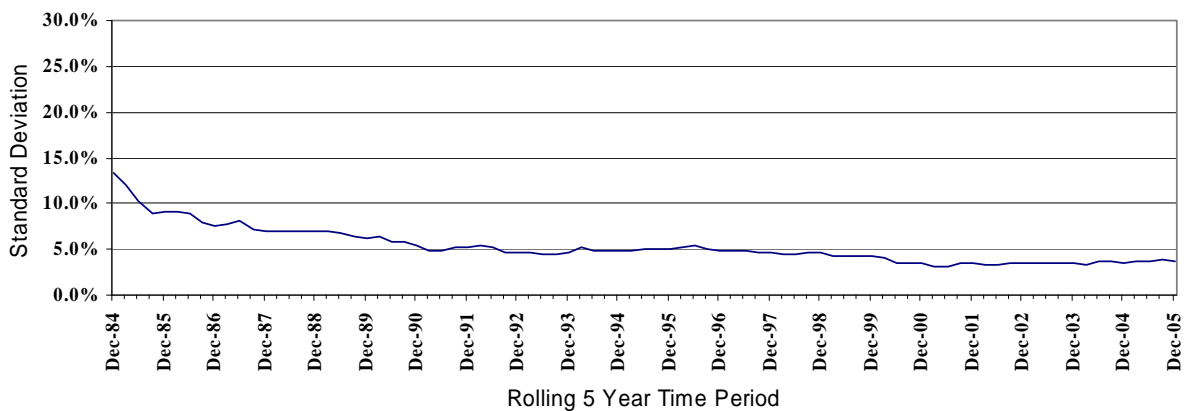
International equities are represented by the Morgan Stanley Capital International (MSCI), Europe, Australia & Far East (EAFE) Index. From 1984 through 1993, the rolling standard deviation was generally between 17% and 25%. There was a pronounced downward trend in the standard deviation from 1993 through mid-1997, when it reached a low of 7%. Since mid-1997, the standard deviation has risen to a high of 24%. It is our expectation that the international equity risk level will range between 19% and 23% going forward.



## Domestic Bonds

The standard deviation of domestic bonds, as represented by the Lehman Aggregate Index, has been approximately 5% over most of the observed time periods. It has declined recently, ending the fourth quarter of 2005 at approximately 4%. However, we believe that a standard deviation of between 6 and 8% to be likely going forward.

**Lehman Aggregate Rolling 5-Yr Std. Deviation**

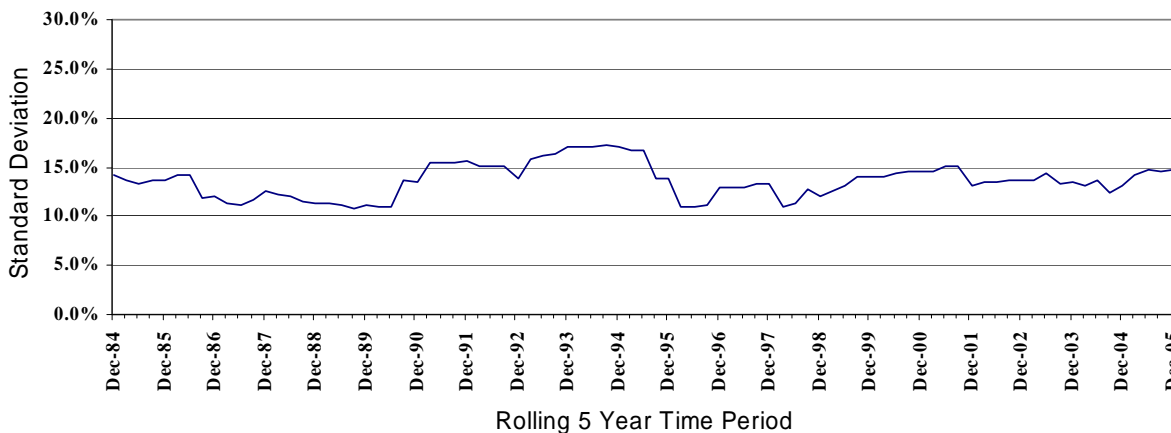


*Real Estate*

The time series used for real estate performance is the NAREIT Equity Index. This is a nationwide index tracking the Equity REIT and publicly traded real estate industry.

Although there is plenty of liquidity in the real estate market, investors should still add a risk premium to this asset class. Over the past 20 years, the volatility of this asset class has remained somewhat constant, ranging from a low of approximately 10% in the late 1980s and mid 1990s to a high of 17% in the early 1990s. We expect equity type volatility for real estate and for standard deviations to be between 13 and 17%.

**NAREIT Equity Rolling 5-Yr Std. Deviation**



### 91-Day Treasury Bills

As expected, the risk of T-Bills, as measured by standard deviation, has been close to zero. We expect the risk to rise somewhat and be between 1 and 2%.

#### 91 Day T-Bill Rolling 5-Yr Std. Deviation

