# Blue Creek Area Transportation Study

## Final Report

Prepared For

City of Billings/Yellowstone County Board of Planning

Prepared By

Interstate Engineering, Inc.
Peaks to Plains Design

October 20, 2009

The preparation of this report has been financed in part through grant[s] from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(f)] of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

# Blue Creek Area Transportation Study
## Table of Contents

## List of Tables



## List of Figures

# SECTION 1 – PROJECT OVERVIEW

## Introduction

The City of Billings / Yellowstone County Planning Department has commissioned a Transportation Study of the Blue Creek area. This report documents the planning analysis results and recommendations of the **Blue Creek Area Transportation Study**. The development of this study was based on a series of six Working Papers that were prepared to document all of the transportation system evaluation, deficiencies analysis and alternative improvements analysis, as well as input received during the public involvement process.

This project was guided by a Project Guidance Committee (PGC) comprised of members of the City/County Planning Department, emergency service providers, the Montana Department of Transportation, and the general public. An extensive public involvement process was also implemented to obtain input from area residents, business owners, and developers.

### Project Guidance Committee (PGC) Members

Scott Walker, City/County Planning Department
Lora Mattox, City/County Planning Department
Sam Johnson, Yellowstone County Public Works Department
Stan Jonutis, Montana Department of Transportation
Bill Iverson, Area Resident
Delores Terpstra, Area Resident
Monica Weldon, Area Resident
Dick Weldon, Area Resident
Dick Schottlaender, Area Resident

The City/County Planning Department retained Interstate Engineering, Inc. to develop this Blue Creek Area Transportation Study. The Interstate Engineering team includes the firm of Peaks to Plains Design, PC. The project began in January, 2008 and was completed in October, 2009.

## Project Purpose

Transportation planning within the Billings Urban Area has been an ongoing process since the first formal transportation plan was prepared in 1961. The Billings Urban Area Transportation Plan has been updated in 1969, 1977, 1983, 1990, 2000, and 2005. The transportation planning process has been under the jurisdiction of the City/County Planning Board throughout its history, with assistance from the Montana Department of Transportation (MDT) and the Federal Highway Administration (FHWA). While the Blue Creek area has always been included in the overall Billings Urban Area Transportation Plan, it has not benefited from a detailed, focused assessment in the overall plan.

The purposes of this study are: 1) to document and analyze the Blue Creek Area surface transportation system, including the roadway network and pedestrian/bikeway facilities; 2) to identify deficiencies of the existing transportation system; 3) to project future growth and expected transportation demands and system improvements; 4) to identify alternative transportation system improvements to meet existing and future deficiencies; and 5) to recommend a prioritized list of short and long-range transportation system improvements together with planning-level cost estimates for implementation of improvements.

## Study Area

The extent of the study area for this project was determined with input from the PGC. Using Blue Creek Road as the spine of the study area, the study area boundary was initially set utilizing Traffic Analysis Zone (TAZ) boundaries inherent in the urban transportation model of the Billings area and the Crow Indian Reservation boundary. Through discussions with the PGC, the initial study area boundary was modified on the east to extend only as far as the Blue Creek watershed boundary. Although the Crow Indian Reservation boundary is utilized as the southeast extent of the study area, the PGC also suggested that Blue Creek Road itself be considered within the study area all the way to its intersection with Pryor Creek Road. The study area is shown in Figure 1.

## Public Involvement Process

Public involvement and input are essential to the success of any transportation plan. As previously indicated, the Blue Creek Area Transportation Study was developed with considerable public and agency input. To allow ample opportunity for public involvement throughout the transportation planning process, the following actions were taken:

- Formation of a Project Guidance Committee consisting of representatives from government agencies, emergency service providers, and study area residents.
- Conducted two (2) general public meetings to gain input on current issues and deficiencies, and to provide input/comment regarding the study results. In addition to announcements in the local newspaper, post card were mailed to raise awareness of the public meetings.
- Conducted four (4) Stakeholder Meetings to gather study input that was focused on specific geographic areas of the study area. Post cards were mailed to raise awareness of the stakeholder meetings and to improve public participation.
- Study products (working papers and draft/final reports) were made available on line through the City of Billings' Web site.

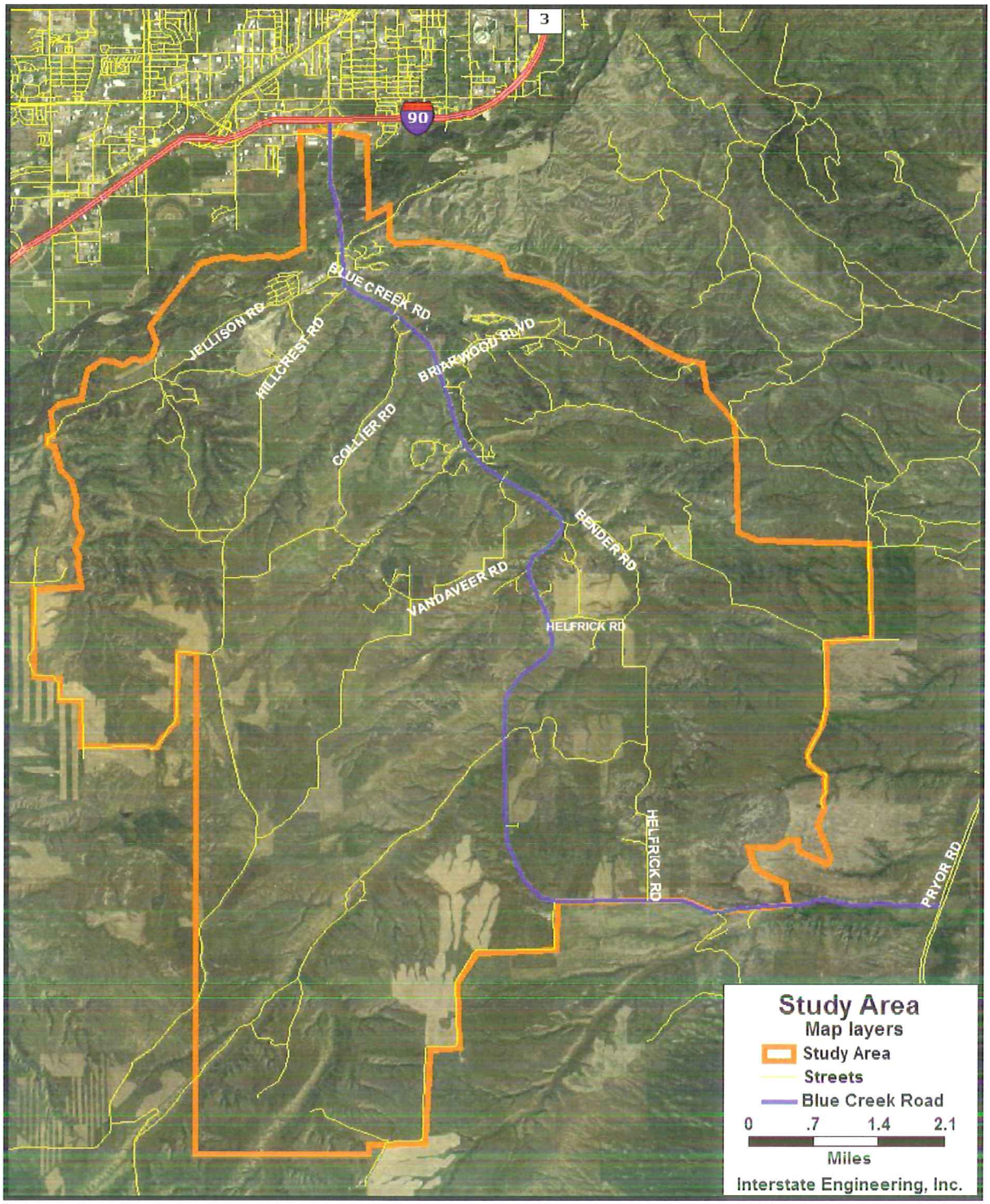



Figure 1 – Study Area

# SECTION 2 – EXISTING CONDITIONS

## Streets & Highways

The study area includes all or portions of 33 city streets, 59 county roads, and one State Secondary Highway. Blue Creek Road (MT S-416) runs approximately north and south through the center of the study area. The following table summarizes the city streets and county roads in the study region.

Study Area Streets

| City Streets | County Roads | |
|---|---|---|
| ABERDARE RD | ACER DR | LUPINE RD |
| BAY HILLS RD | ALDONNA RD | MACDUFF CIR |
| BOWMAN DR | AQUI ESTA | MARLENE ST |
| BRIARWOOD BLVD | AVIEMORE CT | MOONSHINE TRL |
| CARDIFF RD | BASIN CREEK RD | OLD BLUE CREEK RD |
| CASTLE PINES DR | BENDER RD | QUANTA LN |
| CHIVAS RD | BESTROM CIR | REXENE DR |
| CLUBHOUSE | BILLINGS BLVD | RICHARD ST |
| COMYN COOLEE | BOLLINGER LN | ROBINDALE DR |
| CONDO DR | BRISTLECONE PL | S BILLINGS BLVD |
| DENBIGH CT | CHURCHILL DOWNS | SECRET VALLEY DR |
| DONEGAL CT | COLLEEN LN | SHAIA WAY |
| DOZER RD | COLLIER RD | SHARON DR |
| DUMBARTON RD | CORMIER RD | SOUTHRIDGE RD |
| FIFE CIR | DANI ST | STAR PASS TRL |
| GLENFINNAN RD | DAWN LN | STEVE ST |
| JOHN O GROATS CT | DEER PARK RD | STRATTON RD |
| KINCAID RD | DESERT ROSE LN | SUMAC DR |
| LLANELLY CT | DWAYNE ST | SUNFLOWER DR |
| MACTAVISH CIR | ED ST | THORTON RD |
| MCMASTERS RD | FRITZ RD | TOBOGGAN RD |
| PENLLECH RD | HELFRICK RD | VANDAVEER RD |
| PERTH CIR | HEYU COW RANCH RD | VISTA BLUE CIR |
| PRESTWICK RD | HILLCREST RD | WELDON RD |
| ROSEMONT WAY | HOLLOW TREE RD | WILLOW DR |
| SAN FERNANDO DR | JACK ST | |
| SANTA ROSA LN | JELLISON RD | |
| SANTIAGO BLVD | JENE HELENE AVE | |
| SHASTA LN | JIM ST | |
| SONORA LN | KAY MARIE DR | |
| TARTAN RD | KELLER RD | |
| TROON CIR | KELSO | |
| TURNBERRY CIR | LITTLE CREEK LN | |

Blue Creek Road (S-416) runs for just under 15 miles through the study area. Blue Creek Road provides an arterial connection between Interstate 90 and Pryor Creek Road. Blue

Creek Road is the only facility within the study area under the jurisdiction of the Montana Department of Transportation (MDT). Blue Creek Road is paved over its entire length and constitutes over half of the total miles of paved roads within the study area.

In total, 124.2 miles of roads exist within the study area. Not including Blue Creek Road, only 7.4 miles of paved roads exist within the study area. The remaining 88 miles of roads in the study area are gravel surfaced. Figure 2 shows surface types for roads within the study area.

## Traffic Volume

Average weekday traffic volumes were evaluated on 5 different sections of Blue Creek Road and 8 roads intersecting with Blue Creek Road. Volumes were determined from a seven day count conducted November 1-7, 2007 by the City of Billings Traffic Division. Table 1 summarizes traffic volume counts taken within the study area. Count locations and average weekday volumes are shown graphically in Figure 3.

Table 1 - Traffic Count Summary

| LOCATION | 2007 AVERAGE WEEKDAY TRAFFIC |
|---|---|
| Blue Creek Rd. south of Midland Rd. | 9,400 |
| Santiago Blvd. east of Blue Creek Rd. | 700 |
| Jellison Rd. west of Blue Creek Rd. | 2,800 |
| Hillcrest Rd. west of Blue Creek Rd. | 900 |
| Blue Creek Rd. south of Hillcrest Rd. | 5,000 |
| Collier Rd. wet of Blue Creek Rd. | 120 |
| Briarwood Blvd. east of Blue Creek Rd. | 2,300 |
| Robindale Dr. east of Blue Creek Rd. | 210 |
| Blue Creek Rd. south of Robindale Rd. | 2,700 |
| Aqui Esta Dr. east of Blue Creek Rd. | 240 |
| Blue Creek Rd. south of Aqui Esta Dr. | 1,700 |
| Blue Creek Rd. south of Bender Rd. | 1,300 |
| Bender Rd. east of Blue Creek Rd. | 200 |

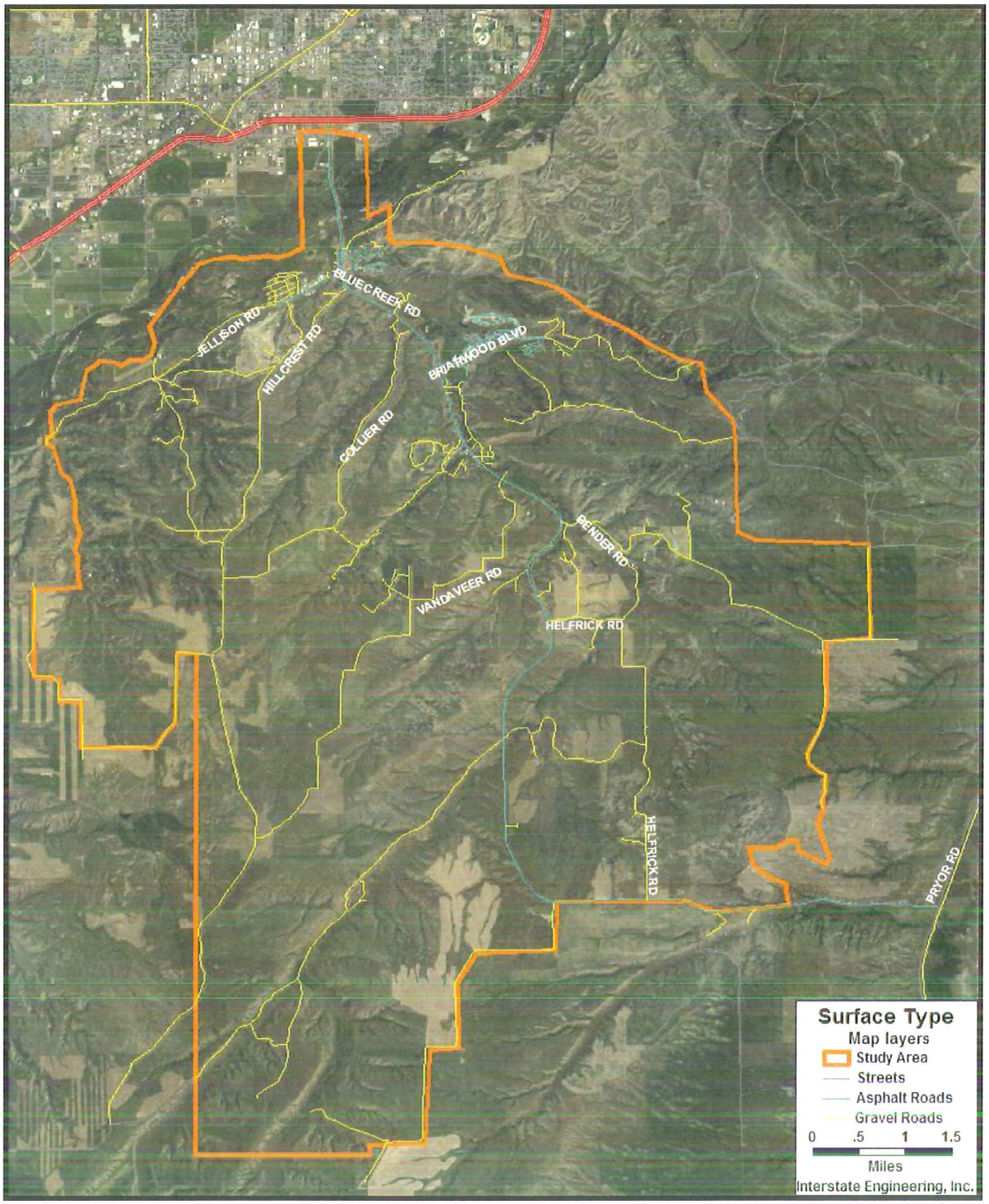



Figure 2 – Roadway Surface Type

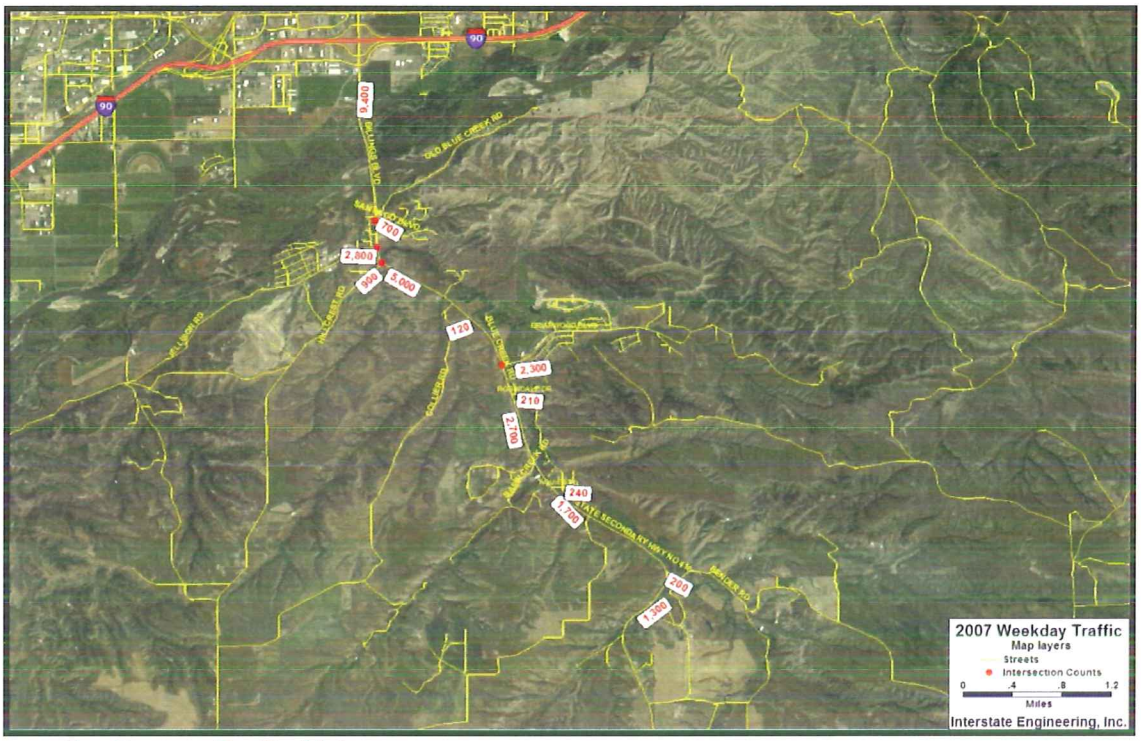


Figure 3 - Current Traffic Volumes

Hourly volumes were calculated by taking the average volumes over the seven day analysis for each of the evaluated sections. On Blue Creek Road, similar hourly traffic trends are seen on all the sections evaluated. Traffic peaks around 8am and 5pm, with slightly higher peaks at 5pm. Closer to the Billings urban area, a noon peak is also evident. The volumes of different sections decrease steadily the father south traveled down Blue Creek Road. Figure 4 illustrates the average hourly traffic volumes on different sections of Blue Creek Road.

On roads intersecting Blue Creek Road, similar trends were also noted. Traffic volumes appear to peak around 8am and 5pm, similar to Blue Creek Road. Jellison Road appears to show a different volume trend with only one peak around 2pm, probably indicative of traffic traveling to and from the City of Billings Landfill. Jellison Road and Briarwood Boulevard have the highest volumes of the evaluated roads intersecting Blue Creek. Hillcrest Road and Santiago Boulevard have the second highest volumes. Collier, Aqui Esta, Bender, and Robindale all have steadily low volumes with typically less than 20 vehicles per hour. Figure 5 illustrates the average hourly traffic volumes for the different local roads that intersect with Blue Creek Road.

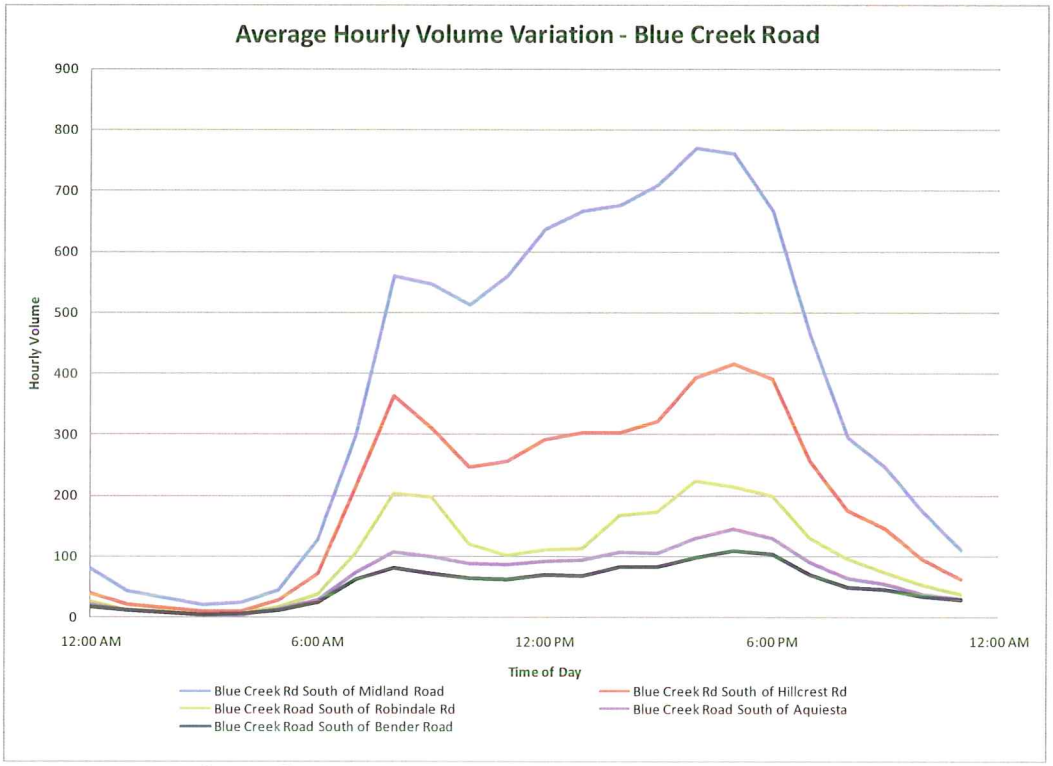



Figure 4 - Hourly Traffic Variation - Blue Creek Road

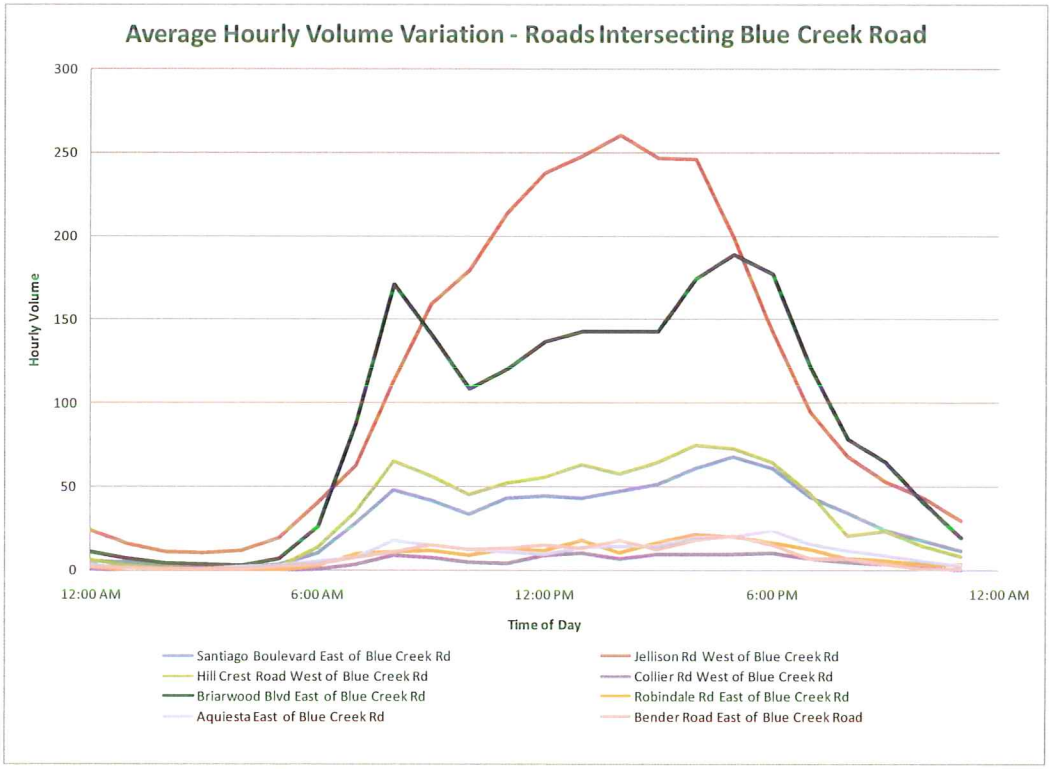



Figure 5 - Hourly Traffic Variation – Local Roads

## Crash History

### Blue Creek Road

Three years of crash statistics were obtained from the Montana Department of Transportation for study area roads. The data includes crash information from 7/1/2004 to 6/30/2007, with data provided separately for state highways (Blue Creek Road) and for "off-system" roads (City and County roads). Within this three year time period, Blue Creek Raod experienced a total of 37 crashes, with one fatal crash and 12 injury crashes (20 injuries). Figure 6 shows the locations in the study area where the fatal, injury, and property damage crashes occurred on Blue Creek Road. The selected crash statistics on Blue Creek Roads also show the following:

- Night Time (Dark) Crashes: 13
- Ice, Snow, Slush Crashes: 5
- Single Vehicle Crashes: 18
- Junction-Related Crashes: 15
- Animal Collisions: 10
- Alcohol/Drug Involved: 3

As would be expected, crash frequency is higher where traffic volumes are higher, and where driveways and intersections are more frequent.

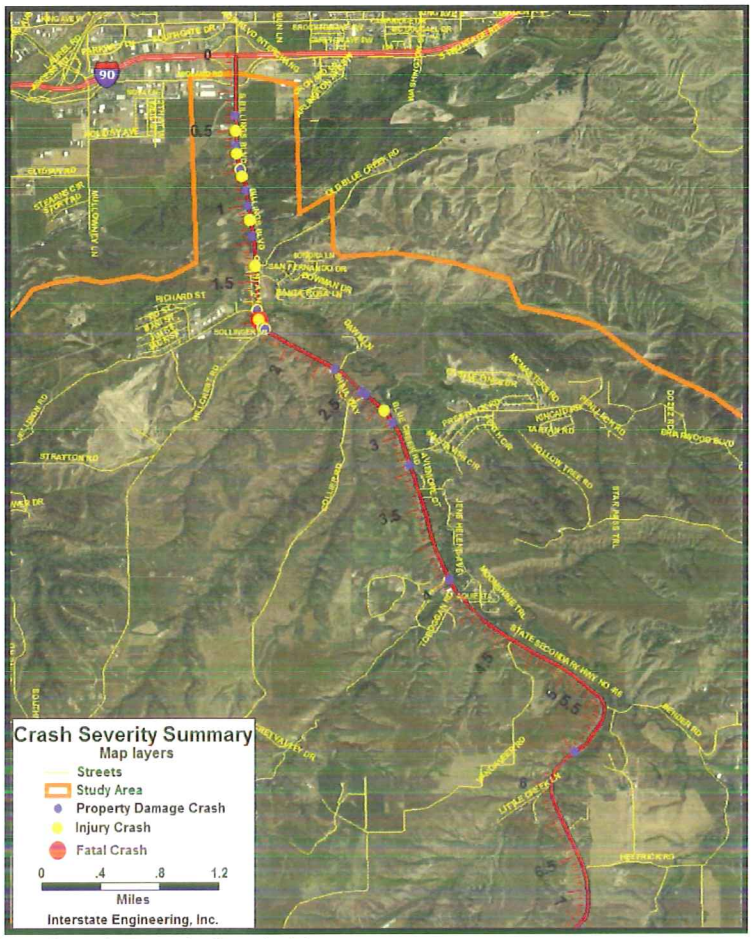



Figure 6 – Blue Creek Road Crash History

## Off-System Roads

Three years of crash statistics on off-system roads were obtained from the Montana Department of Transportation for the study. The data includes crash information from 7/1/2004 to 6/30/2007. Within this three year time period there were a total of 27 crashes with no fatal crashes, and 7 injury crashes (8 injuries). Figure 7 illustrates the locations in the study area where the injury and property damage crashes occurred on off-system roads. The selected crash statistics on the off-system roads also show the following:

- Night Time (Dark) Crashes: 9
- Ice, Snow, Slush Crashes: 4
- Single Vehicle Crashes: 19
- Junction-Related Crashes: 8
- Animal Collisions: 4
- Alcohol/Drug Involved: 10

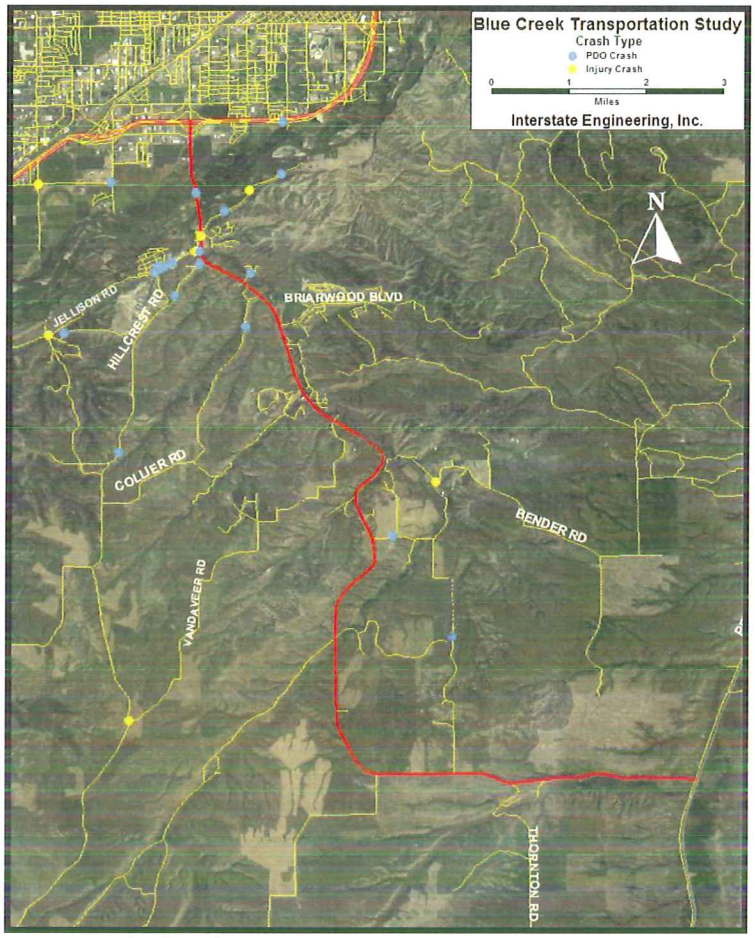



Figure 7 - Off-System Roads Crash History

## Identified System Deficiencies

The identification of needs is broken down into three main categories: capacity/congestion, connectivity/circulation, and safety. Feedback from the Project Guidance Committee (PGC), the first general public meeting, and four stakeholder meetings were used to identify system deficiencies, real or perceived, and receive suggestions for improvements. All issues identified during the course of public input are listed in the following sections. It should be noted that some issues identified are typically not addressed with a transportation plan such as this study. Those issues typically not addressed with transportation planning studies are included for completeness, and are identified by an asterisk (*).

Further discussion and results of any investigations are contained in Section 4 of this study.

Capacity and Congestion

- The intersection of Hillcrest and Jellison Roads with Blue Creek Road were identified as having inadequate site distance and were areas where Blue Creek Road traffic speeds typically exceeded the posted speed limit.
- A peak hour speed reduction or full-time speed reduction to 35mph should be considered from Yellowstone River Bridge to Blue Creek Bridge
- Briarwood Boulevard intersection with Blue Creek Road needs a turn lane or bypass lane on Blue Creek Road.
- Traffic control (stop lights) at Hillcrest and Vandaveer Roads intersection with Blue Creek Road.
- Traffic generation as growth occurs.
- Some areas on Blue Creek Road could have passing.
- During peak hours, turning onto Blue Creek Road from the Cedar Park Subdivision and onto Blue Creek Road from the Quanta Subdivision is difficult.

Connectivity and Circulation (Motorized & Non-Motorized)

- Secondary access for Briarwood and Cedar Park Subdivisions.
- Safe pedestrian and multi-use trails to existing school site and proposed new school site that include crossings.
- **Parent survey to determine how far they (parents) would allow kids to walk to school.*
- Raised pedestrian overpass over Blue Creek Road to the elementary school.
- Incorporation of multi-use trails (pedestrian, bike, equestrian).
- Striping shoulder of Briarwood Boulevard for bike lanes and adding Share the Road signs.
- Striping shoulder of Blue Creek Road for bike lanes and adding Share the Road signs.
- Right-of-way survey for a route to school from the golf course.
- Riverfront Park turn lane or bypass lane.
- Northbound bypass lane at Blue Basket.
- Re-stripe the right turn into Blue Creek School to a right turn lane.
- Update current transportation system to include alternative forms of transportation such as a metro bus system to Blue Creek area and bike/pedestrian facilities.
- In Aqui Esta Subdivision, there is need for a footbridge across Blue Creek to shorten the route to school for children. This bridge, separate from the Aqui Esta roadway bridge, would provide a direct connector from homes in the subdivision to Blue Creek School, and for Briarwood Subdivision students should other connections become reality.

Safety

- Sight distance concerns with higher speeds.
- Proposed Briar Ridge intersection to Blue Creek Road (sight distance).
- Blue Creek Bridge is too narrow and curved.
- The turn lane from Cedar Park Subdivision is used as a passing lane.

- Sight distance and visibility at intersections along Blue Creek Road.
- **Limit commercial and billboard signage on Blue Creek Road.*
- **Increased law enforcement and patrol enforcement.*
- **Blown garbage on roadways leading to the dump by commercial and noncommercial vehicles.*
- **Increase enforcement of garbage ties down, landfill personnel the authority to ticket non-compliant loads.*
- *Better coordination needed between highway cleanup crews and the state mowing.*
- Traffic at Blue Creek Elementary School especially during drop off and pick up.
- Signage notifying travelers about open range area and deer crossing.
- No passing lane on the Yellowstone River Bridge.
- Reduce speed limit to 35 mph at Blue Creek School zone (currently 40 mph when beacon is flashing, 50 mph when beacon is not flashing).
- **Sweeping shoulder of Blue Creek Road so that bikes can ride out of traffic.*
- Safe Routes to School.
- County road maintenance for design and maintenance of gravel roads.
- Students boarding busses at Casey's Corner (formerly The Blue Basket) for the Quantra Subdivision (middle/high school). Suggested is a flashing light reducing speed in the am/pm for students riding bus or expanding the parking lot at the City Water Pumping Structure to accommodate bus turn around.
- Blue Creek Road is dangerous for bikers due to lack of a designated bike/pedestrian route.
- The Blue Creek Bridge and Yellowstone River Bridge are both unsafe for bikers due to the constricted bike pathway and lack of warning signs.
- Jellison Road is too narrow and dangerous for the heavy garbage trucks and other landfill traffic it carries.
- Pavement reconstruction and overlay projects on Blue Creek Road south of Cormier Road has resulted with a significant drop-off at the edge of asphalt (just beyond painted white edge line) without a recoverable shoulder.

## Population & Employment

The Blue Creek study area lies south of the Billings urban area and is mostly rural in nature. Small pockets of commercial development exist in the study area; in the Blue Creek community area, in the Briarwood area, along Jellison Road west of Blue Creek Road, and near the Santiago Boulevard intersection with Blue Creek Road. As with commercial development, residential development in the study area is largely rural in nature with pockets of significantly denser residential development. Concentrations of residential development exist in the Briarwood area, the Cedar Park / Quanta area, Blain's Mobile Home Court, the Hillcrest area, and the Blue Creek Community area (Aqui Esta / Basin Creek). Outside theses pockets of more dense residential development, residential population is scattered in isolated homes across rural portions of the study area.

Until recently, the lack of public water systems has limited growth. City water was extended across the Yellowstone River and as far as the Briarwood area several years ago. Public sewer has also been extended into the Briarwood area just recently. These improvements will allow continued development of this area.

The population of the study is estimated to be between 1,600 and 2,000 residents. Estimates vary depending on the source of the information. The MDT is currently developing a travel demand model for the Billings Urban Area, which includes this study area. Based on the US Census data utilized for development of that model, the population of the study area was approximately 1,600 persons in 2005. The *Draft Blue Creek Area Outdoor Recreation Plan* completed in 2005 utilized US Census data, household counts, and interviews with area developers to estimate the 2005 population closer to 2,000 persons living in 715 homes. The *Draft Blue Creek Area Outdoor Recreation Plan* estimated the population distribution as shown in Table 2:

Table 2 – Current Population Distribution

| AREA | YEAR 2000 HOUSEHOLDS | YEAR 2000 POPULATION |
|---|---|---|
| Briarwood | 248 | 610 |
| Blain's Mobil Home Court | 208* | 540 |
| Cedar Park / Quanta | 103 | 300 |
| Hillcrest | N/A | 200 |
| Aqui Esta / Basin Creek | 71* | 210 |
| Rural Areas | N/A | 140 |
| TOTAL | ----- | 2,000 |

* 2004 data

Employment numbers for the study area are more difficult to estimate. The US Census Bureau does not publish employment by place of employment (only by place of residence). While the *Draft Blue Creek Area Outdoor Recreation Plan* does not estimate employment numbers, the MDT travel demand model does contain estimates of employment. Based on the MDT travel model data available at the time of this study, retail and non-retail employment totaled about 150 employees in 2001.

## Land Use

The study area for this project totals about 56 square miles. While the bulk of lands within the study area are currently rural and used primarily as agricultural lands, pockets of dense residential uses and some commercial uses exist. More dense commercial and residential land uses are concentrated along the Blue Creek Road corridor.

Only about one half of the study area is subject to land use zoning. The City/County zoning jurisdictional boundary runs generally east-west across the study area, crossing Blue Creek Road near its intersection with Vandaveer Road. Land use zoning within the study area is shown in Figures 8 and 9. Approximate areas for each land use zone represented within the study area are summarized in Table 3.

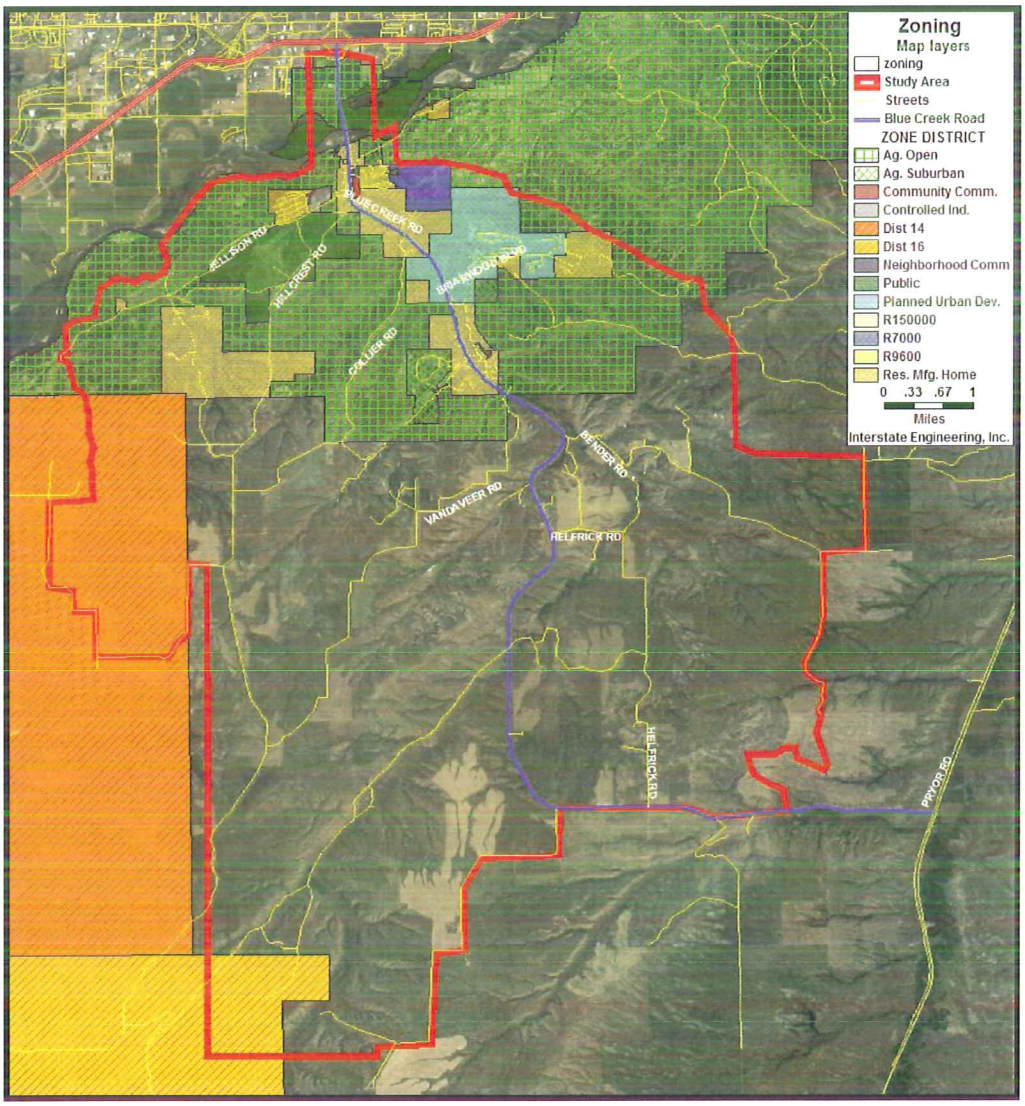


Figure 8 – Study Area Zoning

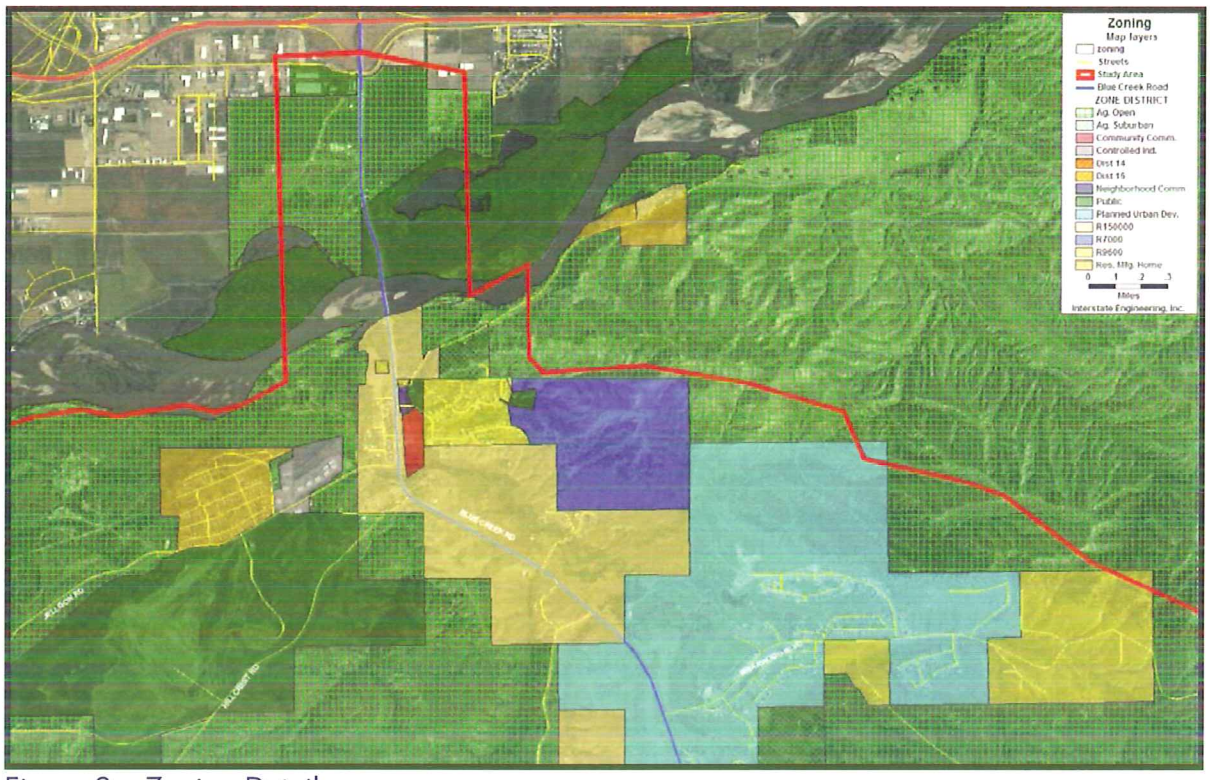



Figure 9 – Zoning Detail

Table 3 – Study Area Zoning Summary

| ZONE DISTRICT | AREA - $mi^2$ (Ac) |
|---|---|
| Public | 1.48 (947) |
| Residential 15000 | 2.29 (1,466) |
| Residential 9600 | 0.42 (269) |
| Residential 7000 | 0.28 (179) |
| Residential Manufactured Home | 0.19 (122) |
| Neighborhood Commercial | 0.004 (3) |
| Community Commercial | 0.02 (11) |
| Planned Unit Development | 1.21 (774) |
| Controlled Industrial | 0.05 (32) |
| Agricultural Open | 8.88 (5,683) |
| Agricultural Suburban | 0.39 (250) |
| District 14 | 3.37 (2,157) |
| District 16 | 1.16 (742) |
| Not Zoned | 36.2 (23,168) |

# SECTION 3 – FUTURE CONDITIONS

## Planned & Programmed System Improvements

Montana Secondary Highway 416 (MT S-416), or Blue Creek Road as it is commonly known, is the only state highway within the study area. The Montana Department of Transportation (MDT) was questioned regarding planned/programmed improvements for the highway. One project is planned for MT S-416, a safety improvement project near the highway's crossing of Blue Creek.

Planned are signing, earthwork, and guardrail improvements. The MDT project (HSIP 416-1(13)1) will seek to reduce crashes on the highway curve just south of the Blue Creek crossing. Included is installation of a flashing beacon on the curve warning sign currently installed for northbound traffic, placing curve chevrons around the curve visible to both travel directions, and adding earth fill to reduce the slope of the embankment on the outside of the curve. Also included are guardrail end-treatment improvements for the Blue Creek bridge guardrail and the Yellowstone River bridge guardrail, further to the north.

The MDT performed a crash analysis for this segment of MT S-416 and determined that 6 of 17 crashes that occurred in this segment were considered correctable with the planned improvements. It was determined that drawing drivers attention to the curve through additional signs and the flashing beacon could work to reduce run-off-road type crashes that occur at this location. Flattening the embankment slopes will also work to reduce the severity of crashes that still might occur.

At the time of this report, the project was slated to have a "ready date" of August 1, 2009, with construction planned to begin in December, 2009. An MDT memorandum regarding additional details of this project is included in the Appendix A to this study.

Other than the MDT project discussed above, no other specific projects are planned or programmed for the study area.

## Population & Employment Growth Forecast

Numerous sources were consulted to enable reasonable forecasts for growth in the study area. Consulted were US Census data for the years of 1990 and 2000, examination of aerial photography from 2005, data collected/developed for the creation of the Blue Creek Outdoor Recreation Plan, the Billings 2008 Growth Policy, and the MDT travel demand model for the Billings Urban Area. The available data yielded a wide variety of data and projections for the study area.

While no clear census tracks match the previously determined study area boundaries, the data did show that the greater Billings area grew by 11.1% in the ten years from 1990 to 2000, and that the Blue Creek area (including areas outside the defined study area) grew by

43.6% over the same period. The US Census data verifies that this area experienced growth higher than the greater Billings urban area during the 10-year period from 1990 to 2000. Growth in the study area was attributed largely to growth in the Briarwood Subdivision, which contains over 30% of the study area households at this time. The US Census data showed population of the rural Blue Creek, emerald Hills, and Duck Creek areas at 4,131 in 1990, and at 5,934 in the year 2000.

The *Blue Creek Outdoor Recreation Plan* contained both high and low growth projections for the study area. High growth projections from the plan anticipated growth of 126% between 2000 and 2010, with an additional 31% between 2010 and 2020. Low growth projections from the plan projected an 81% growth from 2000 and 2010, with an additional 15% between 2010 and 2020. The *Blue Creek Outdoor Recreation Plan* projected a 2020 population of over 5,900 people under the high growth scenario, and a population of over 4,100 by 2020 under the low growth scenario.

The *Billings Neighborhood Land Use Plan* for the South Hills area (just a portion of the Blue Creek Transportation Plan Study Area) shows a 1980 population of 4,041 people, a 1990 population of 4,422 people, and a year 2000 population of 5,924 people. The neighborhood plan shows a growth of 34% from 1990 to the year 2000.

The MDT is currently developing a travel demand model for the Billings urban area that contains population, household, and employment data for current and projected future conditions. Data for the MDT travel demand model is organized by census "blocks", a refined geographic structure. Preliminary MDT data was obtained and assessed for use with this study. The MDT data contained new building permit data for residential structures stratified by section. An examination of the MDT data showed an evident error with the geographic distribution of population growth, with data indicating that growth east of Blue Creek Road projected to exceed an additional 1,073 households from 2000 to 2008 (266% growth), and an additional 195 households for the area west of Blue Creek Road (52% growth). Close examination of the data revealed the errors. MDT is currently correcting the geographic distribution errors. Revised data was not available for this study at the time of this writing.

Lastly, 2005 aerial photography was examined to identify each household within the study area. Also identified were platted subdivision lots that were not yet developed (built) as of 2005. The examination of aerial photography showed 909 total household structures in the study area as of 2005, with 255 platted vacant lots. The platted vacant lots are an indication of areas ready for immediate development. As might be expected, platted vacant lots are primarily located close to the City and within developed subdivisions. The total household distribution and distribution of platted vacant lots within the study area are shown in Figures 10 and 11, and tabulated in Table 4.

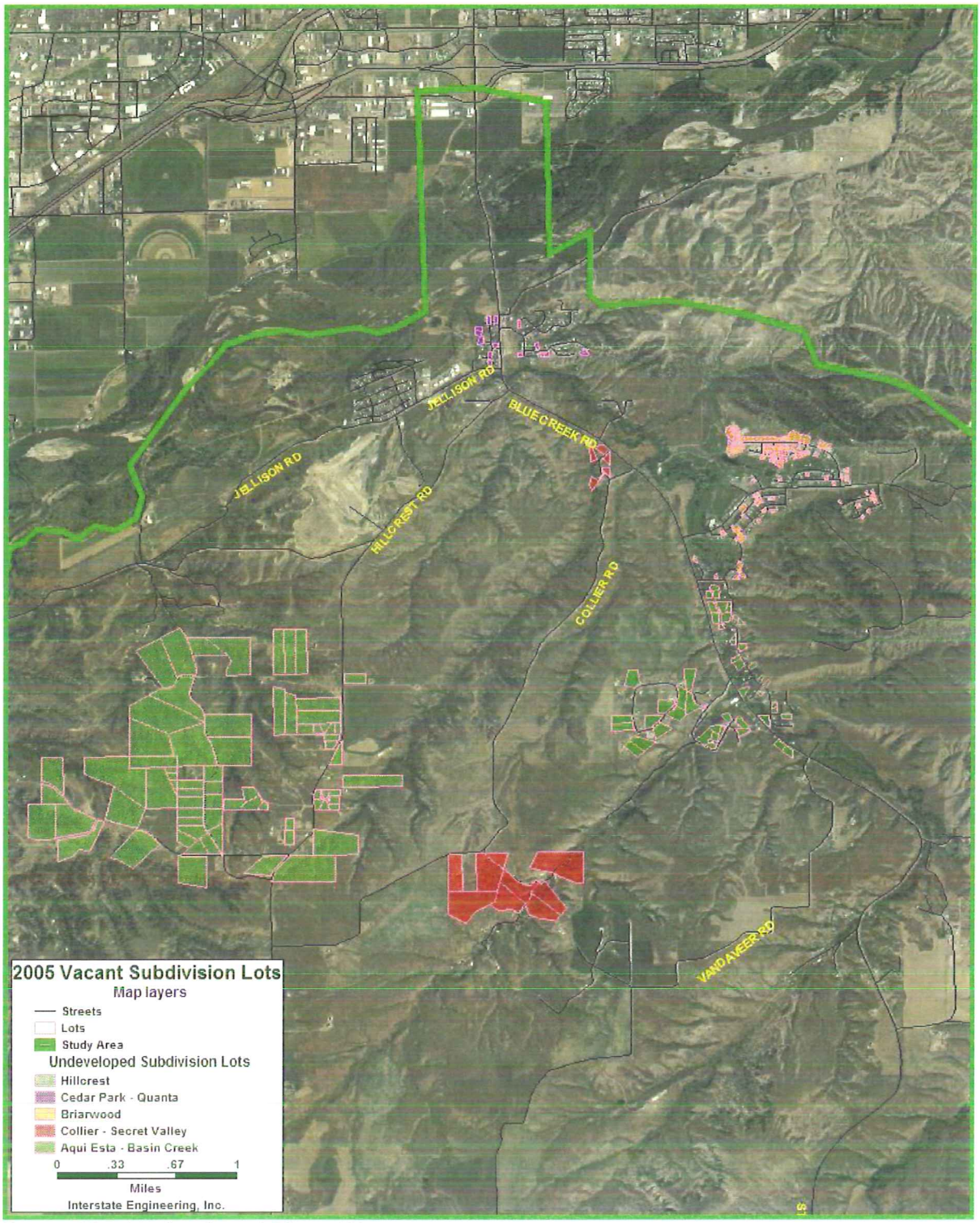



Figure 10 - Undeveloped Platted Vacant Lots

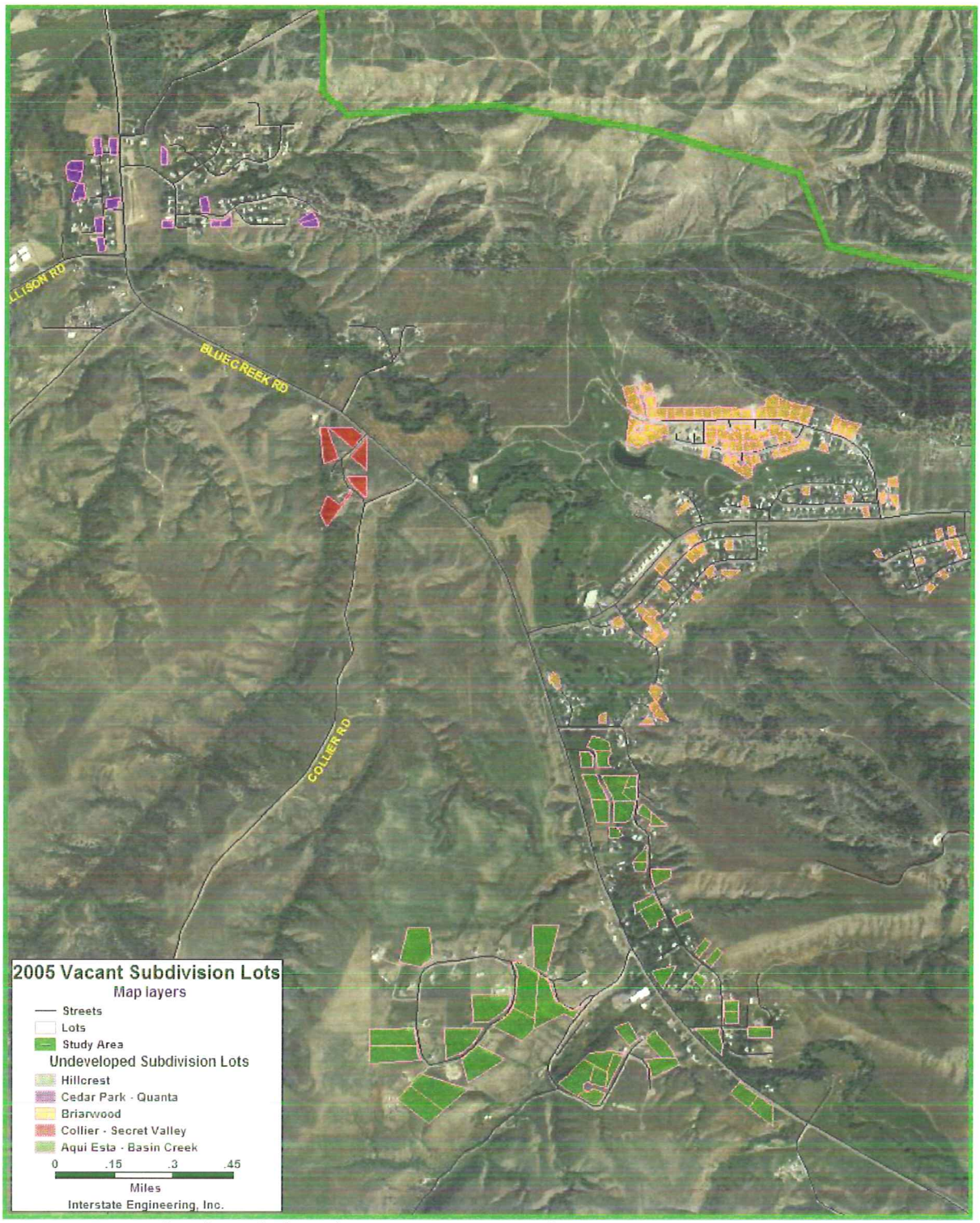



Figure 11 - Undeveloped Platted Vacant Lots – Detail View

With projections from existing sources running the gamut from 12% to over 266% during the next 20 years, it was determined that a reasonable estimate of growth was to assume growth of the study area at 1.5% per year for the next 20 years, or about an overall growth of 35%. Based on this estimate, it is forecasted that an additional 409 households will be established in the study area in the next 20 years (by year 2030). An examination of available, platted subdivision lots, subdivisions in the planning stage, and available water/sewer services resulted with a distribution of future household growth within the study area. Assumed growth within the study area is shown in Table 3.

Table 4 - Household Growth

| Neighborhood | 2005 Households | 2005 Vacant Lots | Household Growth 2005-2030 | Final 2030 Households |
|---|---|---|---|---|
| Aqui Esta - Basin Creek | 94 | 48 | 45 | 139 |
| Blains Mobile Home Park | 193 | N/A | - | 193 |
| Briarwood | 298 | 106 | 200 | 498 |
| Cedar Park - Quantana | 103 | 15 | 30 | 133 |
| Collier - Secret Valley | 22 | 14 | 14 | 36 |
| Hillcrest | 59 | 72 | 50 | 109 |
| Vandaveer | 11 | - | 5 | 16 |
| Remaining Rural Area | 129 | N/A | 25 | 154 |
| Briarridge | - | - | 40 | 40 |
| TOTAL | 909 | 255 | 409 | 1,318 |

Employment growth within the study area is limited. While limited retail development exists within the Blue Creek Community area, and within the area around Blue Creek Road just south of the Yellowstone River, commercial employment growth prospects for the remaining portions of the study area seem limited. It is assumed that household growth will drive growth of transportation needs and traffic volumes.

## Future Traffic Forecasts

Future traffic volumes on study area roads and highways were based primarily on forecasts of household growth. The study area transportation system and study area configuration essentially forms a large cul-de-sac, with most all trips oriented to/from the Billings urban area. As such, it is reasonable to base traffic forecasts on household growth and the assumption that most all trips travel to/from the Billings urban area via Blue Creek Road, which forms the spine of the motorized transportation network.

Utilizing the forecasts of household growth, estimates of future traffic volumes were formulated. The average trip rate of 10 trips per household was used to forecast daily traffic volumes on selected study area roads. Using a combination of average trip rates and the assumed distribution of household growth yielded forecast daily traffic volumes for study area roads, as shown in Figure 12.

As Figure 12 shows, traffic volume on Blue Creek Road is expected to increase to 13,500 vpd just south of Midland Road, to 8,290 vpd south of Hillcrest Road, and to 3,220 vpd

south of Robindale Drive. Connecting roads are also expected to increase in traffic volume, with Briarwood Boulevard increasing the most, from 2,300 vpd to 4,300 vpd. With the increase in traffic volume, impacts to intersection operations are expected along with increasing need for intersection improvements.

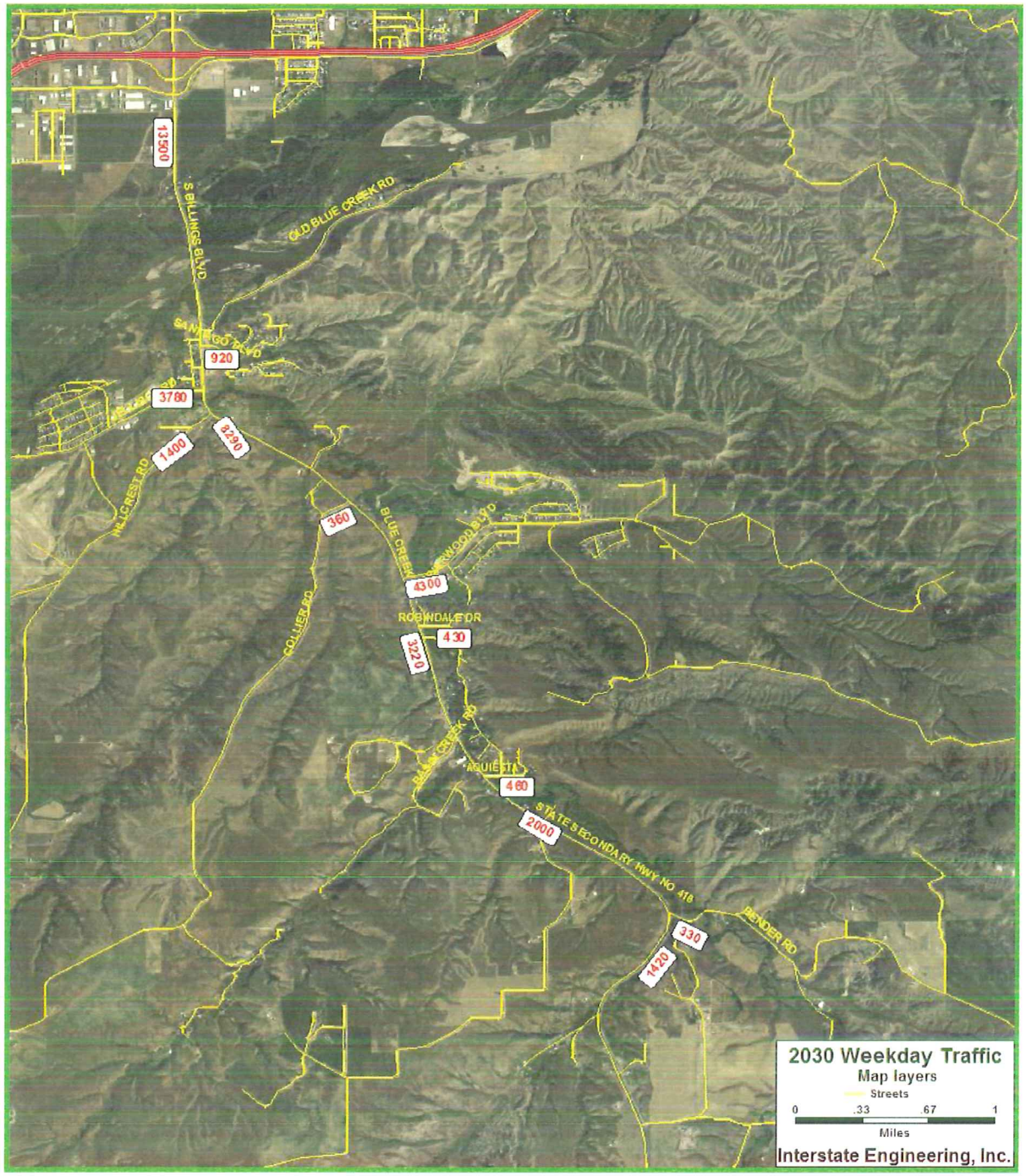


Figure 12 - Year 2030 Daily Traffic

## Levels of Service/Deficiencies Analysis

Peak hour turning movement counts were collected at four key intersections on Blue Creek Road within the study area (at Santiago Blvd. Jellison Rd., Hillcrest Rd., and at Briarwood Blvd.). Key intersections were examined for level of service (LOS) and general traffic operations. Included with the analysis were queuing lengths, traffic delay, warrants for auxiliary turn lanes, etc. Each intersection assessed was analyzed according to Highway Capacity Manual (HCM) procedures implemented through the Synchro/SimTraffic software platform. Key intersections where traffic counts were obtained were assessed for current as well as future forecasted traffic conditions. Peak period intersection turning movement volumes for existing as well as future forecast conditions are contained in Appendix B to this study.

Level of service, viewed as a key result in capacity analysis, is a "qualitative measure of operational conditions within a traffic stream. LOS is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience. Six LOS are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver's perception of those conditions. Safety is not included in the measures that establish LOS".[1]

For this project, LOS analyses have been performed for intersections and two-lane highway segments. While vehicle delay is the primary measure utilized to report LOS at intersections, percent time-spent-following is the primary measure to report LOS on Class II two-lane highways like Blue Creek Road.

The Montana Department of Transportation and City of Billings strive to maintain conditions of LOS C or better for streets, highways, and intersections. LOS D may be acceptable under some circumstances and doesn't necessarily mean an improvement project is required, reasonable, or feasible. When transportation improvement projects are undertaken, it is typical to design improvements so that it will function under future conditions (typically 20 years future) at LOS C or better.

### Blue Creek Road / Santiago Boulevard

Under existing traffic conditions, the Santiago Blvd. approach to Blue Creek Road operates at level of service (LOS) B during both the morning and evening peak period. Vehicle delay on this approach averages 12.7 seconds per vehicle (s/v) during the morning peak, and 10.4 s/v during the evening peak. With increased future traffic, LOS for the Santiago Blvd. approach drops to LOS C during the morning peak and remains at LOS B during the evening peak. Delay for this approach increases to 16.7 s/v during the morning peak and to 11.7 s/v during the evening peak.

It has been suggested that this intersection could benefit from construction of a separate right turn lane on Santiago Boulevard to improve delay experienced during the morning peak traffic period. An analysis shows that the addition of a short (50 foot) right turn lane does result with slight decreased delay for the left turn movement (0.4 s/v less delay under existing traffic, and 1.1 s/v less delay under future traffic conditions). The analysis software does not report delay for the right turn lane, but it is expected to experience similar improvements.

### Blue Creek Road / Jellison Road

Under existing traffic conditions, the Jellison Road approach to Blue Creek Road operates at LOS B during both the morning and evening peak period. Approach delay is 14.4 s/v and 13.6 s/v during the morning and evening peak periods, respectively. With expected increases in traffic volumes, LOS will drop to LOS C for both morning and evening peak periods, with approach delay increasing to 22.0 s/v during the morning, and 19.4 s/v during the evening peak period. During the future morning peak period, vehicle queuing is expected to approach 50 feet in length (2-3 cars).

Since most all traffic on Jellison Road eastbound approach desires to turn left on Blue Creek Road, this movement may benefit from construction of a left turn acceleration lane on Blue Creek Road. In theory, providing a left turn acceleration lane provides benefits, since the Jellison Road approach traffic would not have to wait for a gap in northbound Blue Creek Road traffic...they need only to clear southbound traffic, then merge into northbound traffic once they are on Blue Creek Road. The reality of operational improvements through construction of a left turn acceleration lane is typically much less than might theoretically be expected. This is due, in part, to reluctance of drivers to fully utilize the left turn acceleration lane or their lack of experience with such lanes. The Highway Capacity Manual does not have a specific adjustment procedure to consider LOS improvements due to left turn acceleration lanes.

### Blue Creek Road / Hillcrest Road

Under existing traffic conditions, the Hillcrest Road approach to Blue Creek Road operates at LOS B during both the morning and evening peak period. Approach delay is 13.0 s/v and 12.0 s/v during the morning and evening peak periods, respectively. With expected increases in traffic volumes, LOS will drop to LOS C for both morning and evening peak periods, with approach delay increasing to 21.9 s/v during the morning, and 16.6 s/v during the evening peak period. During the future morning peak period, vehicle queuing is expected to approach 40 feet in length (about 2 cars).

The MDT Montana Road Design Manual contains guidelines for when separate right turn lanes may or may not be justified. The Manual notes that right turn lanes may be justified based on traffic volumes, capacity analysis, or crash history.[2] At this location, the MDT guidelines indicate that current traffic volumes and turn volumes are not adequate to justify a separate right turn lane. Future projected traffic volumes are, however, sufficient to justify consideration of a separate right turn lane.

## Blue Creek Road / Briarwood Boulevard

Under existing traffic conditions, the Briarwood Boulevard approach to Blue Creek Road operates at LOS B during the morning peak period, and at LOS A during the evening peak period. Approach delay is 11.8 s/v and 8.9 s/v during the morning and evening peak periods, respectively. Heavy southbound left turns into Briarwood Boulevard during the evening peak period create some delay to southbound traffic, averaging 3.8 s/v. With future development in Briarwood Subdivision expected to nearly double traffic on this approach, LOS will drop to LOS C for the morning peak period, but remain at LOS A for the evening peak under projected future traffic conditions. Approach delay is expected to increase to19.7 s/v during the morning, and 9.3 s/v during the evening peak period. During the future morning peak period, vehicle queuing is expected to approach 110 feet in length (about 5 cars). Heavy southbound left turns during the evening peak period cause delay on the southbound approach to increase to 4.6 s/v.

The MDT Montana Road Design Manual contains guidelines for when separate left turn lanes may or may not be justified. The Manual notes that left turn lanes may be justified based on traffic volumes, capacity analysis, or crash history.[3] At this location, the MDT guidelines indicate this location currently has sufficient through, left turn, and opposing traffic volumes to justify a separate left turn lane. A schematic sketch of a left turn lane at this location is shown in Figure 13.

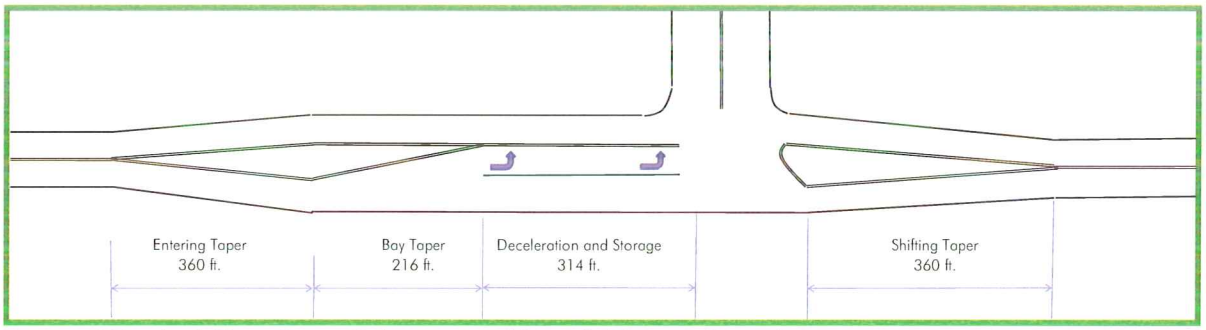



Figure 13 – Left Turn Lane Schematic, 60 mph Design Speed

## Blue Creek Road Corridor

Growth in the study area will bring corresponding growth in traffic volume for Blue Creek Road itself, just as it does for the key intersections. Traffic volumes on Blue Creek Road in the future are expected to exhibit the same characteristics as today's volumes, with similar increased volume in the northern portion of the Blue Creek Road, and similar peaking characteristics.

On Blue Creek Road just south of Midland Road, the peak hourly volume occurs during the evening, with a two-way volume of about 850 vehicles per hour (vph), or about 9% of the daily volume. With daily volume expected to increase to 13,400 vpd, the peak hour can be expected to experience 1,200 vph. With the 75/25 directional split typically experienced on

this facility at this location, the roadway will carry over 900 vph in a single direction. An estimate of roadway operations on this segment of highway shows it will be operating at LOS D with a volume-to-capacity ratio of 0.43 under future traffic conditions.

The HCM notes that LOS D describes a condition of "unstable traffic flow" where the two opposing traffic streams begin to operate separately at higher volume levels, as passing becomes difficult (if allowed). Even though passing demand is high, passing capacity approaches zero. Turning vehicles and roadside distractions can cause major shock waves in the traffic stream, as motorists are delayed in platoons (time spent following) for nearly 80 percent of their travel time.[4]

.

# SECTION 4 – IMPROVEMENT ALTERNATIVES

Transportation deficiencies identified through public meetings, stakeholder meetings, Project Guidance Committee meetings, and technical assessments (previously listed in Section 2) have been reviewed and potential improvement alternatives have been identified. A complete discussion of each identified deficiency, including identifying the "real problem", documentation of any technical investigation conducted, and development of potential improvement alternatives is contained in Appendix C of this Study.

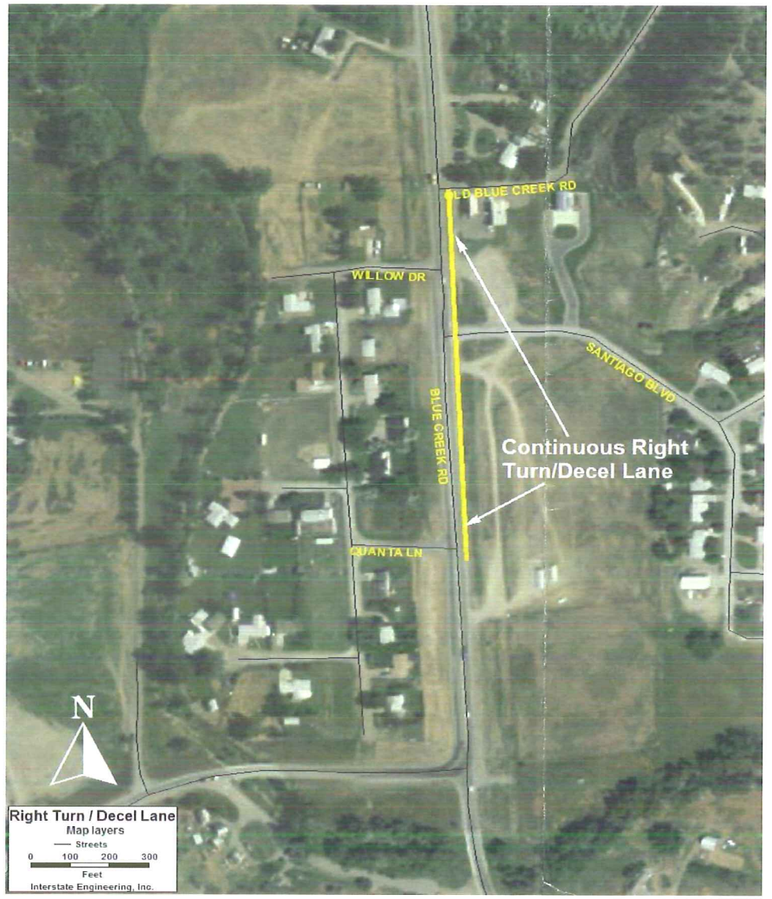
With assistance of the Project Guidance Committee, each identified deficiency and potential improvement alternative was reviewed. The review resulted with a list of 30 specific deficiencies or deficiency areas that, in turn, resulted with 13 separate preferred infrastructure construction projects. It should be noted that not all identified deficiencies resulted with an identified construction project. Many require further study or more detailed investigation to adequately determine a preferred solution. An example is walking routes and safety to Blue Creek Elementary School. It is beyond the scope of this area-wide transportation plan to identify individual routes and necessary improvements to develop adequate safe routes to school for the Blue Creek Elementary School. In this case, it was recommended that a separate Safe Routes to School study be conducted.

The resulting deficiencies and preferred solutions are tabulated in Table 5.

## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Blue Creek Rd., Santiago Blvd. to Old Blue Ck. Rd. | | | | Add Right Turn / Decel Lane - Continuous |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 1,200 | $25.00 /sq.yd. | $30,000 | Additional 12' widening |
| Road Base (12") | 1,400 | $10.00 /sq.yd. | $14,000 | |
| Grading (Uncl.Ex.) | 0 | $8.00 /cu.yd. | $0 | |
| Borrow | 900 | $12.00 /cu.yd. | $10,800 | Import required for embankment. |
| Curb/Gutter | 0 | $15.00 /lin.ft. | $0 | |
| Sidewalk | 0 | $25.00 /sq.yd. | $0 | |
| Utilities | 0.19 | $250,000.00 /mile | $47,500 | Minor utility conflicts |
| Drainage | 0.19 | $200,000.00 /mile | $38,000 | Modify existing approach culverts. |
| Signing/Striping | 0.19 | $75,000.00 /mile | $14,250 | |
| Lighting | 0.19 | $350,000.00 /mile | $66,500 | Assume lighting added for length of project. |
| Const. Traffic Control | 0.19 | $75,000.00 /mile | $14,250 | |
| **Misc. Major Elements** | | | | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| **SUB-TOTAL** | | | $235,300 | |
| Engineering/Design/Const. Serv. (20%) | | | $47,060 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | No ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| **SUB-TOTAL** | | | $282,360 | |
| Contingency (20%) | | | $56,472 | |
| **GRAND TOTAL** | | | **$338,832** | |

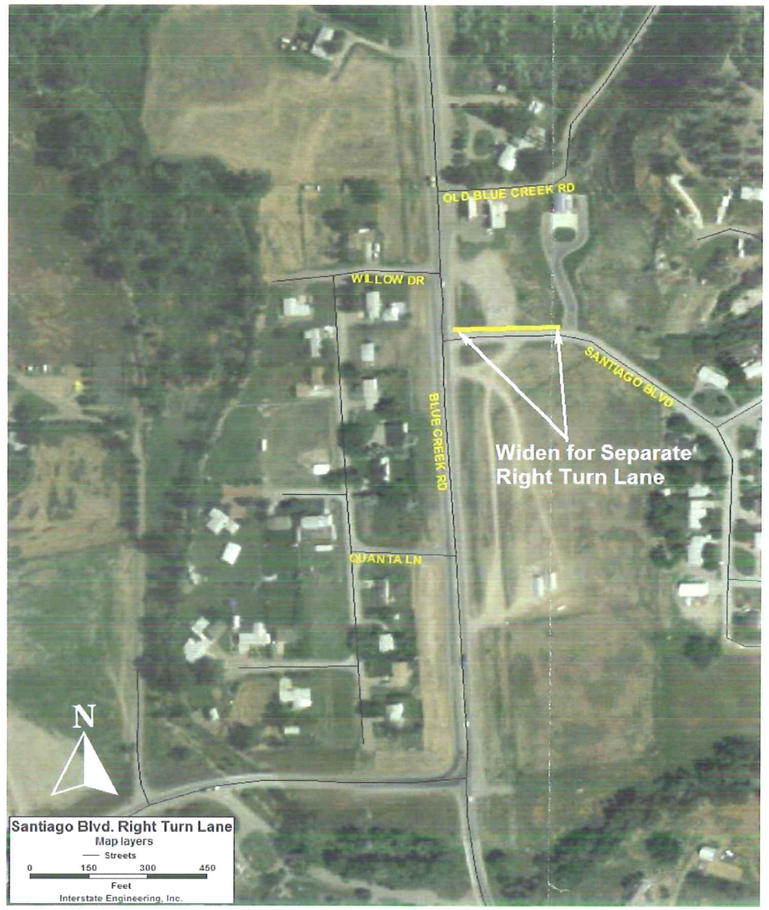
**PROJECT NOTES:**
1. Total length = 985 ft. (0.19 mi.).



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Santiago Blvd. @ Blue Creek Road | | | | Widen approach for separate RT and LT lanes. |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 375 | $25.00 /sq.yd. | $9,375 | Additional 12' widening, 8:1 Taper, 200' Decel., 50' Storage |
| Road Base (12") | 400 | $10.00 /sq.yd. | $4,000 | |
| Grading (Uncl.Ex.) | 0 | $8.00 /cu.yd. | $0 | |
| Borrow | 360 | $12.00 /cu.yd. | $4,320 | Import required for embankment. |
| Curb/Gutter | 0 | $15.00 /lin.ft. | $0 | |
| Sidewalk | 0 | $25.00 /sq.yd. | $0 | |
| Utilities | 0.05 | $250,000.00 /mile | $12,500 | Minor utility conflicts |
| Drainage | 0.05 | $200,000.00 /mile | $10,000 | Modify existing approach culverts. |
| Signing/Striping | 0.05 | $75,000.00 /mile | $3,750 | |
| Lighting | | $350,000.00 /mile | $0 | |
| Const. Traffic Control | 0.05 | $75,000.00 /mile | $3,750 | |
| Misc. Major Elements | | | | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| SUB-TOTAL | | | $47,695 | |
| Engineering/Design/Const. Serv. (20%) | | | $9,539 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | Assume no ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| SUB-TOTAL | | | $57,234 | |
| Contingency (20%) | | | $11,447 | |
| GRAND TOTAL | | | $68,681 | |

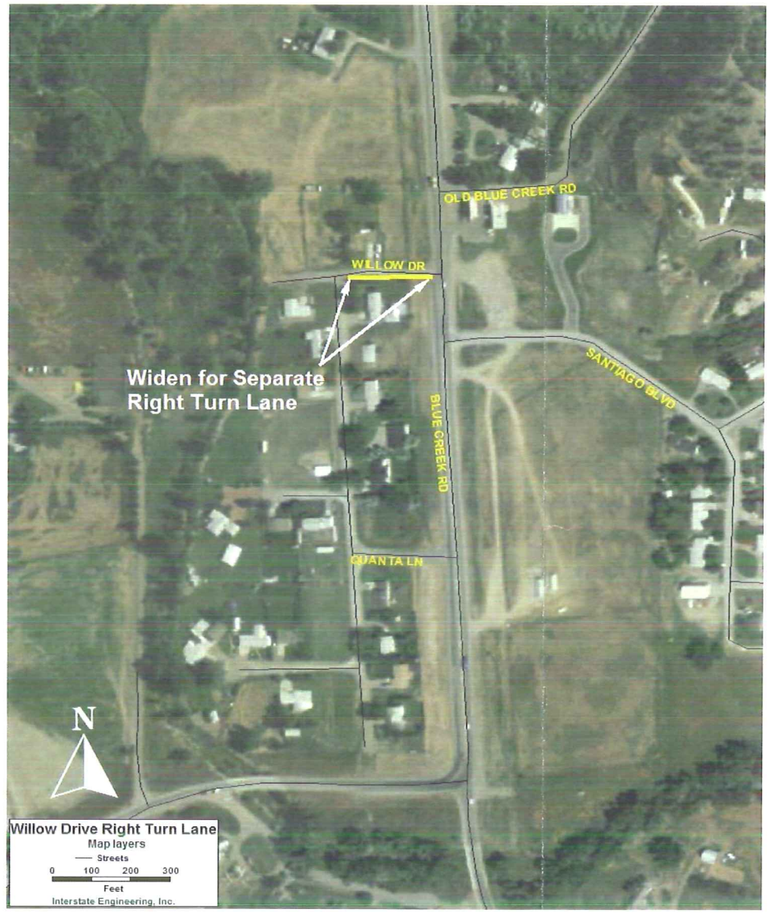
**PROJECT NOTES:**
1. Length of right turn lane limited by entrance to City lift station at 275 ft.
2. Widening may be equally split on both sides of roadway to minimize impacts to existing utilities or other facilities.



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Willow Drive @ Blue Creek Road | | | | Widen approach for separate RT and LT lanes. |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 275 | $25.00 /sq.yd. | $6,875 | Additional 12' widening for 200' (to Quanta St. intersection) |
| Road Base (12") | 300 | $10.00 /sq.yd. | $3,000 | |
| Grading (Uncl.Ex.) | 0 | $8.00 /cu.yd. | $0 | |
| Borrow | 200 | $12.00 /cu.yd. | $2,400 | Import required for embankment. |
| Curb/Gutter | 0 | $15.00 /lin.ft. | $0 | |
| Sidewalk | 0 | $25.00 /sq.yd. | $0 | |
| Utilities | 0.04 | $250,000.00 /mile | $10,000 | Minor utility conflicts |
| Drainage | 0.04 | $200,000.00 /mile | $8,000 | Modify existing approach culverts. |
| Signing/Striping | 0.04 | $75,000.00 /mile | $3,000 | |
| Lighting | | $350,000.00 /mile | $0 | |
| Const. Traffic Control | 0.04 | $75,000.00 /mile | $3,000 | |
| **Misc. Major Elements** | | | | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| **SUB-TOTAL** | | | $36,275 | |
| Engineering/Design/Const. Serv. (20%) | | | $7,255 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | Assume no ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| **SUB-TOTAL** | | | $43,530 | |
| Contingency (20%) | | | $8,706 | |
| **GRAND TOTAL** | | | **$52,236** | |

PROJECT NOTES:



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

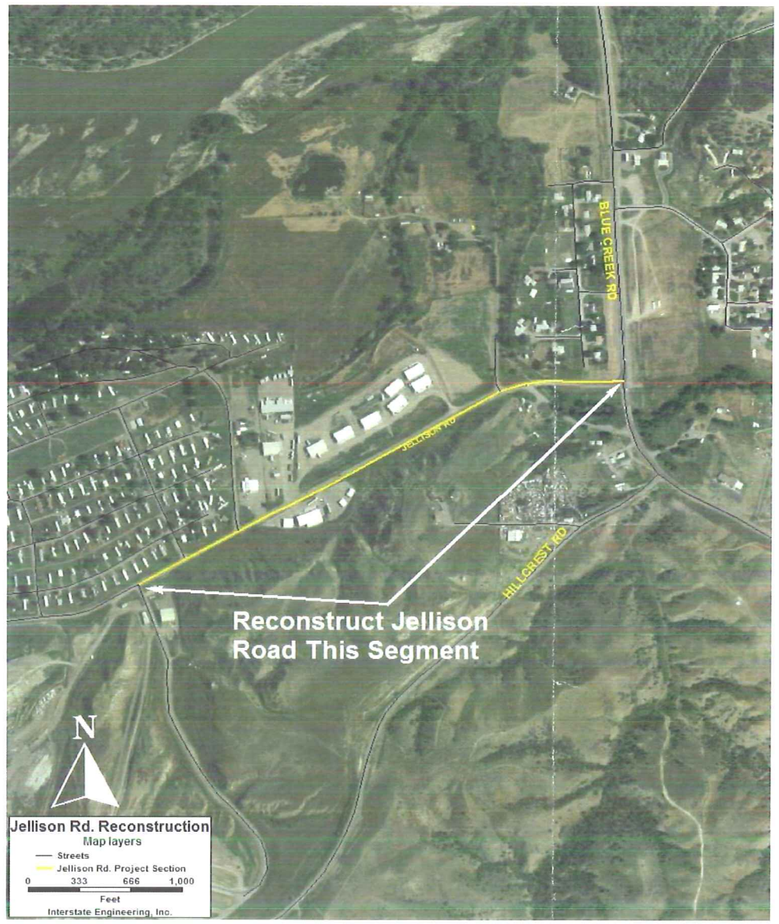
| Blue Creek Road @ Jellison Rd. | | | | Trim/remove trees to improve intersection sight distance. |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 0 | $25.00 /sq.yd. | $0 | Additional 12' widening for 200' (to Quanta St. intersection) |
| Road Base (12") | 0 | $10.00 /sq.yd. | $0 | |
| Grading (Uncl.Ex.) | 0 | $8.00 /cu.yd. | $0 | |
| Borrow | 0 | $12.00 /cu.yd. | $0 | |
| Curb/Gutter | 0 | $15.00 /lin.ft. | $0 | |
| Sidewalk | 0 | $25.00 /sq.yd. | $0 | |
| Utilities | 0.00 | $250,000.00 /mile | $0 | |
| Drainage | 0.00 | $200,000.00 /mile | $0 | |
| Signing/Striping | 0.00 | $75,000.00 /mile | $0 | |
| Lighting | 0.00 | $350,000.00 /mile | $0 | |
| Const. Traffic Control | 0.00 | $75,000.00 /mile | $0 | |
| **Misc. Major Elements** | | | | |
| Large Tree Removal | 6 | $1,000.00 /each | $6,000 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| SUB-TOTAL | | | $6,000 | |
| Engineering/Design/Const. Serv. (20%) | | | $1,200 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | Assume no ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| SUB-TOTAL | | | $7,200 | |
| Contingency (20%) | | | $1,440 | |
| GRAND TOTAL | | | $8,640 | |

**PROJECT NOTES:**
1. Assumes trees are located within public ROW

## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Jellison Road | | | | Reconstruct for Land Fill traffic. |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 11,500 | $25.00 /sq.yd. | $287,500 | 30 ft. wide asphalt roadway |
| Road Base (12") | 12,500 | $10.00 /sq.yd. | $125,000 | Recondition, amend, and place base course |
| Grading (Uncl.Ex.) | 0 | $8.00 /cu.yd. | $0 | |
| Borrow | 400 | $12.00 /cu.yd. | $4,800 | Minor import required to establish shoulders. |
| Curb/Gutter | 0 | $15.00 /lin.ft. | $0 | |
| Sidewalk | 0 | $25.00 /sq.yd. | $0 | |
| Utilities | 0.65 | $250,000.00 /mile | $162,500 | Minor utility conflicts |
| Drainage | 0.00 | $200,000.00 /mile | $0 | No changes required. |
| Signing/Striping | 0.65 | $75,000.00 /mile | $48,750 | |
| Lighting | 0.00 | $350,000.00 /mile | $0 | |
| Const. Traffic Control | 0.65 | $75,000.00 /mile | $48,750 | |
| **Misc. Major Elements** | | | | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| **SUB-TOTAL** | | | $677,300 | |
| Engineering/Design/Const. Serv. (20%) | | | $135,460 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | Assume no ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| **SUB-TOTAL** | | | $812,760 | |
| Contingency (20%) | | | $162,552 | |
| **GRAND TOTAL** | | | $975,312 | |

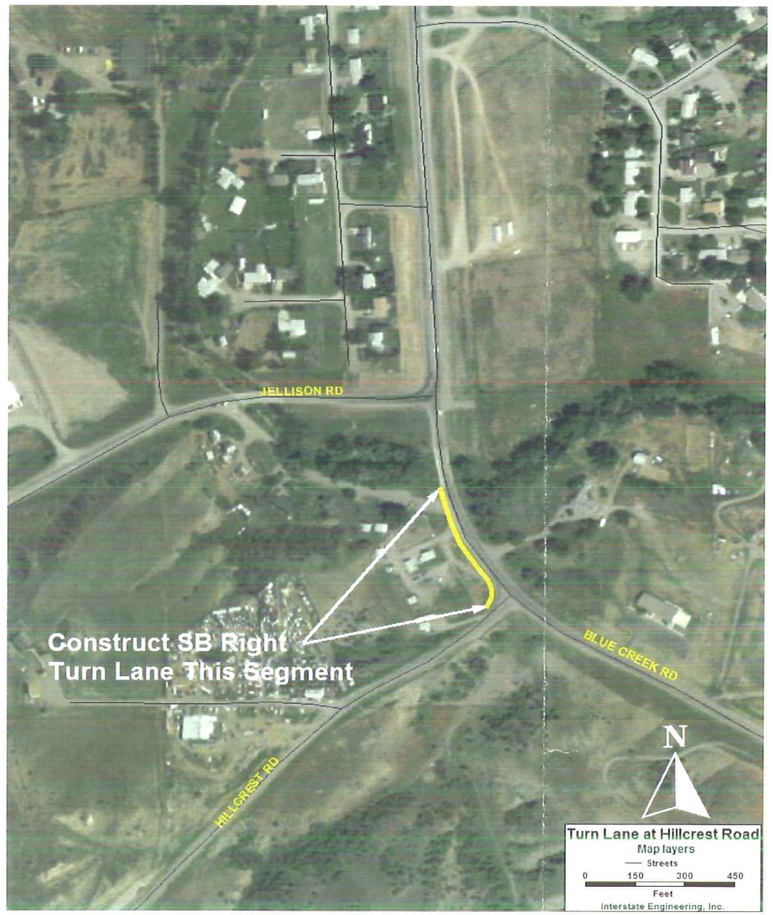
**PROJECT NOTES:**
1. Project length = 3,450 ft. (0.65 mi.)
2. Assume existing Blue Creek Bridge remains.



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Blue Creek Road @ Hillcrest Road | | | | Construct southbound right turn lane |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 575 | $25.00 /sq.yd. | $14,375 | 12 ft. widening on edge of existing road. |
| Road Base (12") | 600 | $10.00 /sq.yd. | $6,000 | |
| Grading (Uncl.Ex.) | | $8.00 /cu.yd. | $0 | |
| Borrow | 450 | $12.00 /cu.yd. | $5,400 | Import required for widening. |
| Curb/Gutter | | $15.00 /lin.ft. | $0 | |
| Sidewalk | | $25.00 /sq.yd. | $0 | |
| Utilities | | $250,000.00 /mile | $0 | |
| Drainage | | $200,000.00 /mile | $0 | No changes required |
| Signing/Striping | 0.08 | $75,000.00 /mile | $6,000 | |
| Lighting | | $350,000.00 /mile | $0 | |
| Const. Traffic Control | 0.08 | $75,000.00 /mile | $6,000 | |
| **Misc. Major Elements** | | | | |
| Relocate Power Pole | 1 | $5,000.00 /each | $5,000 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| SUB-TOTAL | | | $42,775 | |
| Engineering/Design/Const. Serv. (20%) | | | $8,555 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | Assume no ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| SUB-TOTAL | | | $51,330 | |
| Contingency (20%) | | | $10,266 | |
| GRAND TOTAL | | | $61,596 | |

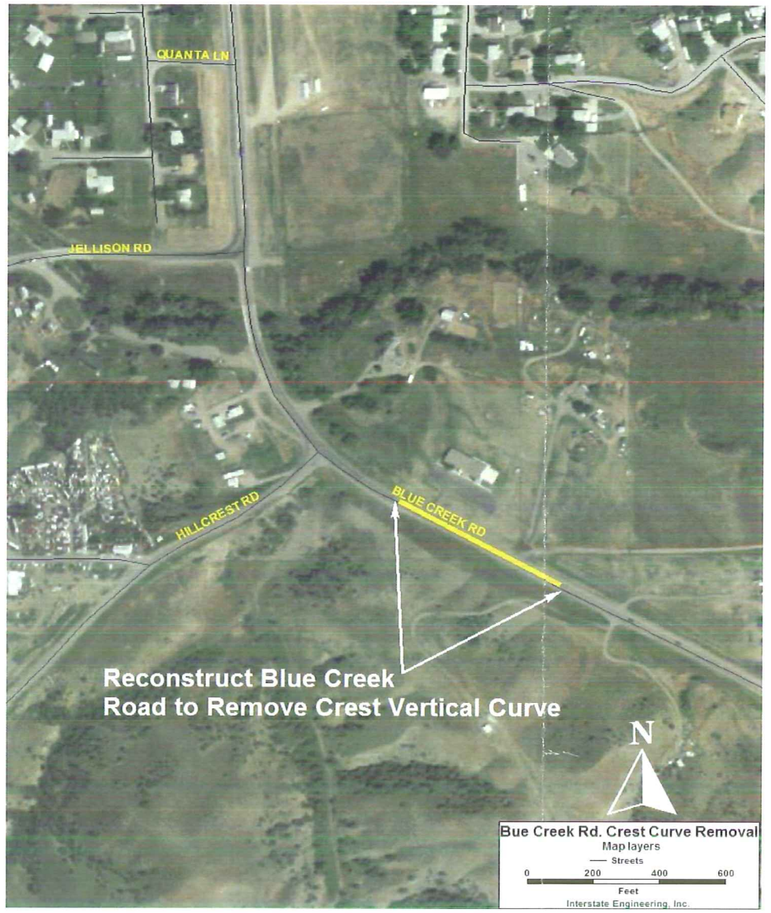
PROJECT NOTES:
1. Project length = 360 ft. (0.08 mi.)



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Blue Creek Road @ Hillcrest Road | | | | Reduce Blue Creek Road crest vertical curve |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 2,500 | $25.00 /sq.yd. | $62,500 | Reconstruct +/- 500 ft. of 40' roadway |
| Road Base (12") | 3,000 | $10.00 /sq.yd. | $30,000 | |
| Grading (Uncl.Ex.) | 5,000 | $8.00 /cu.yd. | $40,000 | Excavation to reduce crest vertical curve |
| Borrow | | $12.00 /cu.yd. | $0 | |
| Curb/Gutter | | $15.00 /lin.ft. | $0 | |
| Sidewalk | | $25.00 /sq.yd. | $0 | |
| Utilities | 0.10 | $500,000.00 /mile | $50,000 | Significant utility impacts |
| Drainage | 0.10 | $200,000.00 /mile | $20,000 | No major changes required |
| Signing/Striping | 0.10 | $75,000.00 /mile | $7,500 | |
| Lighting | | $350,000.00 /mile | $0 | Lighting not anticipated. |
| Const. Traffic Control | 0.10 | $75,000.00 /mile | $7,500 | |
| **Misc. Major Elements** | | | | |
| Adjust Driveways | 3 | $10,000.00 /each | $30,000 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| **SUB-TOTAL** | | | $247,500 | |
| Engineering/Design/Const. Serv. (20%) | | | $49,500 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | Assume no ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| **SUB-TOTAL** | | | $297,000 | |
| Contingency (20%) | | | $59,400 | |
| **GRAND TOTAL** | | | **$356,400** | |

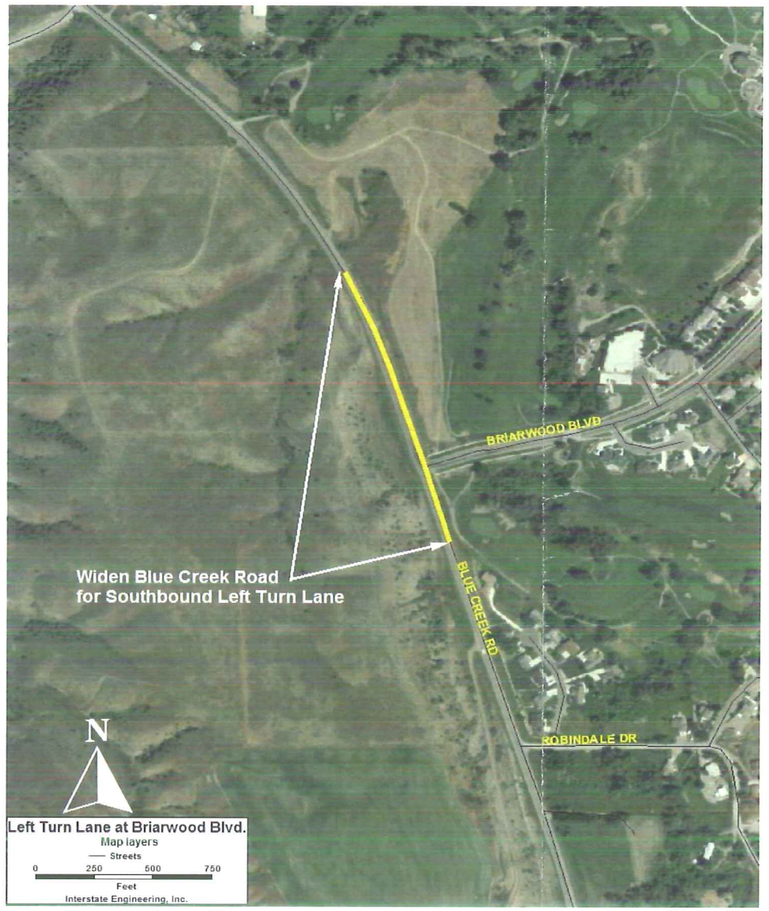
**PROJECT NOTES:**
1. Reconstruct Blue Creek Road for +/ 500 ft. to reduce crest vertical curve.



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Blue Creek Road @ Briarwood Boulevard | | | | Construct southbound left turn lane on Blue Creek Road |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 1,400 | $25.00 /sq.yd. | $35,000 | Widen highway by 6 ft. on either side. |
| Road Base (12") | 1,800 | $10.00 /sq.yd. | $18,000 | Includes extra width for shoulder area. |
| Grading (Uncl.Ex.) | 600 | $8.00 /cu.yd. | $4,800 | Remove topsoil and prep for embankment placement. |
| Borrow | 600 | $12.00 /cu.yd. | $7,200 | Build up for widening |
| Curb/Gutter | | $15.00 /lin.ft. | $0 | |
| Sidewalk | | $25.00 /sq.yd. | $0 | |
| Utilities | 0.25 | $250,000.00 /mile | $62,500 | |
| Drainage | 0.25 | $200,000.00 /mile | $50,000 | |
| Signing/Striping | 0.25 | $75,000.00 /mile | $18,750 | |
| Lighting | | $350,000.00 /mile | $0 | |
| Const. Traffic Control | 0.25 | $75,000.00 /mile | $18,750 | |
| **Misc. Major Elements** | | | | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| **SUB-TOTAL** | | | $215,000 | |
| Engineering/Design/Const. Serv. (20%) | | | $43,000 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | Assume no ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| **SUB-TOTAL** | | | $258,000 | |
| Contingency (20%) | | | $51,600 | |
| **GRAND TOTAL** | | | **$309,600** | |

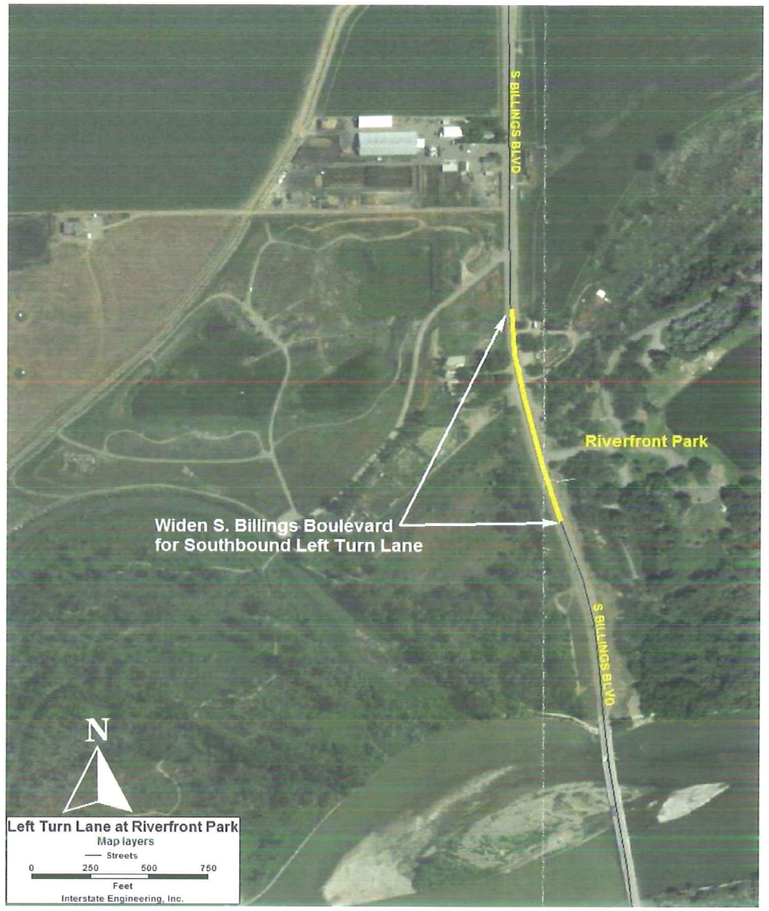
**PROJECT NOTES:**
1. total project length is 1,300 ft. (0.25 mi.)



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Blue Creek Road @ Riverfront Park | | | | Construct southbound left turn lane on S. Billings Blvd. |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 1,100 | $25.00 /sq.yd. | $27,500 | Widen highway by 6 ft. on either side. |
| Road Base (12") | 1,300 | $10.00 /sq.yd. | $13,000 | Includes extra width for shoulder area. |
| Grading (Uncl.Ex.) | 500 | $8.00 /cu.yd. | $4,000 | Remove topsoil and prep for embankment placement. |
| Borrow | 1,000 | $12.00 /cu.yd. | $12,000 | Build up for widening |
| Curb/Gutter | | $15.00 /lin.ft. | $0 | |
| Sidewalk | | $25.00 /sq.yd. | $0 | |
| Utilities | 0.20 | $250,000.00 /mile | $50,000 | |
| Drainage | 0.20 | $200,000.00 /mile | $40,000 | |
| Signing/Striping | 0.20 | $75,000.00 /mile | $15,000 | |
| Lighting | | $350,000.00 /mile | $0 | |
| Const. Traffic Control | 0.20 | $75,000.00 /mile | $15,000 | |
| **Misc. Major Elements** | | | | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| **SUB-TOTAL** | | | $176,500 | |
| Engineering/Design/Const. Serv. (20%) | | | $35,300 | |
| R.O.W. (purchase) | 0 | $4.00 /sq.ft. | $0 | Assume no ROW required. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| **SUB-TOTAL** | | | $211,800 | |
| Contingency (20%) | | | $42,360 | |
| **GRAND TOTAL** | | | **$254,160** | |

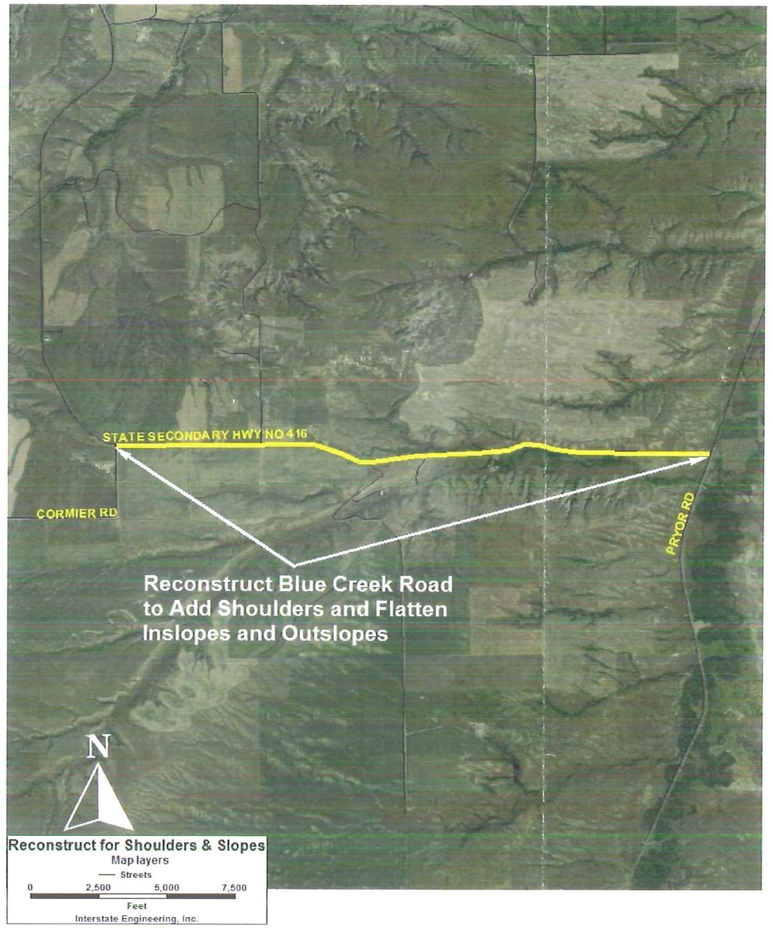
**PROJECT NOTES:**
1. Project length is 1,025 ft. (0.20 mi.)



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Blue Creek Road South of Cormier Road | | | | Widen to add recoverable shoulders and inslopes, flatten backslopes. |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 25,000 | $25.00 /sq.yd. | $625,000 | Add 5 ft. each side of road. |
| Road Base (12") | 30,000 | $10.00 /sq.yd. | $300,000 | |
| Grading (Uncl.Ex.) | 10,000 | $8.00 /cu.yd. | $80,000 | Excavation to flatten backslopes. |
| Borrow | 75,000 | $12.00 /cu.yd. | $900,000 | Embankment to flatten inslopes and support shoulder. |
| Curb/Gutter | | $15.00 /lin.ft. | $0 | |
| Sidewalk | | $25.00 /sq.yd. | $0 | |
| Utilities | 4.15 | $250,000.00 /mile | $1,037,500 | |
| Drainage | 4.15 | $200,000.00 /mile | $830,000 | Adjust culverts, etc. |
| Signing/Striping | 4.15 | $75,000.00 /mile | $311,250 | |
| Lighting | | $350,000.00 /mile | $0 | |
| Const. Traffic Control | 4.15 | $75,000.00 /mile | $311,250 | |
| **Misc. Major Elements** | | | | |
| Adjust Driveways | 10 | $10,000.00 /each | $100,000 | |
| Re-seeding | 25 | $2,000.00 /acre | $50,000 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| **SUB-TOTAL** | | | $4,545,000 | |
| Engineering/Design/Const. Serv. (20%) | | | $909,000 | |
| R.O.W. (purchase) | 438,250 | $2.00 /sq.ft. | $876,500 | Assume additional 10 ft. of ROW required each side of existing. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| **SUB-TOTAL** | | | $6,330,500 | |
| Contingency (20%) | | | $1,266,100 | |
| **GRAND TOTAL** | | | **$7,596,600** | |

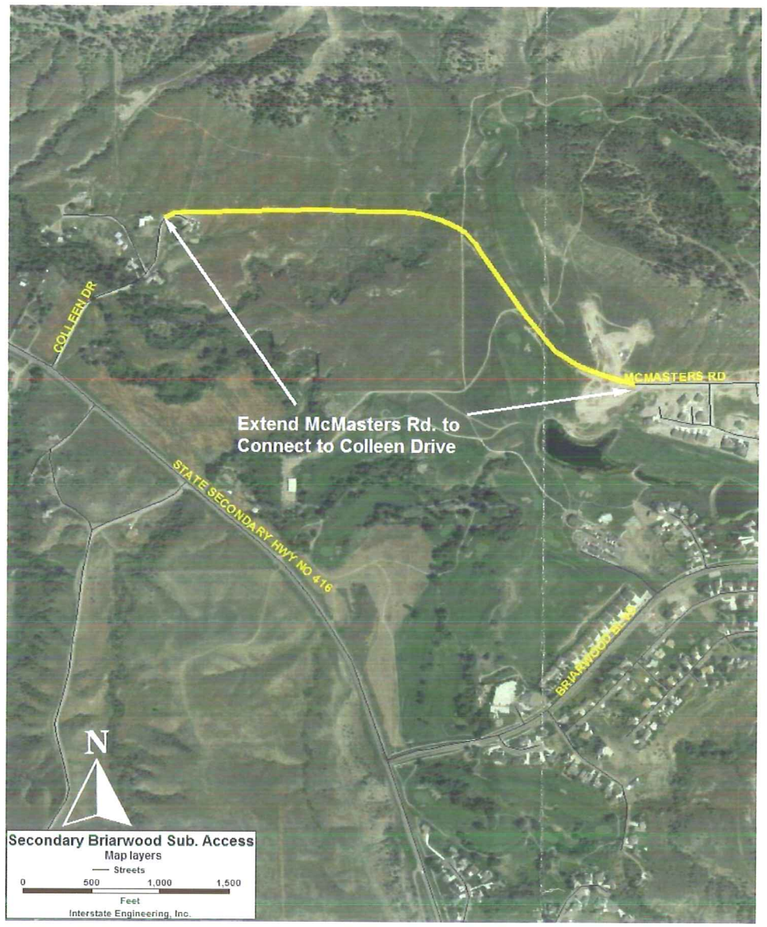
**PROJECT NOTES:**
1. Project length is 4.15 mi.
2. Assume additional 10 ft. of ROW required each side of existing ROW.



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Secondary Access for Briarwood Subdivision | | | | Extend McMasters Rd. to Colleen Dr. |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 27,500 | $25.00 /sq.yd. | $687,500 | 49 ft. B-B Collector Street section. |
| Road Base (12") | 30,000 | $10.00 /sq.yd. | $300,000 | |
| Grading (Uncl.Ex.) | 16,000 | $8.00 /cu.yd. | $128,000 | |
| Borrow | 3,000 | $12.00 /cu.yd. | $36,000 | |
| Curb/Gutter | 11,000 | $15.00 /lin.ft. | $165,000 | |
| Sidewalk | 6,150 | $25.00 /sq.yd. | $153,750 | |
| Utilities | | $250,000.00 /mile | $0 | Little or no existing utilities on route. |
| Drainage | 1.00 | $200,000.00 /mile | $200,000 | |
| Signing/Striping | 1.00 | $75,000.00 /mile | $75,000 | |
| Lighting | | $350,000.00 /mile | $0 | Assume continuous street lighting not required. |
| Const. Traffic Control | 1.00 | $75,000.00 /mile | $75,000 | |
| **Misc. Major Elements** | | | | |
| Replace Blue Creek Br. | 4,500 | $200.00 /sq.ft. | $900,000 | |
| Drainage Structure | 1 | $300,000.00 /each | $300,000 | Box Culvert over unnamed drainage |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| SUB-TOTAL | | | $3,020,250 | |
| Engineering/Design/Const. Serv. (20%) | | | $604,050 | |
| R.O.W. (purchase) | 320,000 | $4.00 /sq.ft. | $1,280,000 | Value of ROW dedicated by developer of Briarwood Subdivision |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| SUB-TOTAL | | | $4,904,300 | |
| Contingency (20%) | | | $980,860 | |
| GRAND TOTAL | | | $5,885,160 | |

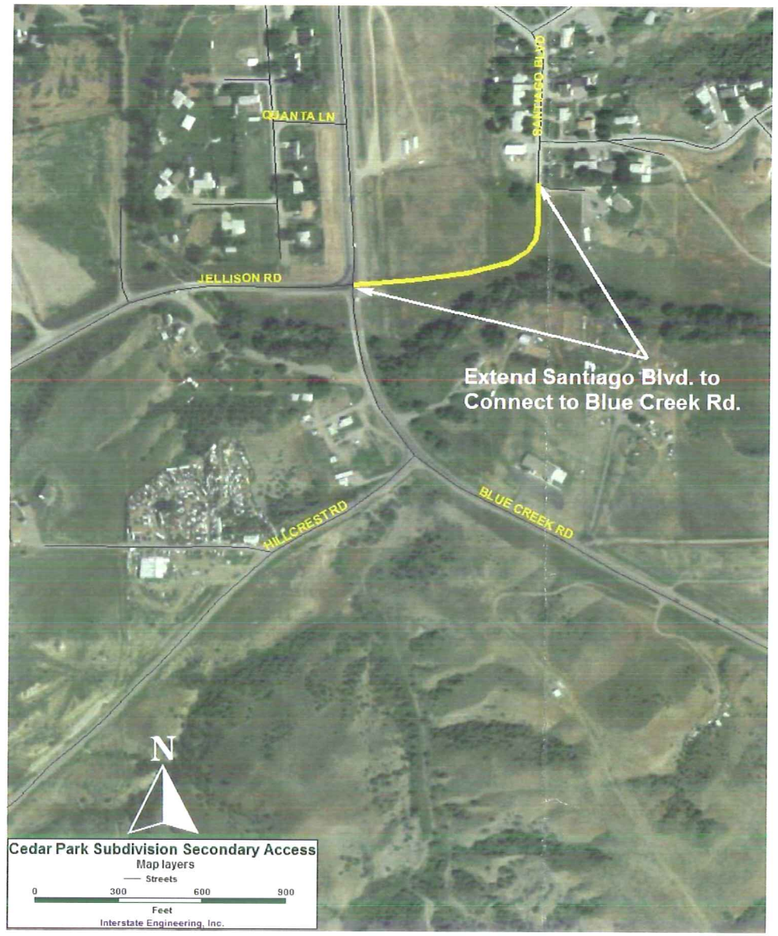
**PROJECT NOTES:**
1. Project length is 0.75 mi.
2. Developer funded project required by City/County Planning Department.
3. Includes upgrading Colleen Drive to collector street standards (1,500 ft.).



## PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS
## Blue Creek Area Transportation Study

| Santiago Boulevard | | | | Extend to Blue Creek Rd. at Jellison Rd., secondary acccess Cedar Pk. |
|---|---|---|---|---|
| ITEM | ESTIMATED QUANTITY | ESTIMATED UNIT COST | EXTENDED COST | NOTES |
| Asphalt (6") | 3,100 | $25.00 /sq.yd. | $77,500 | 37 ft. B-B Local Street section. |
| Road Base (12") | 3,500 | $10.00 /sq.yd. | $35,000 | |
| Grading (Uncl.Ex.) | 2,550 | $8.00 /cu.yd. | $20,400 | |
| Borrow | | $12.00 /cu.yd. | $0 | |
| Curb/Gutter | 1,700 | $15.00 /lin.ft. | $25,500 | Assume C&G and sidewalk required with street construction. |
| Sidewalk | 950 | $25.00 /sq.yd. | $23,750 | Assume C&G and sidewalk required with street construction. |
| Utilities | 0.16 | $250,000.00 /mile | $40,000 | |
| Drainage | 0.16 | $200,000.00 /mile | $32,000 | |
| Signing/Striping | 0.16 | $75,000.00 /mile | $12,000 | |
| Lighting | | $350,000.00 /mile | $0 | Assume continuous lighting not required. |
| Const. Traffic Control | 0.16 | $75,000.00 /mile | $12,000 | |
| **Misc. Major Elements** | | | | |
| | | /sq.ft. | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| | | /each | $0 | |
| **SUB-TOTAL** | | | $278,150 | |
| Engineering/Design/Const. Serv. (20%) | | | $55,630 | |
| R.O.W. (purchase) | 51,000 | $4.00 /sq.ft. | $204,000 | Value of ROW dedicated by developer when platted/constructed. |
| Relocate Res. | | $250,000.00 /each | $0 | |
| Relocate Bus. or Comm. Estab. | | $350,000.00 /each | $0 | |
| **SUB-TOTAL** | | | $537,780 | |
| Contingency (20%) | | | $107,556 | |
| **GRAND TOTAL** | | | **$645,336** | |

**PROJECT NOTES:**
1. Project length is 850 ft. (016 mi.)
2. Developer funded project to be required with additional platting/development.



## Qualitative Environmental Assessment of Improvement Alternatives

Construction projects that involve physical construction (road widening, new construction, etc.) may also have environmental impacts. Impacts may be to the natural environment (wetlands, endangered species, prime farmlands, etc.), or may be to the man-made environment (acquisition of right-of-way, demolition of structures, relocation of population, etc.). While it is not within the scope of this study to outline all possible environmental impacts or to develop an environmental assessment, individual projects will be examined for significant environmental impacts that may be a "fatal flaw" and prevent the project from moving forward.

Some of the identified projects will involve roadway widening, typically for construction of auxiliary turn lanes. Some of those will also require acquisition of right-of-way. Projects that may involve acquisition of right-of-way or easements are as follows:

- Trimming / removing trees to improve sight distance for Jellison Road approach to Blue Creek Road (Proj. #2).
- Widening Blue Creek Road from Cormier Road to Pryor Road (Proj. #19).
- Extending McMasters Road to Colleen Drive (Proj. #20).
- Extending Santiago Boulevard to Blue Creek Road (Proj. #21).
- Reconstruction of Hillcrest Road from Blue Creek Road to Duck Creek Road (Proj. #30).

None of these projects involve demolition of any residential or commercial structures and, are all considered without "fatal flaws" in this respect.

Some of the projects listed involving roadway widening may impact sensitive natural areas such as wetlands. Projects that may involve wetland impacts are as follows:

- Realign Blue Creek Road and replace the Blue Creek bridge with a structure that is straighter and wider (Proj. #8).
- Extending McMasters Road - involves at least one drainageway crossing (Proj. #20)
- Extending Santiago Boulevard - may impact Blue Creek wetlands or floodplain (Proj. #21).
- Reconstruction of Hillcrest Road from Blue Creek Road to Duck Creek Road – project will involve several drainageway crossings (Proj. #30).

While some projects will require environmental documentation, none appear to be fatally flawed such that they aren't viable projects from an environmental standpoint. Most projects identified can be completed with minimal environmental impacts.

## Estimates of Probable Construction Cost of Improvement Alternatives

Planning level cost estimates were developed for projects, whether they involved physical construction or additional studies. Cost estimates included costs for major construction elements such as asphalt, earthwork, utilities, right-of-way, etc. Cost estimates also include costs of engineering and construction as a percentage of construction costs, and included a 20% contingency.

Costs for each project were provided previously in Table 5. Details of cost estimates developed for each construction project are provided in Appendix D. Graphics showing project location and extent are also provided in Appendix D.

# SECTION 5 – PREFERRED IMPROVEMENT ALTERNATIVES

## Preferred Alternatives and Priorities

Upon formulation of the final list of projects that resulted from identified deficiencies, it became necessary to assign priorities. Rather than prioritize individual projects in a sequential order for implementation, it was decided to identify priorities by geography. Working with the Project Guidance Committee, it was determined that the area along Blue Creek Road between the Yellowstone River bridge and Hillcrest Road should be the highest priority. Improvements on Blue Creek Road at Briarwood Boulevard, Riverfront Park, widening Blue Creek Road south of Cormier Road and improved gravel road maintenance were identified as second tier projects. While non-motorized projects, road reconstruction and paving to improve area access to Duck Creek Road, and including transit service to the area were identified as third tier projects.

As Table 4 indicates, several deficiencies identified through the study process require additional study or analysis beyond the scope of this project to determine appropriate action. Those studies should be undertaken as a tier one priority so that additional identified projects can be defined and become eligible for funding and implementation. Higher priority studies include the Safe Routes to School study recommended for Blue Creek Elementary School and passing zone studies for Blue Creek Road.

---

[1] Highway Capacity Manual, Transportation Research Board, National Research Council, Washington DC, 2000, pp 2-2 through 2-3.
[2] Montana Road Design Manual, Montana Department of Transportation, November, 2000
[3] Montana Road Design Manual, Montana Department of Transportation, November, 2000
[4] Highway Capacity Manual, Transportation Research Board, National Research Council, Washington DC, 2000, pp 12-16.

# Appendix A

# MDT Safety Project Detail

serving you with pride

*Montana Department of Transportation*
*PO Box 201001*
*Helena, MT 59620-1001*

**Memorandum**

To: Distribution

From: Duane E. Williams, P E. *initialed DW*
Traffic and Safety Engineer

Date: April 27, 2009

Subject: HSIP 416-1(13)1
SF069-Flasher/Guardrail-S Blgs
UPN 6058 000
310 – Roadway and Roadside Improvements

The Scope of Work Report for this project has hereby been released on April 27, 2009. We request that those on the distribution review this report and submit your concurrence within two weeks of the above date.

Your comments and recommendations are also requested if you do not concur or concur subject to certain conditions.

When all the personnel on the distribution list have concurred, we will submit this report to the Chief Engineer for approval.

I recommend approval:
Approved _____ Date _____

Distribution:
Stefan Streeter, District Administrator
Kent Barnes, Bridge Engineer
Tom Martin, Environmental Services Bureau Chief
Duane Williams, Traffic and Safety Engineer
John Horton, Right-of-Way Bureau Chief
Paul Ferry, Highways Engineer
Lynn Zanto Rail, Transit, & Planning Division Administrator
Jake Goettle, Construction Engineering Services Bureau
Matt Strizich, Materials Engineer
Jon Swartz, Maintenance Administrator

cc (all with attachments):
Dave Jensen, Fiscal Programming Section Supervisor
LeRoy Wosoba, Project Design Manager
Danielle Bolan, Traffic Engineer
Joe Nye, Design Supervisor, Road Design

e-copies:
Jim Walther, Preconstruction Engineer
Lesly Tribelhorn, Highways Design Engineer
Mark Goodman, Hydraulics Engineer
Dave Leitheiser, District Hydraulics Engineer
Bonnie Steg, Env Bureau Resources Section Supervisor
Bill Semmens, District Biologist
Tom Gocksch, District Project Development Engineer
Danielle Bolan, Traffic Engineer
Pierre Jomini, Safety Management Engineer
Bridge Area Engineer, Billings District
Jon Watson, Pavement Engineer
Cameron Kloberdanz, District Geotechnical Manager
Bryce Larsen, Supervisor, Photogrammetry & Survey
Marty Beatty, Engineering Information Services
Paul Grant, Public Involvement Officer
Jake Goettle, Construction Bureau – VA Engineer
Gary Neville, District Preconstruction
Rod Nelson, District Projects Engineer
Randy Roth, District Maintenance Chief
Walt Scott, R/W Utilities Section Supervisor
Jim Mullins, R/W Design Manager
Greg Pizzini, Acquisition Manager
Joe Zody, R/W Access Management Section Manager
Gary Larson, Project Analysis Bureau Chief
Sue Sillick, Research Section Supervisor
Alice Flesch, ADA Coordinator
Mark Keeffe, Bicycle/Pedestrian Coordinator
Wayne Noem, Secondary Roads Engineer
Jason Sorenson, Engineering Cost Analyst
Jean Riley, Planner

## Scope of Work

The proposed project has been nominated through the Safety Engineering Improvement Program to install chevrons and signing for a horizontal curve. A flasher is also proposed to be installed on the existing curve warning sign for the northbound traffic. A review of all existing signing is recommended to ensure proper spacing and sequence between the warning and regulatory signs.

The side slope on the west side (outside of curve) was checked and the slope will be flattened to 6:1. The approach slopes at Stations 23+45 and 26+05 will also be flattened. The existing guard rail will be removed and replaced with guard rail meeting current standards.

The Billings District has requested to modify the programming to include Secondary funds to upgrade the guardrail end terminals on the Yellowstone River Bridge north of this project.

## Project Location and Limits

The project is located in Yellowstone County, on State Secondary Route 416. The project begins at RP 0.11± and extends to RP 1.21± The functional class of this highway is major collector. The speed limit just south of this segment is 70 mph. A speed reduction to 50mph occurs within the project limits.

See attached map.

## Physical Characteristics

This section of roadway was last improved in 1995 under project number RTS 416-1(7)0. In this section of roadway it is a two lane highway. The traveled lanes are 12' each and the shoulder width is 6'.

The project begins at the intersection of Jellison Road which is a tee-type intersection on the west side of S-416. Just south of Jellison Road intersection, S-416 crosses over Blue Creek, travels through both a horizontal curve to the left as well as a sag vertical curve. There are two additional intersections along this segment of highway. Hillcrest Road intersects S-416 as a tee-type intersection on the west side just south of the Blue Creek Bridge and a private drive approach on west side between Hillcrest Rd and Blue Creek Bridge.

## Traffic Data

The traffic data for this location is as follows:

2006 ADT = 4390 (Present)
2008 ADT = 4700 (Letting)
2027 ADT = 9040 (Future)
DHV = 990
T = 5.9%
AGR = 3.5%
EAL = 236

## Accident Analysis

There were 17 recorded crashes at this section from January 1, 1994 to December 31, 2003. 6 of these crashes were considered correctable by the subject improvements. Of these crashes, one was a fatal crash resulting in one fatality, 4 were injury crashes resulting in 4 injuries and one was property damage only crash. The pattern of crashes on this segment of highway is run-off-road type crashes. Drivers appear to miss the curve

warning signs and fail to negotiate the curve.

By installing a flasher on the northbound curve warning sign and installing chevrons, this improvement should highlight the warning signs and delineate the curve radius. The guardrail will be improved by upgrading the optional end treatment and the bridge approach sections. The embankment slope will be flattened on the outside of the curve.

## Major Design Features

a) **Design Speed.** Because of the higher speeds through this segment of highway, the highway functions similar to a rural area even though you are approaching higher density of driveways and intersections. The design speed for this section of roadway based on its functional class of rural major collector is 60 mph
b) **Horizontal Alignment**. The horizontal alignment will not change.
c) **Vertical Alignment**. Vertical alignment will not change
d) **Typical Sections and Surfacing**. No change is proposed.
e) **Grading**. Grading for this project will be measured and paid for as embankment in place. The estimated quantity of embankment in place is less than 500 cubic yards. No shrink/swell factor will be applied to this grading quantity. Existing top soil will be salvaged and replaced on the new slope flattening. The slope design includes 6:1 slope flattening on the outside of the curve from station 23+75 to station 25+75. The approach slopes at Stations 23+45 and 26+05 will also be slope flattened to 10:1 within the clear-zone.
f) **Guardrail**. New guardrail, along with Optional Terminal End Sections Intersecting Roadway Terminal Sections, and Bridge Approach Sections will be installed at the Blue Creek Bridge crossing. The four "Texas Twists" at the Yellowstone River Bridge crossing will be replaced with Optional Terminal End Sections. No other rail or road work is planned at this crossing. Guardrail widening embankment is not required at either of the Optional Terminal End Sections near the Blue Creek Crossing. Five cubic yards will be provided in the Grading Summary Frame for guardrail widening at the Yellowstone River Bridge crossing because the volume needed is unknown.
g) **Geotechnical Considerations**. No geotechnical issue on this project
h) **Hydraulics**. No drainage issues or changes are proposed.
i) **Bridges**. Bridge involvement will be necessary. The bridge approach connection between the guardrail and bridge rail on all four corners of Blue Creek Bridge will be need to have a plan showing these details. Upgrading the end terminals only at the Yellowstone River Bridge shouldn't require any Bridge Bureau involvement.
j) **Traffic.** Traffic signing will be reviewed to ensure proper spacing between the curve warning signs and regulatory speed limit signs. A flashing light will be added to the northbound curve warning sign. Chevrons will be added around the curve. Based on the results of the survey, available R/W and utility issues, slope flattening on the outside of the curve will occur. The existing guardrail protecting the bridge ends on Blue Creek Bridge will upgraded to optional end treatments or intersection rail terminals along with the bridge approach sections.
k) **Pedestrian/Bicycle/ADA**. Not applicable to this project.
l) **Miscellaneous Features**. None.
m) **Context Sensitive Design Issues**. None.

## Design Exceptions

No design exceptions are anticipated.

## Right-of-Way

No additional right of way will be needed

**Utilities/Railroads**
No railroads are near the project location. There are markers indicating fiber optic and natural gas line in the embankment located on the west side of the highway between Blue Creek Bridge and Hillcrest Road as well as underground telephone and overhead power. The Utilities Section will work with any impacted utility companies and municipalities to implement the utility process.

**Environmental Considerations**
An addendum to the Biological Resources Report (dated June 20, 2007) was completed on April 17, 2009. It determined that there was no effect for threatened and endangered species. The project will not adversely impact any species of special concern, fisheries, general wildlife or their habitat. There will be no impacts to any wetlands or other drainages; therefore, a CWA 404 permit and a SPA 124 authorization will not be required.

A Categorical Exclusion (d) provides a sufficient level of documentation for the proposed project in accordance with the guidelines of 23 CFR 771.117. The Categorical Exclusion (d) was approved by FHWA on April 24, 2009 No 404 permit or SPA 124 notification will be required for this project.

**Work Zone Safety and Mobility:**
Level 2 construction zone impacts are anticipated for this project as defined in the Work Zone Safety and Mobility (WZSM) guidance.

Localized lane closures will be needed to modify the guardrail on Blue Creek Bridge. Shoulder closures may be needed for any sign/flasher work along the roadside. The embankment work can also be performed under localized lane closures using the latest MUTCD and MDT requirements for construction shoulder or lane closures on two-lane roads.

**Other Projects**
No other project will be in conflict with this project.

**Intelligent Transportation Systems (ITS) Features**
No ITS solutions are being considered as part of this project.

**Public Involvement**
The level of public involvement for this project will be level A. A news release sent to the local media on February 5, 2008

**Cost Estimate**

| | w/o IDC | w/ IDC 14.06% |
|---|---|---|
| Blue Creek Crossing Guardrail and slope flattening | $58,713.00 | $66,968.05 |
| Signing and Flasher | $2,500.00 | $2,851.50 |
| Yellowstone Crossing | $15,000.00 | $17,109.00 |
| **Subtotal** | $76,213.00 | $86,928.55 |
| Mobilization (18%) | $13,718.34 | $15,647.14 |
| **Subtotal** | $89,931.34 | $102,575.69 |
| Contingencies (10%) | $8,993.13 | $10,257.57 |

| | | |
|---|---|---|
| **Subtotal** | $98,924.47 | $112,833.26 |
| Inflation (from inflation calculator for _0_ years) | $0 | $0 |
| **Total CN** | **$98,924.47** | **$112,834.26** |
| **CE** (10%) | **$9,892.45** | **$11,283.43** |

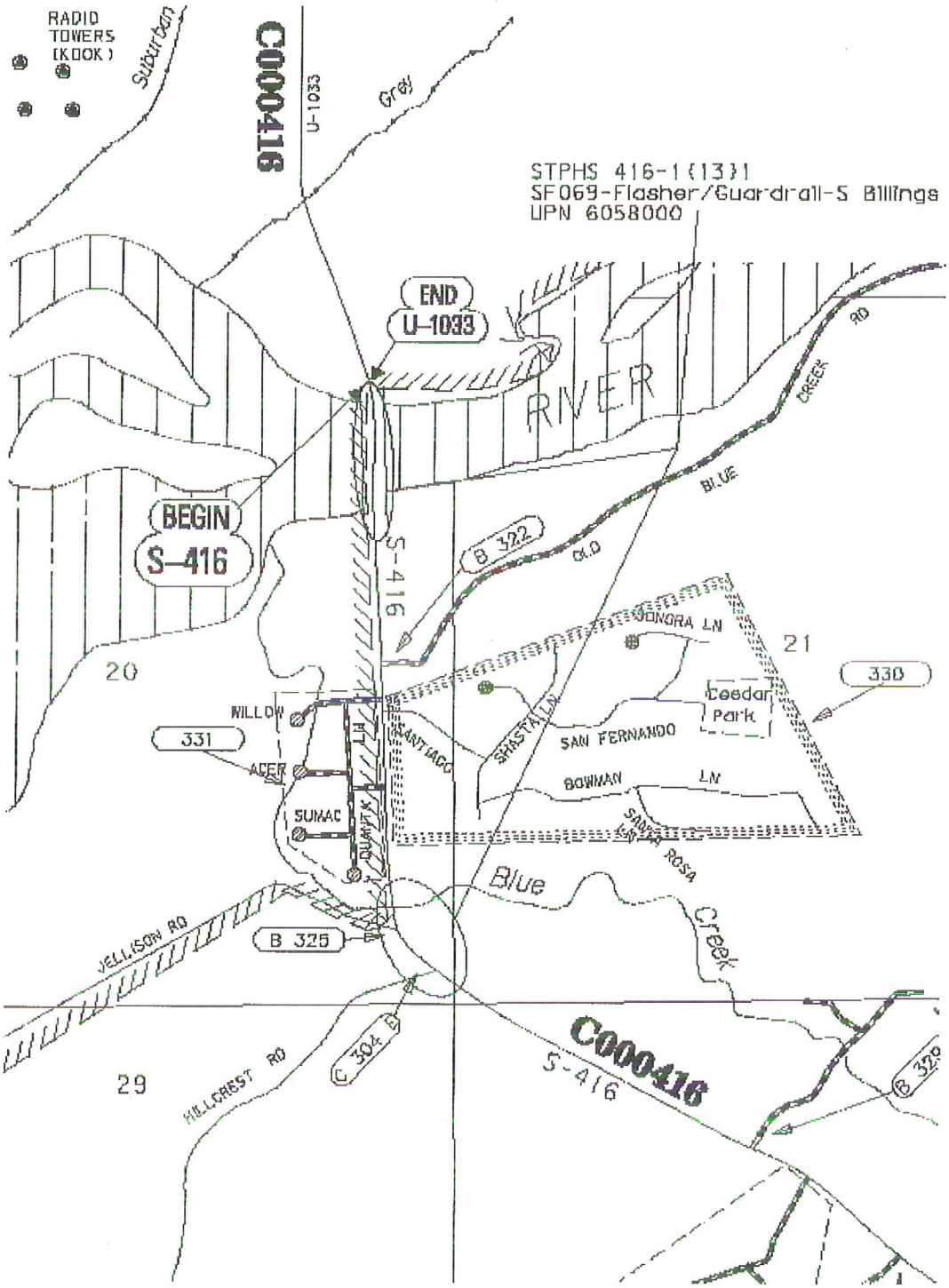
**Project Management**

Traffic Safety will be responsible for management and the design plans of this project.

**Ready Date**

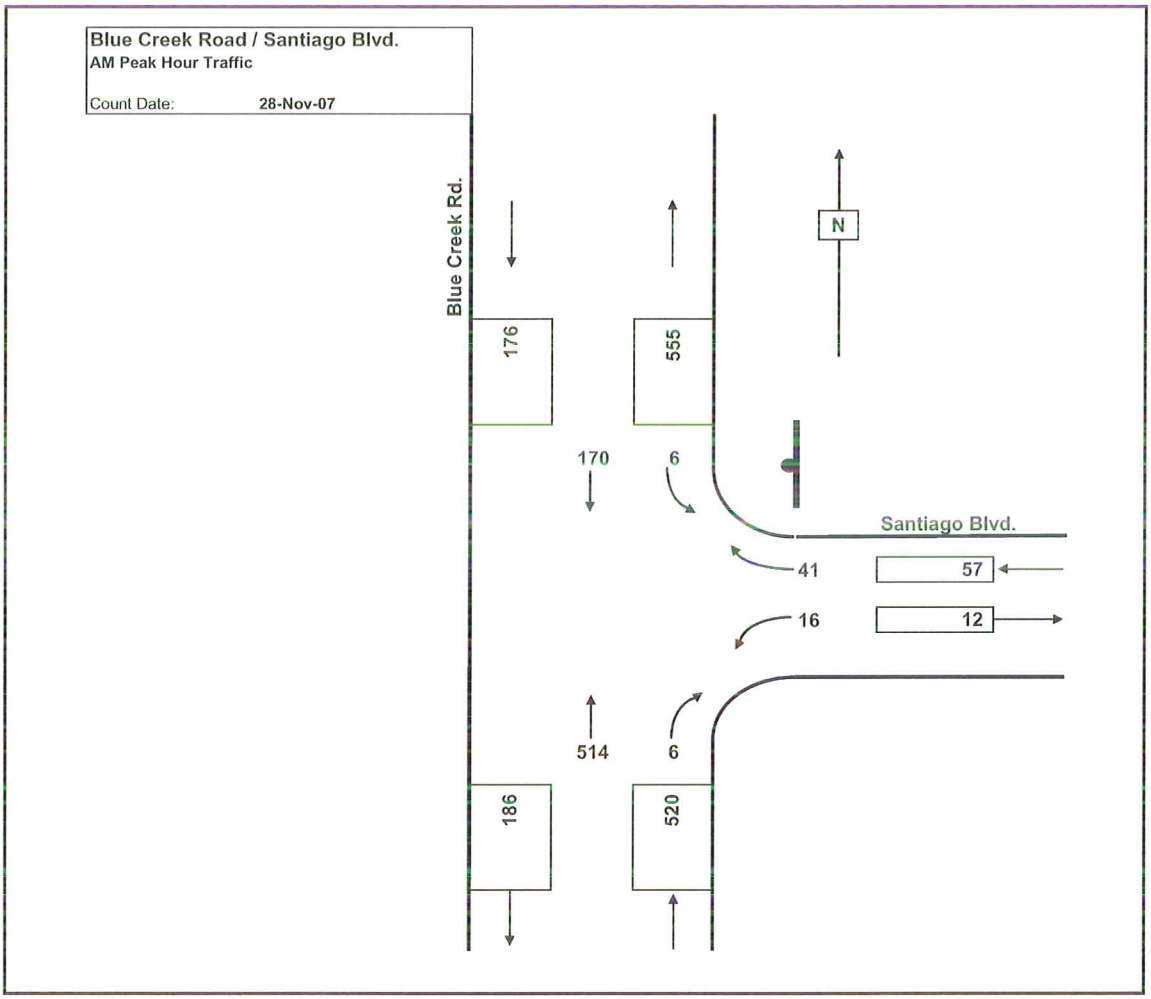
The current ready date for this project is August 1, 2009 with a letting date of December 3, 2009 as shown in the latest Tentative Construction Program.

Attempts will be made to have this project ready sooner than the August 1, 2009 ready date.

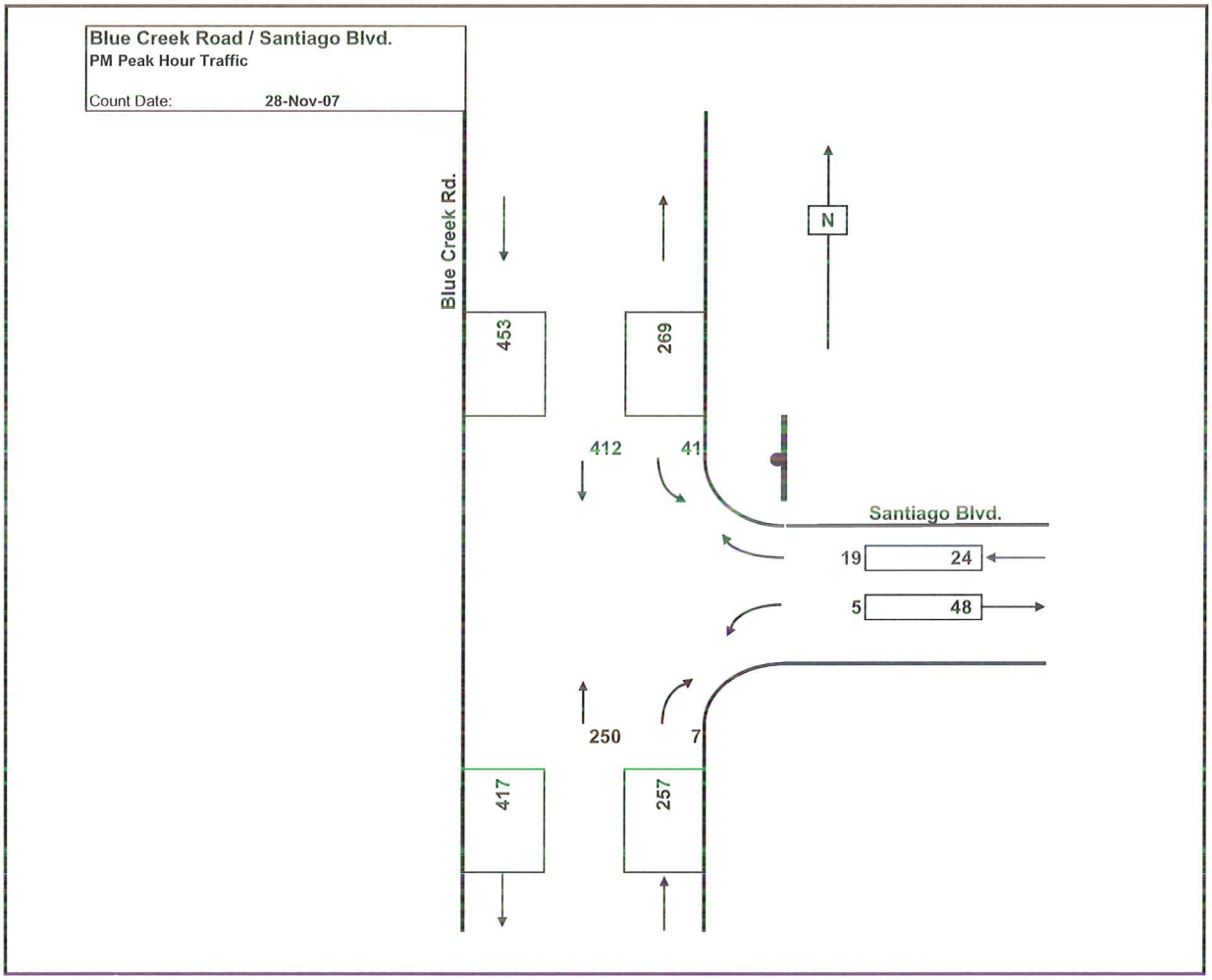

RADIO TOWERS (KOOK)
Suburban
C000416
U-1033
Grey
STPHS 416-1(131)
SF069-Flasher/Guardrail-S Billings
UPN 6058000
END
U-1033
RIVER
BEGIN
S-416
S-416
B 322
BLUE
CREEK RD
SONORA LN
21
20
330
Cedar Park
WILLOW
331
ACER
SUMAC
QUARTZ LN
SAN FERNANDO
SEBASTIAN LN
BOWMAN LN
SANTA ROSA
Blue
Creek
VELLISON RD
B 325
HILLCREST RD
29
C 304
S-416
C000416
B 320

# Appendix B

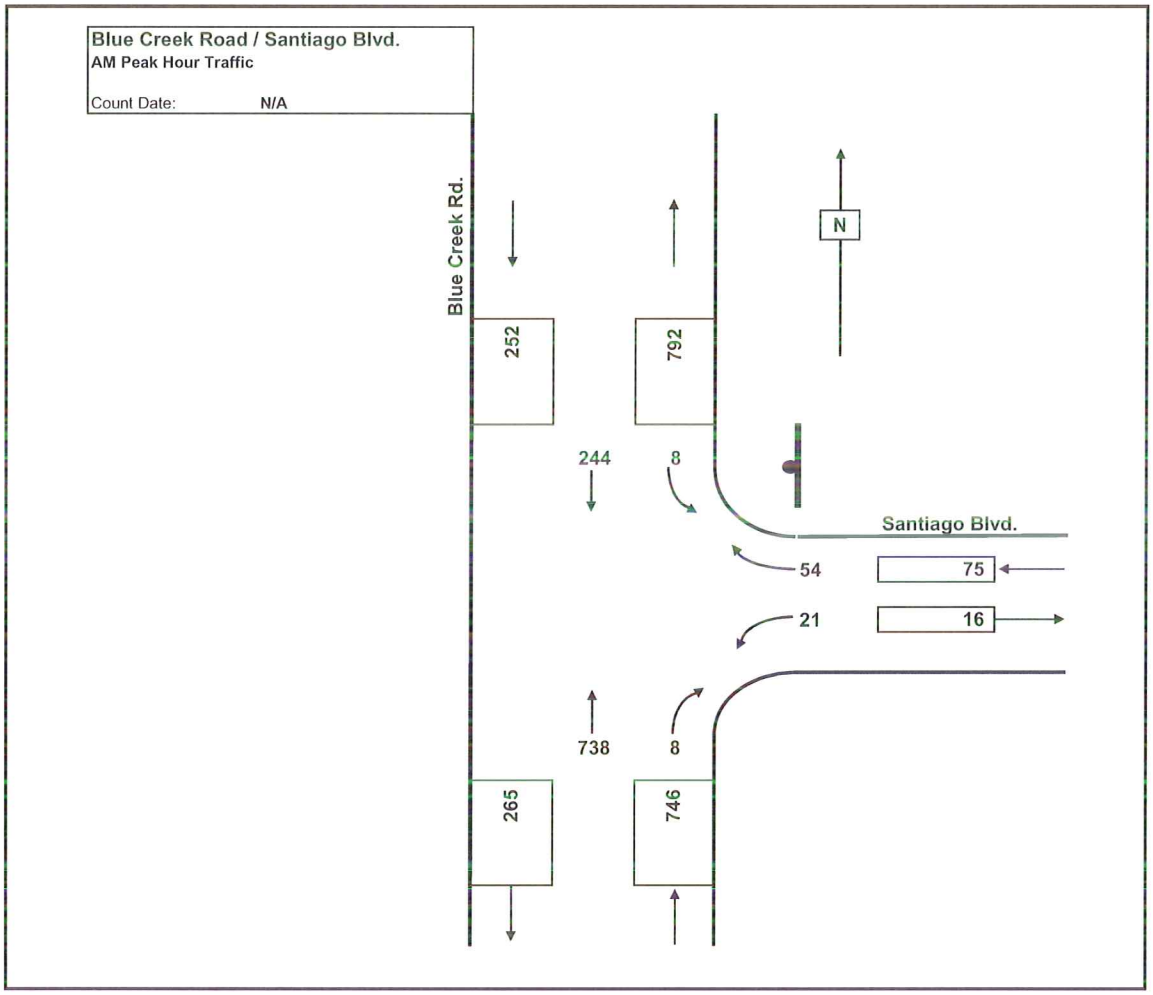
# Intersection Peak Hour Turning Traffic Counts



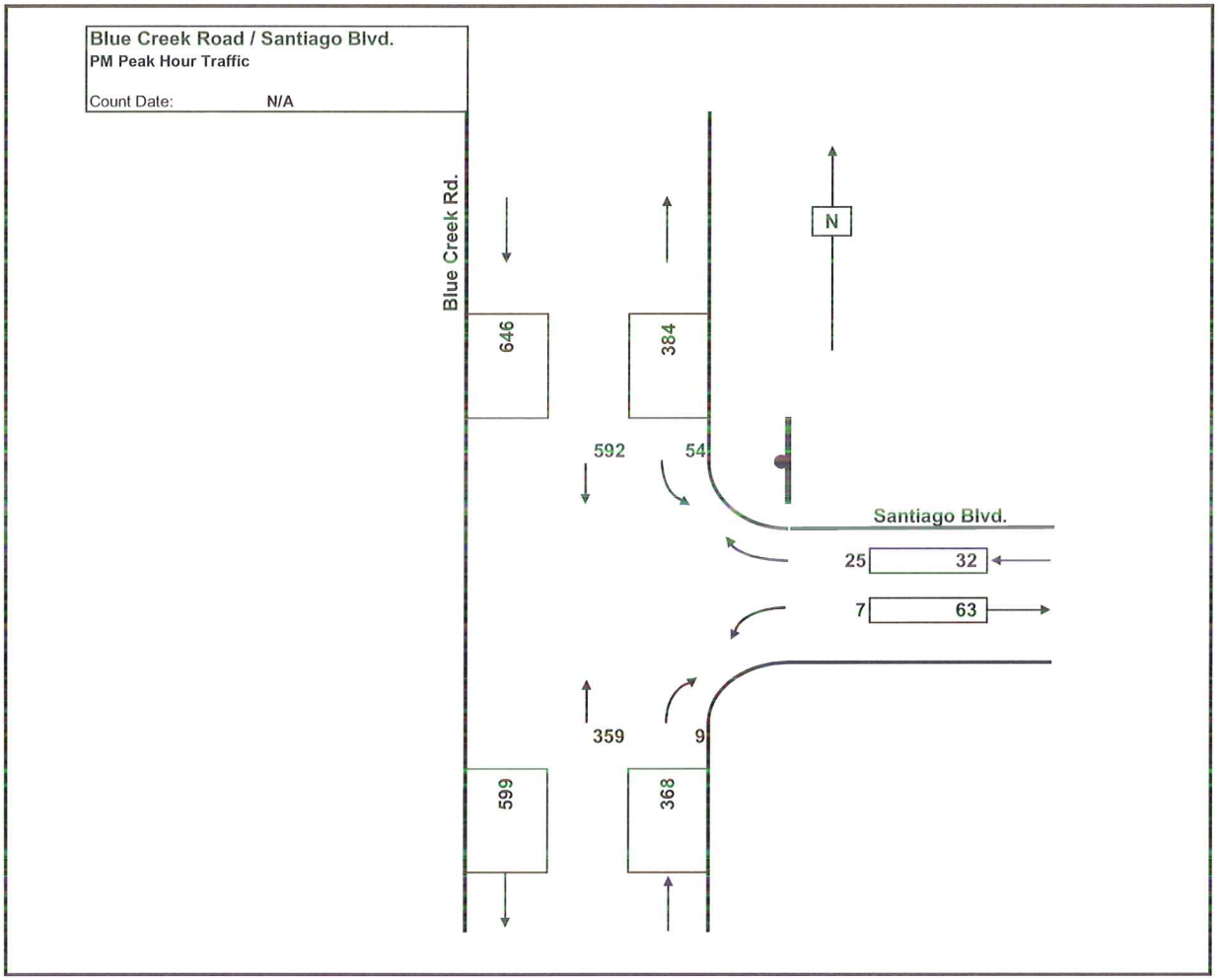

**Blue Creek Road / Santiago Blvd.**
**Existing AM Peak Hour Traffic Volume**




**Blue Creek Road / Santiago Blvd.**
**Existing PM Peak Hour Traffic Volume**

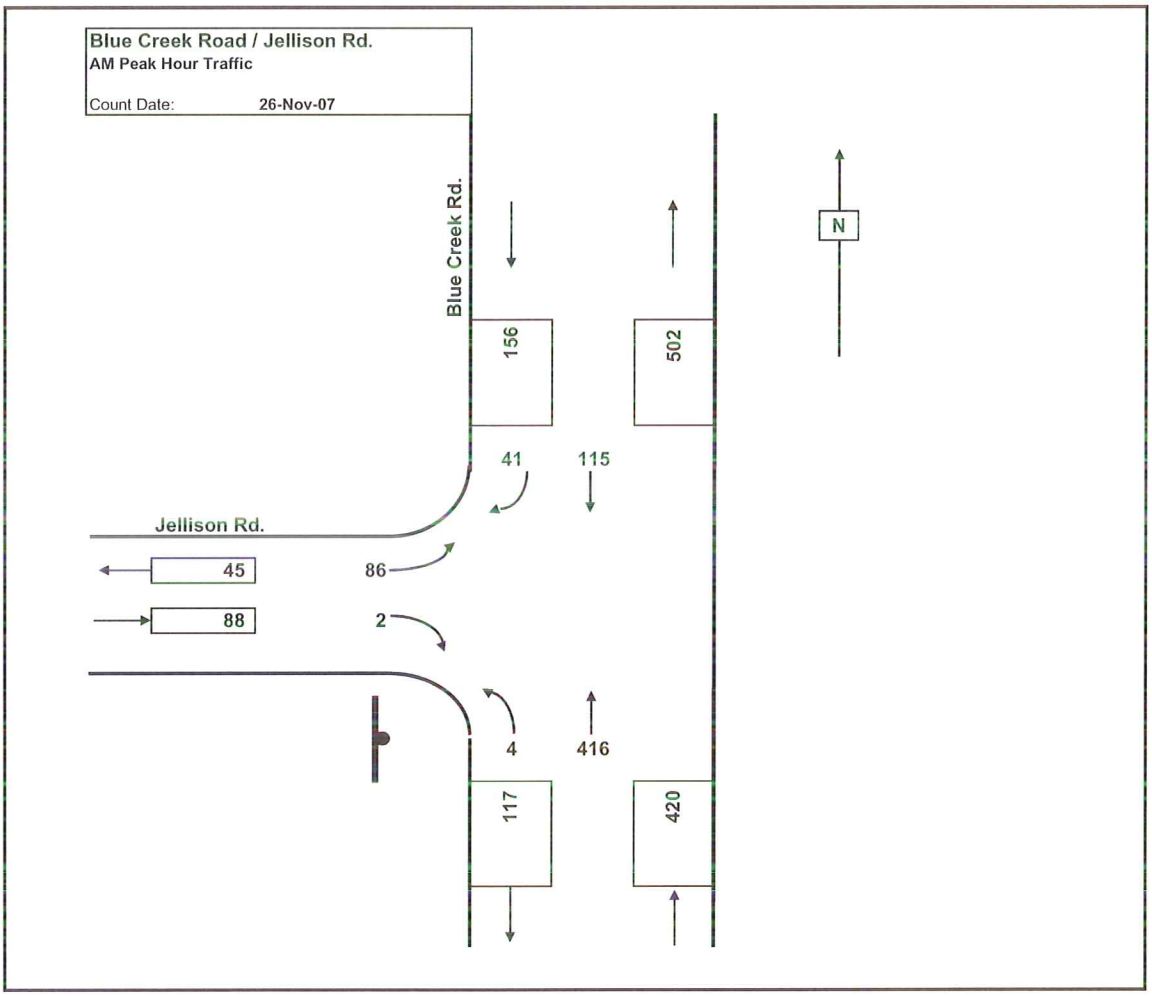



**Blue Creek Road / Santiago Blvd.**
**Future AM Peak Hour Traffic Volume**

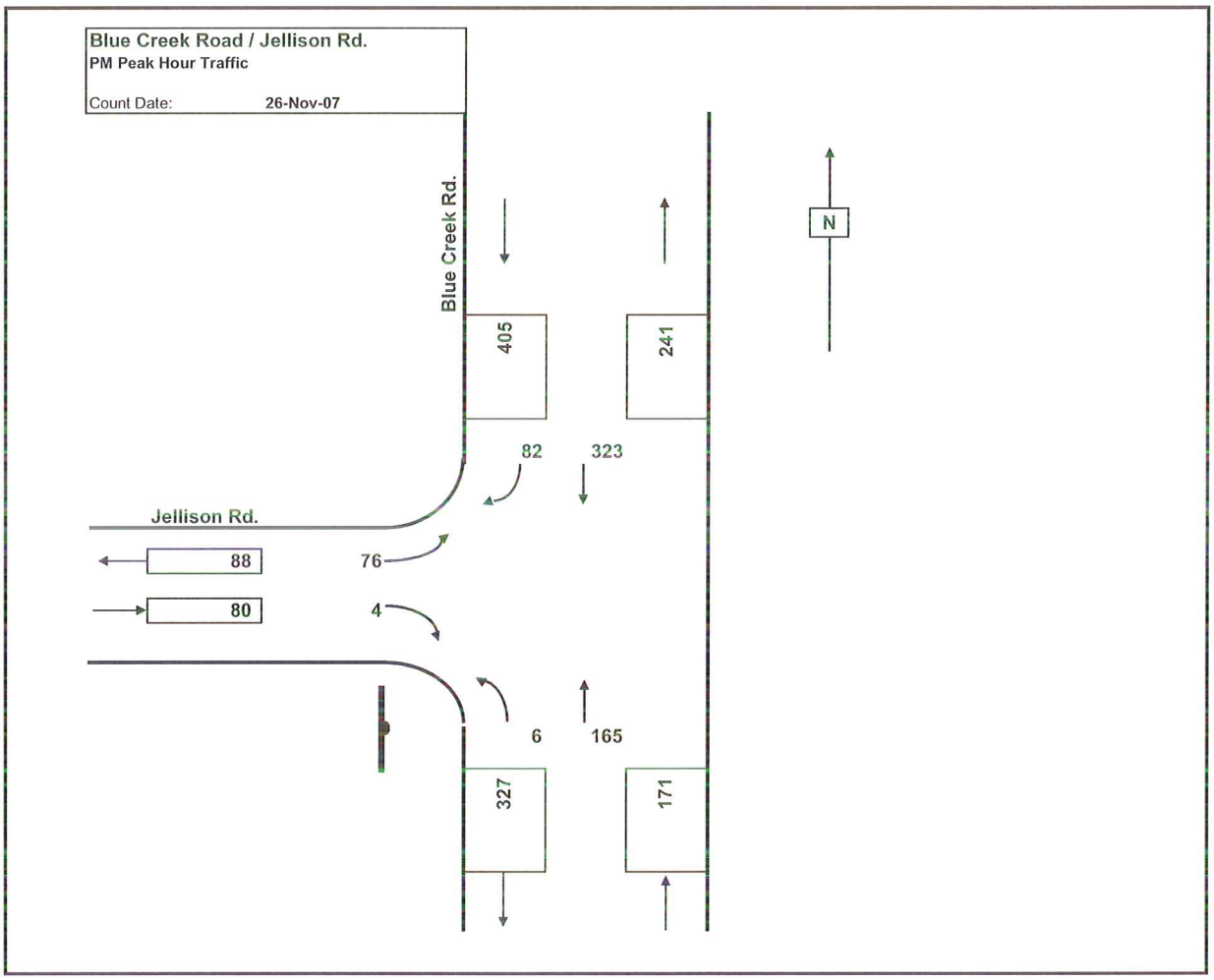



**Blue Creek Road / Santiago Blvd.**

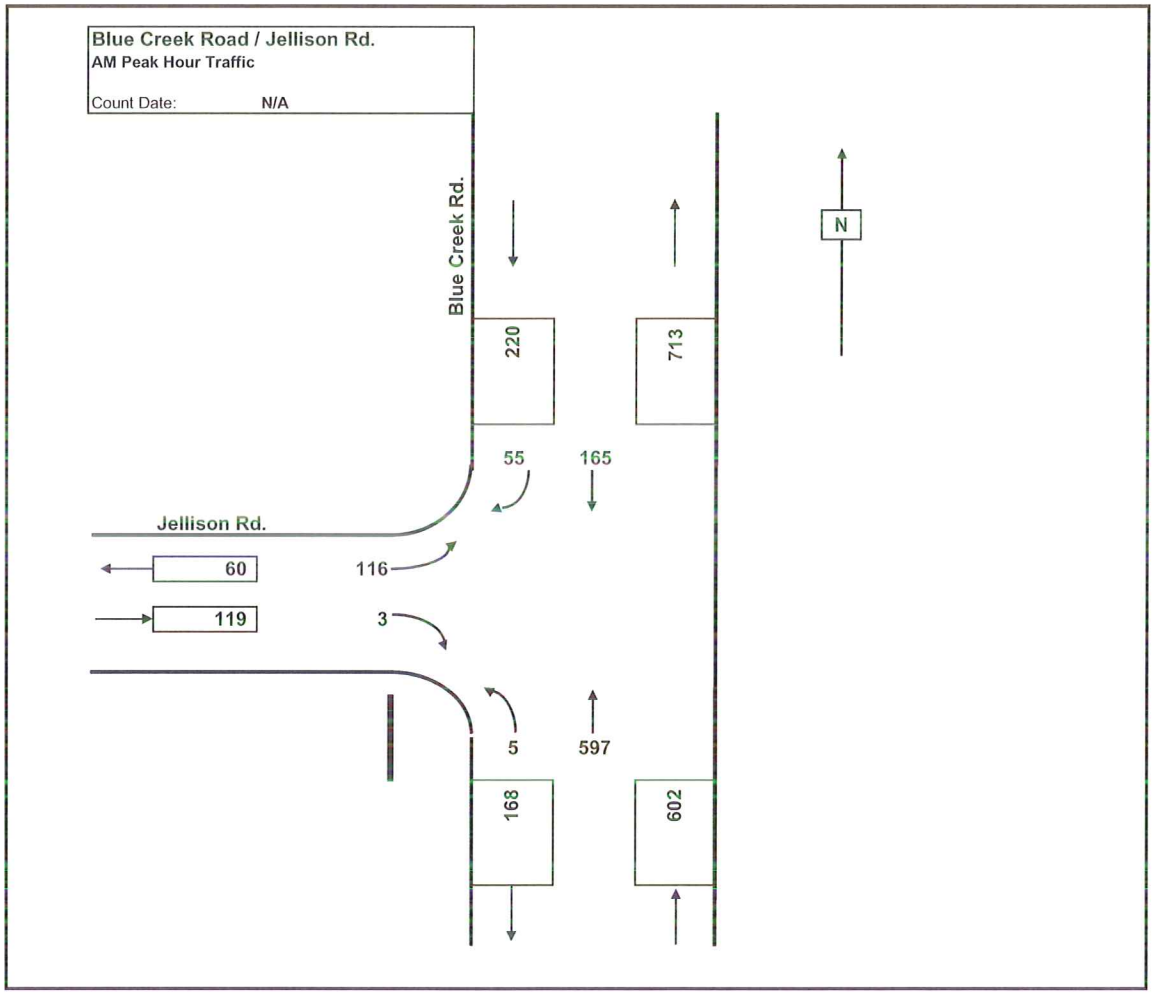
**Future PM Peak Hour Traffic Volume**



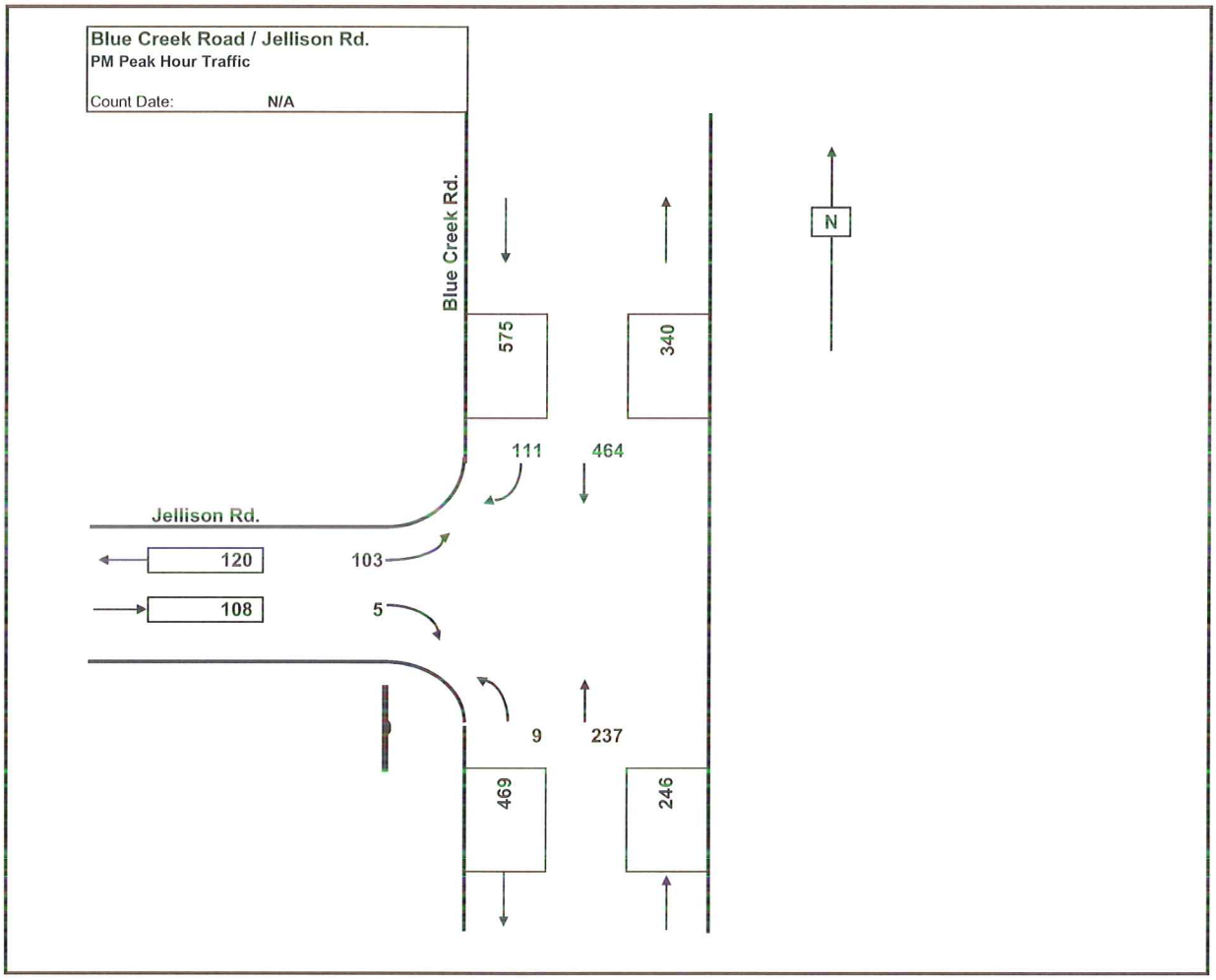

**Blue Creek Road / Jellison Rd.**
**Existing AM Peak Hour Traffic Volume**



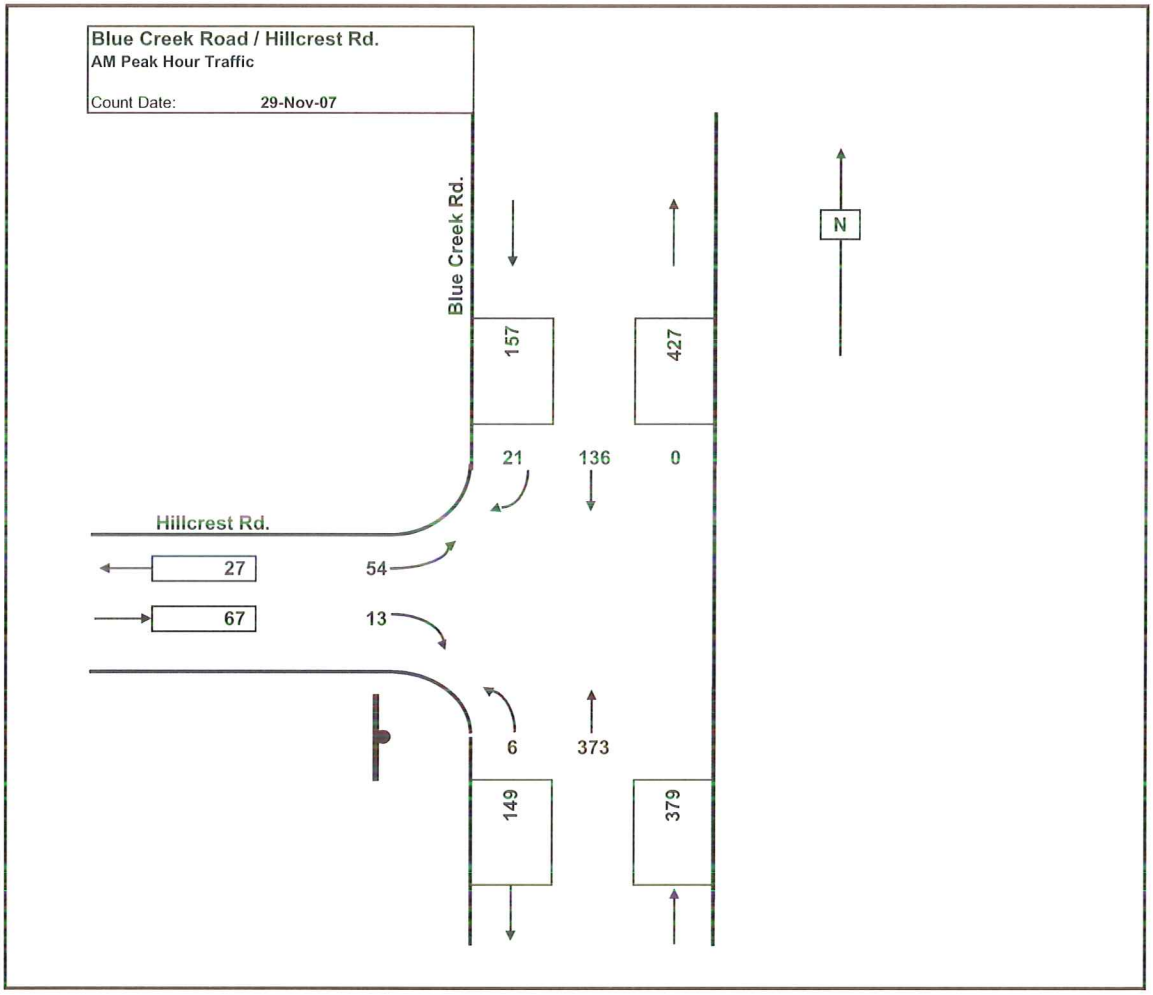

**Blue Creek Road / Jellison Rd.**
**Existing PM Peak Hour Traffic Volume**



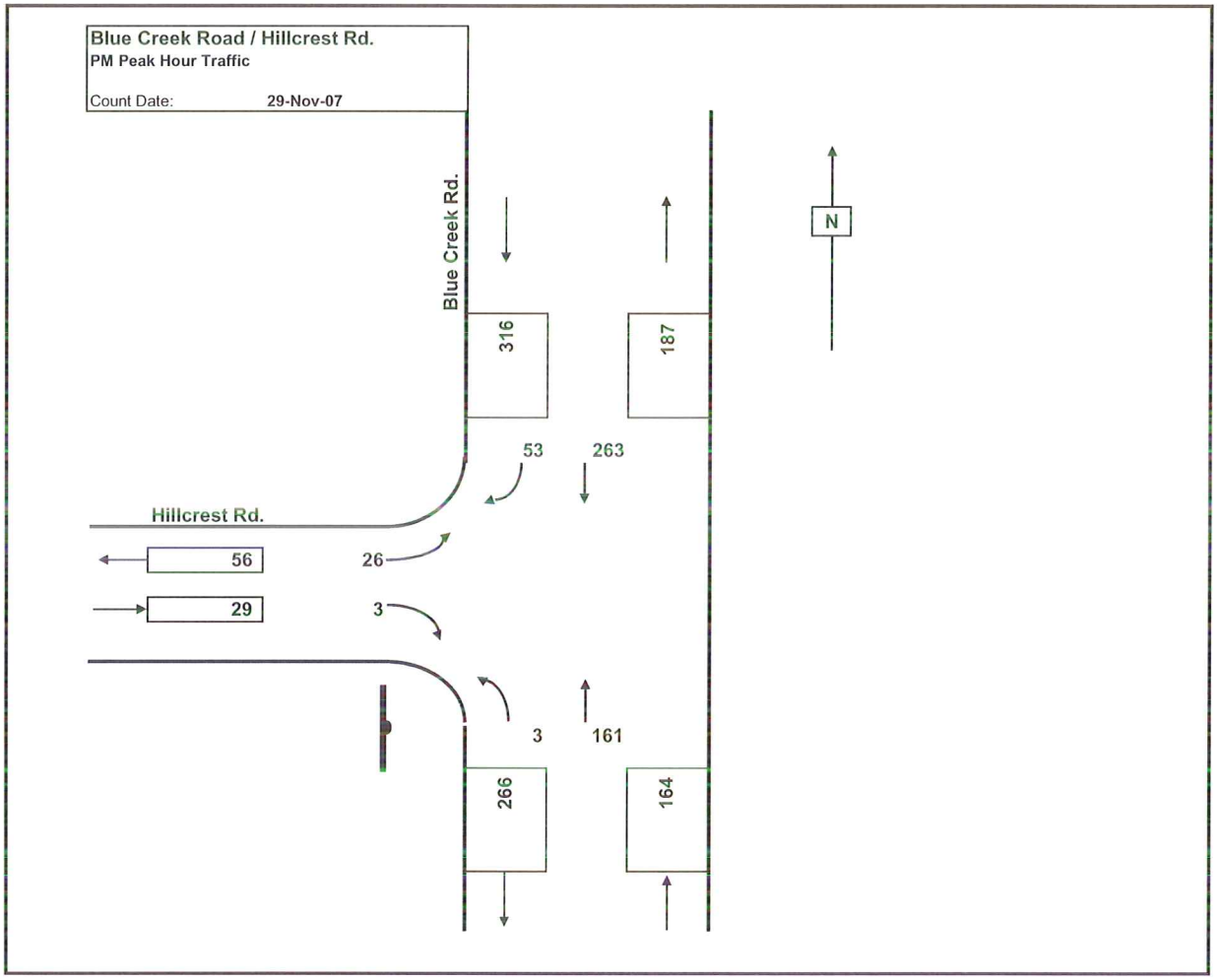

**Blue Creek Road / Jellison Rd.**
**Future AM Peak Hour Traffic Volume**



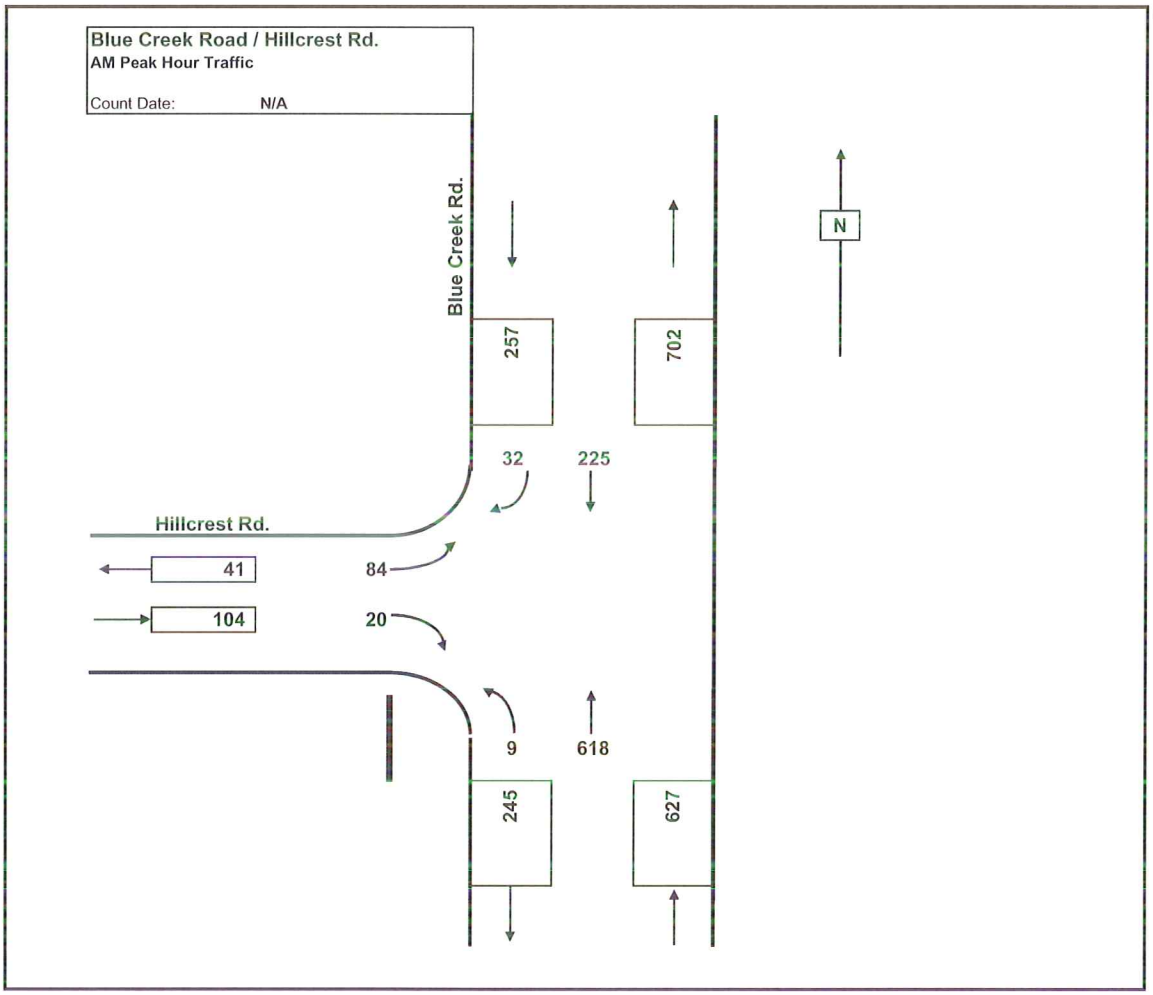

**Blue Creek Road / Jellison Rd.**
**Future PM Peak Hour Traffic Volume**



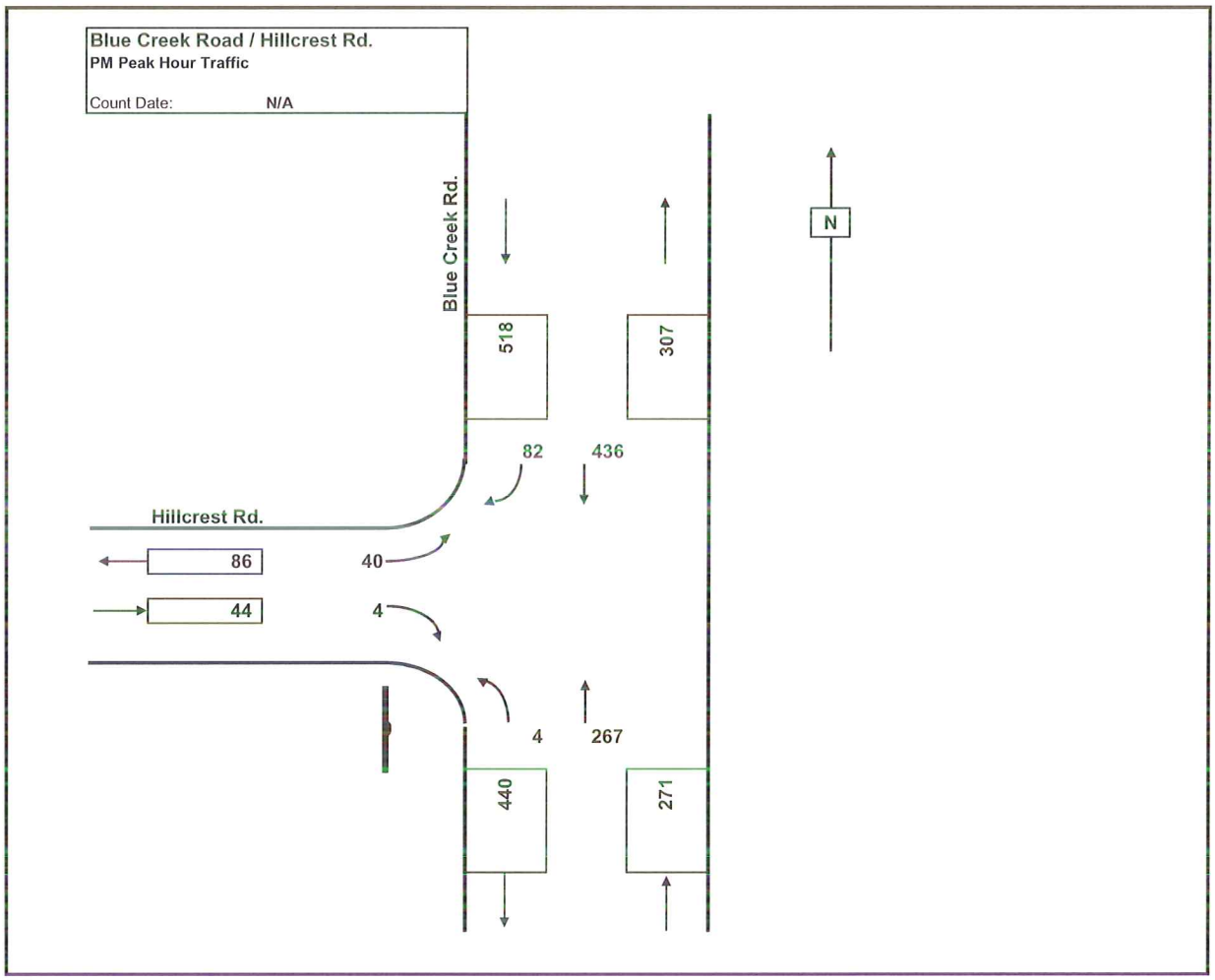

**Blue Creek Road / Hillcrest Rd.**
**Existing AM Peak Hour Traffic Volume**




**Blue Creek Road / Hillcrest Rd.**
**Existing PM Peak Hour Traffic Volume**

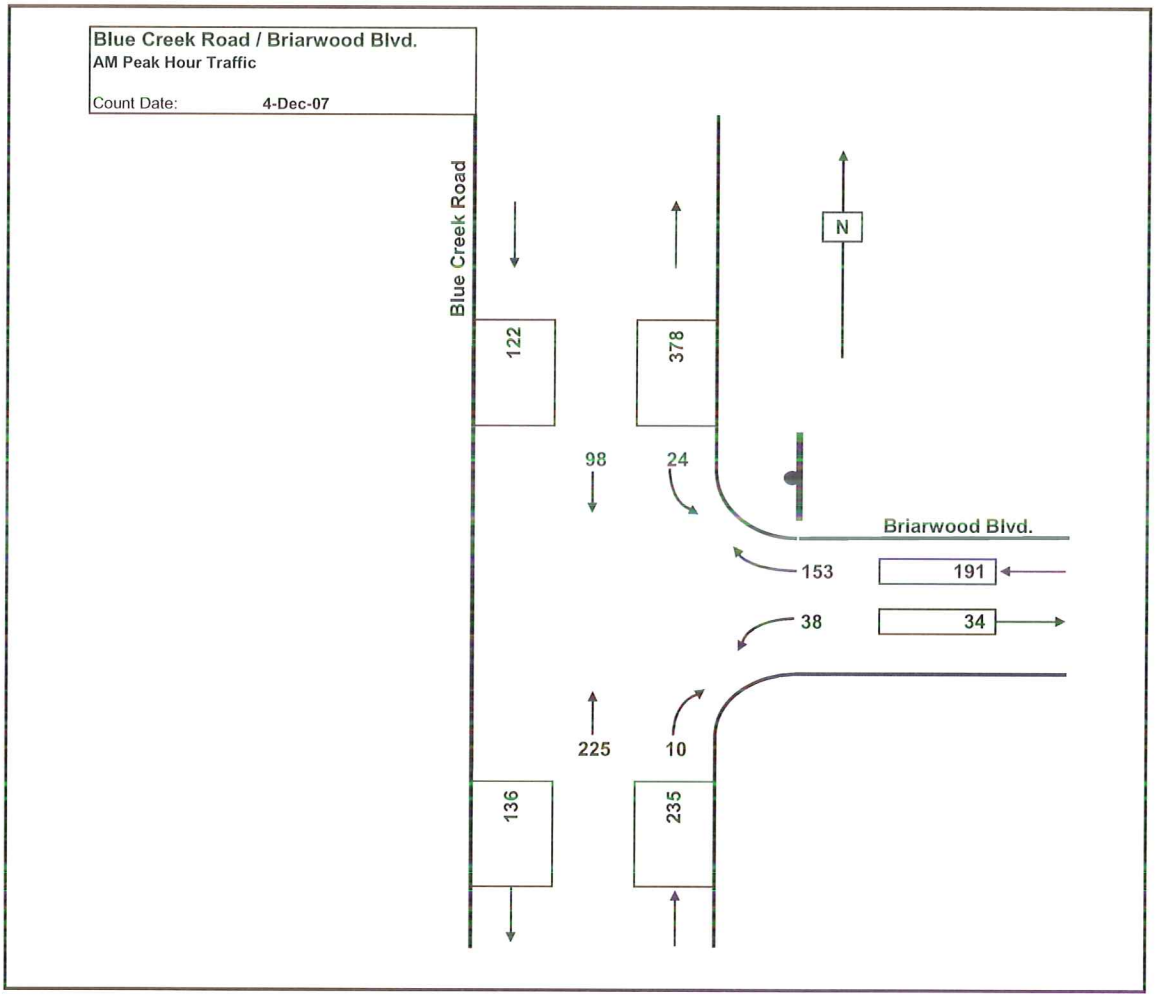



**Blue Creek Road / Hillcrest Rd.**
**Future AM Peak Hour Traffic Volume**

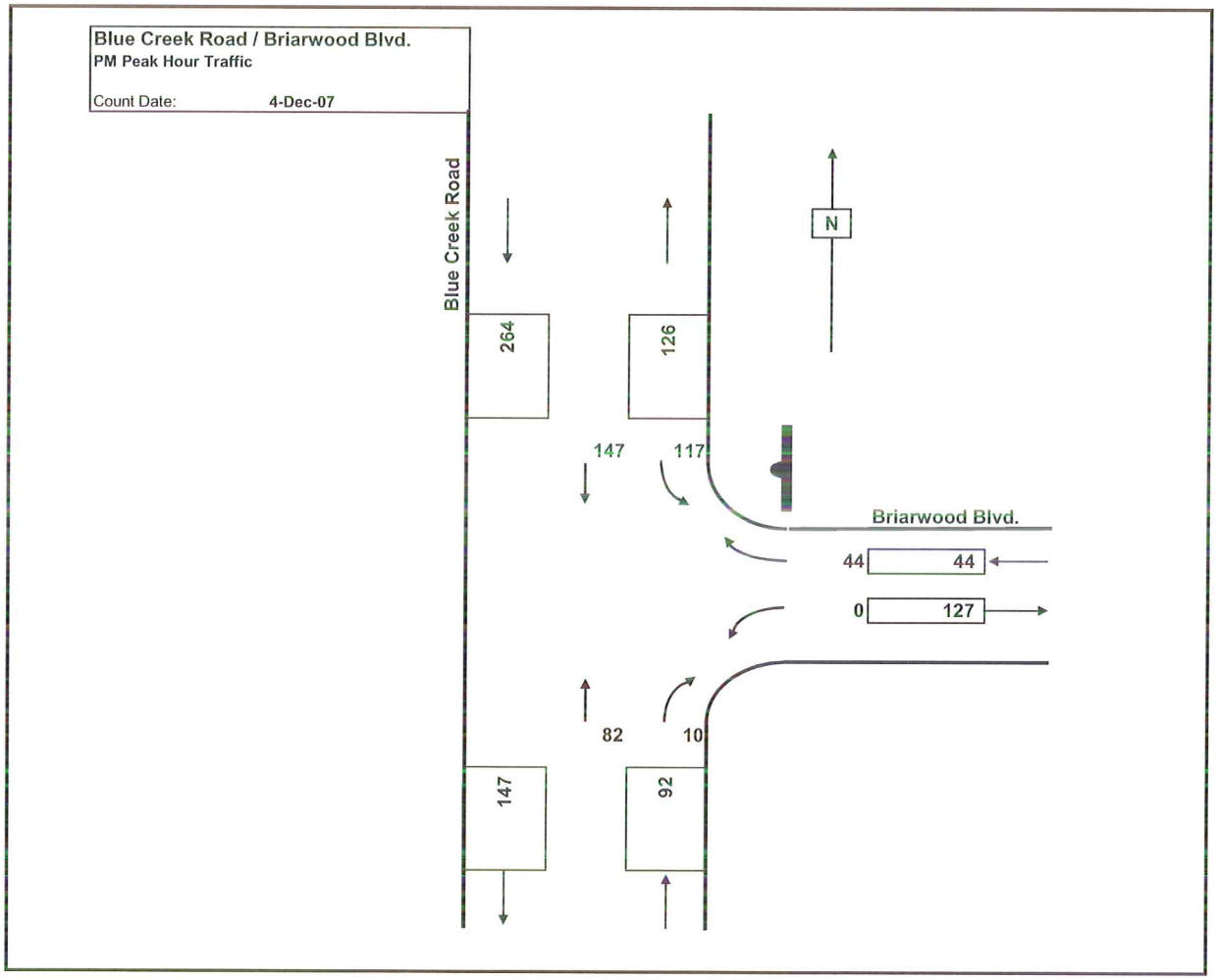



**Blue Creek Road / Hillcrest Rd.**

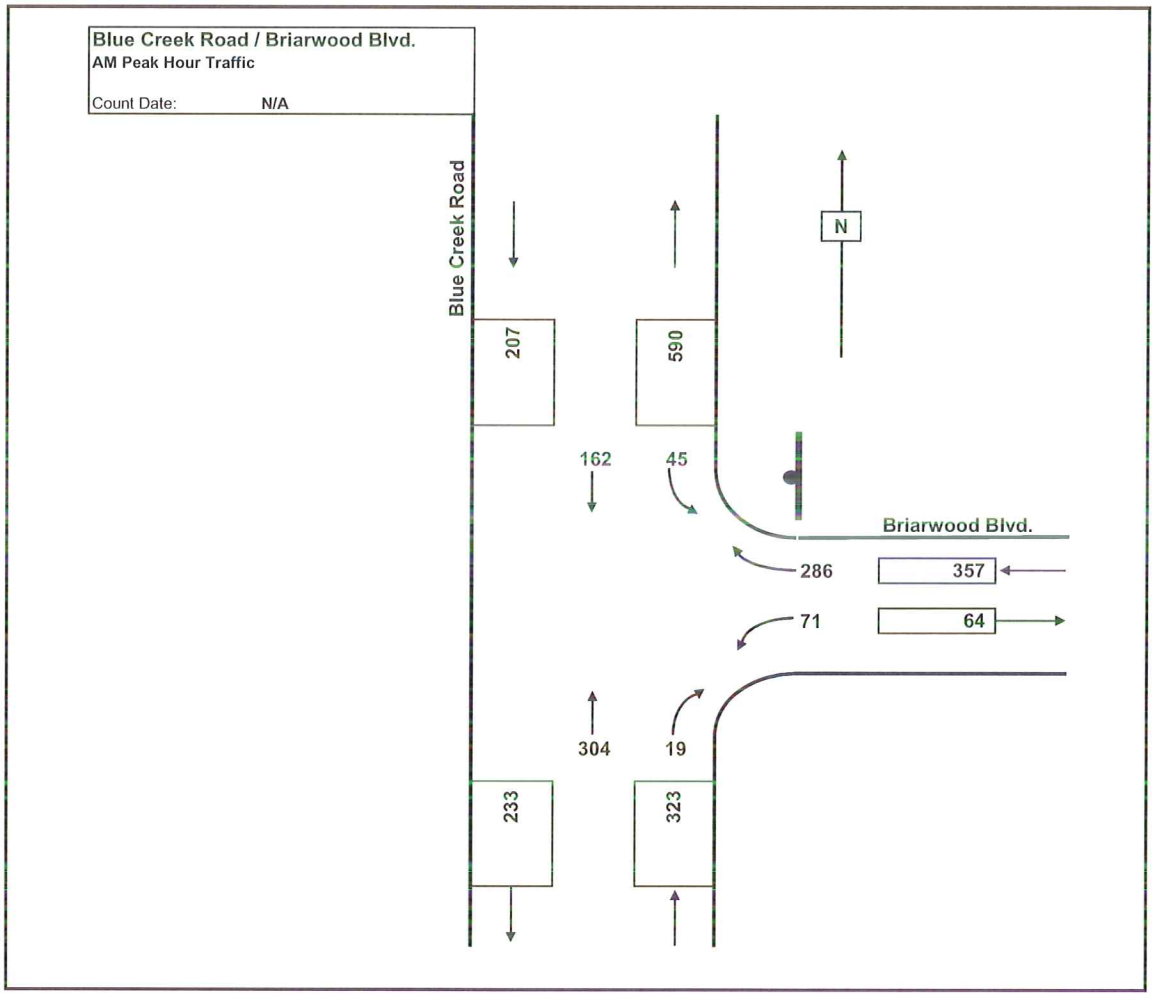
**Future PM Peak Hour Traffic Volume**




**Blue Creek Road / Briarwood Blvd.**
**Existing AM Peak Hour Traffic Volume**

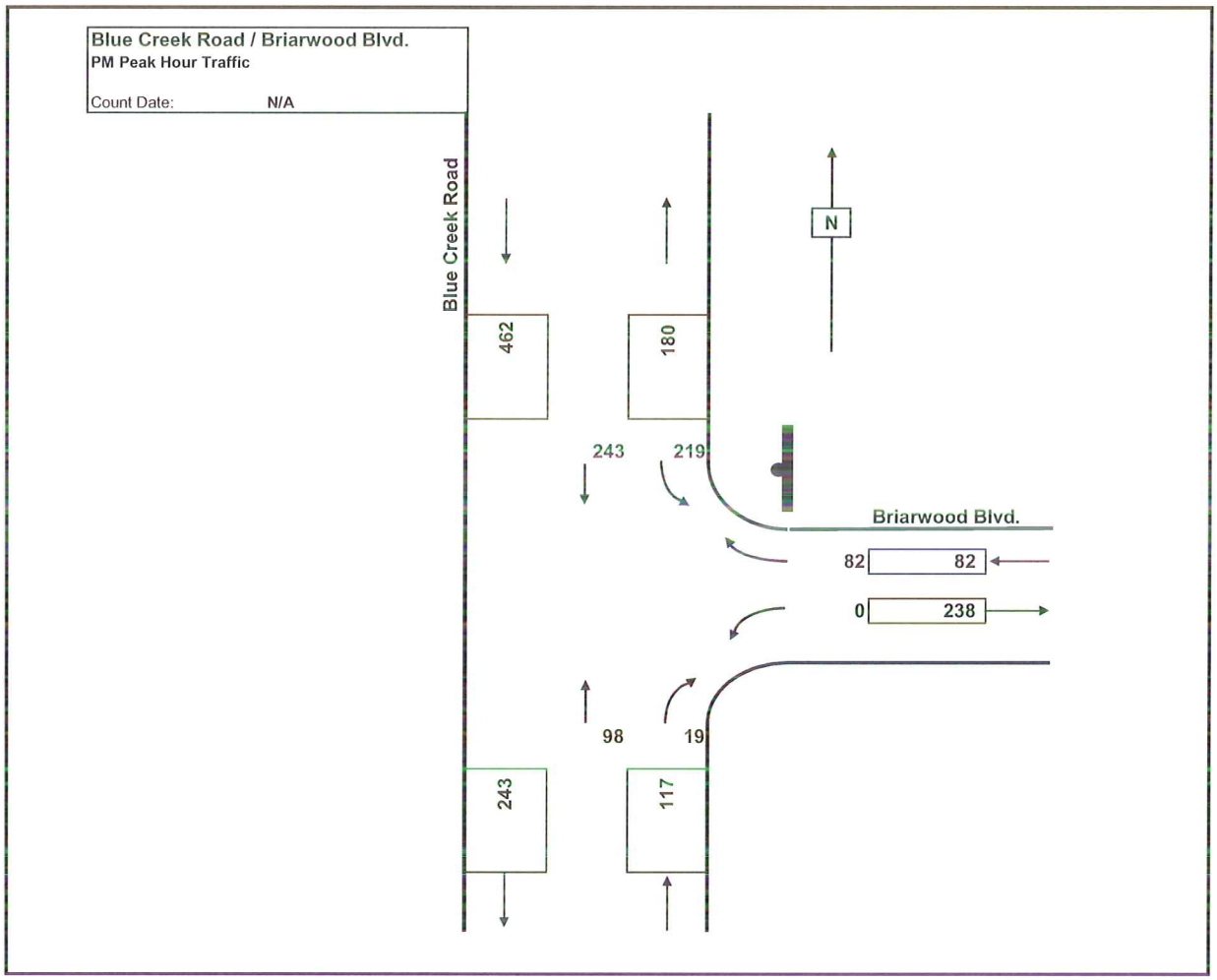



**Blue Creek Road / Briarwood Blvd.**
**Existing PM Peak Hour Traffic Volume**




**Blue Creek Road / Briarwood Blvd.**

**Future AM Peak Hour Traffic Volume**




**Blue Creek Road / Briarwood Blvd.**
**Future PM Peak Hour Traffic Volume**

# Appendix C

# Deficiencies Analysis and Alternatives

## CAPACITY AND CONGESTION

1. The intersection of Hillcrest and Jellison Roads with Blue Creek Road were identified as having inadequate site distance and were areas where Blue Creek Road traffic speeds typically exceeded the posted speed limit.
    - Real Problem: Speed, volume, perception of visibility

    - Discussion/Investigation:
      Based on the posted speed limit at these intersections (50 mph), visibility requirements for left turn movements require a minimum site distance of 555 feet for passenger cars, 700 feet for single unit trucks, and 845 feet for combination trucks. A minimum sight distance of 480 feet for passenger cars, 625 feet for single unit trucks, and 770 feet for combination trucks is required for right turn movements.

      A horizontal curve exists on Blue Creek Road between the Hillcrest and Jellison Road intersections. A highway bridge over Blue Creek also exists on this curve. The distance of the curve between the intersections is approximately 700 feet. This curve, bridge structure, and vegetation (trees) all impose some sight distance restrictions when looking south from the Jellison Road approach. Large cottonwood trees are the limiting factor at this location, especially when leaves are on the trees. At the Jellison Road approach, a vehicle approaching from the south is visible at a distance of 630 feet, adequate for a passenger vehicle but not for trucks. Visibility to the north from this approach exceeds 2,000 feet and is adequate for all vehicle types.

      Visibility from the Hillcrest Road approach is somewhat restricted in both directions. The existing configuration of the intersection provides visibility of 977 feet to the north and 692 feet to the south. This is adequate for passenger vehicles and single unit trucks, but is not adequate for tractor-trailer combination trucks.

      Due to the presence of significant truck traffic on Jellison Road, alternatives should be developed to improve intersection sight distance, or reduce the required sight distance.

      An examination of crash history shows that six (6) crashes were reported at or near the Jellison/Blue Creek Road intersection for the three year reporting period. Four were right angle crashes, one was run off road type, and one was an animal strike. Of the six crashes, five were considered to be in the intersection or intersection related, resulting with a crash rate of 1.40 crashes per million entering vehicles. Although the on-site investigation found that sight distance is somewhat restricted looking south, all right angle intersections involved traffic approaching from the north.

The crash investigation does not show restricted sight distance to be a contributing factor to intersection crashes.

An examination of crash history shows that five (5) crashes were reported at or near the Hillcrest/Blue Creek Road intersection for the three year reporting period. Only one right angle crash was reported, with the remainder (one each) being reported as run off road, sideswipe, rear end, and head on. With four crashes reported as in the intersection or intersection-related, this location experiences a crash rate of 1.49 crashes per million entering vehicles. The crash history does not show crashes of a type that might be caused by limited sight distance.

- Improvement Alternatives:
  - Re-alignment of Blue Creek Road
  - Re-location of the Jellison Road intersection
  - Reduction in the speed limit on Blue Creek Road with aggressive enforcement
  - Improve sight distance by trimming or removing trees (are trees in ROW?)

2. A peak hour speed reduction or full-time speed reduction to 35mph should be considered from Yellowstone River Bridge to Blue Creek Bridge
   - Real Problem: Congestion on Blue Creek Road and number of approaches and intersections contributing to difficulty getting onto and off of Blue Creek Road, feeling of unsafe condition.

   - Discussion/Investigation:
     Consult speed/volume data to examine 85th percentile speed and 10 mph pace speed. Look for wide variations in speed.
     - A speed study was not done in this stretch of Blue Creek Road.
     - Speed data for Blue Creek Road just south of Hillcrest shows 85th percentile speed of 56 mph in a 60 mph zone, indicating good compliance. At this location the 45-55 mph range contained the greatest number of vehicles with 44%, however 22% of traffic was traveling at 40 mph or less, indicating a significant differential speed is present in the traffic stream on Blue Creek Road just south of Hillcrest Road

     Crash records for this section of Blue Creek Road show a total of 12 crashes during the three year reporting period. Of the 12 crashes, speed was reported as a factor in three crashes (two run off roads and a "too fast for conditions" reported for a southbound right turn crash at Jellison Road).

Examine side street traffic volumes and estimate LOS for intersections, accesses, and main-line Blue Creek Road

Perform on-site observation of conditions

- Improvement Alternatives:
  - Revise speed limit and aggressively enforce
  - Install auxiliary lanes (right and left turn lanes) to reduce friction
  - Access consolidation/control

3. Briarwood Boulevard intersection with Blue Creek Road needs a turn lane or bypass lane on Blue Creek Road.
   - Real Problem: Interruption to free-flow of traffic on Blue Creek Road, safety

   - Discussion/Investigation:
     The MDT publication "Approach Standards for Montana Highways" notes that access approaches which will generate 25 or more left turning vehicle movements per peak hour entering the facility should be designed to include a left turn lane on the highway. The intersection of Blue Creek Road and Briarwood Boulevard easily meets this qualification and the highway should be considered for improvement to add a southbound left turn lane. For the design speed of 60 mph, the specifications indicate that the approach will need to have a 360 foot entering taper, a 216 foot bay taper, plus an additional 314 foot deceleration and storage bay. No existing conditions or alignment issues would interfere with reshaping the intersection to meet these standards.

     An investigation of crash history at this location shows no crash history at this location of a type preventable by construction of a left turn lane or a bypass lane.

     While "bypass" lanes are utilized in some jurisdictions, the MDT does not have a standard for bypass lanes. The Minnesota Department of Transportation does provide a standard for a left turn bypass lane for use if a left turn lane is not warranted or if construction of a left turn lane is not practical. The Minnesota standard includes a 1:15 (180 foot) lead in taper, a 250 foot bypass lane, and a 1:15 (180 foot) following taper, requiring widening of the highway for 610 feet.

   - Improvement Alternatives:
     - Install southbound left turn lane
     - Widen & re-stripe shoulder to provide "by-pass" lane

4. Traffic control (stop lights) at Hillcrest and Vandaveer Roads intersection with Blue Creek Road.
    - Real Problem: Delay entering Blue Creek Road from both Hillcrest and Vandaveer Roads due to lack of adequate gaps, or perceived sight distance restriction.

    - Discussion/Investigation:
      The intersections of Hillcrest and Vandaveer Roads currently do not satisfy any of these warrants needed to consider the installation of a signal due to light traffic volumes. Signal installation would be overly restrictive.

      A sight distance investigation was performed at Hillcrest and found that sight distance was adequate for the posted speed limit for both cars and single unit trucks, but is not adequate for large tractor-trailer combination trucks. Since tractor-trailer combination vehicles are not prevalent on Hillcrest, improvements for sight distance are not a high priority need.

      Sight distance should be assessed at Vandaveer to see if improvements can be obtained easily and inexpensively.

    - Improvement Alternatives:
        - Improve intersection sight-distance
        - Construct left-turn acceleration lanes for traffic entering Blue Creek Road
        - Reduced speed limits on Blue Creek Road

5. Traffic generation as growth occurs.
    - Real Problem: Continued growth of traffic volume due to development will exacerbate existing problems in areas of heavy side street traffic

    - Discussion/Investigation:
      Need to perform level of service assessments for existing conditions, then develop future traffic projections for Blue Creek Road and major side roads and then predict future level of service to verify potential problem areas.

    - Improvement Alternatives:
        - Speed limit reductions in areas of congestion
        - Intersection improvements (auxiliary lanes) in areas of increased congestion and worsening LOS
        - Changes to intersection control (signals)

6. Some areas on Blue Creek Road could have passing.
    - Real Problem: Little or no legal opportunity to overtake slower traffic.

- Discussion/Investigation:
  An examination of speed study data shows a significant variation of vehicle speeds on most portions of Blue Creek Road. Although speed limit compliance is generally good and 85th percentile speed shows appropriate limits are posted, significant portions of traffic are traveling at speeds at least 10 mph slower than the posted speed limits.

  For instance, at a location just south of Hillcrest Road the 85th percentile speed was recorded as 56 mph in a 60 mph speed zone. However, 59% of the traffic measured was traveling between 30-50 mph...at least 10 mph below the speed limit. At a location just south of Robindale Drive (posted at 60 mph) the 85th percentile speed was measured at 63 mph, but 34% of all traffic was traveling between 30-50 mph. The data indicates that traffic traveling slower than 10 mph below the posted speed limit makes up a significant portion of the total traffic stream, creating the need to pass.

  The magnitude of the problem needs to be tempered with the impacts of not having passing opportunities. The total distance from the Hillcrest Road intersection to the Blue Creek School is about 12,465 feet (2.4 miles). Traveling at the posted speed limit, it takes 2 minutes and 26 seconds to make the trip. Traveling 10 mph below the speed limit increases trip time to 2 minutes and 56 seconds, 30 seconds longer.

  Lastly, we have to consider the necessary sight distance for a passing maneuver (the distance at which an on-coming vehicle must be visible to complete the passing maneuver). At 50 mph, 1,835 feet of visibility is required. The distance increases to 2,135 feet at 60 mph, and to 2,480 feet at 70 mph. For a perspective, it is about 2,600 feet between the Collier Road and Briarwood Boulevard intersections on Blue Creek Road. It is about 2,900 feet between the Hillcrest and Colleen Drive intersections. Should areas be identified where it appears adequate sight distance may be available for the posted speeds, measurements may be taken to confirm.

  An investigation should also consider the length of any identified potential passing zones...very short passing zones may not be advantageous.

- Improvement Alternatives:
  - Establish passing zones where possible based on existing posted speed limits
  - Reduce speed limits to create or increase the number of passing zones

7. During peak hours, turning right onto Blue Creek Road from the Cedar Park Subdivision and left onto Blue Creek Road from the Quantra Subdivision is difficult.
    - Real Problem: Traffic volume on Blue Creek Road and lack of adequate gaps makes entering the highway difficult from side roads or accesses.

    - Discussion/Investigation:
      Under existing traffic conditions, the Santiago Boulevard approach to Blue Creek Road operates at level of service (LOS) B during both the morning and evening peak period. Vehicle delay on this approach averages 12.7 seconds per vehicle (s/v) during the morning peak, and 10.4 s/v during the evening peak. With increased future traffic, LOS for the Santiago Boulevard approach drops to LOS C during the morning peak and remains at LOS B during the evening peak. Delay for this approach increases to 16.7 s/v during the morning peak and to 11.7 s/v during the evening peak.

      It has been suggested that this intersection could benefit from construction of a separate right turn lane on Santiago Boulevard to improve delay experienced during the morning peak traffic period. An analysis shows that the addition of a short (50 foot) right turn lane does result with slight decreased delay for the left turn movement (0.4 s/v less delay under existing traffic, and 1.1 s/v less delay under future traffic conditions). The analysis software does not report delay for the right turn lane, but it is expected to experience similar improvements.

    - Improvement Alternatives:
        - Improvements (auxiliary lanes) on side streets to separate left and right-turn vehicles to minimize delay.
        - Improvements on Blue Creek Road (acceleration/merge lanes) to facilitate right and left turn traffic onto Blue Creek Road.

8. Proposed Briar Ridge intersection to Blue Creek Road.
    - Real Problem: Access location is perceived as a problem due to limited sight distance.

    - Discussion/Investigation:
      Sight distance was measured at time of Preliminary Plat and found to be inadequate to the south. Subsequent engineering investigation showed the need to modify cut slope on west side of Blue Creek Road to achieve adequate sight distance. Modification of slope was proposed as part of subdivision plan, but subdivision has not moved beyond Preliminary Plat stage.

- Improvement Alternatives:
  - Ensure adequate sight distance is provided as part of State Highway Access permit and City subdivision approval.
  - Require development access at alternative location

## CONNECTIVITY AND CIRCULATION (MOTORIZED & NON-MOTORIZED)

9. Secondary access for Briarwood and Cedar Park Subdivisions.
   - Real Problem: Both Briarwood and Cedar Park subdivisions are essentially large cul-de-sacs with a single access. Single access could prove problematic for emergency access/egress, and could pose a capacity problem depending on traffic volume of the access and Blue Creek Road.

   - Discussion/Investigation: In 2005, the Cedar Park/Quanta neighborhood had 103 households with 15 vacant lots. Access to all lots is currently provided at a single location by Santiago Boulevard. Traffic counts on Santiago Boulevard showed average daily traffic of 700 vpd in 2007. Secondary access is not currently planned for the Cedar Park/Quanta area. Streets extending to the edges of the subdivision include Shasta Lane (stubbed to the northwest), San Fernando Drive (stubbed to the northeast), Santiago Boulevard (stubbed to the southwest), and Bowman Drive (stubbed to the southeast). Santa Rosa Lane also extends to the southern boundary of the developed area.

     Briarwood subdivision contained 298 households in 2005 and had 106 vacant lots at that time. Access to all of Briarwood is currently provided at a single location by Briarwood Boulevard. Traffic counts on Briarwood Boulevard showed an average daily traffic of 2,300 vpd in 2007. Secondary access to the Briarwood subdivision is required under current platting and is anticipated to provide a connection between McMasters Road in Briarwood and Coleen Drive, which provides access to Blue Creek Road about ¼ mile north of the Collier Road/Blue Creek Road intersection.

   - Improvement Alternatives:
     - Provide secondary access for Cedar Park to the north by extending Shasta Lane or San Fernando Drive to Old Blue Creek Road.
     - Provide secondary access for Cedar Park to the south by extending Santiago Boulevard south and west to provide a secondary connection back to Blue Creek Road.
     - Secondary access to the Briarwood subdivision is required under current platting and is anticipated to provide a connection between McMasters Road in Briarwood and Coleen Drive, which provides

access to Blue Creek Road about ¼ mile north of the Collier Road/Blue Creek Road intersection.

10. Safe pedestrian and multi-use trails to existing school site and proposed new school site that include crossings.
    - Real Problem: Desire to create off-road multi-use path to allow children to safely and conveniently walk to school(s). Also, more of a "big picture" desire to develop more off-highway multi-use trails for pedestrian and bicycle circulation for commuting, school, and recreation.

    - Discussion/Investigation:
      School property in Briarwood is located on Briarwood Boulevard east of the currently developed portion of the Briarwood Subdivision. It is currently planned that this school would serve grades 4-8 in the Briarwood/Blue Creek area. It would also include a service area that includes the Cedar Park/Quanta subdivisions and Quanta subdivision, although students from these areas would likely be bussed or driven to school due to the distances involved (from the Jellison/Blue Creek Road intersection, it is 2.6 miles to the school property via Blue Creek Road and Briarwood Boulevard). With the existence of the Blue Creek School, the need for a trail connection for a walk-to-school route between the Briarwood area and Blue Creek School increases.

      As currently constructed, main streets within the Briarwood Subdivision have sidewalks on one or both sides. The existing sidewalks provide space for pedestrian traffic along Briarwood's busier streets.

    - Improvement Alternatives:
      - Multi-use trail along Blue Creek, with connections to Blue Creek School.
      - Multi-use trail along Jene Helene Avenue, with connection to Blue Creek School via existing ROW extension of Marlene Street.
      - Multi-use trail along Jene Helene Avenue, with connection to Blue Creek School via existing ROW extension of Sharon Drive.
      - Multi-use trail connection between Briarwood Subdivision and Aqui Esta Subdivision. Potential connection between Cumin Coulee and MacDuff Circle (both in Briarwood Sub.) to provide connection to Jene Helene Avenue. Also potential connection utilizing Weldon Road and Hollow Tree Road.

11. Raised pedestrian overpass over Blue Creek Road to the elementary school.
    - Real Problem: While the school crossing of Blue Creek Road at the Blue Creek School provides some measure of safety, a grade separated over or under pass would provide a much safer way to cross Blue Creek Road.

- Discussion/Investigation:
  An existing signed and painted school crossing of Blue Creek Road exists at the Blue Creek School. The crossing is within a school speed zone with flashing beacons that reduce the existing speed limit from 50 mph to 40 mph during times the beacon is flashing.

- Improvement Alternatives:
  - Grade separated pedestrian overpass at Blue Creek School in line with Marlene Street ROW connection to Blue Creek Road.
  - Grade separated pedestrian overpass to south of school at Sharon Drive ROW extension to Blue Creek Road.
  - Reduce speed limit through school zone (see issue #28) and retain at-grade painted crosswalk.

12. Incorporation of multi-use trails (pedestrian, bike, equestrian).
    - Real Problem: Need for off-highway multi-use trails for pedestrian and bicycle circulation for commuting, school, and recreation.

    - Discussion/Investigation: The Heritage Trail Plan, developed in June, 2004, shows a mix of on and off-street facilities planned for the Blue Creek area. An "arterial bikeway" along with a "greenway" containing a multi-use trail is shown along Blue Creek Road and Bender Road, reaching to Pryor Road. Greenways are also shown along the Basin Creek and along Blue Creek south of its intersection with Bender Road. Primary bikeways are shown along Briarwood Boulevard, Collier Road, Hillcrest Road, and Stratton Road. Jellison Road is designated for a Secondary Bikeway east of its intersection with Stratton Road, and for a Primary Bikeway west of the intersection. Multi-use Trails are also designated for Jellison Road, Stratton Road, Briarwood Boulevard, the Basin Creek drainageway, and in various locations connecting these alignments. An ambitious plan, the Heritage Trail Plan came under fire from study area residents and the County Commissioner resolution adopting the plan was reversed. However, the plan does show areas where non-motorized facilities are desired from an overall planning perspective.

      In October, 2005, a draft "Blue Creek Area Outdoor Recreation Plan" was developed that, among other things, also addressed the need for multi-use trails and bikeways in the Blue Creek area. While not officially adopted, The Blue Creek Plan proposed trails with two components; Regional trails and bikeways proposed by the Heritage Trails Plan, and local trails and bikeways designed by Blue Creek Plan to supplement the Heritage Trails Plan. The Blue Creek Plan identified feasible trail and bikeway routes or corridors in the vicinity of the five established neighborhoods but especially

in those areas projected to experience rapid growth in the next few years. Ridgetops, floodplains, minor drainages and associated brushy draws are prime resources and locations for trails. Most, but not all, streets and roadways are good locations for bikeways.

Trails proposed by the Blue Creek Plan include trails in the Blue Creek corridor, along Jellison Road from Blue Creek Road to Blain's Mobile Home Court, a trail from the Briarwood area to the vicinity of Pictograph Cave State Park (or an alternative from the Cedar Park area to the caves).

- Improvement Alternatives:
  - Develop multi-use paths and bikeways in accordance with the Heritage Trail Plan.
  - Develop multi-use paths and bikeways of the Blue Creek Outdoor Recreation Plan in addition to those of the Heritage Trail Plan.
  - Require construction of multi-use trails and/or bikeways with any new road construction along plan routes.

13. Striping shoulder of Briarwood Boulevard for bike lanes and adding Share the Road signs.
    - Real Problem: Lack of striped bike lane and signing discourages biking along Briarwood Boulevard. Bikers feel more comfortable if striping and warning signs are provided.

    - Discussion/Investigation:
      While Share the Road signs may offer some peace of mind for cyclists, they may or may not be effective with changing driver behavior. Striping to designate a bicycle lane on the edge of the roadway provides much more positive guidance for vehicle drivers. Bike lanes are typically established with pavement markings and signing along streets in corridors where there is significant bicycle demand, and where there are distinct needs that can be served by them. Bike lanes should be a minimum of four feet wide and should provide at least five feet from the face of any curb or guardrail.

      Shared roadways (no bikeway designation) carry most bicycle travel in the United States today. In some instances, a community's existing street system may be fully adequate for efficient bicycle travel, and signing and striping for bicycle use may be unnecessary and costly.

      Briarwood Boulevard is approximately 40 feet wide, providing width for two lanes of traffic (12 foot lanes) and 8 foot "shoulders" on either side.

Establishing a formal bike lane on Briarwood Boulevard would likely require a prohibition of on-street parking, and would require that any storm drain grates be bicycle-safe.

- Improvement Alternatives:
  - Sign and stripe bike lanes on Briarwood Boulevard.
  - Construct an off-street bicycle or multi-use path.
  - Do nothing.

14. Striping shoulder of Blue Creek Road for bike lanes and adding Share the Road signs.
    - Real Problem: Lack of striped bike lane and signing discourages biking along Blue Creek Road. Bikers feel more comfortable if striping and warning signs are provided.

    - Discussion/Investigation:
      See discussion for Issue #13.

      Blue Creek Road from the community of Blue Creek north generally consists of two 12 foot travel lanes with six foot paved shoulders. Speed limits vary from 45 mph to 60 mph over this stretch. While rural highways are used by touring bicyclists for intercity and recreational travel, such routes should only be designated as bikeways where there is a need for enhanced continuity with other bicycle routes. However, development and maintenance of paved shoulders can significantly improve safety and convenience of bicyclists and motorists along such routes.

      While there are no other bicycle routes connecting with Blue Creek Road, the Heritage Trail Plan does propose an off-highway multi-use trail in the corridor. Signing and marking a bicycle lane along Blue Creek Road could serve as an interim bicycle corridor until the multi-use trail plan is implemented.

    - Improvement Alternatives:
      - Stripe and sign a bike lane on both sides of Blue Creek Road from the Yellowstone River bridge to the Blue Creek community.
      - Construct an off-highway multi-use trail in the Blue Creek Road corridor from the Yellowstone River bridge to the Blue Creek community.

15. Right of way survey for a route to school from the golf course.
    - Real Problem: Safe, direct walking route for children to get from the Briarwood development to Blue Creek Elementary School. Also, more of a "big picture" desire to develop more off-highway multi-use trails for pedestrian and bicycle circulation for commuting, school, and recreation.

    - Discussion/Investigation:
      See Items #10, 11, and 12 for previous discussion about off-street pedestrian connections to schools and between communities.

    - Improvement Alternatives:
        - Multi-use trail along Blue Creek, with connections to Blue Creek School.
        - Multi-use trail along Jene Helene Avenue, with connection to Blue Creek School via existing ROW extension of Marlene Street.
        - Multi-use trail along Jene Helene Avenue, with connection to Blue Creek School via existing ROW extension of Sharon Drive.
        - Multi-use trail connection between Briarwood Subdivision and Aqui Esta Subdivision. Potential connection between Cumin Coulee and MacDuff Circle (both in Briarwood Subdivision) to provide connection to Jene Helene Avenue. Also potential connection utilizing Weldon Road and Hollow Tree Road.
        - Develop multi-use paths and bikeways in accordance with the Heritage Trail Plan.
        - Develop multi-use paths and bikeways of the Blue Creek Outdoor Recreation Plan in addition to those of the Heritage Trail Plan.
        - Require construction of multi-use trails and/or bikeways with any new road construction along plan routes.

16. Riverfront Park turn lane or bypass lane.
    - Real Problem: Interruption to free-flow of traffic on Blue Creek Road, safety.

    - Discussion/Investigation:
      See Item #3. The MDT publication "Approach Standards for Montana Highways" notes that access approach which will generate 25 or more left turning vehicle movements per peak hour entering the facility should be designed to include a left turn lane on the highway. The intersection of Blue Creek Road and Riverfront Park access most likely meets this qualification and the highway should be considered for improvement to add a southbound left turn lane. For the design speed of 50 mph, the specifications indicate that the approach will need to have a 230 foot

taper, 195 foot left turn bay. No existing conditions or alignment issues would interfere with reshaping the intersection to meet these standards.

An investigation of crash history at this location shows four (4) crashes susceptible to correction through construction of a southbound left turn lane or bypass lane.

While "bypass" lanes are utilized in some jurisdictions, the MDT does not have a standard for bypass lanes. The Minnesota Department of Transportation does provide a standard for a left turn bypass lane for use if a left turn lane is not warranted or if construction of a left turn lane is not practical. The Minnesota standard includes a 1:15 (180 foot) lead in taper, a 250 foot bypass lane, and a 1:15 (180 foot) following taper, requiring widening of the highway for 610 feet.

- Improvement Alternatives:
  - Install southbound left turn lane
  - Widen and re-stripe shoulder to provide by-pass lane

17. Northbound bypass lane at Blue Basket.
    - Real Problem: Interruption of through traffic movement by slowing right-turn traffic.

    - Discussion/Investigation:
      This section of highway is currently striped with a center two-way left turn lane. Residents note motorists sometimes pass right turn traffic in the center left turn lane, creating a potential hazard for opposite direction traffic using the lane for left turn maneuvers. An appropriate solution might be to construct speed change lanes for right turn traffic, commonly called deceleration lanes, so right turn traffic can decelerate out of the through lane.

      At this location, a right turn lane would take about 230 foot to develop (taper length) and should be provided with about 200 foot of full width lane to accommodate slowing maneuver. Since there is only about 240 feet between Santiago Boulevard and the Blue Basket entrance drive, it would probably make more sense to start a right turn lane before Santiago Boulevard and continue it to Old Blue Creek Road. A continuous right turn lane as described would also function as an acceleration lane for traffic entering Blue Creek Road from Santiago Boulevard.

      At this location, crash history does not indicate any crashes of a type that would be corrected through construction of a right turn lane (rear end crashes).

- Improvement Alternatives:
  - Construct right turn deceleration lanes along this section of Blue Creek Road, from Santiago Boulevard to Old Blue Creek Road (continuous right turn lane).
  - Reduce speed limit so right turn traffic has less impact to through movements.

18. Re-stripe the right turn into Blue Creek School to a right turn lane.
    - Real Problem: Heavy traffic into Blue Creek School at morning drop-off and afternoon pick-up times slows through traffic on Blue Creek Road. Vehicles making right turn into the school feel unsafe slowing in the through lane.

    - Discussion/Investigation:
      Investigation of crash history at this location shows no crashes susceptible to correction through installation of a right turn lane. Only one crash was reported in this vicinity, a night-time animal crash.

      Both entrance and exit from the school is accomplished at the same, single location. Also present at this location is a marked pedestrian crosswalk. The location is also located within a school speed zone.

      Formalizing a right turn lane would require widening the road. While the shoulder might be used as a right turn lane, it isn't wide enough to provide a full-width lane plus a shoulder area. This is probably why the MDT is reluctant to re-stripe the shoulder area as a right turn lane. The lack of striping, though, does not prevent slowing traffic from utilizing the shoulder to move from the through lane.

    - Improvement Alternatives:
      - Widen and re-stripe shoulder area to allow use as a right-turn lane.
      - Do nothing...slowing of traffic in the through lane is a good thing for pedestrian safety.

19. Update current transportation system to include alternative forms of transportation such as a metro bus system to Blue Creek area and bike/pedestrian facilities.
    - Real Problem: Need to provide alternative transportation options to residents of the Blue Creek Study area.

    - Discussion/Investigation:
      See discussion under Item #12 about the Heritage Trail Plan and the Blue Creek Outdoor Recreation Plan.

      The lack of metro bus service to this area is primarily one of how the MetTransit system is funded and established. Under its current rules/regulations,

MetTransit is not allowed to provide service to areas outside the city limits. While the current rules preventing service to the Blue Creek Area can be changed, service cannot be provided until the rules are amended.

- Improvement Alternatives:
  - Develop multi-use paths and bikeways in accordance with the Heritage Trail Plan.
  - Develop multi-use paths and bikeways of the Blue Creek Outdoor Recreation Plan in addition to those of the Heritage Trail Plan.
  - Require construction of multi-use trails and/or bikeways with any new road construction along plan routes.
  - Work to revise statutes to allow MetTransit to provide service to areas outside the city limits.

20. In Aqui Esta Subdivision, there is need for a footbridge across Blue Creek to shorten the route to school for school children. This bridge would provide a direct connector from homes in the subdivision to Blue Creek School.
    - Real Problem: Desire for a shorter, safer, off-street walking route for school children.

    - Discussion/Investigation:

    See discussion for Items #10, 12, and 15.

- Improvement Alternatives:
  - Multi-use trail along Jene Helene Avenue, with connection to Blue Creek School via existing ROW extension of Marlene Street.
  - Multi-use trail along Jene Helene Avenue, with connection to Blue Creek School via existing ROW extension of Sharon Drive.

## SAFETY

21. Sight distance concerns with higher speeds.
    - Real Problem: Speeding.

    - Discussion/Investigation:
      A roadway's design speed is utilized to develop horizontal and vertical alignment values. In addition to driver comfort and other factors, stopping sight distance is a limiting value when designing horizontal and vertical curves for a street or highway. Stopping sight distance includes driver perception and reaction time as well as braking distance. Stopping sight distance utilizes an assumed driver eye height (above the roadway) of 3.5 feet, and assumes an

object height of 2.0 feet  Stopping sight distance for various design speeds are listed below:

- 45 mph – 360 feet
- 50 mph – 425 feet
- 60 mph – 570 feet
- 70 mph – 730 feet

The geometry (horizontal and vertical) of Blue Creek Road is such that available sight distance exceeds design values everywhere.

In addition to animal strikes, crashes that would indicate inadequate sight distance as a contributing factor are collisions with objects on the road.  On Blue Creek Road itself, 11 animal collisions were reported during the study period.  Of these 11 crashes, all but two occurred after dark.  Seven of the crashes occurred on the segment of Blue Creek Road between Jellison Road and Midland Road, a section with very good sight distance.

- Improvement Alternatives:
  - Increased enforcement of speed limits.
  - Improved tree/brush/weed trimming of roadsides to improve visibility on curves.

22. Blue Creek Bridge is too narrow and curved.
    - Real Problem:  Perception of curve tightness and width caused by roadside encroachments (guardrail).

    - Discussion/Investigation:
      The bridge over Blue Creek is approximately 36 feet. wide.  It is striped with two 12-foot travel lanes and six foot shoulders.  Although the roadway pavement is not significantly narrower over the bridge than it is outside the bridge deck, the presence of the roadside encroachments (guardrail) give the perception of a restricted width section.

      The roadway curve at this location is well within design standards for the posted speed, yet crash history demonstrates eight crashes occurred in the vicinity of the curve or bridge over the study period.  Three of the crashes were run off road type that resulted with injuries.

      The MDT has developed a safety project to better mark the curve, flatten embankment slopes on the outside of the curve, and to improve the existing

guardrail end treatments and bridge approach sections. Delineation of the curve will involve installing "chevrons" around the curve and installing a flasher on the northbound curve warning sign. Construction of the project is expected to begin in December, 2009 or January, 2010.

- Improvement Alternatives:
  - Realignment of highway and replacement of bridge.
  - MDT project.

23. The turn lane from Cedar Park Subdivision is used as a passing lane.
    - Real Problem: Vehicles using the center two-way left turn lane to go around slower right-turn traffic.

    - Discussion/Investigation:
      Two-way left turn lanes are not intended to be utilized as passing lanes. The striping of two-way left turn lanes contains a solid yellow line along with a broken yellow line, indicating that passing is not allowed (much like highway centerline markings would). Using a center two-way left turn lane for passing is a violation and could be subject to a citation from law enforcement.

    - Improvement Alternatives:
      - Increased enforcement.
      - Construction of right turn deceleration lanes on Blue Creek Road.

24. Sight distance and visibility at intersections along Blue Creek Road.
    - Real Problem: Rolling terrain gives perception of visibility restriction. See Item #1.

    - Discussion/Investigation:
      Sight distance measurements have been taken at several Blue Creek Road intersections that were specifically noted as potential problems. See discussion for Item #1.

      The MDT will usually not allow construction of an intersection along a highway without adequate sight distance for expected traffic types.

    - Improvement Alternatives:
      - Provide tree/brush/grass trimming maintenance where noted to cause sight distance restriction.
      - Identify other suspected sight distance restricted intersections and measure/verify if a problem exists, then take appropriate action.

25. Traffic at Blue Creek Elementary School especially during drop off and pick up.
    - Real Problem: Congestion on Blue Creek Road at the entrance to the school during morning drop-off and afternoon pick-up periods.

    - Discussion/Investigation:
      The entrance and exit from the drop-off/pick-up area for Blue Creek School are essentially at a single location on Blue Creek Road. Given the rural nature of the enrollment area and the lack of off-street walk to school routes, a high percentage of students are driven to/picked up from school in private automobiles. Student drop-off/pick-up traffic is concentrated during short time periods, resulting in short-duration congestion at the access location and within the school parking lot.

    - Improvement Alternatives:
        - Provide right and left turn lanes on Blue Creek Road to allow school-related traffic to move out of highway through lanes (this would make pedestrian crossing wider and more complicated...dangerous).
        - Improve on-site circulation pattern to improve ingress/egress congestion on Blue Creek Road.
        - Provide a separate drop-off/pick-up area (perhaps with a connection to Basin Creek Road instead of Blue Creek Road) to move congestion away from school access and pedestrian crossing.

26. Signage notifying travelers about open range area and deer crossing.
    - Real Problem: Desire to increase awareness of animal and livestock hazards in hopes that it will reduce related crashes.

    - Discussion/Investigation:
      Crash history shows the greatest incidents of animal collisions occurs on the section of Blue Creek Road between Jellison Road and Midland Road. This section is marked with deer crossing signs. The second-most active animal crash segment is between Jellison Road and Collier Road where four (4) animal crashes occurred. This section could be marked better.

    - Improvement Alternatives:
        - Review locations of deer crossing signs, compare with animal crash history, and modify as appropriate.
        - Identify open range sections and sign as appropriate

27. No passing lane on the Yellowstone River Bridge.
    - Real Problem: Perception that passing shouldn't be allowed when roadway width is restricted as with the bridge over the Yellowstone River.

- Discussion/Investigation:
  With limited passing opportunities elsewhere along Blue Creek Road, the MDT is offering passing opportunities where sight distance will allow. Although the roadway section on the bridge does not provide the perception of the open road due to encroachments of guardrail, the bridge still provide full width lanes and some shoulder area.

  The crash history does not suggest a problem with allowing passing on the bridge. A total of three (3) crashes occurred on the structure for the study period. One was a rear end collision, one a opposite direction sideswipe under slushy conditions, and the third was a single vehicle crash. All crashes occurred in daylight conditions.

- Improvement Alternatives:
  - Restrict passing on bridge
  - Leave as-is (do nothing)

28. Reduce speed limit to 35 mph at Blue Creek School zone (currently 40 mph when beacon is flashing, 50 mph when beacon is not flashing).
    - Real Problem: Slower is better in school zones, especially when congested with student drop-off/pick-up traffic.

    - Discussion/Investigation:
      While reductions to speed limits in school zones is a common practice, there is no "standard" speed limit or set magnitude of reduction. While school speed zones of 20-25 mph are common within the City of Billings, school zones in rural areas typically utilize higher speed limits. For rural areas, a 10 mph reduction below the ordinary speed limit is common.

      A 5 mph reduction in the school zone speed limit reduces stopping distance (including perception and reaction time) by 55 feet. More important than actual driver speed in school zones is driver awareness of the school zone. If drivers slow to posted school zone speeds, they are aware of the speed zone and therefore the hazards associated with it. It is the driver awareness that results with the biggest safety benefit.

    - Improvement Alternatives:
      - Reduce school zone speed limit to 35 mph.
      - Reduce ordinary speed limit *and* school zone speed limit, keeping the difference at the "ordinary" 10 mph.

29. Safe Routes to School.
    - Real Problem: Need for designated routes to/from school that have, or take advantage of appropriate traffic controls and pedestrian facilities.

    - Discussion/Investigation:
      See Items #10, 11, 12, 15, 19, and 20.

      A safe route to school plan is something every elementary school should have. The plan is typically developed as a cooperative effort with the school, city traffic engineering staff, and law enforcement. Safe routes plans should be reviewed and updated periodically (every 5 years or so) to ensure continued relevance. Routes are typically developed to take advantage of existing traffic controls (stop signs, signals, etc.) and existing pedestrian facilities (sidewalks, paths, etc.). Plans are formalized (map created) and provided to parents each year.

    - Improvement Alternatives:
        - Develop and/or Update current safe routes plan to identify improvements and facilities desired.

30. County road maintenance for design and maintenance of gravel roads.
    - Real Problem: Maintenance of gravel roads to reduce pot holes and washboards.

    - Discussion/Investigation:
      Gravel roads require routine maintenance to reduce incidence of pot holing or development of washboards. The maintenance budget for Yellowstone County Road and Bridge Department is, as one might expect, is limited.

      Routine maintenance for paved roads is less frequent and for the most part, less costly. It is the initial capital cost of paving roads that keeps more gravel roads from becoming paved. Paving with recycled asphalt millings has enjoyed greater prominence in recent years with advances in technology and construction methods regarding use of millings. Still, proper preparation of a gravel road to receive millings can be expensive, but is necessary if pavements are expected to provide a reasonable useful life. Lastly, with increased demand for millings and their re-use with paving projects, the availability of the material is becoming tighter.

    - Improvement Alternatives:
        - Increase frequency of maintenance
        - Designate routes for future paving based on traffic volume and/or maintenance frequency required

- Require paved surfaces for newly constructed roads (subdivisions)

31. Students boarding busses at Blue Basket for the Quantra Subdivision (middle/high school). Suggestion: flashing light reducing speed in the am/pm for students riding bus or expand the parking lot at the City Water Pumping Structure to accommodate bus turn around.
    - Real Problem: Safety of students that must cross Blue Creek Road to access the bus stop, and safety for students while they wait for the bus.

    - Discussion/Investigation:
      Bus routes and stops are typically selected to take advantage of existing features that provide the safest locations for bus stops. On busier roadways, bus stops are typically located at off-roadway locations whenever possible and feasible. The school district provides the bussing service, but does not have funding to own, construct, or maintain off-roadway bus stops.

      In school transportation planning, it is generally assumed that junior high and high school aged kids have much more developed "traffic awareness skills" than elementary school aged students. As such, fewer traffic controls are necessary or typically provided for older school students. School speed zones are rarely established for bus stops.

    - Improvement Alternatives:
      - Post warning signs for bus stop.
      - As part of a greater MetTransit service plan, develop a park-n-ride lot that can be utilized for school buses as well as transit busses.
      - Make improvements to City property (Water Pumping Station) to accommodate bus traffic.

32. Blue Creek Road is dangerous for bikers due to lack of a designated bike/pedestrian route.
    - Real Problem: Lack of striped bike lane and signing discourages biking along Blue Creek Road. Bikers feel more comfortable if striping and warning signs are provided.

    - Discussion/Investigation:
      See Items #13 and 14.

    - Improvement Alternatives:
      - Stripe and sign a bike lane on both sides of Blue Creek Road from the Yellowstone River bridge to the Blue Creek community.

- Construct an off-highway multi-use trail in the Blue Creek Road corridor from the Yellowstone River bridge to the Blue Creek community.

33. The Blue Creek Bridge and Yellowstone River Bridge are both unsafe for bikers due to the constricted bike pathway and lack of warning signs.
    - Real Problem: Blue Creek bridge has wider, more accessible shoulders for bikes than Yellowstone River bridge. Yellowstone River bridge is not bicycle friendly

    - Discussion/Investigation:
      See Items #13 and 14.

      Improvements to the Yellowstone River bridge to widen the deck to better accommodate bicycles or pedestrians is likely to be cost prohibitive, although signs and striping could make drivers more aware of bicyclists or pedestrians on the bridge. While there is a pedestrian "corridor" separate from traffic on the east side of the bridge, accessing the area requires going over the guardrail at the bridge ends. The corridor is narrow and not conductive for bicyclists.

    - Improvement Alternatives:
      - Post signs and paint bikeways on roadway shoulders, including on the bridges.
      - Construct an off-highway multi-use trail in the Blue Creek Road corridor, including separate pedestrian bridges across the Yellowstone River and Blue Creek.

34. Jellison Road is too narrow and dangerous for the heavy garbage trucks and other landfill traffic it carries.
    - Real Problem: Heavy truck traffic destroying roadway surface. Also, tracking of mud and litter from uncovered loads is undesirable.

    - Discussion/Investigation:
      Jellison Road is sufficiently wide to accommodate the land fill traffic for the 0.65 miles from Blue Creek Road to the land fill (its approximately 30 feet wide) at posted speeds.

      The use of this section of Jellison Road by heavy trucks does accelerate pavement wear and shortens the roadways useful life. The presence of land fill loads and heavy trucks is undesirable for residents of Blain's Mobile Home Court and other residents further down Jellison Road.

- Improvement Alternatives:
  - Develop alternate route to land fill (Hillcrest Road?).
  - Reconstruct Jellison Road between the land fill and Blue Creek Road to wider section with concrete for longer lasting riding surface.
  - Install better mud tracking devices on the land fill to reduce dirt and mud that is tracked onto Jellison Road.

35. Pavement reconstruction and overlay projects on Blue Creek Road south of Cormier Road has resulted with a significant drop-off at the edge of asphalt (just beyond painted white edge line) without a recoverable shoulder.
    - Real Problem: Significant asphalt drop-off at the edge of the road presents an obstacle for recovery by errant drivers.

    - Discussion/Investigation:
      Current design practice for highways includes shoulder areas for storage of break-downs and to allow for errant drivers. Current design practice also provide recoverable shoulders such that run off road incidents result with fewer crashes, injuries, and property damage. The resurfacing project completed in this area did not also include earthwork to match shoulders to the edge of asphalt, resulting with the significant edge that currently exists.

      While recoverable shoulders did not exist prior to the resurfacing project, what little shoulder that was available is now less useful for storage or break-downs or recovery of errant vehicles.

    - Improvement Alternatives:
      - Re-grade shoulders to match asphalt surface.
      - Re-grade shoulders to match asphalt surface and to provide adequate recovery zone with flatter slopes.

# Appendix D

# Cost Estimate Details

Table 5 - Deficiencies and Resulting Preferred Solution Alternative

| PROJ. # | SPECIFIC DEFICIENCY/LOCATION | DEFICIENCY | DEFICIENCY TYPE* | DEFICIENCY PRIORITY | PREFERRED SOLUTION ALTERNATIVE | COST (1,000's) | COMMENTS | RESULTING PROJECT SOLUTION |
|---|---|---|---|---|---|---|---|---|
| 1 | Hillcrest Rd. / Blue Creek Rd. Intersection | Sight distance | S/LOS | 1 | Eliminate/reduce crest vertical curve on Blue Creek Rd. south of intersection & add southbound right turn lane onto Hillcrest. | 1: $365<br>2: $62 | Needed to maintain speeds for uphill grade on Hillcrest. | 1: Reconstruct Blue Creek Road to eliminate crest vertical curve. 2: Construct southbound right turn lane from Blue Creek Road to Hillcrest Road. |
| 2 | Jellison Rd. / Blue Creek Rd. Intersection | Sight distance | S | 1 | Trim vegetation (trees) | $9 | Sight distance inadequate for heavy trucks | Trim or remove trees to improve sight distance around curve on Blue Creek Road. |
| 3 | Speed Limit on BCR - Yell. R. to Blue Ck. | Side street delay, numerous accesses | S/LOS | 1 | Construct right turn/deceleration Lane(s) | $339 | Need project to improve access safety with posted speeds. | Construct continuous right turn/acceleration/ deceleration lane for northbound Blue Creek Road from Santiago Blvd. to Old Blue Creek Road. |
| 4 | Blue Creek Rd. - Briarwood Blvd. to Midland Rd. | Capacity for future traffic volume | LOS | 1 | Right turn / deceleration lanes near Blue Basket, plus left turn lane at Briarwood Blvd. | | Need system-wide improvements to handle higher volumes | See above right turn/deceleration lane project. Left turn lane at Briarwood Blvd. is separate project. |
| 5 | Santiago Blvd. / Blue Creek Rd. Intersection | Side street delay | LOS | 1 | Build separate right and left turn lanes on approach to Blue Creek Rd., and add right turn/deceleration lane on Blue Creek Rd. | $69 | | Widen Santiago Blvd. approach to Blue Creek Road to add separate right turn lane. |
| 6 | Willow Dr. / Blue Creek Rd. Intersection | Side street delay | LOS | 1 | Build separate right and left turn lanes on approach to Blue Creek Rd. | $52 | | Widen Willow Drive approach to Blue Creek Road to add separate right turn lane. |
| 7 | Blue Basket | Speed, mixed with right turn traffic slowed/ stopped on roadway | S/LOS | 1 | Construct northbound right turn/deceleration lane on Blue Creek Rd. | N/A | | See above continuous northbound right turn / deceleration lane on Blue Creek Road from Santiago to Old Blue Creek Road |
| 8 | Blue Creek Rd. at Blue Creek Bridge | Narrow, curved bridge | S | 1 | Re-align highway & replace bridge | N/A | | N/A - Consider if/when Blue Creek Road is totally reconstructed. |
| 9 | Blue Creek Rd. - Jellison Rd. to Yellowstone River Bridge | Passing in two way left turn lane | S | 1 | Construct right turn/acceleration / deceleration lane along Blue Creek Rd. in Blue Basket area | N/A | Distance from Jellison to Old Blue Creek Road is 1,560 ft. Total ROW varies 120-160 feet. | See above continuous northbound right turn/acceleration/ deceleration lane on Blue Creek Road from Santiago to Old Blue Creek Road |
| 10 | Yellowstone River Bridge | Passing zone not appropriate this location | S | 1 | Additional study for passing zone | $5 | Only passing zone between Midland Road and Vandaveer Road. | Conduct passing study on Blue Creek Road in area of Yellowstone River Bridge |
| 11 | Blue Basket - School Bus Stop | Inappropriate location | S | 1 | Secure property easement for school loading/unloading, and sign/mark pedestrian crossing. | N/A | | No-cost project for school district and City |
| 12 | Yellowstone River Bridge | Lack of Bicycle Lane | S | 1 | Improve access to existing bicycle/pedestrian facility on bridge. | $12 | Guardrail will be re-positioned with MDT safety project 11/09. | 2009 Safety project (MDT) will amend guard rail for easier access. |
| 13 | Jellison Rd. / Blue Creek Rd. to Land Fill | Road not adequate for land fill traffic | M | 1 | Reconstruct to improve structural section and improve maintenance | $975 | | Reconstruct Jellison Road from Blue Creek Road to Land Fill Road |
| 14 | Briarwood Blvd. / Blue Creek Rd. Intersection | Speed mixed with left turn traffic stopped on roadway, and congestion/delay on Blue Creek Rd. | S/LOS | 2 | Construct southbound left turn lane on Blue Creek Rd. | $310 | | Widen Blue Creek Road to add southbound left turn lane at Briarwood Boulevard intersection. |
| 15 | Blue Creek Rd. - Study Area Length | Lack of passing zones | LOS | 2 | Additional study for passing zones | $30 | | Conduct passing study on Blue Creek Road |
| 16 | River Front Park / Blue Creek Road | Speed, mixed with left turn traffic stopped on roadway. On-highway parking during "events" presents hazard. | S | 2 | Construct southbound left turn lane on Blue Creek Rd. at Riverfront Park entrance, and provide increased parking opportunities within park | $254 | Need increased enforcement of on-highway parking prohibition. | Widen Blue Creek Road to add southbound left turn lane at Riverfront Park Access intersection |

| PROJ. # | SPECIFIC DEFICIENCY/LOCATION | DEFICIENCY | DEFICIENCY TYPE* | DEFICIENCY PRIORITY | PREFERRED SOLUTION ALTERNATIVE | COST (1,000's) | COMMENTS | RESULTING PROJECT SOLUTION |
|---|---|---|---|---|---|---|---|---|
| 17 | Blue Creek Road - Entire Length | Need deer warning signs | S | 2 | Further study for additional signing. | $10 | | Conduct detailed crash study to define need for additional signing. |
| 18 | Gravel Roads - Study Area | Road surface condition | S | 2 | Require paved surfaces for newly constructed subdivision roads, increase maintenance frequency for gravel roads. | N/A | | Proposed subdivision regulations will require paving of appropriate new roads. |
| 19 | Blue Creek Rd. - South of Cormier Road | Road width & abrupt shoulder edge | S | 2 | Narrow travel lanes to provide "shoulder", eventually acquire additional ROW and widen roadway lanes and shoulder to current standards. | $7,597 | Length is 4.15 miles. +/- 60 ft. or ROW exists this section. | Reconstruct Blue Creek Road from Cormier to Pryor Road to provide shoulders and in-slopes and out-slopes that meet current design standards. |
| 20 | Briarwood Subdivision | Secondary access necessary | C | 3 | Construct secondary access between McMasters Road and Coleen Drive. | $5,885 | Developer funded - required by City/County Planning. | Construct extension of McMasters Road to Colleen Drive to provide secondary connection…will be required of developer(s) with further planning within Briarwood Subdivision. |
| 21 | Cedar Park Subdivision | Secondary access necessary | C | 3 | Provide secondary access by extending Santiago Blvd. to Blue Creek Road. | $645 | Extend Santiago Blvd. to Blue Creek Rd. to intersect opposite Jellison Road | Construct extension of Santiago Boulevard to Blue Creek Road opposite Jellison Road intersection to provide secondary connection. |
| 22 | Blue Creek Community | Safe Route to School | P | 3 | Multi-use trail along Blue Creek, with connection(s) to Blue Creek School - implement Heritage Trails Plan. | N/A | | Encourage implementation of Heritage Trail Plan components to provide non-motorized school routes. Conduct separate Safe Routes to School Study for Blue Creek Elementary School. |
| 23 | Briarwood Subdivision | Safe route to Blue Creek School / future school in Briarwood Subdivision | P | 3 | Multi-use trail along Blue Creek, with connection(s) to Blue Creek School - implement Heritage Trails Plan. | N/A | | Encourage implementation of Heritage Trail Plan components to provide non-motorized school routes. Conduct separate Safe Routes to School Study for Blue Creek Elementary School. |
| 24 | Community Wide | Lack of multi-use trails | P | 3 | Implement Heritage Trail Plan | N/A | | N/A - Encourage implementation of Heritage Trail Plan components to provide non-motorized facilities. |
| 25 | Briarwood Blvd. | Lack of marked on-street bike path | P | 3 | Stripe bike path along Briarwood Blvd. | N/A | Is in the works now. | Project is programmed. |
| 26 | Blue Creek Road | Lack of marked on-street bike path | P | 3 | Implement the Heritage Trail Plan by constructing off-highway multi-use trail in Blue Creek Rd. corridor from Yellowstone River Bridge to Blue Creek Community. | N/A | | Encourage implementation of Heritage Trail Plan. |
| 27 | Community Wide | Lack of transit access | M | 3 | Revise MetTransit "charter" to allow service to Blue Creek Area, and construct park-n-ride near Blue Basket. | N/A | | MetTransit service requires change of "charter". Pursue with separate study on feasibility/demand for transit service. |
| 28 | Blue Creek School Entrance | Safety for pedestrians at access | S | 3 | Revise on-site circulation to improve ingress/egress from school property. | $12 | Need to conduct Safe Routes to School Study. | Needs to be addressed with Safe Routes to School Study. |
| 29 | Blue Creek Road @ Blue Creek Elem. School | Traffic speeds | S | 3 | Increased enforcement | N/A | | Suggest increased enforcement…also recognize that speed zoning in study area seems appropriate based on speed studies conducted with this Plan. |
| 30 | Study Area | Lack of secondary arterial connection Across Yellowstone River. | M | 3 | Extend Hillcrest Road to provide connection to Duck Creek Road & Yellowstone River Bridge. | $14,284 | | Reconstruct Hillcrest Road, Keller Road, and Fritz Road to provide paved arterial connection between Blue Creek Road and Duck Creek Road. |

*DEFICIENCY TYPES:

S=Safety
LOS=Capacity
C=Connectivity
P=Pedestrian and/or Bicycle Path
M=Mobility