HEALTH ACTUARIES
A DIVISION OF RISK STRATEGIES

11611 N. MERIDIAN STREET
SUITE 330
CARMEL, IN 46032
317-575-7671

CalPERS Portfolio Return Analysis

By UHAS, a Division of Risk Strategies

5/29/2020

Purpose/Introduction

CalPERS requested that UHAS, a Division of Risk Strategies, produce expected asset yields for the CalPERS Long-Term Care ("LTC") Program by projecting the yields using the current assets, reinvestment assumptions, and asset defaults, along with the CalPERS LTC Program expected liability cash flows. The methodologies and modeling that UHAS utilized are common in the commercial LTC industry. The liability cash flows were from the CalPERS first-principle model that is used for the CalPERS LTC Annual Valuations. The projected assets were completed using the Moody's Actuarial software, AXIS. UHAS' asset modeling was reviewed by Valani, an independent AXIS consultant, and Valani's executive summary is in Appendix A.

The following report is meant to summarize the assumptions and methodologies used to model the CalPERS inforce asset and reinvestment portfolio. The CalPERS asset model is ran as-of 12/31/2019 and projected on a monthly basis for 61 years. Inforce assets and liabilities are projected along with a reinvestment portfolio to estimate future returns and asset holdings of the CalPERS portfolio.

Liability Projections

The model uses the 6/30/2018 liability projections input from the CalPERS First Principles model rolled forward to 12/31/2019.

Yield Curve

The CalPERS asset model projects the following flat treasury yield curve forward for all years:

Date	3 Mo	6 Mo	1 Yr	2 Yr	3 Yr	5 Yr	7 Yr	10 Yr	20 Yr	30 Yr
12/31/2019	1.55%	1.60%	1.59%	1.58%	1.62%	1.69%	1.83%	1.92%	2.25%	2.39%

Yield curve treasury rates are from the US government treasury website as-of 12/31/2019.

Inforce Portfolio Assets

Inforce assets from the CalPERS 12/31/2019 inforce portfolio are modeled as belonging to one of 5 asset groups to mirror the investment indices held by the CalPERS asset group. These five groups include: Bonds, TIPS, Equities, REITS, and Commodities. Bonds and TIPS are modeled individually at the Lot level, whereas Equities, REITS, and Commodities are all modeled at the index level.

Bonds and TIPS

Inforce data information was provided by Christine Reese at the CalPERS asset group, and includes the following data pieces:

1. Purchase Date
2. Issue Date
3. Maturity Date
4. Coupon Rate
5. Coupon Payment Mode
6. Par Value
7. Amortized Cost (current inforce book value)
8. Market value
9. Unrealized Gains/Losses
10. Credit Ratings from S&P, Fitch, and Moody's
11. Asset Class and Issue Type

Bond assumptions and projection methods depend on the asset class of the bond.

Treasury: Treasury bonds are modeled as standard bonds that pay an annual coupon based on the specified coupon rate and payment mode, with the principal repaid at the end of the bond. These bonds are assumed to have no defaults. Unrealized gains/losses are recognized at sale.

TIPS bonds: TIPS bonds are modeled like treasuries, but with an assumed inflation rate of 2% which increases the par value and paid coupons every year until maturity.

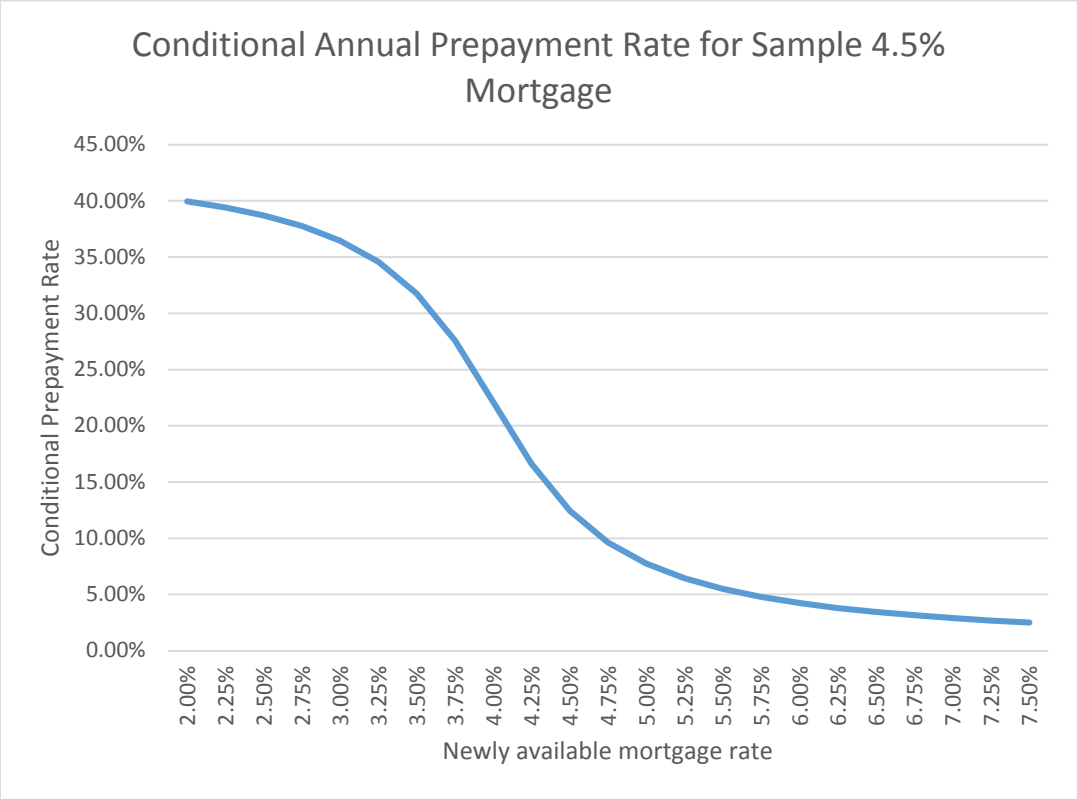
MBS (Mortgage Backed Securities): MBS securities are modeled to amortize monthly with the principal approaching zero at maturity. The coupon rate represents interest paid on the outstanding principal. All MBS assets are assumed to have a default rate equivalent to the AA S&P credit rating. The MBS category includes MBS, ABS, CMBS, and Equipment Trust Certificate assets.

MBS assets use a prepayment assumption. The prepayment assumptions show that some mortgage holders will pay their mortgage off early if they can get a more favorable lending rate from the market. The formula for the prepayment rate is given by the following equation:

Prepayment Rate = .2-0.14*(Arctan(6*(1.1-(Mortgage Rate/Market Rate)

The mortgage rate is the rate on the bond, while the market rate equal to the 10-year treasury rate + 3%.

The equation above is a modified and simplified Richard and Roll prepayment model. The chart below shows prepayment rates for a 4.5% mortgage.



Corporate Bonds (Domestic, foreign, municipal, other): These bonds are modeled like treasuries, but with a default rate based on their S&P or Moody's rating. Default rates for these bonds are based on credit ratings which range from AAA investment grade to CCC speculative grade. The S&P rating is used where possible, while the Moody's bond ratings are used for assets that do not have an S&P rating. Moody's ratings are mapped to the S&P ratings so that the ratings are always shown as S&P. For default modeling purposes, S&P ratings are floored at the CCC grade. Speculative bonds with high implied market yields have their maturity value capped at the ratio of the market value to par value to reflect the reduced likelihood of full payout at maturity.

Cash: A small amount of the Bond money is held as cash. The cash asset is assumed to return the 3-month treasury rate.

All bonds (except for MBS and speculative bonds) are assumed to be sold 7 years before maturity to maintain the portfolio duration, per the CalPERS asset group. The amount a bond is sold for is determined by the market value at the time of sale as calculated by AXIS.

Asset investment expenses (in addition to those modeled on the liability side) are assumed to equal .034% of the portfolio par value on an annual basis.

Book values for all bonds are based on amortized cost, assuming a constant yield to maturity. The prepayment assumption for mortgages accelerates amortization of premium or discount.

Market value yields are calculated by AXIS using the current market value and treasury yield curve. The current spread is solved for by the software; future market values are obtained by discounting the bond cash flows at the future date using this spread. It's possible for there to be multiple solutions to the market yield, and therefore UHAS specifies market return bounds for reasonable yields.

Default rate assumptions are based on table 14 from the following S&P study:
https://www.capitaliq.com/CIQDotNet/CreditResearch/RenderArticle.aspx?articleId=2227935&SctArtId=470720&from=CM&nsl_code=LIME&sourceObjectId=10963227&sourceRevId=1&fee_ind=N&exp_date=20290507-00:59:10

This study shows total default rates over time based on the S&P rating and asset duration. Annual default rates are backed out from this. Please see Exhibit 1 for these default rates. Defaults are assumed to occur on a semi-annual basis. The rates are net of any recoveries or salvage value.

All bonds with a default rate are assumed to have a 40% salvage (recovery) value on the face amount of the bond. The reasonableness of a 40% salvage rate is discussed in the following article:

https://www.forbes.com/sites/investor/2011/10/18/how-cheap-is-high-yield/#49d23676084d

Equities, REITS and Commodities

The asset groups Equities, REITS, and Commodities are all modeled as stock indices in AXIS. The market value, amortized cost, and par value are all set equal to the amount allocated to those funds as of 12/31/2019. As part of the CalPERS portfolio return review, UHAS independently determined appropriate best estimate returns for equity, REITS, and commodity asset indices. These return assumptions were developed using the index strategy sheets from State Street Global Advisors. Returns were given for the last 6 years 2014-2019, and from these returns the following average return and standard deviations were calculated:

	2014	2015	2016	2017	2018	2019	Average	Std Dev
Equities	4.12%	-1.94%	8.74%	24.31%	-9.82%	16.13%	6.33%	12.31%
REITS	15.33%	-0.16%	2.80%	10.69%	-4.86%	20.01%	6.94%	9.61%
Commodities	-33.28%	-33.05%	11.09%	5.29%	-14.14%	8.53%	-11.30%	20.54%

These index returns are assumed to incorporate asset returns, dividends, and defaults for all assets within each index fund.

For purposes of determining an acceptable range of average returns, UHAS assumed a 20-year future time horizon and 25% and 75% bounds for low and high returns assuming a normal distribution. To convert the standard deviation to a 20-year average return standard deviation, the following identity was used Var(avg X) = Var(X)/N where in this case N = 20. This gave the following range of returns:

	Average	Middle 25%-ile	Low Bound	High Bound
Equities	6.33%	1.86%	4.48%	8.19%
REITS	6.94%	1.45%	5.49%	8.39%
Commodities	0.00%	3.10%	-3.10%	3.10%

The average returns for commodities was floored at zero for purposes of this analysis. The historic returns indicate an average return of -11.3% over the past 6 years; however, investments with an expected negative return would be avoided in favor of holding cash and therefore the expectation of any investment index is at least 0%.

In comparing UHAS' return analysis for these asset categories, CalPERS most recent analysis of industry CMA's (Comparative Market Analysis) produced the following 10 Year and 20 Year Assumed Returns:

Index	CalPERS 10 - Year Return	CalPERS 20 - Year Return	CalPERS 20-Year Cumulative Distribution
Public Equity	6.18%	6.89%	61.8%
REITs	6.27%	6.89%	48.5%
Commodities	2.43%	3.51%	87.1%

Given the long-term nature of the CalPERS liability projection, UHAS used the CalPERS 20-year returns for all years of their asset projection to give the baseline returns. The CalPERS 20-year Cumulative Distribution demonstrates where the CalPERS assumed returns fall within the normally distributed range of expected UHAS returns (with 50% being equal to the expected UHAS return, above 50% being higher, and below 50% being lower). This indicates that CalPERS equity and REITS returns are close to the assumed UHAS returns, but the assumed returns for commodities are higher than UHAS expected return.

As a possible improvement, UHAS would like to extend the historic returns from 6 years back to 10 years or more assuming these index funds have this historical data.

Reinvestment and Portfolio Balancing

The reinvestment portfolio for future asset purchases is based on current portfolio allocations. The grid below shows the reinvestment categories.

Reinvestment Asset	Investment Grade	Duration	Allocation	Yield Spread*
Treasury - 10 Yr	N/A	10	8.1%	N/A
Treasury - 30 Yr	N/A	30	16.3%	N/A
MBS 30yr	Default Rate AA	30	14.8%	1.60%
MBS 15yr	Default Rate AA	15	1.8%	1.12%
CMBS	Default Rate AA	30	1.6%	1.24%
Corporate Global 10 Yr A	Default Rate A	10	2.6%	1.29%
Corporate Global 10 Yr BBB	Default Rate BBB	10	4.0%	2.40%
Corporate Global 30 Yr A	Default Rate A	30	3.2%	1.33%
Corporate Global 30 Yr BBB	Default Rate BBB	30	4.8%	2.16%
Corporate Domestic 10 Yr A	Default Rate A	10	0.5%	1.58%
Corporate Domestic 10 Yr BBB	Default Rate BBB	10	0.5%	2.51%
Corporate Domestic 30 Yr A	Default Rate A	30	1.3%	1.49%
Corporate Domestic 30 Yr BBB	Default Rate BBB	30	1.3%	2.40%
TIPS 10 YR	N/A	10	4.8%	N/A
TIPS 30 YR	N/A	30	1.2%	N/A
REIT	N/A	N/A	15.0%	6.94%
Equities	N/A	N/A	12.0%	6.33%
Commodities	N/A	N/A	6.0%	0.00%

*REITS, Equities, and Commodities use a growth rate instead of a spread

AXIS rebalances the portfolio every month by buying and selling these asset groups until the target allocations are met, along with reinvestment any asset and liability cash inflows. All inforce assets are also assigned to one of the above groups as well for purposes for calculating the allocations.

All allocations and yield spreads are estimated from the current inforce assets, as well as target allocations from the CalPERS asset group. The CalPERS asset group uses the following overall target allocations:

Asset Group	Allocation
Bonds	61%
REITS	15%
Equities	12%
TIPS	6%
Commodities	6%

Bond Type	Allocation
Treasury	40%
MBS	30%
Corporate	24%
Sovereign - Foreign*	3%
High - Yield*	3%

*These groups are rolled into the corporate group for modeling purposes

Allocation estimates from CalPERS inforce assets are used to further divide the Bonds and TIPS groups into smaller asset groups. Bond groups were further subdivided in the following allocations:

Treasury	Allocation
30 Year	66.66%
10 Year	33.33%

TIPS	Allocation
30 Year	20%
10 Year	80%

Corporate Bond	Allocation
Global	80%
Domestic	20%

MBS	Allocation
MBS 15yr	10%
MBS 30yr	81%
CMBS	9%

Domestic Bond	Allocation
Duration - 10 Year	30%
Duration - 30 Year	70%
Credit - A Rating	50%
Credit - BBB Rating	50%

Global Bond	Allocation
Duration - 10 Year	45%
Duration - 30 Year	55%
Credit - A Rating	40%
Credit - BBB Rating	60%

Duration Allocations: Inforce assets less than 20 years of duration were grouped into the 10-year category, all other assets were grouped into the 30-year category.

Credit Allocations: Inforce assets S&P rating A- or grater were grouped into the A category. All other assets were grouped into the BBB category

Yield spreads were estimated by averaging the current yield for each bond group of inforce assets and then backing out the treasury rate. Due to prepayments, 15-year MBS assets are modeled with the 7-year treasury rate, and 30-year MBS are modeled with the 10-year treasury rate.

Resolved Issues

Several remaining items from the previous report were resolved. They include the following:

1. Previous Issue: Currently the model assumes a flat rate for all equities for all future years. The CalPERS asset group mentioned that there are separate assumed returns for years 1-10 and years 11+. We are currently waiting for these return assumptions.

Resolution: UHAS developed their own equity return assumptions to use.

2. Previous Issue: TIPS inforce book values are currently marked-to-market due to modeling limitations. This may be addressed with Moody's in the future so that amortized cost may be used instead. The impact of this revision should be small.

Resolution: Lower limits for TIPS book returns specified in AXIS were too high for the given inflation rate and treasury yield curve. The minimum bound was lowered to -3% and the set rate for out of bounds was lowered calculations to 2%, which fixed the book value calculation. TIPS book returns are no longer marked-to-market.

3. Previous Issue: AXIS currently calculates the future market value of assets by backing out an implied spread from the current market value. It's possible that there can be multiple solutions to this calculation, some of which are unrealistic. This issue is causing the calculated market spreads to be too high for some treasuries and the market value too low. Since many bonds and all treasuries are sold 7 years before maturity, the model implies that some of these bonds are being sold for a loss due to low market value. We are working on adding bounds to this calculation in AXIS.

Resolution: UHAS added bounds to the implied yield calculation (-2% lower bound, 35% upper bound) to all bonds, and AXIS now calculates reasonable market yields for these assets.

Summary of Initial Results

Please see appendix B for a step-through from the earlier reported results to the current results, as well as projected returns under the UHAS upper and lower bound average equity returns. This step-through also includes fixes from the "resolved issues" section of this report. The UHAS best estimate projected earned rate (see "New Run 3" in Appendix B) tends to fluctuate around 4% or slightly less, and the projected yields stop in 2044 because in 2045 the assets are projected to be depleted. The model continues to run all projection years despite the negative asset balance.

Assumptions and methodologies can be reviewed with CalPERS for additional approaches and refinements.

Conclusion

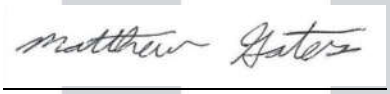
The range of results presented in this document represent reasonable expectations, but all scenarios presented show that assets along with current funding levels are eventually inadequate. Therefore,

additional funding is expected to be required over time. Identification of alternative approaches to pursuing funding options is beyond the scope of this document. The UHAS team is available for further review and discussion of funding alternatives.

Caveats/Limitations

- UHAS has performed the work assigned and prepared this report assuming it will be utilized by persons technically competent in the areas addressed and for the stated purpose. Judgments should be made only after studying this report in its entirety. We are available to explain and/or amplify anything presented in this report, and it is assumed that the user of this report will seek such explanation and/or amplification regarding any matter in question.
- Nothing included in this report is to be used in any filings with any public body such as the Securities and Exchange Commission or State Insurance Departments, without prior written approval from UHAS. Any distribution of this report must be in its entirety.
- The assumptions underlying the projection results summarized in this document and attachments are based on Program data and experience, industry data and experience, discussions with Program management, and informed judgment. We believe the assumptions used are reasonable in the aggregate based on the data/information we have and based on our experience; however, future experience will invariably be different from the projected experience, and other knowledgeable individuals could have different opinions about the appropriateness of any or all of the assumptions used.
- In preparing this report, we have complied with all relevant Actuarial Standards of Practice and any other relevant documents published by the American Academy of Actuaries.
- As indicated previously, this report is not meant to serve as complete actuarial documentation. Much additional relevant data/information is available for distribution and can be provided upon request.
- We relied on data and information supplied by Christine from CalPERS and SSGA personnel for the inforce asset dataset as-of 12/31/2019. Sources for the default assumptions are cited in the default assumptions section. We have not audited or independently verified the information furnished to us. Although we have no reason to suspect the integrity of the underlying data, to the extent that the data are materially flawed, the results of our analysis may be materially impacted.
- The valuation liability projections are based on projections from the CalPERS actuarial office as-of 06/30/2018 rolled forward to 12/31/2019.
- The validity of these projections depends on how actual future experience compares to the asset and liability assumptions that are based upon our evaluation of recent experience and anticipated future trends. Actual experience could be more or less favorable. To the extent that actual experience differs from the assumptions underlying this report, actual results will differ from the projection results presented in this report.
- The projections provided are believed to be reasonable and based on a reasonable range of assumptions, but actual results will vary.

- The range of assumptions and therefore results, are centered around best estimates, but do not include significant consideration of moderately adverse conditions.
- Asset values and expectations are based on the investment environment as of 12/31/2019. The projections do not reflect the investment and economic environment that has emerged in the first four months of 2020.



Matthew Gates, FSA, MAAA

Consulting Actuary

UHAS Inc, a Division of Risk Strategies

June 2, 2020
Date

Clark A. Heitkamp, FSA, MAAA, LTCP

Senior Consulting Actuary

UHAS Inc, a Division of Risk Strategies

June 2, 2020
Date

Appendix A – Valani's Executive Summary

Valani Global Inc was hired to perform a review of an asset model created for the California Public Employees' Retirement System (CalPERS) by United Health Actuarial Services Inc.(UHAS) in Moody's Analytics AXIS® Software. The review included a review of assets, asset details, supporting data, and the process to extract, transform and load the data into AXIS. The review included recommended best practices, assistance with some assumptions, common industry approaches to modeling, validation of the model, and recommended sensitivities.

This report was designed and intended for the internal use of CalPERS and UHAS only, and the distribution of this summary is governed by the agreement between those parties and Valani Global, Inc, and may be distributed to the company's staff, directors, auditors, managers, officers, and third parties upon approval from Valani Global. Although Scott Houghton of Valani Global reviewed the assumptions, it should be recognized that future experience will differ from expected. The review was limited to the in-force and reinvestment assets in the model; long-term care liability cash flows were not reviewed.

The model includes equities, REITs, Commodities, CMOs, MBS, corporate bonds, treasury bonds, and TIPS. Valani confirmed that the AXIS model is structured to reflect the material risks of the asset portfolio, including market risk, interest rate risk, call or prepayment risk, credit risk, liquidity risk, and inflation risk. Recommendations for future sensitivity testing have been provided. Valani assisted UHAS with appropriate prepayment and asset default assumptions for the model.

- Valani tested and/or reviewed model results created by UHAS for the validation steps below. All material findings were addressed by UHAS.
- High level review of asset and liability results. Review of projected metrics, including book value, market values, cash flow, and investment income all show reasonable results.
- Review of output and yields from reinvestment assets all show reasonable results.
- Reviewed and analyzed book value and market value projection of asset classes; all results are reasonable.
- Reviewed market yields and book yields for individual inforce assets. The results are reasonable.
- Analysis of bonds, mortgages, MBS, CMOs and other interest sensitive assets with parallel interest rate shifts input into scenarios to test prepayment assumptions. The results indicate higher prepayments under lower interest rates and that the assumption works as intended. Assets without prepayment provisions are identical under all scenarios as intended.
- Audit of data and model by researching a sample of a few selected CUSIPs; all data matched 3rd party sources.
- Exported asset parameters and assumptions in AXIS to spreadsheet and verify coupon rates, maturities, and asset assumptions matched the source input values.
- Reviewed and/or resolved warning messages and error messages created by the system.

We have concluded after our review that the model is appropriate for its primary intended purpose, which is assisting CalPERS in setting a discount rate for long-term care liabilities.

Exhibit 1

U.S. Corporate Average Default Rates By Rating Modifier (1981-2018)

(%)	--Time horizon (years)--														
Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AAA	-	0.0004	0.0013	0.0012	0.0012	0.0013	0.0004	0.0008	0.0009	0.0008	0.0005	0.0004	0.0005	0.0009	0.0010
AA+	-	0.0008	-	0.0009	0.0010	0.0009	0.0010	0.0010	0.0011	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012
AA	0.0003	0.0002	0.0008	0.0018	0.0018	0.0016	0.0016	0.0013	0.0011	0.0013	0.0011	0.0009	0.0014	0.0009	0.0009
AA-	0.0005	0.0006	0.0014	0.0008	0.0009	0.0015	0.0013	0.0009	0.0007	0.0006	0.0007	0.0007	-	0.0004	0.0008
A+	0.0005	0.0007	0.0016	0.0022	0.0016	0.0015	0.0018	0.0015	0.0021	0.0021	0.0019	0.0020	0.0023	0.0027	0.0023
A	0.0007	0.0012	0.0012	0.0017	0.0018	0.0021	0.0020	0.0021	0.0027	0.0030	0.0023	0.0019	0.0015	0.0012	0.0021
A-	0.0009	0.0017	0.0017	0.0015	0.0018	0.0025	0.0032	0.0025	0.0018	0.0014	0.0018	0.0020	0.0020	0.0012	0.0011
BBB+	0.0015	0.0026	0.0027	0.0031	0.0039	0.0040	0.0029	0.0032	0.0035	0.0033	0.0029	0.0018	0.0020	0.0032	0.0036
BBB	0.0021	0.0035	0.0029	0.0044	0.0043	0.0042	0.0044	0.0046	0.0048	0.0051	0.0051	0.0038	0.0033	0.0013	0.0026
BBB-	0.0025	0.0041	0.0063	0.0074	0.0082	0.0082	0.0073	0.0069	0.0058	0.0056	0.0056	0.0047	0.0043	0.0069	0.0049
BB+	0.0043	0.0087	0.0100	0.0117	0.0118	0.0121	0.0110	0.0077	0.0090	0.0091	0.0066	0.0081	0.0075	0.0052	0.0075
BB	0.0068	0.0117	0.0198	0.0176	0.0173	0.0160	0.0141	0.0125	0.0110	0.0103	0.0107	0.0086	0.0061	0.0044	0.0056
BB-	0.0099	0.0236	0.0253	0.0259	0.0226	0.0226	0.0188	0.0198	0.0168	0.0147	0.0113	0.0104	0.0111	0.0104	0.0092
B+	0.0207	0.0387	0.0396	0.0358	0.0293	0.0234	0.0227	0.0202	0.0191	0.0178	0.0148	0.0100	0.0100	0.0095	0.0093
B	0.0363	0.0492	0.0466	0.0364	0.0305	0.0292	0.0203	0.0143	0.0137	0.0130	0.0106	0.0113	0.0097	0.0080	0.0084
B-	0.0767	0.0843	0.0695	0.0535	0.0406	0.0312	0.0243	0.0170	0.0095	0.0090	0.0103	0.0079	0.0052	0.0058	0.0063
CCC/C	0.2892	0.1525	0.0928	0.0633	0.0506	0.0247	0.0312	0.0203	0.0191	0.0159	0.0154	0.0126	0.0135	0.0127	-
Investment grade	0.0011	0.0020	0.0022	0.0029	0.0030	0.0031	0.0028	0.0028	0.0029	0.0028	0.0027	0.0022	0.0021	0.0020	0.0022
Speculative grade	0.0407	0.0411	0.0373	0.0314	0.0262	0.0226	0.0194	0.0164	0.0149	0.0137	0.0115	0.0099	0.0091	0.0080	0.0079
All rated	0.0179	0.0178	0.0161	0.0137	0.0115	0.0101	0.0086	0.0074	0.0068	0.0063	0.0054	0.0045	0.0041	0.0038	0.0037

Sources: S&P Global Fixed Income Research and S&P Global Market Intelligence's CreditPro

Appendix B

Projected Returns on CalPEERS Assets to the Last Year of Positive Asset Portfolio

	Prior Run	New Run 1	New Run 2	New Run 3	New Run 4	New Run 5
Year	Prior Earned Rate with Approximation - 4/17/2020	New Earned Rate with Fixed Treasury and TIPS Projections, 40% Default Salvage	New Earned Rate with Projection Fixes and CalPERS Equity Assumptions (20Y Returns All Years)	New Earned Rate with UHAS Best Estimate Equity Assumptions	New Earned Rate with UHAS High Range Equity Assumptions	New Earned Rate with UHAS Low Range Equity Assumptions
2020	4.52%	4.58%	4.77%	4.37%	5.14%	3.60%
2021	4.00%	4.13%	4.35%	4.07%	4.72%	3.43%
2022	3.98%	4.05%	4.28%	3.99%	4.65%	3.34%
2023	3.91%	3.92%	4.15%	3.87%	4.52%	3.22%
2024	4.01%	3.99%	4.22%	3.94%	4.60%	3.29%
2025	4.03%	4.08%	4.31%	4.03%	4.68%	3.37%
2026	3.89%	3.95%	4.18%	3.90%	4.56%	3.24%
2027	3.96%	4.07%	4.30%	4.01%	4.67%	3.35%
2028	4.01%	4.15%	4.38%	4.10%	4.75%	3.44%
2029	3.82%	4.03%	4.27%	3.98%	4.64%	3.32%
2030	3.90%	4.13%	4.36%	4.08%	4.74%	3.42%
2031	3.96%	4.23%	4.46%	4.18%	4.82%	3.53%
2032	3.66%	4.07%	4.31%	4.02%	4.68%	3.35%
2033	3.84%	4.20%	4.43%	4.15%	4.79%	3.50%
2034	3.93%	4.34%	4.56%	4.29%	4.92%	3.67%
2035	3.81%	4.18%	4.41%	4.13%	4.77%	3.47%
2036	3.94%	4.37%	4.59%	4.33%	4.93%	3.73%
2037	4.07%	4.59%	4.78%	4.55%	5.09%	4.04%
2038	3.61%	4.28%	4.49%	4.23%	4.84%	3.63%
2039	4.11%	4.56%	4.73%	4.52%	5.03%	4.15%
2040	4.40%	4.88%	4.99%	4.87%	5.22%	5.07%
2041	3.68%	4.28%	4.48%	4.25%	4.81%	3.82%
2042		4.36%	4.51%	4.34%	4.81%	
2043		5.16%	4.98%	5.34%	5.07%	
2044		3.30%	4.05%	2.59%	4.56%	
2045			5.31%		4.89%	