

Po'ipū Road Safety and Mobility Project

Benefit Cost Analysis for the US DOT RAISE 2022 Grant Application

April 2022

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Prepared for:

County of Kaua'i, Hawai'i

In support of a 2022 Rebuilding American Infrastructure with Sustainability and Equity (RAISE) federal grant application to the U.S. Department of Transportation.

Prepared By:

Michael Rodriguez, AICP
AICP # 025763
Falls Church, VA

Disclaimer:

This analysis was prepared by Michael Rodriguez, AICP #025763, as a fee-based independent consultant on behalf of the County of Kaua'i, Hawai'i, and Smith Dawson & Andrews, LLC. This analysis reflects the objective, independent analysis of Michael Rodriguez, AICP, only. It does not reflect the professional work, opinion, or analysis of Mr. Rodriguez' former or current employers or other professional affiliations.

Table of Contents

Executive Summary	iii
Overview	1
Introduction	1
Description of Alternatives	2
Baseline	2
Improved Road	2
Benefit-Cost Analysis Assumptions	4
Travel Modeling	5
VMT Savings	5
Mode Split	6
Benefits	8
Safety Improvements	9
VMT Safety Savings	12
VMT Externality Savings	14
Auto Emissions Reductions	15
Bicycle and Pedestrian Mortality Savings	17
Bike Lane Benefit	19
Bus Shelter Amenity	20
Real Estate Value	22
Residual Value	24
Benefits Summary	25
Costs	28
Capital Costs	28
O&M Costs	28
Costs Summary	28
Results	30
Benefit-Cost Results Summary	30
Results Over Time	31
Summary	33

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Appendix A Detailed Summary of Results 35

Executive Summary

This report constitutes formal benefit-cost analysis (“BCA”) in support of the County of Kaua‘i, Hawai‘i’s (“Applicant”) 2022 RAISE grant application for several safety and mobility improvements along a 3.3-mile segment of Po‘ipū Road (“Project”). Accordingly, this BCA is conducted in compliance with the RAISE Notice of Funding Opportunity¹ and the US Department of Transportation (“US DOT”) 2022 guidance for benefit-cost analysis.²

Po‘ipū Road is an existing road in the south region of the island of Kaua‘i, approximately 3.3 miles long, connecting the town of Kōloa and the Po‘ipū resort area. It is a thoroughfare serving both local and regional needs. Residential neighborhoods with affordable housing, Kōloa Elementary School, a public library, churches, shops and services, visitor accommodations, and access to public parks and beaches are all served by Po‘ipū Road. Po‘ipū Road sits on the boundary of a U.S. Department of Transportation Historically Disadvantaged Community census tract. Po‘ipū Road also borders and partially exists within a Federally Designated Opportunity Zone.

The Project is a rural project with a total capital cost of \$31,046,262. This includes all construction items, project mobilization, a five percent (5%) construction contingency, and construction management/engineering support during bidding and construction. RAISE funds of \$24,837,009.60 are requested toward these costs. A twenty percent (20%) local match of \$ 6,209,252.40 in County funds will be used for this Project. The sources of these local funds include \$341,567 in Capital Improvement Program (CIP) funds and \$5,867,685.40 from the County’s General Excise Tax (GET) transportation surcharge. The County’s GET transportation surcharge generates approximately \$25 million annually. The GET transportation surcharge funds are used for maintenance and resurfacing of County roads and bridges that are not eligible for Federal Aid, operation of our local transit system, and as a local match for Federally funded transportation projects. There are no restrictions as to when or how these local funds are spent in relation to this Project. The match amount and funding sources have been approved by County Council. The County has sufficient funds and successful experience with

¹ U.S. Department of Transportation (March 22, 2022). US DOT Funding Opportunity Number DTOS59-22-RA-RAISE [as amended]. https://www.transportation.gov/sites/dot.gov/files/2022-03/RAISE_2022_NOFO_AMENDMENT_1.pdf

² U.S. Department of Transportation (March 2022). *Benefit-Cost Analysis Guidance for Discretionary Programs*. [Government Report]. Washington: Office of the Secretary of the US Department of Transportation. <https://www.transportation.gov/sites/dot.gov/files/2022-03/Benefit%20Cost%20Analysis%20Guidance%202022%20%28Revised%29.pdf>

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Federal-Aid projects to operate on a reimbursement basis for the Federal share of the Project.

Currently, most people drive single-occupancy vehicles to access jobs, education, services, and recreation along Po'ipū Road. Vehicle speeds on Po'ipū Road and the lack of continuous sidewalks and bike lanes makes it challenging for most people in Po'ipū or Kōloa to get to their destinations by any means. This impacts children who want to walk or bike to school, adults who need to get to work, and families seeking recreation. According to U.S. Census data (2019 American Community Survey 5 Year Estimates), over 80% of workers in the Kōloa census-designated place (CDP) drive to work alone.

Traffic is congested on Po'ipū Road, especially in the vicinity of Kōloa Elementary School during school pick-up and drop-off. While close in distance, the housing center of Kōloa and the employment center of Po'ipū are not connected by a robust multi-modal transportation network. Two-way stops at major intersections along Po'ipū Road in the resort district contribute to delay, confusion, and speeding. Crosswalks along Po'ipū Road are not consistently well-located and vehicular travel speeds are not conducive to pedestrians safely crossing the street. In many places, residents and visitors must walk or bike in the busy travel lanes or on inadequate grass or paved shoulders.

The Project will have a significant regional impact by benefiting local property, roadway users, tourists, and the general public. It will ensure safe mobility while stimulating economic growth.

The total **present value benefits are \$108.8 million (2020 \$ PV)** for a 20-year operations period from 2026 to 2045. The Project would create \$70.5 million (2020 \$ PV) in additional net real estate value. Additionally, it will divert **35.9 million vehicle-miles traveled (“VMT”)** to non-auto uses (walking, cycling, bus). This yields benefits there are associated vehicle externality savings; greenhouse gas and criteria pollutant emissions savings; and road safety savings. Bus shelters and bike lanes accrue significant benefits to those users as well. The benefits of this BCA also include a residual value of the facility in 2045.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Table 1. Cumulative Project benefits, 2026 to 2045, present value 2020 \$

Benefit Category	Value
Safety Modification Savings	\$12,316,852
VMT Safety Savings	\$1,505,382
CO2 Emissions Savings	\$708,410
Other Emissions Savings	\$486,005
Vehicle Externality Savings	\$322,689
Total bike/ped mortality reduction	\$17,661,971
Cycle Lane revealed preference benefit	\$3,035,054
Bus shelter amenity benefit	\$172,829
Total real estate value	\$70,521,188
Residual Value	\$2,097,424
Total Benefits	\$108,827,805

Source: Author calculations.

Secondly, Table 2 outlines the cumulative Project costs, which total \$47.3 million (2020 \$ PV). This includes capital and O&M costs.

Table 2
Cumulative Project costs, 2023 to 2045, present value 2020 \$

Cost Category	Value (2020 \$ PV)
Capital Costs	\$23,840,458
O&M Costs	\$23,450,439
Total Costs	\$47,290,898

Source: Kaua'i County (2022); Author calculations.

The results show that the Project has a **benefit-cost ratio of 2.30 using a 7 percent real discount rate**. This means that the Project benefits exceed Project costs, and have a net present value of \$61.5 million over the 20-year operations period with a 33.2 percent economic rate of return. Table 3 below outlines these results

The benefits are summarized per U.S. DOT standards in the Project Benefits Matrix in Table 4. **This BCA finds that the present value benefits of the Project exceed the present value Project costs through 2045 by a factor of 2.3.**

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Table 3
Summary of Benefit Cost Analysis Metrics

Category	Value
Discount Rate	7%
Benefit-Cost Ratio	2.30
Net Present Value	\$61,536,907
Economic Rate of Return	33.2%
Break-Even Year	2028

Source: Author calculations.

Table 4
Project benefits matrix

Current Status	Change to Baseline	Type of Impacts	Population Affected by Impacts	Present Value Economic Benefit	Summary of Results	Page Reference in BCA
Unsafe road conditions	Various safety improvements and modifications (roundabouts, bike lanes, shoulder improvements)	Reduction in crashes: fewer injuries and fatalities	All roadway users	\$12.3 mil.	Monetized value of reduced crashes (51.3 injuries and 2.3 fatalities)	Page 9
High levels of VMT	Various improvements lead to reductions in 35.9 mil. VMT to non-auto modes	Reductions in crashes (injuries and fatalities) resulting from fewer VMT	All roadway users	\$1.05 mil.	Monetized value of reduced crashes (0.98 injuries, 0.32 fatalities)	Page 12
“”	“”	Reductions in externalities resulting from fewer VMT (congestion and noise)	All roadway users and individuals on properties near road	\$322,600	Monetized value of congestion and noise from reduced VMT	Page 14
“”	“”	Reduction in emissions from reduced VMT	All of society	\$1.19 mil. (\$0.71 mil. CO2, \$0.49 non-CO2)	Monetized value of reduced emissions (16,776 MT of CO2;	Page 15

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Current Status	Change to Baseline	Type of Impacts	Population Affected by Impacts	Present Value Economic Benefit	Summary of Results	Page Reference in BCA
					3.64 MT of non-CO2 pollutants)	
Unsafe/undesirable cycling conditions	Bike lanes and other safety improvements for additional cycling/walking	Mortality benefits from additional cycling and walking	New cyclists and pedestrians	\$17.7 mil.	Monetized value of 5.3 mil induced walk trips, 2.2 mil. Induced bike trips in terms of mortality reduction from active life.	Page 17
“”	“”	Bike Lane revealed preference benefits	New cyclists	\$3.05 mil.	Monetized value of 5.6 bike miles of travel (accounting for double counting in other benefit categories)	Page 19
Undesirable bus stops	Enhanced bus stops with turnarounds, shelters, and timetable	Bus shelter amenity benefits	Existing bus riders	\$172,800	Monetized value of bus shelter, seating, and timetable benefits to 739,000 bus trips on Rt. 30	Page 20

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Current Status	Change to Baseline	Type of Impacts	Population Affected by Impacts	Present Value Economic Benefit	Summary of Results	Page Reference in BCA
Depressed real estate value	Enhanced real estate value from Project	Real estate value increases	Property owners	\$70.5 mil.	Estimated increase in real estate values (accounting for double-counting issues)	Page 22
Baseline investment	Capital investment in Project	Residual value of project in final analysis year	All of society	\$2.10 mil.	Estimated residual value of Project facility in final analysis year	Page 24

Source: Author calculations.

Overview

Introduction

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⁴ U.S. Department of Transportation (March 2022). *Benefit-Cost Analysis Guidance for Discretionary Programs*. [Government Report]. Washington: Office of the Secretary of the US Department of Transportation. <https://www.transportation.gov/sites/dot.gov/files/2022-03/Benefit%20Cost%20Analysis%20Guidance%202022%20%28Revised%29.pdf>

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Federal Aid, operation of our local transit system, and as a local match for Federally funded transportation projects. There are no restrictions as to when or how these local funds are spent in relation to this Project. The match amount and funding sources have been approved by County Council. The County has sufficient funds and successful experience with Federal-Aid projects to operate on a reimbursement basis for the Federal share of the Project.

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Description of Alternatives

Baseline

For the Baseline alternative of this BCA, Po'ipū Road would remain in its existing conditions as a mostly two-lane rural road with lack of sidewalks or adequate facilities for bus riders. The Baseline does not include any improvements to this segment that would otherwise duplicate the Project for which the Applicant is requesting funds. Under the Baseline scenario, this analysis assumes that the Applicant would continue appropriate maintenance of their existing 3.3-mile road, and thus incur a baseline of operations and maintenance (O&M) costs.

Improved Road

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

For the purposes of this BCA, only one alternative is being considered in comparison to the Baseline. This scenario, referred to here as the “Improved Road” scenario, would include several improvements to Po'ipū Road. According to the applicant's statement of work, these improvements will include the following:

- Roadway resurfacing, reconstruction, or construction of new roadway along the entire length of the Project, approximately 3.3 miles.
- Continuous sidewalks along both sides of the street for 1.5 miles, and a sidewalk on one side of the street for 1.25 miles.
- Three new roundabouts at the intersections of Po'ipū Road with Kōloa Road, Po'ipū Road with Kiahuna Plantation Drive, and Po'ipū Road with Ala Kinoiki and Pe'e Road. The latter two roundabouts will each include four crosswalks with median refuges. The roundabout at Kōloa Road will include two crosswalks.
- Left turn lanes at all other intersections and driveways along Po'ipū Road between Lāwa'i Road and Ala Kinoiki.
- Construction of paved shoulders to be marked as bike lanes, with buffers from motor vehicle traffic for the 1.5 miles of roadway where adequate right-of-way exists.
- 11 crosswalks at uncontrolled locations with rectangular rapid flashing beacons; 5 of the crosswalks will have median refuges.
- 11 bus stops with bus shelters and amenities such as trash receptacles and bike racks; 7 of the bus stops will have bus turnouts.
- Drainage and swale improvements
- Medians for approximately 1.15 miles
- On-street parking improvements at select locations
- Landscape planting and irrigation
- Relocation of utilities as needed
- Relocation of private signage at Kiahuna Plantation Drive
- Striping and signage

All roadway features, including roundabouts, will be designed to accommodate transit and freight vehicles. The design vehicle for roundabout turning movements (using a truck apron) is the WB-50 vehicle. The posted speed limit is 25 mph.

Benefit-Cost Analysis Assumptions

This report complies with BCA standards specified by the U.S. DOT in the Benefit-Cost Analysis Guidance for Discretionary Grant Applications.⁵ All recommended values in the U.S. DOT guidance have been updated to real 2020 dollars using GDP price deflators.⁶ While the most current US DOT guidance implies real 2020 dollars for valuation, this analysis uses 2020 as the discount base year.

This analysis was conducted using a customized Microsoft Excel spreadsheet model, and utilizes the assumptions and methods outlined throughout this report. This BCA makes the following general assumptions:

- The total analysis period is 23 years, consisting of a 3-year construction period, and a 20-year operations period.
- 2023-2025: Design, engineering, and construction of the Project improvements
- 2026-2045: Operations for BCA analysis purposes are assumed to start in 2026 for a 20-year analysis period through 2045, inclusive.
- The real discount rate used in this analysis is 7 percent, consistent with U.S. DOT recommendations for a BCA. An exception to this discount rate is for benefits pertaining to greenhouse gas (CO₂) emissions which are discounted at a real discount rate of 3 percent per the same guidance.
- The financial base year of this analysis is 2020. Dollars are expressed in real 2020 dollars, not nominal dollars. When discounted, dollars are discounted to 2022 using a real discount rate of 7 percent unless otherwise specified.

⁵ U.S. Department of Transportation (March 2022). *Benefit-Cost Analysis Guidance for Discretionary Programs*. [Government Report]. Washington: Office of the Secretary of the US Department of Transportation. <https://www.transportation.gov/sites/dot.gov/files/2022-03/Benefit%20Cost%20Analysis%20Guidance%202022%20%28Revised%29.pdf>

⁶ U.S. Bureau of Economic Analysis. National Income and Product Accounts Table 1.1.9 Implicit Price Deflators for Gross Domestic Product. https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&nipa_table_list=13&categories=survey

Travel Modeling

VMT Savings

Several benefits in this BCA derive from the fact that Project improvements will divert trips from automobile towards other uses like walking, cycling, and bus. To understand these effects, the Applicant conducted an ad-hoc travel demand estimate based on the Kaua'i Multimodal Land Transportation Plan.⁷ According to that County plan, Baseline VMT in Kaua'i County was 771.5 million VMT in 2010, and projected to grow 19 percent by 2035 to a total of 918.1 million VMT in that year. This represents a compound growth rate of 0.7 percent during this long-term period. The County's analysis further states that per capita VMT would remain generally unchanged and that VMT growth would occur due to population growth.

The County's same planning analysis considers that their "preferred" scenario would see zero VMT growth in the long-term through 2035. Thus, VMT growth would be mitigated through a combination of bicycle, pedestrian, transit programs, and increased housing development density. This scenario includes the improvements in the Project for which the Applicant is requesting funds.

The Applicant claims certain assumptions to apportion the proposed countywide VMT reduction, generally, to that which can be attributed to the Project.

- The Po'ipū / Kōloa area accounts for 7.96% of County daytime population. Thus, this analysis assumes the Project corridor accounts for that share of VMT.
- The Applicant claims that 15% of future VMT reductions in the corridor, commensurate with the "preferred" plan scenario, would be attributed to the Project.
- This analysis assumes that the same long-term growth rates through 2035 would continue through the analysis period of 2045.

The arithmetic bears that the Po'ipū / Kōloa area had 61.4 million VMT in 2010 and would grow to 73.1 million VMT by 2035. With plan proposals, VMT would remain at a consistent 61.4 million VMT, representing a VMT savings of 11.7 million VMT by 2035.

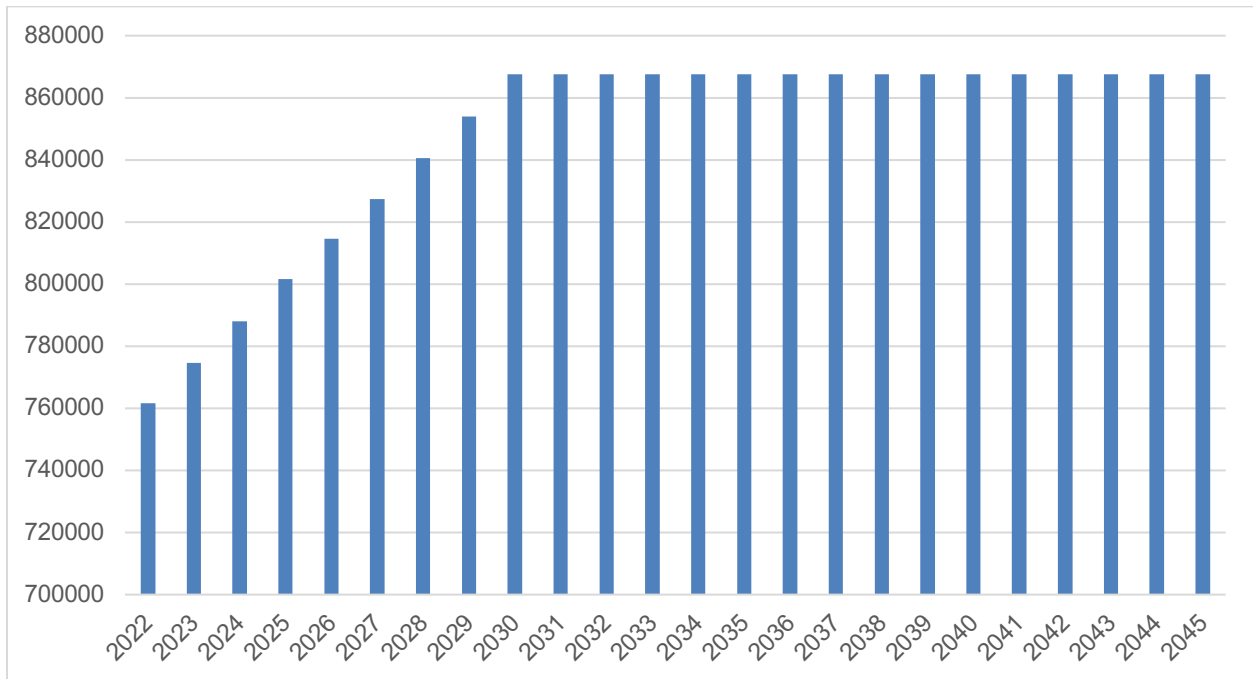
Because the Project is assumed to account for 15 of those VMT savings, this analysis identifies that VMT savings are 1.75 million VMT in 2035.

⁷ Kaua'i County (September 2012). *Kaua'i Multimodal Land Transportation Plan*. [Government report]. <http://plankauai.com/wp-content/uploads/Kauai-MLTP-Final-compressed.pdf>

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Over the 20-year Project operations period of 2026 through 2045, this analysis calculates that the Project would **generate a cumulative reduction 34.9 million VMT**. This represents an average VMT reduction of about 1.80 million VMT per year.

Figure 1
Annual VMT Reduction from Project, forecast 2026-2045



Source: County of Kaua'i (2010); Author calculations (2022).

Mode Split

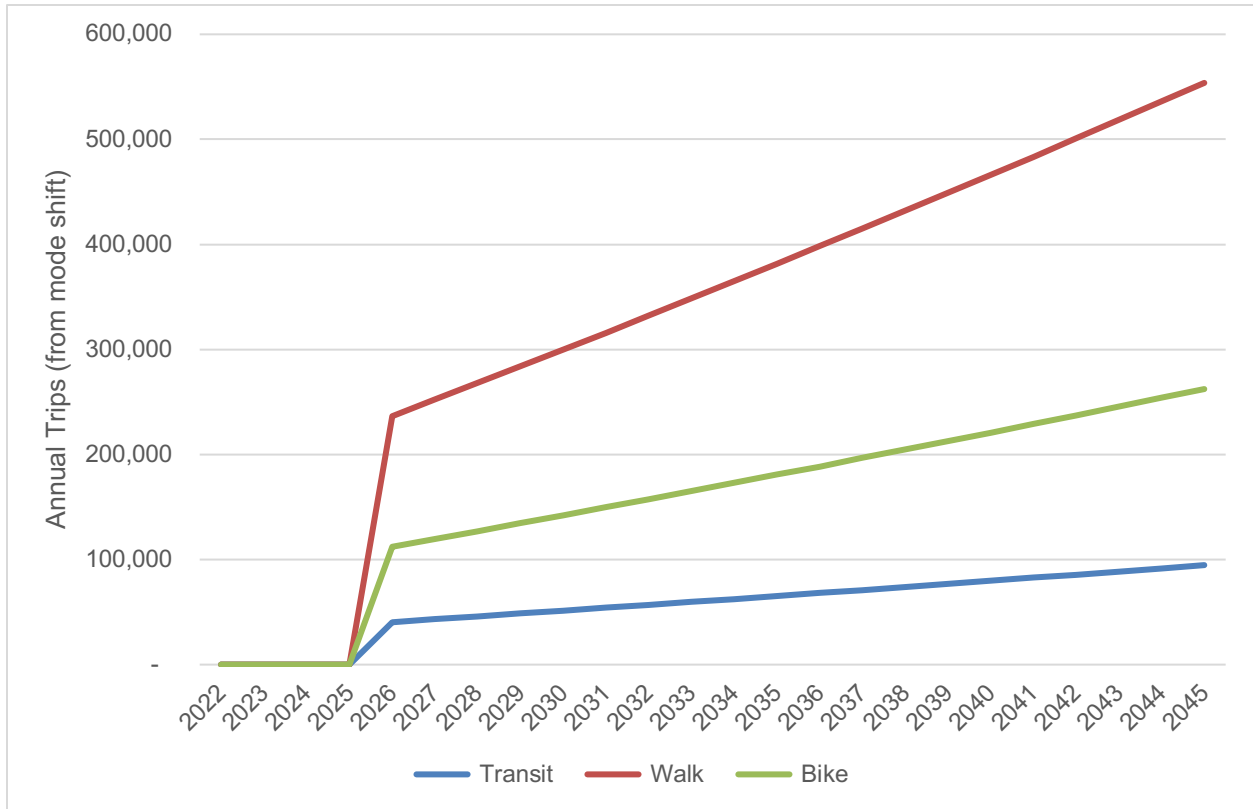
Having established a reduction of 34.9 million VMT as a result of the project, this analysis further estimates how many trips those VMT represent, and to which non-auto mode the trips would go to.

- Average vehicle occupancy is 1.67 persons per vehicle per US DOT guidance.
- The Project corridor is 3.3 miles long, and trips are assumed to be this distance.
- Of non-auto trips, the County estimates that 1.3% are transit, 7.6% are bus, and 3.6% are bicycle. When normalized to 100 percent, of non-auto trips, 10 percent are transit, 61 percent are walk trips, and 29 percent are bike trike.

Using these assumptions, this analysis calculates that the Project would shift **12.9 million person-trips** from auto to non-auto modes over a 20-year analysis period: **1.34 million trips on transit, 7.84 million walking trips, and 3.71 million bike trips**.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Figure 2
Annual trips from mode shift (2025-2046)



Source: Kaua'i County (2010); Author calculations (2022)

Benefits

Benefits in a BCA stem from the idea that different people or entities receive utility from the Project. For BCA purposes, it is important to identify these benefits over the life-cycle of a Project, which for this BCA is 23 years from 2022 to 2045 (3 years of construction plus 20 years of operations).

All dollar amounts are expressed in 2020 present value dollars (2020 \$ PV) using a 7 percent discount rate.⁸

This analysis identifies the U.S. DOT strategic goal that the benefit falls under, as well as the incidence of the benefit (the population affected by the impacts). The five U.S. DOT strategic goals are:

- 1) Safety
- 2) State of Good Repair
- 3) Economic Competitiveness
- 4) Livable Communities
- 5) Environmental Sustainability

A benefit can fall in one or many of these categories.

The incidence of the benefit can fall on either private beneficiaries (specific private individuals or private firms) or public beneficiaries (the public at large or government entities). Thus, the type of benefit depends on the population or entities affected by the impacts. It is possible for a benefit to fall on a mix of populations, and for it to be both a private and a public benefit.

⁸ An exception to the real discount rate is CO₂ emissions which are discounted at 3 percent.

Safety Improvements

The Project will introduce several safety treatments that will significantly improve safety conditions along the corridor leading to a reduction in crashes.

Among these treatments are roundabouts, medians, bike lanes, shoulder improvements, and median/crosswalk/RRFB rail signal treatments. Crash reductions benefit society in the form of reduced medical expenses including public costs of medical expenses, as well the avoided pain and suffering from fatalities.

The Applicant obtained safety records along the Project corridor for a seven-year period from 2013 to 2019. These data indicate that there were **39 injuries** from crashes during this period (about 5.6 per year); and **one fatal crash** in March 2019⁹ (an average of 0.14 crash deaths per year).

Table 5 below reports the detailed crash statistics along the Project corridor at seven sites for which the Project will be constructing improvements. To identify safety benefits, this analysis applies “crash modification factors” from the Crash Modification Clearinghouse¹⁰ (see Table 6).

Finally, Table 7 indicates the US DOT recommended values for the various KABCO scale injuries and fatalities using the suggested **value of statistical life of \$11.6 million**.

Safety Improvements

DOT Goal: Safety

Benefit Incidence: Private and public benefit

20-year Benefit: Reduction in 51.2 injuries and 2.34 fatalities

20-Year Value: \$12.3 mil.

Average per year:
\$615,800

⁹ Fatal crash was reported on March 1, 2019 per the US DOT's Fatal Accident Reporting System (Unique Crash ID 150041). The crash was a two-vehicle crash resulting in one fatality.

¹⁰ U.S. Department of Transportation (2022). *Crash Modification Clearinghouse* [Database]. <https://www.cmfclearinghouse.org/>

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Table 5
Crash history along Project corridor, 2013-2019 (number of individuals per year)

	O – No Injury	C – Possible Injury	B – Non-incapacitating	A – Incapacitating	K – Killed
Roundabout 1	6	0	0	0	0
Roundabout 2	0	0	6	1	1
Medians	5	0	5	0	0
Bike Lanes	0	0	2	0	0
Shoulder 1	4	0	0	0	0
Shoulder 2	0	0	9	0	0
Median & Xwalk & RRFB	0	0	1	0	0
Total	15	0	23	1	1

	U – Injured (Severity Unknown)	# Accidents Reported (Unknown if Injured)	Total Non-Fatal	Total Fatal
Roundabout 1	0	0	6	0
Roundabout 2	0	0	7	1
Medians	0	0	10	0
Bike Lanes	0	0	2	0
Shoulder 1	0	0	4	0
Shoulder 2	0	0	9	0
Median & Xwalk & RRFB	0	0	1	0
Total	0	0	39	1

Source: Kaua'i County (2022); Fatal Accident Reporting System (2022)

Table 6
Crash modification factors used for various Project treatments

	CMF ID	CMF	CRF (1-CMF)	Name
Roundabouts	207	0.42	0.58	Conversion of stop-controlled intersection into single-lane roundabout (non-injury crash)
Roundabouts	211	0.18	0.82	Conversion of stop-controlled intersection into single-lane roundabout (injury crash)
Medians	3034	0.61	0.39	Install Raised Median
Bike Lanes	7840	0.42	0.58	Install Bicycle Lanes
Shoulder 1	6362	0.8	0.2	Widen Shoulder (non-injury crash)
Shoulder 2	6356	0.93	0.07	Widen Shoulder (injury crash)
median & Xwalk & RRFB		0.28	0.72	Multiply .526*.54 for RRFB & median xwalk since both countermeasures will reduce crash type

Source: Crash Modification Factors Clearinghouse (2022)

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Table 7
Value crashes by KABCO severity (2020 \$)

Crash Type	Value Per Person or Incident
O - No Injury	\$3,900
C - Possible Injury	\$77,200
B - Non-incapacitating	\$151,100
A - Incapacitating	\$554,800
K - Killed	\$11,600,000
U - Injured (severity unknown)	\$210,300
# Accidents Reported (unknown if injured)	\$159,800

Source: US DOT (2022).

The safety improvements from the Project would lead to a reduction in **2.34 statistical fatalities¹¹** and **51.2 non-fatal injuries** (on the KABCO scale) over the 20-year operations period in this analysis.

This is both a **private benefit and public benefit**. Private individuals benefit from avoiding risk of injury or death; private companies avoid the cost of crashes; and the public benefits in their reduced medical payments. This benefit advances the U.S. DOT goal of **Safety**.

Over the 20-year operations period, the safety improvement benefits total **\$12.3 million (2020 \$ PV)**, or an average of \$615,800 per year.

¹¹ This analysis places monetary value on fractions of a safety incident (fatality, injury, or crash). The figure 0.1 fatalities means that it would take 10 analysis periods to produce one full fatality. Alternatively, it can be viewed as a probability, or a 10% probability of a fatality occurring in the analysis period.

VMT Safety Savings

Reductions in auto VMT lead to a separate set of safety savings due to reduced exposure to crashes. Simply put, less driving leads to fewer crashes.

It is worth noting that these are safety savings separate from those arising due to physical infrastructure improvements. Those have been accounted for in a previous section. These are savings that derive from fewer crashes due to less VMT on the road.

As established, the Project would lead to a 20-year reduction in **35.9 million VMT**.

This analysis uses recent crash statistics from the US DOT's Highway Safety Improvement Program (HSIP) for the state of Hawaii as recent as 2019.¹² These data indicate the following crash rates:

- 0.97 fatalities per 100 million VMT
- 3.91 injuries per 100 million VMT

To monetize the benefits of reduced injuries, this analysis converts fatalities and injuries at the person level into crashes. This is accomplished using US DOT recommended values of 1.44 injuries per injury crash and 1.09 fatalities per fatal crash.

With that conversion, this analysis uses the following values for fatal and injury crashes:

Table 8
Value of injury and fatal crashes

Crash type	2020 \$ / Crash
Injury Crash	\$302,600
Fatal Crash	\$12,837,400

Source: US DOT (2022)

¹² U.S. Federal Highway Administration (2022). *State highway safety report: Hawaii, 2019 (5-year average rates)*. [Government database].

VMT Safety Savings

DOT Goal: Safety

Benefit Incidence: Private and public

20-year Benefit:

Reductions in crashes: 0.32 fatal crashes; 0.98 injury crashes

20-Year Value: \$1.51 million

Average per year: \$75,300

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

The **35.9 million VMT** reduction translates to reductions in fatalities and injuries. Over 20 years, there are **0.35 fewer (statistical) fatalities and 1.41 fewer injuries**. This is equal to **0.32 fatal crashes and 0.98 injury crashes**.

This is both a **private benefit and public benefit**. Private individuals benefit from avoiding risk of injury or death; private companies avoid the cost of crashes; and the public benefits in their reduced medical payments. This benefit advances the U.S. DOT goal of **Safety**.

In the 20-year operations period, **this benefit totals \$1.51 million (2020 \$ PV)**, or an annual average of \$75,300 per year.

VMT Externality Savings

As previously indicated, this Project would reduce **35.9 million VMT** over 20 years. This reduction in countywide VMT has broad public externality savings. This analysis estimates externalities in the form of congestion reductions and noise reductions. Pavement reduction savings are de minimis for rural automobiles and thus not monetized.

Congestion reductions stem from resulting travel time savings on other drivers when overall VMT reduces. Finally, noise savings are benefits from reduced noise on the roadway network. There are additional externalities in emissions and safety that this analysis calculates separately in other sections of this analysis.

The Federal Highway Administration estimates the per-VMT value of externalities light-duty vehicles in a rural setting. The following table represents the values as recommended by the US DOT:

Table 9
Value of vehicle externalities

Type	Value per VMT
Reduced Congestion	\$0.026
Noise Reduction	\$0.0002
Total Externality Savings	\$0.0817

Source: US DOT (2022)

These benefits constitute **public savings** because they are positive externalities that benefit all of society.

Reduced congestion advances **Economic Competitiveness** since it is tied to travel time benefits for roadway users. Finally, noise reduction advances the **Environmental Sustainability** goal because they are tied to the ambient noise environment.

The **35.9 million VMT** reduction translates to a benefit in the two externality categories. In the 20-year operations period, **this benefit totals \$322,700 (2020 \$ PV)**, or an annual average of over \$16,100 per year.

VMT Externality Savings

DOT Goals: Economic Competitiveness; Environmental Sustainability

Benefit Incidence: Public benefit; all of society.

20-year Benefit: 36.9 million reduced VMT; lower costs in externality categories.

20-Year Value: \$322,700

Average per year: \$16,100

Auto Emissions Reductions

Reductions in auto VMT lead to reductions in several emissions. This analysis considers criteria pollutants in the form of greenhouse gas emissions as carbon dioxide (CO₂); and other pollutants in the form of nitrous oxides (NO_x), particulate matter (PM_{2.5}), sulfurous oxides (SO₂).

Reductions in criteria pollutants are localized and yield improved air quality – and better health – in the local area. Reductions in CO₂, a greenhouse gas, contribute to the fight against global climate change and all the benefits that stem from that.

The first step was to identify how reductions in **35.9 million VMT** translate to reductions in emissions.

Emissions rates from automobiles are from an author-analyzed custom run of the EPA MOVES model for light duty automobiles at 30 mph, which varies by year.¹³ The emissions rates at the mid-point of the analysis, year 2035, is provided in Table 10.

This analysis utilized the per-ton emissions monetized values in Table 11 per U.S. DOT guidance.¹⁴ These values also vary over time and a year 2035 mid-point is displayed.

Truck Emissions Reductions

DOT Goal: Environmental Sustainability

Benefit Incidence: Public benefit; all of society.

20-year Benefit: Emissions savings: CO₂ = 16,776 MT; NO_x = 1.87 MT; PM_{2.5} = 1.60 MT; SO₂ = 0.17 MT

20-Year Value: \$1.31 mil.

Average per year: \$65,400

¹³ U.S. Environmental Protection Agency (2021). *Motor Vehicle Emissions Simulator (MOVES)*. [Software package, version MOVES3]. Washington: Environmental Protection Agency. <https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves>

¹⁴ U.S. Department of Transportation (2022). *Benefit-Cost Analysis Guidance for Discretionary Programs*. [Government Report]. Washington: Office of the Secretary of the US Department of Transportation.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Table 10
Emissions rates, analysis mid-point 2035

Emission Type	grams / VMT
CO ₂	423.4
NO _x	0.0497
PM _{2.5}	0.0403
SO ₂	0.0043

Source: US EPA MOVES3 (2019); Author software using EPA Moves (2021)

Table 11
Value of emissions, analysis mid-point 2035 (2020 \$ per metric ton)

Emission Type	\$ / metric ton (MT)
CO ₂	\$67.00
NO _x	\$18,100.00
PM _{2.5}	\$867,600.00
SO ₂	\$49,100.00

Source: US DOT (2022)

The **35.9 million VMT** reduction translates to reductions of all emissions categories. The cumulative reductions over 20 years amount to: **16,776 metric tons (MT) of CO₂, 1.87 MT of NO_x, 1.60 MT of PM_{2.5}, 0.17 MT of SO₂.**

Emissions reductions are a **public benefit**, as a positive externality, because all of society benefits from reductions in these emissions via improved health, well-being, and reductions in global warming. This benefit advances the U.S. DOT goal of **Environmental Sustainability**.

In the 20-year operations period, **this benefit totals \$1.19 million (2020 \$ PV)¹⁵**, or an annual average of \$59,700 per year. Of the total benefit, \$708,400 is from reductions in CO₂ and \$486,000 are from reductions in the remaining pollutants.

¹⁵ Benefits from reduced CO₂ emissions are separately discounted at 3 percent.

Bicycle and Pedestrian Mortality Savings

Cycling and walking are known to improve health outcomes by improving cardiovascular fitness and leading to reductions in hypertension, heart disease, and other mortality risks. To estimate the benefits of mortality reduction benefits of induced active transportation, this analysis relies on US DOT recommended values.

First, the Travel Modeling section of this report established that there would be induced mode shift from auto to cycling and walking from this project. Specifically, this analysis estimated that the Project would generate **7.85 million walk trips and 3.71 million cycling trips** over the 20-year operations period. These are *induced* trips from non-active to active modes.

Because US DOT recommends that these benefits accrue to those age 20-74 (walking) and age 20-64 (cycling), this analysis uses the Department's recommended factors to scale down total trips to trips in that population. Specifically, **68 percent of walking trips and 59 percent of bike trips fall into this category.**

This arithmetic yields **5.33 million active walk trips and 2.19 million active bike trips** over the 20-year operations period. Those trips are valued as below:

Table 12
Value of active transportation benefits

Type	Value per active trip
Walking	\$7.08
Cycling	\$6.31

Source: US DOT (2022)

Reductions in mortality would be a **private benefit** accruing to individuals experiencing healthier and longer life, as well as a **public benefit** as society would benefit from reduced mortality, health care costs, and the burdens of losing loved ones early. This benefit advances the U.S. DOT goal of **Safety** and **Livable Communities**.

Bike/Ped Mortality Savings

DOT Goal: Safety; Livable Communities

Benefit Incidence: Private benefit (individuals); public benefit (reduced burden from mortality)

20-year Benefit: Reduced mortality from 5.3 mil. induced walk trips and 2.2 mil. induced bike trips

20-Year Value: \$17.7 mil.

Average per year:
\$833,000

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

In the 20-year operations period, **these benefits total \$17.7 million (2020 \$ PV)**, or an annual average of \$833,000 per year.

Bike Lane Benefit

One of the core components of the Project is to reconstruct paved shoulders to be marked as bike lanes, with buffers from motor vehicle traffic for 1.5 miles of roadway where adequate right of way exists. These 1.5 miles of dedicated cycling lanes have a benefit in terms of safety and comfort to cyclists.

Presently there are no parallel facilities available. The previous Travel Modeling section of this report estimated that the Project would induce **3.7 million bike trips** over the 20-year operations period. Because the bike facility is **1.5 miles**, this analysis assumes each trip would be 1.5 miles, although many bike trips would use general right of way and likely be longer. This yields **5.7 million bike-miles** over this period.

To monetize the benefit, one can rely on “revealed preference” values where individuals convey the willingness to pay for facilities. Based on such studies, the US DOT recommends a facility value of **\$1.69 per cycling mile** for “dedicated cycling lanes”.

To avoid double-counting, this analysis subtracted benefits deriving from the bike lane in the Safety Improvements section. That benefit totaled approximately \$500,700 over 20 years in undiscounted terms.

Bike lane benefits are a **private benefit** accruing to individuals who cycle; as well as a **public benefit** as society would benefit from reduced risk of accidents.

In the 20-year operations period, **this benefit totals \$3.04 million (2020 \$ PV)**, or an annual average of \$151,800 per year.

Bike Lane Benefit

DOT Goal: Safety; Livable communities

Benefit Incidence: Private benefit (individuals); public benefit (reduced burden from mortality)

20-year Benefit: Reduced mortality from 5.3 mil. Induced walk trips and 2.2 mil. Bike trips

20-Year Value: \$3.04 mil.

Average per year:
\$151,800

Bus Shelter Amenity

The Project includes 11 bus stops with bus shelters and amenities such as trash receptacles and bike racks. Seven of these bus stops will also have bus turnouts. The bus shelters provide a benefit to bus riders in providing comfort from seating and weather protection, as well as providing timetable signage and other information.

Currently, the Number 30 Kōloa Shuttle provides bus service in this corridor. The County reports that 2020 boardings on this bus route were **29,222 riders per year**.

This analysis assumes a modest growth of 1.5 percent per year in long-term ridership, such that there are a total **738,700 bus riders** on this route, cumulatively, over the 20-year Project operations period.

One way of ascertaining benefits to amenities is through “stated preference” studies where individuals report the economic value they place on several types of amenities. The US DOT summarizes such studies and provides recommended values for several amenities. For the Project bus shelters, this analysis focuses on the amenity from seating, weather protection, and timetables. The recommended values are as follows:

Table 13
Value of bus facility amenities

Amenity	Value per user trip (2020 \$)
Platform/Stop Seating Availability	\$0.18
Platform/Stop Weather Protection	\$0.24
Timetables	\$0.22
Total	\$0.64

Source: US DOT (2022)

Bus Shelter Amenity

DOT Goal: Safety; Livable communities

Benefit Incidence: Private benefit (bus riders); public benefit (aesthetic value)

20-year Benefit: Reduced mortality from 5.3 mil. Induced walk trips and 2.2 mil. Bike trips

20-Year Value: \$197,800

Average per year: \$9,900

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Bus shelter benefits are a **private benefit** accruing to individuals who use the bus; as well as a **public benefit** as society benefits from aesthetic and safety improvements. These shelters enhance the US DOT strategic goals of **Safety** and **Livable Communities**.

In the 20-year operations period, **this benefit totals \$172,800 (2020 \$ PV)**, or an annual average of \$8,600 per year.

Real Estate Value

The Project would significantly improve the economic vitality of the corridor and an economically distressed area of Kaua'i. One way the project benefits the community is in increases to property values that would otherwise not occur without the project; and that are above and beyond any real estate value generation that otherwise would have occurred in the County.

The Applicant has provided a real estate analysis that stipulates two areas of real estate value generation: anticipated "infill" development in an area of about 67 acres, and anticipated upzoning development in an area of about 187 acres.

Infill. The infill development parcels currently total 68.1 acres and are presently assessed at \$425,927 per acre. Thus, the current assessed value is about \$29.0 million in property value. The County asserts that the Project would attract infill development and help alleviate much-needed housing supply issues. Based on the development potential, the per-acre values would increase to \$1,437,500 per acre, for a total assessed valuation of \$97.9 million. This represents an increase in property value of **\$68.9 million in undiscounted dollars.**

Upzoning. The County asserts a second area of development (Mahaulepu Farm) that totals 187.17 acres in size, and this property would be primed for intended upzoning along the "gateway" improvement vicinity. This upzoning would depend on the Project going forward and would not be successful without the Project. The parcels currently are assessed at \$52,908 per acres, or a current assessed value of \$9.90 million. The County's analysis suggests, based on current resale of similarly zoned 25-acre R-10 zoned land, that the new valuation would be \$437,248. Thus, the future value would be \$81.8 million, representing an increase of **\$71.0 million in undiscounted dollars.**

Residual Value

DOT Goal: Economic Competitiveness

Benefit Incidence: Private benefit; owner of facility.

20-year Benefit: Residual value left in the asset in the final year of analysis.

20-Year Value: \$70.5 mil.

Average per year: \$7.05 mil. (over a 10-year "phase in" period)

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

This analysis provides certain adjustments to these property value increases. First, the value increase is assumed to **accrue over a 10-year period**. This is a more conservative assumption than allowing a large one-time stock increase early in the Project operations period. It respects the fact that real estate development takes time and growth has to occur over a longer period. Therefore, the real estate values increase equally over 10 years from 2026 through 2035.

Secondly, this analysis respects that real estate value benefits are susceptible to double-counting of benefits. Many benefits are otherwise “capitalized” into real estate values, creating this problem. To account for this, two benefits elsewhere in this BCA have been deducted from the nominal property values: bike lane benefits and bus shelter amenities. The undiscounted value of these other “double counted” benefits amount to **\$9.4 million and were subtracted from the real estate value** to avoid the double-count.

These benefits are the ones that are most likely to be capitalized into real estate. Other benefits in this BCA, such as safety and externalities, are broader public benefits and not necessarily susceptible to significantly being capitalized into real estate. Further, this analysis does not account for any travel time savings or operation cost savings, which are the traditional values that are most capitalized into real estate.

These real estate value benefits are **private benefits** occurring to property owners of land and real estate, and they advance the US DOT goal of **Economic Competitiveness**.

Over the 20-year operations period (or, effectively, the 10-year phase in period for this benefit), **the property value increases amount to \$70.5 million (2020 \$ PV)**. This is equal to an average of \$8.07 per year during the 10-year phase in period.

Residual Value

The undiscounted capital costs of the Project are \$31.0 million, and this analysis assumes an expected life cycle of 30 years for these (mostly) road improvements. Because this BCA is over a 20-year analysis period, there is value remaining in the asset in 2045, the final analysis year. This value is known as the “residual value” and added as a benefit per US DOT BCA guidance.

This BCA assumes that the asset **begins with a value of \$31.0 million** and will depreciate linearly towards \$0 over a 30-year period. Thus, the asset has an **annual depreciation rate of \$1.03 million per year**.

At the end of the analysis period, by 2045, the asset will have a residual value of \$11.4 million in undiscounted terms.

This benefit is a **public benefit** occurring to the people of Kaua'i County, the owner of the facility. It advances the US DOT goal of **Economic Competitiveness**.

In 2045, **the residual value amounts to \$2.10 million (2020 \$ PV)**, treated as a one-time benefit in the final analysis year.

Residual Value

DOT Goal: Economic Competitiveness

Benefit Incidence: Private benefit; owner of facility.

20-year Benefit: Residual value left in the asset in the final year of analysis.

20-Year Value: \$2.10

Average per year: n.a.; applied in final year of analysis only.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Benefits Summary

Over a 20-year operations period from 2026 to 2045, the **cumulative benefits total \$108.8 million** (2020 \$ PV).

Table 14. Cumulative Project benefits, 2026 to 2045, present value 2020 \$

Benefit Category	Value
Safety Modification Savings	\$12,316,852
VMT Safety Savings	\$1,505,382
CO2 Emissions Savings	\$708,410
Other Emissions Savings	\$486,005
Vehicle Externality Savings	\$322,689
Total bike/ped mortality reduction	\$17,661,971
Cycle Lane revealed preference benefit	\$3,035,054
Bus shelter amenity benefit	\$172,829
Total real estate value	\$70,521,188
Residual Value	\$2,097,424
Total Benefits	\$108,827,805

Source: Author calculations.

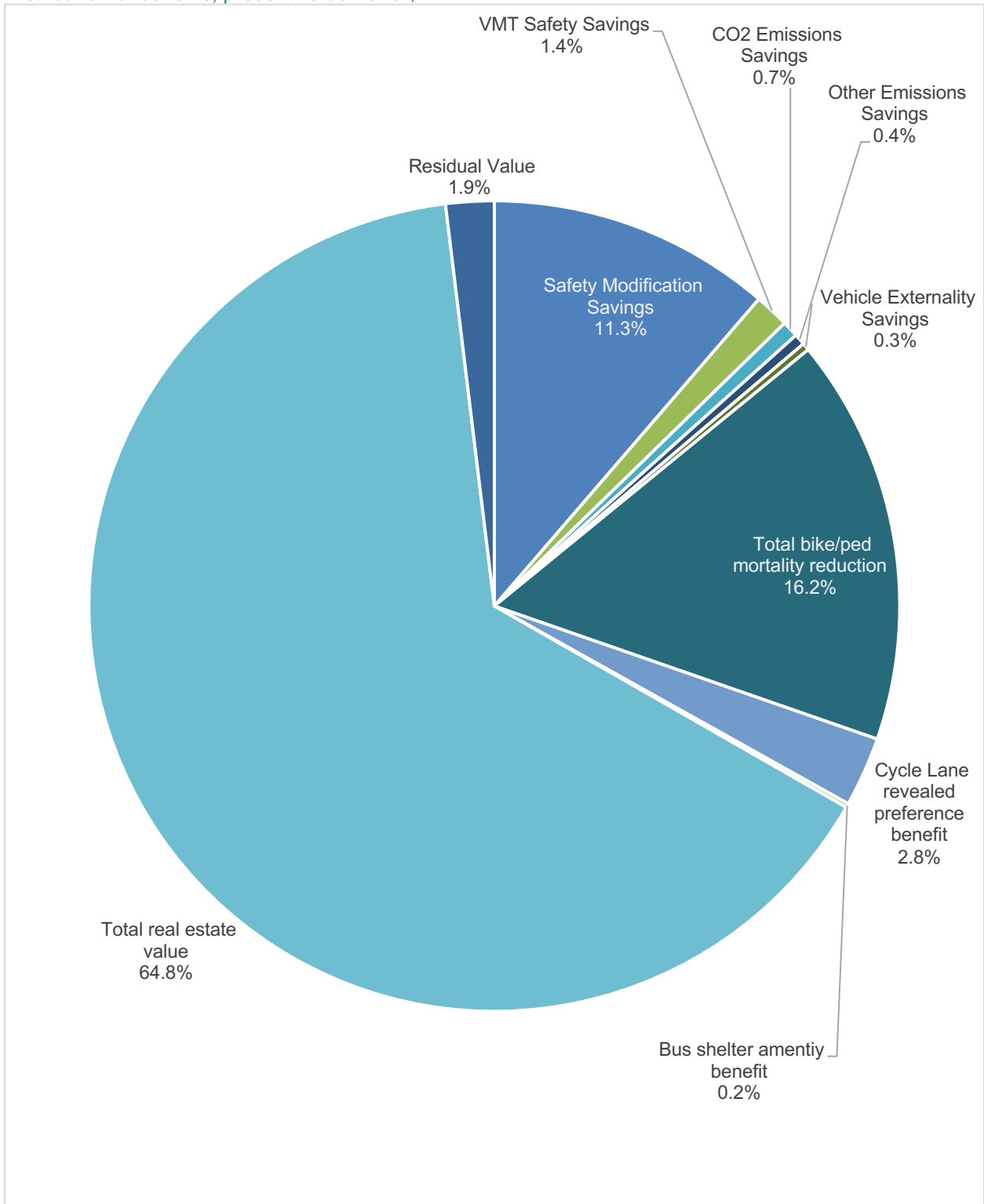
Figure 3 outlines the distribution of benefits. The majority (65 percent) of the benefits come from the real estate value increases.

The second largest category is mortality reductions to cyclists and pedestrians (16.2 percent) followed by safety modification savings (11.3 percent), underscoring that the Project indeed improves safety in substantial ways. All other benefits account for no more than 3 percent of benefits in individually and round out the remaining 7.5 percent of benefits.

It is worth noting that the magnitude the real estate value alone would be enough in present-value terms to exceed present-value Project costs (discussed in the next section). However, it is only needed in part. As a sensitivity analysis, the real estate value increases could be reduced by up to 87 percent and the Project would still have a benefit-cost ratio over 1.0.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

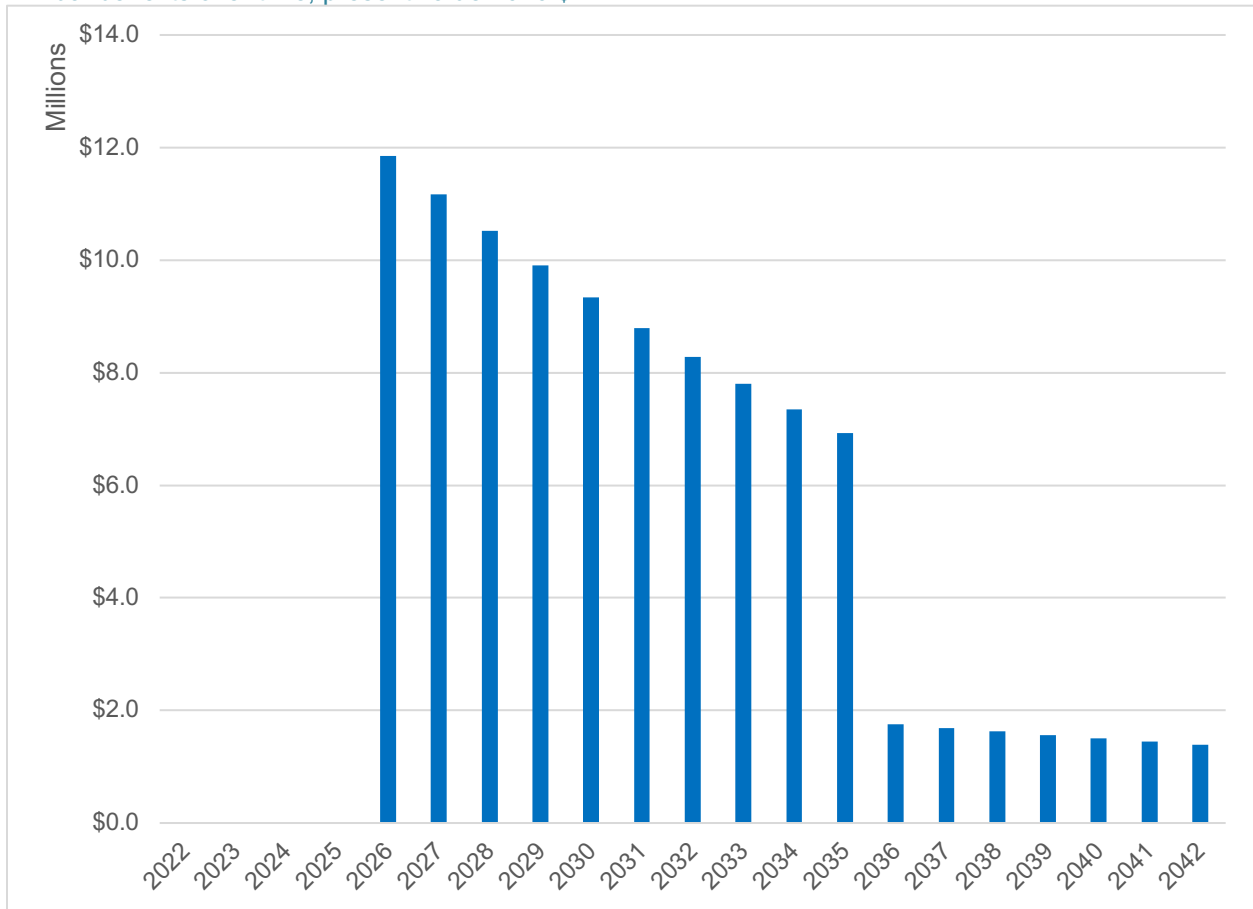
Figure 3
Distribution of benefits, present value 2020 \$



Source: Author calculations.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Figure 4
Annual benefits over time, present value 2020 \$



Source: Author calculations.

Costs

Capital Costs

The Applicant provided estimates of the Project **capital costs of \$31,046,262** in current undiscounted 2020 dollars. This includes all construction items, project mobilization, a five percent construction contingency, and construction management and engineering support during bidding and construction.

They also indicate that construction spending would occur over a 3-year period from 2023 through 2025. In these years, 29 percent of the spend would be in 2023; 50 percent in 2024; and 21 percent in 2025.

Accordingly, in present value 2020 dollars, **the Project capital costs are \$23.8 million.**

O&M Costs

This analysis assumes that O&M costs for the Project are 10 percent of capital costs on an annual basis. Thus, O&M costs are estimated at \$3.10 million per year in undiscounted 2020 dollars.

These long-term O&M costs would account for items such as routine maintenance of facilities, road surfacing, repainting, and other items that provide acceptable O&M for a capital facility of this type. These costs are incurred annually during the 20-year operations period from 2026 through 2045.

It is worth note that these O&M cost estimates are conservative. Under the Baseline scenario, the County would still incur costs to maintain and operate the roadway and other facilities as they are under existing conditions. Thus, the “net” O&M costs of the Project are likely lower when accounting for existing O&M costs that would otherwise occur.

Over the 20-year operations period the **O&M costs are cumulatively \$23.5 million (2020 \$ PV).**

Costs Summary

The total costs of the Project are \$47.3 million (2020 \$ PV) from the beginning of construction in 2023 through the end of the 20-year operations analysis period in 2045. These costs include capital and O&M.

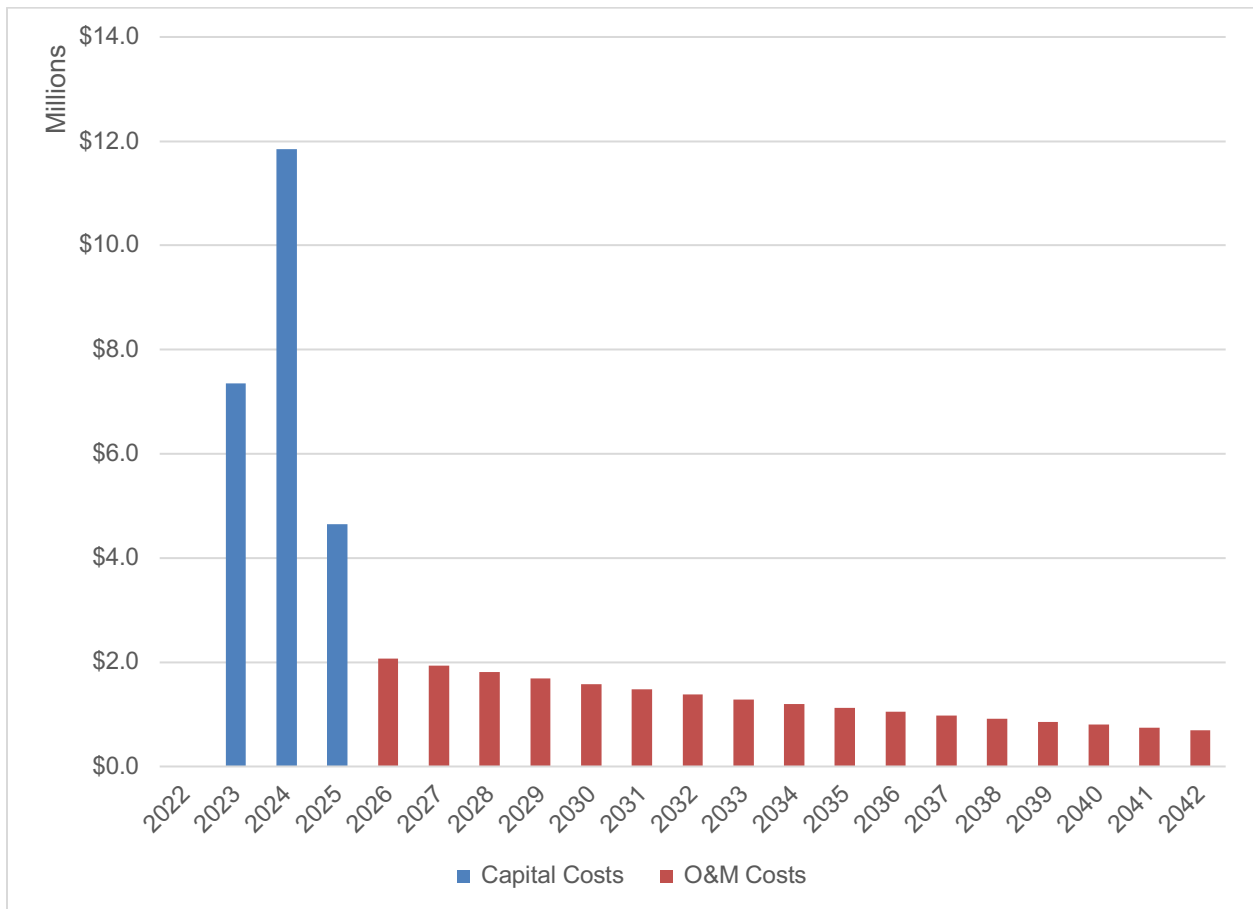
2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Table 15
Cumulative Project costs, 2023 to 2045, present value 2020 \$

Cost Category	Value (2020 \$ PV)
Capital Costs	\$27,294,941
O&M Costs	\$26,848,408
Total Costs	\$54,143,349

Source: Kaua'i County (2022); Author calculations.

Table 16
Project costs over time, present value 2020 \$



Source: Author calculations.

Results

This BCA reports the results of the Project at a 7 percent real discount rate. The metrics reported in this analysis include:

- Benefit-cost ratio (“BCR”): the ratio of present value benefits to present value costs
- Economic rate of return (“ERR”): the rate of return of the economic benefits, or alternatively, the discount rate at which the benefit-cost ratio would be exactly 1.0. It is calculated off the undiscounted benefit and cost streams.
- Net present value (“NPV”): the difference of present value benefits and present value costs.
- Break-even year: the year in which cumulative present value benefits exceed present value costs.

Benefit-Cost Results Summary

The BCR of the Project, using the methodology described in this report, is a **benefit-cost ratio of 2.30** at a 7 percent real discount rate from 2023 to 2045.¹⁶ **This suggests that the Project present value benefits are greater than the present value costs.**

The **net present value is \$61.5 million**. The present value cumulative benefits would exceed cumulative costs after the third year of operations, by 2028. This means the Project would take only three years of operations to “break even.”

The **economic rate of return of the Project is 33.2 percent**.

¹⁶ Benefits from reduced CO₂ emissions are separately discounted at 3 percent.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Table 17
Summary of Benefit Cost Analysis Metrics

Category	Value
Discount Rate	7%
Benefit-Cost Ratio	2.30
Net Present Value	\$61,536,907
Economic Rate of Return	33.2%
Break-Even Year	2028

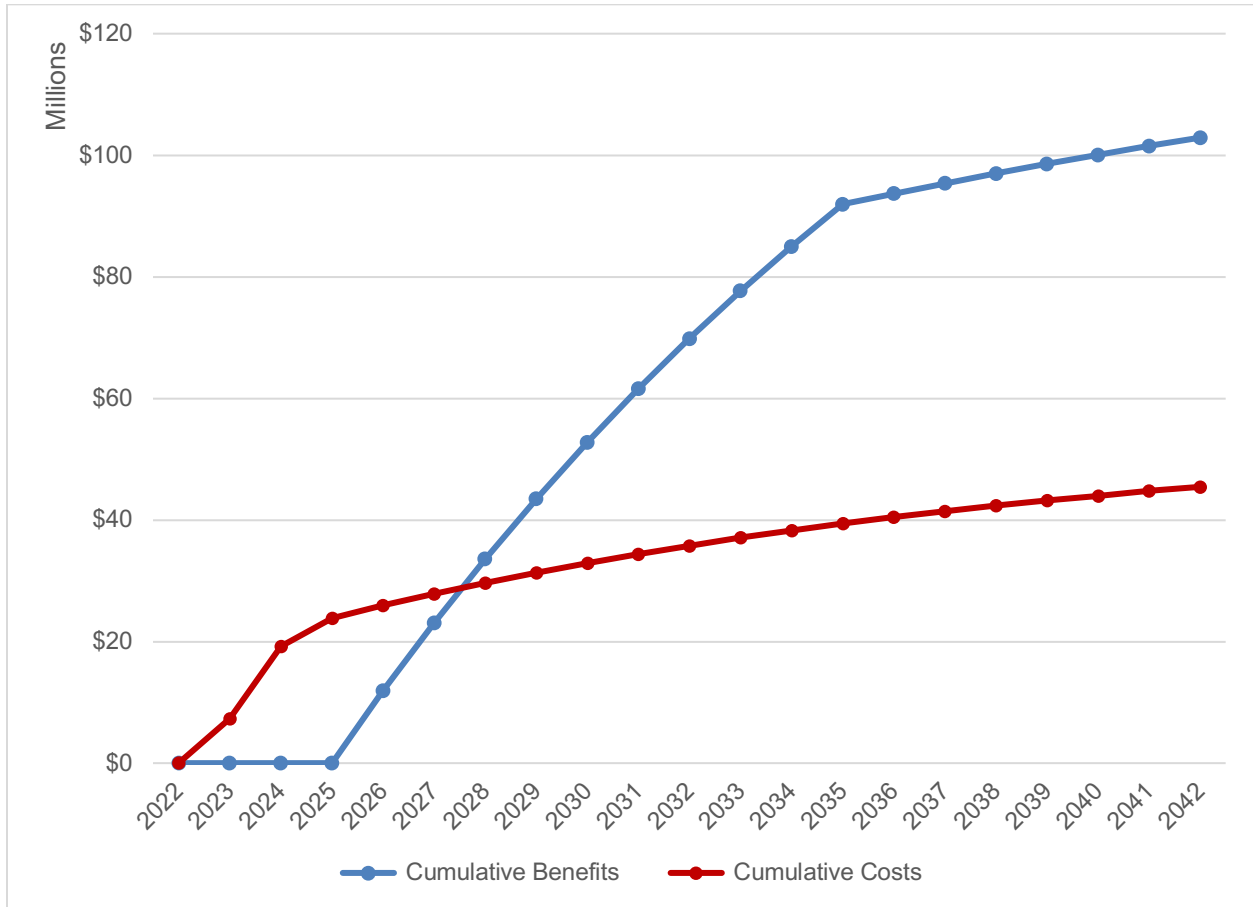
Source: Author calculations.

Results Over Time

Figure 5 below shows the benefits and costs of the Project over time. At a 7 percent real discount rate, present value benefits exceed present value costs by 2028, after the third year of operations. Thus, after only three years of operations we would expect the Project to “break even” in both cumulative and marginal terms.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Figure 5
Cumulative Project Benefits and Costs, Present Value 2020 \$



Source: Author calculations

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Summary

This report is a benefit-cost analysis of proposed safety and mobility improvements on Po'ipū Road in Kaua'i County, Hawai'i. This thoroughfare is in need of significant improvements for safety and quality of life of areas that are Historically Disadvantaged and are next to a Federally Designated Opportunity Zone.

The improvements are many, and they are summarized throughout this report and by the Applicant in the primary RAISE grant application. They include highlights such as road resurfacing, roundabouts, improved intersections, new sidewalks, crosswalks, bus shelters, and bike lanes.

Based on the methodologies outlined in the report, **the benefit-cost ratio of the Project is 2.30** with a 7 percent real discount rate. This means that the Project is beneficial to society in present value 2020 dollars at a 7 percent discount rate.

This analysis, like all BCAs, quantified many categories of benefits but cannot be exhaustive of every benefit imaginable. Other important elements of the Project are economic generation through additional employment and multiplier effects (the scope of an economic impact analysis, beyond the scope of BCA). There are also many benefits and positive attributes to the Project that either are qualitative (and discussed in the main RAISE application narrative), or otherwise cannot be readily quantified. Many of these benefits include:

- Water quality improvements due to stormwater filtration and groundwater recharge through the use of bioswales.
- The roadway's heat island effect is reduced through tree planting.
- Carbon capture is increased through the planting of medians with trees.
- Personal out-of-pocket transportation costs are reduced by being able to use non-auto modes of transportation.
- Stress is reduced for roadway users by having safer streets for all modes of transportation.
- The improved roadway creates a more vibrant and livable environment.

To summarize, this BCA finds that **the present value benefits of the Project exceed the present value Project costs through 2045 by a factor of 2.30.**

The Project stands to improve the economy of the communities in Kaua'i. It would enhance the economic vitality of the region as reflected in significantly increased property values, a mere reflection of the way that this Project will improve lives. Additionally, adding non-auto facilities like bike lanes, sidewalks, and bus shelters

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

enhances the safety and well-being of local residents and provides for more mobility options.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Appendix A
Detailed Summary of Results

Table 18
Detailed benefit results

Year	Safety Modification Savings	VMT Safety Savings	CO2 Emissions Savings	Other Emissions Savings	Vehicle Externality Savings
2022	-	-	-	-	-
2023	-	-	-	-	-
2024	-	-	-	-	-
2025	-	-	-	-	-
2026	1,630,640	132,592	29,114	40,420	28,422
2027	1,630,640	141,379	31,563	43,745	30,306
2028	1,630,640	150,228	34,667	47,198	32,202
2029	1,630,640	159,138	37,305	50,778	34,112
2030	1,630,640	168,111	40,022	54,503	36,036
2031	1,630,640	177,146	42,818	57,437	37,973
2032	1,630,640	186,245	45,695	60,406	39,923
2033	1,630,640	195,407	48,652	63,409	41,887
2034	1,630,640	204,633	51,691	66,450	43,864
2035	1,630,640	213,923	54,812	69,527	45,856
2036	1,630,640	223,279	58,869	72,643	47,861
2037	1,630,640	232,699	62,192	75,798	49,881
2038	1,630,640	242,185	65,599	78,992	51,914
2039	1,630,640	251,738	69,091	82,227	53,962
2040	1,630,640	261,357	72,668	85,504	56,024
2041	1,630,640	271,044	76,332	88,822	58,100
2042	1,630,640	280,798	81,150	92,182	60,191
2043	1,630,640	290,620	85,025	95,586	62,296
2044	1,630,640	300,511	88,988	99,033	64,417
2045	1,630,640	310,471	93,040	102,524	66,552
Total	32,612,797	4,393,505	1,169,293	1,427,184	941,777
* CO2 benefits discounted at 3%					

(Table continued below)

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project: Benefit-Cost Analysis

Year	Total bike/ped mortality reduction	Cycle Lane revealed preferenc	Bus shelter amentiy benefit	Total real estate value	Residual Value	Total Benefits (2020 \$)	Total Benefits (PV 2020 \$)
2022	-	-	-	-	-	-	-
2023	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-
2026	1,555,639	258,942	20,450	14,082,504	-	17,778,722	13,566,959
2027	1,658,737	277,762	20,756	14,082,504	-	17,917,392	12,779,576
2028	1,762,555	296,714	21,068	14,082,504	-	18,057,776	12,038,591
2029	1,867,098	315,799	21,384	14,082,504	-	18,198,758	11,340,373
2030	1,972,371	335,016	21,705	14,082,504	-	18,340,907	10,682,875
2031	2,078,379	354,368	22,030	14,082,504	-	18,483,295	10,063,214
2032	2,185,127	373,855	22,361	14,082,504	-	18,626,755	9,479,670
2033	2,292,621	393,478	22,696	14,082,504	-	18,771,294	8,930,140
2034	2,400,865	413,238	23,036	14,082,504	-	18,916,921	8,412,643
2035	2,509,865	433,136	23,382	14,082,504	-	19,063,645	7,925,314
2036	2,619,626	453,172	23,733	-	-	5,129,823	2,005,523
2037	2,730,154	473,349	24,089	-	-	5,278,801	1,930,658
2038	2,841,453	493,667	24,450	-	-	5,428,900	1,857,615
2039	2,953,529	514,126	24,817	-	-	5,580,130	1,786,455
2040	3,066,388	534,729	25,189	-	-	5,732,498	1,717,224
2041	3,180,035	555,475	25,567	-	-	5,886,013	1,649,956
2042	3,294,475	576,366	25,950	-	-	6,041,752	1,585,264
2043	3,409,715	597,403	26,340	-	-	6,197,624	1,521,978
2044	3,525,759	618,587	26,735	-	-	6,354,668	1,460,689
2045	3,642,613	639,918	27,136	-	11,383,629	17,896,523	3,802,732
Total	32,612,797	4,393,505	1,169,293	1,427,184	941,777	253,682,198	124,537,447

Source: Author calculations.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Table 19
Detailed cost results

Year	Capital Costs	Operating Costs	Total Costs 2020 \$	Total Total Costs PV 2020 \$
2022	-	-	-	-
2023	9,003,416	-	9,003,416	8,414,407
2024	15,523,131	-	15,523,131	13,558,504
2025	6,519,715	-	6,519,715	5,322,030
2026	-	3,104,626	3,104,626	2,368,504
2027	-	3,104,626	3,104,626	2,213,556
2028	-	3,104,626	3,104,626	2,068,744
2029	-	3,104,626	3,104,626	1,933,405
2030	-	3,104,626	3,104,626	1,806,921
2031	-	3,104,626	3,104,626	1,688,711
2032	-	3,104,626	3,104,626	1,578,235
2033	-	3,104,626	3,104,626	1,474,986
2034	-	3,104,626	3,104,626	1,378,491
2035	-	3,104,626	3,104,626	1,288,309
2036	-	3,104,626	3,104,626	1,204,028
2037	-	3,104,626	3,104,626	1,125,259
2038	-	3,104,626	3,104,626	1,051,644
2039	-	3,104,626	3,104,626	982,845
2040	-	3,104,626	3,104,626	918,547
2041	-	3,104,626	3,104,626	858,455
2042	-	3,104,626	3,104,626	802,294
2043	-	3,104,626	3,104,626	749,808
2044	-	3,104,626	3,104,626	700,755
2045	-	3,104,626	3,104,626	654,911
Total	31,046,262	52,778,645	83,824,907	52,037,875

Source: Kaua'i County (2022); Author calculations.

2022 RAISE Grant Application Po'ipū Road Safety and Mobility Project:
Benefit-Cost Analysis

Table 20
Detailed benefit, cost, and net present value (NPV) results

Year	Present Value Benefits	Present Value Costs	Net Present Value	Cumulative Present Value Benefits	Cumulative Present Value Costs	Cumulative NPV
2022	-	-	-	-	-	-
2023	-	8,414,407	(8,414,407)	-	8,414,407	(8,414,407)
2024	-	13,558,504	(13,558,504)	-	21,972,911	(21,972,911)
2025	-	5,322,030	(5,322,030)	-	27,294,941	(27,294,941)
2026	13,566,959	2,368,504	11,198,454	13,566,959	29,663,445	(16,096,487)
2027	12,779,576	2,213,556	10,566,020	26,346,534	31,877,001	(5,530,467)
2028	12,038,591	2,068,744	9,969,848	38,385,125	33,945,744	4,439,381
2029	11,340,373	1,933,405	9,406,967	49,725,498	35,879,150	13,846,348
2030	10,682,875	1,806,921	8,875,954	60,408,373	37,686,070	22,722,303
2031	10,063,214	1,688,711	8,374,503	70,471,587	39,374,781	31,096,806
2032	9,479,670	1,578,235	7,901,435	79,951,257	40,953,016	38,998,241
2033	8,930,140	1,474,986	7,455,154	88,881,397	42,428,001	46,453,395
2034	8,412,643	1,378,491	7,034,152	97,294,040	43,806,492	53,487,547
2035	7,925,314	1,288,309	6,637,005	105,219,354	45,094,802	60,124,552
2036	2,005,523	1,204,028	801,495	107,224,877	46,298,829	60,926,048
2037	1,930,658	1,125,259	805,398	109,155,535	47,424,089	61,731,446
2038	1,857,615	1,051,644	805,970	111,013,150	48,475,733	62,537,416
2039	1,786,455	982,845	803,610	112,799,604	49,458,578	63,341,026
2040	1,717,224	918,547	798,677	114,516,829	50,377,125	64,139,703
2041	1,649,956	858,455	791,501	116,166,785	51,235,580	64,931,205
2042	1,585,264	802,294	782,969	117,752,049	52,037,875	65,714,174
2043	1,521,978	749,808	772,170	119,274,026	52,787,682	66,486,344
2044	1,460,689	700,755	759,934	120,734,715	53,488,437	67,246,277
2045	3,802,732	654,911	3,147,821	124,537,447	54,143,349	70,394,098
Total	124,537,447	54,143,349	70,394,098	NA	NA	NA

Source: Author calculations.

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