NCIA Implementation Benchmark Whitepaper

Rationale, Structure, Dynamic Attribution Layer, and Historical Backfill

Prepared for	NCIA Board
Prepared by	NCIA Staff
Purpose	Document the Implementation Benchmark rationale, structure, operating rules, attribution layer, and historical backfill approach
Date	May 2026

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1. Executive Summary

This paper documents the rationale, structure, and operating methodology for the North Carolina Retirement Systems (NCRS) Implementation Benchmark. It is anchored in the Board-approved Investment Policy Statement (IPS), effective February 25, 2026, and is intended to provide a clear operating specification for performance oversight, custodian calculation, and consistent performance reporting.

The IPS establishes three formal total-plan performance benchmarks: the Actuarial Assumed Rate of Return of 6.50%, the Reference Portfolio Benchmark of 65% MSCI ACWI IMI (net) and 35% ICE BofA 5+ Years U.S. Treasury, and an Implementation Benchmark. The IPS establishes the Implementation Benchmark at the total-plan architecture level and delegates the Implementation Benchmark components, methodology, maintenance, and updates to the CIO.

The CIO-approved methodology defines the Implementation Benchmark as a hierarchical, total-return, U.S.-dollar-based custom composite. Static policy weights apply at the primary strategic asset-class levels, while dynamic (actual market value) weights apply within designated floating sleeves.

In addition, NCIA may maintain a Dynamic Implementation Benchmark, which applies actual portfolio weights at the strategic nodes of the benchmark hierarchy. This benchmark serves as a complementary attribution tool to distinguish between policy allocation decisions and implementation effects.

Core documentation conclusion
The Implementation Benchmark should be maintained as a transparent benchmark hierarchy: IPS static weights at strategic nodes and actual monthly market-value weights within implementation sleeves where the IPS does not set fixed sub-sleeve targets. The Dynamic Implementation Benchmark is an internal attribution layer, not a fourth formal IPS benchmark.

2. IPS Strategic Asset Allocation Overview

The IPS strategic asset allocation provides the high-level structure that the Implementation Benchmark must reflect. The IPS organizes the Pension Fund around Equity, Debt, and Multi-Strategy, with selected sub-targets for Corporate Equity, Real Asset Equity, Investment Grade, Credit, and Cash. These strategic targets define the static weighted nodes of the Implementation Benchmark hierarchy.

The IPS does not define fixed strategic allocation targets for all lower-level implementation sleeves. For example, the IPS provides ranges for Public Equity and Private Equity, and for Infrastructure and Natural Resources and Real Estate, but does not assign a fixed policy weight to every implementation sleeve used in portfolio construction. As a result, lower-level benchmark weights are intentionally dynamic and asset-weighted to reflect actual portfolio construction rather than impose artificial policy targets where none exist.

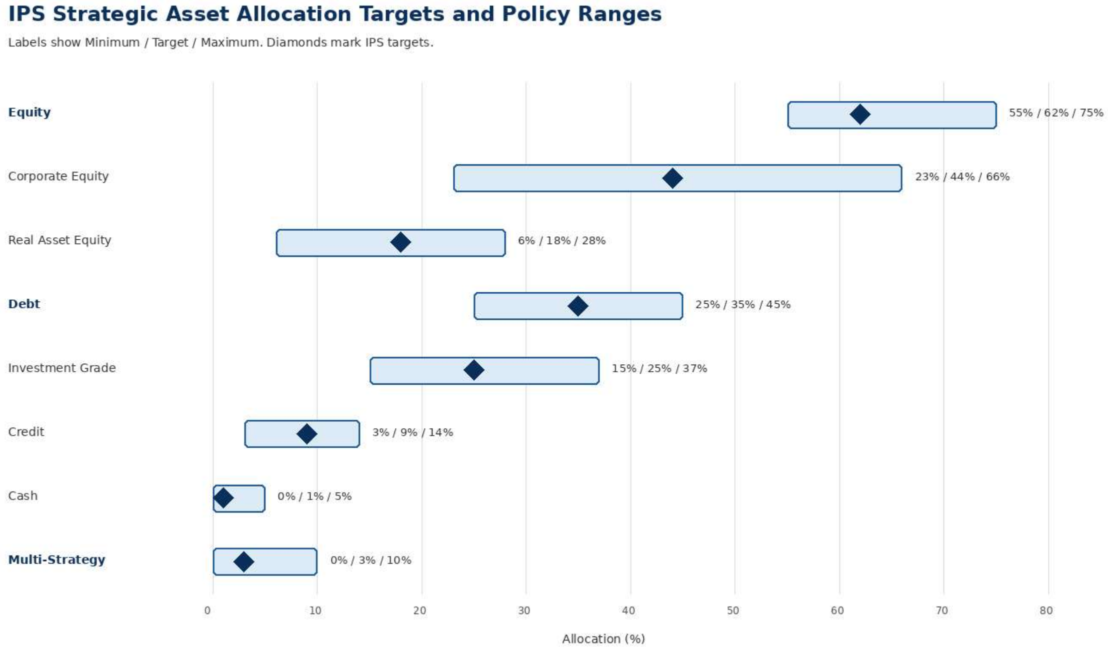


Exhibit 1. IPS strategic asset allocation targets and policy ranges.

3. Benchmark Architecture

The benchmark architecture is designed to answer distinct questions without conflating funding sufficiency, passive opportunity cost, implementation structure, and attribution diagnostics.

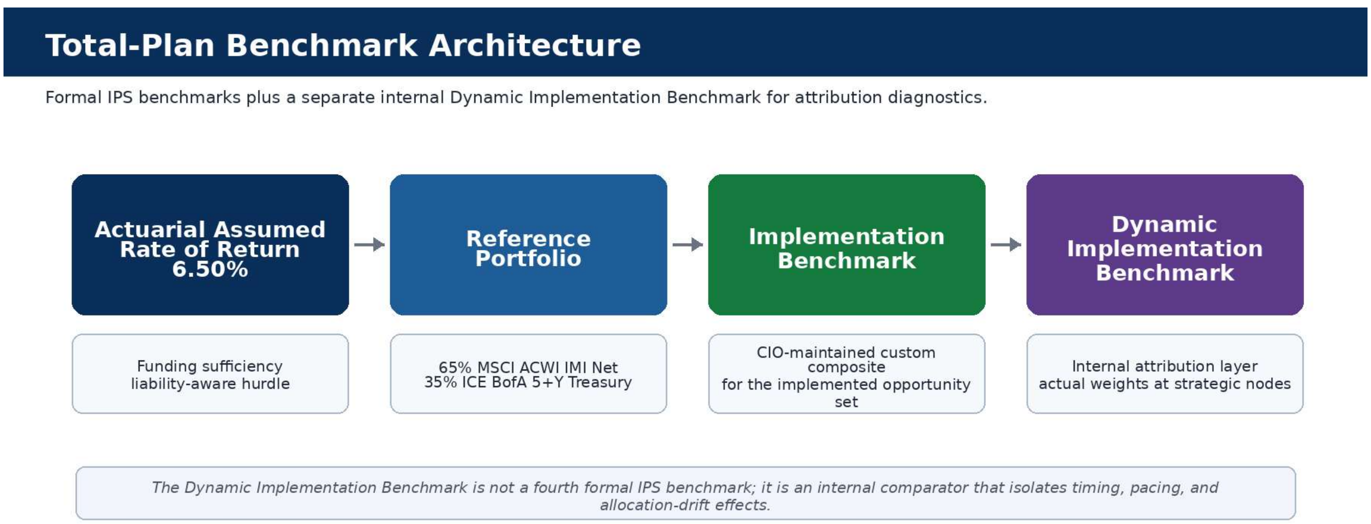


Exhibit 2. Total-plan benchmark architecture and governance purpose.

Benchmark	Primary question	Governance use
Actuarial Assumed Rate of Return	Is the Fund earning enough to support long-term funding assumptions?	Funding sufficiency and liability-aware performance context for the long-term
Reference Portfolio	Are strategic and tactical deviations from a low-cost passive market baseline adding value?	Passive opportunity-cost test over the market cycle

Benchmark	Primary question	Governance use
Implementation Benchmark	Are CIO, staff, managers, tactical allocations, pacing decisions, and transition execution adding value relative to the asset class specific benchmarks that reflect the implementation opportunity sets?	Board and management oversight of performance relative to opportunity sets over shorter- and longer-periods.
Dynamic Implementation Benchmark	How much of performance is driven by actual asset allocation vs policy weights?	Internal attribution layer; not a formal IPS benchmark

4. Implementation Benchmark Methodology

Subject to the IPS and the CIO's delegated authority, the NCIA Implementation Benchmark shall be a total-return, USD-based, multi-level custom benchmark composed of broadly diversified, industry-standard asset-class indexes. Static policy weights shall apply at designated strategic levels. Floating sleeves shall use monthly market values of the underlying subcomponents. The weighting schemes will be applied to monthly returns when aggregating to a higher level benchmark.

Public-market and private-market benchmark returns shall be calculated and reported monthly. Public-market benchmarks will use official monthly total-return index data. Private-market benchmarks will be incorporated using official provider returns, typically reported quarterly with a lag.

For interim monthly reporting, the custodian will apply a proxy methodology that aligns quarterly benchmark returns with monthly portfolio reporting, ensuring consistency between portfolio and benchmark measurement. The methodology must be documented in the Benchmark Master File and applied consistently across live reporting and historical backfill.

Operating principle	Application
Total return only	Use total-return series for all benchmarks; avoid price-only series.
USD base currency	Report total-plan, asset-class, and sub-asset benchmark returns in the same currency as the Fund.
Monthly calculation frequency	Both portfolio and benchmark returns will be calculated and reported monthly.
Monthly strategic rebalancing	Rebalance static nodes back to IPS policy weights monthly unless formally suspended during a strategic transition.
Monthly market-value weighting	Use monthly portfolio market values for floating nodes to avoid look-ahead bias.
Private-market lag discipline	Use official provider returns when available; apply a documented quarterly-to-monthly convention for interim and backfilled monthly reporting.

5. Benchmark Composition and Operating Rules

The Implementation Benchmark is organized as a weighted benchmark hierarchy that is representative of the asset allocation described within the IPS. Policy weights are fixed at the strategic nodes of the hierarchy; lower nodes use floating, dynamic, or asset-weighted weights based on the portfolio's monthly market value invested in each node.

The IPS defines target allocations at the primary asset-class level (Equity, Debt, Multi-Strategy) and selected sub-asset categories (e.g., Corporate Equity, Real Asset Equity) but does not define fixed strategic allocation targets for underlying implementation sleeves such as Private Equity, Public Equity, Infrastructure, or Real Estate.

As a result, these lower-level benchmark weights are intentionally dynamic (asset-weighted) to reflect actual portfolio construction and avoid imposing artificial policy constraints where none exist.

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Benchmark Index	Policy Weight	In Next Level Up	Weight Method
Total Trust						Composite of Level 1 Benchmarks	100%		
Total Trust (100%)	Debt 35%					Composite Return of Level 2 Benchmarks	35%	Yes	Static
		Cash				ICE 3m Tbill Index Total Return	1%	Yes	Static
		Credit				MSCI Global Private Credit Index	9%	Yes	Static
		Investment Grade				ICE BAML Custom Index (H167). 35% ICE BofA 5+ Year Investment Grade Corporates, 35% ICE BofA Mortgage Master, 30% ICE BofA 5+ Year Governments.	25%	Yes	Static
	Equity 62%					Composite Return of Level 2 Benchmarks	62%	Yes	Static
		Corporate Equity				Composite Return of Level 3 Benchmarks	44%	Yes	Static
			Private Equity			MSCI Global Private Equity		Yes	Dynamic (Actual Wgt)
			Public Equity			MSCI ACWI IMI Net		Yes	Dynamic (Actual Wgt)
		Real Asset Equity				Composite Return of Level 3 Benchmarks	18%	Yes	Static
			Infrastructure & Natural Resources			MSCI Global Private Infrastructure and Natural Resources Index		Yes	Dynamic (Actual Wgt)
			Real Estate			Composite Return of Level 4 Benchmarks		Yes	Dynamic (Actual Wgt)
				Private Real Estate		MSCI US Private Real Estate Index		Yes	Dynamic (Actual Wgt)
					Core	NCREIF ODCE		No	
					Non Core	MSCI US Private Opportunistic and Value Add Real Estate Index		No	
				Public Real Estate		FTSE EPRA NAREIT Global		Yes	Dynamic (Actual Wgt)
	Multi Strategy 3%					Pivotal Path MultStrategy Index	3%	Yes	Static
		Alpha Book						No	
		Total Portfolio						No	

6. Benchmark Selection Principles

Benchmark selection should prioritize the characteristics commonly associated with effective benchmarks: unambiguous, investable to the greatest extent possible, measurable, appropriate, reflective of current investment options, specified in advance, and accountable to the decision maker. For private markets, NCIA will prioritize appropriateness to the modeled and implemented private investable universe even when a benchmark is less investable than a public-market proxy.

Sleeve	Preferred benchmark	Rationale
Cash	ICE 3-Month T-Bill Total Return	Clean liquidity benchmark for funded cash and collateral balances.
Credit	MSCI Global Private Capital Credit Universe	Best fit for a credit allocation spanning direct lending, asset-backed debt, real-estate debt, infrastructure debt, and natural-resources debt.
Investment Grade	ICE BofA Custom H167 (35% IG 5+ Year Corporates, 35% Mortgage Master, 30% 5+ Year Govt)	Best fit to the IPS-directed government, corporate, and mortgage mix and expected duration role; strong custom-index documentation.
Private Equity	MSCI Global Private Capital Equity Universe	Broad, rules-based private equity benchmark family integrated with MSCI private capital analytics.
Public Equity	MSCI ACWI IMI Net	Comprehensive global equity opportunity-set proxy and consistent with the Reference Portfolio equity component.
Infrastructure and Natural Resources	Composite MSCI Global Private Capital Infrastructure and Natural Resources Universe	Best match to a private real-assets implementation; liquid public proxies should be limited to staging.
Private Real Estate	MSCI Private Capital US Real Estate Universe	Best match for a US focused private real estate mandate
Public Real Estate	FTSE EPRA Nareit Global	Direct, investable, globally recognized listed real-estate benchmark.
Multi Strategy	PivotalPath Multistrategy Universe	Closer peer context for an institutional multi-strategy alpha book.

The key conclusion is that NCIA will use broad private-market benchmarks for private sleeves where they best represent the intended investable universe. Liquid public proxies will be retained for transition analytics, staging analysis, and diagnostics, but will not displace private-market benchmarks as the primary benchmark for private sleeves.

7. Dynamic Implementation Benchmark and Attribution

NCIA will maintain a Dynamic Implementation Benchmark for internal attribution. The Dynamic Implementation Benchmark applies actual portfolio weights at the strategic nodes of the benchmark hierarchy and uses the same underlying benchmark return series used in the Implementation Benchmark. It is not a fourth formal IPS benchmark.

The Dynamic Implementation Benchmark is designed to answer how much performance is driven by actual asset allocation relative to policy weights. It helps distinguish the performance impact of strategic policy structure, transition/pacing, and implementation execution.

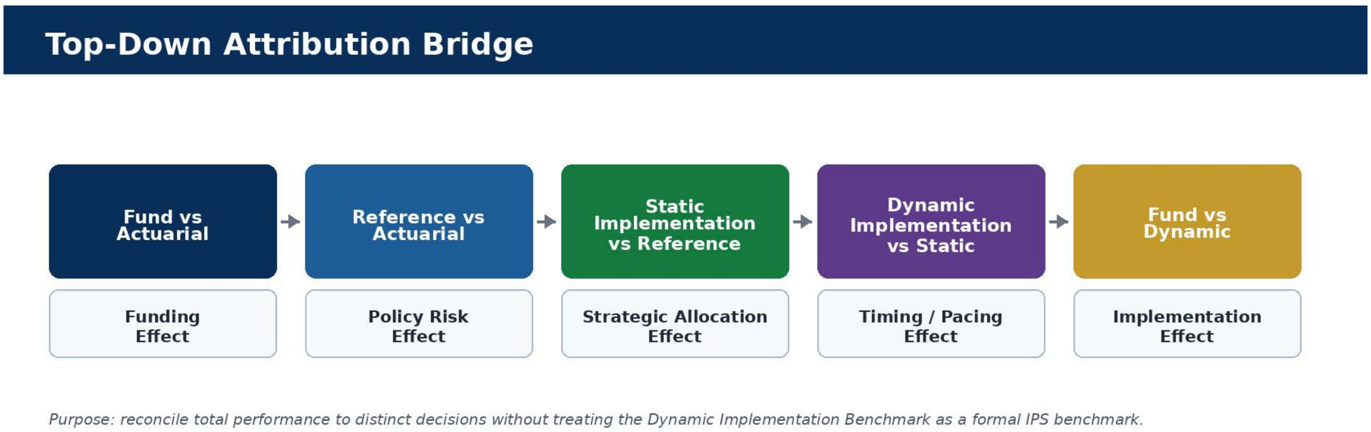


Exhibit 4. Top-down attribution bridge using the Dynamic Implementation Benchmark as an internal attribution layer.

Attribution layer	Effect	Interpretation
Fund vs Actuarial	Funding Effect	Measures whether actual returns exceed the funding hurdle.
Reference vs Actuarial	Policy Risk Effect	Measures whether passive public-market risk exposure is sufficient relative to the actuarial hurdle.
Static Implementation vs Reference	Strategic Allocation Effect	Measures the effect of the approved implementation structure relative to the Reference Portfolio.
Dynamic Implementation vs Static	Timing / Pacing Effect	Measures the impact of actual allocation weights, transition pace, and allocation drift.
Fund vs Dynamic	Implementation Effect	Measures manager selection, security selection, execution, and cost effects after adjusting for actual allocation weights.

Attribution measure	Formula
Reference Portfolio return	R_RP,t = 0.65 x R_ACWIIMI,t + 0.35 x R_UST5+,t
Static Implementation Benchmark return	R_SIB,t = sum_i w_policy,i x r_impl,i,t
Dynamic Implementation Benchmark return	R_DIB,t = sum_i w_actual,i, x r_impl,i,t
Strategic allocation effect	SA_t = R_SIB,t - R_RP,t
Timing / pacing effect	TP_t = R_DIB,t - R_SIB,t
Implementation effect	IMPL_t = R_Fund,t - R_DIB,t
Total value-add versus Reference Portfolio	R_Fund,t - R_RP,t = SA_t + TP_t + IMPL_t

8. Historical Benchmark Return Backfill

Benchmark returns prior to March 2026 (first month post NCIA IPS effective date) will be preserved and incorporated into the new implementation benchmark at the total benchmark level, and underlying levels where the underlying asset classes are similar. This will ensure the benchmark returns reflect the historical governance and mandate structure. For new asset classes or where asset class components changed materially, historical benchmark returns that aggregate into higher levels of the implementation benchmark will be retroactively backfilled using the new benchmark and or a new composite weighting of underlying prior benchmarks.

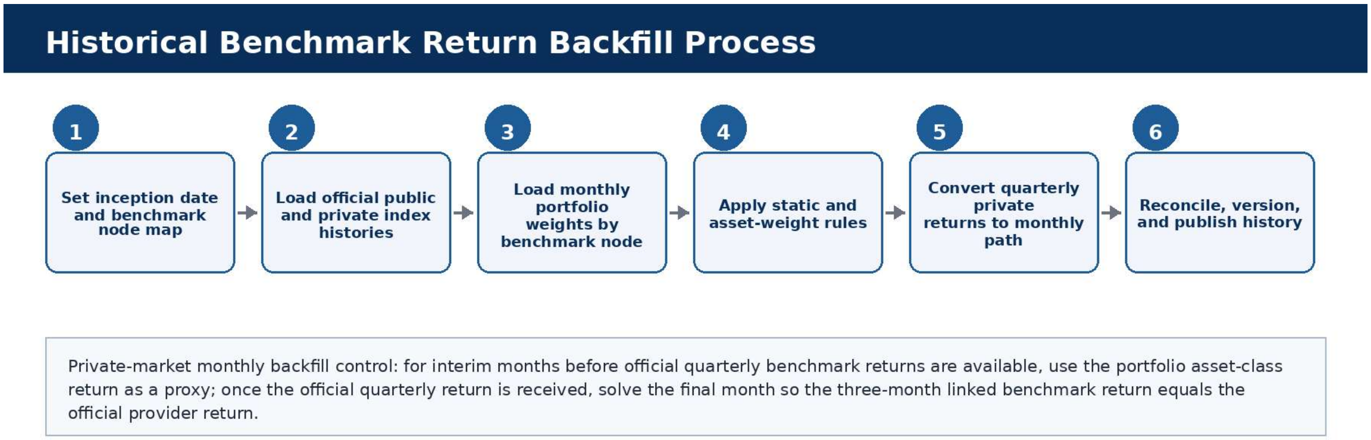


Exhibit 5. Historical benchmark return backfill process.

8.1 Backfill principles

- Backfilled returns should use the same benchmark hierarchy and node definitions and weighting methodologies used for live reporting for those asset classes that are new or have materially changed in structure retroactively due to the asset retroactive remapping.
- Static strategic nodes will be backfilled using the 2026 board approved IPS target weights where appropriate in higher level benchmark calculations
- Floating sleeves will use monthly market values.
- Backfilled returns should be version-controlled and reconciled to the custodian performance system before publication.

8.2 Monthly backfill treatment for private-market benchmarks

Private market benchmarks will be incorporated using official provider returns, typically reported quarterly with a lag. For interim monthly reporting, the custodian will apply a proxy methodology that aligns quarterly benchmark returns with monthly portfolio reporting, ensuring consistency between portfolio and benchmark measurement.

For the first two months of a calendar quarter, the custodian will assign the portfolio's asset-class return to the representative benchmark as a temporary monthly proxy. Once the official quarterly benchmark return is received, the third monthly benchmark return will be calculated so that the linked three-month benchmark return equals the official lagged quarterly return received from the provider.

Monthly alignment formula: if r1 and r2 are the first two monthly proxy returns and RQ is the official quarterly provider return, then the final month is calculated as:

Quarterly-to-monthly reconciliation formula
r3 = (1 + RQ) / [(1 + r1) x (1 + r2)] - 1. This ensures that (1 + r1) x (1 + r2) x (1 + r3) - 1 equals the official quarterly benchmark return.

8.3 Backfill controls

- Maintain a backfill start date for each benchmark node.
- Document periods with proxy returns, missing data, custom history construction, or methodology exceptions.
- Do not retroactively change benchmark assignments except to correct errors, complete the initial backfill, or implement a documented methodology change with a clear effective date.

9. Governance, Reporting, and Change Control

The governance framework preserves the IPS division of responsibilities. The Board owns the IPS-level benchmark architecture and reviews performance benchmarks and key risk indicators for oversight. The CIO owns the design, approval, maintenance, and updating of the Implementation Benchmark components and methodology, subject to IPS requirements, documentation, review, and material-change governance. The custodian independently calculates returns and maintains benchmark histories sufficient for total-fund and subcomponent assessment.

9.1 Benchmark Master File

NCIA will maintain a Benchmark Master File as an operational control document, maintained by the Risk & Operations team.

A summarized version of fields is included in Appendix B. The full operational file will be maintained outside this whitepaper to allow efficient updates without requiring document revision.

9.2 Material benchmark changes

A material benchmark change includes any change to a primary benchmark provider, benchmark family, return type, currency basis, static/floating weighting rule, private-history convention, or total-plan methodology. Changes should be prospective, documented, and disclosed through the governance process.

Routine Implementation Benchmark component and methodology changes that remain consistent with the IPS delegation should be reviewed through the Investment Committee process, approved by the CIO, and documented; material changes should be considered for noting to the Board in the quarterly Performance Update presentations. Proposed changes to the Reference Portfolio, the IPS-level benchmark architecture, or any Board-reserved policy decision must be brought to the Board.

Appendix A. Implementation Benchmark Specification

The table below summarizes the working Implementation Benchmark specification. Custodian mnemonics and licensed provider identifiers should be completed in the Benchmark Master File.

Node	Weight / rule	Benchmark index	Calculation note
Debt	35% IPS static	IPS static weighted return of underlying benchmarks	Monthly rebalance to IPS target
Cash	1.0% IPS static	ICE 3-Month T-Bill Index Total Return	Monthly rebalance to IPS target
Credit	9.0% IPS static	MSCI Global Private Credit Index	Monthly reporting with private-market lag convention
Investment Grade	25% IPS static	ICE BofA Custom Index H167: 35% 5+Y IG Corporates, 35% Mortgage Master, 30% 5+Y Governments	Monthly rebalance to IPS target
Equity	62% IPS static	IPS static weighted return of underlying benchmarks	Monthly rebalance to IPS target
Corporate Equity	44% IPS static	Asset-weighted return of Private Equity and Public Equity benchmarks	Monthly rebalance to IPS target
Private Equity	Asset-weighted	MSCI Global Private Equity Universe	Monthly actual funded asset weight; private-market lag convention
Public Equity	Asset-weighted	MSCI ACWI IMI Net	Monthly actual asset weight

Node	Weight / rule	Benchmark index	Calculation note
Real Asset Equity	18% IPS static	Asset-weighted return of Infrastructure & Natural Resources and Real Estate benchmarks	Monthly rebalance to IPS target
Infrastructure & Natural Resources	Asset-weighted	Composite MSCI Global Private Infrastructure and Natural Resources Universe	Monthly actual asset weight; private-market lag convention
Real Estate	Asset-weighted	Asset-weighted return of underlying real-estate benchmarks	Monthly actual asset weight
Private Real Estate	Asset-weighted	MSCI US Private Real Estate Universe	Monthly actual asset weight
Public Real Estate	Asset-weighted	FTSE EPRA NAREIT Global	Monthly actual asset weight
Multi-Strategy	3% IPS static	Pivotal Path MultiStrategy	Monthly rebalance to IPS target

Appendix B. Required Data Inputs and Benchmark Master File

Required data inputs include:

- Monthly portfolio market values by benchmark node.
- Net returns by sleeve and total portfolio.
- Benchmark net returns for each assigned index.
- Benchmark metadata, including provider, return type, currency, and weighting rule.

Benchmark Master File field	Definition
Benchmark node	Hierarchy node name used in the Implementation Benchmark.
Formal benchmark name	Provider-official benchmark name or custom composite name.
Provider	Index provider or benchmark family owner.
Public identifier	Ticker, index ID, or published provider code, where available.
Custodian mnemonic	Custodian performance system benchmark code.
Return type	Total return, net return, gross return, frozen, unfrozen, or custom composite.
Currency	Base currency used for reporting.
Weighting rule	IPS static weight, monthly actual market value, or other documented rule.
Rebalancing rule	Monthly IPS target reset or monthly market-value weighting.
Effective date	Date benchmark assignment becomes official.
Backfill start date	First date included in historical benchmark backfill.
History convention	Source and treatment of backfilled or revised private-market history.
Publication lag	Expected timing of official benchmark return availability.
Data source	Vendor, custodian feed, or internal system.
Owner	Accountable role for maintenance.
Review frequency	Monthly, quarterly, annual, biennial, or event-driven.
Exception notes	Known limitations, temporary proxy use, or sunset criteria.

Appendix C. Glossary

Term	Definition
Actuarial Assumed Rate of Return	The long-term return assumption used as a funding sufficiency hurdle; currently 6.50%.
Reference Portfolio	A simple low-cost passive market mix used to assess the value of the chosen policy risk posture.

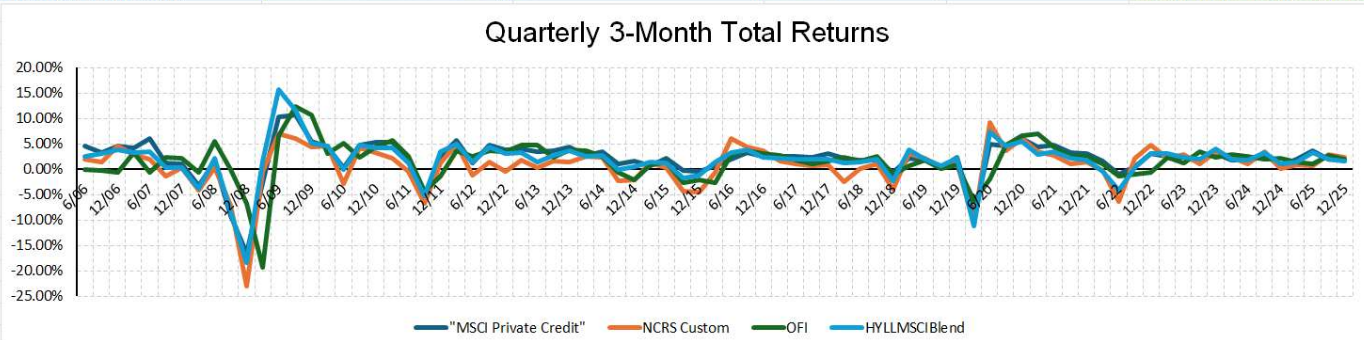
Term	Definition
Implementation Benchmark	The formal total-plan benchmark established by the IPS whose CIO-approved components and methodology reflect the Board-approved asset mix and the opportunity set actually being implemented.
Dynamic Implementation Benchmark	An internal attribution comparator that uses actual portfolio weights at strategic nodes and the same underlying implementation benchmark returns.
Static weight	A benchmark weight rebalanced to a fixed IPS policy target.
Floating / dynamic weight / asset weighted	A benchmark weight based on monthly market values of funded assets.
Staging portfolio	A temporary liquid exposure used while building a less-liquid target exposure.
Timing / Pacing Effect	The performance difference caused by deviations between policy target weights and actual implementation weights during transition or ongoing pacing.
Frozen private index history	A private-market benchmark history that does not revise prior periods after publication.
Unfrozen private index history	A private-market benchmark history that may be revised as additional data becomes available.

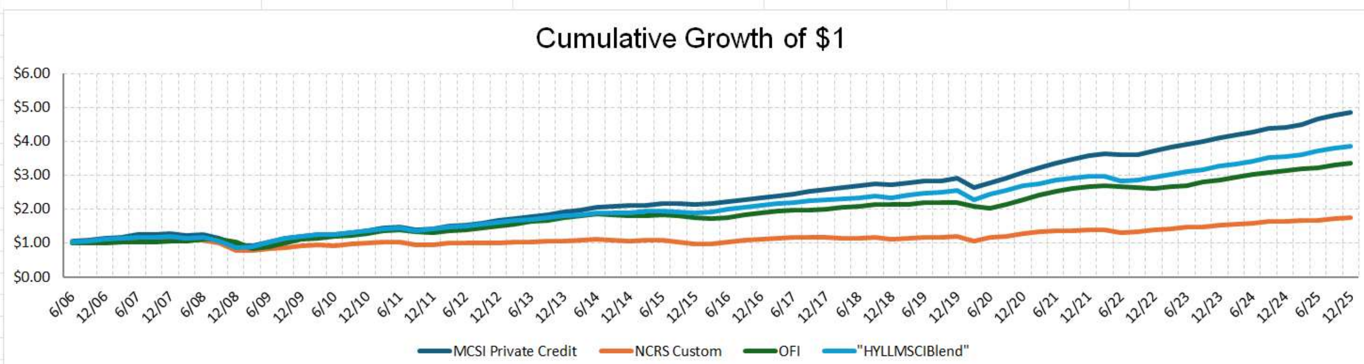
Appendix D. Benchmark Fit Analysis - Credit

Credit (OFI) Historical Benchmark Fit Analysis

Reference	OFI	MSCI Private Credit Universe	NCRS OFI Bench	25HY25LL50MSCI PC
Observations	79	79	79	79
Start date	6/30/2006	6/30/2006	6/30/2006	6/30/2006
End date	12/31/2025	12/31/2025	12/31/2025	12/31/2025
Annualized Return	6.34%	8.31%	2.88%	7.06%
Cumulative Return	236.82%	384.02%	75.03%	284.38%
Annualized Vol	7.71%	7.39%	8.48%	8.17%

Metric	MSCI Private Credit Universe	NCRS OFI Bench	25HY25LL50MSCI PC	Preferred	Winner
Correlation to OFI	63.2%	50.3%	53.8%	Higher	**MSCI Private Credit Universe**
R-squared vs OFI	40.0%	25.3%	29.0%	Higher	**MSCI Private Credit Universe**
Beta of OFI vs benchmark	0.66	0.46	0.51	Closer to 1	**MSCI Private Credit Universe**
Quarterly alpha	0.25%	1.26%	0.71%	Closer to 0	**MSCI Private Credit Universe**
Tracking error	3.24%	4.05%	3.82%	Lower	**MSCI Private Credit Universe**
RMSE	3.25%	4.11%	3.80%	Lower	**MSCI Private Credit Universe**
Mean absolute error	2.01%	2.65%	2.21%	Lower	**MSCI Private Credit Universe**
Avg active return	-0.46%	0.82%	-0.18%	Closer to 0	**25HY25LL50MSCI PC**
Same-direction hit rate	87.3%	82.3%	84.8%	Higher	**MSCI Private Credit Universe**
Annualized return gap vs OFI	1.97%	3.47%	0.71%	Lower	**25HY25LL50MSCI PC**
Cumulative return gap vs OFI	147.20%	161.79%	47.56%	Lower	**25HY25LL50MSCI PC**
Fit score / metric wins	8	0	3		**MSCI Private Credit Universe**



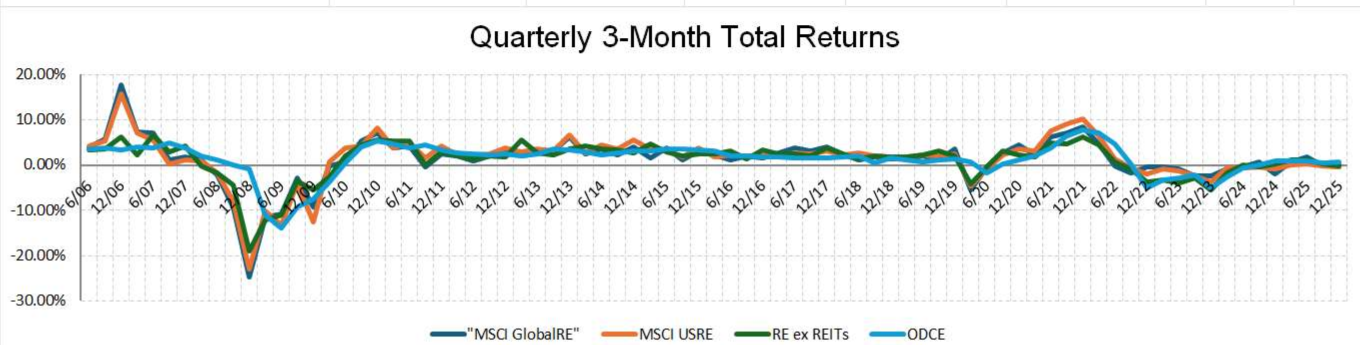


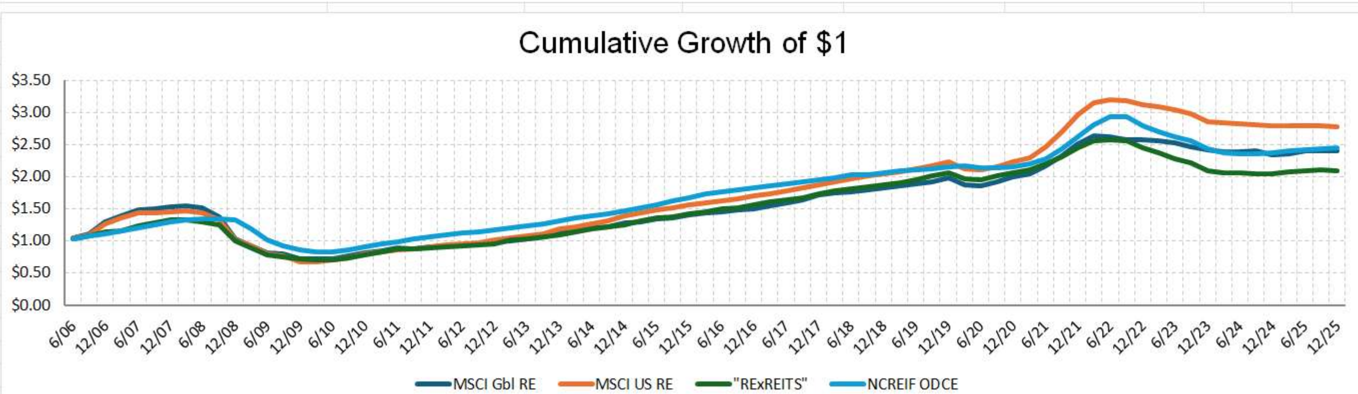
Appendix E. Benchmark Fit Analysis – Private Real Estate

RE ex REITS Historical Benchmark Fit Analysis

Reference	RE ex REITS	MSCI Gbl RE	MSCI US RE	NCREIF ODCE
Observations	79	79	79	79
Start date	6/30/2006	6/30/2006	6/30/2006	6/30/2006
End date	12/31/2025	12/31/2025	12/31/2025	12/31/2025
Annualized Return	3.81%	4.52%	5.30%	4.63%
Cumulative Return	109.41%	139.46%	177.51%	144.36%
Annualized Vol	8.35%	10.14%	10.30%	7.29%

Metric	MSCI Gbl RE	MSCI US RE	NCREIF ODCE	Preferred	Winner
Correlation to RE ex REITS	90.3%	91.5%	76.5%	Higher	**MSCI US RE**
R-squared vs RE ex REITS	81.6%	83.6%	58.5%	Higher	**MSCI US RE**
Beta of RE ex REITS vs benchmark	0.74	0.74	0.88	Closer to 1	**NCREIF ODCE**
Quarterly alpha	0.10%	-0.04%	-0.02%	Closer to 0	**NCREIF ODCE**
Tracking error	2.21%	2.15%	2.73%	Lower	**MSCI US RE**
RMSE	2.21%	2.17%	2.71%	Lower	**MSCI US RE**
Mean absolute error	1.46%	1.49%	1.57%	Lower	**MSCI Gbl RE**
Avg active return	-0.22%	-0.41%	-0.17%	Closer to 0	**NCREIF ODCE**
Same-direction hit rate	93.7%	93.7%	89.9%	Higher	**MSCI Gbl RE**
Annualized return gap vs RE ex REITS	0.71%	1.49%	0.81%	Lower	**MSCI Gbl RE**
Cumulative return gap vs RE ex REITS	30.05%	68.10%	34.96%	Lower	**MSCI Gbl RE**
Fit score / metric wins	4	4	3		**Tie**

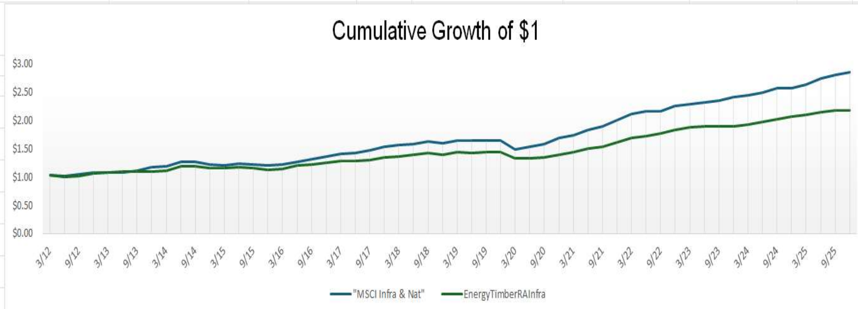




Appendix F. Benchmark Fit Analysis – Infrastructure and Natural Resources

Infrastructure and Natural Resources (Energy/Timber/RA/Infra) Historical Benchmark Fit Analysis

	EnergyTimberRAInfra	MSCI Infra and Nat
Observations	56	56
Start date	3/31/2012	3/31/2012
End date	12/31/2025	12/31/2025
Annualized Return	5.73%	7.78%
Cumulative Return	118.23%	185.56%
Annualized Volatility	4.70%	5.46%



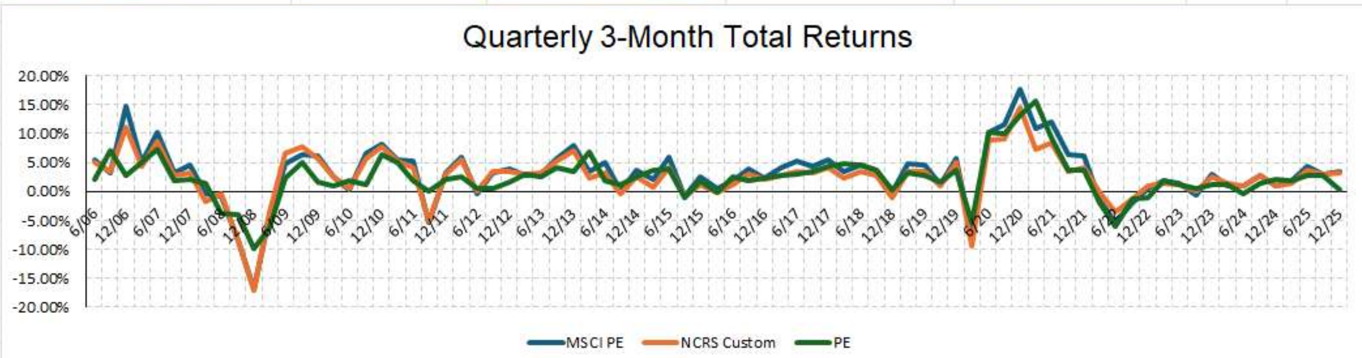
Metric	MSCI Infra and Nat
Correlation	83.2%
R-squared	69.2%
Beta vs benchmark	0.71
Quarterly alpha	0.1%
Tracking error	1.5%
RMSE	1.6%
Mean absolute error	1.3%
Avg active return	-0.5%
Same-direction hit rate	85.7%
Annualized return gap	2.1%
Cumulative return gap	67.3%

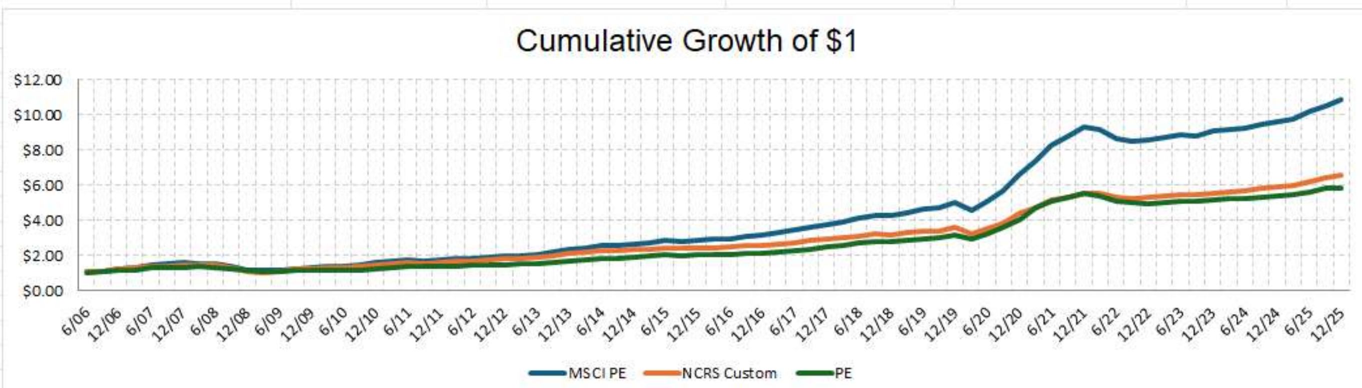
Appendix G. Benchmark Fit Analysis – Private Equity

PE Historical Benchmark Fit Analysis

PE Reference	PE	MSCI Private Equity	NCRS Custom PE index
Observations	79	79	79
Start date	6/30/2006	6/30/2006	6/30/2006
End date	12/31/2025	12/31/2025	12/31/2025
Annualized return	9.31%	12.82%	10.01%
Cumulative return	480.20%	982.99%	558.63%
Annualized volatility	7.66%	9.82%	8.69%

Metric	MSCI Private Equity	NCRS Custom PE index	Preferred	Winner
Correlation to PE	85.0%	81.4%	Higher	MSCI Private Equity
R-squared vs PE	72.3%	66.3%	Higher	MSCI Private Equity
Beta of PE vs benchmark	0.66	0.72	Closer to 1	NCRS Custom PE index
Quarterly alpha	0.21%	0.52%	Closer to 0	MSCI Private Equity
Tracking error	2.61%	2.54%	Lower	NCRS Custom PE index
RMSE	2.73%	2.53%	Lower	NCRS Custom PE index
Mean absolute error	1.99%	1.78%	Lower	NCRS Custom PE index
Avg active return	-0.86%	-0.19%	Closer to 0	NCRS Custom PE index
Same-direction hit rate	89.9%	92.4%	Higher	NCRS Custom PE index
Annualized return gap vs PE	3.51%	0.70%	Lower	NCRS Custom PE index
Cumulative return gap vs PE	502.79%	78.43%	Lower	NCRS Custom PE index
Fit score / metric wins	3	8		**NCRS Custom PE index**





Appendix H. Benchmark Structure Diagram

NCIA IMPLEMENTATION BENCHMARK HIERARCHY

Hybrid Weighted (blend of static and dynamic) Implementation Benchmark of Total Trust Assets

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Benchmark Index	Policy Weight	In Next Level Up	Weight Method	Next Level Up Bench Weight	Returns Prior to March 2026
Total Trust						Composite of Level 1 Benchmarks	100%				Prior Benchmark
Total Trust (100%)	Debt 35%					Composite Return of Level 2 Benchmarks	35%	Yes	Static	35%	Wtd Underlying
		Cash				ICE 3m Tbill Index Total Return	1%	Yes	Static	3%	Prior Benchmark
		Credit				MSCI Global Private Credit Index	9%	Yes	Static	26%	Prior Benchmark
		Investment Grade				ICE BAML Custom Index (H167). 35% ICE BofA 5+ Year Investment Grade Corporates, 35% ICE BofA Mortgage Master, 30% ICE BofA 5+ Year Governments.	25%	Yes	Static	71%	New Backfill
	Equity 62%					Composite Return of Level 2 Benchmarks	62%	Yes	Static	62%	Wtd Underlying
		Corporate Equity				Composite Return of Level 3 Benchmarks	44%	Yes	Static	71.0%	Wtd Underlying
			Private Equity			MSCI Global Private Equity		Yes	Dynamic (Actual Wgt)	Asset Wgt	Prior Benchmark
			Public Equity			MSCI ACWI IMI Net		Yes	Dynamic (Actual Wgt)	Asset Wgt	Prior Benchmark
		Real Asset Equity				Composite Return of Level 3 Benchmarks	18%	Yes	Static	29.0%	Wtd Underlying
			Infrastructure & Natural Resources			MSCI Global Private Infrastructure and Natural Resources Index		Yes	Dynamic (Actual Wgt)	Asset Wgt	New Backfill
			Real Estate			Composite Return of Level 4 Benchmarks		Yes	Dynamic (Actual Wgt)	Asset Wgt	Wtd Underlying
				Private Real Estate		MSCI US Private Real Estate Index		Yes	Dynamic (Actual Wgt)	Asset Wgt	Wtd Underlying
					Core	NCREIF ODCE		No			Prior Benchmark
					Non Core	MSCI US Private Opportunistic and Value Add Real Estate Index		No			Prior Benchmark
				Public Real Estate		FTSE EPRA NAREIT Global		Yes	Dynamic (Actual Wgt)	Asset Wgt	Prior Benchmark
	Multi Strategy 3%					Pivotal Path MultStrategy Index	3%	Yes	Static	3%	Prior Benchmark
		Alpha Book						No			
		Total Portfolio						No			

WEIGHTING METHODOLOGY	BENCHMARK NOTES	RETURN BACKFILL METHODOLOGY
Static: Policy weights that are rebalanced Monthly to target. Dynamic (Actual Wgt): Sub-asset class weights reflect actual portfolio exposures within each parent category and are rebalanced Monthly.	• The Implementation Benchmark uses a hybrid weighting methodology. • Static weights are applied at strategic levels (Level 2 and above). • Dynamic (actual) weights are used for select sub-asset class levels below the strategic level. • It reflects the actual asset allocation within each asset class and sub-asset class over time. • All returns are total returns.	• Returns from March 2026 onward will be calculated according to the new implementation structure at the total and asset class levels • Returns prior to March 2026 will either be backfilled with the prior benchmark, the new benchmark, or a weigting of the underlying benchmarks.