
21 June 2018

# Hedging Strategy (Risk Management Program) for Lifetime Income Fund

**Version Control**

| Version Number | Date | Author |
|---|---|---|
| 0.1 | 3 November 2014 | Ralph Stewart |
| 0.2 | 5 November 2014 | Feedback from Milliman |
| 0.3 | 8 November 2014 | Milliman amendments incorporated – MOS implications – hedge and Tax |
| 0.4 | 14 November 2014 | Hedge transactions are taxable under PIE |
| 0.5 | 27 April 2015 | Clarifications following final RBNZ VA standard.<br>Updated Rho trading thresholds following additional Milliman trader feedback on best practices. |
| 0.6 | 21 June 2018 | Minimum trade sizes changed for NZD Interest Rate Swaps as a result of trading cleared swaps rather than OTC.<br>20yr swap rates replaced by the 15yr as the last tradeable tenor. Key rate buckets have been amended accordingly |

Contents

## 1. Purpose and Scope

The Fund offers Units in the Fund, which is a portfolio investment entity (**PIE**) for tax purposes. The Fund comprises two separate portfolios: (the **Balanced Portfolio** and the **Cash Portfolio**).

Investments are pooled in the Fund with money from other Unit holders, and invested in accordance with the investment strategy of the Fund.

From the fund premiums are paid to Lifetime Income Limited for the provision of a Variable Annuity offering - Lifetime Withdrawal Benefits (guaranteed Income).

The Guaranteed Lifetime Withdrawal Benefits (GLWB) exposes Lifetime Income Limited to capital market, actuarial/demographic, policyholder behaviour and other non-market risks.

This document sets out the principles, risk exposures, measurement methodologies, hedge policies, operational parameters and controls used to determine Lifetime Income Limited's overarching hedging strategy for this class of business.

## 2. Approval and Review of Hedge Policy

This Hedge Strategy document is owned by the Board and will be reviewed at least annually by the investment committee and approved annually by the Board.

This document should be considered the current hedging strategy and will evolve over time. Due to materiality and operational implications, this first hedging strategy will focus on the dynamic hedging of the main first order sensitivities (delta and rho). This strategy will not address second order sensitivities like gamma or rho convexity. Such sensitivities may be calculated for risks monitoring and P&L attribution purposes.

As the book of business grows, the hedging strategy may be revisited to address more sensitivities and to cover more risk elements (such as second order sensitivities).

While operating the hedge strategy, conflicts between the overarching principles and the specified methods and practices may arise. Wherever there is a potential conflict, any guiding principles should be taken to override any specified rules.

## 3. Risk Management Principles

***Principle 1***: Ensure the promises and obligations made by Lifetime Income Limited are achievable in a fair and equitable manner.

To adhere to the 1st principle, the primary focus of the risk management strategy should be on the long term economic value of the targeted asset or liability. Accounting policies designed to smooth or otherwise alter the apparent economic value of an asset or liability should be considered only as a constraint to the hedge strategy, and not as its primary objective.

This economic hedging does not aim to specifically hedge the regulatory or accounting guarantee liability or earnings, minimize capital requirements, or protect the overall profitability of the product. However, by hedging the economic value of the embedded option, the hedging strategy will bring benefits in terms of capital, protect the profitability of the product and will be expected to reduce the volatility of P&L.

Whether the hedge target is the P&L or a measure of tail exposure (e.g. regulatory capital) will be a function of many variables including contribution to earnings, relative downside risk, and consumption of capital. In either case, managing the economic value of the guarantee should remain the primary objective.

***Principle 2***: Clearly establish risk objectives, limits, constraints and guidelines.

To adhere to the 2nd principle, the objectives of any risk management strategy must be clearly stated and easily measurable. If there is any ambiguity in the stated objective and/or it is difficult to measure whether said objective is being met, then the objective should be reconsidered.

Limits and constraints should be established to define all limits and tolerable residual risks. These can be expressed in percentage or dollar terms, and might include items such as VaR limits, maximum allowable loss, limits on the value of business and limits on the volume of new business. Limits and constraints must be easily measurable.

Guidelines should be set to ensure checks and balances are in place and to establish acceptable tactical approaches to risk management. These guidelines should cover things like hedge governance, policies and procedures for when limits/constraints are breached, frequency of reviews.

***Principle 3***: Risk management strategies should be as complex as they have to be and no more.

To adhere to the 3rd principle, every effort should be made to avoid over-engineering a solution that simply replaces economic risk with model or operational risk.

Erring on the side of parsimony and adopting a phased approach when entering new or unfamiliar territory (e.g. in terms of product features, risks managed, or instruments used to manage risks) will help to minimise errors and maximise management’s understanding.

## 4. Risk Management Tools

There are various ways to manage the risks associated with the variable annuity.

### 4.1 Capital

Posting sufficient capital is a first line of defence against insolvency.

### 4.2 Product Features

| | |
|---|---|
| Product Type | Variable Annuity with Guaranteed Lifetime Withdrawal Benefit (GLWB) |
| Currency | New Zealand Dollars (NZD) |
| Base Product Charges | [0.95%] per annum, as percentage of Account Value, assessed daily |
| GLWB Charges | [1.35%] per annum for single life as percentage of the greater of Benefit Base and Account Value, assessed monthly. May be increased or decreased for inforce policies, subject to a maximum of [2.00%]. |
| Withdrawal Charges | None |
| Ratchet | Annual ratchet of Protected Income Base on policy inception anniversary to closing Account Balance, if greater than current Protected Income Base. |
| Distributor Commission | [1.00%] of each Premium, subject to [100% in year 1, and 50% in year 2] proportionate chargeback if withdrawals in a policy year exceed Annual Withdrawal Benefit. Each premium is tracked separately for commission and chargebacks. No asset-based trail commission. |
| Guaranteed Withdrawals | 5% per annum of Protected Income Base at age 65, increasing by [0.1]% per annum for each whole year of deferral of lifetime income after age 65 |

| | |
|---|---|
| Unplanned Withdrawals | Up to 20% of initial investment can be withdrawn at any time as unplanned withdrawal. Reduces Protected Income Base proportionately to decrease in Account Balance.<br>Unplanned withdrawals above 20% to be treated as a full withdrawal. |
| Spouse Benefit | No, single life only |
| Minimum Death Benefit | Return of Account Balance only |

### 4.3 Capital Markets Hedge

Capital market option pricing theory and hedging techniques can be leveraged to mitigate the exposure introduced by the embedded guarantees. Appendix A covers the management of this risk in greater detail.

### 4.4 Reinsurance

Reinsurance can be used to transfer variable annuity risks to a third party. The ability to do this depends on available reinsurance capacity, the relative costs of purchasing reinsurance, and having sufficient scale to prove attractive to reinsurance counterparties.

### 4.5 Risk Management Within Policyholder Funds

Various strategies can be used to manage risk within policyholder funds. As well as managing market risks for policyholders, these strategies also act to reduce the risk when writing certain derivative-like positions on the underlying policyholder unit funds. As such they also have a knock-on effect of reducing the residual risk to Lifetime Income Limited from writing Lifetime Withdrawal Benefits.

In particular, Lifetime Income Limited will use the Milliman Managed Risk Strategy (MMRS) to directly manage risk exposures within underlying policyholder funds. MMRS has two primary components:

Volatility management strategy

This aims to cap volatility of returns within the unit fund (or a specified subsection of those funds, e.g. the equity or growth components). The resulting volatility of the funds should therefore be more stable than a traditional fund offering .This should result in greatly reduced *Vega risk***,** lower capital requirements (due to the lower exposure to unexpected increases in volatility) and more stability in the Greeks (and hence improved hedge efficiency) of the VA contracts.

Capital management strategy

This aims to limit the potential for downside losses by replicating a put-option strategy to reduce the potential for capital drawdowns in falling and sustained down markets. By reducing potential for such drawdowns, the risk of gamma and gap risk losses from large and sustained downturns in underlying unit holdings is reduced. This acts to reduce the size of any residual delta hedge required in Lifetime Income Limited to manage the residual VA risks.

# 5. Overview of Dynamic Hedging and Liability Measurement

Dynamic Hedging can be considered as creating and constantly managing an investment position intended to offset changes in the guarantee liability value, such that a sufficient pool of assets is held to pay future guarantee claims.

The value of the client's investment portfolio goes up and down with market movements, potentially crystallising into a guarantee claim at the end of the term. The purpose of hedging is therefore to match these gains and losses as markets fall, so that we can pay the claims when they arise.

## 5.1 Valuation Model

All liability valuations are carried out using Milliman's MG-Hedge liability modelling software. MG-Hedge has been developed and used by Milliman and their clients since 1998 in the valuation and management of variable annuity guarantees, equity indexed annuities and dynamic risk management products.

Milliman has a range of generic pre-built MG-Hedge models are used as a starting point for client specific customisations. These are updated from time to time to reflect new features and enhancements. Combined with Milliman's C-Squared or Grid-Step grid computing platform, valuations of client portfolios are able to be undertaken on a per policy seriatim basis every night multiple times, in order to derive the full valuation grid and Greek risk sensitivities that drive a static or dynamic replicating portfolio.

All model developments follow Milliman's software development process, with appropriate source control, sign-off, redundancy and (where appropriate) client validation prior to deployment in production systems. Milliman's development systems are subject to Millimans' BCP and disaster recovery processes.

The MG-Hedge Valuation Model uses an in-built Economic Scenario Generator (ESG) to generate scenarios on the fly, in order to give it the speed and accuracy that is necessary to run a dynamic hedging program. For NZIG, a basic Geometric Brownian Motion equity model and deterministic interest rate model are used in the valuation process. This is consistent with common practice for VA contracts where payoffs exhibit limited or no dependence on interest rates, and as such a stochastic interest rate model is not necessary.

Milliman provides a range of outputs to validate the implementation of MG-Hedge including:
- Seriatim liability and Greek calculations
- Detailed cashflow calculations at a scenario level for selected model points
- Transparent open coded shadow models using VBA / Excel that can be used for reconciliation and auditing of the MG-Hedge valuation model

The NZIG model used is a customised version of the Milliman MG-Hedge projection model with MMRS modelling. As at the date of this document the current NZIG model release is v3.3.10.0, released on 2 December 2014.

## 5.2 Guarantee Liability

The guarantee liability is calculated as follows:

$$\text{Guarantee liability} = \text{PV(Claims)} + \text{PV(Expenses)} - \text{PV(Fees)}$$

The guarantee liability can be thought of as two components: the value of the embedded option, and the guarantee product margin.

The value of the embedded option (or hedging liability) is defined as below:

Hedging liability =PV(Claims) – PV(EHC)

By definition the hedge liability is set to zero at outset. The PV(EHC) can therefore be considered to be the proportion of the guarantee fee equal to the expected value of claims (assuming these are perfectly hedged) over the life of each contract.

The value of the guarantee margin is then defined as below:

Guarantee margin = - PV(Expenses) + PV(fees) –PV(EHC)

Therefore, we have the following:

Guarantee liability = Hedging liability - Guarantee margin

From a hedging perspective, we propose to hedge the option value only, and not the guarantee margin. Conceptually, the guarantee margin is similar to the margin earned on any form of funds management business. It is sensitive to market movements, but this is accepted by the business.

Note that here all present values are calculated using a risk neutral option valuation methodology by simulation, consistent with the assumptions determined at each valuation point using the data sources set out in Appendix B. Initially, 10,000 stochastic scenarios will be used per policy. This number may be reduced as the book of business grows and simulation error becomes less significant across the entire portfolio.

### 5.3 Economic Hedge Cost

By definition, the hedging liability is always zero at inception (for each individual policy at the point of sale).

Let's assume that for one particular policy, the PV of claims is 120 and the PV of charges is 150 on the basis of a product charge per annum of 1%. We will compute an economic hedge cost which represents how much we need to cover the expected claims. In this particular example we need to get 120 of charges to cover the expected claims, therefore the economic hedge cost (EHC) will be

EHC = PV(Claims) / PV(Charges) × Guarantee fee = 120/150 × 1% = 0.8%.

This EHC is computed only once and is the basis for the ongoing hedging program.

EHC = PV(Claims) / PV(Product Charges) * product charge_%[1]

For that particular client, at inception, the guarantee liability value is, per construction:

Hedging liability (or option value) = PV(Claims) – PV(Hedge Charges) = 120 – 0.8%/1% * 150 = 0

This means, that under a perfect hedging strategy, we would be able to cover the expected claims and the cost of the hedging strategy would be 0.8% (per annum). Under a perfect hedging strategy, the hedged P&L will be 0 (on the basis of hedging the hedging liability which starts at 0).

The difference of 0.2% (the difference between the guarantee fee and the economic hedge cost) is the margin.

[1] In practice PV(Claims)/PV(Account Value) will be used to allow for situations where the guarantee fee changes over time (when the contribution feature stops for instance). Also, the EHC will be capped at the guarantee fee in cases where the theoretical EHC would be higher than the guarantee fee (these cases should be rare as they imply pricing at a loss).

The additional expected 30 of charges are part of the product margin and would arise through time to cover expenses, residual risks under the hedging strategy and profit.

The P&L can be expressed as below:

P&L = Fees received – Claims paid - Change in value of liability + Change in asset values

The fees received and the claims paid will be a feed from Compass, and are realized effective elements. The change in asset values will be a feed from NAB Asset Servicing acting as custodian of the assets, based on our hedging portfolio. The change in liability will be an output of the liability model.

In theory, this P&L equals the margin portion of the fees received. Therefore, in theory, the below P&L should be zero:

P&L = EHC – Claims paid - Change in value of liability + Change in asset values

In practice, we can't practically perfectly hedge all risks, so there will be some P&L movements. Also, the accounting treatment of the liability may not always fully equivalent to the economic liability. This will cause an impact in the way the margin will arise (timing impact of accounting rules on profit realisation).

Throughout this document, the terms option value and guarantee liability refer to the hedging liability.

## 6. Risk Tolerance

The tolerance of Lifetime Income Limited to residual balance sheet and financial risk after the operation of any hedge strategies has been determined as follows:

### 6.1 P&L Losses

Less than 5% probability of sustaining losses greater than 0.75% of funds under management in any one year ***due to hedged capital market movements***. In other words, losses of more than 0.75% of funds under management should occur less than once every 20 years in respect of items being hedged (e.g. Delta and Rho risks).

Less than 10% probability of sustaining losses greater than 1% of funds under management in any one year, ***regardless of the source of risk***. In other words, losses of more than 1% of funds under management should occur less than once every 10 years.

### 6.2 P&L Volatility

Expected volatility of profit and loss after all hedging activities of 0.5% of funds under management. For $100m of funds under management, this equates to a volatility of profit and loss of $500,000 per annum.

### 6.3 Unhedged Risks

No appetite for accepting risks outside of those described in this hedge strategy document.

Acceptance of all longevity risks within NZIG, subject to holding sufficient capital and adequate monitoring of longevity experience relative to assumed pricing assumptions.

## 7. Hedge Strategy

### 7.1 Overview

The option value is sensitive to many variables. Each of these sensitivities is associated to a particular risk, which can be hedged, partially hedged, or unhedged depending on risk appetite and strategy implementation costs, operational considerations, and availability/unavailability of hedging assets to cover such risk.

Hedging assets are used to mitigate financial risks. Demographic risks and other type of risks will remain unhedged. We refer to these risks as residual risks. This term does not imply that these risks are necessarily small, but simply means that they remain despite the hedging strategy.

The following table summarizes the scope of the hedging strategy and the risks that will be hedged and those that will remain unhedged.

| Greek | Description | Hedgeable | Current strategy |
|---|---|---|---|
| Delta | Sensitivity to changes in underlying asset values | Yes (with basis risk) | Yes |
| Rho | Sensitivity to changes in interest rates | Yes, up to 30y | Yes |
| Gamma | Sensitivity of delta to changes in underlying asset values. Under a delta hedging strategy, gamma introduces realized volatility and gamma risks | Yes (using equity options) | No. Managed through frequent hedge rebalancing only, expected gamma losses priced via volatility assumptions |
| Rho convexity | Sensitivity of rho to changes in interest rates. Under a rho hedging strategy, rho convexity introduces realized interest rate volatility | Yes (using interest rate options) | No, will be considered part of future risk management strategies based on materiality and risk appetite |
| Vega | Sensitivity to volatility | Yes (using equity options) | No |
| Interest rate vega | Sensitivity to interest rate volatility | Yes (using interest rate options) | No |
| Cross-effects | Sensitivity due to combined changes in assumptions and market conditions (rates level and fund prices for instance) | No | No |

| | | | |
|---|---|---|---|
| Correlation | Sensitivity to correlations | No | No |
| FX | Sensitivity to FX movements | Yes | No, as all underlying unit fund assets are hedged back to NZD, no residual exposure will exist in the liability |

### 7.2 Objectives

The primary objective of the hedge strategy is to hedge the (after tax) economic value of the Lifetime Income Fund guarantee liability.

Two key economic exposures will be targeted for hedging:

- Equity market exposure
- Interest rate exposure

> Equity market exposure

The delta risk of the economic value of the guarantee liability will be hedged using equity derivatives. Gamma risk will not be directly hedged but will be managed through the rebalancing strategy used to manage the delta risk.

> Interest rate exposure

The key rate rho risk of the economic value of claims will be hedged using interest rate derivatives. Key rate convexity risk will not be directly hedged but will be managed through the rebalancing strategy used to manage the key rate rho risk.

The effectiveness of a dynamic delta hedge is dependent upon actual interest rates equalling expected interest rates. Hedging interest rate exposure at policy inception reduces the exposure from actual interest rates deviating from expected. This, in turn, will better enable Lifetime Income Limited to meet its long term economic obligations to policyholders.

Other initially unhedged Greeks will be monitored via the regular reporting process. Should these Greeks become a material source of profit and loss volatility, consideration will be given to amending this Hedge Strategy to incorporate additional hedges against these risk factors.

### 7.3 Authorised Hedge Instruments

This section sets out the specific instruments which are permitted to be used as part of the hedge strategy implementation.

| Risk Factor | Exposure | Hedge Instruments Used |
|---|---|---|
| Equity & Bond | Sensitivity to changes in domestic and foreign equity markets (delta). | ASX SPI200 Futures<br>USD S&P e-mini futures |

| | | |
|---|---|---|
| Interest Rates | Calculated both in aggregate and at each individual bond/equity asset class.<br><br>Sensitivity to changes in underlying fixed income funds (bond delta)<br><br>Calculated both in aggregate and at each individual equity asset class.<br><br>Sensitivity to changes in valuation interest rates (rho)<br><br>Calculated both as parallel shifts and in each of the key rate buckets | EUROSTOXX futures<br>FTSE100 futures<br>NIKKEI futures[2]<br><br>AUD 3Y Bond Futures<br>AUD 10Y Bond Futures<br>USD 2Y T-Bond Futures<br>USD 5Y T-Bond Futures<br><br>New Zealand Cleared Interest Rate Swaps<br>[1Y, 5Y, 10Y, & 15Y] |

Exposures mapped to low volatility assets (i.e. Cash) will not be hedged.

### 7.4 Approved Counterparties

The following OTC counterparties have been approved to trade swaps, based on an acceptable credit rating and their ability to execute New Zealand swaps in the market.

| Counterparty | Long-Term Credit Rating (S&P) |
|---|---|
| Goldman Sachs | A |
| Bank of America Merrill Lynch | A |
| JP Morgan | A |
| Deutsche Bank | A |
| Barclays | A |
| Credit Suisse First Boston | A |
| HSBC | A+ |
| Societe Generale | A |

[2] Note that no NZX equity future exists, and so any NZX exposure will (initially) be mapped to other allowable indices in the fund regression process used to determine risk exposure allocations for hedging. At some point in the future use of NZX equity ETF's may be considered for inclusion within the hedging process to better manage this risk, however for operational simplicity this is excluded in the initial hedge strategy.

| | |
|---|---|
| National Australia Bank | AA- |
| ANZ Bank | AA- |
| Commonwealth Bank of Australia | AA- |
| Westpac | AA- |

Given the small (initial) size of the book and therefore relatively small initial trade sizes, no specific limits have been set on total counterparty exposure within the book.

Moving forward, swap transactions are increasingly being executed on centrally cleared exchanges, although this typically involves posting higher levels of margin than direct transactions with a counterparty. Specific concentration limits on individual issuers may be introduced at subsequent reviews once sufficient scale is achieved, and dependent on the progress of any central clearing mechanisms.

### 7.5 Hedge Rebalancing and Frequency

Hedge positions will be monitored and rebalanced in real-time during opening hours of the Sydney, London & Chicago financial markets. Real-time updating of liability Greek positions will be estimated by the hedge outsource provider using a Taylor Series expansion methodology discussed in Appendix A.

In order to minimise transaction costs and avoid excessive gamma losses from very regular rebalancing in volatile markets, rebalancing of trades will only occur when pre-specified Greek mismatch thresholds are breached. These thresholds may be set at both an individual exposure level and at an aggregate level across exposures, for instance at an overall level based on the total delta hedge mismatch across the entire portfolio.

| | | |
|---|---|---|
| Delta – Individual Equity and Bond Assets | 5% mismatch of equity Delta in each hedged asset class | Individual buckets are traded only if this will also reduce total equity exposure mismatch |
| Rho – Parallel | 3% mismatch of parallel rho | The most relevant individual buckets will be traded to reduce parallel rho mismatch and (as a secondary goal) decrease individual key rate mismatches. |
| Rho – KR1 | See Key Rate Rho test below | Individual buckets are traded only if this will also reduce parallel rho mismatch |
| Rho – KR5 | See Key Rate Rho test below | Individual buckets are traded only if this will also reduce parallel rho mismatch |
| Rho – KR10 | See Key Rate Rho test below | Individual buckets are traded only if this will also reduce parallel rho mismatch |

| | | |
|---|---|---|
| Rho – KR15 | See Key Rate Rho test below | Individual buckets are traded only if this will also reduce parallel rho mismatch |

**Key Rate Rho Test**

When managing Key Rate Rho buckets, Asset Key Rate Rho's will be compared to the Liability Key Rate Rhos based on the following test:

$$\sum|KR_i| < \mathbf{3} * (3\% * \text{ABS(Liability Parallel Rho)})$$

Where $KR_i$ is the sum of the Asset and Liability Key Rate Rho at a given tenor i, i.e. the mismatch in Rho between asset and liabilities for that key rate bucket. For example, KR10, that is the 10yr Key Rate Rho test = Asset 10yr Key Rate Rho + Liability 10yr Key Rate Rho.

The objective of this **scalar adjusted (3x)** formulation is to provide some control over curve risk, without being overly restrictive, given both practical considerations and the tendencies for correlation of moves across adjacent parts of the curve.

Where the Key Rate Rho test fails (i.e. the sum of Key Rate bucket mismatches exceeds the scalar adjustment multiplied by 3% of the Liability rho) traders will have discretion to trade at relevant key rates in order to reduce mismatches back towards zero (with the following priority):

1) Firstly, to reduce the parallel rho key rate mismatch
2) Secondly, subject to achieving 1), to reduce the aggregate Key Rate Rho mismatch (i.e. $\sum|KR_i|$)
3) Thirdly, subject to achieving 1) and 2), to reduce the mismatch on any individual Key Rate Rho bucket traded.

### 7.6 Incorporation of Updated Inforce and Unit Price Data

Note that whenever new inforce information is received, this will be incorporated into the overnight valuation and Trading Grid and will immediately impact the overall portfolio upon. New trades will be added following the incorporation of this information only where they cause a breach of any relevant thresholds.

Similarly, updated unit price data will be incorporated into the updated liability valuation and Trading Grid to reflect the most recent source of underlying unit price information.

Currently, new inforce data is expected to be incorporated into trading information weekly. Unit prices will be refreshed daily.

### 7.7 Minimum Transaction Sizes

Minimum transaction sizes for allowable hedge instruments will limit the extent to which hedge assets can be added and removed. This is particularly relevant when the block of business is small.

The following minimum transaction sizes apply:

| | | |
|---|---|---|
| ASX SPI200 Equity Futures | 1 contract | Contract size AUD$25, implied Delta ~ AUD$1500 |
| USD S&P e-mini futures | 1 contract | Contract size USD$50, implied Delta ~ USD$$1050 |
| EUROSTOXX futures | 1 contract | Contract size EUR€10, implied Delta ~ EUR€350 |
| FTSE100 futures | 1 contract | Contract size GBP£10, implied Delta ~ GBP£700 |
| Nikkei futures | 1 contract | Contract size JPY¥1000, implied Delta ~ JPY¥200,000 |
| Swap 1Y | Notional NZD3m | Estimate rho of 1bp shift on minimum notional ~ NZD$250 |
| Swap 5Y | Notional NZD1m | Estimate rho of 1bp shift on minimum notional ~ NZD$250 |
| Swap 10Y | Notional NZD500,000 | Estimate rho of 1bp shift on minimum notional ~ NZD$400 |
| Swap 15Y | Notional NZD500,000 | Estimate rho of 1bp shift on minimum notional ~ NZD$600 |

### 7.8 No Hedging Until FUM Reaches Critical Levels

No hedging will take place prior to FUM reaching sufficient levels to enable adequate ability to meaningfully rebalance hedge positions, including where necessary unwinding positions. This depends on a number of factors: the size of the liability Greeks, the rebalance thresholds, and the minimum transaction sizes of the hedge instruments used.

Given the expected makeup of the portfolio, the following Greeks have been estimated for an assumed FUM of $100m. These are compared to Greeks at the minimum transaction sizes for each hedge contract.

| | Liability<br>$ Delta NZD (per 100k AV) | Asset<br>$ Delta NZD | FUM required before 1 trade possible at estimated futures delta |
|---|---|---|---|
| ASX200 | -78.5 | 1,500 | $1,911,694 |
| S&P500 | -43.2 | 1,350 | $3,125,387 |
| Eurostoxx | -12.4 | 500 | $4,036,330 |
| FTSE100 | -15.4 | 1,350 | $8,786,369 |
| Nikkei | -9.7 | 2,150 | $22,263,521 |
| AUD 3Yr Bond | -34.2 | 1,100 | $3,212,802 |
| AUD 10Yr Bond | -52.8 | 1,300 | $2,460,610 |
| USD 2Yr Bond | -22.1 | 2,800 | $12,665,820 |
| USD 5Yr Bond | -14.3 | 1,540 | $10,777,024 |

Given this, the minimum FUM before any hedging will take place is set at $5m. In addition, individual risks will only be entered into once individual minimum trade sizes can be transacted for each contract. All capital market risks will be monitored prior to FUM reaching this level.

### 7.9 Unhedged Items

The sensitivity of accounting expenses and profit margins to capital market items are deemed immaterial and thus will not be targeted for hedging. Exposure to expenses and profit will however be a part of standard reporting and monitored regularly.

Other non-actuarial assumptions will also be unhedged, for example assumed dynamic lapses/ policyholder behaviour, longevity risk and unexpected changes in

### 7.10Hedge Effectiveness

Hedge effectiveness will be measured according to the following formula

$$HE(\%) = \frac{change\ in\ value\ of\ hedge\ assets}{change\ in\ value\ of\ hedged\ liability}$$

Given that changes in liability values can be small (or zero) which distorts this ratio, hedge effectiveness will also be considered by the ratio of hedged profit & loss relative to total assets under management, both considering the hedged and total (hedged + unhedged) components of total P&L. This will be measured both in absolute percentage terms and in terms of P&L volatility:

$$P\&L_{HEDGED}(\%) = \frac{change\ in\ hedge\ assets - change\ in\ hedged\ liabillity}{average\ underlying\ FUM\ over\ period}$$

$$P\&L_{TOTAL}(\%) = \frac{change\ in\ hedge\ assets - change\ in\ liabillity}{average\ underlying\ FUM\ over\ period}$$

Effectiveness will be monitored to the following guidelines:

| Measure | Warning – Requires Explanation from Milliman | | | Escalation – Requires Discussion and Potential Action | | |
|---|---|---|---|---|---|---|
| | Weekly | Monthly | Yearly | Weekly | Monthly | Yearly |
| $HE$ | <90% or > 110% | <90% or > 110% | <90% or > 110% | <85% or > 115% | <85% or > 115% | <85% or > 115% |
| $P\&L_{HEDGED}$ | 0.05% | 0.10% | 0.50% | 0.10% | 0.15% | 0.75% |
| $P\&L_{TOTAL}$ | 0.05% | 0.10% | 0.50% | 0.10% | 0.15% | 0.75% |

### 7.11 Liquidity Management

All derivative instruments used for hedging require posting of initial margin and (potentially) maintenance margin by the counterparty or clearing house. This reflects a deposit of cash to margin accounts to cover mark-to-market P&L losses under the derivative contracts, which can be expected to occur when liability values fall in value.

The outsource provider will estimate and manage Lifetime Income Limited's margin requirements, such that a buffer sufficient to maintain minimum margin requirements for a 1-month period is maintained within margin accounts.

Should additional collateral be required to maintain coverage of margin requirements, the outsource provider will request that Lifetime Income Limited transfer sufficient cash into margin accounts from other cash accounts within the life company Statutory Fund.

### 7.12 Periods of Market Illiquidity & Market Gap Events

Periods of market illiquidity may occur, whereby trading in the markets used to implement the hedging strategy either becomes impossible (due to a complete lack of any liquidity in a market) or unduly expensive.

### 7.13Other Considerations

Regulatory Capital will not directly be targeted for hedging.  However by hedging the economic value of claims and P&L volatility, capital will be indirectly hedged. This is because the Reserve Bank of New Zealand capital standard applying to VA business creates some allowance to reflect the role of hedges in their prescribed calculation of capital.

There are multiple measures of risk and value that Lifetime Income Limited will be accountable for. Selecting a particular target, or targets, to hedge will have consequences to targets left unhedged. It is important to understand what these are in terms of magnitude and volatility, and whether or not they exceed management tolerance levels.

## 8. Hedge Instruments

### 8.1 Futures

A future is a derivative instrument synthetically equivalent to buying an asset at a defined price at a defined date in the future. Equity and bond futures will be used to hedge the delta risk of the portfolio. For hedging the Lifetime Income fund liabilities we will typically be selling (i.e. short) futures.

These instruments are exchanged traded and involve initial margin deposits and margin calls as profit and loss is recognised daily. Transaction costs are about 1bp of the traded notional, on top of which brokerage fees apply (in the range of a few dollars per contract, or equivalent to 0.003% of traded notional on average).

Equity and Bond futures contracts typically mature after 3 months, at which point they must be rolled into a new contract with a further (say) 3 months to maturity. This is done by closing (selling) the old position and re-entering (buying) the same position on the newer contract. For liquidity purposes this is typically carried out up to 2 days prior to expiry of the old contract (or, for bond futures, a few days prior to the time at which the contract switches to physical delivery on maturity). Contract rolls are typically subject to brokerage but no transaction costs.

### 8.2 Interest Rate swaps

Cleared interest rate swaps will be used to hedge the interest rate risk, usually receiving a fixed interest rate (fixed leg) and paying a floating interest rate (floating leg).

Standard swaps, which pay quarterly coupons up to tenors of three years and semi-annual coupons for tenors beyond, will be used.

Transaction costs in relation to interest rates swaps arise from the buy/sell spread on the fixed leg. These buy/sell spreads are in the order of 1.5 to 3 basis points, although spreads are likely to be higher (5-8bps) for less liquid 15Y swaps.

### 8.3 Forwards

FX forwards can be used to hedge the currency risk on the portfolio (including FX delta risk and realised foreign currency P&L exposure). Periodic, one-off spot changes may be made to optimise balances in each currency, in which case a synchronised trade on forwards will be made to unwind the existing position hedging the changed notional.

Forwards are used instead of futures as only USD has a future against NZD and therefore using futures would require trading pairs (USD/NZD future and AUD/USD future to get an exposure on AUD/NZD for instance), which is operationally complex and likely to involve doubling up on roll costs. Forwards can be traded in relation to the main currencies over the counter (OTC).

Forwards transaction costs are 2.5bp of traded notional, and 5bp per annum for rolls.

Note that as all (or the vast majority) of underlying fund exposures will be hedged back to NZD, no currency hedging should be required on the balance sheet of Lifetime Income Limited in respect of providing the Lifetime Income Fund.

## 9. Reporting & Management

This section sets out details of the reporting and management

The hedge effectiveness guidelines set out in section 7.10 will be reported to senior management each month, with breaching of the tolerances highlighted in those reports. Where hedge effectiveness exceeds Warning levels, Milliman will be required to provide an explanation of the causes of these warning levels being breached. Additional action may be taken to improve the hedge performance following discussion with Milliman and responsible senior management.

Where hedge effectiveness exceeds Escalation levels, a breach report will be prepared, including a discussion of the reasons for the breach, whether such a breach is likely to recur, and providing advice on whether or not, and how, hedge effectiveness levels can be brought back within thresholds.

Breach reporting is the responsibility of the Chief Operating Officer, who reports all breaches to the Chair of the Risk Committee, and tracks and reports all breach's to the board via monthly report and to the Trustee via monthly representation report.

Annual profit and loss amounts and volatility relative to the company's risk tolerance as set out in section 6 will be monitored and reported to the board at least annually.

# 1 Appendix A: Product Risks and Sensitivities Measured

## Market Risks

The following is a list of risks associated with The Lifetime Income Fund.  These risks are theoretically capable of being hedged, although in practice some practical limitations may exist to make hedging prohibitively expensive or impractical.  In all cases, each of these risks is estimated for the hedge liability using the same Monte-Carlo simulation techniques used for the base liability valuation, by stressing the underlying market parameters and revaluing the liabilities.

### (Equity) Market Risks (Delta and Gamma)

A fall in underlying equity markets will typically increase the value of the liability and cause a P&L loss if left unhedged.

**Delta Risk:** Delta is a linear measure of equity market risk and is an accurate risk measure for small changes in equity markets, typically less than 1%. For a put option P with an underlying stock S, this measure is written mathematically as (on a percentage and dollar basis respectively):

$$\Delta = \frac{\delta P}{\delta S}; \$\Delta = \frac{\delta P}{\delta S} dS$$

**Gamma Risk:** Gamma is a second order measure of equity market risk that more accurately captures this risk for relatively large drops in equity markets, typically greater than 1%. Mathematically:

$$\Gamma = \frac{\delta^2 P}{\delta S^2}; \$\Gamma = \frac{\delta^2 P}{\delta S^2} dS^2$$

Under a delta hedged portfolio, gamma losses will be expected to be offset by time value movements whenever realised volatility is consistent with volatility assumed under the hedging basis.  In other words under this assumption hedge premiums would be sufficient to recoup gamma losses.  In practice realised volatility differing from assumed volatility will result in some P&L drift over time (gains or losses).

When estimating delta and gamma exposures, global delta/gamma is assumed across each unit fund. This is then apportioned to individual hedged index exposures in line with the fund mapping weights. This method is consistent with an assumption that underlying weights to each index are rebalanced immediately after any shocks to underlying index values.

**Cross Gamma Risk:** Where a guarantee is not on a single underlying equity fund but on a basket of underlying equity funds, it is subject to risk arising as a result of funds moving in relation to one another. This is an equity market risk known as Cross Gamma. This is considered a short term risk measure as opposed to correlation risk (discussed below) which is more of a long term risk measure.

$$x\Gamma = \frac{\delta^2 P}{\delta S_i \delta S_j}; \$x\Gamma = \frac{\delta^2 P}{\delta S_i \delta S_j} dS_i dS_j$$

### Foreign Exchange Risk (FX Risk)

There are two potential sources of FX risk, exposure to our underlying funds and exposure to gains and losses on any foreign currency denominated hedge instruments. In the case of the former, a strengthening of the Australian dollar will increase liability and cause a P&L loss if left unhedged. Regarding the latter, downside risk to P&L is dependent on net exposure (gains or losses).

Mathematically:

$$FX = \frac{\delta P}{\delta(AUD\colon for.curr.)}; \$FX = \frac{\delta P}{\delta(AUD\colon for.curr.)} d(AUD\colon for.curr.)$$

### Volatility Risk (Vega Risk)

An increase in the implied volatility assumption used to value the embedded guarantees will increase liability and cause a P&L loss if left unhedged. Mathematically:

$$Vega = \frac{\delta P}{\delta \sigma_{IV}}; \$Vega = \frac{\delta P}{\delta \sigma_{IV}} d\sigma_{IV}$$

A component of the overall volatility used to value the embedded guarantee is the correlation assumption. This is an average measure of how funds move relative to one another in the long term. It is loosely related to Cross Gamma but whereas Cross Gamma is in relation to market movements, correlation is in relation to market volatility.

An increase in the correlation assumption used to value the embedded guarantees will increase liability and cause a P&L loss if left unhedged. Mathematically:

$$\%\ Sensitivity\ to\ Corr = \frac{\delta P}{\delta Corr}; \$\ Sensitivity\ to\ Corr = \frac{\delta P}{\delta Corr} dCorr$$

### Interest Rate Risk (Rho)

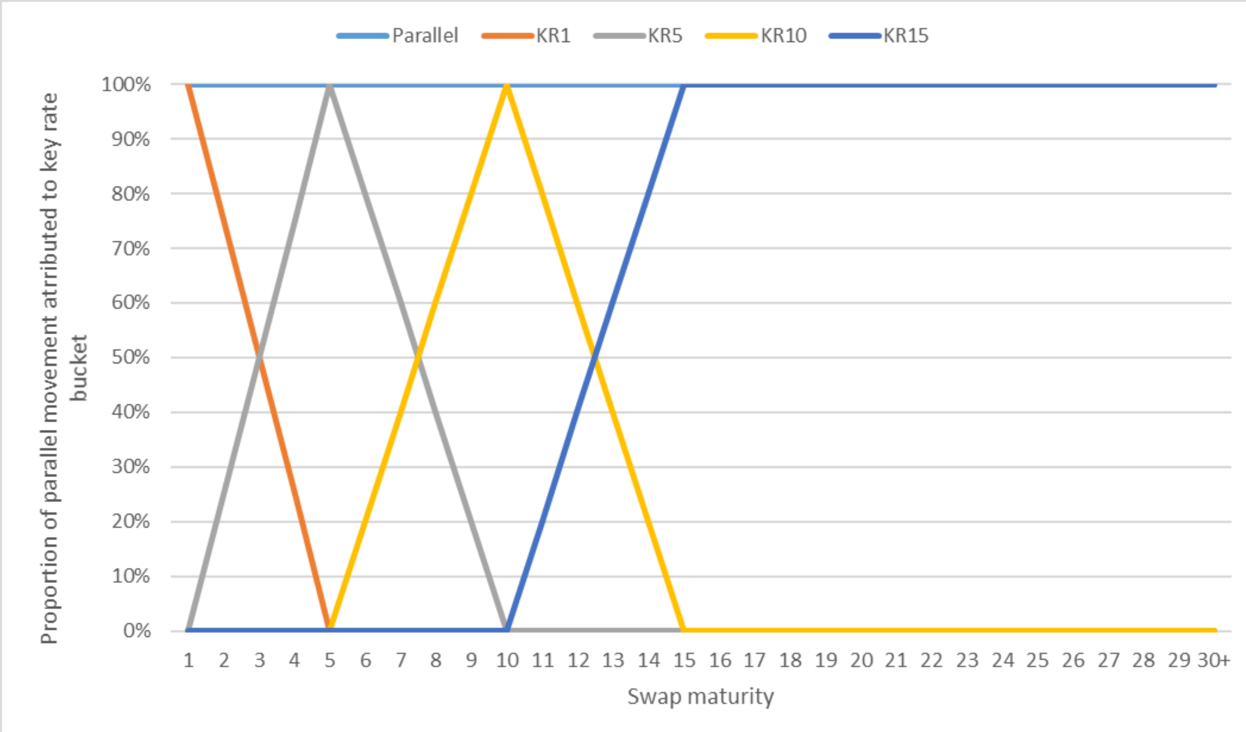
A decrease in the interest rate assumption used to value the embedded guarantees will increase liability and cause a P&L loss if left unhedged.

**Rho Risk:** Rho is a linear measure of interest rate (*r*) risk and is a very accurate risk measure for relatively small interest rate moves, typically less than 5bps. Key Rate Rho risk is a measure of interest rate risk associated with the interest rate at a particular tenor. This is estimated using a “triangular shock” methodology to split total movements across the entire yield curve into components centred around the “key rates”. Mathematically:

$$\rho = \frac{\delta P}{\delta r}; \$\ \rho = \frac{\delta P}{\delta r} dr$$

$$KeyRate\rho_i = \frac{\delta P}{\delta r_i}; \$KeyRate\rho_i = \frac{\delta P}{\delta r_i} dr_i$$

Initially, key rates will be split into 1Y, 5Y, 10Y and 15Y buckets. This reflects the more liquid swap tenors at which trading will occur. Visually, this breaks parallel interest shifts down into key rate movements as follows:




**Convexity Risk:** Convexity risk is the interest rate analogue of Gamma risk for equity markets. Mathematically:

$$Conv = \frac{\delta^2 P}{\delta r^2}; \$Conv = \frac{\delta^2 P}{\delta r^2} dr^2$$

$$KeyRateConv_i = \frac{\delta^2 P}{\delta r_i^2}; \$KeyRateConv_i = \frac{\delta^2 P}{\delta_i^2} dr_i^2$$

**Cross Convexity Risk:** Cross Convexity risk is the interest rate analogue of Cross Gamma risk for equity markets. Mathematically:

$$xConv = \frac{\delta^2 P}{\delta r_i \delta r_j}; \$xConv = \frac{\delta^2 P}{\delta r_i \delta r_j} dr_i r_j$$

### Time Decay (Theta Risk)

As time to maturity decreases, typically the value of the embedded guarantees will decrease (there are times when deep in the money options can have positive theta). Mathematically:

$$\Theta = \frac{\delta P}{\delta t}; \$\Theta = \frac{\delta P}{\delta t} dt$$

### Cross Greeks and Higher Order Terms

Many of the exposures already identified have higher order sensitivities and additional cross effects. For example, the change in the liability due to changes in equity markets and changes in interest rates is not additive and the change in the liability can either be dampened or exacerbated depending on the complex interrelationships of these risk factors.

### Credit Risk

The risk that credit spreads in the underlying fixed income funds offered to policyholders widens. This will increase liability and cause a P&L loss if left unhedged.

## Real-time Risk Exposure Estimation

To calculate a full set of sensitivities listed above, seriatim (policy-by-policy) valuations will be run at a fixed time each night, based on market prices established following the close of New Zealand markets. This process will typically involve updating unit price information to reflect capital market levels as at the valuation time.

As these valuations are complex and time-consuming to produce, they will typically only be produced once per day. The Greek positions from the overnight valuation are summarised each day in a *Trading Grid* setting out the overall liability risk positions each day.

However risk positions will vary over the course of the day as equity, interest rate and other market parameters adjust in real-time. As such, a proxy methodology will be used to estimate real-time Greek positions. This will be carried out using a Taylor Series expansion methodology, by estimating higher-order sensitivities (e.g. Gamma, Rho Convexity, Cross Effects) and using these to update the first-order sensitivities (i.e. Delta/Rho/Vega) taking into account the changes in market variables since the overnight valuation time.

In all cases, Greeks are estimated using central difference approximations of the above partial derivatives, estimated by Monte-Carlo simulation. These will be calculated based on 1% movements in equity assets/underlying fund values, 10bp shifts in interest rates, and 10bps movements in implied volatilities.

## Non-Market Risk

The following is a list of risks associated with The Lifetime Income fund that are deemed not hedge-able using capital market instruments.

### Policyholder Behaviour Risk

The risk is that policyholders lapse their policies at a rate different than assumed in pricing and hedging. In the short term this will create P&L volatility. In the long run it could jeopardize Lifetime Income Limited's ability to meet its policyholder obligations.

Another component of policyholder behaviour that can influence P&L volatility is switching of investment dollars between guaranteed funds. Some funds are more volatile than others and switching from a low volatility fund to a high volatility fund increases the cost of the guarantee.

This risk can be managed by holding capital, by managing the richness of the product and/or through reinsurance.

### Basis Risk

The risk that the performance of the underlying funds differs from that of the hedge assets. In the short term this will create P&L volatility. In the long run it could jeopardize Lifetime Income Limited's ability to meet its policyholder obligations.

This risk can be managed by holding capital, by managing the richness of the product and/or by careful selection of the underlying fund offering.

### Longevity Risk

The risk that policyholders will live longer than that assumed in pricing and hedging.

This risk can be managed by holding capital, by managing the product characteristics (cap age of payout), through reinsurance and/or through a natural internal hedge such as life insurance where the risk is to policyholders not living long enough.

### Arbitrage Risk

The risk that policyholders or advisors will find a loophole in the product, by which to execute options available to them and hence arbitrage the product structure.

This risk can be managed best by managing the product characteristics to eliminate or discourage arbitrage activity. A typical example of this is the risk that policyholder laps and re-enter to re-establish a guarantee base. This can be managed by including a ratchet feature in the product, which can then be adequately charged for and incorporated in the hedging programme.

### Liquidity Risk

The risk that Lifetime Income Limited is unable to find a willing counterparty to take the opposite side of a trade.

This risk can be managed best by adhering to predefined counterparty exposure limits. The hedging instruments authorised for use are the most liquid available contracts (equity index and bond futures, and vanilla interest rate swaps) which are either exchange-traded and expected

## Legislative and Regulatory Risk

The risk that legislative or regulatory changes require the product design (including capital adequacy requirements) to be adjusted such that the product is unable to meet to Lifetime Income Limited's commercial requirements.

This risk can be managed best by minimizing the number of product characteristics that can be influenced by legislative and regulatory changes.

## Counterparty Risk

For exchange traded derivatives, a mark-to market condition and margin requirements in trading futures will greatly limit the counterparty risks.

When dealing with OTC counterparties, Lifetime Income will manage the exposures to a particular counterparty to minimise concentration risks and exposures. Margin requirements established through ISDA and CSA agreements will be another buffer against overall counterparty exposure.

# 2 Appendix B: Capital Market and Other Data Sources

## Equity and Bond Market Levels

Equity and bond cash index and futures mid prices are sourced from Bloomberg in real-time for trade monitoring.

Prices used to determine daily liability valuation levels will be determined at a valuation time at or shortly after the close of markets in Tokyo each day (chosen as this will follow closing of New Zealand, Australian and Japanese markets).

In general the first ("front") or subsequent ("back") maturing futures contract prices in the relevant markets will be used to mark liabilities each day. Prices for the back contract will typically be used 2 days prior to the maturity (or first date at which delivery moves to exchange for physical) of the front contract, reflecting typical practice when rolling futures contracts. The following index levels will be used:

| Index | Description | Bloomberg Ticker(s) |
|---|---|---|
| ASX SPI 200 | Australian ASX200 Equity Futures Price | XP1 Index, XP2 Index |
| S&P 500 | US S&P 500 Equity E-mini Futures Price | ES1 Index, ES2 Index |
| Eurostoxx | EUR Eurostoxx50 Futures price | VG1 Index, VG2 Index |
| Nikkei 225 | Japanese Nikkei 225 Futures price | NK1 Index, NK2 Index |
| FTSE 100 | British FTSE 100 Futures price | Z 1 Index, Z 2 Index |
| Aus 3Yr Bond | Australian Govt 3Y Bond Future price | YM1 Comdty, YM2 Comdty |
| Aus 10Y Bond | Australian Govt 10Y Bond Future price | XM1 Comdty, XM2 Comdty |
| US Treasury 2Yr Bond | US 2Y Treasury Note Future price | TU1 Comdty, TU2 Comdty |
| US Treasury 5Yr Bond | US 5Y Treasury Bond Future price | FV1 Comdty, FV2 Comdty |

## FX Rates

Mid spot FX rates between relevant currency pairs will be sourced from Bloomberg in real-time for trade monitoring.

Prices used to determine daily liability valuation levels will be determined at a valuation time at or shortly after the close of markets in Tokyo each day (chosen as this will follow closing of New Zealand, Australian and Japanese markets).

FX rates will be needed for all unhedged currency pairs. All currency risk is intended to be hedged within the fund, leaving no residual unhedged currency exposures. Note also that P&L under foreign currency futures should be swept back to a single currency (NZD) margin account each day in order to remove any exposure to FX movements due to overseas futures profit and losses.  This will be carried out directly by the futures broker used.

## Risk Free (Swap) Interest Rates

NZ LIBOR swap curves for liability valuations will be built from the following set of instruments, with prices sourced from mid-swap rates in real-time from Bloomberg.

| **Rate** | **Bloomberg Ticker** |
|---|---|
| NZ Overnight Cash Rate | NZOCRS Index |
| New Zealand 1M Bank Bill Rate | NDBB1M Curncy |
| New Zealand 2M Bank Bill Rate | NDBB2M Curncy |
| New Zealand 3M Bank Bill Rate | NDBB4M Curncy |
| New Zealand 4M Bank Bill Rate | NDBB5M Curncy |
| New Zealand 5M Bank Bill Rate | NDBB6M Curncy |
| New Zealand 1Y mid LIBOR Swap Rate | NDSWAP1 Curncy |
| New Zealand 2Y mid LIBOR Swap Rate | NDSWAP2 Curncy |
| New Zealand 3Y mid LIBOR Swap Rate | NDSWAP3 Curncy |
| New Zealand 4Y mid LIBOR Swap Rate | NDSWAP4 Curncy |
| New Zealand 5Y mid LIBOR Swap Rate | NDSWAP5 Curncy |
| New Zealand 7Y mid LIBOR Swap Rate | NDSWAP7 Curncy |
| New Zealand 10Y mid LIBOR Swap Rate | NDSWAP10 Curncy |
| New Zealand 12Y mid LIBOR Swap Rate | NDSWAP12 Curncy |
| New Zealand 15Y mid LIBOR Swap Rate | NDSWAP15 Curncy |

Prices used to determine daily liability valuation levels will be determined at a valuation time at or shortly after the close of markets in Tokyo each day (chosen as this will follow closing of New Zealand, Australian and Japanese markets).

Curves will be extrapolated beyond any available data using a constant forward rate methodology.

### Implied Volatilities

Implied volatilities assumed for underlying funds will be based on the target volatility levels determined for the MMRS strategy. In practice the MMRS strategy acts to target a given level of volatility in the underlying fund, which theoretically removes the dependence of the underlying fund volatility on constituent index volatilities. Due to the volatility mechanism preventing gearing of equity exposure, during periods of low volatility the fund would be expected to produce a realised volatility below the volatility target. As such the target volatility mechanism effectively acts as a "capped" volatility mechanism, and the use of the target volatility assumption as a modelling assumption is broadly conservative.

This assumption will need to be revisited if non-MMRS investment funds are modelled in future.

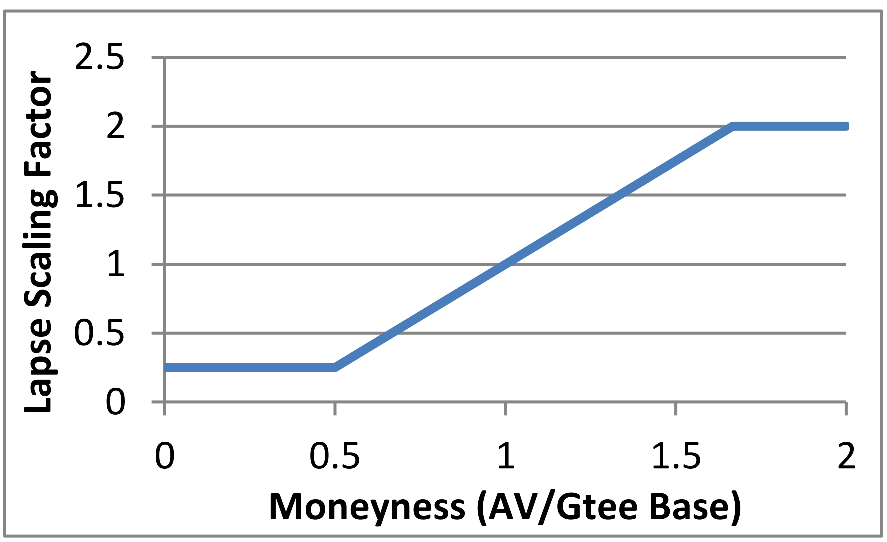
### Correlations

As there will be a single modelled MMRS strategy applying to a single unit fund only, no correlation assumptions are required between underlying indices. This assumption will need to be revisited if further investment funds are modelled in future.

### Lapse / Dynamic Lapse Assumptions

Base lapse rates of 6% p.a. are assumed at all policy durations. This parameter has been chosen at inception based on expected experience for at-the-money guarantees, based on discontinuance rates seen for other long-term investment products and Milliman experience of lapse rates under similar VA products written in Australia. As this is a new block of business, no actual experience will exist to ascertain underlying lapse rates in New Zealand for such business for some time.

In addition, a dynamic lapse multiplier will be assumed, scaling all baseline lapse rates depending on the simulated moneyness of the guarantee, defined to be equal to Account Value / Guarantee Base. The following scaling function is used:




The dynamic lapse function has been chosen based on feedback received from Milliman regarding typical dynamic lapse functions assumed by providers of similar VA products overseas. More complex assumptions are also made by some VA providers, for instance linking a calculation of moneyness to the value of annuity streams and hence income rates, rather than just the Guarantee Base. Evidence for the validity of such assumptions is limited and inconclusive, and as such a simpler approach has been adopted, while still retaining dynamism relative to the value of the VA guarantee to customers.

All lapse assumptions and dynamic lapse assumptions will be reviewed annually, subject to having sufficient experience data to draw conclusions around underlying lapse experience.

### Mortality Assumptions

Best Estimate mortality rates equal to a scaling of the New Zealand Period Life Tables 2010-12, non-Maori males and females are assumed. The base tables were extrapolated from Age 105 to 115 assuming probability of death linearly increases to 90% by age x=115. All projections are assumed to cease beyond age 115.

Additionally, a mortality improvement factor has been assumed for all future projection years, equivalent to multiplying death rates by a factor of (1 – Improvement Factor) for each year elapsed in the projection.

Mortality rates and improvement factors have been set at the upper end of potential ranges suggested by Milliman, based on an analysis of US and UK annuitant and variable annuity policyholder mortality experience. This included a small allowance for the use of non-Maori population tables rather than population mortality, which the Milliman study used as a comparison in other countries.

The use of rates at the upper end of the ranges suggested by Milliman has been chosen given available evidence from New Zealand pension fund mortality bases, which have typically experienced significantly heavier mortality than overseas annuity / longevity providers relative to population mortality; and the target market for the NZIG VA product, which is targeting KiwiSaver accounts with lower account balances / socio-economic groupings than overseas (especially US) VA providers, where significant tax deferral benefits have tended to make VA products particularly attractive to wealthier, higher socio-economic groupings.

As with lapse experience, mortality assumptions will be assessed against experience once credible data is available to make reasonable inferences about actual experience.

The baseline death rates (i.e. qx before any improvement factor) are set out below.

**Base Mortality Rates By Age and Gender (as at 2012)**

| Age | Male | Female |
|---|---|---|
| 65 | 0.007689 | 0.004988 |
| 66 | 0.008523 | 0.005588 |
| 67 | 0.009458 | 0.006248 |
| 68 | 0.010517 | 0.006969 |
| 69 | 0.011719 | 0.007744 |
| 70 | 0.013097 | 0.008606 |
| 71 | 0.014669 | 0.009579 |
| 72 | 0.016469 | 0.010695 |
| 73 | 0.018509 | 0.011973 |
| 74 | 0.020834 | 0.013447 |
| 75 | 0.023455 | 0.015152 |
| 76 | 0.02641 | 0.017148 |
| 77 | 0.02972 | 0.019472 |
| 78 | 0.03348 | 0.02217 |
| 79 | 0.037778 | 0.025304 |
| 80 | 0.042714 | 0.02899 |
| 81 | 0.048364 | 0.033358 |
| 82 | 0.05483 | 0.038536 |
| 83 | 0.062192 | 0.044654 |
| 84 | 0.070541 | 0.05182 |
| 85 | 0.079951 | 0.060018 |
| 86 | 0.090865 | 0.069641 |
| 87 | 0.102761 | 0.080066 |
| 88 | 0.115519 | 0.091559 |
| 89 | 0.12899 | 0.104139 |
| 90 | 0.143023 | 0.11805 |

| Age | Male | Female |
|---|---|---|
| 91 | 0.157626 | 0.133569 |
| 92 | 0.174065 | 0.150951 |
| 93 | 0.192584 | 0.170439 |
| 94 | 0.213305 | 0.192157 |
| 95 | 0.235667 | 0.215542 |
| 96 | 0.260144 | 0.241037 |
| 97 | 0.286202 | 0.268137 |
| 98 | 0.313706 | 0.296714 |
| 99 | 0.34248 | 0.326593 |
| 100 | 0.37232 | 0.35758 |
| 101 | 0.3982 | 0.38479 |
| 102 | 0.42398 | 0.4119 |
| 103 | 0.44935 | 0.43859 |
| 104 | 0.47397 | 0.46455 |
| 105 | 0.4975 | 0.48941 |
| 106 | 0.54775 | 0.540469 |
| 107 | 0.598 | 0.591528 |
| 108 | 0.64825 | 0.642587 |
| 109 | 0.6985 | 0.693646 |
| 110 | 0.74875 | 0.744705 |
| 111 | 0.799 | 0.795764 |
| 112 | 0.84925 | 0.846823 |
| 113 | 0.8995 | 0.897882 |
| 114 | 0.94975 | 0.948941 |
| 115 | 1 | 1 |

Improvement factors at each age are as follows:

**Improvement Factors by Age and Gender (Per year beyond 2012)**

| Age | Male | Female | Age | Male | Female |
|---|---|---|---|---|---|
| 65 | 3.00% | 3.00% | 91 | 0.70% | 0.70% |
| 66 | 2.90% | 2.90% | 92 | 0.65% | 0.65% |
| 67 | 2.80% | 2.80% | 93 | 0.60% | 0.60% |
| 68 | 2.70% | 2.70% | 94 | 0.55% | 0.55% |
| 69 | 2.60% | 2.60% | 95 | 0.50% | 0.50% |
| 70 | 2.50% | 2.50% | 96 | 0.50% | 0.50% |
| 71 | 2.40% | 2.40% | 97 | 0.50% | 0.50% |
| 72 | 2.30% | 2.30% | 98 | 0.50% | 0.50% |
| 73 | 2.20% | 2.20% | 99 | 0.50% | 0.50% |
| 74 | 2.10% | 2.10% | 100 | 0.50% | 0.50% |
| 75 | 2.00% | 2.00% | 101 | 0.50% | 0.50% |
| 76 | 1.90% | 1.90% | 102 | 0.50% | 0.50% |
| 77 | 1.80% | 1.80% | 103 | 0.50% | 0.50% |
| 78 | 1.70% | 1.70% | 104 | 0.50% | 0.50% |
| 79 | 1.60% | 1.60% | 105 | 0.50% | 0.50% |
| 80 | 1.50% | 1.50% | 106 | 0.50% | 0.50% |
| 81 | 1.40% | 1.40% | 107 | 0.50% | 0.50% |
| 82 | 1.30% | 1.30% | 108 | 0.50% | 0.50% |
| 83 | 1.20% | 1.20% | 109 | 0.50% | 0.50% |
| 84 | 1.10% | 1.10% | 110 | 0.50% | 0.50% |
| 85 | 1.00% | 1.00% | 111 | 0.50% | 0.50% |
| 86 | 0.95% | 0.95% | 112 | 0.50% | 0.50% |
| 87 | 0.90% | 0.90% | 113 | 0.50% | 0.50% |
| 88 | 0.85% | 0.85% | 114 | 0.50% | 0.50% |
| 89 | 0.80% | 0.80% | 115 | 0.50% | 0.50% |
| 90 | 0.75% | 0.75% | | | |

## Unit Prices

Unit prices for the underlying funds will be provided daily to the outsource provider and used to update account balances in the daily valuation process.

Unit prices received will be rolled to the daily valuation time based on market movements from the assumed unit pricing time to the liability valuation time, based on the mapping of underlying unit funds to the various indices used for modelling and hedging. For the purpose of this roll-forward process, underlying unit prices as at day T will be assumed to be based on capital market price levels as at T-1 (i.e. at close of business one working day prior to the assumed daily valuation time).

Fund mappings to map exposures in the underlying unit funds to the various indices used for modelling and hedging will be determined based on a regression of historical unit fund data, based on 10 years of monthly return data. Initial mappings use a historical unit price series recreated from underlying index fund returns. The mappings will be refreshed monthly.

## Inforce Policy Data

Updated data on the contract details for each inforce policy will be provided weekly to the outsource provider and used to update seriatim contract details used in the daily valuation process. In addition, the extract will provide details of any terminated or lapsed policies, including cause and date of termination, to be used in attributing performance over the period.

Inforce data will be rolled forward from the time of the inforce extract to the valuation time based on expected (best estimate) lapses, withdrawals, fees, contributions and any other policy feature (e.g. expected ratchets).