

F. Operations and Maintenance Costs

The O&M costs are based on WSDOT's ITS Maintenance database of estimated annual costs for the various systems including variable message signs, changeable message signs, communication hubs, and closed circuit television cameras. The estimated maintenance costs are based on WSDOT's work done by Mike Katzer who serves as the NWR Area 5 Assistant Maintenance Superintendent and conversations with Archie Allen who serves as WSDOT's Northwest Region (NWR) Bridge Maintenance Superintendent and Mark Newman who is WSDOT's NWR Signal Maintenance Supervisor – ITS. The original costs provided by WSDOT were based on their 2003-2005 biennium pay scales. These rates have been increased by ten percent to reflect their latest pay increase in July 2007. Likewise, equipment costs have also been adjusted.

The following unit rates were used for the various labor and equipment categories. Material costs may include replacement/repair parts, materials and other incidentals. In most cases, the Maintenance Technician category was used to handle traffic control, maintenance, and repairs. Total costs are rounded to the nearest two or three significant digits.

Unit Rates

Work Activity	Details	Cost
Labor	Maintenance Technicians for Traffic Control and Repair	\$40 / hour / person
	Bridge Inspectors (Structural Engineers)	\$50 / hour / person
Equipment	Man Lift	\$16 / hour
	Pickup	\$5 / hour
	Van	\$4 / hour
	Truck-Mounted Impact Attenuator	\$3 / hour
Materials	Varies	Varies

Sign Bridge Structural Inspections

The WSDOT Bridge Preservation Office is required to inspect each sign bridge (gantry) and cantilever structure every five years. No inspections are allowed at night, so the inspections will need to be done early Saturday or on Sunday mornings. This translates into higher labor costs because it will most likely require overtime labor to achieve this. The number of hours allowed for this type of work will be small due to the high traffic volumes. Thus, maintenance for these inspections will require multiple sessions of setting up and removing traffic control, so the work will be inefficient.

The estimated time required to inspect one sign bridge is four hours. This includes traffic control set up, inspection and traffic control removal.

Structural Inspections

Work Activity	Qty	Details	Cost
Labor	4	Maintenance Technician for Traffic Control	\$640
	2	Bridge Inspector (Structural Engineer)	\$400
Equipment	1	Man Lift Truck	\$64
	1	Pickup	\$20
	2	Van	\$32
	1	Truck-Mounted Impact Attenuator	\$12
Total Cost per Structure (every 5 years)			\$1,200
Total Cost per Structure (annually)			\$240

For speed harmonization on the south section of I-405, the preliminary estimate requires 50 new sign bridges over the 12-mile segment. This calculates to 50 sign structures @ \$1,200/5 years = \$60,000 every five years for sign structure inspection or \$12,000 annually.

Variable Message Signs

The recommended maintenance schedule for VMS signs is one major preventative maintenance (PM) per year plus monthly minor PMs. Major PM for a sign over a traffic lane typically takes between six to eight hours (assume eight hours for the cost estimate). Traffic control is a major cost when the sign is over traffic. The traffic control requires about two hours to set up and one hour to take down. In addition, arrow board trucks, truck-mounted impact attenuators (one per closed lane) and numerous signs and barrels are needed. For signs located over the shoulder or off the road, the assumption is that the costs will be the same because the shoulder and at least one travel lane will be closed for safety reasons.

Major PM for a VMS over Traffic

Work Activity	Qty	Details	Cost
Labor	6	Maintenance Technician	\$1,920
Equipment	2	Man Lift Truck	\$256
	1	Pickup	\$40
	1	Van	\$32
	2	Truck-Mounted Impact Attenuator	\$48
Materials			\$500
Total Cost per Sign (annually)			\$2,800

Minor PM would be conducted on a monthly basis and require one hour of labor, except for the month when the major PM occurs. So, this translates into 11 minor PMs per year.

Monthly Minor PM for VMS

Work Activity	Qty	Details	Cost
Labor	1	Maintenance Technician	\$40
Equipment	0	Man Lift Truck	\$0
	0	Pickup	\$0
	1	Van	\$4
	0	Truck-Mounted Impact Attenuator	\$0
Materials			\$0
Total Cost per Sign (per visit)			\$44
Total Cost per Sign (annually)			\$480

Repair Costs also need to be accounted for as some signs will need repair over time. For a VMS sign over traffic, the cost includes traffic control set up and take down and is estimated at six hours per year per sign.

Repair (VMS over Traffic)

Work Activity	Qty	Details	Cost
Labor	6	Maintenance Technician	\$1,440
Equipment	2	Man Lift Truck	\$192
	1	Pickup	\$30
	1	Van	\$24
	2	Truck-Mounted Impact Attenuator	\$36
Materials		Repair parts and materials	\$400
Total Cost per Sign (annually)			\$2,100

Maintenance Summary Costs - VMS

For the section of I-405 from Tukwila to I-90, the yearly maintenance cost for VMS over the roadway is \$5,380 per sign per year. The annual maintenance cost for VMS off the roadway is the same.

VMS over traffic

Major PM.....	\$2,800
Monthly Minor PM.....	\$480
Repair.....	\$2,100
TOTAL.....	\$5,380

Assuming that there will be 50 new sign bridges and one VMS on every other sign bridge, there will be 26 new VMS signs. This translates into an annual maintenance cost of approximately \$140,000 for VMS mounted over the roadway.

Data Stations

WSDOT’s recommendation for maintenance of data stations is four preventative maintenance (PM) visits per year. One would be a major PM and the other three would be minor PMs. The work would include such activities as checking loops, all wire connections, heater, fan, communications, and the controller; vegetation management

around the cabinet; graffiti removal; and cabinet cleaning, etc. Major PM would require six hours of labor. Minor PM requires two hours per visit.

Major PM for Data Stations

Work Activity	Qty	Details	Cost
Labor	1	Maintenance Technician	\$240
Equipment	0	Man Lift Truck	\$0
	0	Pickup	\$0
	1	Van	\$24
	0	Truck-Mounted Impact Attenuator	\$0
Materials			\$100
Total Cost per Data Station (annually)			\$360

Minor PM for Data Stations

Work Activity	Qty	Details	Cost
Labor	1	Maintenance Technician	\$80
Equipment	0	Man Lift Truck	\$0
	0	Pickup	\$0
	1	Van	\$8
	0	Truck-Mounted Impact Attenuator	\$0
Materials			\$100
Total Cost per Data Station (per visit)			\$190
Total Cost per Data Station (annually)			\$570

Maintenance Summary Costs – Data Stations

The total annual cost per data station is \$930. Assuming ¼-mile spacing of the data stations and that there are currently data stations spaced every ½ mile, about 50 new data stations would need to be installed. The total annual maintenance cost for the 50 new data stations is approximately \$47,000.

Variable Speed Limit Signs and Lane Control Displays

The variable speed limit (VSL) signs would not be full VMS signs, but rather LED type signs. The assumption is that each sign bridge will have three VSL signs and three LCDs, one set over each travel lane. Maintenance costs will be less than for full matrix VMS and these types of signs should be more reliable. The recommended maintenance schedule is one major preventative maintenance (PM) per year and monthly minor PMs. The major PM requires six hours/sign bridge: three hours traffic control and three hours maintenance for all the signs on the bridge.

Major PM for VSL signs and LCDs

Work Activity	Qty	Details	Cost
Labor	6	Maintenance Technician	\$1,440
Equipment	2	Man Lift Truck	\$192
	1	Pickup	\$30
	1	Van	\$24
	2	Truck-Mounted Impact Attenuator	\$36
Materials			\$200
Total Cost per Sign Bridge (annually)			\$1,900

Minor PM would be conducted on a monthly basis and require one hour of labor, except for the month when the major PM occurs. So, this translates into 11 minor PMs per year.

Monthly Minor PM for VSL signs and LCDs

Work Activity	Qty	Details	Cost
Labor	1	Maintenance Technician	\$40
Equipment	0	Man Lift Truck	\$0
	0	Pickup	\$0
	1	Van	\$4
	0	Truck-Mounted Impact Attenuator	\$0
Materials			\$0
Total Cost per Sign (per visit)			\$44
Total Cost per Sign (annually)			\$480

Because some signs will require repair, the repair costs need to be included. For signs over traffic, the cost includes traffic control set up and take down and is estimated at six hours every five years per sign. For each sign bridge, the maintenance estimate is \$2,100 every five years or \$420 annually.

Repair (VSL/LCD over Traffic)

Work Activity	Qty	Details	Cost
Labor	6	Maintenance Technician	\$1,440
Equipment	2	Man Lift Truck	\$192
	1	Pickup	\$30
	1	Van	\$24
	2	Truck-Mounted Impact Attenuator	\$36
Materials		Repair parts and materials	\$400
Total Cost per Sign (every 5 years)			\$2,100
Total Cost per Sign (annually)			\$420

Maintenance Summary Costs – VSL/LCD

The following is a summary for the I-405 segment from Tukwila to I-90. The yearly maintenance cost for a VSL/LCD sign bridge over the roadway is \$2,800 per year. Assuming that there will be 50 new sign bridges, the annual maintenance cost is \$140,000.

VSL/LCD (signs over traffic)

Major PM.....	\$1,900
Monthly Minor PM.....	\$480
Repair.....	\$420
TOTAL.....	\$2,800

Operations Costs

With speed harmonization, there will be a need for an operator (Engineer/Intern) in the Traffic Management Center 24/7. There are currently operators on duty on weekdays about 13 hours per day and on weekends eight hours per day. Therefore, an additional 2.5 FTEs are needed to cover the remaining shifts for a cost of \$50,000 per FTE or \$125,000 per year.

Master Summary Costs

The O&M costs for speed harmonization are summarized in Table 1. Combining the VMS, data stations and VSL/LCD maintenance costs with the added operations costs for the entire speed harmonization system yields an annual maintenance cost of \$464,000.

Table 1 - Annual O&M Cost for Speed Harmonization (Signs over Roadway)

Work Activity	Cost
Structural Inspections	\$12,000
Data Station Maintenance	\$47,000
VMS Full Matrix Maintenance	\$140,000
Variable Speed Limit and Lane Control Displays Maintenance	\$140,000
Added Operations Costs	\$125,000
Total O&M Costs	\$464,000

Notes (1) Cost is for 12-mile segment on I-405 from I-5 (Tukwila) to I-90.

Motorist Information Signing Maintenance

The motorist information signing (travel time information) can be used at four potential sites:

- Southbound I-405 at I-90
- Westbound I-90 at I-405
- Southbound I-405 at SR 167
- Northbound I-5 at I-405

The number of travel time signs varies between one to three signs per location (assume two for the cost estimate). Using the annual maintenance cost of \$5,380 per VMS over the roadway, the total annual maintenance cost for the eight VMSs is approximately \$43,000. There are no additional operations costs associated with this ATM technique.