

Introduction

The Downtown Billings Partnership requested an evaluation of potential traffic calming measures for Montana Avenue from North 27th Street to North 22nd Street. Significant past and on-going redevelopment efforts within this area have revitalized businesses in this downtown area and have increased both vehicle and pedestrian activity. A recent streetscape project is part of revitalization efforts and has already contributed to significant improvements in aesthetics, traffic control, parking, and pedestrian safety. The study area is shown in the vicinity map included as Figure 1.

Figure 1 – Vicinity Map



Montana Avenue is a principal arterial street as identified by the Billings Urban Area Functional Classification System and is also the designated I-90 Business Route (eastbound) through downtown Billings. Montana Avenue in the study area currently exists as a 3-lane, one-way facility and carries traffic volume of between 13,000 and 8,500 vehicles per day between North 27th Street and North 22nd Street. Although posted with a 25 mph speed limit, traffic speeds, and volumes through the study area are perceived as incompatible with urban setting and current level of pedestrian activity. It is desired to utilize traffic calming techniques to improve area safety, reduce the impacts of vehicles on urban life, and to provide additional amenities to the area.

Interstate Engineering was retained by the City of Billings to perform a traffic calming study in order to define the problem, research existing physical and operational conditions in the corridor, develop specific project outcomes and objectives based on

community values and realities, and from there, develop strategies that would evolve into specific actions and schemes to satisfy the desired outcomes and objectives of the project.

Traffic calming affects a wide range of interests including pedestrians, motorists, businesses, and the municipal government. In order to understand the full range of interests and impacts to the community cross-section, a Project Guidance Committee (PGC) was formed. This committee included representatives from corridor businesses (retail, restaurants, technology, etc.), the City of Billings Traffic and Engineering Division, the City of Billings Parking Division, the Yellowstone County/City of Billings Planning Department, the City of Billings Police and Fire Departments, and the Yellowstone Regional Planning Association Traffic Advisory Board.

The goal of forming the committee was to make the project process an interactive one with fact-finding, good communications and understanding coupled with competent technical analysis. In this way, the committee was involved with defining community values and realities, and with helping form desired project outcomes and objectives along with specific actions and treatments to achieve those objectives. Formation of the committee was critical to plan development and community acceptance of traffic calming alternatives.

The process of selecting specific traffic calming methods to achieve project goals was one in which data was gathered, analyzed, and shared with the PGC to pinpoint problems, define where they exist, and determine what might be done to correct them. The process involved discussion with PGC members and the consultant team related to the findings of data gathering activities, potential improvement alternatives, and included a preference survey to define specific traffic calming treatments preferred for use in the corridor. The consult team provided technical input regarding how the treatments would impact the corridor environment, traffic operations, pedestrian safety, and other lifestyle qualities in the area. Data collection, analysis and interpretation, coupled with an understanding of alternative treatments and their impacts lead to development of a preferred alternative.

This report provides a summary of the project process, including the following steps:

- Data collection and analysis,
- Presentation of the data to the PGC,
- Discussion of documented and perceived problems in the corridor,
- Discussion of project values, realities, desired outcomes and objectives,
- Discussion on how the various alternatives were formed, and
- How the preferred alternative was selected for further refinement.

The impacts and concept level costs of the preferred alternative are also discussed.

Project Goals, Objectives, and Desired Outcomes

Traffic calming is defined as “the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users”. Traffic calming was pursued in this corridor to accomplish the overall goal of increasing the vitality of this downtown business area.

To accomplish the overall project goal, specific objectives were developed by the PGC. Project objectives generally were to reduce the negative impact of vehicle traffic, and create a pedestrian-friendly atmosphere throughout the project corridor.

In order to accomplish project objectives, the PGC developed a list of specific problems to be addressed through the use of traffic calming measures. Identification of the problems enabled the PGC to define specific desired outcomes of traffic calming measures, i.e. – it is desired to reduce traffic speeds to the posted 25 mph speed limit.

Through discussions in the first two PGC meetings, it became apparent that there are three main concerns or problem areas that are the underlying reason for pursuit of a traffic calming project. The problems focus on the following issues: vehicles speeding through the corridor, pedestrian safety, and parking availability. These three issues defined the desired project outcomes:

- Reduce Vehicle Speeds
- Improve Pedestrian Safety
- Increase Parking Availability.

While increasing parking availability is not a traffic calming objective, it can be an indirect result of other traffic calming measures implemented to achieve other desired outcomes.

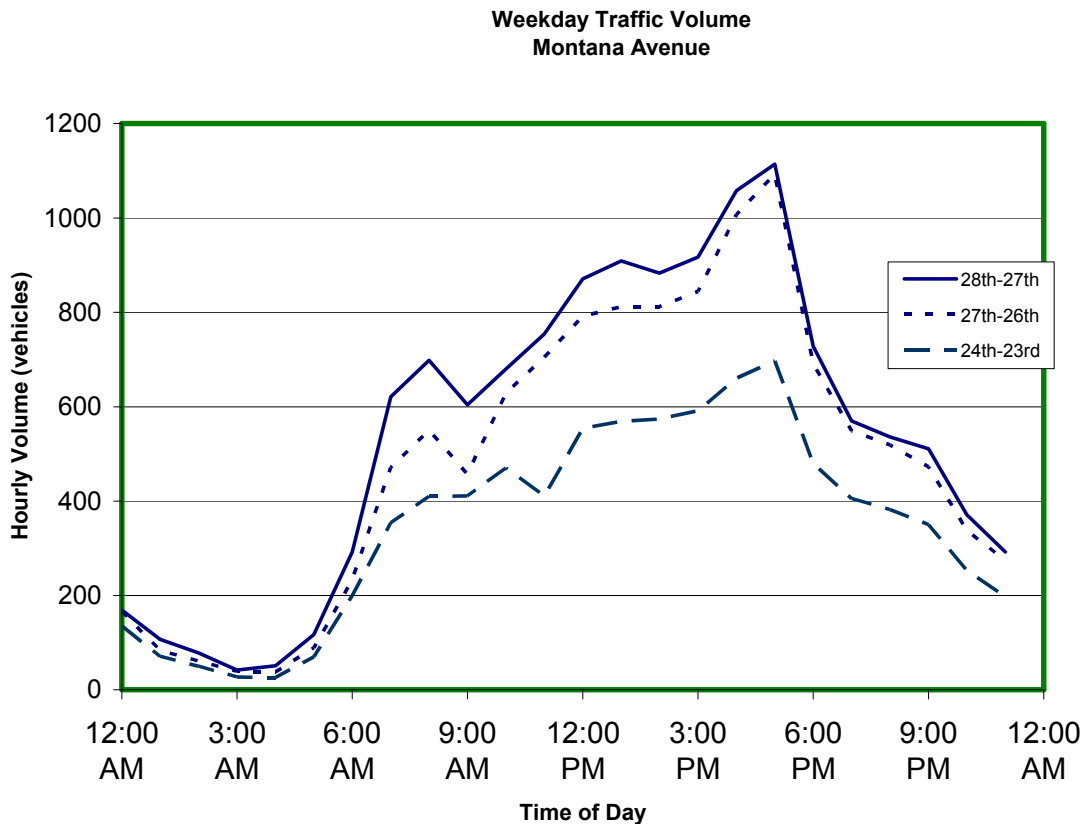
Identification of the desired outcomes allowed the PGC to choose preferred traffic calming measures that were focused and would lead to achieving overall project objectives. The resulting “preferred alternative” is documented later in this report. A look at the conditions that lead to defining these desired outcomes and objectives, and eventually to development of the preferred alternative, is detailed in subsequent sections.

Existing Conditions

In a preliminary kickoff meeting with the City of Billings, data collection needs were discussed. Data needs included daily traffic volume and speed data gathered by city forces using tube counters. This data was gathered so that volume and speed could be viewed by time-of-day and day-of-week. Having specific information helped to better refine and target the necessary traffic calming measures. Additionally, crash history for the past five years was gathered – including both intersection and non-intersection related crashes.

The traffic volume data revealed that approximately 13,000 vehicles per day (vpd) are traveling on Montana Avenue at the west end of the study area, and approximately 8,500 vpd are traveling on Montana Avenue at the east end of the study area (around North 22nd Street). Traffic varies with time-of-day, showing morning, noon and evening peaks, but generally building throughout the day. Peak traffic volume occurs during the evening “rush hour” between 5pm and 6pm. The variation of traffic volume by time-of-day at three locations within the study corridor is illustrated by Figure 2 below:

Figure 2 – Hourly Traffic Volume



Speed data was gathered at three different locations: Montana Avenue between 28th and 27th Streets, between 27th and 26th Streets, and between 24th and 23rd Streets. Analysis of the data revealed that in many locations throughout the corridor, speeding is a problem. The 85th percentile speed (the speed at which 85 percent of the vehicles are traveling at or below) is about four to seven miles per hour (mph) above the posted speed limit of 25 mph.

Crash data revealed that the highest intersection accident rate is 0.86 crashes per million entering vehicles. This rate occurred at the intersection of Montana Avenue and 27th Street. The highest roadway segment crash rate is 4.34 crashes per million vehicle miles. This occurred between 24th and 23rd streets. Neither the State of Montana nor the City of

Billings have compiled information to establish expected crash rates for similar facilities, but it is estimated through comparison with national statistics and other sources, that these rates fall within normal ranges for crash rates on similar type facilities.

Data Presentation

After the initial data collection and analysis, the results were presented to the PGC in an initial kickoff meeting in early August, 2003. This initial meeting also served to bring out some of the concerns of the PGC, particularly those who do business in the project corridor. After the presentation of the data, the underlying themes began to manifest themselves through comments aired by members of the PGC. Members expressed their concerns about vehicle speeds in the corridor, the apparent disregard for pedestrians by motorists, and emphasized the number of pedestrians crossing the street within the study corridor. It was felt by some of the PGC businessmen that new businesses may not want to locate to the corridor because of fear over pedestrian safety. Members also expressed concerns about the lack of parking. The potential that traffic calming measures would deter traffic from the corridor was also raised.

Additional Data Collection

Based on the comments, concerns, and questions from the first PGC meeting, additional data collection was undertaken to better answer and address some of the questions and concerns. Additional data collection included a pedestrian gap availability study in the corridor at 25th Street, gathering additional traffic volume data in the corridor at 26th Street for the purpose of performing a signal warrant study based on the pedestrian warrant, and taking intersection turning movement counts at area intersections where traffic could potentially divert.

The additional data was gathered by the City of Billings and Interstate Engineering during the months of August and September. The pedestrian gap study was performed during the hours of 11 a.m. to 1 p.m., and from 4 p.m. to 6 p.m. These hours were perceived by the PGC to have the highest pedestrian activity during the day and also contain the highest traffic volume. A spot speed study and pedestrian counts were performed during the same hours as the gap study to enable direct correlation of data.

Analysis of the gap data revealed that there are more than enough adequate gaps during all the hours surveyed for pedestrians to cross the street. Adequate gaps are defined as the amount of time it takes an average pedestrian to cross the street. Since the crossing distance is approximately 36 feet (three travel lanes), an assumed average walking speed of 4 feet per second yields an required gap time of 9 seconds to cross Montana Avenue. 60 gaps per hour is considered sufficient for unassisted pedestrian crossings. The gap data indicated that there are anywhere from 80 to 110 adequate gaps during the hours of heaviest pedestrian and traffic activity. The average time between acceptable gaps was found to be about 18 seconds. The longest gap recorded during the study period was about 53 seconds. It is observed and noted that the signal at 27th and Montana creates

good vehicle platoons as well as gaps in vehicle traffic, creating adequate gaps for pedestrians to cross Montana Avenue downstream between platoons.

A high number of jaywalkers were also observed during the gap study. This is an indication that pedestrians will utilize the most direct route rather than walk “out-of-direction” to utilize established pedestrian crosswalks. It was also noted that the heaviest pedestrian crossing activity is currently occurring between 27th and 25th Streets, rather than to the east of 25th Street as was perceived by the PGC.

The spot speed study revealed that 85th percentile speeds at 25th are about 29 mph during the evening hours and about 27 mph during the mid-day hours. An observation from doing spot speeds was the fact that most of the extremely high speeds (above 35 mph) were occurring in the right-most (south) travel lane. This is indicative of vehicles racing ahead trying to get back in the center lane before being forced to turn at 21st Street.

Additional traffic volume data revealed that a signal is not currently warranted at the intersection of Montana Avenue with 26th Street. The data also indicated that the intersection of Montana Avenue with 27th Street is currently operating at acceptable levels of service during peak traffic periods.

Development of Alternatives

2nd PGC Meeting

The additional data and analysis was brought before the PGC in a 2nd meeting in the beginning of September, 2003. The purpose of this meeting was to present additional data and analysis, quantify the magnitude and character of the problems, introduce available alternative treatments that could be used to target problems, and obtain feedback on the desirability of alternative treatments.

One of the meeting objectives was to quantify how much of a speed reduction was desired and how much diverted traffic was desired. It was discovered that intentionally diverting traffic was not a desire of the committee, but rather an acknowledgment that traffic would be diverted as a result of the treatments, and may have adverse impacts to area facilities not within the project corridor.

Attention then turned to discussion of specific traffic calming measures, how they might affect the performance of Montana Avenue, and how effective they may be in achieving the desired outcomes and objectives of the PGC. The various treatments were discussed one-by-one with graphics showing what a particular treatment might look like and how it might fit in to the project. It was noted that not all of the treatments could be tailored for use in the project area, but it was important for the PGC to see the entire “toolbox” of treatments. Available alternative traffic calming measures introduced are listed below:

- **Traffic Volume Control Measures**
 - Street or lane closures
 - Traffic diverters or semi-diverters

- Median barriers
- Forced turn islands
- **Traffic Speed Control Measures (vertical and horizontal measures)**
 - Speed humps or tables
 - Raised intersections
 - Raised crosswalks
 - Textured pavements
 - Traffic circles (intersection islands)
 - Roundabouts
 - Lateral shifts
 - Chicanes
 - Narrowings from road edge
 - Narrowings from road center
 - Chokers
 - Convert to 2-way street
- **Pedestrian Safety Measures**
 - Reallocation of right-of-way
 - drop one or more travel lanes
 - wider sidewalks
 - narrower lanes
 - add bike lanes
 - Street edge treatments
 - reduced building set-backs
 - street furniture
 - trees and other plantings
 - Warning signs
 - Warning beacons
 - In-pavement warning lights
 - Pedestrian signal(s)
 - In-roadway signing
- **Parking Availability Measures**
 - Change to angle parking (increase supply)
 - Install metered parking on-street (increase turnover)
 - Install metered parking off-street (increase turnover)
 - Construct additional off-street parking lots/structures (increase supply)
 - Require off-site “employee” parking (increase close-in supply)

The PGC members responded with their thoughts on different measures and talked about likes and dislikes. The PGC members were surveyed and asked to rate the various traffic calming measures based on how they thought the measure would work in the study area environment. PGC members were asked to complete and return the surveys within two weeks. PGC

members were also encouraged to make copies of the surveys and share them with colleagues and people outside the PGC circle. The purpose of the surveys was to assist with development of preliminary alternative “packages” of calming measures.

Three Alternative Scenarios

Throughout the previous two PGC meetings, some of the discussion focused on likes and dislikes of the various traffic calming treatments. This discussion, in addition to technical expertise on the effectiveness of the various treatments in accomplishing desired project outcomes and objectives, gave the technical staff a good base from which to start forming the three alternatives.

Three different alternative packages were developed for consideration by the PGC. They are described in the following paragraphs.

Alternative 1

Alternative 1 included a series of raised crosswalks throughout the corridor beginning at 26th street and occurring at every intersection to 22nd street. Additionally, raised intersections were proposed at 24th Street (speed table – rather than raised intersection) and 22nd Street. All raised intersections would include textured pavement. These vertical measures (particularly raised crosswalks) are most effective at reducing speeds and can effectively reduce speed throughout the corridor when used in a series as proposed. Additionally, the raised crosswalk enhances pedestrian safety not only by reducing speed of vehicles, but by making the pedestrian more visible to oncoming vehicles.

A forced left-turn for left lane traffic at 25th Street that provided “shadowing” for back-in angle parking on the north side of Montana Avenue for two blocks was also included. This measure results with an increased supply of on-street parking and also resulted with a narrower corridor width from the edge to give the feel of a more closed-in travel space. The combination of narrowing with a lateral shift at the east end of the corridor also enabled the introduction of a few new parallel parking spaces on the south side of Montana Avenue. The corridor narrowing also provides increased pedestrian safety because the distance to cross the street is reduced.

In-pavement warning lights were proposed as a pedestrian safety measure at the raised crosswalk at 26th Street since this location was the first crosswalk encountered in the study corridor and since crossing distance at this location was the greatest (three lane crossing). Finally, the corridor narrowing allowed for the introduction of a separate, exclusive right turn lane at 21st Street rather than a forced turn lane such as currently exists. A concept-level estimate of cost to implement this alternative is about \$274,000.

Alternative 2

Alternative 2 is almost an exact replica of Alternative 1 except that it provides parallel parking where back-in angle parking is proposed in Alternative 1. This alternative does not result with an increase to the on-street parking supply. Additionally, it was proposed to have textured pavement along the entire length of the corridor to provide a sense of a

more pedestrian friendly environment. A sub-alternative of Alternative 2 was to retain parallel parking at the existing curbs, not physically narrow the street, and put in a bike lane or other buffer between the parking and traffic lane. The purpose of this sub alternative was to overcome potential fire department if they could not support a physically narrower street. A concept-level cost estimate for this alternative was \$736,000. The dramatic increase from Alternative 1 is due to the increase in pavement texturing throughout the corridor.

Alternative 3

Alternative 3 is quite different from Alternatives 1 and 2. It has many of the same treatments such as raised crosswalks and intersections, textured pavement, lane drop, lateral shifts, and road narrowing. However, the location of the lane drop, lateral shift, and road narrowing are different. This alternative proposes to drop the north lane of Montana Avenue at 27th Street on the west side of the intersection, introduce a lateral shift between 27th and 25th Streets, and to split the two travel lanes with a raised center island starting between 25th and 24th Streets and continuing through the rest of the corridor. This alternative would have the advantage of reducing pedestrian crossing distances even more than previous alternatives. The distance to cross would only be one lane at a time. Pedestrians could cross to the center median, use that as a refuge, and cross the rest of the distance when it is clear. A concept-level cost estimate for this alternative was \$500,000.

Presentation of Alternatives to the PGC

Concept level plan view drawings of each alternative were presented to the PGC for review and discussion in a third meeting in October. Major discussion points and comments about the project alternatives are listed below.

- **Alt. 1** - A raised speed table at 24th Street provides too broad of an area for pedestrians to cross and would create a safety hazard with pedestrians become to casual about crossing and not pay attention to oncoming vehicles. Many PGC members desired a smaller raised crosswalk that gave a narrower and better definition to the crossing area.
- **Alt. 1** - There was a concern over unfamiliarity with back-in angle parking was also a big issue with certain members of the committee. It was felt that unfamiliar drivers might try to proceed the wrong direction up Montana Avenue to reach what would appear to be head-in angle parking.
- **Alt. 2** - Textured pavement along the entire corridor might be cost prohibitive – this is probably not a good treatment.
- **Alt. 2** - The noise that the textured pavement would produce if used along the entire corridor was a concern.
- **Alt. 2** - One suggestion was made to grind down to the old historic brick that is underneath the pavement. It was pointed out that the structural integrity of

the brick has been compromised by pavement cuts and utility work over the years where the brick was not restored.

- **Alt. 2** - PGC members expressed concerns about placing a bike lane between the parking and traffic lanes and had reservations about supporting this alternative. Comments also indicated that it would be desirable to reduce the magnitude of the lateral shift on the east end of the corridor and relax the transition for the right turn lane at 21st street so it was not so abrupt.
- **Alt. 3** – There were concerns over access to parking from side streets. Additional concerns included a scenario where if a vehicle was on the north side of the median, how would it access the parking areas on the south side of Montana.
- **All Alts.** - In-pavement warning lights were not favored because of maintenance issues in the snow. They were also not favored because some PGC members thought that a precedent might be set throughout the city in which all new crosswalks would be required to have the in-pavement warning lights.
- **All Alts.** - There were concerns with fire truck access into a narrow corridor and their ability to fight fires. The trucks need a minimum curb to curb distance to fight fires. A narrow corridor with lack of parking enforcement may be problematic. 28 feet of curb to curb distance should be okay.

Preferred Alternative

After some discussion, the PGC came to the consensus that Alternative 1 would be the preferred alternative, but with several modifications. They favored raised crosswalks for speed control and pedestrian safety. However, the PGC did not want raised intersections. The PGC wanted to eliminate the raised intersection and the two crosswalks at 24th Street and provide just one crosswalk. Additionally, they wanted only a raised crosswalk at 22nd, not a full raised intersection. The PGC also did not favor in pavement warning lights at the 26th Street raised crosswalk or anywhere else.

The PGC did not want to utilize textured pavement on any extended street segments – they only wanted the textured pavement at the raised crosswalks. As for the lane drop, street narrowing, and lateral shift, the PGC favored these treatments. Further, they favored using physical measures (raised curb, bulb outs) for these treatments rather than paint. The committee also favored placement of warning signs throughout the corridor to warn drivers of pedestrian activity and crosswalk locations.

The PGC generally also favored back-in angle parking. It was noted that this treatment can only go forward if the Montana Department of Transportation (MDT) approves. In light of this, the PGC desired to document and retain a sub alternative that would continue to utilize parallel parking if MDT does not allow the use of back-in angle parking.

Alternative 1, with its subsequent modifications by the PGC, has been selected to move forward as the preferred traffic calming alternative. This alternative provides actions and schemes that meet the desired project outcomes and objectives, which are:

- Reduce Vehicle Speeds
- Improve Pedestrian Safety
- Increase Parking Availability

The summary below lists the individual treatments utilized with the preferred alternative and indicates how the desired outcomes and objectives are achieved. The preferred traffic calming alternative treatments are graphically illustrated by figures in Appendix A of this Summary Report. A concept-level cost estimate for the preferred alternative shows design & construction costs of approximately \$305,000.

Measures Targeted at Reducing Vehicle Speeds:

- Raised crosswalks (speed humps/tables)
- Textured pavement (at raised crosswalks)
- Lateral shift
- Narrowing from road edge
- Chokers

It is estimated that the speed reduction measures will provide a 5 mph reduction of 85th percentile speeds throughout the study corridor.

Measures Targeted at Improving Pedestrian Safety:

- Raised crosswalks (speed humps/tables) – makes pedestrians more visible and slows vehicles
- Reallocation of right-of-way
 - Lane drop
 - Wider sidewalks
- Reduced pedestrian crossing distance
- Warning signs (not shown on graphic)

Pedestrian safety is improved through reduction of vehicle speeds (especially in close proximity to crosswalks), through a reduction of the pedestrian crossing distance, and through a reduction of the complexity of the crossing maneuver (crossing two lanes of traffic rather than three).

Measures Targeted at Increasing Parking Supply:

- Use of back-in angle parking
- Creation of new parallel parking area

Parking supply is increased through the conversion of parallel parking to angle parking (additional 10 parking spaces), and through the introduction of new parallel parking (additional 5 parking spaces).

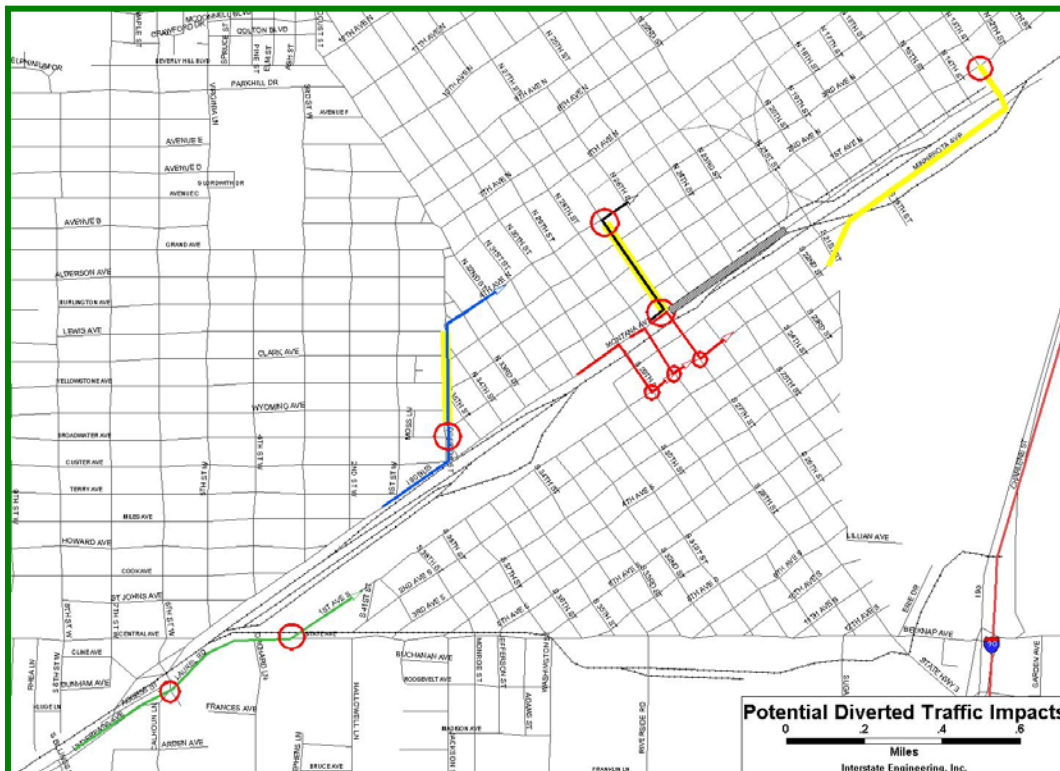
Impacts of Diverted Traffic

Because Montana Avenue is a major arterial and commuter route through Billings, a major discussion point of the PGC involved the impacts to surrounding roadway facilities from traffic that may divert away from Montana Avenue with the incorporation of traffic calming measures.

An analysis of the impacts of diverted traffic to surrounding roadway facilities was performed in order to quantify the impacts and determine if there would be negative effects caused by diverting traffic.

The first step was to identify major intersections along diversion routes that would be impacted. Interstate Engineering and the City of Billings determined that the State Street to 1st South corridor and the 4th North corridor would be major routes that diverting vehicles would utilize to avoid traffic calming measures on Montana Avenue. Intersections of concern along the State Street/1st South route included 6th West/State, 1st South/State, and 1st South/S 27th Street. Intersection of concern along the 4th North route would be the Division St./Broadwater Ave. intersection. Other potentially impacted intersections considered included Montana Avenue at 30th, 29th, and 28th Streets. These latter intersections were dropped from consideration because of the very low potential to carry diverting traffic. It was assumed that traffic this close to the project area would continue to travel through. Potential diversion routes and intersections of concern are shown in Figure 3.

Figure 3 – Potential Diversion Routes and Intersections of Concern



Analysis of Montana Avenue in the project area revealed that there would be no significant impacts to traffic operations on Montana Avenue due to lane reductions or other traffic calming measures that might restrict traffic flow. Even with two lanes, Montana Avenue has the capacity to carry the current volumes.

In order to appropriately determine the impacts of diverted traffic at the major intersections on potential diversion routes, an estimate of traffic that would potentially divert from Montana Avenue was made. This estimate assumed that 20 percent of the through traffic (about 220 vph) traveling past the Montana Avenue/25th Street intersection would divert at earlier locations. The estimate is based on case studies of similar facilities with similar traffic volumes located throughout the United States.

It was assumed that most of the major diversion would occur at the intersection of Division St./Broadwater Ave. and at points further west. Traffic was reduced proportionally according to the contribution of traffic at the Division/Broadwater intersection to the downstream traffic on Montana Avenue. Of the 20 percent that would divert from Montana Avenue, approximately 80 percent of these were assumed to be on Montana Avenue traveling eastbound (approximately 170 vph) at Division Street. Of the 170 vph, approximately 75 percent (about 130) were assumed to turn north at Division and travel to the 4th North diversion route. The other 25 percent (about 40 of the 170 vph) were assumed to exit Montana Avenue at the exit ramp just west of 6th Street West in order to travel the State Street to 1st South diversion route.

The other diverted traffic impacts at the Division/Broadwater intersection included right turns from Broadwater to go to Montana Avenue. It was assumed that approximately 40 of the 217 vph doing this movement would instead turn left from Broadwater onto Division to travel north to 4th North instead. There was some concern over the merging that vehicles are required to do to be in the right turn lane at 4th north, but the additional 40 vehicles will not likely affect the merge much more than what is currently occurring. This is aided by the fact that the majority of diverting vehicles were assumed to travel northbound on Division from Montana and would likely be in the correct lane to make the turn at 4th north as they traverse the Broadwater Ave. intersection, thus eliminating the need for a merging maneuver. Additionally, the northbound through and the eastbound left-turn vehicles proceed through the intersection on different signal phases.

With the additional traffic diverting through the Broadwater/Division intersection and the rearrangement of other turning movements, the impacts at this intersection will be negligible. The intersection currently operates at LOS "C" and will continue to do so with the diverted traffic

Impacts were also analyzed at the three major intersections along the other diversion route. These included an additional 40 vph to the left and through movements at the State/6th West, State/1st South, and 1st South/S 27th St intersections. These intersections currently operate at LOS "C" or better and will continue to operate at LOS "C" or better with the addition of diverted traffic.

A sensitivity analysis was performed at the major intersections along diversion routes in order to quantify the additional traffic necessary to reduce intersection operations to LOS D. The analysis revealed that a substantial amount of traffic (far above what is projected for the diverted traffic) can be added to these movements without dropping the overall and individual movement LOS below “D” at intersections of concern.

Impacts to other area intersections due to diverted traffic from the Montana Avenue corridor will be negligible.

APPENDIX A

CONCEPT PLAN -

PREFERRED ALTERNATIVE