12 January 2006

SR 520 Bridge Replacement and HOV Project Draft EIS

6-Lane Alternative Options

Addendum to Energy Discipline Report

Washington State Department of Transportation

SoundTransit

U.S. Department of Transportation Federal Highway Administration

SR 520 Bridge Replacement and HOV Project EIS

6-Lane Alternative Options

Addendum to Energy Discipline Report

Prepared for

Washington State Department of Transportation

Federal Highway Administration

Sound Transit

Lead Author

CH2M HILL

Consultant Team

Parametrix, Inc.

CH2M HILL

Parsons Brinckerhoff

Michael Minor and Associates

January 12, 2006

Contents

List of Exhibits

Acronyms and Abbreviations

MBtus	million British thermal units
mph	miles per hour
mpg	miles per gallon
VMT	vehicle miles traveled

Introduction

This addendum to the *Energy Discipline Report* (CH2M HILL 2005; Appendix F to the Draft Environmental Impact Statement [Draft EIS]) describes the affected environment and environmental consequences of the three options to the 6-Lane Alternative. Two of these options are in Seattle and one is on the Eastside.

What are the key points of this addendum?

Based on data provided in the *Addendum to the Transportation Discipline Report*, operation of each 6-Lane Alternative option would consume less energy than the 2030 No Build Alternative, assuming that tolls would be charged for the build alternatives. Tolls are expected to result in fewer vehicle trips on SR 520 compared to the No Build Alternative.

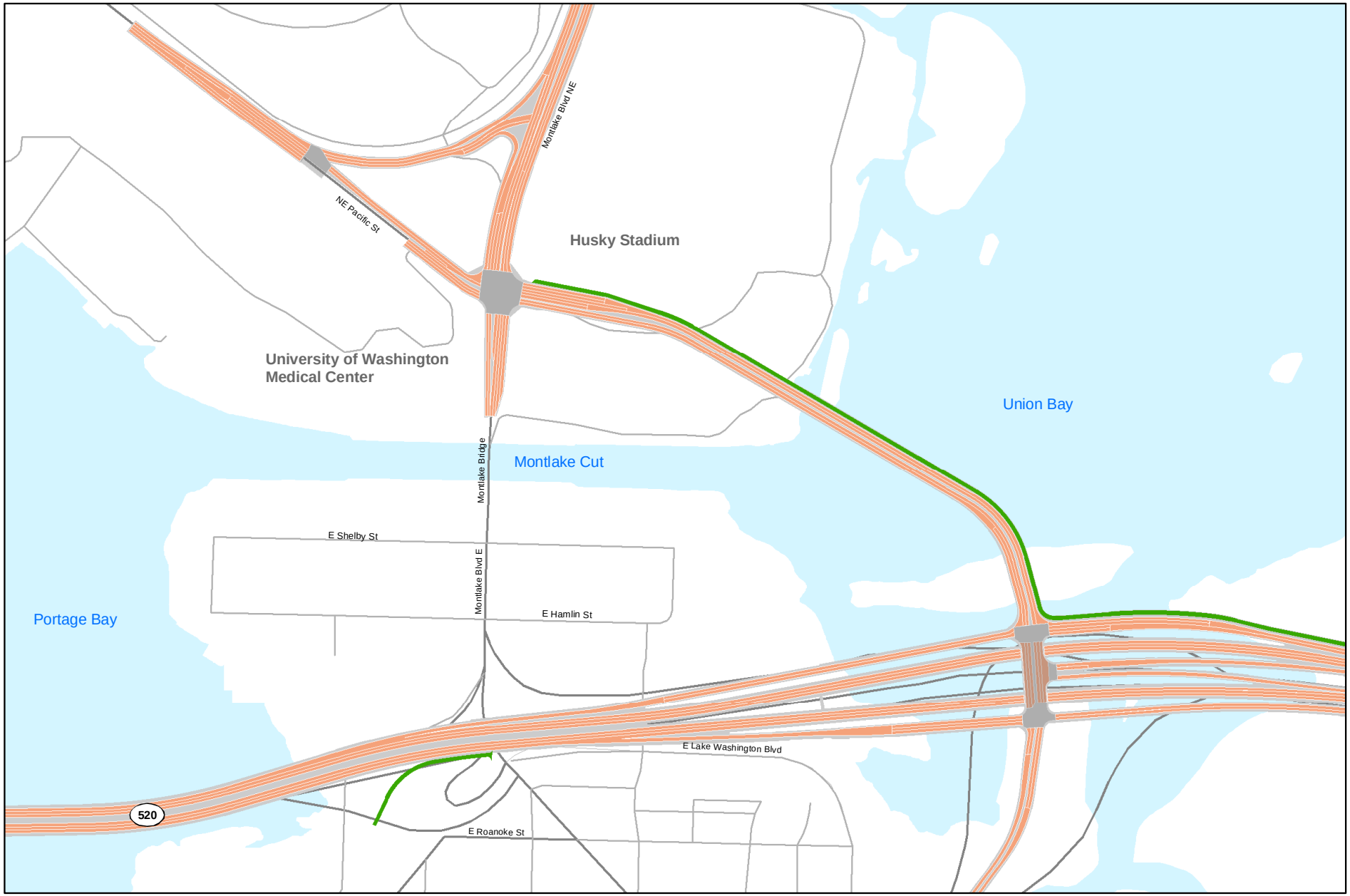
Based on revised construction cost estimates, energy consumed during construction of the proposed project would meet 9 years of energy demands for 23,400 homes under the original 6-Lane Alternative; 27,400 homes under the 6 Lanes with Pacific Street Interchange option; and 24,000 homes under both the Second Montlake Bridge and the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast options.

What options are being considered in this addendum?

6 Lanes with Pacific Street Interchange Option

This option would remove the Montlake interchange along SR 520 and would construct a new interchange at Pacific Street, just east of the Montlake interchange. Exhibit 1 shows the proposed lane configuration for this option.

The new interchange would be primarily located over the WSDOT-owned peninsula near the Washington Park Arboretum. A new on- and off-ramp to and from the north would extend to Pacific Street at the University of Washington. A column-supported ramp of four general-purpose lanes (two lanes in each direction) extending over Union Bay



Option Lane Configuration
Bicycle/Pedestrian Path
Shoulders and Barriers
Intersections

N

0 125 250 500 Feet

Exhibit 1. **Lane Configuration of the 6 Lanes with Pacific Street Interchange Option**
SR 520 Bridge Replacement and HOV Project

File Path: \\Simba\proj\Parametrix\168395\180171 SR 520 Bridge Replacement\GIS\Layouts\Addendum\Graphics\PacificIC_LaneConfig.mxd, Date: December 5, 2005 2:04:22 PM

(referred to as the Union Bay Bridge in this addendum) from the new interchange would touch down at the University of Washington Husky Stadium parking lot before joining the intersection of Pacific Street and Montlake Boulevard. At that intersection, the roadway would be lowered 8 to 10 feet from the existing elevation to provide vehicle-only access. The intersection would be covered to allow pedestrian access above and away from vehicular traffic.

The roadway on Montlake Boulevard north of Pacific Street would be widened to the east until just south of Northeast 45th Street. The navigational channel crossed by the new Union Bay Bridge would be the same width as the existing Union Bay reach (175 feet), with a vertical clearance of either 70 or 110 feet.[1] Columns would be placed just outside the width of the ship canal to not block boat traffic.

Ramps to and from Lake Washington Boulevard would still be included in this option; however, their footprint would be slightly different from the original 6-Lane Alternative. The ramp connections to and from Lake Washington Boulevard and to and from the Union Bay Bridge would construct a full diamond interchange, as opposed to a partial diamond interchange under the original 6-Lane Alternative. This full diamond interchange would provide more access to and from Lake Washington Boulevard. No access to or from SR 520 would be provided at Montlake Boulevard.

From Montlake Boulevard to I-5, SR 520 would be six lanes wide (three in either direction). The profile of the Portage Bay Bridge would not differ under this option from the original 6-Lane Alternative. Buses would access SR 520 via the Union Bay Bridge through the University area, providing for a more direct connection between buses and the proposed Sound Transit North Link Station at Husky Stadium. Instead of connecting to the Montlake interchange as in the original 6-Lane Alternative, the bicycle/pedestrian path would follow the Union Bay Bridge from SR 520 and would end at the Pacific Street interchange, close to the Burke-Gilman Trail.

[1] The establishment of a new governing clearance would prevent any vessel with a higher clearance requirement from traveling east from the Montlake Cut to Lake Washington north of the Evergreen Point Bridge. Before establishing a new governing clearance, the Coast Guard will consider whether vessels requiring a higher clearance have an essential use in north Lake Washington. Two vessels with a vertical clearance higher than 70 feet are known to travel this part of the lake. No vessels with a vertical clearance higher than 110 feet travel this part of the lake.

Second Montlake Bridge Option

The intent of the Second Montlake Bridge option is to narrow the SR 520 footprint through the Montlake neighborhood, while providing for transit (bus) access from SR 520 to the University of Washington. Exhibit 2 shows the propose lane configuration for this option, which would be the same as the No Montlake Freeway Transit Stop option, except that it would also include a second Montlake bridge across the Montlake Cut. This bridge would be a parallel bascule (draw) bridge located just east of the existing Montlake Bridge. One bridge would carry northbound traffic, and one would carry southbound traffic.

South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option

The intent of the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option is to improve access for buses to the South Kirkland Park-and-Ride from eastbound SR 520 and from the South Kirkland Park-and-Ride to westbound SR 520. This option, which is shown in Exhibit 3, would add a new transit/HOV-only westbound on-ramp from 108th Avenue Northeast and a new transit/HOV-only eastbound off-ramp to 108th Avenue Northeast.

The footprint of SR 520 east of Bellevue Way would be widened slightly to accommodate the new ramps. Both 108th Avenue Northeast and Northup Way would be widened and improved under this option. One lane would be added to 108th Avenue Northeast between the eastbound on-ramp and 38th Place Northeast. Along with the additional through lane on 108th Avenue Northeast, the northbound leg of the 108th Avenue Northeast/Northup Way intersection would be channelized to include two exclusive left-turn lanes, a through lane, and a shared through/right-turn lane.

There is also a possibility for adding a westbound second left-turn lane at the 108th Avenue Northeast/Northup Way intersection to facilitate clearing the left-turn queue and serving a higher number of westbound left-turn and through trips.

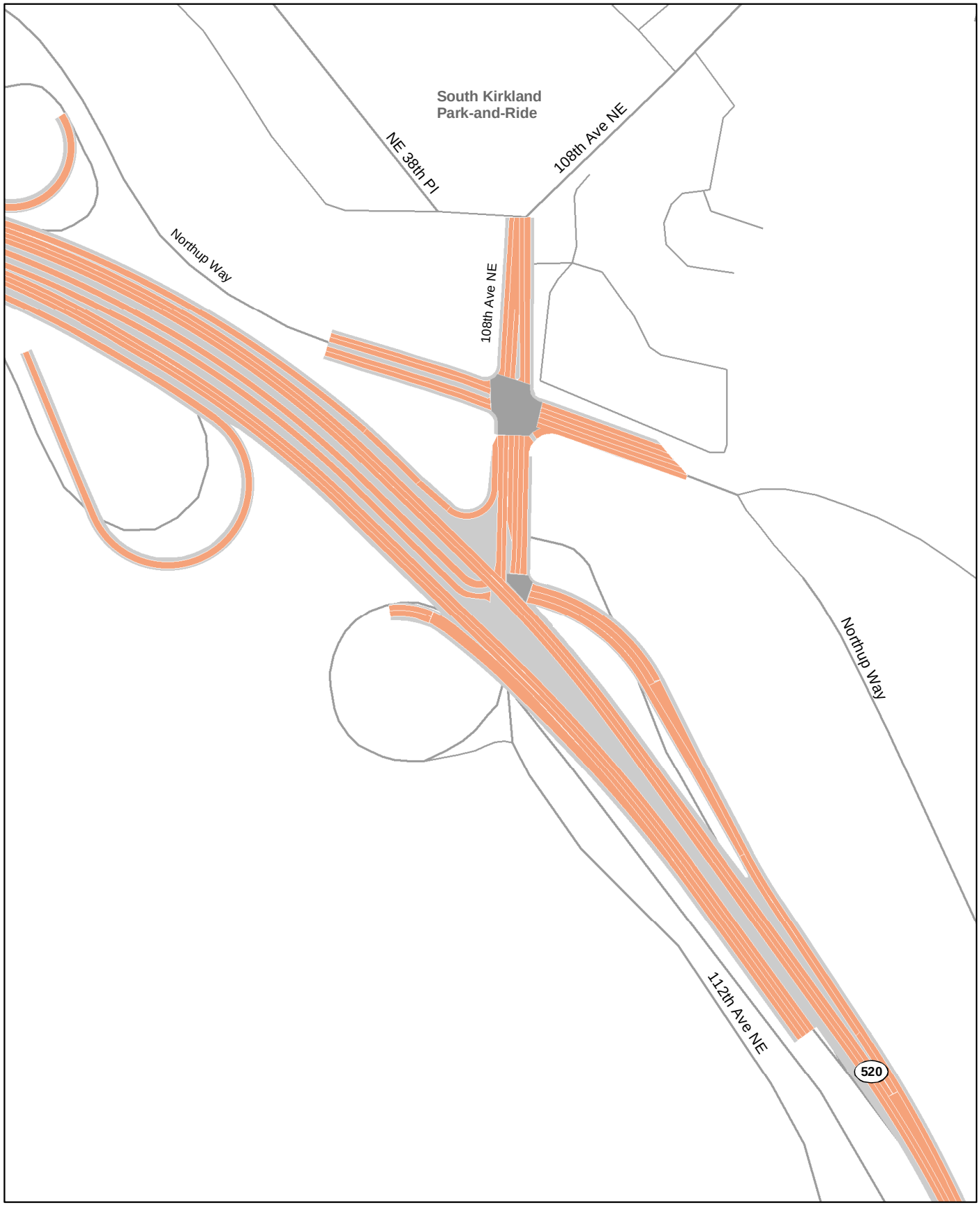
What additional information was collected for this analysis?

The energy discipline team calculated how much energy would be used under each additional option based on vehicle miles traveled (VMT)

Exhibit 2. **Lane Configuration of the Second Montlake Bridge Option**

SR 520 Bridge Replacement and HOV Project

File Path: \\Simba\proj\Parametrix\168395\180171 SR 520 Bridge Replacement\GIS\Layouts\Addendum\Graphics\PacificIC_LaneConfig.mxd, Date: December 5, 2005



Option Lane Configuration
Shoulders and Barriers
Intersections

N

0 125 250 500 Feet

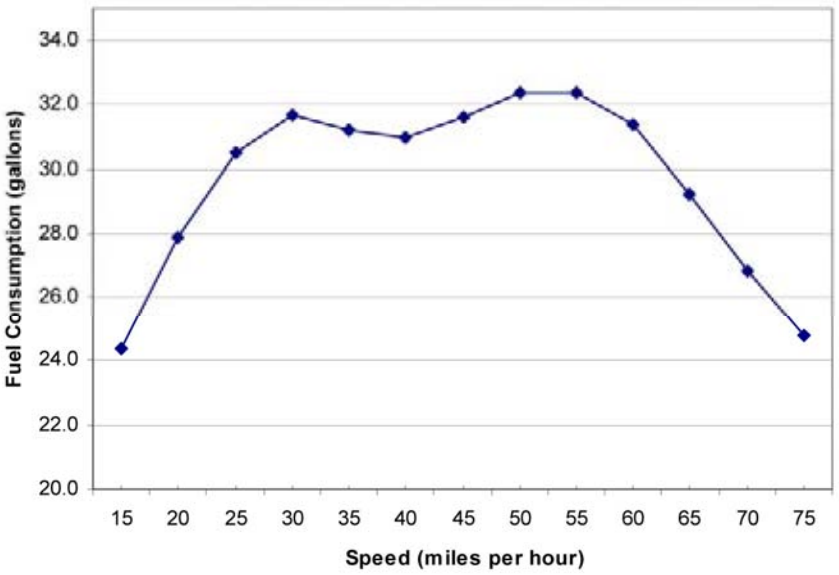
Exhibit 3. **Lane Configuration for the South Kirkland Park-and-Ride Transit Access - 108th Avenue Northeast Option**
SR 520 Bridge Replacement and HOV Project

File Path: \\Simba\proj\Parametrix\168395\180171 SR 520 Bridge Replacement\GIS\Layouts\Addendum\Graphics\PacificIC_LaneConfig.mxd, Date: December 5, 2005

estimates presented in the *Addendum to Transportation Discipline Report*. The discipline team also derived the amount of fuel efficiency (gallons per mile) for each additional option from information prepared by the U.S. Department of Energy and the U.S. Environmental Protection Agency. The methodology for these calculations is slightly different than described in the *Energy Discipline Report* because regional area data are used rather than project area data for traffic calculations. Traffic numbers in this addendum are larger than those in the *Energy Discipline Report*. Project-level traffic data were not available for this addendum; therefore, VMT and vehicle hours traveled for the region were used for comparative purposes. Data for all options and alternatives, including the No Build and the original 6-Lane Alternatives, are presented at the regionwide level in this analysis. This analysis also incorporated updated construction costs to estimate energy consumption during construction.

Affected Environment

This addendum uses the same information as collected for the *Energy Discipline Report*, except for the fuel consumption rates. Exhibit 4 presents the adjusted fuel consumption rates used for this analysis. As shown on the graph, fuel efficiency is greatest when vehicles are traveling between 45 and 55 miles per hour (mph). Because of the current conditions in the SR 520 corridor, the corridor is congested many times throughout the day and vehicles are operating at inefficient speeds.



Source: U.S. Department of Energy and U.S. Environmental Protection Agency (2004).

Exhibit 4. Average Automobile Fuel Consumption Rate

Potential Effects of the Project

What methods were used to evaluate the project's potential effects?

The energy discipline team estimated operational effects by calculating the total number of gallons of fuel consumed under each option. The team then estimated the vehicle fuel consumption for each alternative by applying the fuel consumption rates presented in Exhibit 4 (also see the *What additional information was collected for this analysis?* section).

During project construction, energy would be consumed during the mining and production of construction materials and transport of materials to the site. Operating and maintaining construction equipment would also consume resources. Construction-related effects were estimated by applying a highway construction energy factor to the total cost of each of the 6-Lane Alternative options.

How would the project permanently affect energy use?

The analysis in this report is based on the direct effects on energy on projected year 2030 regional traffic volumes and total VMT. Traffic volumes and average speeds for each option were obtained from the *Addendum to the Transportation Discipline Report*. Annual VMT was calculated by multiplying a factor of 345 days per year by daily VMT for the region.

At the regional level, VMT calculations for each option are very similar with small differences in average speed. There is also minor differences in fuel consumption between each option. Exhibit 5 presents estimates of annual fuel consumption during operation.

Exhibit 5. Regional Fuel Consumption Estimates by Alternative

Alternative or Option	Annual VMT (millions) [a]	Average Speed (mph)	Fuel Consumption Rate (mpg) [b]	Gallons/Year (millions)	% Change versus No Build 2030	MBtus/Yr (millions) [c]
No Build Alternative – 2030	39,071	26	30.7	1,272.7	0.0%	159
6-Lane Alternative – 2030	38,842	26	30.7	1,265.2	-0.6%	158
6 Lanes with Pacific Street Interchange option – 2030	38,798	27	31.0	1,251.6	-1.7%	156
Second Montlake Bridge option – 2030	38,807	27	31.0	1,251.8	-1.6%	156

Source: Horntvedt (pers. comm. 2005), U.S. Department of Energy and U.S. Environmental Protection Agency (2004).
[a] An annualization factor of 345 was used to convert daily VMT to annual VMT.
[b] Fuel consumption rate (mpg) was estimated by interpolating U.S. Department of Energy data presented in Exhibit 4.
[c] 1 gallon of gasoline = 0.125 MBtus (million British thermal units)

No Build Alternative

Under the No Build Alternative's Continued Operation Scenario, the annual VMT for the region is forecast to be approximately 39 billion miles in 2030. This annual VMT is expected to be higher than under the original 6-Lane Alternative and options because the tolls assessed under the options would reduce the number of vehicles using the Evergreen Point Bridge. Vehicles operating in the region would consume about 1.27 billion gallons of fuel per year, or 159 million British thermal units (MBtus) of energy.

Original 6-Lane Alternative

In 2030, the original 6-Lane Alternative is projected to result in 38.8 billion VMT in the region. The average speed would be 26 mph, and vehicles would consume 1.26 billion gallons of fuel, a reduction of 0.6 percent when compared to the No Build Alternative. The fuel used in the 6-Lane Alternative would consume 158 MBtus of energy.

6 Lanes with Pacific Street Interchange Option

In 2030, the 6 Lanes with Pacific Street Interchange option is projected to result in 38.8 billion VMT in the region. Vehicles are forecast to travel at an average speed of 27 mph and to consume an estimated 1.25 billion gallons of fuel, which is approximately 1.7 percent less than the 2030 No Build Alternative. This option would have lower energy consumption than the original 6-Lane Alternative and similar energy

consumption to the Second Montlake Bridge option; fuel would consume approximately 156 MBtus of energy.

Second Montlake Bridge Option

In 2030, the Second Montlake Bridge option is projected to result in 38.8 billion VMT in the region. The average speed would be 27 mph, and vehicles would consume 1.25 billion gallons of fuel, a reduction of 1.6 percent when compared to the No Build Alternative. This option would have lower energy consumption than the original 6-Lane Alternative and similar energy consumption to the 6 Lanes with Pacific Street Interchange option. The fuel used with this option would consume 156 MBtus of energy.

South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option

The energy discipline team did not do traffic modeling for this option because it would have the same energy effects as the original 6-Lane Alternative.

How would project construction temporarily affect energy use?

During construction of the proposed project, energy would be consumed during the mining and production of construction materials and when transporting materials and equipment to the site. Operating construction equipment and providing construction lighting would also consume energy resources. The amount of energy used during the construction of a project would be roughly proportional to the size of the project.

For this analysis, the energy discipline team estimated energy consumption during construction by applying a construction energy consumption factor to the total project costs. Energy consumption calculations reported in this analysis are for the entire construction period. In the 1983 report *Energy and Transportation Systems* (Caltrans 1983), the California Department of Transportation derived energy consumption factors for different roadway facilities that are still widely used in the industry today. For this analysis, the discipline team used the energy consumption factors for urban freeways, bridges, and interchanges to estimate the energy that would be consumed during the

proposed project. The consumption factors were reported in MBtus per thousand dollars of construction spending.

The discipline team used a 90 percent risk cost, which was estimated during WSDOT's cost estimating validation process, to calculate energy consumption during the construction period. Because professional engineering and right-of-way costs are not direct construction activities, they were removed from this analysis.

Total construction cost estimates, less professional engineering and right-of-way costs, are presented in Exhibit 6. Cost estimates were updated in 2005 and escalated to 2013 dollars to represent the mid-point of expenditure for the proposed project. Construction costs were then allocated between roadway, bridge, and interchange structures. The updated construction cost analysis now estimates $2.1 billion for the original 6-Lane Alternative, $2.4 billion for the 6 Lanes with Pacific Street Interchange option, $2.2 billion for the Second Montlake Bridge option, and $2.1 billion for the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option.

Exhibit 6. Construction Costs and Total Energy Consumption During Construction

Alternative or Option	Construction Cost (2013 Dollars)	MBtus
Original 6-Lane Alternative	$2.10 billion	19.4 million
6 Lanes with Pacific Street Interchange option	$2.44 billion	22.7 million
Second Montlake Bridge option	$2.17 billion	20.0 million
South Kirkland Park-and-Ride Transit Access –108th Avenue Northeast option	$2.15 billion	20.0 million

Notes: Construction costs reflect the estimated mid-point of expenditure for the project.
A 90 percent risk cost was used to estimate construction energy consumption.

Exhibit 6 also presents total energy consumption for construction of the original 6-Lane Alternative and options. The energy consumed during construction would be spread out over the entire construction period. The original 6-Lane Alternative would consume approximately 19.4 MBtus. The 6 Lanes with Pacific Street Interchange option would consume approximately 22.7 MBtus, which is the highest of the all the options because interchanges typically use the most construction energy. The Second Montlake Bridge and the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast options would both consume approximately 20 MBtus.

Mitigation

No operational mitigation measures are anticipated because each of the 6-Lane Alternative options would result in net savings in energy consumption when compared to the No Build Alternative. Construction plans should make every attempt to minimize roadway congestion and adhere to construction practices that encourage efficient energy use, such as limiting idling equipment, encouraging construction workers to carpool, and locating staging areas near work sites.

References and Bibliography

Adury, Murli K. Parsons Brinckerhoff, Bellevue, Washington. May 2004—personal communication with Kurt Playstead of CH2M HILL regarding source of annualization factor derived from Puget Sound Regional Council data.

Caltrans. 1983. *Energy and Transportation Systems*. California Department of Transportation.

CH2M HILL. 2004. *Energy Discipline Report*. SR 520 Bridge Replacement and HOV Project EIS. Prepared for Washington State Department of Transportation.

CTED. *Energy Indicators*. http://www.cted.wa.gov/DesktopDefault.aspx?TabId=77. Last updated in 2002, accessed on March 2, 2004. State of Washington Department of Community, Trade, and Economic Development.

Horntvedt, Michael, Parametrix, Inc. December 12, 2005 – Email communication with Kurt Playstead, CH2M HILL, regarding vehicle miles traveled/vehicle hours delayed/vehicle hours traveled for Montlake options.

Moore, Craig, CH2M HILL. November 2005 – Personal communication with Kurt Playstead, CH2M HILL, regarding construction cost estimates.

Parametrix, Inc. and Parsons Brinckerhoff. 2005. *Transportation Discipline Report*. SR 520 Bridge Replacement and HOV Project EIS. Prepared for Washington State Department of Transportation.

U.S. Department of Energy. State Energy Data 2000. http://www.eia.doe.gov/emeu/states/sep_use/total/use_tot_wa.html, last updated 2000, accessed on May 27, 2004. Energy Information Administration.

U.S. Department of Energy. Residential Energy Consumption Survey, 2001. http://www.eia.doe.gov last updated 2002, accessed on June 1, 2004.

U.S. Department of Energy and U.S. Environmental Protection Agency. *Fueleconomy.gov: Driving more efficiently*. http://www.fueleconomy.gov/feg/driveHabits.shtml, accessed on March 16, 2004.