

4 EVALUATION CRITERIA

The purpose of this section is to define the evaluation criteria developed and used to evaluate alternative improvement measures. The methodology used to phase and prioritize the alternatives is described in Section 5. As discussed earlier in the report, the purpose and objective of the I-80/I-680/I-780 Major Investment and Corridor Study is to evaluate the existing and future transportation networks within the study corridors, and to develop a long range prioritization list of multi-modal improvements necessary to serve existing and future transportation needs.

4.1 Evaluation Methodology Overview

Based on input from local agencies, the STA, Caltrans and the study's Project Development Team (PDT), a list of evaluation criteria was developed. These criteria were then used to evaluate the alternatives relative to one another, so that the improvement recommendations developed could be ranked and prioritized. The following nine performance measures were developed and applied for the alternative improvement recommendations.

1. Traffic Operations including Link Volume/Capacity Ratio, Levels of Service, Bottlenecks, Queuing and Vehicle Delay;
2. Safety;
3. High Occupancy Vehicles (HOV) Lane Performance;
4. Preliminary Right-of-Way (ROW) Requirements;
5. Preliminary Environmental Constraints;
6. Order of Magnitude Costs;
7. Complement Transit Plan;
8. Compliance with Engineering Standards; and
9. User Benefit.

These criteria provide a relative indication of mobility, traffic operational characteristics, impacts, benefits and costs for each alternative.

4.2 Description of Criteria

The nine evaluation criteria are described in detail in this section.

4.2.1 Traffic Operations

The ability of each alternative to accommodate existing and future traffic levels was evaluated. Two levels of traffic operations analysis were conducted. First, as a baseline analysis to assist in the initial development of alternative improvement measures, volume to capacity ratios and levels of service on critical links were calculated using the "unconstrained" forecasts of the Solano County Travel Demand Model. This analysis was conducted for the years 2010, 2020 and 2030.

In addition to the unconstrained evaluation of baseline traffic conditions, a more detailed

evaluation of “constrained” conditions throughout the study corridors was conducted. The constrained analysis identified the following performance characteristics for each alternative:

- Freeway bottleneck sections;
- Length of queue upstream of each bottleneck;
- Vehicle delay associated with each bottleneck;
- HOV time savings, wherever applicable; and
- Queuing on ramps and freeway-to-freeway connectors.

This analysis was first conducted for the years 2010, 2020 and 2030 assuming the implementation of no improvement measures. The analysis was then refined through the development, evaluation and prioritization of mainline improvement measures to iteratively predict delays, queues and bottlenecks in different time horizons under different geometric scenarios as the improvement measures are implemented in their identified order of priority.

4.2.1.1 Bottlenecks

The constrained traffic operations analysis takes into account the constraining effects of existing and future bottlenecks through the study corridors. Where capacity constraints are found to exist, downstream travel demand is adjusted downwards accordingly. Figure 4-1 presents an example of this type of constrained bottleneck analysis. In Figure 4-1, demand on a hypothetical section, in this case 8,900 vehicles per hour, exceeds capacity (8,000 vehicles per hour) by 900 vehicles per hour. In the constrained analysis, these 900 vehicles are stored at the bottleneck location and subtracted proportionately from downstream sections. For each bottleneck, the number of stored vehicles, delay and queue lengths are calculated.

4.2.1.2 Delay

For each identified bottleneck, the amount of vehicular delay is calculated using the following formula:

$$\text{Total Bottleneck Delay} = (\text{Stored Vehicles} \times 60) / \text{Capacity}$$

4.2.1.3 Queues

The length of vehicular queues upstream of the identified bottlenecks has been calculated based on the ratio of speeds and volume/capacity ratios (V/C) on upstream sections. Figure 4-2 presents the relationship of V/C ratio to travel speeds on typical California freeways.

A typical California freeway lane has a maximum capacity of approximately 2,000 vehicles per hour. The amount of traffic served on a segment of freeway is dependent on travel speeds and travel demands. When demands exceed capacity, queues form, speeds slow and the operation of the freeway section is constrained. When demands are less than capacity, a freeway section operates in an unconstrained manner. The top

half of the curve presented in Figure 4-2 illustrates an unconstrained operation, while the bottom half illustrates a constrained operation, where demands exceed capacity.

In an unconstrained condition when a segment's V/C is smaller than 0.2 (point A on Figure 4-2), vehicles can travel at the 60 mph speed limit assumed in this instance. When an unconstrained section's V/C increases to 0.8 (point B), the average speed reduces to approximately 55 mph. When a freeway reaches its maximum capacity (V/C = 1, point C), the average speed reduces further to approximately 40 mph. With the presence of a downstream bottleneck, vehicle speeds are limited and queues are formed. In these areas of queue, speeds decrease, as does the section's throughput. At point D on Figure 4-2, for example, average vehicle speeds are reduced to 14 mph. Due to the slow travel speeds and stop-and-go traffic, only 1,200 vehicles per hour can travel through this segment instead of the 2,000 that the lane will ideally accommodate when demand is less than capacity. As demand begins to exceed capacity, speeds slow and fewer vehicles can travel through the section, resulting in backups, or queues. Thus, while the unconstrained demand in the section can exceed capacity (i.e. v/c greater than 1.0), from an operational perspective, a section's throughput can never actually exceed its capacity.

Table 4-1 illustrates the relationship between section speeds (as determined by V/C ratio) and throughput.

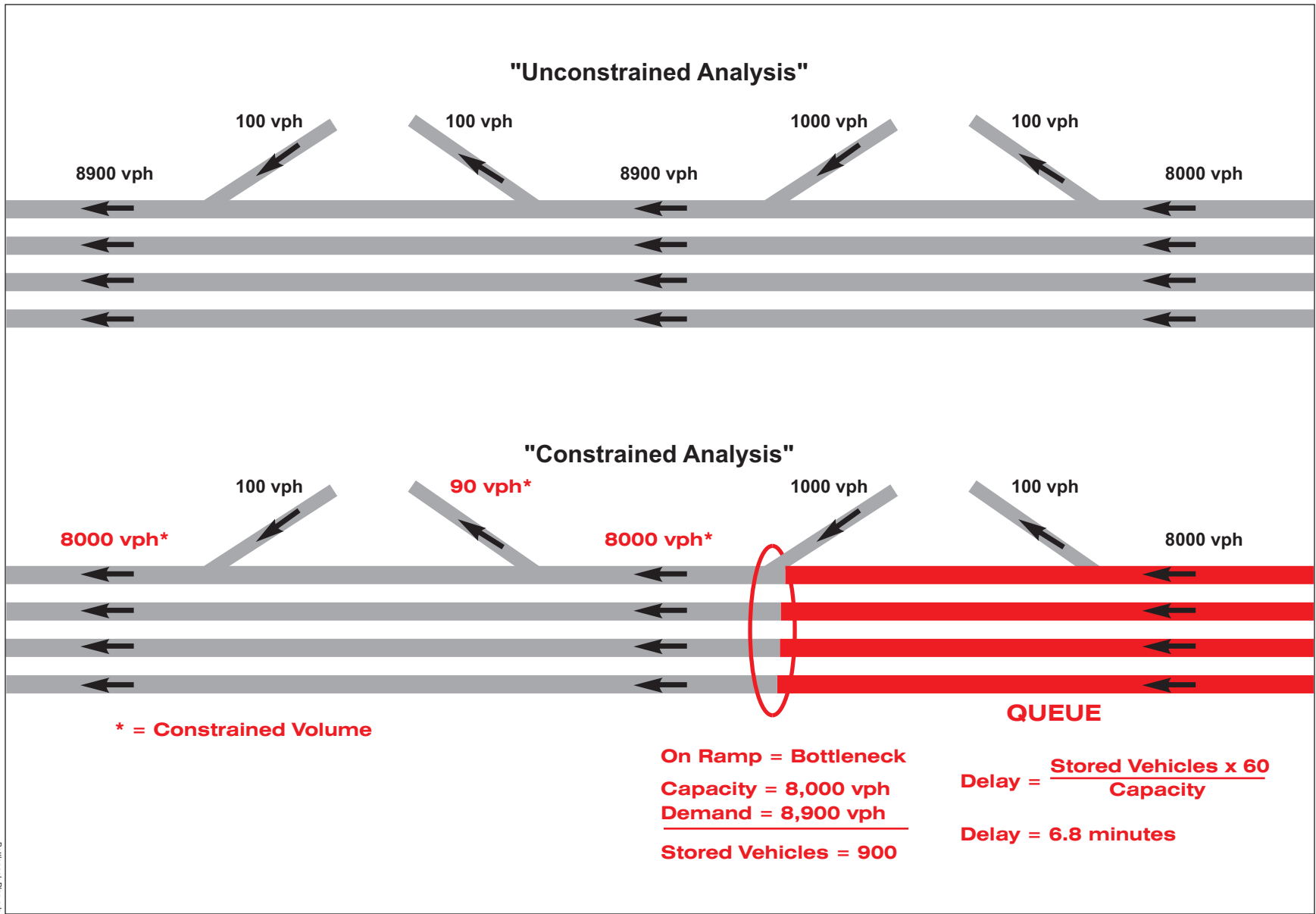
Table 4-1 Speed, V/C and Throughput Relationship

Speed (mph)	V/C	Vehicles Per Hour	Reference Point on Figure 4-1
UNCONSTRAINED – AREAS WITHOUT QUEUE			
59	0.2	400	A
58	0.4	800	
57	0.6	1,200	
55	0.8	1,600	B
54	0.9	1,800	
39-44	1	2,000	C
CONSTRAINED – AREAS IN QUEUE			
25	(Demand > 1.0) Actual = 0.9	1,800	
19	(Demand > 1.0) Actual = 0.8	1,600	
11	(Demand > 1.0) Actual = 0.6	1,200	D
5	(Demand > 1.0) Actual = 0.4	800	
2.5	(Demand > 1.0) Actual = 0.2	400	

For each section (distance between consecutive ramps) of freeway, upstream of an identified bottleneck, the volume to capacity ratio is calculated. Using Figure 4-2, the speed on that section is then identified. Based on the speed achieved in the section of upstream bottleneck, the amount of vehicular delay experienced in the section is calculated. The amount of delay utilized in a given section is calculated through the following equation:

$$\text{Delay (minute/mile)} = (60/\text{Section Speed}) - (60/\text{Freelflow Speed})$$

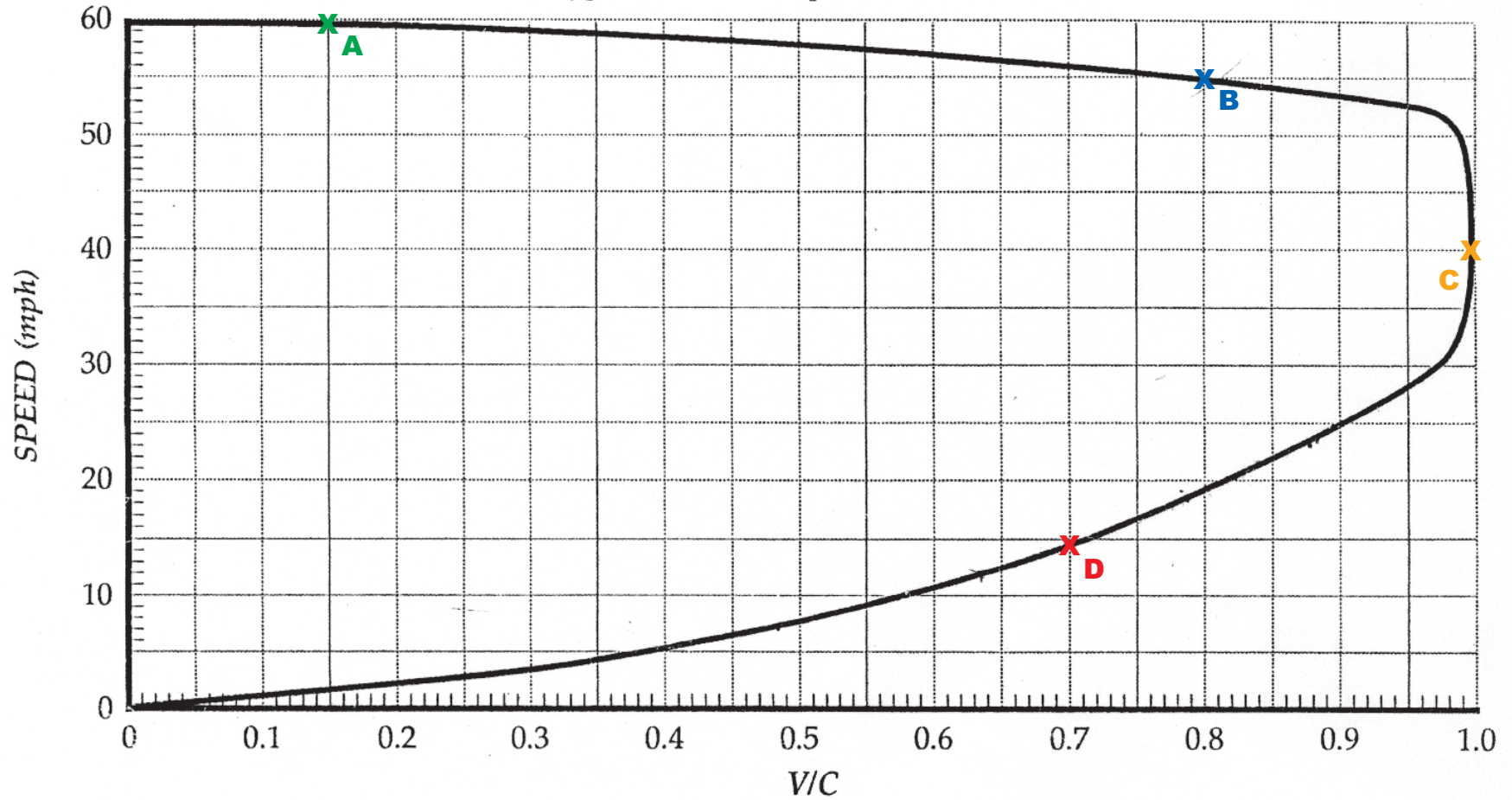
The delay experienced in each section upstream of the bottleneck is calculated. The point where all of the delay has been utilized represents the back of the queue in question, or the total length of the queue from the bottleneck.



Bottleneck Plan.ctb

Figure 4-1
EXAMPLE OF BOTTLENECK CONSTRAINT
4 Lane Freeway Section

SPEED-FLOW RELATIONSHIP (Typical California Operation)



Source: Caltrans District 4, Office of Highway Operations

I-80 / I-680 / I-780 MIS / CORRIDOR STUDY

Figure 4-2

SPEED-FLOW RELATIONSHIP

4.2.2 Safety

Each alternative's impact on vehicular safety was qualitatively identified. The degree to which each alternative would resolve an existing safety issue or problem was identified. If an improvement was specifically designed to remedy existing substandard geometry, it was identified as having a safety improvement. If an improvement, designed to industry engineering design standards, was developed to increase mainline capacity, or remedy an existing traffic operational problem, it was identified as having no effect on safety. No alternatives are proposed that would present a safety problem or concern.

4.2.3 HOV Lane Performance

The operational performance and effectiveness of HOV lanes was evaluated for those alternatives which include the development of an HOV lane. The two primary measures of HOV lane performance evaluated were HOV lane usage (i.e. number of HOVs) and travel time savings.

4.2.3.1 Travel Forecast Model

As described in Section 3, the travel demand forecasts used for the evaluation of HOV lanes are based on year 2030 traffic projections from the Napa/Solano County travel model. The Napa/Solano County travel model does not separately account for HOV vehicles. Therefore, the model was modified, specifically for this study, to provide separate projections for vehicles with one occupant, two occupants, or three or more occupants, as well as trucks.

4.2.3.2 Road Network Coding

The model road network was modified to include separate coding of HOV lanes. Freeway HOV lanes were coded the same as freeways, but a code was added to identify whether they are restricted to 2-person or 3+-person carpools. Additional network segments were added to connect the HOV lanes to the mixed-flow lanes. These connectors were coded between freeway interchanges, to account for the distance that was required to merge into or out of HOV lanes. This coding procedure also ensured that the model would not allow vehicles to use the HOV lane to travel between adjacent freeway interchanges.

4.2.3.3 HOV Demand

Two sources were used to estimate the initial HOV demand. The first source was the regional travel model maintained by the Metropolitan Transportation Commission (MTC). The second source is vehicle occupancy counts conducted in the year 2001 for the Solano County Comprehensive Transportation Plan. These counts are summarized in Section 2. The MTC travel model includes separate vehicle trip estimates for single occupant vehicles, 2-person vehicles, 3+-person vehicles and trucks.

The MTC a.m. peak period projections for the year 2025 were obtained from the forecasts conducted for the most recent Regional Transportation Plan. These trips were

compressed to the nine Bay Area counties plus major gateways to the Bay Area (such as I-80 at the Yolo County line). Percentages of vehicle trips were calculated for each of the four vehicle types and for each county-to-county or gateway-to-county combination. The following regional default values were used for any combination where projections were not available:

Single occupant:	87%
2-person carpool:	10%
3+-person carpool:	3%
Trucks:	<1%

The vehicle split factors were then applied to the Solano County model year 2030 a.m. peak hour trip forecasts. The reverse-direction factors were applied to the Solano County model year 2030 p.m. peak hour trips. For example, the MTC a.m. vehicle split factors for trips from Solano County to San Francisco County were applied to the Solano County model a.m. trips from Solano County to San Francisco County and the Solano County model p.m. trips from San Francisco County to Solano County.

The resulting trips were assigned to the road network and the vehicle occupancy splits were compared to the counts conducted in 2001. Additional adjustments were necessary to bring the vehicle occupancy splits derived from MTC closer to the observed counts. Three iterations of adjustments were used on key corridors within Solano County. Table 4-2 shows the resulting HOV percentages at selected points on the study corridor.

Table 4-2 HOV Percentages in the Study Corridor

Peak Hour	Direction	Traffic Counts (2001)			Revised Solano County Model (2030)		
		2 Person	3+ Person	Total	2 Person	3+ Person	Total
<i>I-80 at Meridian Rd.</i>							
AM	EB	15	2	17	17	4	21
	WB	12	3	15	15	3	18
PM	EB	20	3	23	19	3	22
	WB	20	5	25	21	4	25
<i>I-80 at Suisun Valley</i>							
AM	EB	16	4	20	15	4	19
	WB	17	3	20	14	4	18
PM	EB	18	6	24	19	4	23
	WB	14	7	21	22	5	27
<i>I-80 at Magazine Street</i>							
AM	EB	16	5	21	20	5	25
	WB	15	4	19	17	5	22
PM	EB	22	6	28	24	6	30
	WB	20	5	25	25	6	31
<i>SR 12 at Red Top Rd.</i>							
AM	EB	11	1	12	11	2	13
	WB	16	5	21	16	3	19
PM	EB	19	6	25	21	3	24
	WB	23	5	28	21	3	24
<i>SR 29 at Magazine Street</i>							
AM	NB	20	4	24	17	5	22
	SB	21	9	30	18	5	23
PM	NB	25	9	34	25	5	30
	SB	25	3	28	21	6	27

Source: MTC Regional Travel Model; STA vehicle occupancy counts collected by FPA (2001).

4.2.3.4 HOV Assignment

The version of the software used for the Solano County travel model (TRANPLAN) does not fully support the assignment of multiple vehicle types using different road segments such as HOV lanes. For this study, the traffic assignment process from the model was converted to a different software (TP+). By setting parameters to be the same as the Solano County model, the TP+ assignment could closely match the 2030 forecasts produced by the original Solano County model.

The assignment procedure was then modified to allow for the full analysis of HOV lanes. The single occupant and truck vehicles were prohibited from using designated HOV lanes and connectors. In addition, the assumed lane capacities were adjusted from the Solano County model assumption of 75 percent of full capacity to 100 percent of capacity in order to allow maximum use of the HOV lanes. With these modifications, the travel model did not fully replicate the original Solano County model results, but provided more information on potential HOV lane usage.

By comparing the year 2030 forecasts from a roadway network model without proposed HOV projects to the one with proposed projects, the effectiveness of these projects was evaluated in terms of the likely magnitude of usage, and the travel time savings for both vehicles and total persons.

4.2.4 Preliminary Right-of-Way Requirements

Right-of-way requirements and estimates of right-of-way costs were prepared at a preliminary level for each alternative. Alternatives which require a relatively high amount of right of way, or a relatively high amount of sensitive right of way, are identified as having a “high” relative cost/“low” relative benefit under this evaluation criterion. For the purposes of this analysis, the acquisition of unencumbered right of way is treated as being less impactful than encumbered right of way (i.e. taking a home or business is treated as a greater impact than the taking of an empty field). Alternatives which require relatively small amounts of right of way are identified as having a “low” relative cost/“high” relative benefit.

It should also be noted that land use impacts are also evaluated in detail as part of the Environmental Constraint analysis presented in Section 4.2.5 below.

4.2.5 Preliminary Environmental Constraints

Widening of freeways or construction of new facilities may have effects on the adjacent environment. The degree of environmental constraints may cause some alternatives to be fatally flawed or require extensive mitigation. The environmental screening analysis provides a discussion of planning considerations including land use, general plan and zoning designations and applicable policies, and a brief overview of potential environmental constraints associated with each of the alternatives. Specifically, the alternatives are relatively evaluated for the following areas of environmental concern:

- Land Use Displacement;
- Biological Resources;

- Visual Resources;
- Construction Noise; and
- Air Quality.

Information has been compiled based on field reconnaissance, review of existing planning and environmental documents obtained from local jurisdictions, and consultation with planning and public works staff from Benicia, Dixon, Fairfield, Vacaville and Solano County.

4.2.6 Order of Magnitude Costs

4.2.6.1 Introduction

The purpose of cost estimating during the Major Investment Study phase is to determine the order-of-magnitude capital costs for proposed improvements and to compare costs between alternatives. This is essential for determining the fiscal requirements for a project, performing cost-effectiveness analyses and for project financial planning.

Capital cost estimates have been prepared using Caltrans' standard Preliminary Engineering Estimate format which estimates roadway, structure and right-of-way costs. The estimate accounts for major items which are easily identified through field observations and review of as-built drawings. Costs for right-of-way and land use takes are estimated separately. All costs are expressed in current year dollars, and unit costs have been developed using recent data from similar projects.

Quantities have been determined for major construction bid items, since typically the largest 20 percent of the bid items determine 80 percent of project cost. After quantities are prepared for the major bid items, the remaining construction items are estimated by applying percentages for minor work construction based on observed historical percentages of the major work.

4.2.6.2 Assumptions and Basis of Estimates

The following assumptions have been used to prepare the construction cost estimates:

- Except where noted, all highway improvements comply with Caltrans standards and local interchange improvement projects comply with jurisdiction requirements.
- A Traffic Management Plan is necessary for each project.
- Culvert extensions are included as part of project drainage and are within the LS value.
- Relocation or protection of underground utilities is identified by the vicinity of the area outside the Caltrans right-of-way and, if necessary, is included with a LS value.
- Right-of-way estimates are based on the approximate area required for the proposed improvements. All structure/land use costs are based on the latest available information regarding real estate values in the area affected.

Table 4-3 summarizes the basic roadway improvement assumptions, all of which are consistent with Caltrans standard plans.

Table 4-3 Roadway Element Summary

Roadway Elements	Dimensions
Lane Width (typical for freeway and local roads)	3.6 m (12-feet)
Inside*/Outside Shoulder Width (for freeway)	3.0 m (10-feet)
Outside Shoulder Width (for ramps)	2.4 m (8-feet)
Inside Shoulder Width (for ramps)	1.2 m (4-feet)
Bridge or Creek Crossing Width	Lane Widths + Shoulders + Railings
Local Roads' Shoulder	2.4 m (8-feet)
Side Slope	2:1 maximum

* Only as applicable. Exemptions are sometimes made due to spatial constraints.

Source: *Standard Plans*, Caltrans, July 1999

4.2.6.3 Unit Costs

Unit prices have been compiled from previous engineers' estimates, completed projects, standard estimating manuals and an application of standard estimating practices. The unit costs include contractor or supplier mark-ups for overhead, risk and insurance, profit, mobilization/demobilization, traffic control and cost allocations for utility relocation, as appropriate. The following is a description of these items, which historically represent 75-85 percent of the total project costs for the types of improvements under consideration:

- Clearing & grubbing – includes removal and disposal of materials (such as trees, rocks, etc.).
- Roadway excavation – includes excavation, placement of embankment, and compaction and hauling costs.
- Imported borrow – includes soils trucked to the site, placed in embankment and compacted.
- Edge drains – unit cost includes trench excavation, installation of edge drain and backfill. This cost is used for ramp or freeway improvements.
- Pavement section – includes placement and compaction of asphalt concrete surface, aggregate base and sub-base coarse on roadway, shoulders and multipurpose paths.
- Drainage facilities – unit cost includes trench excavation, installation of culverts or special drainage features. Unit cost varies by culvert size.
- Storm drains – unit cost includes trench excavation, installation of culverts and backfill.
- Pumping plants – required when tunnel structure is proposed.
- Project drainage – included for any special feature, such as a new creek crossing that requires special attention. The cost of the new crossing is included as part of structural costs.
- Retaining walls/sound walls – retaining/sound wall costs include structural excavation, foundation, wall and railings. All retaining walls are assumed to have an average height of 3m.
- Barriers and guard rails - cost of installing three-beam guard rail including posts and rail according to Caltrans HDM requirements.
- Temporary railings - cost of installing temporary railing when required.

- Erosion control – unit cost includes straw or seeding of disturbed ground to limits of grading.
- Curb & gutter – includes all necessary appurtenances, material and labor required to construct curb and gutter, such as aggregate, Portland cement concrete, form work, etc.
- AC dike – includes all necessary appurtenances, material and labor required to construct AC dike, such as aggregate, Portland cement concrete, form work, etc. This item is installed where new ramps are proposed.
- Bridge demolition – includes all material, labor and equipment cost to demolish existing bridges. Temporary structures are included under a separate cost under the structural cost section.
- Lighting allowance – usually included if the project is located near commercial or residential areas where pedestrian traffic is expected.
- Overhead sign structure – typical for all new construction of ramps or auxiliary lanes in order to direct traffic appropriately.
- Traffic Delineation – cost of temporary traffic control during construction.
- Signing & striping – unit cost includes centerline, lane and edge lines, post(s) and panel(s) for one or two post installations.
- Temporary traffic control - providing temporary facilities and controls, which includes traffic control, temporary utility facilities and protection and maintenance of existing utilities. Traffic control includes flaggers and construction area signs required for traffic control during construction of the roadway. It also includes placing, removing, storing, maintaining, moving to new locations, replacing and disposing of the components of the traffic control system. Construction area signs required for the direction of public traffic through and around the work will also be furnished.
- Traffic signal – traffic signal costs include signal heads, mast arms, poles, induction loops, interconnection and controllers. Traffic signals are estimated on a case-by-case basis.
- Traffic management plan – cost for handling traffic during construction. Includes cost of planning and meeting with local and state agencies.
- Structural cost (bridges or creek crossings) – bridge costs include structural excavation, foundation, abutments, piers, decks and railings.
- Right-of-way acquisition – right-of-way costs include the capital costs for securing and providing all the property rights required for implementation of the project. These include acquisition of property in fee or easement, damages to remnant parcels and relocation costs. Services to secure the right-of-way and contingency factors for right-of-way are included as a multiplier to the right-of-way costs.

Right-of-way is measured by area (square meter) at a parcel-by-parcel level, based on the proposed right-of-way and easement lines indicated on the conceptual plans for the project. Rates for right-of-way are derived from the best available local data, such as sales and comparable acquisitions. The source of this information is local real estate title companies, real estate professionals, and local appraisers. In addition to right-of-way cost estimates, relocation costs are also determined for occupied parcels.

Table 4-4 summarizes the unit cost for each of the items described above.

Table 4-4 Unit Costs of Construction Elements

Line item:	Unit	Unit Cost
Clearing and Grubbing	ha	\$10,000.00
Roadway Excavation:	m	
▪ 1 Lane Freeway (with shoulder)		\$80.00
▪ Additional Lane Freeway (no shoulder)		\$45.00
▪ 1 Lane Ramp (with shoulders)		\$80.00
▪ Additional Lane Ramp (no shoulder)		\$40.00
▪ 2 Lane Local Road		\$70.00
▪ Additional Lane (Local Road)		\$30.00
Imported Borrow	m ³	\$30.00
Edge Drains	m	\$180.00
Pavement Sections:	m	
▪ 1 Lane Freeway (with shoulder)		\$345.00
▪ Additional Lane Freeway (no shoulder)		\$180.00
▪ 1 Lane Ramp (with shoulders)		\$400.00
▪ Additional Lane Ramp (no shoulder)		\$220.00
▪ 2 Lane Local Road		\$330.00
▪ Additional Lane (Local Road)		\$165.00
Drainage Facilities	LS	Varies
Storm Drains	m	\$200.00
Pumping Plants	LS	Varies
Project Drainage	LS	Varies
Retaining Wall/Sound Wall	m	\$2,400.00
Barriers & Guardrails	m	\$120.00
Temporary Railing	m	\$30.00
Erosion Control	m	\$60.00
Curb and Gutter	m	\$260.00
AC Dike	m	\$15.00
Bridge Demolition	m ²	\$1000.00
Lighting Allowance	LS	varies
Overhead Sign Structure	EA	\$50,000.00
Traffic Delineation	m	\$15.00
Signing and Striping:	m	
▪ 1 Lane Freeway (with shoulder)		\$10
▪ Additional Lane Freeway (no shoulder)		\$5
▪ 1 Lane Ramp (with shoulders)		\$10
▪ Additional Lane Ramp (no shoulder)		\$5
▪ 2 Lane Local Road		\$10
▪ Additional Lane (Local Road)		\$5
Temporary Traffic Control	LS	varies
Traffic Signal	EA	\$150,000.00
Traffic Management Plan	LS	varies
Structural Bridge:	m ²	
▪ Over-crossing Structure		\$1,600.00-\$2,400.00
▪ Viaduct Structure & HOV Connector		\$3,000.00
▪ Creek Crossing		\$1,400.00-\$1,600.00
▪ Tunnel Structure		\$4,500.00
Right-of Way (general for Solano County)	m ²	\$65-\$216.00

Source: 2002 Caltrans Contract Cost Data, recalculated by Korve Engineering

4.2.6.4 Contingencies

The project contingency allowance includes items and conditions which cannot be assessed at the time of the cost estimate due to the level of completeness of the design. Contingency allowances are needed to account for items not covered in the conceptual design phase. The contingency reflects the degree of risk associated with the level of design detail available and the characteristics of the specific design element. Contingency allowances are applied to roadway cost subtotals, structural subtotals and right-of-way subtotals.

Roadway Design Contingency

A roadway design contingency of 35 percent is applied to the subtotal cost for roadways. This is added to the cost of minor items, roadway mobilization and supplemental work covered under the Caltrans Standard Estimating format.

Structural Design Contingency

The Structural Design Contingency for bridges is 25 percent.

Right-of-Way Cost Contingency

A contingency factor is also applied to right-of-way costs to ensure that sufficient funds are identified to secure the necessary right-of-way. The following three items are added to the base right-of-way estimate to arrive at a final cost figure.

- A Damage Allowance to provide for compensation for damages which might occur in the event that a relatively small area of land acquisition is necessary, but the impact to the remainder of the parcel is felt to be high by the property owner. The Damage Allowance is 20 percent of the partial parcel cost.
- A Negotiation Allowance is applied to reflect the cost of right-of-way as consecutive parcels enter into negotiation. If a high acquisition price is successfully negotiated by a property owner early on, subsequent property owners may use that value to increase their compensation. The Damage Allowance is 20 percent of the partial parcel cost.
- A Condemnation Allowance provides for professional condemnation proceedings for right-of-way acquisition. The allowance is 20 percent for each parcel.

The total right-of-way allowance described above is 60 percent, which is applied to the estimated cost of the project right-of-way. The following items are also applied to the cost of right-of-way. These elements in combination result in a 40 percent add-on.

- Right-of-way engineering;
- Right-of-way agent staff time; and
- Right-of-way appraisal.

The total right-of-way allowance results in a multiplier of 2. This multiplier is applied to small, partial takes. For large, complete takes the multiplier is reduced to 1.5.

4.2.6.5 Project Development Costs

Project development costs include those costs that agencies must fund to complete the design and approval process and manage project work. Project development costs are divided into two categories. The first category is for funds set aside for unknown risks. These include environmental mitigation, construction change orders and project reserves.

Environmental Mitigation Allowance

The Environmental Mitigation Allowance is the cost for new roadway projects associated with the costs of environmental documentation and public review. An estimated mitigation is made for each alternative based on an assessment of the known environmental impact.

Construction Change Order

The Construction Change Order Contingency includes funds for unknown risks that will occur during construction. These risks include delays by the owner, weather delays, hazardous material discoveries and archeological discoveries. The construction change order contingency is 6 percent of the construction cost.

Project Reserve

Project reserves include funds for unforeseen site conditions, buried obstructions, hazardous material discoveries and archeological discoveries. The project reserve is 7 percent of the construction cost.

The second category of project development costs is for design engineering, construction management, agency costs, environmental documentation and project management. The allowances for these activities are shown in Table 4-5.

Table 4-5 Engineering and Project Management Costs

Design Engineering	10%
Construction Management	8%
Agency Costs	3%
Environmental Documentation	3%
Project Management	3%
Subtotal Project Development Costs	27%

Source: 2002 Caltrans Contract Cost Data, recalculated by Korve Engineering

4.2.6.6 Construction Change Order Contingency

As noted above, the design contingency percentage decreases as the project design detail increases. The capital cost estimate for a contract package can then be compared to contractors' bids. However a construction contingency will also be needed for change orders during construction. A Construction Change Order Contingency of 6 percent is applied to the project cost estimate at the final design stage to account for cost items outside of the normal bid package. The Change Order Contingency is included as part of the cost multiplier applied to the Construction Subtotal.

4.2.7 Complement Transit Plan

Alternatives which complement transit plans within the study corridor are rated as having a “high” relative benefit under this evaluation criterion. Alternatives which offer the greatest complement to the movement of transit through the study corridors include park and ride and HOV lane improvements.

4.2.8 Compliance with Standards

Preliminary designs and cost estimates have been prepared for each of the alternatives. In the great majority of instances, the proposed alternatives were designed in compliance with the latest standards of the Caltrans *Highway Design Manual, Fifth Edition*. However, due to site constraints, some design standards could not be met for some projects. The required design exceptions in these cases are discussed and identified under this evaluation criterion. Alternatives which require design exceptions are identified as having “low” relative benefit under this category of evaluation.

4.2.9 User Benefit

An alternative’s “user benefit” is the sum of the travel times of each trip in the model as compared to the baseline alternative. When the travel time benefit of each alternative is known, a standard time value can be applied to calculate the monetary benefit of each alternative. By comparing the monetary benefit with the cost estimated based on the method described in Section 4.2.6, numerical benefit/cost ratios for proposed projects were calculated. Since the travel demand model cannot accurately predict the relative benefits of smaller local improvement projects, the user benefit calculation was only applied to larger projects with regional travel demand significance.

User benefits of transportation projects were calculated based on daily and annual time and cost savings for persons and goods movement and by using the procedures established by Metropolitan Transportation Commission for the 2001 RTP. Average values of time were used to convert travel time savings to cost savings. User benefits were calculated for all road segments that are represented in the Solano County travel model. The user benefit calculations were based on the travel demand model results, and did not include the potential additional HOV lanes that would be projected using the Federal Highway Administration (FHWA) methodology.

4.2.9.1 Person-Hours of Travel

The peak period person-hours of travel for each project were estimated by multiplying the persons on each road segment by the peak hour congested time on the segment. The persons on each road segment were calculated as the sum of single occupant vehicles plus two-person vehicles multiplied by 2 plus three-plus person vehicles multiplied by an assumed average occupancy of 3.5. The congested times on each road segment were calculated based on the ratio of projected volume to segment capacity (V/C). The Solano County travel model has defined a volume-delay function for each major type of road: freeways, highways and local streets. The functions are based on data presented in the *Highway Capacity Manual*.

The benefits of improvement projects are expected to extend beyond the a.m. and p.m. peak hour. The duration of peak conditions on each road segment was estimated using procedures established for the Santa Clara County Valley Transportation Plan 2020. The Santa Clara Valley Transportation Authority (VTA) collects data on traffic volumes, congested speeds and duration of congestion on all freeways in the county. VTA data were used to estimate duration of congestion as follows:

- If $V/C < 1.07$ Duration = 1.0 hours.
- If $1.07 < V/C < 1.20$ Duration = $(V/C * 25.8) - 26.8$.
- If $V/C > 1.20$ Duration = 4.0 hours.

The congested travel times on each segment were assumed to apply to the vehicles and persons that would travel through the segment during the entire duration of congested conditions.

4.2.9.2 Goods Movement

The benefits of each project on goods movement were calculated based on the time savings for trucks. The total truck hours of travel were calculated by summing the truck volume on each segment multiplied by the congested travel time for the segment.

4.2.9.3 Bus Travel

Improvement projects that include HOV lanes or direct HOV connectors can provide significant time savings for bus transit passengers. Projected peak hour bus volumes were provided from the Transit Corridor Study performed by Wilbur Smith and Associates. It was assumed that these bus volumes would benefit from reductions in congestion for two hours during the morning commute and two hours during the evening commute. An average bus ridership of 20 passengers per vehicle was assumed for the benefit calculation. The total benefits were calculated by multiplying the bus passengers in each corridor times the travel time savings associated with each improvement project.

4.2.9.4 Value of Time

The benefit calculations used in the MTC model assume the following values of time:

- Person Hours – \$17.03 per hour (75% of average wage of \$22.71).
- Truck Hours – \$80.00 per hour.

Annual benefits were calculated as 300 times average weekday benefits. By adding up the monetary values of time-savings for all users derived from each project, the user benefits of different projects can be compared directly.

4.2.10 Prioritization Based on Criteria

The screening analysis based on the above performance measures provided a rationale for prioritizing the most promising options. Efforts were made to develop quantitative information to support as much of the evaluation as is feasible, given the level of detail

involved with some of the evaluation criteria. Sections 6 and 7 detail the alternatives evaluation and prioritization process and results.

4.3 Public Participation

Three levels of public participation occurred throughout the development of this Corridor Study. First, at project initiation, public scoping meetings were held to allow County residents to comment on the study scope and approach. Secondly, monthly Working Group and Project Development Team meetings were held with local decision makers. In addition, the project's scope, progress and recommendations were presented and discussed at a number of STA Board meetings throughout the course of the study.

4.3.1 Public Outreach

Public outreach meetings were held at the project initiation to allow the public to provide input to the study scope and process. Three public meetings were conducted to introduce the study to the public and gain input to the scope and approach. These meetings were as follows:

1. City of Dixon – June 27, 2002;
2. City of Vacaville – July 17, 2002; and
3. City of Fairfield – July 23, 2002.

A presentation was prepared by the project team and presented at the public meeting. The presentation covered the following issues:

- Study Scope of Work;
- Study Goals;
- Study Process;
- Background and Existing Conditions;
- Corridor Operational Issues;
- Study Schedule; and
- Next Steps.

In April and May 2004, presentations were made to update decision makers on the Corridor Study's draft recommendations and findings. These presentations included updates with the following bodies:

- Benicia City Council;
- Dixon City Council;
- Fairfield City Council;
- Rio Vista City Council;
- Solano County Board of Supervisors;
- STA Board;
- Suisun City Council;
- Vacaville City Council; and
- Vallejo City Council.

4.3.2 Working Group/PDT Meetings

A study Working Group and Project Development Team (PDT) were formed to review project work products and guide the direction of the MIS. These two committees met once a month throughout the course of the project. Representatives of the following jurisdictions were included in the Working Group:

- City of Benicia;
- City of Dixon;
- City of Fairfield;
- County of Solano;
- STA;
- City of Vacaville; and
- City of Vallejo.

In addition to the study Working Group, a Project Development Team (PDT) was formed and met once a month throughout the course of the study. The PDT included representatives from the following agencies:

- Caltrans District 4 Division of Transportation Planning and Local Assistance;
- Caltrans District 4 Division of Operations;
- Caltrans District 4 Division of Design, North Counties; and
- Solano Transportation Authority.