# SESSION ONE

## Utilizing the Asset/Liability Management (ALM) Framework: Practical Approach and Theory


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# CA Government Code 53600.5

*People don't drink the sand because they are thirsty. They drink the sand because they don't know the difference*

**– Michael Douglas, The American President**

**When investing, reinvesting, purchasing, acquiring, exchanging, selling, or managing public funds, the primary objective of a trustee shall be to safeguard the principal of the funds under its control.**

**The secondary objective shall be to meet the liquidity needs of the depositor.**

**The third objective shall be to achieve a return on the funds under its control.**

# Suitability – Building a Plan with Purposeful Evaluation

*In a room full of public fund managers, when asked the question, "In importance, how do you rank the objectives of safety, liquidity and income in the performance of your job?" most of the respondents would rank safety and liquidity combined at 80 percent to 90 percent. In light of the above example, why then would the typical performance evaluation be based on a portfolio's total return –or even a peer group comparison– given that, of the three policy objectives, return receives the lowest priority?*

1) Performance Evaluation involves both qualitative and quantitative components to form the basis for reporting how well a manager is doing in meeting investment objectives.
2) Suitability is the one standard that can "specify performance measures as are appropriate for the nature and size of the public funds within the custody or the unit of local government"
3) The five "w's" of suitability sets a baseline for questions to be answered while developing a strategy.



***Beyond Total Return, Ben Finkelstein & Felicia Landerman**
**https://cdn.ymaws.com/www.cmta.org/resource/resmgr/imported/newsletters/06_winter_newsletter.pdf**

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# Five Points of Suitability

- Questions you should ask yourself to evaluate performance.

1

**Liquidity**

Is there adequate liquidity to meet operating expenses without the need to sell bonds before maturity?

2

**Duration**

Is the portfolio exposed to an appropriate level of interest rate risk (duration) in the portfolio?

3

**Allocation**

Does the portfolio have a diversified asset allocation along type, structure and maturity timeframes?

4

**Legal**

Does the portfolio meet compliance and policy/statute constraints?

5

**Earnings**

Is the portfolio earning a “market rate of return” through budgetary and economic cycles?

# Strategy Development Steps for Public Investors (cont. 2 of 2)

Cash flow forecast/liquidity analysis is key. asset-liability (ALM) approach mitigates large liquidity needs

Set a strategic allocation among sectors to reflect cashflow profile and risk tolerances for a stable, legal and diversified portfolio

Review at least annually and make necessary changes


Setting a portfolio duration target tackles the core risk you face, interest-rate risk

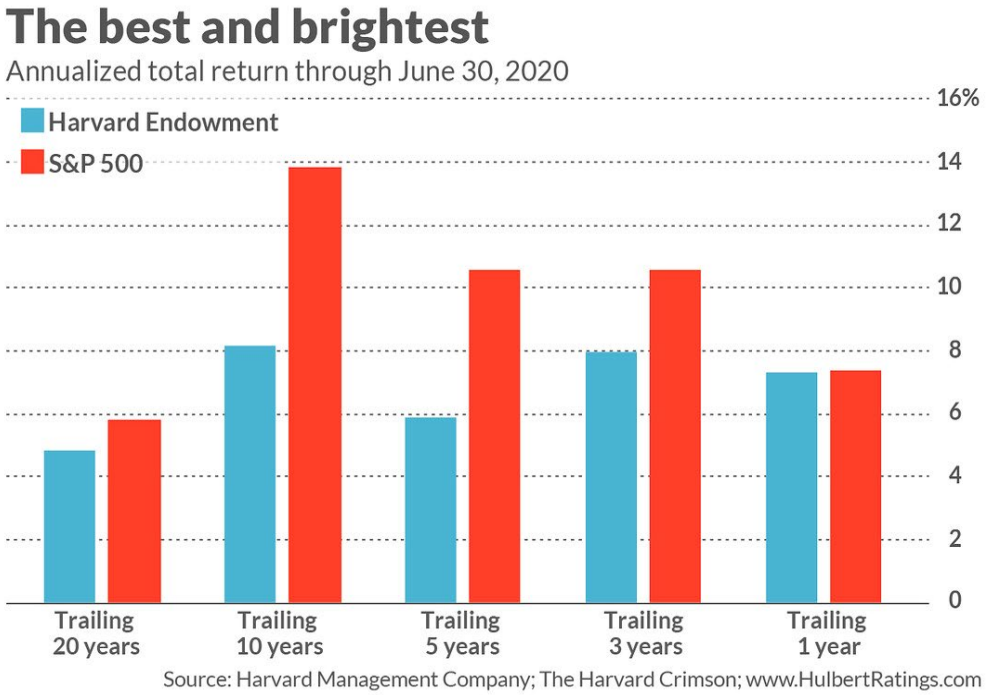
Utilize both excess liquidity investing and market opportunities to maintain a "market rate of return"

# “Don’t Beat the Market, Be the Market”

**Harvard Endowment:** Had 230 employees until 2017. Top 6 executives took home over $40MM in compensation.

*Lost to S&P index by over 100bp over last 20 years and almost 500Bp over past 10 years.*

*Lost to the S&P annually for the last 12 years straight.*




**5 Takeaway’s:**

- Performance Persistance is Rare:
  - Harvard’s few moments of glory have been dwarfed by its failures.
- Overconfidence is an obstacle:
  - Those who have seen success get complacent and assume they are smarter than they really are.
- Reversion to the mean is powerful:
  - Sector outperformance comes and goes and is hard to predict.
- Many years of skill required to beat luck:
  - Statistically speaking, you would need many decades to understand if manager is superior.
- Indexes are hard to beat:
  - Harvard would have even lost out to a blended portfolio of 60% stocks, 40% US Bonds over last 20 years.



Source: Marketwatch - “What the Harvard Endowment’s Below Average Grade Can Teach You About Index Funds and Your Investments”, October 10, 2020

# “Don’t Beat the Market, Be the Market”

## What does Nevada’s $35 billion fund manager do all day? Nothing.


Image: The Wall Street Journal

Steve Edmundson has no co-workers, rarely takes meetings and often eats leftovers at his desk. With that dynamic workday, the investment chief for the Nevada Public Employees’ Retirement System is out-earning pension funds that have hundreds on staff.

His daily trading strategy: Do as little as possible, usually nothing.

The Nevada system’s stocks and bonds are all in low-cost funds that mimic indexes. Edmundson may make one change to the portfolio a year.

**Nevada PERS**
December 31, 2023
Performance Gross of Fees

| Asset Class | Sub-Asset Class | | Market Value (Millions) | Target Allocation | Actual Allocation | FYTD Return | One Year | 3 Years | 5 Years | 10 Years | Since Inception |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U.S. Stocks | S&P 500 Index | $ | 24,767 | 41.0% | 41.0% | 8.1% | 26.3% | 10.1% | 15.7% | 12.0% | 10.7% |
| | **Total U.S. Stocks** | **$** | **24,767** | **41.0%** | **41.0%** | **8.1%** | **26.3%** | **10.1%** | **15.7%** | **12.0%** | **11.4%** |
| | **Market Return** | | | | | **8.0%** | **26.3%** | **10.0%** | **15.7%** | **12.0%** | **11.6%** |
| International Stocks | MSCI World x US Index | $ | 9,476 | 16.0% | 15.7% | 6.0% | 18.1% | 4.8% | 8.8% | 4.7% | 5.9% |
| | **Total Intl. Stocks** | **$** | **9,477** | **16.0%** | **15.7%** | **6.0%** | **18.1%** | **4.8%** | **8.8%** | **4.7%** | **5.6%** |
| | **Market Return** | | | | | **6.0%** | **17.9%** | **4.4%** | **8.5%** | **4.4%** | **5.1%** |
| U.S. Bonds | US Bond Index | $ | 16,520 | 28.0% | 27.4% | 2.3% | 3.9% | -1.0% | 2.4% | 2.3% | 4.2% |
| | **Total U.S. Bonds** | **$** | **16,520** | **28.0%** | **27.4%** | **2.3%** | **3.9%** | **-1.0%** | **2.4%** | **2.3%** | **6.5%** |
| | **Market Return** | | | | | **2.4%** | **4.1%** | **-1.1%** | **2.3%** | **2.3%** | **6.5%** |
| Private Markets | Private Real Estate | $ | 2,869 | 6.0% | 4.8% | -4.8% | -10.7% | 3.8% | 4.6% | 7.4% | 7.3% |
| | Private Equity | $ | 4,787 | 6.0% | 7.9% | 2.1% | 5.4% | 16.9% | 18.0% | 17.0% | 13.5% |
| | **Total Private Markets** | **$** | **7,656** | **12.0%** | **12.7%** | **-0.6%** | **-1.2%** | **11.7%** | **12.4%** | **12.7%** | **10.6%** |
| | **Market Return** | | | | | **4.0%** | **13.0%** | **9.6%** | **12.5%** | **11.4%** | **8.6%** |
| Cash | | $ | 1,959 | 3.0% | 3.2% | | | | | | |
| **Total PERS' Fund** | | **$** | **60,379** | **100.0%** | **100.0%** | **4.8%** | **14.4%** | **6.3%** | **10.8%** | **8.2%** | **9.4%** |
| **Market Return** | | | | | | **5.6%** | **16.7%** | **6.0%** | **10.5%** | **8.0%** | **9.1%** |

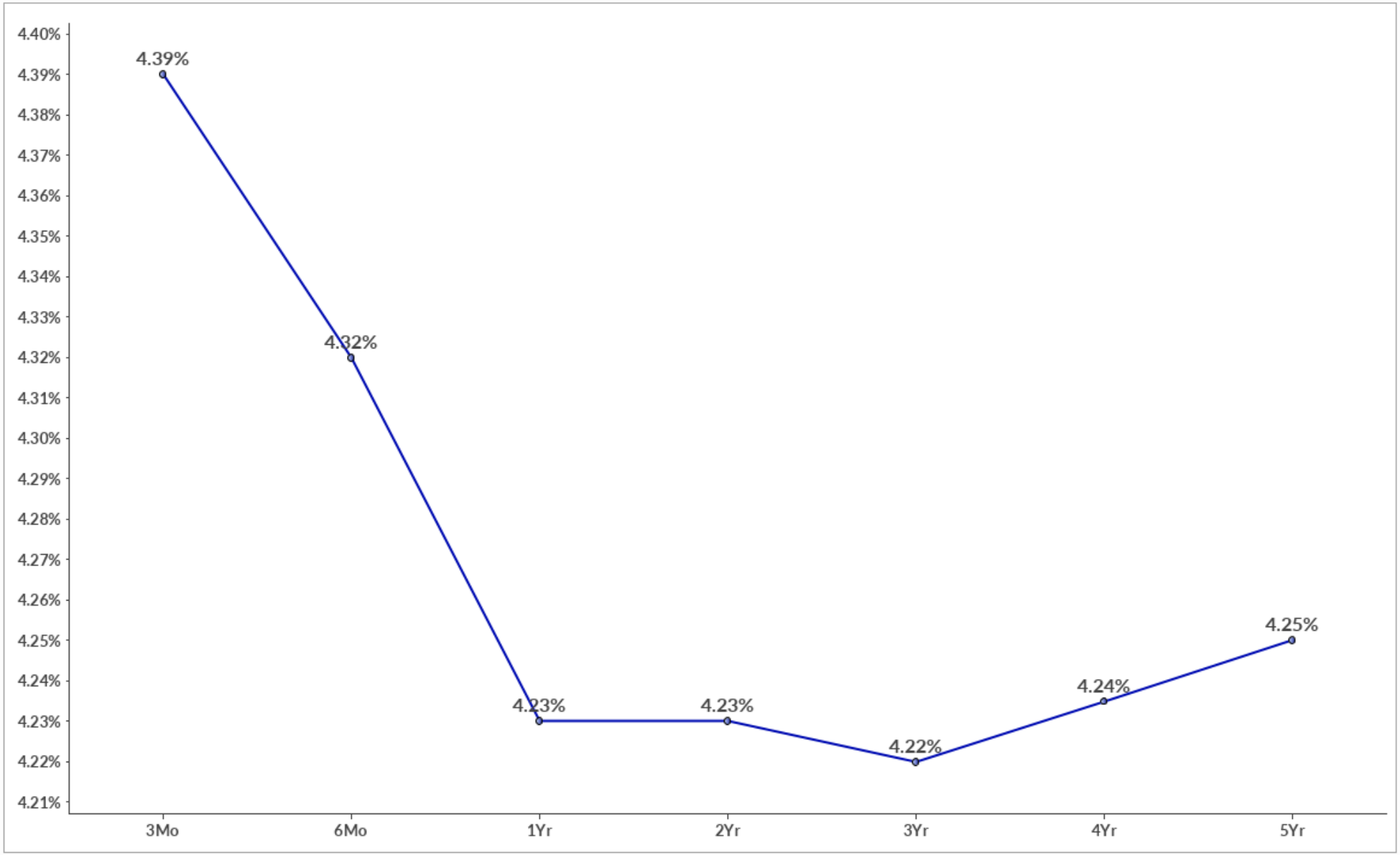
Source: Nvpers

Edmundson’s do-nothing strategy slightly outperformed the market per year over the past three, five, and ten years.

And this is the most awesome fact: over the past five and ten years, he beat the pants off 90% of US pension funds, with over $1 billion in assets, based on data from pension fund tracker Callan Associates.

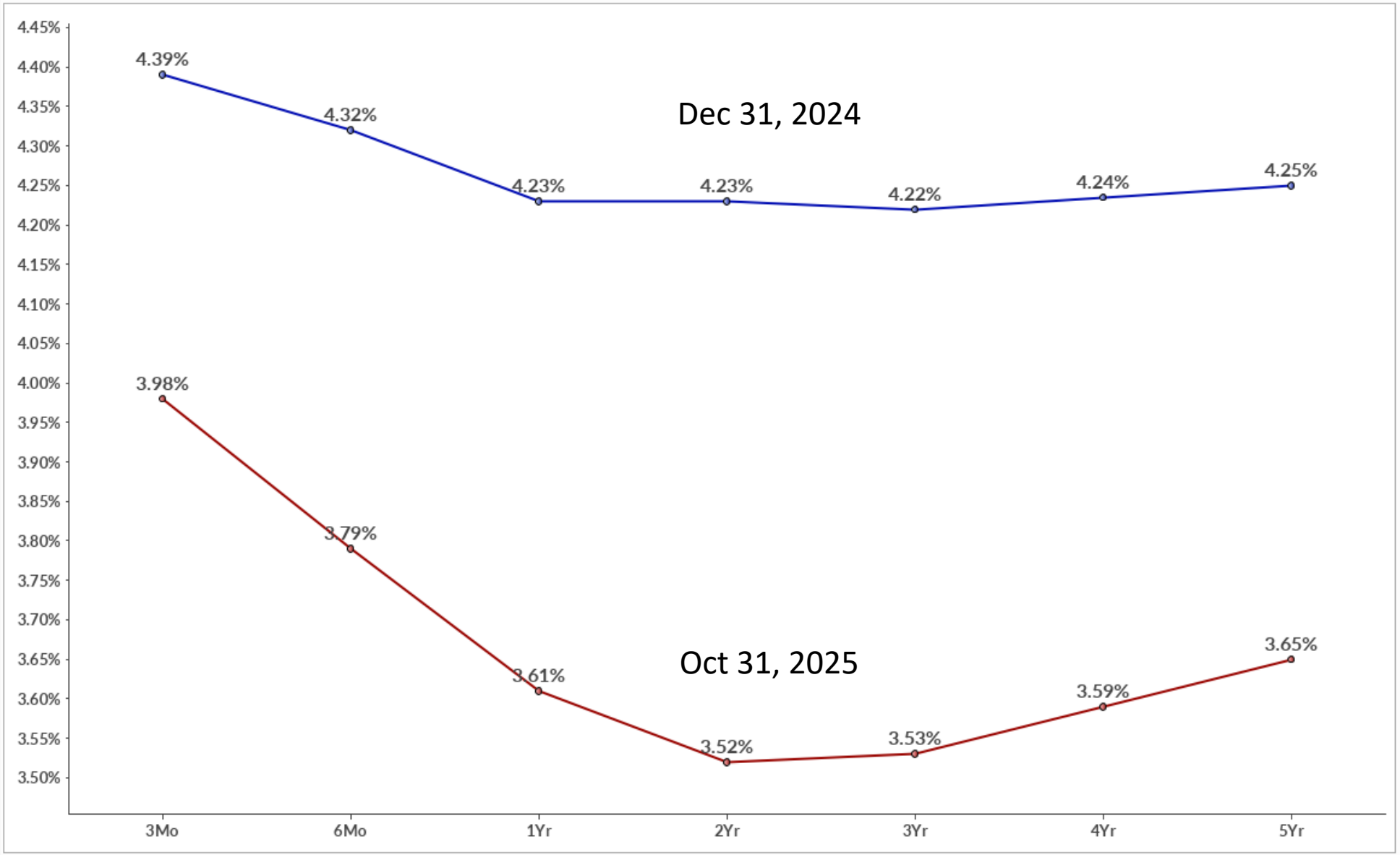
# Treasury Yield Curve Dec 31, 2024

What would you choose?



# Treasury Yield Curves

What would you choose?



# Interest Rate Speculation

*The Truth About Flat Yield Curves*

**Rates: Aug 1983 to Sep 2025**
**$100MM Portfolio**

**Speculate Holding 3Mo Tbill in Lieu of Longer Bond**
**Dates Reviewed: 08/31/1983 To 09/30/2025**

Buy 3MoTBill

| | | | |
|---|---|---|---|
| Start Date | 08/31/1983 | Portfolio Size | $100,000,000.00 |
| End Date | 09/30/2025 | | |

| 3Mo TBill vs. | Observations in Months | Observations in Years | Number of Times Shorter Bond Wins | % of Wins | Number of Times Shorter Bond Loses | % of Losses | Average Annual Basis Point Win | Average Annual Basis Point Loss | Average Performance of Staying in Short Bond Over Period in Basis Points Annually | Average Performance of Staying in Short Bond Over Holding Period in Dollars | Average Spread of Shorter Bond to Buy Bond at Decision Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Buy 2YrTsy | 506 | 42.17 | 118 | 23.32% | 388 | 76.68% | 66.83 | (126.27) | (81.24) | ($1,624,733.20) | (66.89) |
| Buy 5YrTsy | 506 | 42.17 | 57 | 11.26% | 449 | 88.74% | 111.79 | (200.98) | (165.75) | ($8,287,519.76) | (116.07) |

**Speculate Holding 3Mo Tbill in Lieu of Longer Bond**
**Dates Reviewed: 08/31/1983 To 09/30/2025**

Buy 3MoTBill

| | | | |
|---|---|---|---|
| Start Date | 08/31/1983 | Portfolio Size | $100,000,000.00 |
| End Date | 09/30/2025 | 3Mo Spread at Decision | 0 |

| 3Mo TBill vs. | Observations in Months | Observations in Years | Number of Times Shorter Bond Wins | % of Wins | Number of Times Shorter Bond Loses | % of Losses | Average Annual Basis Point Win | Average Annual Basis Point Loss | Average Performance of Staying in Short Bond Over Period in Basis Points Annually | Average Performance of Staying in Short Bond Over Holding Period in Dollars | Average Spread of Shorter Bond to Buy Bond at Decision Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Buy 2YrTsy | 52 | 4.33 | 11 | 21.15% | 41 | 78.85% | 65.15 | (152.39) | (106.38) | ($2,127,500.00) | 29.33 |
| Buy 5YrTsy | 59 | 4.92 | 20 | 33.90% | 39 | 66.10% | 132.43 | (277.24) | (138.37) | ($6,918,644.07) | 52.25 |

# Speculation Miscalculation

In 2014, the Bernalillo County Treasurer's office, under then-Treasurer Manny Ortiz and former Treasurer/Investment Officer Patrick Padilla, faced a major scandal for losing **nearly $20 million in taxpayer money** due to risky investments. A subsequent audit found an additional $900 million in questionable investments with incomplete or no records.

**Investment Losses**: The county was forced to sell long-term investments at an approximately $17 million loss in 2014 to meet its immediate cash flow needs (liquidity).

**Audits and Investigations**: State Auditor Hector Balderas initiated a special audit due to concerns about bond investments and payments to brokers, which revealed high-risk strategies and a lack of proper documentation. The New Mexico Securities Division also got involved, alleging that two brokerage firms, Oppenheimer & Co., Inc. and BOSC Inc., and their brokers did not exercise due diligence with public funds.

# Can’t Beat the Market, So Now What?

- Public entities generally exhibit predictive cash flows in both magnitude and timing.
- This allows public funds to create duration optimized (interest rate risk centric) allocations.
- Allocations should reflect the legal guidance of the investment policy and the desired weights of allowable sectors based on risk/reward and ALM preferences.
- Portfolio construction: Safety (IR Risk, credit), liquidity, diversified, legal, market rate of return.



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# Duration, Duration, Duration!

***Being invested is more important than the allocation decision!***

Moving from Cash to two duration in Treasuries:

***Pickup approx. 30Bp Avg Yield***

Moving from two duration in Treasuries to two duration in Agency Bullets:

***Pickup approx. 7Bp Avg Yield***

Moving from two duration in Agency Bullets to maturity matched Agency Callables:

***Pickup approx. 12Bp in Avg Yield***

Custom Model Stats
Analysis Dates: Dec 31, 2014 - Dec 31, 2024

| MODEL WEIGHTING | | Cash Proxy | Treasury | Agency Bullet | Agency Callable |
|---|---|---|---|---|---|
| L0US | OVERNIGHT CASH | 100.00% | | | |
| G0QA | Treasury 0-1Yr | | 34.00% | | |
| H541 | Agy Composite 0-1Yr | | | 32.00% | 32.00% |
| G1O2 | Treasury 1-3Yr | | 36.00% | | |
| G1PB | Agy Bullet 1-3Yr | | | 37.00% | |
| G1PC | Agy Callable 1-3Yr | | | | 37.00% |
| G2O2 | Treasury 3-5Yr | | 30.00% | | |
| G2PB | Agy Bullet 3-5Yr | | | 31.00% | |
| G2PC | Agy Callable 3-5Yr | | | | 31.00% |

| MODEL STATS | Annualized Total Return | Annualized Price Return | Annualized Income Return | Annualized Std Dev Total Return | Avg Yield to Worst | Std Dev Yld | Avg Eff Dur |
|---|---|---|---|---|---|---|---|
| Cash Proxy | 1.760% | 0.000% | 1.760% | 0.553% | 1.725% | 1.886% | 0.003 |
| Treasury | 1.506% | (0.369%) | 1.819% | 1.641% | 2.018% | 1.595% | 1.982 |
| Agency Bullet | 1.631% | (0.558%) | 2.092% | 1.575% | 2.083% | 1.592% | 1.981 |
| Agency Callable | 1.339% | (0.295%) | 1.594% | 1.407% | 2.202% | 1.658% | 1.427 |

# Anatomy of Duration

## ***MACAULAY DURATION***

Economist Frederick Macaulay proposed a simple formula (1938) to measure the ***time*** required to recover the initial cost of the bond (present value).

Weights are given to the present value of each cash flow (coupon payment) at the applicable interest rate for the life of the bond (YTM) then divided by the market price.

**[PV(CF1)*p1+PV(CF2)*p2…PV(CFn)*Pn} / Market Price of Bond**

Thus, Macaulay Duration states the time period within which the present value of the bond will be realized.

*e.g. Current 5 Year Treasury has a duration of 4.805.*

The duration of a bond will always be less than its maturity period.

## ***MODIFIED DURATION***

Macaulay Duration was a good tool when it was conceived to compare bonds on a relative basis as to when an investor could expect to receive the cost of their investment back. The shorter the Macaulay Duration, the “less risk” was perceived by the investor since the PV of the bond would be received sooner.

However, Macaulay Duration’s shortfall was its inability to measure risk associated with holding the bond during its existence. Macaulay Duration lacks the ability to measure changes in value as interest rates fluctuate.

To correct for this, the simple division of the Macaulay Duration by (1+YTM) will convert the Mac Duration from a ***time-based*** receipt of cash flows to the ***approximate change*** in price given a 100bp move in rates.

## ***EFFECTIVE DURATION***

Same as Modified Duration but accounts for prepayment risk in callables and amortizing product. Requires additional sophistication (OAS Model) to obtain.

Effective Duration ***SHOULD ALWAYS*** be used when a portfolio invests in callable or MBS type securities.

# Why Do We Care?

- We know modified duration measures the approximate change in value for a 100bp change in interest rates.
- Because Modified Duration has Macaulay Duration as an input, we know that TVM (time value of money) principles apply.
- Thus, we can show that in normal markets over long periods of time, the more duration we take on (risk), the more return we can achieve.
- Since earning a Market Rate of Return is a core objective (albeit a lower priority one), maximizing duration given safety and liquidity are taken care of is important. It will be the **core** determinant of how much income/return can be derived from the portfolio.
- Sector and structure profile is of secondary importance to duration.



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# Approaches for Determining Portfolio Duration

## Market Based – Index Sets

- Manager uses a set of indices and measures risk/reward profiles accordingly (ICE/BAML, Lehman/Bloomberg, etc...)
- Like multiple curves, the manager could weight their preference of sectors and structures and determine the optimal blended duration for the portfolio.

# Market Based Approach

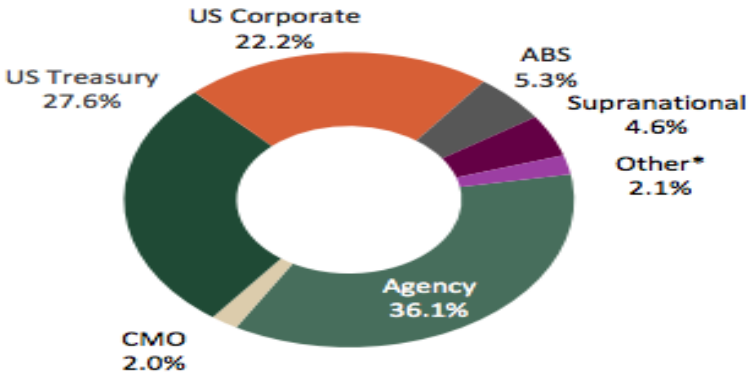
## Single or Multiple Index Analysis

| CHARACTERISTICS | [redacted] | ICE BAML 1-5 Year US Treasury & Agency Index |
|---|---|---|
| Average Maturity | 2.53 | 2.67 |
| Average Duration | 2.31 | 2.54 |
| Yield-to-Maturity | 2.71% | 2.52% |
| Average Quality* | AA | AAA |
| Average Coupon | 1.99% | 2.18% |

*Composite quality based on S&P ratings. Index quality reflects S&P equivalent of composite/average of S&P, Moody's and Fitch ratings. Composite characteristics are supplemental information under GIPS and supplement the composite presentation herein.

***Treasuries represent 96.5% of this index as of Aug 31, 2021***

**ASSET ALLOCATION**




**Other includes Cash, Commercial Paper, Foreign Corporate, Municipal Bonds and Negotiable CD.*

**MATURITY BREAKDOWN**

# Approaches for Determining Portfolio Duration (cont. 3 of 3)

## Cash Flow Based - ALM

- Utilizes cash flow analysis to measure the timing and magnitude of liabilities.
- Uses immunization techniques utilized in the insurance and pension world to measure individual liability streams.
- These liability streams are combined and weighted to derive a total portfolio duration that will suffice to match the liability needs.

# CA Investment Primer – Portfolio Structuring

"One of the most important objectives in the investment of public funds is ensuring that funds are available to fund an organization's cashflow needs. Investment officials **must** identify periods when cash will be needed from the portfolio and **invest funds to mature on those dates.** Furthermore, most investment officials will want to provide a cushion of cash to meet unexpected cash outlays. This cushion may be maintained in short-term investments, money market funds, or in LAIF."

"In developing a portfolio structuring strategy, it is the investor's primary goal to balance the portfolio's safety and liquidity with the **secondary** goal of yield. Safety is achieved through careful selection and monitoring of high credit quality investments and **matching maturities of investments to cash needs.**"



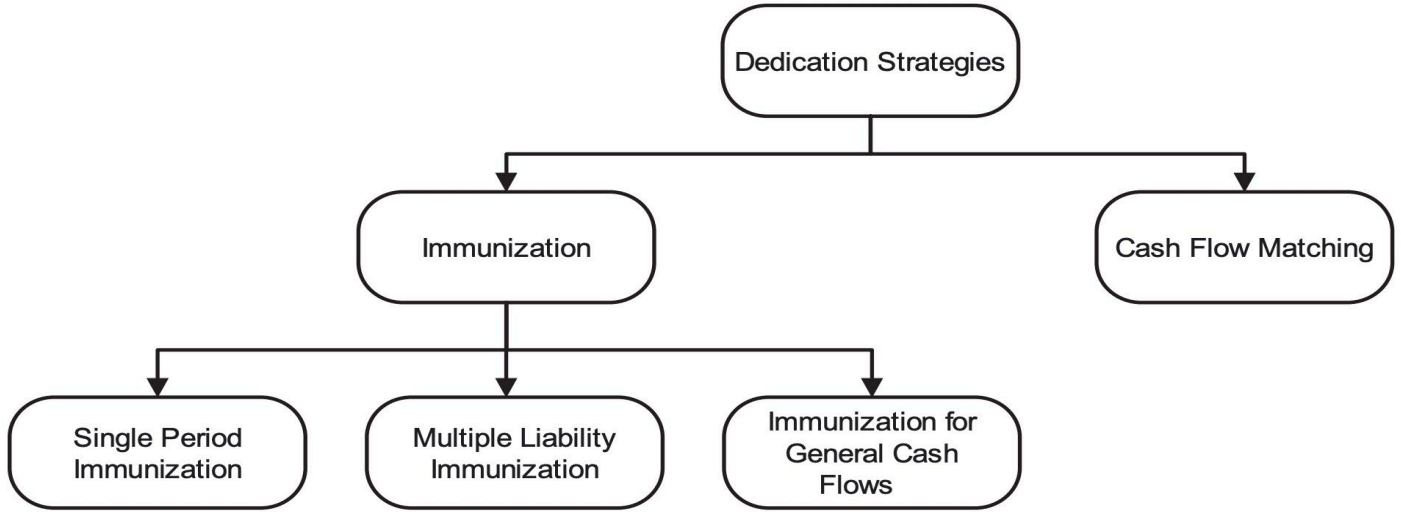

Source: CDIAC - "California Public fund Investment Primer", December 2009

# Cash Flow Based Approach

## ALM Analysis

**Dedication Strategy**: Specialized fixed-income strategy designed to accommodate specific funding needs of the investor. They generally are classified as passive in nature, although it is possible to add some active management elements to them.

***Exhibit 6*** **Dedication Strategies**






**CFA Instititute, Fixed-Income Analysis 3rd Edition*

# Cash Flow Based Approach

## ALM Analysis

**Immunization:** Aims to construct a portfolio that, over a specified horizon, will earn a predetermined return regardless of interest rate changes (duration focused). An increase in rates and the corresponding drop in investment value partially offset by an increase in re-investment rates (and vice-versa).

**Cash Flow Matching:** Provides the future funding of a liability stream from the coupon and matured principal payments of the portfolio (not duration focused). A simple accumulation of the coupon, reinvestment return and value at horizon will offset liability in full.

***Neither strategy perfectly fits public treasury as public entities must focus on Duration as a primary risk metric and typically spend coupons as anticipated by their budget.***



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# Cash Flow Based Approach

**ALM Analysis**

**Combination Matching (also called horizon matching):** Popular variation of multiple immunization and cash flow matching to fund liabilities by combining the two strategies. A portfolio is created that is duration-matched with the added constraint that it be cash flow-matched in the first few years, usually the first five years.

***Since most public entities are policy constrained to five years and in, we can combine the strategies for the entire legal timeframe of the portfolio.***



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# Cash Flow Based Approach

**ALM Analysis**

**Step 1 – Liquidity Profile**

Enter Receipts and Disbursements for 36 months (or desired length) to calculate Net Cash Flow per month over the last three years.

If data is difficult to obtain, a portfolio proxy can be used by utilizing the month over month change in book value of the portfolio as the net cash flow.

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**Cash Flow Entry**
**Sample City**

Update Data

| | Date | Receipts | Expenditures | Net Flow |
|---|---|---|---|---|
| 1 | 08/31/2018 | $24,471,632.81 | $26,953,467.16 | ($2,481,834.35) |
| 2 | 09/30/2018 | $23,559,974.56 | $25,279,925.18 | ($1,719,950.62) |
| 3 | 10/31/2018 | $30,230,063.91 | $32,487,689.44 | ($2,257,625.53) |
| 4 | 11/30/2018 | $51,936,945.68 | $29,593,564.84 | $22,343,380.84 |
| 5 | 12/31/2018 | $24,127,233.19 | $36,589,847.89 | ($12,462,614.70) |
| 6 | 01/31/2019 | $24,918,896.36 | $38,186,973.19 | ($13,268,076.83) |
| 7 | 02/28/2019 | $25,734,823.79 | $29,043,844.20 | ($3,309,020.41) |
| 8 | 03/31/2019 | $16,548,385.34 | $27,337,583.28 | ($10,789,197.94) |
| 9 | 04/30/2019 | $20,508,348.59 | $29,534,947.01 | ($9,026,598.42) |
| 10 | 05/31/2019 | $89,102,085.61 | $36,728,474.91 | $52,373,610.70 |
| 11 | 06/30/2019 | $45,733,196.26 | $41,057,162.97 | $4,676,033.29 |
| 12 | 07/31/2019 | $28,962,367.65 | $32,115,824.92 | ($3,153,457.27) |
| 13 | 08/31/2019 | $27,149,309.89 | $30,267,442.20 | ($3,118,132.31) |
| 14 | 09/30/2019 | $20,715,835.31 | $26,719,598.11 | ($6,003,762.80) |
| 15 | 10/31/2019 | $26,003,560.74 | $32,235,031.27 | ($6,231,470.53) |
| 16 | 11/30/2019 | $62,252,076.52 | $37,799,795.37 | $24,452,281.15 |
| 17 | 12/31/2019 | $29,319,020.67 | $40,322,210.03 | ($11,003,189.36) |
| 18 | 01/31/2020 | $28,241,721.32 | $43,668,419.60 | ($15,426,698.28) |
| 19 | 02/29/2020 | $31,291,231.95 | $34,078,791.63 | ($2,787,559.68) |
| 20 | 03/31/2020 | $19,500,350.84 | $37,131,753.46 | ($17,631,402.62) |
| 21 | 04/30/2020 | $16,677,064.70 | $26,304,041.58 | ($9,626,976.88) |
| 22 | 05/31/2020 | $88,324,955.64 | $48,333,158.15 | $39,991,797.49 |
| 23 | 06/30/2020 | $52,111,610.18 | $46,363,012.78 | $5,748,597.40 |
| 24 | 07/31/2020 | $33,638,613.02 | $34,979,405.09 | ($1,340,792.07) |
| 25 | 08/31/2020 | $28,346,100.41 | $31,194,182.34 | ($2,848,081.93) |
| 26 | 09/30/2020 | $22,215,127.23 | $32,450,056.41 | ($10,234,929.18) |
| 27 | 10/31/2020 | $20,081,784.50 | $35,741,768.07 | ($15,659,983.57) |
| 28 | 11/30/2020 | $62,542,916.58 | $36,943,063.72 | $25,599,852.86 |
| 29 | 12/31/2020 | $30,429,996.34 | $42,419,717.79 | ($11,989,721.45) |
| 30 | 01/31/2021 | $30,074,891.47 | $43,632,363.40 | ($13,557,471.93) |
| 31 | 02/28/2021 | $31,592,189.05 | $34,700,203.72 | ($3,108,014.67) |
| 32 | 03/31/2021 | $20,648,902.89 | $34,525,669.42 | ($13,876,766.53) |
| 33 | 04/30/2021 | $30,150,467.58 | $37,415,760.79 | ($7,265,293.21) |
| 34 | 05/31/2021 | $99,478,439.49 | $48,720,733.83 | $50,757,705.66 |
| 35 | 06/30/2021 | $44,395,717.46 | $43,679,333.78 | $716,383.68 |
| 36 | 07/31/2021 | $37,275,538.69 | $34,980,269.97 | $2,295,268.72 |

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# Cash Flow Based Approach

## ALM Analysis

## Step 1 – Liquidity Profile

| Institution Name | Sample City |
|---|---|
| Portfolio Balance | $300,000,000.00 |
| Primary Liquidity | $60,000,000.00 |
| Analysis Date | 07/31/2021 |

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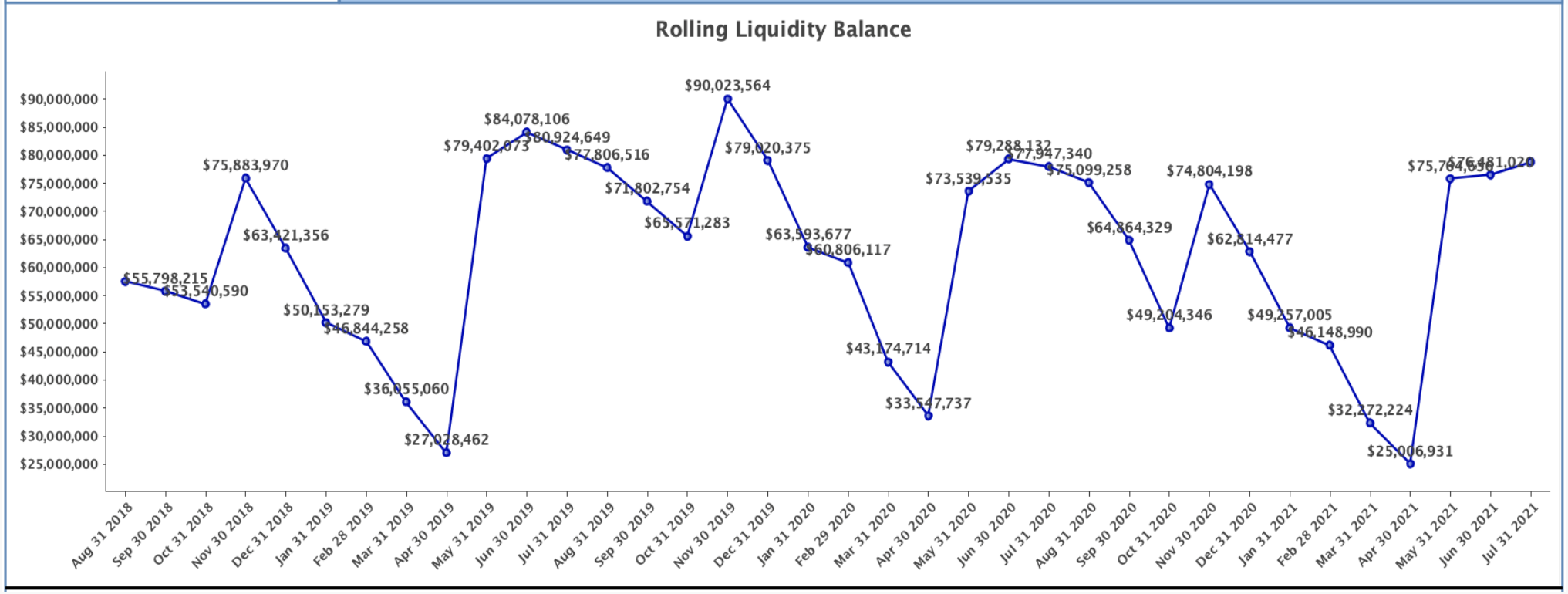
**Liquidity Graph**
**Sample City**
**Analysis Date: Jul 31, 2021**

| MONTHS REVIEWED | |
|---|---|
| Months | 36 |

| BALANCE DATA | |
|---|---|
| Min Balance | $25,006,931 |
| Max Balance | $90,023,564 |
| Max Drawdown | $34,993,069 |

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# Cash Flow Based Approach

**ALM Analysis**

**Step 1 – Liquidity Profile**

| | |
|---|---|
| Liquidity Buffer | 1.50 |
| Liquidity % | 17.50% |

| Rolling Liquidity Evaluation | 36 | |
|---|---|---|
| | **Value** | **Date** |
| Minimum Balance | $25,006,930.66 | |
| Maximum Balance | $90,023,564.27 | |
| Maximum Drawdown | ($34,993,069.34) | 4/30/21 |
| **Required Liquidity** | | ***Multiplier*** |
| Strategic Primary Liquidity | **$34,993,069.34** | **1.00x / 11.7%** |
| Strategic Book Liquidity | **$34,993,069.34** | **1.00x / 11.7%** |
| Strategic Total Liquidity | **$69,986,138.68** | **2.00x / 23.3%** |
| **Actual Liquidity** | | ***Multiplier*** |
| Actual Primary Liquidity | $60,000,000.00 | 1.71x / 20.0% |
| Actual Book Liquidity | $0.00 | 0.00x / 0.0% |
| Actual Total Liquidity | $60,000,000.00 | 1.71x / 20.0% |
| **Investable Liquidity** | | ***% Change*** |
| Investable Primary Liquidity | $25,006,930.66 | 41.68% |
| Investable Book Liquidity | ($34,993,069.34) | N/A |
| Total Investable Liquidity | ($9,986,138.68) | N/A |



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# Cash Flow Based Approach

**ALM Analysis**

**Step 2 – Projected Cash Flows**

Using your own assumptions or average/worst case cash flow projections, we can establish a liability ladder to measure against.

These projections are the net inflow and outflow expectations laddered over the policy limited timeframe of the portfolio.

| Projected Net Cash Flows by Year | | Worst Outflow | Average Outflow | User Outflow |
|---|---|---|---|---|
| 1 | August | ($3,118,132.31) | ($2,816,016.20) | |
| | September | ($10,234,929.18) | ($5,986,214.20) | |
| | October | ($15,659,983.57) | ($8,049,693.21) | |
| | November | $22,343,380.84 | $24,131,838.28 | |
| | December | ($12,462,614.70) | ($11,818,508.50) | |
| | January | ($15,426,698.28) | ($14,084,082.35) | |
| | February | ($3,309,020.41) | ($3,068,198.25) | |
| | March | ($17,631,402.62) | ($14,099,122.36) | |
| | April | ($9,626,976.88) | ($8,639,622.84) | |
| | May | $39,991,797.49 | $47,707,704.62 | |
| | June | $716,383.68 | $3,713,671.46 | |
| | July | ($3,153,457.27) | ($732,993.54) | |
| 2 | August | ($3,118,132.31) | ($2,816,016.20) | |
| | September | ($10,234,929.18) | ($5,986,214.20) | |
| | October | ($15,659,983.57) | ($8,049,693.21) | |
| | November | $22,343,380.84 | $24,131,838.28 | |
| | December | ($12,462,614.70) | ($11,818,508.50) | |
| | January | ($15,426,698.28) | ($14,084,082.35) | |
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| | July | ($3,153,457.27) | ($732,993.54) | |
| 3 | August | ($3,118,132.31) | ($2,816,016.20) | |
| | September | ($10,234,929.18) | ($5,986,214.20) | |
| | October | ($15,659,983.57) | ($8,049,693.21) | |
| | November | $22,343,380.84 | $24,131,838.28 | |
| | December | ($12,462,614.70) | ($11,818,508.50) | |
| | January | ($15,426,698.28) | ($14,084,082.35) | |
| | February | ($3,309,020.41) | ($3,068,198.25) | |
| | March | ($17,631,402.62) | ($14,099,122.36) | |
| | April | ($9,626,976.88) | ($8,639,622.84) | |
| | May | $39,991,797.49 | $47,707,704.62 | |
| | June | $716,383.68 | $3,713,671.46 | |
| | July | ($3,153,457.27) | ($732,993.54) | |

# Cash Flow Based Approach

## ALM Analysis

## Step 3 – DCF/Duration Analysis of Cash Flows

Year 1 Modified Monthly Duration = 5.815/(1+(Wtd Avg Tsy yield/12))=5.810
Year 1 Annualized Modified Duration = 5.810/12 = .484

| Duration Optimization Calcs | | NetFlow | NegNetFlow | Hedge Security | PV Rate | Period | PV NegFlow | PV Factor | Weight | PeriodWt |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | August | ($2,816,016.20) | ($2,816,016.20) | 3Mo Tsy | 0.946% | 1 | $2,813,797.84 | 0.999 | 4.08% | 0.041 |
| | September | ($5,986,214.20) | ($5,986,214.20) | 3Mo Tsy | 0.946% | 2 | $5,976,786.48 | 0.998 | 8.67% | 0.173 |
| | October | ($8,049,693.21) | ($8,049,693.21) | 3Mo Tsy | 0.946% | 3 | $8,030,684.44 | 0.998 | 11.65% | 0.349 |
| | November | $24,131,838.28 | | | | | | | | |
| | December | ($11,818,508.50) | ($11,818,508.50) | 6Mo Tsy | 1.040% | 5 | $11,767,443.55 | 0.996 | 17.07% | 0.853 |
| | January | ($14,084,082.35) | ($14,084,082.35) | 6Mo Tsy | 1.040% | 6 | $14,011,089.19 | 0.995 | 20.32% | 1.219 |
| | February | ($3,068,198.25) | ($3,068,198.25) | 9Mo Tsy | 1.101% | 7 | $3,048,568.85 | 0.994 | 4.42% | 0.310 |
| | March | ($14,099,122.36) | ($14,099,122.36) | 9Mo Tsy | 1.101% | 8 | $13,996,081.63 | 0.993 | 20.30% | 1.624 |
| | April | ($8,639,622.84) | ($8,639,622.84) | 9Mo Tsy | 1.101% | 9 | $8,568,621.70 | 0.992 | 12.43% | 1.119 |
| | May | $47,707,704.62 | | | | | | | | |
| | June | $3,713,671.46 | | | | | | | | |
| | July | ($732,993.54) | ($732,993.54) | 1.00Yr Tsy | 1.162% | 12 | $724,530.44 | 0.988 | 1.05% | 0.126 |
| 2 | August | ($2,816,016.20) | ($2,816,016.20) | 1.25Yr Tsy | 1.193% | 13 | $2,779,866.49 | 0.987 | 4.09% | 0.531 |
| | September | ($5,986,214.20) | ($5,986,214.20) | 1.25Yr Tsy | 1.193% | 14 | $5,903,497.88 | 0.986 | 8.68% | 1.215 |
| | October | ($8,049,693.21) | ($8,049,693.21) | 1.25Yr Tsy | 1.193% | 15 | $7,930,578.28 | 0.985 | 11.66% | 1.748 |
| | November | $24,131,838.28 | | | | | | | | |
| | December | ($11,818,508.50) | ($11,818,508.50) | 1.50Yr Tsy | 1.225% | 17 | $11,615,346.67 | 0.983 | 17.07% | 2.902 |
| | January | ($14,084,082.35) | ($14,084,082.35) | 1.50Yr Tsy | 1.225% | 18 | $13,827,863.69 | 0.982 | 20.32% | 3.658 |
| | February | ($3,068,198.25) | ($3,068,198.25) | 1.75Yr Tsy | 1.256% | 19 | $3,007,817.97 | 0.980 | 4.42% | 0.840 |
| | March | ($14,099,122.36) | ($14,099,122.36) | 1.75Yr Tsy | 1.256% | 20 | $13,807,209.12 | 0.979 | 20.29% | 4.059 |
| | April | ($8,639,622.84) | ($8,639,622.84) | 1.75Yr Tsy | 1.256% | 21 | $8,451,898.98 | 0.978 | 12.42% | 2.609 |
| | May | $47,707,704.62 | | | | | | | | |
| | June | $3,713,671.46 | | | | | | | | |
| | July | ($732,993.54) | ($732,993.54) | 2.00Yr Tsy | 1.287% | 24 | $714,372.32 | 0.975 | 1.05% | 0.252 |

Macaulay Dur = Sum PeriodWt = 5.815

Macaulay Dur = Sum PeriodWt = 17.814

Year 2 Modified Monthly Duration = 17.814/(1+(Wtd Avg Tsy yield/12))=17.795
Year 2 Annualized Mod Duration = 17.795/12 = 1.483

# Cash Flow Based Approach

**ALM Analysis**

**Step 3 – DCF/Duration Analysis of Cash Flows**

Once the annualized duration's are calculated, we now weight each year based on our preference of coverage of each year's total liabilities.

| Duration Optimization Values by Year | | |
|---|---|---|
| 1 | *Annualized Duration* | *0.484* |
| 2 | *Annualized Duration* | *1.483* |
| 3 | *Annualized Duration* | *2.481* |
| 4 | *Annualized Duration* | *3.480* |
| 5 | *Annualized Duration* | *4.477* |



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# Cash Flow Based Approach

## ALM Analysis

## Step 3 – DCF/Duration Analysis of Cash Flows

| | |
|---|---|
| Portfolio Size | $300,000,000.00 |
| Immunized Portfolio | $299,992,155.11 |
| Percent Immunized | 100.00% |

| Immunization Weight | |
|---|---|
| Year 1 | 90.00% |
| Year 2 | 70.50% |
| Year 3 | 70.00% |
| Year 4 | 70.00% |
| Year 5 | 70.00% |

The total immunization weights for each year should create a portfolio that is 100% immunized relative to the portfolio size.

| Duration Optimization Values by Year | | |
|---|---|---|
| 1 | Sum Present Value of Outflows | $68,937,604.13 |
| | Sum of Asset Matched Present Values | $62,043,843.72 |
| | Asset Matched Weight in Portfolio | 20.681% |
| | Annual Total Liquidity Coverage Required | $6,893,760.41 |
| | *Annualized Duration* | *0.484* |
| | *Weighted Duration* | *0.100* |
| 2 | Sum Present Value of Outflows | $68,038,451.40 |
| | Sum of Asset Matched Present Values | $47,967,108.24 |
| | Asset Matched Weight in Portfolio | 15.989% |
| | Annual Total Liquidity Coverage Required | $20,071,343.16 |
| | *Annualized Duration* | *1.483* |
| | *Weighted Duration* | *0.237* |
| 3 | Sum Present Value of Outflows | $66,942,361.12 |
| | Sum of Asset Matched Present Values | $46,859,652.79 |
| | Asset Matched Weight in Portfolio | 15.620% |
| | Annual Total Liquidity Coverage Required | $20,082,708.34 |
| | *Annualized Duration* | *2.481* |
| | *Weighted Duration* | *0.388* |

# Cash Flow Based Approach

## ALM Analysis

## Step 3 – DCF/Duration Analysis of Cash Flows

| Duration Estimation and Allocation Bucket Approximation | |
|---|---|
| Starting Liquidity | $52,500,000.00 |
| 1Yr Min Liquidity | $47,360,819.51 |
| Weighted Average Cash Flow Duration | 1.92 |
| Cash (Liquidity Profile) | 17.50% |
| 0-1Yr | 20.68% |
| 1-3Yr | 31.61% |
| 3-5Yr | 30.21% |

*Sum of Weighted Durations (4 & 5 Year Not Shown)*

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|---|---|---|
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# Cash Flow Based Approach

## ALM Analysis

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# Cash Flow Based Approach

## ALM Analysis

## Step 3 – DCF/Duration Analysis of Cash Flows

| Duration Estimation and Allocation Bucket Approximation | |
|---|---|
| Starting Liquidity | $52,500,000.00 |
| 1Yr Min Liquidity | $47,360,819.51 |
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| Cash (Liquidity Profile) | 17.50% |
| 0-1Yr | 20.68% |
| 1-3Yr | 31.61% |
| 3-5Yr | 30.21% |

| Duration Optimization Values by Year | | |
|---|---|---|
| 1 | Sum of Asset Matched Present Values | $62,043,843.72 |
| | *Weighted Duration* | *0.100* |
| 2 | Sum of Asset Matched Present Values | $47,967,108.24 |
| | *Weighted Duration* | *0.237* |
| 3 | Sum of Asset Matched Present Values | $46,859,652.79 |
| | *Weighted Duration* | *0.388* |
| 4 | Sum of Asset Matched Present Values | $45,889,528.29 |
| | *Weighted Duration* | *0.532* |
| 5 | Sum of Asset Matched Present Values | $44,732,022.07 |
| | *Weighted Duration* | *0.668* |

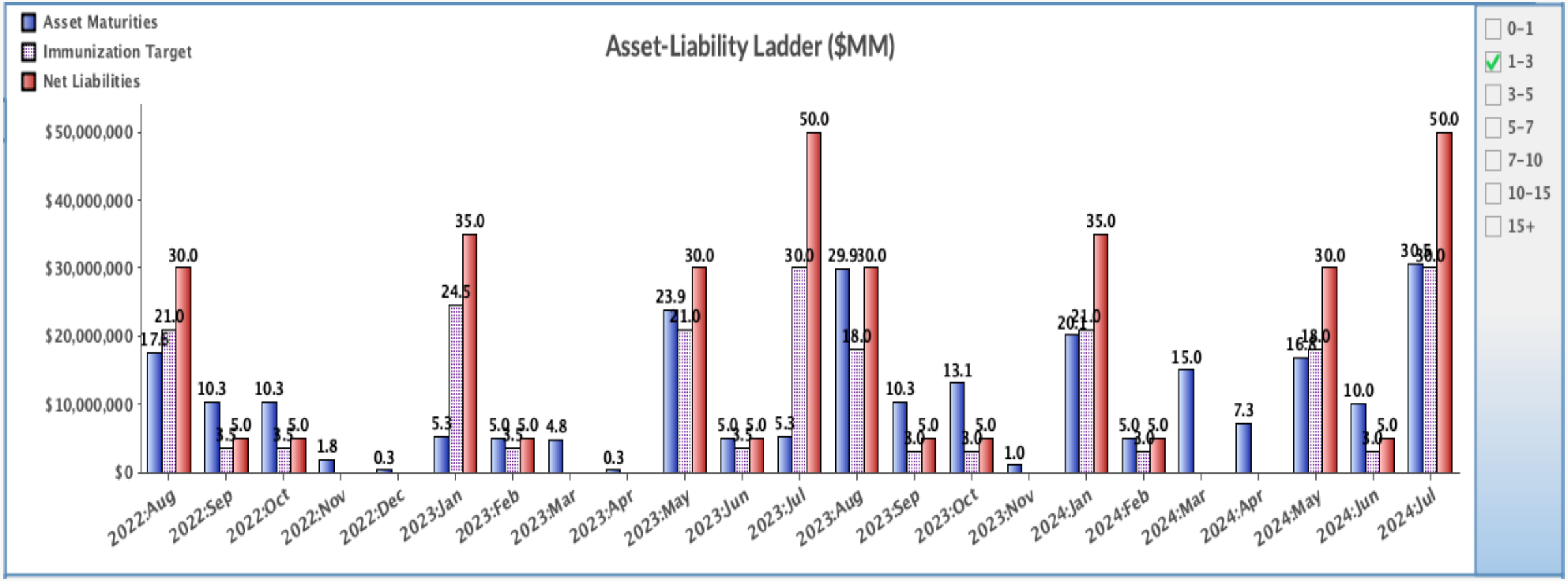
# Cash Flow Based Approach

## ALM Analysis

| | | NetFlow | PV NegFlow | Assets Needed | 1Yr Liquidity Change | 1Yr Liquidity Rolling Balance |
|---|---|---|---|---|---|---|
| 1 | August | ($2,816,016.20) | $2,813,797.84 | $2,532,418 | ($281,380) | $52,218,620 |
| | September | ($5,986,214.20) | $5,976,786.48 | $5,379,108 | ($597,679) | $51,620,942 |
| | October | ($8,049,693.21) | $8,030,684.44 | $7,227,616 | ($803,068) | $50,817,873 |
| | November | $24,131,838.28 | | | $1,682,127 | $52,500,000 |
| | December | ($11,818,508.50) | $11,767,443.55 | $10,590,699 | ($1,176,744) | $51,323,256 |
| | January | ($14,084,082.35) | $14,011,089.19 | $12,609,980 | ($1,401,109) | $49,922,147 |
| | February | ($3,068,198.25) | $3,048,568.85 | $2,743,712 | ($304,857) | $49,617,290 |
| | March | ($14,099,122.36) | $13,996,081.63 | $12,596,473 | ($1,399,608) | $48,217,682 |
| | April | ($8,639,622.84) | $8,568,621.70 | $7,711,760 | ($856,862) | $47,360,820 |
| | May | $47,707,704.62 | | | $5,139,180 | $52,500,000 |
| | June | $3,713,671.46 | | | | $52,500,000 |
| | July | ($732,993.54) | $724,530.44 | $652,077 | ($72,453) | $52,427,547 |
| 2 | August | ($2,816,016.20) | $2,779,866.49 | $1,959,806 | | |
| | September | ($5,986,214.20) | $5,903,497.88 | $4,161,966 | | |
| | October | ($8,049,693.21) | $7,930,578.28 | $5,591,058 | | |
| | November | $24,131,838.28 | | | | |
| | December | ($11,818,508.50) | $11,615,346.67 | $8,188,819 | | |
| | January | ($14,084,082.35) | $13,827,863.69 | $9,748,644 | | |
| | February | ($3,068,198.25) | $3,007,817.97 | $2,120,512 | | |
| | March | ($14,099,122.36) | $13,807,209.12 | $9,734,082 | | |
| | April | ($8,639,622.84) | $8,451,898.98 | $5,958,589 | | |
| | May | $47,707,704.62 | | | | |
| | June | $3,713,671.46 | | | | |
| | July | ($732,993.54) | $714,372.32 | $503,632 | | |
| 3 | August | ($2,816,016.20) | $2,738,872.78 | $1,917,211 | | |
| | September | ($5,986,214.20) | $5,815,759.42 | $4,071,032 | | |
| | October | ($8,049,693.21) | $7,811,797.51 | $5,468,258 | | |
| | November | $24,131,838.28 | | | | |
| | December | ($11,818,508.50) | $11,430,879.00 | $8,001,615 | | |
| | January | ($14,084,082.35) | $13,606,489.65 | $9,524,543 | | |
| | February | ($3,068,198.25) | $2,957,182.76 | $2,070,028 | | |
| | March | ($14,099,122.36) | $13,572,833.72 | $9,500,984 | | |
| | April | ($8,639,622.84) | $8,307,243.38 | $5,815,070 | | |
| | May | $47,707,704.62 | | | | |
| | June | $3,713,671.46 | | | | |
| | July | ($732,993.54) | $701,302.90 | $490,912 | | |

# Cash Flow Based Approach

## ALM Analysis



# Cash Flow Based Approach

**ALM Analysis**

- Uses institution's actual cash flow data to measure future liabilities and derive duration needs
- Eliminates bias and idiosyncratic problems that public entities can have with market-based approaches (liquidity, sector and structure differences).
- Ensures each institution's duration is unique and not peer or market related.
- Places emphasis on timing and magnitude of investments relative to liabilities versus market-based optimizations for the masses.
- Does require more data and effort to establish the projected liability stream and involves calculations that may not be familiar.
- There are opportunity costs associated by limiting the investment universe to any particular timeframe, however it can be argued that maintaining a stable duration and limiting cash balances can more than offset any costs associated with security selection constraints (without this process, cash balances tend to be higher and more conservative securities are purchased due to uncertainty).



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# Case Study: City and County of San Francisco (1 of 12)

## CCSF Investment Pool

- CCSF Investment Pool currently is $16.0 billion
- Many different participants both discretionary and non-discretionary with 13 major participants
- Monthly apportionment to each participant
- Consists of operating reserves and bond issuance proceeds

## Investment Strategy

- Focus is on Safety of Principal and Liquidity – return is considered after the first two mandates are satisfied
- Emphasis on Asset/Liability Management – matching asset maturities with cash outflows
- Maintaining a consistent average maturity consistent with cashflow profile – not market timing
- Income generation is key – not total return



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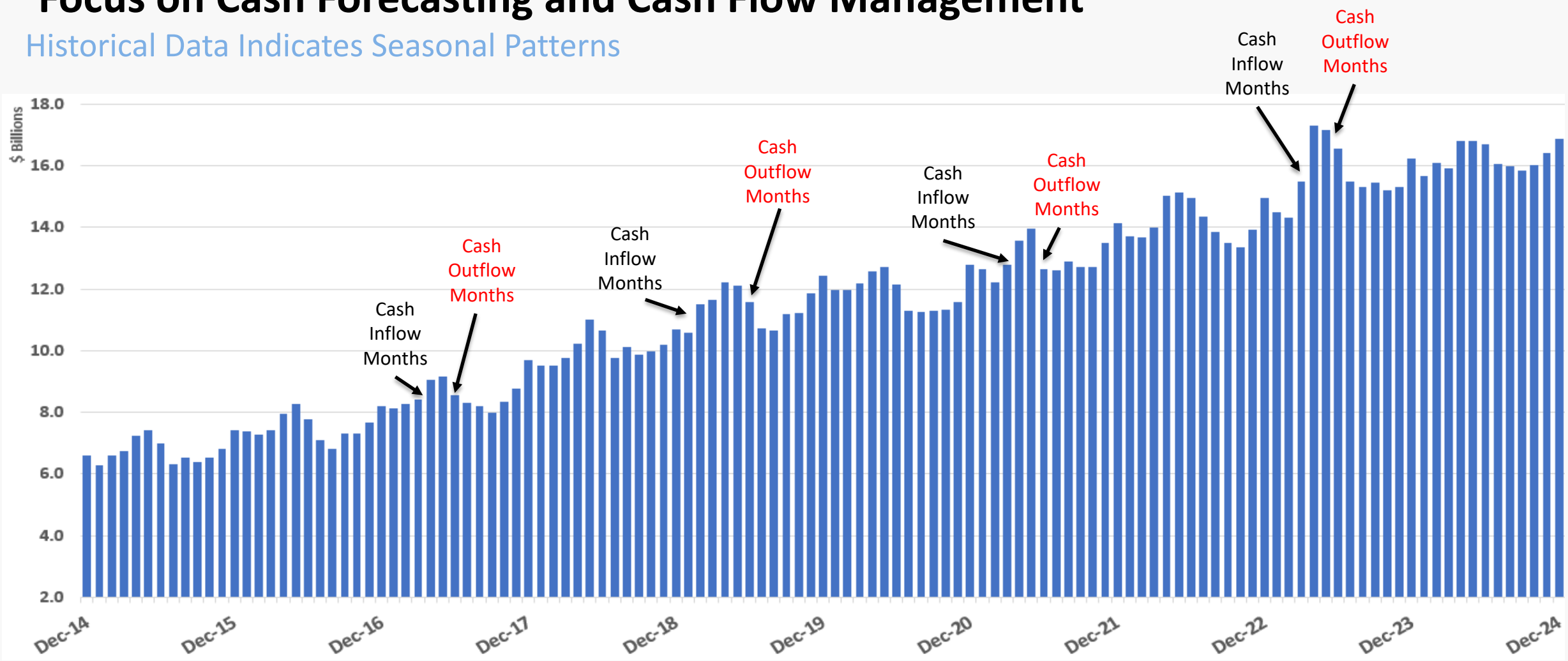
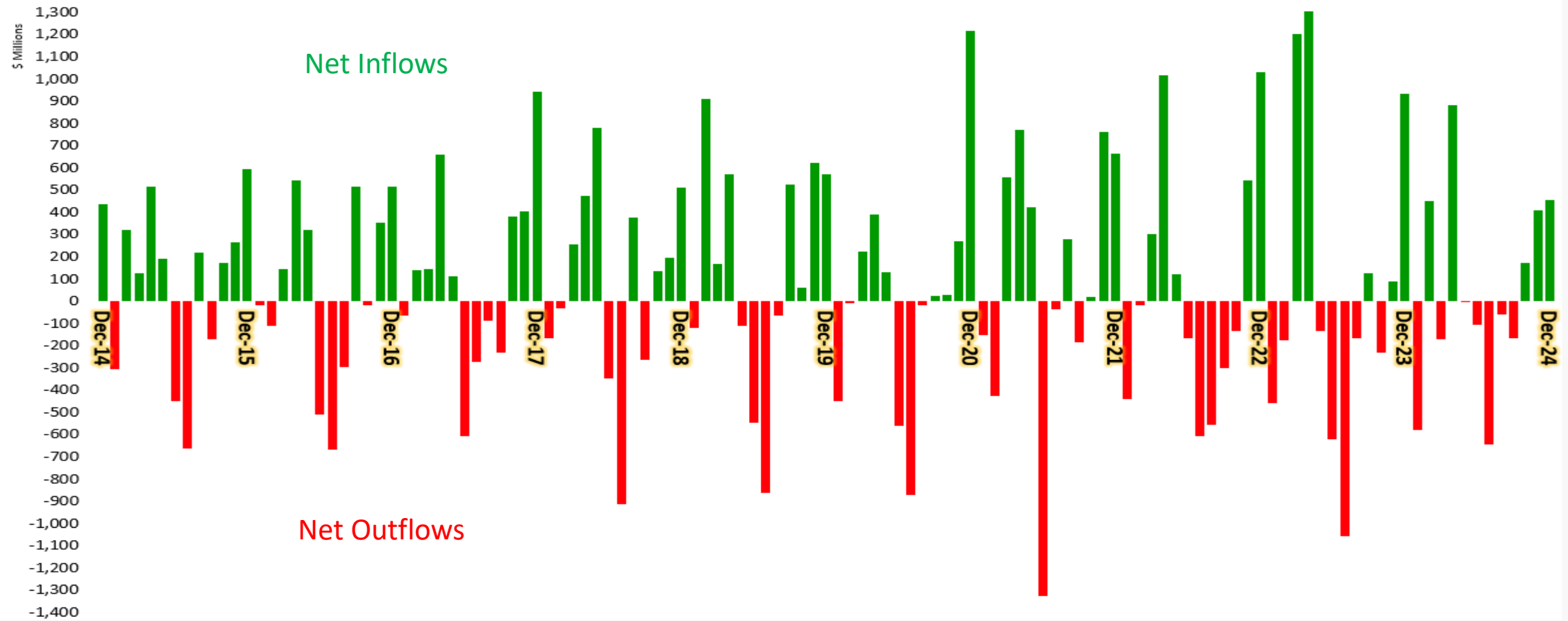
# Focus on Cash Forecasting and Cash Flow Management

## Historical Data Indicates Seasonal Patterns



# Historic Monthly Net Cash Flows



# Historic Monthly Net Cash Flows By Year

Flow Selection Type

| Historical Net Cash Flow by Year | 2022 | 2023 | 2024 |
|---|---|---|---|
| January | ($439,872,611.00) | ($458,300,095.42) | ($578,173,942.23) |
| February | ($16,209,979.34) | ($175,564,278.95) | $448,920,642.27 |
| March | $302,531,367.33 | $1,199,815,397.87 | ($172,783,085.66) |
| April | $1,016,711,651.48 | $1,794,556,009.34 | $882,388,597.46 |
| May | $120,346,417.41 | ($135,693,701.05) | ($2,593,056.93) |
| June | ($167,005,356.90) | ($621,177,196.91) | ($104,551,113.68) |
| July | ($605,180,069.90) | ($1,056,587,419.46) | ($646,609,328.27) |
| August | ($558,558,396.91) | ($165,758,497.24) | ($58,834,843.17) |
| September | ($299,599,809.30) | $124,100,271.43 | ($167,079,177.05) |
| October | ($134,221,025.12) | ($230,792,042.69) | $173,721,190.05 |
| November | $543,970,916.97 | $86,464,242.78 | $408,359,971.65 |
| December | $1,028,851,841.11 | $931,058,986.32 | $454,705,371.20 |

# Projected Cash Flows

| Projected Net Cash Flows by Year | | Worst Outflow | Average Outflow | User Outflow |
|---|---|---|---|---|
| 1 | January | ($578,173,942.23) | ($492,115,549.55) | |
| | February | ($175,564,278.95) | $85,715,461.33 | |
| | March | ($172,783,085.66) | $443,187,893.18 | |
| | April | $882,388,597.46 | $1,231,218,752.76 | |
| | May | ($135,693,701.05) | ($5,980,113.52) | |
| | June | ($621,177,196.91) | ($297,577,889.16) | |
| | July | ($1,056,587,419.46) | ($769,458,939.21) | |
| | August | ($558,558,396.91) | ($261,050,579.11) | |
| | September | ($299,599,809.30) | ($114,192,904.97) | |
| | October | ($230,792,042.69) | ($63,763,959.25) | |
| | November | $86,464,242.78 | $346,265,043.80 | |
| | December | $454,705,371.20 | $804,872,066.21 | |
| 2 | January | ($578,173,942.23) | ($492,115,549.55) | |
| | February | ($175,564,278.95) | $85,715,461.33 | |
| | March | ($172,783,085.66) | $443,187,893.18 | |
| | April | $882,388,597.46 | $1,231,218,752.76 | |
| | May | ($135,693,701.05) | ($5,980,113.52) | |
| | June | ($621,177,196.91) | ($297,577,889.16) | |
| | July | ($1,056,587,419.46) | ($769,458,939.21) | |
| | August | ($558,558,396.91) | ($261,050,579.11) | |
| | September | ($299,599,809.30) | ($114,192,904.97) | |
| | October | ($230,792,042.69) | ($63,763,959.25) | |
| | November | $86,464,242.78 | $346,265,043.80 | |
| | December | $454,705,371.20 | $804,872,066.21 | |
| 3 | January | ($578,173,942.23) | ($492,115,549.55) | |
| | February | ($175,564,278.95) | $85,715,461.33 | |
| | March | ($172,783,085.66) | $443,187,893.18 | |
| | April | $882,388,597.46 | $1,231,218,752.76 | |
| | May | ($135,693,701.05) | ($5,980,113.52) | |
| | June | ($621,177,196.91) | ($297,577,889.16) | |
| | July | ($1,056,587,419.46) | ($769,458,939.21) | |
| | August | ($558,558,396.91) | ($261,050,579.11) | |
| | September | ($299,599,809.30) | ($114,192,904.97) | |
| | October | ($230,792,042.69) | ($63,763,959.25) | |
| | November | $86,464,242.78 | $346,265,043.80 | |
| | December | $454,705,371.20 | $804,872,066.21 | |

| Projected Net Cash Flows by Year | | Worst Outflow | Average Outflow | User Outflow |
|---|---|---|---|---|
| 4 | January | ($578,173,942.23) | ($492,115,549.55) | |
| | February | ($175,564,278.95) | $85,715,461.33 | |
| | March | ($172,783,085.66) | $443,187,893.18 | |
| | April | $882,388,597.46 | $1,231,218,752.76 | |
| | May | ($135,693,701.05) | ($5,980,113.52) | |
| | June | ($621,177,196.91) | ($297,577,889.16) | |
| | July | ($1,056,587,419.46) | ($769,458,939.21) | |
| | August | ($558,558,396.91) | ($261,050,579.11) | |
| | September | ($299,599,809.30) | ($114,192,904.97) | |
| | October | ($230,792,042.69) | ($63,763,959.25) | |
| | November | $86,464,242.78 | $346,265,043.80 | |
| | December | $454,705,371.20 | $804,872,066.21 | |
| 5 | January | ($578,173,942.23) | ($492,115,549.55) | |
| | February | ($175,564,278.95) | $85,715,461.33 | |
| | March | ($172,783,085.66) | $443,187,893.18 | |
| | April | $882,388,597.46 | $1,231,218,752.76 | |
| | May | ($135,693,701.05) | ($5,980,113.52) | |
| | June | ($621,177,196.91) | ($297,577,889.16) | |
| | July | ($1,056,587,419.46) | ($769,458,939.21) | |
| | August | ($558,558,396.91) | ($261,050,579.11) | |
| | September | ($299,599,809.30) | ($114,192,904.97) | |
| | October | ($230,792,042.69) | ($63,763,959.25) | |
| | November | $86,464,242.78 | $346,265,043.80 | |
| | December | $454,705,371.20 | $804,872,066.21 | |

# Case Study: City and County of San Francisco (cont. 6 of 12)

## Worst Outflow Scenario

Duration Optimization

**Duration Estimation and Allocation Bucket Approximation**

| | |
|---|---|
| Portfolio Size | $16,890,243,867.88 |
| Immunized Portfolio | $16,889,935,702.81 |
| Percent Immunized | 100.00% |
| Starting Liquidity | $1,351,219,509.43 |
| 1Yr Min Liquidity | $1,351,219,509.43 |
| Weighted Average Cash Flow Duration | 2.04 |
| Cash (Liquidity Profile) | 8.00% |
| 0-1Yr | 22.20% |
| 1-3Yr | 41.88% |
| 3-5Yr | 27.92% |

| | |
|---|---|
| 3Mo Tsy | 0.232 |
| 6Mo Tsy | 0.477 |
| 9Mo Tsy | 0.724 |
| 1.00Yr Tsy | 0.970 |
| 1.25Yr Tsy | 1.202 |
| 1.50Yr Tsy | 1.434 |
| 1.75Yr Tsy | 1.666 |
| 2.00Yr Tsy | 1.898 |
| 2.25Yr Tsy | 2.114 |
| 2.50Yr Tsy | 2.330 |
| 2.75Yr Tsy | 2.546 |
| 3.00Yr Tsy | 2.762 |
| 3.25Yr Tsy | 2.977 |

**INDEX DATES**

| | |
|---|---|
| Start Date | 1/31/22 |
| End Date | 12/31/24 |

**Outflow Selection**

| | |
|---|---|
| OutFlow Selection | Worst Outflow |
| Maximum Maturity (Yrs) | 5.00 |

**Immunization Weight**

| | |
|---|---|
| Year 1 | 100.00% |
| Year 2 | 100.00% |
| Year 3 | 100.00% |
| Year 4 | 75.00% |
| Year 5 | 68.20% |

# Worst Outflow Scenario

| Duration Optimization Values by Year | | | | | |
|---|---|---|---|---|---|
| 1 | Sum Present Value of Outflows | $3,749,836,286.83 | 4 | Sum Present Value of Outflows | $3,348,695,612.97 |
| | Sum of Asset Matched Present Values | $3,749,836,286.83 | | Sum of Asset Matched Present Values | $2,511,521,709.73 |
| | Asset Matched Weight in Portfolio | 22.201% | | Asset Matched Weight in Portfolio | 14.870% |
| | *Annualized Duration* | *0.491* | | *Annualized Duration* | *3.481* |
| | *Weighted Duration* | *0.109* | | *Weighted Duration* | *0.518* |
| 2 | Sum Present Value of Outflows | $3,601,097,818.14 | 5 | Sum Present Value of Outflows | $3,232,395,622.16 |
| | Sum of Asset Matched Present Values | $3,601,097,818.14 | | Sum of Asset Matched Present Values | $2,204,493,814.31 |
| | Asset Matched Weight in Portfolio | 21.321% | | Asset Matched Weight in Portfolio | 13.052% |
| | *Annualized Duration* | *1.487* | | *Annualized Duration* | *4.479* |
| | *Weighted Duration* | *0.317* | | *Weighted Duration* | *0.585* |
| 3 | Sum Present Value of Outflows | $3,471,766,564.37 | | | |
| | Sum of Asset Matched Present Values | $3,471,766,564.37 | | | |
| | Asset Matched Weight in Portfolio | 20.555% | | | |
| | *Annualized Duration* | *2.484* | | | |
| | *Weighted Duration* | *0.511* | | | |

# Worst Outflow Scenario

MaxQ Analytics

**City and County of San Francisco**

| Month | Net Flow Expectation |
|---|---|
| January | ($578,173,942.23) |
| February | ($175,564,278.95) |
| March | ($172,783,085.66) |
| April | $882,388,597.46 |
| May | ($135,693,701.05) |
| June | ($621,177,196.91) |
| July | ($1,056,587,419.46) |
| August | ($558,558,396.91) |
| September | ($299,599,809.30) |
| October | ($230,792,042.69) |
| November | $86,464,242.78 |
| December | $454,705,371.20 |

| Treasury | Rate |
|---|---|
| 1YR | 4.28% |
| 2YR | 4.37% |
| 3YR | 4.48% |
| 4YR | 4.57% |
| 5YR | 4.60% |

| Portfolio Inputs | Value |
|---|---|
| Portfolio Size | $16,890,243,867.88 |
| Starting Liquidity | $1,351,219,509.43 |

| CF Duration & Maturity Buckets | Values |
|---|---|
| Weighted Average Cash Flow Duration | 2.04 |
| Cash | 8.004% |
| 0-1Yr | 22.197% |
| 1-3Yr | 41.518% |
| 3-5Yr | 28.282% |

| Immunization Timeframe | Weight |
|---|---|
| 0-1Yr | 100.00% |
| 1-2Yr | 100.00% |
| 2-3Yr | 100.00% |
| 3-4Yr | 81.00% |
| 4-5Yr | 68.45% |
| Percent Immunized | 100.00% |

CDIAC

# Worst Outflow Scenario

| Duration Optimization Year One | Values |
|---|---|
| Sum PV of Outflows | $3,749,058,574.14 |
| Sum PV Immunized Assets | $3,749,058,574.14 |
| Asset Matched Weight in Portfolio | 22.197% |
| Annual Liquidity Coverage Required | $0.00 |
| Annualized Duration | 0.491 |
| Weighted Duration | 0.109 |

| Duration Optimization Year Two | Values |
|---|---|
| Sum PV of Outflows | $3,587,453,718.52 |
| Sum PV Immunized Assets | $3,587,453,718.52 |
| Asset Matched Weight in Portfolio | 21.240% |
| Annual Liquidity Coverage Required | $0.00 |
| Annualized Duration | 1.487 |
| Weighted Duration | 0.316 |

| Duration Optimization Year Three | Values |
|---|---|
| Sum PV of Outflows | $3,424,963,043.56 |
| Sum PV Immunized Assets | $3,424,963,043.56 |
| Asset Matched Weight in Portfolio | 20.278% |
| Annual Liquidity Coverage Required | $0.00 |
| Annualized Duration | 2.483 |
| Weighted Duration | 0.503 |

| Duration Optimization Year Four | Values |
|---|---|
| Sum PV of Outflows | $3,264,945,110.67 |
| Sum PV Immunized Assets | $2,644,605,539.64 |
| Asset Matched Weight in Portfolio | 15.658% |
| Annual Liquidity Coverage Required | $620,339,571.03 |
| Annualized Duration | 3.479 |
| Weighted Duration | 0.545 |

| Duration Optimization Year Five | Values |
|---|---|
| Sum PV of Outflows | $3,115,180,942.42 |
| Sum PV Immunized Assets | $2,132,341,355.09 |
| Asset Matched Weight in Portfolio | 12.625% |
| Annual Liquidity Coverage Required | $982,839,587.33 |
| Annualized Duration | 4.475 |
| Weighted Duration | 0.565 |



CDIAC

# Case Study: City and County of San Francisco (cont. 10 of 12)

## Asset-Liability Ladder ($MM)

# Case Study: City and County of San Francisco (cont. 11 of 12)

## Cash Flow Schedule

| | |
|---|---|
| Projected EOD Bank Balance | $8,057,655.44 |
| EC Bank Balance Target | $10,000,000.00 |
| Net Bank Balance Available | ($1,942,344.56) |
| Portfolio Cash/MMKT Holdings | $1,760,247,137.20 |
| Intra-Day Cash/MMKT Transactions | |
| Target Liquidity | ($1,500,000,000.00) |
| Net Cash/MMKT Balance Available | $260,247,137.20 |
| Spendable Cash Non-Immunized | $258,304,792.64 |

| | |
|---|---|
| CF Start Date | 1/14/2025 |
| CF End Date | 1/31/2030 |
| Reporting Date | 01/14/2025 |
| REAL Mode | Trade Date |

☑ Include MMKT Holdings
☑ Include Target Liquidity
Update CF Model

| | |
|---|---|
| Net Bank Balance Available | ($1,942,344.56) |
| Portfolio Cash/MMKT Holdings | $1,760,247,137.20 |
| Cash/MMKT Immunizations | ($120,545,111.00) |
| Portfolio Cash/MMKT Actual | $1,639,702,026.20 |
| Intra-Day Cash/MMKT Transactions | |
| Target Liquidity | ($1,500,000,000.00) |
| Net Cash/MMKT Balance Available | $139,702,026.20 |
| Spendable Cash Immunized | $137,759,681.64 |

| | |
|---|---|
| Min Liquidity | ($21,481,248,715.61) |
| Max Liquidity | $1,009,404,002.25 |
| Avg Liquidity | ($8,963,200,201.92) |
| Immun Min Liquidity | ($21,481,248,715.61) |
| Immun Max Liquidity | $502,123,597.37 |
| Immun Avg Liquidity | ($9,070,658,395.54) |
| Negative Net Outflow Filter Amount | $0.00 |

☑ Activate Filter

### Cash Flow By Day

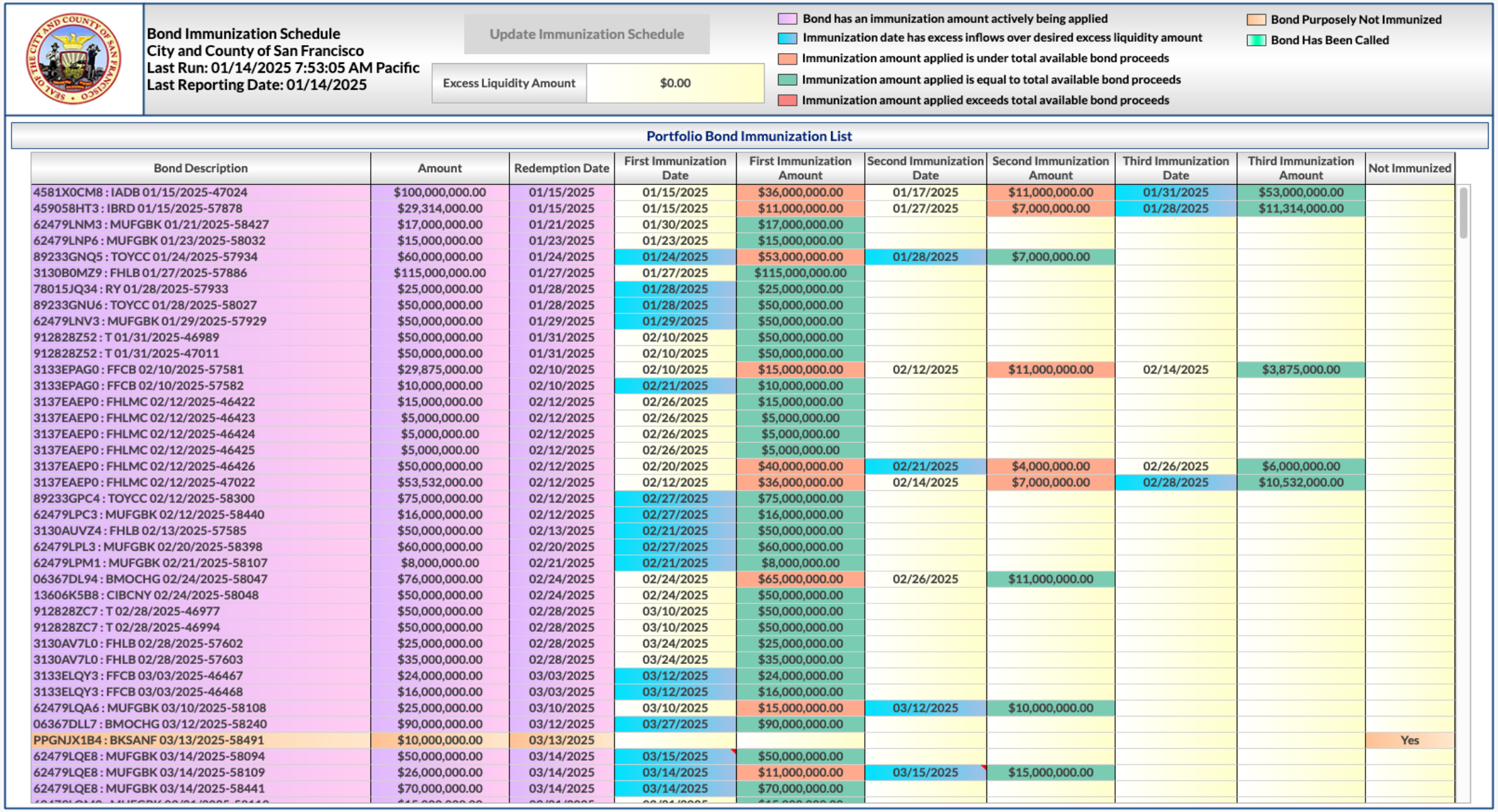
| | | Total CF | Adjusted Liquidity |
|---|---|---|---|
| 01/15/2025 | 4581X0CM8 : IADB 01/15/2025-47024 | 100,000,000.00 | |
| | 459058HT3 : IBRD 01/15/2025-57878 | 29,314,000.00 | |
| | CCSF Payroll Tax 1 | (47,000,000.00) | |
| | **Total Cash Flow** | **82,314,000.00** | **340,618,792.64** |
| 01/17/2025 | CCSF Payroll Tax 2 | (11,000,000.00) | |
| | **Total Cash Flow** | **(11,000,000.00)** | **329,618,792.64** |
| 01/21/2025 | 62479LNM3 : MUFGBK 01/21/2025-58427 | 17,000,000.00 | |
| | **Total Cash Flow** | **17,000,000.00** | **346,618,792.64** |
| 01/23/2025 | 62479LNP6 : MUFGBK 01/23/2025-58032 | 15,000,000.00 | |
| | Blue Shield CA Monthly ACH | (15,000,000.00) | |
| | **Total Cash Flow** | **0.00** | **346,618,792.64** |
| 01/24/2025 | 89233GNQ5 : TOYCC 01/24/2025-57934 | 60,000,000.00 | |
| | SFO Debt Service ACH | (52,603,083.00) | |
| | **Total Cash Flow** | **7,396,917.00** | **354,015,709.64** |
| 01/27/2025 | 3130B0MZ9 : FHLB 01/27/2025-57886 | 115,000,000.00 | |
| | Payroll Transfer to Bank | (122,000,000.00) | |
| | **Total Cash Flow** | **(7,000,000.00)** | **347,015,709.64** |
| 01/28/2025 | 78015JQ34 : RY 01/28/2025-57933 | 25,000,000.00 | |
| | 89233GNU6 : TOYCC 01/28/2025-58027 | 50,000,000.00 | |
| | OCII Debt Service | (90,733,398.10) | |
| | **Total Cash Flow** | **(15,733,398.10)** | **331,282,311.54** |
| 01/29/2025 | 62479LNV3 : MUFGBK 01/29/2025-57929 | 50,000,000.00 | |
| | CCSF Payroll Tax 1 | (47,000,000.00) | |
| | **Total Cash Flow** | **3,000,000.00** | **334,282,311.54** |
| 01/30/2025 | SF PUC Power Enterprise 2024 Spending Projection | (17,264,682.00) | |
| | SF PUC Wastewater 2024 Spending Projection | (67,226,819.00) | |
| | **Total Cash Flow** | **(84,491,501.00)** | **249,790,810.54** |
| 01/31/2025 | SFO Operating Revenue Projections | 131,271,440.00 | |
| | Pension Payment Northern Trust Pmt | 115,000,000.00 | |
| | 912828Z52 : T 01/31/2025-46989 | 50,000,000.00 | |
| | 912828Z52 : T 01/31/2025-47011 | 50,000,000.00 | |
| | SFO Projected Capital Expenditures | (86,254,698.00) | |
| | Retiree Pension Payment | (115,000,000.00) | |

### Immunized Cash Flow By Day

| | | Total CF | Adjusted Liquidity |
|---|---|---|---|
| 05/21/2025 | PPGQ38MB6 : FIVSTR 05/21/2025-58454 | $20,000,000.00 | |
| | CCSF Payroll Tax 1 | ($47,000,000.00) | |
| | **Total Cash Flow** | **($27,000,000.00)** | **$475,123,597.37** |
| 05/22/2025 | SFO Debt Service ACH | ($52,603,083.00) | |
| | **Total Cash Flow** | **($52,603,083.00)** | **$422,520,514.37** |
| 05/23/2025 | 3133ENXE5 : FFCB 05/23/2025-47376 | $6,000,000.00 | |
| | CCSF Payroll Tax 2 | ($11,000,000.00) | |
| | Blue Shield CA Monthly ACH | ($15,000,000.00) | |
| | **Total Cash Flow** | **($20,000,000.00)** | **$402,520,514.37** |
| 05/29/2025 | SF PUC Wastewater 2024 Spending Projection | ($84,943,451.00) | |
| | **Total Cash Flow** | **($84,943,451.00)** | **$317,577,063.37** |
| 06/02/2025 | Pension Payment Northern Trust Pmt | $115,000,000.00 | |
| | 78015J5G8 : RY 06/02/2025-58461 | $100,000,000.00 | |
| | 13606DCU4 : CIBCNY 06/02/2025-58462 | $25,000,000.00 | |
| | Payroll Transfer to Bank | ($122,000,000.00) | |
| | Retiree Pension Payment | ($115,000,000.00) | |
| | SF PUC West Recyle CWSRF Loan | ($6,634,452.00) | |
| | **Total Cash Flow** | **($3,634,452.00)** | **$370,732,540.37** |
| 06/03/2025 | Kaiser Health Premium | ($46,000,000.00) | |
| | **Total Cash Flow** | **($46,000,000.00)** | **$324,732,540.37** |
| 06/04/2025 | CCSF Payroll Tax 1 | ($47,000,000.00) | |
| | **Total Cash Flow** | **($47,000,000.00)** | **$277,732,540.37** |
| 06/06/2025 | CCSF Payroll Tax 2 | ($11,000,000.00) | |
| | **Total Cash Flow** | **($11,000,000.00)** | **$266,732,540.37** |
| 06/18/2025 | 3135G04Z3 : FNMA 06/17/2025-47239 | $10,000,000.00 | |
| | 3135G04Z3 : FNMA 06/17/2025-47241 | $4,655,000.00 | |
| | CCSF Payroll Tax 1 | ($47,000,000.00) | |
| | **Total Cash Flow** | **($32,345,000.00)** | **$240,662,041.25** |
| 06/20/2025 | CCSF Payroll Tax 2 | ($11,000,000.00) | |
| | **Total Cash Flow** | **($11,000,000.00)** | **$229,662,041.25** |
| 06/23/2025 | 06367DNE1 : BMOCHG 06/23/2025-58483 | $50,000,000.00 | |
| | SFO Debt Service ACH | ($75,724,696.00) | |
| | Blue Shield CA Monthly ACH | ($15,000,000.00) | |

# Case Study: City and County of San Francisco (cont. 12 of 12)

## Immunization List



Bond Immunization Schedule
City and County of San Francisco
Last Run: 01/14/2025 7:53:05 AM Pacific
Last Reporting Date: 01/14/2025

Update Immunization Schedule

Excess Liquidity Amount: $0.00

- Bond has an immunization amount actively being applied
- Immunization date has excess inflows over desired excess liquidity amount
- Immunization amount applied is under total available bond proceeds
- Immunization amount applied is equal to total available bond proceeds
- Immunization amount applied exceeds total available bond proceeds
- Bond Purposely Not Immunized
- Bond Has Been Called

**Portfolio Bond Immunization List**

| Bond Description | Amount | Redemption Date | First Immunization Date | First Immunization Amount | Second Immunization Date | Second Immunization Amount | Third Immunization Date | Third Immunization Amount | Not Immunized |
|---|---|---|---|---|---|---|---|---|---|
| 4581X0CM8 : IADB 01/15/2025-47024 | $100,000,000.00 | 01/15/2025 | 01/15/2025 | $36,000,000.00 | 01/17/2025 | $11,000,000.00 | 01/31/2025 | $53,000,000.00 | |
| 459058HT3 : IBRD 01/15/2025-57878 | $29,314,000.00 | 01/15/2025 | 01/15/2025 | $11,000,000.00 | 01/27/2025 | $7,000,000.00 | 01/28/2025 | $11,314,000.00 | |
| 62479LNM3 : MUFGBK 01/21/2025-58427 | $17,000,000.00 | 01/21/2025 | 01/30/2025 | $17,000,000.00 | | | | | |
| 62479LNP6 : MUFGBK 01/23/2025-58032 | $15,000,000.00 | 01/23/2025 | 01/23/2025 | $15,000,000.00 | | | | | |
| 89233GNQ5 : TOYCC 01/24/2025-57934 | $60,000,000.00 | 01/24/2025 | 01/24/2025 | $53,000,000.00 | 01/28/2025 | $7,000,000.00 | | | |
| 3130B0MZ9 : FHLB 01/27/2025-57886 | $115,000,000.00 | 01/27/2025 | 01/27/2025 | $115,000,000.00 | | | | | |
| 78015JQ34 : RY 01/28/2025-57933 | $25,000,000.00 | 01/28/2025 | 01/28/2025 | $25,000,000.00 | | | | | |
| 89233GNU6 : TOYCC 01/28/2025-58027 | $50,000,000.00 | 01/28/2025 | 01/28/2025 | $50,000,000.00 | | | | | |
| 62479LNV3 : MUFGBK 01/29/2025-57929 | $50,000,000.00 | 01/29/2025 | 01/29/2025 | $50,000,000.00 | | | | | |
| 912828Z52 : T 01/31/2025-46989 | $50,000,000.00 | 01/31/2025 | 02/10/2025 | $50,000,000.00 | | | | | |
| 912828Z52 : T 01/31/2025-47011 | $50,000,000.00 | 01/31/2025 | 02/10/2025 | $50,000,000.00 | | | | | |
| 3133EPAG0 : FFCB 02/10/2025-57581 | $29,875,000.00 | 02/10/2025 | 02/10/2025 | $15,000,000.00 | 02/12/2025 | $11,000,000.00 | 02/14/2025 | $3,875,000.00 | |
| 3133EPAG0 : FFCB 02/10/2025-57582 | $10,000,000.00 | 02/10/2025 | 02/21/2025 | $10,000,000.00 | | | | | |
| 3137EAEP0 : FHLMC 02/12/2025-46422 | $15,000,000.00 | 02/12/2025 | 02/26/2025 | $15,000,000.00 | | | | | |
| 3137EAEP0 : FHLMC 02/12/2025-46423 | $5,000,000.00 | 02/12/2025 | 02/26/2025 | $5,000,000.00 | | | | | |
| 3137EAEP0 : FHLMC 02/12/2025-46424 | $5,000,000.00 | 02/12/2025 | 02/26/2025 | $5,000,000.00 | | | | | |
| 3137EAEP0 : FHLMC 02/12/2025-46425 | $5,000,000.00 | 02/12/2025 | 02/26/2025 | $5,000,000.00 | | | | | |
| 3137EAEP0 : FHLMC 02/12/2025-46426 | $50,000,000.00 | 02/12/2025 | 02/20/2025 | $40,000,000.00 | 02/21/2025 | $4,000,000.00 | 02/26/2025 | $6,000,000.00 | |
| 3137EAEP0 : FHLMC 02/12/2025-47022 | $53,532,000.00 | 02/12/2025 | 02/12/2025 | $36,000,000.00 | 02/14/2025 | $7,000,000.00 | 02/28/2025 | $10,532,000.00 | |
| 89233GPC4 : TOYCC 02/12/2025-58300 | $75,000,000.00 | 02/12/2025 | 02/27/2025 | $75,000,000.00 | | | | | |
| 62479LPC3 : MUFGBK 02/12/2025-58440 | $16,000,000.00 | 02/12/2025 | 02/27/2025 | $16,000,000.00 | | | | | |
| 3130AUVZ4 : FHLB 02/13/2025-57585 | $50,000,000.00 | 02/13/2025 | 02/21/2025 | $50,000,000.00 | | | | | |
| 62479LPL3 : MUFGBK 02/20/2025-58398 | $60,000,000.00 | 02/20/2025 | 02/27/2025 | $60,000,000.00 | | | | | |
| 62479LPM1 : MUFGBK 02/21/2025-58107 | $8,000,000.00 | 02/21/2025 | 02/21/2025 | $8,000,000.00 | | | | | |
| 06367DL94 : BMOCHG 02/24/2025-58047 | $76,000,000.00 | 02/24/2025 | 02/24/2025 | $65,000,000.00 | 02/26/2025 | $11,000,000.00 | | | |
| 13606K5B8 : CIBCNY 02/24/2025-58048 | $50,000,000.00 | 02/24/2025 | 02/24/2025 | $50,000,000.00 | | | | | |
| 912828ZC7 : T 02/28/2025-46977 | $50,000,000.00 | 02/28/2025 | 03/10/2025 | $50,000,000.00 | | | | | |
| 912828ZC7 : T 02/28/2025-46994 | $50,000,000.00 | 02/28/2025 | 03/10/2025 | $50,000,000.00 | | | | | |
| 3130AV7L0 : FHLB 02/28/2025-57602 | $25,000,000.00 | 02/28/2025 | 03/24/2025 | $25,000,000.00 | | | | | |
| 3130AV7L0 : FHLB 02/28/2025-57603 | $35,000,000.00 | 02/28/2025 | 03/24/2025 | $35,000,000.00 | | | | | |
| 3133ELQY3 : FFCB 03/03/2025-46467 | $24,000,000.00 | 03/03/2025 | 03/12/2025 | $24,000,000.00 | | | | | |
| 3133ELQY3 : FFCB 03/03/2025-46468 | $16,000,000.00 | 03/03/2025 | 03/12/2025 | $16,000,000.00 | | | | | |
| 62479LQA6 : MUFGBK 03/10/2025-58108 | $25,000,000.00 | 03/10/2025 | 03/10/2025 | $15,000,000.00 | 03/12/2025 | $10,000,000.00 | | | |
| 06367DLL7 : BMOCHG 03/12/2025-58240 | $90,000,000.00 | 03/12/2025 | 03/27/2025 | $90,000,000.00 | | | | | |
| PPGNJX1B4 : BKSANF 03/13/2025-58491 | $10,000,000.00 | 03/13/2025 | | | | | | | Yes |
| 62479LQE8 : MUFGBK 03/14/2025-58094 | $50,000,000.00 | 03/14/2025 | 03/15/2025 | $50,000,000.00 | | | | | |
| 62479LQE8 : MUFGBK 03/14/2025-58109 | $26,000,000.00 | 03/14/2025 | 03/14/2025 | $11,000,000.00 | 03/15/2025 | $15,000,000.00 | | | |
| 62479LQE8 : MUFGBK 03/14/2025-58441 | $70,000,000.00 | 03/14/2025 | 03/14/2025 | $70,000,000.00 | | | | | |

# QUESTIONS?

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