# San Francisco Bay Trail Expansion and Repair

# Benefit-Cost Analysis Report

**City of Alameda**
**East Bay Regional Park District**

**May 31, 2013**

# EXECUTIVE SUMMARY

The benefit-cost analysis for this project follows the principles and parameters documented in the National Academy of Sciences Transportation Research Board, National Cooperative Highway Research Program (NCHRP) Report 552: *Guidelines for Analysis of Investments in Bicycle Facilities* (2006). This document represents the standard benefit-cost analysis method for analysis of bicycle facilities. This method complies with the principles outlined in the Office of Management and Budget (OMB) Circular A-94 and with the distinctions between benefit-cost analysis and economic impact analysis made in the Federal Register announcement for the Tiger II program. This document is based on the analysis developed for the TIGER II program in 2010 by Dr. Kenneth A. Goettel of Goettel & Associates, Inc. The following categories of benefits are considered:

- Mobility benefits;
- Health benefits;
- Recreation benefits; and
- Reduced auto use benefits.

The costs for the proposed project are $15,000,000. For benefit-cost analyses, these costs are adjusted to include the net present value of annual maintenance and operating costs for the trails and the construction costs which are incurred from 2010 to 2014 are adjusted to net present value. Annual benefits were calculated for "high", "best", and "low" data inputs, following the NCHRP Report 552 methodology for both 7 and 3 percent discount rates. These results are shown in Table 1.

**Table 1: Total Annual Benefits**

| Category | High Estimate | Best Estimate | Low Estimate |
|---|---|---|---|
| Mobility Benefits | $7,460,770 | **$6,055,862** | $4,651,690 |
| Health Benefits | $1,664,000 | **$896,000** | $384,000 |
| Recreation Benefits | $47,450,000 | **$25,550,000** | $10,950,000 |
| Reduced Auto Use Benefits | $292,500 | **$234,000** | $175,500 |
| **Total Annual Benefits** | **$56,867,270** | **$32,735,862** | **$16,161,190** |

The "best estimate" annual benefits are almost $33 million. The net present value benefit-cost results are shown on the following page (Table 2). For the 7 and 3 percent real discount rates, the best estimate benefit-cost ratios are 23.73 and 36.57, respectively. Thus, the net present value of benefits greatly exceeds the project costs for the proposed project. The "low" estimates are conservative and underestimate the actual benefits. Nevertheless, the "low" estimate benefit-cost ratios for the 7 and 3 percent discount rates are 11.71 and 18.05, respectively.

**Table 2: Benefit-Cost Results**

| Benefit-Cost Analysis | Net Present Value of Benefits | Costs | Benefit-Cost Ratio |
|---|---|---|---|
| Benefits with 7% Discount Rate | | | |
| High Estimate | $685,417,065 | $16,630,640 | 41.21 |
| **Best Estimate** | **$394,562,961** | **$16,630,640** | **23.73** |
| Low Estimate | $194,789,646 | $16,630,640 | 11.71 |
| Benefits with 3% Discount Rate | | | |
| High Estimate | $1,155,880,361 | $18,194,839 | 63.53 |
| **Best Estimate** | **$665,386,961** | **$18,194,839** | **36.57** |
| Low Estimate | $328,491,277 | $18,194,839 | 18.05 |

The project costs shown above include the net present value of annual maintenance and operating costs, as required for benefit-cost analysis. Total project costs are higher for the 3 percent discount rate case than for the 7 percent discount case because the lower discount rate results in less discounting of construction costs and annual maintenance costs in later years.

Furthermore, these estimates are based on conservative, lower-bound type data inputs and assumptions, and there are additional categories of benefits that have not been considered in the above analysis. The actual benefit-cost ratios are likely substantially higher than those shown above because:

- The census data on bicycle commuters probably substantially underestimate the actual percentages of bicycle commuters. In Alameda and Contra Costa counties, a substantial number of bicycle commuters commute to the Bay Area Rapid Transit (BART) or Amtrak commuter rail stations. These bicycle commuters are probably counted under “transit” rather than “bicycle.” BART data indicate that an average of 7.6 percent of BART riders bicycle to the BART station.
- Because of the East Bay’s very dry temperate climate, with relatively few rainy days, cycling is a 12 month per year activity and the percentages of adult cyclists are likely underestimated by the NCHRP’s national estimates, which include many areas with severe winters and/or many more rainy days.
- The proposed trail projects fill “gaps” in existing East Bay network of heavily used trails, many of which are through flat, highly scenic areas. Filling the gaps will likely have a multiplier effect with much greater usage of the new trail segments than would be the case if the new trails were isolated trails.
- The benefit-cost analysis considers only the benefits for bicycle commuters and adult cyclists. The benefits for pedestrians are also substantial and are likely a sizeable fraction of the benefits calculated for cyclists.

## 1.0 Introduction

Alameda and Contra Costa Counties, situated on the eastern shore of San Francisco Bay in Northern California, are home to over 2.5 million people and some the most congested roads in the country. The San Francisco Bay Trail Expansion and Repair project is uniquely positioned to improve the condition of existing transportation facilities by reducing congestion, lowering maintenance costs and minimizing life-cycle costs. Providing low-cost, healthy transportation choices in crowded urban areas will improve the nation's economic competitiveness by reducing transportation and health care costs while increasing the mobility of the labor force. Walking and bicycling are the most environmentally sustainable forms of transportation, are energy efficient, and generate no greenhouse gasses or other pollutants.

In the mid-1970's, East Bay Regional Park District pioneered the concept of developing an integrated network of paved bicycle and pedestrian trails linking the 33 communities throughout the East Bay. Working closely with local and regional transportation planners and transit agencies, the District has developed over 175 miles of paved, non-motorized trails. These "Green Transportation" corridors provide "last mile" connections to transit centers, as well as access to schools, employment centers and businesses. Providing safe convenient non-motorized alternatives for commuters, students, employees and shoppers reduces highway congestion, greenhouse gasses and our dependence on fossil fuel, creates livable communities and enhances opportunities for healthy lifestyles close to home.

The benefits of this project are especially high because:

- The five infrastructure segments provide gap closures in an existing extensive trails system and thus will have much higher use than if they were isolated trail segments.
- The five project locations are in immediate proximity to high density residential neighborhoods.
- The five project segments are within easy cycling distance of transit centers.
- The East Bay communities have extensive heavily-used multi-modal transit systems, including commuter rail, BART, bus lines and ferries, all of which are fed by the trails system.
- The East Bay communities have unusually high rates of commuting by bicycle or walking; for example, 25 percent of BART riders arrive by walking or cycling. The five trail gap closures will substantially enhance the use of bicycling and walking to connect with other transportation modes.
- The East Bay communities have a long-established very-strong history of support for and extensive use of non-motorized transportation.

## 2. Benefit-Cost Analysis: Approach and Methods

The benefit-cost analysis for this project follows the principles and parameters documented in the National Academy of Sciences Transportation Research Board, NCHRP Report 552: *Guidelines for Analysis of Investments in Bicycle Facilities* (2006). This document represents the standard benefit-cost analysis method for analysis of bicycle facilities. This method complies with the principles outlined in OMB Circular A-94 and with the distinctions between benefit-cost analysis and economic impact analysis made in the Federal Register announcement for the Tiger II program. The following categories of benefits are considered:

- Mobility benefits;
- Health benefits;
- Recreation benefits; and
- Reduced auto use benefits.

The benefit-cost calculations below use a project useful lifetime of 30 years, which is a conservative lower-bound type estimate for the actual useful lifetime of the trails. The benefit-cost calculations use a real discount rate of 7 percent, which is the standard OMB discount rate for most federally-funded projects. Nevertheless, as noted in Appendix A of the Tiger II program announcement in the Federal Register Volume 75, page 30476*: "Applicants may also provide an alternative analysis using a real discount rate of 3 percent. The later approach should be used when the alternative use of funds currently dedicated to the project would be other public expenditures, rather than private investment."*

The alternative use of funds currently dedicated to this project would be other public expenditures. Thus, results are presented both with a 7 percent discount rate and with a 3 percent discount rate. The data inputs, analyses and benefits calculation are conservative throughout and there are other categories of benefits not considered in the present benefit-cost analysis. Thus, the benefits and the benefit-cost ratio calculated below are very conservative lower-bound type results. The actual benefits and benefit-cost ratio for this project will almost certainly be higher than calculated below. Benefit-cost calculations are based on the 2012 American Community Survey estimates for Alameda and Contra Costa Counties. The rate of population growth from 2000 to 2012 is 0.80 percent per year, as shown below in Table 3.

**Table 3: Annual Population Growth Rate**

| Category | Alameda County | Contra Costa County | Totals |
|---|---|---|---|
| Population 2000 | 1,443,741 | 948,816 | 2,392,557 |
| Population 2010 | 1,510,271 | 1,049,025 | 2,559,296 |
| Population 2012 (estimate) | 1,554,720 | 1,079,597 | 2,634,317 |
| Increase | 110,979 | 130,781 | 241,760 |
| | **Annual Population Growth Rate:** | | 0.80% |

Source: United States Census, American Community Survey, 2012

As discussed in the following benefit-cost analysis sections, as per the NCHRP Report 552 methodology, all of the calculations are directly proportional to population. The above annual population growth rate is used to project future population over the 30 year project useful lifetime and thus to adjust the future benefits for anticipated population growth.

# 3. Benefit-Cost Analysis: Data and Calculations

## 3.1 Project Costs

The project costs are summarized below in Table 4, including the net present value of annual maintenance and operational costs for discount rates of 7 percent and 3 percent.

**Table 4: Project Costs**

| Project Segment | Length (miles) | Cost | Annual Maintenance Costs |
|---|---|---|---|
| Bay Farm Island Trail Resurface/Widen | 3.0 | $3 million | $75,000 |
| Clement Avenue Bikeway/Truck Route | 1.0 | $3 million | $25,000 |
| Gilman to Buchanan Bay Trail | 1.0 | $3 million | $25,000 |
| Pinole Shores to Bayfront Park Trail | 0.5 | $5 million | $12,500 |
| Shore Line Drive / Westline Drive Cycle Track | 1.8 | $1 million | $45,000 |
| **Totals** | **7.3** | **$15 million** | **$182,500** |
| Net Present Value Calculations: 7% Real Discount Rate<br>Net Present Value of Annual Maintenance Costs[1] | | | $2,518,500 |
| Net Present Value Calculations: 3% Real Discount Rate<br>Net Present Value of Annual Maintenance Costs[2] | | | $3,577,000 |

[1] The present value coefficient for a project useful lifetime of 30 years and a discount rate of 7% is 13.80; that is, the net present value of each dollar of annual maintenance costs is $13.80.

[2] The present value coefficient for a project useful lifetime of 30 years and a discount rate of 3% is 19.60; that is, the net present value of each dollar of annual maintenance costs is $19.60.

In more detail, the construction schedule for the project runs from the 1st quarter of 2014 through the 4th quarter of 2015. For benefit-cost analysis, future construction costs are discounted to net present value ($2013). The final cost estimates for both 7 and 3 percent discount rates are shown below (Table 5). Total project costs are higher for the 3 percent discount rate case than for the 7 percent discount case because the lower discount rate results in less discounting of construction costs and annual maintenance costs in later years.

**Table 5: Project Costs - Including Annual Maintenance Costs and Discounting to Present Value**

| Year | Quarter | Project Cost Expenditure | Discounted Present Value of Costs 7% Discount Rate | Discounted Present Value of Costs 3% Discount Rate |
|---|---|---|---|---|
| 2014 | 1 | $1,000,000 | $1,000,000 | $1,000,000 |
| 2014 | 2 | $3,000,000 | $2,946,000 | $2,977,200 |
| 2014 | 3 | $2,000,000 | $1,928,648 | $1,969,716 |
| 2014 | 4 | $2,000,000 | $1,893,932 | $1,954,746 |
| 2015 | 1 | $1,000,000 | $929,921 | $969,945 |
| 2015 | 2 | $3,000,000 | $2,739,546 | $2,887,719 |
| 2015 | 3 | $2,000,000 | $1,793,490 | $1,910,515 |
| 2015 | 4 | $1,000,000 | $880,603 | $947,998 |
| | **Total** | **$15,000,000** | **$14,112,140** | **$14,617,839** |
| Net Present Value of Annual Maintenance Costs | | | $2,518,500 | $3,577,000 |
| **Net Present Value of Total Project Costs** | | | **$16,630,640** | **$18,194,839** |

### 3.2 Benefit-Cost Analysis Data

As per the NCHRP Report 552: *Guidelines for Analysis of Investments in Bicycle Facilities* (2006), the benefits of off-road trails for bicycle commuters and the total adult cycling population are proportional to the percentage of bicycle commuters and the populations within various distances of the off-road trails. Relevant data are summarized below in Tables 6 and 7.

**Table 6: Bicycle Commuters**

| Category | Alameda County | Contra Costa County | Totals |
|---|---|---|---|
| Population | 1,554,720 | 1,079,597 | 2,634,317 |
| Percentage of Adults | 77.7% | 75.6% | 76.8% |
| Total Commuters | 632,963 | 471,399 | 1,104,362 |
| Total Commuters (%) | 40.7% | 40.9% | 41.9% |
| Bicycle Commuters | | | |
| High Estimate | 17,304 | 3,332 | 20,636 |
| Best Estimate | 14,596 | 2,389 | 16,985 |
| Low Estimate | 11,889 | 1,446 | 13,335 |
| Bicycle Commuters: % of Commuters | | | |
| High Estimate | 2.7% | 0.7% | 1.9% |
| Best Estimate | 2.3% | 0.5% | 1.5% |
| Low Estimate | 1.9% | 0.3% | 1.2% |
| Bicycle Commuters: % of Population | | | |
| High Estimate | 1.1% | 0.3% | 0.8% |
| Best Estimate | 0.9% | 0.2% | 0.7% |
| Low Estimate | 0.8% | 0.1% | 0.5% |

[1] High and low estimates for number of bicycle commuters are the 2011 American Community Survey estimates plus or minus the stated statistical uncertainties. Uncertainties in total population and total commuters are less than 1% and are not considered in the present analysis.

**Table 7: Population Estimates within Various Distances of Project Locations**

| Project Segments | Nearest Station | Distance (miles) | County | Population within 1/4 mile | Population within 1/2 mile | Population within 1 mile |
|---|---|---|---|---|---|---|
| Bay Farm Island Trail Resurface/Widen | Fruitvale BART | 2.0 | Alameda | 5,000 | 10,000 | 15,000 |
| Clement Avenue Bikeway/Truck Route | Fruitvale BART | 1.0 | Alameda | 5,000 | 15,000 | 30,000 |
| Gilman to Buchanan Bay Trail | El Cerrito | 1.0 | Alameda | 20,000 | 30,000 | 50,000 |
| Pinole Shores to Bayfront Park Trail | Hercules | 0.5 | Contra Costa | 5,000 | 20,000 | 35,000 |
| Shore Line Drive / Westline Drive Cycle Track | Fruitvale BART | 2.0 | Alameda | 15,000 | 20,000 | 40,000 |
| Population Estimates | | | **Totals:** | **50,000** | **95,000** | **170,000** |

Source: U.S. Census Tract Data (2012) and GIS Mapping

## 3.3 Benefits Calculations

Benefits are calculated from the above data and the algorithms in NCHRP Report 552 for the following four categories of benefits:

- Mobility benefits,
- Health benefits,
- Recreation benefits, and
- Reduced auto use benefits.

In each case, values are shown for the "best estimate" data as well as for the "high estimate" and "low estimate" data. Nevertheless, benefit-cost analysis results are interpreted for the results derived from the "best estimate" data. The proposed project consists of adding five trail segments to close gaps in the existing trail system. A single benefit-cost analysis is done for the entire project because conceptually the project is really one project: to add trails to improve access for the population within various distances of the trails. The sum of benefits for each of the five trail segments would yield exactly the same benefits as obtained by doing a single benefit-cost analysis. Doing multiple benefit-cost analyses would be necessary only if the analytic formulation of the calculations differed for conceptually different project elements, which does not apply to the proposed project.

### Mobility Benefits

Mobility benefits are derived in NCHRP Report 552 based on stated preference analysis, which places an economic value on people's time and the amount of extra time that bicycle commuters would be willing to spend on an off-street bicycle trail rather than to commute on a street with parked cars. Mobility benefits apply to both existing and new bicycle commuters. The best estimate annual mobility benefits are $6,055,862 (Table 8). It is assumed that 25 percent of the bicycle commuters in Alameda and Contra Costa Counties will use these five proposed trail segments, and these projects will approximately double the number of existing bicycle commuters. Per the NCHRP Report 552, the mobility benefit for riding on an off-street bicycle trail, compared to riding on a street with parked cars is $4.08 per trip with 2 trips per day, 3 days per week and 30 weeks per year.

**Table 8: Annual Mobility Benefits for Bicycle Commuters**

| Bicyclists | Number | Annual Mobility Benefit |
|---|---|---|
| ***Existing*** | | |
| High Estimate | 5,159 | $3,788,770 |
| Best Estimate | 4,246 | $3,118,262 |
| Low Estimate | 3,334 | $2,448,490 |
| ***New*** | | |
| High Estimate | 5,000 | $3,672,000 |
| Best Estimate | 4,000 | $2,937,600 |
| Low Estimate | 3,000 | $2,203,200 |
| ***Total*** | | |
| High Estimate | 10,159 | $7,460,770 |
| **Best Estimate** | **8,246** | **$6,055,862** |
| Low Estimate | 6,334 | $4,651,690 |

Source: NCHRP Report 552 (2006)

## Health Benefits

Annual health benefits are attributed to new adult cyclists only. The health benefits for existing and new bicycle commuters are included under mobility benefits above and thus not counted here to avoid double counting of benefits. Per the economic analysis in NCHRP Report 552, the annual health benefits are $128 per person. According to the California Air Resources Board, it is assumed that 10 percent of the adjacent population would be new adult cyclists based on data in Tables 6 and 7. The best estimate annual health benefits are $896,000 (Table 9).

**Table 9: Annual Health Benefits for Total New Adult Bicyclists**

| New Adult Bicyclists | Number | Annual Health Benefit |
|---|---|---|
| High Estimate | 13,000 | $1,664,000 |
| **Best Estimate** | **7,000** | **$896,000** |
| Low Estimate | 3,000 | $384,000 |

Source: California Air Resources Board, Bicycle Fact Sheet (2008)

## Recreation Benefits

The annual recreation benefits for new adult cyclists (excluding new bicycle commuters) are valued using the NCHRP Report 552 value of $10 per day, which is based on a wide variety of studies referenced in NCHRP Report 552. New bicycle commuters are excluded because these benefits for bicycle commuters are included in the mobility benefits calculated previously. The best estimate annual recreation benefits are $25,550,000 (Table 10).

**Table 10: Annual Recreation Benefits for New Adult Bicyclists**

| New Adult Bicyclists | Number | Annual Recreation Benefit |
|---|---|---|
| High Estimate | 13,000 | $47,450,000 |
| **Best Estimate** | **7,000** | **$25,550,000** |
| Low Estimate | 3,000 | $10,950,000 |

Source: NCHRP Report 552 (2006)

## Reduced Auto Use Benefits

Reduced auto use benefits apply only to new bicycle commuters. The annual reduced auto use benefits are valued using the NCHRP Report 552 value of $0.13 per mile for urban areas as applicable to this project, with an estimated average round trip length of 5 miles for three days per week and 30 weeks per year. The best estimate annual reduced auto benefits are $234,000. The details for the calculation of annual reduced auto benefits are as shown in the table below (Table 11).

**Table 11: New Daily Bicycle Commuters and Daily Adult Bicyclists**

| New Adult Bicyclists | Number | Annual Reduced Auto Use Benefit |
|---|---|---|
| High Estimate | 5,000 | $292,500 |
| **Best Estimate** | **4,000** | **$234,000** |
| Low Estimate | 3,000 | $175,500 |

Source: NCHRP Report 552 (2006)

### Total Annual Benefits

Total annual benefits are the sum of the four categories of annual benefits presented above (Table 12). The best estimate total annual benefits are $32,735,862.

**Table 12: Total Annual Benefits**

| Category | High Estimate | Best Estimate | Low Estimate |
|---|---|---|---|
| Mobility Benefits | $7,460,770 | **$6,055,862** | $4,651,690 |
| Health Benefits | $1,664,000 | **$896,000** | $384,000 |
| Recreation Benefits | $47,450,000 | **$25,550,000** | $10,950,000 |
| Reduced Auto Use Benefits | $292,500 | **$234,000** | $175,500 |
| **Total Annual Benefits** | **$56,867,270** | **$32,735,862** | **$16,161,190** |

## 4.0 Benefit-Cost Results

The net present value of the annual benefits is derived from the calculated annual benefits above, taking into account:

- Project useful lifetime of 30 years, which is the minimum lifetime for the proposed trails projects; and
- Discount rates of 7 percent or 3 percent.

The construction schedule for the project runs from the 1st quarter of 2014 through the 4th quarter of 2015. As shown in Table 5, the construction costs by quarter were discounted to obtain the net present value of construction costs. Similarly, the benefits need to be discounted to reflect that as construction proceeds, only a fraction of the benefits will be available. For the net present value calculations, we assume that there are no annual benefits in 2013, with 50 percent of the annual benefits in 2014 and 100 percent of the annual benefits in later years.

Concurrently, the annual benefits are increased each year by 0.80 percent, reflecting the projection of the historical annual population growth rate of 0.80 percent per year into the future. These annual benefits calculations are summarized in Table 13 below. The net present value of benefits results shown in Table 13 are for the “best estimate” analyses as shown in Table 12.

**Table 13: Detailed Calculation of Net Present Value of Benefits**

| Year | Annual Benefits | Years in Future | 7% Discount Factor | 3% Discount Factor | Net Present Value 7% Discount Rate | Net Present Value 3% Discount Rate |
|---|---|---|---|---|---|---|
| 2014 | $16,367,931 | 1 | 0.93 | 0.97 | $15,222,176 | $15,876,893 |
| 2015 | $32,866,805 | 2 | 0.86 | 0.94 | $28,265,452 | $30,894,797 |
| 2016 | $33,129,739 | 3 | 0.80 | 0.91 | $26,503,791 | $30,148,062 |
| 2017 | $33,394,777 | 4 | 0.75 | 0.89 | $25,046,083 | $29,721,352 |
| 2018 | $33,661,935 | 5 | 0.70 | 0.86 | $23,563,355 | $28,949,264 |
| 2019 | $33,931,231 | 6 | 0.65 | 0.83 | $22,055,300 | $28,162,922 |
| 2020 | $34,202,681 | 7 | 0.60 | 0.81 | $20,521,609 | $27,704,172 |
| 2021 | $34,476,302 | 8 | 0.56 | 0.78 | $19,306,729 | $26,891,516 |
| 2022 | $34,752,112 | 9 | 0.52 | 0.76 | $18,071,098 | $26,411,605 |
| 2023 | $35,030,129 | 10 | 0.48 | 0.74 | $16,814,462 | $25,922,295 |
| 2024 | $35,310,370 | 11 | 0.45 | 0.72 | $15,889,667 | $25,423,466 |
| 2025 | $35,592,853 | 12 | 0.42 | 0.69 | $14,948,998 | $24,559,069 |
| 2026 | $35,877,596 | 13 | 0.39 | 0.67 | $13,992,262 | $24,037,989 |
| 2027 | $36,164,617 | 14 | 0.36 | 0.65 | $13,019,262 | $23,507,001 |
| 2028 | $36,453,934 | 15 | 0.34 | 0.63 | $12,394,338 | $22,965,978 |
| 2029 | $36,745,565 | 16 | 0.31 | 0.61 | $11,391,125 | $22,414,795 |
| 2030 | $37,039,530 | 17 | 0.29 | 0.60 | $10,741,464 | $22,223,718 |
| 2031 | $37,335,846 | 18 | 0.27 | 0.58 | $10,080,678 | $21,654,791 |
| 2032 | $37,634,533 | 19 | 0.25 | 0.56 | $9,408,633 | $21,075,338 |
| 2033 | $37,935,609 | 20 | 0.23 | 0.54 | $8,725,190 | $20,485,229 |
| 2034 | $38,239,094 | 21 | 0.22 | 0.53 | $8,412,601 | $20,266,720 |
| 2035 | $38,545,007 | 22 | 0.20 | 0.51 | $7,709,001 | $19,657,954 |
| 2036 | $38,853,367 | 23 | 0.19 | 0.50 | $7,382,140 | $19,426,684 |
| 2037 | $39,164,194 | 24 | 0.18 | 0.48 | $7,049,555 | $18,798,813 |
| 2038 | $39,477,508 | 25 | 0.16 | 0.47 | $6,316,401 | $18,554,429 |
| 2039 | $39,793,328 | 26 | 0.15 | 0.45 | $5,968,999 | $17,906,998 |
| 2040 | $40,111,675 | 27 | 0.14 | 0.44 | $5,615,635 | $17,649,137 |
| 2041 | $40,432,568 | 28 | 0.13 | 0.43 | $5,256,234 | $17,386,004 |
| 2042 | $40,756,029 | 29 | 0.12 | 0.41 | $4,890,723 | $16,709,972 |
| | | | | **Totals** | **$394,562,961** | **$665,386,961** |

Net present value of benefits results for the “high estimate” and “low estimate” analyses are directly proportional to their annual benefits relative to the “best estimate.” These results are shown below in Table 14 for the two discount rates and the “high”, “best” and “low” estimates. The benefit-cost ratio is calculated by dividing the net present value of benefits by the total project costs.

**Table 14: Benefit-Cost Results**

| Benefit-Cost Analysis | Net Present Value of Benefits | Costs | Benefit-Cost Ratio |
|---|---|---|---|
| Benefits with 7% Discount Rate | | | |
| High Estimate | $685,417,065 | $16,630,640 | 41.21 |
| **Best Estimate** | **$394,562,961** | **$16,630,640** | **23.73** |
| Low Estimate | $194,789,646 | $16,630,640 | 11.71 |
| Benefits with 3% Discount Rate | | | |
| High Estimate | $1,155,880,361 | $18,194,839 | 63.53 |
| **Best Estimate** | **$665,386,961** | **$18,194,839** | **36.57** |
| Low Estimate | $328,491,277 | $18,194,839 | 18.05 |

For the 7 and 3 percent real discount rates, the best estimate benefit-cost ratios are 23.73 and 36.57, respectively. Thus, the net present value of benefits greatly exceeds the project costs for the proposed projects. The "low" estimates are conservative and underestimate the actual benefits. Nevertheless, the "low" estimate benefit-cost ratios for the 7 and 3 percent discount rates are 11.71 and 18.05, respectively.

Furthermore, there is an important caveat on the above benefit-cost results: these estimates are based on conservative, lower-bound type data inputs and assumptions and there are additional categories of benefits that have not been considered in the above analysis. The actual benefit-cost ratios are likely substantially higher than those shown above in Table 11 because:

- The census data on bicycle commuters probably substantially underestimate the actual percentages of bicycle commuters. In Alameda and Contra Costa counties, a substantial number of bicycle commuters commute to BART or Amtrak commuter rail stations. These bicycle commuters probably are counted under "transit" rather than "bicycle." BART data indicate that an average of 7.6 percent of BART riders bicycle to the BART station.
- Because of the East Bay's dry temperate climate, with relatively few rainy days, cycling often is a 12 month per year activity and the percentages of adult cyclists are likely underestimated by the NCHRP's national estimates, which include many areas with severe winters or many more rainy days.
- The proposed trail projects fill "gaps" in existing East Bay network of heavily used trails, many of which are through flat, highly scenic areas. Filling the gaps will likely have a multiplier effect with much greater usage of the new trail segments than would be the case if the new trails were isolated trails.
- The benefit-cost analysis considers only the benefits for bicycle commuters and adult cyclists. The benefits for pedestrians also are substantial and are likely a sizeable fraction of the benefits calculated for cyclists.