



## Appendix O: Cost Benefit Analysis

## Benefit Cost Analysis

Crash costs were computed for the entire network (US 378, N. Pike, and S. Pike) for No-Build and Alternatives 1, Alternative 2, Alternative 3A, and Alternative 3B over a 3.75-year crash period.

Calculations and assumptions for each alternative are listed below for Crash Benefit (Annual Benefit):

### ALT 1

- Alternative 1 retains the free flow, higher speed traffic along US 378 with grade separation at Wesmark Boulevard, Wise Street and Miller Road avoiding any conflicts with US 378 traffic.
- Six roundabouts are proposed at these three roadway intersections with South and North Pikes.
- Adjusted intersection crashes at Miller Road based on conversion to roundabouts with CMFs from the study below. Removed 3 US 378 pedestrian fatalities near Miller Road.

<input type="checkbox"/>	0.28	72		All	K (fatal)	Not specified	ELVIK, R., 2017
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- Highest cost and lowest B/C ratio
- This Alternative retains the numerous existing driveway access along North and South Pikes and adds new roundabout intersections developed on Wesmark Boulevard or Wise Drive. The slower speeds along the Pikes (traffic calming with roundabouts) and new full movement intersections were treated as a neutral crash benefit.

### ALT 2

- Adjusted intersection crashes (5 PDO increase, 3 Injury 1 reduction, 15 Injury 2 increase, 3 pedestrian fatalities reduced, 1 vehicle fatal was converted to Injury 3 based on reduced speed) based on converting the freeway with parallel frontage roads (3 roadways) to a boulevard design (1 roadway).
- Removed 3 pedestrian fatalities near Miller Rd and reduced the vehicle crash severity near Wise Drive from a fatal to an injury 3 crash based on reduced speed. Once adjusted for new geometry, we applied a CMF for speed management reduction of 0.85 based on a study from the CMF Clearing House as speed limit on US 378 would be reduced from 60 mph to 45 mph.

<input type="checkbox"/>	0.8553	14.4		All	All	Not specified	PARK ET AL. (2010), 2010
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- The proposed boulevard for Alt 2 will have limited access points as compared to a typical boulevard in the near vicinity. There are 3 new signal-controlled intersections and 11 additional access points that are controlled by restricted right in / right out or Reduced Conflict Intersections (RCI) movements with lower conflict points than a typical full access intersection.
- The 14 new intersections on US 378 for Alt 2 are expected to create a boulevard with roughly 5 access points per mile. In comparison, a review of the parallel boulevard just south of the corridor along Broad Street from Market Street to Reese Street was conducted. This 1-mile segment has 101 access points per mile or nearly 20 times the number of access points as proposed for Alt 2.
- Although 14 new access points are added for Alt 2 along US 378, there are 84 existing access points along S. and N. Pike where the proposed Alt 2 design will remove free flow, high speed traffic through

paralleling the US 378 corridor. This will not only significantly reduce the number of conflict points along both Pikes but will similarly reduce speeds as existing intersections will mostly function as driveway access to existing business and residential destinations.

- This alternative had the highest net safety benefits and second highest B/C ratio

### **ALT 3A**

- This alternative includes providing a new signalized intersection at Wesmark Boulevard; however, an access-controlled US 378 freeway remains east of this intersection.
- New crashes are likely with a new signal but this alternative also introduces a roundabout at Miller Road at S Pike. The existing crashes at this intersection were reduced to reflect the improved safety at roundabouts with CMFs from the following study:

<input type="checkbox"/>	0.28	72		All	K (fatal)	Not specified	ELVIK, R., 2017
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- Three pedestrian fatalities are expected to be reduced as a result of the new culvert near Miller Road under 378.
- This alternative retains most of the free flow speeds along the Pikes and has minimal impact on improving overall safety as compared to Alt 2.
- Lowest cost alternative but a lower crash benefit and second highest network delay.

### **ALT 3B**

- This alternative includes providing a new signalized intersection at Wesmark Boulevard; however, an access-controlled US 378 freeway remains east of this intersection.
- For this alternative, grade separation over Miller Road with roundabouts at both Pikes are proposed. The existing crashes at these intersections were reduced to reflect the improved safety at roundabouts with CMFs from the following study:

<input type="checkbox"/>	0.28	72		All	K (fatal)	Not specified	ELVIK, R., 2017
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- Three pedestrian fatalities are expected to be reduced as a result of grade separation near Miller Road under 378.
- This alternative retains most of the free flow speeds along the Pikes and has minimal impact on improving overall safety as compared to Alt 2.
- Average crash and delay benefit and medium cost alternative.

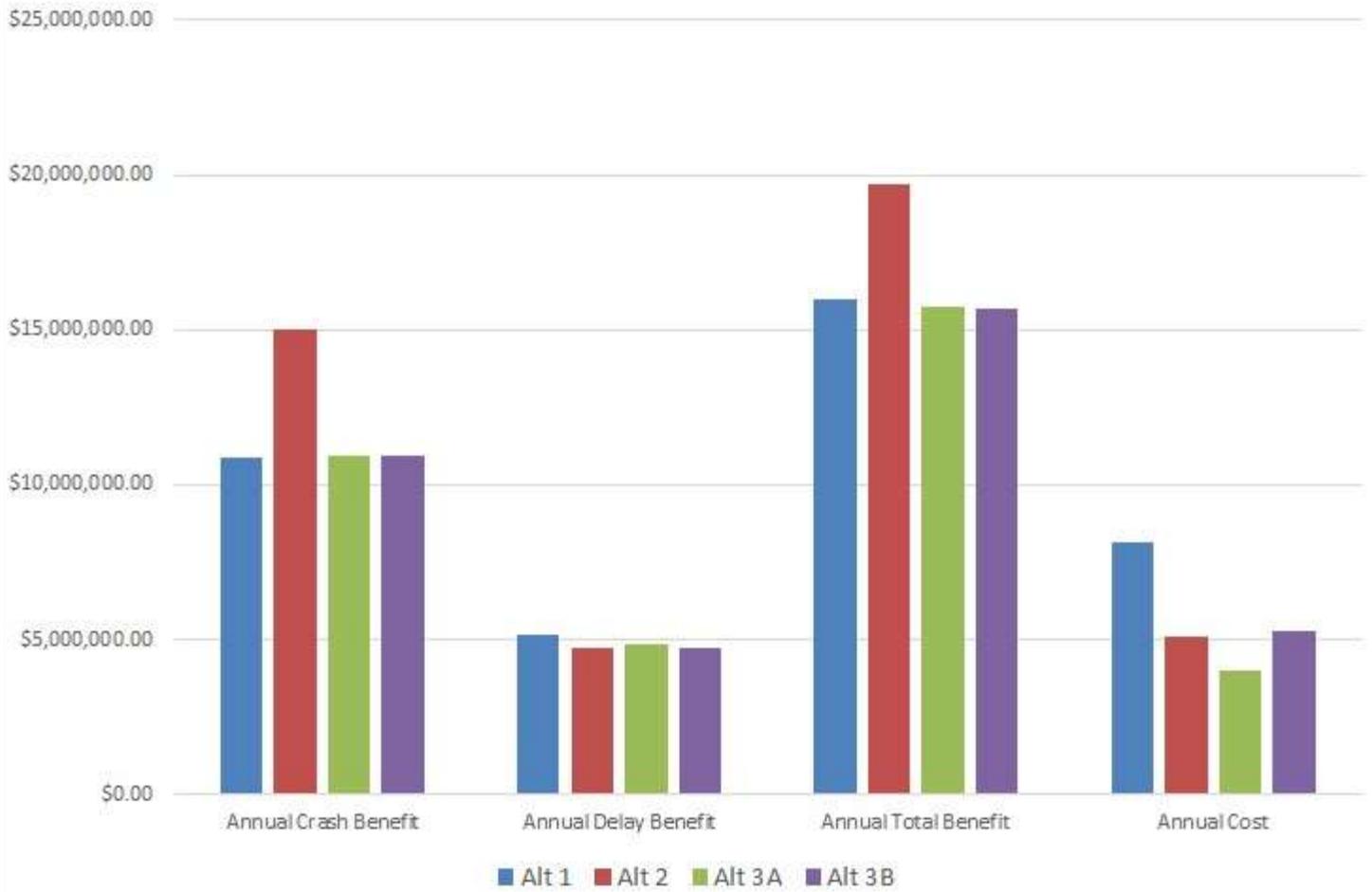
	Total AM Delay (hr)	Total PM Delay (hr)
<b>No-Build 2050 with S Pike Signal</b>	203.6	1714.5
<b>Alternative 1</b>	84.7	239.2
<b>Alternative 2</b>	121.6	334.4
<b>Alternative 3A</b>	92.2	327.5
<b>Alternative 3B</b>	94.3	360.3

	AM Time Saved from No-Build (hr)	PM Time Saved from No-Build (hr)
Alt 1	118.9	1475.3
Alt 2	82	1380.1
Alt 3A	111.4	1387
Alt 3B	109.3	1354.2

	AM Peak Hour Savings (USD)	PM Peak Hour Savings (USD)	Combined Peak Hour Savings (USD)	Annual Delay Benefit (USD)
Alt 1	<b>\$1,471.98</b>	<b>\$18,264.21</b>	\$19,736.20	<b><u>\$5,131,410.96</u></b>
Alt 2	<b>\$1,015.16</b>	<b>\$17,085.64</b>	\$18,100.80	<b><u>\$4,706,207.48</u></b>
Alt 3A	<b>\$1,379.13</b>	<b>\$17,171.06</b>	\$18,550.19	<b><u>\$4,823,049.92</u></b>
Alt 3B	<b>\$1,353.13</b>	<b>\$16,765.00</b>	\$18,118.13	<b><u>\$4,710,713.80</u></b>

Travel Time & Delay Analysis where the No Build contains no improvements along US 521.

### Cost Comparison



	B/C Ratio
Alt 1	<b>1.96</b>
Alt 2	<b>3.89</b>
Alt 3A	<b>3.94</b>
Alt 3B	<b>2.96</b>