

NORTHSIDE
TRANSPORTATION PLAN
LIVINGSTON, MONTANA

Prepared for
CITY OF LIVINGSTON

Prepared by



MARVIN & ASSOCIATES
1300 North Transtech Way
Billings, MT 59102

August 23, 2018

P.T.O.E. # 259

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Marvin & Associates

NORTHSIDE LIVINGSTON TRANSPORTATION STUDY

INTRODUCTION

This report summarizes a Transportation Plan Study for an area of Livingston known as the “Northside”. The study was commissioned by the City of Livingston because the Northside area has seen the largest share of development in Livingston during the past 20 years and various proposals for future land development in that area are rapidly advancing. In addition to anticipated growth within the Northside area, the existing transportation infrastructure is already being challenged by lack of connectivity to other areas of Livingston and major transportation links. The purpose of this study was to develop concepts that would improve connectivity while creating a planned street system structure to guide future development proposals.

In 2017, Marvin & Associates prepared an update for the year 2000 City of Livingston Transportation Study. A number of street and intersection traffic counts from the updated study were used in the completion of this study. Analysis of the Northside Livingston area’s growth potential was not included in the 2017 Transportation Study Update, but was deferred to a planning oriented study focused on future street locations and connectivity. One project addressed in the original year 2000 Transportation study was a railroad underpass connecting Front Street and Star Road to US Highway 10. That project entered preliminary stages of design in 2007, but was later shelved due to high costs and limited funding potential. Traffic projections for the Star Road underpass did not exhibit marked benefits in 2007 because of slow growth in the Northside area. The most recent proposals by the City of Livingston, includes a new east-west arterial roadway extending Front Street to the west, paralleling the railroad tracks to a point northeast of the US Highway 10/Interstate 90 Interchange. The new arterial would then cross under the railroad connecting Front Street to US Highway 10. The new east-west arterial roadway represents the primary link associated with the future Northside Livingston street system, which would serve all developable lands north of the railroad.

This report presents existing traffic and demographic data along with operational conditions pertinent to the study area. Potential future development within the area is evaluated and an analysis of full development trip generation is used to develop future traffic projections. Traffic models were developed for initial and future developments along with new street system links based on travel time calculations. Future street system links within the study area were conceived and classifications developed to create a system structure that would serve both access and mobility. Recommendation for alternative bicycle facilities were also determined to parallel primary travel paths while reducing conflicts with motorized vehicle modes. Specific street and intersection improvement geometry and controls were developed based on safety and efficiency and are presented herein. Phasing of improvements and implementation recommendations are also presented.

This study differs from the Livingston Transportation Study Update study in both scope and study area boundaries. Thus, this study focuses on specific intersections and street corridors that would be directly impacted by planned growth within the Northside Livingston study area. Since the potential for growth in the area is of such a large magnitude, proposed improvements not only need to address impacts on existing facilities, but the planned system of streets and intersections needs to be evaluated to ensure that future developments will have an organized structure on which to build.

Figure 1 on the following page illustrates the approximate area included in the Northside Livingston transportation study. The study area was determined in the original project scoping and modified as additional information regarding planned developments were discovered.

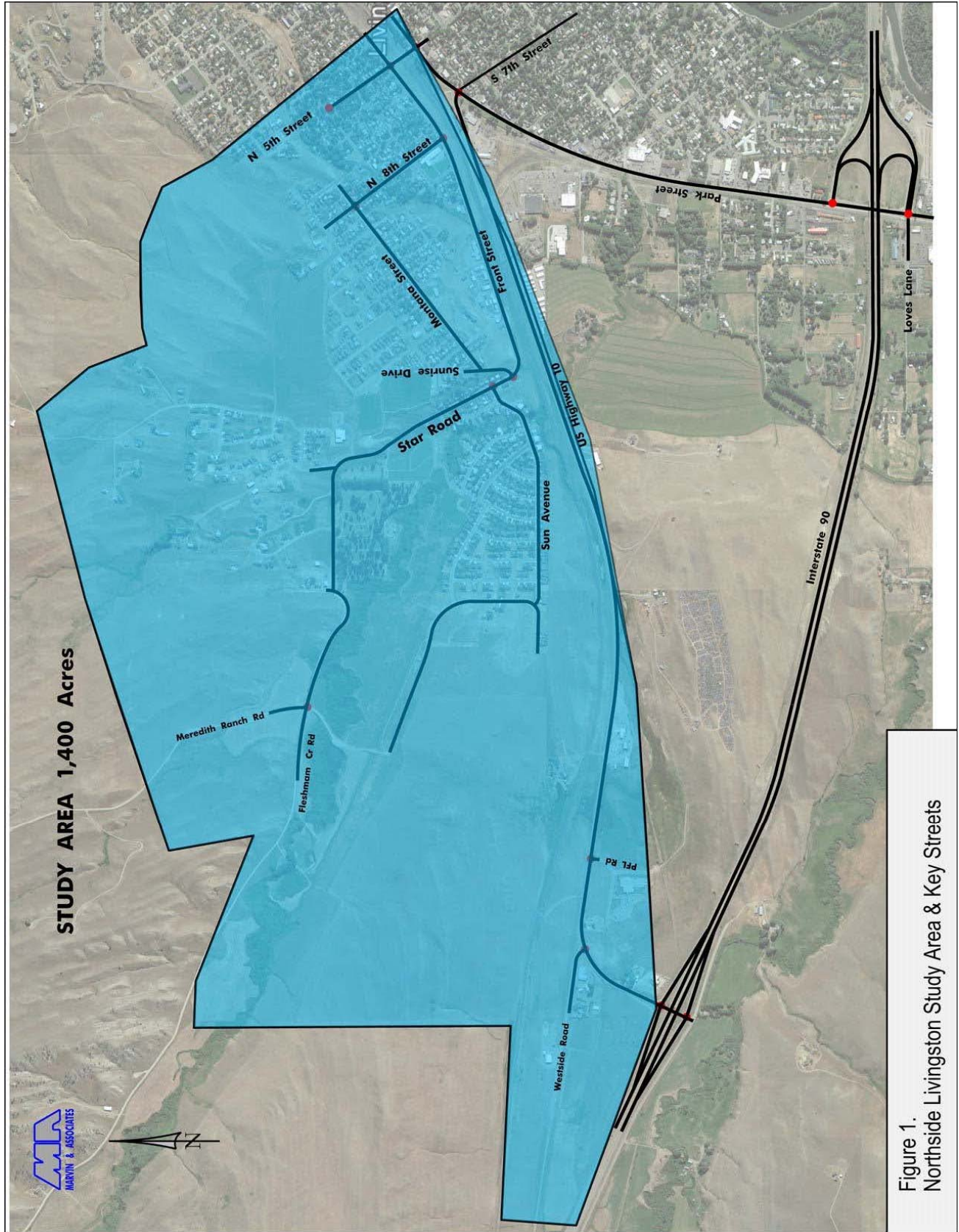


Figure 1.
Northside Livingston Study Area & Key Streets

EXISTING STREET SYSTEM

2018 Traffic Counts

TD&H Engineering provided Mio-vision camera files for an additional 7 intersections in 2018 as a part of this study. Appendix A of this report contains the count details along with 8 pertinent intersections that were counted for the 2017 Transportation Study Update. In addition to the intersection counts, electronic 24 hour counts were taken during a seven-day period at four key locations. Appendix B contains hourly and daily traffic variations data for the electronic counts.

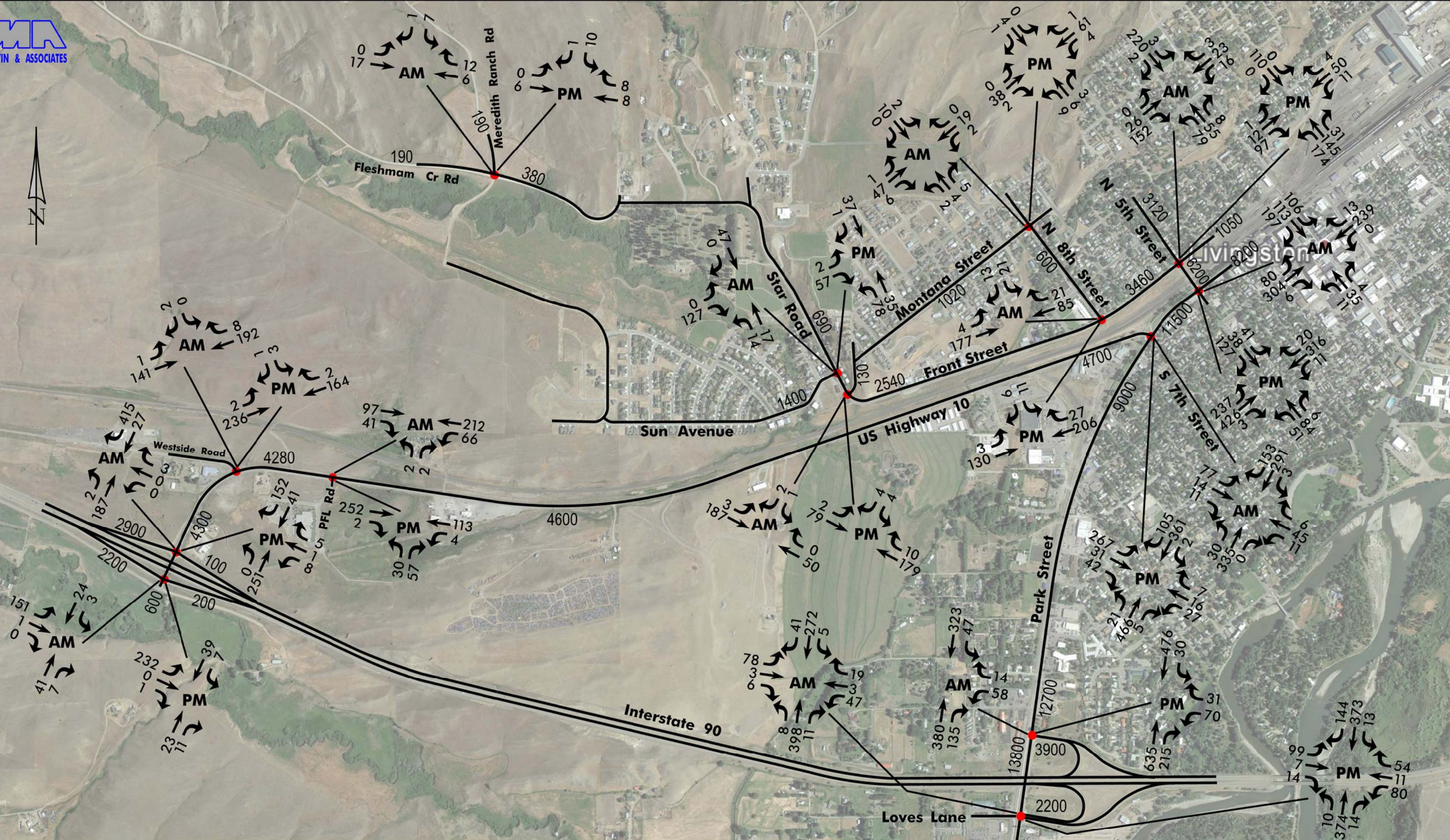
Front Street East of Sunrise Drive

Front Street West of N 5th Street

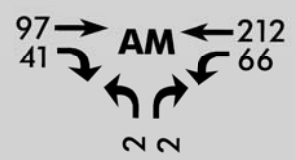
N 5th Street North of Front Street

I90 Business Route (US HWY 10) West of PFL Road

Count summaries indicate that on both Front Street and 5th Street the peak hour of the average weekday is between 4:30 and 5:30 pm with an average of approximately 9.5% average weekday traffic (AWT). On US HWY 10, the peak hour traffic occurs between 5:00 and 6:00 pm with approximately 10.7% of AWT. The peak day of the week on Front Street is on Thursday with approximately 109% of AWT. On 5th Street the highest volume day is Friday with approximately 105% of AWT. The highest traffic day on US HWY 10 is also on a Friday with 111% of AWT. Weekend traffic volume is appreciably less than weekday traffic, which averages between 65% and 75% of AWT. Figure 2 provides a summary of traffic counts at key intersections and AWT traffic on key street links used for analysis within this study.



Peak Hour Turning Movement Volumes (Typical)



4600
Average Weekday Traffic (Typical)

Figure 2.
Key Intersection & Street
Traffic Volumes 2018

Vehicle Speed & Classification Data

Vehicles speed and vehicle classification data was recorded at the electronic counter locations and speed statistics are contained in Appendix C of this report. It was determined that the 85th percentile vehicles speed on Front Street and on 5th Street ranged between 23 mph and 30 mph. On US HWY 10, west of PFL Road the 85th percentile speed was found to be approximately 52 mph. Field observations indicated that the 85th percentile speeds on all study streets were within a reasonable range of existing speed limits.

Classification summaries at the count stations indicate that on Front Street and N 5th Street the percentage of heavy truck traffic is approximately 3% on the average weekday. On US HWY 10 the percentage of heavy vehicles is approximately 4% during the average weekday. However, during high wind events on I-90 heavy truck traffic can be substantially higher.

Capacity Calculations

Peak pm hour existing capacity calculations were completed for the intersections shown in Figure 2 using the *HCS7* software package (see Appendix D). The calculation results indicate that all approach movements for all the intersections currently operate at or above a LOS “C”, with the exception of the westbound leg of the Park Street & I-90 Westbound Ramp intersection and the Front Street and 5th Street intersection. For this study, capacity calculations are primarily used to determine intersection delay associated with alternative travel paths used in the traffic models. Additional information on delay and travel times is contained in following sections of the report.

Crash Statistics

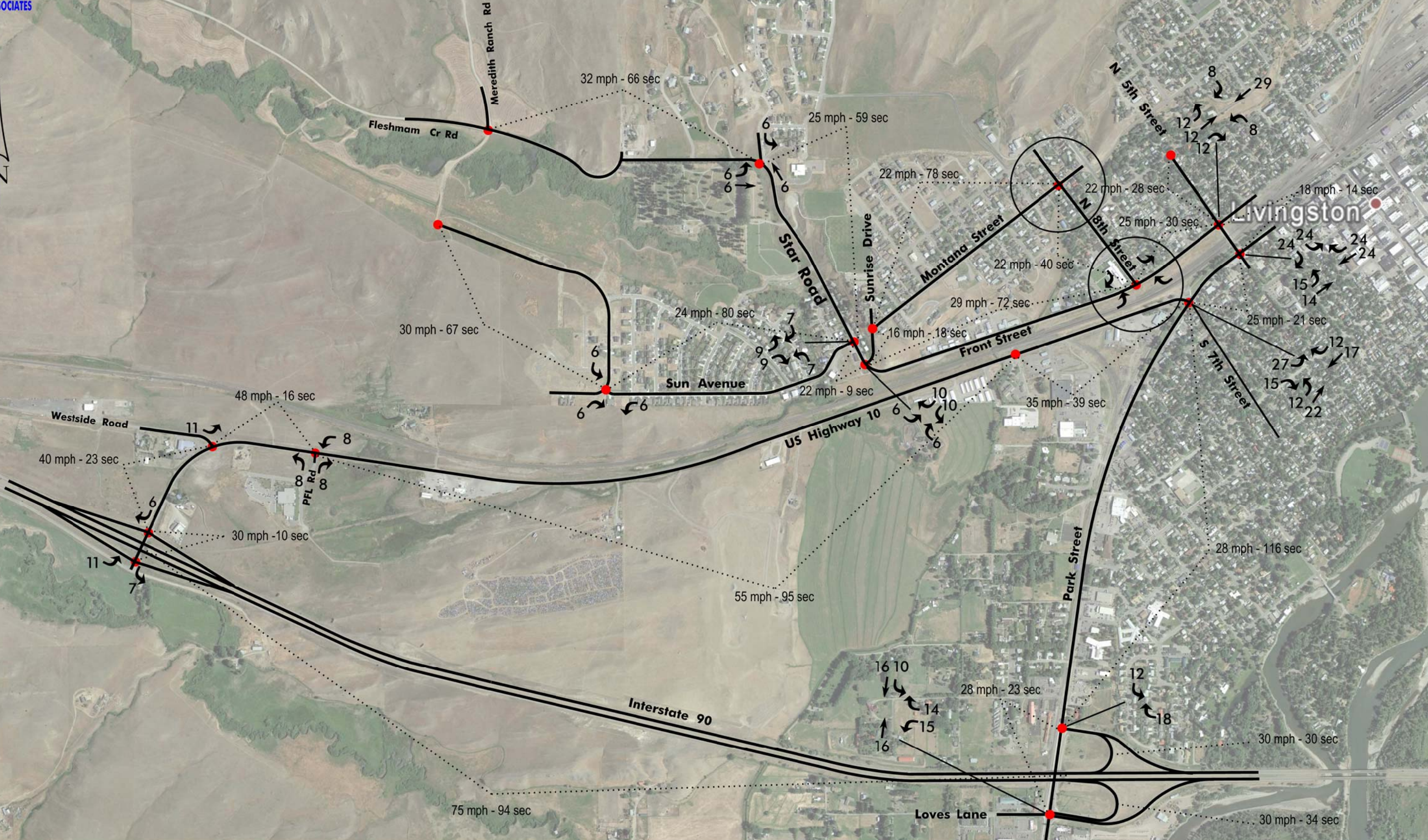
MDT Traffic Safety Section provided crash statistics for all Urban System Routes in Livingston for a five-year period between 2008 and 2013 as part of the 2017 Livingston Transportation Study Update. The only intersections that were flagged as having

potential safety issues in that study are Park Street intersections with 5th Street, US HWY 10, and the I-90 Interchange. The intersection of Front Street and N 5th Street was also identified as having a total of 9 crashes in a five year reporting period.

TRAFFIC MODELING

Travel Time on Existing Street System

There are numerous methods used to predict traffic volumes on streets and at intersections. The year 2000 Livingston Transportation Study utilized a QRS II computer model which was based on traffic zone demographics and the hierarchy of streets within Livingston, which utilized speeds to assign traffic. Since that time, more sophisticated models have been developed and the QRS II program has been largely abandoned. With increased sophistication, the newer computer models have become more expensive, especially in terms of data requirements and model input time requirements. Since the Northside Livingston study area is within a concentrated area of town with a single point access (N5th Street and Front Street), the limited number of travel paths reduces the complexity involved in traffic assignment and it was determined that a custom model would produce relatively accurate results. Therefore, a spreadsheet model was developed for this study that uses a route-link algorithm where the study area is divided into sectors based on least travel time routing to various external origin-destination zones and trips generated within each area sector are routed onto street links based on travel times. The first data input required for this model is travel times on the existing street system. Figure 3 presents travel times on street system links (based on speed) and intersection delay (based on capacity calculations). Additional calculations are made to determine travel time and delay for new street links and the travel time comparison are made to determine least time routing for each development area sector (see Appendix E).



KEY:

Mean Link Speed | Link Travel Time in Seconds
30 mph - 45 sec

Intersection Control Delay

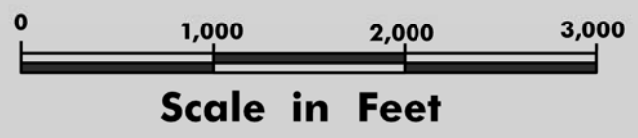
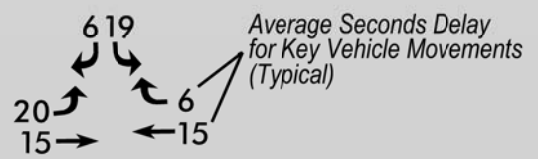


Figure 3.
Existing Street Link Travel Time
Based on Speed & Control Delay

Future Area Development

The City of Livingston provided information regarding potential developments in the area that have been proposed or discussed. Figure 4 illustrates the development areas along with a description of the development land use and potential number of residences and businesses being proposed. Area A would contain a mix of residential and commercial businesses centered around the PFL Road intersection with HWY US 10. The majority of residents and commercial businesses would be within a parcel of land south of US HWY 10 surrounding the existing PFL building complex. Area B would be a 215-acre parcel with approximate 960 single family housing lots. This parcel is located north of the railroad tracks extending north to the Fleshman Creek drainage. A 150-acre parcel designated as Area C would be north of Fleshman Creek and would contain approximately 615 homes. Area D, commonly known as North Town is a 135-acre parcel that would have the potential for development of approximately 550 homes. Discovery Vista Subdivision is an existing development located in the northwest corner of the Star Road and Sun Avenue Drive intersection. Currently there are 256 occupied dwelling units with an additional 76 lots that are not currently occupied.

The total number of dwelling units that could be added within the study area is approximately 2,240. If each unit were to house approximately 2.5 persons, this would represent a population increase of approximately 5,600. The population of Livingston in the year 2017 was estimated to be approximately 7,530 and in the year 2000 the census estimate was approximately 7,090, which represents a growth of 6% over a 17-year period. If that growth rate was to continue for the next 20 years, the population would only increase by approximately 600 residents. Thus, full occupancy of the study area in 20 years would be unlikely unless a rapid increase in the annual growth rate occurs. In any case, planning the street system for ultimate growth and implementing it in a structured and purposeful manner would ensure safe and efficient future operations.

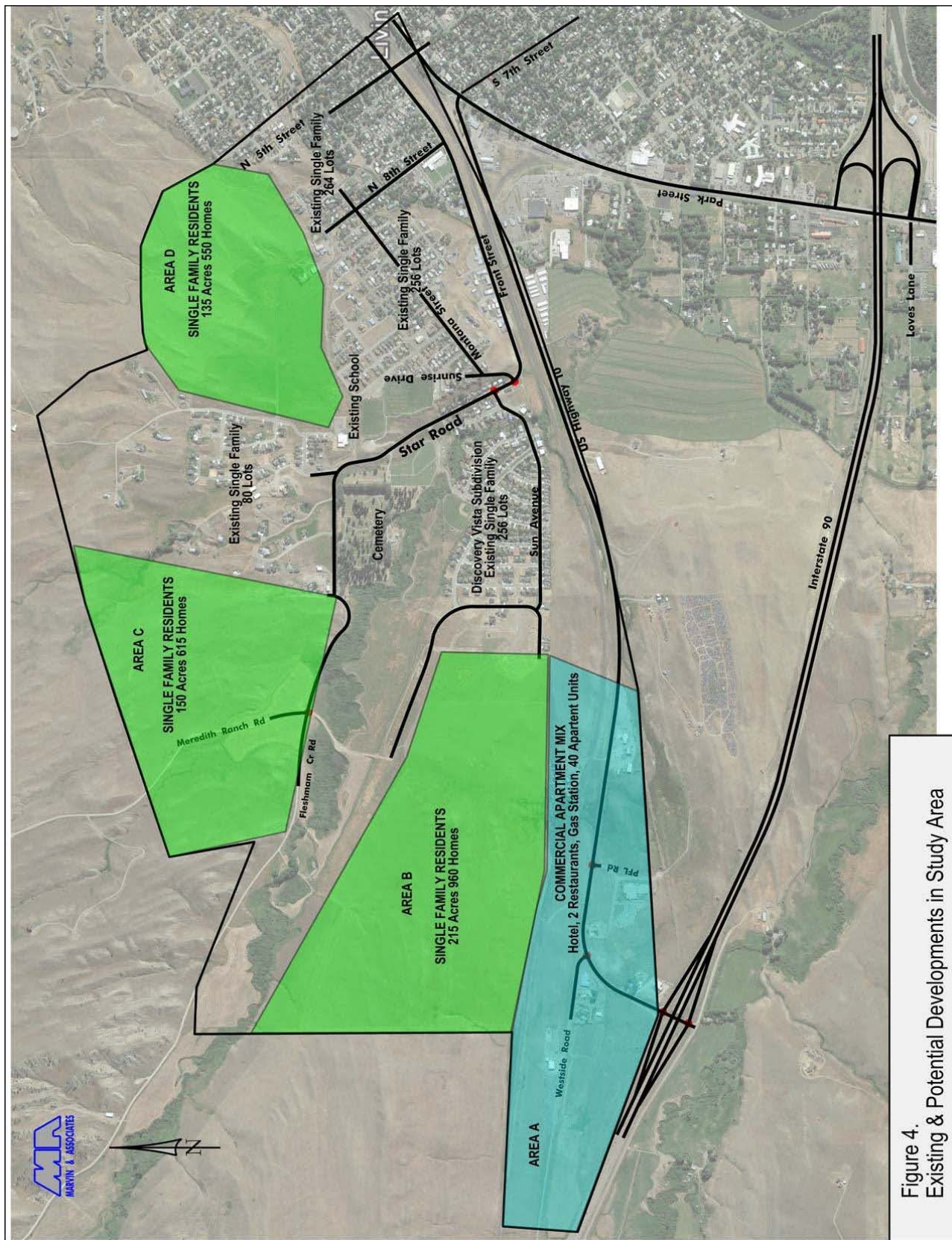


Figure 4. Existing & Potential Developments in Study Area

Study Area Trip Generation

Table 1 is a trip generation summary for the study area’s anticipated development. Trip generation rates from ITE’s Trip Generation Report, 10th Edition were evaluated to determine the land use rates that would be most representative of the proposed development land uses. Within Table 1, trip generation rates and resulting trip projections for the average weekday and the am and pm peak hours for each area of development are noted along with the total for full development of the subdivision. The gross number of average weekday trips (AWT) would be 25,020 for full development. The pm peak hour period would be the highest peak hour of the day with a maximum of 2,282 trips (1,406 entering and 876 exiting the site). At this hour of the day, traffic on the area street system is also at its average daily peak.

Table 1. Northside Livingston Future Trip Generation Potential

	No. of Units	Rate Units	Average Weekday		Peak AM Hour				Peak PM Hour			
			Rate	Total Trips	Rate	Trips	Enter	Exit	Rate	Trips	Enter	Exit
Area A												
Code 310 Hotel	110	Rooms	1	1091	2	74	43	31	3	77	38	39
Code 932 High Turnover Restaurant	10	1,000 S.F.	4	1272	5	108	59	49	6	99	59	40
Code 853 C-Store with Gasoline	3	1,000 S.F.	7	2537	8	123	62	61	9	153	77	76
Code 220 Apartments	40	Dwellings	10	266	11	23	5	18	12	40	26	14
Area A Totals =				5166		328	169	159		369	200	169
Area B												
Code 210 Single Family Houses	960	Dwellings	13	8413	14	682	171	511	15	805	507	298
Area C												
Code 210 Single Family Houses	615	Dwellings	13	5585	14	440	110	330	15	539	340	199
Area D												
Code 210 Single Family Houses	550	Dwellings	13	5040	14	395	99	296	15	487	307	180
Discovery Vista Remaining Lots												
Code 210 Single Family Houses	76	Dwellings	13	816	14	63	16	47	15	82	52	30
Potential Future Development Totals =				25020	56	1908	565	1343	60	2282	1406	876

1 - $T = 9.92(X)$
 4 - $T = 127.15(X)$
 7 - $T = 845.6(X)$
 10 - $T = 6.65(X)$
 13 - $\ln(T) = 0.92 \ln(X) + 2.72$

2 - $T = 0.67(X)$ (58% enter)
 5 - $T = 10.81(X)$ (55% enter)
 8 - $T = 40.92(X)$ (50% enter)
 11 - $T = 0.49(X) + 3.73$ (20% enter)
 14 - $T = 0.70(X) + 9.74$ (25% enter)

3 - $T = 0.70(X)$ (49% enter)
 6 - $T = 9.85(X)$ (60% enter)
 9 - $T = 50.92(X)$ (50% enter)
 12 - $T = 0.55(X) + 17.65$ (65% enter)
 15 - $\ln(T) = 0.90 \ln(X) + 0.51$ (63% enter)

Land use developments typically produce multi-modal trips that include pedestrian, bicycle, and transit trips, in addition to other vehicular trips. When evaluating vehicular impacts, these non-vehicular and transit-related types of trips can often be considered negligible in terms of their potential impacts on site access points. The study area is large and there is the possibility that schools, parks, and neighborhood commercial could be

incorporated in the future. Thus, bicycle and pedestrian trip modes would be probable. For this study it was assumed that approximately 5% of the trip would be bicycle and pedestrian trips.

Trip generation potential can be further refined by determining the number of “new” external trips that would appear, as vehicular traffic, at development access points. It is common for developments containing multiple land uses and/or complementary facilities to have trip origins and destinations within the development site boundaries. These trips are part of the total trip generation number, but do not have origins or destinations external to the development site, and as such, do not have an impact on the traffic network external to the development. These types of trips are known as “Internal Capture Trips” (ICT). Because there would be a mix of residential developments and also employees at internal businesses there is a definite possibility that ICT trips could occur. For this study it was assumed that between 2% and 5% of trips would be ICT related.

Once the number of external vehicle trips is determined, they can be further categorized as primary purpose, diverted link, or passerby purpose trips. Primary purpose trips are trips for which the development is a primary destination from any particular origin. Diverted link trips are trips made to a development as a secondary destination that must be diverted from a path between the origin and primary destination. Passerby trips are also trips made to a development as a secondary destination, but without a diversion from the primary trip path (i.e., a stop on the way home from work). Passerby trips do not represent “new” trips added to the adjacent street system. Thus, site generated passerby trips must be considered as new external trips (movements) at the site approach or approaches, but do not appear as new trips on the adjacent street system. For this development, the only passerby trips would be associated with Area A with commercial land uses. Approximately 50% of those trips would be passerby trips.

Table 2 presents a summary of trip mode and classification calculations that result in the projected number of vehicular trips external to the study area. There would be

. 20,039 external trips on the average weekday, with 1,688 trips in the am peak hour and 1,881 trips in the peak pm hour.

Table 2. Trip Mode & Classification Summary

Time Period	Total Trips	Ped/Bike Trips	Net Veh. Trips	ICT Trips	Net Ext. Trips	Passerby Trips	Net New Trips
AREA A							
Average Weekday	5166	155	5011	1033	3978	1989	1989
Peak AM Hour	328	10	318	66	252	126	126
Peak PM Hour	369	11	358	74	284	142	142
AREA B							
Average Weekday	8413	421	7992	421	7571	0	7571
Peak AM Hour	682	34	648	34	614	0	614
Peak PM Hour	805	40	765	40	725	0	725
AREA C							
Average Weekday	5585	279	5306	223	5083	0	5083
Peak AM Hour	440	22	418	18	400	0	400
Peak PM Hour	539	27	512	22	490	0	490
AREA D							
Average Weekday	5040	252	4788	151	4637	0	4637
Peak AM Hour	395	20	375	12	363	0	363
Peak PM Hour	487	24	463	15	448	0	448
Discovery Vista							
Average Weekday	816	41	775	16	759	0	759
Peak AM Hour	63	3	60	1	59	0	59
Peak PM Hour	82	4	78	2	76	0	76

Total Subdivision	Total Trips	Ped/Bike Trips	Net Veh. Trips	ICT Trips	Net Ext. Trips	Passerby Trips	Net New Trips
Average Weekday	25020	1148	23872	1844	22028	1989	20039
Peak AM Hour	1908	89	1819	131	1688	126	1562
Peak PM Hour	2282	106	2176	153	2023	142	1881

Trip Type Summary AM & PM Hours

	Peak AM Hour			Peak PM Hour 4:30-5:30		
	Enter	Exit	Total	Enter	Exit	Total
New External Trips	426	1136	1562	1173	708	1881
Passerby Trips	66	60	126	68	74	142
Access Vehicles	492	1196	1688	1241	782	2023

Distribution of Trips to External Origin-Destination Zones

Trip attractions to and from the study area can be determined in a number of different ways. In this case, the study area has a single access point at the intersection of N 5th Street and Front Street and existing directional traffic flows can be used to replicate origins and destinations. Disaggregation of existing am and pm hour traffic counts at key intersections (see Figure 2) provides directional components at each intersection that can be compounded from one intersection to the next which when compounded, provides a percentage distribution to each external zone.

Figure 5 presents the results of the distribution analysis completed for the study area utilizing the above stated methodology. There were a total of seven external zones identified and Figure 5 illustrates the relative attraction between the study area and each external zone in terms of percentages. Three of the zones represent trips attracted to and from the downtown area and eastern portions of Livingston via Front Street, Park Street, and S 5th Street. In total, 51% of the trips have an origin or destination in downtown and eastern portions of Livingston.

Approximately 31% of the trips have an attraction to commercial and recreational land uses in Livingston south of Interstate 90 on Park Street and south of Livingston on US HWY 89. Approximately 2% of the trips are attracted to commercial land uses along US HWY 10 and to attractions accessible by Interstate 90 east of Livingston.

Interstate 90 west of Livingston has the largest trip attraction for remote external areas with 15% of trips to and from the Bozeman/Belgrade area. This somewhat tends to illustrate the function of Livingston as a quasi-bedroom community. Higher housing costs in Bozeman creates a situation where the 20 to 30-minute commute from Livingston is worth the difference in travel cost.

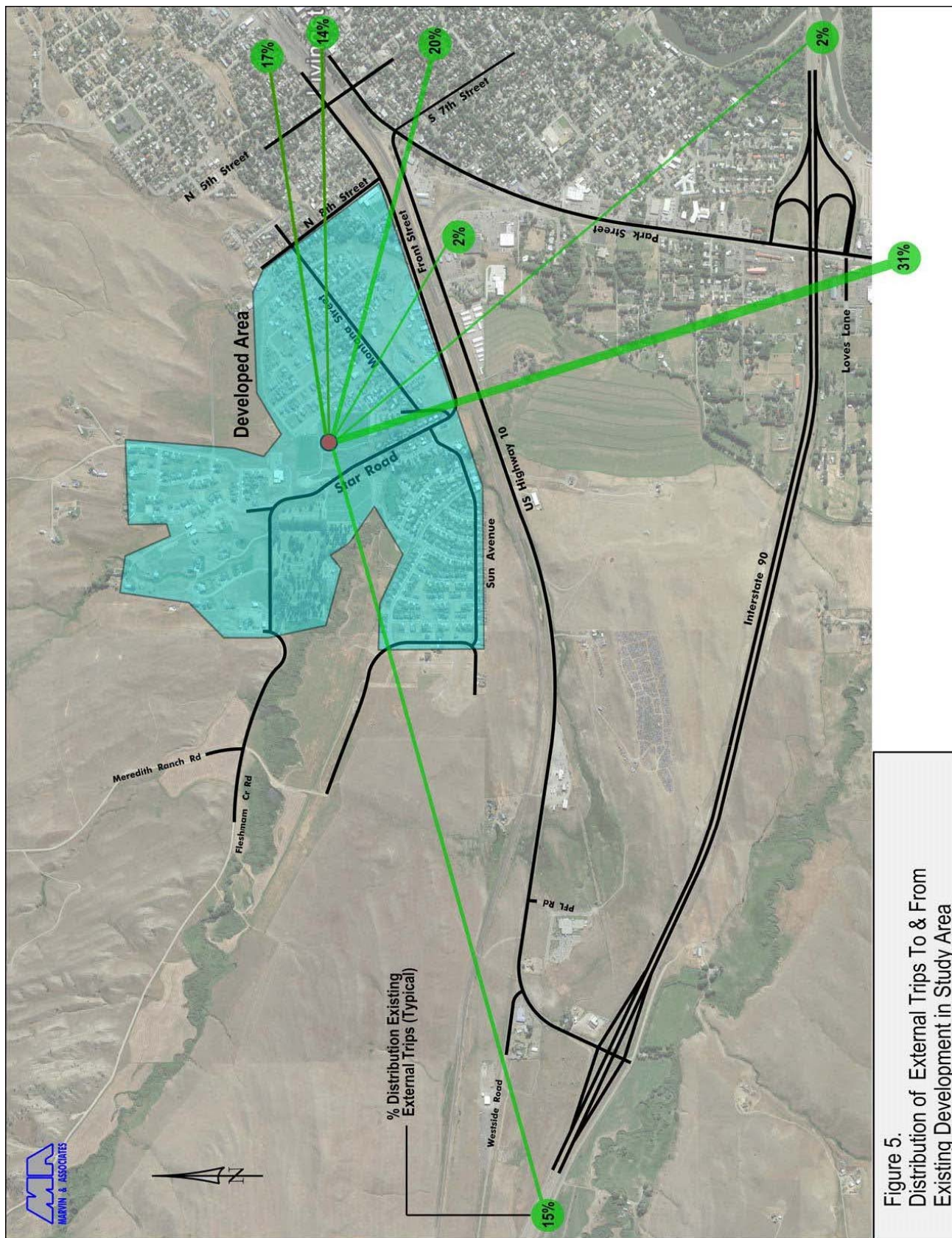


Figure 5. Distribution of External Trips To & From Existing Development in Study Area

Initial Improvement Phase Traffic Projections

It is assumed that the initial phase of system improvements would entail construction of a new east-west arterial street north of the railroad tracks and an at-grade railroad crossing near the US HWY 10 interchange with Interstate 90. The arterial connection road would intersect US HWY 10 at the closest point possible to the interchange. Sight distance measurements indicate that the closest point would be very near the intersection with PFL Road. In order to minimize operational concerns, the new arterial road would need to align directly with PFL Road creating a four legged intersection.

A traffic model for initial operations was completed using all of the aforementioned inputs. Appendix F contains model spread sheets for am and pm hour traffic projections on area street links. Figure 6 presents the proposed alignment of the new east-west arterial roadway along with peak am and pm hour traffic projections at five key intersections and AWT volumes on pertinent street system links. It should be noted that the projection matrix contained in Appendix F does not exactly match traffic volumes shown in Figure 6 since the spreadsheet separates volume entering and exiting the study area and on some links directional volumes are reversed, depending on the link location. Additional manipulations of spreadsheet volumes were made by rounding and adjusting volumes to provide balanced flow, where necessary.

Initial model conditions assumed that the additional 76 vacant lots in the Discovery Vista Subdivision would be occupied and minor development or in-fill of exiting lots would occur prior to completion of the east-west arterial roadway. Volumes shown in Figure 6 indicate that construction of the east-west arterial and railroad crossing would attract approximately 3,500 vehicles on the average weekday. Comparing the AWT in Figure 6 to those in Figure 2, it can be seen that initial conditions would add approximately 2,000 to the total traffic entering and exiting the study area, yet AWT entering key intersections on N 5th Street would be very near equal to existing conditions.

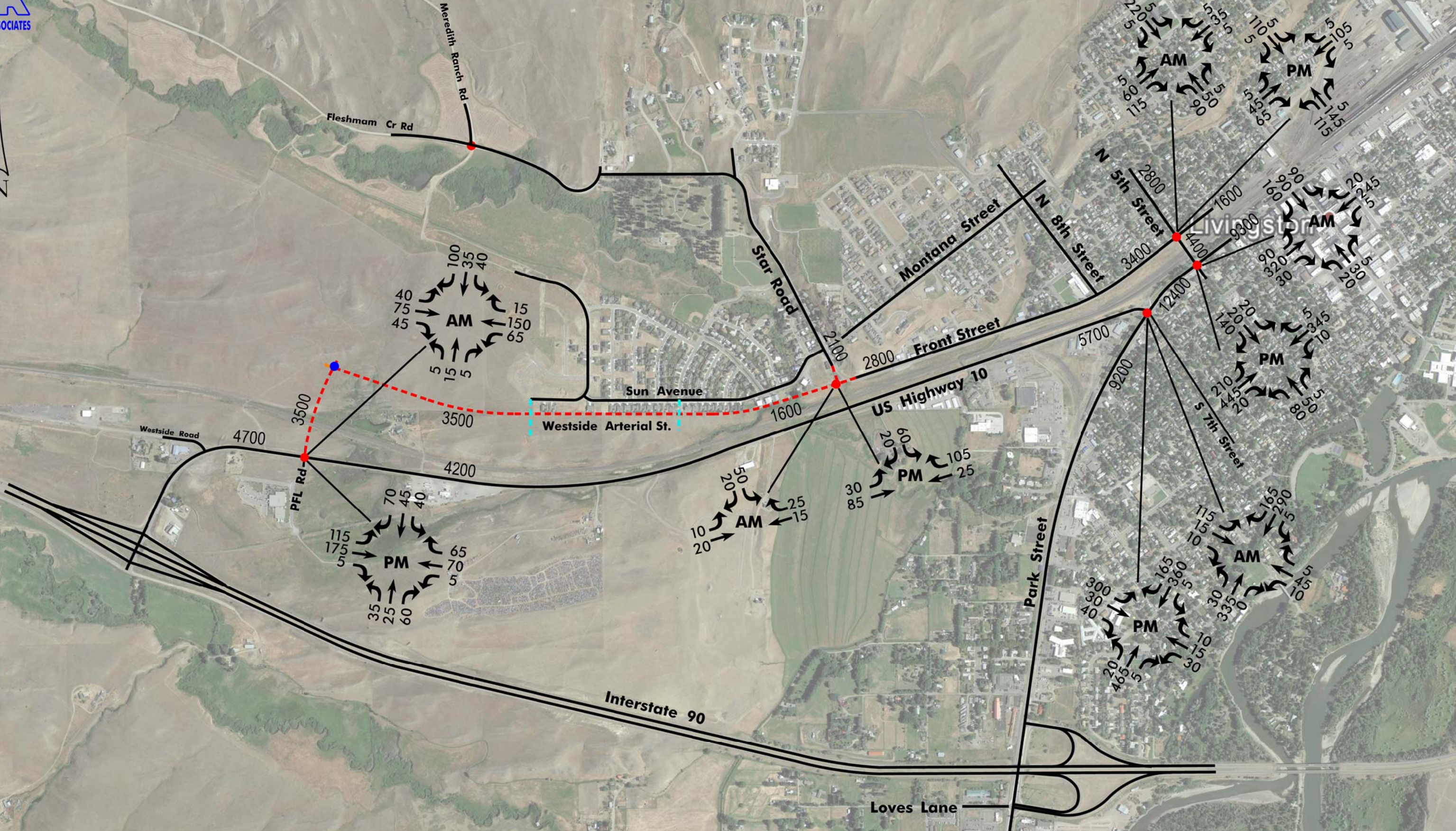


Figure 6.
Initial Traffic Projections at Key Intersections
& Streets - Construction of Westside
Arterial & At-grade RRR Crossing

FUTURE AREA STREET SYSTEM

Developments of the magnitude envisioned within the study area will require an organized system of arterial and collector street upon which to build a logical system of safe and efficient streets. With no definitive development proposals on official record at the present time, standard planning criteria should be used to develop a concept system. Typically, arterial streets should be spaced at approximately one mile intervals in urban areas and collector streets at half-mile intervals. The street system should attempt to maintain a grid system as close as possible aligned in true north orientation to simplify directional orientations.

Figure 7 presents the recommended future street system hierarchy and location concepts. Two north-south arterial roadways should be designated. Star Road exists as a logical candidate for arterial status because of its location and the fact that there is very little direct access to adjacent properties. On the western side of the study area, the City of Livingston already owns right-of-way for a roadway, portions of which could be used for future development of a north-south arterial street. An extension of Meredith Ranch Road south to the new east-west arterial street would provide a connection to the Star Road alignment, which would create an arterial loop road within the entire study area. The locations of collector street intersections to the arterial street should be placed equidistant from intersecting arterial streets. To avoid a relatively sharp curve in the new east-west arterial street, its alignment should intersect the proposed north-south arterial aka “Meredith Ranch Road” at right angles on the north side of the railroad a sufficient distance north to maintain sight distance and to accommodate future intersection operations.

In addition to arterial roadways the collector street system would include a new outlet street for the North Town development to allow access to the Star Road arterial shown in Figure 7. This collector would minimize impacts on existing local streets from a development that could generate in excess of 4,000 AWT.

LEGEND



- Existing Arterial
- Existing Local Street
- Proposed Arterial
- Proposed Collector
- Proposed Local Connect
- Alternative Connection
- Proposed Bike/Ped Path

Study Area Boundary

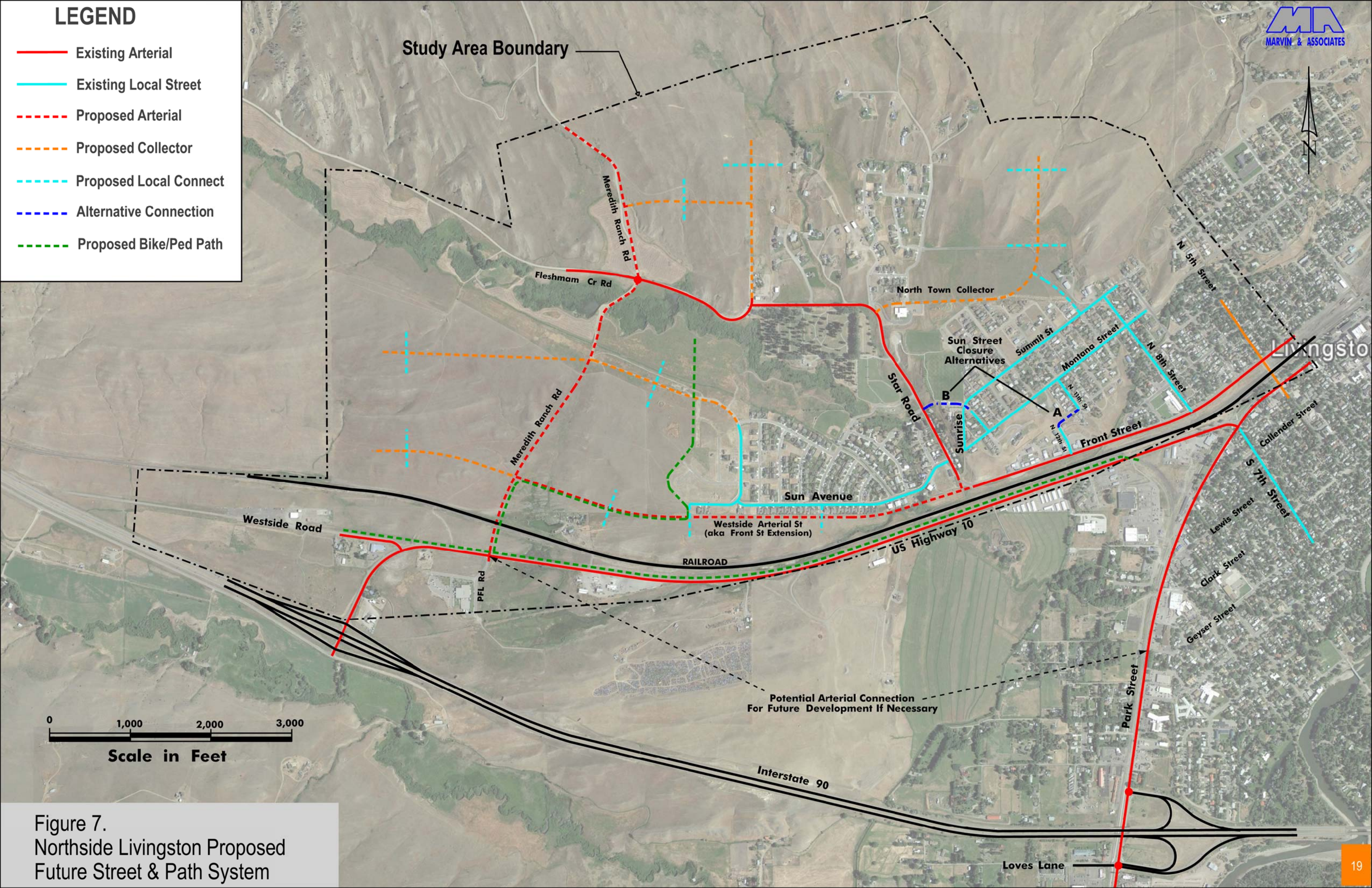
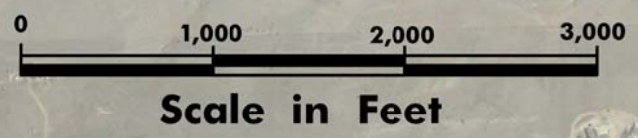


Figure 7.
Northside Livingston Proposed
Future Street & Path System

Existing local streets north of Front Street and east of Star Road would have improved access to Front Street and less travel time to the west if one of the two alternatives shown in Figure 7 were to be implemented. Both alternatives would eliminate a very steep approach on Sunset Drive to its current intersection with Star Road. Alternative A would connect N 11th Street to N 12th Street allowing direct connection to Front Street, while Alternative B would connect Summit Street directly to Star Road. Alternative B would have the advantage of providing more direct access for westbound traffic via Star Road for a large number of residences.

Development within the proposed commercial subdivision on PFL Road could be designed to accommodate a potential extension of the arterial south and east to accommodate potential for future development in the large triangular property Between US HWY 10 and Interstate 90. A connection to Park Street could be made near Elk Horn Lane. An arterial connection between US HWY 10, Meredith Ranch Road, and Park Street could play a big role in reducing travel demand pressures at the 5th Street railroad crossing.

Figure 7 also indicates where the primary pedestrian/bike path would be located. A number of additional paths should be considered as future development proposals are reviewed.

Future Trip Distribution

Figure 8 presents the distribution of future trips based on the recommended study area street system and a full development scenario. Increased commercialization within Study Area A along with increased attraction to expanding demographics and jobs growth in Bozeman would change the current attraction in the seven origin-destination zones. The I-90 west external zone would increase to 16% of trips while the PLF Road commercial properties would attract approximately 6% of trips. The downtown and eastern Livingston zone would attract 47% of the trips while the southern Livingston zone would attract approximately 28%. The future distribution percentages are used in development of the future traffic projection model.

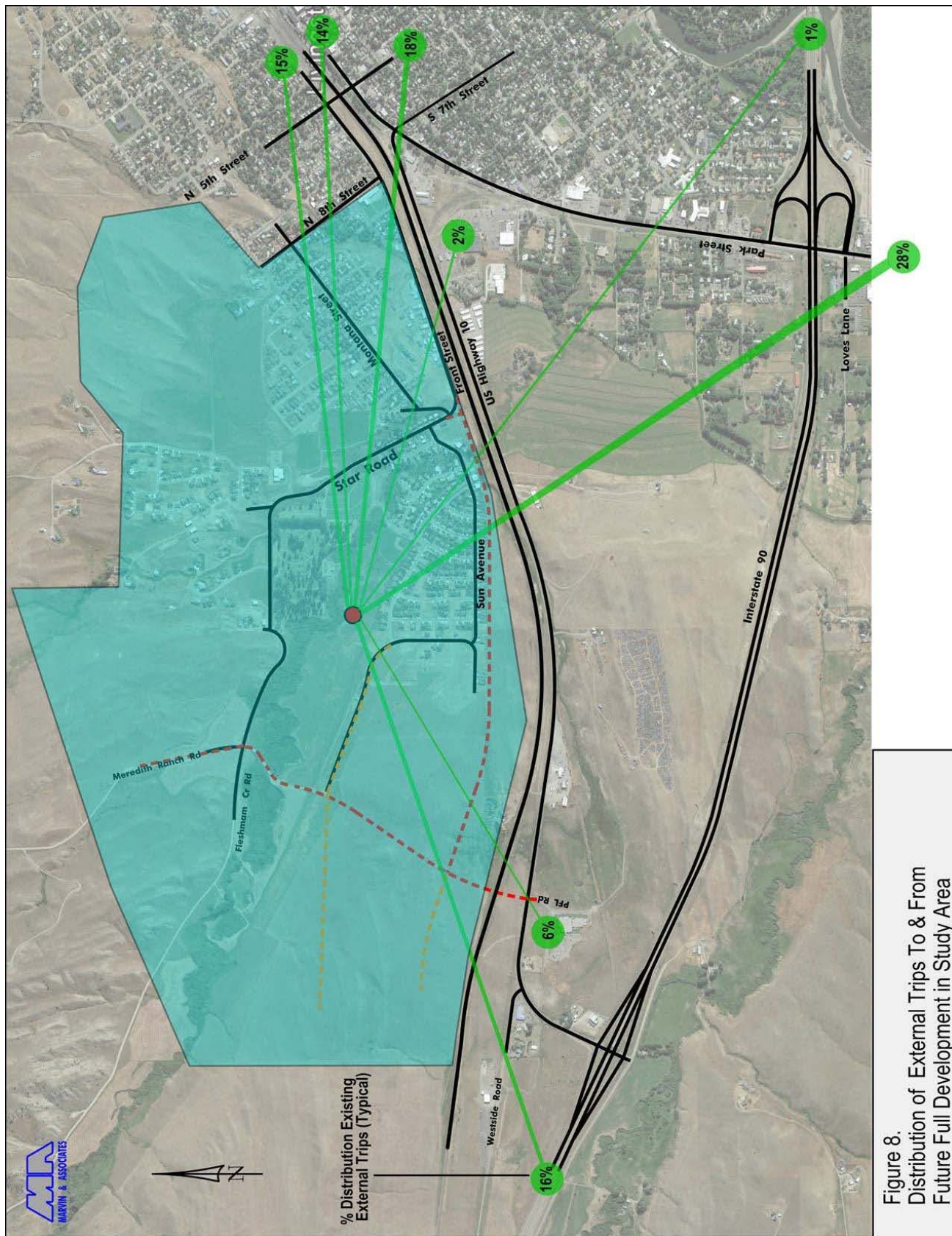


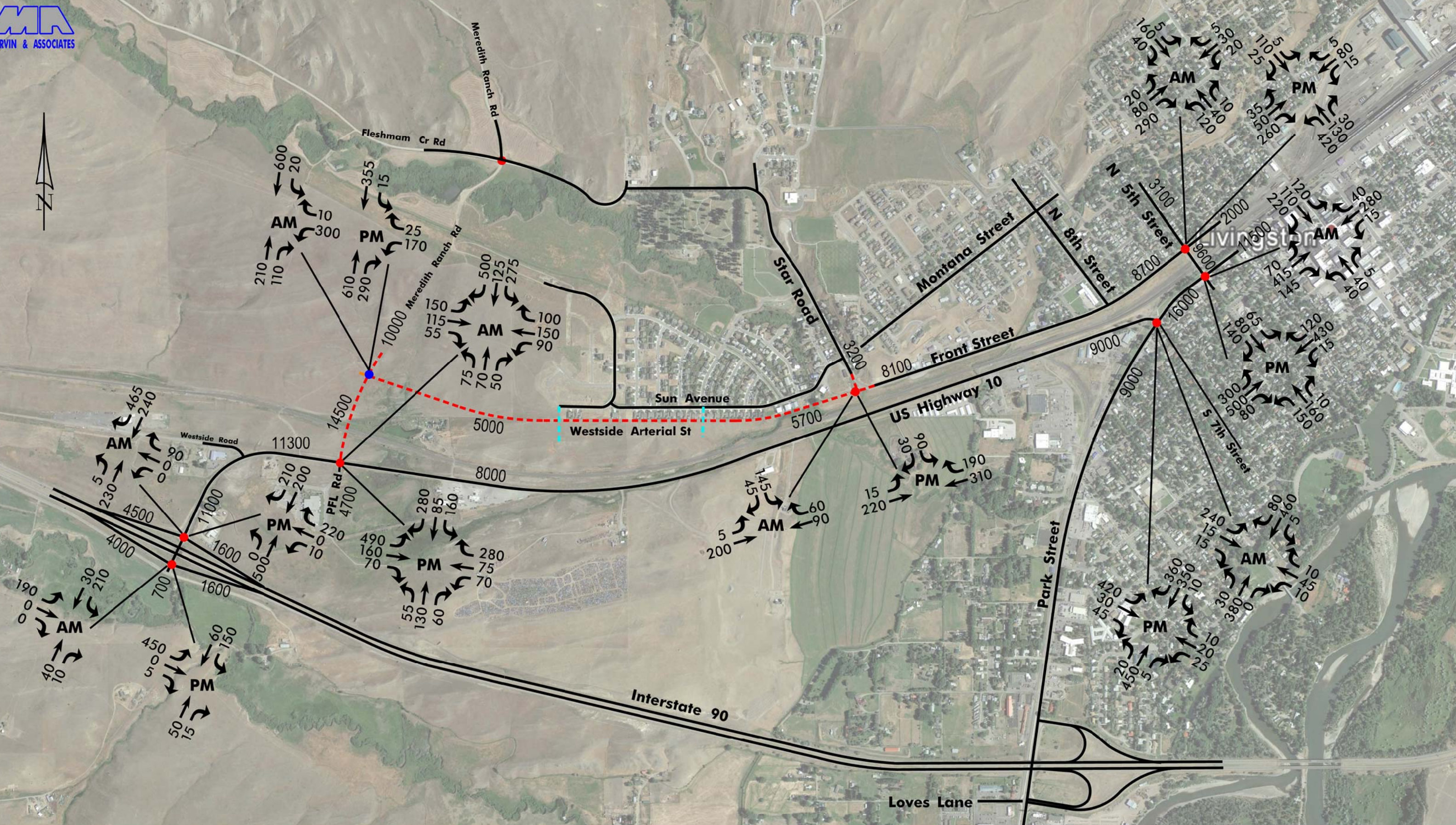
Figure 8. Distribution of External Trips To & From Future Full Development in Study Area

Future Traffic Projections

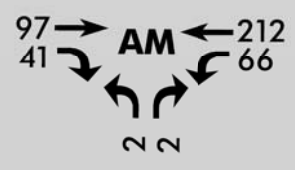
The existing system traffic assignment model was modified for future system conditions and traffic projections for full development within the study area was calculated. Appendix G contains the link assignment matrix and Figure 9 is a graphical representation of the balanced traffic flows for future conditions. Figure 9 shows both am and pm peak hours traffic and AWT volumes on key street links. Since full development within the study area represents a population growth rate that far exceeds historical rates, it was assumed that growth in other areas of Livingston would be relatively minor. Therefore, existing traffic without origins or destinations within the study area was assumed to be at existing levels.

Figure 9 traffic volumes indicate that the Westside Arterial Street would carry approximately 5,000 AWT while Meredith Ranch Road north of US HWY 10 would carry approximately 14,500 AWT. North 5th Street, south of Front Street, would carry approximately 9,600 AWT and Front Street east of N 5th Street would have an AWT of approximately 2,000. Thus, total AWT entering and exiting the study area would be approximately 26,000.

Peak am and pm turning movement projections shown in Figure 9 included six key intersections where special traffic control features would be required when the recommended area street system is implemented. No traffic projections for streets or intersections within the study areas north of the Westside Arterial Street were made since traffic assignment would be dependent upon actual subdivision layout information.



Peak Hour Turning Movement Volumes (Typical)



4600
Average Weekday Traffic (Typical)

Figure 9.
Future Traffic Projections at Key Intersections & Streets - Full Development Within Study Area On Proposed Street System

INITIAL & FUTURE INTERSECTION CONTROLS

Capacity calculations (see Appendix H & I) were completed for key intersections shown in Figure 9, which provided guidance on desirable lane usage and intersection controls. The following report sections provide specific information with regard to ultimate design considerations relative to the initial and future planned street system.

US HWY 10 & I-90 Interchange Ramps

Initial development of the area street system would result in traffic volume demand similar to existing traffic volumes. Thus, no changes to existing operations would be warranted at either of the Interstate 90 ramp intersections. However, future area full development traffic would increase demand on all I-90 ramp movements and capacity calculations indicate that the intersection US HWY 10 and the I-90 Eastbound Off-ramp would operate at LOS “F” during the peak PM hour period. The vehicular queue on the ramp would exceed 18 vehicles which would shorten the deceleration length on the ramp by more than 500 feet. Signalization of that ramp would likely be required or the interchange could be reconfigured to provide a dual roundabout “Dog Bone” ramp intersection layout. In either case, the intersection would probably warrant reconstruction prior to full development of the study area.

US HWY 10 & Meredith Ranch Road/PFL Road

The initial phase of area development, when Westside Arterial Street is constructed to Meredith Ranch Road and an at-grade railroad crossing allows access to US HWY 10 at PFL Road, left-turn lanes would be warranted at the intersection of US HWY 10 and Meredith Ranch Road. Capacity calculations indicate that the intersection would operate at level of service (LOS) “C” or better with auxiliary left-turn lanes on each leg of the intersection and stop control on the north and south approaches. Future improvements would require traffic signals or roundabouts at the intersection of Meredith Ranch Road and US HWY 10.

Westside Arterial Street & Meredith Ranch Road

In the initial phase of the Westside Arterial street construction, the intersection would not likely serve future eastbound or southbound approaches. Therefore, intersection control would only need to address the turning movements associated with northbound and westbound traffic. The eastbound and southbound approaches should be stubbed-out to insure that appropriate future geometrics will be constructed.

Future development with full traffic demand at this intersection would warranted a traffic signal or a roundabout. A roundabout would be the preferred control, since initial operations would be enhanced in terms of safety when northbound and westbound movements would be physically separated. Safer and more efficient operations during off-peak hours would also be associated with a roundabout at this location.

Star Road and Westside Arterial Street

Both initial and full development capacity would be at LOS “B” at the Star Road and Westside Arterial/Front Street intersection if constructed with a two lane southbound approach on Star Road and an auxiliary left-turn lane on the Westside Arterial Street. An alternative to construction of multiple left-turn lanes at this intersection would be construction of a single lane roundabout at this intersection.

N 5th Street Intersections

Initial operations of the N 5th Street intersections with Front Street and Park Street would be improved by redirecting traffic to the new Westside Arterial Street and Meredith Ranch Road accesses. However, substantial traffic demand increases would be realized when the study area is fully developed in the future. Both intersection would operate at less than acceptable levels of service which would be exacerbated when train traffic occurs. Solutions to mitigate the efficiency impacts would not be simple or cheap. The most likely results would either be additional traffic diverted to the Meredith Ranch Road access because of increased delay and/or development within the study area would be stunted.

Initial & Future Area Street Improvements

The initial phase of development within the area was assumed to be construction of Westside Arterial Street from Front Street to Meredith Ranch Road and Meredith Ranch Road to US HWY 10. The projected traffic on Westside Arterial Street is well within the operating range of a two lane roadway. However, consideration should be given to future traffic demand when planning the construction. Even though projected future volumes could be served by a two lane roadway, there a couple scenarios that could increase traffic demand by a significant degree.

- Congestion on N 5th Street intersections could force more traffic onto the Westside Arterial Street.
- If a new arterial connection from US HWY 10 to Park Street were to materialize, substantial traffic volumes could be drawn away from the N 5th Street & Park Street intersection.

In light of these possibility, it is recommended that the ultimate cross section of the Westside Arterial Street include 2 through traffic lanes and a two-way left-turn lane (TWLTL) in the center. In addition, a 10' wide shared-use path should be constructed on the south side of the street. Shoulders should be constructed on each side of the roadway unless curb & gutter sections are used and the bike path should be separated from the roadway by a depressed ditch section or a boulevard section. The average right-of-way for the section should be a minimum of 100'. The same roadway section should be used for Meredith Ranch Road and other new arterials as may be required during subsequent development within the area.

US HWY 10 would experience full development traffic approaching the capacity limitations of a two-lane roadway east of PFL Road and in excess of two-lane roadway capacity west of PFL Road. The Montana Department of Transportation (MDT) will need to review future developments to determine if reconstruction of the highway fits within their projected future plans for that roadway. A bike path located on the north side of the highway is recommended to connect with the Park Street path and coordination of effort

would be required to ensure that the path is located on an alignment that is compatible with future roadway improvements.

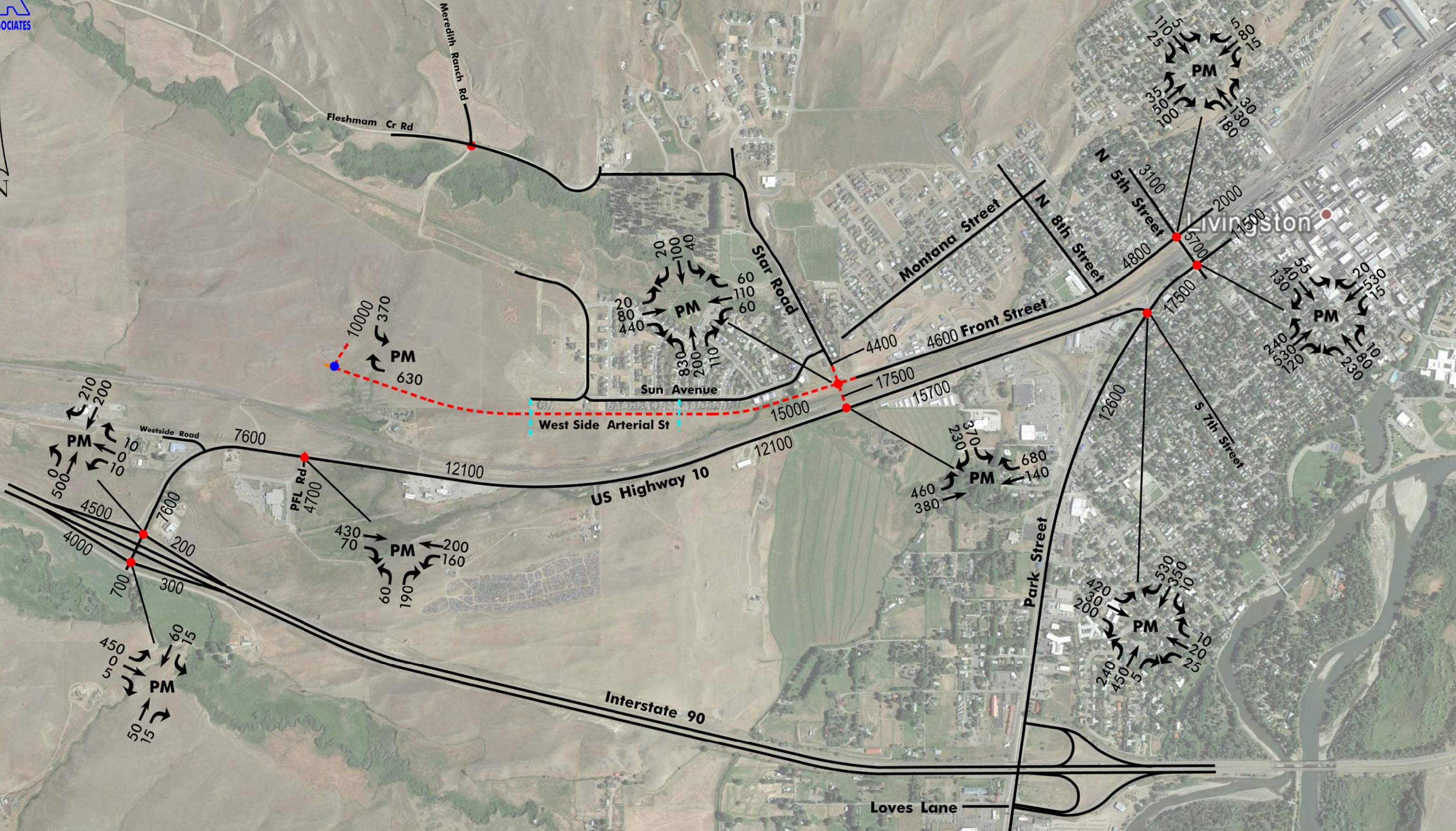
Collector streets within the study area should have 2-12' through lanes with 10' shoulders or parking lanes as required. Provisions for bikes lanes on collector street should be incorporated which would add 10', to the overall street width.

ALTERNATIVE RAILROAD CROSSING LOCATION ANALYSIS

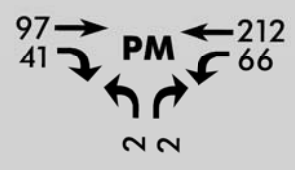
In order to compare the proposed street system with respect to the railroad crossing location at PFL Road, it was determined that the original Star Road Underpass proposal would need to be reevaluated using the same growth projections contained in this study. In 2007, it was determined that developments within the study area would be relatively minor in comparison to the level of growth currently being experienced. With the higher growth projections, it was felt that the Star Road Underpass could become feasible from the benefit side of the benefit/cost ratio. Therefore, additional analysis of traffic assignment and operating efficiencies was completed to determine the feasibility of the Star Road Underpass connection to US 10.

Traffic Assignment Analysis

The same general trip generation and trip distribution models created for this study were used and an abbreviated travel time analysis was completed in an effort to assign traffic at the Star Road Underpass location. It was determined that the majority of the study area west of 8th Street would use the Star Road Underpass to travel to and from the east and south, while the entire study area would use the Star Road Underpass to access I-90 to and from the west. The traffic assignment model was modified and it was determined that the Star Road Underpass would initially accommodate approximately 3,750 vehicles per day. Future traffic assignment analysis yielded the average weekday and peak PM hour traffic volumes shown in Figure 10.



Peak Hour Turning Movement Volumes (Typical)



4600
Average Weekday Traffic (Typical)

Figure 10.
Star Road Underpass Alternative Future
Traffic Projections at Key Intersections
Full Development Within Study Area

It was assumed that the Westside Arterial roadway would be required to access new developments on the west side of the study area, which would result in a four legged intersection with Front Street and Star Road. The Star Road Underpass connection would have a future demand of approximately 17,500 vehicles per day in comparison to the 14,500 AWT projected for the PFL underpass location. Traffic on the existing 5th Street railroad crossing would be at the same approximate level as currently exists (5,700). However, traffic volumes on US 10, west of Park Street would increase substantially from 9,000 AWT to 15,700 AWT (Figure 9). Park Street at 5th Street would also increase from 16,000 in Figure 9 to 17,500 in Figure 10. Turning movements at all of the intersections would be appreciably different between the two grade separation alternatives.

Initial & Future Intersection Controls

Capacity calculations (see Appendix J) were completed for key intersections shown in Figure 9, which provided guidance on desirable lane usage and intersection controls. It was determined that initial operations using stop control at Star Road and US 10 would operate at LOS “B” or better. However, it was determined that a westbound right turn lane would be warranted on US 10 to safely accommodate right turning traffic in the peak PM hour.

Future traffic demand would require signals at both US 10 and Front Street intersections with Star Road. Various intersection concepts were tested and it was determined that the Front Street intersection with Star Road would require dual northbound left-turn lanes and thru/right lanes. The eastbound approach would require separate left, thru, and right turn lanes while the remaining approaches would have separate left and thru/right lanes. With that lane configuration, the intersection could operate at LOS “B”. At the Star Road and US 10 Intersection, the eastbound approach would need an auxiliary left turn lane, the westbound approach would need an auxiliary right-turn lane, and the southbound

approach would need separate left and right turn lanes. That lane configuration would allow the intersection to operate at a LOS “B” in the peak PM hour.

When attempting to layout the geometric concepts for the two adjacent intersections using the calculated vehicle storage requirements it became obvious that the two intersections were too closely spaced. The northbound approach to the Star Road intersection with front Street would require a minimum of 350’ to store the maximum vehicle queue of 14 cars, while the southbound approach to US 10 would have a maximum queue of 15 cars and would require 375’ of storage. The effective in-lane storage distance between intersections is measured at approximate 195 feet. It was determined that a minimum separation distance between intersections would need to be well over 600’ to avoid gridlock conditions. Dual roundabouts were investigated as an alternative, but the north bound leg at the Front Street and Star Road intersection would have a total entering and circulating volume in excess of 1200 vehicles which would be very problematic from an operational perspective.

At the intersection of US 10 and Park Street, it was determined the traffic demand would create a need for an additional eastbound lane to accommodate the increase in right turn traffic volumes associated with the Star Road Underpass connection. Even with the additional lane, the southbound left-turn movement would operate at LOS “D”.

The intersection of Park and 5th Street would operate at LOS “C”, but the westbound and northbound approaches would have movements operating at LOS “D”. The operation would be similar to the proposed street system using the PFL Road underpass location. The reason for similar operational constraints is the fact that the level of traffic entering the intersection would be about the same for both alternatives even though vehicles would enter the intersection from different directions for each alternative.

SUMMARY & RECOMMENDATIONS

The scope of this study was designed to evaluate future development in the Northside Livingston study area and advance concepts for a future street system that would safely and efficiently serve access and mobility for pedestrians, bikes, and vehicles. While total development of the study area may be beyond a 20-year horizon, the street system should be structured in a manner that does not constrain future growth. The concept street system presented herein provides a framework for future development considerations. It appears that the most critical aspect of the future street system rests with development of a major east-west arterial street that would function as a manifold to funnel north-south traffic to existing street arterials. Traffic outlets on the east-west arterial are limited by a barrier created by the railroad tracks, which in itself becomes the prime consideration. The proposed PFL Road location for a railroad crossing would appear, at first glance, to be too far removed from the existing urbanized area. However, when the potential for future development is fully examined, it become apparent that a crossing of the barrier needs to be unconstrained by limitations associated with existing street system geometrics and operational controls.

Analysis of the Star Road Underpass location has indicated that it would initially operate in an efficient manner, but the efficiency would be short lived and geometric constraints would create the need for yet another outlet for traffic generated within the study area. For that reason, it is recommended that the street system structure illustrated in Figure 7 be adopted as the plan framework for future street system development.

INITIAL IMPROVEMENTS COST ESTIMATES

Figure 11 presents typical roadway sections and operational controls envisioned for the Westside Arterial and Meredith Ranch Road connections at the PFL Road railroad crossing location. This graphic represents full study area build-out future operation conditions. Initial construction of improvements could involve two lane roadways with auxiliary left turn lanes on US 10. Various design options would be available, but any right-of-way acquisitions should include the necessary width for future lane and bike path additions.

Cost estimates for three different construction options are contained in Appendix K of this report. The estimates include the Front Street Extension (Westside Arterial Street), The Merideth Ranch Road connection to US 10 and the grade separation structure. Total costs for the three options are presented below.

➤ Total Cost with Street, Curb & Gutter and Water & Sewer	\$12,302,033.36
➤ Total Cost with Street, Water & Sewer	\$11,880,374.98
➤ Total Cost with Street Only	\$10,388,578.95



Viable Alternatives to Traffic Signals Would Be Roundabouts

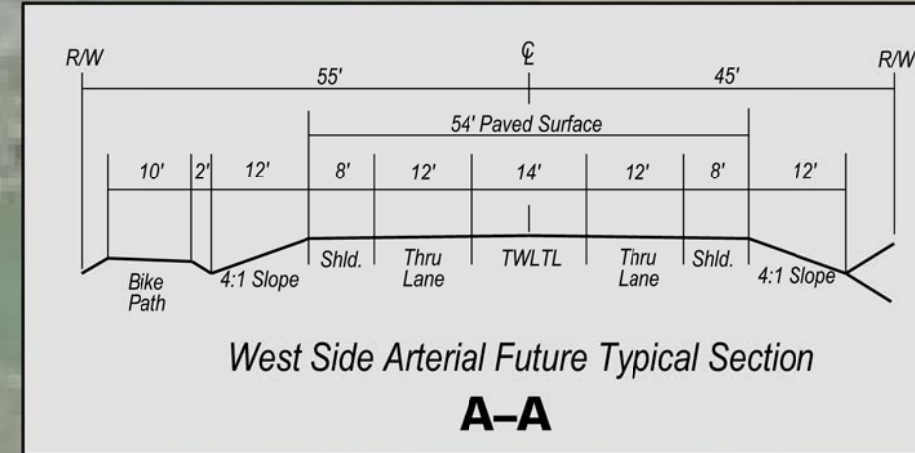
Meredith Ranch Road

**West Side Arterial St
(aka Front Street Extension)**

Bike Path

**Railroad
Grade
Separation**

Railroad



US HWY 10

Bike Path

PFL Road

Figure 11.
Future Roadway Geometrics & Traffic Controls
For West Side Arterial At PFL Road Underpass
With Connection to HWY 10

APPENDIX A

INTERSECTION TRAFFIC COUNTS

Intersection:

Star & Sun

Date: Feb 2018

Begin Time	Sunrise Drive						Star Road						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00				0		2	4		0	0		27	33
7:15				1		0	3		0	0		27	31
7:30				1		1	8		0	2		79	91
7:45				0		1	18		0	1		60	80
8:00				0		0	13		0	0		26	39
8:15				0		0	11		0	0		22	33
8:30				0		1	7		0	0		16	24
8:45				0		0	12		0	0		16	28
Peak AM Hour				1		2	50		0	3		187	243
4:00				2		0	22		0	1		20	45
4:15				1		0	25		1	1		24	52
4:30				1		2	30		0	0		26	59
4:45				1		2	36		3	1		16	59
5:00				0		1	46		4	1		15	67
5:15				1		1	49		1	0		16	68
5:30				2		0	48		2	0		32	84
5:45				2		1	34		1	0		25	63
Peak PM Hour				4		4	179		10	2		79	278

AM phf = 0.67
PM phf = 0.83

Intersection:

US 10 & I90 Eastbound Ramps

Date: Feb 2018

Begin Time	I-90 Eastbound Ramps						US HWY 10 (I90 Bus Route)						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	17	0	0				3		0	1		3	24
7:15	23	1	0				11		0	2		6	43
7:30	36	0	0				10		1	2		2	51
7:45	49	0	0				14		2	0		5	70
8:00	31	1	0				10		3	1		9	55
8:15	35	0	0				7		1	0		8	51
8:30	36	0	0				4		1	0		5	46
8:45	27	1	0				4		1	0		7	40
Peak AM Hour	151	1	0	0	0	0	0	41	7	3	24	0	227
4:00	44	0	0				2		1	0		11	58
4:15	39	1	2				7		1	1		6	57
4:30	44	1	0				4		2	4		6	61
4:45	59	0	0				7		6	0		3	75
5:00	54	0	0				7		1	5		9	76
5:15	58	0	1				6		3	1		18	87
5:30	61	0	0				3		1	1		9	75
5:45	56	1	0				3		2	1		7	70
Peak PM Hour	232	0	1				23	11	7	39			313

AM phf = 0.81
PM phf = 0.90

Intersection:

US 10 & I90 Westbound Ramps

Date: 11/30/2016

Begin Time	I-90 Westbound Ramps						US HWY 10 (I90 Bus Route)						Total Vehicles	
	Eastbound			Westbound			Northbound			Southbound				
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		
7:00				0	0	1	0		25		5	101	132	
7:15				0	0	0	0		26		8	99	133	
7:30				0	0	2	0		45		3	105	155	
7:45				0	0	0	0		59		5	78	142	
8:00				0	0	0	1		43		13	105	162	
8:15				0	0	1	1		40		6	127	175	
8:30				0	0	0	0		38		5	88	131	
8:45				0	0	0	1		29		8	91	129	
Peak AM Hour				0	0	3	2		187		27	415	634	
4:00				5	0	0	0		46		7	33	91	
4:15				2	0	3	11		40		4	26	86	
4:30				3	0	2	0		51		7	37	100	
4:45				0	0	2	0		60		1	28	91	
5:00				1	0	1	0		66		11	46	125	
5:15				2	0	1	0		63		17	36	119	
5:30				4	0	2	0		58		7	42	113	
5:45				1	1	1	0		64		6	28	101	
Peak PM Hour				8	1	5	0		251	0	0	41	152	458

AM phf = 0.91
PM phf = 0.92

Intersection:

US 10 & West Side Road

Date: 2/12/2018

Begin Time	US HWY 10						West Side Road						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	0	14			55	0				0		0	69
7:15	1	18			53	0				1		0	73
7:30	0	41			46	1				0		0	88
7:45	0	46			48	5				0		1	100
8:00	1	28			44	2				0		0	75
8:15	0	26			54	0				0		1	81
8:30	1	25			42	0				1		0	69
8:45	1	18			27	3				1		1	51
Peak AM Hour	1	141			192	8				0		2	344
4:00	0	40			35	0				4		0	79
4:15	0	41			34	0				1		0	76
4:30	0	43			35	0				0		0	78
4:45	0	59			40	1				0		1	101
5:00	1	44			49	0				2		0	96
5:15	0	62			37	1				0		0	100
5:30	1	71			38	0				1		0	111
5:45	1	60			23	0				0		0	84
Peak PM Hour	2	236			164	2				3		1	408

AM phf = 0.86
 PM phf = 0.92

Intersection:

Front Street & 5th Street

Date: 11/28/2016

Begin Time	Front Street						5th Street						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	0	8	19	2	1	0	2	5	2	8	25	0	72
7:15	0	6	21	1	3	0	7	5	1	1	44	2	91
7:30	0	5	43	3	1	0	13	8	1	1	62	1	138
7:45	0	5	43	3	1	0	13	8	1	1	62	1	138
8:00	0	5	42	4	13	0	25	20	3	1	60	0	173
8:15	0	11	24	6	8	3	28	19	3	0	36	0	138
8:30	0	2	34	4	3	0	16	20	5	1	28	0	113
8:45	0	15	20	0	4	0	11	7	1	2	25	0	85
Peak AM Hour	0	26	152	16	23	3	79	55	8	3	220	2	587
4:00	0	7	22	6	6	1	27	27	5	1	34	1	137
4:15	0	2	26	3	13	0	40	30	6	0	27	1	148
4:30	0	3	24	3	11	1	31	31	12	0	25	0	141
4:45	1	3	30	4	8	2	44	37	5	0	27	0	161
5:00	0	4	21	2	14	1	52	31	6	0	34	0	165
5:15	0	2	22	2	17	0	47	46	8	0	24	0	168
5:30	3	8	18	2	10	1	29	18	5	7	14	1	116
5:45	0	7	13	2	9	2	29	25	4	1	19	1	112
Peak PM Hour	1	12	97	11	50	4	174	145	31	0	110	0	635

AM phf = 0.85
 PM phf = 0.94

Intersection:

Park Street & 5th Street

Date: 11/28/2016

Begin Time	Park Street						5th Street						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	6	39	0	1	60	0	2	3	1	7	7	29	155
7:15	8	52	0	0	45	0	2	2	0	13	13	38	173
7:30	14	65	0	0	55	3	2	6	2	31	27	45	250
7:45	21	93	4	0	66	3	3	16	0	36	48	65	355
8:00	37	94	2	0	73	7	4	11	2	26	25	49	330
8:15	5	14	1	1	13	4	0	6	3	7	7	21	82
8:30	30	77	3	1	69	3	9	9	5	19	9	37	271
8:45	15	75	4	0	60	0	7	5	2	11	5	33	217
Peak AM Hour	80	304	6	0	239	13	11	35	4	106	113	197	1108
4:00	44	107	0	0	89	4	12	11	1	13	15	26	322
4:15	55	119	1	3	89	8	16	16	3	8	13	29	360
4:30	49	111	1	5	82	2	14	23	1	10	10	30	338
4:45	60	100	0	1	65	8	10	20	1	12	9	34	320
5:00	63	96	1	2	80	2	11	25	1	11	6	34	332
5:15	75	96	0	1	82	4	4	25	0	10	8	39	344
5:30	45	121	1	1	68	2	5	9	4	4	5	24	289
5:45	38	100	2	2	48	2	4	8	2	4	3	24	237
Peak PM Hour	227	426	3	11	316	20	51	84	6	41	38	127	1350

AM phf = 0.78
 PM phf = 0.94

Intersection:

US HWY 10 & PFL Road

Date: Feb 2018

Begin Time	Callender						B Street						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00		17	1	11	64		0		2				95
7:15		15	9	54	7		0		0				85
7:30		38	3	8	52		0		0				101
7:45		30	15	28	50		1		1				125
8:00		18	11	15	54		1		1				100
8:15		11	12	15	56		0		0				94
8:30		19	6	5	40		0		1				71
8:45		15	6	9	25		4		1				60
Peak AM Hour		97	41	66	212		2		2				420
4:00		41	2	1	29		3		11				87
4:15		43	0	2	35		4		7				91
4:30		43	0	3	32		2		16				96
4:45		59	0	0	36		6		9				110
5:00		68	0	1	31		7		16				123
5:15		58	2	3	27		7		17				114
5:30		67	0	0	19		10		15				111
5:45		57	0	1	17		4		9				88
Peak PM Hour		252	2	4	113		30		57				458

AM phf = 0.84
PM phf = 0.93

Intersection:

Star Road & Sunrise Drive

Date: Feb 2018

Begin Time	Sun Avenue						Star Road						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	0		4				2	0			1	0	7
7:15	0		9				3	1			3	0	16
7:30	0		8				2	2			0	3	15
7:45	0		12				2	2			2	0	18
8:00	0		21				1	0			7	0	29
8:15	0		26				4	1			9	0	40
8:30	0		44				5	3			14	0	66
8:45	0		36				4	13			17	0	70
Peak AM Hour	0		127				14	17			47	0	205
4:00	0		8				5	9			19	0	41
4:15	0		9				14	5			14	1	43
4:30	0		6				10	9			6	0	31
4:45	0		6				22	8			6	1	43
5:00	0		14				21	1+			6	1	42
5:15	0		18				10	13			8	0	49
5:30	2		9				24	7			14	0	56
5:45	0		16				23	15			9	0	63
Peak PM Hour	2		57				78	35			37	1	210

AM phf = 0.73
PM phf = 0.83

Intersection:

W Montana & N 8th Street

Date: 2/15/2018

Begin Time	Montana Street						N 8th Street						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	0	12	0	0	2	0	0	1	0	0	2	0	17
7:15	0	8	3	1	4	0	0	0	1	0	1	0	18
7:30	1	19	2	1	7	0	1	0	2	2	4	0	39
7:45	0	18	0	0	0	0	0	1	0	0	3	0	22
8:00	0	7	3	0	2	0	1	1	0	0	2	0	16
8:15	0	3	1	1	10	0	0	2	3	0	1	0	21
8:30	0	9	1	1	6	0	0	1	0	0	1	0	19
8:45	0	2	0	0	3	1	0	1	0	0	1	0	8
Peak AM Hour	1	47	6	2	19	0	2	4	5	2	10	0	64
4:00	0	12	0	0	15	0	3	3	1	1	1	0	36
4:15	0	7	1	1	12	2	0	2	2	0	0	0	27
4:30	0	6	1	0	12	0	0	0	1	0	1	0	21
4:45	0	13	1	1	12	0	1	1	0	0	1	0	30
5:00	0	8	0	2	15	1	1	0	1	0	0	0	28
5:15	0	11	0	1	15	0	3	2	1	0	0	0	33
5:30	0	6	1	0	19	0	4	3	1	0	3	1	38
5:45	0	14	2	0	13	0	0	0	0	0	1	0	30
Peak PM Hour	0	38	2	4	61	1	9	6	3	0	4	1	129

AM phf = 0.76
PM phf = 0.85

Intersection:

Front Street & 8th Street

Date: 1/11/2017

Begin Time	Front Street						N 8th Street						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	0	20			2	0				0		0	22
7:15	0	33			7	1				1		0	42
7:30	2	59			11	0				2		1	75
7:45	2	60			21	10				8		4	105
8:00	0	33			26	3				5		5	72
8:15	0	25			27	8				6		3	69
8:30	1	25			13	1				8		1	49
8:45	0	28			22	1				6		0	57
Peak AM Hour	4	177			85	21				21		13	321
4:00	0	24			43	6				2		2	77
4:15	0	27			31	8				2		0	68
4:30	2	30			30	3				3		0	68
4:45	1	26			42	6				3		1	79
5:00	0	41			60	7				4		4	116
5:15	0	33			59	8				2		2	104
5:30	0	25			43	5				4		0	77
5:45	3	31			44	7				1		0	86
Peak PM Hour	3	130			206	27				11		6	383

AM phf = 0.76
 PM phf = 0.83

Intersection:

Fleshman Road & Meredith Ranch Road

Date: 1/11/2017

Begin Time	Fleshman Creek Road						Meredith Ranch Road						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	0	0			0	0				0		0	0
7:15	0	0			1	0				1		0	2
7:30	0	8			0	2				3		0	13
7:45	0	5			1	5				0		0	11
8:00	0	1			2	1				4		1	9
8:15	0	3			3	4				0		0	10
8:30	0	0			1	0				1		0	2
8:45	0	1			0	1				2		0	4
Peak AM Hour	0	17			6	12				7		1	43
4:00	0	0			2	1				3		0	6
4:15	0	2			0	0				1		1	4
4:30	0	3			1	2				5		0	11
4:45	0	1			2	2				2		0	7
5:00	0	1			3	2				2		0	8
5:15	0	1			2	2				1		1	7
5:30	0	0			2	3				4		0	9
5:45	0	0			2	2				3		0	7
Peak PM Hour	0	6			8	8				10		1	33

AM phf = 0.83
 PM phf = 0.75

Intersection:

Park & 7th Street

Date: 1/16/2017

Begin Time	Park Street						7th Street						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	5	29	0	0	26	43	2	4	0	14	3	1	127
7:15	3	28	0	1	50	57	1	6	1	11	2	1	161
7:30	9	77	0	1	55	31	2	9	1	18	4	4	211
7:45	7	79	0	1	66	54	4	15	0	22	7	2	257
8:00	2	94	0	0	71	34	2	10	3	25	1	3	245
8:15	12	85	0	1	99	34	3	11	2	12	2	2	263
8:30	7	56	0	0	61	36	6	2	1	18	4	4	195
8:45	8	64	0	0	78	35	8	7	2	26	2	4	234
Peak AM Hour	30	335	0	3	291	153	11	45	6	77	14	11	976
4:00	4	112	1	2	105	28	7	6	0	46	6	8	325
4:15	6	91	1	1	89	27	9	2	3	41	8	5	283
4:30	8	96	0	1	105	29	4	3	3	50	6	8	313
4:45	8	129	1	1	87	30	4	6	2	56	8	6	338
5:00	1	109	1	1	98	23	12	2	2	74	10	10	343
5:15	9	114	1	0	104	30	5	4	2	55	8	15	347
5:30	3	114	2	0	72	22	6	4	1	82	5	11	322
5:45	1	96	0	0	47	15	4	0	0	54	77	16	310
Peak PM Hour	21	466	5	2	361	105	27	16	7	267	31	42	1350

AM phf = 0.93
 PM phf = 0.97

Intersection:

Park & I-90 Eastbound Ramps (Loves Lane)

Date: 1/18/2017

Begin Time	Loves Lane						Park Street (US 87)						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00	9	0	0	9	0	1	0	48	1	1	47	9	125
7:15	10	2	1	9	0	5	2	57	0	2	38	6	132
7:30	10	0	1	13	1	5	1	94	1	1	61	8	196
7:45	32	0	3	9	1	7	2	126	2	1	67	12	262
8:00	23	2	2	13	0	3	4	100	5	0	72	9	233
8:15	13	1	0	12	1	4	1	78	3	3	72	12	200
8:30	11	1	1	8	1	4	2	72	4	4	60	6	174
8:45	10	0	2	23	1	4	2	63	1	2	57	16	181
Peak AM Hour	78	3	6	47	3	19	8	398	11	5	272	41	891
4:00	25	2	3	12	10	12	2	85	4	2	83	25	265
4:15	21	2	6	19	2	9	1	80	1	2	87	33	263
4:30	26	4	3	19	3	9	1	81	2	4	89	34	275
4:45	22	1	0	23	5	15	3	100	6	3	82	36	296
5:00	30	0	5	19	1	21	5	113	5	4	115	41	359
5:15	27	4	4	27	8	10	5	84	2	7	72	39	289
5:30	25	3	3	32	5	12	5	81	5	9	71	23	274
5:45	17	0	1	23	9	16	2	51	5	3	56	24	207
Peak PM Hour	99	7	14	80	11	54	10	374	14	13	373	144	1193

AM phf = 0.85
 PM phf = 0.83

Intersection:

Park Street & I-90 Westbound Ramps

Date: 7/6/2017

Begin Time	I-90 Westbound Ramps						Park Street						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
7:00				2		2		44	31	19	47		145
7:15				8		3		57	33	7	53		161
7:30				23		3		86	28	17	89		246
7:45				10		4		122	38	10	63		247
8:00				10		6		99	30	9	81		235
8:15				15		1		73	40	11	90		230
8:30				10		0		92	48	9	75		234
8:45				18		2		99	30	9	60		218
Peak AM Hour				58		14		380	136	47	323		958

AM phf = 0.97

Intersection:

Park Street & I-90 Westbound Ramps

Date: 7/6/2017

Begin Time	I-90 Westbound Ramps						Park Street						Total Vehicles
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
4:00				14		8		148	29	8	102		309
4:15				14		10		150	52	8	100		334
4:30				20		3		142	57	4	130		356
4:45				23		10		175	45	10	111		374
5:00				13		8		168	61	8	135		393
5:15				17		6		150	39	8	80		300
5:30				14		5		165	66	6	90		346
5:45				11		2		151	43	11	92		310
Peak PM Hour				70		31		635	215	30	476		1457

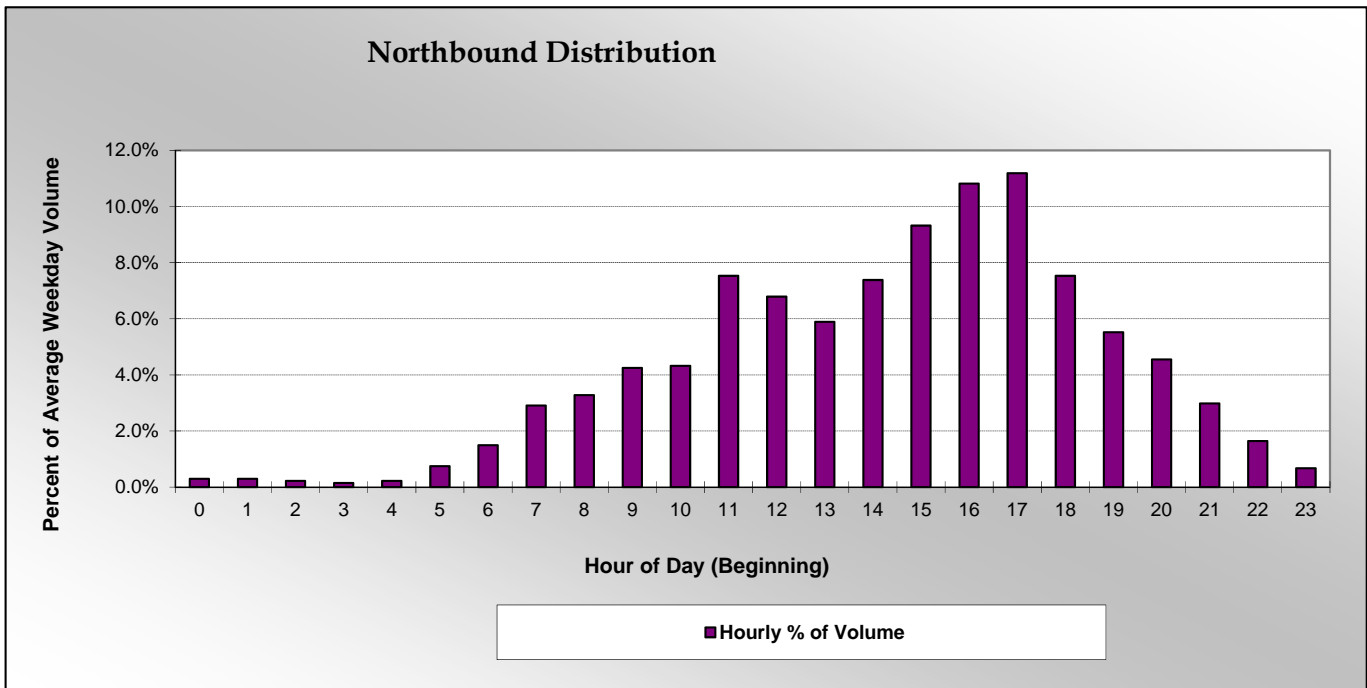
PM phf = 0.93

APPENDIX B

DAILY & HOURLY TRAFFIC VARIATIONS

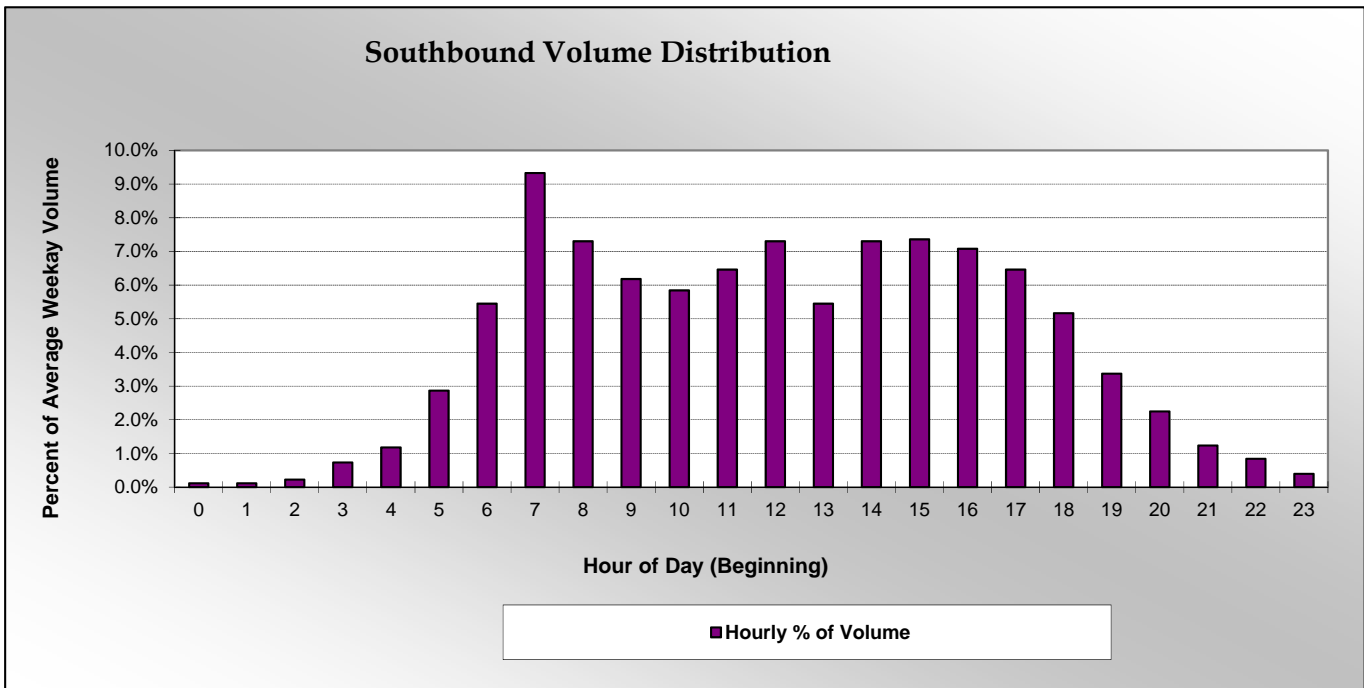
5th Street North of Front Street - Northbound Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	3	1	10	14	8	2	2	6	4	0.3%
1	2	3	7	10	7	4	3	5	4	0.3%
2	4	3	3	5	2	1	5	3	3	0.2%
3	2	2	1	3	3	3	3	2	2	0.1%
4	3	3	1	3	5	4	2	3	3	0.2%
5	10	16	3	6	2	10	9	8	10	0.7%
6	21	19	15	7	7	26	20	16	20	1.5%
7	37	54	35	23	21	31	36	34	39	2.9%
8	43	48	44	31	38	43	42	41	44	3.3%
9	52	67	71	48	66	43	50	57	57	4.3%
10	52	53	63	66	79	69	53	62	58	4.3%
11	103	102	105	86	67	94	102	94	101	7.5%
12	90	104	104	78	90	79	78	89	91	6.8%
13	78	65	91	70	54	80	80	74	79	5.9%
14	97	94	110	95	83	103	92	96	99	7.4%
15	145	127	132	107	110	102	120	120	125	9.3%
16	141	165	141	88	65	138	142	126	145	10.8%
17	134	164	144	57	90	163	145	128	150	11.2%
18	138	97	86	48	72	83	103	90	101	7.5%
19	67	80	87	79	59	68	69	73	74	5.5%
20	67	56	70	39	38	50	64	55	61	4.5%
21	39	33	43	36	26	43	40	37	40	3.0%
22	24	23	26	29	11	15	21	21	22	1.6%
23	6	7	21	22	6	6	5	10	9	0.7%
Total	1358	1386	1413	1050	1009	1260	1286	1252	1341	100.0%



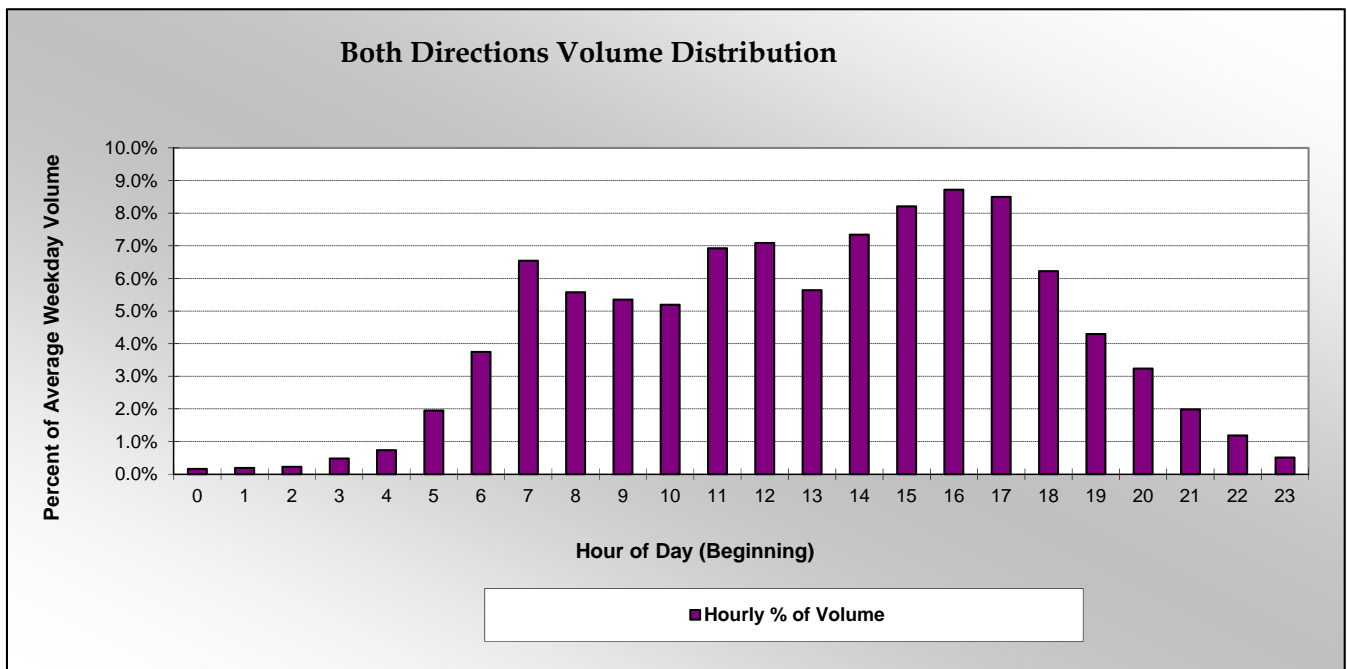
5th Street North of Front Street - Southbound Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	2	2	1	8	7	1	3	3	2	0.1%
1	1	2	3	6	2	1	2	2	2	0.1%
2	4	1	5	6	4	4	5	4	4	0.2%
3	15	15	12	4	3	11	13	10	13	0.7%
4	23	25	17	11	7	18	21	17	21	1.2%
5	54	56	47	17	16	48	51	41	51	2.9%
6	98	101	91	34	23	93	103	78	97	5.4%
7	160	231	142	62	42	138	158	133	166	9.3%
8	130	138	144	104	77	118	120	119	130	7.3%
9	101	97	152	98	117	97	103	109	110	6.2%
10	99	98	112	111	113	110	100	106	104	5.8%
11	105	110	111	106	130	133	115	116	115	6.5%
12	135	112	136	110	109	120	148	124	130	7.3%
13	96	98	106	95	98	92	93	97	97	5.4%
14	165	141	131	106	95	117	94	121	130	7.3%
15	120	120	155	99	103	129	132	123	131	7.4%
16	132	131	120	94	99	121	128	118	126	7.1%
17	126	119	126	76	75	97	106	104	115	6.5%
18	104	93	87	64	62	79	98	84	92	5.2%
19	64	56	68	54	47	54	56	57	60	3.4%
20	45	34	42	32	27	37	41	37	40	2.2%
21	21	18	26	20	19	24	23	22	22	1.2%
22	15	18	19	13	13	12	13	15	15	0.8%
23	6	7	12	12	7	6	5	8	7	0.4%
Total	1821	1823	1865	1342	1295	1660	1731	1648	1780	100.0%



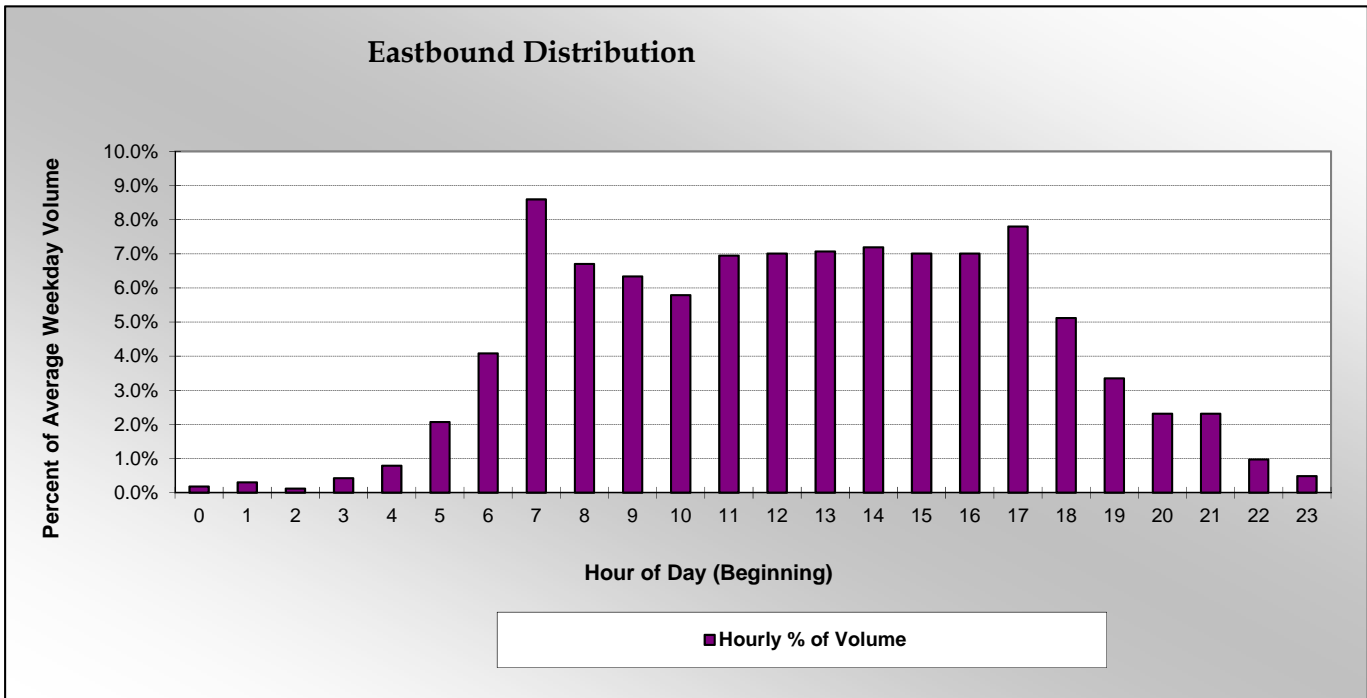
5th Street North of Front Street - NB & SB Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	5	3	11	22	15	3	5	9	5	0.2%
1	3	5	10	16	9	5	5	8	6	0.2%
2	8	4	8	11	6	5	10	7	7	0.2%
3	17	17	13	7	6	14	16	13	15	0.5%
4	26	28	18	14	12	22	23	20	23	0.7%
5	64	72	50	23	18	58	60	49	61	2.0%
6	119	120	106	41	30	119	123	94	117	3.8%
7	197	285	177	85	63	169	194	167	204	6.5%
8	173	186	188	135	115	161	162	160	174	5.6%
9	153	164	223	146	183	140	153	166	167	5.4%
10	151	151	175	177	192	179	153	168	162	5.2%
11	208	212	216	192	197	227	217	210	216	6.9%
12	225	216	240	188	199	199	226	213	221	7.1%
13	174	163	197	165	152	172	173	171	176	5.6%
14	262	235	241	201	178	220	186	218	229	7.3%
15	265	247	287	206	213	231	252	243	256	8.2%
16	273	296	261	182	164	259	270	244	272	8.7%
17	260	283	270	133	165	260	251	232	265	8.5%
18	242	190	173	112	134	162	201	173	194	6.2%
19	131	136	155	133	106	122	125	130	134	4.3%
20	112	90	112	71	65	87	105	92	101	3.2%
21	60	51	69	56	45	67	63	59	62	2.0%
22	39	41	45	42	24	27	34	36	37	1.2%
23	12	14	33	34	13	12	10	18	16	0.5%
Total	3179	3209	3278	2392	2304	2920	3017	2900	3120	100.0%



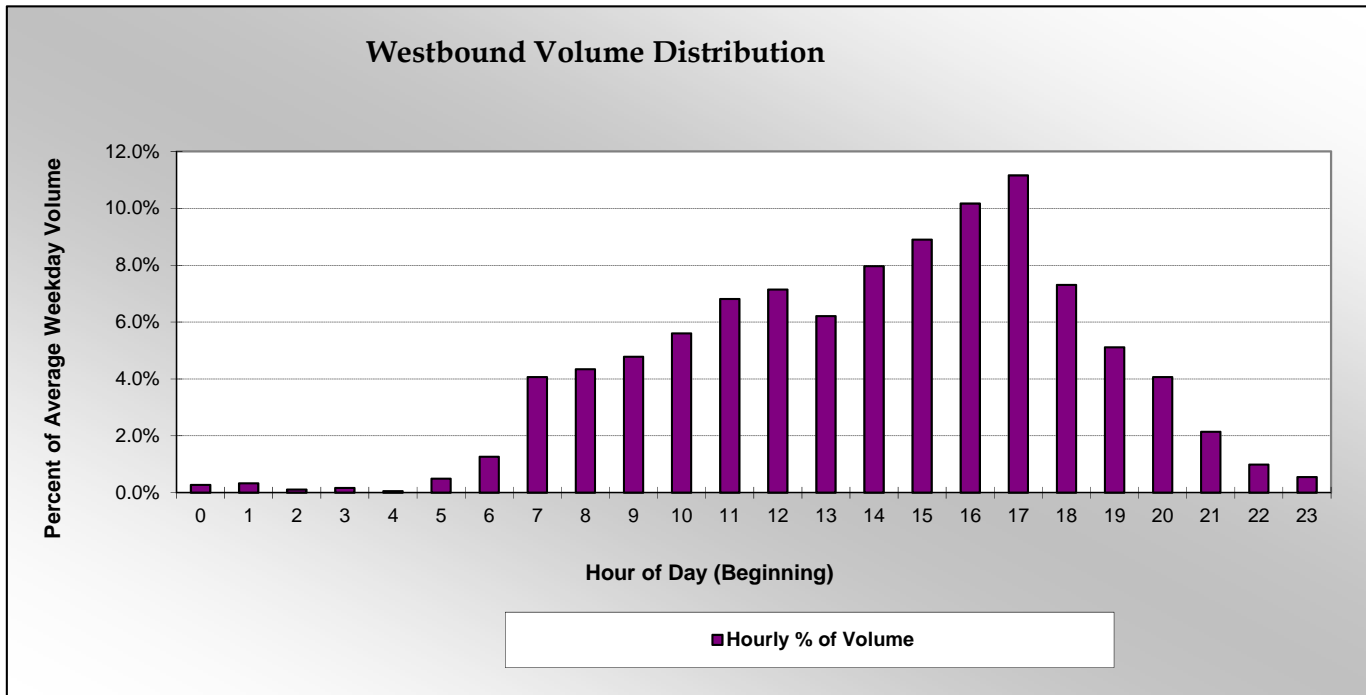
Front Street West of 5th Street - Eastbound Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	3	5	2	8	5	2	1	4	3	0.2%
1	4	3	7	4	3	4	5	4	5	0.3%
2	2	1	0	4	1	2	3	2	2	0.1%
3	7	7	6	5	4	7	7	6	7	0.4%
4	15	16	11	4	6	12	13	11	13	0.8%
5	39	47	27	7	8	26	30	26	34	2.1%
6	71	66	61	24	11	61	75	53	67	4.1%
7	151	174	126	27	44	129	127	111	141	8.6%
8	117	122	109	64	53	92	111	95	110	6.7%
9	111	120	101	71	69	88	102	95	104	6.3%
10	91	83	102	79	80	100	98	90	95	5.8%
11	110	113	143	83	75	96	107	104	114	6.9%
12	111	122	129	87	88	113	99	107	115	7.0%
13	112	104	117	88	76	129	120	107	116	7.1%
14	97	127	155	91	81	111	98	109	118	7.2%
15	115	147	110	106	96	96	106	111	115	7.0%
16	131	119	114	84	72	97	114	104	115	7.0%
17	145	149	130	71	76	96	121	113	128	7.8%
18	91	84	74	64	53	85	88	77	84	5.1%
19	59	58	49	47	47	54	57	53	55	3.4%
20	29	34	41	37	42	46	38	38	38	2.3%
21	41	39	40	29	13	33	37	33	38	2.3%
22	18	17	23	25	8	7	13	16	16	1.0%
23	3	4	22	23	5	5	4	9	8	0.5%
Total	1673	1761	1699	1132	1016	1491	1574	1478	1641	100.0%



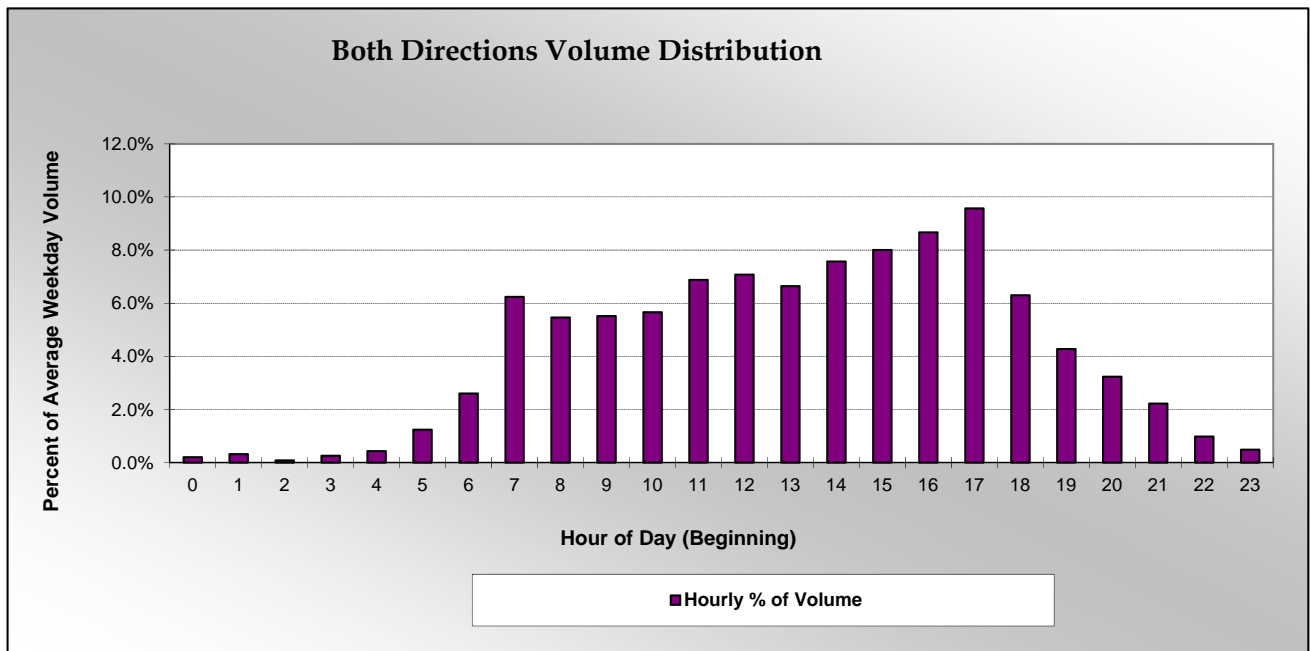
Front Street West of 5th Street - Westbound Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	4	4	4	12	8	7	4	6	5	0.3%
1	5	5	8	5	4	7	5	6	6	0.3%
2	2	2	3	2	2	0	1	2	2	0.1%
3	3	1	3	4	2	2	4	3	3	0.2%
4	2	2	1	1	2	1	1	1	1	0.1%
5	10	10	11	3	3	6	9	7	9	0.5%
6	25	24	24	6	5	16	25	18	23	1.3%
7	84	104	71	17	11	48	64	57	74	4.1%
8	87	102	69	44	32	63	72	67	79	4.3%
9	89	92	92	57	50	76	85	77	87	4.8%
10	105	104	92	67	87	101	106	95	102	5.6%
11	129	139	132	96	96	103	119	116	124	6.8%
12	131	141	133	96	111	125	120	122	130	7.1%
13	102	109	132	97	115	128	95	111	113	6.2%
14	139	158	150	132	90	137	140	135	145	8.0%
15	183	187	151	109	93	133	158	145	162	8.9%
16	202	209	169	109	129	162	182	166	185	10.2%
17	206	245	187	104	100	183	195	174	203	11.2%
18	157	139	108	71	80	123	140	117	133	7.3%
19	103	88	99	61	51	81	92	82	93	5.1%
20	77	69	106	54	45	54	66	67	74	4.1%
21	35	33	50	33	16	38	37	35	39	2.1%
22	13	22	31	23	15	12	13	18	18	1.0%
23	4	13	15	20	9	9	7	11	10	0.5%
Total	1897	2002	1841	1223	1156	1615	1740	1639	1820	100.0%



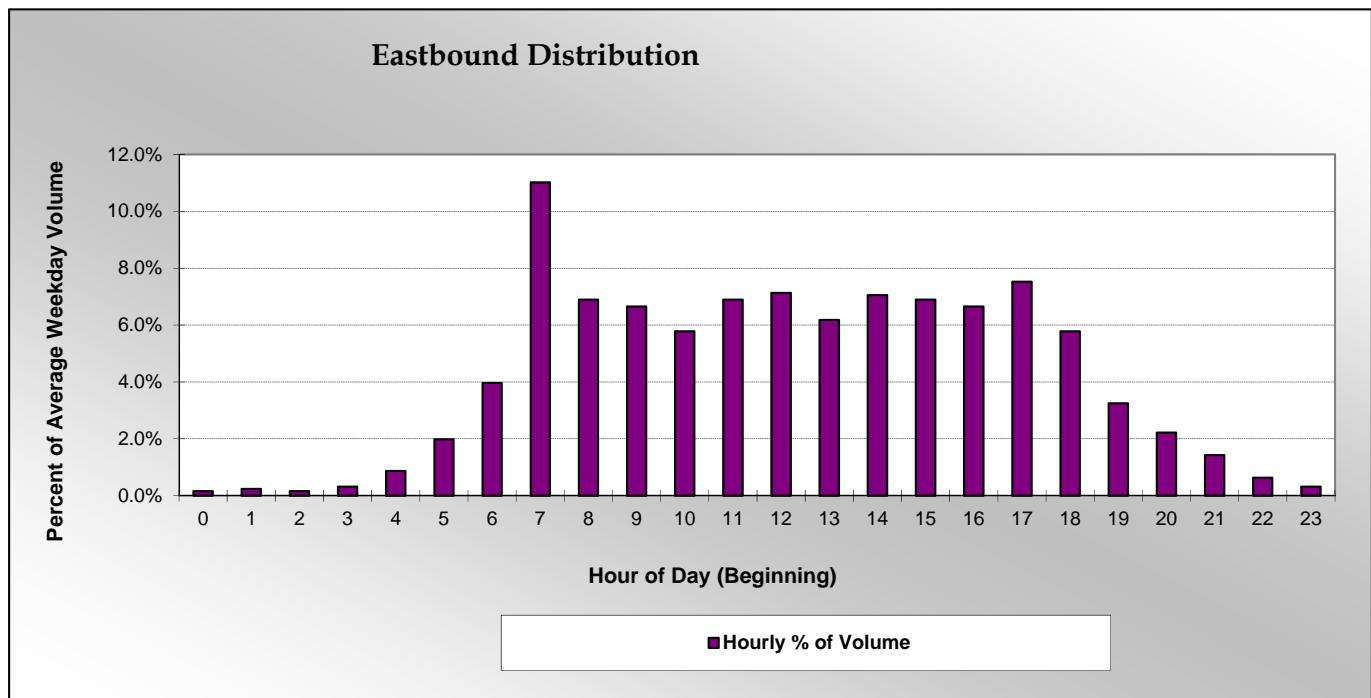
Front Street West of 5th Street - EB & WB Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	7	9	6	20	13	9	5	10	7	0.2%
1	9	8	15	9	7	11	10	10	11	0.3%
2	4	3	3	6	3	2	4	4	3	0.1%
3	10	8	9	9	6	9	11	9	9	0.3%
4	17	18	12	5	8	13	14	12	15	0.4%
5	49	57	38	10	11	32	39	34	43	1.2%
6	96	90	85	30	16	77	100	71	90	2.6%
7	235	278	197	44	55	177	191	168	216	6.2%
8	204	224	178	108	85	155	183	162	189	5.5%
9	200	212	193	128	119	164	187	172	191	5.5%
10	196	187	194	146	167	201	204	185	196	5.7%
11	239	252	275	179	171	199	226	220	238	6.9%
12	242	263	262	183	199	238	219	229	245	7.1%
13	214	213	249	185	191	257	215	218	230	6.6%
14	236	285	305	223	171	248	238	244	262	7.6%
15	298	334	261	215	189	229	264	256	277	8.0%
16	333	328	283	193	201	259	296	270	300	8.7%
17	351	394	317	175	176	279	316	287	331	9.6%
18	248	223	182	135	133	208	228	194	218	6.3%
19	162	146	148	108	98	135	149	135	148	4.3%
20	106	103	147	91	87	100	104	105	112	3.2%
21	76	72	90	62	29	71	74	68	77	2.2%
22	31	39	54	48	23	19	26	34	34	1.0%
23	7	17	37	43	14	14	11	20	17	0.5%
Total	3570	3763	3540	2355	2172	3106	3314	3117	3459	100.0%



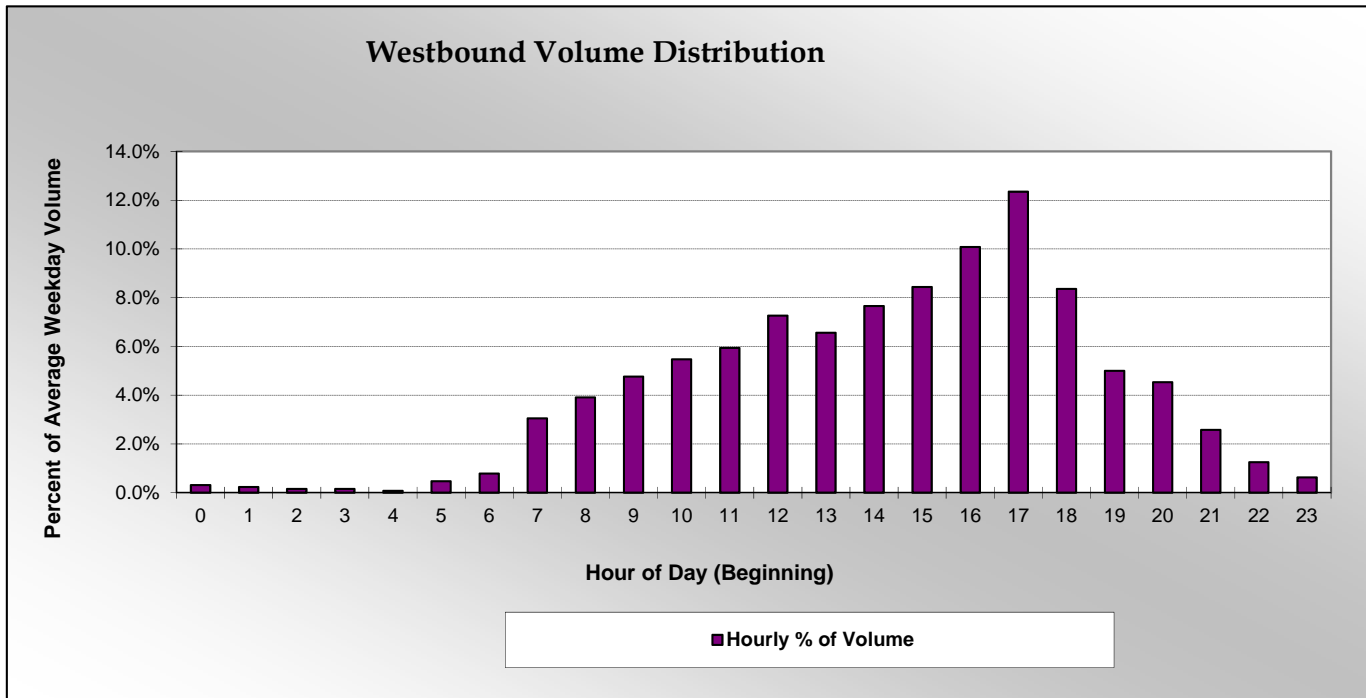
Front Street East of Sunrise Street - Eastbound Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	3	4	2	1	5	1	1	2	2	0.2%
1	3	1	4	3	1	3	4	3	3	0.2%
2	2	1	0	2	0	2	3	1	2	0.2%
3	4	2	3	3	4	5	6	4	4	0.3%
4	12	12	9	5	2	10	11	9	11	0.9%
5	28	34	21	4	4	19	22	19	25	2.0%
6	53	50	42	19	8	50	55	40	50	4.0%
7	148	168	138	27	38	112	127	108	139	11.0%
8	93	102	88	49	42	69	84	75	87	6.9%
9	90	91	82	55	52	70	89	76	84	6.7%
10	71	70	77	65	71	74	71	71	73	5.8%
11	78	75	119	65	57	80	81	79	87	6.9%
12	90	94	99	68	62	84	85	83	90	7.1%
13	74	69	86	72	68	85	78	76	78	6.2%
14	83	89	109	61	55	90	76	80	89	7.1%
15	74	113	94	74	65	77	76	82	87	6.9%
16	100	96	69	65	65	71	86	79	84	6.7%
17	106	103	111	50	53	67	87	82	95	7.5%
18	85	86	65	46	46	59	72	66	73	5.8%
19	38	52	35	35	39	41	40	40	41	3.2%
20	19	31	36	31	25	28	24	28	28	2.2%
21	17	14	23	25	11	19	18	18	18	1.4%
22	5	8	16	13	5	5	5	8	8	0.6%
23	3	3	7	10	1	4	4	5	4	0.3%
Total	1279	1368	1335	848	779	1125	1205	1134	1262	100.0%



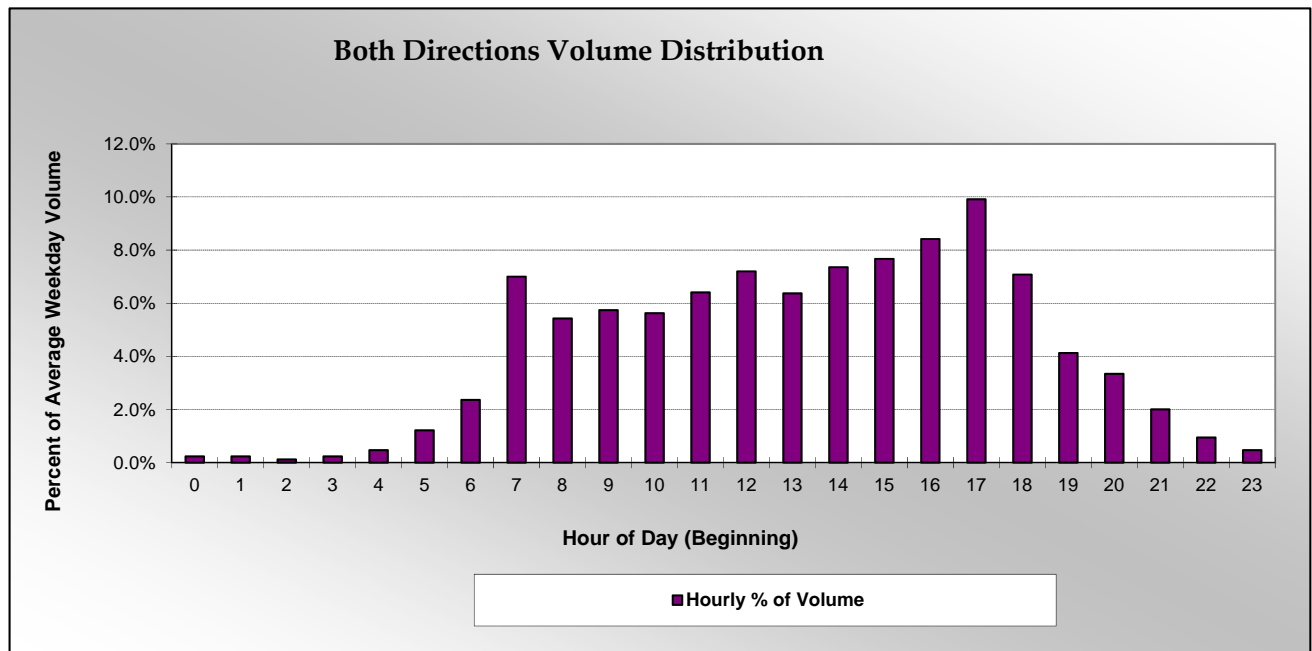
Front Street East of Sunrise Street - Westbound Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	4	3	2	12	7	6	5	6	4	0.3%
1	2	2	4	4	3	4	2	3	3	0.2%
2	2	2	1	2	2	3	1	2	2	0.2%
3	3	2	3	3	1	1	3	2	2	0.2%
4	1	0	0	0	1	1	2	1	1	0.1%
5	7	6	7	3	2	4	8	5	6	0.5%
6	10	12	13	2	2	8	8	8	10	0.8%
7	41	41	40	16	9	32	41	31	39	3.0%
8	55	57	49	24	20	38	53	42	50	3.9%
9	64	64	59	39	29	57	63	54	61	4.8%
10	69	72	76	38	51	70	65	63	70	5.5%
11	80	83	84	50	54	59	76	69	76	5.9%
12	92	103	107	68	65	81	81	85	93	7.3%
13	81	78	93	58	70	83	84	78	84	6.6%
14	93	96	123	94	63	88	89	92	98	7.7%
15	112	132	101	90	68	92	102	100	108	8.4%
16	147	144	123	74	96	106	127	117	129	10.1%
17	176	195	134	68	66	130	153	132	158	12.3%
18	115	110	92	56	63	107	111	93	107	8.4%
19	59	74	63	38	46	63	61	58	64	5.0%
20	61	58	76	49	31	42	52	53	58	4.5%
21	30	39	33	30	16	31	31	30	33	2.6%
22	14	16	25	18	9	12	13	15	16	1.3%
23	5	12	9	15	6	7	6	9	8	0.6%
Total	1323	1401	1317	851	780	1125	1237	1148	1280	100.0%



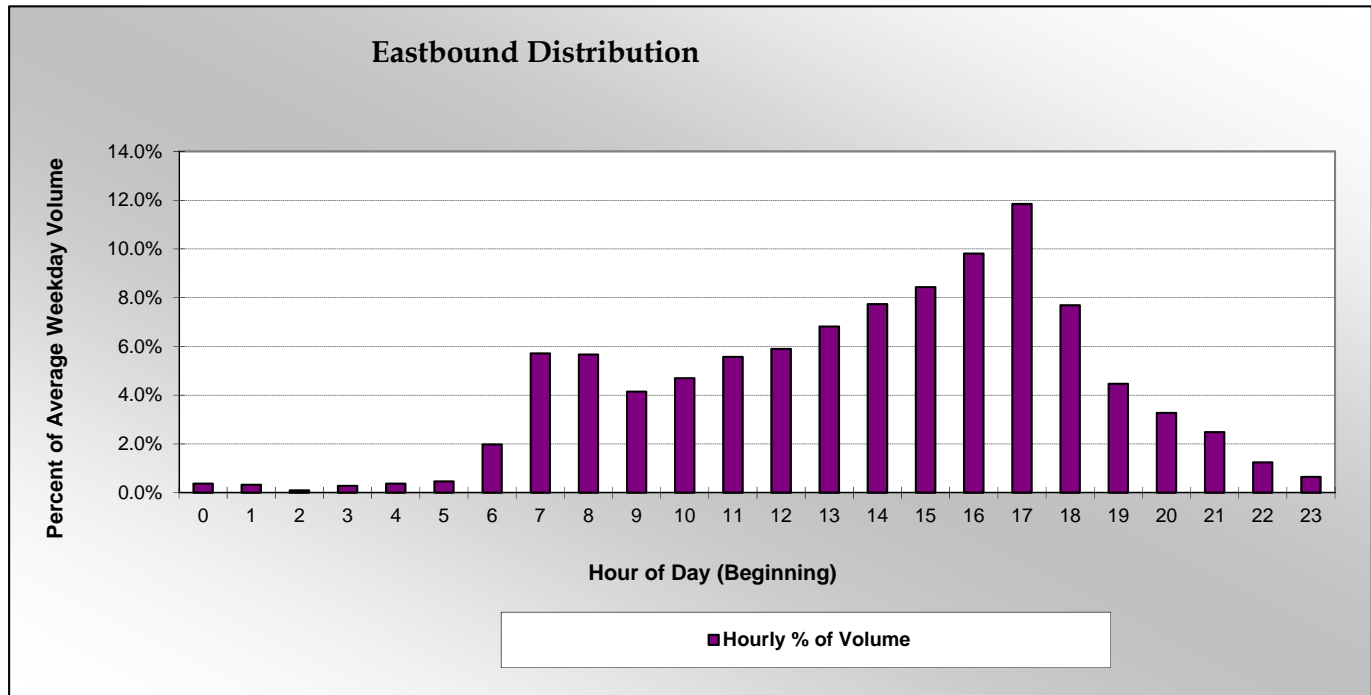
Front Street East of Sunrise Street - EB & WB Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	7	7	4	13	12	7	6	8	6	0.2%
1	5	3	8	7	4	7	6	6	6	0.2%
2	4	3	1	4	2	5	4	3	3	0.1%
3	7	4	6	6	5	6	9	6	6	0.2%
4	13	12	9	5	3	11	13	9	12	0.5%
5	35	40	28	7	6	23	30	24	31	1.2%
6	63	62	55	21	10	58	63	47	60	2.4%
7	189	209	178	43	47	144	168	140	178	7.0%
8	148	159	137	73	62	107	137	118	138	5.4%
9	154	155	141	94	81	127	152	129	146	5.7%
10	140	142	153	103	122	144	136	134	143	5.6%
11	158	158	203	115	111	139	157	149	163	6.4%
12	182	197	206	136	127	165	166	168	183	7.2%
13	155	147	179	130	138	168	162	154	162	6.4%
14	176	185	232	155	118	178	165	173	187	7.4%
15	186	245	195	164	133	169	178	181	195	7.7%
16	247	240	192	139	161	177	213	196	214	8.4%
17	282	298	245	118	119	197	240	214	252	9.9%
18	200	196	157	102	109	166	183	159	180	7.1%
19	97	126	98	73	85	104	101	98	105	4.1%
20	80	89	112	80	56	70	76	80	85	3.3%
21	47	53	56	55	27	50	49	48	51	2.0%
22	19	24	41	31	14	17	18	23	24	0.9%
23	8	15	16	25	7	11	10	13	12	0.5%
Total	2602	2769	2652	1699	1559	2250	2442	2282	2542	100.0%



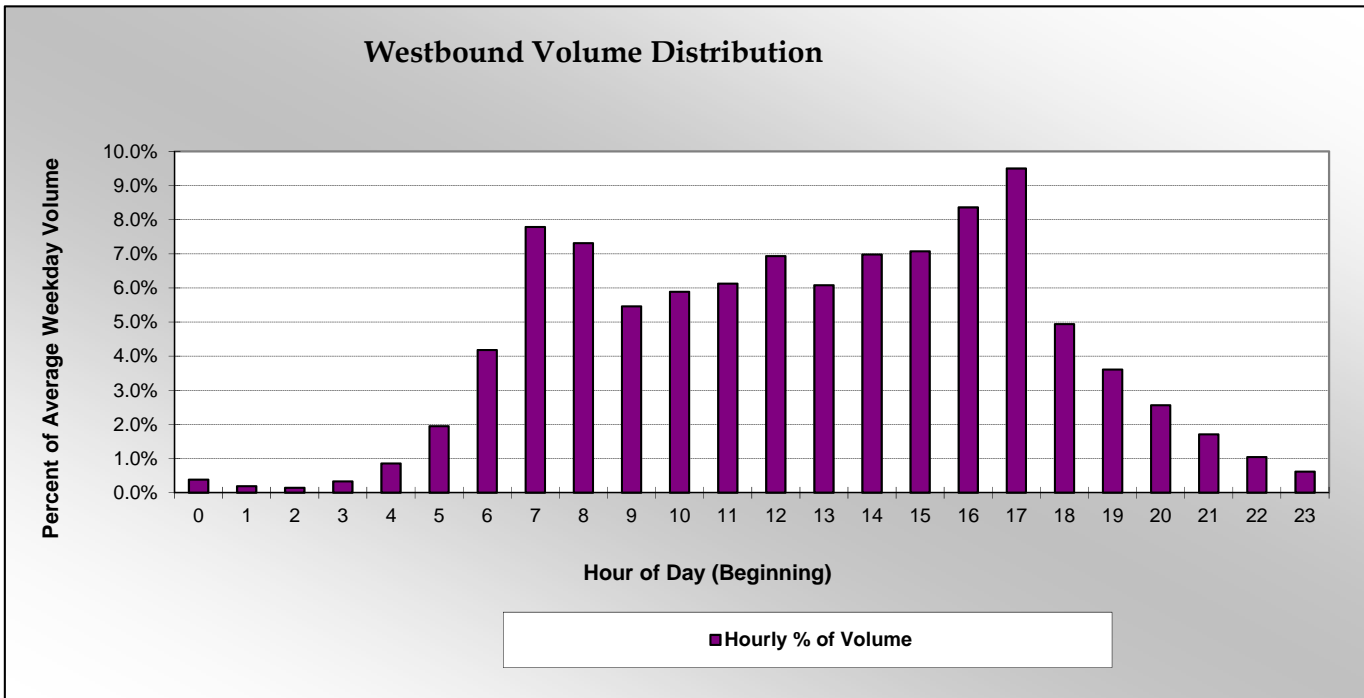
I90 Business Loop East of Interchange - Eastbound Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	8	3	8	20	10	6	13	10	8	0.4%
1	9	10	9	7	8	2	7	7	7	0.3%
2	2	2	4	3	2	0	2	2	2	0.1%
3	7	5	6	5	3	5	8	6	6	0.3%
4	9	9	9	9	6	5	8	8	8	0.4%
5	12	15	7	4	3	10	8	8	10	0.5%
6	44	43	39	14	11	46	44	34	43	2.0%
7	136	147	110	25	20	104	124	95	124	5.7%
8	129	135	105	49	38	124	123	100	123	5.7%
9	93	99	106	38	53	65	87	77	90	4.1%
10	104	111	103	81	77	97	97	96	102	4.7%
11	119	112	130	98	89	120	125	113	121	5.6%
12	123	120	159	87	94	114	125	117	128	5.9%
13	141	140	191	109	113	127	142	138	148	6.8%
14	165	179	177	134	138	169	151	159	168	7.7%
15	188	193	191	146	141	166	177	172	183	8.4%
16	222	187	248	152	147	198	210	195	213	9.8%
17	259	264	267	119	123	245	252	218	257	11.8%
18	159	180	190	104	93	152	156	148	167	7.7%
19	93	91	122	87	64	88	91	91	97	4.5%
20	76	67	88	63	48	58	67	67	71	3.3%
21	55	53	71	31	34	41	48	48	54	2.5%
22	24	22	33	25	30	28	26	27	27	1.2%
23	17	13	17	24	13	10	14	15	14	0.6%
Total	2194	2200	2390	1434	1358	1980	2105	1952	2171	100.0%



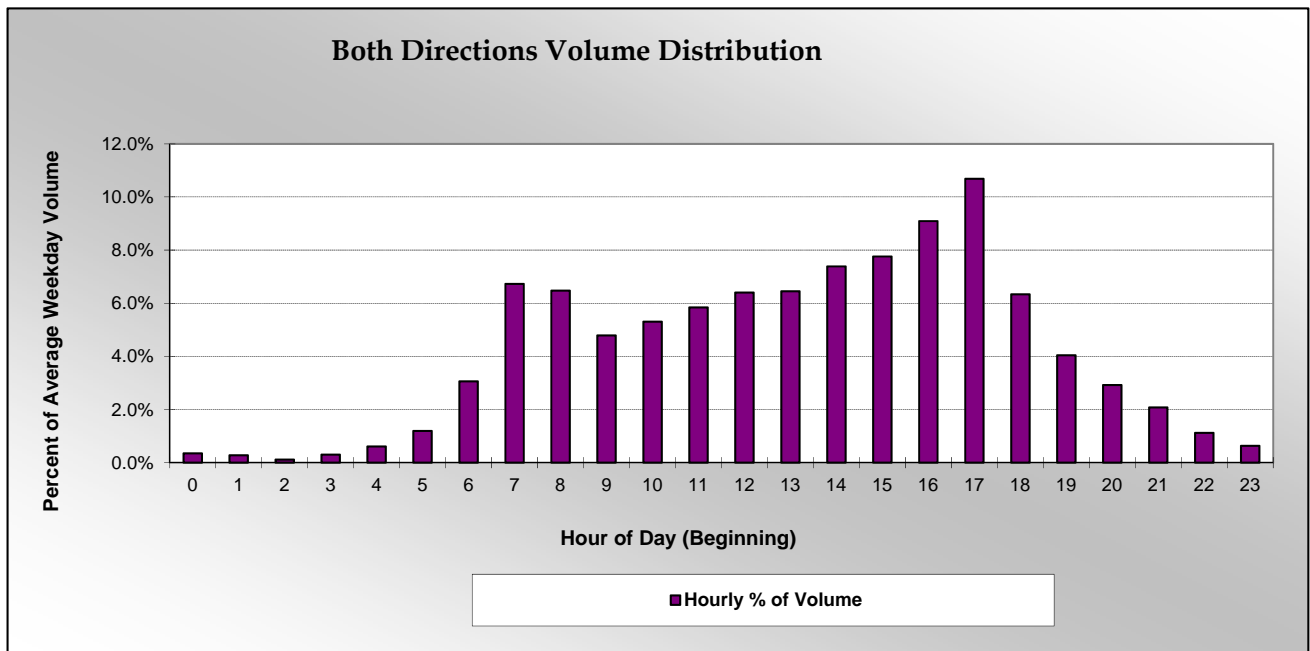
I90 Business Loop East of Interchange - Westbound Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	9	5	5	15	9	6	13	9	8	0.4%
1	5	2	5	8	3	2	7	5	4	0.2%
2	3	4	6	11	7	0	2	5	3	0.1%
3	8	8	6	6	6	5	8	7	7	0.3%
4	19	30	26	11	9	5	8	15	18	0.9%
5	46	84	55	16	22	10	8	34	41	1.9%
6	93	142	113	48	27	46	44	73	88	4.2%
7	176	227	189	75	45	104	124	134	164	7.8%
8	156	188	179	109	82	124	123	137	154	7.3%
9	113	138	170	100	103	65	87	111	115	5.5%
10	125	152	150	115	110	97	97	121	124	5.9%
11	121	116	164	137	105	120	125	127	129	6.1%
12	147	169	173	119	122	114	125	138	146	6.9%
13	122	102	146	105	97	127	142	120	128	6.1%
14	134	117	166	104	74	169	151	131	147	7.0%
15	136	137	157	96	120	166	151	138	149	7.1%
16	162	191	148	78	84	198	180	149	176	8.4%
17	182	164	195	81	70	245	214	164	200	9.5%
18	85	77	86	73	58	152	119	93	104	4.9%
19	65	82	68	54	51	88	77	69	76	3.6%
20	55	42	57	35	24	58	57	47	54	2.6%
21	34	25	40	40	25	41	38	35	36	1.7%
22	11	17	32	12	11	28	20	19	22	1.0%
23	9	10	24	25	9	10	10	14	13	0.6%
Total	2016	2229	2360	1473	1273	1980	1930	1894	2106	100.0%



I90 Business Loop East of Interchange - EB & WB Volume Distribution

Hour Begin	3/21/18 Wed	3/22/18 Thur	3/23/18 Fri	3/24/18 Sat	3/25/18 Sun	3/26/18 Mon	3/27/18 Tue	Average Daily	Average Weekday	% of Weekday
0	17	8	13	35	19	12	26	19	15	0.4%
1	14	12	14	15	11	4	14	12	12	0.3%
2	5	6	10	14	9	0	4	7	5	0.1%
3	15	13	12	11	9	10	16	12	13	0.3%
4	28	39	35	20	15	10	16	23	26	0.6%
5	58	99	62	20	25	20	16	43	51	1.2%
6	137	185	152	62	38	92	88	108	131	3.1%
7	312	374	299	100	65	208	248	229	288	6.7%
8	285	323	284	158	120	248	246	238	277	6.5%
9	206	237	276	138	156	130	174	188	205	4.8%
10	229	263	253	196	187	194	194	217	227	5.3%
11	240	228	294	235	194	240	250	240	250	5.8%
12	270	289	332	206	216	228	250	256	274	6.4%
13	263	242	337	214	210	254	284	258	276	6.5%
14	299	296	343	238	212	338	302	290	316	7.4%
15	324	330	348	242	261	332	328	309	332	7.8%
16	384	378	396	230	231	396	390	344	389	9.1%
17	441	428	462	200	193	490	466	383	457	10.7%
18	244	257	276	177	151	304	275	241	271	6.3%
19	158	173	190	141	115	176	168	160	173	4.0%
20	131	109	145	98	72	116	124	114	125	2.9%
21	89	78	111	71	59	82	86	82	89	2.1%
22	35	39	65	37	41	56	46	46	48	1.1%
23	26	23	41	49	22	20	24	29	27	0.6%
Total	4210	4429	4750	2907	2631	3960	4035	3846	4277	100.0%



APPENDIX C

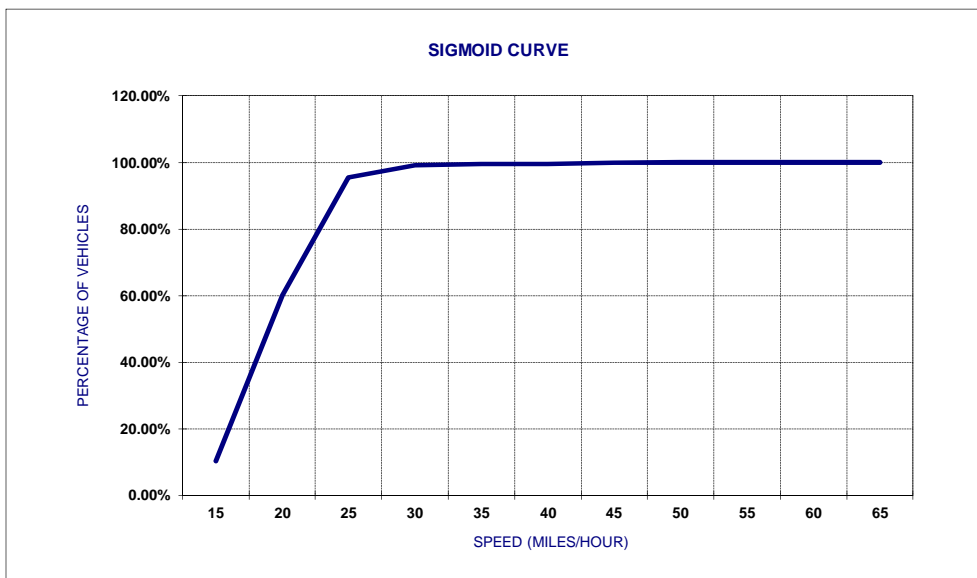
SPEED STATISTICS

SPOT SPEED STUDY ANALYSIS (Counter)



SITE : 5th Street North of Front Street
DIRECTION: Both Directions
DATE: 3/21/18
TIME: 30 Hours

SPEED RANGE	SPEED VALUE	SPEED FREQUENCY	CUMULATIVE FREQUENCY	RELATIVE FREQ (%)	CUMULATIVE FREQ (%)
0 to 15	15	175	175	10.35%	10.35%
16 to 20	20	842	1017	49.79%	60.14%
21 to 25	25	599	1616	35.42%	95.56%
26 to 30	30	62	1678	3.67%	99.23%
31 to 35	35	4	1682	0.24%	99.47%
36 to 40	40	1	1683	0.06%	99.53%
41 to 45	45	5	1688	0.30%	99.82%
46 to 50	50	3	1691	0.18%	100.00%
51 to 55	55	0	1691	0.00%	100.00%
56 to 60	60	0	1691	0.00%	100.00%
61 to 65	65	0	1691	0.00%	100.00%
66 to 70	70	0	1691	0.00%	100.00%
TOTAL VEHICLES =		1691	750		
MEAN SPEED =		21.79	mph		
85TH PERCENTILE =		23.51	mph		
PACE SPEED =		16	mph	TO	25 mph
		Number of Vehicles in Pace =	1441		
		% of Total Vehicles in Pace =	85.2%		

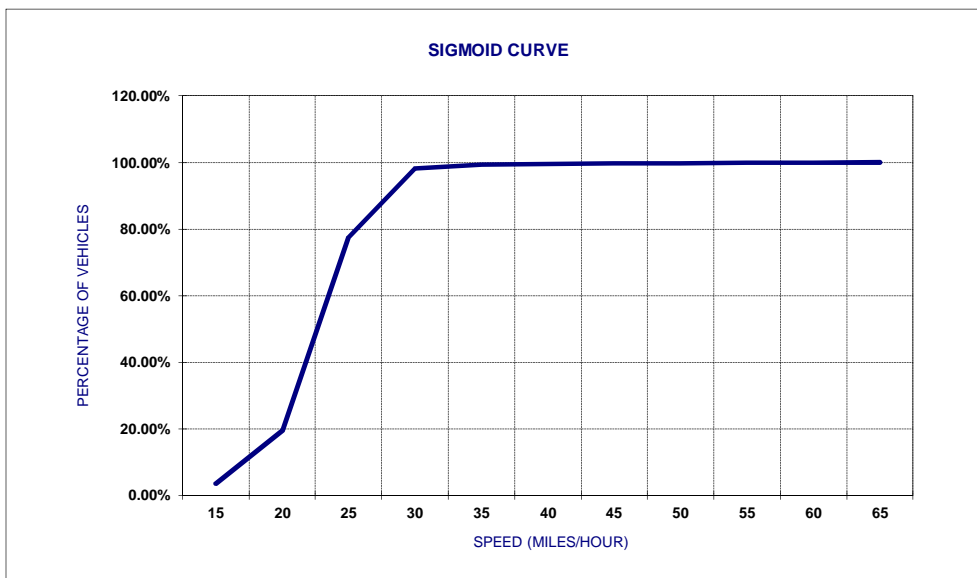


SPOT SPEED STUDY ANALYSIS (Counter)



SITE : Front Street West of 5th St
DIRECTION: EB & WB
DATE: 3/21/18
TIME: 90 Hours

SPEED RANGE	SPEED VALUE	SPEED FREQUENCY	CUMULATIVE FREQUENCY	RELATIVE FREQ (%)	CUMULATIVE FREQ (%)	
0 to 15	15	655	655	3.62%	3.62%	
16 to 20	20	2871	3526	15.86%	19.48%	
21 to 25	25	10489	14015	57.94%	77.41%	
26 to 30	30	3765	17780	20.80%	98.21%	
31 to 35	35	212	17992	1.17%	99.38%	
36 to 40	40	35	18027	0.19%	99.57%	
41 to 45	45	26	18053	0.14%	99.72%	
46 to 50	50	11	18064	0.06%	99.78%	
51 to 55	55	12	18076	0.07%	99.85%	
56 to 60	60	12	18088	0.07%	99.91%	
61 to 65	65	11	18099	0.06%	99.97%	
66 to 70	70	5	18104	0.03%	100.00%	
TOTAL VEHICLES =		18104				
MEAN SPEED =		25.14	mph			
85TH PERCENTILE =		26.82	mph			
PACE SPEED =		21	mph	TO	30 mph	
		Number of Vehicles in Pace =	14254			
		% of Total Vehicles in Pace =	78.7%			

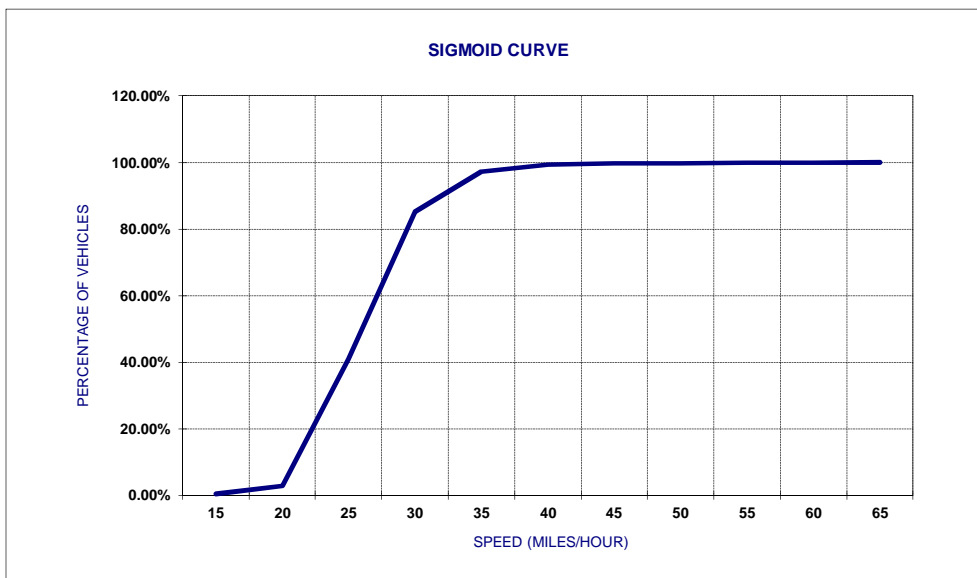


SPOT SPEED STUDY ANALYSIS (Counter)



SITE : Front Street East of Sunrise
DIRECTION: EB & WB
DATE: 3/21/18
TIME: 72 Hours

SPEED RANGE	SPEED VALUE	SPEED FREQUENCY	CUMULATIVE FREQUENCY	RELATIVE FREQ (%)	CUMULATIVE FREQ (%)
0 to 15	15	63	63	0.47%	0.47%
16 to 20	20	328	391	2.44%	2.91%
21 to 25	25	5109	5500	38.06%	40.97%
26 to 30	30	5929	11429	44.17%	85.14%
31 to 35	35	1623	13052	12.09%	97.24%
36 to 40	40	287	13339	2.14%	99.37%
41 to 45	45	45	13384	0.34%	99.71%
46 to 50	50	12	13396	0.09%	99.80%
51 to 55	55	4	13400	0.03%	99.83%
56 to 60	60	10	13410	0.07%	99.90%
61 to 65	65	6	13416	0.04%	99.95%
66 to 70	70	7	13423	0.05%	100.00%
TOTAL VEHICLES =		13423	750		
MEAN SPEED =		28.70	mph		
85TH PERCENTILE =		29.98	mph		
PACE SPEED =		21	mph	TO	30 mph
Number of Vehicles in Pace =			11038		
% of Total Vehicles in Pace =			82.2%		

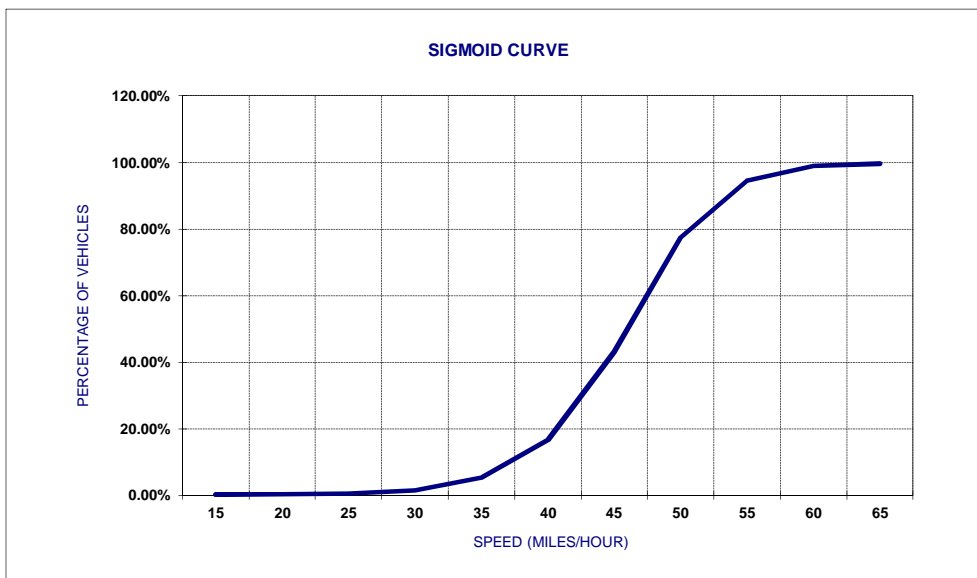


SPOT SPEED STUDY ANALYSIS (Counter)



SITE : US HWY 10 East of I90 Interchange
DIRECTION: EB & WB
DATE: 3/21/18
TIME: 130 Hours

SPEED RANGE	SPEED VALUE	SPEED FREQUENCY	CUMULATIVE FREQUENCY	RELATIVE FREQ (%)	CUMULATIVE FREQ (%)
0 to 15	15	74	74	0.32%	0.32%
16 to 20	20	7	81	0.03%	0.35%
21 to 25	25	43	124	0.19%	0.54%
26 to 30	30	245	369	1.06%	1.60%
31 to 35	35	859	1228	3.72%	5.31%
36 to 40	40	2650	3878	11.46%	16.78%
41 to 45	45	6084	9962	26.32%	43.10%
46 to 50	50	7926	17888	34.29%	77.39%
51 to 55	55	3948	21836	17.08%	94.47%
56 to 60	60	1058	22894	4.58%	99.05%
61 to 65	65	135	23029	0.58%	99.63%
66 to 70	70	85	23114	0.37%	100.00%
TOTAL VEHICLES =		23114	750		
MEAN SPEED =		47.82	mph		
85TH PERCENTILE =		52.23	mph		
PACE SPEED =		41	mph	TO	50 mph
Number of Vehicles in Pace =			14010		
% of Total Vehicles in Pace =			60.6%		



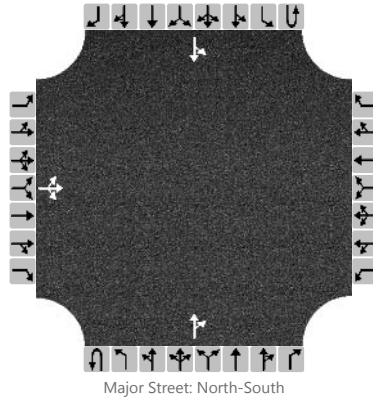
APPENDIX D

2018 EXISTING CAPACITY CALCULATIONS

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	R Marvin	Intersection	I90 EB Ramps & US 10
Agency/Co.	Marvin & Associates	Jurisdiction	Livingston
Date Performed	4/10/2018	East/West Street	I90 EB Ramps
Analysis Year	2018	North/South Street	US HWY 10
Time Analyzed	Peak AM Hour Existing	Peak Hour Factor	0.81
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Northside Livingston Transportation Study		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	1	0		0	0	0		0	1	0		0	1	0	
Configuration			LTR									TR		LT			
Volume, V (veh/h)		151	1	1							41	7		3	24		
Percent Heavy Vehicles (%)		3	3	3										3			
Proportion Time Blocked																	
Percent Grade (%)		0															
Right Turn Channelized		No					No					No					
Median Type/Storage		Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2										4.1		
Critical Headway (sec)		6.43	6.53	6.23										4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3										2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33										2.23		

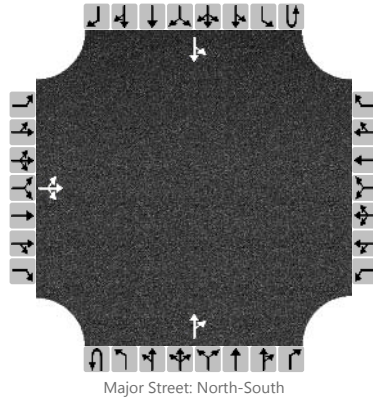
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			189										4		
Capacity, c (veh/h)			905										1537		
v/c Ratio			0.21										0.00		
95% Queue Length, Q ₉₅ (veh)			0.8										0.0		
Control Delay (s/veh)			10.0										7.3		
Level of Service, LOS			B										A		
Approach Delay (s/veh)		10.0										0.8			
Approach LOS		B													

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 EB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	4/10/2018			East/West Street	I90 EB Ramps		
Analysis Year	2018			North/South Street	US HWY 10		
Time Analyzed	Peak PM Hour Existing			Peak Hour Factor	0.81		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	1	0		0	0	0		0	1	0		0	1	0	
Configuration			LTR									TR		LT			
Volume, V (veh/h)		232	1	1							23	11		7	39		
Percent Heavy Vehicles (%)		3	3	3										3			
Proportion Time Blocked																	
Percent Grade (%)		0															
Right Turn Channelized		No					No					No					
Median Type/Storage		Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2										4.1		
Critical Headway (sec)		6.43	6.53	6.23										4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3										2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33										2.23		

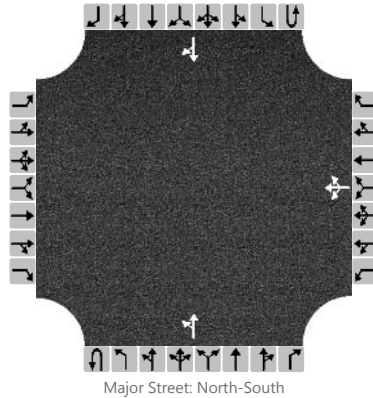
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			289										9		
Capacity, c (veh/h)			894										1559		
v/c Ratio			0.32										0.01		
95% Queue Length, Q ₉₅ (veh)			1.4										0.0		
Control Delay (s/veh)			10.9										7.3		
Level of Service, LOS			B										A		
Approach Delay (s/veh)		10.9										1.1			
Approach LOS		B													

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 WB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	4/10/2018			East/West Street	I90 WB Ramps		
Analysis Year	2018			North/South Street	US HWY 10		
Time Analyzed	Peak AM Hour Existing			Peak Hour Factor	0.91		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR			LT						TR
Volume, V (veh/h)						1	1	3		2	187					27
Percent Heavy Vehicles (%)						3	3	3		3						
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1	6.5	6.2		4.1						
Critical Headway (sec)						6.43	6.53	6.23		4.13						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2						
Follow-Up Headway (sec)						3.53	4.03	3.33		2.23						

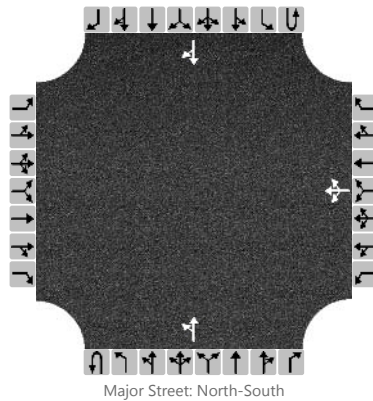
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						5				2						
Capacity, c (veh/h)						612				1071						
v/c Ratio						0.01				0.00						
95% Queue Length, Q ₉₅ (veh)						0.0				0.0						
Control Delay (s/veh)						10.9				8.4						
Level of Service, LOS						B				A						
Approach Delay (s/veh)					10.9				0.1							
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 WB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	4/10/2018			East/West Street	I90 WB Ramps		
Analysis Year	2018			North/South Street	US HWY 10		
Time Analyzed	Peak PM Hour Existing			Peak Hour Factor	0.93		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR			LT						TR
Volume, V (veh/h)						8	1	5		2	251				41	152
Percent Heavy Vehicles (%)						3	3	3		3						
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1	6.5	6.2		4.1						
Critical Headway (sec)						6.43	6.53	6.23		4.13						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2						
Follow-Up Headway (sec)						3.53	4.03	3.33		2.23						

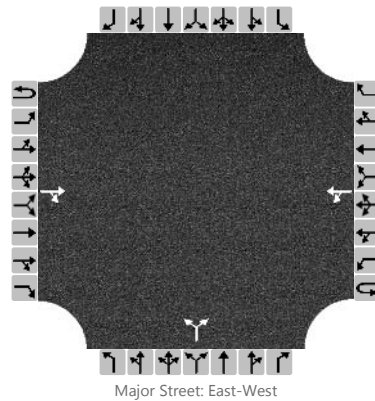
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						15				2						
Capacity, c (veh/h)						640				1355						
v/c Ratio						0.02				0.00						
95% Queue Length, Q ₉₅ (veh)						0.1				0.0						
Control Delay (s/veh)						10.8				7.7						
Level of Service, LOS						B				A						
Approach Delay (s/veh)					10.8				0.1							
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	US 10 & PFL Road		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	4/10/2018			East/West Street	US HWY 10		
Analysis Year	2018			North/South Street	PFL Road		
Time Analyzed	Peak AM Hour Existing			Peak Hour Factor	0.84		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			97	41		66	212			2		2				
Percent Heavy Vehicles (%)						3				3		3				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.13				6.43		6.23				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.23				3.53		3.33				

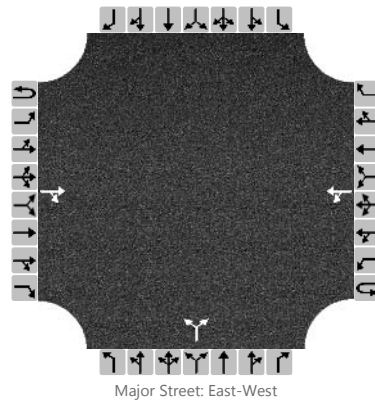
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						79						5				
Capacity, c (veh/h)						1407						616				
v/c Ratio						0.06						0.01				
95% Queue Length, Q ₉₅ (veh)						0.2						0.0				
Control Delay (s/veh)						7.7						10.9				
Level of Service, LOS						A						B				
Approach Delay (s/veh)					2.2				10.9							
Approach LOS									B							

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	US 10 & PFL Road		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	4/10/2018			East/West Street	US HWY 10		
Analysis Year	2018			North/South Street	PFL Road		
Time Analyzed	Peak PM Hour Existing			Peak Hour Factor	0.93		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			252	2		4	113			30		57				
Percent Heavy Vehicles (%)						3				3		3				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1					7.1		6.2			
Critical Headway (sec)						4.13					6.43		6.23			
Base Follow-Up Headway (sec)						2.2					3.5		3.3			
Follow-Up Headway (sec)						2.23					3.53		3.33			

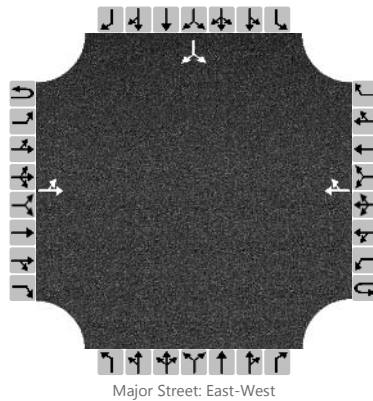
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						4					94					
Capacity, c (veh/h)						1283					698					
v/c Ratio						0.00					0.13					
95% Queue Length, Q ₉₅ (veh)						0.0					0.5					
Control Delay (s/veh)						7.8					11.0					
Level of Service, LOS						A					B					
Approach Delay (s/veh)					0.3				11.0							
Approach LOS									B							

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	US 10 & Westside Road		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	4/10/2018			East/West Street	US HWY 10		
Analysis Year	2018			North/South Street	Westside Road		
Time Analyzed	Peak AM Hour Existing			Peak Hour Factor	0.86		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0		0	1	0	
Configuration		LT						TR							LR	
Volume, V (veh/h)		1	141				192	8						1		2
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

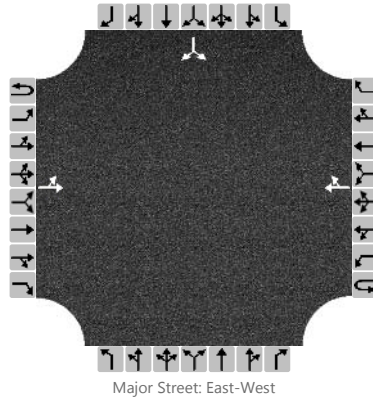
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		1														3	
Capacity, c (veh/h)		1327														728	
v/c Ratio		0.00														0.00	
95% Queue Length, Q ₉₅ (veh)		0.0														0.0	
Control Delay (s/veh)		7.7														10.0	
Level of Service, LOS		A														A	
Approach Delay (s/veh)		0.1												10.0			
Approach LOS														A			

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	US 10 & Westside Road		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	4/10/2018			East/West Street	US HWY 10		
Analysis Year	2018			North/South Street	Westside Road		
Time Analyzed	Peak PM Hour Existing			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12	
Priority																	
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0	
Configuration		LT						TR							LR		
Volume, V (veh/h)		2	236				164	2						3		1	
Percent Heavy Vehicles (%)		3												3		3	
Proportion Time Blocked																	
Percent Grade (%)																0	
Right Turn Channelized		No			No				No			No					
Median Type/Storage		Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

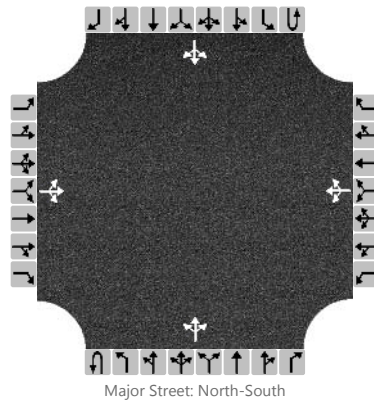
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		2														4
Capacity, c (veh/h)		1388														624
v/c Ratio		0.00														0.01
95% Queue Length, Q ₉₅ (veh)		0.0														0.0
Control Delay (s/veh)		7.6														10.8
Level of Service, LOS		A														B
Approach Delay (s/veh)		0.1											10.8			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Front & 5th		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	3/22/2017			East/West Street	Front Street		
Analysis Year	2017			North/South Street	5th Street		
Time Analyzed	Peak PM			Peak Hour Factor	0.87		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Livingston Trans Plan Update						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		1	14	112		13	58	5		200	167	36		0	127	0
Percent Heavy Vehicles (%)		0	0	0		0	0	0		0				0		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.10	6.50	6.20		4.10				4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.50	4.00	3.30		2.20				2.20		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			146				88				230				0	
Capacity, c (veh/h)			673				245				1436				1335	
v/c Ratio			0.22				0.36				0.16				0.00	
95% Queue Length, Q ₉₅ (veh)			0.8				1.6				0.6				0.0	
Control Delay (s/veh)			11.8				27.7				8.0				7.7	
Level of Service, LOS			B				D				A				A	
Approach Delay (s/veh)	11.8				27.7				4.7				0.0			
Approach LOS	B				D											

HCM Analysis Summary

Lingston Trans Plan Update
R Marvin
Peak PM 2017

Park Street/5th Street
3/23/17
Case: 2027 Park and 5th

Area Type: Non CBD
Analysis Duration: 15 mins.

Lanes			Geometry: Movements Serviced by Lane and Lane Widths (feet)											
	Approach	Outbound	Lane 1		Lane 2		Lane 3		Lane 4		Lane 5		Lane 6	
EB	2	1	L	12.0	TR	12.0								
WB	2	1	L	12.0	TR	12.0								
NB	1	1	LTR	12.0										
SB	1	1	LTR	12.0										
Data			East			West			North			South		
			L	T	R	L	T	R	L	T	R	L	T	R
Movement Volume (vph)			261	533	4	14	395	23	64	97	8	47	44	146
PHF			0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
% Heavy Vehicles			2	2	2	2	2	2	2	2	2	2	2	2
Lane Groups			L	TR		L	TR		LTR			LTR		
Arrival Type			3	3		3	3		3			3		
RTOR Vol (vph)			0			5			0			72		
Peds/Hour			5			5			5			5		
% Grade			0			0			0			0		
Buses/Hour			0			0			0			0		
Parkers/Hour (Left Right)			---		---		---		---		---		---	
Signal Settings: Actuated			Operational Analysis				Cycle Length: 90.0 Sec				Lost Time Per Cycle: 13.0 Sec			
Phase:			1	2	3	4	5	6	7	8	Ped Only			
EB			LTR	LTP										
WB				LTP										
NB					LTP									
SB					LTP									
Green			12.0	37.0	28.0									0
Yellow	All Red	3.0	0.0	3.5	1.5	3.5	1.5							

Capacity Analysis Results										Approach:	
App	Lane Group	Cap (vph)	v/s Ratio	g/C Ratio	Lane Group	v/c Ratio	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
EB	Lper	262	0.075	0.467					14.1	B	
	* Lpro	236	0.133	0.133	L	0.558	15.3	B			
	TR	1075	0.307	0.578	TR	0.531	13.5	B			
WB	L	319	0.019	0.411	L	0.047	16.2	B	23.4	C	
	* TR	761	0.237	0.411	TR	0.577	23.6	C			
NB	LTR	482	0.116	0.311	LTR	0.373	24.3	C	24.3	C	
SB	LTR	473	0.116	0.311	LTR	0.372	24.3	C	24.3	C	

NETSIM Summary Results

Lingston Trans Plan Update
 R Marvin
 Peak PM 2017

Park Street/5th Street
 3/23/17
 Case: 2027 Park and 5th

App	Lane Group	Queues Per Lane Avg/Max (veh)	Average Speed (mph)	Spillback in Worst Lane (% of Peak Period)	
EB	L	8 / 13	3.2	4.7	
	TR	8 / 10	15.8	0.0	
	All		10.3	4.7	
WB	L	0 / 1	6.5	0.0	
	TR	6 / 7	11.9	0.0	
	All		11.7	0.0	
NB	LTR	3 / 4	10.9	0.0	
	All		10.9	0.0	
SB	LTR	4 / 5	11.7	0.0	
	All		11.7	0.0	
Intersect.			10.9		

HCM Analysis Summary

Livingston Trans Plan Update
R Marvin
Peak PM 2017

Highway 10 W/Park Street
3/23/17
Case: Park & 7th 2017 PM

Area Type: Non CBD
Analysis Duration: 15 mins.

Lanes			Geometry: Movements Serviced by Lane and Lane Widths (feet)											
	Approach	Outbound	Lane 1		Lane 2		Lane 3		Lane 4		Lane 5		Lane 6	
EB	2	1	L	12.0	TR	12.0								
WB	3	1	L	12.0	T	12.0	R	12.0						
NB	1	1	LTR	12.0										
SB	1	1	LTR	12.0										
Data			East			West			North			South		
			L	T	R	L	T	R	L	T	R	L	T	R
Movement Volume (vph)			26	583	6	3	451	131	31	18	8	307	36	48
PHF			0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
% Heavy Vehicles			4	0	1	0	0	0	1	4	0	0	4	4
Lane Groups			L	TR		L	T	R		LTR			LTR	
Arrival Type			3	3		3	3	3		3			3	
RTOR Vol (vph)			0			48			2			5		
Peds/Hour			5			0			10			5		
% Grade			0			0			0			0		
Buses/Hour			0			0			0			0		
Parkers/Hour (Left Right)			---		---		---		---		---		---	
Signal Settings: Actuated			Operational Analysis				Cycle Length: 75.0 Sec				Lost Time Per Cycle: 10.0 Sec			
Phase:		1	2	3	4	5	6	7	8	Ped Only				
EB		LTP												
WB		LTP												
NB			LTP											
SB			LTP											
Green		35.0		30.0									0	
Yellow	All Red	3.5	1.5	3.5	1.5									

Capacity Analysis Results										Approach:	
App	Lane Group	Cap (vph)	v/s Ratio	g/C Ratio	Lane Group	v/c Ratio	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
EB	L	315	0.040	0.467	L	0.086	11.6	B	21.1	C	
	* TR	839	0.338	0.467	TR	0.723	21.5	C			
WB	L	216	0.006	0.467	L	0.014	10.9	B	16.1	B	
	T	840	0.258	0.467	T	0.554	17.0	B			
	R	754	0.053	0.467	R	0.114	11.6	B			
NB	LTR	523	0.044	0.400	LTR	0.109	14.1	B	14.1	B	
SB	* LTR	508	0.312	0.400	LTR	0.781	26.7	C	26.7	C	

NETSIM Summary Results

Livingston Trans Plan Update
 R Marvin
 Peak PM 2017

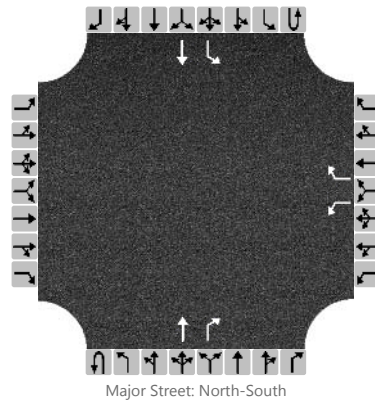
Highway 10 W/Park Street
 3/23/17
 Case: Park & 7th 2017 PM

App	Lane Group	Queues Per Lane Avg/Max (veh)	Average Speed (mph)	Spillback in Worst Lane (% of Peak Period)	
EB	L	0 / 1	8.3	0.0	
	TR	8 / 9	12.9	0.0	
	All		12.7	0.0	
WB	L	0 / 0	0.0	0.0	
	T	7 / 8	14.1	0.0	
	R	1 / 1	21.4	0.0	
	All		14.7	0.0	
NB	LTR	1 / 1	17.2	0.0	
	All		17.2	0.0	
SB	LTR	5 / 6	13.0	0.0	
	All		13.0	0.0	
Intersect.			13.6		

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I-90 WB Ramps & Park St		
Agency/Co.	Marvin Associates			Jurisdiction	City of Livingston		
Date Performed	8/25/2017			East/West Street	I-90 WB Ramps		
Analysis Year	2017			North/South Street	Park Street		
Time Analyzed	Peak PM Existing			Peak Hour Factor	0.93		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Livingston Transportation Update						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1		0	1	1		0	1	0
Configuration						L		R			T	R		L	T	
Volume, V (veh/h)						81		36			730	247		35	547	
Percent Heavy Vehicles (%)						8		8						5		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.48		6.28						4.15		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.57		3.37						2.24		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						87		39						38		
Capacity, c (veh/h)						132		384						652		
v/c Ratio						0.66		0.10						0.06		
95% Queue Length, Q ₉₅ (veh)						3.6		0.3						0.2		
Control Delay (s/veh)						73.9		15.4						10.9		
Level of Service, LOS						F		C						B		
Approach Delay (s/veh)					55.8								0.7			
Approach LOS					F											

APPENDIX E

TRAVEL TIME CALCULATIONS

Existing Travel Paths

Path 1 Sunrise & Star to & From West I90 Interchange			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Sun	9	Sun to Sunrise	9
Sun to 8th Street	72	8th Street to Sun	72
8th Street to 5th Street	30	5th Street to 8th Street	30
Right onto 5th	12	LT onto Front Street	8
Front Street to Park Street	14	Park to 5th on 5th Street	14
RT onto Park Street	24	LT onto 5th Street	15
5th Street to 7th Street	21	7th Street to 5th Street	21
RT onto US 10	12	LT onto Park	27
Park Street to Speed Change	39	Speed Change to Park Street	39
US 10 to PFL Road	95	PFL Road to Speed Change	95
PFL Road to Westside Road	16	Westside Road to PFL Road	16
Westside Road to WB I90 Ramp	23	EB Ramp to Westside Road	33
RT onto WB I90	6	LT EB Ramp onto US 10	11
Total Time =	379	Total Time =	397

Path 2 Sunrise & Star to & From Park Street East			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Sun	9	Sun to Sunrise	9
Sun to 8th Street	72	8th Street to Sun	72
8th Street to 5th Street	30	5th Street to 8th Street	30
Right onto 5th	12	LT onto Front Street	8
Front Street to Park Street	14	Park to 5th on 5th Street	14
RT onto Park Street	24	RT onto 5th Street	24
Total Time =	167	Total Time =	164

Path 3 Sunrise & Star to & From Park Street I90 Interchange Westbound			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Sun	9	Sun to Sunrise	9
Sun to 8th Street	72	8th Street to Sun	72
8th Street to 5th Street	30	5th Street to 8th Street	30
Right onto 5th	12	LT onto Front Street	8
Front Street to Park Street	14	Park to 5th on 5th Street	14
RT onto Park Street	24	LT onto 5th Street	15
5th Street to 7th Street	21	US 10 to 5th Street	21
7th Street to I90 WB Ramps	116	WB Ramps to 7th Street	116
LT onto WB Ramp	12	EB Ramps to WB Ramps	23
		RT onto Park Street	14
Total Time =	316	Total Time =	329

Path 4 Sunrise & Star to & From Park Street I90 Interchange Eastbound			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Sun	9	Sun to Sunrise	9
Sun to 8th Street	72	8th Street to Sun	72
8th Street to 5th Street	30	5th Street to 8th Street	30
Right onto 5th	12	LT onto Front Street	8
Front Street to Park Street	14	Park to 5th on 5th Street	14
RT onto Park Street	24	LT onto 5th Street	15
5th Street to 7th Street	21	US 10 to 5th Street	21
7th Street to I90 WB Ramps	116	WB Ramps to 7th Street	116
WB Ramps to EB Ramps	23	RT onto Park Street	18
LT onto EB Ramps	10		
Total Time =	337	Total Time =	310

Path 5 Sunrise & Star to & South Livingston at Park Street I90 Interchange			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Sun	9	Sun to Sunrise	9
Sun to 8th Street	72	8th Street to Sun	72
8th Street to 5th Street	30	5th Street to 8th Street	30
Right onto 5th	12	LT onto Front Street	8
Front Street to Park Street	14	Park to 5th on 5th Street	14
RT onto Park Street	24	LT onto 5th Street	15
5th Street to 7th Street	21	US 10 to 5th Street	21
7th Street to I90 WB Ramps	116	WB Ramps to 7th Street	116
WB Ramps to EB Ramps	23	EB Ramps to WB Ramps	23
Thru Delay to South	10	Thru Delay to north	16
Total Time =	337	Total Time =	331

Travel Paths With Front Street Arterial Extension

Path 1 Sunrise & Star to & From West I90 Interchange			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Front Street	15	Front Street to Sunset	15
RT onto Front Street Extension	9	LT onto Star	10
Star to Underpass Avenue	95	Underpass Ave to Star	95
Left onto Underpass Avenue	9	RT onto Front Street Extension	9
Front Extension to US 10	20	US 10 to Front Street Extension	20
RT onto US 10	9	LT onto Underpass Avenue	9
PFL Road to Westside Road	16	Westside Road to PFL Road	16
Westside Road to WB I90 Ramp	23	EB Ramp to Westside Road	33
RT onto WB I90	6	LT EB Ramp onto US 10	11
Total Time =	208	Total Time =	225

Travel Time Difference = -189 Travel Time Difference = -172

All of Study Area Cutoff

Path 2 Sunrise & Star to & From Park Street East			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Front Street	15	Front Street to Sunset	15
RT onto Front Street Extension	9	LT onto Star	10
Star to Underpass Avenue	95	Underpass Ave to Star	95
Left onto Underpass Avenue	9	RT onto Front Street Extension	9
Front Extension to US 10	20	US 10 to Front Street Extension	20
RT onto US 10	10	RT onto Underpass Avenue	9
PFL Road to Speed Change	95	Speed Chne to PFL	95
Speed Change to Park Street	39	Park to Speed Change	39
LT onto Park	27	RT onto US 10	12
7th Street to 5th Street	21	5th Street to 7th Street	21
Thru Delay at 5th	14	Thru Delay at 5th	24
Total Time =	360	Total Time =	356

Travel Time Difference = 193 Travel Time Difference = 192

West of Sunrise Subdivision Cutoff

Path 3 Sunrise & Star to & From Park Street I90 Interchange Westbound			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Front Street	15	Front Street to Sunset	15
RT onto Front Street Extension	9	LT onto Star	10
Star to Underpass Avenue	95	Underpass Ave to Star	95
Left onto Underpass Avenue	9	RT onto Front Street Extension	9
Front Extension to US 10	20	US 10 to Front Street Extension	20
RT onto US 10	9	LT onto Underpass Avenue	9
PFL Road to Westside Road	16	Westside Road to PFL Road	16
Westside Road to WB I90 Ramp	23	EB Ramp to Westside Road	33
RT onto WB I90	6	LT EB Ramp onto US 10	11
Total Time =	208	Total Time =	225

Travel Time Difference = -108 Travel Time Difference = -104

5th Street Cutoff

Path 4 Sunrise & Star to & From Park Street I90 Interchange Eastbound			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Sun	9	Sun to Sunrise	9
RT onto Front Street Extension	9	LT onto Star	10
Star to Underpass Avenue	95	Underpass Ave to Star	95
Left onto Underpass Avenue	9	RT onto Front Street Extension	9
Front Extension to US 10	20	US 10 to Front Street Extension	20
RT onto US 10	9	LT onto Underpass Avenue	9
PFL Road to Westside Road	16	Westside Road to PFL Road	16
Westside Road to WB I90 Ramp	23	WB Ramp to Westside Road	33
WB Ramps to EB Ramps	10	RT onto US 10	9
LT onto EB Ramp	7	I90 from Park Int to West Int	94
I90 from West Int to Park Int	94		
Total Time =	307	Total Time =	311

Travel Time Difference = -30 Travel Time Difference = 1

Star Road Cutoff

Path 5 Sunrise & Star to South Livingston at Park Street I90 Interchange			
Sunrise & Star To External Node	Seconds	External Node to Sunrise & Star	Seconds
Sunrise RT on Star	6	LT onto Sunrise	7
Sunrise to Sun	9	Sun to Sunrise	9
RT onto Front Street Extension	9	LT onto Star	10
Star to Underpass Avenue	95	Underpass Ave to Star	95
Left onto Underpass Avenue	9	RT onto Front Street Extension	9
Front Extension to US 10	20	US 10 to Front Street Extension	20
RT onto US 10	9	LT onto Underpass Avenue	9
PFL Road to Westside Road	16	Westside Road to PFL Road	16
Westside Road to WB I90 Ramp	23	WB Ramp to Westside Road	33
WB Ramps to EB Ramps	10	RT onto US 10	9
Thru Delay at EB Ramps	16	I90 from Park Int to West Int	94
I90 from West Int to Park Int	94	EB to WB Ramps	23
LT from RB Ramp	15	Thru Delay at EB Ramp	16
Total Time =	331	Total Time =	350

Travel Time Difference = -6 Travel Time Difference = 19

400' West of Star Road Cutoff

Star

APPENDIX F

INITIAL TRAFFIC ASSIGNMENT MODEL

Northside Livingston Traffic Study Initial Assignment Model

Peak AM Hour

Street		Link		Origin- Destination Zone Trips																	
				16%		6%		28%		1%		2%		18%		14%		15%		100%	
				I-90 West		PFL Road		South Park		I-90 East		US 10 Acc		5th South		Park East		Front East		Link Totals	
		IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT		
Westside Arterial	East of Sunrise Sub	30	78	11	29											6	18	48	125		
Westside Arterial	West of Sunrise Sub	37	97	14	36	0	0	0	0	1	2	8	22	6	17	6	18	71	193		
Underpass Road	North of Westside Arterial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Underpass Road	South of Westside Arterial	37	97	14	36	0	0	0	0	1	2	8	22	6	17			65	175		
PFL Road	South of HWY 10	8	10	14	36	14	17	1	1									36	63		
HWY 10	West of PFL Road	45	107	8	10	14	17	1	1									68	134		
HWY 10	East of PFL									1	2	8	22	6	17			14	41		
HWY 10	West of Park St											8	22	6	17			13	39		
Star Road	North of Front St	5	14	2	5	8	24	0	1	1	2	5	15	4	12	4	13	29	85		
Front Street	East of Star Road					8	24	0	1	1	2	5	15	4	12	4	13	23	67		
Front Street	E of 5th St	7	20	3	7			0	1	1	2	1	2	1	2			12	34		
N 5th Street	North of Front St	35	9	13	3	62	15	2	1	4	1	40	10	31	8	33	8	220	55		
N 5th Street	South of Front St					45	112	2	4	3	8	29	72	22	56			101	252		
N 5th Street	South of Park St											36	94					36	94		
Park Street	East of 5th St													6	19			6	19		
Park Street	West of 5th St					43	129					8	22	6	17			56	168		
Park Street	West (S) of HWY 10					43	129											43	129		
Park Street	South of I-90					57	146											57	146		
I-90	West of Hwy 10	45	107															45	107		
I-90	East of HWY 10					14	17	1	1									15	17		
I-90	East of Park St							1	1									1	1		
Total Enter & Exit Study Area =																		178	462		

Northside Livingston Traffic Study Initial Assignment Model

Peak PM Hour

Street		Link		Origin- Destination Zone Trips																	
				16%		6%		28%		1%		2%		18%		14%		15%		100%	
				I-90 West		PFL Road		South Park		I-90 East		US 10 Acc		5th South		Park East		Front East		Link Totals	
		IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT		
Westside Arterial	East of Sunrise Sub	85	49	32	18											28	17	145	84		
Westside Arterial	West of Sunrise Sub	115	67	43	25	0	0	0	0	4	2	34	20	26	15	28	17	251	146		
Underpass Road	North of Westside Arterial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Underpass Road	South of Westside Arterial	115	67	43	25	0	0	0	0	4	2	34	20	26	15			223	129		
PFL Road	South of HWY 10	3	16	43	25	6	28	0	1									52	70		
HWY 10	West of PFL Road	119	83	3	16	6	28	0	1									128	128		
HWY 10	East of PFL									4	2	34	20	26	15			64	37		
HWY 10	West of Park St											34	20	26	15			60	35		
Star Road	North of Front St	21	12	8	5	37	22	1	1	3	2	24	14	19	11	20	12	132	77		
Front Street	East of Star Road					37	22	1	1	3	2	24	14	19	11	20	12	103	60		
Front Street	E of 5th St	30	18	11	7			2	1	4	2	3	2	3	2			53	31		
N 5th Street	North of Front St	35	9	13	3	62	15	2	1	4	1	40	10	31	8	33	8	220	55		
N 5th Street	South of Front St					112	64	4	2	8	5	72	41	56	32			252	145		
N 5th Street	South of Park St											106	61					106	61		
Park Street	East of 5th St													29	17			29	17		
Park Street	West of 5th St					159	67					34	20	26	15			220	102		
Park Street	West (S) of HWY 10					159	67											159	67		
Park Street	South of I-90					165	95											165	95		
I-90	West of Hwy 10	119	83															119	83		
I-90	East of HWY 10					6	28	0	1									6	29		
I-90	East of Park St							0	1									0	1		
Total Enter & Exit Study Area =																		528	305		

APPENDIX G

FUTURE TRAFFIC ASSIGNMENT MODEL

Northside Livingston Traffic Study Future Assignment Model

Peak AM Hour

Street		Link		Origin- Destination Zone Trips																	
				16%		6%		28%		1%		2%		18%		14%		15%		100%	
				I-90 West		PFL Road		South Park		I-90 East		US 10 Acc		5th South		Park East		Front East		Link Totals	
		IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT		
Westside Arterial	East of Sunrise Sub	50	138	19	52											41	120	110	310		
Westside Arterial	West of Sunrise Sub	58	160	22	60	13	37	0	1	1	3	8	24	6	19	7	20	114	325		
Underpass Road	North of Westside Arterial	36	107	14	40	51	149	2	5	5	13	41	120	32	93	34	100	213	627		
Underpass Road	South of Westside Arterial	94	266	35	100	63	186	2	7	5	16	49	144	38	112			287	832		
PFL Road	South of HWY 10	11	10	35	100	18	17	1	1									65	127		
HWY 10	West of PFL Road	104	276	11	10	82	203	3	7									200	496		
HWY 10	East of PFL									5	16	49	144	38	112			92	273		
HWY 10	West of Park St											49	144	38	112			87	257		
Star Road	North of Front St	10	30	4	11	18	53	1	2	1	4	11	34	9	27	10	29	64	190		
Front Street	East of Star Road					18	53	1	2	1	4	11	34	9	27	10	29	50	149		
Front Street	E of 5th St	15	44	5	16			1	3	2	5	2	5	1	4			26	77		
N 5th Street	North of Front St	35	9	13	3	62	15	2	1	4	1	40	10	31	8	33	8	220	55		
N 5th Street	South of Front St					70	188	3	7	5	13	45	121	35	94			158	423		
N 5th Street	South of Park St											94	265					94	265		
Park Street	East of 5th St													39	116			39	116		
Park Street	West of 5th St					64	209					49	144	38	112			151	466		
Park Street	West (S) of HWY 10					64	209											64	209		
Park Street	South of I-90					146	413											146	413		
I-90	West of Hwy 10	104	276															104	276		
I-90	East of HWY 10					82	203	3	7									85	211		
I-90	East of Park St							3	7									3	7		
Total Enter & Exit Study Area =																	470	1332			

Northside Livingston Traffic Study Future Assignment Model

Peak PM Hour

Street		Link		Origin- Destination Zone Trips																	
				16%		6%		28%		1%		2%		18%		14%		15%		100%	
				I-90 West		PFL Road		South Park		I-90 East		US 10 Acc		5th South		Park East		Front East		Link Totals	
		IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT		
Westside Arterial	East of Sunrise Sub	141	82	53	31											122	72	316	184		
Westside Arterial	West of Sunrise Sub	163	95	61	36	38	22	1	1	3	2	25	15	20	12	21	12	332	194		
Underpass Road	North of Westside Arterial	108	63	40	24	151	88	5	3	13	8	121	71	94	55	101	59	635	371		
Underpass Road	South of Westside Arterial	271	158	102	59	189	110	7	4	16	10	147	86	114	67			845	494		
PFL Road	South of HWY 10	11	10	102	59	18	17	1	1									131	86		
HWY 10	West of PFL Road	282	168	11	10	207	127	7	5									507	309		
HWY 10	East of PFL									16	10	147	86	114	67			277	162		
HWY 10	West of Park St											147	86	114	67			260	153		
Star Road	North of Front St	32	19	12	7	55	33	2	1	4	2	36	21	28	16	30	17	197	116		
Front Street	East of Star Road					55	33	2	1	4	2	36	21	28	16	30	17	154	91		
Front Street	E of 5th St	45	27	17	10			3	2	6	3	5	3	4	2			80	47		
N 5th Street	North of Front St	24	18	9	7	42	31	2	1	3	2	27	20	21	15	23	17	150	110		
N 5th Street	South of Front St					191	111	7	4	14	8	123	71	95	55			430	249		
N 5th Street	South of Park St											269	157					269	157		
Park Street	East of 5th St													118	69			118	69		
Park Street	West of 5th St					212	117					147	86	114	67			472	270		
Park Street	West (S) of HWY 10					212	117											212	117		
Park Street	South of I-90					419	244											419	244		
I-90	West of Hwy 10	282	168															282	168		
I-90	East of HWY 10					207	127	7	5									215	132		
I-90	East of Park St							7	5									7	5		
Total Enter & Exit Study Area =																	1354	790			

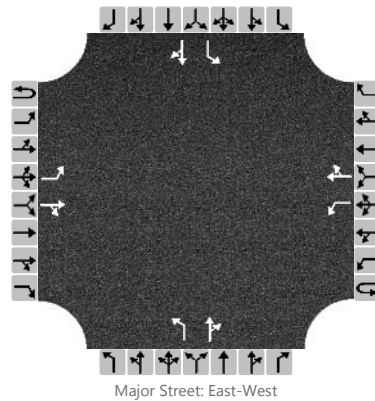
APPENDIX H

INITIAL CAPACITY CALCULATIONS

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	US HWY 10 & Underpass Rd		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	7/5/2018			East/West Street	US HWY 10		
Analysis Year	2020			North/South Street	Underpass Road		
Time Analyzed	Peak AM Initial			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12	
Priority																	
Number of Lanes	0	1	1	0	0	1	1	0		1	1	0		1	1	0	
Configuration		L		TR		L		TR		L		TR		L		TR	
Volume, V (veh/h)		40	75	45		65	150	15		5	15	5		40	35	100	
Percent Heavy Vehicles (%)		2				2				1	1	1		2	2	2	
Proportion Time Blocked																	
Percent Grade (%)										0				0			
Right Turn Channelized		No			No					No			No				
Median Type/Storage		Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.12				4.12				7.11	6.51	6.21		7.12	6.52	6.22
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.22				2.22				3.51	4.01	3.31		3.52	4.02	3.32

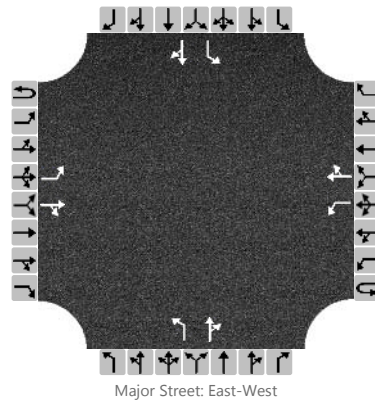
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		43				71				5		22		43		147
Capacity, c (veh/h)		1396				1454				328		497		426		681
v/c Ratio		0.03				0.05				0.02		0.04		0.10		0.22
95% Queue Length, Q ₉₅ (veh)		0.1				0.2				0.1		0.1		0.3		0.8
Control Delay (s/veh)		7.7				7.6				16.2		12.6		14.4		11.7
Level of Service, LOS		A				A				C		B		B		B
Approach Delay (s/veh)		1.9			2.1					13.3			12.3			
Approach LOS		A			A					B			B			

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	US HWY 10 & Underpass Rd		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	7/5/2018			East/West Street	US HWY 10		
Analysis Year	2020			North/South Street	Underpass Road		
Time Analyzed	Peak PM Initial			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12	
Priority																	
Number of Lanes	0	1	1	0	0	1	1	0		1	1	0		1	1	0	
Configuration		L		TR		L		TR		L		TR		L		TR	
Volume, V (veh/h)		115	175	5		5	70	65		35	25	60		40	45	70	
Percent Heavy Vehicles (%)		2				2				1	1	1		2	2	2	
Proportion Time Blocked																	
Percent Grade (%)										0				0			
Right Turn Channelized		No			No					No				No			
Median Type/Storage		Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.12				4.12				7.11	6.51	6.21		7.12	6.52	6.22
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.22				2.22				3.51	4.01	3.31		3.52	4.02	3.32

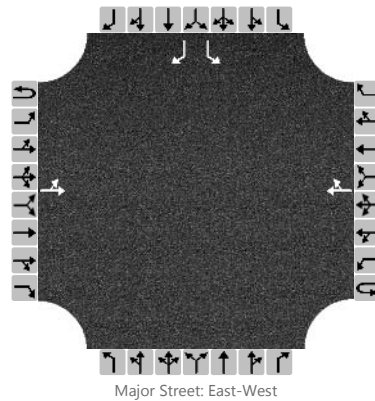
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		125				5				38		92		43		125	
Capacity, c (veh/h)		1434				1376				308		622		330		609	
v/c Ratio		0.09				0.00				0.12		0.15		0.13		0.21	
95% Queue Length, Q ₉₅ (veh)		0.3				0.0				0.4		0.5		0.4		0.8	
Control Delay (s/veh)		7.8				7.6				18.4		11.8		17.6		12.4	
Level of Service, LOS		A				A				C		B		C		B	
Approach Delay (s/veh)		3.0			0.3					13.7				13.8			
Approach LOS										B				B			

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Star Road & Westside Art		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	7/5/2018			East/West Street	Westside Arterial		
Analysis Year	2020			North/South Street	Star Road		
Time Analyzed	Peak AM Initial			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		LT						TR						L		R
Volume, V (veh/h)		10	20				15	25						50		20
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)																0
Right Turn Channelized		No			No				No				No			
Median Type/Storage		Left Only							1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

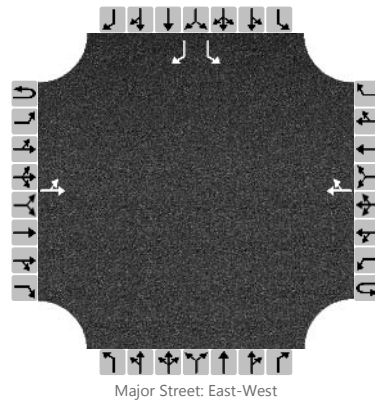
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11												54		22	
Capacity, c (veh/h)		1543												853		1029	
v/c Ratio		0.01												0.06		0.02	
95% Queue Length, Q ₉₅ (veh)		0.0												0.2		0.1	
Control Delay (s/veh)		7.3												9.5		8.6	
Level of Service, LOS		A												A		A	
Approach Delay (s/veh)		2.5												9.2			
Approach LOS														A			

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Star Road & Westside Art		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	7/5/2018			East/West Street	Westside Arterial		
Analysis Year	2020			North/South Street	Star Road		
Time Analyzed	Peak PM Initial			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12	
Priority																	
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		1	0	1	
Configuration		LT						TR						L		R	
Volume, V (veh/h)		30	85				25	105						60		20	
Percent Heavy Vehicles (%)		3												3		3	
Proportion Time Blocked																	
Percent Grade (%)																0	
Right Turn Channelized		No			No				No				No				
Median Type/Storage		Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

Delay, Queue Length, and Level of Service

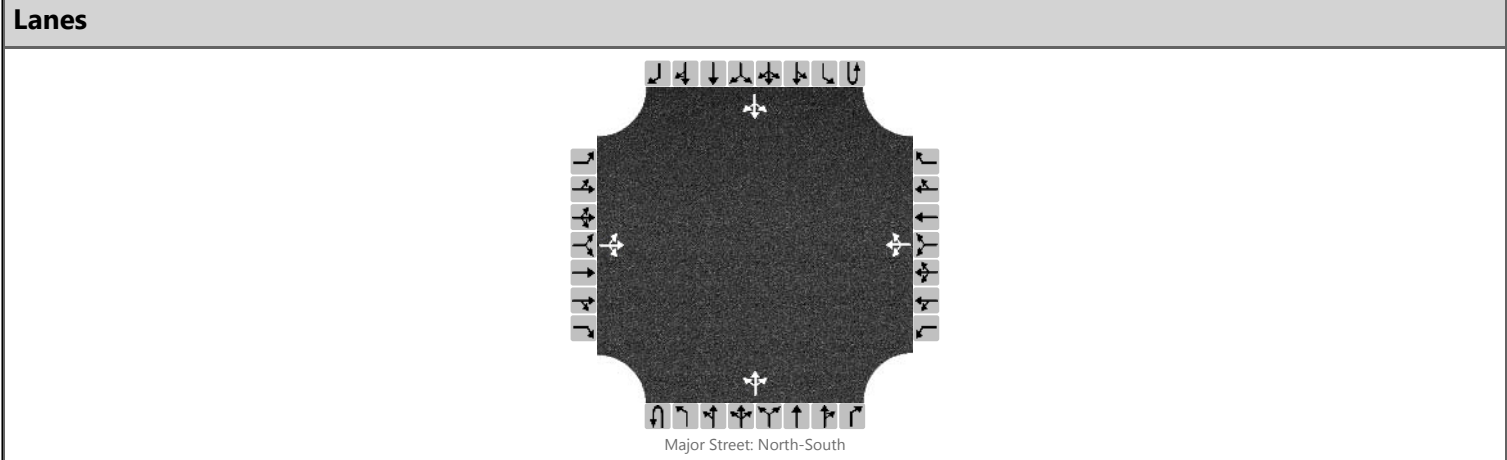
Flow Rate, v (veh/h)		33												65		22	
Capacity, c (veh/h)		1421												722		961	
v/c Ratio		0.02												0.09		0.02	
95% Queue Length, Q ₉₅ (veh)		0.1												0.3		0.1	
Control Delay (s/veh)		7.6												10.5		8.8	
Level of Service, LOS		A												B		A	
Approach Delay (s/veh)		2.1												10.1			
Approach LOS														B			

APPENDIX I

FUTURE CAPACITY CALCULATIONS

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Front & 5th		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	6/29/18			East/West Street	Front Street		
Analysis Year	2040			North/South Street	5th Street		
Time Analyzed	Peak AM Future			Peak Hour Factor	0.90		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		20	80	290		20	30	5		120	40	10		5	160	40
Percent Heavy Vehicles (%)		0	0	0		0	0	0		0				0		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.10	6.50	6.20		4.10				4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.50	4.00	3.30		2.20				2.20		

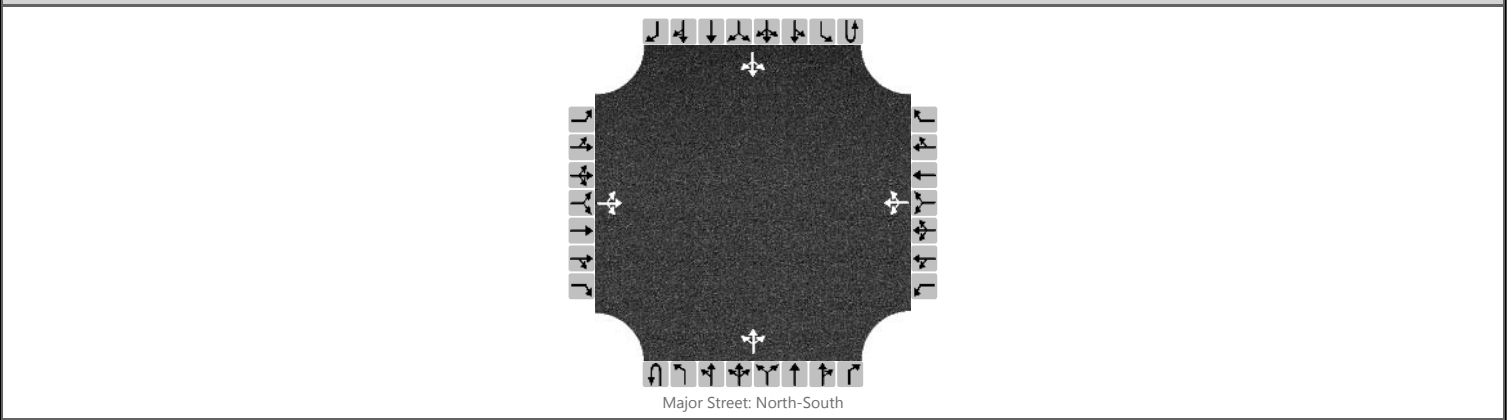
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			433				61				133				6	
Capacity, c (veh/h)			645				260				1347				1548	
v/c Ratio			0.67				0.24				0.10				0.00	
95% Queue Length, Q ₉₅ (veh)			5.1				0.9				0.3				0.0	
Control Delay (s/veh)			21.2				23.1				8.0				7.3	
Level of Service, LOS			C				C				A				A	
Approach Delay (s/veh)	21.2				23.1				5.9				0.2			
Approach LOS	C				C											

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Front & 5th		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	6/29/18			East/West Street	Front Street		
Analysis Year	2040			North/South Street	5th Street		
Time Analyzed	Peak PM Future			Peak Hour Factor	0.90		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		35	50	260		15	80	5		420	130	30		5	110	25
Percent Heavy Vehicles (%)		0	0	0		0	0	0		0				0		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.10	6.50	6.20		4.10				4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.50	4.00	3.30		2.20				2.20		

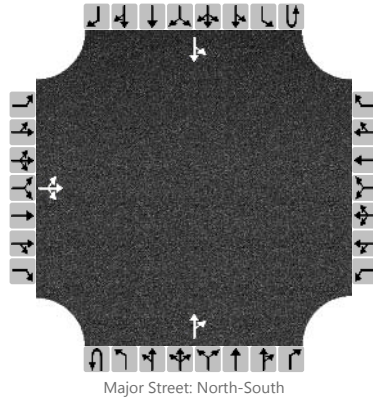
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			383				111				467				6	
Capacity, c (veh/h)			186				83				1431				1398	
v/c Ratio			2.06				1.33				0.33				0.00	
95% Queue Length, Q ₉₅ (veh)			29.5				8.4				1.4				0.0	
Control Delay (s/veh)			536.0				300.4				8.7				7.6	
Level of Service, LOS			F				F				A				A	
Approach Delay (s/veh)	536.0				300.4				7.2				0.3			
Approach LOS	F				F											

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 EB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	6/29/2018			East/West Street	I90 EB Ramps		
Analysis Year	2040			North/South Street	US HWY 10		
Time Analyzed	Peak AM Hour Future			Peak Hour Factor	0.81		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	1	0		0	0	0		0	1	0		0	1	0	
Configuration			LTR									TR		LT			
Volume, V (veh/h)		190	1	1							40	10		210	30		
Percent Heavy Vehicles (%)		3	3	3										3			
Proportion Time Blocked																	
Percent Grade (%)		0															
Right Turn Channelized		No					No					No					
Median Type/Storage		Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2										4.1		
Critical Headway (sec)		6.43	6.53	6.23										4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3										2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33										2.23		

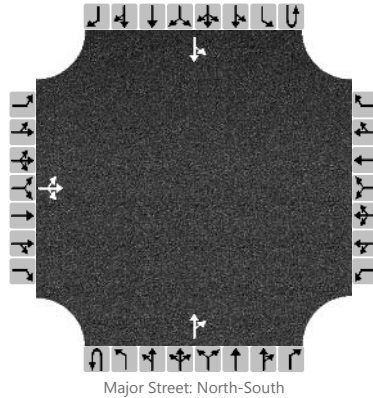
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			237											259		
Capacity, c (veh/h)			456											1533		
v/c Ratio			0.52											0.17		
95% Queue Length, Q ₉₅ (veh)			2.9											0.6		
Control Delay (s/veh)			21.1											7.8		
Level of Service, LOS			C											A		
Approach Delay (s/veh)		21.1										7.0				
Approach LOS		C														

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 EB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	6/29/2018			East/West Street	I90 EB Ramps		
Analysis Year	2040			North/South Street	US HWY 10		
Time Analyzed	Peak PM Hour Future			Peak Hour Factor	0.81		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0	
Configuration			LTR									TR		LT			
Volume, V (veh/h)		450	1	5							50	15		150	60		
Percent Heavy Vehicles (%)		3	3	3										3			
Proportion Time Blocked																	
Percent Grade (%)		0															
Right Turn Channelized		No					No					No					
Median Type/Storage		Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2										4.1		
Critical Headway (sec)		6.43	6.53	6.23										4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3										2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33										2.23		

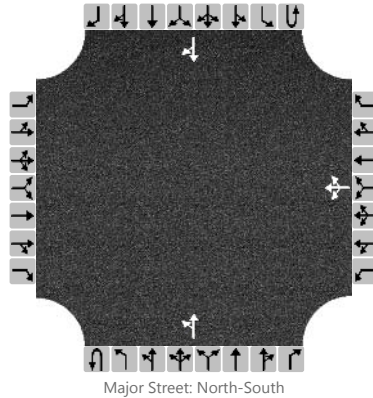
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			563										185		
Capacity, c (veh/h)			520										1510		
v/c Ratio			1.08										0.12		
95% Queue Length, Q ₉₅ (veh)			17.4										0.4		
Control Delay (s/veh)			91.4										7.7		
Level of Service, LOS			F										A		
Approach Delay (s/veh)		91.4										5.8			
Approach LOS		F													

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 WB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	6/29/2018			East/West Street	I90 WB Ramps		
Analysis Year	2040			North/South Street	US HWY 10		
Time Analyzed	Peak AM HourFuture			Peak Hour Factor	0.91		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR			LT						TR
Volume, V (veh/h)						1	1	90		5	230				240	465
Percent Heavy Vehicles (%)						3	3	3		3						
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1	6.5	6.2		4.1						
Critical Headway (sec)						6.43	6.53	6.23		4.13						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2						
Follow-Up Headway (sec)						3.53	4.03	3.33		2.23						

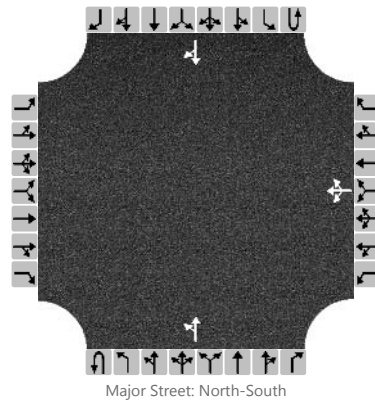
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						101				5						
Capacity, c (veh/h)						753				836						
v/c Ratio						0.13				0.01						
95% Queue Length, Q ₉₅ (veh)						0.5				0.0						
Control Delay (s/veh)						10.5				9.3						
Level of Service, LOS						B				A						
Approach Delay (s/veh)					10.5				0.3							
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 WB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	6/29/2018			East/West Street	I90 WB Ramps		
Analysis Year	2040			North/South Street	US HWY 10		
Time Analyzed	Peak PM HourFuture			Peak Hour Factor	0.91		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR			LT						TR
Volume, V (veh/h)						10	1	220		1	500				200	210
Percent Heavy Vehicles (%)						3	3	3		3						
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1	6.5	6.2		4.1						
Critical Headway (sec)						6.43	6.53	6.23		4.13						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2						
Follow-Up Headway (sec)						3.53	4.03	3.33		2.23						

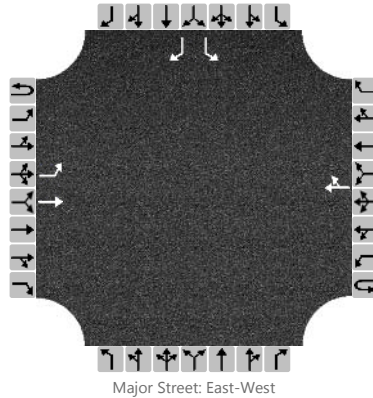
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						254				1						
Capacity, c (veh/h)						515				1103						
v/c Ratio						0.49				0.00						
95% Queue Length, Q ₉₅ (veh)						2.7				0.0						
Control Delay (s/veh)						18.6				8.3						
Level of Service, LOS						C				A						
Approach Delay (s/veh)					18.6				0.0							
Approach LOS					C											

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Star Road & Westside Art		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	7/5/2018			East/West Street	Westside Arterial		
Analysis Year	2040			North/South Street	Star Road		
Time Analyzed	Peak AM Future			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		5	200				90	60						145		45
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)																0
Right Turn Channelized		No			No				No				No			
Median Type/Storage		Left Only							1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

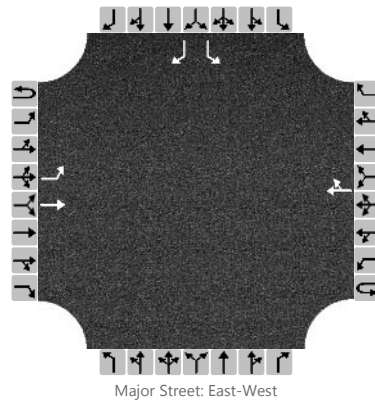
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		5												158		49
Capacity, c (veh/h)		1395												663		906
v/c Ratio		0.00												0.24		0.05
95% Queue Length, Q ₉₅ (veh)		0.0												0.9		0.2
Control Delay (s/veh)		7.6												12.1		9.2
Level of Service, LOS		A												B		A
Approach Delay (s/veh)		0.2											11.4			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Star Road & Westside Art		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	7/5/2018			East/West Street	Westside Arterial		
Analysis Year	2040			North/South Street	Star Road		
Time Analyzed	Peak PM Future			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		15	220				310	190						90		30
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)																0
Right Turn Channelized		No			No				No				No			
Median Type/Storage		Left Only							1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

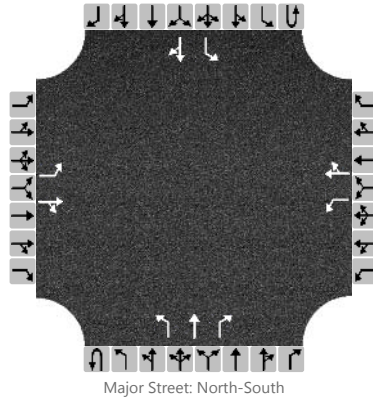
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		16												98		33	
Capacity, c (veh/h)		1011												487		608	
v/c Ratio		0.02												0.20		0.05	
95% Queue Length, Q ₉₅ (veh)		0.0												0.7		0.2	
Control Delay (s/veh)		8.6												14.2		11.3	
Level of Service, LOS		A												B		B	
Approach Delay (s/veh)		0.6												13.5			
Approach LOS														B			

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Westside & Underpass Rd		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	7/5/2018			East/West Street	Westside Arterial		
Analysis Year	2040			North/South Street	Underpass Road		
Time Analyzed	Peak AM Future			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		1	1	0	0	1	1	1	0	1	1	0
Configuration		L		TR		L		TR		L	T	R		L		TR
Volume, V (veh/h)		5	5	5		300	5	10		5	210	110		20	600	5
Percent Heavy Vehicles (%)		3	3	3		3	3	3		3				3		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.13	6.53	6.23		7.13	6.53	6.23		4.13				4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		3.53	4.03	3.33		2.23				2.23		

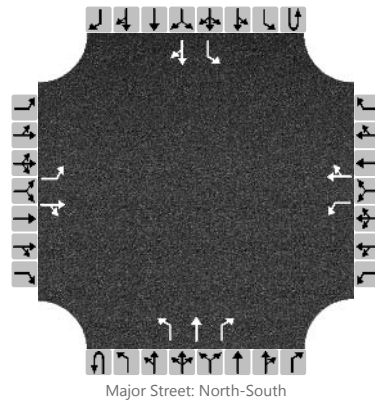
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		5		11		326		16		5				22		
Capacity, c (veh/h)		322		297		326		471		924				1204		
v/c Ratio		0.02		0.04		1.00		0.03		0.01				0.02		
95% Queue Length, Q ₉₅ (veh)		0.1		0.1		11.1		0.1		0.0				0.1		
Control Delay (s/veh)		16.4		17.6		86.6		12.9		8.9				8.0		
Level of Service, LOS		C		C		F		B		A				A		
Approach Delay (s/veh)	17.2				83.1				0.1				0.3			
Approach LOS	C				F											

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	Westside & Underpass Rd		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	7/5/2018			East/West Street	Westside Arterial		
Analysis Year	2040			North/South Street	Underpass Road		
Time Analyzed	Peak PM Future			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		1	1	0	0	1	1	1	0	1	1	0
Configuration		L		TR		L		TR		L	T	R		L		TR
Volume, V (veh/h)		5	5	5		170	5	25		5	610	290		15	355	5
Percent Heavy Vehicles (%)		3	3	3		3	3	3		3				3		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.13	6.53	6.23		7.13	6.53	6.23		4.13				4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		3.53	4.03	3.33		2.23				2.23		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		5		11		185		33		5				16		
Capacity, c (veh/h)		236		222		303		381		1161				701		
v/c Ratio		0.02		0.05		0.61		0.09		0.00				0.02		
95% Queue Length, Q ₉₅ (veh)		0.1		0.2		3.7		0.3		0.0				0.1		
Control Delay (s/veh)		20.6		22.0		33.7		15.3		8.1				10.3		
Level of Service, LOS		C		C		D		C		A				B		
Approach Delay (s/veh)	21.6				31.0				0.0				0.4			
Approach LOS	C				D											

HCM Analysis Summary

Northside Trans Plan R Marvin Peak PM Future			Park Street/5th Street 8/9/18 Case: PARK AND 5TH PM Future				Area Type: Non CBD Analysis Duration: 15 mins.							
Lanes			Geometry: Movements Serviced by Lane and Lane Widths (feet)											
	Approach	Outbound	Lane 1		Lane 2		Lane 3		Lane 4		Lane 5		Lane 6	
EB	2	1	L	12.0	TR	12.0								
WB	2	1	L	12.0	TR	12.0								
NB	1	1	LTR	12.0										
SB	1	1	LTR	12.0										
Data			East			West			North			South		
			L	T	R	L	T	R	L	T	R	L	T	R
Movement Volume (vph)			300	500	80	16	430	120	150	160	10	65	80	140
PHF			0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
% Heavy Vehicles			2	2	2	2	2	2	2	2	2	2	2	2
Lane Groups			L	TR		L	TR		LTR				LTR	
Arrival Type			3	3		3	3		3				3	
RTOR Vol (vph)			0			7			0			50		
Peds/Hour			5			5			5			5		
% Grade			0			0			0			0		
Buses/Hour			0			0			0			0		
Parkers/Hour (Left Right)			---		---		---		---		---		---	
Signal Settings: Actuated			Operational Analysis				Cycle Length: 94.0 Sec				Lost Time Per Cycle: 13.0 Sec			
Phase:		1	2	3	4	5	6	7	8	Ped Only				
EB		LTR	LTP											
WB			LTP											
NB				LTP										
SB				LTP										
Green		15.0	36.0	30.0						0				
Yellow	All Red	3.0	0.0	3.5	1.5	3.5	1.5							

Capacity Analysis Results										Approach:	
App	Lane Group	Cap (vph)	v/s Ratio	g/C Ratio	Lane Group	v/c Ratio	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
EB	Lper	121	0.134	0.436					21.4	C	
	* Lpro	282	0.159	0.160	L	0.792	33.1	C			
	TR	1047	0.338	0.574	TR	0.589	15.3	B			
WB	L	282	0.023	0.383	L	0.060	18.7	B	37.3	D	
	* TR	690	0.320	0.383	TR	0.836	37.8	D			
NB	LTR	400	0.272	0.319	LTR	0.853	45.3	D	45.3	D	
SB	LTR	457	0.175	0.319	LTR	0.547	27.2	C	27.2	C	

NETSIM Summary Results

Northside Trans Plan
R Marvin
Peak PM Future

Park Street/5th Street
8/9/18
Case: PARK AND 5TH PM Future

App	Lane Group	Queues Per Lane Avg/Max (veh)	Average Speed (mph)	Spillback in Worst Lane (% of Peak Period)	
EB	L	12 / 16	2.1	23.8	
	TR	7 / 10	12.7	0.0	
	All		7.5	23.8	
WB	L	1 / 1	4.8	0.0	
	TR	10 / 13	9.5	0.0	
	All		9.3	0.0	
NB	LTR	11 / 14	4.3	0.0	
	All		4.3	0.0	
SB	LTR	5 / 8	9.9	0.0	
	All		9.9	0.0	
Intersect.			7.3		

HCM Analysis Summary

Northside Trans Plan R Marvin Future PM Hour			US 10/PFI Road 08/09/2018 Case: US 10 & Underpass Ave Future PM						Area Type: Non CBD Analysis Duration: 15 mins.					
Lanes			Geometry: Movements Serviced by Lane and Lane Widths (feet)											
	Approach	Outbound	Lane 1		Lane 2		Lane 3		Lane 4		Lane 5		Lane 6	
EB	2	1	L	12.0	TR	12.0								
WB	3	1	L	12.0	T	12.0	R	12.0						
NB	2	1	L	12.0	TR	12.0								
SB	3	1	L	12.0	T	12.0	R	12.0						
Data			East			West			North			South		
			L	T	R	L	T	R	L	T	R	L	T	R
Movement Volume (vph)			490	160	70	70	75	280	55	130	60	160	85	280
PHF			0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
% Heavy Vehicles			2	5	2	2	5	2	2	2	2	2	2	2
Lane Groups			L	TR		L	T	R	L	TR		L	T	R
Arrival Type			3	3		3	3	3	3	3		3	3	3
RTOR Vol (vph)			20			100			20			80		
Peds/Hour			0			0			0			0		
% Grade			0			0			0			0		
Buses/Hour			0			0			0			0		
Parkers/Hour (Left Right)			---		---		---		---		---		---	
Signal Settings: Actuated			Operational Analysis						Cycle Length: 92.0 Sec			Lost Time Per Cycle: 13.0 Sec		
Phase:		1	2	3	4	5	6	7	8	Ped Only				
EB		LTP	LTP											
WB			LTP	R										
NB				L	LTP									
SB		R		L	LTP									
Green		15.0	30.0	8.0	20.0					0				
Yellow	All Red	4.0	0.0	4.0	2.0	4.0	0.0	3.5	1.5					

Capacity Analysis Results										Approach:	
App	Lane Group	Cap (vph)	v/s Ratio	g/C Ratio	Lane Group	v/c Ratio	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
EB	* Lper	470	0.212	0.391					17.3	B	
	* Lpro	289	0.163	0.163	L	0.717	19.5	B			
	TR	938	0.133	0.533	TR	0.249	12.2	B			
WB	L	372	0.068	0.326	L	0.210	23.7	C	19.4	B	
	T	590	0.046	0.326	T	0.141	22.4	C			
	R	723	0.126	0.457	R	0.277	16.5	B			
NB	Lper	296	0.000	0.272					28.8	C	
	Lpro	154	0.034	0.087	L	0.136	19.7	B			
	* TR	391	0.105	0.217	TR	0.481	31.8	C			
SB	Lper	215	0.030	0.272					21.6	C	
	* Lpro	154	0.087	0.087	L	0.482	21.8	C			
	T	405	0.050	0.217	T	0.232	29.8	C			
	R	671	0.140	0.424	R	0.331	17.9	B			

NETSIM Summary Results

Northside Trans Plan
R Marvin
Future PM Hour

US 10/PFI Road
08/09/2018
Case: US 10 & Underpass Ave Future PM

App	Lane Group	Queues Per Lane Avg/Max (veh)	Average Speed (mph)	Spillback in Worst Lane (% of Peak Period)	
EB	L	8 / 10	11.6	0.0	
	TR	4 / 6	15.8	0.0	
	All		12.7	0.0	
WB	L	1 / 3	9.6	0.0	
	T	1 / 2	18.7	0.0	
	R	3 / 4	17.7	0.0	
	All		16.7	0.0	
NB	L	1 / 3	13.7	0.0	
	TR	4 / 5	10.0	0.0	
	All		10.7	0.0	
SB	L	3 / 6	6.8	0.0	
	T	1 / 4	20.2	0.0	
	R	2 / 3	19.7	0.0	
	All		15.6	0.0	
Intersect.			13.8		

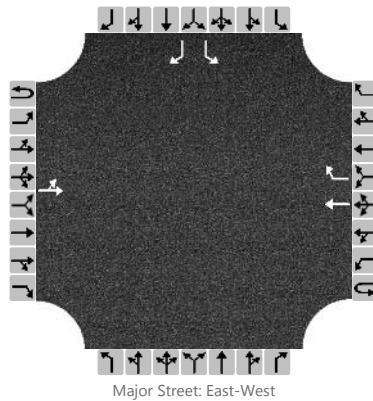
APPENDIX J

STAR ROAD UNDERPASS ALTERNATIVE CAPACITY CALCULATIONS

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	US 10 & Star Road		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	8/10/2018			East/West Street	US 10		
Analysis Year	2020			North/South Street	Star Road Underpass Alt		
Time Analyzed	Initial Operations PM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Transportation Plan						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6	7	8	9		10	11	12	
Priority																
Number of Lanes	0	0	1	0	0	0	1	1	0	0	0		1	0	1	
Configuration		LT					T	R						L		R
Volume, V (veh/h)		35	220				100	200						120		20
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		38												130		22
Capacity, c (veh/h)		1227												560		941
v/c Ratio		0.03												0.23		0.02
95% Queue Length, Q ₉₅ (veh)		0.1												0.9		0.1
Control Delay (s/veh)		8.0												13.4		8.9
Level of Service, LOS		A												B		A
Approach Delay (s/veh)		1.3												12.7		
Approach LOS														B		

HCM Analysis Summary

Star Road RXR ALT R Marvin PM Future			Front St/Star Road 08/09/2018 Case: Star Road & Front Star ALT Future PM						Area Type: Non CBD Analysis Duration: 15 mins.						
Lanes			Geometry: Movements Serviced by Lane and Lane Widths (feet)												
	Approach	Outbound	Lane 1		Lane 2		Lane 3		Lane 4		Lane 5		Lane 6		
EB	3	1	L	12.0	T	12.0	R	12.0							
WB	2	1	L	12.0	TR	12.0									
NB	3	1	L	12.0	L	12.0	TR	12.0							
SB	2	1	L	12.0	TR	12.0									
Data			East			West			North			South			
			L	T	R	L	T	R	L	T	R	L	T	R	
Movement Volume (vph)			20	80	440	60	110	60	830	200	110	40	100	20	
PHF			0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
% Heavy Vehicles			2	2	2	2	2	2	2	2	2	2	2	2	
Lane Groups			L	T	R	L	TR		L	TR		L	TR		
Arrival Type			3	3	3	3	3		3	3		3	3		
RTOR Vol (vph)			100			20			30			10			
Peds/Hour			5			5			5			5			
% Grade			0			0			0			0			
Buses/Hour			0			0			0			0			
Parkers/Hour (Left/Right)			---		---		---		---		---		---		
Signal Settings: Actuated			Operational Analysis						Cycle Length: 91.0 Sec		Lost Time Per Cycle: 15.0 Sec				
Phase:		1	2	3	4	5	6	7	8	Ped Only					
EB		LTP	R												
WB		LTP													
NB			LTP												
SB				LTP											
Green		20.0	40.0	16.0						0					
Yellow	All Red	3.5	1.5	4.0	1.0	3.5	1.5								

Capacity Analysis Results										Approach:	
App	Lane Group	Cap (vph)	v/s Ratio	g/C Ratio	Lane Group	v/c Ratio	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
EB	L	235	0.021	0.220	L	0.094	28.3	C	10.4	B	
	T	409	0.048	0.220	T	0.218	29.2	C			
	R	1127	0.240	0.714	R	0.335	4.9	A			
WB	L	284	0.052	0.220	L	0.236	29.4	C	30.4	C	
	* TR	392	0.093	0.220	TR	0.423	30.8	C			
NB	* L	1509	0.269	0.440	L	0.611	20.1	C	19.4	B	
	TR	782	0.175	0.440	TR	0.398	17.4	B			
SB	L	311	0.025	0.176	L	0.141	31.8	C	33.0	C	
	* TR	323	0.066	0.176	TR	0.378	33.4	C			

NETSIM Summary Results

Star Road RXR ALT
R Marvin
PM Future

Front St/Star Road
08/09/2018
Case: Star Road & Front Star ALT Future PM

App	Lane Group	Queues Per Lane Avg/Max (veh)	Average Speed (mph)	Spillback in Worst Lane (% of Peak Period)	
EB	L	0 / 2	7.0	0.0	
	T	4 / 7	14.1	0.0	
	R	3 / 4	18.9	0.0	
	All		15.3	0.0	
WB	L	1 / 2	8.7	0.0	
	TR	5 / 6	10.9	0.0	
	All		10.6	0.0	
NB	L	10 / 14	6.5	0.0	
	TR	4 / 8	15.2	0.0	
	All		7.9	0.0	
SB	L	1 / 2	4.9	0.0	
	TR	3 / 4	10.5	0.0	
	All		9.7	0.0	
Intersect.			9.5		

HCM Analysis Summary

Star Road Underpass Alt R Marvin Future PM			US 10/ 08/08/2018 Case: Star Road & US 10 Future PM				Area Type: Non CBD Analysis Duration: 15 mins.							
Lanes			Geometry: Movements Serviced by Lane and Lane Widths (feet)											
	Approach	Outbound	Lane 1		Lane 2		Lane 3		Lane 4		Lane 5		Lane 6	
EB	2	1	L	12.0	T	12.0								
WB	2	1	T	12.0	R	12.0								
NB	0	1												
SB	2	0	L	12.0	R	12.0								
Data			East			West			North			South		
			L	T	R	L	T	R	L	T	R	L	T	R
Movement Volume (vph)			460	380	0	0	140	680	0	0	0	370	0	230
PHF			0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
% Heavy Vehicles			2	5	2	2	5	2	2	2	2	2	2	2
Lane Groups			L	T			T	R				L		R
Arrival Type			3	3			3	3				3		3
RTOR Vol (vph)			0			100			0			100		
Peds/Hour			5			5			0			0		
% Grade			0			0			0			0		
Buses/Hour			0			0			0			0		
Parkers/Hour (Left Right)			---		---		---		---		---		---	
Signal Settings: Actuated			Operational Analysis				Cycle Length: 80.0 Sec				Lost Time Per Cycle: 11.0 Sec			
Phase:		1	2	3	4	5	6	7	8	Ped Only				
EB		LT	LT											
WB			TP	R										
NB														
SB		R		L R										
Green		18.0	20.0	25.0						0				
Yellow	All Red	4.0	2.0	4.0	2.0	3.5	1.5							

Capacity Analysis Results										Approach:	
App	Lane Group	Cap (vph)	v/s Ratio	g/C Ratio	Lane Group	v/c Ratio	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
EB	Lper	310	0.118	0.325					15.2	B	
	* Lpro	398	0.225	0.225	L	0.722	18.0	B			
	T	996	0.233	0.550	T	0.424	11.9	B			
WB											
	T	453	0.086	0.250	T	0.344	26.7	C	15.6	B	
	* R	986	0.408	0.625	R	0.653	12.9	B			
SB	L	553	0.232	0.313	L	0.743	29.4	C	23.6	C	
	R	950	0.091	0.600	R	0.152	7.1	A			

NETSIM Summary Results

Star Road Underpass Alt
R Marvin
Future PM

US 10/
08/08/2018
Case: Star Road & US 10 Future PM

App	Lane Group	Queues Per Lane Avg/Max (veh)	Average Speed (mph)	Spillback in Worst Lane (% of Peak Period)		
EB	L	14 / 18	3.5	11.9		
	T	5 / 9	16.0	0.0		
	All		7.8	11.9		
WB	T	2 / 5	18.1	0.0		
	R	7 / 10	10.1	0.0		
	All		13.3	0.0		
SB	L	9 / 15	8.5	0.0		1
	R	1 / 3	18.6	0.0		2
	Intersect.		9.7			3

HCM Analysis Summary

Star Road Underpass R Marvin Peak PM Future			Highway 10 W/Park Street 8/9/18 Case: Park & 7th US10 Future PM					Area Type: Non CBD Analysis Duration: 15 mins.						
Lanes			Geometry: Movements Serviced by Lane and Lane Widths (feet)											
	Approach	Outbound	Lane 1		Lane 2		Lane 3		Lane 4		Lane 5		Lane 6	
EB	2	1	L	12.0	TR	12.0								
WB	3	1	L	12.0	T	12.0	R	12.0						
NB	1	1	LTR	12.0										
SB	2	1	LT	12.0	R	12.0								
Data			East			West			North			South		
			L	T	R	L	T	R	L	T	R	L	T	R
Movement Volume (vph)			240	450	5	10	350	530	25	20	10	420	30	200
PHF			0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
% Heavy Vehicles			4	0	1	0	0	0	1	4	0	0	4	4
Lane Groups			L	TR		L	T	R		LTR			LT	R
Arrival Type			3	3		3	3	3		3			3	3
RTOR Vol (vph)			0			200			2			100		
Peds/Hour			5			0			10			5		
% Grade			0			0			0			0		
Buses/Hour			0			0			0			0		
Parkers/Hour (Left Right)			---		---		---		---		---		---	
Signal Settings: Actuated			Operational Analysis					Cycle Length: 76.0 Sec			Lost Time Per Cycle: 10.0 Sec			
Phase:		1	2	3	4	5	6	7	8	Ped Only				
EB		LTP												
WB		LTP												
NB			LTP											
SB			LTP											
Green		36.0		30.0										0
Yellow	All Red	3.5	1.5	3.5	1.5									

Capacity Analysis Results										Approach:	
App	Lane Group	Cap (vph)	v/s Ratio	g/C Ratio	Lane Group	v/c Ratio	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
EB	* L	406	0.288	0.474	L	0.608	21.4	C	18.4	B	
	TR	851	0.261	0.474	TR	0.551	16.8	B			
WB	L	332	0.014	0.474	L	0.030	10.8	B	14.9	B	
	T	853	0.201	0.474	T	0.423	14.7	B			
	R	765	0.211	0.474	R	0.444	15.2	B			
NB	LTR	529	0.041	0.395	LTR	0.104	14.5	B	14.5	B	
SB	* LT	492	0.372	0.395	LT	0.943	48.8	D	42.6	D	
	R	609	0.067	0.395	R	0.169	15.0	B			

NETSIM Summary Results

Star Road Underpass
R Marvin
Peak PM Future

Highway 10 W/Park Street
8/9/18
Case: Park & 7th US10 Future PM

App	Lane Group	Queues Per Lane Avg/Max (veh)	Average Speed (mph)	Spillback in Worst Lane (% of Peak Period)	
EB	L	19 / 25	0.9	50.3	
	TR	10 / 17	4.2	34.7	
	All		2.4	50.3	
WB	L	0 / 2	10.2	0.0	
	T	4 / 6	18.0	0.0	
	R	2 / 3	18.8	0.0	
	All		18.1	0.0	
NB	LTR	1 / 1	17.6	0.0	
	All		17.6	0.0	
SB	LT	6 / 10	11.9	0.0	
	R	2 / 4	18.6	0.0	
	All		13.6	0.0	
Intersect.			6.7		

HCM Analysis Summary

Northside Star RXR ALT R Marvin Peak PM Future			Park Street/5th Street 8/9/18 Case: PARK AND 5TH Star ALT PM FUTURE				Area Type: Non CBD Analysis Duration: 15 mins.							
Lanes			Geometry: Movements Serviced by Lane and Lane Widths (feet)											
	Approach	Outbound	Lane 1		Lane 2		Lane 3		Lane 4		Lane 5		Lane 6	
EB	2	1	L	12.0	TR	12.0								
WB	2	1	L	12.0	TR	12.0								
NB	1	1	LTR	12.0										
SB	1	1	LTR	12.0										
Data			East			West			North			South		
			L	T	R	L	T	R	L	T	R	L	T	R
Movement Volume (vph)			240	530	120	16	530	20	230	80	10	55	40	130
PHF			0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
% Heavy Vehicles			2	2	2	2	2	2	2	2	2	2	2	2
Lane Groups			L	TR		L	TR			LTR			LTR	
Arrival Type			3	3		3	3			3			3	
RTOR Vol (vph)			10			7			0			50		
Peds/Hour			5			5			5			5		
% Grade			0			0			0			0		
Buses/Hour			0			0			0			0		
Parkers/Hour (Left Right)			---		---		---		---		---		---	
Signal Settings: Actuated			Operational Analysis				Cycle Length: 94.0 Sec				Lost Time Per Cycle: 13.0 Sec			
Phase:		1	2	3	4	5	6	7	8	Ped Only				
EB		LTR	LTP											
WB			LTP											
NB				LTP										
SB				LTP										
Green		15.0	36.0	30.0						0				
Yellow	All Red	3.0	0.0	3.5	1.5	3.5	1.5							

Capacity Analysis Results										Approach:	
App	Lane Group	Cap (vph)	v/s Ratio	g/C Ratio	Lane Group	v/c Ratio	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
EB	Lper	120	0.000	0.436					18.3	B	
	* Lpro	282	0.144	0.160	L	0.634	22.2	C			
	TR	1042	0.376	0.574	TR	0.654	16.8	B			
WB	L	238	0.027	0.383	L	0.071	19.0	B	35.4	D	
	* TR	711	0.311	0.383	TR	0.813	35.8	D			
NB	LTR	382	0.285	0.319	LTR	0.893	52.2	D	52.2	D	
SB	LTR	464	0.129	0.319	LTR	0.403	25.2	C	25.2	C	

NETSIM Summary Results

Northside Star RXR ALT
R Marvin
Peak PM Future

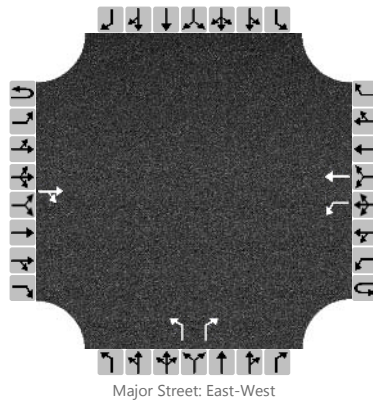
Park Street/5th Street
8/9/18
Case: PARK AND 5TH Star ALT PM FUTURE

App	Lane Group	Queues Per Lane Avg/Max (veh)	Average Speed (mph)	Spillback in Worst Lane (% of Peak Period)	
EB	L	9 / 11	2.9	2.6	
	TR	8 / 9	14.7	0.0	
	All		9.9	2.6	
WB	L	1 / 1	6.5	0.0	
	TR	10 / 13	9.5	0.0	
	All		9.4	0.0	
NB	LTR	6 / 8	8.9	0.0	
	All		8.9	0.0	
SB	LTR	3 / 4	13.0	0.0	
	All		13.0	0.0	
Intersect.			9.8		

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	US 10 & PFL Road		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	8/9/18			East/West Street	US HWY 10		
Analysis Year	2038			North/South Street	PFL Road		
Time Analyzed	Star Road RXR Alt PM			Peak Hour Factor	0.93		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	1	1	0		1	0	1		0	0	0
Configuration				TR		L	T			L		R				
Volume, V (veh/h)			430	70		160	200			60		190				
Percent Heavy Vehicles (%)						3				3		3				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No				No				No				No			
Median Type/Storage					Left Only								1			

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.13				6.43		6.23				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.23				3.53		3.33				

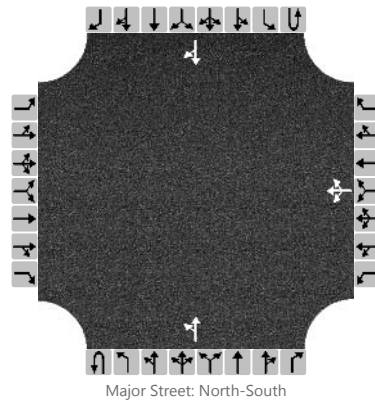
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						172				65		204				
Capacity, c (veh/h)						1024				335		568				
v/c Ratio						0.17				0.19		0.36				
95% Queue Length, Q ₉₅ (veh)						0.6				0.7		1.6				
Control Delay (s/veh)						9.2				18.3		14.8				
Level of Service, LOS						A				C		B				
Approach Delay (s/veh)					4.1				15.7							
Approach LOS									C							

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 WB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	8/9/18			East/West Street	I90 WB Ramps		
Analysis Year	2038			North/South Street	US HWY 10		
Time Analyzed	Star Road Alt PM			Peak Hour Factor	0.93		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR			LT						TR
Volume, V (veh/h)						8	1	10		2	500				65	210
Percent Heavy Vehicles (%)						3	3	3		3						
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1	6.5	6.2		4.1						
Critical Headway (sec)						6.43	6.53	6.23		4.13						
Base Follow-Up Headway (sec)						3.5	4.0	3.3		2.2						
Follow-Up Headway (sec)						3.53	4.03	3.33		2.23						

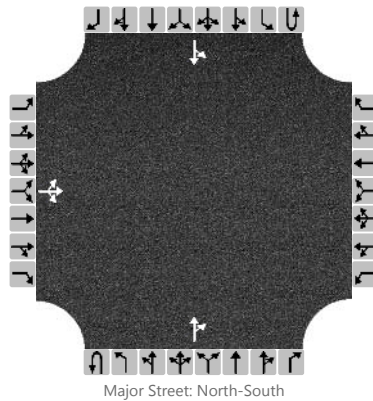
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						20				2						
Capacity, c (veh/h)						449				1258						
v/c Ratio						0.05				0.00						
95% Queue Length, Q ₉₅ (veh)						0.1				0.0						
Control Delay (s/veh)						13.4				7.9						
Level of Service, LOS						B				A						
Approach Delay (s/veh)					13.4				0.1							
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	R Marvin			Intersection	I90 EB Ramps & US 10		
Agency/Co.	Marvin & Associates			Jurisdiction	Livingston		
Date Performed	8/9/18			East/West Street	I90 EB Ramps		
Analysis Year	2038			North/South Street	US HWY 10		
Time Analyzed	Star RD Alt PM			Peak Hour Factor	0.81		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Northside Livingston Transportation Study						

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0		0	1	0		0	1	0
Configuration			LTR								TR			LT		
Volume, V (veh/h)		450	1	5							50	15		15	60	
Percent Heavy Vehicles (%)		3	3	3										3		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2										4.1		
Critical Headway (sec)		6.43	6.53	6.23										4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3										2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33										2.23		

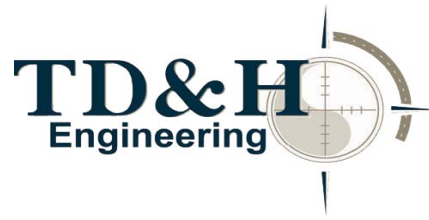
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			563										19			
Capacity, c (veh/h)			806										1510			
v/c Ratio			0.70										0.01			
95% Queue Length, Q ₉₅ (veh)			5.8										0.0			
Control Delay (s/veh)			19.1										7.4			
Level of Service, LOS			C										A			
Approach Delay (s/veh)		19.1												1.6		
Approach LOS		C														

APPENDIX K

PROJECT COST ESTIMATES

Front Street Extension
For: City of Livingston
Date: 8/7/18



Front Street (Water, Sewer, and Curb and Gutter)

Description	Quantity	Unit	Unit Price	Total Price
Topsoil and Subgrade prep 3' deep.	5.56	CY	\$ 5.75	\$ 31.94
4" Asphalt	4.78	SY	\$ 24.00	\$ 114.67
6" Minus Sub Base Gravel	5.44	SY	\$ 8.00	\$ 43.56
1 1/2" Minus Crushed Base Course	5.22	SY	\$ 20.00	\$ 104.44
Mirafi 600X fabric	5.44	SY	\$ 2.00	\$ 10.89
Striping	6	LF	\$ 2.40	\$ 14.40
Water main 10" PVC	1	LF	\$ 79.73	\$ 79.73
Sewer Main 8" SDR 35	1	LF	\$ 56.00	\$ 56.00
Curb and Gutter and storm drain	1	2Lf/ft	\$ 40.00	\$ 40.00
Total Per LF				\$ 495.63

Roadway Construction	5702	LF	\$ 495.63	\$ 2,826,296.16
General Conditions (9%)	1	LS	\$ 254,366.65	\$ 254,366.65
Creek Crossing Culverts Conc Box 7 x 7	250	LF	\$ 900.00	\$ 225,000.00
Creek Diversion	1	LS	\$ 50,000.00	\$ 50,000.00
Total				\$ 3,355,662.81

Contingency for Construction 15%	1	LS	\$ 503,349.42	\$ 503,349.42
Engineering (Design, Construction and Administration) 25%	1	LS	\$ 838,915.70	\$ 838,915.70
Permitting/Environmental	1	LS	\$ 250,000.00	\$ 250,000.00
Easement and Land Acquisition	11.8	AC	\$ 53,000.00	\$ 624,502.07

Total				\$ 5,572,430.01
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Front Street (Water and Sewer)

Description	Quantity	Unit	Unit Price	Total Price
Topsoil and Subgrade prep 3' deep.	5.56	CY	\$ 5.75	\$ 31.94
4" Asphalt	4.78	SY	\$ 24.00	\$ 114.67
6" Minus Sub Base Gravel	5.44	SY	\$ 8.00	\$ 43.56
1 1/2" Minus Crushed Base Course	5.22	SY	\$ 20.00	\$ 104.44
Mirafi 600X fabric	5.44	SY	\$ 2.00	\$ 10.89
Striping	6.00	LF	\$ 2.40	\$ 14.40
Water main 10" PVC	1.00	LF	\$ 79.73	\$ 79.73
Sewer Main 8" SDR 35	1.00	LF	\$ 56.00	\$ 56.00
	1.00		\$ 40.00	
Total Per LF	0.00		\$ -	\$ 455.63

	0.00		\$ -	
Roadway Construction	5702.40	LF	\$ 455.63	\$ 2,598,184.51
General Conditions (9%)	1.00	LS	\$ 233,836.61	\$ 233,836.61
Creek Crossing Culverts Conc Box 7 x 7	250.00	LF	\$ 900.00	\$ 225,000.00
Creek Diversion	1.00	LS	\$ 50,000.00	\$ 50,000.00
Total			\$ -	\$ 3,107,021.12

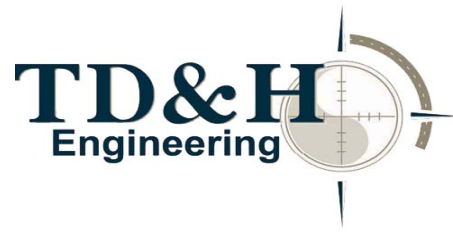
			\$ -	
Contingency for Construction 15%	1.00	LS	\$ 466,053.17	\$ 466,053.17
Engineering (Design, Construction and Administration) 25%	1.00	LS	\$ 776,755.28	\$ 776,755.28

Permitting/Environmental	1.00	LS	\$ 250,000.00	\$ 250,000.00
Easement and Land Acquisition	11.78	AC	\$ 53,000.00	\$ 624,502.07
			\$ -	
Total				\$ 5,224,331.63
				\$ 348,098.37

Front Street (Street Only)

Description	Quantity	Unit	Unit Price	Total Price
Topsoil and Subgrade prep 3' deep.	5.56	CY	\$ 5.75	\$ 31.94
4" Asphalt	4.78	SY	\$ 24.00	\$ 114.67
6" Minus Sub Base Gravel	5.44	SY	\$ 8.00	\$ 43.56
1 1/2" Minus Crushed Base Course	5.22	SY	\$ 20.00	\$ 104.44
Mirafi 600X fabric	5.44	SY	\$ 2.00	\$ 10.89
Striping	6.00	LF	\$ 2.40	\$ 14.40
Water main 10" PVC	0.00	LF	\$ 79.73	\$ -
Sewer Main 8" SDR 35	0.00	LF	\$ 56.00	\$ -
Total Per LF			\$ -	\$ 319.90
			\$ -	
Roadway Construction	5702.40	LF	\$ 319.90	\$ 1,824,197.76
General Conditions (9%)	1.00	LS	\$ 164,177.80	\$ 164,177.80
Creek Crossing Culverts Conc Box 7 x 7	250.00	LF	\$ 900.00	\$ 225,000.00
Creek Diversion	1.00	LS	\$ 50,000.00	\$ 50,000.00
Total			\$ -	\$ 2,263,375.56
			\$ -	
Contingency for Construction 15%	1.00	LS	\$ 339,506.33	\$ 339,506.33
Engineering (Design, Construction and Administration) 25%	1.00	LS	\$ 565,843.89	\$ 565,843.89
Permitting/Environmental	1.00	LS	\$ 250,000.00	\$ 250,000.00
Easement and Land Acquisition	11.78	AC	\$ 53,000.00	\$ 624,502.07
			\$ -	
Total				\$ 4,043,227.85

Merideth Ranch Road
For: City of Livingston
Date: 8/13/18



Merideth Ranch Road (Water, Sewer, and Curb and Gutter)

Description	Quantity	Unit	Unit Price	Total Price
Topsoil and Subgrade prep 3' deep.	5.56	CY	\$ 5.75	\$ 31.94
4" Asphalt	4.78	SY	\$ 24.00	\$ 114.67
6" Minus Sub Base Gravel	5.44	SY	\$ 8.00	\$ 43.56
1 1/2" Minus Crushed Base Course	5.22	SY	\$ 20.00	\$ 104.44
Mirafi 600X fabric	5.44	SY	\$ 2.00	\$ 10.89
Striping	6	LF	\$ 2.40	\$ 14.40
Water main 10" PVC	1	LF	\$ 79.73	\$ 79.73
Sewer Main 8" SDR 35	1	LF	\$ 56.00	\$ 56.00
curb and gutter and Storm Drain	1	2 LF/l	\$ 40.00	\$ 40.00
Total Per LF			\$	495.63

Roadway Construction	1500	LF	\$ 495.63	\$ 743,449.12
General Conditions (9%)	1	LS	\$ 66,910.42	\$ 66,910.42

Total **\$ 810,359.54**

Contingency for Construction 15%	1	LS	\$ 121,553.93	\$ 121,553.93
Engineering (Design, Construction and Administration) 25%	1	LS	\$ 202,589.88	\$ 202,589.88
Permitting/Environmental	1	LS	\$ 75,000.00	\$ 75,000.00
Easement and Land Acquisition	2.2	AC	\$ 53,000.00	\$ 116,600.00

Total **\$ 1,326,103.35**

Merideth Ranch Road (Wate and Sewer)

Description	Quantity	Unit	Unit Price	Total Price
Topsoil and Subgrade prep 3' deep.	5.56	CY	\$ 5.75	\$ 31.94
4" Asphalt	4.78	SY	\$ 24.00	\$ 114.67
6" Minus Sub Base Gravel	5.44	SY	\$ 8.00	\$ 43.56
1 1/2" Minus Crushed Base Course	5.22	SY	\$ 20.00	\$ 104.44
Mirafi 600X fabric	5.44	SY	\$ 2.00	\$ 10.89
Striping	6.00	LF	\$ 2.40	\$ 14.40
Water main 10" PVC	1.00	LF	\$ 79.73	\$ 79.73
Sewer Main 8" SDR 35	1.00	LF	\$ 56.00	\$ 56.00
Total Per LF			\$ -	\$ 455.63

Roadway Construction	1500.00	LF	\$ 455.63	\$ 683,449.12
General Conditions (9%)	1.00	LS	\$ 61,510.42	\$ 61,510.42

Total **\$ 744,959.54**

			\$	-		
Contingency for Construction 15%	1.00	LS	\$	111,743.93	\$	111,743.93
Engineering (Design, Construction and Administration) 25%	1.00	LS	\$	186,239.88	\$	186,239.88
Permitting/Environmental	1.00	LS	\$	75,000.00	\$	75,000.00
Easement and Land Acquisition	2.20	AC	\$	53,000.00	\$	116,600.00
			\$	-		

Total					\$	1,234,543.35
					\$	91,560.00

Merideth Ranch Road

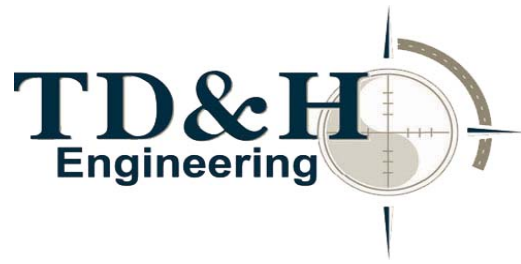
Description	Quantity	Unit	Unit Price	Total Price
Topsoil and Subgrade prep 3' deep.	5.56	CY	\$ 5.75	\$ 31.94
4" Asphalt	4.78	SY	\$ 24.00	\$ 114.67
6" Minus Sub Base Gravel	5.44	SY	\$ 8.00	\$ 43.56
1 1/2" Minus Crushed Base Course	5.22	SY	\$ 20.00	\$ 104.44
Mirafi 600X fabric	5.44	SY	\$ 2.00	\$ 10.89
Striping	6.00	LF	\$ 2.40	\$ 14.40
Water main 10" PVC		LF	\$ 79.73	\$ -
Sewer Main 8" SDR 35		LF	\$ 56.00	\$ -
	1.00		\$ -	
Total Per LF	0.00		\$ -	\$ 319.90

	0.00		\$ -	
Roadway Construction(To PFL Way)	1500.00	LF	\$ 319.90	\$ 479,850.00
General Conditions (9%)	1.00	LS	\$ 43,186.50	\$ 43,186.50
Total			\$ -	\$ 523,036.50

			\$	-		
Contingency for Construction 15%	1.00	LS	\$	78,455.48	\$	78,455.48
Engineering (Design, Construction and Administration) 25%	1.00	LS	\$	130,759.13	\$	130,759.13
Permitting/Environmental	1.00	LS	\$	75,000.00	\$	75,000.00
Easement and Land Acquisition	2.20	AC	\$	53,000.00	\$	116,600.00
			\$	-		

Total					\$	923,851.10
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Underpass at PFL Connector
For: City of Livingston
Date: 8/7/18



Description	Quantity	Unit	Unit Price	Total Price
RR Bridge Structure	1	LS	\$ 2,530,000.00	\$ 2,530,000.00
Total				\$ 2,530,000.00
Contingency for Construction 15%	1	LS	\$ 379,500.00	\$ 379,500.00
Engineering (Design, Construction and Administration) 2	1	LS	\$ 632,500.00	\$ 632,500.00
Permitting/Environmental	1	LS	\$ 379,500.00	\$ 379,500.00
Total				\$ 3,921,500.00

Potential Cost Savings vs Star Rd X-ing.

- Eliminate lowering Hwy 10 by 14 vertical feet
- Existing RR track is elevated already on embankment
- Eliminate relocating Fleshman Creek underneath Hwy 10
- Storm drainage is greatly simplified as the new crossing is not below grade.
- Traffic control costs dramatically reduced.

Total Estimate- PFL location

Front Street (Curb and Gutter, Water and Sewer)	\$	5,572,430.01
Front Street (Water and Sewer)	\$	5,224,331.63
Front Street Only	\$	4,043,227.85

Merideth Ranch Road(Curb and Gutter, Water and Sewer)	\$	1,326,103.35
Merideth Ranch Road(Water and Sewer)	\$	1,234,543.35
Merideth Ranch Road Only	\$	923,851.10

Underpass Bridge Structure	\$	3,921,500.00
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Cost with Street, Curb and Gutter and Water and Sewer	\$	10,820,033.36
Cost with Street, Water and Sewer	\$	10,380,374.98
Cost with Street only	\$	8,888,578.95

MDT Indirect costs \$ **1,500,000.00**

Total PFL Underpass

Total Cost with Street, Curb and Gutter and Water and Sewer	\$	12,320,033.36
Total Cost with Street, Water and Sewer	\$	11,880,374.98
Total Cost with Street only	\$	10,388,578.95