

Technical Memorandum: Benefit Cost Analysis

Restoring Oakland's Working Waterfront

Date: October 31, 2011
Subject: Benefit-Cost Analysis for Restoring Oakland's Working Waterfront
TIGER III Application

This technical memorandum describes whether and how the City of Oakland meets the definition of an Economically Distressed Area, estimates the job impacts associated the construction and operation of Oakland's Restored Working Waterfront Project, and estimates the long-term benefits associated with the Project. The long-term benefits presented relate to the five (5) Long-term Outcomes identified in the TIGER III guidance¹: State of Good Repair, Economic Competitiveness, Livability, Sustainability, and Safety. The final section discounts the stream of anticipated benefits and calculates a Benefit / Cost ratio for the Project.

Economically Distressed Area

Both the City of Oakland and the Oakland-Fremont-Hayward Metropolitan Division meet the unemployment rate criteria contained in the definition of "Economically Distressed Areas" from section 301 of the Public Works and Economic Development Act of 1965 (42 U.S.C. 3161). The city has an unemployment rate of 16.5 percent, which is more than 7 percentage points above the US average of 9.4 percent. Because unemployment rate at the city level lags the US data by one month, the 24 month span reported here runs from October 2009 – September 2011. The Metropolitan Division unemployment rate of 11.0 percent for Oakland-Fremont-Hayward was 1.6 percentage points above the US average. This is the most recent data available at the time of this application. As these data are subject to revision in the time period following the application deadline, copies of the downloaded unemployment data are provided for the reviewers' verification in the supplementary documentation (see Economic Distress.xlsx).

Project Timeline for Recovery Benefits

Near-term Impacts: Construction Expenditures and Job Creation

The quarterly construction schedule and direct, on-project jobs created in the San Francisco-Oakland-Fremont, CA MSA for the construction period are shown in Exhibit 1.² The construction costs shown in the tables are for the project planning and construction activities only—broken out by environmental remediation, construction, and professional services.

¹ <http://edocket.access.gpo.gov/2011/pdf/2011-20577.pdf>

² The direct employment impacts were estimated using the quarterly construction expenditures RIMS II multipliers for the New Orleans MSA. Given the multiplier relationships, the final-demand employment multiplier divided by the direct-effect employment multiplier yields an estimate of the initial (or direct) employment per \$1 million final demand. Please see BEA RIMS II Workshop Presentation, Slide 71, <http://uwf.edu/auber/conf/Pensacola07/presentations/AUBER%20RIMS%20Presentation.ppt>

Exhibit 1: Quarterly Project Capital Expenditures and Direct Jobs Created (in job years)

	2010				2011				2012				2013			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TOTAL PROJECT COSTS (Mil 2011\$)	\$ 0.8	\$ 0.8	\$ 0.8	\$ 0.8	\$ 0.8	\$ 0.8	\$ 0.8	\$ 0.8	\$ 4.0	\$ 5.8	\$ 5.9	\$ 2.9	\$ 2.1	\$ 12.9	\$ 20.6	\$ 19.0
Direct Employment	5	5	5	5	5	5	5	5	25	36	36	18	13	75	119	110
Total Employment	10	10	10	10	10	10	10	10	52	74	75	37	27	150	238	220
Total Earnings (Millions 2011\$)	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 2.9	\$ 4.2	\$ 4.2	\$ 2.1	\$ 1.5	\$ 7.8	\$ 12.3	\$ 11.4
Discounted @ 7%	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 2.7	\$ 3.9	\$ 3.9	\$ 2.0	\$ 1.3	\$ 6.8	\$ 10.7	\$ 9.9
Discounted @ 3%	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 0.6	\$ 2.8	\$ 4.0	\$ 4.1	\$ 2.0	\$ 1.4	\$ 7.3	\$ 11.6	\$ 10.7

	2014				2015				2016				2017				2018	TOTAL
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	
TOTAL PROJECT COSTS (Mil 2011\$)	\$ 36.6	\$ 49.0	\$ 39.6	\$ 50.2	\$ 45.5	\$ 29.1	\$ 17.9	\$ 17.9	\$ 17.7	\$ 7.6	\$ 7.7	\$ 7.7	\$ 7.5	\$ 7.6	\$ 7.7	\$ 7.7	\$ 1.7	\$ 438.1
Direct Employment	209	279	226	286	259	166	101	101	100	43	43	43	42	43	43	43	9	2,507
Total Employment	411	548	446	561	509	327	195	195	193	83	84	84	82	83	84	84	18	4,941
Total Earnings (Millions 2011\$)	\$ 20.8	\$ 27.5	\$ 22.5	\$ 28.1	\$ 25.5	\$ 16.5	\$ 9.6	\$ 9.6	\$ 9.5	\$ 4.1	\$ 4.1	\$ 4.1	\$ 4.0	\$ 4.1	\$ 4.1	\$ 4.1	\$ 0.9	\$ 249.8
Discounted @ 7%	\$ 17.0	\$ 22.4	\$ 18.3	\$ 23.0	\$ 19.5	\$ 12.6	\$ 7.3	\$ 7.3	\$ 6.8	\$ 2.9	\$ 2.9	\$ 2.9	\$ 2.7	\$ 2.7	\$ 2.7	\$ 2.7	\$ 0.6	\$ 200.2
Discounted @ 3%	\$ 19.0	\$ 25.1	\$ 20.6	\$ 25.7	\$ 22.7	\$ 14.7	\$ 8.5	\$ 8.5	\$ 8.2	\$ 3.5	\$ 3.5	\$ 3.5	\$ 3.4	\$ 3.4	\$ 3.4	\$ 3.4	\$ 0.7	\$ 226.6

The reconstruction of the Oakland Army Base (OAB) as contained in the Project represents a large capital investment in the economically distressed City of Oakland as well as the regional economy.³ This spending will increase employment and earnings in the City and the region for the duration of the construction process. Construction is estimated to support or create over 4,900 jobs of one-year's duration, including 2,500 direct jobs, as detailed in Exhibit 1 above. A job for one person that lasts three years would be equivalent to three person year jobs. These jobs are temporary; they last for the duration of the construction period, ramping up and down with the construction cycle.⁴

On-Going Benefits: Project Operation Job Creation

The long-term job creation resulting from Project operation primarily will result from the private investments in the commercial uses at the Port of Oakland. These investments will create opportunities for residents of the City of Oakland to have access to high quality, skilled jobs at the Port facilities, including the new rail terminal and moved recycling centers. In anticipation of the project's implementation, the city has begun an outreach initiative with the Oakland community and other key stakeholders to ensure that local residents share in the economic prosperity created by the Restoring Oakland's Working Waterfront investment. Still in development, the package of benefits, once adopted by the City's Agency Board, will apply to all developers and will be supported by all key project stakeholders, including Community Coalitions. Some of the key guidelines and goals, subject to coordination with any required federal regulations, identified to date include:

- All new apprentices at the Port are required to be City of Oakland residents.
- 50% (plus one) work hours for Oakland residents, craft by craft.
- Additional priority for local hire given to West Oakland residents and Enterprise Zone residents (or another proxy for areas of low-income, high unemployment etc.)
- Locating a Jobs Center in West Oakland that will be readily accessible and will serve as a resource for contractors, employers, and job seekers during Construction and Operations phases.
- The Center will connect job seekers with job training, education and other support services, such as transportation.
- A Young Adult/Re-entry Employment Program also is being developed.

These components are designed to build skills in the local community and provide employment and higher-income opportunities for the economically distressed residents in the City of Oakland.

³ The Project construction and operation occur within the Oakland city limits; and therefore, many of the employment and earnings impacts will benefit the economically distressed city. However, the RIMS II multipliers are not available at the city level; therefore, impacts are estimated for the San Francisco-Oakland-Fresno, CA MSA.

⁴ The economic impacts from the construction of the Project are estimated for the San Francisco-Oakland-Fremont, CA MSA based on the construction and professional services expenditures and the construction and professional services RIMS II multipliers for the region. The Final Demand construction RIMS II multipliers are 0.5360 (earnings) and 11.1141 (employment) for the MSA. The Final Demand professional services RIMS II multipliers are 0.7146 (earnings) and 12.9941 (employment). Please note that to use the final demand multipliers for employment, the costs were deflated to 2008 dollars using GDP deflator for non-defense direct capital because the RIMS II multipliers are based on 2008 data.

Long-term Outcomes

The project described in this application—Restoring Oakland’s Working Waterfront—hereon referred to as the Project, will support the region’s economy over the long term through its reconstruction of the Oakland Army Base, which includes:

- Construction of a new rail terminal
- Restoration of Oakland’s only deep water break bulk terminal, a unique component of the Marine Highway
- Construction of new trade and logistics facilities for warehousing directly within the Port area
- Relocation of export-oriented recycling operations and trucking operations from impacted neighborhoods
- Improvements to the backbone infrastructure of the former Oakland Army Base, including roadway improvements to Maritime Street and Burma Road

These improvements generate numerous benefits in the City of Oakland and the larger San Francisco-Oakland-Fremont region, including state of good repair benefits, costs avoided, water savings, shipping savings, reduced emissions, and safety benefits.

The balance of this discussion describes the assumptions and methods used to develop the benefit-cost analysis, and estimates the value of the long-term benefits generated by the investment. Project construction will be fully-complete in 2018, but some operations are expected to come online in 2014. As directed in the TIGER III guidance, the useful life of the Project’s capital investment has been estimated over a 20-year analysis horizon. The stream of benefits and costs over time are converted to the present value using the required 7 percent discount rate. The equivalent results are also shown at a 3 percent discount rate. All benefits are estimated in accordance with guidance provided by US DOT for benefit cost analysis. If no DOT guidance applied to the estimate, the project team consulted industry research for the best practice and information on which to base the assumptions and methodology. The section concludes with a summary table, Exhibit 6, which aggregates the benefits and compares them to the costs.

State of Good Repair

Much of the infrastructure at the Project site is at the end of its useful life, and maintenance costs are rising steadily. Implementation of the Project will return the road, drainage and water systems to a state of good repair and significantly reduce maintenance costs over the long-term. For example, Maritime Street is a route servicing thousands of trucks and vehicles on a daily basis. In addition to providing access to all four City development areas, Maritime Street is also used to access some of the Port’s land available for development. Maritime Street’s pavement is already showing significant signs of deterioration due to constant and heavy truck loading. In order to preserve Maritime’s infrastructure, the recommended course of action would include a reconstruction of Maritime Street. A proper reconstruction would reduce any future maintenance, and put Maritime on a 20-year maintenance cycle for minimal surface restoration.

Similarly, Burma Road is the only connector road between Maritime Street to the proposed West Gateway Area, existing Caltrans maintenance facilities and a planned Gateway Park to be constructed to provide pedestrian and bike access to the new Bay Bridge. Burma Road is in critical need of pavement reconstruction and is considered failed due to settlement, broken pavement, base failures and other indications of pavement failure. Improvements would include roadway reconstruction, including new sidewalk, curb and gutter, parking, bike lanes and travel lanes, curb ramps, adjustments of existing castings to grade, traffic signage and lane striping.

The existing water mains also are in a state of disrepair. A comparison of the “utility main” meter volumes and the “sub-meter” volumes of tenants yields an estimate of the losses due to leakage between 62% and 83% of the water delivered to the site, which is accelerating the settlement of the road system. The gallons leaked per year are increasing at a rate of 15%.

The Project will upgrade and restore the Oakland Army Base and its supporting systems (roads, sanitary, and stormwater) to a state of good repair, resulting in significant operations and maintenance cost savings. It is estimated that to maintain the system “as is”, over \$2 million in annual road, sanitary, and stormwater maintenance will be necessary. As these infrastructure systems are slated to be replaced and upgraded as part of the Project, there is a significant net savings for the operations and maintenance of the new system over the existing one. ***Over the analysis period, the operations and maintenance cost savings associated with the new systems and roads discounted at 7 percent total \$17.15 million.***

The useful life of the Project investments is 28 to 60 years for facilities, systems, and rail assets (not vehicles) according to BEA guidance. Thus, the Project’s new assets will have value beyond the 20-year analysis period used in this study. In order to estimate the residual value of these assets, the capital investments in railroad track, associated rail facilities, and new utility improvements were depreciated (straight-line) over the full life of the assets. The first 20 years of the series was excluded from the residual estimation; this is the basis of the benefits estimation reported elsewhere. The remaining 8 to 40 years of the series was discounted back at a 7 percent rate and summed. ***The value of the remaining useful life for the Project assets discounted is \$33.27 million.***

Economic Competitiveness

By providing rail access to both the new rail terminal and the break bulk terminal, the Project eliminates the need for freight to be trucked to the Port. Currently, containers traveling to or from the Port of Oakland must travel by truck to/from the nearest intermodal facilities in Stockton and Lathrop—both of which are more than 80 miles from the Port. With the Project, rail tracks and intermodal facilities will be located at the Port. Cranes will now place containers directly from ships onto trains, eliminating the drayage costs. The drayage savings per container was estimated to be \$300 by the Port of Oakland, and with over 374,000 containers annually, the savings at full build is expected to be \$112 million annually. Based on projected port volumes and financial plans, 20 percent of the full build savings will be reached in 2014 and the full build benefits of the intermodal rail yard are expected to be achieved in 2018. ***Annualizing and applying a discount rate of 7 percent, the total shipping savings is \$866.30 million over the analysis period.***

Livability

The livability benefits are qualitative; and therefore, are discussed in the TIGER III application.

Sustainability

The operation of the Project’s intermodal facilities at the Port of Oakland will eliminate truck drayage to/from the port facilities. As a result, the region will experience a steep reduction in truck VMT—more than 120 million VMT when full build of the rail facilities is reached in 2018—and the associated air pollutants. The VMT estimate is based on the number of truck trips and the distance between the Port and Stockton and Lathrop as included in the 2009 Amended TCIF Funding Nomination report, which is available for review in the TIGER III application’s supporting materials (see Executed Baseline Agreement OHIT.pdf for details). Additionally, the VMT shown in the TCIF report was multiplied by 98.6 percent because this is the percentage of the volume shown in the TCIF that is included in the TIGER III Project.

This reduction in VMT decreases the amount of Carbon Monoxide (CO), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC), Particulate Matter (PM2.5 and PM10), Sulfur Dioxide (SO2), and Carbon Dioxide (CO2) in the atmosphere. Federal Motor Carrier Safety Administration guidance for the pollutant factors associated with truck drayage from the Hours of Service Environmental Assessment were applied to the annual VMT reduced.⁵ The economic benefit of the decreased emissions is estimated by applying the economic cost of air emissions to the reduction of CO, NOx, PM2.5, PM10, SO2, and VOC.⁶ **Applying USDOT guidance for the pollutant factors and discounted at 7 percent, the estimated value of the improved air quality associated with these diversions is \$46.16 million.** Alternately, using the Interagency Working Group on Social Cost of Carbon guidance⁷, the value of carbon dioxide benefits are discounted at 3 percent, which **yields a total savings of \$35.71 million in greenhouse gas (or climate change) benefits.**

Additionally, the utility system at the Port of Oakland leaks treated water into the San Francisco Bay. This results in a growing proportion of the City's water being treated and never sold. In 2011, a projected 52.9 million gallons of water will be leaked, the equivalent of 83 percent of the gallons billed by the East Bay Municipal Utilities District. Approximately 15 percent more gallons of water will be leaked in 2011 than in 2010, and the number is expected to continue to increase if the utilities are not adequately replaced. With the reconstruction associated with the Project, these water and sewer lines will be replaced, and the treated water will no longer leak into the Bay and can instead be sold. This results in savings associated with the cost of the lost water as well as the cost of treating the leaked water. **Discounted at 7 percent and taken over the 20-year analysis period, a benefit of \$9.63 million in water savings is associated with the Project.**

Safety

The operation of the new rail and break bulk terminals at the Port will provide on-dock rail access that will reduce the need to transport containers between ship and train by truck. As a result, drayage will no longer be necessary, yielding a significant reduction in annual truck VMT. This reduces the rate or likelihood of crashes and associated deaths, injuries and property damage because fewer trucks will be traveling between the Port and the intermodal facilities in Stockton and Lathrop.

To convert the VMT avoided into crashes avoided, the following crash rates from the Bureau of Transportation Statistics were applied.

Exhibit 2: BTS Accident Rates per 100,000,000 VMT, 2009

Fatalities	1.144675318	per 100,000,000 VMT
Injured persons	75.06345185	per 100,000,000 VMT
Crashes (PDO)	186.3889501	per 100,000,000 VMT

Source: 2011 BTS Motor Vehicle Safety Data Table 2-17, 2009 data

http://www.bts.gov/publications/national_transportation_statistics/#chapter_2

⁵ FMCSA, *Hours of Service (HOS) Environmental Assessment, Appendix A: Analysis of Air Quality Impacts*, Dec 2010.

⁶ The economic costs of air emissions are taken from Chapter VIII of the Final Regulatory Impact Analysis of the National Highway Traffic Safety Administration's rulemaking on Corporate Average Fuel Economy for MY 2012-2016 Passenger Cars and Light Trucks.

⁷ Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, February 2010

These crash reduction factors were then converted to the MAIS accident types in order to apply US DOT Guidance on the value of avoiding an accident. The conversion is based on the NHTSA KABCO-AIS Conversion Table (July 2011) provided on page 50308 of the TIGER III Notice of Funding Availability (August 12, 2011) for Injury (severity unknown) and No Injury accidents.

Exhibit 3A below summarizes the VMT reduced (or avoided) associated with the Project, while Exhibit 3B shows the number of accidents avoided by severity in 2018 due to the Project (the first year of full build). The accidents avoided in 2018 conservatively are held constant throughout the remaining analysis years.

Exhibit 3A: VMT and Accidents Avoided Due to the Project

	2018
Annual VMT Reduced at Full Build	121,301,590

Source: 2009 Amended TCIF Funding Nomination multiplied by 98.6 percent to represent the proportionate volume of traffic associated with the TIGER III Project.

Exhibit 3B: Projected Crashes Avoided in 2018 by MAIS Crash Type

	2018
Fatalities	1.3885
MAIS 5	0.9483
MAIS 4	0.4025
MAIS 3	3.5309
MAIS 2	9.9172
MAIS 1	73.5234
PDO	228.8237

The values shown above are projections of annual ***fatalities and injuries avoided*** because the BTS crash types are based on fatalities, injuries, and damage per 100,000,000 VMT, which takes into consideration vehicle occupancy. Based on the number of fatalities, injuries, and property damage incidents, their total annual value is found from the US DOT Guidance and the National Highway Safety Council estimates for the value of avoiding an accident. The estimates applied in this analysis are summarized in Exhibit 4 below.

Exhibit 4: Value of One Person Avoiding a Crash, \$2011

Crash Type	Value of Avoiding Crash, \$2011	Source
Value of Statistical Life (VSL)	\$6,200,000	Based on 2011 OST Guidance
MAIS 5 Critical (0.593) Fraction of VSL	\$3,676,600	Based on 2011 OST Guidance
MAIS 4 Severe (0.266) Fraction of VSL	\$1,649,200	Based on 2011 OST Guidance
MAIS 3 Serious (0.0575) Fraction of VSL	\$651,000	Based on 2011 OST Guidance
MAIS 2 Moderate (0.047) Fraction of VSL	\$291,400	Based on 2011 OST Guidance
MAIS 1 Minor (0.003) Fraction of VSL	\$18,600	Based on 2011 OST Guidance
PDO \$3,285 (2010\$)	\$3,329	NHTSA, Economic Impact of Motor Vehicle Crashes, 2000, escalated to \$2011 using GDP Price Index Deflator

Applying the crash costs in Exhibit 4 to the projections of crash reductions provided in Exhibit 3 yields the annual savings. The total projected accident cost savings are shown below in Exhibit 5.

Exhibit 5: Total Projected Savings in Crash Costs, Millions of 2011\$

	20-Year Total
Reduced Truck Drayage	\$ 361.56
Discounted @ 7%	\$ 155.15
Discounted @ 3%	\$ 245.97

These results aggregate the benefit stream over 20 years yielding a total safety benefit of \$155.15 million discounted at 7 percent.

Summary

Exhibit 6 below summarizes the discounted value of the economic benefits discussed in this memorandum. Taken in total and using a 7 percent discount rate, the state of good repair, economic competitiveness, sustainability, and safety benefits from the Restoring Oakland's Working Waterfront Project provide over \$1,163 million of benefits over the 20-year analysis period. Compared to similarly discounted cost estimates, the Benefit Cost Ratio for the project is 3.31, an excellent return on investment. This ratio rises to 4.66 percent when benefits and costs are discounted at 3 percent.

Exhibit 6: Benefit Cost Analysis of Restoring Oakland's Working Waterfront (\$2011 M)

	20-year Total	
	Discounted @ 3%	Discounted @ 7%
<u>Benefits</u>		
O&M Costs Avoided	\$ 25.54	\$ 17.15
Residual	\$ 99.42	\$ 33.27
Shipping Savings	\$ 1,373.45	\$ 866.30
Air Quality	\$ 68.58	\$ 46.16
Climate Change	\$ 35.71	\$ 35.71
Water Savings	\$ 17.34	\$ 9.63
Safety	\$ 245.97	\$ 155.15
Total	\$ 1,866.00	\$ 1,163.36
<u>Costs</u>		
Capital	\$ 396.51	\$ 349.39
Operating	\$ 3.79	\$ 2.21
Total	\$ 400.30	\$ 351.60
Benefit Cost Ratio	4.66	3.31

*Climate Change benefits are only discounted at 3% per Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, Feb 2010

List of Attachments and Supporting Information

AECOM, Economic Distress.xlsx (Excel spreadsheet with supporting data)

AECOM, Final Port of Oakland TIGER III BCA.xlsx (Excel spreadsheet with BCA calculations by benefit type and summary)

California Capital and Investment Group, Tiger III tasks by quarter.xlsx (Excel spreadsheet with quarterly costs)

Executed Baseline Agreement OHIT.pdf (Document with VMT avoided projections for 2009 TCIF Funding Nomination)

Kennedy & Associates, OAB Infrastructure Status, 2011, 2011-10-26 Frank
Kennedy_Infrastructure_Status_Final.doc (O&M cost memo for existing facilities)

Kennedy & Associates, OAB Infrastructure Status – Maintenance (New), 2011, Infrastructure
Maintenance Status_New.doc (O&M cost memo for new facilities)