METROPOLITAN
TRANSPORTATION
COMMISSION

Joseph P. Bort MetroCenter
101 Eighth Street
Oakland, CA 94607-4700
TEL 510.817.5700
TDD/TTY 510.817.5769
FAX 510.817.5848
E-MAIL info@mtc.ca.gov
WEB www.mtc.ca.gov

Memorandum

TO: Planning Committee DATE: October 28, 2011

FR: Executive Director

RE: Plan Bay Area: Project Performance Assessment – Draft Results

Over the past several months, MTC staff has undertaken a project performance assessment to help inform the Commission's discussion of trade-offs in developing a draft program of transportation investments for Plan Bay Area in early 2012. This memo describes the analytical approach. Staff will present the draft results at your meeting on November 4. Staff is conducting a technical review of the performance data with transit operators, Congestion Management Agencies (CMAs), and an ad hoc technical advisory committee (Attachment 1).

Background

All non-committed projects, as defined by the Commission in its Committed Funds and Projects Policy for Plan Bay Area (Resolution No. 4006) adopted in April 2011, are subject to the performance assessment. Our intent is to assess the degree to which potential transportation projects and programs: (1) advance the ten performance targets adopted by MTC and ABAG in January 2011 (Resolution No. 3987) and (2) are cost-effective. The performance assessment allows comparison of projects on a consistent qualitative and quantitative basis to the extent possible and practical. The Commission ultimately will use its policy discretion along with the performance results to determine which projects and programs are included in the Plan Bay Area investment strategy.

Project Assessment Approach

MTC staff issued a "call for projects" in February, 2011 and received submittals for approximately 900 projects with a total cost of $180 billion (in 2013$). Of this total, approximately 180 larger projects (those with cost greater than $50 million) worth a total cost of $170 billion were selected for individual assessment. The remaining 700-plus smaller projects were grouped by type. MTC staff based the performance assessment on project definitions and cost estimates provided by project sponsors through the call for projects and follow-up discussion with sponsors, as needed.

Attachment 1 compares the approach used for Transportation 2035 and for Plan Bay Area. In both cases, the performance assessment includes two primary components, target achievement and benefit-cost ratio. The methodologies and criteria for both components were developed with input from the ad hoc technical advisory committee.

1. **Targets Assessment**: MTC conducted a qualitative targets assessment for all projects, either individually, for the 180 larger projects, or by type, for the remaining projects. The

assessment considers the degree to which projects support or have an adverse impact on the ten adopted Plan Bay Area Targets, which are all weighted equally. **Attachment 3** describes the Targets Assessment methodology and criteria in more detail.

2. **Benefit-Cost**: Similar to the methodology used in Transportation 2035, MTC calculated quantitative benefit-cost ratios (B/Cs) for approximately 90 of the larger transit and roadway expansion and operations projects, and regional programs (e.g., maintenance funding and Transportation for Livable Communities). The benefit-cost calculation monetizes project impacts on travel time, emissions, collisions, health costs due to level of physical activity, noise and out-of-pocket user costs. See **Attachment 4** for details on the benefit-cost methodology. The analysis results will categorize projects, such as "High" (B/C > 10), "Medium" (B/C between 1 and 9), and "Low" (B/C < 1).

Policy Considerations

The project performance results are intended to help the Commission identify projects that will be included in the adopted RTP long-range investment strategy. The evaluation identifies outliers at both ends of the spectrum. Some projects will be especially high-performing and cost-effective and as such should be strong candidates for inclusion in Plan Bay Area. The assessment will also identify "lower-scoring" projects, which for various policy reasons deemed important by the Commission, might still be worthy candidates for Plan Bay Area.

Next Steps

Following release of the draft analysis results at your November 4 meeting, staff will discuss the outcomes with several committees through the rest of the month and into early December:

- Plan Bay Area Equity Working Group – November 9
- MTC Policy Advisory Council – November 9
- Partnership Technical Advisory Committee – December 5

Should this process generate substantial comments or revisions, staff will report back to the Planning Committee at your December meeting. Additional milestones include:

- Release Scenario Assessment Results – December 2011
- Conduct Public Outreach – January 2012
- Discuss Infrastructure Needs and Investment Trade-Offs – October 2011 – February 2012
- Identify Preferred Scenario (includes Preliminary Investment Strategy) – February 2012
- Release Preferred Scenario Assessment Results – March 2012
- Approve Preferred Scenario (includes Proposed Investment Strategy) – May 2012

Steve Heminger

Attachments

Attachment 1: Overview of Plan Bay Area Transportation Project Performance Assessment
Attachment 2: Participants in Ad Hoc Project Performance Technical Advisory Committee
Attachment 3: Targets Assessment Methodology
Attachment 4: Benefit Cost Assessment Methodology

Attachment 1: Overview of Plan Bay Area Transportation Project Performance Assessment

	Plan Bay Area	Transportation 2035
Subject to Assessment	All uncommitted projects and regional programs	All uncommitted projects and regional programs
Individual Assessment **Larger Projects (>$50 M in costs or regional impacts)**	*Note: many projects were considered "committed" in T-2035 are considered "uncommitted" in Plan Bay Area, resulting in more projects subject to individual analysis* <u>Targets Assessment</u> (all larger projects, 160 total) • Evaluate support for adopted targets qualitatively through criteria-based evaluation. Where available, quantitative results from the B/C analysis inform this assessment. <u>Benefit/Cost Assessment</u> (80 projects) • MTC model analysis, combined with off-model analysis where applicable B/C ratio in 2035 including o Travel time (with adjustments to valuation of nonrecurring delay) o Emissions (CO_2, $PM_{2.5}$, PM_{10}, ROG, NOx) o Health costs associated with changes in active transportation levels o Collisions (injuries, fatalities, or property damage only) o Direct user costs (vehicle operating/ownership) o Noise • Determine level of confidence in the B/C results for each project (also known as the "inclusiveness analysis") o Degree to which major benefits are captured o Degree to which benefits accrue early or late **Other** • Identify projects located in PDAs and in Communities of Concern	<u>Qualitative Goals Assessment</u> • Based on project type (see below) <u>Benefit/Cost Assessment</u> (60 projects) • MTC model analysis , with off model analysis for regional programs 1. B/C ratio in 2035 including o Delay o Emissions (CO_2 and PM_{10} and $PM_{2.5}$) o Collisions (injuries & fatalities) o Direct user costs (vehicle operating/ownership) 2. Cost per reduction on CO_2 3. Cost per reduction in VMT 4. Cost per low-income household served by new transit Goals not reflected in B/C are captured through the qualitative assessment
Project Type **Smaller Projects (<$50 M in costs or localized impacts)**	<u>Targets Assessment</u> (700 projects) • Projects grouped into 9 categories by type • Evaluate support for adopted targets by project type	<u>Qualitative Goals Assessment</u> (all projects, 700+) • Projects grouped into 13 categories by types • Evaluate support for T-2035 goals by type

Attachment 2: Participants in
Ad Hoc Project Performance Technical Advisory Committee

First Name	Last Name	Organization
Transit Operators		
Val	Menotti	BART
Joanne	Parker	SMART
Congestion Management Agencies		
Liz	Brisson	San Francisco County Transportation Authority
Matt	Kelly	Contra Costa Transportation Authority
Bob	Macaulay	Solano Transportation Authority
Joseph	Kott	C/CAG of San Mateo County
Local Government		
Janet	Abelson	City of El Cerrito
April	Wooden	Suisan City
Lori	Macnab	City of Santa Rosa
MTC Policy Advisory Council/ABAG Regional Planning Committee		
Randi	Kinman	MTC Policy Advisory Council
Bena	Chang	MTC Policy Advisory Council / Silicon Valley Leadership Group
Cathleen	Baker	MTC Policy Advisory Council / County of San Mateo
Egon	Terplan	MTC Policy Advisory Council/ ABAG RPC/ San Francisco Planning and Urban Research Association
John	Holtzclaw	ABAG RPC/ Sierra Club
Stuart	Cohen	ABAG RPC/ TransForm
Regional/State Agencies		
Dave	Burch	BAAQMD
Neil	Maizlish	California Department of Public Health
Marisa	Raya	ABAG
Beth	Thomas	Caltrans

This ad hoc committee was designed to have representation from a variety of stakeholder groups while maintaining a manageable size for technical discussions. Our goal was to have representation as follows:

- 5 representatives of transportation agencies from PTAC (at least 2 transit and 2 CMAs)
- 4 representatives of local government
- 3 members of MTC's Policy Advisory Council
- 3 representatives of non-governmental advocacy groups represented on ABAG's Regional Policy Committee

Attachment 3: Targets Assessment Methodology

The targets assessment considers the extent to which projects and programs support the ten Plan Bay Area targets adopted by the Commission. Attachment 3-A lists the criteria used to rate the projects for each of the targets. These targets were developed with input from the Partnership Advisory Technical Group, the Regional Advisory Working Group and the ad hoc Project Performance Technical Advisory Committee.

MTC staff measured support for each of the ten adopted targets on a five-point scale:

- strong support (1)
- moderate support (0.5)
- minimal impact (0)
- moderate adverse impact (-0.5)
- strong adverse impact (-1)

MTC staff summarized the targets assessment by combining the scores for all the targets into an overall "target score" while also noting subtotals for targets supported and targets where the impact is adverse. Each of the ten targets counts equally toward the total since the Commission has not assigned relative weights. Target 3, which related to particulate matter emissions, comprises three sub-elements but counts as a single target in this assessment. Likewise, Target 9, which calls for improving/increasing non-auto travel and decreasing VMT, has two sub-elements and counts as a single target in this analysis.

We originally intended to use quantitative output from the travel demand model where available from the benefit cost assessment. However, we found it challenging to integrate the quantitative model results, which are available for only some projects and targets, with qualitative assessment criteria. In the end, we applied the qualitative criteria in Attachment 1 to all projects.

MTC conducted the targets assessment for all uncommitted projects. We looked at about 180 larger projects (costs greater than $50 million) on an individual basis; this total includes the 90 projects subject to benefit cost assessment plus 90 additional large projects that could not be represented in the regional travel demand model. For projects assessed on an individual basis, we considered particulars such as geography, which is important for targets such as Housing, Open Space/Agricultural Preservation, and Economic Vitality.

<u>Smaller Project Assessment</u>

We grouped the remaining 700 smaller projects into nine types based on mode and project purpose/function (e.g., expansion, operations, safety, etc.). These groupings capture many important distinctions relative to the targets but do not allow us to consider geography. A complete list of the 700 small projects sorted by type can be provided upon request.

Example projects were selected for each project category and were scored with numeric values to assess the impact on Plan Bay Area targets using the criteria in Attachment 3A. These representative projects served as the benchmark for each project category.

Priority Development Areas and Communities of Concern

While not explicitly addressed in the targets assessment, the relationship of projects to Priority Development Areas (PDAs) and Communities of Concern (CoCs) is clearly of interest. To inform the trade-off discussion, MTC staff will identify whether projects are located in PDAs and CoCs. Projects that are located in one of these areas and have strong support for the targets can generally be considered supportive of the PDA or CoC.

Appendix 3-A: Targets Assessment Criteria

	Adopted Targets		Qualitative Assessment Criteria	
Outcome/ Goals	*(all targets are for year 2035 compared to year 2005 base)*		*Project Support*	*Adverse Impact*
Climate Protection	**1**	Reduce per-capita CO_2 emissions from cars and light-duty trucks by 15%	• Advances clean fuels and/or vehicles beyond CARB targets • Provides an alternative to driving alone • Provides a VMT reduction	• Results in increased VMT
Adequate Housing	**2**	House 100% of the region's projected 25-year growth by income level without displacing current low-income residents	• Provides accessibility to and from areas with planned housing growth • Amount of planned housing growth in areas served • Amount of planned affordable housing (meets 2 strong, 1 medium) o Jurisdiction has an HCD-certified housing element o Jurisdictions that permitted better that than regional average for percentage of allocated very low and low income units	
Healthy and Safe Communities	**3**	Reduce premature deaths from exposure to PM2.5 by 10%	• Provides a VMT reduction • Increases walk/bike trips • Increases transit trips	• Results in increased VMT
		Reduce premature deaths from exposure to PM10 by 30%	• Provides a VMT reduction • Increases walk/bike trips • Increases transit trips	• Results in increased VMT
		Achieve greater reductions of PM in CARE communities	• Strong reduction in CARE community • Moderate reduction in CARE community • No reduction in CARE community	• Increases PM or VMT in CARE communities
	4	Reduce by 50% the number of injuries and fatalities from all collisions	• Implements safety improvements (for all modes) • Reduces VMT • Enhances safety or security for transit passengers	• Results in increased VMT
	5	Increase the average daily time walking and biking per person	• Provides infrastructure to enhance bicycle and pedestrian trips	• Encourages auto trips

	Adopted Targets		Qualitative Assessment Criteria	
Outcome/ Goals	*(all targets are for year 2035 compared to year 2005 base)*		*Project Support*	*Adverse Impact*
		for transportation by 60%	• Increases walk and bike trips to transit	
Open Space and Agricultural Preservation	**6**	Direct all non-agricultural development within the urban footprint (existing urban development and urban growth boundaries)	• Project would NOT consume areas of open space • Project would NOT consume areas of agricultural land • Improves freeway, arterial or rail access to agricultural lands	• Project would consume areas of open space/ agricultural land
Equitable Access	**7**	Decrease by 10% the share of low-income and lower middle income residents' household income consumed by transportation and housing	• Provides low-cost transportation options for low income households • Reduces household auto ownership costs/transportation costs for low income households • Promotes development of affordable housing across community types	• Increases transportation or housing costs for low income households
Economic Vitality	**8**	Increase gross regional product (GRP) by 90%	• Improves operations to/from ports or in truck corridors • Improves access to/from employment centers and areas (all modes)	• Decreases access to port, truck or employment centers
Transportation System Effectiveness	**9a**	Decrease average per-trip travel time by 10% for non-auto modes	• Improved transit service headways • More direct active transportation routes • Reduces transit travel times	• Increases transit service headways

	Adopted Targets		Qualitative Assessment Criteria	
Outcome/ Goals	*(all targets are for year 2035 compared to year 2005 base)*		*Project Support*	*Adverse Impact*
	9b	Decrease auto vehicle miles traveled per capita by 10%	• Provides alternatives to the single occupant auto • Reduces household vehicle ownership	• Increases need of use of single occupant auto
	10	Maintain the system in a state of good repair • Increase local roadway pavement condition index (PCI) to 75 or better • Decrease distressed lane-miles on the state highways to less than 10% of the system • Reduce average transit asset age to 50% of useful life	• Improve roadway surface condition • Project will replace or extend the life of bus , rail or ferry assets	

General Application Rules

- In the individual project assessments (for projects with cost > $50 million), efforts were made to account for project scale so that transit projects likely to attract more riders received more credit for reducing VMT, collisions, emissions, etc.
- Roadway projects that include transit & ridesharing improvements were given credit in the rating
- Due to their smaller scale, highway auxiliary lanes and other operations projects were considered less adverse than highway expansion for targets assessed base on changes in VMT.

Attachment 4: Benefit-Cost Assessment Methodology

MTC calculated benefit cost ratios for approximately 90 higher-cost projects with regionally significant impacts based on project definitions and cost estimates provided by projects sponsors. Impacts and costs reflected in the benefit cost ratio are listed below. The calculation, which is based on best practices for benefit-cost assessment, captures many of the factors reflected in the adopted targets.

Project Impacts	Project Costs
• travel time • emissions • collisions • out-of-pocket user costs (including parking, auto ownership, and auto operating costs) • health costs due to level of physical activity • noise	• Capital cost • Net operating and maintenance cost

The benefit-cost ratio compares annual benefits in year 2035 with annualized cost. For most projects, MTC used the regional travel demand model to estimate project impacts in year 2035. For regional programs such as TLC, Lifeline, and the Regional Bike Network, MTC estimated impacts using sketch planning approaches similar to those used in Transportation 2035. Larger locally sponsored projects that cannot be represented in the regional travel demand model were not subject to the benefit-cost analysis but are still evaluated on an individual basis in the target assessment. **Attachment 4-A** includes a discussion of the criteria MTC staff used to determine which larger projects could be assessed using the regional travel demand model. In general, this group includes projects with cost greater than $50 million (in 2013 dollars) that expand or significantly enhance transit services, freeways, state highways or local roads. The methodologies used to estimate benefits (using the travel demand model) and costs are described in **Attachment 4-B**.

The benefit-cost calculation monetizes project impacts on travel time, emissions, collisions, health costs due to level of physical activity, noise, and out-of-pocket user costs. These benefits are expressed in monetary terms. For example, the monetary value of travel time is tied to the average regional wage rate; similarly, the monetary value of particulate matter emissions reflects the costs associated with the known health impacts. MTC conducted research into current best practices for valuing project impacts; this information was reviewed with the ad hoc Project Performance Technical Advisory Committee prior to embarking on the analysis. The basis for valuing each benefit is described in **Attachment 4-C**.

In reviewing the benefit cost methodology, it is important to recognize the intent is to identify outliers and make broad comparisons. Projects will be grouped in benefit-cost ranges such as **High** (B/C ratio > 10), **Medium** (B/C ratio between 1 and 9), and **Low** (B/C ratio < 1).

In an effort to provide a more robust analysis, MTC staff will conduct sensitivity testing of the benefit cost assumptions. We also will develop a "confidence rating" as described below.

Sensitivity testing – We are conducting sensitivity tests to validate the robustness of our results. We principally aim to understand if certain assumptions fundamentally change the position of projects among the benefit-cost ranges. Sensitivity tests may include:

- Testing of travel time valuation
    - Value non-recurring delay reduction at three times the value of travel time
    - Only consider delay reduction for auto modes + transit travel time savings (similar to Transportation 2035)
- Testing of CO_2 valuation
    - Value CO_2 at significantly higher level (based on recent GHG valuation studies from the U.K.)
- Testing of collision valuations
    - Value collisions using USDOT valuations (these valuations are slightly higher than the Cal B/C values used in the analysis)
- Testing of noise valuation
    - Value noise levels to better capture health impacts (based on pending discussions with SFDPH staff)

Confidence rating – We see value in identifying the strengths and shortcomings of the benefit-cost assessment. As discussed in the spring, we plan on identifying our level of confidence with each of the benefit-cost ratios and indicating whether or not each project's B/C ratio has been under- or over-estimated. Three primary criteria will be used to develop this rating:

- **Modeling Accuracy**
    - Has MTC's model (known as Travel Model One) been successful at modeling similar types of projects, or does the model have limitations in understanding a particular type of travel behavior?
    - Does the "mode choice" modeling approach under- or over-estimate the number of trips affected by a particular project?
- **Framework Completeness**
    - Does the model capture all of the primary benefits of the project?
    - Are we capturing real-world limitations (e.g. system capacity issues)?
- **Timeframe Inclusiveness**
    - Is the project an "early winner" (i.e. can be implemented quickly and provides key benefits in the short term)?
    - Is the project a "late bloomer" (i.e. benefits will not be realized until the final years of the planning horizon)?

Attachment 4-A: Projects Subject to Benefit-Cost Analysis

MTC staff selected projects from among projects submitted in response to the 2011 Call for Projects. Staff selected from projects submitted both as "New Commitments" (i.e. financially constrained) and as "Vision" projects, based on the following guidelines:

1. Committed projects and programs as defined by Commission action in April 2011 (MTC Resolution No. 4006) are not subject to project evaluation (benefit-cost or targets assessment).
2. MTC staff selected approximately 90 uncommitted transit and roadway projects for benefit-cost assessment based on a combination of cost and functional criteria. Projects with total costs greater than $50 million (2013$) were candidates for analysis. In addition, it was necessary that projects' impacts could be captured in the regional travel demand model. Examples include:
    - New/enhanced transit service, including transit priority measures
    - Freeway-to-freeway interchanges
    - Freeway widenings, including HOV lanes & auxiliary lanes, generally more than 5 miles
    - State highway widenings and major arterial connectors/reliever route improvements, generally more than 5 miles

    A few projects that cost less than $50 million were selected if they had area-wide impacts. Examples include the Grand-MacArthur BRT and the Alameda-Oakland BRT.

    In some cases, multiple project phases submitted as individual projects were grouped together for project evaluation. Examples include the SR-4 Bypass widening and SMART's "Phase 2" projects.

3. Due to technology and resource limitations, some transit and roadway improvements costing more than $50 million were not evaluated. These include projects considered to have localized impacts and other projects ill-suited for our analysis tools. Examples include:
    - Arterial or intersection improvements
    - Freeway-to freeway interchanges that do not include mainline widening
    - Local interchanges
    - Transit center improvements & parking expansion
    - Core transit capacity improvements, which do not result in more frequent service, though they may impact carrying capacity
    - Grade separations
    - Freight improvements

4. Regional Programs that are not "committed" under Commission policy are also subject to the benefit-cost assessment: Local Streets and Roads Maintenance & Transit Capital Need programs; New Freedom Program & Lifeline; Climate Initiative Program; Transportation for Livable Communities; Regional Bikeway Network; Freeway Performance Initiative; and emissions reduction programs (Electric Vehicle Solar Installation, Truck and Motorcycle Retirement, Heavy Duty Truck Replacement)

Attachment 4-B: Modeling Approach & Approach to Costs

Modeling Approach to Estimate Benefits

For approximately 80 of the 90 projects, impacts (e.g., changes in travel time, emissions, and out-of-pocket costs) were estimated using the regional travel demand model. Each project was coded as its own "Build" scenario and compared to a "No Build", which included only those projects "committed" as per Commission policy. Both the Build and No Build reflect the land use assumptions in ABAG's Current Regional Plans scenario. MTC's Travel Model One was used for the analysis. The travel model estimates daily impacts by projecting travel conditions during five time periods over a 24-hour day. MTC multiplied the daily impacts by a factor of 300 to estimate annual impacts.

For nine regional programs, MTC staff employed off-model analysis, based on available research, to estimate benefits, using approaches similar to those used in Transportation 2035. These projects include:

- Transportation for Livable Communities
- Lifeline
- Climate Initiatives Program
- Regional Bikeway Network
- Local Streets and Roads Maintenance
- Transit Capital Need
- New Freedom
- Emissions reduction programs (Electric Vehicle Solar Installation, Truck and Motorcycle Retirement, Heavy Duty Truck Replacement)
- Selected elements of the Freeway Performance Initiative (incident management, emergency preparedness and 511 Ridershare)

Cost Approach

All measures are calculated based on annualized benefits in year 2035 and annualized total costs. Both benefits and costs are expressed in 2013 dollars.

Annualized total costs are capital costs divided by the expected life of the capital investment (as shown in the table below) plus one year of net operating and maintenance costs in 2035. The total project cost, as opposed to the discretionary funding request, was used as the basis for the benefit-cost calculation. Project sponsors provided capital cost estimates. Where annual operating and maintenance cost estimates were provided, they were used. Where sponsors did not provide estimates (all cases were roadway projects), MTC staff estimated them using average per-mile road maintenance costs.

Project Lifecycle Assumptions by Project Type	Expected Useful Life of Improvement (in years)
Local Bus (1)	**14**
Over-the-Road Bus (1)	**18**
BRT Systems (2)	**20**
Rail Project - if majority of costs are new tunnels and/or stations (3)	**80**

Project Lifecycle Assumptions by Project Type	Expected Useful Life of Improvement (in years)
Rail Project – all others (4)	**30**
Ferry (1)	**30 to 50**
Technology/Operations Components (5)	**20**
Roadway (6)	**20**

Sources:

(1) Reflects with MTC's Transit Capital Priorities Process and Criteria (MTC Resolution No. 3908). For ferry projects: (1) Water Emergency Transportation Authority (WETA) has asked MTC to use a useful life of 50 years for ferry boats; the longer lifecycle is further appropriate because WETA projects include costs for constructing new terminals; (2) the useful life for other operators' ferries is assumed to be 30 years.

(2) Reflects that BRT system costs typically reflect considerable roadway improvements.

(3) Reflects FTA New Starts Guidelines, which estimates a useful life of 125 years for tunnels and underground stations and 50 to 70 years for other stations. An average of 80 years was used to reflect that a portion of costs are for vehicles, track and systems, which typically have a useful life of 20 to 30 years.

(4) Reflects MTC's Transit Capital Priorities Process and Criteria (MTC Resolution No. 3908), which assumes a 25-year replacement cycle for light rail vehicles, heavy rail vehicles and locomotives, in conjunction with FTA's New Starts Guidelines, which suggest a 20 to 35 year lifecycle for guideway and track.

(5) Caltrans Transportation System Management Inventory (December 2003) gives lifecycles for various TOS field elements ranging from 10 to 35 years. Video cameras (10 years), communications hubs (10 years) and HAR elements (15 years); fiber optics (35 years), CMS (25 years) and metering equipment (25 years) are at the high end. 20 year is used as a middle-of-the-road number.

(6) Reflects guidance in Caltrans' Life-Cycle Cost Analysis Procedures Manual (November 2007), which suggests pavement may have a useful life of 10, 20 or 40 years depending on the type of pavement and project. 20 year was assumed as a mid-point.

Attachment 4-C: Benefit Valuation

Benefit	Plan Bay Area Valuation ($2013)	What does this valuation include?
In-Vehicle Travel Time (Auto and Transit) per Person Hour of Travel	**$16.03**	This valuation is set equal to one-half of the mean regional wage rate ($32.06). The valuation represents the discomfort to travelers of enduring transportation-related delay and the loss in regional productivity for on-the-clock travelers & commuters. *Sources: Caltrans Cal B-C Model; Bureau of Labor Statistics National Compensation Survey, 2011*
Out-of-Vehicle Travel Time (Transit) per Person Hour of Travel	**$35.27**	This valuation is set equal to 2.2 times the valuation of in-vehicle transit time. The valuation represents the additional discomfort to travelers of experiencing uncertainty of transit arrival time, exposure to inclement weather conditions, and exposure to safety risks. *Source: FHWA Surface Transportation Economic Analysis Model (STEAM)*
In-vehicle Travel Time (Freight/ Trucks) per Vehicle Hour of Travel	**$26.24**	The valuation is set equal to the average wage rate for a Bay Area employee in the Transportation – Truck Driver (average of heavy and light) occupation sector ($23.83/hour), plus the average hourly carrying value of cargo ($2.41/hour). *Sources: FHWA Highway Economic Requirements System; Bureau of Labor Statistics National Compensation Survey, 2011*
Travel Time Reliability per Person Hour (Auto) or per Vehicle Hour (Truck) of Non-recurring Delay	**$16.03 [Auto]** **$26.24 [Truck]**	The valuation represents the additional traveler frustration and loss of regional productivity of experiencing non-expected incident related travel delays. The value is set equal to the value of in-vehicle travel time for autos and trucks. *Source: SHRP2 L05 Project – "Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes"*
Fatality Collisions *(valuation per fatality)*	**$4,590,000**	The valuation includes the internal costs to a fatality collision victim (and their family) resulting from the loss of life, as well as the external societal costs. The valuation represents: • Loss of life for the victims • Medical costs incurred in attempts to revive victims • Loss of enjoyment of family member to other members of the family • Loss of productivity to the family unit (e.g. loss of earnings) • Loss of productivity to society • Loss of societal investment in the victim (e.g. educational costs) *Sources: Caltrans Cal-BC Model, 2010; National Safety Council, 2010*
Injury Collisions *(valuation per injury)*	**$64,000**	The valuation includes the internal costs to an individual (and their family) resulting from the injury, as well as the external societal costs. The valuation represents: • Pain and inconvenience for the individuals • Pain and inconvenience for the other family members • Medical costs for injury treatment • Loss of productivity to the family unit (e.g. loss of earnings) • Loss of productivity to society *Sources: Caltrans Cal-BC Model, 2010; National Safety Council, 2010*

Benefit	Plan Bay Area Valuation ($2013)	What does this valuation include?
Property Damage Only (PDO) Collisions ***(valuation per incident)***	**$2,455**	The valuation includes the internal costs to a property damage collision victim (and their family) resulting from the time required to deal with the collision, as well as the external societal costs from this loss of time. The valuation represents: • Inconvenience to the individual and to other members of the family • Loss of productivity to the family unit • Loss of productivity to society *Source: Caltrans Cal-BC Model, 2010*
CO_2 per Metric Ton	**$55.35**	This valuation represents the full global social cost of an incremental unit (metric ton) of CO_2 emissions from the time of production to the damage it imposes over the whole of its time in the atmosphere. *Source: BAAQMD Clean Air Plan, 2010 (uprated to year 2035 using a 2% annual adjustment)*
Particulate Matter per Ton	**$490,300 [diesel $PM_{2.5}$]** **$487,200 [direct $PM_{2.5}$]**	These valuations represent the negative health effects of increased emissions including: • Loss of productive time (work & school) • Direct medical costs from avoiding or responding to adverse health effects (illness or death). • Pain, inconvenience, and anxiety that results from adverse effects (illness or death), or efforts to avoid or treat these effects • Loss of enjoyment and leisure time • Adverse effects on others resulting from their own adverse health effects *Source: BAAQMD Clean Air Plan, 2010*
NOx per Ton	**$7,800**	
ROG per Ton	**$5,700 [acetaldehyde]** **$12,800 [benzene]** **$32,200 [1,3-butadiene]** **$6,400 [formaldehyde]** **$5,100 [all other ROG]**	
SO_2 per Ton	**$40,500**	
Vehicle Operating Costs per Vehicle Mile Traveled (VMT)	**$0.2518 [Auto]** **$0.3700 [Truck]**	This valuation represents the variable costs (per mile) of operating a vehicle. This valuation includes fuel, maintenance, depreciation (mileage), and tires. *Source: Caltrans Cal-BC Model, 2010*
Noise per Vehicle Mile Traveled	**$0.0012 [Auto]** **$0.0150 [Truck]**	This valuation represents the value of property value decreases and societal cost of noise abatement. *Source: FHWA Federal Cost Allocation Report*
Costs of Physical Inactivity	**$1,220**	This valuation represents the savings achieved by influencing an insufficiently active adult to engage in moderate physical activity five or more days per week for at least 30 minutes. It reflects annual Bay Area health care cost savings of $326 (2006 dollars), as well as productivity savings of $717 (2006 dollars). *Source: California Center for Public Health Advocacy/ Chenoweth & Associates 2006, "The Economic Costs of Overweight, Obesity, and Physical Inactivity Among California Adults"*
Auto Ownership Costs per Vehicle (change in the number of autos)	**$6,290**	This valuation represents the annual ownership costs of vehicles, beyond the per mile operating costs. This valuation includes purchase/lease cost, maintenance, and finance charges. *Source: MTC Bay Area auto ownership analysis, 2011*