BILLINGS AIRPORT ROAD & MAIN STREET Concept

TECHNICAL MEMORANDUM #3B

Date: March 30, 2016

Project #: 18460

To: Wade Salyards, PE
Montana Department of Transportation

From: Brett Korporaal and Andy Daleiden, PE

Project: Airport Road/Main Street – Billings, CM 1099(102), UPN 8718000

Subject: Tier II: Selection of a Preferred Alternative

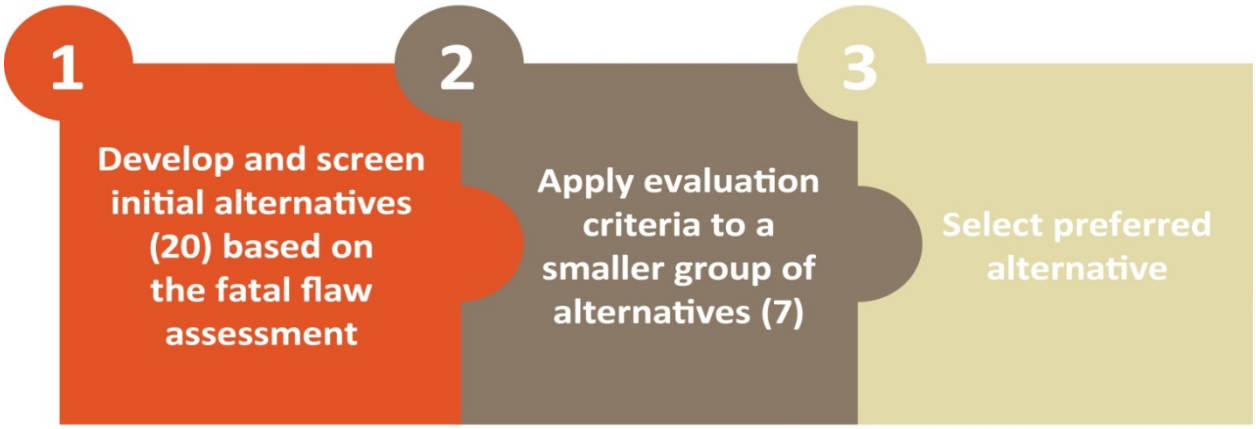
This technical memorandum summarizes the evaluation of the seven alternatives (includes the no-build alternative) selected for further refinement and evaluation from PAC Meeting #2 in October 2015. Each alternative was refined and developed into a design concept and then evaluated based on the mobility, safety, land use, and implementation criteria for the study. This memorandum addresses the following items:

- Tiered Approach to the Alternatives Evaluation
- Design Concepts, Year 2040 Operations, and Evaluation Results
- Near-Term and Long-Term Recommendations
- Next Steps

Tiered Approach to the Alternatives Evaluation

We used a tiered approach to develop, refine, and evaluate the seven alternatives at the Airport Road and Main Street intersection. Exhibit 1 illustrates the tiered approach.

Exhibit 1. Tiered Approach to Alternatives Evaluation



As shown in Exhibit 1, we developed twenty initial alternatives in Tier 1 and grouped them into six categories (parentheses represents number of alternatives): No Build (1), Conventional Intersection

(5), Quadrant Intersection (4), One-Way Intersection or Couplet (4), Alternative Intersection (3), and Grade Separated (3). These initial alternatives were evaluated based on a fatal flaw assessment, which included the ability to accommodate critical traffic volumes, any environmental impacts, and support from the PAC. At the conclusion of Tier 1, seven alternatives were identified for further evaluation in Tier II. The seven alternatives are listed below:

- Alternative 1 – No Build
- Alternative 2D – Dual Eastbound Left-Turn Lanes and Signal Phasing Modification
- Alternative 2E – Triple Eastbound Left-Turn Lanes and Signal Phasing Modification
- Alternative 3B – Signalized Southwest Quadrant
- Alternative 4B - Signalized Southwest Quadrant and One-Way Eastbound on E. Airport Road
- Alternative 5A – Median U-Turn (North and South)
- Alternative 5B – Partial Displaced Left-Turn (Southwest Quadrant)

In Tier II, the seven alternatives were refined into concept designs and evaluated based on the detailed evaluation criteria presented in Table 1.

Table 1. Evaluation Criteria

Goal	Objective	Evaluation Criteria	Performance Measure	Analysis Tool / Approach
Mobility	▪ Accommodate critical traffic patterns at the intersection. ▪ Decrease travel time for vehicles and freight. ▪ Improve vehicle operations in the future.	▪ Does the project accommodate the critical traffic patterns? ▪ Does the project reduce expected travel time for vehicles and freight? ▪ Does the project improve future intersection operations?	▪ Critical movements (EBLT, NBLT, NBTH, SBTH at Main Street/Airport Road and NBLT at Main Street/Aronson Avenue) ▪ Vehicle movement travel time for NBL, NBTH, and SBTH ▪ Indirect or direct freight routes ▪ Intersection volume-to-capacity ratio and delay (LOS)	▪ Critical movement analysis ▪ Synchro 8, SIMTraffic ▪ HCM 2000, 2010, 2015 ▪ Comparison of freight routes
Safety	▪ Minimize conflicts at the intersection for vehicles. ▪ Provide improved access and response times for emergency vehicles. ▪ Provide improved connectivity and crossing opportunities for pedestrians and bicyclists	▪ Does the project reduce conflict points for vehicles? ▪ Does the project reduce the highest crash trends (in this case, rear-end crashes)? ▪ Does the project improve accessibility and response time for emergency vehicles? ▪ Does the project improve or worsen pedestrian connectivity and crossing opportunities? ▪ Does the project improve or worsen bicycle connectivity and crossing opportunities? ▪ Does the project include reasonable driver comprehension and signing element?	▪ Conflict points ▪ Countermeasure to reduce rear end crashes (Qualitative) ▪ Travel time, intersection delay, and routing ▪ Pedestrian crossing locations and design enhancements ▪ Bicycle crossing locations and design enhancements ▪ Signage (simple or complex)	▪ Conflict point diagram ▪ Synchro 8, SIMTraffic ▪ HCM 2000, 2010, 2015 ▪ Comparison of emergency vehicle routes ▪ Comparison of pedestrian and bicycle crossing locations ▪ Comparison of pedestrian and bicycle infrastructure enhancements ▪ Route continuity for signing
Land Use	▪ Connect existing neighborhoods and businesses. ▪ Provide appropriate access to businesses and land uses. ▪ Minimize right-of-way needs. ▪ Minimize to the extent possible geographic constraints. ▪ Minimize to the extent possible impacts to environmental resources.	▪ Does the project negatively impact access into and out of MetraPark? ▪ Does the project provide reasonable access to businesses and land uses? ▪ Does the project impact the environment negatively?	▪ Access to MetraPark ▪ Special event routes ▪ ROW requirements ▪ Impacts to geographic, 4f, 6f, and other resource elements	▪ Comparison of routes for special events ▪ Quadrant assessment of access impacts to each business ▪ ROW impacts based on design concepts ▪ Assess impacts to environmental elements
Implementation	▪ Coordinate with existing land use and transportation plans. ▪ Identify relative magnitude of project costs. ▪ Consider staged construction. ▪ Gather support from stakeholders and the public.	▪ Is the project consistent with adopted plans and policies? ▪ Is the overall cost of the project restrictive? ▪ Can the project be constructed in multiple phases? ▪ Does the project add significant maintenance lane miles? ▪ Is there community support for the project?	▪ Compatibility with adopted plans and policies ▪ Planning level ROW costs ▪ Planning level construction costs ▪ Phasing opportunities ▪ Additional lane miles or areas ▪ Input from stakeholders and public	▪ Check consistency with LRTP, Bench Blvd plans ▪ Planning level costs based on design concepts (low, medium, high) ▪ Construction staging assessment ▪ Lane miles or area assessment ▪ Online commenting tool and meeting forums (PAC meetings and open houses)

We used a detailed spreadsheet to assess each alternative related to the evaluation criteria shown in Table 1. The alternatives were scored based on a -1 (poor), -0.5, 0 (fair), 0.5, or 1 (good) scoring system for each sub-criteria included within a category. The evaluation was performed through independent analyses to assess each alternative individually and relative to other alternatives to determine its effectiveness in meeting the various project goals, objectives, and evaluation criteria.

The scores in each category were summed to provide a total score for each alternative, as well as a normalized score for each alternative. The total score has an artificial weighting factor built-in with mobility as the top priority, followed by safety, implementation, and land use. The normalized score removes the artificial weighting factor that occurs when a category has several sub-criteria. The evaluation results included in the table provide both scores.

The analysis methodology and design criteria are discussed in the next section.

ANALYSIS METHODOLOGY

An updated operational analysis was performed for all of the alternatives using Synchro 8 and SIMTraffic traffic analysis software tools, except for Alternative 5B – Partial Displaced Left Turn (SW Quadrant). These two software tools do not have the capability of modeling a displaced left turn intersection. The upcoming 2015 Highway Capacity Manual (HCM) includes a methodology for analyzing alternative intersection forms, including the displaced left turn intersection. McTrans, the software developer of the Highway Capacity Software (HCS) has incorporated a beta version of the HCS with the displaced left turn intersection analysis tool. We used this beta version to analyze the displaced left turn intersection alternative and checked the analysis for reasonableness with a critical movement analysis.

The Synchro 8 operational analysis was used in the Tier 1 evaluation, but further refined based on updated geometry for each alternative. Delay, level of service, volume-to-capacity ratio, and 95th percentile queue lengths were obtained from the Synchro operational models. SimTraffic, a microsimulation tool was used to assess the alternatives in a dynamic environment. We performed ten simulation runs and reported the average total delay by intersection for each alternative. Additionally, the queuing and blocking reports from each alternative's SimTraffic runs was used to determine appropriate turn-lane lengths within the alternative.

Each alternative was analyzed under year 2040 traffic conditions during the weekday a.m. and p.m. peak hours. The operational analysis included the following assumptions: year 2040 traffic volumes during the weekday a.m. and p.m. peak hours, optimized signal timings, and a peak hour factor of 1.0 (given the 20-year planning horizon).

DESIGN CRITERIA FOR CONCEPT DEVELOPMENT

Chapter 2 of the *Montana Department of Transportation (MDT) Road Design Manual* outlined the basic design controls for the roadways within the study area. The MDT Functional Classification Map defines Main Street and Airport Road as urban principal arterials. Based on the classification of these roadways, a design speed of 40 mph was used in the development of the design concepts. Alternatives that included roadway widening adhered to the minimum travel lane width of 12 feet. Because of the high volume of heavy vehicles, MDT verified the WB-67 as the design vehicle. Design

concepts that included lane markings, channelization, additional turn lanes, and improvements to pedestrian crosswalks referenced design standards from Chapter 19 of the *MDT Traffic Engineering Manual.* Additionally, *A Policy on Geometric Design of Highways and Streets, 6th Edition by* the American Association of State Highway and Transportation (AASHTO) was used as a supportive reference manual during the design of each alternative.

Right-of-way and parcel information was obtained from Yellowstone County and verified by MDT using previous studies and design work (e.g. 6th Ave N to Bench Blvd. - BLGS, Billings - Airport Road) within the study area.

PLANNING-LEVEL COST ESTIMATES

Planning-level cost estimates were prepared for each of the preferred alternatives. KAI developed the costs estimate based on input from MDT and guidance from MDT's *Roadway Design Manual* in determining appropriate bid items and percentage based costs. Specific bid item costs were derived from MDT's January 2016 bid item prices available through MDT's Consultant Design webpage. Right-of-way was assumed at $20 per square foot. Percentage-based costs are highlighted below:

- Signing – 2%
- Utilities – 5%
- Storm sewer - 15%
- Mobilization – 18%
- Temporary construction traffic control - 5%
- Temporary erosion control – 3%
- Construction/ROW easements – 2%
- Engineering design/construction mgmt. - 30%
- Contingency - 25% of total costs

Each alternative's concept design was used to calculate appropriate quantities of each applicable bid item.

Design Concepts, Year 2040 Operations, and Evaluation Results

We developed design concepts of each alternative in MicroStation using the results of the operational analysis and design criteria. Figures 1-1 through 7-1 show the design concepts for each alternative. Figures 1-2 through 7-2 show the design concepts for each alternative along with the year 2040 traffic volumes and operations and evaluation results. The year 2040 traffic conditions are shown for the

two key intersections: Airport Road/Main Street and Aronson Avenue/Main Street. The evaluation results are provided for the no-build and respective alternative for comparison purposes. The figures are included at the end of the document to assist with readability of this memorandum.

Cost estimates and specific bid item prices and percentage based costs for each alternative are provided in Attachment A. Planning level cost estimates for each alternative are as follows:

Table 2. Planning Level Cost Estimates

Alternative	Signal Modifications	New Traffic Signals	Approximate Right-of-Way (sf)	Planning Level Cost Estimate
Alt 1 – No Build	-	-	-	$0
Alt 2D – Dual Eastbound Left-Turn Lane and Signal Phasing Modification	1	0	0	$1,000,000 - $1,300,000
Alt 2E – Triple Eastbound Left-Turn Lane and Signal Phasing Modification	1	0	1,450	$1,200,000 - $1,600,000
Alt 3B – Signalized Southwest Quadrant	2	1	3,080	$3,700,000 - $4,700,000
Alt 4B – Signalized Southwest Quadrant (One-way Eastbound on E Airport Rd)	3	1	8,805	$4,000,000 - $5,100,000
Alt 5A – Median U-Turn (North and South)	3	1	7,110	$4,200,000 - $5,300,000
Alt 5B – Partial Displaced Left-Turn (Southwest Quadrant)	0	2	52,970	$5,600,00 - $7,000,000

Table 3 summarizes the Tier 2 evaluation results for each alternative. For now, the "Is there community support for the project?" sub-criteria is not scored, as this element is intended to gather input from the PAC, stakeholders, and community through PAC meetings #3 and #4, and a future open house on May 18, 2016. We would plan to update the evaluation results with information from these groups.

Table 3. Evaluation Results for the Tier II Alternatives

Evaluation Criteria		Preferred Alternative's Evaluation Scores						
		Alt 1 - No Build	Alt 2D - Dual EB Left-Turn Lanes and Signal Modification	Alt 2E - Triple EB Left-Turn Lanes and Signal Modification	Alt 3B - Signalized Southwest Quadrant	Alt 4B - Signalized Southwest Quadrant (One-Way EB)	Alt 5A - Median U-Turn (NB and SB)	Alt 5B - Partial Displaced Left-Turn (Southwest Quadrant)
Mobility	Does the project accommodate the critical traffic patterns?	-3.5	-3.0	-0.5	7.0	8.5	7.0	8.5
	Does the project reduce expected travel time for vehicles and freight?	0.0	0.0	0.0	1.0	0.5	1.0	1.0
	Does the project improve future intersection operations?	-2.0	-1.5	-1.5	1.5	2.0	1.5	2.0
	Mobility Subtotal (Raw)	-5.5	-4.5	-2.0	9.5	**11.0**	9.5	**11.5**
	Normalized Evaluation Subtotal	-0.6	-0.5	-0.2	1.1	**1.2**	1.1	**1.3**
Safety	Does the project reduce conflict points for vehicles?	-0.5	-0.5	-0.5	0.5	0.5	0.0	0.0
	Does the project reduce the highest crash trends (in this case, rear-end crashes)?	0.0	0.0	0.0	0.5	0.5	0.5	0.5
	Does the project improve accessibility and response time for emergency vehicles?	0.0	0.0	0.0	0.5	0.0	0.5	-0.5
	Does the project improve or worsen pedestrian connectivity and crossing opportunities?	-0.5	-0.5	-0.5	1.0	1.0	0.5	0.5
	Does the project improve or worsen bicycle connectivity and crossing opportunities?	-0.5	-0.5	-0.5	0.5	0.5	0.0	0.0
	Does the project include reasonable driver comprehension and signing element?	1.0	1.0	1.0	0.0	-0.5	0.0	0.5
	Safety Subtotal (Raw)	-0.5	-0.5	-0.5	**3.0**	**2.0**	1.5	**2.0**
	Normalized Evaluation Subtotal	-0.1	-0.1	-0.1	**0.5**	**0.3**	**0.3**	**0.3**
Land Use	Does the project negatively impact access into and out of MetraPark?	0	0.5	0.5	-0.5	-1.0	-0.5	-0.5
	Does the project provide reasonable access to businesses and land uses?	1.0	1.0	1.0	0.5	-0.5	0.5	-0.5
	Does the project impact the environment negatively?	0.5	0.0	0.0	-0.5	-0.5	-0.5	-1.0
	Land Use Subtotal (Raw)	**1.5**	**1.5**	**1.5**	-0.5	-2.0	-0.5	-2.0
	Normalized Evaluation Subtotal	**0.5**	**0.5**	**0.5**	-0.2	-0.7	-0.2	-0.7
Implementation	Is the project consistent with adopted plans and policies?	-1.0	-0.5	-0.5	1.0	-0.5	0.5	1.0
	Is the overall cost of the project restrictive?	1.0	0.5	0.5	0.0	0.0	-0.5	-0.5
	Can the project be constructed in multiple phases?	-1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Does the project add significant maintenance lane miles?	1.0	1.0	1.0	0.0	0.0	0.0	0.5
	Is there community support for the project?	-	-	-	-	-	-	-
	Implementation Subtotal (Raw)	0.0	**2.0**	**2.0**	**2.0**	0.5	1.0	1.5
	Normalized Evaluation Subtotal	0.0	**0.4**	**0.4**	**0.4**	0.1	0.2	0.3
	Total Evaluation Score (Raw)	-4.5	-1.5	1.0	**14.0**	11.5	11.5	**13.0**
	Total Normalized Score	-0.2	0.3	0.6	**1.8**	1.0	**1.3**	**1.2**

Bold text represents the two alternatives with the best ranking for each category and total score.

As shown in Table 3, Alternatives 2E, 3B, 4B, 5A, and 5B all have a positive raw score from the evaluation. Alternatives 1 and 2D have a negative raw score from the evaluation. Alternatives 3B, 4B, 5A, and 5B range from 11.5 to 14 in total raw score. Below is a summary discussion of each alternative and the advantages/disadvantages based on the evaluation categories:

- **Alternative 1 – No Build**: This alternative includes no improvements to the intersection. The alternative scores poor in the mobility and safety categories since there are no geometric improvements at the intersection. The alternative scores good and fair in the land use and implementation categories, since it has minimal impact to adjacent businesses, low cost, and low maintenance.
- **Alternative 2D – Dual Eastbound Left-Turn Lanes and Signal Phasing Modification:** This alternative includes minor geometric and phasing improvements and has similar scores to the no-build alternative.
- **Alternative 2E – Triple Eastbound Left-Turn Lanes and Signal Phasing Modification:** The alternative includes an additional left-turn on the eastbound approach. This improvement provides an operational benefit to the eastbound left-turn and some benefit to the northbound and southbound through movements as more green time can be allocated to these critical movements. The evaluation scores for this alternative are better than Alternatives 1 and 2D, but still ranks poorly amongst all of the alternatives as a viable long-term solution at this intersection.
- **Alternative 3B – Signalized Southwest Quadrant:** This alternative includes significant changes to the connectivity and routing of movements at the Airport Road/Main Street intersection. A key element of this alternative is using the available capacity of Aronson Avenue and the existing interchange to route vehicles through the area. This alternatives ranks fair to good for mobility, as the intersection operations are under or just at capacity in the year 2040. It scores best in the safety and implementation categories, as it generally maintains or enhances connectivity and uses existing infrastructure to have moderate costs. For land use, the alternative ranks in the middle with moderate impacts to adjacent businesses, routing for MetraPark, and right-of way.
- **Alternative 4B - Signalized Southwest Quadrant and One-Way Eastbound on E. Airport Road:** This alternative includes significant changes to the connectivity and routing of movements at the Airport Road/Main Street intersection, including removing the westbound movements at the Airport Road/Main Street intersection. Overall, this alternative has some similarity to Alternative 3B in terms of mobility and safety performance. However, it ranks poorly in the land use and implementation categories, due to significant impacts to routing and access for MetraPark and businesses, as well as consistency with local connectivity policies.
- **Alternative 5A – Median U-Turn (North and South):** This alternative includes significant changes to the connectivity and routing of movements at the Airport Road/Main Street

intersection, including providing U-turn movements at Aronson Avenue and Lake Elmo Drive. This alternative has a similar performance to Alternative 3B for mobility and land use. However, it ranks worse in the safety and implementation categories, due to a lower number of pedestrian/bicycle crossings and right-of-way impacts with the U-turn movements and loons.

- **Alternative 5B – Partial Displaced Left-Turn (Southwest Quadrant):** This alternative includes significant changes at the Aronson Avenue/Main Street and Airport Road/Main Street intersections. This alternative intersection form would be the first in the State of Montana. This alternative is the top performer in the mobility category, as it provides an under capacity intersection operation in the year 2040. It scores fair in safety and implementation, as it has the lowest number of vehicle to vehicle conflict points and maintains route continuity between Airport Road and Main Street. This alternative is anticipated to have the highest cost, as it has major impacts to one parcel in the southwest quadrant of the Airport Road/Main Street intersection.

In summary, Alternative 3B has the top score for both the total raw score and normalized score from the evaluation. Alternatives 5A and 5B rank second depending on the evaluation score used for comparison.

Near-Term and Long-Term Recommendations

As part of this study, the PAC had an interest in identifying a preferred near-term and long-term alternative. This section presents our preliminary recommendations on the preferred near-term and long-term intersection improvements.

NEAR-TERM

Based on our evaluation of the alternatives, we would recommend that Alternative 2E – Triple Eastbound Left-Turns be considered as the preferred near-term alternative at the Airport Road/Main Street intersection. This intersection improvement includes four major components:

- adding a third eastbound left-turn lane,
- adding a southbound right-turn lane,
- restriping the westbound approach to improve lane alignment, and
- modifying the existing traffic signal for the geometric and left-turn phasing changes.

In the year 2040, this alternative improves the Airport Road/Main Street intersection operations by 15-20% from the no-build option. The intersection will operate at capacity (1.00) during the weekday a.m. peak hour and over-capacity (v/c of 1.12) during the weekday p.m. peak hour.

If implemented today, the intersection would operate under capacity today and Table 3 below summarizes the life span of this improvement assuming different growth projections at the intersection.

Table 4. Operational Lifespan of Alternative 2E – Triple Eastbound Left-Turns

Time Period	Current Intersection Configuration	With Alternative 2E In Place			
	Year 2015 Traffic Volumes	Year 2015 Traffic Volumes	@ 2% growth for 10 years	@ 3% growth for 10 years	@ 4% growth for 10 years
Weekday AM Peak Hour	LOS C V/C = 0.92	LOS B V/C = 0.73	LOS C V/C = 0.81	LOS D V/C = 0.88	LOS E V/C = 0.95
Weekday PM Peak Hour	LOS D V/C = 0.92	LOS C V/C = 0.80	LOS D V/C = 0.95	LOS E V/C = 1.04	LOS E V/C = 1.11

As shown in Table 4, Alternative 2E is projected to provide acceptable operations at the intersection for at least 10 years and potentially longer, depending on the growth scenario that occurs within Billings.

LONG-TERM

Based on our evaluation of the alternatives, we would recommend that Alternative 3B – Signalized Southwest Quadrant and Alternative 5B – Partial Displaced Left-Turn (Southwest Quadrant) be considered as the preferred long-term alternatives at the Airport Road/Main Street intersection.

Both of these alternatives provide significant operational benefit through the year 2040 to the Airport Road/Main Street intersection and adjacent intersections in the study area.

The two alternatives are significantly different in the geometric approach and types of improvements provided to address the long-term operational deficiency.

- **Alternative 3B** utilizes existing infrastructure (e.g. Aronson Road and Aronson Road/Airport Road interchange) to enhance the traffic operations through utilizing the available capacity that exists today on these underutilized facilities. However, route continuity on Airport Road to Main Street is changed for some of the movements with this alternative.
- **Alternative 5B** utilizes an alternative intersection form to improve operations at the Airport Road/ Main Street intersection. This alternative intersection form would be the first in the State of Montana. Although this intersection form is unique, route continuity is maintained for all movements on Airport Road to Main Street with this alternative. However, this alternative has a major impact to the parcel in the southwest quadrant of the Airport Road/Main Street intersection. This alternative has the most property impacts of the alternatives being considered, so it becomes a trade-off when comparing the two

alternatives with the operations, safety, land use, and implementation benefits and challenges.

At this time, the operational analysis presented for both of these alternatives is based on different operating environments. If these two alternatives are considered further as long-term solutions for this intersection, we would recommend that a VISSIM microsimulation model be developed to compare the traffic operations in a similar environment. This information can also be used to develop animation videos of the alternatives for future meetings with the PAC and at a future public informational meeting.

Next Steps

We identified the following items as next steps for completing the study after our PAC Meeting #3 and #4:

- KAI will prepare a VISSIM model for existing conditions as well as the two top ranking alternatives (3B and 5B) for use in comparing the two alternatives in the same operations environment and for use as videos at the public informational meeting.
- Present the evaluation results at a public informational meeting to obtain additional input from the public on the alternatives, scheduled for Wednesday, May 18, 2016.
- Based on the input from the PAC and public informational meeting on the alternatives, prepare the final study report for the preferred alternative.

If you have any questions, please contact Andy Daleiden via email at adaleiden@kittelson.com or by phone at 208.388.2683.

MONTANA MDT DEPARTMENT OF TRANSPORTATION

BILLINGS AIRPORT ROAD & MAIN STREET Concept

ALTERNATIVE 1 - NO BUILD
DESIGN CONCEPT
BILLINGS, MONTANA

SCALE: 1" = 100'

0 100' 200'

FIGURE 1-1

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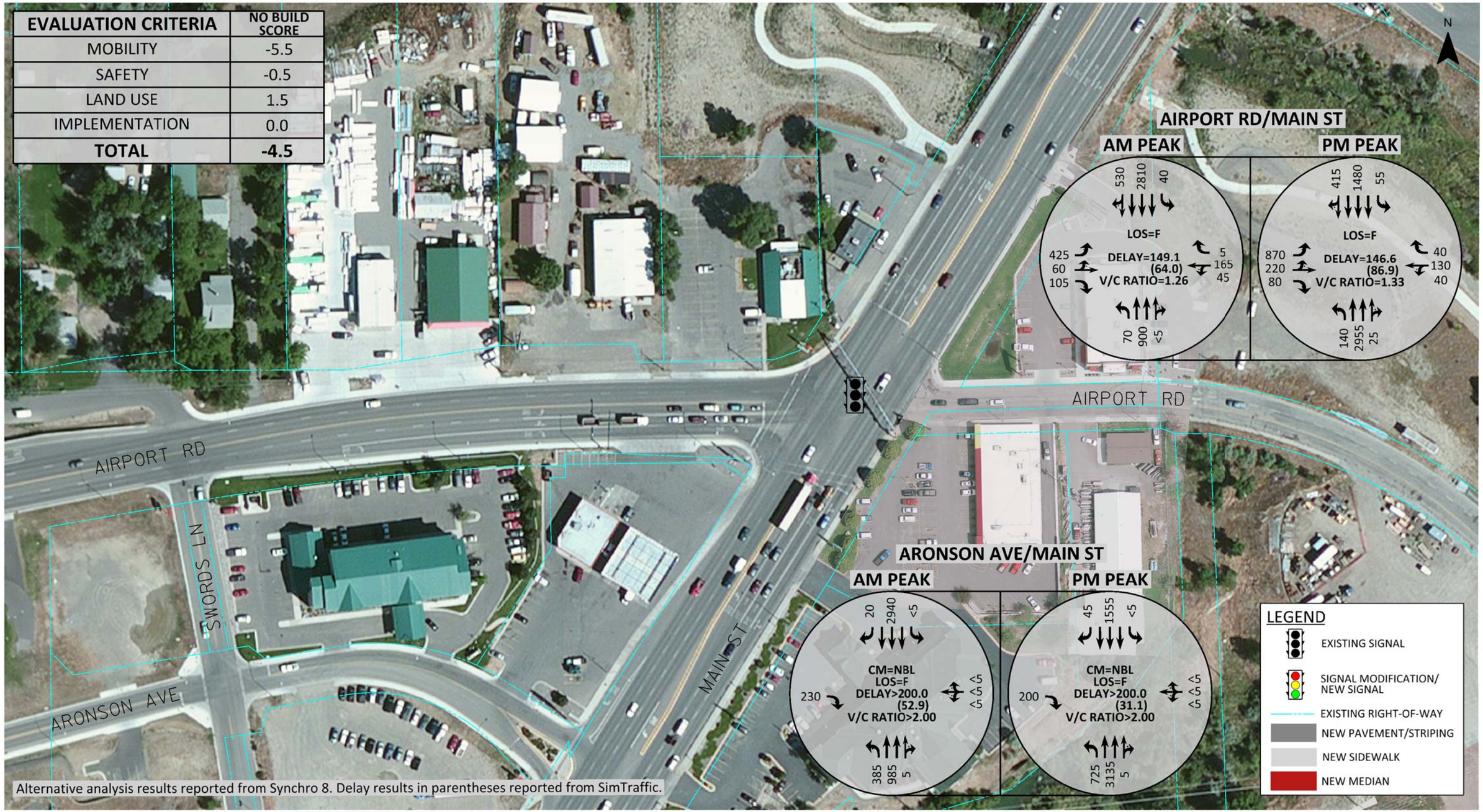
TRANSPORTATION ENGINEERING/PLANNING



EVALUATION CRITERIA	NO BUILD SCORE
MOBILITY	-5.5
SAFETY	-0.5
LAND USE	1.5
IMPLEMENTATION	0.0
TOTAL	**-4.5**

Alternative analysis results reported from Synchro 8. Delay results in parentheses reported from SimTraffic.

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BILLINGS AIRPORT ROAD & MAIN STREET Concept

ALTERNATIVE 1 - NO BUILD
EVALUATION RESULTS AND YEAR 2040 TRAFFIC VOLUMES AND OPERATIONS
BILLINGS, MONTANA

SCALE: 1" = 100'
0 100' 200'

FIGURE 1-2

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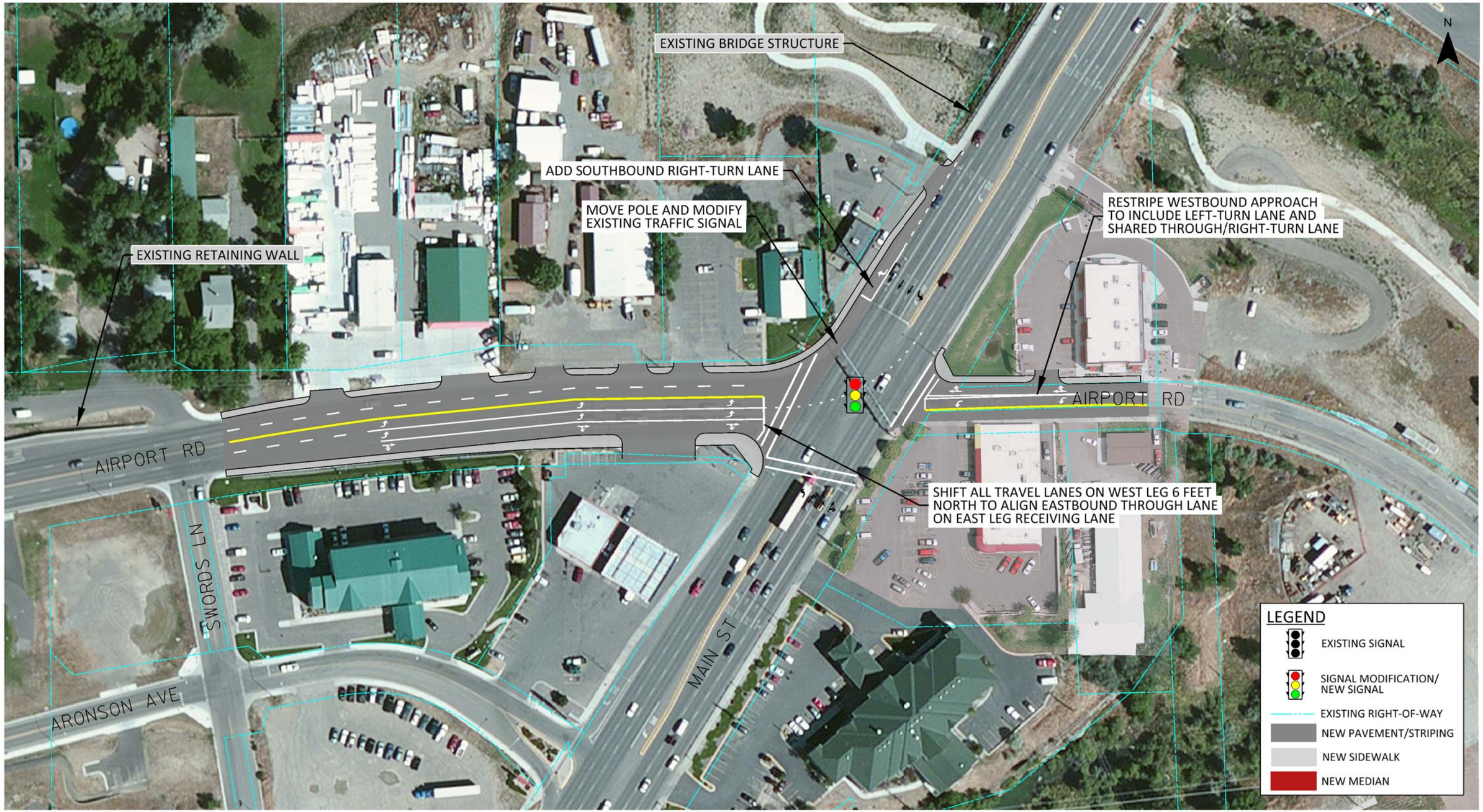
TRANSPORTATION ENGINEERING/PLANNING



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BILLINGS AIRPORT ROAD & MAIN STREET Concept

ALTERNATIVE 2D - DUAL EASTBOUND LEFT-TURN LANES AND SIGNAL PHASING MODIFICATION
DESIGN CONCEPT
BILLINGS, MONTANA

SCALE: 1" = 100'

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FIGURE 2-1

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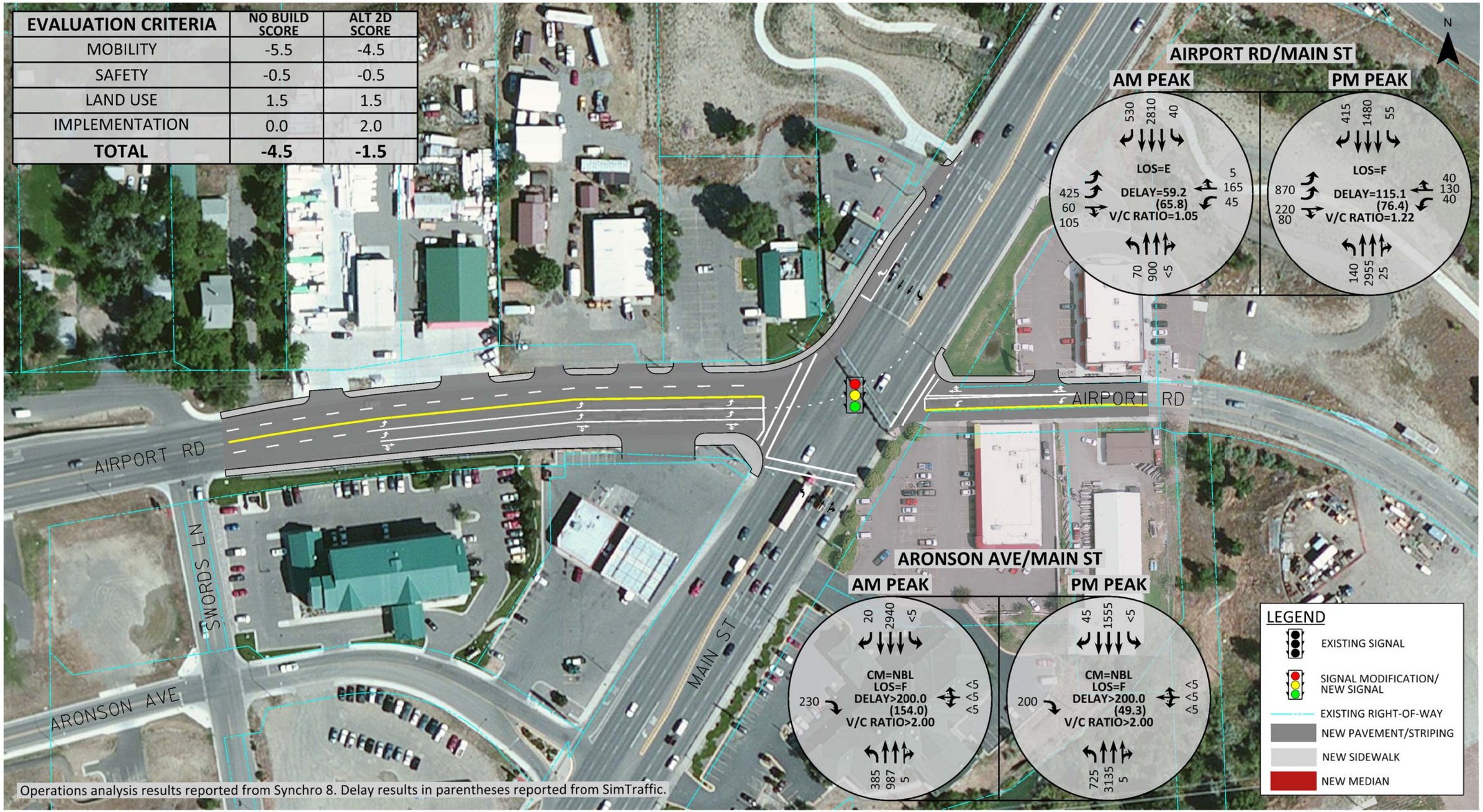
TRANSPORTATION ENGINEERING/PLANNING



EVALUATION CRITERIA	NO BUILD SCORE	ALT 2D SCORE
MOBILITY	-5.5	-4.5
SAFETY	-0.5	-0.5
LAND USE	1.5	1.5
IMPLEMENTATION	0.0	2.0
TOTAL	**-4.5**	**-1.5**

Operations analysis results reported from Synchro 8. Delay results in parentheses reported from SimTraffic.

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ALTERNATIVE 2D - DUAL EASTBOUND LEFT-TURN LANES AND SIGNAL PHASING MODIFICATION
EVALUATION RESULTS AND YEAR 2040 TRAFFIC VOLUMES AND OPERATIONS
BILLINGS, MONTANA

SCALE: 1" = 100'

0 100' 200'

FIGURE 2-2

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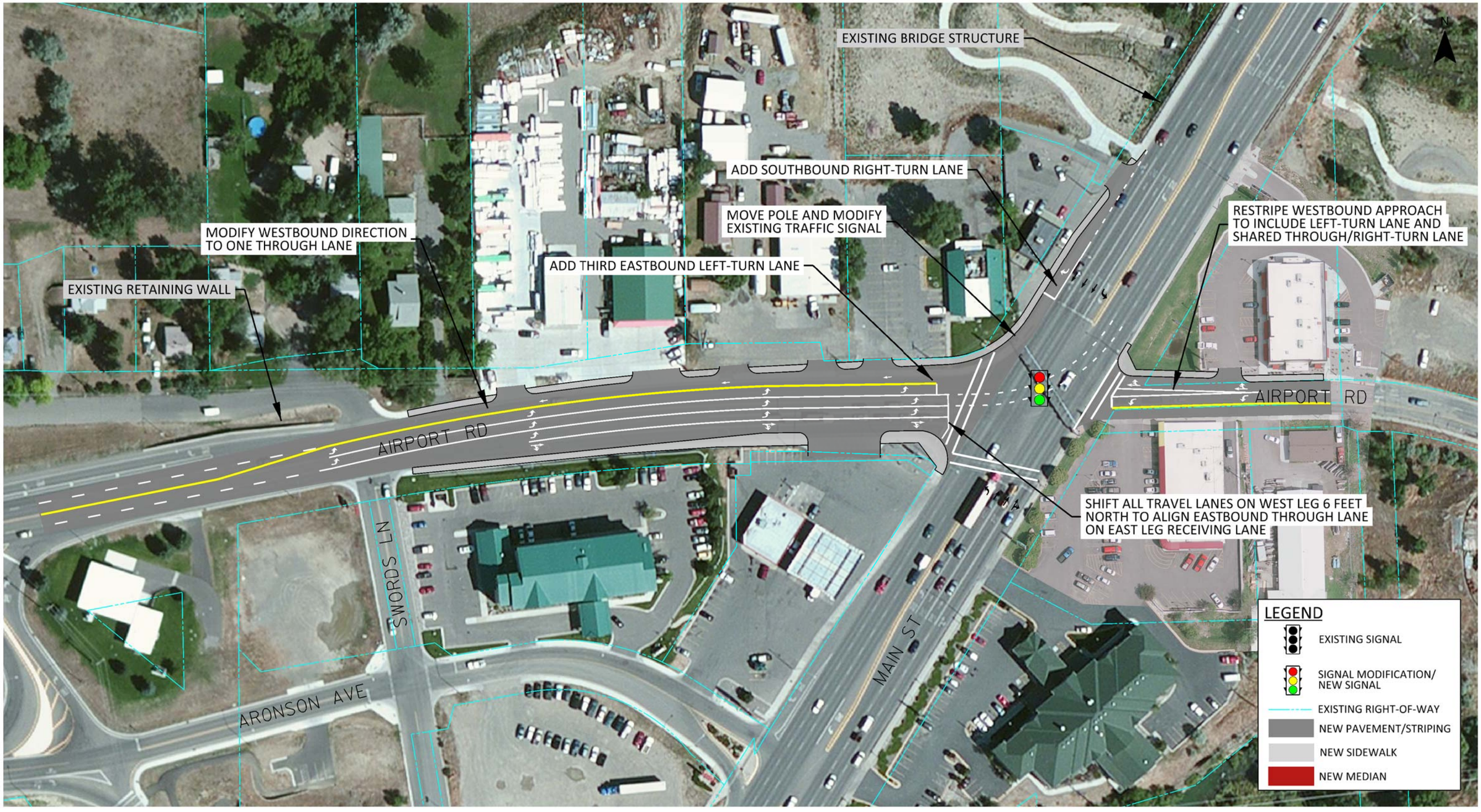
TRANSPORTATION ENGINEERING/PLANNING



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ALTERNATIVE 2E - TRIPLE EASTBOUND LEFT-TURN LANES AND SIGNAL PHASING MODIFICATION
DESIGN CONCEPT
BILLINGS, MONTANA

SCALE: 1" = 100'

0 100' 200'

FIGURE 3-1

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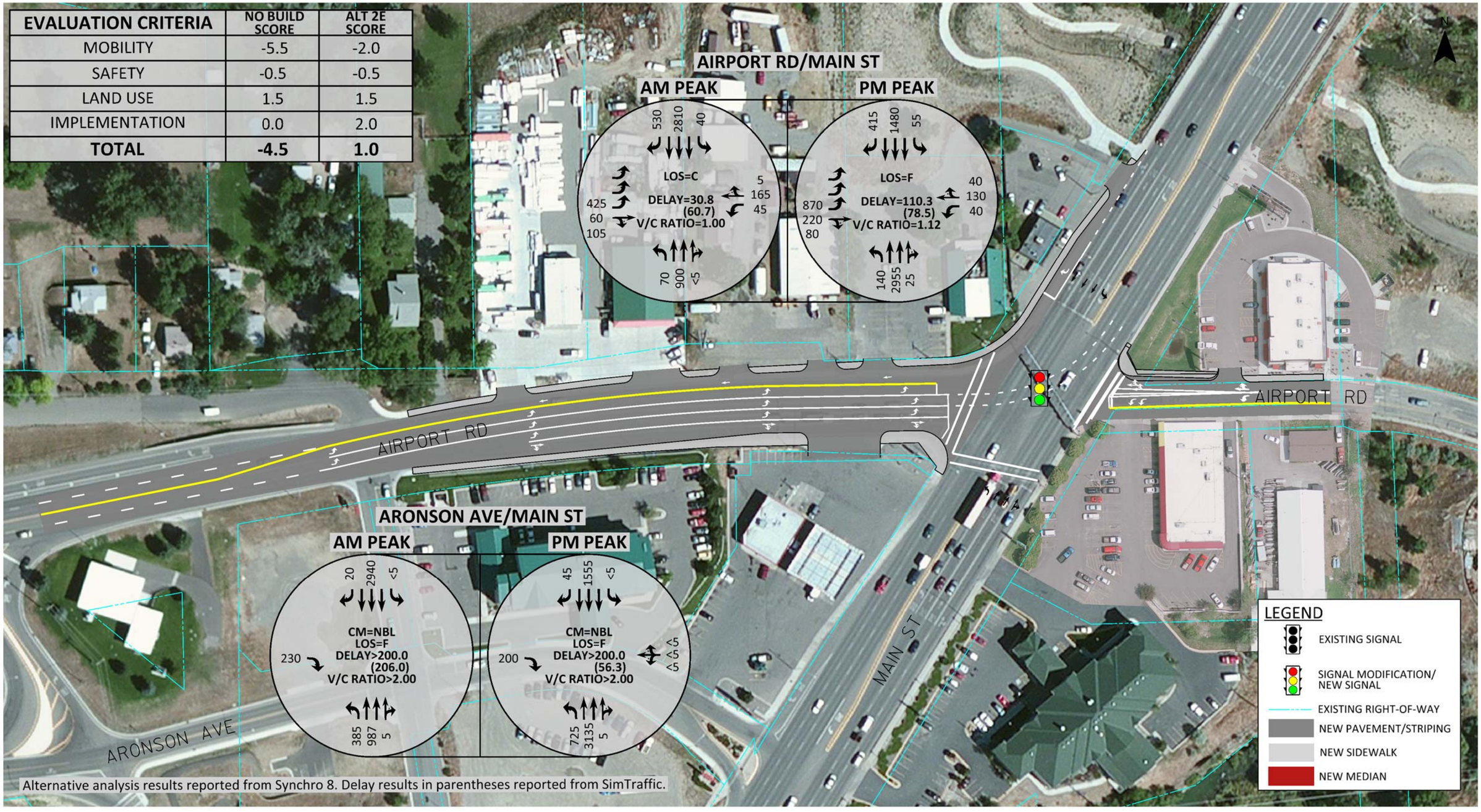


EVALUATION CRITERIA	NO BUILD SCORE	ALT 2E SCORE
MOBILITY	-5.5	-2.0
SAFETY	-0.5	-0.5
LAND USE	1.5	1.5
IMPLEMENTATION	0.0	2.0
TOTAL	**-4.5**	**1.0**

Alternative analysis results reported from Synchro 8. Delay results in parentheses reported from SimTraffic.

MONTANA MDT DEPARTMENT OF TRANSPORTATION

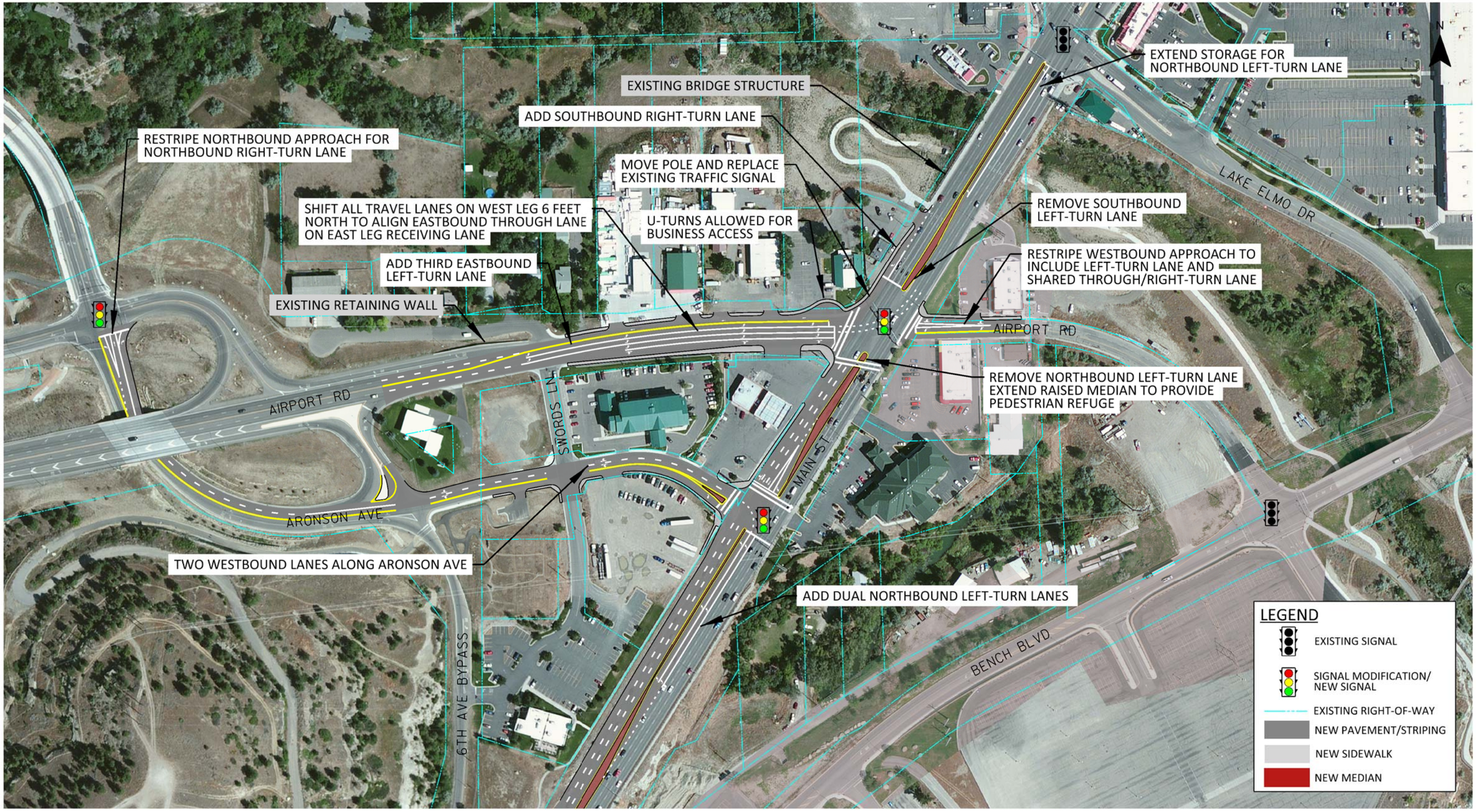
BILLINGS AIRPORT ROAD MAIN STREET Concept

ALTERNATIVE 2E - TRIPLE EASTBOUND LEFT-TURN LANES AND SIGNAL PHASING MODIFICATION
EVALUATION RESULTS AND YEAR 2040 TRAFFIC VOLUMES AND OPERATIONS
BILLINGS, MONTANA

SCALE: 1" = 100'
0 100' 200'

FIGURE 3-2

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING



MONTANA MDT DEPARTMENT OF TRANSPORTATION

BILLINGS AIRPORT ROAD & MAIN STREET Concept

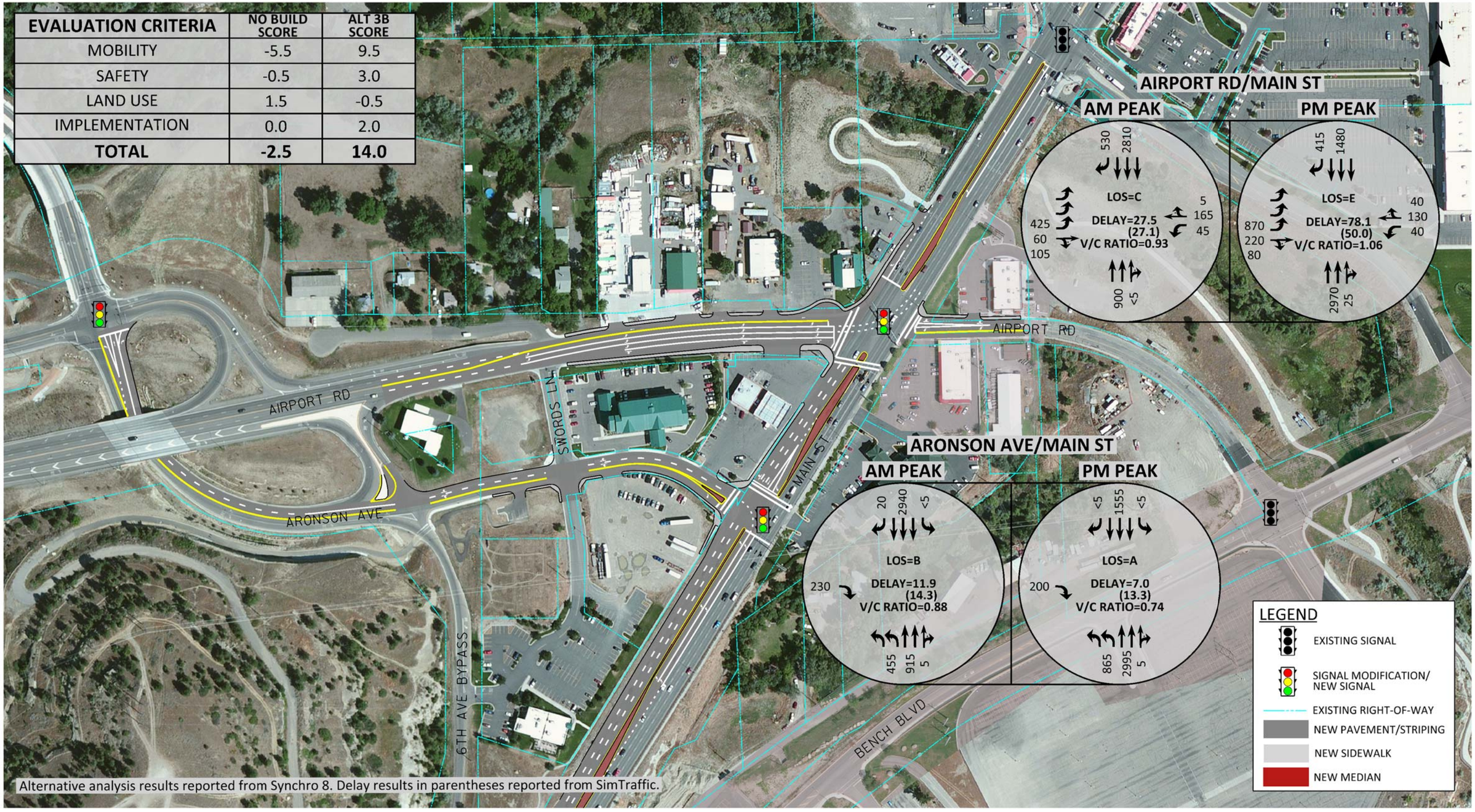
ALTERNATIVE 3B - SIGNALIZED SOUTHWEST QUADRANT
DESIGN CONCEPT
BILLINGS, MONTANA

SCALE: 1" = 200'

0 200' 400'

FIGURE 4-1

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING



EVALUATION CRITERIA	NO BUILD SCORE	ALT 3B SCORE
MOBILITY	-5.5	9.5
SAFETY	-0.5	3.0
LAND USE	1.5	-0.5
IMPLEMENTATION	0.0	2.0
TOTAL	**-2.5**	**14.0**

MONTANA MDT DEPARTMENT OF TRANSPORTATION

BILLINGS AIRPORT ROAD & MAIN STREET Concept

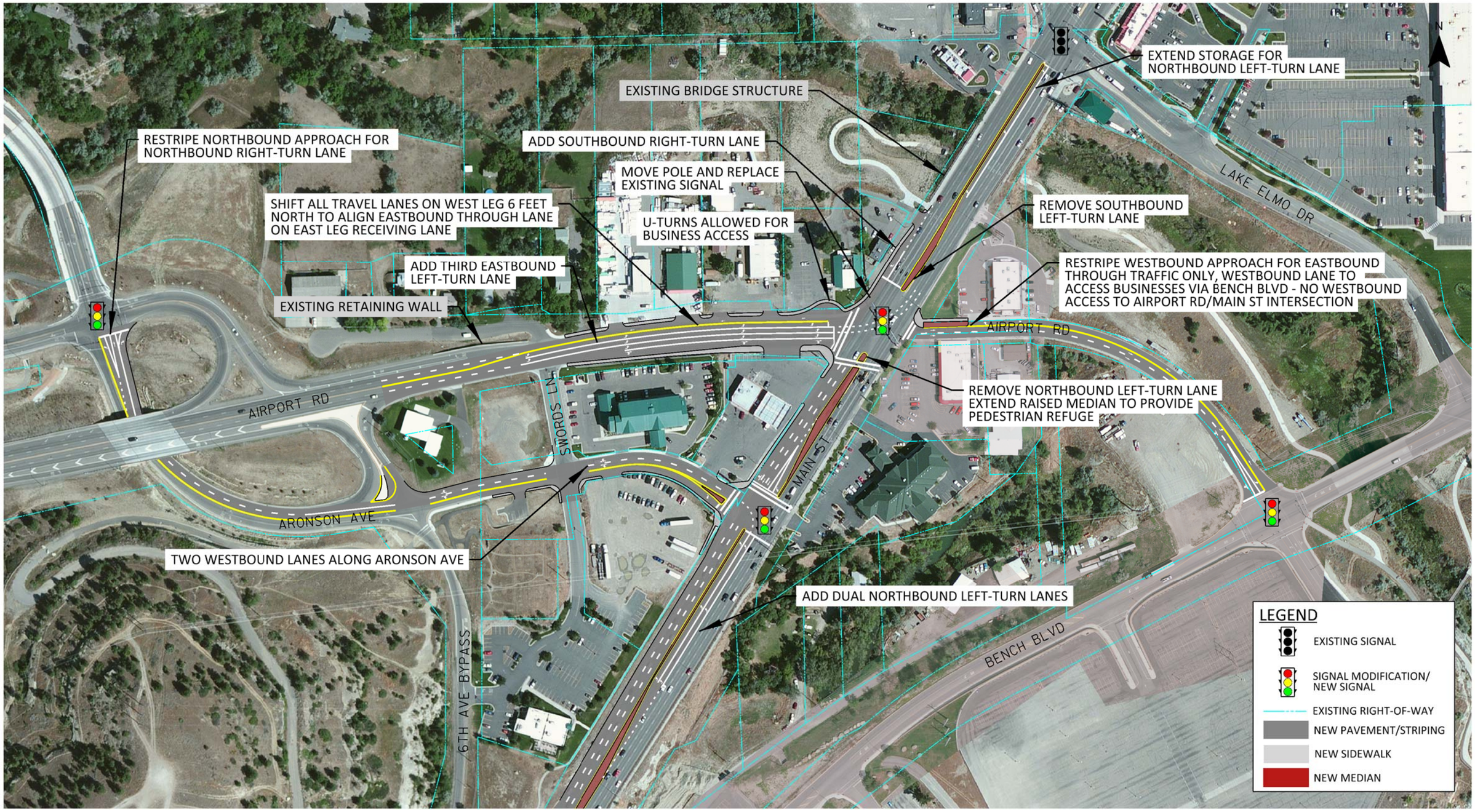
ALTERNATIVE 3B - SIGNALIZED SOUTHWEST QUADRANT
EVALUATION RESULTS AND YEAR 2040 TRAFFIC VOLUMES AND OPERATIONS
BILLINGS, MONTANA

SCALE: 1" = 200'

0 200' 400'

FIGURE 4-2

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING



MONTANA MDT DEPARTMENT OF TRANSPORTATION

BILLINGS AIRPORT ROAD & MAIN STREET Concept

ALTERNATIVE 4B - SIGNALIZED SOUTHWEST QUADRANT (ONE-WAY EASTBOUND ON E AIRPORT RD)
DESIGN CONCEPT
BILLINGS, MONTANA

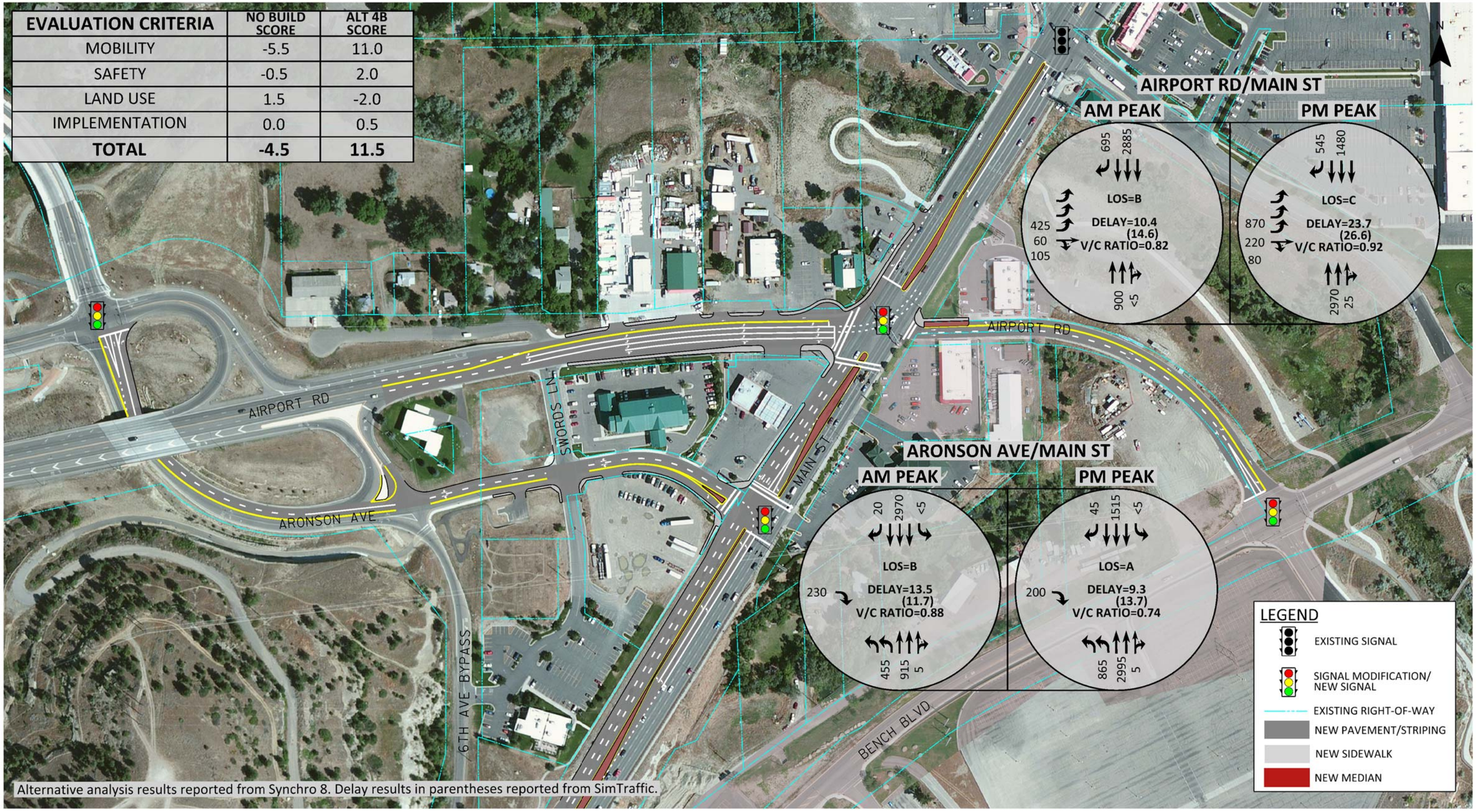
SCALE: 1" = 200'

0 200' 400'

FIGURE 5-1

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

EVALUATION CRITERIA	NO BUILD SCORE	ALT 4B SCORE
MOBILITY	-5.5	11.0
SAFETY	-0.5	2.0
LAND USE	1.5	-2.0
IMPLEMENTATION	0.0	0.5
TOTAL	**-4.5**	**11.5**



Alternative analysis results reported from Synchro 8. Delay results in parentheses reported from SimTraffic.

MONTANA MDT DEPARTMENT OF TRANSPORTATION

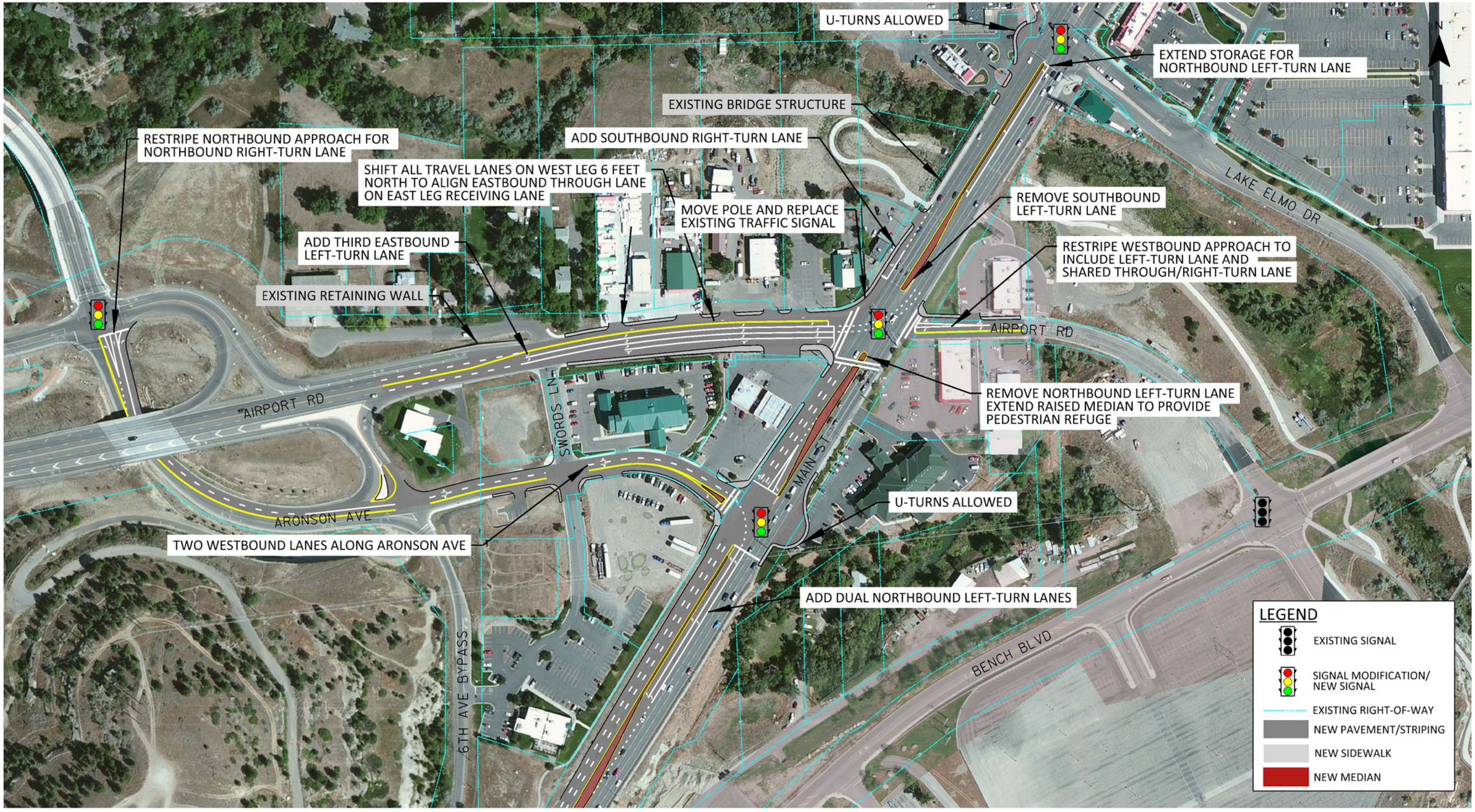
BILLINGS AIRPORT ROAD MAIN STREET Concept

ALTERNATIVE 4B - SIGNALIZED SOUTHWEST QUADRANT (ONE-WAY EASTBOUND ON E AIRPORT RD)
EVALUATION RESULTS AND YEAR 2040 TRAFFIC VOLUMES AND OPERATIONS
BILLINGS, MONTANA

SCALE: 1" = 200'
0 200' 400'

FIGURE 5-2

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING



MONTANA MDT DEPARTMENT OF TRANSPORTATION

BILLINGS AIRPORT ROAD & MAIN STREET Concept

ALTERNATIVE 5A - MEDIAN U-TURN (NORTH AND SOUTH)
DESIGN CONCEPT
BILLINGS, MONTANA

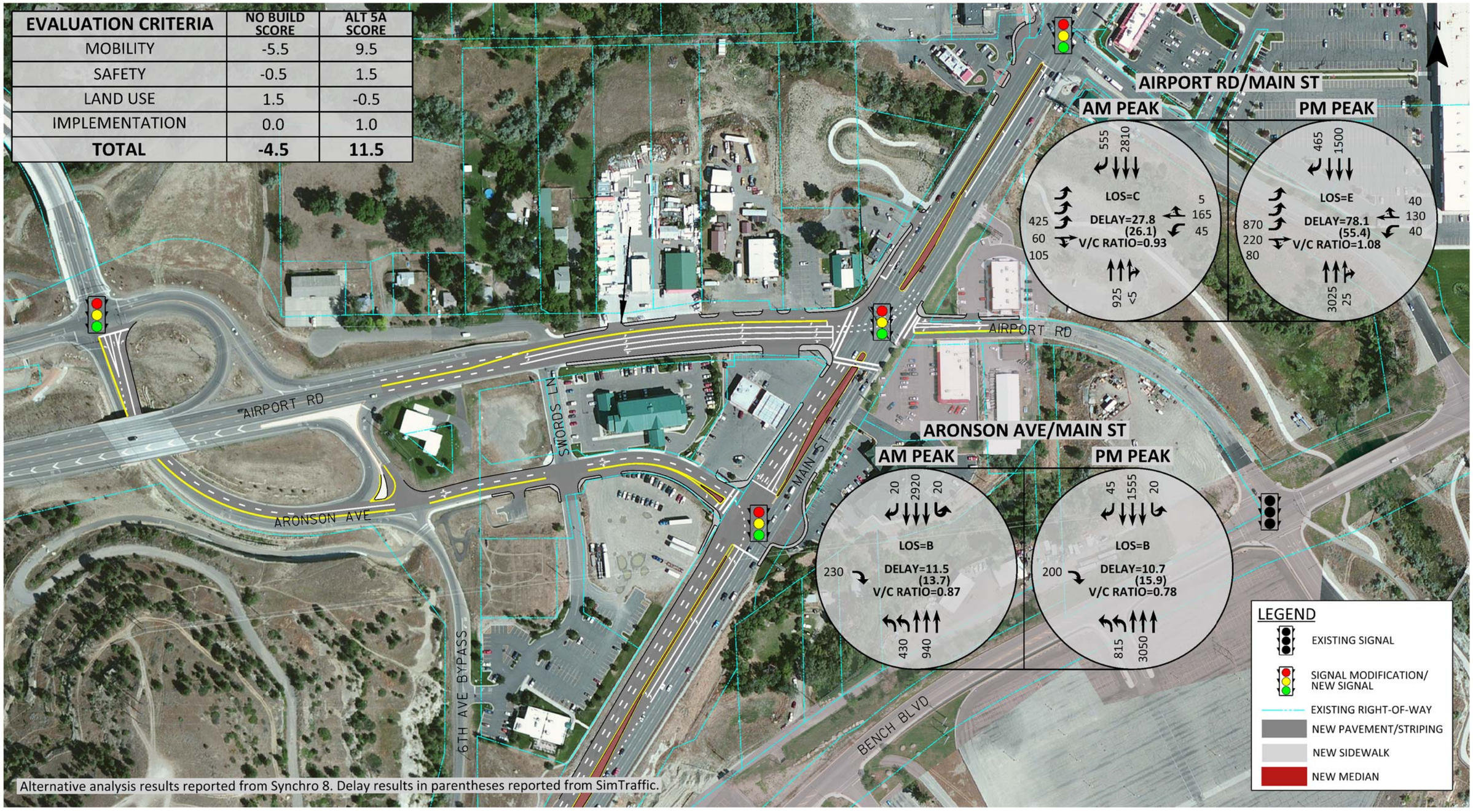
SCALE: 1" = 200'

0 200' 400'

FIGURE 6-1

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

EVALUATION CRITERIA	NO BUILD SCORE	ALT 5A SCORE
MOBILITY	-5.5	9.5
SAFETY	-0.5	1.5
LAND USE	1.5	-0.5
IMPLEMENTATION	0.0	1.0
TOTAL	**-4.5**	**11.5**



Alternative analysis results reported from Synchro 8. Delay results in parentheses reported from SimTraffic.

MONTANA MDT DEPARTMENT OF TRANSPORTATION

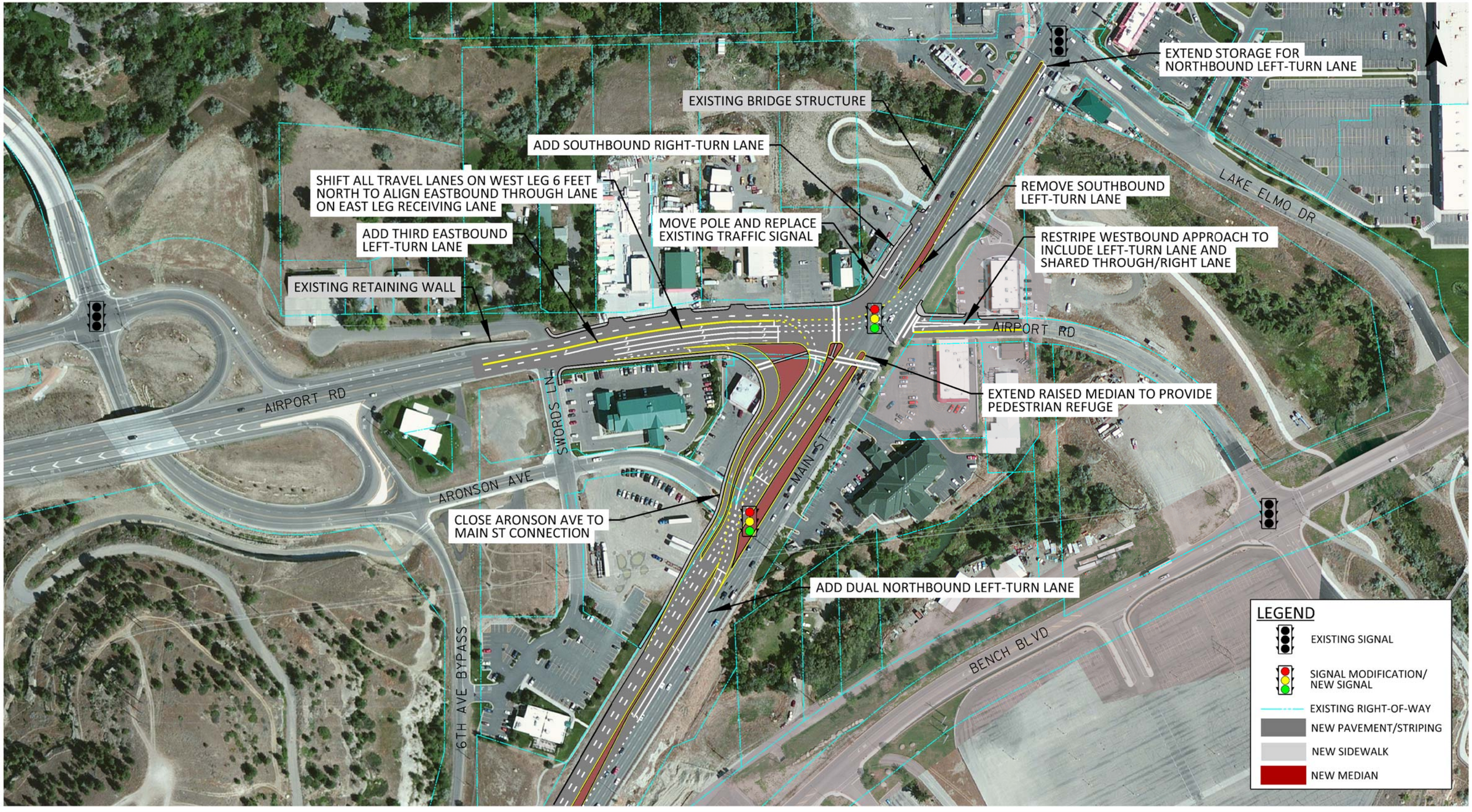
BILLINGS AIRPORT ROAD MAIN STREET Concept

ALTERNATIVE 5A - MEDIAN U-TURN (NORTH AND SOUTH)
EVALUATION RESULTS AND YEAR 2040 TRAFFIC VOLUMES AND OPERATIONS
BILLINGS, MONTANA

SCALE: 1" = 200'
0 200' 400'

FIGURE 6-2

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING



MONTANA MDT DEPARTMENT OF TRANSPORTATION

BILLINGS AIRPORT ROAD MAIN STREET Concept

ALTERNATIVE 5B - PARTIAL DISPLACED LEFT-TURN (SOUTHWEST QUADRANT)
DESIGN CONCEPT
BILLINGS, MONTANA

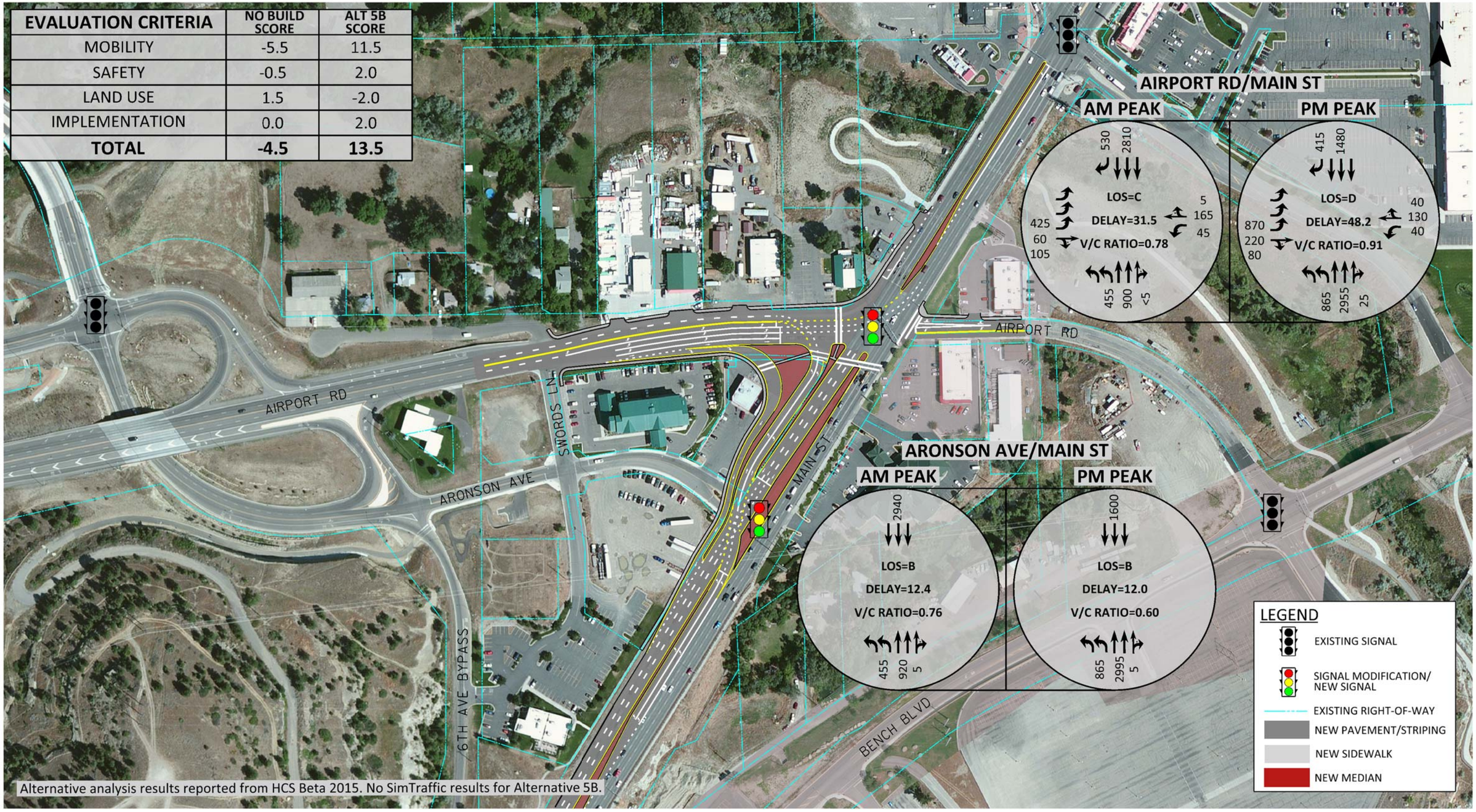
SCALE: 1" = 200'

0 200' 400'

FIGURE 7-1

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

EVALUATION CRITERIA	NO BUILD SCORE	ALT 5B SCORE
MOBILITY	-5.5	11.5
SAFETY	-0.5	2.0
LAND USE	1.5	-2.0
IMPLEMENTATION	0.0	2.0
TOTAL	**-4.5**	**13.5**



Alternative analysis results reported from HCS Beta 2015. No SimTraffic results for Alternative 5B.

MONTANA MDT DEPARTMENT OF TRANSPORTATION

BILLINGS AIRPORT ROAD MAIN STREET Concept

ALTERNATIVE 5B - PARTIAL DISPLACED LEFT-TURN (SOUTHWEST QUADRANT)
EVALUATION RESULTS AND YEAR 2040 TRAFFIC VOLUMES AND OPERATIONS
BILLINGS, MONTANA

SCALE: 1" = 200'
0 200' 400'

FIGURE 7-2

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Attachment A Cost Estimate Worksheets

Airport Rd/Main St - Billings, CM 1099(102), UPN 8718000

Task 006 - Preferred Alternatives - Cost Estimations

Alternative 2D - Dual Eastbound Left-Turn Lane and Signal Phasing Modification

Montana Department of Transportation

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Engineer's Estimate - Conceptual

Prepared By: Andy Daleiden, PE, Brett Korporaal, & Jesus Cuellar — *Date: February 17, 2016*

This Estimate has a Rating of: **2B** *(See rating scale guide below.)*

	ITEM	UNIT	TOTAL QUANTITY	UNIT PRICE	TOTAL COST
1	Excavation-Street (203020225)	CY	3,509	$ 13.96	$ 48,982.75
2	Removal of Obstructions (202020055)	% of Excavation	15%	$ 48,982.75	$ 7,347.41
3	Cold Milling - (411010000)	SY	2,318	$ 1.29	$ 2,989.83
4	Geotextile Stabilization (622011084)	SY	4,168	$ 1.29	$ 5,377.30
5	Crushed Aggregate Course (301020340)	CY	2,807	$ 24.13	$ 67,733.74
6	Plant Mix Surf GR S-3/4 (401020045)	TONS	2,108	$ 31.12	$ 65,600.92
7	Asphalt Cement PG 70-28 (402020095)	5.4% of Plant Mix	114	$ 670.09	$ 76,277.64
8	Cover Type II (409000020)	SY	6,486	$ 0.54	$ 3,502.52
9	Concrete Curbs, Standard Curb and Gutter (609010200)	LF	1,260	$ 27.84	$ 35,078.40
10	Sidewalk-Concrete 6" (608010050)	SY	1,131	$ 81.69	$ 92,419.98
11	Raised Median - Decorative Concrete 6" (608010112)	SY	0	$ 85.00	$ -
12	Concrete Driveways Approaches	EACH	8	$ 1,000.00	$ 8,000.00
13	Truncated Domes (617903255)	EACH	6	$ 971.96	$ 5,831.76
14	Striping and Pavement Markings - Urban	MILE	0.80	$ 20,000.00	$ 15,909.09
				Subtotal A	**$ 435,051**
15	Existing Traffic Signal System Modification (Airport Rd/Main St)	LS	1	$ 150,000	$ 150,000.00
16	New Traffic Signal System (Aronson Ave/Main St)	LS	0	$ 225,000	$ -
17	Prelim Signing - Urban (P61900110)	% of Subtotal A	2%	$ 435,051	$ 8,701.03
18	Utility Design Coordination (999107190)	% of Subtotal A	5%	$ 435,051	$ 21,752.57
19	Storm Sewer System, Complete	% of Subtotal A	15%	$ 435,051	$ 65,257.70
20	Mobilization	% of Subtotal A	18%	$ 435,051	$ 78,309.24
21	Temporary Protection & Direction of Traffic	% of Subtotal A	5%	$ 435,051	$ 21,752.57
22	Temporary Erosion Control (208010200)	% of Subtotal A	3%	$ 435,051	$ 13,051.54
				Subtotal B	**$ 358,825**
23	Right-of-Way Area	SF	0	$ 20.00	$ -
24	Construction/Right-of-Way Easement Area	% of Subtotal A & B	2%	$ 793,876	$ 15,877.52
25	Engineering Design & Construction Management	% of Subtotal A & B	30%	$ 793,876	$ 238,200.00
				Subtotal C	**$ 254,078**
				TOTAL PROJECT SUBTOTAL	**$ 1,047,954**
				25% Contingency	**$ 261,990**
				TOTAL ESTIMATED PROJECT COST	**$ 1,309,944**

Scope Accuracy:

Level 1: Project scope well understood and well defined.

Level 2: Project scope conceptual. Scope lacks detail due to potential permit requirements; Unknown project conditions; limited knowledge of external impacts.

Level 3: Project scope is a "vision" with limited detail.

Engineering Effort:

Level A: Preliminary engineering performed. Technical information is available, engineering calculations have been performed; clear understanding of the materials size and quantities needed to execute job. Schedule understood; staff and permitting is fairly clear, (however this element may still need refining). Project Development & Construction Contingencies ranges between 10%-20%.

Level B: Conceptual engineering performed. Technical information is available, rough engineering calculations may have been performed, or similar information from previous similar work is compared and used. Project Development Contingencies ranges between 15% to 25% and Construction Contingencies ranges between 20% to 30%.

Level C: No engineering performed. Educated guesstimating. Limited technical information available and/or analysis performed. Project Development and Construction Contingencies should be selected appropriately by Project Manager. Contingency may range up to 50%.

Airport Rd/Main St - Billings, CM 1099(102), UPN 8718000

Task 006 - Preferred Alternatives - Cost Estimations

Alternative 2E - Triple Eastbound Left-Turn Lane and Signal Phasing Modification

Montana Department of Transportation

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Engineer's Estimate - Conceptual

Prepared By: Andy Daleiden, PE, Brett Korporaal, & Jesus Cuellar — *Date: February 17, 2016*

This Estimate has a Rating of: **2B** *(See rating scale guide below.)*

	ITEM	UNIT	TOTAL QUANTITY	UNIT PRICE	TOTAL COST
1	Excavation-Street (203020225)	CY	3,545	$ 13.96	$ 49,486.86
2	Removal of Obstructions (202020055)	% of Excavation	15%	$ 49,486.86	$ 7,423.03
3	Cold Milling - (411010000)	SY	4,509	$ 1.29	$ 5,816.48
4	Geotextile Stabilization (622011084)	SY	4,211	$ 1.29	$ 5,432.64
5	Crushed Aggregate Course (301020340)	CY	2,836	$ 24.13	$ 68,430.82
6	Plant Mix Surf GR S-3/4 (401020045)	TONS	2,834	$ 31.12	$ 88,196.61
7	Asphalt Cement PG 70-28 (402020095)	5.4% of Plant Mix	153	$ 670.09	$ 102,550.83
8	Cover Type II (409000020)	SY	8,720	$ 0.54	$ 4,708.94
9	Concrete Curbs, Standard Curb and Gutter (609010200)	LF	1,605	$ 27.84	$ 44,683.20
10	Sidewalk-Concrete 6" (608010050)	SY	1,235	$ 81.69	$ 100,911.66
11	Raised Median - Decorative Concrete 6" (608010112)	SY	0	$ 85.00	$ -
12	Concrete Driveways Approaches	EACH	8	$ 1,000.00	$ 8,000.00
13	Truncated Domes (617903255)	EACH	6	$ 971.96	$ 5,831.76
14	Striping and Pavement Markings - Urban	MILE	1.23	$ 20,000.00	$ 24,526.52
				Subtotal A	**$ 515,999**
15	Existing Traffic Signal System Modification (Airport Rd/Main St)	LS	1	$ 150,000	$ 150,000.00
16	New Traffic Signal System (Aronson Ave/Main St)	LS	0	$ 225,000	$ -
17	Prelim Signing - Urban (P61900110)	% of Subtotal A	2%	$ 515,999	$ 10,319.99
18	Utility Relocation (999107000)	% of Subtotal A	5%	$ 515,999	$ 25,799.97
19	Storm Sewer System, Complete	% of Subtotal A	15%	$ 515,999	$ 77,399.90
20	Mobilization	% of Subtotal A	18%	$ 515,999	$ 92,879.88
21	Temporary Protection & Direction of Traffic	% of Subtotal A	5%	$ 515,999	$ 25,799.97
22	Temporary Erosion Control (208010200)	% of Subtotal A	3%	$ 515,999	$ 15,479.98
				Subtotal B	**$ 397,680**
23	Right-of-Way Area	SF	1,450	$ 20.00	$ 29,000.00
24	Construction/Right-of-Way Easement Area	% of Subtotal A & B	2%	$ 913,679	$ 18,273.58
25	Engineering Design & Construction Management	% of Subtotal A & B	30%	$ 913,679	$ 274,200.00
				Subtotal C	**$ 321,474**
				TOTAL PROJECT SUBTOTAL	**$ 1,235,153**
				25% Contingency	**$ 308,790**
				TOTAL ESTIMATED PROJECT COST	**$ 1,543,943**

Scope Accuracy:

Level 1: Project scope well understood and well defined.

Level 2: Project scope conceptual. Scope lacks detail due to potential permit requirements; Unknown project conditions; limited knowledge of external impacts.

Level 3: Project scope is a "vision" with limited detail.

Engineering Effort:

Level A: Preliminary engineering performed. Technical information is available, engineering calculations have been performed; clear understanding of the

Level B: Conceptual engineering performed. Technical information is available, rough engineering calculations may have been performed, or similar information from previous similar work is compared and used. Project Development Contingencies ranges between 15% to 25% and Construction Contingencies ranges between 20% to 30%.

Level C: No engineering performed. Educated guesstimating. Limited technical information available and/or analysis performed. Project Development and Construction Contingencies should be selected appropriately by Project Manager. Contingency may range up to 50%.

Airport Rd/Main St - Billings, CM 1099(102), UPN 8718000

Task 006 - Preferred Alternatives - Cost Estimations

Alternative 3B - Signalized Southwest Quadrant

Montana Department of Transportation

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Engineer's Estimate - Conceptual

Prepared By: Andy Daleiden, PE, Brett Korporaal, & Jesus Cuellar — *Date: February 17, 2016*

This Estimate has a Rating of: **2B** *(See rating scale guide below.)*

	ITEM	UNIT	TOTAL QUANTITY	UNIT PRICE	TOTAL COST
1	Excavation-Street (203020225)	CY	13,236	$ 13.96	$ 184,769.46
2	Removal of Obstructions (202020055)	% of Excavation	15%	$ 184,769.46	$ 27,715.42
3	Cold Milling - (411010000)	SY	6,641	$ 1.29	$ 8,566.50
4	Geotextile Stabilization (622011084)	SY	15,724	$ 1.29	$ 20,283.90
5	Crushed Aggregate Course (301020340)	CY	10,589	$ 24.13	$ 255,500.70
6	Plant Mix Surf GR S-3/4 (401020045)	TONS	7,269	$ 31.12	$ 226,196.07
7	Asphalt Cement PG 70-28 (402020095)	5.4% of Plant Mix	392	$ 670.09	$ 263,010.06
8	Cover Type II (409000020)	SY	22,365	$ 0.54	$ 12,076.91
9	Concrete Curbs, Standard Curb and Gutter (609010200)	LF	7,480	$ 27.84	$ 208,243.20
10	Sidewalk-Concrete 6" (608010050)	SY	1,931	$ 81.69	$ 157,747.47
11	Raised Median - Decorative Concrete 6" (608010112)	SY	1,596	$ 85.00	$ 135,621.75
12	Concrete Driveways Approaches	EACH	10	$ 1,000.00	$ 10,000.00
13	Truncated Domes (617903255)	EACH	10	$ 971.96	$ 9,719.60
14	Striping and Pavement Markings - Urban	MILE	3.55	$ 20,000.00	$ 71,060.61
				Subtotal A	**$ 1,590,512**
15	Existing Traffic Signal System Modification (Airport Rd/Main St)	LS	1	$ 150,000	$ 150,000.00
16	Existing Traffic Signal System Modification (Aronson Ave/Alkali Creek Rd)	LS	1	$ 50,000	$ 50,000.00
17	New Traffic Signal System (Aronson Ave/Main St)	LS	1	$ 225,000	$ 225,000.00
18	Prelim Signing - Urban (P61900110)	% of Subtotal A	3%	$ 1,590,512	$ 47,715.35
19	Utility Relocation (999107000)	% of Subtotal A	5%	$ 1,590,512	$ 79,525.58
20	Storm Sewer System, Complete	% of Subtotal A	15%	$ 1,590,512	$ 238,576.75
21	Mobilization	% of Subtotal A	18%	$ 1,590,512	$ 286,292.10
22	Temporary Protection & Direction of Traffic	% of Subtotal A	5%	$ 1,590,512	$ 79,525.58
23	Temporary Erosion Control (208010200)	% of Subtotal A	3%	$ 1,590,512	$ 47,715.35
				Subtotal B	**$ 1,204,351**
24	Right-of-Way Area	SF	3,080	$ 20.00	$ 61,600.00
25	Public Utility Easement Area	% of Subtotal A & B	2%	$ 2,794,862	$ 55,897.25
26	Engineering Design & Construction Management	% of Subtotal A & B	30%	$ 2,794,862	$ 838,458.71
				Subtotal C	**$ 955,956**
				TOTAL PROJECT SUBTOTAL	**$ 3,750,818**
				25% Contingency	**$ 937,710**
				TOTAL ESTIMATED PROJECT COST	**$ 4,688,528**

Scope Accuracy:

Level 1: Project scope well understood and well defined.

Level 2: Project scope conceptual. Scope lacks detail due to potential permit requirements; Unknown project conditions; limited knowledge of external impacts.

Level 3: Project scope is a "vision" with limited detail.

Engineering Effort:

Level A: Preliminary engineering performed. Technical information is available, engineering calculations have been performed; clear understanding of the materials size and quantities needed to execute job. Schedule understood; staff and permitting is fairly clear, (however this element may still need refining). Project Development & Construction Contingencies ranges between 10%-20%.

Level B: Conceptual engineering performed. Technical information is available, rough engineering calculations may have been performed, or similar information from previous similar work is compared and used. Project Development Contingencies ranges between 15% to 25% and Construction Contingencies ranges between 20% to 30%.

Level C: No engineering performed. Educated guesstimating. Limited technical information available and/or analysis performed. Project Development and Construction Contingencies should be selected appropriately by Project Manager. Contingency may range up to 50%.

Airport Rd/Main St - Billings, CM 1099(102), UPN 8718000

Task 006 - Preferred Alternatives - Cost Estimations

Alternative 4B - Signalized Southwest Quadrant (One-way Eastbound on E Airport Rd)

Montana Department of Transportation

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Engineer's Estimate - Conceptual

Prepared By: Andy Daleiden, PE, Brett Korporaal, & Jesus Cuellar — *Date: February 17, 2016*

This Estimate has a Rating of: **2B** *(See rating scale guide below.)*

	ITEM	UNIT	TOTAL QUANTITY	UNIT PRICE	TOTAL COST
1	Excavation-Street (203020225)	CY	13,236	$ 13.96	$ 184,769.46
2	Removal of Obstructions (202020055)	% of Excavation	15%	$ 184,769.46	$ 27,715.42
3	Cold Milling - (411010000)	SY	9,259	$ 1.29	$ 11,943.72
4	Geotextile Stabilization (622011084)	SY	15,724	$ 1.29	$ 20,283.90
5	Crushed Aggregate Course (301020340)	CY	10,589	$ 24.13	$ 255,500.70
6	Plant Mix Surf GR S-3/4 (401020045)	TONS	8,119	$ 31.12	$ 252,674.52
7	Asphalt Cement PG 70-28 (402020095)	5.4% of Plant Mix	438	$ 670.09	$ 293,797.95
8	Cover Type II (409000020)	SY	24,983	$ 0.54	$ 13,490.63
9	Concrete Curbs, Standard Curb and Gutter (609010200)	LF	7,405	$ 27.84	$ 206,155.20
10	Sidewalk-Concrete 6" (608010050)	SY	1,893	$ 81.69	$ 154,647.34
11	Raised Median - Decorative Concrete 6" (608010112)	SY	1,715	$ 85.00	$ 145,766.50
12	Concrete Driveways Approaches	EACH	9	$ 1,000.00	$ 9,000.00
13	Truncated Domes (617903255)	EACH	10	$ 971.96	$ 9,719.60
14	Striping and Pavement Markings - Urban	MILE	3.90	$ 20,000.00	$ 77,935.61
				Subtotal A	**$ 1,663,401**
15	Existing Traffic Signal System Modification (Airport Rd/Main St)	LS	1	$ 150,000	$ 150,000.00
16	Existing Traffic Signal System Modification	LS	2	$ 50,000	$ 100,000.00
17	New Traffic Signal System (Aronson Ave/Main St)	LS	1	$ 225,000	$ 225,000.00
18	Prelim Signing - Urban (P61900110)	% of Subtotal A	3%	$ 1,663,401	$ 49,902.02
19	Utility Relocation (999107000)	% of Subtotal A	5%	$ 1,663,401	$ 83,170.03
20	Storm Sewer System, Complete	% of Subtotal A	15%	$ 1,663,401	$ 249,510.08
21	Mobilization	% of Subtotal A	18%	$ 1,663,401	$ 299,412.10
22	Temporary Protection & Direction of Traffic	% of Subtotal A	5%	$ 1,663,401	$ 83,170.03
23	Temporary Erosion Control (208010200)	% of Subtotal A	3%	$ 1,663,401	$ 49,902.02
				Subtotal B	**$ 1,290,066**
24	Right-of-Way Area	SF	8,805	$ 20.00	$ 176,100.00
25	Public Utility Easement Area	% of Subtotal A & B	2%	$ 2,953,467	$ 59,069.34
26	Engineering Design & Construction Management	% of Subtotal A & B	30%	$ 2,953,467	$ 886,040.04
				Subtotal C	**$ 1,121,209**
				TOTAL PROJECT SUBTOTAL	**$ 4,074,676**
				25% Contingency	**$ 1,018,670**
				TOTAL ESTIMATED PROJECT COST	**$ 5,093,346**

Scope Accuracy:

Level 1: Project scope well understood and well defined.

Level 2: Project scope conceptual. Scope lacks detail due to potential permit requirements; Unknown project conditions; limited knowledge of external impacts.

Level 3: Project scope is a "vision" with limited detail.

Engineering Effort:

Level A: Preliminary engineering performed. Technical information is available, engineering calculations have been performed; clear understanding of the materials size and quantities needed to execute job. Schedule understood; staff and permitting is fairly clear, (however this element may still need refining). Project Development & Construction Contingencies ranges between 10%-20%.

Level B: Conceptual engineering performed. Technical information is available, rough engineering calculations may have been performed, or similar information from previous similar work is compared and used. Project Development Contingencies ranges between 15% to 25% and Construction Contingencies ranges between 20% to 30%.

Level C: No engineering performed. Educated guesstimating. Limited technical information available and/or analysis performed. Project Development and Construction Contingencies should be selected appropriately by Project Manager. Contingency may range up to 50%.

Airport Rd/Main St - Billings, CM 1099(102), UPN 8718000

Task 006 - Preferred Alternatives - Cost Estimations

Alternative 5A - Median U-Turn (North and South)

Montana Department of Transportation

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Engineer's Estimate - Conceptual

Prepared By: Andy Daleiden, PE, Brett Korporaal, & Jesus Cuellar — *Date: February 17, 2016*

This Estimate has a Rating of: **2B** *(See rating scale guide below.)*

	ITEM	UNIT	TOTAL QUANTITY	UNIT PRICE	TOTAL COST
1	Excavation-Street (203020225)	CY	14,742	$ 13.96	$ 205,793.46
2	Removal of Obstructions (202020055)	% of Excavation	15%	$ 205,793.46	$ 30,869.02
3	Cold Milling - (411010000)	SY	5,747	$ 1.29	$ 7,413.57
4	Geotextile Stabilization (622011084)	SY	17,513	$ 1.29	$ 22,591.90
5	Crushed Aggregate Course (301020340)	CY	11,793	$ 24.13	$ 284,572.85
6	Plant Mix Surf GR S-3/4 (401020045)	TONS	7,560	$ 31.12	$ 235,252.15
7	Asphalt Cement PG 70-28 (402020095)	5.4% of Plant Mix	408	$ 670.09	$ 273,540.04
8	Cover Type II (409000020)	SY	23,260	$ 0.54	$ 12,560.43
9	Concrete Curbs, Standard Curb and Gutter (609010200)	LF	8,050	$ 27.84	$ 224,112.00
10	Sidewalk-Concrete 6" (608010050)	SY	2,239	$ 81.69	$ 182,863.07
11	Raised Median - Decorative Concrete 6" (608010112)	SY	1,824	$ 85.00	$ 155,023.00
12	Concrete Driveways Approaches	EACH	13	$ 1,000.00	$ 13,000.00
13	Truncated Domes (617903255)	EACH	8	$ 971.96	$ 7,775.68
14	Striping and Pavement Markings - Urban	MILE	3.63	$ 20,000.00	$ 72,537.88
				Subtotal A	**$ 1,727,905**
15	Existing Traffic Signal System Modification (Airport Rd/Main St)	LS	1	$ 150,000	$ 150,000.00
16	Existing Traffic Signal System Modification	LS	2	$ 50,000	$ 100,000.00
17	New Traffic Signal System (Aronson Ave/Main St)	LS	1	$ 225,000	$ 225,000.00
18	Prelim Signing - Urban (P61900110)	% of Subtotal A	4%	$ 1,727,905	$ 69,116.20
19	Utility Relocation (999107000)	% of Subtotal A	5%	$ 1,727,905	$ 86,395.25
20	Storm Sewer System, Complete	% of Subtotal A	15%	$ 1,727,905	$ 259,185.75
21	Mobilization	% of Subtotal A	18%	$ 1,727,905	$ 311,022.90
22	Temporary Protection & Direction of Traffic	% of Subtotal A	5%	$ 1,727,905	$ 86,395.25
23	Temporary Erosion Control (208010200)	% of Subtotal A	3%	$ 1,727,905	$ 51,837.15
				Subtotal B	**$ 1,338,953**
24	Right-of-Way Area	SF	7,110	$ 20.00	$142,200.00
25	Public Utility Easement Area	% of Subtotal A & B	2%	$ 3,066,858	$61,400.00
26	Engineering Design & Construction Management	% of Subtotal A & B	30%	$ 3,066,858	$920,100.00
				Subtotal C	**$ 1,123,700**
				TOTAL PROJECT SUBTOTAL	**$ 4,190,558**
				25% Contingency	**$ 1,047,640**
				TOTAL ESTIMATED PROJECT COST	**$ 5,238,198**

Scope Accuracy:

Level 1: Project scope well understood and well defined.

Level 2: Project scope conceptual. Scope lacks detail due to potential permit requirements; Unknown project conditions; limited knowledge of external impacts.

Level 3: Project scope is a "vision" with limited detail.

Engineering Effort:

Level A: Preliminary engineering performed. Technical information is available, engineering calculations have been performed; clear understanding of the materials size and quantities needed to execute job. Schedule understood; staff and permitting is fairly clear, (however this element may still need refining). Project Development & Construction Contingencies ranges between 10%-20%.

Level B: Conceptual engineering performed. Technical information is available, rough engineering calculations may have been performed, or similar information from previous similar work is compared and used. Project Development Contingencies ranges between 15% to 25% and Construction Contingencies ranges between 20% to 30%.

Level C: No engineering performed. Educated guesstimating. Limited technical information available and/or analysis performed. Project Development and Construction Contingencies should be selected appropriately by Project Manager. Contingency may range up to 50%.

Airport Rd/Main St - Billings, CM 1099(102), UPN 8718000

Task 006 - Preferred Alternatives - Cost Estimations

Alternative 5B - Partial Displaced Left-Turn (Southwest Quadrant)

Montana Department of Transportation

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Engineer's Estimate - Conceptual

Prepared By: Andy Daleiden, PE, Brett Korporaal, & Jesus Cuellar — *Date: February 17, 2016*

This Estimate has a Rating of: **2B** *(See rating scale guide below.)*

	ITEM	UNIT	TOTAL QUANTITY	UNIT PRICE	TOTAL COST
1	Excavation-Street (203020225)	CY	15,796	$ 13.96	$ 220,516.08
2	Removal of Obstructions (202020055)	% of Excavation	15%	$ 220,516.08	$ 33,077.41
3	Cold Milling - (411010000)	SY	815	$ 1.29	$ 1,050.77
4	Geotextile Stabilization (622011084)	SY	18,766	$ 1.29	$ 24,208.14
5	Crushed Aggregate Course (301020340)	CY	12,637	$ 24.13	$ 304,931.40
6	Plant Mix Surf GR S-3/4 (401020045)	TONS	6,226	$ 31.12	$ 193,743.28
7	Asphalt Cement PG 70-28 (402020095)	5.4% of Plant Mix	336	$ 670.09	$ 225,275.49
8	Cover Type II (409000020)	SY	19,156	$ 0.54	$ 10,344.21
9	Concrete Curbs, Standard Curb and Gutter (609010200)	LF	15,515	$ 27.84	$ 431,937.60
10	Sidewalk-Concrete 6" (608010050)	SY	1,698	$ 81.69	$ 138,742.30
11	Raised Median - Decorative Concrete 6" (608010112)	SY	3,594	$ 85.00	$ 305,464.50
12	Concrete Driveways Approaches	EACH	5	$ 1,000.00	$ 5,000.00
13	Truncated Domes (617903255)	EACH	10	$ 971.96	$ 9,719.60
14	Striping and Pavement Markings - Urban	MILE	3.61	$ 20,000.00	$ 72,234.85
				Subtotal A	**$ 1,976,246**
15	New Traffic Signal System (Aronson Ave/Main St & Airport Rd/Main St)	LS	2	$ 225,000	$ 450,000.00
16	Prelim Signing - Urban (P61900110)	% of Subtotal A	5%	$ 1,976,246	$ 98,812.28
17	Utility Relocation (999107000)	% of Subtotal A	5%	$ 1,976,246	$ 98,812.28
18	Storm Sewer System, Complete	% of Subtotal A	15%	$ 1,976,246	$ 296,436.84
19	Mobilization	% of Subtotal A	18%	$ 1,976,246	$ 355,724.21
20	Temporary Protection & Direction of Traffic	% of Subtotal A	5%	$ 1,976,246	$ 98,812.28
21	Temporary Erosion Control (208010200)	% of Subtotal A	3%	$ 1,976,246	$ 59,287.37
				Subtotal B	**$ 1,457,885**
22	Right-of-Way Area	SF	52,970	$ 20.00	$ 1,059,400.00
23	Public Utility Easement Area	% of Subtotal A & B	2%	$ 3,434,131	$ 68,700.00
24	Engineering Design & Construction Management	% of Subtotal A & B	30%	$ 3,434,131	$ 1,030,300.00
				Subtotal C	**$ 2,158,400**
				TOTAL PROJECT SUBTOTAL	**$ 5,592,531**
				25% Contingency	**$ 1,398,140**
				TOTAL ESTIMATED PROJECT COST	**$ 6,990,671**

Scope Accuracy:

Level 1: Project scope well understood and well defined.

Level 2: Project scope conceptual. Scope lacks detail due to potential permit requirements; Unknown project conditions; limited knowledge of external impacts.

Level 3: Project scope is a "vision" with limited detail.

Engineering Effort:

Level A: Preliminary engineering performed. Technical information is available, engineering calculations have been performed; clear understanding of the materials size and quantities needed to execute job. Schedule understood; staff and permitting is fairly clear, (however this element may still need refining). Project Development & Construction Contingencies ranges between 10%-20%.

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Level C: No engineering performed. Educated guesstimating. Limited technical information available and/or analysis performed. Project Development and Construction Contingencies should be selected appropriately by Project Manager. Contingency may range up to 50%.