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# Incorporating Additional Metrics into Existing Asset Management Technology

Example Methodologies and Case Studies for Asset Management Analysis

# What is asset management analysis?

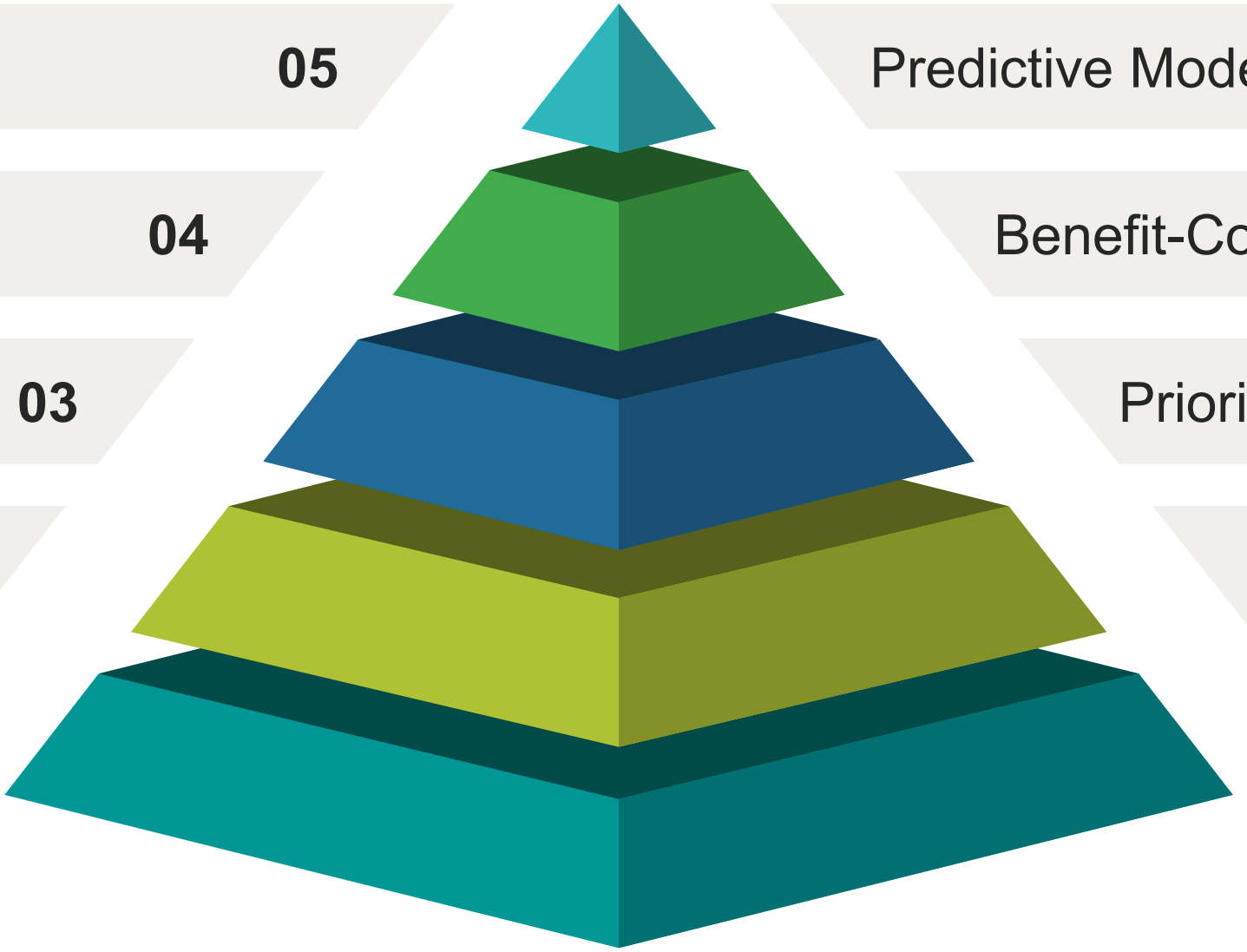
05 Predictive Modeling / Optimization

04 Benefit-Cost Analysis

03 Prioritization

02 Condition

01 Inventory



# Modifying budget constraints

# Modifying benefit calculation

# Approach 1 – Modifying Budget Constraints

## Baseline Scenario

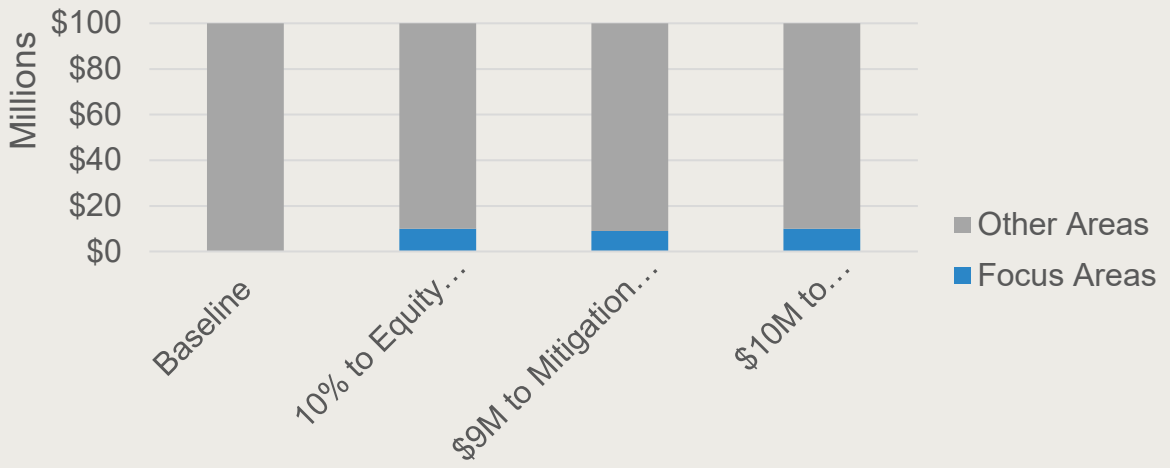
- Includes Planned Projects
- Includes Baseline/Expected Budget
- Includes X% Cost Inflation each year of the analysis

## Analysis Scenarios:

- Funding or % of funding allocated to projects or areas

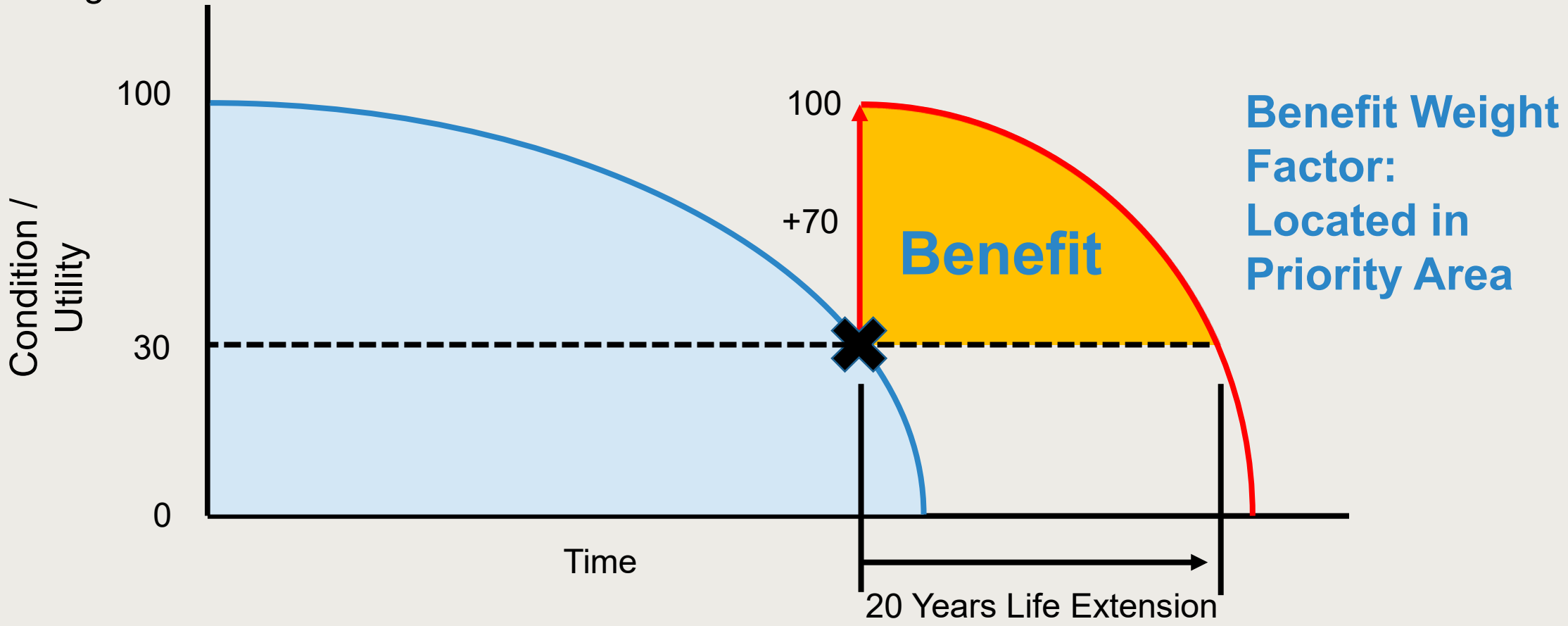
## Example Budget Constraints

| Scenario | Total Annual Budget | Annual Budget Allocated |
|---|---|---|
| Baseline | $100 Million | $0 |
| 10% to Equity Focus Areas | $100 Million | $10 Million |
| $9M to Mitigation Projects | $100 Million | $9 Million |
| $10M to Rejuvenators | $100 Million | $10 Million |



# Approach 2 – Modifying Benefit Calculation

Objective of Optimization – Maximize the Amount of Benefit from the Work Plan under Limited Budget




**Benefit = Condition Improvement * Life Extension * Benefit Weighting**

# Scenario Analysis – Capabilities

## Step 1 – Define Metric

- Agency to identify priority area(s) or projects and methodology for measuring/tracking

## Step 2 – Incorporate Metric into Management System

- Configure management system to consider metric in analysis
  - Identify existing scenario results (for comparison)

## Step 3 – Identify Optimal Long-Term Strategy

- Approach 1 - Modifying budget constraints
- Approach 2 - Modifying benefit calculation

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# Examples: Equity

## Including Equity Metrics in Optimizing Long Term Road Strategy

# Scenario Analysis – Equity

## Step 1 – Define Equity Metric

- Agency to identify areas of inequity/priority areas
  - Tag roadways with the value identified (typically by GIS)

## Step 2 – Incorporate Equity Metric into Pavement Management System

- Incorporating metrics into PMS analysis
  - Identify existing scenario results (compare to policy/targets)

## Step 3 – Identify Optimal Long-Term Strategy

- Approach 1 - Modifying budget constraints – City of Dallas, TX
- Approach 2 - Modifying benefit calculation – Alachua County, FL

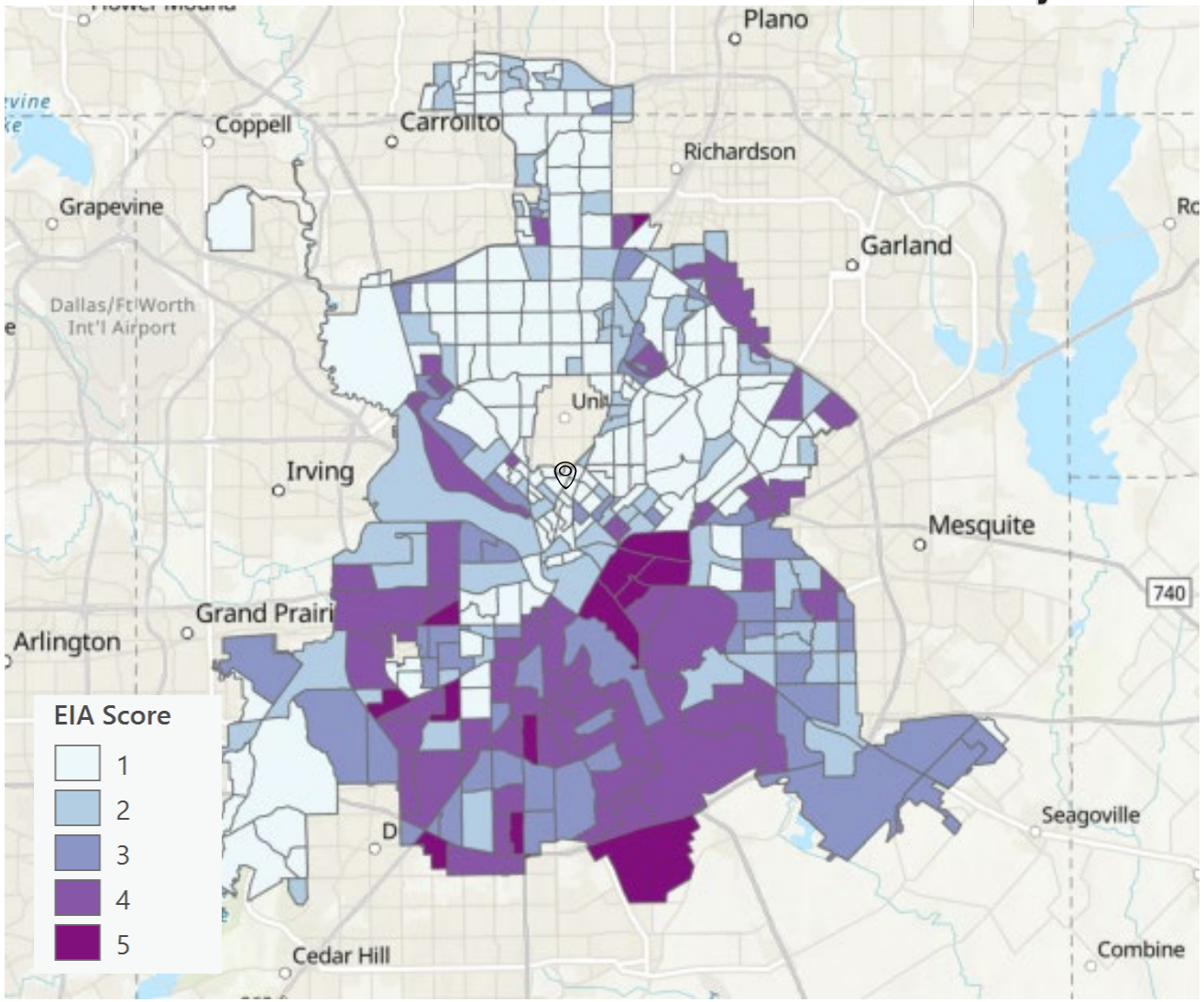
# City of Dallas, TX – Equity Priority Areas

In developing **Equity Priority Areas** and measures to advance equity, the City of Dallas looks at departments' technical criteria and data consistent with race, ethnicity, socioeconomic status, and social vulnerability.

**Equity Priority Areas:** Those areas that demonstrate the greatest investment needs using multiple tools and data consistent with the Equity Impact Assessment Tool, Racially & Ethnically Concentrated Areas of Poverty (HUD – Department of Housing and Urban Development), Market Value Analysis, Social Vulnerability Index (CDC – Center for Disease Control and Prevention) and Qualified Census Tracts (HUD).

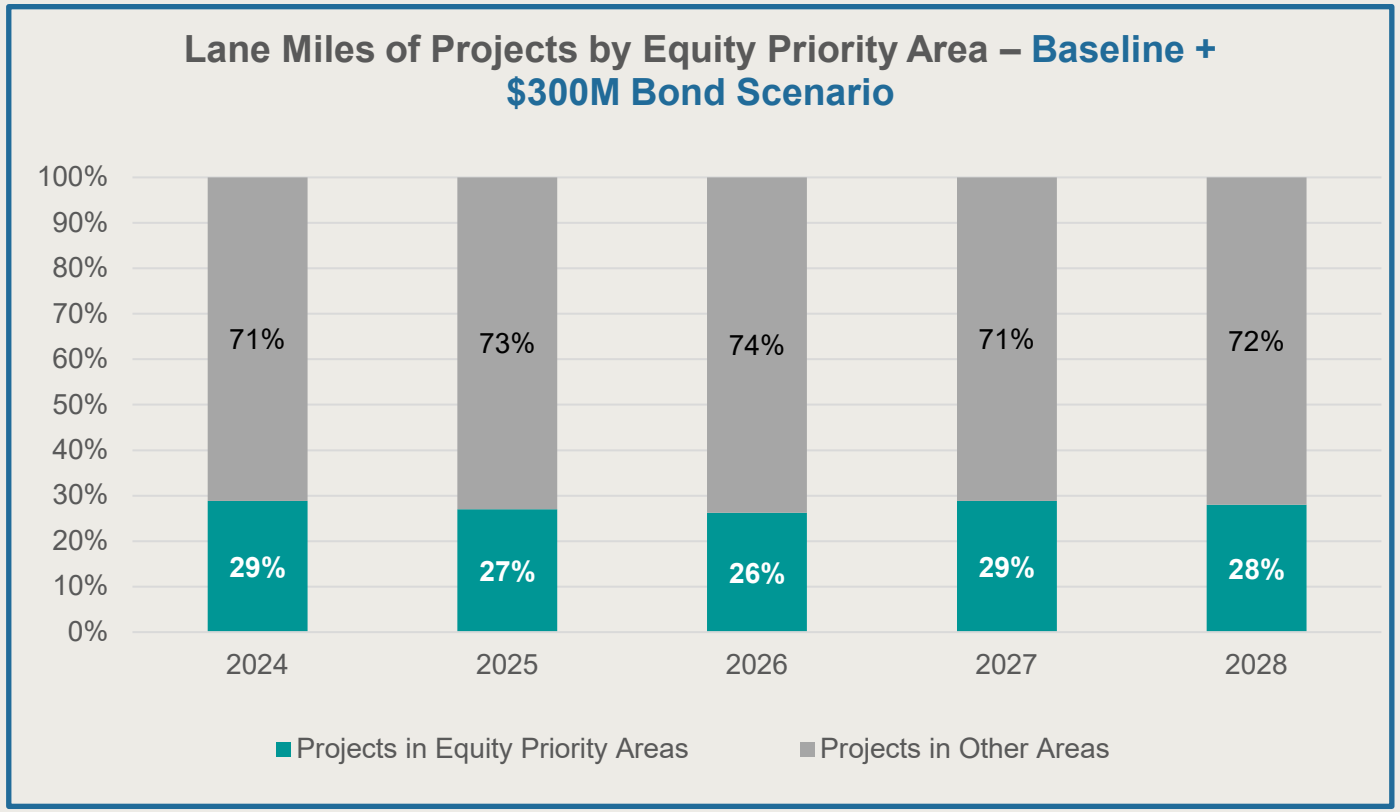
(Page 149 of Racial Equity Plan)

**Equity Impact Assessment Score (EIA) ≥ 4**



# Approach 1 – Dallas – Constraint Adjustments

City of Dallas



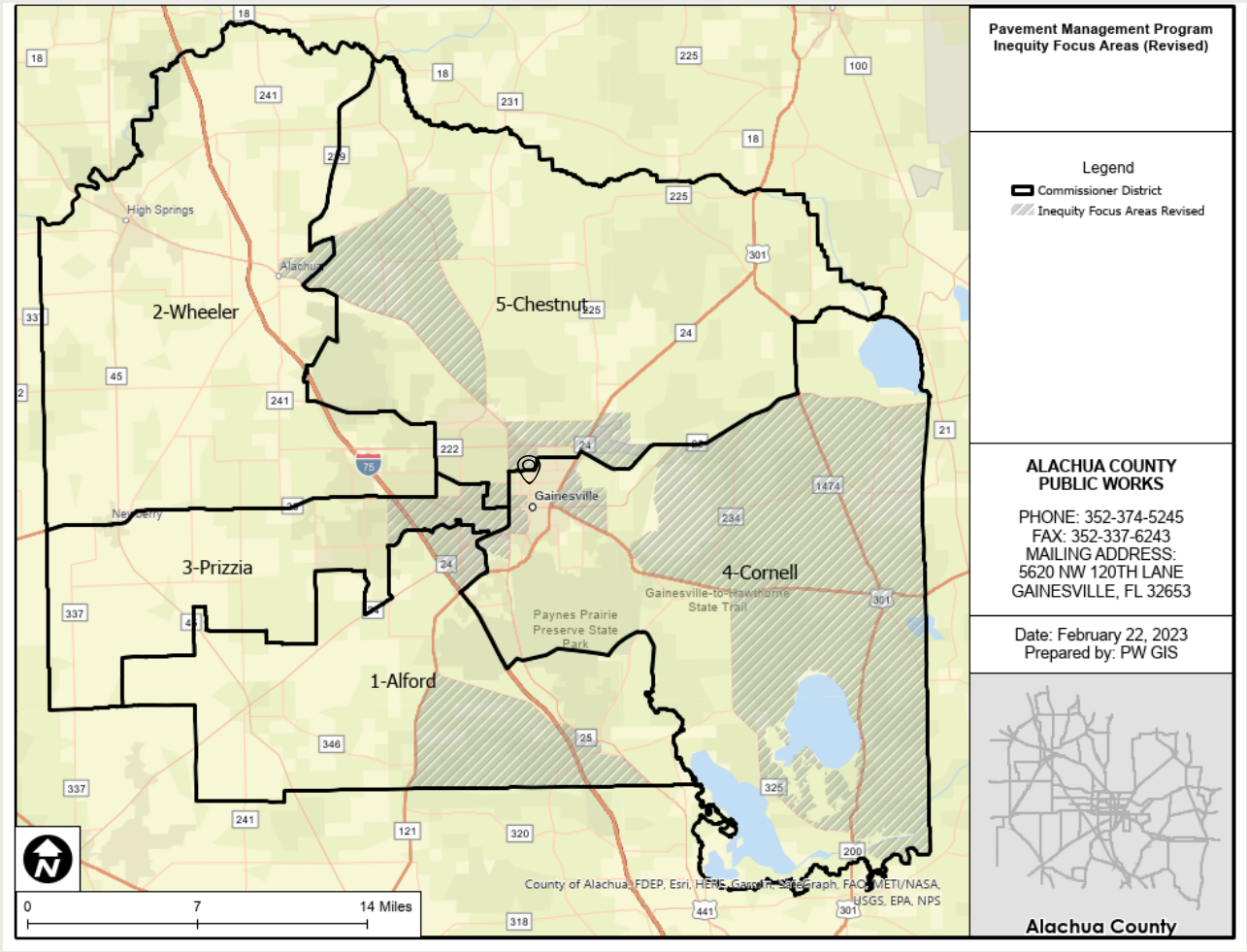

Targeting >=20% of projects by lane miles in Equity Priority Areas

# Alachua County, FL – Inequity Area Development

- **Board Direction to develop a metric to evaluate equity in the pavement management program**

- **Staff utilized three metrics to identify Inequity Areas:**
  - U.S. Housing and Urban Development Qualified Census Tracts
    - 50 percent of households with incomes below 60 percent of the Area Median Gross Income (AMGI) OR
    - have a poverty rate of 25 percent or more
  - Census Tracts with Median Income <185% of Federal Poverty Guideline
  - Properties with residential improvement values in the bottom 20% of all values
    - Added a buffer of 1,320 ft.

- **Population in Inequity Area:**
  - 2020 Population is just less than 90,000, or about 1/3 of County Population
  - Includes both incorporated and unincorporated residents



# Approach 2 – Alachua – Benefit Adjustments

Pavement Management Program Analysis Scenarios

## Baseline Scenario

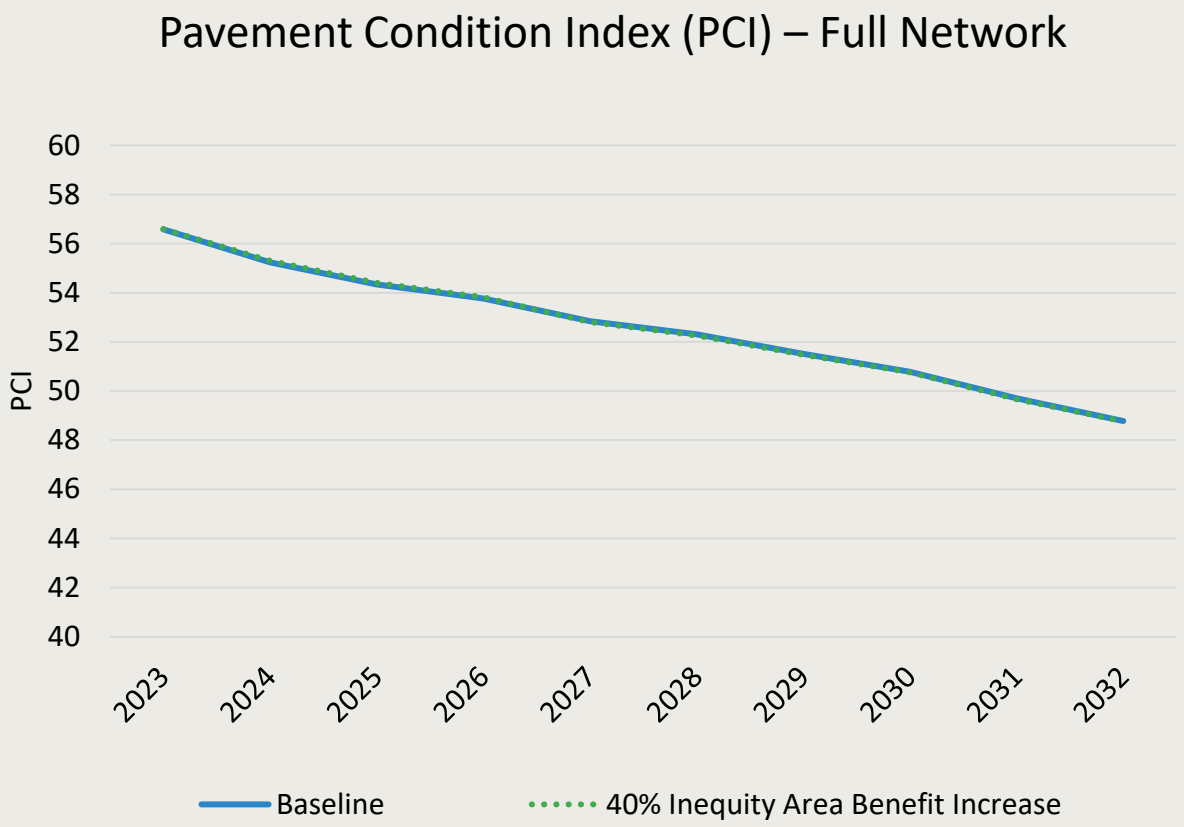
- **Includes Surtax with Base budget in 2023 = $17.7 Million**
- **Includes 2% Budget Escalation each year of the analysis**
- **Includes 3% Cost Inflation each year of the analysis**

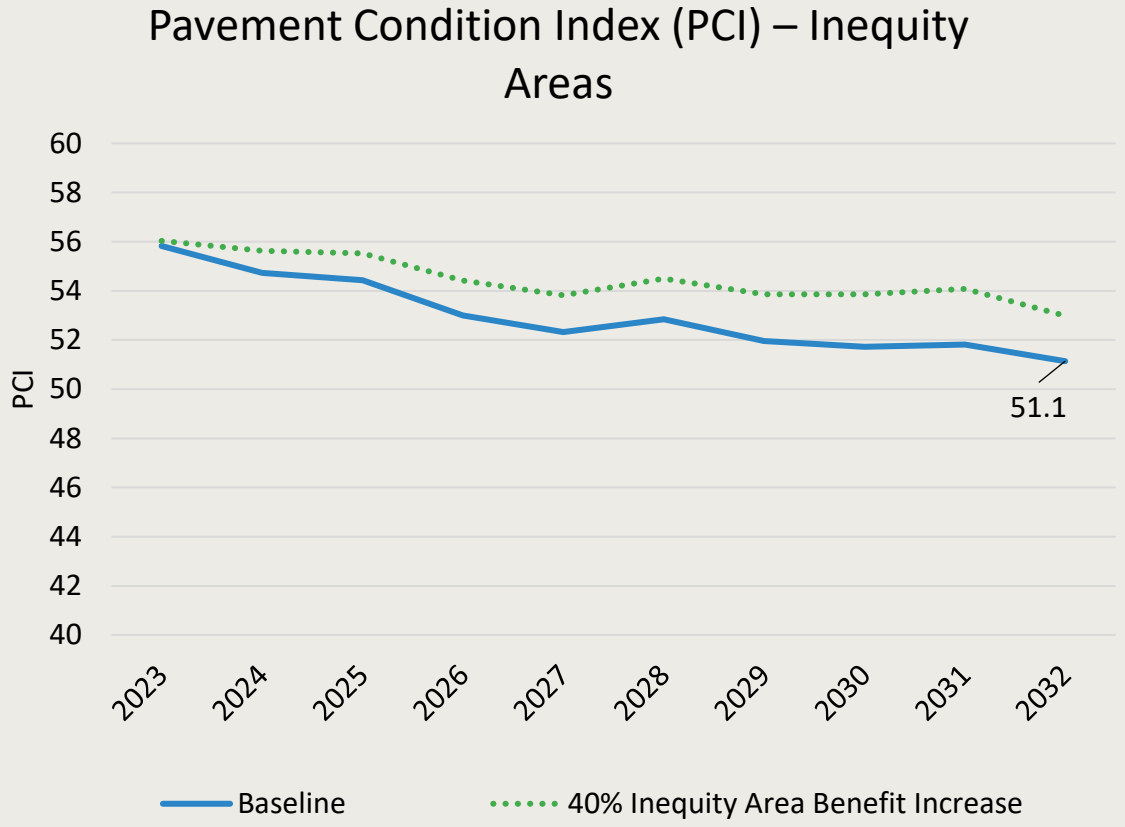
## Areas of Inequity Analysis Scenarios:

- **20% Benefit Increase (Base Benefit * 1.2)**
- **30% Benefit Increase (Base Benefit * 1.3)**
- **40% Benefit Increase (Base Benefit * 1.4)**
- **50% Benefit Increase (Base Benefit * 1.5)**

# Approach 2 – Alachua – Benefit Adjustments

## Pavement Condition Index (PCI) Summaries



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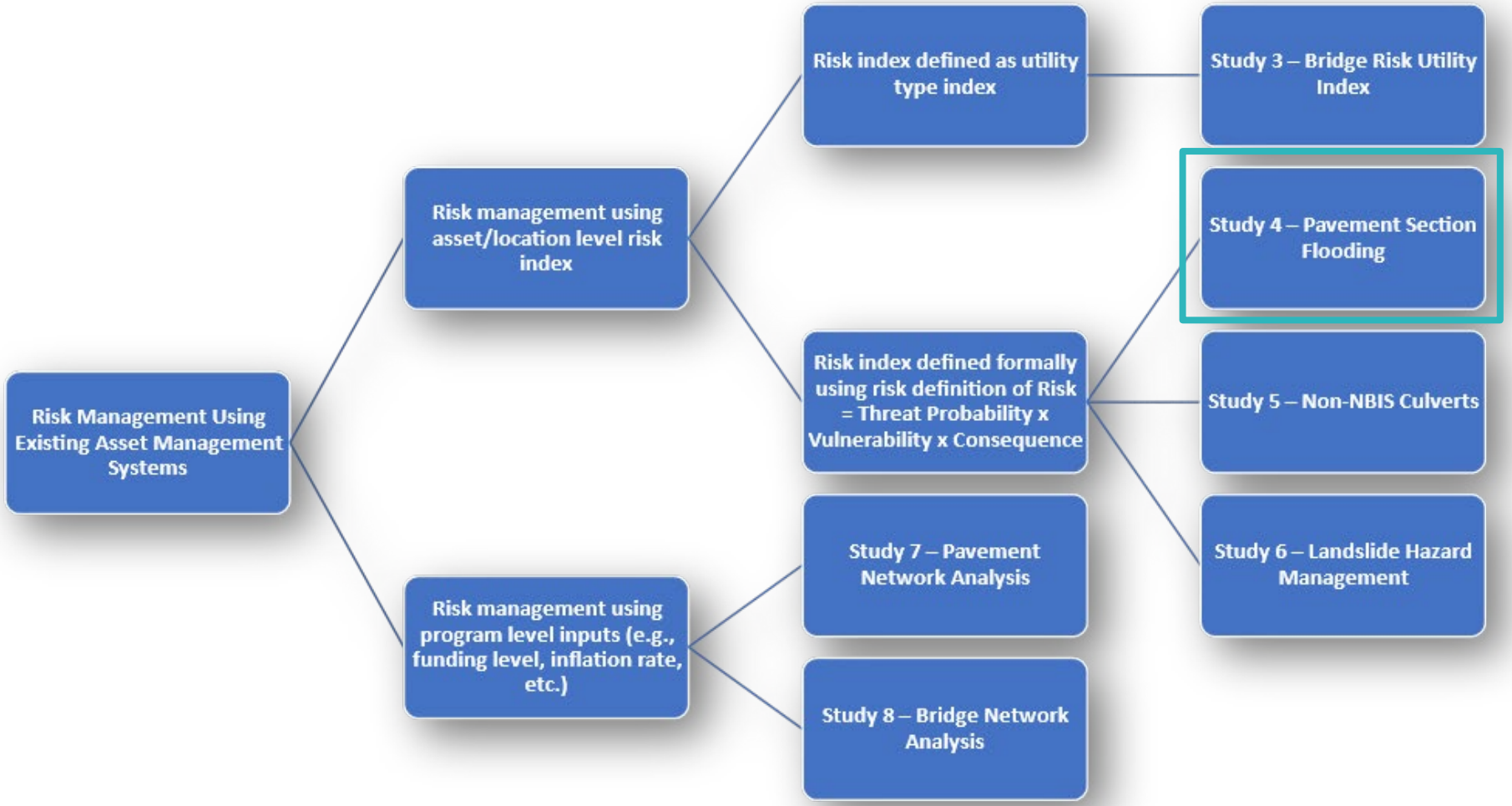
# Example: Risk

Including Risk Metrics in Optimizing Long Term Road Strategy

# Approaches to Managing Risk in Asset Management Systems




(5) NCHRP 08-118 Risk Assessment Techniques for Transportation Asset Management

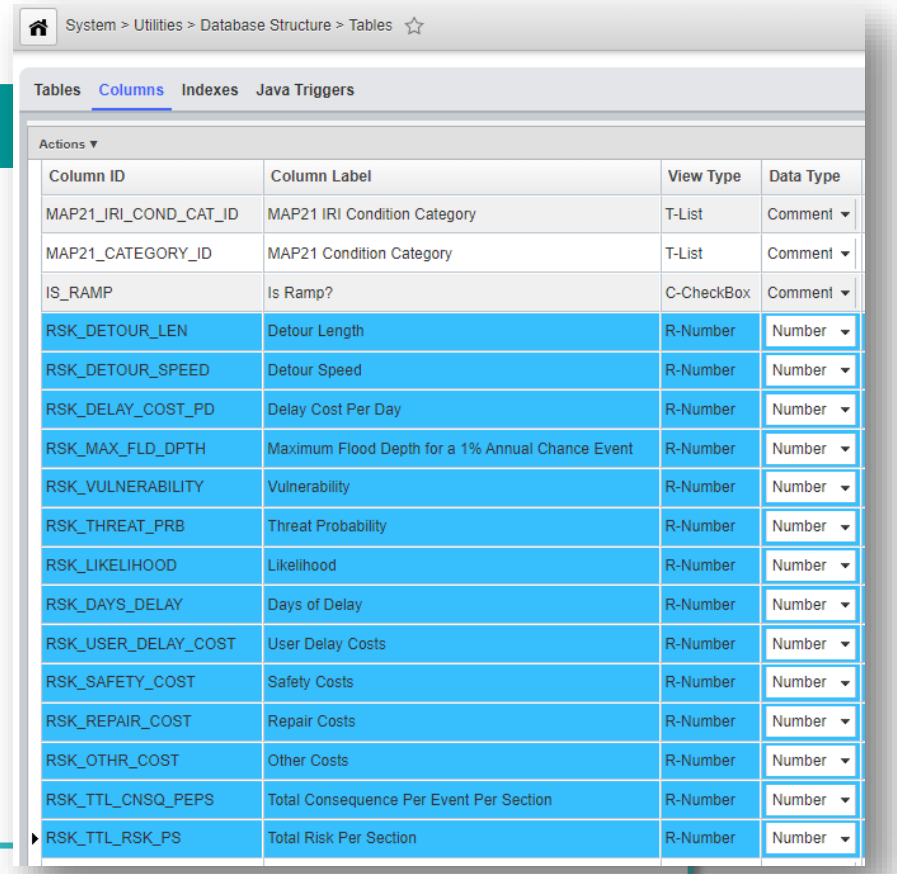
# Scenario Analysis – Capabilities

## Step 1 – Define Risk Metric

- Agency to determine risk index components
  - Likelihood
  - Vulnerability
  - Consequence
- Calculate Risk Index and identify deterioration models

## Step 2 – Incorporate Metric into Management System

- Incorporating metric into PMS analysis
  - Identify risk mitigation actions and associated reduction to Risk Index
  - Identify existing scenario results (compare to policy/targets)




| Column ID | Column Label | View Type | Data Type |
|---|---|---|---|
| MAP21_IRI_COND_CAT_ID | MAP21 IRI Condition Category | T-List | Comment |
| MAP21_CATEGORY_ID | MAP21 Condition Category | T-List | Comment |
| IS_RAMP | Is Ramp? | C-CheckBox | Comment |
| RSK_DETOUR_LEN | Detour Length | R-Number | Number |
| RSK_DETOUR_SPEED | Detour Speed | R-Number | Number |
| RSK_DELAY_COST_PD | Delay Cost Per Day | R-Number | Number |
| RSK_MAX_FLD_DPTH | Maximum Flood Depth for a 1% Annual Chance Event | R-Number | Number |
| RSK_VULNERABILITY | Vulnerability | R-Number | Number |
| RSK_THREAT_PRB | Threat Probability | R-Number | Number |
| RSK_LIKELIHOOD | Likelihood | R-Number | Number |
| RSK_DAYS_DELAY | Days of Delay | R-Number | Number |
| RSK_USER_DELAY_COST | User Delay Costs | R-Number | Number |
| RSK_SAFETY_COST | Safety Costs | R-Number | Number |
| RSK_REPAIR_COST | Repair Costs | R-Number | Number |
| RSK_OTHR_COST | Other Costs | R-Number | Number |
| RSK_TTL_CNSQ_PEPS | Total Consequence Per Event Per Section | R-Number | Number |
| RSK_TTL_RSK_PS | Total Risk Per Section | R-Number | Number |

$$Total\ Annual\ Expected\ Risk\ per\ Flood\ Event = \frac{\%\ Chance\ of\ Flood\ Event}{100} * Vulnerability * Total\ Consequence\ Costs$$

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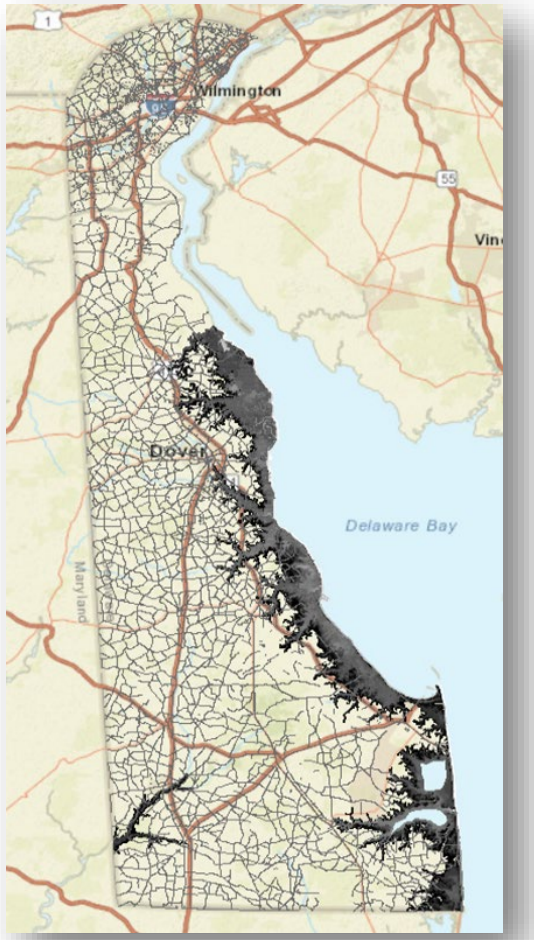
# Outcome – Selecting Risk Mitigation Projects




| Treatment Types | Risk Not Included | Risk Included |
|---|---|---|
| Chipseal (47) | 972 | 972 |
| Chipseal + Patch (68) | 6 | 6 |
| Crackseal (42) | 138 | 139 |
| Patch – Bit 5% (36) | 28 | 28 |
| Patch PCC (50) | 2 | 2 |
| Preservation (1485) | 424 | 419 |
| Reconstruction – Risk Mitigation (1493) | 0 | 16 |
| Rehab Functional (38) | 1402 | 1387 |
| Rehab Structural (51) | 369 | 359 |

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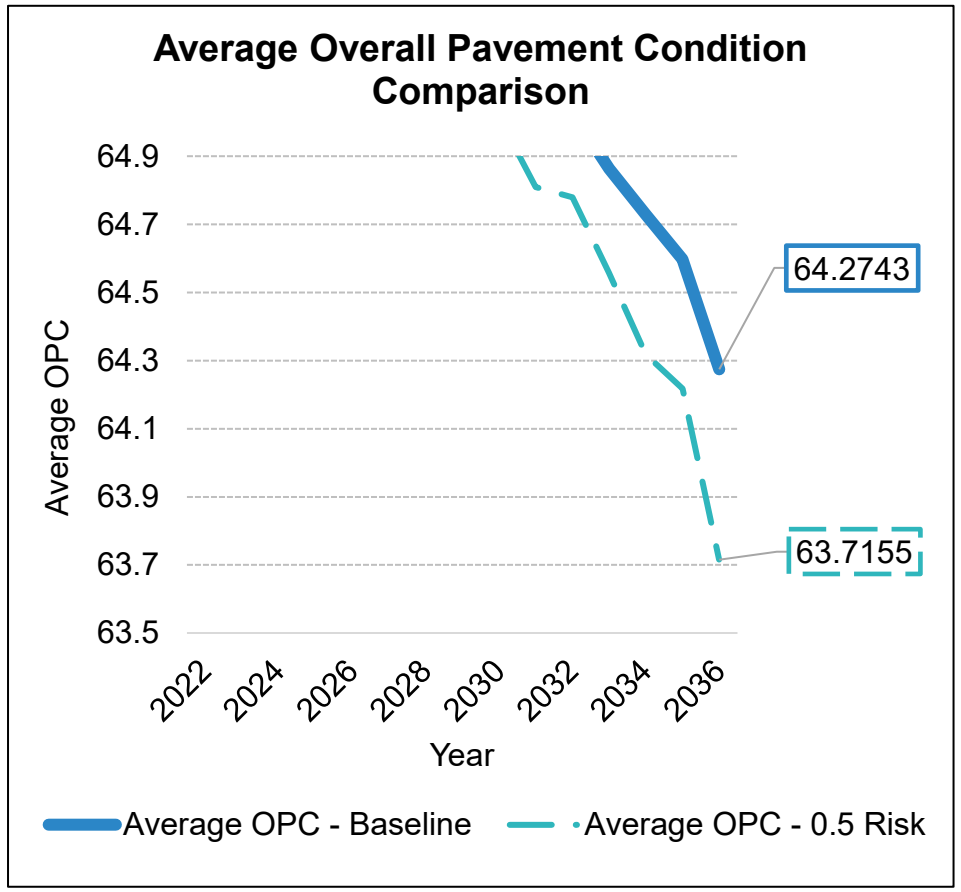
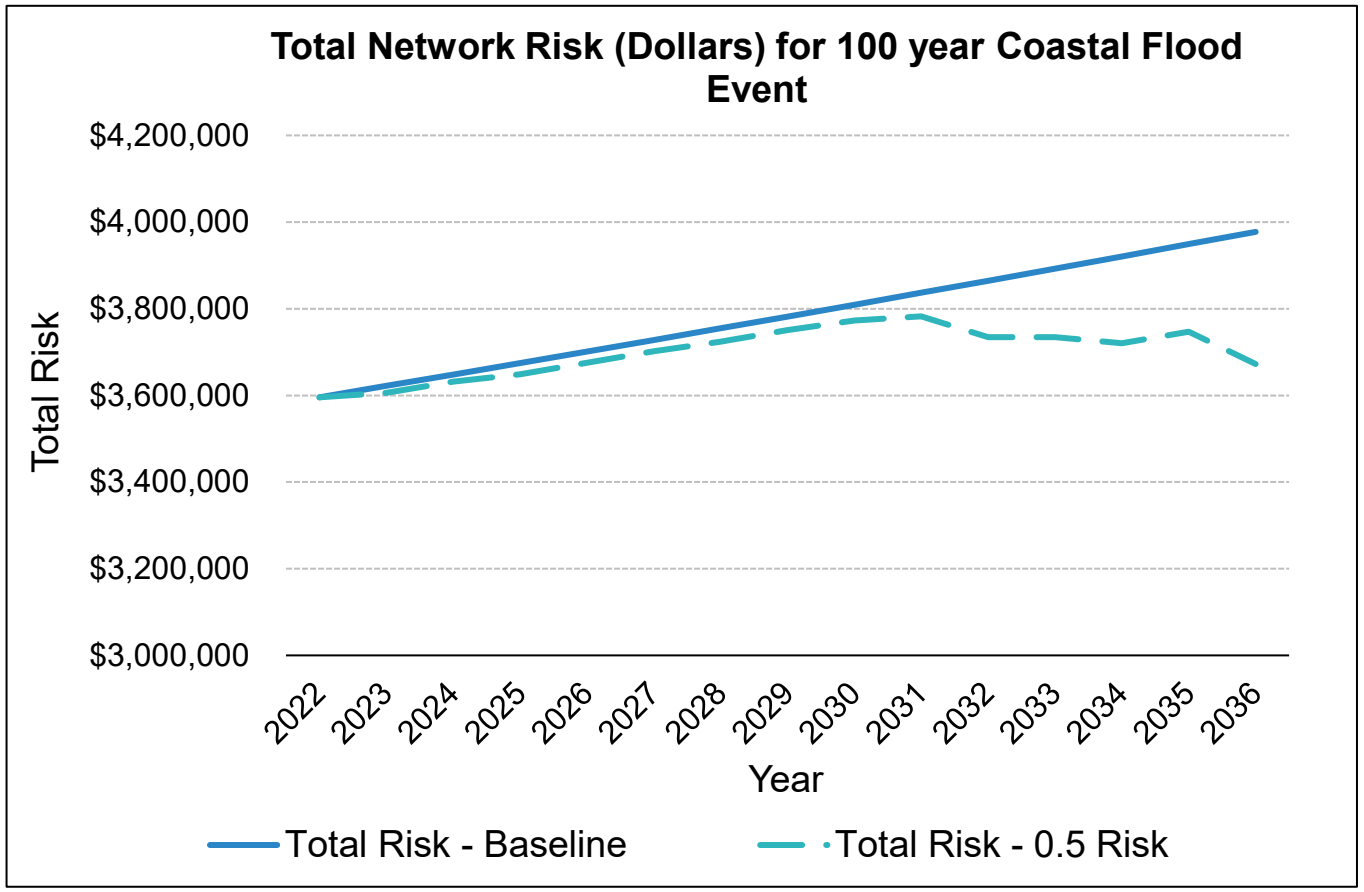
# Outcome – Mitigating Consequences

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# In Closing

# Things to Remember…

1. Assets are all at varying conditions needing varying projects

2. There is usually not enough money to fix them all

3. Optimization is determining which few assets will best spend the limited funds (this builds the project work plan)

4. When budget is allocated to specific categories (districts, treatment types, priority areas, etc.), the system is required to identify projects that fit in the category

5. When you apply a Weight Factor, you are increasing the attractiveness of selecting some projects over others


**Policy**

The policy and definitions are the hard part.

**Analysis**

If systems (the ‘right’ system) in place and data available, incorporating additional metrics is relatively easy

**Implementation**

The process is iterative – balance impacts to other areas of asset network and find the sweet spot. (finite $, taking money from other areas and accepting impacts to conditions).

# Acknowledgements


**Mott MacDonald**

**Caroline Dickey, PE**

- E caroline.dickey@mottmac.com

**Charles Pilson, PhD, PE**

- E charles.pilson@mottmac.com

**Aaron Gerber, PE**

- E aaron.gerber@mottmac.com

**Qazi Aurangzeb, PhD, PE**

- E qazi.Aurangzeb@mottmac.com

**Eric Perrone**

- E eric.perrone@mottmac.com

**Tracy Pilson**

- E tracy.pilson@mottmac.com

**Delaware Department of Transportation**

- Maureen Kelley, PE
  - E maureen.kelley@delaware.gov

**City of Dallas, TX**

- Ali Hatefi, PE, CFM
  - E alireza.hatefi@dallas.gov

**Alachua County, FL**

- Ramon Gavarrete
  - E rgavarrete@alachuacounty.us

# References


**(1) Memorandum – INFORMATION: State Asset Management Plan Under BIL**

- https://www.fhwa.dot.gov/asset/guidance/may2022memo.pdf

**(2) U.S. DOT Equity Action Plan**

- U.S. DOT Equity Action Plan - January 2022 (transportation.gov)

**(3) U.S. DOT Justice40 Initiative**

- Justice40 Initiative | US Department of Transportation

**(4) 23 USC 175 Carbon Reduction Program (d) Carbon Reduction Strategy (2) Requirements (D)**

- 23 USC 175: Carbon reduction program (house.gov)

**(5) NCHRP 08-118 Risk Assessment Techniques for Transportation Asset Management**

- apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4556

**(6) City of Dallas's 2022-2023 Racial Equity Plan**

- https://dallascityhall.com/departments/office-of-equity-and-inclusion/Equity/DCH Documents/COD_RacialEquityPlan22_Final.pdf