FINAL REPORT
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Montana Avenue/Valley Drive PER & Corridor Study

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Project Background

East Helena is a small city located in Lewis & Clark County in west central Montana just five miles east of Helena, the capital city of Montana. East Helena was originally founded in the 1860s as a stagecoach way station known as Prickly Pear Junction. In 1888, the Helena and Livingston Smelting Company constructed a large lead smelter on the banks of Prickly Pear Creek and East Helena was officially born. The smelter was in operation for over 100 years, providing a livelihood for thousands of families along the way before shutting down in 2001. Today, East Helena serves primarily as a bedroom community for Helena yet maintains the same industrious sense of pride and community that has sustained it since its humble beginnings.

The population of East Helena was recorded at 1984 as of the 2010 census and was estimated to be 2265 as of 2017. Area growth has caused local elementary and junior high schools to be overcrowded, as well as to create demand for a local high school to improve convenience for residents and relieve some pressure on the high schools in Helena. In May of 2017, the residents of East Helena approved a $12 million facilities bond to build a new elementary school in order to address overcrowding at the Eastgate and Radley elementary schools. Prickly Pear Elementary School opened its doors along the west side of Valley Drive, north of Lewis Street, in August of 2018. In May of 2018, voters approved a $29.5 million bond to build a new high school that will also be located along the west side of Valley Drive approximately one-half mile north of Prickly Pear Elementary School. Construction is under way on the high school now with the doors expected to open late in the summer of 2020.

Other area development is also planned or ongoing, including a large, multi-phase single-family residential subdivision to be situated between the two school campuses along Valley Drive and a smaller single-family residential subdivision that may also have multiple phases to the west of the corridor off of Plant Road. The rapid development along the Montana Avenue/Valley Drive corridor will bring with it increased traffic demand that will impact the roadway and its intersections both physically in terms of infrastructure wear and tear, but also with respect to traffic congestion and safety conditions. Therefore, the City of East Helena proactively initiated a project to study the corridor and develop a program for constructing improvements intended to improve the corridor and provide for long-term safety and efficiency of travel for all users. Figure 1 on the following page provides an illustration of the corridor study limits and key attributes.

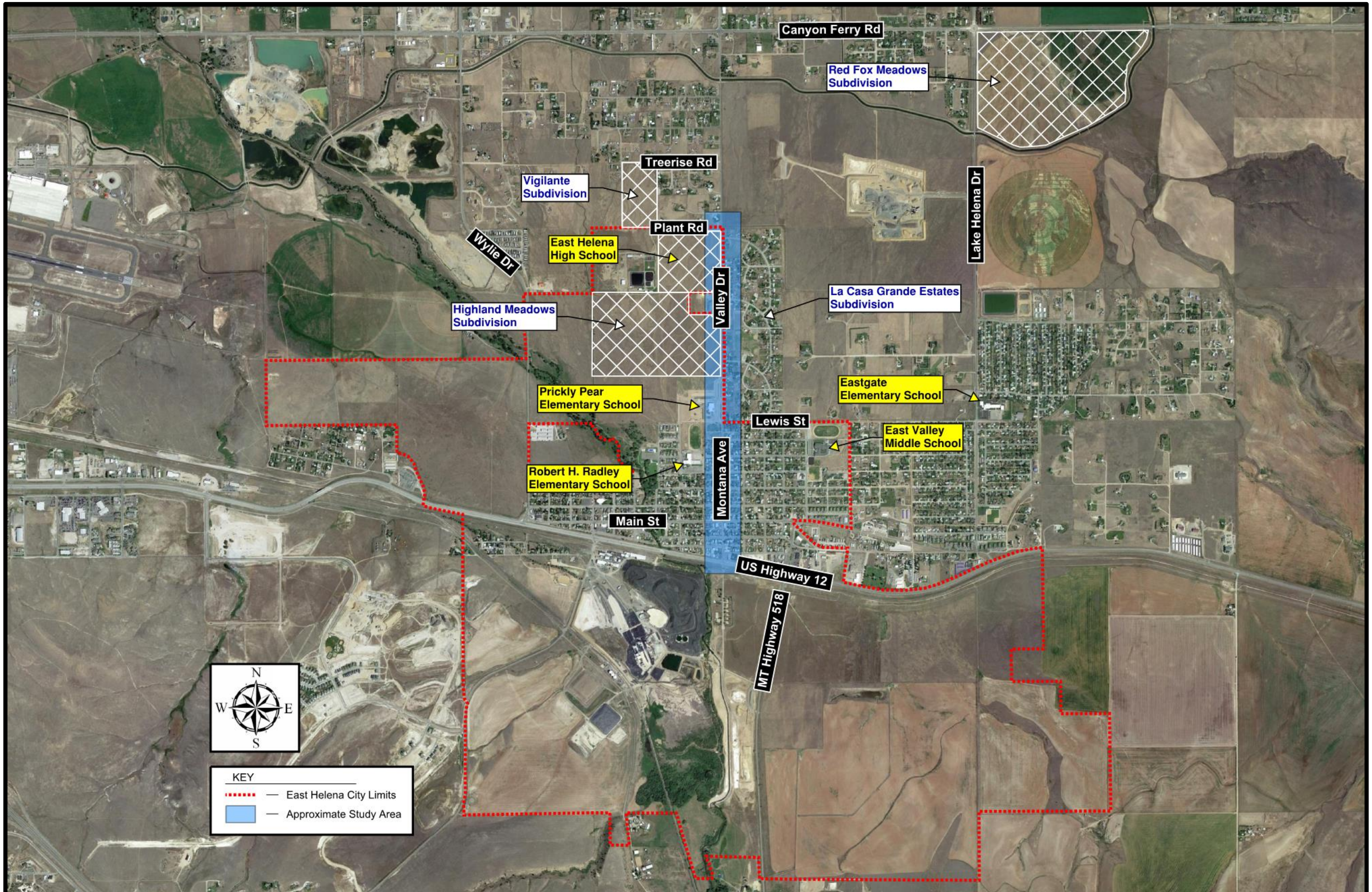

Figure 1. Study Area

Goals & Objectives

The purpose of the Montana Avenue/Valley Drive Corridor Study/Preliminary Engineering Report (PER) project was to develop a framework for constructing transportation-based improvements that will provide safe and efficient traffic operations at a sustainable level up to and beyond a 20-year design horizon. It is important to note that the intent of this study was very specific relative to identifying improvements needs specifically for a limited segment of the Montana Avenue/Valley Drive corridor only. As such, the report generally does not evaluate alternate, intersecting, or parallel corridors except with respect to specific impacts to a prospective reconstruction project for Montana Avenue/Valley Drive.

The following study objectives were identified by the City of East Helena at the outset of the project and have thus guided the development of the study report:

1. Evaluate current conditions for the Montana Avenue/Valley Drive corridor from US Highway 12 to Plant Road
2. Project traffic and roadway-related impacts to the corridor associated with development of the new high school, other planned or ongoing land development projects, and general projected growth in East Helena
3. Develop prioritized recommendations for roadway and intersection improvements based on a 20-year design horizon
4. Estimate design and construction costs for recommended improvements
5. Develop a recommended approach for calculating proportionate cost share of improvements to be assigned to School District #9, the City of East Helena, Lewis and Clark County, and private development; additionally, provide guidance on development of a special improvements district (SID) scheme to pay back the cost proportion assigned to the City

Literature Review

Prior to performing the analysis for this project, Sanderson Stewart thoroughly reviewed a selection of previously-completed traffic impact and corridor studies that focused on the project corridor and/or land development projects that have the potential to impact corridor operations. In addition, we reviewed a handful of other planning documents applicable to East Helena and the surrounding area. The following paragraphs provide brief summaries of the key information in each of those documents.

Planning/Corridor Studies

The *Preliminary Engineering Report (PER) for Valley Drive* was completed by Robert Peccia & Associates in February of 2012. The PER provided an evaluation of the Valley Drive corridor between Lewis Street and York Road by analyzing road deficiencies, identifying future needs, and providing an assessment of improvements necessary to meet or exceed Lewis & Clark County road standards. It also provided base reconstruction cost estimates. The PER found that the existing roadway does not meet several minimum design criteria, and that the estimated cost to reconstruct the road to meet the design criteria would be approximately $1.15 million per mile including further engineering, traffic control during construction, right-of-way acquisition and other contingencies. Additional estimates of cost were also provided for several ancillary features not included in standard roadway reconstruction, including a traffic signal, turn lane, sanitary sewer main, water main, and bicycle/pedestrian path reconstruction.

The study area for the *Greater Helena Area Long Range Transportation Plan – 2014 Update (*Robert Peccia & Associates/ALTA Planning + Design, 2015*)* included all of the East Helena city limits a large portion of Lewis & Clark County to the east and north of East Helena. Areas of concern identified through public outreach and coordination with the East Helena City Council and the Prickly Pear Land Trust included the possible signalization of the Main Street/Montana Avenue intersection, an additional east/west connection from East Helena to Airport Road, and the extension of a trail system along Prickly Pear Creek to East Helena. Recommended major street network (MSN) projects in the LRTP that could impact traffic operations for the Montana Avenue/Valley Drive corridor in East Helena included an extension of Airport Road from "B" Street to Wylie Drive and the reconstruction of Montana Avenue from Lewis Street to US Highway 12 "to an appropriate urban collector street standard." Recommended county road network (CRN) projects included reconstruction of sections of Valley Drive between Lewis Street and York Road "to various typical sections to bring into alignment with major collector roadway standards," the reconstruction of Wylie Drive from Canyon Ferry Road to the East Helena city limits to "reduce future maintenance needs and better accommodate traffic increases . . .," and the reconstruction of Lake Helena Drive from Main Street to Lincoln Road East "to achieve a 32-foot top surfacing width and to bring into alignment with minor collector roadway standards." Recommended transportation system management (TSM) projects included modification of the Main Street/Montana Avenue intersection "to improve operations," referencing an engineering study that should include a traffic signal warrants analysis. None of the other recommended improvement projects or programs were significant relative to operations in the Montana Avenue/Valley Drive corridor.

Traffic Impact Studies

The *Red Fox Meadows Traffic Impact Study* was completed for the Hamlin Construction and Development Company, Inc. by WWC Engineering in July of 2015. The study evaluated a proposed mixed-use residential and commercial subdivision to be located on the southeast corner of the intersection of Canyon Ferry Road and Lake Helena Drive. It was determined that traffic generated by the Red Fox Meadows Subdivision could be adequately accommodated at proposed access points and the existing Canyon Ferry Road/Lake Helena Drive intersection without any substantial improvements. Recommendations included access restrictions at two of the site access intersections and installation of stop signs at all approaches to public streets. No turn lanes were found to be warranted at site access intersections.

The *Traffic Impact Study – New East Helena Elementary School* was completed for WWC Engineering, Inc. by Abelin Traffic Services in May of 2017. The study evaluated impacts for Prickly Pear Elementary School, which opened its doors in late summer 2018. The study determined that the new school would not significantly increase travel delay at nearby intersections, although some improvements to surrounding roadways were recommended. These recommendations included creating a school zone on Valley Drive and lowering the speed limit to 25 mph (from 35 mph) south of Prickly Pear Avenue, adding a stop sign on East Lewis Street at its intersection with Thurman Avenue (to accommodate bus traffic utilizing the intersection to enter the school site), and installing a pedestrian crosswalk across Valley Drive just north of Lewis Street.

The *East Helena High School Traffic Impact Study* was completed for East Helena Public Schools by Abelin Traffic Services in June of 2018. The new high school is currently under construction along the west side of Valley Drive approximately ½ mile north of Prickly Pear Elementary School. The study determined that the new high school would not significantly change operations at intersections along Montana Avenue/Valley Drive, though some generalized recommendations were made to accommodate the expected increase in vehicle and pedestrian demand around both schools. It was recommended that a structural analysis be performed for Montana Avenue/Valley Drive to predict the design life of the road. Other recommendations included a review of traffic operations at the Montana Avenue/Lewis Street and Main Street/Montana Avenue intersections at full enrollment to determine if all-way stop-control is necessary at either intersection, review of vehicle speeds on Valley Drive in front of the East Helena High School to determine if modifications to the speed limit are warranted, evaluation of turn lanes on Valley Drive at the school entrances, and consideration of pedestrian access from the existing residential area to the north of the high school site.

Abelin Traffic Services performed an evaluation of school crosswalks for the City of East Helena in October of 2018, summarizing the study in a letter to the City. The study evaluated crosswalks at the intersections of Montana Avenue and Lewis Street (adjacent to Prickly Pear Elementary School) and Thurman Avenue and Clinton Street (adjacent to Radley Elementary School). At the Montana Avenue/Lewis Street intersection, it was found that the new school approach onto Montana Avenue was functioning adequately, and that high traffic flow during pick-up and drop-off periods slows down traffic which has a positive impact on overall safety. It was determined that the existing 25 mph speed limit is appropriate given the operating conditions. It was recommended that a new signed pedestrian crosswalk be installed along the south side of the Montana Avenue/Lewis Street intersection with inclusion of Rectangular Rapid Flash Beacons (RRFB) considered to enhance visibility. Installation of a pedestrian path or sidewalk along the west shoulder of Montana Avenue between Lewis Street and King Street was also recommended for consideration to facilitate pedestrian use and to keep pedestrians out of the road. Recommendations at the Thurman Avenue/Clinton Street intersection included a full redesign of the Clinton Street/Radley School parking lot to create defined separation between the road and the parking area. Roadside and intersection vegetation trimming was strongly recommended for both intersections to improve visibility of pedestrians and to allow adequate intersection sight distance of 200-250 feet for vehicles. Lastly, it was recommended that all signs be removed from intersection sight triangles.

The *Highland Meadows Residential Development Traffic Impact Study* was completed for Stahly Engineering & Associates, Inc. by Abelin Traffic Services in February of 2019. The study evaluated the proposed Highland Meadows Subdivision located west of Valley Drive between Prickly Pear Elementary School and the new East Helena High School. The study concluded that development of the 320-lot single family residential subdivision would not significantly change operations at the intersections along Montana Avenue/Valley Drive near the development site, but it was expected that future vehicle flows at the South Main Street/Montana Avenue intersection would be such that all-way stop-control should be implemented. It was also recommended that the developers should consider participating in the upcoming PER (this study) and proportionally share in any necessary roadway improvements identified therein.

The *Vigilante Subdivision Traffic Impact Study* was completed for Triple Tree Engineering by Abelin Traffic Services in June of 2019. The study evaluated the proposed single-family residential subdivision which is to be annexed into the City of East Helena through the entitlement process. The TIS concluded that development of the subdivision "would not significantly change the operations at intersections along Valley Drive and Montana Avenue near the proposed development site," recommending that all-way stop control be implemented at the Main Street/Montana Avenue intersection but stating that the improvement would be necessary regardless of construction of Vigilante Subdivision. Lastly, the TIS recommended that the developers waive the right to protest inclusion in a SID to provide road improvements along Valley Drive.

Public Participation

A project website was created (http://sandersonstewart.com/projects/easthelenacorridorstudy/) for the dual purposes of presenting project deliverables and notifications to the public as well as providing an avenue for public input/feedback. A public hearing was held on August 29, 2019 to present preliminary findings and recommendations from the corridor study. Approximately 20-25 people attended the meeting, including City staff. Comments received at the public hearing, via the website, or through direct communications with the City or the project team have been summarized in a comment-response spreadsheet that is included as an attachment in Appendix A.

EXISTING CONDITIONS

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In order to establish a baseline for recommended improvements to the Montana Avenue/Valley Drive corridor, it was first necessary to perform a thorough examination of the physical and operational characteristics of the existing roadway and key intersections. The following sections of the report provide background information on the transportation system and summarize current conditions.

Streets

The following paragraphs describe the existing area roadways that are most likely to be affected by this development. The references to functional classification are made with respect to designations in the *Greater Helena Area Long Range Transportation Plan – 2014 Update* (Robert Peccia & Associates/Alta Planning + Design, 2015).

Montana Avenue/Valley Drive

Montana Avenue/Valley Drive is functionally classified as a local road to the south of US Highway 12 (US 12) and as a minor collector from US 12 to York Road. The name of the street changes from Montana Avenue to Valley Drive at Lewis Street. The segment to the south of US 12 has a typical paved width of approximately 24 feet with no striping, curb and gutter, sidewalk or other associated improvements. A Montana Rail Link (MRL) railroad line that parallels US 12 crosses Montana Avenue south of the highway at a location approximately 120 feet south of the (center of) the intersection. Montana Avenue dead-ends at a barricade approximately 200 feet south of the railroad line, though the pavement actually terminates approximately 400 feet south of the railroad. Between US 12 and Lewis Street, Montana Avenue has a two-lane typical section with a paved surface width of approximately 32 feet and intermittent sidewalk along the west side of the road. There is no curb and gutter along Montana Avenue. The speed limit is posted at 25 mph.

Valley Drive extends north from Lewis Street as a paved street (to Howard Road) and then as a gravel road for a total distance of almost 6 miles before terminating at Merritt Lane. To the north of Lewis Street, the private property along the east side of the road falls outside the city limits in Lewis & Clark County jurisdiction, while the properties fronting the west side of the road are within the city limits up to Plant Road (see Figure 1). Valley Drive itself is a City street (annexed) up to the Plant Road intersection. Between Lewis Street and Plant Road, the typical section for Valley Drive is two lanes with a paved width of approximately 25-26 feet lanes (no curb and gutter). There is a 10-ft gravel multi-use trail along the west side of Valley Drive from Lewis Street to Plant Road. The multi-use trail is offset from the edge of pavement by approximately 35 feet. The speed limit for Valley Drive increases from 25 mph to 35 mph approximately 200 feet north of Lewis Street. Currently there is no school zone (reduced speed limit) in place along the Montana Avenue/Valley Drive corridor. Additional detail on right-of-way, roadway surfacing, drainage facilities, and traffic-related aspects of the Montana Avenue/Valley Drive corridor are provided in later sections of this report. Valley Drive has permanent load weight restrictions of 7 tons/axel and 14 tons/tandem axel or 350 lbs/inch width of tire from Lewis Street to Canyon Ferry Road that were originally enacted when the section of the road from Lewis Street to Plant Road was under County jurisdiction.

US Highway 12

US Highway 12 (US 12) is classified a principal arterial. As it passes through East Helena, US 12 has two thru lanes in each direction with a hatched (striped) flush median that is utilized for dedicated left-turn bays at intersections and 10-foot paved shoulders. There is a paved multi-use path on the north side of US 12 from Montana Avenue to an unconventional termination point approximately 200 feet east of Lane Avenue. The posted speed limit on US 12 is 45 mph in the vicinity of the Montana Avenue intersection.

East Main Street

East Main Street is classified as a major collector. To the west of Montana Avenue, East Main Street terminates at 4th Street on the west edge of the city. To the east of Montana Avenue, East Main Street terminates at Lake Helena Drive. The alignment of the street coincides with what was the original US Highway 12. East Main Street has a two-lane typical section with wide shoulders and on-street parallel parking from 4th Street to Washington Avenue. That stretch generally also has sidewalk on both sides of the street. To the east of Washington Avenue, East Main Street has narrow shoulders and no sidewalks. The posted speed limit on East Main Street is 25 mph.

Lewis Street

Lewis Street is classified as a local street. East of Valley Drive/Montana Avenue, Lewis Street has a paved width of approximately 25-26 feet. There is not striping to delineate lanes. To the west of Valley Drive and offset approximately 30 feet to the north (centerline to centerline) is an exit-only approach from Prickly Pear Elementary School. The posted speed limit on East Lewis Street is 25 mph.

Prickly Pear Avenue

Prickly Pear Avenue is classified as a local street. It extends east from Valley Drive, turning south through La Casa Grande Subdivision to intersect with Lewis Street and continues south through town to terminate at Porter Street. Between Valley Drive and Lewis Street, Prickly Pear Avenue is a County street. South of Lewis Street, it is a City street. Near its intersection with Valley Drive, Prickly Pear Avenue has a paved surface width of approximately 28-30 feet and provides local access to single-family homes in Casa Grande Subdivision.

Cobre Drive

Cobre Drive is classified as a local street. It extends east from Valley Drive, turning south through La Casa Grande Subdivision to terminate at Prickly Pear Avenue. Cobre Drive is a County street with a paved surface width of approximately 28-30 feet that provides local access to single-family homes in Casa Grande Subdivision.

Bandera Drive

Bandera Drive is classified as a local street. It extends east from Valley Drive, turning south through La Casa Grande Subdivision to terminate at Cobre Drive. Cobre Drive is a County street with a paved surface width of approximately 28-30 feet that provides local access to single-family homes in Casa Grande Subdivision.

Plant Road

Plant Road is classified as a local street. It is a gravel road with a surface width of approximately 22 feet that provides access to three residences and the City of East Helena sewer plant. There is no posted speed limit on Plant Road.

Academic Street

Academic Street is a private roadway the extends west from Valley Drive through the Prickly Pear Elementary School Campus, eventually turning south and tying into Thurman Avenue. As it is a private street, there is no enforceable speed limit.

Wylie Drive

Wylie Drive is classified as a major collector that extends from US 12 to York Road as a paved, two-lane highway before becoming a gravel road. It is generally located one mile to the west of Montana Avenue/Valley Drive, although it jogs approximately ¼ mile to the east in the vicinity of East Helena to tie into US 12 at a distance of approximately 4000 feet to the west of the project corridor. Posted speed limits on Wylie Drive range from 25 mph (adjacent to town) to 55 mph. The primary significance of Wylie Drive to this study is in relation to a future possible east/west roadway connection between Valley Drive and Wylie Drive that would be located at approximately the boundary between the Highland Meadows Subdivision and East Helena High School properties. More discussion on this potential roadway connection can be found in the Future Transportation Network section of the report on page 23.

Intersections

The following paragraphs describe the existing major street intersections that are adjacent to the development site and will potentially be impacted by the new development.

US Highway 12/Montana Avenue

The intersection of US Highway 12 (US 12) and Montana Avenue has four legs and is stop-controlled on the north and south (Montana Avenue) approaches. The east and west (US 12) approaches each have two thru lanes and a dedicated left-turn lane. There is a marked crosswalk on the west approach although there are no sidewalks to the north or south along Montana Avenue. The north and south approaches have single lanes. As referenced previously, there is a signalized MRL railroad crossing on the south leg (Montana Avenue) located approximately 70 feet south of US 12 (measured from the south edge of asphalt). Through preliminary discussions with MRL that were initiated with regard to the potential need for future traffic signal preemption at this intersection as it relates to the railroad crossing, they have indicated that they would prefer to have the at-grade railroad crossing on Montana Avenue closed (i.e., that the south leg of the intersection be closed) to improve safety and reduce costs associated with operations/maintenance. In lieu of the grade crossing at Montana Avenue, MRL proposes providing a public roadway easement (dedicated to the City of East Helena) south of the tracks for a new roadway which would be built from Montana Highway 518 to Montana Avenue south of the tracks that would provide general access to that area, which has been discussed as a possible location for a large, public space/park.

Main Street/Montana Avenue

The intersection of Montana Avenue and East Main Street has four legs and is stop-controlled on the north and south (Montana Avenue) approaches. There are no auxiliary turn lanes on any of the intersection approaches. The west approach has a marked crosswalk that connects to a sidewalk on the northwest corner of the intersection. Sight distance to the east is poor from the south approach due to the location of a building on the southeast intersection corner.

Montana Avenue – Valley Drive/Lewis Street – Prickly Pear Elementary School South Access

The intersection of Montana Avenue/Valley Drive with Lewis Street and the south approach to the Prickly Pear Elementary School campus has four legs, although the west (Prickly Pear) approach is offset to the north from Lewis Street by approximately 30 feet. The east (Lewis Street) and west (Prickly Pear) approaches are stop-controlled. The west (Prickly Pear) approach is an egress-only approach that has separate lanes striped for left-turn and right-turn movements. There is a marked crosswalk on the west approach that connects to the gravel multi-use trail to the north. There is no sidewalk or multi-use trail to the south. Due to the offset from Lewis Street, the west approach does not have any markings for an eastbound thru movement to Lewis Street. It is thereby implied that a driver would make a right-turn from that approach onto Montana

Avenue and then make an immediate left-turn movement onto Lewis Street. However, there is very little vehicle queue storage space between the intersections. There are no turn lanes on the north or south intersection approaches.

Valley Drive/Prickly Pear Elementary School Central Access

The intersection of Valley Drive and the central Prickly Pear Elementary School access approach is a "T" intersection that is stop-controlled on the west (Prickly Pear) approach. That west approach is egress-only, is intended for use only by school buses, and is restricted (by pavement markings and alignment geometry) to right-out only operation. However, it is likely that non-school bus vehicles use this approach at times and make left turns onto Valley Drive since it is not physically difficult to do so. There is a marked crosswalk on the west approach that connects to the gravel multi-use trail to the north and south.

Valley Drive/Prickly Pear Elementary School North Access

The intersection of Valley Drive and the north Prickly Pear Elementary School access approach is a "T" intersection that is stop-controlled on the west (Prickly Pear) leg. There are no auxiliary turn lanes at this intersection. There is a marked crosswalk on the west approach that connects to the gravel multi-use trail to the north and south.

Valley Drive/Prickly Pear Avenue

The intersection of Valley Drive and Prickly Pear Avenue is stop-controlled on the east (Prickly Pear Avenue) approach. There are no auxiliary lanes at the intersection.

Valley Drive/Cobre Drive

The intersection of Valley Drive and Cobre Drive is stop-controlled on the east (Cobre Drive) approach. There are no auxiliary lanes at the intersection.

Valley Drive/Bandera Drive

The intersection of Valley Drive and Bandera Drive is stop-controlled on the east (Bandera Drive) approach. There are no auxiliary lanes at the intersection.

Valley Drive / Plant Road

The intersection of Valley Drive and Plant Road is an uncontrolled intersection that likely operates as would a yield-controlled intersection whereby vehicles on the minor (Plant Road) approach yield to oncoming traffic. There are no auxiliary lanes at the intersection.

Right-Of-Way

This section of the report describes the existing public street right of way and easements along the Montana Avenue/Valley Drive corridor from US Highway 12 to Plant Road. The following subdivision plats and certificates of survey were used to determine the existing right of way in the corridor:

- Townsite of East Helena (C.O.S. 1000769)
- Syndicate Addition to East Helena (C.O.S. 1000832)
- La Casa Grande Estates (C.O.S. 278434)
- DeCunzo Subdivision (C.O.S. 3281132)
- Dartman Field Minor Subdivision (C.O.S. 3330122)
- C.O.S. 442171
- C.O.S. 544756
- C.O.S. 628344
- C.O.S. 3016384
- C.O.S. 3254911

- C.O.S. 3290768
- C.O.S. 3318935

Additionally, the right-of-way plans for MDT project FF-DP-77(20)R/W East Helena – E.&W. were utilized to help establish right-of-way boundaries along US 12. The following comments describe the existing right of way along the Montana Avenue/Valley Drive corridor:

1. The physical centerline of Montana Avenue/Valley Drive matches the right of way centerline.
2. Sixty (60) feet of right of way (30' left and 30' right of centerline) is dedicated along Montana Avenue from US 12 to Groschell Street (2 blocks north of Main Street).
3. Sixty-five (65) feet of right of way (35' left of centerline, 30' right of centerline) is dedicated along Montana Avenue from Groschell Street to Lewis Street.
4. A 60-foot public access and utility easement (30' left and 30' right of centerline) is maintained along Valley Drive from Lewis Street to Plant Road.
5. Tract C (C.O.S. 3254911) adds an additional 64-foot public easement and right of way along Valley Drive from Lewis Street to Plant Road left of centerline, totaling in 94 feet from centerline.

Roadway Surfacing

SK Geotechnical performed a preliminary geotechnical investigation for the project corridor as a part of this study. The summary report is included as an attachment to this study in Appendix B. The pavement surface on the street was generally observed to be in poor condition with intermittent rutting, longitudinal cracking, and minor potholes throughout. Borings in the roadway and the existing gravel multi-use trail were drilled on April 22, 2019 (see summary report for boring locations map). The borings showed that the existing asphalt varies in thickness from approximately 2 inches to 6 ½ inches. Base gravel under the asphalt varies from approximately 0 inches to 3 inches. Below the pavement and base gravel, the subgrade is made up primarily of clayey sands and sandy lean clays to depths of between 1 ½ feet and 3 feet underlain by sandy gravels. Borings in the multi-use trail showed approximately 1 foot of clayey sand/clayey gravel fill underlain by sandy gravels. No groundwater was encountered in any of the roadway or multi-use trail borings.

Drainage Facilities

A site reconnaissance visit and drainage facilities inventory was performed by Great West on April 30, 2019. A drainage structure inventory summary is included in Appendix C that provides photos, locations (approximate mile post), structure characteristics, and condition of drainage structures located within the study area. For reference, mile post (MP) stationing begins (0.00) at US 12, with Lewis Street at approximately MP 0.54, and Plant Road at approximately MP 1.28. The following is a summary of the existing drainage facilities.

The corridor segment from US 12 to Lewis Street (MP 0.00–0.54) does not have much in the way of existing storm water management facilities. The only curb and gutter along this segment lies along the west-side frontage of the commercial property occupied by the Man Store located on the northwest corner of the US 12/Montana Avenue intersection. That curb and gutter seems to drain to the north, but does not feed to any inlets, an outfall, or a collection system of any kind. Raised sidewalks that may collect/channel runoff front the corridor in a few locations, though again not to a particular collection location. There is an area inlet on the southeast corner of the Main Street/Montana Avenue intersection that connects to a manhole with a grate lid on the southwest corner of the same intersection that in turn connects to another manhole (also with a grate lid) that is inline on a 21-inch storm drain main running east-west along the south side of Main Street. The inlets at the Main Street intersection appear to pick up some flow from Montana Avenue between US 12 and Main Street, as well as some flow from Main Street. However, it is likely that only a small portion of the surface runoff on Montana Avenue would find its way to the inlets due to a lack of consistent longitudinal grade or curb and gutter facilities to channel the flows. The 21-inch storm drain main in Main Street flows west to an outfall in Prickly Pear Creek.

Also, in the corridor segment between US 12 and Lewis Street, there is an area inlet in the pavement on the northeast corner of the Montana Avenue-Valley Drive/Lewis Street intersection that drains to a dry well system. The inlet does not benefit from any curb and gutter, valley gutter, or other channelization system to collect runoff, nor does it appear to be in a depression relative to the surrounding pavement. Multiple areas of ponding were observed in the driving lanes, roadway shoulders, and driveway approaches during the site visit due to recent rain, which provided a prime example of what is generally poor drainage in the US Highway 12 to Lewis Street segment.

The segment of the corridor from Lewis Street to Plant Road (MP 0.54–1.28) showed an increased use of storm water drainage features, albeit of a rural roadway nature. Roadside ditches on the east and west sides of the roadway were observed to convey storm water with culverts under driveway and street approaches. The ditches were quite shallow in various locations along the roadway, but generally appeared adequate for drainage. The longitudinal ditch grade appeared to be generally sufficient for drainage as well. One exception to this was observed in the vicinity of the Prickly Pear Avenue intersection, where the ditch slope appeared to flatten for 300 to 400 feet going north.

Along with the roadside drainage ditches, there are numerous culverts that convey water across driveway and street approaches. A wide variety of culvert materials were observed including high-density polyethylene (HDPE), reinforced concrete pipe (RCP), corrugated metal pipe (CMP), and steel. Various culverts were deemed to be non-functional (as noted in the inventory summary) because they had crushed, buried, or clogged inlets and/or outlets. The culverts on the west side of the study area generally appeared to be properly sized and in good condition, presumably due to recent construction/reconstruction on that side of the road via the school projects. A single mainline cross drain culvert was found to be located within the study area and was thought to have previously served an irrigation ditch, flowing from northeast to southwest. It appeared that the irrigation ditch was not in use.

FEMA flood maps (30049C2333E & 30049C2331E) were analyzed to determine if the study area is located within a floodplain. It was determined that the study area is not within a FEMA designated floodplain. It was noted that the 100-year floodplain (Zone A) for Prickly Pear Creek does appear to cross Valley Drive at approximately 1500 and 2000 feet north of Plant Road. It was also noted that north of Plant Road on Valley Drive (out of the study area) roadway drainage significantly deteriorates with roadside ditches becoming less prominent and even non-existent and with very few approach culverts installed under driveway or road connections.

Signs/Pavement Markings

A sign inventory was completed for the Montana Avenue/Valley Drive corridor on April 20, 2019. Most signs were found to be in fair or good condition, with a few exceptions as noted in the sign inventory summary (Appendix D). Existing signs are mounted on a variety of post types, including telespar (square, perforated metal), U-channel, round metal posts, square wood posts, and on street lights. Sign mounting heights and offsets from the roadway were found to vary greatly as well. As was noted earlier in this report, there is no signed school zone on Valley Drive adjacent to Prickly Pear Elementary School, although there are several school crossing warning signs for uncontrolled crosswalks on Main Street (crosswalk on west leg of Montana Avenue intersection) and on Montana Avenue (crosswalk on north leg of Clinton Street intersection and crosswalk on south leg of Lewis Street intersection). It should also be noted that there are several sign assemblies on the private access approaches to the Prickly Pear Elementary School campus whereby multiple signs are mounted on individual posts, including multiple signs facing the same direction, signs mounted back-to-back to face two directions, and combinations of multiple regulatory signs, as well as combinations of regulatory and warning signs. The Manual on Uniform Traffic Control Devices (MUTCD) recommends that signs should be installed on separate posts or mountings except in cases where one sign supplements another (such as a street name sign with a stop sign or a supplementary speed plaque with a warning sign). In particular, it is typically considered a bad practice to install a warning sign and regulatory sign (for example, a stop sign and a school crossing warning sign) on the same post, because the combination of messages could dilute their effectiveness.

Pavement markings in the project corridor are generally faint and in poor condition, except on the approaches to the Prickly Pear Elementary School campus. In particular, transverse markings such as stop bars and crosswalks are worn and to the point of being less visible, particularly in nighttime lighting conditions.

Bicycle/Pedestrian Facilities

Sidewalk is generally limited along the Montana Avenue/Valley Drive corridor to the west side of the street for a three and one-half block stretch from East Main Street to mid-block between Clinton Street and King Street. Various of the east-west streets that intersect with Montana Avenue have intermittent sidewalks, some of which terminate at Montana Avenue. Only East Main Street has sidewalk on both sides of the street both east and west of Montana Avenue. As was previously referenced, there is a 10-ft gravel multi-use trail offset along the west side of Valley Drive from Lewis Street to Plant Road.

Public Transit

Capital Transit Service is the public bus and paratransit service provider for Helena and portions of Lewis & Clark County. There are currently two standard public bus routes, neither of which extend to East Helena. However, Capital Transit Service does provide a paratransit service bus service known as the "East Valley Bus" that includes checkpoints at the East Helena Library and East Helena City Hall. No other public transit systems are currently in operation in the Helena area.

Street Lights

Street lighting for the corridor is generally limited to public street and alley intersections. Most such intersections between US 12 and Lewis Street have a single street light positioned on an intersection corner. The luminaires are mounted on power poles. Only the alleys intersection between King Street and Lewis Street do not have street lights. To the north of Lewis Street there are no street lights along Valley Drive.

Private Utilities

Various private utility companies occupy or cross the Montana Avenue/Valley Drive corridor. Northwestern Energy has an overhead power line and a natural gas pipeline located along the east side of the corridor, as well as overhead power service poles along the west side of the street. The power poles sit at offsets from the travel lanes varying from approximately 10-20 feet with the east-side poles in closer proximity (10-15 feet). The Northwestern Energy natural gas pipeline sits approximately 7-9 feet east of the east edge of asphalt (as measured north of Lewis Street). Centurylink has four (4) telecommunications lines located along the west side of the corridor approximately 5 feet to 26 feet from the west edge of asphalt (as measured north of Lewis Street). Three (3) of those lines are direct-bury cables and the fourth is in a conduit.

Traffic Operations Analysis

Sanderson Stewart performed a traffic operations analysis based on existing intersection geometry, traffic control, and peak hour traffic demand conditions for the purposes of documenting any current operational or safety concerns and to establish a baseline for comparison of future project conditions. The following sections of the report summarize the results of the existing conditions traffic operations analysis effort.

Traffic Volumes

Prior to performing traffic data collection for this project, Sanderson Stewart reviewed existing available traffic data from recent/ongoing traffic impact studies and from the Montana Department of Transportation website. Raw turning movement count data was then collected using Miovision Scout video-based systems at five (5) existing intersections (see bulleted list below). The day/date of the counts was Wednesday, April 3, 2019.

- US Highway 12/Montana Avenue

- Main Street/Montana Avenue
- Montana Avenue-Valley Drive/Lewis Street- South Prickly Pear Elementary School Access
- Valley Drive/Central Prickly Pear Elementary School Access
- Valley Drive/North Prickly Pear Elementary School Access

The morning, after school, and evening peak hour periods were generally found to occur from 7:30 to 8:30 AM, 2:45 to 3:45 PM, and 4:45 to 5:45 PM, respectively. Note that evening peak hour count data was not processed for the central and north Prickly Pear Elementary School access intersections, since that facility typically does not generate substantial traffic at that time of day except on special occasions. Raw count data was adjusted for seasonal variations using MDT seasonal adjustment factors. Figure 2 on the following page summarizes the calculated Existing Conditions (2019) peak hour turning movement volumes the morning, after school, and evening peak hours. Note that traffic volumes for the Valley Drive/Plant Road intersection were projected based on count information contained in the *East Helena High School Traffic Impact Study* (Abelin Traffic Services, 2018). Detailed traffic count data worksheets are included in Appendix E.

Intersection Capacity

Existing Conditions (2019) intersection capacity calculations were performed for the study area intersections listed above using Highway Capacity Software (HCS7), which is based on methodology from the Highway Capacity Manual, 6th Edition (Transportation Research Board, 2016). The most universally recognizable metric for describing intersection capacity is level of service. Level of service (LOS) is defined as a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience. LOS is a quantitative measure of the performance of an intersection with values ranging from LOS A, indicating good operation and low vehicle delays, to LOS F, which indicates congestion and longer vehicle delays.

The results of the Existing Conditions (2019) intersection capacity analysis for this study showed that all intersections operate at LOS C or better during each of the three peak hours (morning, after school, and evening). Projected queue lengths were minimal for all of the study area intersection approaches. In short, none of the study area intersections seem to experience any significant congestion, even during peak periods, based on typical weekday conditions. Table 1 on page 15 summarizes the results of the Existing Conditions (2019) intersection capacity calculation results. Capacity calculation worksheets for each of the study area intersections can be found in Appendix F.

Auxiliary Turn Lane Warrants

Auxiliary right- and left-turn lane warrants were evaluated based on the methodologies outlined in the AASHTO "green book" and MDT's Traffic Engineering Manual (November 2007), respectively, for all study area intersections using existing traffic volumes. It was determined on that basis that no auxiliary turn lanes are needed based on existing traffic volumes. It's worth noting that the minimum design speeds for analyzing auxiliary turn lane warrants based on the AASHTO and MDT methodologies are 40 mph and 45 mph, respectively, so the warrant criteria are generally more appropriately applicable for the segment of the corridor north of Lewis Street where the speed limit is posted at 35 mph (vs. between US 12 and Lewis Street where the posted speed limit is 25 mph). A more detailed summary of turn lane warrant calculations in presented in Appendix G.

Traffic Signal Warrants

Traffic signal warrants were evaluated for the US 12/Montana Avenue intersection using the criteria outlined in the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD presents a number of different warrants that can be considered, including various traffic volume-based warrants, and warrants that focus on school crossings, railroad crossings, crash history, and other considerations. For the purposes of this study, Warrants 4, 5, and 9 (Pedestrian Volume, School Crossing, and Intersection Near a Grade Crossing) were not considered to be applicable for the subject intersections since pedestrian volumes (school-related or otherwise) in this area are very low and will likely continue to be relatively low in the future and given that the south leg of the intersection is likely to be closed in order to eliminate the at-grade railroad crossing. For the US 12 intersection, the high-proportion of right-turn movements on the north (minor) approach invokes the subjective question

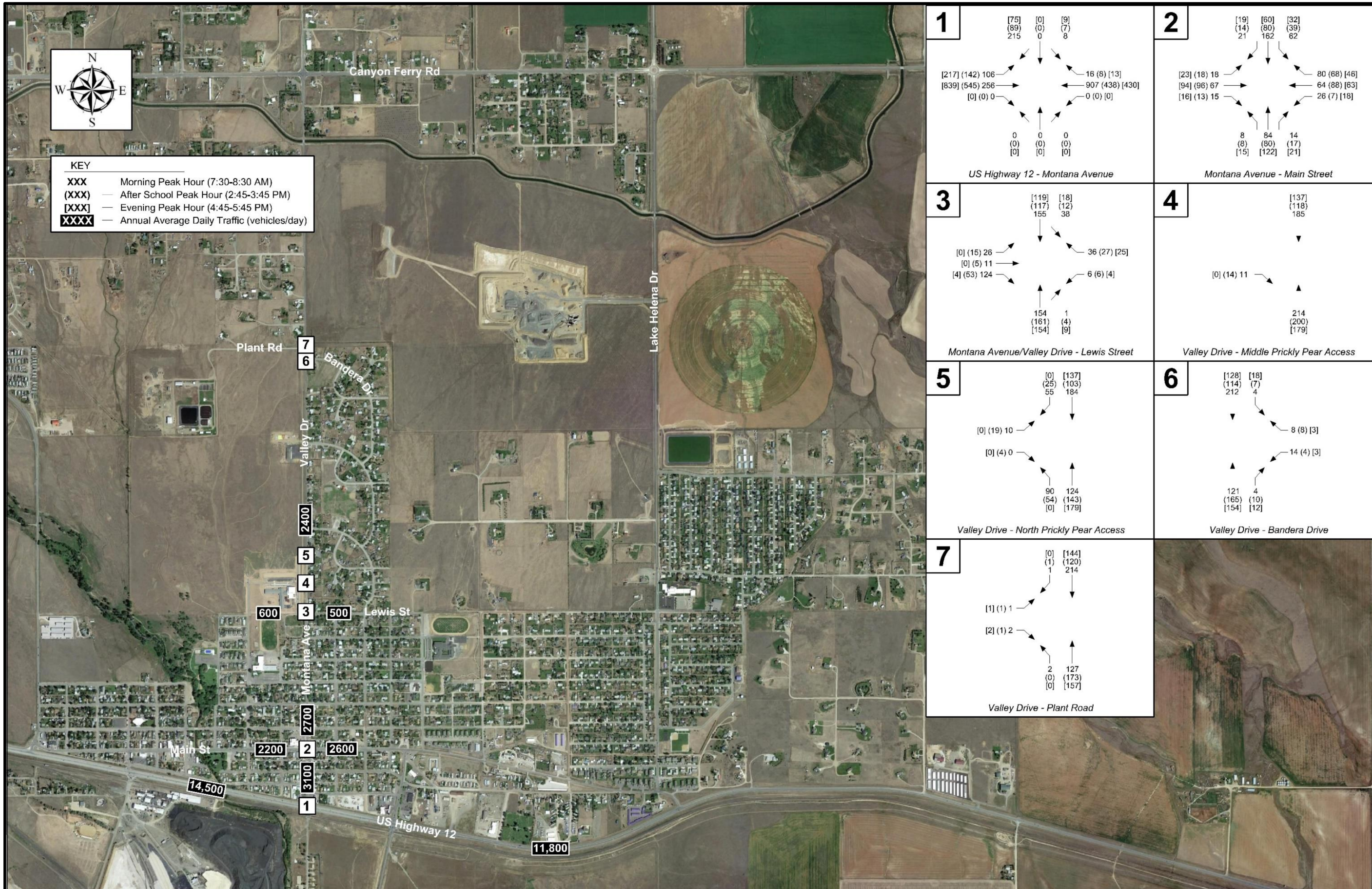


Figure 2. Existing Conditions (2019) Traffic Volumes Summary

Table 1. Existing Conditions (2019) Intersection Capacity Calculation Results

Intersection	Approach	Existing (2019)								
		Morning Peak			After School Peak			Evening Peak		
		Avg Delay (s/veh)	LOS	95th % Queue (veh)	Avg Delay (s/veh)	LOS	95th % Queue (veh)	Avg Delay (s/veh)	LOS	95th % Queue (veh)
Intersection Control		*Two-Way Stop-Control (NB/SB)*								
US 12/Montana Avenue	EB	3.0	A	1	1.8	A	1	1.8	A	1
	WB	0.0	A	0	0.0	A	0	0.0	A	0
	NB	5.0	A	0	5.0	A	0	5.0	A	0
	SB	17.5	C	3	11.2	B	1	13.0	B	1
Intersection Control		*Two-Way Stop Control (NB/SB)*								
Main Street/Montana Avenue	EB	1.5	A	1	1.1	A	0	1.3	A	0
	WB	1.3	A	1	0.4	A	0	1.2	A	0
	NB	14.3	B	2	13.5	B	1	13.4	B	2
	SB	21.6	C	5	14.7	B	2	12.9	B	1
Intersection Control		*Two-Way Stop-Control (EB/WB)*								
Montana Avenue-Valley Drive/Lewis Street-South Prickly Pear Elementary School access	EB	11.7	B	1	10.8	B	1	8.9	A	0
	WB	11.0	B	1	11.0	B	1	9.6	A	1
	NB	--	--	--	--	--	--	--	--	--
	SB	1.8	A	1	0.8	A	0	1.1	A	0
Intersection Control		*One-Way Stop-Control (EB)*								
Valley Drive/Central Prickly Pear Elementary School Access (Exit Only)	EB	10.3	B	1	9.7	A	1	9.3	A	0
	NB	--	--	--	--	--	--	--	--	--
	SB	--	--	--	--	--	--	--	--	--
Intersection Control		*One-Way Stop-Control (WB)*								
Valley Drive/North Prickly Pear Elementary School Access	EB	14.4	B	1	12.9	B	1	10.9	B	1
	NB	3.9	A	1	2.5	A	1	0.5	A	0
	SB	--	--	--	--	--	--	--	--	--

of whether or not the traffic demand for that movement should be included in the warrant analyses. The MUTCD directs that the engineer should use discretion in this determination based on whether or not a right-turn movement in a dedicated lane can be made with "low conflict." There is not currently a dedicated lane for the southbound right-turn movement at the intersection, but such a lane could be provided with relative ease. The more complicated question is whether or not the right-turn movements should be considered as low conflict. There are two receiving lanes on US 12, which helps to spread out conflicting westbound traffic, thereby creating more gaps in the traffic stream. However, travel speeds on US 12 in this area are also relatively high (speed limit of 45 mph), which makes the judgement of gaps more difficult, particularly at night. Based on the count data collected for this study, approximately 93% of the traffic demand for the north approach at the intersection consisted of right turns. A review of video footage from the Miovision traffic data collection effort for the morning peak hour shoed that right-turning vehicles from the minor approach were generally able to merge into the traffic stream without causing frequent braking by westbound major street vehicles. This may be indicative that southbound right-turns could be considered as low-conflict movements. Although it was shown through traffic signal warrant calculations that all three of the traffic volume-based warrants would be met if 100% of the minor approach traffic demand is included in the analysis, if even half of the right-turn volume is removed from consideration, only the Peak Hour warrant would still be satisfied, and a reduction by 60% would eliminate the Peak Hour warrant as well. Incidentally, a traffic signal is not typically considered to be justifiable based on satisfaction of only the Peak Hour warrant. Considering all of the above discussion, a traffic signal may or may not be considered as warranted for the US 12/Main Street intersection depending on whether or not the minor approach right-turn movements are constituted as being low-conflict. Note that MDT, by virtue of a letter providing review comments on the draft report (see comments in Appendix A), indicated that they do not support installation of a traffic signal at this location for a variety of reasons. Detailed signal warrant calculations are provided in Appendix H.

Crash History

Historical crash data was requested from MDT for all study area intersections for the most recent available five-year period. MDT was able to provide crash records for three (3) intersections (US 12/Montana Avenue, Montana Avenue/East Main Street, and Montana Avenue-Valley Drive/Lewis Street-Prickly Pear Elementary School south access) for the five-year period from January 1, 2014 through December 31, 2018. The City of East Helena supplemented that data from with additional crash records. The combined data was analyzed for the purposes of calculating intersection crash and severity rates. Table 2 below summarizes the results of the analysis. Intersection crash rates were calculated on the standard basis of crashes per million vehicles entering (MVE) for each intersection. The MVE metric was estimated based on 2019 peak hour traffic counts and MDT published ADTs. Crash and severity rates were generally very low. No fatalities were reported for any of the crashes during the five-year analysis period.

As a means of evaluating the historical crash frequency rates, Sanderson Stewart calculated expected rates using the predictive crash rate formulas in the AASHTO Highway Safety Manual (HSM). The process involves calculating the number of crashes predicted in a year based on traffic demand (AADTs) and various physical and traffic environment-based conditions such as lane configurations, intersection traffic control, and intersection geometry. The calculation results in a crashes-per-year prediction. Sanderson Stewart then calculated a predicted frequency rate on the basis of million vehicles entering for the sake of comparison with the actual historical crash rate. The results of the calculations for this study showed that the calculated historical crash rates were approximately equal to or substantially lower than what was predicted for all three intersections based on the HSM analysis. The HSM rate predictions and crash totals for each intersection are also summarized in Table 2.

Severity index is defined as the weighted average by crash severity, including fatality, injury, and property damage only (PDO) crashes. Severity rate is defined as the crash rate multiplied by the severity index. Severity rates were the same as the frequency rates as both intersections only experienced PDO crashes. Severity rates are summarized in Table 2.

Table 2. Historical Crash Data Analysis Results

Intersection	2014-2018 DEV[1]	Reported Crashes[2]	Crash Type			Crash Rates (per MVE[3])		HSM Predictions[4]	
			PDO	Injury	Fatality	Frequency	Severity	Annual Crashes	Frequency (crashes/MVE)
US 12/Montana Avenue	14177	7	4	3	0	0.27	0.50	1.3	0.25
Main Street/Montana Avenue	5779	4	3	1	0	0.38	0.57	0.9	0.43
Montana Avenue-Valley Drive/Lewis Street-Prickly Pear Elementary School south access	3665	1	1	0	0	0.15	0.15	0.6	0.45

[1] Daily Entering Volume (DEV) estimated based on MDT-published ADT volumes and 2019 peak hour counts.

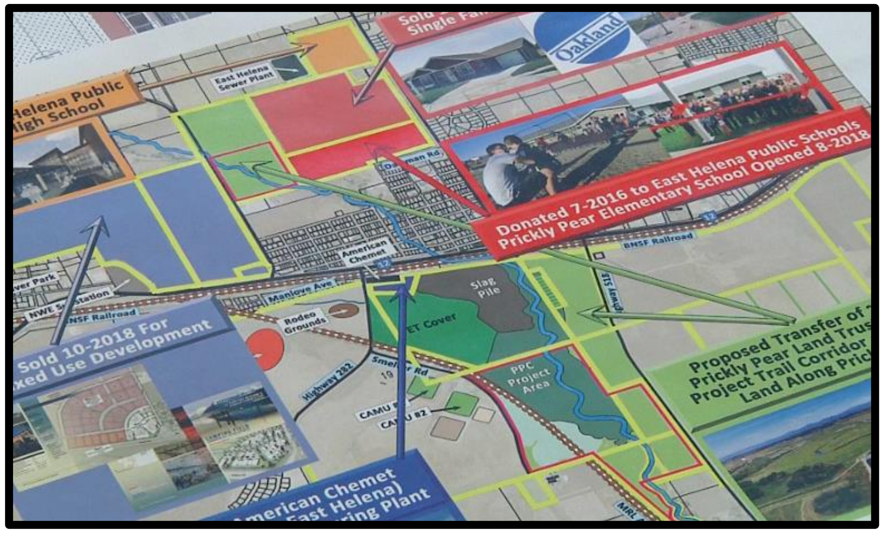
[2] Crashes reported by the Montana Department of Transportation (MDT) and the City of East Helena for period from January 1, 2014 to December 31, 2018

[3] Crash and severity rates expressed as crashes per million vehicles entering (MVE) based on MDT severity factors

[4] Rates calculated using Highway Safety Manual (HSM) 1st Edition predictive methodology

CORRIDOR GROWTH/TRAFFIC PROJECTIONS

3



The East Helena community is growing, and the expectation is that growth in and around the city may intensify in the coming years based on a variety of socioeconomic considerations. In order to properly evaluate infrastructure needs for the Montana Avenue/Valley Drive corridor, it was necessary to first develop a reasonable forecast of land development activity and resulting traffic growth such that recommendations for roadway, intersection, utility, and multi-modal safety improvements would account for likely growth for a 20-year design horizon. This chapter of the report summarizes land development potential in and around the project corridor and the subsequent calculation of future traffic volume projections that were developed as the basis of the infrastructure improvements analysis that will be discussed in a later section of the document.

Planned/Ongoing Land Development

Various land development projects in the vicinity of the Montana Avenue/Valley Drive corridor are currently in the planning, construction, or sales/occupancy phases as of the writing of this PER. Each is likely to have some level of impact on vehicular, pedestrian, and bicycle traffic demand in the corridor. The following paragraphs describe each known development project and summarize how trip generation potential was assigned for each development for the ultimate purpose of calculating future traffic projections.

Prickly Pear Elementary School

Prickly Pear Elementary School began operation in August of 2018 with a first-year enrollment (current as of late in the 2018-19 school year) of 279 students. Access to the campus is provided via three (3) approaches on Valley Drive and a connection to Thurman Avenue. Appendix I contains a site plan exhibit for Prickly Pear Elementary School that illustrates the site layout and access configuration. The south access approach on Valley Drive is a two-lane, exit-only approach that is offset to the north from Lewis Street by approximately 30 feet. The middle approach on Valley Drive is also exit-only with just one (1) lane and is restricted to bus traffic only. It is located approximately 430 feet north of the south approach and 410 feet south of the north approach. The north approach is a full access (single entry and exit lanes) that is located approximately 400 feet south of Prickly Pear Avenue.

Since Prickly Pear Elementary School was in operation during the traffic counts collected for this study, that data reflect trips generation for the school at approximately a 77.5% level. Its long-term full capacity is estimated by the school district at 360 students, so trip generation was calculated to account for the 81 additional students expected to max out the enrollment in the coming years and 5 additional full-time employees. Table 3 on page 20 summarizes the trip generation calculations for Prickly Pear Elementary School. The breakdown of trips is primarily based on detailed information provided by the school district on bus usage, walking and biking trips, carpooling, and employee trips. An adjustment for pass-by trips was also made based on standard Institute of Transportation Engineers (ITE) procedures. In total, this study projects that the additional enrollment and employees for Prickly Pear Elementary School will generate approximately 104 net new vehicular average weekday trips (52 entering/52 exiting) with 43 trips (23 entering/20 exiting) during the morning peak, 47 trips (23 entering/24 exiting) during the after-school peak, and 2 trips (0 entering/2 exiting) during the evening peak.

The assignment of site-generated trips for Prickly Pear Elementary School to/from the north and south along the Montana Avenue/Valley Drive corridor was modeled at a 30/70 ratio for the purposes of this analysis. This estimated split generally matches the distribution of existing peak hour traffic to/from the site based on the traffic counts collected for this study.

East Helena Clinic

Purview Health Center opened a new clinic in May of 2019 that is located on the Prickly Pear Elementary School campus at 250 Academic Street. The clinic is open to the public Monday through Thursday, providing medical (Tuesday/Thursday), dental (Tuesday/Thursday), and behavioral health (Monday-Thursday) services. The clinic provides approximately 2000 square feet of interior floor space. Using the Clinic land use category to calculate ITE trip generation, the facility is projected to generate approximately 76 vehicle trips (38 entering/38 exiting) on an average weekday with 7 trips (5 entering/2 exiting during the typical morning peak, 7 trips (2 entering/5 exiting) during the typical evening peak, and an estimated 4-8 trips during the after-school peak. Clinic officials noted that they have seen only approximately 6 patients/day on average since opening, but they expect to be busier once school is back in session. Since the estimated trip generation for the clinic is minimal and given that a segment of those trips will be made by pedestrians, vehicular trips were considered to be negligible for this land use for the purposes of this study (and thus are not included in Table 3).

East Helena High School

East Helena High School is currently under construction with plans to open in late summer of 2020. Access to the high school campus is planned via four (4) approaches to Valley Drive, each of them full-movement approaches. Appendix I contains a site plan exhibit for East Helena High School that illustrates the site layout and access configuration. The south approach is to be located approximately 300 feet north of the Valley Drive/Cobre Drive intersection. It will provide access to employee parking, visitor parking, a student drop-off loop, and the dedicated bus loop. The next approach to the north is the other end of the bus loop that wraps around the back of the campus to tie back into Valley Drive approximately 575 feet north of the south bus loop approach and 375 feet south of Bandera Drive. The two northerly approaches provide access to the student parking lot. The southerly of those two approaches is located 150 feet north of the north bus loop approach and 225 feet south of Bandera Drive. The northerly student parking lot approach is aligned with Bandera Drive, which in turn is only 150 feet south of the Plant Road intersection.

The projected enrollment for East Helena High School at full capacity is 600 students, and it is expected that approximately 40 full-time employees will be needed to service that enrollment. Trip generation was calculated to account for 600 students and 40 full-time employees with breakdowns of trip type based on detailed information provided by the school district on bus usage, walking and biking trips, carpooling, and employee trips. An adjustment for pass-by trips was also made as part of these calculations. Table 3 on page 20 summarizes the resulting calculations. In total, this study projects that East Helena High School will generate approximately 663 net new vehicular average weekday trips (324 entering/339 exiting) with 276 trips (148 entering/128 exiting) during the morning peak, 251 trips (118 entering/133 exiting) during the after-school peak, and 64 trips (22 entering/42 exiting) during the evening peak. The magnitude of vehicular trip generation is likely to fluctuate based on weather conditions and other factors. Special events traffic will also create peak traffic events at times, but the majority of those events will not coincide with peak traffic (rush hour) periods for the adjacent roadway corridor.

The assignment of site-generated trips for East Helena High School to the north and south along the Montana Avenue/Valley Drive corridor was split at a 30/70 ratio for the purposes of this analysis. Given that this school would be the first and only high school in the immediate vicinity of East Helena, it is more likely that a large majority of trips to/from the school would be generated from within the currently-developed part of town, and the 30/70 ratio matches that for site-generated traffic for Prickly Pear Elementary School.

Highland Meadows Subdivision

Highland Meadows Subdivision is a proposed 320-lot, single-family residential subdivision located along the west side of Valley Drive between Prickly Pear Elementary School and the East Valley Volunteer Fire Department and East Helena High School properties. Access to the subdivision is proposed via two, full-movement approaches to Valley Drive. Appendix I contains a site plan exhibit for Highland Meadows Subdivision that illustrates the site layout and access configuration. The south access approach is proposed approximately 160 feet north of Prickly Pear Avenue. The north approach is proposed in a location approximately 670 feet north of the south approach and 275 feet south of the oversized (extra-width) approach to the East Valley Volunteer Fire District complex.

Trip generation for Highland Meadows Subdivision was calculated using *Trip Generation (10th Edition)* published by ITE, which is the most widely accepted source in the United States for calculating development-based traffic generation projections. The Single-Family Detached Housing land use category was utilized with dwelling units as the independent variable. Table 3 on page 20 summarizes the resulting calculations. In total, this study projects that Highland Meadows Subdivision will generate approximately 2567 net new vehicular average weekday trips (1284 entering/1283 exiting) with 201 trips (50 entering/151 exiting) during the morning peak, 187 trips (93 entering/94 exiting) during the after-school peak, and 269 trips (170 entering/99 exiting) during the evening peak. Note that a 15% reduction in gross trips was made to account for overlap of trips generated by the schools and area residential subdivisions.

The assignment of site-generated trips for Highland Meadows Subdivision to the north and south along the Montana Avenue/Valley Drive corridor was split at a 25/75 ratio for the purposes of this analysis. This distribution of trips was calculated based on proximity of the subdivision to East Helena itself, the new schools, and convenient commuter routes to/from Helena (since Helena is the primary location for commerce and employment in the area).

Vigilante Subdivision

Vigilante Subdivision is a proposed 74-lot, single-family residential subdivision located north of Plant Road and south of Treerise Road approximately 1/4 mile west of Valley Drive. Access to the subdivision is proposed via two, full-movement approaches each on Plant Road and Treerise Road. Appendix I contains a site plan exhibit for Vigilante Subdivision that illustrates the site layout and access configuration.

Trip generation for Vigilante Subdivision was calculated using *Trip Generation (10th Edition)* published by ITE, which is the most widely accepted source in the United States for calculating development-based traffic generation projections. The Single-Family Detached Housing land use category was utilized with dwelling units as the independent variable. Table 3 on page 20 summarizes the resulting calculations. In total, this study projects that Vigilante Subdivision will generate approximately 594 net new vehicular average weekday trips (297 entering/297 exiting) with 47 trips (12 entering/35 exiting) during the morning peak, 43 trips (21 entering/22 exiting) during the after-school peak, and 62 trips (39 entering/23 exiting) during the evening peak. A 15% reduction in gross trips was made to account for overlap of trips generated by the schools and area residential subdivisions.

The assignment of site-generated trips for Vigilante Subdivision to the north and south along the Montana Avenue/Valley Drive corridor was split at a 50/50 ratio for the purposes of this analysis. This distribution of trips was calculated based on proximity of the subdivision to East Helena itself, the new schools, and convenient commuter routes to/from Helena (since Helena is the primary location for commerce and employment in the area). The distribution for this subdivision is more heavily weighted toward the north due to its closer proximity to Canyon Ferry Road (commuter route to/from Helena).

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Table 3. Trip Generation Summary

Land Use	Independent Variable Intensity	Units	Weekday total	Weekday enter	Weekday exit	Morning Peak total	Morning Peak enter	Morning Peak exit	After School Peak total	After School Peak enter	After School Peak exit	Evening Peak total	Evening Peak enter	Evening Peak exit
East Helena High School														
Student School Bus Trips	120	Students	32	16	16	16	8	8	16	8	8	0	0	0
Student Walking/Biking Trips	30	Students	40	20	20	20	10	10	16	8	8	4	2	2
Parent/Student/Misc. Personal Vehicle Trips	450	Students	690	345	345	300	150	150	240	120	120	60	30	30
Pass-By Trips**			144	72	72	80	40	40	30	15	15	16	8	8
Employee Personal Vehicle Trips	40	Employees	85	35	50	40	30	10	25	5	20	20	0	20
Net New External Vehicle Trips			**663**	**324**	**339**	**276**	**148**	**128**	**251**	**118**	**133**	**64**	**22**	**42**
Prickly Pear Elementary School														
Student School Bus Trips	28	Students	8	4	4	4	2	2	4	2	2	0	0	0
Student Walking/Biking Trips	8	Students	16	8	8	8	4	4	8	4	4	0	0	0
Parent/Student/Misc. Personal Vehicle Trips	45	Students	106	53	53	46	23	23	46	23	23	0	0	0
Pass-By Trips**			20	10	10	12	6	6	6	3	3	0	0	0
Employee Personal Vehicle Trips	5	Employees	10	5	5	5	4	1	3	1	2	2	0	2
Net New External Vehicle Trips			**104**	**52**	**52**	**43**	**23**	**20**	**47**	**23**	**24**	**2**	**0**	**2**
Highland Meadows Subdivision														
Single-Family Detached Housing - Land Use Code 210[3]	320	Dwelling Units	3021	1511	1510	237	59	178	221	110	111	317	200	117
Internal Capture Trips**			0	0	0	0	0	0	0	0	0	0	0	0
Pass-By Trips**			0	0	0	0	0	0	0	0	0	0	0	0
Inter-Area School Trips (15%)			454	227	227	36	9	27	34	17	17	48	30	18
Net New External Vehicle Trips			**2567**	**1284**	**1283**	**201**	**50**	**151**	**187**	**93**	**94**	**269**	**170**	**99**
Vigilante Subdivision														
Single-Family Detached Housing - Land Use Code 210[3]	74	Dwelling Units	699	349	350	55	14	41	51	25	26	73	46	27
Internal Capture Trips**			0	0	0	0	0	0	0	0	0	0	0	0
Pass-By Trips**			0	0	0	0	0	0	0	0	0	0	0	0
Inter-Area School Trips (15%)			105	52	53	8	2	6	8	4	4	11	7	4
Net New External Vehicle Trips			**594**	**297**	**297**	**47**	**12**	**35**	**43**	**21**	**22**	**62**	**39**	**23**
Red Fox Meadows Subdivision														
Single-Family Detached Housing - Land Use Code 210[3]	110	Dwelling Units	1038	519	519	81	20	61	76	38	38	109	69	40
Internal Capture Trips**			199	90	109	7	1	6	13	6	7	30	19	11
Pass-By Trips**			0	0	0	0	0	0	0	0	0	0	0	0
Inter-Area School Trips (15%)			126	64	62	11	3	8	10	5	5	12	8	4
Multifamily Housing (Low-Rise) - Land Use Code 220[4]	125	Dwelling Units	915	458	457	58	13	45	49	24	25	70	44	26
Internal Capture Trips**			175	79	96	5	0	5	11	5	6	26	16	10
Pass-By Trips**			0	0	0	0	0	0	0	0	0	0	0	0
Inter-Area School Trips (15%)			111	57	54	8	2	6	6	3	3	6	4	2
Convenience Market with Gasoline Pumps - Land Use Code 853[5]	16	Vehicle Fueling Positions	2064	1032	1032	133	67	66	103	51	52	148	74	74
Internal Capture Trips**			374	205	169	12	11	1	24	13	11	56	21	35
Pass-By Trips**			1090	533	557	76	35	41	51	25	26	61	35	26
Mini Warehouse - Land Use Code 151[6]	72	1000 SF Gross Floor Area	109	54	55	7	4	3	9	4	5	12	6	6
Internal Capture Trips**			0	0	0	0	0	0	0	0	0	0	0	0
Pass-By Trips**			0	0	0	0	0	0	0	0	0	0	0	0
Net New External Vehicle Trips			**3141**	**1568**	**1573**	**236**	**87**	**149**	**173**	**85**	**88**	**209**	**125**	**84**
Total Gross Trips			**8833**	**4409**	**4424**	**1010**	**408**	**602**	**867**	**423**	**444**	**815**	**471**	**344**
Total Internal Capture Trips			**748**	**374**	**374**	**24**	**12**	**12**	**48**	**24**	**24**	**112**	**56**	**56**
Total Pass-by Trips			**1254**	**615**	**639**	**168**	**81**	**87**	**87**	**43**	**44**	**77**	**43**	**34**
Total Inter-Area School Trips			**796**	**400**	**396**	**63**	**16**	**47**	**58**	**29**	**29**	**77**	**49**	**28**
Total New External Trips			**6035**	**3020**	**3015**	**755**	**299**	**456**	**674**	**327**	**347**	**549**	**323**	**226**

(1) High School - Land Use Code 530	Units = Students	
Weekday (Average Weekday):	Average Rate = 2.03	(50% entering, 50% exiting)
Morning Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 7 and 9 AM):	Average Rate = 0.52	(67% entering, 33% exiting)
After School Peak (Weekday, PM Peak Hour of Generator):	Average Rate = 0.33	(32% entering, 68% exiting)
Evening Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 4 and 6 PM):	Average Rate = 0.14	(48% entering, 52% exiting)
(2) Elementary School - Land Use Code 520	Units = Students	
Weekday (Average Weekday):	Average Rate = 1.89	(50% entering, 50% exiting)
Morning Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 7 and 9 AM):	Average Rate = 0.67	(54% entering, 46% exiting)
After School Peak (Weekday, PM Peak Hour of Generator):	Average Rate = 0.34	(45% entering, 55% exiting)
Evening Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 4 and 6 PM):	Average Rate = 0.17	(48% entering, 52% exiting)
(3) Single-Family Detached Housing - Land Use Code 210	Units = Dwelling Units	
Weekday (Average Weekday):	Average Rate = 9.44	(50% entering, 50% exiting)
Morning Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 7 and 9 AM):	Average Rate = 0.74	(25% entering, 75% exiting)
After School Peak:	Average Rate = 0.69	(50% entering, 50% exiting)
Evening Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 4 and 6 PM):	Average Rate = 0.99	(73% entering, 27% exiting)
(4) Multifamily Housing (Low-Rise) - Land Use Code 220	Units = Dwelling Units	
Weekday (Average Weekday):	Average Rate = 7.32	(50% entering, 50% exiting)
Morning Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 7 and 9 AM):	Average Rate = 0.46	(23% entering, 77% exiting)
After School Peak:	Average Rate = 0.39	(50% entering, 50% exiting)
Evening Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 4 and 6 PM):	Average Rate = 0.56	(63% entering, 37% exiting)
(5) Convenience Market with Gasoline Pumps - Land Use Code 853	Units = Vehicle Fueling Positions	
Weekday (Average Weekday):	Average Rate = 322.5	(50% entering, 50% exiting)
Morning Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 7 and 9 AM):	Average Rate = 20.76	(50% entering, 50% exiting)
After School Peak (Assume 70% of Evening Peak Rate):	Average Rate = 16.13	(50% entering, 50% exiting)
Evening Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 4 and 6 PM):	Average Rate = 23.04	(50% entering, 50% exiting)
(6) Mini-Warehouse - Land Use Code 151	Units = 1000 SF GFA	
Weekday (Average Weekday):	Average Rate = 1.51	(50% entering, 50% exiting)
Morning Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 7 and 9 AM):	Average Rate = 0.10	(60% entering, 40% exiting)
After School Peak (Assume 70% of Evening Peak Rate):	Average Rate = 0.12	(50% entering, 50% exiting)
Evening Peak (Weekday, Peak Hour of the Adjacent Street, One Hour between 4 and 6 PM):	Average Rate = 0.17	(47% entering, 53% exiting)

Trip Generation, 10th Edition, Institute of Transportation Engineers, 2017

***Trip Generation Handbook, 3rd Edition*, Institute of Transportation Engineers, 2017

Red Fox Meadows Subdivision

Red Fox Meadows Subdivision is a mixed-use development located on the southeast corner of the Canyon Ferry Road/Lake Helena Drive intersection approximately 2 miles northeast of East Helena. Land use in the development includes 110 single-family home lots, 125 condominium units, approximately 72,000 SF of mini-storage, and a planned gas station/convenience store. Access to the subdivision is proposed along both Canyon Ferry Road and Lake Helena Drive. Appendix I contains a site plan exhibit for Red Fox Meadows Subdivision that illustrates the site layout and access configuration.

Trip generation for Red Fox Meadows Subdivision was calculated using *Trip Generation (10th Edition)* published by ITE, which is the most widely accepted source in the United States for calculating development-based traffic generation projections. Multiple land use categories were utilized to project trip generation. Table 3 on page 20 summarizes the resulting calculations. In total, this study projects that Red Fox Meadows Subdivision will generate approximately 3141 net new vehicular average weekday trips (1568 entering/1573 exiting) with 236 trips (87 entering/149 exiting) during the morning peak, 173 trips (85 entering/88 exiting) during the after-school peak, and 209 trips (125 entering/84 exiting) during the evening peak. A 15% reduction in gross residential trips was made to account for overlap of trips generated by the schools.

The assignment of site-generated trips for Red Fox Meadows Subdivision to and from the Montana Avenue/Valley Drive corridor was estimated at 15% based on the type of development and its location directly along Canyon Ferry Road (relative to commuter route access to/from Helena). Also, travel to/from East Helena is likely to be more concentrated along Lake Helena Drive, with the exception of trips with origins and destinations along Valley Drive (such as for the new schools).

Other Development Potential

There are various other properties in the vicinity of East Helena that have the potential to develop within the design horizon (20 year-period) of this study and contribute to population and traffic growth. The most significant potential source of growth may be the planned re-development of parts of the Montana Environmental Custodial Trust property located south of US 12. However, few details on specific development plans for that property were available at the time this study was prepared. As such, and since other potential development projects are either located such that impacts to the Montana Avenue/Valley Drive corridor would be limited, or are also just in stages of high-level, conceptual discussion, projected traffic growth over and above the assignment for the developments specifically listed in this section of the report were handled through the application of annual background traffic growth rates of 0.5%-1.0% depending upon location/route.

Design Year (2040) Traffic Projections

The design horizon for this study was set at 20 years based on that length of time being a typical design life for a roadway. Although this study will be completed in 2019, the Design Year was set as 2040 given that construction of improvements is not likely to occur until 2020 or beyond. Figure 3 on the following page presents the Design Year (2040) peak hour turning movement volume projections and average daily traffic (ADT) projections calculated for key existing and proposed study area intersections. The projections represent a compilation of existing traffic volumes (based on recent count data), projected traffic assignment figures from the various land development projects that were discussed earlier in this chapter of the report, and an estimation of background traffic demand growth intended to account for unknown development overall population growth in the greater Helena valley. The traffic projections presented in Figure 3 will serve as the basis for the future conditions analyses and recommended improvements to be discussed in the next chapters of this report.

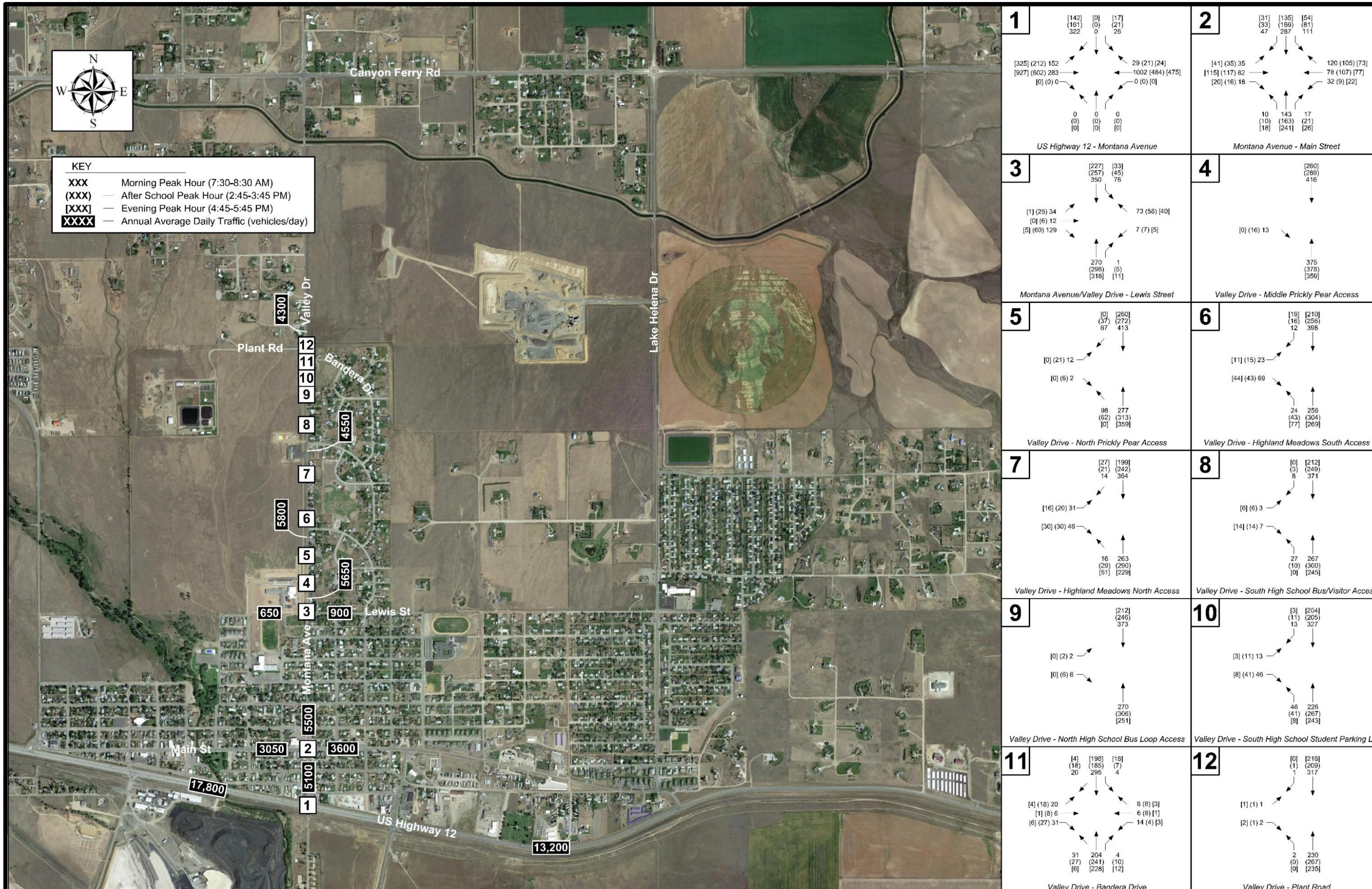


Figure 3. Design Year (2040) Traffic Volume Projections

FUTURE CONDITIONS ANALYSIS

4

In order to evaluate the level of improvements needed to build and maintain a safe and efficient roadway environment for at least the 20-year design life that is contemplated by this study, the project team utilized the Design Year (2040) traffic volume projections to analyze traffic operations and roadway and multi-use trail pavement section requirements. This chapter of the report summarizes those analyses and presents the results.

Future Transportation Network

The future street network based on recommended projects in the *Greater Helena Area Long Range Transportation Plan – 2014 Update* does not include many projects that would have direct and substantial impact to the Montana Avenue/Valley Drive corridor. However, there is discussion of a new street that would extend from B Street (in the vicinity of Helena Regional Airport) to Wylie Drive. Dovetailing with that concept, the City has discussed a possible street connection between Wylie Drive and Valley Drive, targeting the property boundary between the Highland Meadows Subdivision property and the East Helena High School property. Highland Meadows Subdivision is dedicating a half right-of-way for such a road through the platting process. However, the school district was not required to make a dedication via its subdivision process for the high school property and does not appear to be interested in providing a right-of-way dedication now for such a roadway. If such a connection was constructed between Valley Drive and Wylie Drive in this general area, it would likely have a substantial impact on traffic demand for the Montana Avenue/Valley Drive corridor, particularly if a direct access to the roadway was implemented for Highland Meadows Subdivision (such an access is not currently include in the preliminary plat) or the high school (also not part of the current site plan). From an overall transportation planning standpoint, an additional connection between Montana/Valley and Wylie Drive in this vicinity would make a lot of sense as it would be located approximately half way between Main Street and Canyon Ferry Road. However, given that such a connection doesn't appear to be imminent, it was not referenced as an available travel route for the future conditions analysis for this study.

Traffic Operations

Intersection Capacity

Design Year (2040) intersection capacity calculations were initially performed for the existing and proposed study area intersections using Highway Capacity Software (HCS7). Proposed site access intersections were presumed to be stop-controlled with auxiliary turn lanes as noted in previous descriptions of the development site plans. All study area intersections were otherwise initially evaluated based on existing traffic control and lane configurations. Table 4 on the follow page presents the intersection capacity calculation results. All intersections are projected to operate at LOS C or better during each of the three peak hour periods (morning, after school, and evening) with the following three exceptions:

1. The north approach at the US 12/Montana Avenue intersection is projected to operate at LOS F during the morning peak hour and LOS D during the evening peak hour.
2. The north and south approaches at the Main Street/Montana Avenue intersection are projected to operate at LOS D and LOS F, respectively, during the morning peak hour. The north approach is additionally projected to operate at LOS F during the after school peak hour.
3. The west approach at the Valley Drive/North Prickly Pear Elementary School access intersection is projected to operate at LOS D during the morning peak hour.

Projected 95th percentile queue lengths were also shown to be excessive for the north approaches at the US 12/Montana Avenue and Main Street/Montana Avenue intersections during the morning peak hour (both intersections) and during the after school peak hour (Main Street/Montana Avenue). Detailed capacity calculation worksheets for the Design Year (2040) scenario for all study area intersections can be found in Appendix J.

Auxiliary Turn Lane Warrants

Auxiliary right- and left-turn lane warrants were evaluated for study area intersections that exhibited high proportions or right-turn or left-turn movements on uncontrolled approaches using the previously referenced AASHTO and MDT auxiliary turn lane warrant criteria and based on Design Year (2040) peak period turning movement volumes. The following intersection approaches were shown to "warrant" consideration of auxiliary turn lanes as summarized:

- Right-turn lane on the east (westbound) approach at the Main Street/Montana Avenue intersection
- Left-turn lane on the north (southbound) approach at the Montana Avenue-Valley Drive/Lewis Street-Prickly Pear Elementary School south access intersection
- Left-turn lane on south (northbound) approach at Valley Drive/Prickly Pear Elementary School north access intersection
- Right-turn lane on north (southbound) approach at Valley Drive/Prickly Pear Elementary School north access intersection
- Left-turn lane on south (northbound) approach at Valley Drive/Highland Meadows Subdivision south access intersection

It should again be noted that the minimum design speeds for analyzing auxiliary turn lane warrants based on the AASHTO and MDT methodologies are 40 mph and 45 mph, respectively. As a result, the warrant criteria are generally more appropriately applicable for the segment of the corridor north of Lewis Street where the speed limit is posted at 35 mph (vs. between US 12 and Lewis Street where the posted speed limit is 25 mph). A more detailed summary of turn lane warrant calculations is presented in Appendix G.

Multi-Way Stop Warrants

The MUTCD provides guidance on the decision to implement multi-way stop control at an intersection. That criteria was applied for the Main Street/Montana Avenue intersection since Design Year (2040) scenario operations are projected to be sub-standard under two-way stop control and given that only the Peak Hour traffic signal warrant was shown to be met for that scenario. Based on the available crash history data and traffic projections calculated for this study, the minimum criteria relative to crash frequency and traffic demand were not found to be met, though it's worth noting again that City officials indicated that crashes do occur more frequently at this intersection than as is reflected in the data provided by MDT. If it could be shown that four (4) or more reported crashes had been reported within a 12-month period that are considered to be

Table 4. Design Year (2040) Intersection Capacity Calculation Results - Unimproved

Intersection	Approach	Design Year (2040)								
		Morning Peak			After School Peak			Evening Peak		
		Avg Delay (s/veh)	LOS	95th % Queue (veh)	Avg Delay (s/veh)	LOS	95th % Queue (veh)	Avg Delay (s/veh)	LOS	95th % Queue (veh)
Intersection Control		*Two-Way Stop-Control (NB/SB)*								
US 12/Montana Avenue	EB	4.5	A	2	2.5	A	1	2.7	A	2
	WB	0.0	A	0	0.0	A	0	0.0	A	0
	NB	5.0	A	0	5.0	A	0	5.0	A	0
	SB	300.6	F	36	19.2	C	3	30.7	D	4
Intersection Control		*Two-Way Stop Control (NB/SB)*								
Main Street/Montana Avenue	EB	2.3	A	1	1.9	A	1	2.0	A	1
	WB	1.3	A	1	0.4	A	0	1.1	A	1
	NB	25.3	D	4	23.3	C	4	24.3	C	5
	SB	672.8	F	83	75.0	F	15	24.5	C	4
Intersection Control		*Two-Way Stop-Control (EB/WB)*								
Montana Avenue-Valley Drive/Lewis Street-South Prickly Pear Elementary School access	EB	20.1	C	2	18.2	C	1	10.6	B	0
	WB	14.9	B	1	15.1	C	1	11.1	B	1
	NB	--	--	--	--	--	--	--	--	--
	SB	2.2	A	1	1.8	A	1	1.3	A	1
Intersection Control		*One-Way Stop-Control (EB)*								
Valley Drive/Central Prickly Pear Elementary School Access (Exit Only)	EB	13.5	B	1	11.7	B	1	0.0	A	0
	NB	--	--	--	--	--	--	--	--	--
	SB	--	--	--	--	--	--	--	--	--
Intersection Control		*One-Way Stop-Control (WB)*								
Valley Drive/North Prickly Pear Elementary School Access	EB	25.8	D	1	22.5	C	1	5.0	A	0
	NB	3.7	A	1	2.3	A	1	0.0	A	0
	SB	--	--	--	--	--	--	--	--	--
Intersection Control		*One-Way Stop-Control (EB)*								
Valley Drive/Highland Meadows Subdivision South Access	EB	17.7	C	2	16.0	C	1	11.4	B	1
	NB	1.1	A	1	1.6	A	1	2.2	A	1
	SB	--	--	--	--	--	--	--	--	
Intersection Control		*One-Way Stop-Control (EB)*								
Valley Drive/Highland Meadows Subdivision North Access	EB	17.7	C	2	16.7	C	1	11.5	B	1
	NB	0.7	A	1	1.1	A	1	1.7	A	1
	SB	--	--	--	--	--	--	--	--	
Intersection Control		*One-Way Stop-Control (EB)*								
Valley Drive/East Helena High School South Bus Loop Access	EB	14.3	B	1	13.4	B	1	10.6	B	1
	NB	1.1	A	1	0.4	A	0	0.0	A	0
	SB	--	--	--	--	--	--	--	--	
Intersection Control		*One-Way Stop-Control (EB)*								
Valley Drive/East Helena High School North Bus Loop Access	EB	13.3	B	1	12.5	B	1	5.0	A	0
	NB	--	--	--	--	--	--	--	--	
	SB	--	--	--	--	--	--	--	--	
Intersection Control		*One-Way Stop-Control (EB)*								
Valley Drive/East Helena High School South Student Parking Lot Access	EB	14.2	B	1	13.2	B	1	10.3	B	1
	NB	1.9	A	1	1.5	A	1	0.3	A	0
	SB	--	--	--	--	--	--	--	--	
Intersection Control		*Two-Way Stop-Control (EB/WB)*								
Valley Drive/Bandera Drive-East Helena High School North Student Parking Lot Access	EB	15.6	C	1	15.8	C	1	11.0	B	1
	WB	16.9	C	1	15.6	C	1	11.7	B	0
	NB	1.4	A	1	1.1	A	1	0.2	A	0
	SB	0.1	A	0	0.4	A	0	0.8	A	0
Intersection Control		*One-Way Stop-Control (EB)*								
Valley Drive/Plant Road	EB	12.1	B	0	11.7	B	0	10.5	B	0
	NB	0.1	A	0	0.0	A	0	0.0	A	0
	SB	--	--	--	--	--	--	--	--	

correctable through the implementation of multi-way stop control, the warrants would be met based on criteria 04 D (Section 2B.07).

Traffic Signal Warrants

Based on the results of the Design Year (2040) scenario intersection capacity analyses, MUTCD traffic signal warrants were evaluated for the US 12/Montana Avenue and Main Street/Montana Avenue intersections. As was the case for the existing conditions scenario, the proportion of right-turn movements for the projected design year minor approach traffic demand is very high (approximately 91%). A removal of right-turns approaching that percentage would invalidate the volume-based traffic signal warrants accordingly. The subjective question about whether or not the minor approach right-turn movements are low-conflict will become more and more difficult as traffic demands increase for the intersection. Given the results of the Design Year (2040) peak hour intersection capacity analysis, particularly for the morning peak, it seems likely that a traffic signal will become a justifiable improvement for the US 12/Montana Avenue intersection at some point in the future, though some drivers will likely adjust their travel routes to avoid the impacts of such congestion. Note that MDT also suggested that a restriction to right-turn only movements from the southbound minor approach should also be considered for this intersection. Doing so would eliminate exposure to long delays and potential safety concerns associated with left-turn or thru movements. However, it would presumably only reduce traffic demands by less than 10% given the previously-referenced ratios of right-turns. It would also be somewhat unusual to restrict access for a collector street approach, and it's possible that Montana Avenue could be reclassified as an arterial at some point in the future given its role in the overall street network system for East Helena.

The traffic signal warrants analysis for the Main Street/Montana Avenue intersection showed that the Peak Hour warrant is projected to be met for the Design Year (2040) scenario. However, installation of a traffic signal is typically not considered to be justifiable on the basis of satisfying the Peak Hour warrant alone, the reason being that implementation of a traffic signal at such an intersection may in fact result in an increase in overall delay for the intersection. Design Year (2040) traffic signal warrant calculation worksheets are provided in Appendix H.

Intersection Capacity – Mitigation Improvements

An additional round of intersection capacity calculations was performed for study area intersections that exhibited poor LOS conditions for the Design Year (2040) scenario and/or where auxiliary lanes or traffic control improvements were found to be warranted. Where traffic signal warrants were found to be met, intersection capacity was evaluated for both a signalized intersection alternative and a roundabout. Traffic signal-based capacity calculations were performed using *Synchro, Version 8*. Roundabout capacity calculations were performed using *Sidra Intersection 8*. Table 5 on page 28 summarizes the results of the Design Year (2040) intersection capacity calculations with mitigation improvement options in place. Detailed capacity calculation worksheets for these applications can be found in Appendix K.

Traffic signal and roundabout options were evaluated for the US 12/Montana Avenue intersection. For the purposes of this analysis, it was presumed that the south intersection approach would be closed as per the previously detailed discussion about eliminating the at-grade railroad crossing in that location. Therein, the traffic signal alternative was evaluated with a left-turn lane and dual thru lanes on the west approach, a thru lane and shared thru/right-turn lane on the east approach, and separate left-turn and right-turn lanes on the north approach. A phasing plan was modeled with an eastbound lead phase and overlapping protected southbound right-turns followed by full-movement phases eastbound/westbound and then southbound. The capacity calculation for this setup showed that all intersection approaches would operate at LOS C or better during all three peak periods with manageable queuing. The intersection would operate at LOS B during the morning peak period and LOS A during the after-school and evening peaks.

It was assumed for the purposes of the roundabout analysis at US 12/Montana Avenue that there would be two circulating lanes eastbound and westbound and a single entry and exit lane for the north approach. The capacity calculation results for this roundabout configuration showed that all approaches would operate at LOS A under this configuration

Several potential modifications to lane configurations and/or traffic control were evaluated for the intersection of Main Street and Montana Avenue. The auxiliary turn lane warrants analysis had shown that an east approach (westbound) right-turn lane was warranted. Although the addition of that turn lane projected to improve intersection capacity metrics, the north (southbound) intersection approach was still projected to operate at LOS F during the morning peak hour and LOS E during the after-school peak hour.

Given that the entering volumes for the north and south approaches are projected to be higher than for the east and west approaches for the Design Year (2040) scenario, a modification to the traffic control whereby the intersection would still be stop-controlled but with stop signs on the east and west approaches (thereby making the northbound and southbound movements uncontrolled) was also evaluated. Calculation results for that configuration showed that the west (eastbound) approach would fail during all three peak hour periods and that the east (westbound) approach would fail during two of the three peaks.

Although the total traffic demand northbound/southbound is higher than for eastbound/westbound, the overall turning movement volumes are relatively balanced for all four approaches. As such, all-way stop control was evaluated as a potential mitigation solution even though it was previously shown that MUTCD warrants are not satisfied. The intersection was initially modeled with single-lane approaches, in which case the north (southbound) approach was projected to operate at LOS F during the morning peak with a 95th percentile queue projection that exceeded 20 vehicles. The addition of an auxiliary left-turn bay for that (southbound) approach, however, would improve LOS for that approach to C for the morning peak hour, although the left-turn movement itself would operate at LOS D. The max 95th percentile queue for the approach would reduce from 21 vehicles down to 8 vehicles. In general, all-way stop control with a southbound left-turn bay would provide for LOS C or better operations for all approaches during all three peak periods.

The analysis of MUTCD traffic signal warrants for the Main Street/Montana Avenue intersection had shown that only the Peak Hour warrant is projected to be satisfied based on Design Year (2040) traffic volume projections. A signalized capacity calculation was performed with all four intersection approaches having an auxiliary left-turn lane and shared thru/right-turn lane. A simple two-phase signal timing/phasing plan was modeled. The calculation results showed that the intersection would operate at LOS B during the morning and after-school peaks and LOS A during the evening peak with all individual approaches also operating at LOS B or better. Likewise, a capacity calculation that modeled a single-lane roundabout showed that the intersection would operate at LOS A during all three peak periods.

The Montana Avenue-Valley Drive/Lewis Street-Prickly Pear Elementary School south access intersection was modeled with a southbound auxiliary left-turn lane. Improvements to intersection capacity metrics were relatively minor, but the intersection had not exhibited any deficiencies that required mitigation.

The intersection of Valley Drive and the Prickly Pear Elementary School north access had exhibited a LOS D on the minor approach during the morning peak hour for the Design Year (2040) analysis scenario with no improvements. The addition of warranted northbound auxiliary left-turn and southbound auxiliary right-turn lanes eliminated that LOS deficiency.

A northbound auxiliary left-turn lane had also been shown as warranted for the Valley Drive/Highland Meadows Subdivision south access intersection. The addition of that improvement resulted in very minor reductions to average delay, but that intersection also is not projected to have any operational problems for the design year scenario.

Pavements Design

Using the information collected from soil borings in combination with equivalent single axle load (ESAL) calculations derived from the Design Year (2040) scenario traffic projections, the project team developed surfacing section alternatives for the street and the multi-use trail. ESAL calculations were based on a standard cross section of vehicle classifications. The following sections of the report summarize that analysis.

Table 5. Design Year (2040) Intersection Capacity Calculation Results – Mitigation Improvements

Intersection	Approach	Design Year (2040)								
		Morning Peak			After School Peak			Evening Peak		
		Avg Delay (s/veh)	LOS	95th % Queue (veh)	Avg Delay (s/veh)	LOS	95th % Queue (veh)	Avg Delay (s/veh)	LOS	95th % Queue (veh)
Intersection Control		*Traffic Signal*								
US 12/Montana Avenue	EB	5.1	A	2	4.2	A	2	4.5	A	4
	WB	12.3	B	10	10.3	B	5	11.5	B	5
	SB	30.2	C	8	10.0	B	2	9.4	A	2
	Intersection	14.0	B	--	6.9	A	--	6.7	A	--
Intersection Control		*Roundabout*								
US 12/Montana Avenue	EB	4.3	A	1	5.7	A	2	8.0	A	4
	WB	8.3	A	3	6.0	A	2	6.6	A	2
	SB	23.2	C	5	6.5	A	1	6.0	A	1
	Intersection	10.2	B	--	5.9	A	--	7.4	A	--
Intersection Control		*Two-Way Stop Control/WB Right-Turn Lane*								
Main Street/Montana Avenue	EB	2.3	A	1	1.9	A	1	2.0	A	1
	WB	1.1	A	1	0.3	A	0	1.0	A	1
	NB	18.6	C	3	18.2	C	3	20.3	C	4
	SB	378.8	F	57	40.9	E	10	21.3	C	4
Intersection Control		*Two-Way Stop-Control (EB/WB)*								
Main Street/Montana Avenue	EB	120.2	F	12	51.2	F	8	25.5	D	4
	WB	77.4	F	13	26.4	D	5	18.7	C	3
	NB	0.6	A	0	0.5	A	0	0.6	A	0
	SB	2.8	A	1	2.8	A	1	2.3	A	1
Intersection Control		*All-Way Stop-Control (no turn lanes)*								
Main Street/Montana Avenue	EB	13.8	B	2	13.2	B	2	11.4	B	2
	WB	16.8	C	4	14.0	B	3	11.0	B	2
	NB	14.1	B	2	13.5	B	3	13.2	B	3
	SB	64.6	F	21	17.2	C	4	11.8	B	2
	Intersection	37.6	E	--	14.8	B	--	12.0	B	--
Intersection Control		*All-Way Stop-Control (SB Left-Turn Lane)*								
Main Street/Montana Avenue	EB	13.0	B	2	12.9	B	2	11.4	B	2
	WB	15.4	C	3	13.7	B	3	11.0	B	2
	NB	13.7	B	2	13.7	B	3	13.6	B	3
	SB	23.0	C	8	13.3	B	3	11.0	B	2
	Intersection	18.2	C	--	13.4	B	--	11.9	B	--
Intersection Control		*Traffic Signal*								
Main Street/Montana Avenue	EB	17.9	B	3	16.4	B	3	17.6	B	3
	WB	19.3	B	3	17.7	B	3	17.9	B	3
	NB	5.0	A	2	5.5	A	3	4.4	A	3
	SB	6.3	A	4	5.9	A	3	4.2	A	2
	Intersection	10.7	B	--	10.8	B	--	9.8	A	--
Intersection Control		*Roundabout*								
Main Street/Montana Avenue	EB	7.5	A	1	6.0	A	1	4.9	A	1
	WB	6.0	A	2	6.3	A	2	5.5	A	1
	NB	5.6	A	1	6.1	A	2	6.1	A	2
	SB	8.3	A	4	6.0	A	2	4.7	A	1
	Intersection	7.2	A	--	6.1	A	--	5.4	A	--
Intersection Control		*Two-Way Stop-Control (EB/WB) SB Left-Turn*								
Montana Avenue-Valley Drive/Lewis Street-South Prickly Pear Elementary School access	EB	19.8	C	2	18.0	C	1	10.6	B	0
	WB	14.8	B	1	15.1	C	1	11.1	B	1
	NB	--	--	--	--	--	--	--	--	--
	SB	1.5	A	1	1.3	A	1	1.0	A	1
Intersection Control		*One-Way Stop-Control (WB) NB Left-Turn Lane, SB Right-Turn Lane*								
Valley Drive/North Prickly Pear Elementary School Access	EB	24.5	C	1	21.7	C	1	5.0	A	0
	NB	2.5	A	1	1.4	A	1	0.0	A	0
	SB	--	--	--	--	--	--	--	--	--
Intersection Control		*One-Way Stop-Control (EB) NB Left-Turn Lane*								
Valley Drive/Highland Meadows Subdivision South Access	EB	17.7	C	2	15.9	C	1	11.4	B	1
	NB	0.7	A	1	1.0	A	1	1.8	A	1
	SB	--	--	--	--	--	--	--	--	

Street Surfacing

The soil borings collected along the Montana Avenue/Valley Drive corridor showed that the in-situ roadway subgrade generally consists of approximately 1.5-3.0 feet of clayey sands and sandy lean clays underlain by sandy gravels. Based on this information, four (4) pavement section alternatives were developed and evaluated as summarized in Table 6 (below). Ultimately it was determined that pavement section Alternative 3 would perform best in combination with complete removal of the fine-grained, clayey subgrade soils down to a depth where the dense gravels are located. Based on the thickness of Alternative 3, subexcavation will generally not be necessary from Lewis Street to Plant Road in order to remove the poor subgrade material. However, between US 12 and Lewis Street, subexcavation will be necessary in order to build the new pavement section up from the stable gravel layer.

Table 6. Street Pavement Section Alternatives

Material Course/Thickness (inches)	Pavement Section Alternative			
	1	2	3	4
Asphalt Pavement	3.0	4.0	3.0	4.0
Crushed Base Course (1 1/2-inch minus)	16.0	13.0	4.0	4.0
Sub-base Course (3-inch minus)	-	-	18.5	14.0
Total Section Thickness	**19.0**	**17.0**	**22.5**	**22.0**

Multi-Use Trail Surfacing

For the multi-use trail, asphalt and concrete surfacing sections were evaluated. The recommended asphalt pavement section consists of 2 inches of asphalt pavement over 6 inches of crushed base course (1 ½-inch minus) underlain by a 6-oz non-woven separation fabric. The recommended concrete paving section consists of 4 inches of Portland cement concrete pavement over 6 inches of crushed base course (1 ½-inch minus) underlain by a 6-oz non-woven separation fabric. The geotechnical report also notes that the removal of clayey subgrade soils would reduce the potential for frost heave and potentially improve long-term performance but would increase costs considerably. If the multi-use trail is paved with asphalt, any deleterious material should be removed from on top of the in-situ subgrade and a weed barrier fabric should be installed between subgrade and the base course in order to prevent weeds from growing up through the path over time.

DESIGN ALTERNATIVES

5

Basis of Design

From a design standpoint, the primary objective of this study was to recommend improvements to the Montana Avenue/Valley Drive corridor that would provide safe and efficient operational conditions for all manner of roadway users for a 20-year design life with cost and anticipated benefit also key considerations for the project. The character of the corridor differs currently to the north and south of Lewis Street. To the south, there is a more urban, low-speed environment with close spacing of residential driveway access. To the north of Lewis Street, Valley Drive has a more rural, open-highway feel, albeit with closely-spaced residential driveways lining the east side of the corridor in La Casa Grande Subdivision. East Helena High School, in combination with Prickly Pear Elementary School and the proposed Highland Meadows Subdivision will dampen the rural feel of this part of the corridor from a development density standpoint. However, given that the properties along the east side of the road to the north of Lewis Street are in the County, there will still be a natural transition in the feel of the corridor from a user perspective. Lewis Street also serves as a natural break in the corridor relative to storm water drainage/management strategy.

In order to give the City of East Helena a complete understanding of how an improved corridor can be achieved, the project team developed two comprehensive roadway reconstruction alternatives. The primary difference between the two alternatives (known for the purposes of this study as the "Baseline Construction Alternative" and the "Storm Drain Upgrade Alternative") would be the implementation of curb and gutter and a storm drain piping system between US 12 and Lewis Street for the Storm Drain Upgrade Alternative. The following section of the report compares and contrasts the recommended features and design details for the two reconstruction alternatives.

Design Details

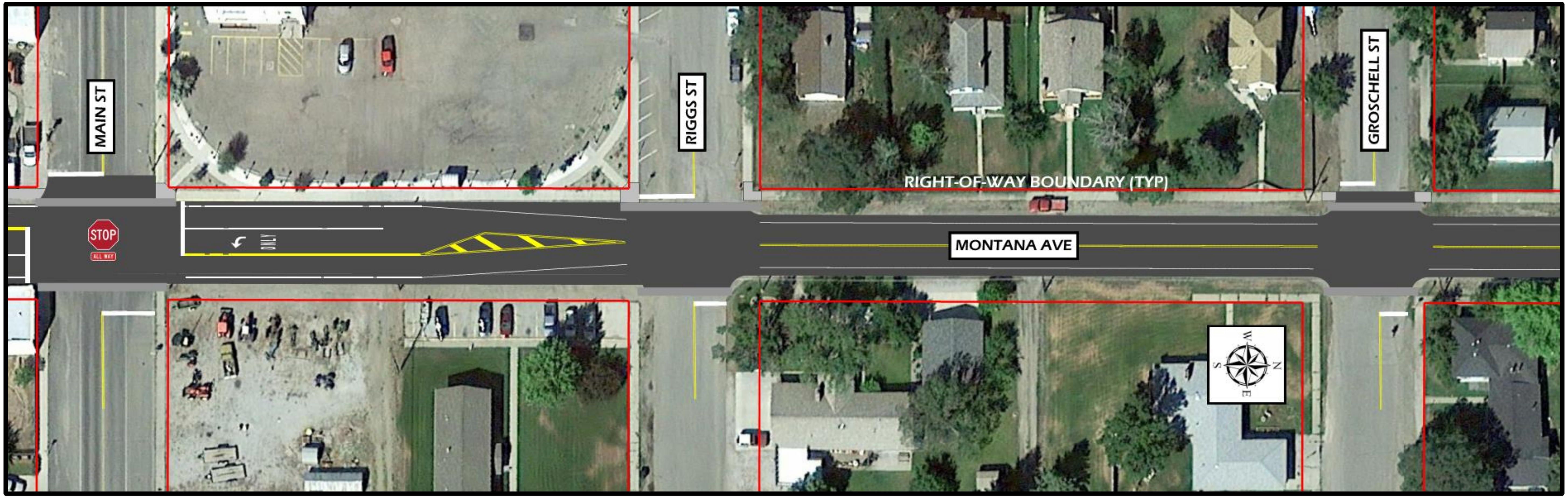
Typical Sections

As was alluded to above, the Baseline Construction and Storm Drain Upgrade alternatives developed for this project differ primarily in what the recommended improvements are for the segment from US 12 to Lewis Street. The Baseline Construction Alternative would fully reconstruct Montana Avenue (south of Lewis Street) to a paved width of 32 feet, generally matching the existing paved surface width. The lane configuration at that paved width could provide for single 12-ft travel lanes in each direction with 4-ft paved shoulders or 11-ft travel lanes with 5-ft shoulders that could be striped as bike lanes to provide for dedicated facilities for bicycles south of Lewis Street. On-street parking would be allowed on both sides of the road via gravel shoulder swales. The gravel shoulders would vary in width from approximately 8-9 feet along the west side of the street where continuous sidewalk would be constructed/perpetuated and from 8-14 feet along the east side of the street, depending on the presence of existing sidewalk. The gravel shoulders would have depressed flowlines to double as shallow-depth swales for surface runoff retention and percolation into the sub-surface gravel layers under the existing roadway subgrade (more details on drainage are provided in a later section of this chapter). The paved width of the street would be increased on the north approaches to Main Street and US 12 to accommodate turn lanes (southbound left-turn lane and southbound right-turn lane, respectively). Where auxiliary turn lanes are implemented, on-street parking would be displaced. There is also an existing bus stop on the west side of Montana Avenue between Main Street and Riggs Street that may need to be relocated or accommodated differently given the additional functional street width required in the area where turn lanes are needed.

New concrete sidewalk (5-ft recommended width) would be constructed along the west side of the road to fill in where sidewalk does not currently exist and/or to replace sidewalk that is in poor condition. Figure 4 on the following page illustrates one version of the Baseline Construction Alternative typical section for the US 12 to Lewis Street segment of the corridor along with a plan view snapshot of the concept design improvements. Additional details on special features such as accessibility ramps and valley gutters are discussed in later sections of this chapter. The recommended pavement sections for all typical sections are consistent with the discussion in the previous chapter of this report.

For the Storm Drain Upgrade Alternative, Montana Avenue would be reconstructed from US 12 to Lewis Street to a width of 42 feet (top back of curb to top back of curb) with two (2) 12-ft travel lanes, 8.5-ft parallel parking aisles on each shoulder (measured from shoulder strip to face of curb), and 5-ft concrete sidewalks separated from the curb and gutter by 3-ft wide, landscaped boulevard strips. This configuration would not provide for on-street bike lanes, but the travel lanes could be marked with sharrows and signs could be erected to notify drivers of the intention of shared use. Alternatively, on-street bike lanes could be provided either in lieu of on-street parking or by eliminating the landscape boulevard areas on each side and either slightly narrowed travel or parking lanes or a slightly wider typical section. New street lights could be located in the landscaped boulevards on both sides of the roadway (alternating spacing) to illuminate the traveled way. The standard roadway width would allow for auxiliary left-turn lanes to be implemented on the north and south approaches to Main Street and on the north approach to US 12 to provide for additional intersection capacity (on-street parking would be prohibited adjacent to the three-lane sections). Figure 5 on page 33 illustrates one version of the Storm Drain Upgrade Alternative typical section for the US 12 to Lewis Street segment of the corridor along with a plan view snapshot of the concept design improvements. Additional details on special features such as accessibility ramps and valley gutters are discussed in later sections of this chapter.

To the north of Lewis Street, the recommended conceptual design typical section is very similar for both the Baseline Construction and Storm Drain Upgrade alternatives. It consists of a 44-ft paved-width, rural section roadway with single, 12-ft travel lanes in each direction, a 12-ft two-way left-turn lane (TWLTL) and 4-ft paved shoulders. Although driveway spacing is dense along both sides of the road south of Lewis Street, the north segment also has a very dense driveway spacing along the east side of the road and numerous existing or planned driveways to the west that will support high peak-period turning movement volumes. It was previously shown through the traffic analysis part of this study that auxiliary left-turn lanes are projected to be warranted for multiple driveways at the schools, Highland Meadows Subdivision, and for the north approach at the Lewis Street intersection. The TWLTL is an important feature both relative to safety and operations efficiency in this section of the corridor. From a width standpoint, AASHTO recommends (in the green book) 14 feet as a standard but allows for a range of widths based on circumstances. A wider lane in this case would make drivers feel less constricted and more comfortable. Although driver comfort is a good thing, the implementation of a narrower (12-ft) TWLTL would likely help to reduce speeds slightly in what is intended to be a low-speed environment (25 mph and 35 mph speed limits plus further reductions when school zone speed limits are in effect). The narrower lane width would also help to reduce project



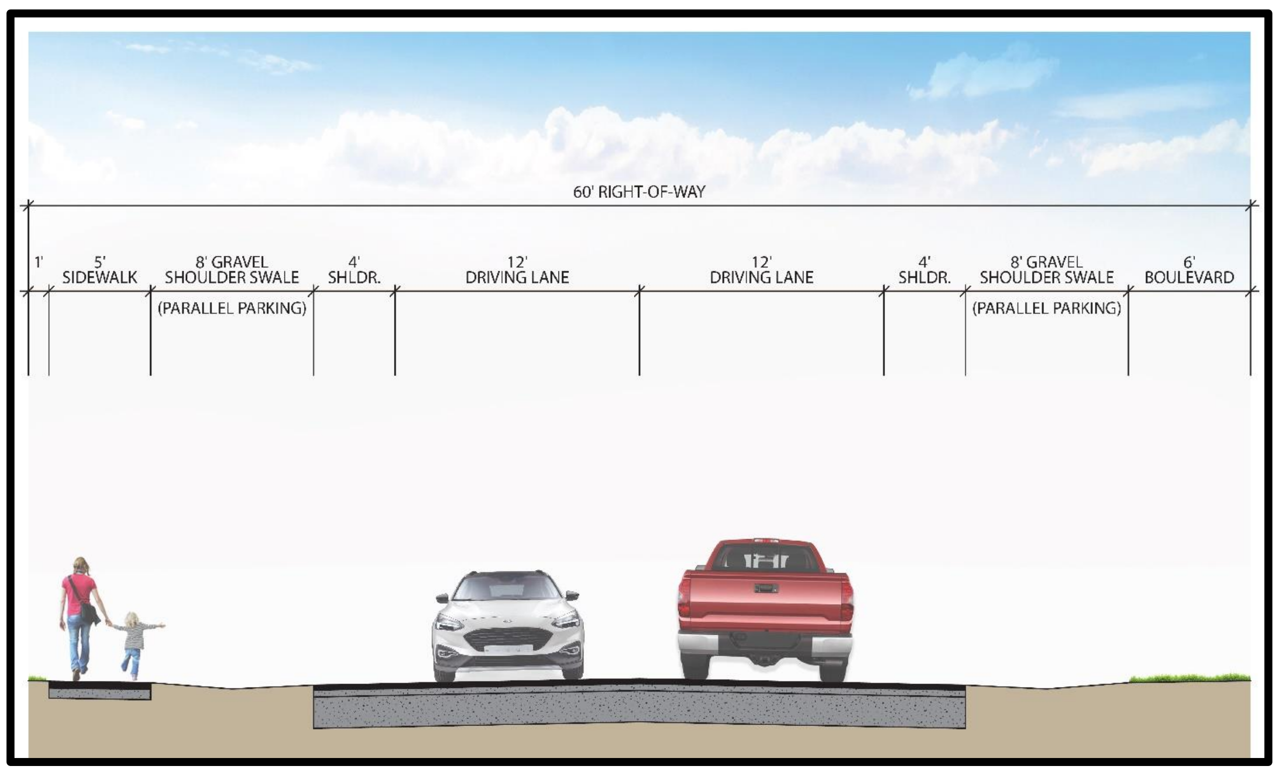
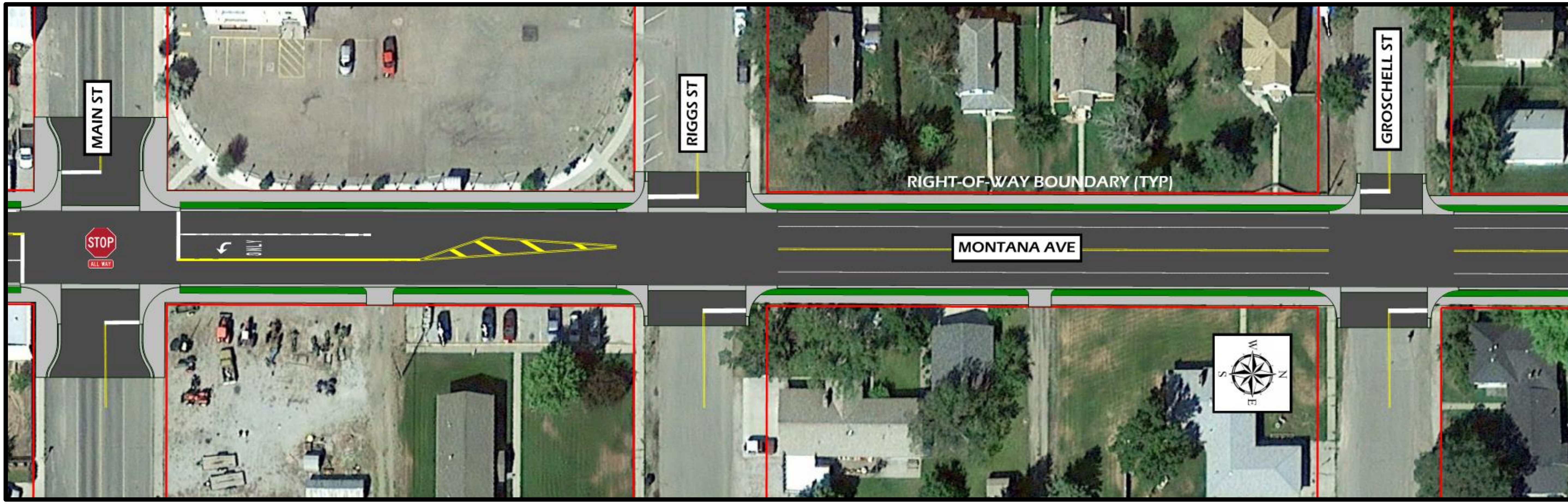


Figure 4. Baseline Construction Alternative – US 12 to Lewis Street Plan View Snapshot and Typical Section



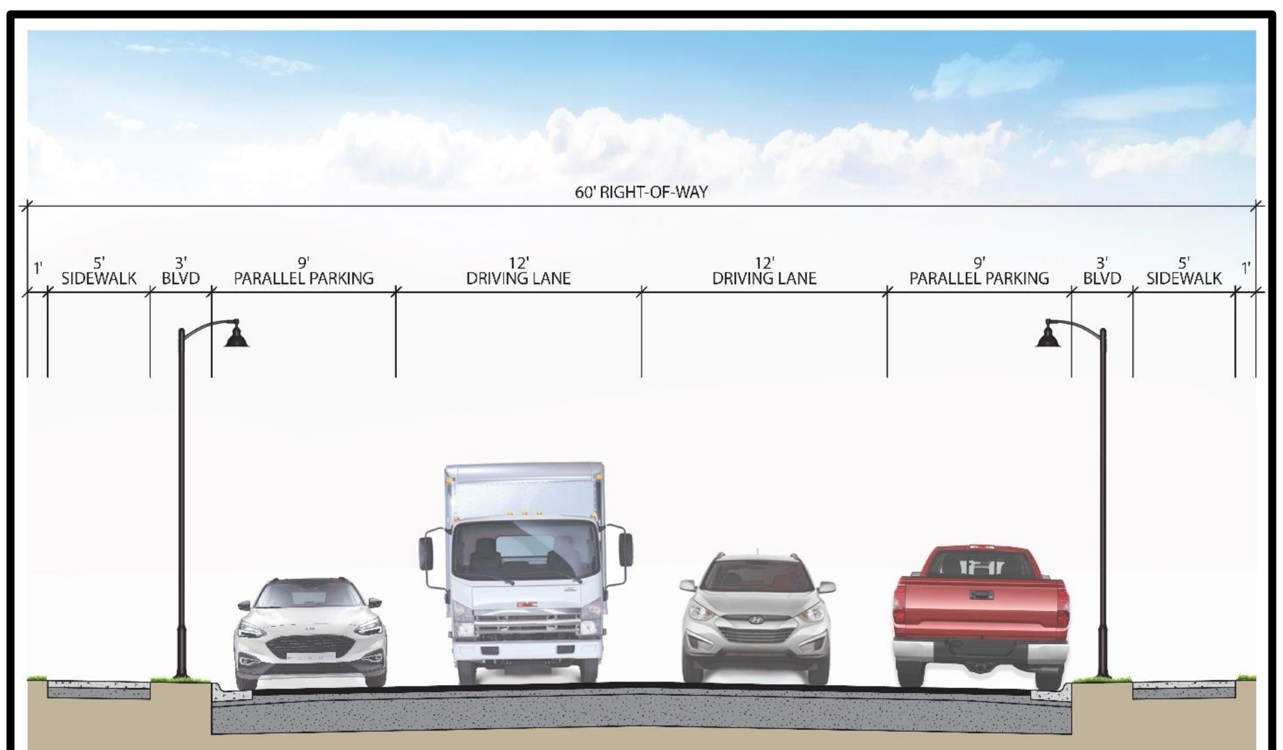
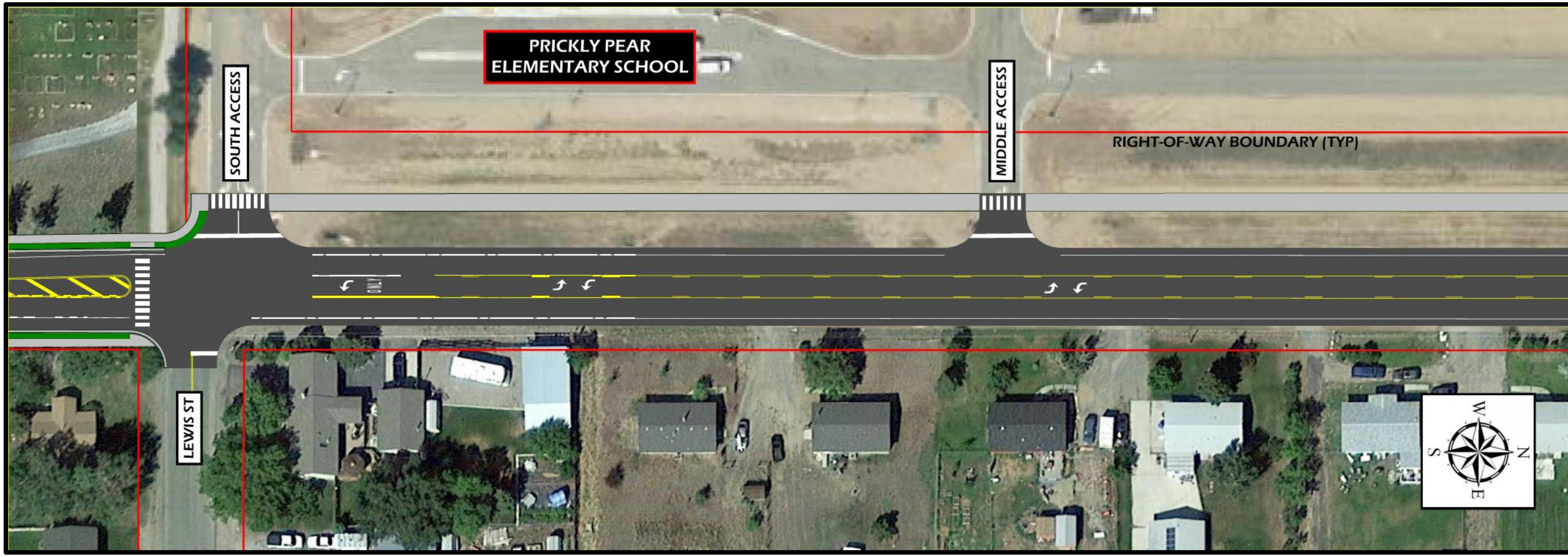


Figure 5. Storm Drain Upgrade Alternative – US 12 to Lewis Street Plan View Snapshot and Typical Section



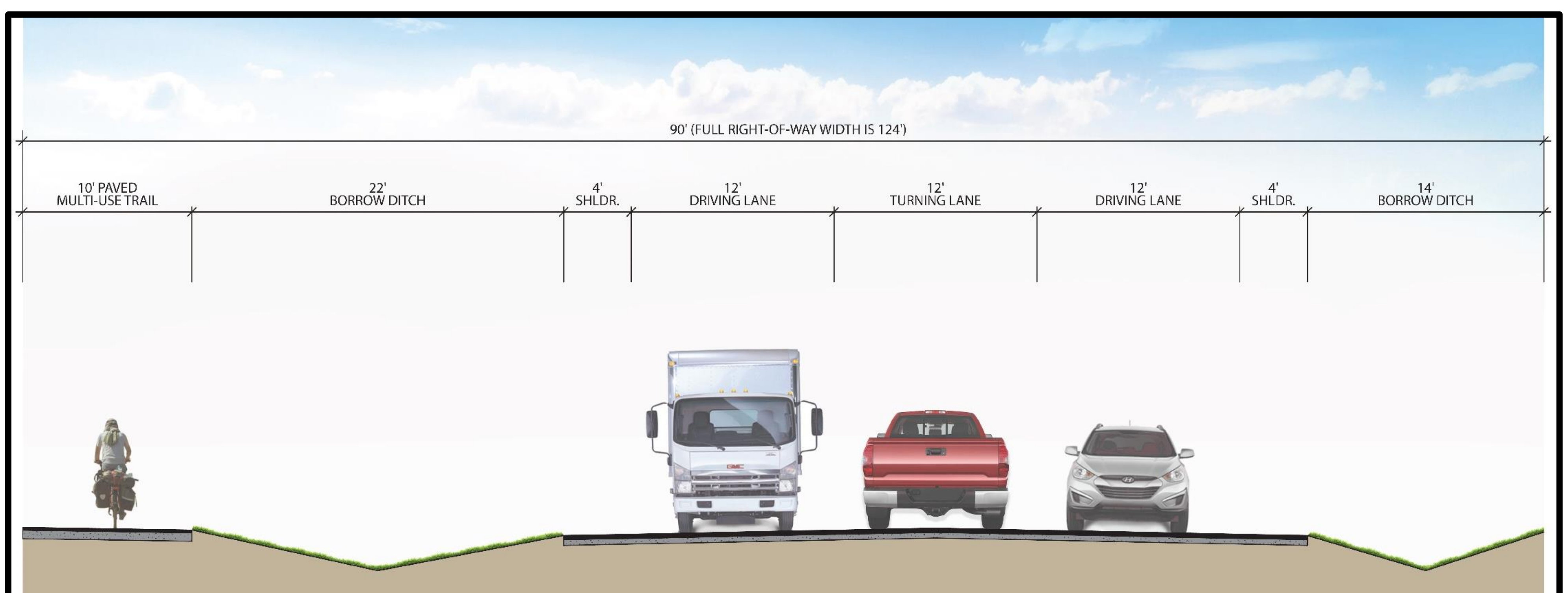


Figure 6. Lewis Street to Plant Road Plan View Snapshot and Typical Section

construction costs and would shorten any pedestrian crosswalks that are implemented through this stretch. Additional consideration of lane widths should be given during the formal design process.

A southbound auxiliary right-turn lane is also recommended for the Prickly Pear Elementary School north access intersection. Paving of the existing gravel multi-use trail is recommended at a minimum width of 10-ft per the *Guide for Development of Bicycle Facilities, 4th Edition* (AASHTO, 2012). A reduced width of 8 feet could be implemented as a cost savings measure, but in that case, AASHTO would recommend design and implementation of intermittent widened passing areas to accommodate two-way traffic. Asphalt pavement is modeled (for the purposes of construction cost estimates) for the multi-use trail as part of the Baseline Construction typical section vs. concrete for the Storm Drain Upgrade alternative. The primary advantage of concrete would be durability and longevity, but an asphalt trail would serve this area very well. Figure 6 on the previous page illustrate the Baseline Construction and Storm Drain Upgrade alternatives typical sections for the Lewis Street to Plant Road segment of the corridor along with plan view snapshots of the concept design improvements.

Right-of-way/Easements

Based on the above-recommended typical section alternatives, it is not expected that there would be a need for substantial right-of-way acquisition in order to build a street reconstruction project. The widening of the roadway from Lewis Street to Plant Road would generally be easily accommodated within the existing right-of-way given the extra right-of-way that has been and/or would be dedicated along the west side of the corridor through the development of the school projects and Highland Meadows Subdivision. Right-of-way is however tight along the east side of the corridor, so most of the widening north of Lewis Street would likely need to be accomplished to the west. The right-of-way for that segment is narrower (60-65 feet) than to the north (124 feet). Since the majority of the widening in the north segment will most likely occur to the west side of the road (taking advantage of the extra right-of-way), the transition from thee lanes to two lanes immediately south of Lewis Street is likely to also be shaded to the west. In order to make that transition from the proposed three-lane typical section to the two-lane section while maintaining standard lane widths, transition tapers, and sidewalk offsets, it may be necessary (for the Storm Drain Upgrade Alternative only) to acquire right-of-way or an easement from the East Helena Cemetery property located along the west side of Montana Avenue between Lewis Street and Dudley Street. Figure 7 on the following page illustrates the proposed right-of-way impacts for the cemetery property with Storm Drain Upgrade Alternative improvements in place. The estimated right-of-way or easement need based on relocating the property line to the back of the proposed sidewalk would only be approximately 1280 feet (0.03 acres). Physically-speaking, impacts to function and aesthetics of the cemetery would be minimal. Relocation or replacement of a portion of the chain link fence would be required, and it's possible one or more existing pine trees may need to be removed. However, it is expected that efforts to avoid impacts to the threes would be made when the project is designed If the acquisition of right-of-way (or an easement) is considered to be undesirable, adjustments to the proposed design could likely be made to fit the roadway typical section transition within the existing right-of-way, although compromises would be required relative to some of the standard design features for the typical section (Storm Drain Upgrade Alternative) and/or the geometrics of the transition.

Additional acquisition of right-of-way or easements may be required for the Storm Drain Upgrade alternative in order to build a storm drain outfall from the Montana Avenue/Valley Drive corridor to Prickly Pear Creek. Further discussion of proposed drainage improvements can be found in the next section of this chapter.

Drainage Facilities

Drainage in the Montana Avenue/Valley Drive corridor is currently addressed handled via roadside borrow ditches with culverts under drive approaches to the north of Lewis Street. Between US 12 and Lewis Street, there is no existing collection or distribution system in place with the exception of three area inlets at the Main Street intersection that feed water to a storm drain main in Main Street that outfalls to Prickly Pear Creek. The conceptual design for this study proposed that the existing drainage system generally be perpetuated for the Baseline Construction alternative. A couple of enhancements are recommended as follows:

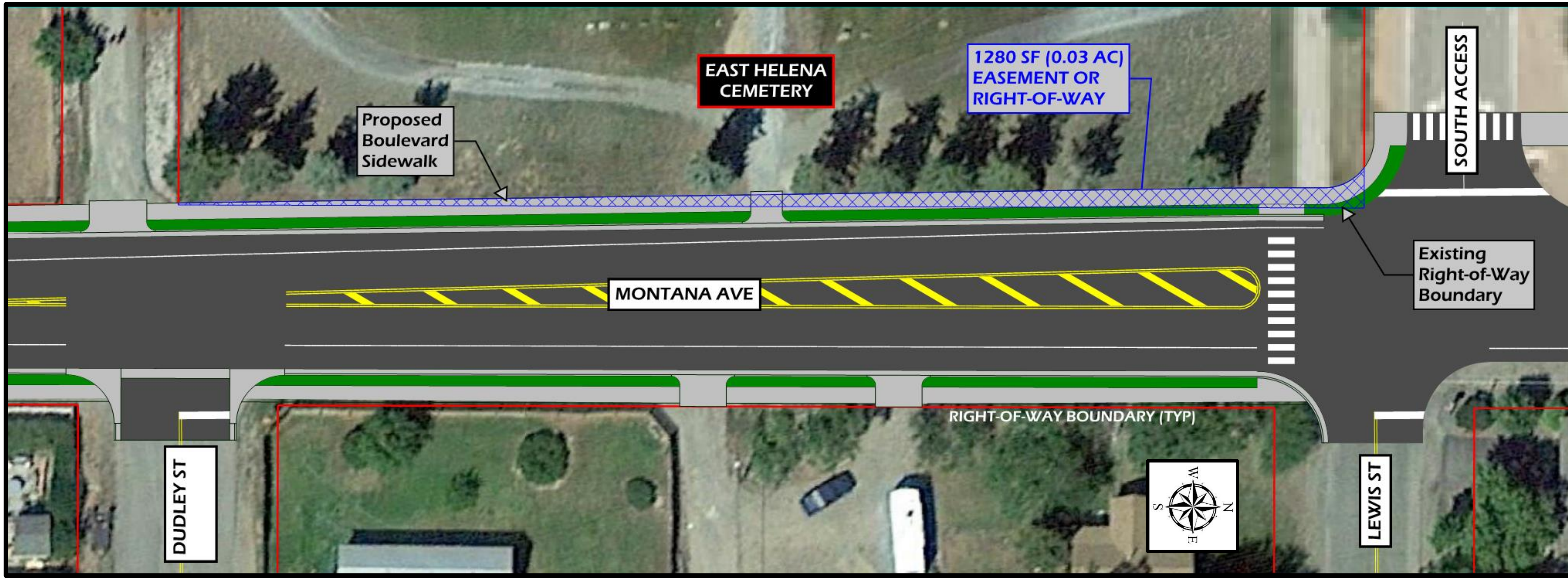


Figure 7. Right-of-Way Impact Exhibit

- Construction of concrete valley gutters across side street approaches to convey water out of the intersections and protect the pavement from degradation related to infiltration of water
- Establishment of more well-defined, albeit shallow gravel swales along the roadway shoulders between US 12 and Lewis Street to provide for runoff collection and percolation areas (keyed into subsurface gravels to prevent subgrade or pavement section saturation) and to protect against flooding of private property
- Replacement of damaged or undersized approach culverts for segment north of Lewis Street
- Regrading of borrow ditches as necessary to promote positive drainage

For the Storm Drain Upgrade Alternative, a new storm drain system would be installed in Montana Avenue between US 12 and Lewis Street. The system would consist of two separate mains, one toward the south end of that segment that outfalls to the existing storm drain main in Main Street (which would most likely need to be either constructed to increase the size of that main or have an additional, parallel main installed to accommodate the increased runoff), and the other to the north end of the segment south of Lewis that would connect to a new lateral main heading west from the Lewis Street intersection toward a presumed new outfall at Prickly Pear Creek. As a cost savings measure, it was presumed for the purposes of the conceptual design and associated cost estimate that the lateral would be piped west to a point just beyond the Lewis Street/Hanson Avenue intersection, at which point it could become an open-channel facility since the property from there to the creek is owned by the City. Surface runoff would be collected in strategically-placed curb inlets. The lateral main heading west from the Montana Avenue/Valley Drive/Lewis Street intersection could also potentially be utilized as an outfall for some runoff from the segment of the corridor to the north. Figure 8 on the following page provides a conceptual illustration of where the referenced north main and outfall ditch could be located. As with the Baseline Construction Alternative, valley gutters would be constructed at side street approaches to convey water to inlets as necessary depending upon how each side street approach is graded. To the north of Lewis Drive, drainage improvements would match those for the Baseline Construction alternative with runoff being capture and conveyed via borrow ditches with culverts under approaches.

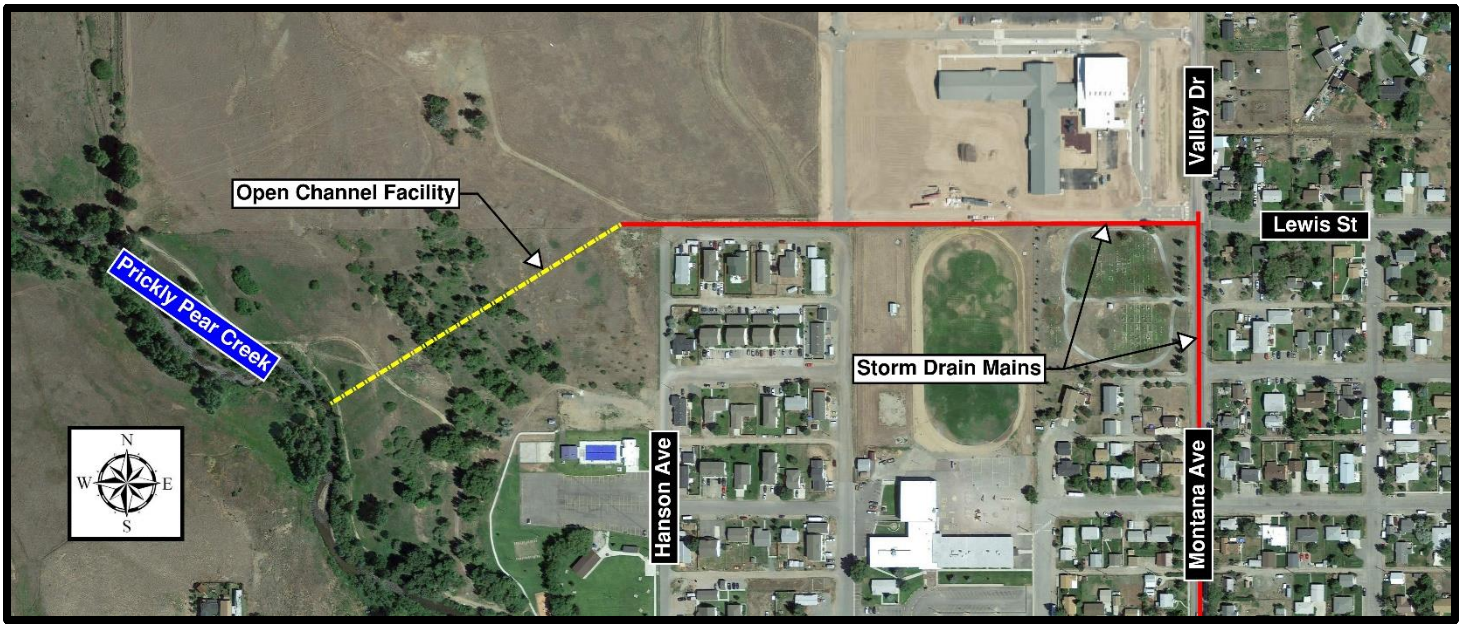


Figure 8. Storm Drain Main/Outfall Ditch Exhibit

Bicycle/Pedestrian Facilities

As was briefly referenced in the Typical Sections section of this chapter, sidewalk along the west side of Montana Avenue from US 12 to Lewis Street would be completed through installation of new sidewalk where gaps currently exist. Sidewalk that is in poor condition or that does not meet Americans with Disabilities Act (ADA) standards would also be replaced. ADA-compliant accessibility ramps would be constructed at intersection corners in alignment with the sidewalk along the west side of the road. To the north of the Lewis Street intersection, it is recommended that the existing gravel multi-use trail be paved with asphalt at a minimum width of 8 feet or up to an ideal width of 10 feet. Through the Storm Drain Upgrade Alternative, new sidewalk would be constructed (replacing all existing sidewalk) along both sides of Montana Avenue from US 12 to Lewis Street. ADA-compliant accessibility ramps would be constructed on intersection corners along both sides of the corridor as well. Bulbouts should be considered for the Main Street/Montana Avenue intersection (extending into Main Street only). The primary purpose of bulbouts is to shorten the crossing distance for pedestrians by extending a pedestrian refuge area into the street. However, bulbouts would also likely improve visibility of waiting pedestrians for drivers while also providing a built-in traffic-calming feature. It is recommended that the bulbouts only extend into (infringe upon) the Main Street portions of each corner, since having bulbouts extend into Montana Avenue would eliminate the ability to provide auxiliary left turn lanes. The existing gravel multi-use path would be paved with concrete at a minimum width of 8 feet or up to an ideal width of 10 feet for the Storm Drain Upgrade alternative. Additional discussion of pedestrian crosswalk-related improvements related to school zone crosswalks is included in the Signs/Pavement Markings section of this chapter.

Intersection Traffic Control

Based on the results of the traffic operations analysis that was performed for this study, it is recommended that a traffic signal be installed at the intersection of US 12 and Montana Avenue. It is expected that the south approach at that intersection will be closed so as to eliminate the at-grade railroad crossing that is located in close proximity to the intersection. Closure of the south approach would eliminate the need for railroad pre-emption as a part of the traffic signal system. Video detection or some other actuation mechanism should be implemented to help with optimizing operations.

Although it was shown that the MUTCD criteria for warranting installation of multi-way stop control is not projected to be met for even the Design Year (2040) scenario at the Main Street/Montana Avenue intersection, the intersection is projected to fail badly during one or more peak periods for that scenario under two-way stop control. Furthermore, City officials have expressed concerns relative to both pedestrian safety and sight distance for drivers stopped at the stop-controlled south approach. Since only the Peak Hour traffic signal warrant is projected to be met for the Design Year (2040) scenario, a signal should not be installed until additional traffic signal warrants are shown to be met. All-way stop control should be implemented as an interim measure to improve intersection operations and safety until the time that a traffic signal is warranted.

The above-recommended intersection traffic control improvements are applicable for both the Baseline Construction and Storm Drain Upgrade alternatives. No further intersection traffic control improvements are anticipated to be necessary.

Signs/Pavement Markings

Signs and pavement markings would generally be upgraded throughout the corridor without much variation between the two conceptual design alternatives. Epoxy paint is recommended for pavement markings over water-based paint because it is a more durable product. Yellow curb paint should be considered for locations where parking is prohibited for the Storm Drain Upgrade Alternative.

To promote safety in the corridor adjacent to the schools, two school zones should be implemented with reduced school zone speed limits that are in effect only during school days and only for certain hours of the day. Figure 9 on the following page illustrates the recommended extents and sign configurations for the two school zones. The south school zone should extend from approximately 200 feet south of Clinton Street to a point approximately 200 feet north of the Prickly Pear Elementary School north property boundary. The north school zone should extend from a point 200 feet south of the south property line for East Helena High School to a point 200 feet north of the north property boundary. By State of Montana statute, school zone speed limits can be set no lower than 80% of the overriding speed limit rounded down to the nearest 5 mph increment. The current overriding speed limits in the corridor are 25 mph from US 12 to approximately 200 feet north of Lewis Street and 35 mph from that point to the north. As such, the overriding speed limit and thereby the minimum allowable school zone speed limit would change within the limits of the recommended south school zone. To avoid that scenario, the transition from the overriding 25 mph speed limit to a 35 mph speed limit should be relocated to the Prickly Pear Avenue intersection. The school zone speed limit for the south (elementary schools) school zone should be 20 mph. The school speed zone for the north (high school) speed zone should be 25 mph. The school zone speed limits signs should be supplemented with S4-4P plaques that read "WHEN FLASHING," and with solar-powered flashers than can be set to flash only during certain hours on school days. Rectangular rapid flash beacon (RRFB) pedestrian-actuated signals should be installed to supplement marked crosswalks at the more heavily used of the Clinton Street or King Street marked crosswalks, and at the Lewis Street intersection marked crosswalk. School crossing guards should be stationed at all three crosswalks regardless of whether or not RRFB signals are ultimately implemented. The above recommended school zone improvements should be implemented regardless of the chosen design alternative.

Street/Intersection Lighting

Addition of improved intersection lighting is recommended as part of the traffic signal installation at the US 12/Montana Avenue intersection for both design alternatives. Additionally, the Storm Drain Upgrade Alternative includes new street lighting along both sides of the corridor (alternating pattern) from US 12 to Lewis Street. The street lights would be located in the 3-ft landscaped boulevard between the curb and gutter and sidewalk.

Private Utilities Considerations

Based on the conceptual design and research information available at the time this study was performed, it does not appear that any existing private utilities would need to be relocated to accommodate the range of roadway and utility improvements discussed herein. Centurylink has indicated that its lines could stay in place with the roadway widened to be over the top of them as long as there are no depth-related conflicts associated with excavation and installation of the roadway surfacing section(s). Regarding the overhead power lines, there is no curb and gutter to serve as a physical barrier for most of the corridor. As such, the power poles along at least the east side of the street likely sit within suggested clear zones as defined by the *Roadwise Design Guide, 4th Edition* (AASHTO, 2011). The low speeds (25 mph speed limit) and virtually flat slopes for the segment between US 12 and Lewis Street are such that the close-proximity locations of the poles are of lesser concern. North

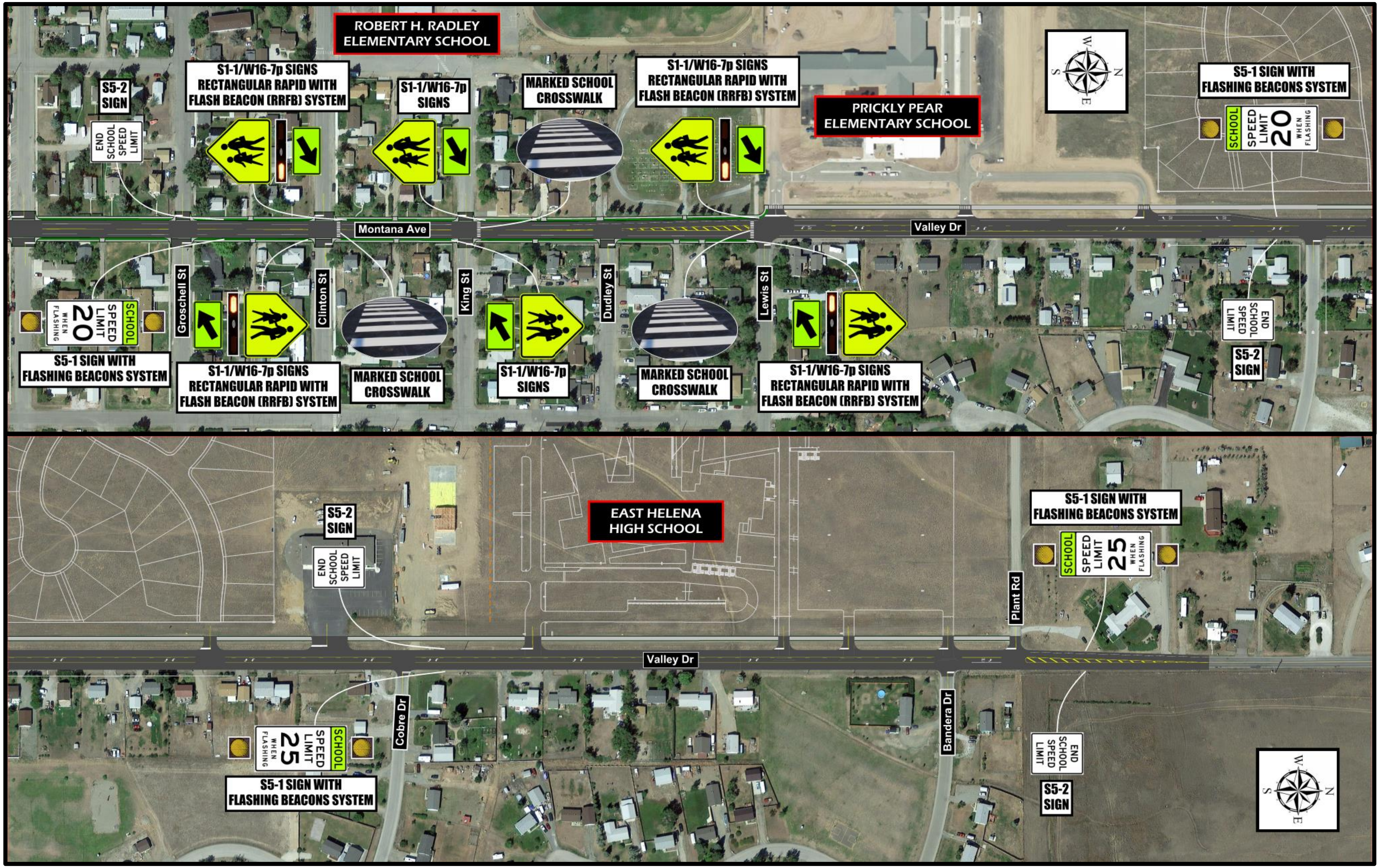


Figure 9. Recommended School Zone Improvements

of Lewis Street, the speed limit is 35 mph (typical design speed equivalent to 40 mph). In that case, AASHTO recommends clear zone distances of 12-14 feet for 6:1 or flatter ditch slopes and 14-16 feet for 4:1 or 5:1 ditch slopes based on the typical volume of traffic on the roadway. Some or all of the existing power poles may violate those recommended offsets. The exact separation distances and ditch slopes will need to be verified through topographic survey during project design. The existing power line appears to be located at back of the right-of-way and thus could not be relocated farther from the road without encroaching on private property. Mitigation options could include some combination of:

- Lowering of the speed limit from 35 mph to 25 mph throughout the corridor
- Shifting the roadway to the west to create the required separation suggested by AASHTO
- Flattening of ditch slopes to be 6:1 or flatter to reduce the suggested clear zone distance
- Protection of poles using a roadside barrier system such as guardrail
- Conversion of the overhead power line to an underground line

In general, relocations of private utilities within City street right-of-way are often made at no cost to the municipality. However, the conversion of power lines to underground facilities is typically very expensive and may not be a requirement in order to eliminate conflicts with the roadway or utilities or from a safety perspective. As such, that cost would presumably need to be born or at least shared by the City, whereas moving existing buried lines or overhead power would typically be the responsibility of the provider (when initiated by a City project).

Construction Cost Estimates

The project team developed estimates of probable cost for the two conceptual design alternatives described in the previous section of this report. Bid item quantities were calculated based on conceptual design line work (no boundary or topographic survey information), concept-level storm water analysis calculations, and recommendations from the project geotechnical report. Unit prices for bid items were estimated based on similar projects. A 15% contingency was added to the estimated construction total to account for potential bid pricing fluctuations and unknown design/construction considerations. Engineering design and construction-phase consultant fees were estimated based on a percentage basis relative to the estimated construction cost. In total the estimate of probable cost for the Baseline Construction Alternative is approximately $3,100,000 including approximately $475,000.00 estimated for consultant design and construction administration services. The total estimate of probable cost for the Storm Drain Upgrade Alternative is approximately $5,500,000, including approximately $850,000 estimated for consultant design and construction administration services. Note that these estimates do not account for any costs that might be associated with State agency application or review fees or right of way/easement acquisition costs. Detailed breakdowns of the cost estimates for the two conceptual design alternatives are attached in Appendix L.

PROJECT FUNDING

6

A variety of possible funding sources to aid in the design and construction of improvements to the Montana Avenue/Valley Drive corridor were researched for this study. This chapter of the report provides a brief summary of grant opportunities and options for assessments to existing residents and new land development projects.

Proportionate Cost Share

The City of East Helena currently has a subdivision improvements agreement (SIA) in place with East Helena School District that obligates the school district to contribute a proportionate share (not to exceed $700,000) for "the cost of engineering and improvements to Valley Drive." Subsequent to when that SIA was recorded in September of 2018, a 320-lot single family residential subdivision project called Highland Meadows Subdivision was proposed along Valley Drive between Prickly Pear Elementary School and the East Helena High School site. One primary purpose of study was to evaluate options for a cost share arrangement to equitably assign proportionate financial responsibility for street and utility reconstruction improvements to the Montana Avenue/Valley Drive corridor (US 12 to Plant Road) amongst the East Helena School District (for the high school project only), Oakland & Company (developer for Highland Meadows Subdivision), and the City of East Helena. The project team evaluated several possible approaches to assigning proportionate cost share, including calculations on the basis of traffic generation, frontage length along the roadway, and property square footage (relative to overall taxable area in the City).

The most equitable of those approach was found to be a calculation made on the basis of property frontage, because the resulting range of contribution amounts (calculated based on the two concept design alternative estimates of probably construction cost) were considered to be reasonably in line with off-site improvement assessments that may have been required for each individual project (such as for turn lane improvements or construction of sidewalk or multi-use path). The total length of frontage, including both sides of the roadway from the north right-of-way line for US 12 to the north right-of-way line for Plant Road was calculated to be 13,574 feet (rounded to the nearest foot) based on available plats and certificates of survey. That total includes the La Casa Grande Subdivision frontage, because although that subdivision is not in the City, the frontage of the roadway adjacent to it is still the responsibility of the City as it relates to a potential reconstruction project.

The frontage distance along Valley Drive for Highland Meadows Subdivision based on the current plat is 1327 feet (rounded to the nearest foot), which equates to a 9.8% proportion. That percentage when applied to the total estimated project cost for the Baseline Construction Alternative ($3,100,000) would equate to a contribution amount of $303,800. The same calculation relative to the storm drain upgrade alternative ($5,500,000) would equate to a contribution amount of $539,000. The frontage distance for the high school property is 1238 feet (rounded to the nearest foot), which equates to a 9.1% proportion. That percentage when applied to the total estimated project cost for the baseline construction alternative ($3,100,000) would equate to a contribution amount of $282,100. The same calculation relative to the Storm Drain Upgrade Alternative ($5,500,000) would equate to a contribution amount of $500,500. It's important to acknowledge that the dollar amounts are simply an estimate of possible contribution figures, because they are based on estimates of probable construction cost associated with concept/planning level design. However, the relative contribution percentages of 9.8% for Highland Meadows Subdivision and 9.1% for East Helena High School would not change regardless of the cost of a proposed reconstruction project and thus should be considered as recommendations resulting from this study effort.

Community Assessment Options

Regarding the proportion of cost that is ultimately determined to be the responsibility of the City, there are a variety of options for how those costs could be assessed to the community. One such option could be through the creation of a special improvement district (SID). An SID is grouping of properties as a legal entity that agree as a majority (no more than a 50% protest) to pay for public improvements. The assessments for each property owner in the SID can be determined through a variety of methods, but the methodology must be considered equitable to all properties and approved by bond counsel, because the upfront funding for construction is generated through bond sales. The key to creating an SID is determining an equitable approach to spreading the assessment based on the anticipated public benefit of the improvements. Assessments can typically be paid off in a lump sum or they can be amortized over a period of time (12 to 15 years is typical). Although the City of East Helena has not previously utilized an SID to fund improvements, it is a common tool in many cities in Montana and around the country.

Montana statute does also allow for an SID to include properties outside of a city (i.e., County property) if the SID improvements benefit the property. However, for those properties to be included, not less than 40% of the property owners being assessed outside the City limits can protest the creation of the district. A joint resolution between the City and County must be passed agreeing to terms of the SID prior to creation of the district. Since the proposed improvements would front upon County property (La Casa Grande Subdivision) and would benefit countless other County residents that utilize the roadway, a joint SID would seem to be an appropriate option if the City and County can agree on structure and rally residents to not protest the assessment.

The City may also want to consider a General Obligation Bond for funding their share of the improvements. In a case like this, the City would issue bonds that would be repaid through a general tax assessment to all property owners within the City's jurisdiction.

Alternative Funding Sources

A variety of other grant/funding programs exist that may provide financial assistance for the construction of public roadway and/or utility improvements. Table 7 on the following page summarizes the list of prospective programs and provides brief commentary on general requirements. Various of the listed opportunities may be applicable for parts of the work included in this project. In general, the timeframes for requesting and getting approval of grant funding through these of programs is lengthy. As such, if the City is interested in pursuing these types of funding programs, a strategy should be developed whereby certain specific improvements could be carved out of the large improvement project and constructed separately if a funding request is granted.

Table 7. Alternate Funding Source Summary

Funding Program	Commentary
Treasure State Endowment Program (TSEP) Renewable Resource Grant and Loan Program (RRGL) State Revolving Fund Loan Program (SRF) Community Development Block Grant Program (CDBG) USDA Rural Development Program (RD)	These State and Federal programs provide funding for storm water, water, sewer systems, and bridges. If the City of East Helena wants or needs to replace the infrastructure beneath the roadway, these programs could be feasible options for requesting partial funding. These programs are very competitive.
Bridge and Road Safety Accountability Act (BaRSAA)	This funding mechanism approved by the 2017 legislature provides increased fuel tax funding for cities and counties. The City of East Helena would need to choose to allocate their BaRSAA funds to this specific project.
MDT Transportation Alternatives Program (TA)	This program provides funding for smaller scale transportation projects such as sidewalks and trails. The program is currently not accepting new applications due to lack of Federal funding. If the program receives funding in the future, it could be an option for sidewalk or trail improvements associated with this project.
MDT Traffic Safety Improvement Funding	MDT allocates Federal funding for roadway improvement projects that have a history of traveler safety concerns. For this project however, there is not a documented crash history concern, which may make it difficult to get requested project funding approved through this program.
HB 652 – Delivering Local Assistance (DLA) School Infrastructure Funding	HB 652 passed by the 2019 Legislature provided $10.75 million of funding for school district infrastructure projects. A school district infrastructure project means a project: (i) that is related to life safety or security issues; (ii) for major repairs or deferred maintenance to an existing school facility; or (iii) for major improvements or enhancements to an existing school facility. The program is administered by the Department of Commerce (DOC). Road construction is not considered an eligible use of DLA funding. Funding from this project may be considered applicable for improvements related to storm water management or pedestrian safety improvements.
Optional Motor Vehicle Tax Local Option Motor Fuel Excise Tax	Local tax options typically require approval of the voters within the City and/or County.

CONCLUSIONS & RECOMMENDATIONS

7

The preceding corridor study has identified a variety of existing deficiencies within the Montana Avenue/Valley Drive corridor, as well as projected future impacts based on anticipated and ongoing development and general area growth. Through the course of this study, two (2) concept-level roadway reconstruction design alternatives were developed that are intended to address the most critical operational and safety concerns and to ultimately provide for a safe and efficient roadway corridor for all multi-modal users through and beyond a 20-year design horizon. The primary difference between the two design alternatives is the inclusion of an underground storm drain system to drain Montana Avenue between US 12 and Lewis Street while providing a fully-finished reconstructed street with curb and gutter and sidewalks along both sides of the roadway. Preliminary estimates of probable design and construction cost were prepared for both design alternatives, and various options were considered for how to equitably levy a proportionate share of the anticipated improvement costs to the East Helena School District, the City of East Helena, and to Oakland & Company for mitigation of impacts associated with the proposed Highland Meadows Subdivision. The following is a bulleted list of concluding thoughts and recommendations for moving forward with a successful reconstruction project:

- Any known or planned subsurface work that is anticipated to occur within the next 10 years, such as sanitary sewer or water system replacements, installation of storm drain improvements, or private utility installations or modifications should be programmed for construction prior to or along with the roadway reconstruction project so that the new pavement and associated surface improvements for the street reconstruction will not have to be disturbed to make subsurface improvements in the relative near future. In addition to maintaining higher levels of aesthetic quality, durability, and drivability, there would also likely be a cost savings associated with installing sub-surface improvements under the same project as the roadway reconstruction based on economy of scale considerations.

- If funding can be programmed accordingly, the Storm Drain Upgrade Alternative should be constructed, since it would provide the highest level of operational and safety improvements for the roadway corridor, including roadway lighting and drainage improvements. However, as presented in this report, the Baseline Construction Alternative would adequately reconstruct the roadway and improve traffic operations and multi-modal user safety conditions such that the corridor should function well through the project design year of 2040. Variations of either of the recommended alternatives or phasing of certain improvements may also be considered based on the anticipated availability and/or timing of funding. For example, paving of the multi-use trail could be postponed in order to save on initial project costs. Likewise, the installation of street lighting as recommended with the Storm Drain Upgrade Alternative could be completed at a later time with little or no impact to the street if conduits were installed under the roadway so that trenching and boring would not be necessary to install wiring. However, the following specific improvements should be considered as minimally required in order to provide for safety and efficiency in the project corridor:

- ✓ The Montana Avenue/Valley Drive corridor from US 12 to Plant Road should be fully reconstructed with a new asphalt pavement section as recommended in this report and based on the detailed recommendations in the supportive geotechnical report.
  - ➢ The segment of the corridor from Lewis Street to Plant Road should be widened to three lanes (with a continuous two-way left-turn lane).
  - ➢ Concrete valley gutters should be installed on all side-street approaches (public streets) to promote positive drainage away from the asphalt and reduce exposure to degradation from ponding, pumping, and infiltration.
  - ➢ Sidewalks along the west side of Montana Avenue from US 12 to Lewis Street should be constructed/reconstructed as necessary to complete a continuous pedestrian facility that meets Americans with Disability Act (ADA) standards.
- ✓ The Montana Department of Transportation (MDT) has indicated that it will not support installation of a traffic signal at the US 12/Montana Avenue intersection for a variety of reasons referenced earlier in the body of this report and as detailed in the comment-response spreadsheet included in Appendix A. From a traffic operations perspective, the intersection does seem to operate with limited delay and congestion now, although conditions are likely to worsen over time as the high school and area subdivisions contribute increased traffic demand to the corridor. As such, traffic demand, operations, and safety should be monitored closely going forward in cooperation with MDT to determine if and when in the future a traffic signal may be needed at the intersection. In the interim, the north approach at the intersection should be configured to provide for a shared left-turn/thru lane and a dedicated right-turn lane.
- ✓ All-way stop control should be implemented at the Main Street/Montana Avenue intersection. Although it is likely not necessary now based on traffic volume demands, it would improve safety relative to both sight distance restrictions on the south approach and pedestrian safety, while also improving traffic operations in the future as traffic demand increases on Montana Avenue. An auxiliary left-turn lane should be implemented on the north (southbound) approach to mitigate expected delay and queueing concerns that will arise, particularly during the morning peak hour, as traffic demand increases on Montana Avenue.
- ✓ A school zone with a reduced speed limit for specific school-day time periods, improved signage, and marked school crosswalks [augmented with rectangular rapid flash beacon (RRFB) systems at two (2) targeted locations – see report sub-section titled "Signs/Pavement Markings" on page 38 for additional details] should be installed to improve safety for all pedestrians and for students in particular. A volunteer crossing guard program should also be implemented by the School District to assist students with crossing at key marked crosswalks during the before-school and after-school peak periods.

- Where possible, intersections of private driveway and/or public street approaches along the corridor that are currently offset by less than 200 feet should be modified to be in alignment for the purposes of eliminating conflicts between turning vehicles entering and exiting the offset approaches. Any new or reconstructed approaches should be designed with radii and proper width to accommodate appropriate design vehicles (a standard, fire truck and school bus at a minimum).

- The ultimate design of the roadway reconstruction project should also pay specific attention to private utility impacts, roadside hazard/clear zone considerations, and right-of-way impacts in order to minimize overall project cost while maximizing safety. Coordination with Lewis & Clark County will be key as well relative to providing for continuity of future roadway improvements on Valley Drive to the north of Plant Road.

- A possible future roadway connection between Valley Drive and Wylie Drive along the north property boundary for Highland Meadows Subdivision and the south property boundary for East Helena High School should be pursued further since that link would serve as the only east-west connection between the two major north-south routes for a distance of approximately one mile. The addition of that roadway to the street network would likely reduce congestion in the Montana Avenue/Valley Drive corridor, particularly if access to the street is constructed from Highland Meadows Subdivision and/or East Helena High School.

- The most equitable approach for assessing East Helena School District (high school property only) and Highland Meadows Subdivision is on the basis of length of frontage along the corridor. Alternative methodologies for calculating cost share were not found to be equitable when considered relative to approximate anticipated off-site improvement costs that would be recommended for each project on an individual basis. Based on Sanderson Stewart's conceptual evaluation of a frontage-based calculation of contribution percentages, East Helena School District would contribute 9.1% of project costs and Oakland & Company would contribute 9.8% of project costs, thereby leaving 81.1% responsibility to the City of East Helena.

PUBLIC COMMENTS

APPENDIX A

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

Montana Avenue/Valley Drive PER & Corridor Study - Comment-Response Spreadsheet

Item No.	Page No.	Source & Company or Agency	Comment Date	Comment	Response
1	Pages 3-4	Jeremy Fadness WWC Engineering Planning Consultant on behalf of City of East Helena	8/12/2019 E-mail	Pages 3 and 4 – Literature Review – The TIS for Vigilante Subdivision was not included in this section. It is included in the proposed developments for Valley Drive but the TIS was not included as literature that was reviewed for this project. Was the TIS provided to them and if so why was it not included in the analysis?	At the time we were initially working on trip generation and traffic projection analysis, a TIS had not yet been completed for Vigilante Subdivision. The City had instead provided us with a copy of the subdivision application and draft preliminary plat. We based our trip generation and traffic assignment calculations for this study on the information in that package and our estimation of how trips would be routed from the development (i.e., we did include Vigilante Subdivision in the analysis). If a copy of the finished TIS is available (this has since been provided to Sanderson Stewart), it should certainly be reviewed for inclusion in any revised analysis and in the literature review section of the final report.
2	N/A	Jeremy Fadness WWC Engineering Planning Consultant on behalf of City of East Helena	8/12/2019 E-mail	The Prickly Pear Elementary School approaches were included in the existing traffic counts and these approaches were analyzed with the existing traffic count data. The traffic counts were conducted in the spring of 2018 while school was in session and would have included the elementary school traffic. In Chapter 3 it appears the elementary school was included in projected traffic. Is the elementary school counted twice, once in existing and then added again in projected?	Prickly Pear Elementary School was in operation when traffic counts were collected, but the school was only operating at partial capacity relative to the ultimate expected enrollment. The traffic generation from the school is for the additional anticipated enrollment per information from Ron Whitmoyer.
3	Chapter 6	Jeremy Fadness WWC Engineering Planning Consultant on behalf of City of East Helena	8/12/2019 E-mail	Chapter 6 proportionate share provides a method for cost sharing based on frontage length to Valley Drive for development. What about developments that do not front on Valley Drive but all traffic generated utilizes Valley Drive such as Vigilante Subdivision. There should be a way to assess proportionate share based on something other than frontage. The developers of Vigilante will potentially be developing another 20 acres to the west in the future and we will need a way to assess proportionate share to that as well. How do we assess these developments for their share when they do not have frontage on Valley Drive? Since these developments directly access Valley Drive via Plant Road and Trerise Road it seems only fair they pay a proportionate share of costs for improvements. Unless the improvements to Plant Road will be sufficient and then we assume we will set up an SID and they would be part of the SID for the Valley Drive improvements.	Based on discussions with the City of East Helena, the developer(s) of Vigilante Subdivision will be required to improve Plant Road and Treerise Road and will not be required to make a proportionate share contribution for improvements to Montana Avenue/Valley Drive. They may however be included in the SID or other future assessments at the discretion of the City.
4	N/A	Jeremy Fadness WWC Engineering Planning Consultant on behalf of City of East Helena	8/12/2019 E-mail	The sentence of the proportionate share section says that they evaluated an approach to spread the cost based on traffic generation but the approach was determined to be inequitable for a variety of reasons but do not provide the reasons. I would be curious to know what the reasoning is or a little more discussion on this.	The discussion and explanation of the methodologies considered and ultimately recommended for calculating proportionate share contributions will be discussed in more depth in the final version of the report.
5	N/A	Brad Koenig Robert Peccia & Associates Engineering Consultant on behalf of City of East Helena	8/29/2019 Letter	I know you discussed Vigilante Subdivision in your correspondence with Jeremy. This subdivision is planning to be annexed into the City and will have an impact on the traffic load to Valley Drive. It appears this development should be included in the intersection analysis. They should also be a contributor and pay their proportional share (Chapter 6).	See response to similar comment above (comment #1).
6	N/A	Brad Koenig Robert Peccia & Associates Engineering Consultant on behalf of City of East Helena	8/29/2019 Letter	The report does not identify what utilities would need to be relocated (if any). It did not appear that there were any costs included in the construction estimate for utility re-location. Consider a brief discussion identifying existing utilities and those that may be in conflict with proposed improvements.	Additional discussion on this topic will be provided in the final report. Costs will be added to the estimates of probable construction cost as required.

7	N/A	Brad Koenig Robert Peccia & Associates Engineering Consultant on behalf of City of East Helena	8/29/2019 Letter	Regarding the drainage improvements, I did not understand specifically where the open channel portions of the storm drainage system would be. Possibly behind the swimming pool? A diagram of the proposed storm drain improvements would be helpful, particularly given the high cost of this aspect. Also, does the cost estimate include up-sizing the existing storm drain on Main Street? This piping was not designed for any additional load. Is there an opportunity for a parallel main (to decrease the total cost of the improvements)?	We will provide clarification in the final report as to where the open-channel portion of the storm drain system is anticipated to be possible. The estimate of probable construction cost does include anticipated costs (on a conceptual basis) for upsizing the existing storm drain main in Main Street. A parallel main may be considered as an alternative to upsizing the existing main once formal design is initiated.
8	N/A	Brad Koenig Robert Peccia & Associates Engineering Consultant on behalf of City of East Helena	8/29/2019 Letter	The City has been planning for an East-West Road that runs between Wylie Drive and Valley Drive. It would be located between the proposed Highland Meadows Subdivision and the Wastewater Treatment Plant. I am uncertain of the time frame on this road and believe the idea originally came from a County Transportation Plan (although I am not certain). Currently the Highland Meadows Subdivision is planning to dedicate ROW for this improvement. I do not see any mention of this road in the PER. It seems that this future road could have a significant impact on Valley Drive.	Sanderson Stewart had not previously discussed this potential roadway connection with the City, although it is referenced in the transportation plan for Helena. We will address its potential impacts to the Montana Avenue/Valley Drive corridor in the final report.
9	N/A	Brad Koenig Robert Peccia & Associates Engineering Consultant on behalf of City of East Helena	8/29/2019 Letter	In Chapter 6 you discuss and SID. Such a District could include properties that deliver traffic to Valley Drive for primary access (such as LaCasa Grande). There are methods other than frontage for assessments within these districts such as property value and square footage. I am sure that you are aware of these alternatives but am curious if these were considered or evaluated in any way. Looking for a more equitable distribution of costs for those benefiting from the improvement.	Sanderson Stewart has discussed with the City a variety of options for proposed assessments to help fund improvements to the Montana Avenue/Valley Drive corridor. Additional discussion on these options will be provided in the final report.
10	N/A	David Hill	8/29/2019 Public Hearing	Appendix A in the draft report did not contain any content.	Appendix A in the final report will contain a comment/response matrix spreadsheet printout that will document comments received at this public meeting and via other channels.
11	N/A	Jim McCormick Lewis & Clark County Commissioner	8/29/2019 Public Hearing	Has there been any discussion about re-routing Valley Drive and making the current alignment an internal roadway? Mr. McCormick also noted that a BUILD grant application might be more well received on a larger-scale project.	This had not previously been discussed as an option. The City does not consider it feasible to re-route Valley Drive and utilize the current alignment as an internal street. It is our opinion that it would be very difficult to accomplish this change without negatively impacting general area traffic flow.
12	N/A	Scott St. Clair, City of East Helena Public Works Director	8/29/2019 Public Hearing	Should load weight restrictions be placed on Montana Avenue? To Mr. St. Clair's knowledge, there are currently load weight restrictions on the County portion of the road, but not the City portion.	Load weight restrictions would serve the purpose of protecting the new roadway from wear and tear, but may also then transfer that wear and tear to an adjacent parallel route. We will add discussion this topic to the final report.
13	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	8/29/2019 Public Hearing	Ms. Riley suggested that internal connections amongst the school and subdivision sites (such as from Thurman Ave to Plant Rd) would reduce traffic pressure on Valley Drive.	Although additional parallel routes to Valley Drive would likely help in reducing traffic demand in the corridor, the plats and/or current site plans for the schools and Highland Meadows Subdivision do not provide for that sort of interconnectivity.
14	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	8/29/2019 Public Hearing	Ms. Riley also commented that it would be difficult for to gain access to Valley Drive from the private driveways along the east side of the corridor as a result of having a two-way left-turn lane on Valley Drive.	It is the opinion of Sanderson Stewart that the implementation of a two-way left-turn lane would reduce congestion in the Valley Drive corridor by separating left-turn queues from through traffic. The two-way left-turn lane would also provide provide for the ability for vehicles entering the corridor to use it as a refuge and make a two-stage entrance movement.
15	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	8/29/2019 Public Hearing	Why was a 12-ft two-way left-turn lane contemplated for Valley Drive vs. a wider (14-ft) lane? Ms. Riley suggested that we reference a range of widths in the final report.	The design in this case was intended to be very conceptual. Specific design details will be vetted and established through the formal design process. A wider two-way left-turn lane may provide some level of benefit related to safety but would also increase the cost of a reconstruction project. As such, the cost vs. benefit aspect must be weighed accordingly.

16	N/A	Paul Jensen	8/29/2019 Public Hearing	An origin-destination study should have been completed to determine the trip distribution for future site-generated traffic in the corridor.	An origin-destination study was not considered to be necessary for estimating distribution of site-generated trips for this study. Although use of a travel demand model would have been helpful, the time frame and budget for the project did not allow for creation of a dedicated model (ideal solution) or manipulation of an existing area-wide model for use in projecting traffic demand. Since modifications to the existing system of streets were not being evaluated (i.e, new routes or links in the system), it was determined that the calculation of trip distribution on the basis of existing traffic demand and proximity to available travel routes would be adequate for predicting future traffic demand for this study, particularly as it relates to the specific goals and outcomes of the study.
17	N/A	Paul Jensen	8/29/2019 Public Hearing	Calculation of ESALs should be based on a distribution fo Class 4-7 trucks (as opposed to using all truck classes) since that is what is predominantly using the Montana Avenue/Valley Drive corridor.	The geotechnical subconsultant for this study (SK Geotechnical) feels that the analysis utilized provides a reasonable likely recommended pavement section for conceptual design and cost estimating purposes for this study.
18	N/A	David Jensen	8/29/2019 Public Hearing	Should bus traffic for the schools be shown as coming to/from the north based on where they would be stored (off of Canyon Ferry Road)?	Ron Whitmoyer responded to say that the buses are (in the case of Prickly Pear Elementary) and will be (in the case of the high school) stored at Eastgate Elementary School.
19	Page 7	David Jensen	8/29/2019 Public Hearing	Mr. Jensen commented that he is not in favor of closing the south approach of the US 12/Montana Avenue intersection because doing so would limit access to the area beyond to the south. He suggested that a quiet zone would be a good trade-off for agreeing to the closure of the approach.	Montana Rail Link (MRL) had suggested in their correspondence that access to the area south of the railroad crossing could be accomodated from MT Highway 518 as an alternative to the access from the south intersection approach.
20	Page 17	David Jensen	8/29/2019 Public Hearing	The trip distribution for traffic generated by Highland Meadows Subdivision should be 50/50 or 75/25 in reverse.	The trip distribution for Highland Meadows Subdivision was projected based on proximity of subdivision accesses to a) East Helena and other surrounding areas, including Helena; and b) routes to/from Helena. Sanderson Stewart considers the projected distribution to be a reasonable approximation as calculated.
21	Page 37	David Jensen	8/29/2019 Public Hearing	The $700K number referenced in the SIA for East Helena High School was based on a 33% share of a $2.1M estimate for roadway reconstruction. The draft report does not consider a phased-build approach. The section of the project from just south of Lewis Street to north of Plant Road should be constructed first using the $700K contribution from School District 9 plus contributions from the residential subdivisions. The segment of Valley Drive north of Plant Road (in the County) must also be considered.	Duly noted.
22	Page 37	David Jensen	8/29/2019 Public Hearing	Proportionate share funding calculations should include water, sewer, and other improvements that help what is a valley solution, not just an East Helena solution.	It is our understanding that the school is paying for extensions of water and sewer infrastructure to serve those facilities. Proportionate share funding contributions related to this project would apply to all improvements constructed by the project.
23	N/A	David Jensen	8/29/2019 Public Hearing	Nothing should be constructed until money is in-hand to pay for the project. The City should not assume that an SID would be approved by voters to fund a project.	Duly noted.
24	N/A	Scott Walter, East Helena School District Board Chair	8/29/2019 Public Hearing	Clarifications should be provided in the report as to how trip distribution splits were calculated.	This will be addressed in more depth in the final report.
25	N/A	Scott Walter, East Helena School District Board Chair	8/29/2019 Public Hearing	Has MDT signed off on a traffic signal at the US 12/Montana Avenue intersection?	MDT provided a letter with study review comments as referenced later in this comment-response spreadsheet. MDT does not support installation of a traffic signal at the US 12/Montana Avenue intersection as detailed in their comments.
26	N/A	Scott Walter, East Helena School District Board Chair	8/29/2019 Public Hearing	The proportionate share percentages listed in the draft report do not match those from the public hearing presentation.	The percentages presented in the draft report were preliminary. The decision was made prior to the public hearing to present a percentage range to more accurately represent what the final recommended percentages would likely be.
27	N/A	Scott Walter, East Helena School District Board Chair	8/29/2019 Public Hearing	Does the cost estimate include costs associated with abandonment of the south approach at the US 12/Montana Avenue intersection?	The cost estimates are very conceptual and contain contingency amounts intended to help account for unkonwns. However, it is expected that the (physical construction) cost to abandon the referenced approach would be relatively small. As such, it is considered that said cost is generally accounted for in the estimates.

28	N/A	Paul Jensen	8/29/2019 Public Hearing	There is a cost associated with abandonment of access to private property from the south approach. This would fall under MDT's jurisdiction. Further investigation should be undertaken to determine potential costs of closing the south apporach.	Duly noted.
29	N/A	Ron Whitmoyer, East Helena School District Superintendent	8/29/2019 Public Hearing	A closure of the railroad crossing would be a huge mistake for the City because it would limit access to an area that could be developed in the future.	If the railroad crossing and associated access to this area was to be closed, it is generally expected that alternate access would be provided from Highway 518.
30	N/A	Scott St. Clair, City of East Helena Public Works Director	8/29/2019 Public Hearing	Why shouldn't La Casa Grande Subdivision pay a contribution based on having direct access to the corridor?	It may be possible to assess residents of La Casa Grande Subdivision (which is in the County) via a joint SID with the County. However, there is not currently a mechanism in place to require an up-front contribution similar to those being required from School District 9 (for the high school project) and Oakland Companies (for Highland Meadows Subdivision).
31	N/A	Pete Elverum, City of East Helena City Attorney	8/29/2019 Public Hearing	The only mechanism available for assessing County properties would be through a joint arrangement with the County.	Duly noted.
32	N/A	Jim McCormick, Lewis & Clark County Commissioner	8/29/2019 Public Hearing	Rural Improvement Districts (RIDs) in the County rely on an establishment of proportionate share and presumed benefit.	Duly noted.
33	N/A	Mike Misowic, City of East Helena Councilperson	8/29/2019 Public Hearing	The ashpalt surfacing at and around the railroad crossing (south of US 12/Montana Avenue intersection) was partially intended to provide for bicycle and pedestrian access to the south.	Duly noted.
34	N/A	Mike Misowic, City of East Helena Councilperson	8/29/2019 Public Hearing	Is there demographic information available regarding how many students at East Helena Schools reside in the City vs. County to help with establishment of traffic patterns?	Ron Whitmoyer provided some demographic data to help with trip generation projections for schools. Ron also responded directly (see next comment).
35	N/A	Ron Whitmoyer, East Helena School District Superintendent	8/29/2019 Public Hearing	Detailed data about City vs. County residency for students is not currently available.	Duly noted.
36	N/A	Dan Karlin, Lewis & Clark County Public Works Director	8/29/2019 Public Hearing	Lewis & Clark County has been working with the City and Sanderson Stewart regarding this study and on a memorandum of understanding (MOU) to jointly design the corridor (including the County segment from Plant Road to Canyon Ferry Road). There is an impact to the County segment of the road due to City development. The County does not have a mechanism for extracting developer contributions. General tax base funding is all that is available to pay for design/construction work.	Duly noted.
37	N/A	Dan Karlin, Lewis & Clark County Public Works Director	8/29/2019 Public Hearing	Lewis & Clark County decided to not participate in the PER because they have an existing PER in hand that they consider to be valid.	Duly noted. The PER is referenced in the Literature Review section of the report.
38	N/A	Jim McCormick Lewis & Clark County Commissioner	8/29/2019 Public Hearing	RIDs are typically community-initiated vs. being initiated by the County.	Duly noted.
39	N/A	Scott St. Clair, City of East Helena Public Works Director	8/29/2019 Public Hearing	The possible need to relocate private utilities (fiber, etc) in order to widen the road north of Lewis Street is not addressed in the draft report.	A discussion on this will be added to the final report. If there is a cost to the City associated with any required relocations (typically private utilities in street right-of-way are relocated at no cost to a City), those costs will be added to the cost estimates.
40	N/A	Scott St. Clair, City of East Helena Public Works Director	8/29/2019 Public Hearing	What are the next steps? Design next? A phased build based on the anticipation of available funding?	Next steps at the time were to receive additional public comments through 9/13, summarize and discuss those comments with the City, revise the and finalize the draft report, and then it would be up to the City to determine if and what type of project should be programmed for design and construction.
41	N/A	David Jensen	8/29/2019 Public Hearing	A frontage-based calculation of proportionate share is not equitable given that Highland Meadows Subdivision would have 320 new homes in it vs. 800 existing homes in the City. The proportionate share should be determined based on traffic generation and the school should pay as much as possible ($700K based on the capped amount in the SIA).	Duly noted.
42	N/A	David Jensen	8/29/2019 Public Hearing	The reference to a "proportionate share" should be removed since the school's contribution amount is capped.	Duly noted.

43	N/A	Paul Jensen	8/29/2019 Public Hearing	The draft report does not include a transportation asset management plan. There should be a discussion of life-cycle costs for maintenance over a 20-year period for things like chip seals, crack sealing, slurry seals, etc.	Maintenance costs are an important consideration for any municipality relative to budgeting and general financial planning. However, the inclusion of a transportation asset management plan and/or budgeting for long-term maintenance was not part of the scope of this project.
44	N/A	Greg Wirth, Stahly Engineering Engineer for Oakland Companies (Highland Meadows Subdivision)	8/29/2019 Public Hearing	La Casa Grande Subdivision has a lot of frontage along the project corridor and should be a participant in funding the improvements.	Duly noted.
45	N/A	Greg Wirth, Stahly Engineering Engineer for Oakland Companies (Highland Meadows Subdivision)	8/29/2019 Public Hearing	Has the City discussed how collection of proportionate share contributions would be administered in terms of timing and mechanisms?	The administration of contribution assessments has not yet been determined.
46	N/A	Greg Wirth, Stahly Engineering Engineer for Oakland Companies (Highland Meadows Subdivision)	8/29/2019 Public Hearing	Neither Highland Meadows Subdivision or School District 9 would be able to protest SIDs based on previously executed agreements that included waivers of protest.	Duly noted.
47	N/A	Mike Misowic, City of East Helena Councilperson	8/29/2019 Public Hearing	Is the County in a position to be able to move ahead with any road construction?	We are not able to answer that question on behalf of the County.
48	N/A	Ron Whitmoyer, East Helena School District Superintendent	8/29/2019 Public Hearing	Proportional share approach is defined in the SIA for the high school. The estimated traffic generatoin for the school is lesser than for Highland Meadows Subdvision. As such, a calculation of proportionate share on that basis is advantageous for the School District.	Duly noted.
49	N/A	Ron Whitmoyer, East Helena School District Superintendent	8/29/2019 Public Hearing	The referenced frontage distances listed for the High School property vs. for Highland Meadows Subdvision seem incorrect.	The frontage distances referenced are based on what is shown on the plats for the two properties and thus should be accurate.
50	N/A	Dan Karlin, Lewis & Clark County Public Works Director	8/29/2019 Public Hearing	Proportionate share contributions should be based on new development. La Casa Grande Subdivision made contributions in the past when the subdivision was originally developed. They have contributed their fair share.	Duly noted.
51	N/A	David Hill, Prickly Pear Junction	8/31/2019 Website Comment Submittal	I was at the meeting at Fireman's Hall Thursday and found your presentation to be very enlightening. Thank you. Question: is there anywhere online that shows details for the two plans for rebuilding Montana Ave. / Valley Drive? Thanks again.	Here are the links to locations for the: 1. Draft report - https://drive.google.com/drive/folders/1Lkk918O1J3Q8rDXi599I6TQVjcGRCQRI 2. Draft report exhibits (individually) - https://drive.google.com/drive/folders/1fNOVq53aR2DRDczeiOY6q4wnywQcSEgC 3. Public hearing presentation - https://drive.google.com/drive/folders/1-mC6yWsoQmsn0h74YBQbF1yt-x_jFW_1 Please let me know if you have any trouble accessing any of the documents. Thanks!
52	N/A	David Hill, Prickly Pear Junction	9/9/2019 E-mail	Quick response: thanks so much. Seems like a while before anything is actually started. Here is something else I am a bit confused about: I thought there was only one subdividion going in but it looks like there are 3 named subdivisions: Highland Meadows, Vigilante and Red Fox Meadows ... so the question is: how many actual individual homes does that involve? I keep hearing 319 but is that total for all 3 subdivisions? Thanks again for all of your input. People in my neighborhood are very interested in this stuff, trust me.	The 320 number you're hearing is only for Highland Meadows Subdivision (the one to be situated between Prickly Pear Elementary School and East Helena High School along the west side of Valley Drive). Vigilante Subdivision currently proposed 74 additional homes between Plant Road and Treerise Road to the west of Valley Drive with the possibility of a future phase consisting of 20 more acres. Red Fox Meadows Subdivision is a project that has already been constructed, though I think homes are just now starting to be constructed. That subdivision is located up on the southeast corner of Canyon Ferry Road and Lake Helena Drive, so it won't necessarily contribute a huge amount of traffic to the Valley Drive corridor (most commuter traffic will either use Canyon Ferry Road to get to/from Helena or take Lake Helena Drive to/from US 12) other than as generated by the schools.

53	Figure 1 Page 2	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Figure 1. Study Area. The East Valley Middle School is incorrectly labeled as the Eastgate Elementary School. The Eastgate Elementary School off Lake Helena Drive is not labeled. Further into the document there are inconstancies in the naming of the streets. The maps and the text must match. There are streets referenced that are not on the map. Having multiple maps may be easier for references.	Corrections will be made in the final report to clarify the school and street names.
54	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Literature Review - The study did not include reviews of The Greater Helena Transportation Plan, the City of East Helena Growth Policy, Capital Improvement Plan, and Extension of Services plan. These documents have recommendations that should be reviewed and incorporated into this study. There is no information on the proposed TA project that will impact this corridor.	The additional documents will be reviewed (or re-reviewed) with the City and referenced in the final report as is deemed appropriate by the City. The TA project (which is being designed by Sanderson Stewart) will not directly impact improvements associated with this project, but a reference will be added to the report.
55	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The information concerning previous traffic studies indicates there are adverse impact to the roadway users. These impacts have not been addressed such as slowing of traffic and additional volumes through substandard intersections. Slowing traffic results in a reduction in the Level of Service (LOS). Further discussion of the impact should be noted.	A future conditions intersection capacity analysis was performed and documented in the report to show impacts of additional traffic in the corridor. A substantial slowing of traffic is not expected other than as related to implementation of school speed zones. Additional comments will be added to the final report to acknowledge the impacts to speed in the corridor.
56	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The intersection of US 12 and Montana Avenue is operating as a T-intersection. With the public road being removed by the METG this intersection should be reviewed as a T-intersection without the 4th leg. This could result in changes to the recommendations.	It has not yet been decided that the south leg of the intersection will be closed. The configuration as a four-way or three-way intersection may impact the ultimate traffic signal timing/phasing plan, presuming that MDT approves installation of a traffic signal. The configuration of the interscetion as a four-way or three-way intersection would not change the analysis of traffic signal warrants or the recommendation that a traffic signal is installed at this location.
57	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The discussion on East Main Street is incorrect west of Morton Ave it is West Main and East of Morton Ave is East Main. There should be a discussion of how Main Street operates both ways from Wiley Drive to Lake Helena Drive. Also, the posted speed limit is not 25 MPH throughout Main Street.	To simplify the references, East Main Street/West Main Street is generally referred to in the report simply as Main Street. Any inconsistencies in that regard will be corrected for the final report. Traffic operations for Main Street are not part of the scope of work for this project other than as related directly to the intersection with Montana Avenue. The speed limit on Main Street is 25 mph at the Montana Avenue intersection.
58	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Academic Street - When the High School was proposed, the School District discussed connecting Thurman Road to Plant Street. This would allow for alternate routes and better circulation of all including have another access route for the emergency service providers on Valley Drive. Since the School District has allowed others on the property, is this still a private road, who is responsible for maintenance?	Academic Street is a private road owned and maintained by the school district.
59	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The US 12 right-of-way is totally within MRL property, any improvements or changes to US 12 must be coordinated not only with MDT but also with MRL.	Duly noted.
60	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The Existing Conditions and Intersection Capacity should have looked at all public road approaches onto the corridor, especially north of Lewis St. This will assist in determining the left turn lane recommendations. There may need to be dedicated turn lanes not just a two-way left for safety concerns.	The budget for this project was limited, and the goals in terms of what was to be analyzed were very specific. With cost in mind, it was determined through discussions with the City which intersetions would be counted and analyzed. If the City would like, Sanderson Stewart could yet collect traffic data and analyze additional intersections. However, we do not expect that this analysis would change the recommendation that a two-way left-turn lane is appropriate for the segment of the corridor north of Lewis Street. The number and spacing of private and public approaches in that segment of roadway is such that it would be very difficult to provide adequate bay tapers, transition tapers, and turn lane storage for separate, auxiliary turn bays.

61	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Prickly Pear Elementary School - When looking at the approaches to the developments and public approaches, it should be noted when the approaches are not adequately constructed to allow for design vehicles (fire trucks/ambulances} to ingress/egress without encroachment into oncoming traffic. The north approach to the Prickly Pear Elementary School does not meet basic design requirements. As East Helena has a mutual aid agreement with East Valley Fire, all approaches should be designed for emergency vehicles.	Comments will be added to the final report to address recommendations that approaches be designed to accommodate emergency vehicles, as well as to document locations where existing approaches do not seem to meet such design recommendations.
62	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	East Helena Clinic- The northern approach at Prickly Pear Elementary School does not meet design for emergency vehicles (ingress and egress) this should be noted in the report.	See previous response.
63	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	East Helena High School - the split on the trips does not include when there are events. Depending on the usage of the school, these events could result in significant impacts to the through traffic. This should be discussed within the document. How can the school district predict the bus traffic for the new high school, the conditions will be substantially different from what is happening today with the students going to Helena High School? Most of the new development is happening to the north and east and East Helena is aging, the trip ratio does not appear to be correct.	Traffic operations analysis is typcally performed with respect to average day, peak period conditions. Special event traffic is difficult to predict. However, references to special event traffic will be added to the final report, as it is an important consideration. The trip distribution for site generated traffic from the high school accounted for student home origins in East Helena, Helena, Montana City/Clancy, the "east county" area, the "northeast county" area, and the local residential subdivisions direclty adjacent to the school. Sanderson Stewart considers the projected distribution to be a reasonable approximation as calculated.
64	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Vigilante Subdivision - Again the split may not be correct. US 12 is the access for all properties in Helena north of the railroad tracks. Also, with the congestion on Custer at peak time, this area is being avoided by travelers which results in changing traffic patterns.	From the standpoint of proximity, Vigilante Subdivision and it's primiary access routes are much closer to Canyon Ferry Road than to US 12. In addition, the route south along Valley Drive/Montana Avenue and through the proposed school zones would be somewhat slow and congested during peak traffic periods. Sanderson Stewart considers the projected distribution to be a reasonable approximation as calculated.
65	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The Figures for the Baseline Construction Alternative typical sections and aerial layouts do not match and make it difficult to review. These (following) comments are based on the aerial layouts.	Each individual comment is addressed below.
66	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Figure 4 - The additional lanes on Montana Ave at Main Street result in the removal of on street parking and the Bus Stop, this must be noted to fully inform the public. Are the business owners and the City ok with the removal of on-street parking?	The potential reduction in parking and impacts to the bus stop will be noted as a possible impact associated with providing auxiliary turn lanes at the Main Street/Montana Avenue intersection in the final report.
67	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	On the Storm drain upgrade alternatives the drop inlets are not noted nor is the connection to the existing storm drain, or if new storm drain is needed. If there is limited right-of-way, why is a 3' boulevard being proposed. The sidewalk could be back of curb resulting in 6-feet less right-of-way . This could reduce the impacts to the cemetery.	The connection to the existing storm drain main in Main Street and need for inlets is discussed in the Drainage Facilities section on page 32. Right-of-way is generally not "limited" relative to the proposed street section to the south of Lewis Street. The boulevard area would provide space for limited landscape improvements and for locating street lights. The boulevard area, depending upon the chosen level of improvements, would likely provide for a cost savings when compared to additional sidewalk or street width to complete improvements within the right-of-way. It is noted on page 32 in the Right-of-way/Easements section of the report that the design could be tailored in the vicinity of the potential right-of-way impact for the cemetery so as to eliminate that impact.
68	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Figure 6 - a 12' two-way left turn lane is very narrow considering the types of vehicle mix that will be using the lane, buses, campers, RVs, trucks pulling trailers. A 14' two- way left turn would improve allow of additional shy distance and sight distance, resulting in a safer roadway. Looking at the right-of-way width, there does not appear to be a need to reduce the width. Where there are no approaches or egresses north of Lewis Street should there be a dedicated left turn instead of a two-way left turn lane?	The comment about conceptual design width of the two-way left-turn lane was also made at the public hearing and is addressed above (comment #15). The implementation of individual, dedicated left-turn lanes vs. a continuous two-way left-turn lane would not be possible in accordance with AASHTO or MDT geometric design standards (for bay length, tapers, etc) due to the very close proximity of access points along both sides of the corridor north of Lewis Street.

69	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Figure 7 - if there are concerns with additional right-of-way why are boulevards being considered. Removing the boulevard would result in less impact to the cemetery.	This comment is addressed above (comment #67).
70	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	Figure 8 - the speed limit signs should be reviewed for driver expectancy. Why not reduce the speed limit to 25 MPH from Plant Road south.	It is unclear what is meant by the first comment regarding driver expectancy. However, the final location of speed limit signs should be determined during the design phase of the project. Lowering the speed limit an additional 10 mph from the north boundary of Prickly Pear Elementary School to Plant Road would reduce the capacity/efficiency for traffic in that part of the corridor. It is our belief that a speed study for that area would likely show that drivers are traveling faster than 35 mph given the rural highway nature of that part of the corridor. The school zone speed limits are intended to slow traffic during key periods of the day for school-related traffic (vehicles, pedestrians, and bicycles), while allowing for more typical travel speeds during non-peak periods and when school is not in session.
71	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	North of Lewis Street, the two-way left turn lane will result in substantial impacts to the existing approaches. The report should discuss the length of the left turning queue and explain how many of private approaches that will be blocked. Young/inexperienced drivers may enter the two-way left early and cut off the opposing left turning vehicles resulting in additional conflicts. This should also be discussed and noted. The report should estimate the left turn storage needed in the two-way left-turn during peak hours. Does the queue overlap with existing approaches on the west? How will the queued traffic impact sight distance?	This comment was also partially made at the public hearing and is partially addressed above (comment #14). Queuing due to left turn movements would be much worse without the benefit of a two-way left-turn lane, because through vehicles would also be stopped in the queues.
72	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	There should be a discussion on the potential for lining up the existing approaches on the west to public road approaches to the east (especially the approach into the search and rescue). This will result in a safer roadway and a better functioning roadway.	Sanderson Stewart agrees that any new approaches should be aligned with existing approaches on the opposite side of the roadway wherever possible. Unfortunately, the locations of approaches for the schools and Highland Meadows Subdivision have largely been determined through previously approved plats. A recommendation will however be added to the final report to require any future approaches to be aligned if possible, as well as with regard to minimum spacing between approaches on the same side of the road and on opposite sides of the road.
73	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The some of the funding programs listed are not available for this roadway. Check with MDT on the types of federal funds allowable.	We will follow up with MDT on this question and rectify any discrepencies in the final report.
74	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The report is only looking at the very small secti on. If there are additional recommendations (other connections or other through streets) this should be noted.	The scope of work for this study directed us to evaluate the segment of Montana Avenue/Valley Drive from US Highway 12 to Plant Road. It was discussed with Lewis & Clark County to include the additional segment from Plant Road to Canyon Ferry Road. However, the County declined to participate.
75	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	All public and school approaches must be designed to handle emergency vehicles.	Duly noted.
76	N/A	Jean Riley, City of East Helena Planning and Zoning Commissioner	9/12/2019 Letter	The Report should capture the impact on existing approaches (both public and private) through the entire corridor.	Duly noted.

77	N/A	Ron Whitmoyer, East Helena School District Superintendent	9/16/2019 Website Comment Submittal	Specifically I am having concern over the decision for the analysis of proportionate share of the cost for the paving project for Valley Drive. The school district wants to challenge the choice of the model for determining percentage for contribution. As the school superintendent I would request that we consider percentage of use as calculated in the model. The school district finds it unfair because the school district is the the biggest loser in recalculating according to frontage. It seems that the model, from your comments too, was chosen to more evenly distribute the costs between the two main parties Highland Meadows and the East Helena School District. The school district wishes to suggest that the actual projected usage, which is what we started out to understand would be the correct model, is a better representation of a fair distribution of the costs. Why, when the actual usage was calculated at 5 - 10% of the total project cost for the school district would you assign a higher value to the school district using the frontage calculation? We would like to suggest that this calculation be reconsidered.	Sanderson Stewart reviewed a variety of different methods for calculating proportionate share contributions as referenced in the draft report. We then made a recommendation to the City of East Helena that the frontage-based calculation provided for the most equitable means of calculating the contributions. The intent was never to tailor those calculations toward a specific outcome, but instead to arrive at an equitable magnitude and distribution of contribution amounts given the projected impacts to the corridor for each land use. A more in-depth discussion of the proportionate share calculations will be included in the final report.
78	N/A	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	The City proposes a traffic signal control at US 12 and Montana in the corridor study. MDT does not concur with the recommendation for the following reasons: •The warrant analysis did not include a discount for southbound right turn vehicles which is allowed by the MUTCD. Looking at the peak hour volumes the southbound distribution is comprised of 90+/- percent right turn volume. As noted in the MUTCD this movement may enter the mainline volume with a minimum of impedance. Current LOS is 'C' for the southbound movement with 95th% queue stated as 3- vehicles. •Reported crashes are not significantly exceeding HSM expectations as stated in the report. •Installing traffic signal control will result in increased delay and "nuisance" calls due to the right turn vehicles triggering unneeded service calls. This may increase rear end collisions on US 12. •There is reasonable access to the existing traffic signal control at S-518 and installing traffic signal control at Montana Avenue may cause the existing traffic signal control to be unwarranted. •While the report discussed a roundabout option, the corridor study should also address movement restrictions. The report should investigate a southbound right turn only in lieu of a signal. The southbound right turn only concept has the benefit of removing any delay to the high right turn movement caused by left and through traffic and mitigating the right-angle conflict. The plan does not require any modification to the south approach and removes southbound through movement Railroad crossing and relocates them to a crossing controlled with the existing traffic signal at S-518. •There are a reasonable number of access locations that travelling public may utilize if right turn delay/queuing is ever realized in the design year. S-518 currently has a southbound right turn lane. •An alternative that addresses capacity and reduces conflict points (crash exposure) should be explored instead of traffic signal control at the US 12 and Montana Avenue intersection.	A reduction in traffic signal warrant volumes based on the high proportion of right-turn movements is a valid consideration that was discussed internally during our analysis and which should have been discussed in the draft report. Ultimately we questioned whether or not right turns could be considered a low-conflict movement in this case, even with multiple receiving lanes, given the travel speeds on US 12. Also, although existing conditions intersection capacity metrics are well within an acceptable range, the projected design year scenario minor approach LOS and queueing for the morning peak hour is at a failure level. The final report will be updated to provide additional discussion of the right-turn reduction, the other comments provided herein by MDT, and the ultimate conclusion that MDT does not support installation of a traffic signal at this location.
79	N/A	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	The Montana Avenue/Valley Drive PER and Corridor Study report does not contain an environmental section or discussion on impacts to topic areas such as biological resources and cultural resources; MDT will provide additional review if materials are made available.	A review of environmental impacts was not included in the scope of work for the study.

80	N/A	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	There is mention that right-of-way acquisition will be required. Since right-of-way involvement is anticipated, a cultural resource survey will likely be required at some point during the project development process.	Duly noted.
81	N/A	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	US 12 is eased onto Railroad right of way in this area. Any plans to alter Montana Avenue and US 12 resulting from the findings in this study are subject to coordination and approvals from the Railroad authority.	Duly noted. We had previously contacted Montana Rail Link to discuss implementation of railroad pre-emption with a prospective traffic signal.
82	Pages 3-4	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	The Greater Helena Area Long Range Transportation Plan — 2014 update should be one of the documents reviewed for this study. East Helena is included in the Helena Urban Area.	A discussion of that reference and the recommended improvements in it will be added to the final report.
83	Pages 5-6	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	All the street descriptions need to be revised as MDT does not designate functional classification. By federal law, all public roads must be functionally classified in accordance with FHWA's guidelines. The Montana Transportation Commission and the FHWA must approve changes to functional classification.	The references to functional classification will be updated accordingly in the final report.
84	Page 14	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	3rd sentence — suggest removing "from" to make the sentence read better.	Duly noted.
85	Page 26	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	Multi-use trail — standard starting width for a shared-use path is 10'. Narrowing the path to 8' is usually an design exception due to area constraints. No exceptions appear to exist at the proposed location. MDT recommends a 10' path. The study does not address how bicyclists will navigate the area once the shared-use path ends south of Lewis. Do the preparers of the study anticipate bicyclists will share the road with vehicle traffic? This may not be the best solution considering the predominant user of the path is expected to be school children.	The consideration of a path that is narrower than 10 feet in this case would be on the basis of funding limitations for the project. However, it is correct that there are not any known physical constraints that would limit the width of the multi-use trail to less than 10 feet. As such, the recommendatoin of a 10-ft path will be noted in the final report. We will also add some discussion about accommodation of bicycles for the corridor segment to the south of Lewis Street.
86	Page 33	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	Bicycle/Pedestrian Facilities — multi-use trail width minimum, per AASHTO guidance is 10'.	See previous response.
87	Page 39	Mike Tierney, Planner Policy, Program and Performance Analysis Montana Department of Transportation	10/20/2019 Letter	Table 7 — remove MDT Surface Transportation Program — Urban (STPU). STPU funding is for routes designated as part of the Urban Highway System, Montana/Valley is not a designated urban route. Also MDT recommends removing Federal Land Access Program (FLAP) funding unless a clear explanation as to how this route qualifies for the program since it does not access nor is adjacent to Federal lands.	The adjustment will be made in the final report as recommended herein.

GEOTECHNICAL REPORT – SK GEOTECHNICAL

APPENDIX B

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

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July 16, 2019 Project 19-3797G

Mr. D. J. Clark, PE
Sanderson Stewart
1300 North Transtech Way
Billings, Montana 59102

Dear Mr. Clark:

Re: Pavement Evaluation, Proposed Valley Drive Improvements, Highway 12 to Plant Road East Helena, Montana

We have completed the pavement evaluation report for the above-referenced project. Our report was completed in general accordance with our Subconsultant Services Agreement dated March 4, 2019.

The attached report contains the following information.

- Results of the three penetration test borings performed in pavement along Valley Drive.
- Results of the three penetration tests performed along the multi-use path.
- Recommendations for pavement sections in stable and unstable subgrade areas for total reconstruction.
- Recommendations for multi-use path.

Thank you for using SK Geotechnical. If you have any questions regarding this report, please contact Dustin Hutzenbiler at (406) 652-3930.

Sincerely,

Dustin Hutzenbiler, PE
Geotechnical Engineer

for

Gregory T. Staffileno, PE
Reviewing Engineer

Attachment:
Pavement Evaluation Report

Table of Contents

Table of Contents (continued)

A. Introduction

A.1. Project

The City of East Helena is planning to improve the section of Valley Drive extending from Highway 12 north approximately 1.3 miles to the intersection with Plant Road. Sanderson Stewart is the civil engineering firm for the project. For approximately the first 1/2 mile of the project, Valley Drive extends through the City of East Helena and is generally surrounded by urban development. For the remainder of the project, residential developments are situated along the east side of Valley Drive and the west side is primarily undeveloped range land with the exception of the new schools. The project also includes improvements to curb and gutter for a portion of the alignment as well as a new multi-use path along the west side of Valley Drive. The relevant extent of the project is shown on the Boring Location Sketch in the appendix.

A.2. Purpose of this Evaluation

The purpose of the geotechnical evaluation was to assist Sanderson Stewart, the City of East Helena, and the selected contractor in designing new pavements and multi-use paths and preparing plans and specifications for the project.

A.3. Scope

The desired scope of services was outlined in our revised proposal to Sanderson Stewart dated March 4, 2019. Sanderson Stewart authorized us to proceed in accordance with the proposal by issuing a subconsultant services agreement dated March 4, 2019.

Our scope of services was limited to:

- Reconnaissance of the site by a geotechnical engineer.
- Staking the penetration test borings along the project.
- Coordinating the locating of underground utilities near the boring locations and coordinating traffic control services.
- Conducting three penetration test borings in Valley Drive to a depth of 5 feet for our pavement evaluation. Conducting three test holes to a depth of about 3 feet along the multi-use path.
- Collecting bag samples of pavement subgrade soils for laboratory tests.
- Conducting laboratory tests consisting of classification and moisture-content tests on subgrade samples from the project.

- Analyzing the results and formulating recommendations for pavement thicknesses, and new sidewalks.
- Discussing the project with Mr. D.J. Clark, of Sanderson Stewart.
- Submitting this pavement evaluation report containing logs of the borings, our analysis of the field and laboratory tests, and recommendations for pavement thicknesses, and multi-use path improvements.

A.4. Documents Provided

Sanderson Stewart provided us with recently completed traffic counts and truck volumes along the Valley Drive. Sanderson Stewart also provided us with the projected equivalent single 18-kip axle loads (ESALs) for Valley Drive. This information was provided in an email dated May 29, 2019.

A.5. Locations and Elevations

Boring locations were selected and staked by our personnel and the approximate locations are shown on the attached Boring Location Sketch. Penetration test borings are designated with the prefix “ST”. Ground surface elevations at the borings were not determined.

B. Results

B.1. Logs

Log of Boring sheets indicating the depths and identifications of the various pavement materials, soil strata, penetration resistances, laboratory test data, and water level information are attached. It should be noted the depths shown as boundaries between the strata are only approximate. The actual changes may be transitions and the depths of the changes vary between borings.

Geologic origins presented for each stratum on the Log of Boring sheets are based on the soil types, blows per foot (BPF), and available common knowledge of the depositional history of the site. Because of the complex glacial and post-glacial depositional environments, geologic origins are frequently difficult to ascertain. A detailed evaluation of the geologic history of the site was not performed.

B.2. Site Conditions

According to the Montana Bureau of Mines and Geology (MBMG) Geologic map of the Helena Valley, West-Central Montana, by Michael C. Stickney and Susan and Vuke, 2017, Valley Drive is generally situated within older alluvial plain deposits. The supporting text of the geologic map indicates that the older alluvial plain deposits are primarily moderately sorted, cobble to pebble-sized gravel in a light brown silt and sand matrix. Gravels are well-rounded and subrounded, becoming generally better sorted toward Lake Helena. As previously mentioned, for the first about 1/2 mile of the project, Valley Drive is bordered by both residential and commercial developments on both sides of the roadway. For the remainder of the project, Valley Drive is bordered by residential developments to the east and primarily undeveloped land to the west. However, at the time of our fieldwork, the land to the west of Valley Drive was being developed for the new high school and middle school. Irrigation ditches parallel both sides of the Valley Drive, from about East Lewis Street to Plant Road.

B.3. Pavement Condition Observations

To better evaluate pavement construction alternatives, we performed observations of the existing pavement. These observations are summarized below.

Valley Drive, Highway 12 to Lewis Street

- Severe rutting and severe alligator cracking as well as transverse and longitudinal cracking.
- Moderate differential settlement and heave along utility trench pavement patches.
- Multiple large potholes, some patched, while some not patched.

Lewis Street to Plant Road

- Moderate rutting and isolated transverse cracks.
- Isolated areas of deep rutting and severe alligator cracking.
- Isolated areas of very deep rutting, alligator cracking, and pavement shoving.
- Minor differential movement between utility patches.

Based on these pavement observations within the project limits, we judged the pavement to be in extremely poor condition from the beginning of the project to about Lewis Street. From Lewis Street to the end of the project at Plant Road, we judged the pavement to be in poor condition with areas of very poor condition.

B.4. Existing Pavement and Soils

B.4.a. Pavement Borings. Table 1 below summarizes the existing pavement thicknesses and subgrade soils encountered along Valley Drive as well as the anticipated subgrade soils along the multi-use path.

Table 1. Existing Pavement and Anticipated Subgrade Conditions

Project Section	**Valley Drive**			**Multi-use Path**		
Boring	ST-1	ST-2	ST-3	ST-4	ST-5	ST-6
Date Drilled	4/22/2019	4/22/2019	4/22/2019	4/22/2019	4/22/2019	4/22/2019
Station, Offset	N/A	N/A	N/A	N/A	N/A	N/A
Existing PMS	6 1/2"	2"	2"	None	None	None
Existing Base/Subbase	None	2 1/2"	3"	None	None	None
Total Thickness	**6 1/2"**	**4 1/2"**	**5"**	None	None	None
Subgrade[(1)]						
Description	3' Clayey Sand over Poorly Graded Gravel with Sand and Silt	2 1/2' Sandy Lean Clay with Gravel over Poorly Graded Gravel with Sand and Silt	1 1/2' Silty Clayey Sand with Gravel over Poorly Graded Gravel with Sand and Silt	1/2' Clayey Sand over Poorly Graded Gravel with Sand and Silt	1' Clayey Sand over Poorly Graded Gravel with Sand and Silt	1' Clayey Sand over Poorly Graded Gravel with Sand and Silt
ASTM Class	SC over GP-GM	CL over GP-GM	SC-SM over GP-GM	SC over GP-GM	SC over GP-GM	SC over GP-GM
N-Values	21, 25	18, 50-2 1/2"	42,61	14, 32	13, 30	15, 44
Consistency	Medium Dense over Very Dense	Very Stiff over Very Dense	Dense over Very Dense	Medium Dense over Dense	Medium Dense over Medium Dense	Medium Dense over Dense
Moisture Content	11, 9	4, 6	12, 10	10, 4	11, 3	12, 7
Optimum Moisture Content	SC: 12% GP-GM: 6%	SC: 12% GP-GM: 6%	SC-SM: 12% GP-GM: 6%	SC: 12% GP-GM: 6%	SC: 12% GP-GM: 6%	SC: 12% GP-GM: 6%
Risk of Subgrade Failure During Total Reconstruction	Low	Low	Low	Low	Low	Low
Geosynthetic Recommended	No	No	No	No	No	No

[(1)]Anticipated subgrade that will be present beneath the proposed pavement section;

Note: Optimum Moisture Contents based on engineering judgement of similar soils.

As the table indicates, the existing pavement ranged from 2 to 6 1/2 inches thick with an average of 3 1/2 inches thick. Beneath the existing asphalt pavement, two of the borings encountered existing base course ranging in thickness from 2 1/2 to 3 inches thick. Boring ST-1 did not encounter any existing base or subbase course. Beneath the pavement sections, borings encountered mixed layers of existing fill consisting of clayey sand, silty clayey sand and sandy lean clay to depths ranging from about 1 1/2 to 3 feet below existing grades. Poorly graded gravel with sand, silt, and cobbles was then encountered to the boring termination depths of 5 1/2 feet.

Along Valley Drive, the penetration resistances in the fine-grained subgrade soils generally ranged from 18 to 21 BPF indicating the subgrade soils were generally medium dense and very stiff. Penetration resistances recorded in the underlying gravels generally ranged from 61 BPF to 50 blows for 2 1/2 inches of penetration indicating the gravels were generally very dense.

Borings ST-4, ST-5 and ST-6 were performed along the multi-use path. The test holes generally encountered about 6 inches to 1 foot of clayey sand underlain by poorly graded gravel with sand, silt, and cobbles to termination depths at about 3 1/2 feet. Penetration resistances recorded in the clayey sand generally ranged from about 13 to 15 BPF indicating the sands were generally medium dense. Penetration resistances recorded in the poorly graded gravel with sand generally ranged from about 30 to 45 BPF indicating the gravels were medium dense to dense.

B.5. Groundwater Observations

Groundwater was not encountered in any of the borings or test holes at the time of our fieldwork. Groundwater levels are likely below the termination depths of our borings. Groundwater levels along the project can fluctuate in the late fall during peak irrigation season. In our opinion, groundwater levels can fluctuate up to 3 feet higher than early summer levels. However, based on our soil borings, we do not anticipate groundwater will affect the proposed construction.

B.6. Laboratory Tests

B.6.a. Moisture Content Tests. Moisture contents were determined on all of the penetration test samples from Borings ST-1 through ST-6. The results are indicated on the attached Log of Boring sheets. These moisture contents generally indicated the soils beneath the existing pavement were moist.

B.6.b. Classification. Four samples recovered from the borings were selected for classification testing. The results are summarized in Table 2 below.

Table 2. Summary of Laboratory Tests

Boring	Depth (feet)	Atterberg Limits			P_{200} (%)	ASTM Classification
		LL	PL	PI		
ST-1	1.0 – 3.0	25	15	10	52	SC
ST-2	0.2 - 0.4	21	17	5	11	GC-GM
ST-5	0.0 – 1.5	24	17	7	20	SC-SM
ST-6	0.0 – 1.0	28	17	11	28	SC

We wish to point out, however, obtaining representative samples of the subgrade soils was difficult due to the presence of large cobbles in the underlying gravels.

C. Analyses and Recommendations

C.1. Proposed Construction

A proposed project includes reconstructing a portion of Valley Drive from Highway 12 to Plant Road in East Helena, Montana. For the first 1/2 mile of the project from Highway 12 to East Lewis Street, Valley Drive extends through urban development associated with the City of East Helena. From east Lewis Street to the end of the project at Plan Road, residential developments are located along the east side of Valley Drive, while to the west side is primarily undeveloped range land with exception of the new schools.

The proposed improvements also include a new multi-use path extending from East Lewis Street to Plant Road on the west side of Valley Drive to provide a walkway to schools. Drawings containing specific extents of the proposed improvements were not yet available. If there are changes to design, we should be informed, additional analysis and recommendations may be necessary.

C.2. Discussion

C.2.a. Existing Fill. Existing fill likely associated with nearby developments and small embankments beneath the existing pavement was encountered by the borings. The existing fill consisted primarily of clayey sand with gravel, sandy lean clay with gravel, and silty clayey sand with gravel to depths ranging from about 1 to 2 1/2 feet below grade. Also, within about the first 1/2 mile of the project, we observed numerous pavement patches likely associated with buried utilities and failed pavement areas. We also observed moderate differential movement between pavement patches and the existing pavement surface. The differential movement most likely indicates a lack of compaction of various backfills. Additionally, previous developments surrounding the project and their associated earthwork have most likely created variable types of fill consisting of gravels, clays, and mixtures of clays and gravels. Variable conditions will likely be encountered during construction. Also, deeper fills will likely be encountered away from the boring locations associated with other buried utilities and previous developments.

Due to the variable fills, we recommend observations be performed during construction along with proof rolling to identify areas of excessive deflection. These areas may require additional subexcavation. We recommend a contingency in the project budget be provided for unsuitable conditions and possible digouts during construction, if necessary.

C.2.b. Pavement Design. Pavement sections were evaluated using the 1993 AASHTO Guide for Design of Pavement Structures and a spreadsheet developed by the Montana Department of Transportation (MDT) based on this AASHTO guide. For the pavement design initial and terminal serviceability indexes of 4.2 and 2.5 were used. An inherent reliability of 75 percent, a standard deviation of 0.45, and a design life of 20 years were also used. Traffic analysis was performed by Sanderson Stewart and the design ESALs were provided to us in an email dated May 29, 2019. Traffic projections indicated a total design ESAL of 530,000 over a 20-year life. This equates to approximately 73 ESALs per day, which is typical for a major collector such as Valley Drive.

C.2.c. Unstable Subgrades. The borings performed along Valley Drive encountered a sandy lean clay or clayey sand subgrade directly beneath the existing pavement section. In previous Table 1, we evaluated the risk of the subgrade becoming unstable during construction and, as the table indicates, a low risk is present based on the data from the borings. However, these soils are very moisture sensitive and when these clayey soils become wet, their shear strength is reduced. When wet and subjected to heavy rubber-tired construction equipment, they become unstable. Unstable subgrades are identified when excessive pumping and rutting occurs beneath the construction equipment and they typically cannot be recompacted to specification. Identification of these unstable areas can be evaluated by proof rolling and careful observations during construction. Unstable subgrades are discussed in more detail later in this report.

C.3. Pavement Design and Thickness Recommendations

C.3.a. Subgrade. The soil borings indicate that the subgrade soils directly beneath the existing pavement section are primarily clayey sands and sandy lean clays. It has been our experience CBR values for these types of soils typically range from about 2 to 5. Based on our engineering experience, we selected a design subgrade CBR value of 3 for our pavement analysis. This equates to subgrade modulus, M_R, of 4,500 pounds per square inch (psi).

C.3.b. Method. Using the design ESALs provided by Sanderson Stewart, we evaluated pavement sections for the roadway using an Excel spreadsheet based on the 1993 AASHTO Guide for Design of Pavements Structures for a 20-year design life, which is attached. Table 3 below contains the summary of the input parameters used for our pavement design.

Table 3. Summary of Input Parameters

Parameter	Valley Drive
Period	20 years
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability	75%
Design CBR	3.0
Design M_R	4,500 psi
Daily ESALs	73
Total ESALs (20-year)	530,000
Required SN	3.43

As can be seen above, the analysis results in a structural number (SN) which the pavement section should meet or exceed. The resulting structural number for Valley Drive was 3.43 which was used for design.

C.3.c. Alternative Pavement Sections for Total Reconstruction. Alternative pavement sections for Valley Drive are indicated in Table 4 below. We wish to emphasize that for each of these typicals, the sections indicated are based on a stable subgrade that has been scarified to a depth of 8 inches and recompacted to a minimum 95 percent of its standard Proctor maximum dry density (MPWSS 02230) as well as subjected to proof rolling observations.

It is not designed for constructing over soft unstable subgrades. Unstable subgrades are discussed in more detailed later in this report.

Table 4. Stable Subgrade Pavement Sections

	Crushed Base Course Sections		Subbase Sections	
Typical Section	**1**	**2**	**3**	**4**
Plant Mix Surfacing	3”	4”	3”	4”
Crushed Base Course	16"	13”	4”	4”
Subbase Course	---	--	18 ½”	14”
Total Thickness	**19"**	**17"**	**25½"**	**22"**
Calculated SN	**3.47**	**3.46**	**3.46**	**3.46**

Based on the results of our soil borings and when considering the anticipated bus traffic, we recommend Typical Section No. 3 for the project. Where possible, we recommend removing the fine-grained clayey soils down to the dense native gravels and building up from there with subbase. Therefore, the thicker subbase section appears to be more practical. With Typical Section No. 3 our borings indicate this will generally be incidental from about Lewis Street to Plant Road where gravels were encountered between 1 1/2 and 2 1/2 feet below the existing surface. Therefore, we especially recommend Typical Section No. 3 for this portion of the project.

From Highway 12 to East Lewis Street, our borings indicate the clayey soils are about 2 1/2 feet thick at the north end (East Lewis Street) and 3 feet thick at the south end (Highway 12). Therefore, some over excavation would be necessary to reach the gravels. Additionally, some areas of utility backfill with less suitable material will likely be encountered throughout this portion of the project. However, it is our opinion doing the over excavation down to the native gravels uniformly across the roadway and using Typical Section No. 3 will provide a better performing pavement section over the long term. However, if the over excavation and thicker pavement section is an issue, consideration could be given to using Typical Section Nos. 1 or 2, for this portion of the project. These alternatives will require working directly on the clayey subgrade, which could become unstable during construction and may require digouts. For the digout areas, we recommend removing the clayey soils down to the gravels and using Typical Section No. 3 as described below.

C.3.d. Unstable Subgrades.

C.3.d.1. Sensitive Clayey Soils and Water. The borings indicated the primary subgrade along the project will be sandy lean clay, and clayey sand, which are considered highly moisture sensitive soils. If these soils become wet, their shear strength is reduced and they will become unstable, particularly if they are subjected to heavy rubber-tired construction traffic. Water is a trigger mechanism for creating these unstable subgrades. Water can seep through the existing pavement cracks saturating the underlying base course and subgrade. Water can also be running laterally from the nearby irrigation ditches saturating specific portions of the subgrade. During construction, it could rain and when the subgrade is exposed and/or lacks positive runoff, will result in these clay soils becoming saturated. Numerous other unapparent sources of water could also be present. Unstable subgrades can also be created during construction by heavy rubber-tired equipment, poor drainage, and other factors that are difficult to control.

C.3.d.2. Identification and Extent. After the existing grades have been cut to subgrade elevation and recompacted. We recommend the following indicators be used to identify unstable subgrades.

- Subgrade deflects 3/4 inch or more when proof rolled with a loaded tandem axle dump truck.
- The subgrade cannot be recompacted to MPWSS specifications because it is deflecting when compacted with a vibratory/static smooth drum or sheepsfoot roller.
- The subgrade contains excessive deleterious or organic materials.

The extent of these unstable subgrades is difficult to estimate when considering the limited number of borings performed along the project. Based on our observations, we recommend assuming 25 percent of the total alignment could encounter unstable subgrades requiring subgrade stabilization if best construction practices are followed and low ground pressure equipment is used. The actual extent and determination of unstable subgrade should be determined by observations during construction. If heavy rubber-tired construction equipment is used and the subgrade becomes wet, then more of the alignment will require subgrade stabilization. If this work can be delayed until late summer or early fall when it rains less and clays are drier, then the risk of creating unstable subgrades is typically reduced.

C.3.d.3. Unstable Subgrade Repair Alternatives. Several alternatives are available to repair unstable subgrades. The least expensive method is to avoid the area and allow it to dry out and restabilize. Consideration can be given to scarifying the subgrade to promote drying. Eventually, the clayey soils will dry out, the subgrade recompacted to specification, and the pavement section constructed on top of it. This method, however, can take several weeks or longer, and is dependent on favorable weather. When considering the traffic volumes and the nature of the roadway, time is probably of the essence and quicker repairs may be required.

When considering the dense gravels range from about 1 1/2 to 3 feet below existing grades, if unstable subgrades are encountered, we recommend subexcavating the clayey soils down to stable gravels and replacing with subbase material and basically constructing Typical Section No. 3. A unit cost for subbase should be included in the documents in case more subbase than estimated is needed.

In some areas, particularly in the first 1/2 mile of the project, deeper clayey soils could be encountered associated with utility trench backfills. If these areas become unstable and over excavation is not an option, another alternative to more quickly repair excessively soft subgrades is to use geosynthetics as part of the pavement structure. Subgrade stabilization sections using Tensar TX160 or Mirafi RS380i geosynthetics are recommended for deeper unstable subgrades if encountered. Substitutions are not recommended. When unstable subgrades are encountered, we recommend providing the pavement section as indicated and Table 5 below.

Table 5. Unstable Subgrade Pavement Sections Geosynthetic Reinforced Sections

	Alternative 1 **TX5 Section**	**Alternative 2** **RS380i Section**
Plant Mix Surfacing	3"	3"
Crushed Base Course	24"	25"
Tensar TX1605	Yes	---
4-ounce Non-Woven Fabric	Yes	---
Mirafi RS380i	---	Yes
Total Thickness	**27"**	**28"**

On-site observations should be performed to not only identify the locations of soft soils, but also to further evaluate their in-place strength and CBR. If the in-place CBR is less than 1, then additional subexcavation could be necessary.

Once the soft areas have been identified, the subgrade stabilization methods discussed above should be performed to provide a stable subgrade. To reiterate, unstable subgrade repair alternative discussed above consist of:

1. Stop working in the subgrade area and allow the clays to dry out and stabilize
2. Over excavate the unstable clayey soils down to dense gravels and replace with subbase material followed by Typical Section No. 3
3. Over excavate the unsuitable clayey soils down 27 inches from top of future asphalt and place the sections indicated in Table 5 above.
4. Other repair alternatives are likely available but will not become apparent until construction.

The subexcavation should extend 10 feet horizontally beyond the ends of the soft subgrade (in all directions up to the pavement edge), then have 10:1 (horizontal:vertical) slopes up to the stable subgrade.

If the geosynthetic alternative is chosen, the geosynthetic can then be placed along the stable subgrade and ramp down along the 10:1 slopes where unstable subgrades are placed.

For the geosynthetic alternative, the first lift of Crushed Base Course (CBC) placed over the geosynthetics should be a minimum of 18 inches thick to assist in bridging. An end dumping method should be used where the CBC is pushed out across the geosynthetic. Equipment must not operate directly on the geosynthetic. Geosynthetics must be installed in accordance with the manufacturer's specifications.

C.4. Multi-use Path

C.4.a. Subgrade. As previously indicated, penetration tests ST-4 through ST-6 were performed along the alignment of the multi-use path. The general soil profile encountered by these borings was 1 foot of clayey sands and clayey gravels over alluvial gravels. As can be seen of the attached photos, deep rutting and unstable subgrades near the multi-use path were observed, which appeared to have been caused by poor drainage during construction and heavy rubber-tired equipment. Therefore, these clayey sands, if wet during construction, could become unstable and not support construction equipment or the new path.

C.4.b. Unstable Subgrade Identification and Extent. Unstable subgrades beneath the multi-use path can be identified by the following indicators.

- Subgrade deflects 1/2 inch or more when proof rolled with a loaded Skidsteer or equivalent relatively light equipment.
- The subgrade cannot be scarified and recompacted to specification because it deflects beneath compaction equipment.
- The presence of unsuitable deleterious or organic materials.

Based on the borings, potentially unstable clay subgrades could be encountered or created during construction. Therefore, we recommend assuming 20 to 30 percent of the multi-use path alignment could encounter unstable subgrades for budgeting purposes. The actual extent and determination of unstable subgrades should be determined by observations during construction. If encountered, we recommend removing the unstable (soft) clayey soils down to the native gravels, then replacing these soils with subbase.

C.4.c. Multi-use Path Sections. Table 6 below contain our recommended sections for the multi-use path.

Table 6. Multi-use Path Sections

	Alternative 1	**Alternative 2**
Portland Cement Concrete Pavement	4"	--
Plant Mix Surfacing	--	2”
Crushed Base Course	6"	6"
6 ounce Nonwoven Separation Fabric	Yes	Yes
Total Thickness	**10"**	**8"**

Separation fabric is recommended beneath base course to protect it over the long term. Prior to placing the fabric, we recommend the top 8 inches of the subgrade be scarified and recompacted to a minimum of 95 percent.

C.5. Specifications

We recommend all earthwork, subgrade preparation, gravel base, subbase, concrete, and asphalt be specified and constructed in accordance with the most current version of MPWSS. If geotextiles are utilized, we recommend they be installed in accordance with the manufacturer's specifications. In particular, it is critical the specified overlap be provided.

D. Construction

D.1. Excavation

It is our opinion the soils encountered by the borings can be excavated with a backhoe front end loader, skid steer dozer or scraper. However, the clayey sands and sandy lean clays as previously mentioned are highly moisture sensitive and if they become wet and are subjected to heavy rubber-tired construction equipment such as a front-end loader, the clayey soils could become unstable requiring additional digouts. Therefore, to reduce the risk of creating unstable subgrade, we recommend low ground pressure equipment be used for working directly on the clayey subgrades.

We recommend all soils be considered Type C soils under OSHA guidelines. All earthwork and construction should be performed in accordance with OSHA guidelines.

D.2. Observations

We recommend pavement and multi-use path subgrades be observed by a geotechnical engineer or engineering assistant working under direction of a geotechnical engineer to see if the subgrade soils are similar to those encountered by the borings. As previously indicated, subgrade observations along this project are critical to determine the extent of unstable subgrades. The removal of unsuitable existing fill and unsuitable deleterious materials from beneath the proposed pavements should also be observed. The installation of geosynthetics beneath pavement and pathways should be observed to confirm they are installed in accordance with the manufacturer's specification.

D.3. Moisture Conditioning

Site soils encountered by the borings appear to be near optimum moisture content. Once the pavement is removed and the subgrade is exposed, we anticipate it may be necessary to add some additional moisture to achieve a moisture content near or slightly above optimum. It should also be anticipated that imported fill and backfill materials will be below optimum moisture content and additional moisture will be necessary to achieve a moisture content near or slightly above optimum.

D.4. Subgrade Disturbance

The borings indicated that the surficial subgrade will primarily be sandy lean clay and clayey sands. These fine grain soils are considered highly moisture sensitive and are easily disturbed when wet. When they become wet, such as after precipitation events, and are subjected to heavy rubber-tired construction equipment, the subgrade soils can go from stable to unstable very quickly requiring additional digouts. Therefore, we recommend good drainage of surface water be provided during construction to help avoid ponding areas. Ponding water will also result in saturation of the clay soils creating soft spots. Construction traffic driving across the soft spots can create large ruts and excessively disturbed areas. It is then very difficult to recompact these areas to specification and can result in construction delays and change orders.

D.5. Testing

We recommend density tests of fills and backfills placed beneath pavement, sidewalks, and pathways. We also recommend density testing of the compacted pavement subgrade and gravel base course. We recommend slump, temperature, air content, and strength tests on Portland cement concrete. Samples of proposed backfill and fill materials should be submitted to our testing laboratory at least three days prior to placement on the site for evaluation and determination of their optimum moisture contents and maximum dry densities.

We recommend density testing of the asphaltic concrete pavement (cores and nuclear density gauge). The maximum density of the asphaltic concrete mix should be determined by ASTM D 2041 (Rice). We also recommend Marshall tests of the asphalt mix to evaluate strength and air voids.

D.6. Cold Weather Construction

If site grading and construction is anticipated during cold weather, we recommend good winter construction practices be observed. All snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on soils that have frozen or contain frozen material. No frozen soils should be used as fill.

Concrete delivered to the site should meet the temperature requirements of ASTM C 94. Concrete should not be placed on frozen soils or soils that contain frozen material. Concrete should be protected from freezing until the necessary strength is attained. Frost should not be permitted to penetrate below footings bearing on frost-susceptible soil since such freezing could heave and crack the footings and/or foundation walls.

E. Procedures

E.1. Drilling and Sampling

E.1.a. Penetration Test Borings. The penetration test borings were performed on April 22, 2019, with a truck-mounted core and auger drill. Traffic control was provided by the City of East Helena. Sampling for the borings was conducted in accordance with ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils." Using this method, we advanced the borehole with hollow-stem auger to the desired test depth. Then a 140-pound hammer falling 30 inches drove a standard, 2-inch OD, split-barrel sampler a total penetration of 1 1/2 feet below the tip of the hollow-stem auger. The blows for the last foot of penetration were recorded and are an index of soil strength characteristics.

E.1.b. Penetration Test Holes. Three penetration test holes were performed along the multi-use path on April 22, 2019. The penetration test holes were performed using a California test sampler and split barrel sampler using the same methods as indicated in E.1.a above.

E.2. Soil Classification

The field engineer visually and manually classified the soils encountered in the borings in accordance with ASTM D 2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)." A summary of the ASTM classification system is attached.

E.3. Groundwater Observations

About 10 minutes after taking the final sample in the bottom of a boring, the driller probed through the hollow-stem auger to check for the presence of groundwater. Immediately after withdrawal of the auger, the driller again probed the depth to water or cave-in. The boring was then backfilled.

F. General Recommendations

F.1. Basis of Recommendations

The analyses and recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated on the attached sketch. Often, variations occur between these borings, the nature and extent of which do not become evident until additional exploration or construction is conducted. A reevaluation of the recommendations in this report should be made after performing on-site observations during construction to note the characteristics of any variations. The variations may result in additional earthwork, construction, and/or material costs, and it is recommended a contingency be provided for this purpose. This contingency is even more critical for fast-track projects.

It is recommended we be retained to perform the observation and testing program for the site preparation phase of this project. This will allow correlation of the soil conditions encountered during construction to the soil borings and will provide continuity of professional responsibility.

F.2. Review of Design

This report is based on the design of the proposed roadway improvements as related to us for preparation of this report. Limited information was available at the time of this report. It is recommended we be retained to review the geotechnical aspects of the designs and specifications. With the review, we will evaluate whether any changes in design have affected the validity of the recommendations, and whether our recommendations have been correctly interpreted and implemented in the design and specifications.

F.3. Groundwater Fluctuations

We made water level observations in the borings at the times and under the conditions stated on the boring logs. These data were interpreted in the text of this report. The period of observation was relatively short, and fluctuation in the groundwater level may occur due to rainfall, flooding, irrigation, spring thaw, drainage, and other seasonal and annual factors not evident at the time the observations were made. Design drawings and specifications and construction planning should recognize the possibility of fluctuations.

F.4. Use of Report

This report is for the exclusive use of Sanderson Stewart and the City of East Helena to use to design the proposed roadway improvements and prepare construction documents. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations are not appropriate for other structures or purposes. We recommend parties contemplating other structures or purposes contact us.

F.5. Level of Care

Services performed by SK Geotechnical Corporation personnel for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is made.

Professional Certification

I hereby certify that this report was prepared by me and that I am a duly Licensed Professional Engineer under the laws of the State of Montana.

MONTANA
DUSTIN P.
HUTZENBILER
No. 41795 PE
LICENSED
PROFESSIONAL ENGINEER

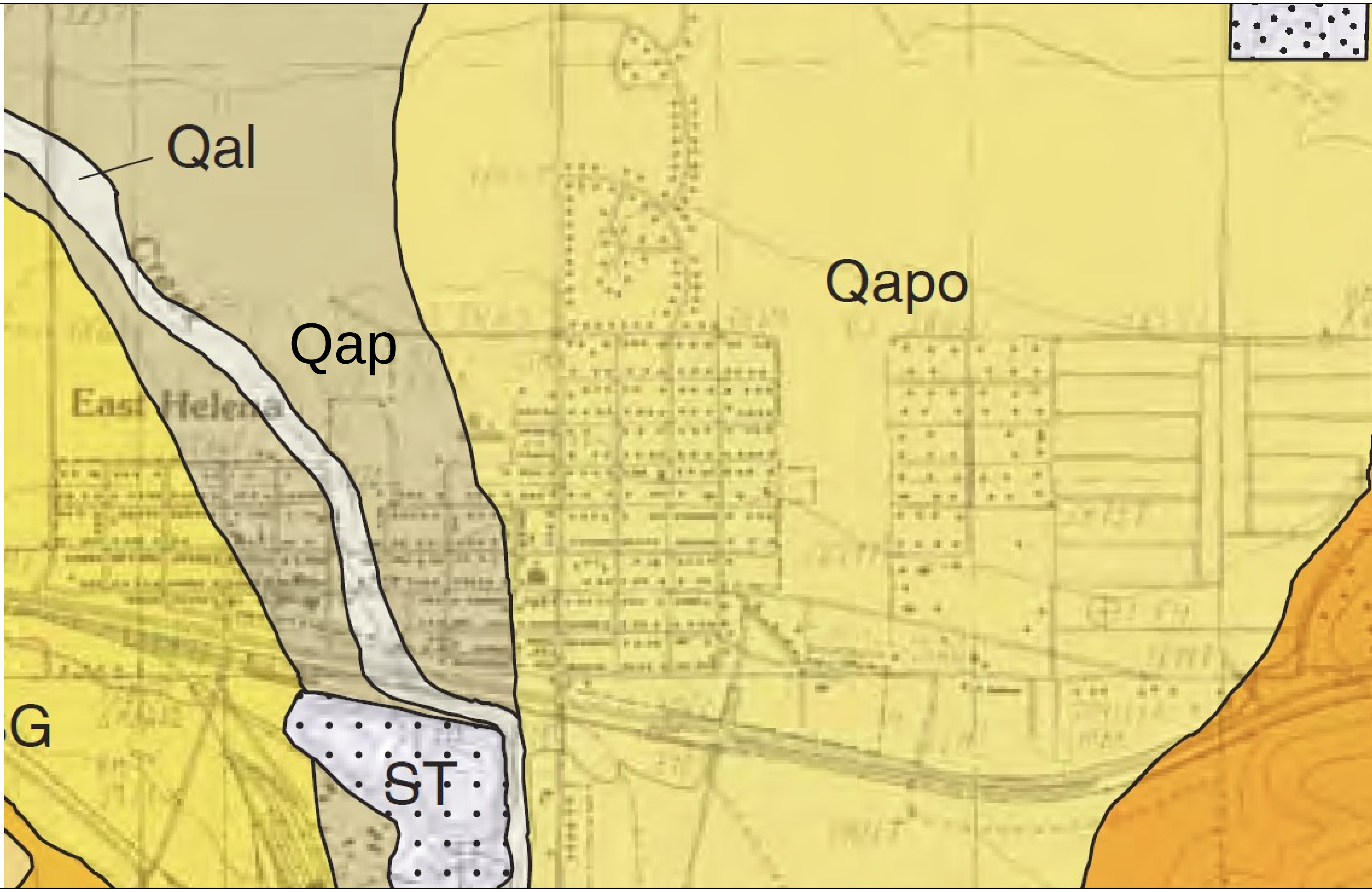
Dustin P. Hutzenbiler, PE
Geotechnical Engineer
License Number 41795PE
July 16, 2019

Appendix

SK GEOTECHNICAL

BORING LOCATION SKETCH
Proposed Valley Drive Pavement Improvements
East Helena, Montana

Drawn by:	Google Earth/SK Geo	Date	07/09/2019
Project:	19-3797G		
Scale:	Not to Scale		FIGURE
Sheet	1 of 1		



Geologic Map of the Helena Valley, West-Central Montana, Michael C. Stickney and Susan M. Vuke, 2017.
ST-Smelter Tailings; Qapo-Alluvial Plain Deposit, older; Qal-Alluvium; Qap-Alluvial Plain

SK GEOTECHNICAL

GEOLOGIC SKETCH
Proposed Valley Drive Pavement Improvements
East Helena, Montana

Drawn by:	MBMG/SK Geo	Date	07/09/2019
Project:	19-3797G		
Scale:	Not to Scale		FIGURE
Sheet	1 of 1		

Descriptive Terminology

Standard D 2487
Classification of Soils for Engineering Purposes (Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines [C]	$C_U \geq 4$ and $1 \leq C_C \leq 3$ [E]	GW	Well graded gravel [F]
			$C_U < 4$ and/or $1 > C_C > 3$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines [D]	$C_U \geq 6$ and $1 \leq C_C \leq 3$ [E]	SW	Well graded sand [I]
			$C_U < 6$ and/or $1 > C_C > 3$ [E]	SP	Poorly graded sand [I]
		Sands with Fines More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid Limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OL	Organic clay [K, L, M, N] Organic silt [K, L, M, O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OH	Organic clay [K, L, M, P] Organic silt [K, L, M, Q]
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

[A] Based on the material passing the 3" (75 mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols.
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E] $C_U = D_{60} / D_{10}$
$C_C = (D_{30})^2 / (D_{10} \times D_{60})$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

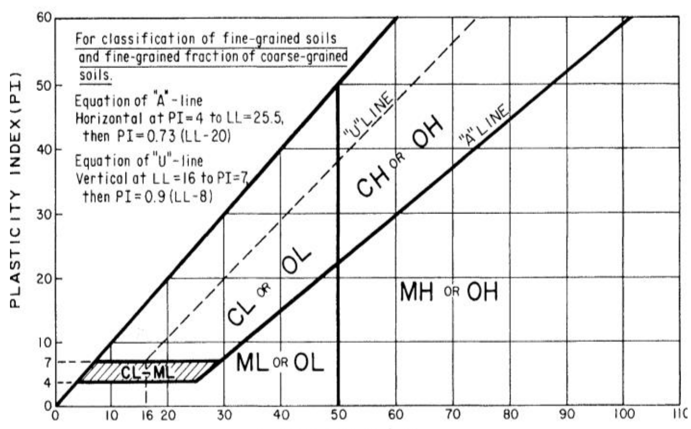


FIG. 4 Plasticity Chart

Laboratory Tests

DD	Dry density, pcf	WD	Wet density, pcf	OC	Organic content, %
LL	Liquid limit	PL	Plastic limit	PI	Plasticity index
P_{200}	% passing 200 sieve	MC	Natural moisture content, %		
MDD	Maximum dry density (Proctor), pcf	OMC	Optimum moisture content (Proctor), %		
qu	Unconfined compressive strength, psf	UCS	Unconfined compressive strength, psi		
qp	Pocket penetrometer strength, tsf				

Particle Size Identification

Boulders .... over 12"
Cobbles .... 3" to 12"
Gravel
- coarse .... 3/4" to 3"
- fine .... No. 4 to 3/4"

Sand
- coarse .... No. 4 to No. 10
- medium .... No. 10 to No. 40
- fine .... No. 40 to No. 200

Silt .... No. 200 to .005 mm
Clay .... less than .005 mm

Relative Density of Cohesionless Soils

very loose .... 0 to 4 BPF
loose .... 5 to 10 BPF
medium dense .... 11 to 30 BPF
dense .... 31 to 50 BPF
very dense .... over 50 BPF

Consistency of Cohesive Soils

very soft .... 0 to 1 BPF
soft .... 2 to 3 BPF
rather soft .... 4 to 5 BPF
medium .... 6 to 8 BPF
rather stiff .... 9 to 12 BPF
stiff .... 13 to 16 BPF
very stiff .... 17 to 30 BPF
hard .... over 30 BPF

Moisture Content (MC) Description

rather dry	MC less than 5%, absence of moisture, dusty
moist	MC below optimum, but no visible water
wet	Soil is over optimum MC
waterbearing	Granular, cohesionless or low plasticity soil with free water, typically near or below groundwater table
very wet	Cohesive soil well over OMC, typically near or below groundwater table

Drilling Notes

Standard penetration test borings were advanced by 3¼" or 4¼" ID hollow-stem augers, unless noted otherwise. Standard penetration test borings are designated by the prefix "ST" (split tube). Hand auger borings were advanced manually with a 2 to 3" diameter auger to the depths indicated. Hand auger borings are indicated by the prefix "HA."

Sampling. All samples were taken with the standard 2" OD split-tube sampler, except where noted. TW indicates thin-walled tube sample. CS indicates California tube sample. BS indicates bulk sample.

BPF. Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they were separated by backslash (/). In very dense/hard strata, the depth driven in 50 blows is indicated.

WH. WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

Note. All tests were run in general accordance with applicable ASTM standards.

SK GEOTECHNICAL
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Phone: 406.652.3930
Fax: 406.652.3944

LOG OF BORING

PROJECT: 19-3797G
PAVEMENT EVALUATION
Proposed Valley Drive Improvements
East Helena, Montana

BORING: **ST-1**

LOCATION:
See Boring Location Sketch

DRILLED BY: S. Robertson | METHOD: 3 1/4" HSA, Automatic | DATE: 4/22/19 | SCALE: 1" = 1'

Elev.	Depth	Symbol	Description of Materials	BPF	WL MC	qp	Remarks
	0.0		6½" Existing Asphalt Pavement (poor condition).				No base course under pavement.
	0.5		FILL: Clayey Sand with Gravel, low plasticity, fine- to coarse-grained, brown, moist.				
	1.0	SC	CLAYEY SAND, low plasticity, trace FeOx, brown, moist, medium dense. (Alluvium)	21	11.4 9.6		Bulk Subgrade Sample 1' - 3' LL=25, PL=15, PI=10 P_{200}=34%
	3.0	GP GM	POORLY GRADED GRAVEL with SAND, SILT, and COBBLES, fine- to coarse-grained, brown, moist, dense to very dense. (Alluvium)	6/19	18.8		
	4.7			50-2½"	2.0		
			END OF BORING Water not observed with 4' of hollow-stem auger in the ground. Water not observed to dry cave-in depth of 1½' immediately after withdrawal of auger. Boring then backfilled.				

BORING BPF WL-MC QP 3797.GPJ LAGNNN06.GDT 7/16/19

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LOG OF BORING

PROJECT: 19-3797G
PAVEMENT EVALUATION
Proposed Valley Drive Improvements
East Helena, Montana

BORING: **ST-2**

LOCATION:
See Boring Location Sketch

DRILLED BY: S. Robertson | METHOD: 3 1/4" HSA, Automatic | DATE: 4/22/19 | SCALE: 1" = 1'

Elev.	Depth	Symbol	Description of Materials	BPF	WL / MC	qp	Remarks
	0.0–0.2		2" Existing Asphalt Pavement (poor condition).				
	0.2–0.4		2" to 4½" Base Course: Poorly Graded Gravel with Clay and Sand, fine- to coarse-grained, brown, moist, medium dense.		4.2		Base Course Sample 0.2' - 0.4' LL=22, PL=17, PI=5 P_{200}=11%
	0.4–2.5		FILL: Sandy Lean Clay with Gravel, low plasticity, brown, moist, very stiff.	6/12	6.1		
	2.5–5.0	GP GM	POORLY GRADED GRAVEL with SAND, SILT, and COBBLES, fine- to coarse-grained, brown, moist, very dense. (Alluvium)	50-2½"	3.2		
				50-5½"	1.8		
	5.0		END OF BORING Water not observed with 4' of hollow-stem auger in the ground. Water not observed to dry cave-in depth of 1½' immediately after withdrawal of auger. Boring then backfilled.				

BORING BPF WL-MC QP 3797.GPJ LAGNNN06.GDT 7/16/19

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LOG OF BORING

PROJECT: 19-3797G
PAVEMENT EVALUATION
Proposed Valley Drive Improvements
East Helena, Montana

BORING: **ST-3**

LOCATION:
See Boring Location Sketch

DRILLED BY: S. Robertson | METHOD: 3 1/4" HSA, Automatic | DATE: 4/22/19 | SCALE: 1" = 1'

Elev.	Depth	Symbol	Description of Materials	BPF	WL MC	qp	Remarks
	0.0						
	0.2		2" Existing Asphalt Pavement (poor condition).				
	0.4		2" to 5" Base Course: Poorly Graded Gravel with Sand, fine- to coarse-grained, brown, moist, medium dense.		12.2		Base Course Sample 0.2' - 0.7'
			FILL: Silty Clayey Sand with Gravel, slightly plastic, fine- to coarse-grained, seams of lean clay, brown, moist, dense.	42	10.2		
	1.5	GP GM	POORLY GRADED GRAVEL with SAND, SILT, and COBBLES, fine- to coarse-grained, brown, moist, very dense. (Alluvium)	61	2.3		
				79	1.6		
	5.5		END OF BORING Water not observed with 4' of hollow-stem auger in the ground. Water not observed to dry cave-in depth of 1½' immediately after withdrawal of auger. Boring then backfilled.				

BORING BPF WL-MC QP 3797.GPJ LAGNNN06.GDT 7/16/19

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LOG OF TEST HOLE

PROJECT: 19-3797G
PAVEMENT EVALUATION
Proposed Valley Drive Improvements
East Helena, Montana

BORING: **ST-4**

LOCATION:
See Boring Location Sketch

DRILLED BY: S. Robertson | METHOD: 3 1/4" HSA, Automatic | DATE: 4/22/19 | SCALE: 1" = 1'

Elev.	Depth	Symbol	Description of Materials	B	MC (%)	qp	Remarks
	0.0		FILL: Clayey Sand with Gravel, low plasticity, trace roots, brown, moist, stiff.	7	10.9		California sampler from 0 to 1.5'
	0.6		FILL: Clayey Gravel with Sand, fine- to coarse-grained, trace FeOx, brown, moist, dense.	16	4.0		
	1.0	GP GM	POORLY GRADED GRAVEL with SAND, SILT, and COBBLES, fine- to coarse-grained, brown, moist, medium dense to dense. (Alluvium)	20	3.7		
				22			Standard split-barrel sampler from 1.5' to 3.5'
				17	1.5		
				14			
				14			
	3.5		END OF PENETRATION TEST Water not observed in test hole. Test hole then backfilled.				

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LOG OF TEST HOLE

PROJECT: 19-3797G **PAVEMENT EVALUATION** Proposed Valley Drive Improvements East Helena, Montana	BORING: **ST-5** LOCATION: See Boring Location Sketch
DRILLED BY: S. Robertson / METHOD: 3 1/4" HSA, Automatic	DATE: 4/22/19 / SCALE: 1" = 1'

Elev.	Depth	Symbol	Description of Materials	B	MC (%)	qp	Remarks
	0.0	SC	2" CLAYEY GRAVEL with SAND FILL over CLAYEY SAND, low plasticity, trace gravel and roots, brown, moist, medium dense. (Alluvium)	5			California sampler from 0 to 1.5' LL=24, PL=17, PI=7 P_{200}=20%
				8	10.5		
	1.0	GP GM	POORLY GRADED GRAVEL with SAND, SILT, and COBBLES, fine- to coarse-grained, brown, moist, medium dense to dense. (Alluvium)	14	2.8		
				16			Standard split-barrel sampler from 1.5' to 3.5'
				7			
				14			
				28			
	3.5		END OF PENETRATION TEST Water not observed in test hole. Test hole then backfilled.				

TEST HOLE B MC QP 3797.GPJ LAGNNN06.GDT 7/16/19

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LOG OF TEST HOLE

PROJECT: 19-3797G **PAVEMENT EVALUATION** Proposed Valley Drive Improvements East Helena, Montana	BORING: **ST-6** LOCATION: See Boring Location Sketch

DRILLED BY: S. Robertson	METHOD: 3 1/4" HSA, Automatic	DATE: 4/22/19	SCALE: 1" = 1'

Elev.	Depth 0.0	Symbol	Description of Materials	B	MC (%)	qp	Remarks
		SC	3" Clayey Sand with gravel FILL over Clayey Sand, low plasticity, trace gravel, brown, moist, medium dense. (Alluvium)	7 8	 12.2		California sampler from 0 to 1.5' LL=28, PL=17, PI=11 P_{200}=28%
	1.0	GP GM	POORLY GRADED GRAVEL with SAND, SILT, and COBBLES, fine- to coarse-grained, brown, moist. (Alluvium)	22 50-5½" 45 46 50-2"	6.7 2.4 		Standard split-barrel sampler from 1.5' to 3.5'
	3.2		END OF PENETRATION TEST Water not observed in test hole. Test hole then backfilled.				

TEST HOLE B MC QP 3797.GPJ LAGNNN06.GDT 7/16/19

Beginning of Valley Drive looking south.

Beginning of Valley Drive looking north.

Boring ST-3 looking north.

Boring ST-3 looking south.

Valley Drive and Rigg Street looking north.

Valley Drive and Rigg Street looking southwest.

Valley Drive looking north.

Valley Drive looking toward Groschell Street.


Valley Drive looking toward King Street.


Valley Drive looking west towards cemetery.


Valley Drive looking south towards E. Lewis Street.


Boring ST-2 looking north.


Boring ST-2 looking north.


Valley Drive looking south.


Valley Drive looking north.


Valley Drive looking south.

Staked Boring ST-1, looking south. Boring adjusted slightly north from painted location due to utility conflicts.

Boring ST-1 looking north.

Valley Drive looking north.

Test hole ST-4 looking south.


Unstable subgrades just north of proposed path.


Unstable subgrades just north of proposed path.


Test hole ST-5 looking south.


Test hole ST-6 looking south.

UPN				
Route				
Name	Valley Drive - East Helena, Montana			
Date of Run	7/16/2019			
Typical Section	**1**	**2**	**3**	**4**
Traffic				
Daily ESAL	73	73	73	73
Yearly ESAL	26645	26645	26645	26645
20 Year ESAL	532900	532900	532900	532900
Demand	*3" Asphalt*	*4" Asphalt*	*3" Asphalt*	*4" Asphalt*
Note	CBC Section	CBC Section	Subbase	Subbase
Note			Section	Section
Reliability	75	75	75	75
So	0.45	0.45	0.45	0.45
DeltaPSI	1.7	1.7	1.7	1.7
Mr	4500	4500	4500	4500
SNDES	**3.43**	**3.43**	**3.43**	**3.43**
W18	*532900*	*532900*	*532900*	*532900*
Zr	*-0.674*	*-0.674*	*-0.674*	*-0.674*
ESAL	*73*	*73*	*73*	*73*
Life	*20.0*	*20.0*	*20.0*	*20.0*
Capacity				
a1	0.41	0.41	0.41	0.41
D1 (in)	**3**	**4**	**3**	**4**
SN1	1.2	1.6	1.2	1.6
a2	**0.14**	**0.14**	**0.14**	**0.14**
m2	1	1	1	1
D2 (in)	**16.0**	**13.0**	**4.0**	**4.0**
SN2	2.2	1.8	0.6	0.6
a3			**0.09**	**0.09**
m3	1	1	1	1
D3 (in)			**18.5**	**14.0**
SN3	0.0	0.0	1.7	1.3
a4				
m4	1	1	1	1
D4 (in)				
SN4	0.0	0.0	0.0	0.0
Sntot = SN1+SN2+SN3+SN4	**3.47**	**3.46**	**3.46**	**3.46**
Traffic Chk W18=20 Yr ESAL	OK	OK	OK	OK
SN Check	OK	OK	OK	OK
Design Check	**DESIGN OK**	**DESIGN OK**	**DESIGN OK**	**DESIGN OK**
Layer 1 (ft)	0.25	0.33	0.25	0.33
Layer 2 (ft)	1.33	1.08	0.33	0.33
Layer 3 (ft)	0.00	0.00	1.54	1.17
Layer 4 (ft)	0.00	0.00	0.00	0.00
Total	1.58	1.42	2.13	1.83

DRAINAGE STRUCTURE SUMMARY – GREAT WEST

APPENDIX C

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

MEMORANDUM

Date: May 30, 2019

To: DJ Clark, Sanderson Stewart

From: Great West Engineering, Inc.

Subject: East Helena Montana Ave/Valley Dr. Corridor Study – Drainage Evaluation

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Introduction

The purpose of this memo is to provide a cursory evaluation of the existing surface drainage/storm water management on Montana Avenue/Valley Drive (hereby referred to as "study area") from Highway 12 to Plant Road. This memo summarizes the drainage findings from Great West Engineering's site visit in May 2019. The previously submitted Drainage Structure Inventory should be used to supplement this memo. It provides photos, locations, structure characteristics, and conditions for drainage structures located within the study area and discussed in this memo. For reference, mile post (MP) stationing begins at Highway 12, Lewis Street is at approximately MP 0.54, and Plant Road is at approximately MP 1.28.

Surface drainage in the study area generally follows a south-to-north flow path. During the investigation, it was found that the study area could be broken into two segments based on drainage patterns and improvements: Highway 12 to Lewis Street and Lewis Street to Plant Road. See the respective headings below for additional discussion on each segment.

Highway 12 to Lewis Street (MP 0.00 – 0.54)

The Highway 12 to Lewis Street segment showed little to no surface/storm water management. Storm water inlets were observed at the intersections with Main Street and with Lewis Street. The inlets at the south intersection with Main Street appear to pick up flow from Montana Avenue between Highway 12 and Main Street. Due to the lack of consistent longitudinal grade, it is unlikely that much water collected along Montana Avenue finds its way to the inlets. Due to recent rains, multiple areas of ponding were observed in the driving lanes, roadway shoulders, and driveway approaches. This provided a prime example of the poor drainage in this segment (See Figure 1).

Figure 1 – Typical Ponding on Segment 1

To provide adequate drainage and given the urban setting, curb and gutter would need to be installed along the east and west sides of the roadway with an integral storm drain system. Full reconstruction of the roadway would also likely be necessary to provide adequate drainage of the driving surface and to function properly with the new curb and gutter. At the northwest intersection with Main Street, asphalt was shaped to form a valley gutter along the sidewalk.

An obvious location for a storm water outfall was not apparent during the site visit. This will require additional consideration if implementation of a storm water system is considered further. These improvements would allow for removal of surface water from the roadway surface and provide safer driving conditions.

Lewis Street to Plant Road (MP 0.54 – 1.28)

North of Lewis Street, the increased use of storm water drainage features was observed. Roadside ditches on the east and west side of the roadway convey storm water with culverts under driveway and street approaches. The ditches are shallow in sporadic locations along the roadway, but generally appear adequate for drainage. The longitudinal ditch grade also appears generally sufficient for drainage and may require minimal regrading to drain. The exception to this was observed starting at Prickly Pear Road, where the ditch slope appears to flatten for 300 to 400 feet. Regrading will likely be required in this Section. It should also be noted, that if roadway reconstruction is considered on this segment existing ditches do not appear to meet Lewis & Clark County depth and slope standards and should be replaced according to these standards.

A wide variety of culvert materials were observed including; HDPE, RCP, CMP, and steel. Although driveway and street approach culverts were observed, most have been deemed non-functional. Most culverts have crushed, buried, or clogged inlets and/or outlets. Due to the recent construction on the west side of the study area, the culverts in this area generally appear to be properly sized and in good condition. The culverts on the east side of the study area reflect the observations stated above and will likely need to be replaced to provide adequate drainage.

A single main-line cross drain culvert is located within the study area. It appears to have previously served an irrigation ditch, flowing from northeast to southwest. Due to construction of the East Helena High School, it appears the irrigation ditch has been removed and is not in use. If this irrigation canal and culvert are in fact not in use, water rights should be researched and confirmed to determine if removal of the existing ditch and culvert is feasible.

Additional Comments

FEMA flood maps, 30049C2333E & 30049C2331E, were analyzed to determine if the study area is located with a floodplain. After review of the flood maps it was determined that the study area is <u>not</u> within a FEMA designated floodplain. Note that the 100-year floodplain (Zone A) for Prickly Pear Creek does appear to cross Valley Drive at approximately 1500 and 2000 feet north of Plant Road.

Although out of the scope of this project, it should be noted that as you continue north on Valley Drive out of the study area (north of Plant Road), roadway drainage significantly deteriorates. Roadside ditches become less prominent to non-existent and very few approach culverts are installed. If the drainage improvements are implemented it can be reasonably assumed the system downstream will see higher flows. A detention or retention system may be needed if downstream improvements aren't performed.

Summary of Hydraulic Recommendations

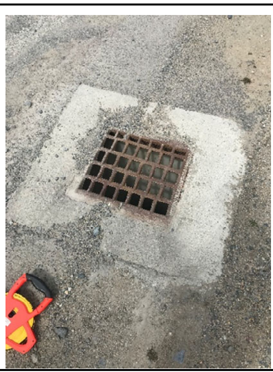
Highway 12 to Lewis Road Street (MP 0.00 – 0.54)

- Install curb and gutter with a storm drain system the full length of this segment.

Lewis Road Street to Plant Road (MP 0.54 – 1.28)

- Replace all culverts on the east side of the roadway.
- Recut ditch where longitudinal slopes are not adequate.
- Remove and/or decommission cross drain culvert and irrigation ditch if not in use.

Due to the limited scope of this evaluation, further analysis will be required to properly identify the quantity of storm water and sizing requirements of any new stormwater infrastructure.

	CORRIDOR STUDY							DATE: APRIL 30, 2019
	PROJECT NO.: 1-18317							
	PROJECT DESCRIPTION: EAST HELENA CORRIDOR STUDY							
		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
MAINLINE CROSS DRAINS								
		1.16	LT	CSP	24"	20'	12"	Perpendicular to Valley Dr. on Walking Trail Outlet Partially Clogged Good Condition
		1.16	N/A	CSP	18"±	33'	24"	Perpendicular to Valley Dr. Deformed Inlet and Outlet Resulted in Measurement Difficulties, Inlet and Outlet Partially Clogged Poor Condition
STORM DRAIN STRUCTURES								
	No Image Available	0.15	RT	Storm Drain	N/A	N/A	N/A	On S. Montana Ave. 24" x 24" Storm Drain Good Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
	No Image Available	0.15	LT	Storm Drain	N/A	N/A	N/A	On S. Montana Ave. at Main Street Intersection 24" x 24" Storm Drain Fair Condition
	No Image Available	0.15	LT	N/A	N/A	N/A	N/A	On S. Montana Ave. at Main Street Intersection 24" x 24" Storm Drain Fair Condition
	No Image Available	0.35	RT	N/A	N/A	N/A	N/A	Parallel to N. Montana Ave. 16" Wide by 6' Long Drain in Sidewalk Fair Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
	No Image Available	0.54	RT	N/A	N/A	N/A	N/A	On N. Montana Ave. 26" Dia. Storm Drain Good Condition
APPROACH CROSS DRAINS								
		0.56	RT	CSP	16"	34.5'	6"	Parallel to Valley Dr. Partially Clogged Good Condition
		0.57	RT	HDPE	16"	20.5	6"	Parallel to Valley Dr. Good Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		0.60	RT	CSP	16"	26'	0"-6"	Parallel to Valley Dr. Inlet and Outlet Deformed Fair Condition
		0.61	LT	Concrete	18"	67'	12"	Parallel to Valley Dr. Good Condition
	No Image Available	0.64	RT	CSP	18"	29'	6"	Parallel to Valley Dr. Inlet Deformed Poor Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		0.66	RT	HDPE	16"	22'	6"	Parallel to Valley Dr. HDPE Culvert in Steel Pipe Good Condition
		0.68	RT	HDPE & Concrete	18"	44'	6"	Parallel to Valley Dr. Inlet is Concrete, Outlet is HDPE Good Condition
	No Image Available	0.70	RT	HDPE	10"	20'	6"	Parallel to Valley Dr. Good Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		0.70	LT	Concrete	18"	60'	12"	Parallel to Valley Dr. Good Condition
		0.71	RT	CSP	18"	37'	6"	Parallel to Valley Dr. Inlet Slightly Deformed, Outlet Partially Clogged Fair Condition
		0.75	RT	CSP	18"	25'	6"	Parallel to Valley Dr. Inlet and Outlet Deformed and Partially Clogged Poor Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		0.77	RT	CSP	24"	57'	24"	Parallel to Valley Dr. Good Condition
		0.80	RT	CSP	18"	23'	8"	Parallel to Valley Dr. Outlet Slightly Deformed Fair Condition
		0.82	RT	CSP & HDPE	18"	48'	12"	Parallel to Valley Dr. Inlet is HDPE, Outlet is CSP Good Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
	No Image Available	0.85	RT	CSP	16"	20'	18"	Parallel to Valley Dr. Inlet Partially Clogged Fair Condition
		0.86	RT	CSP	16"	28'	12"	Parallel to Valley Dr. Good Condition
	No Image Available	0.89	RT	CSP	18"	28'	10"	Parallel to Valley Dr. Good Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		0.90	RT	CSP	16"	19'	12"	Parallel to Valley Dr. Inlet Slightly Deformed Fair Condition
		0.92	RT	HDPE	18"	26'	6"	Parallel to Valley Dr. Good Condition
		0.94	RT	CSP	16"	30'	8"	Parallel to Valley Dr. Inlet and Outlet Partially Clogged Good Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		0.95	RT	CSP	14"	38'	6"	Parallel to Valley Dr. Inlet Deformed, Outlet Partially Clogged Poor Condition
		0.97	RT	HDPE	14.5"	20.5'	8"	Parallel to Valley Dr. HDPE Culvert With Concrete Collar Good Condition
		0.98	LT	CSP	18"	78'	24"	Parallel to Valley Dr. Inlet and Outlet Clogged Fair Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		1.00	RT	CSP	12"	20'	18"	Parallel to Valley Dr. Outlet Deformed, Inlet and Outlet Partially Clogged Fair Condition
		1.01	RT	CSP	18"	40'	30"	Parallel to Valley Dr. Good Condition
		1.02	LT	Concrete	18"	40'	12"	Parallel to Valley Dr. Good Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		1.06	RT	HDPE	12"	18'	6"	Parallel to Valley Dr. Outlet Slightly Deformed, Inlet and Outlet Partially Clogged Fair Condition
		1.07	LT	Concrete	15" x 30"	60'	12"	Parallel to Valley Dr. Good Condition
		1.05	RT	CSP	12"	46'	12"	Parallel to Valley Dr. Inlet Slightly Deformed and Partially Clogged, Outlet Covered Fair Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		1.10	RT	CSP	12"	20'	10"	Parallel to Valley Dr. Inlet Mostly Clogged, Outlet Partially Clogged Fair Condition
		1.11	RT	CSP	12"	19'	6"	Parallel to Valley Dr. Inlet and Outlet Deformed Poor Condition
		1.12	RT	CSP	18"	28'	6"	Parallel to Valley Dr. Inlet and Outlet Deformed Fair Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		1.15	RT	Metal	14"	40.5'	0"	Parallel to Valley Dr. Visible Holes Throughout Pipe Poor Condition
		1.18	LT	Concrete	15" x 30"	47.5'	TBD	Parallel to Valley Dr. Good Condition
		1.21	LT	Concrete	15" x 30"	47.5'	TBD	Parallel to Valley Dr. Good Condition

		MILE POST	LT or RT	PIPE TYPE	PIPE DIA.	PIPE LENGTH	ROAD COVER	REMARKS - CONDITION
		1.25	LT	Concrete	5211-1101	R1-1	TBD	Parallel to Valley Dr. Good Condition
		1.25	RT	CSP	5211-5603	R5-1A	24"	Parallel to Valley Dr. Good Condition
		1.28	LT	CSP	N/A	D3-1	18"	Parallel to Valley Dr. Outlet Completely Clogged Poor Condition

SIGN INVENTORY

APPENDIX D

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

	CORRIDOR STUDY										DATE: APRIL 30, 2019	
	PROJECT NO.: 1-18317											
	PROJECT DESCRIPTION: EAST HELENA CORRIDOR STUDY											
	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
SIGN INVENTORY												
	0.01	LT	2006	5221-1102	(2) D3-1	45" X 10"	60"	2.5" Sq. Metal Tube	83"	Yes	Good Condition	
	0.01	LT	2006	5211-1101	R1-1	30" x 30"	60"	2.5" Sq. Metal Tube	83"	Yes	Good Condition	
	0.01	LT	N/A	N/A	N/A	N/A	150"	(2) 8" X 8" Steel Poles	N/A	N/A	Private Billboard	
	0.03	RT	N/A	N/A	D3-1	30" x 6"	99"	3" 'U' Pole	84"	Yes	Porter St. Street Sign Good Condition	
	0.03	RT	N/A	N/A	D3-1	30" x 6"	99"	3" 'U' Pole	84"	Yes	Montana Ave. S. Street Sign Good Condition	
	0.03	RT	N/A	5211-1101	R1-1	30" x 30"	99"	3" 'U' Pole	84"	Yes	Good Condition	
	0.05	LT	N/A	N/A	D3-1	30" x 6"	189"	3" 'U' Pole	79"	Yes	Pacific St. Street Sign Good Condition	
	0.05	LT	N/A	N/A	D3-1	30" x 6"	189"	3" 'U' Pole	79"	Yes	Montana Ave. S. Street Sign Good Condition	
	0.05	LT	N/A	5211-1101	R1-1	30" x 30"	189"	3" 'U' Pole	79"	Yes	Fair Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.06	RT	N/A	N/A	R7-203 (Modified)	18" x 24"	82"	3" 'U' Pole	81.5"	Yes	Emergency Snow Route Sign Fair Condition	
	0.09	LT	N/A	N/A	D3-1	6" X 30"	147"	3" 'U' Pole	81"	Yes	Clark St. Street Sign Good Condition	
	0.09	LT	N/A	N/A	D3-1	6" X 30"	147"	3" 'U' Pole	81"	Yes	Montana Ave. S. Street Sign Good Condition	
	0.09	LT	N/A	5211-1101	R1-1	30" X 30"	147"	3" 'U' Pole	81"	Yes	Poor Condition	
	0.10	RT	N/A	5211-1101	R1-1	30" x 30"	208"	3" 'U' Pole	73.5"	Yes	Poor Condition	
	0.13	RT	N/A	N/A	N/A	12" x 15"	71"	3" 'U' Pole	78"	Yes	Neighborhood Watch Sign Fair Condition	
	0.13	RT	N/A	N/A	I-8 (Modified)	12" x 15"	71"	3" 'U' Pole	78"	Yes	Library Sign Fair Condition	
	0.13	RT	N/A	N/A	N/A	12" x 6"	71"	3" 'U' Pole	78"	Yes	Left Arrow Sign Fair Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.15	RT	N/A	N/A	D3-1	6" x 30"	79"	3" 'U' Pole	81"	Yes	Montana Ave. S. Street Sign Good Condition	
	0.15	RT	N/A	N/A	D3-1	6" x 24"	79"	3" 'U' Pole	81"	Yes	E. Main Street Sign Fair Condition	
	0.15	RT	N/A	5211-1101	R1-1	30" x 30"	79"	3" 'U' Pole	81"	Yes	Fair Condition	
	0.15	LT	8/27/2001	5217-1111	S1-1	36" x 36"	18'	4.5" Wood Pole	67"	N/A	Good Condition	
	0.15	LT	8/27/2001	N/A	N/A	36" x 18"	18'	4.5" Wood Pole	67"	N/A	Stop When Occupied Sign Good Condition	
	0.15	LT	8/27/2001	5217-1111	S1-1	36" x 36"	470'	Bolted to Light Pole	86"	N/A	Good Condition	
	0.15	LT	8/27/2001	5217-1109	W16-9P	36" x 12"	470'	Bolted to Light Pole	86"	N/A	Good Condition	
	0.16	LT	N/A	N/A	D3-1	6" x 30"	N/A	3" 'U' Pole	83"	Yes	Montana Ave. N. Street Sign Fair Condition	
	0.16	LT	N/A	N/A	D3-1	6" x 24"	N/A	3" 'U' Pole	83"	Yes	E. Main Street Sign Fair Condition	
	0.16	LT	N/A	5211-1101	R1-1	30" x 30"	N/A	3" 'U' Pole	83"	Yes	Fair Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.16	RT	8/28/2015	5217-1111	S1-1	36" x 36"	42'	2.5" Sq. Metal Tube	58"	Yes	Good Condition	
	0.16	RT	8/27/2001	N/A	N/A	36" x 18"	42'	2.5" Sq. Metal Tube	58"	Yes	Stop When Occupied Sign Good Condition	
	0.16	RT	6/23/2001	5217-1111	S1-1	36" x 36"	387'	3" x 5" Wood Pole	83"	N/A	Good Condition	
	0.16	RT	6/23/2001	5217-1109	W16-9P	36" x 12"	387'	3" x 5" Wood Pole	83"	N/A	Good Condition	
	0.16	RT	N/A	5212-1805 (Modified)	R7-8B (Modified)	12" x 18"	101"	3" 'U' Pole	79"	Yes	Fair Condition	
	0.17	LT	N/A	N/A	R7-3 (Modified)	12" x 18"	N/A	3" 'U' Pole	61.5"	No	Poor Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.19	LT	N/A	N/A	N/A	12" x 18"	N/A	8" Wood Post	53"	No	City of Helena Bus Stop Sign Fair Condition	
	0.19	RT	N/A	N/A	N/A	6" x 12"	N/A	2.5" 'U' Pole	34"	No	"0" Mile Marker Sign Poor Condition	
	0.21	LT	N/A	N/A	D3-1	6" x 24"	90"	3.5" 'U' Pole	72"	Yes	E. Riggs St. Street Sign Fair Condition	
	0.21	LT	N/A	N/A	D3-1	6" x 30"	90"	3.5" 'U' Pole	72"	Yes	Montana Ave. N. Street Sign Fair Condition	
	0.21	LT	N/A	5211-1101	R1-1	30" x 30"	90"	3.5" 'U' Pole	72"	Yes	Good Condition	
	0.22	LT	N/A	5211-3211	R3-4	24" x 24"	104"	3" 'U' Pole	76"	Yes	Good Condition	
	0.22	LT	N/A	N/A	N/A	24" x 18"	76"	3" 'U' Pole	76"	Yes	No U Turn Sign Good Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.22	RT	N/A	5211-1101	R1-1	30" x 30"	127"	3" 'U' Pole	77"	Yes	Fair Condition	
	0.28	LT	N/A	N/A	D3-1	6" x 30"	163"	3" 'U' Pole	78"	Yes	E. Groschell St. Street Sign Fair Condition	
	0.28	LT	N/A	N/A	D3-1	6" x 30"	163"	3" 'U' Pole	78"	Yes	Montana Ave. N. Street Sign Fair Condition	
	0.28	LT	N/A	5211-1101	R1-1	30" x 30"	163"	3" 'U' Pole	78"	Yes	Poor Condition	
	0.29	RT	N/A	5211-1101	R1-1	30" x 30"	177"	3" 'U' Pole	80"	Yes	Poor Condition	
	0.29	RT	N/A	5211-1501	R2-1	24" x 30"	108"	3" x 3" Wood Post	88"	N/A	Good Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.29	RT	N/A	N/A	N/A	10" x 24"	71"	3" 'U' Pole	63"	Yes	School Crossing Sign Fair Condition	
	0.29	RT	N/A	N/A	S1-1	30" x 30"	71"	3" 'U' Pole	63"	Yes	Fair Condition	
	0.34	LT	N/A	N/A	D3-1	24" x 6"	168"	3" 'U' Pole	80"	Yes	Clinton St. Street Sign Good Condition	
	0.34	LT	N/A	N/A	D3-1	24" x 6"	168"	3" 'U' Pole	80"	Yes	Montana Ave. Street Sign Good Condition	
	0.34	LT	N/A	5211-1101	R1-1	24" x 6"	168"	3" 'U' Pole	80"	Yes	Good Condition	
	0.34	RT	N/A	N/A	S1-1	30" x 30"	194"	Mounted to Light Pole with 2" pipe	72" to Flashing Light 95" to Sign	No	School Crossing Sign with Flashing Lights Fair Condition	
	0.34	RT	N/A	N/A	N/A	10" x 24"	194"	Mounted to Light Pole with 2" pipe	72" to Flashing Light 95" to Sign	No	Stop When Occupied Sign Fair Condition	
	0.35	RT	N/A	5211-1101	R1-1	30" x 30"	194"	3" 'U' Pole	84"	Yes	Fair Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.35	LT	N/A		S1-1	30" x 30"	88"	Mounted to Light Pole with 2" pipe	83" to Flashing Light 106" to Sign	No	School Crossing Sign with Flashing Lights Fair Condition	
	0.35	LT	N/A		N/A	10" x 24"	88"	Mounted to Light Pole with 2" pipe	83" to Flashing Light 106" to Sign	No	Stop When Occupied Sign Fair Condition	
	0.40	LT	N/A	N/A	N/A	10" x 24"	84"	3" 'U' Pole	64"	Yes	School Crossing Sign Fair Condition	
	0.40	LT	N/A	N/A	S1-1	30" x 30"	84"	3" 'U' Pole	64"	Yes	Fair Condition	
	0.40	LT	N/A	N/A	D3-1	24" x 6"	147"	3" 'U' Pole	81"	Yes	King St. Street Sign Good Condition	
	0.40	LT	N/A	N/A	D3-1	30" x 6"	147"	3" 'U' Pole	81"	Yes	Montana Ave. N. Good Condition	
	0.40	LT	N/A	5211-1101	R1-1	30" x 30"	147"	3" 'U' Pole	81"	Yes	Fair Condition	
	0.41	RT	N/A	5211-1101	R1-1	30" x 30"	103"	3" 'U' Pole	83"	Yes	Good Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.47	RT	N/A	N/A	D3-1	24" x 6"	265"	3" 'U' Pole	81"	Yes	Dudly St. Street Sign Fair Condition	
	0.47	RT	N/A	N/A	D3-1	30" x 6"	265"	3" 'U' Pole	81"	Yes	Montana Ave. N. Fair Condition	
	0.47	RT	N/A	5211-1101	R1-1	30" x 30"	265"	3" 'U' Pole	81"	Yes	Fair Condition	
	0.49	RT	N/A	N/A	S1-1	30" x 30"	55"	3.5" 'U' Pole	67"	Yes	Good Condition	
	0.49	RT	N/A	N/A	W16-9P	24" x 12"	55"	3.5" 'U' Pole	67"	Yes	Good Condition	
	0.49	LT	N/A	N/A	N/A	48" x 24"	N/A	3" Metal Pole	43"	N/A	Private Sign Good Condition	
	0.50	LT	N/A	N/A	R7-203 (Modified)	18" x 24"	74"	3.5" 'U' Pole	80"	Yes	Emergency Snow Route Sign Good Condition	
	0.50	LT	N/A	N/A	N/A	12" x 18"	74"	3.5" 'U' Pole	80"	Yes	Neighborhood Watch Sign Good Condition	

	MILE	LT	INSTALL	MDT	MUTCD		OFFSET FROM		MOUNTING HEIGHT	BREAKAWAY		
	POST	or RT	DATE	CALL OUT	CALL OUT	SIGN SIZE	EDGE OF ROAD	POST, TYPE & SIZE	MEASURED TO BOTTOM SIGN	BASE	REMARKS-CONDITION	ACTION
	0.53	RT	N/A	5211-3011	R3-2	24" x 24"	101"	3.5" 'U' Pole	72"	Yes	Good Condition	
	0.53	RT	N/A	N/A	S1-1	30" x 30"	64"	2" Sq. Metal Tube	68"	Yes	Good Condition	
	0.53	RT	N/A	N/A	W17-7P	24" x 12"	64"	2" Sq. Metal Tube	68"	Yes	Good Condition	
	0.53	RT	N/A	N/A	D3-1	6" x 24"	238"	3" 'U' Pole	119"	Yes	Lewis St. Street Sign Good Condition	
	0.53	RT	N/A	N/A	D3-1	6" x 30"	238"	3" 'U' Pole	119"	Yes	Montana Ave. N. Good Condition	
	0.54	LT	N/A	5211-1103	R1-1	36" x 36"	265"	2" Sq. Metal Tube	44"	Yes	Good Condition	
	0.54	LT	N/A	5211-3303	R3-5	30" x 36"	265"	2" Sq. Metal Tube	44"	Yes	Good Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.54	LT	N/A	N/A	R5-1	24" x 24"	265"	2" Sq. Metal Tube	70"	Yes	Good Condition	
	0.54	LT	N/A	5211-5603	R5-1A	36" x 24"	265"	2" Sq. Metal Tube	70"	Yes	Good Condition	
	0.54	RT	N/A	5211-1101	R1-1	30" x 30"	238"	4" x 4" Wood Post	65"	N/A	Fair Condition	
	0.54	RT	N/A	N/A	D3-1	6" x 24"	148"	2.5" Metal Tube	96"	N/A	Valley Dr. Street Sign Poor Condition	
	0.54	LT	N/A	5211-1103	R1-1	36" x 36"	247"	2" Sq. Metal Tube	49"	Yes	Good Condition	
	0.54	LT	N/A	5211-3301	R3-5	30" x 36"	247"	2" Sq. Metal Tube	49"	Yes	Good Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.54	LT	N/A	N/A	R5-1	24" x 24"	247"	2" Sq. Metal Tube	73"	Yes	Good Condition	
	0.54	LT	N/A	5211-5603	R5-1A	36" x 24"	247"	2" Sq. Metal Tube	73"	Yes	Good Condition	
	0.55	LT	N/A	N/A	S1-1	30" x 30"	95"	2" Sq. Metal Tube	74"	Yes	Good Condition	
	0.55	LT	N/A	N/A	W17-7P	24" x 12"	95"	2" Sq. Metal Tube	74"	Yes	Good Condition	
	0.55	RT	N/A	5212-5905	R12-6	24" x 20"	101"	3" 'U' Pole	67"	Yes	Fair Condition	
	0.55	LT	N/A	5211-2911	R3-1	24" x 24"	126"	3.5" 'U' Pole	72"	Yes	Good Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.58	LT	N/A	5211-1501	R2-1	24" x 30"	101"	3.5" 'U' Pole	68"	Yes	Good Condition	
	0.58	RT	N/A	5211-1501	R2-1	24" x 30"	147"	3.5" 'U' Pole	84"	Yes	Good Condition	
	0.61	RT	N/A	5211-3011	R3-2	24" x 24"	147"	2" Sq. Metal Tube	93"	Yes	Good Condition	
	0.62	LT	N/A	5211-3303	R3-5	30" x 36"	282"	2" Sq. Metal Tube	84"	Yes	Good Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.62	RT	N/A	5211-1103	R1-1	36" x 36"	282"	2" Sq. Metal Tube	36"	Yes	Good Condition	
	0.62	RT	N/A	5217-1112	S1-1	36" x 36"	282"	2" Sq. Metal Tube	36"	Yes	Good Condition	
	0.62	RT	N/A	N/A	W17-7P	12" x 24"	282"	2" Sq. Metal Tube	36"	Yes	Good Condition	
	0.62	RT	N/A	N/A	R5-1	24" x 24"	282"	2" Sq. Metal Tube	70"	Yes	Good Condition	
	0.62	RT	N/A	5211-5603	R5-1A	36" x 24"	282"	2" Sq. Metal Tube	70"	Yes	Good Condition	
	0.63	RT	N/A	5211-2911	R3-1	24" x 24"	51"	2" Sq. Metal Tube	93"	Yes	Good Condition	
	0.63	RT	N/A	N/A	N/A	6" x 18"	N/A	2" Sq. Metal Tube	29"	N/A	Private Sign Fair Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	0.70	LT	N/A	5211-1103	R1-1	36" x 36"	227"	2" Sq. Metal Tube	36"	Yes	Good Condition	
	0.70	LT	N/A	5217-1112	S1-1	36" x 36"	227"	2" Sq. Metal Tube	36"	Yes	Good Condition	
	0.70	LT	N/A	N/A	W17-7P	12" x 24"	227"	2" Sq. Metal Tube	36"	Yes	Good Condition	
	0.78	RT	N/A	N/A	D3-1	6" x 30"	232"	3" 'U' Pole	72"	Yes	Valley Dr. Street Sign Fair Condition	
	0.78	RT	N/A	N/A	D3-1	6" x 30"	232"	3" 'U' Pole	72"	Yes	Prickly Pear Ave. Street Sign Fair Condition	
	0.78	RT	N/A	5211-1102	R1-1	30" x 30"	232"	3" 'U' Pole	72"	Yes	Fair Condition	
	0.81	LT	N/A	5211-1501	R2-1	24" x 30"	119"	3.5" 'U' Pole	92"	Yes	Good Condition	
	0.81	RT	N/A	5211-1601	R2-1	24" x 30"	70"	3.5" 'U' Pole	92"	Yes	Good Condition	

	MILE POST	LT or RT	INSTALL DATE	MDT CALL OUT	MUTCD CALL OUT	SIGN SIZE	OFFSET FROM EDGE OF ROAD	POST, TYPE & SIZE	MOUNTING HEIGHT MEASURED TO BOTTOM SIGN	BREAKAWAY BASE	REMARKS-CONDITION	ACTION
	1.01	RT	N/A	N/A	D3-1	6" x 24"	208"	2.5" Metal Tube	104"	N/A	Cobre Dr. Street Sign Fair Condition	
	1.02	RT	N/A	5211-1102	R1-1	30" x 30"	245"	3" x 3" Wood Post	87"	N/A	Good Condition	
	1.26	RT	N/A	N/A	D3-1	6" x 30"	188"	3.5" 'U' Pole	94"	Yes	Bandera Dr. Street Sign Fair Condition	
	1.26	RT	N/A	N/A	D3-1	6" x 30"	188"	3.5" 'U' Pole	94"	Yes	Valley Dr. Street Sign Poor Condition	
	1.26	RT	N/A	5211-1102	D3-1	30" x 30"	188"	3.5" 'U' Pole	94"	Yes	Good Condition	

TRAFFIC COUNT DATA

APPENDIX E

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

SANDERSON STEWART

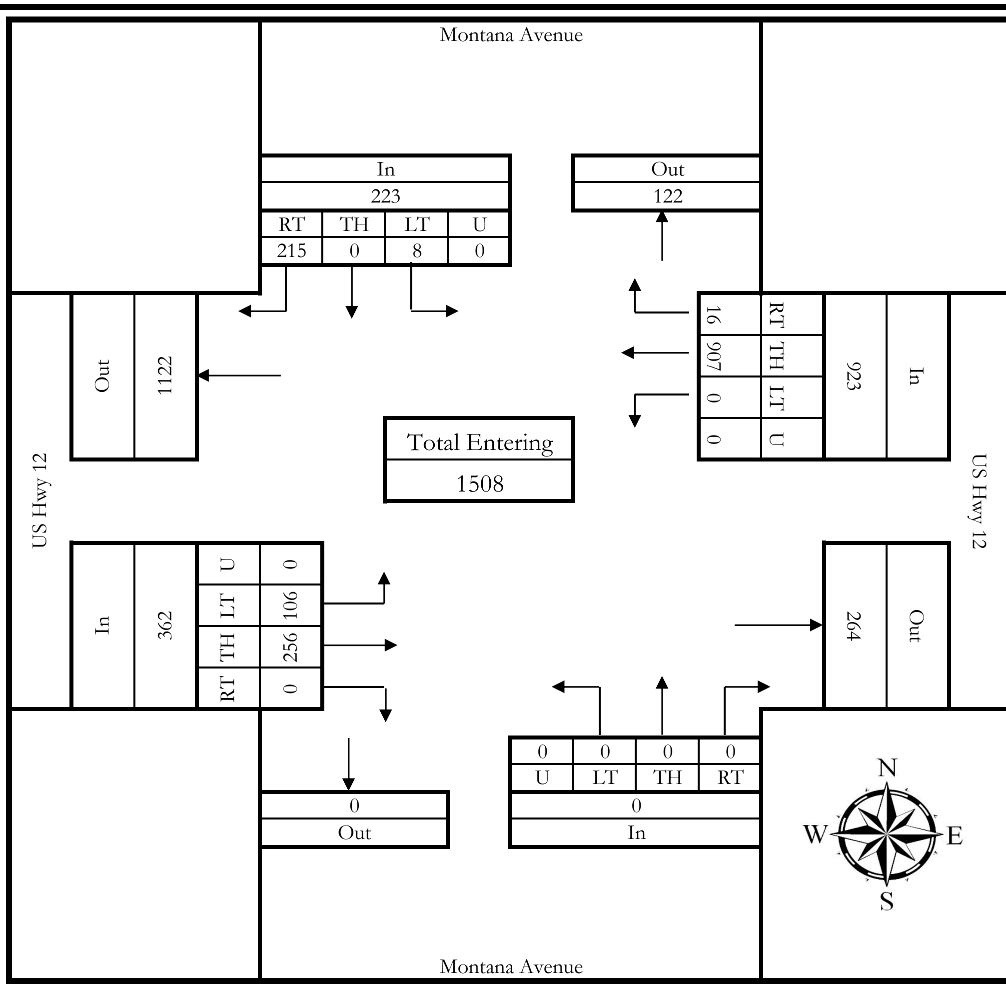
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	US Hwy 12 & Montana Avenue
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Morning Peak Hour (7:30 - 8:30 AM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue	East/West Street:	US Hwy 12

Vehicle Volumes and Adjustments

	Montana Avenue Southbound					Montana Avenue Northbound					US Hwy 12 Eastbound					US Hwy 12 Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.10	1.10	1.10	1.10		1.10	1.10	1.10	1.10		
7:30 AM	56	0	1	0	57	0	0	0	0	0	0	49	20	0	69	3	292	0	0	295	421
7:45 AM	68	0	0	0	68	0	0	0	0	0	0	60	34	0	94	2	256	0	0	258	420
8:00 AM	52	0	4	0	56	0	0	0	0	0	0	67	33	0	100	8	190	0	0	198	354
8:15 AM	39	0	3	0	42	0	0	0	0	0	0	80	19	0	99	3	169	0	0	172	313
Grand Total	215	0	8	0	223	0	0	0	0	0	0	256	106	0	362	16	907	0	0	923	1508
Medium Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.9	0.0	2.5	0.0	0.3	0.0	0.0	0.3	
Heavy Truck %	0.5	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	1.7	0.0	1.8	0.0	0.0	1.7	
Total Truck %	0.5	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.9	0.0	4.1	0.0	2.1	0.0	0.0	2.1	
Total %	14.3	0.0	0.5	0.0	14.8	0.0	0.0	0.0	0.0	0.0	0.0	17.0	7.0	0.0	24.0	1.1	60.1	0.0	0.0	61.2	100.0
PHF	0.82	0.82	0.82			1.00	1.00	1.00			0.96	0.96	0.96			0.89	0.89	0.89			0.89



SANDERSON STEWART

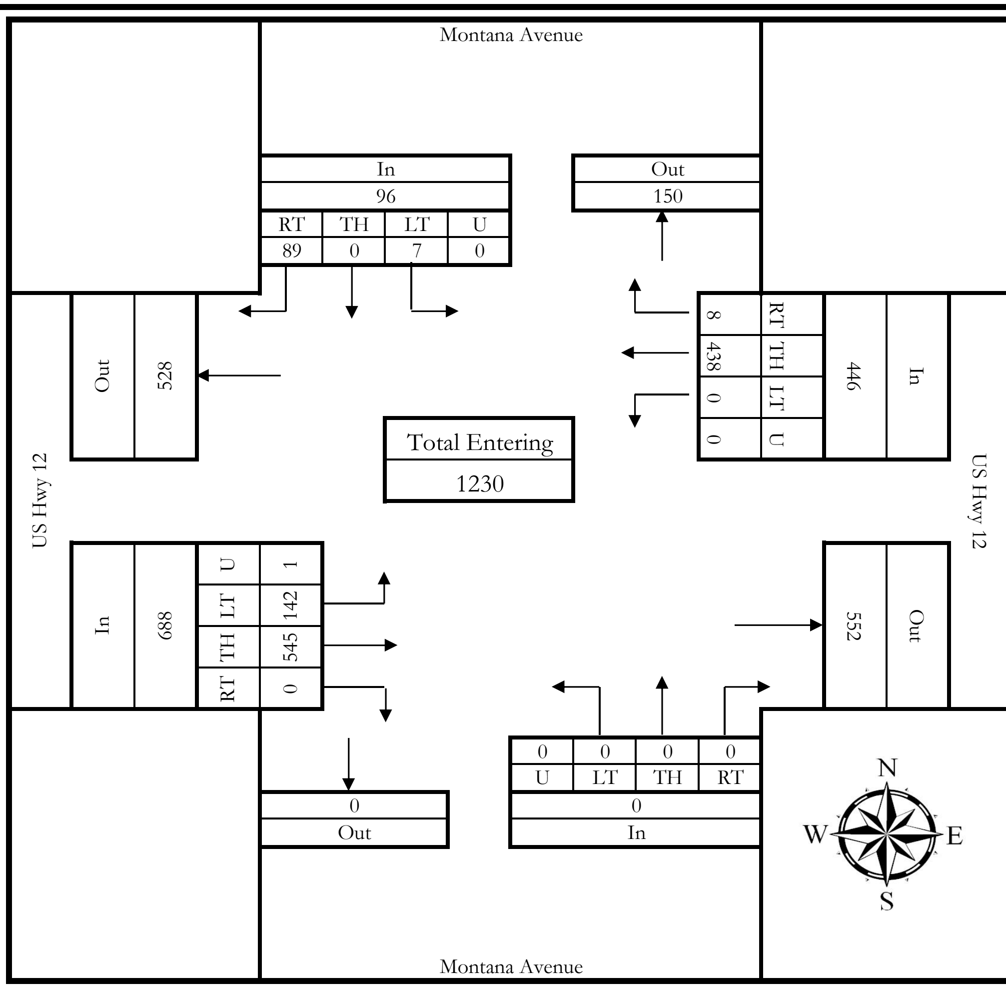
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	US Hwy 12 & Montana Avenue
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	After School Peak Hour (2:45 - 3:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue	East/West Street:	US Hwy 12

Vehicle Volumes and Adjustments

	Montana Avenue Southbound					Montana Avenue Northbound					US Hwy 12 Eastbound					US Hwy 12 Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.10	1.10	1.10	1.10		1.10	1.10	1.10	1.10		
2:45 PM	17	0	2	0	19	0	0	0	0	0	0	122	42	1	165	2	92	0	0	94	278
3:00 PM	18	0	2	0	20	0	0	0	0	0	0	144	32	0	176	3	89	0	0	92	288
3:15 PM	31	0	3	0	34	0	0	0	0	0	0	127	31	0	158	2	129	0	0	131	323
3:30 PM	23	0	0	0	23	0	0	0	0	0	0	152	37	0	189	1	128	0	0	129	341
Grand Total	89	0	7	0	96	0	0	0	0	0	0	545	142	1	688	8	438	0	0	446	1230
Medium Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.7	0.0	0.5	0.0	0.0	0.4	
Heavy Truck %	1.1	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	1.7	0.0	8.0	0.0	0.0	7.8	
Total Truck %	1.1	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	1.4	0.0	2.5	0.0	8.4	0.0	0.0	8.3	
Total %	7.2	0.0	0.6	0.0	7.8	0.0	0.0	0.0	0.0	0.0	0.0	44.3	11.5	0.1	55.9	0.7	35.6	0.0	0.0	36.3	100.0
PHF	1.00	1.00	1.00			1.00	1.00	1.00			0.91	0.91	0.91			0.86	0.86	0.86			0.90



SANDERSON STEWART

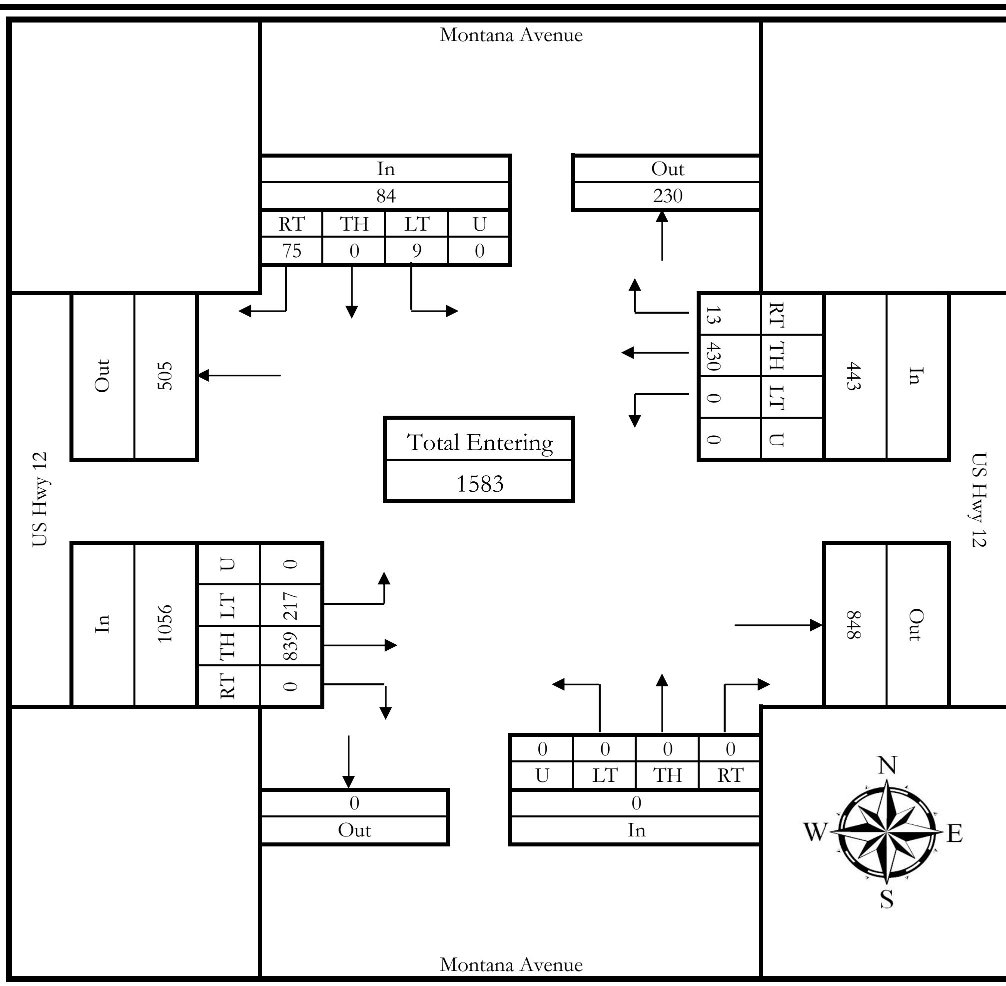
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	US Hwy 12 & Montana Avenue
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Evening Peak Hour (4:45 - 5:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue	East/West Street:	US Hwy 12

Vehicle Volumes and Adjustments

	Montana Avenue Southbound					Montana Avenue Northbound					US Hwy 12 Eastbound					US Hwy 12 Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.10	1.10	1.10	1.10		1.10	1.10	1.10	1.10		
4:45 PM	20	0	0	0	20	0	0	0	0	0	0	205	35	0	240	2	121	0	0	123	383
5:00 PM	17	0	4	0	21	0	0	0	0	0	0	198	61	0	259	3	104	0	0	107	387
5:15 PM	18	0	3	0	21	0	0	0	0	0	0	255	66	0	321	3	103	0	0	106	448
5:30 PM	20	0	2	0	22	0	0	0	0	0	0	181	55	0	236	5	102	0	0	107	365
Grand Total	75	0	9	0	84	0	0	0	0	0	0	839	217	0	1056	13	430	0	0	443	1583
Medium Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Heavy Truck %	1.3	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.9	0.0	1.7	0.0	4.7	0.0	0.0	4.5	
Total Truck %	1.3	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.9	0.0	1.7	0.0	4.7	0.0	0.0	4.5	
Total %	4.7	0.0	0.6	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	53.0	13.7	0.0	66.7	0.8	27.2	0.0	0.0	28.0	100.0
PHF	0.99	0.99	0.99			1.00	1.00	1.00			0.82	0.82	0.82			1.00	1.00	1.00			0.88



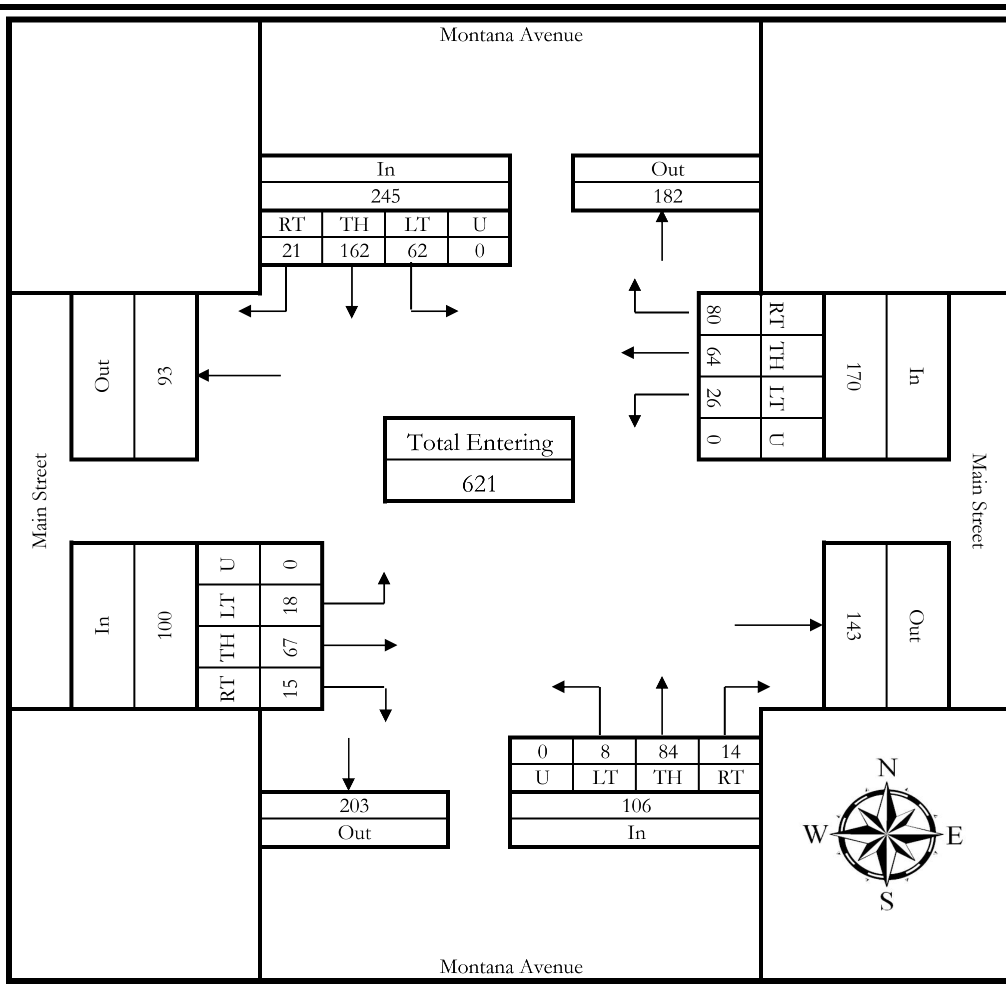
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Main Street & Montana Avenue
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Morning Peak Hour (7:30 - 8:30 AM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue	East/West Street:	Main Street

Vehicle Volumes and Adjustments

	Montana Avenue Southbound					Montana Avenue Northbound					Main Street Eastbound					Main Street Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		
7:30 AM	2	35	8	0	45	4	17	3	0	24	6	17	4	0	27	6	20	5	0	31	127
7:45 AM	8	51	20	0	79	3	27	2	0	32	3	21	7	0	31	38	15	12	0	65	207
8:00 AM	7	39	28	0	74	4	29	2	0	35	4	20	2	0	26	25	14	6	0	45	180
8:15 AM	4	37	6	0	47	3	11	1	0	15	2	9	5	0	16	11	15	3	0	29	107
Grand Total	21	162	62	0	245	14	84	8	0	106	15	67	18	0	100	80	64	26	0	170	621
Medium Truck %	0.0	0.0	4.8	0.0	1.2	0.0	1.2	0.0	0.0	0.9	0.0	1.5	5.6	0.0	2.0	2.5	0.0	0.0	0.0	1.2	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0	0.9	13.3	3.0	5.6	0.0	5.0	0.0	1.6	0.0	0.0	0.6	
Total Truck %	0.0	0.0	4.8	0.0	1.2	0.0	1.2	12.5	0.0	1.9	13.3	4.5	11.1	0.0	7.0	2.5	1.6	0.0	0.0	1.8	
Total %	3.4	26.1	10.0	0.0	39.5	2.3	13.5	1.3	0.0	17.1	2.4	10.8	2.9	0.0	16.1	12.9	10.3	4.2	0.0	27.4	100.0
PHF	0.77	0.77	0.77			0.84	0.84	0.84			0.80	0.80	0.80			0.65	0.65	0.65			0.75



SANDERSON STEWART

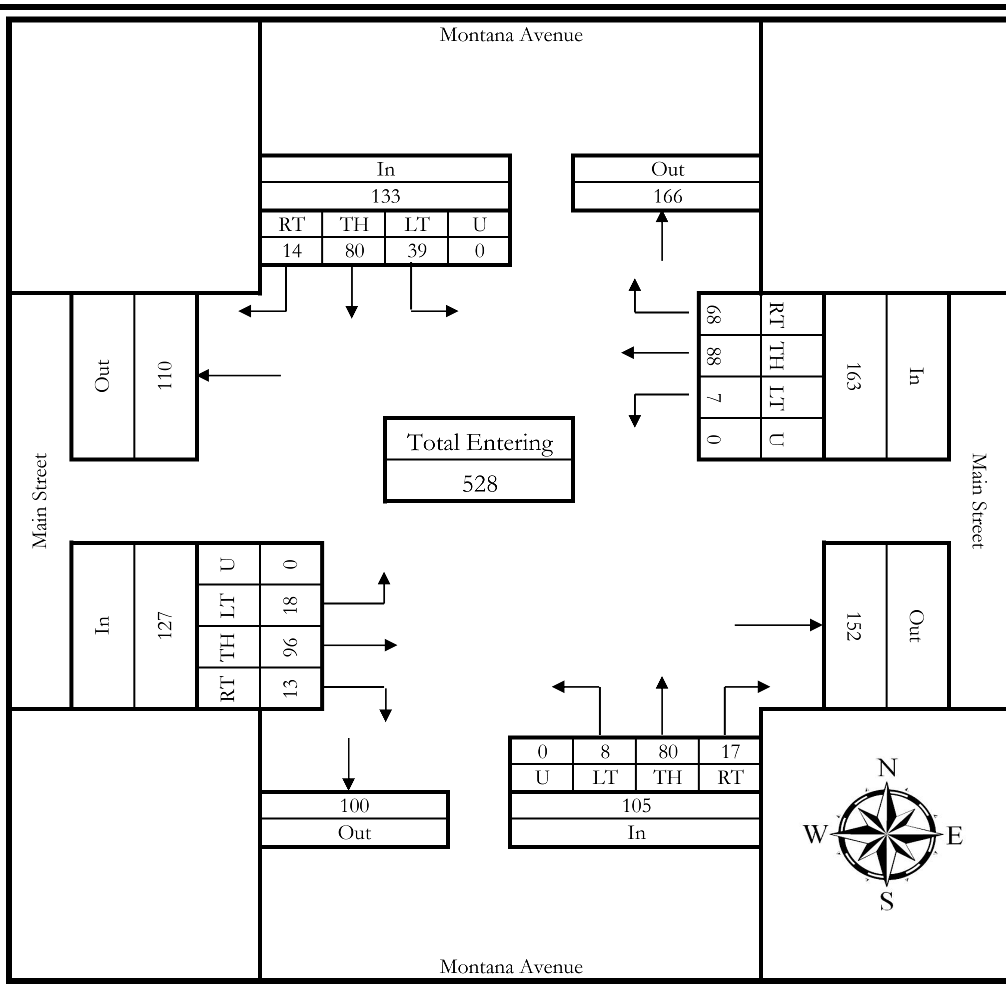
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Main Street & Montana Avenue
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	After School Peak Hour (2:45 - 3:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue	East/West Street:	Main Street

Vehicle Volumes and Adjustments

	Montana Avenue Southbound					Montana Avenue Northbound					Main Street Eastbound					Main Street Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		
2:45 PM	1	11	5	0	17	8	17	3	0	28	5	28	4	0	37	22	14	0	0	36	118
3:00 PM	2	17	4	0	23	2	20	2	0	24	3	22	6	0	31	19	25	2	0	46	124
3:15 PM	7	35	17	0	59	4	21	2	0	27	3	28	5	0	36	19	30	2	0	51	173
3:30 PM	4	17	13	0	34	3	22	1	0	26	2	18	3	0	23	8	19	3	0	30	113
Grand Total	14	80	39	0	133	17	80	8	0	105	13	96	18	0	127	68	88	7	0	163	528
Medium Truck %	0.0	0.0	2.6	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	1.6	4.4	2.3	0.0	0.0	3.1	
Heavy Truck %	7.1	0.0	0.0	0.0	0.8	0.0	3.8	12.5	0.0	3.8	7.7	3.1	0.0	0.0	3.1	0.0	1.1	0.0	0.0	0.6	
Total Truck %	7.1	0.0	2.6	0.0	1.5	0.0	3.8	12.5	0.0	3.8	7.7	5.2	0.0	0.0	4.7	4.4	3.4	0.0	0.0	3.7	
Total %	2.7	15.2	7.4	0.0	25.2	3.2	15.2	1.5	0.0	19.9	2.5	18.2	3.4	0.0	24.1	12.9	16.7	1.3	0.0	30.9	100.0
PHF	0.55	0.55	0.55			0.98	0.98	0.98			0.87	0.87	0.87			0.79	0.79	0.79			0.76



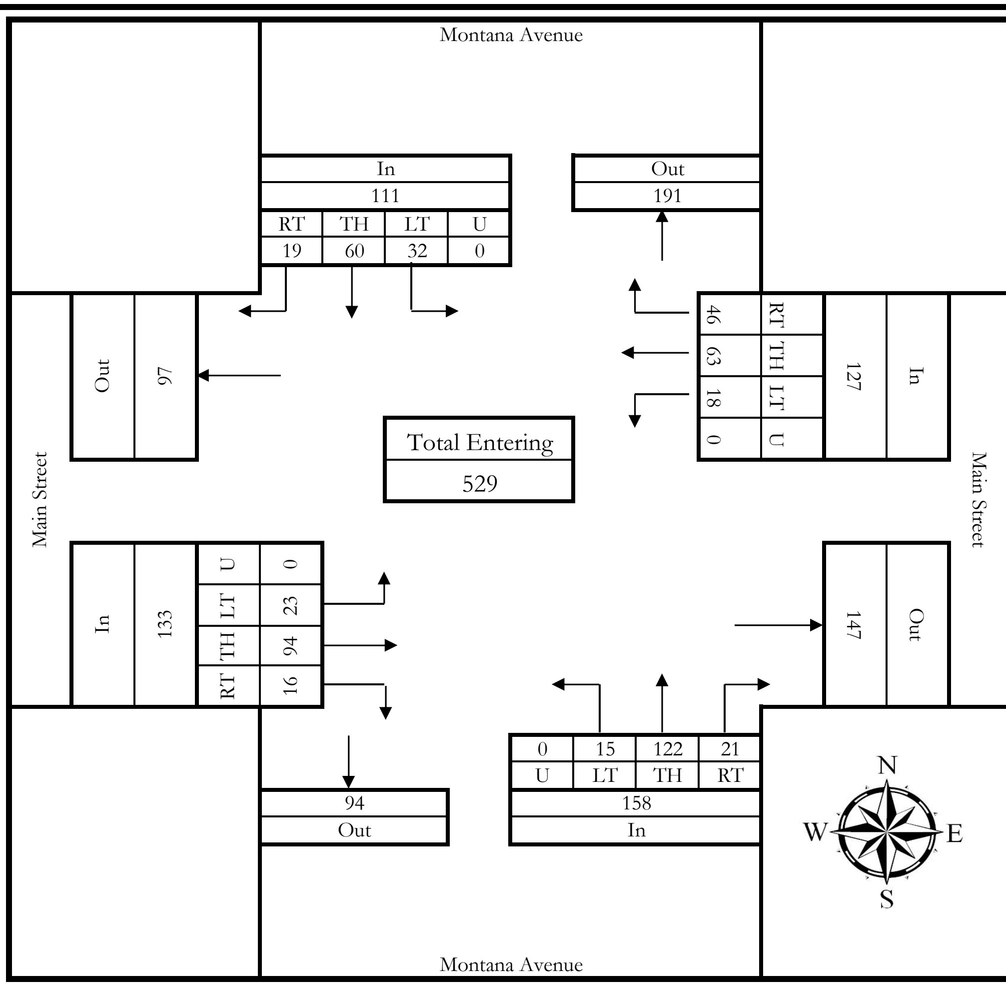
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Main Street & Montana Avenue
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Evening Peak Hour (4:45 - 5:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue	East/West Street:	Main Street

Vehicle Volumes and Adjustments

	Montana Avenue Southbound					Montana Avenue Northbound					Main Street Eastbound					Main Street Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		
4:45 PM	4	9	12	0	25	0	22	4	0	26	7	21	4	0	32	11	14	4	0	29	112
5:00 PM	5	17	5	0	27	8	37	4	0	49	1	33	8	0	42	11	21	2	0	34	152
5:15 PM	7	17	9	0	33	6	28	2	0	36	5	23	6	0	34	17	13	7	0	37	140
5:30 PM	3	17	6	0	26	7	35	5	0	47	3	17	5	0	25	7	15	5	0	27	125
Grand Total	19	60	32	0	111	21	122	15	0	158	16	94	23	0	133	46	63	18	0	127	529
Medium Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.0	1.9	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.8	
Total Truck %	0.0	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.0	1.9	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.8	
Total %	3.6	11.3	6.0	0.0	21.0	4.0	23.1	2.8	0.0	29.9	3.0	17.8	4.3	0.0	25.1	8.7	11.9	3.4	0.0	24.0	100.0
PHF	1.00	1.00	1.00			0.81	0.81	0.81			0.78	0.78	0.78			0.93	0.93	0.93			0.87

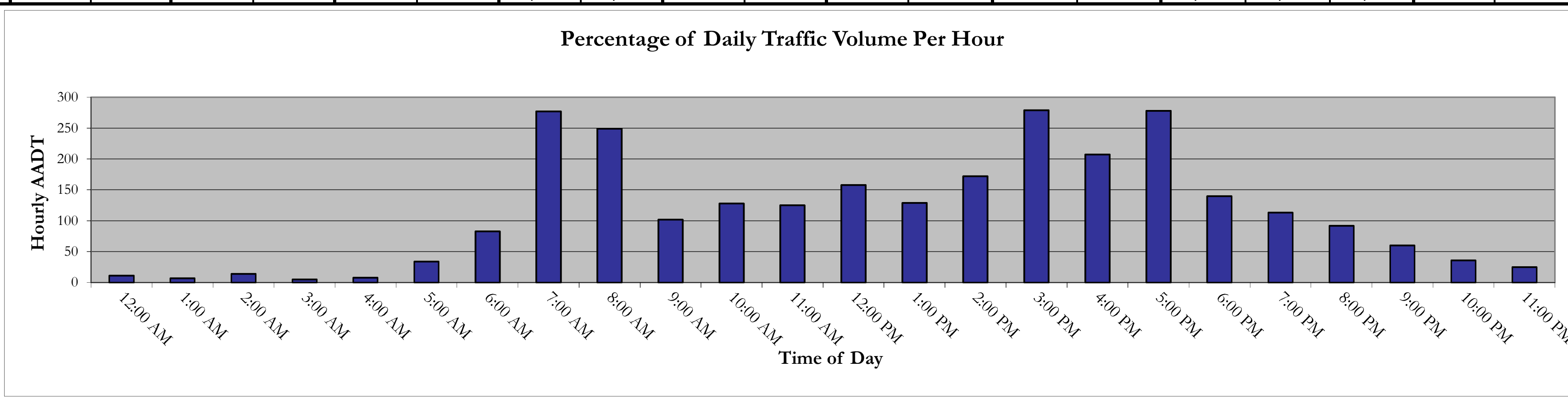


VOLUME COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Count Location:	Montana Avenue - north of Main Street
Agency/Company:	Sanderson Stewart		
Dates Performed:	4/3/2019	Jurisdiction:	City of East Helena
Project Number:	19011	Street Classification:	Rural Major Collector
Project Description:	East Helena Corridor Study		
		Seasonal Count Factor:	0.92

Hour	3/31/2019 Sunday		4/1/2019 Monday		4/2/2019 Tuesday		4/3/2019 Wednesday		4/4/2019 Thursday		4/5/2019 Friday		4/6/2019 Saturday		Annual Average Daily Traffic (AADT)			Hourly Percentage of Total (%)		
Begin	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	ADT	NB	SB	ADT
0:00							10	1							10	1	11	0.7%	0.1%	0.4%
1:00							6	1							6	1	7	0.4%	0.1%	0.3%
2:00							12	2							12	2	14	0.9%	0.2%	0.5%
3:00							2	3							2	3	5	0.1%	0.2%	0.2%
4:00							2	6							2	6	8	0.1%	0.5%	0.3%
5:00							6	28							6	28	34	0.4%	2.1%	1.2%
6:00							18	65							18	65	83	1.3%	4.9%	3.0%
7:00							118	159							118	159	277	8.4%	12.0%	10.1%
8:00							98	151							98	151	249	7.0%	11.4%	9.1%
9:00							47	55							47	55	102	3.3%	4.1%	3.7%
10:00							57	71							57	71	128	4.1%	5.3%	4.7%
11:00							62	63							62	63	125	4.4%	4.7%	4.6%
12:00							82	76							82	76	158	5.8%	5.7%	5.8%
13:00							66	63							66	63	129	4.7%	4.7%	4.7%
14:00							110	62							110	62	172	7.8%	4.7%	6.3%
15:00							142	137							142	137	279	10.1%	10.3%	10.2%
16:00							117	90							117	90	207	8.3%	6.8%	7.6%
17:00							174	104							174	104	278	12.4%	7.8%	10.2%
18:00							81	59							81	59	140	5.8%	4.4%	5.1%
19:00							62	51							62	51	113	4.4%	3.8%	4.1%
20:00							55	37							55	37	92	3.9%	2.8%	3.4%
21:00							36	24							36	24	60	2.6%	1.8%	2.2%
22:00							26	10							26	10	36	1.9%	0.8%	1.3%
23:00							15	10							15	10	25	1.1%	0.8%	0.9%
TOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**1,404**	**1,328**	**0**	**0**	**0**	**0**	**0**	**0**	**1,404**	**1,328**	**2,732**	**100.0%**	**100.0%**	**100.0%**

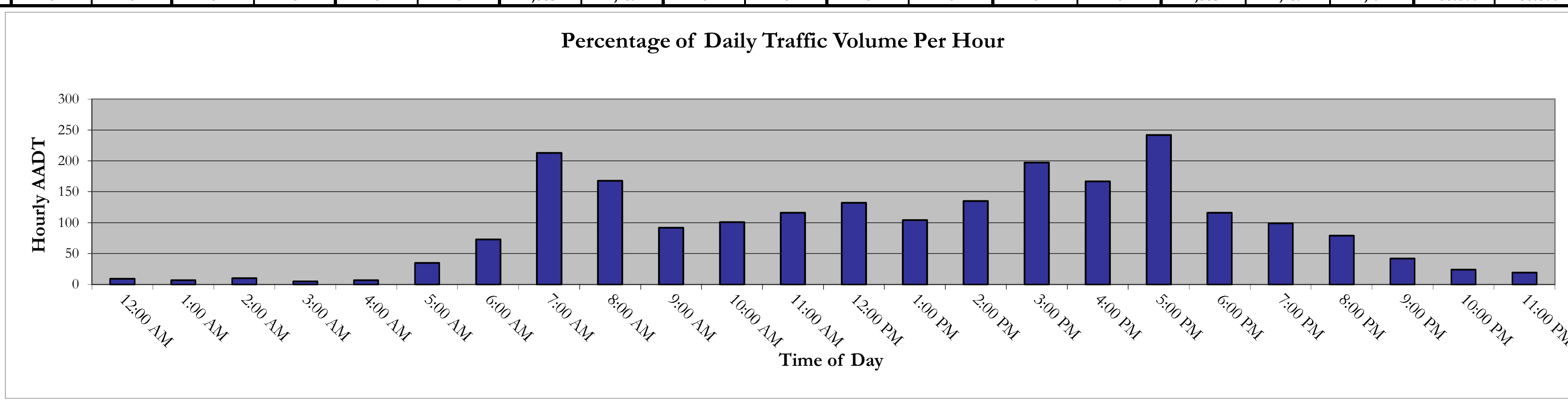


VOLUME COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Count Location:	Montana Avenue - south of Main Street
Agency/Company:	Sanderson Stewart		
Dates Performed:	4/3/2019	Jurisdiction:	City of East Helena
Project Number:	19011	Street Classification:	Rural Major Collector
Project Description:	East Helena Corridor Study		
		Seasonal Count Factor:	0.92

Hour	3/31/2019 Sunday		4/1/2019 Monday		4/2/2019 Tuesday		4/3/2019 Wednesday		4/4/2019 Thursday		4/5/2019 Friday		4/6/2019 Saturday		Annual Average Daily Traffic (AADT)			Hourly Percentage of Total (%)		
Begin	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	ADT	NB	SB	ADT
0:00							7	2							7	2	9	0.6%	0.2%	0.4%
1:00							6	1							6	1	7	0.6%	0.1%	0.3%
2:00							9	1							9	1	10	0.8%	0.1%	0.5%
3:00							2	3							2	3	5	0.2%	0.3%	0.2%
4:00							2	5							2	5	7	0.2%	0.5%	0.3%
5:00							6	29							6	29	35	0.6%	2.6%	1.6%
6:00							16	57							16	57	73	1.5%	5.1%	3.3%
7:00							67	146							67	146	213	6.2%	13.2%	9.7%
8:00							57	111							57	111	168	5.3%	10.0%	7.7%
9:00							39	53							39	53	92	3.6%	4.8%	4.2%
10:00							39	62							39	62	101	3.6%	5.6%	4.6%
11:00							49	67							49	67	116	4.5%	6.0%	5.3%
12:00							67	65							67	65	132	6.2%	5.9%	6.0%
13:00							56	48							56	48	104	5.2%	4.3%	4.7%
14:00							89	46							89	46	135	8.2%	4.1%	6.2%
15:00							97	100							97	100	197	9.0%	9.0%	9.0%
16:00							93	74							93	74	167	8.6%	6.7%	7.6%
17:00							151	91							151	91	242	13.9%	8.2%	11.0%
18:00							74	42							74	42	116	6.8%	3.8%	5.3%
19:00							60	39							60	39	99	5.5%	3.5%	4.5%
20:00							46	33							46	33	79	4.2%	3.0%	3.6%
21:00							25	17							25	17	42	2.3%	1.5%	1.9%
22:00							16	8							16	8	24	1.5%	0.7%	1.1%
23:00							10	9							10	9	19	0.9%	0.8%	0.9%
TOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**1,083**	**1,109**	**0**	**0**	**0**	**0**	**0**	**0**	**1,083**	**1,109**	**2,192**	**100.0%**	**100.0%**	**100.0%**



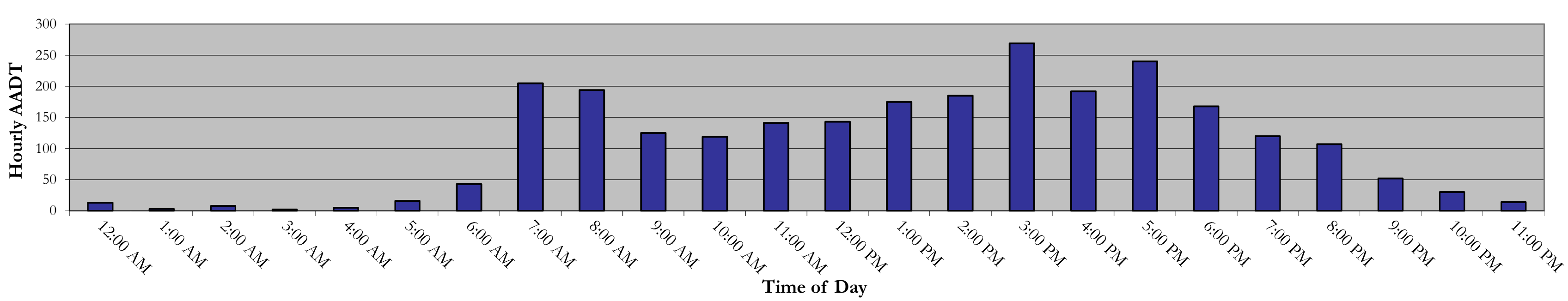
VOLUME COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Count Location:	Main St - east of Montana Avenue
Agency/Company:	Sanderson Stewart		
Dates Performed:	4/3/2019	Jurisdiction:	City of East Helena
Project Number:	19011	Street Classification:	Rural Major Collector
Project Description:	East Helena Corridor Study		
		Seasonal Count Factor:	0.92

Hour	3/31/2019 Sunday		4/1/2019 Monday		4/2/2019 Tuesday		4/3/2019 Wednesday		4/4/2019 Thursday		4/5/2019 Friday		4/6/2019 Saturday		Annual Average Daily Traffic (AADT)			Hourly Percentage of Total (%)		
Begin	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	ADT	EB	WB	ADT
0:00							7	6							7	6	13	0.5%	0.5%	0.5%
1:00							2	1							2	1	3	0.1%	0.1%	0.1%
2:00							4	4							4	4	8	0.3%	0.3%	0.3%
3:00							1	1							1	1	2	0.1%	0.1%	0.1%
4:00							4	1							4	1	5	0.3%	0.1%	0.2%
5:00							6	10							6	10	16	0.4%	0.8%	0.6%
6:00							16	27							16	27	43	1.2%	2.2%	1.7%
7:00							84	121							84	121	205	6.2%	9.9%	8.0%
8:00							95	99							95	99	194	7.0%	8.1%	7.6%
9:00							63	62							63	62	125	4.7%	5.1%	4.9%
10:00							57	62							57	62	119	4.2%	5.1%	4.6%
11:00							70	71							70	71	141	5.2%	5.8%	5.5%
12:00							80	63							80	63	143	5.9%	5.2%	5.6%
13:00							94	81							94	81	175	7.0%	6.6%	6.8%
14:00							102	83							102	83	185	7.6%	6.8%	7.2%
15:00							135	134							135	134	269	10.0%	11.0%	10.5%
16:00							112	80							112	80	192	8.3%	6.6%	7.5%
17:00							130	110							130	110	240	9.6%	9.0%	9.3%
18:00							96	72							96	72	168	7.1%	5.9%	6.5%
19:00							73	47							73	47	120	5.4%	3.9%	4.7%
20:00							60	47							60	47	107	4.4%	3.9%	4.2%
21:00							32	20							32	20	52	2.4%	1.6%	2.0%
22:00							18	12							18	12	30	1.3%	1.0%	1.2%
23:00							8	6							8	6	14	0.6%	0.5%	0.5%
TOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**1,349**	**1,220**	**0**	**0**	**0**	**0**	**0**	**0**	**1,349**	**1,220**	**2,569**	**100.0%**	**100.0%**	**100.0%**

Percentage of Daily Traffic Volume Per Hour

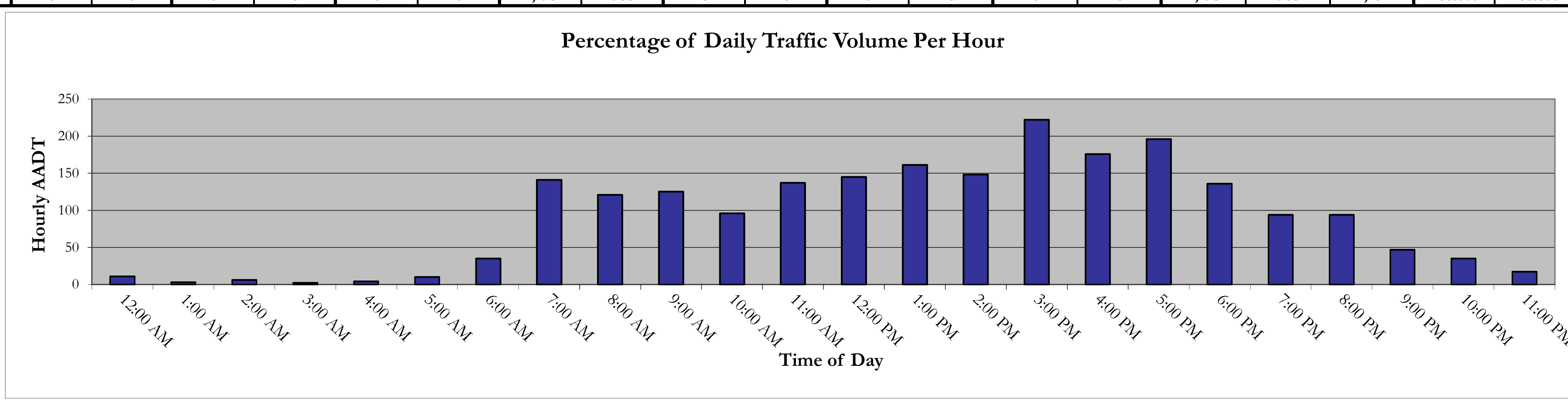


VOLUME COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Count Location:	Main St - west of Montana Avenue
Agency/Company:	Sanderson Stewart		
Dates Performed:	4/3/2019	Jurisdiction:	City of East Helena
Project Number:	19011	Street Classification:	Rural Major Collector
Project Description:	East Helena Corridor Study		
		Seasonal Count Factor:	0.92

Hour Begin	3/31/2019 Sunday		4/1/2019 Monday		4/2/2019 Tuesday		4/3/2019 Wednesday		4/4/2019 Thursday		4/5/2019 Friday		4/6/2019 Saturday		Annual Average Daily Traffic (AADT)			Hourly Percentage of Total (%)		
	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	ADT	EB	WB	ADT
0:00							8	3							8	3	11	0.7%	0.3%	0.5%
1:00							2	1							2	1	3	0.2%	0.1%	0.1%
2:00							4	2							4	2	6	0.3%	0.2%	0.3%
3:00							1	1							1	1	2	0.1%	0.1%	0.1%
4:00							3	1							3	1	4	0.3%	0.1%	0.2%
5:00							4	6							4	6	10	0.3%	0.6%	0.5%
6:00							9	26							9	26	35	0.8%	2.7%	1.6%
7:00							71	70							71	70	141	5.9%	7.2%	6.5%
8:00							59	62							59	62	121	4.9%	6.4%	5.6%
9:00							66	59							66	59	125	5.5%	6.1%	5.8%
10:00							50	46							50	46	96	4.2%	4.8%	4.4%
11:00							76	61							76	61	137	6.4%	6.3%	6.3%
12:00							83	62							83	62	145	6.9%	6.4%	6.7%
13:00							84	77							84	77	161	7.0%	8.0%	7.4%
14:00							86	62							86	62	148	7.2%	6.4%	6.8%
15:00							116	106							116	106	222	9.7%	11.0%	10.3%
16:00							108	68							108	68	176	9.0%	7.0%	8.1%
17:00							113	83							113	83	196	9.4%	8.6%	9.1%
18:00							75	61							75	61	136	6.3%	6.3%	6.3%
19:00							55	39							55	39	94	4.6%	4.0%	4.3%
20:00							56	38							56	38	94	4.7%	3.9%	4.3%
21:00							31	16							31	16	47	2.6%	1.7%	2.2%
22:00							25	10							25	10	35	2.1%	1.0%	1.6%
23:00							11	6							11	6	17	0.9%	0.6%	0.8%
TOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**1,196**	**966**	**0**	**0**	**0**	**0**	**0**	**0**	**1,196**	**966**	**2,162**	**100.0%**	**100.0%**	**100.0%**



SANDERSON STEWART

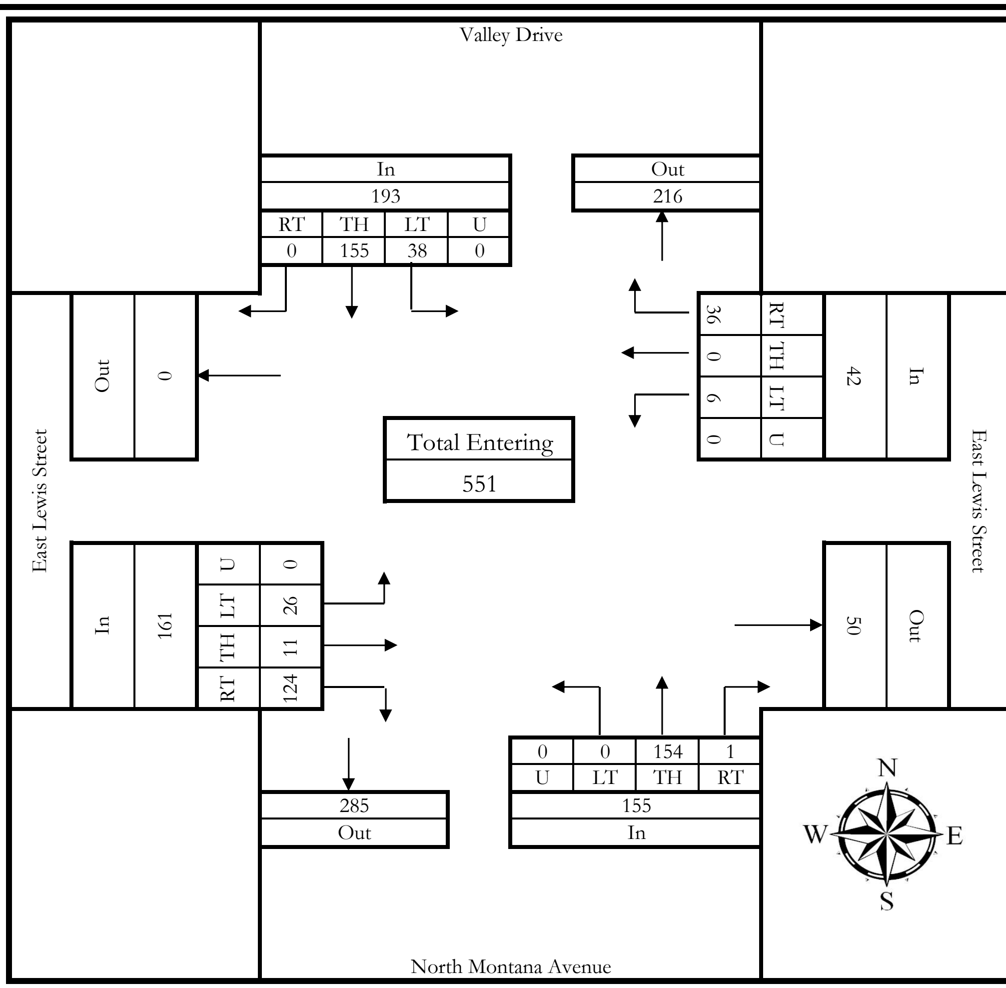
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Montana Avenue/Valley Drive & Lewis Street
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Morning Peak Hour (7:30 - 8:30 AM)		
Project Number:	19011.	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue/Valley Drive	East/West Street:	East Lewis Street

Vehicle Volumes and Adjustments

	Valley Drive Southbound					North Montana Avenue Northbound					East Lewis Street Eastbound					East Lewis Street Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
7:30 AM	0	49	11	0	60	0	23	0	0	23	14	6	2	0	22	9	0	1	0	10	115
7:45 AM	0	45	19	0	64	0	55	0	0	55	46	3	5	0	54	18	0	2	0	20	193
8:00 AM	0	38	6	0	44	0	60	0	0	60	53	1	16	0	70	9	0	0	0	9	183
8:15 AM	0	23	2	0	25	1	16	0	0	17	11	1	3	0	15	0	0	3	0	3	60
Grand Total	0	155	38	0	193	1	154	0	0	155	124	11	26	0	161	36	0	6	0	42	551
Medium Truck %	0.0	4.5	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	2.4	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Truck %	0.0	4.5	0.0	0.0	3.6	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	2.4	
Total %	0.0	28.1	6.9	0.0	35.0	0.2	27.9	0.0	0.0	28.1	22.5	2.0	4.7	0.0	29.2	6.5	0.0	1.1	0.0	7.6	100.0
PHF	0.75	0.75	0.75			0.70	0.70	0.70			0.75	0.75	0.75			0.53	0.53	0.53			0.71



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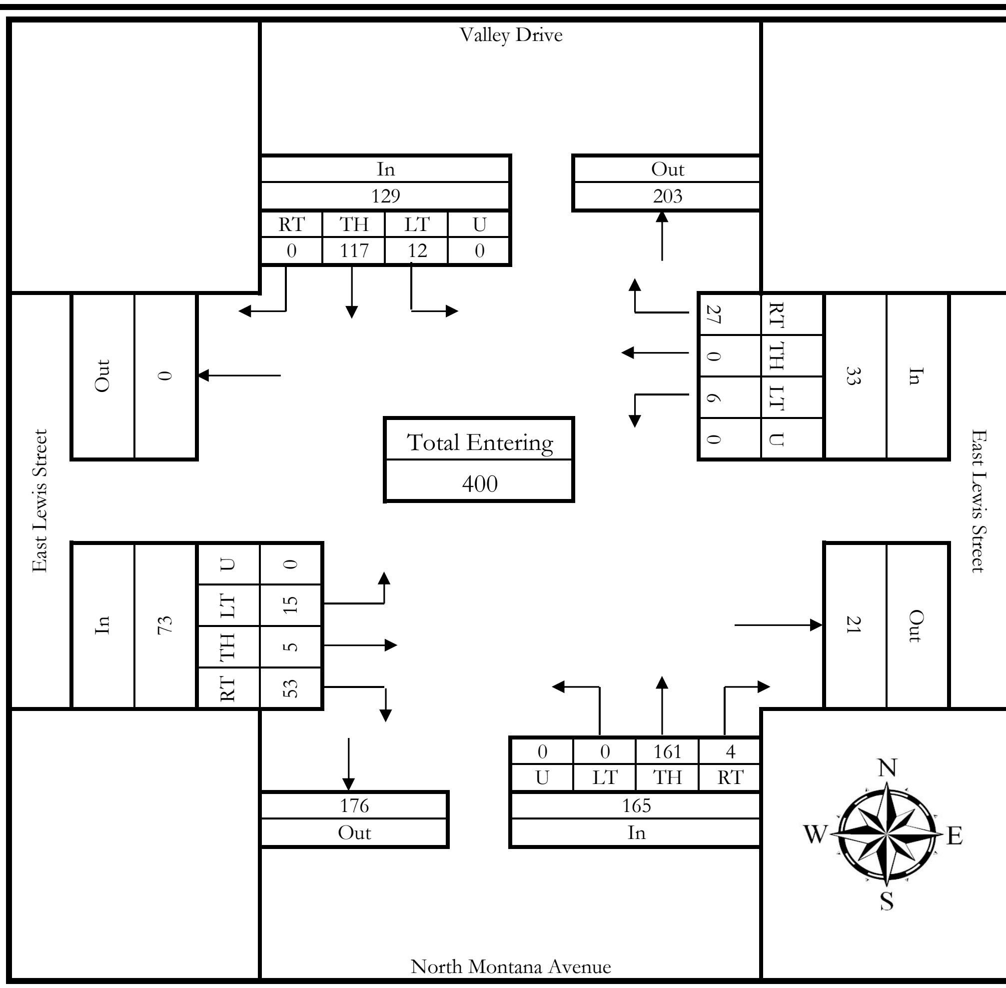
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Montana Avenue/Valley Drive & Lewis Street
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	After School Peak Hour (2:45 - 3:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue/Valley Drive	East/West Street:	East Lewis Street

Vehicle Volumes and Adjustments

	Valley Drive Southbound					North Montana Avenue Northbound					East Lewis Street Eastbound					East Lewis Street Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
2:45 PM	0	24	3	0	27	1	35	0	0	36	1	0	0	0	1	1	0	1	0	2	66
3:00 PM	0	26	5	0	31	2	33	0	0	35	14	2	2	0	18	10	0	1	0	11	95
3:15 PM	0	37	3	0	40	1	63	0	0	64	30	3	12	0	45	13	0	3	0	16	165
3:30 PM	0	30	1	0	31	0	30	0	0	30	8	0	1	0	9	3	0	1	0	4	74
Grand Total	0	117	12	0	129	4	161	0	0	165	53	5	15	0	73	27	0	6	0	33	400
Medium Truck %	0.0	4.3	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	3.0	
Total Truck %	0.0	4.3	0.0	0.0	3.9	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	3.0	
Total %	0.0	29.3	3.0	0.0	32.3	1.0	40.3	0.0	0.0	41.3	13.3	1.3	3.8	0.0	18.3	6.8	0.0	1.5	0.0	8.3	100.0
PHF	0.81	0.81	0.81			0.64	0.64	0.64			0.41	0.41	0.41			0.52	0.52	0.52			0.61



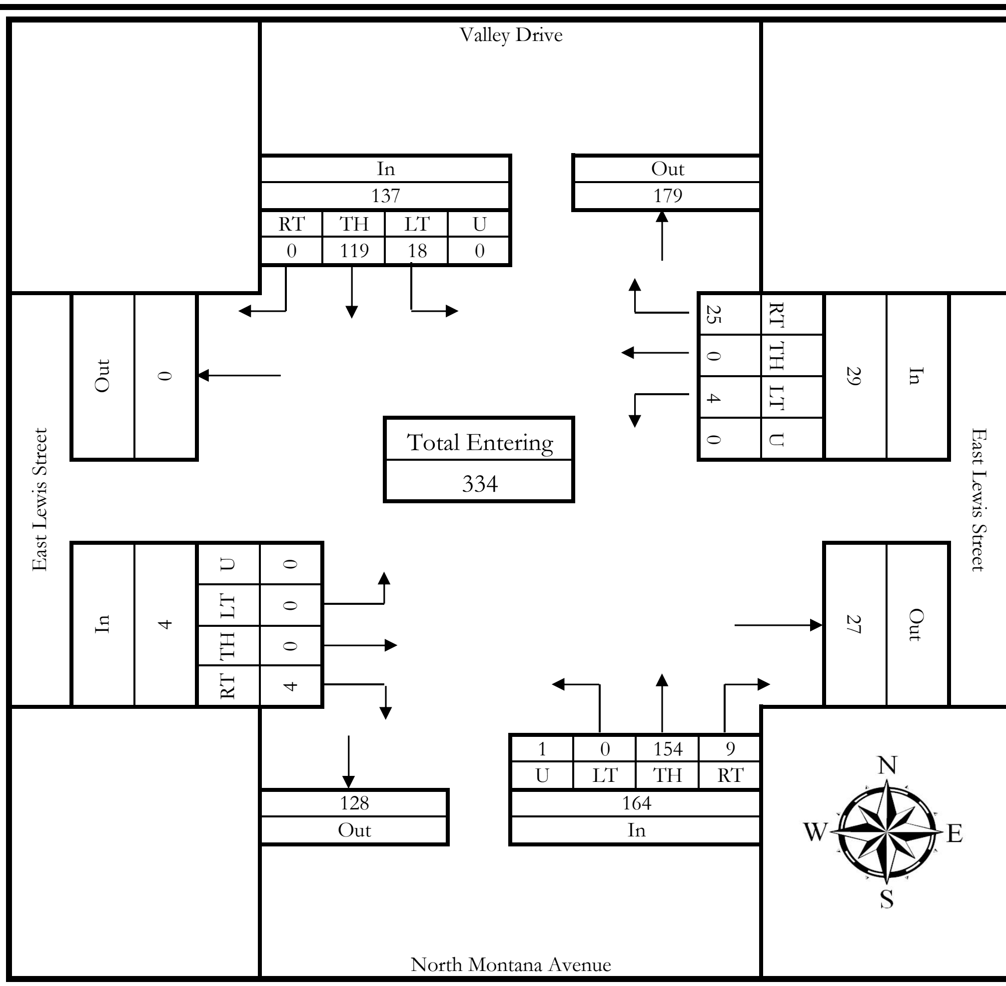
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Montana Avenue/Valley Drive & Lewis Street
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Evening Peak Hour (4:45 - 5:45 PM)		
Project Number:	19011.	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Montana Avenue/Valley Drive	East/West Street:	East Lewis Street

Vehicle Volumes and Adjustments

	Valley Drive Southbound					North Montana Avenue Northbound					East Lewis Street Eastbound					East Lewis Street Westbound					Int. Total
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
4:45 PM	0	30	7	0	37	1	28	0	0	29	1	0	0	0	1	5	0	0	0	5	72
5:00 PM	0	23	5	0	28	5	50	0	0	55	0	0	0	0	0	14	0	2	0	16	99
5:15 PM	0	41	2	0	43	0	40	0	0	40	3	0	0	0	3	0	0	1	0	1	87
5:30 PM	0	25	4	0	29	3	36	0	1	40	0	0	0	0	0	6	0	1	0	7	76
Grand Total	0	119	18	0	137	9	154	0	1	164	4	0	0	0	4	25	0	4	0	29	334
Medium Truck %	0.0	2.5	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Truck %	0.0	2.5	0.0	0.0	2.2	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	35.6	5.4	0.0	41.0	2.7	46.1	0.0	0.3	49.1	1.2	0.0	0.0	0.0	1.2	7.5	0.0	1.2	0.0	8.7	100.0
PHF	1.00	1.00	1.00			0.74	0.74	0.74			1.00	1.00	1.00			0.45	0.45	0.45			0.85



SANDERSON STEWART

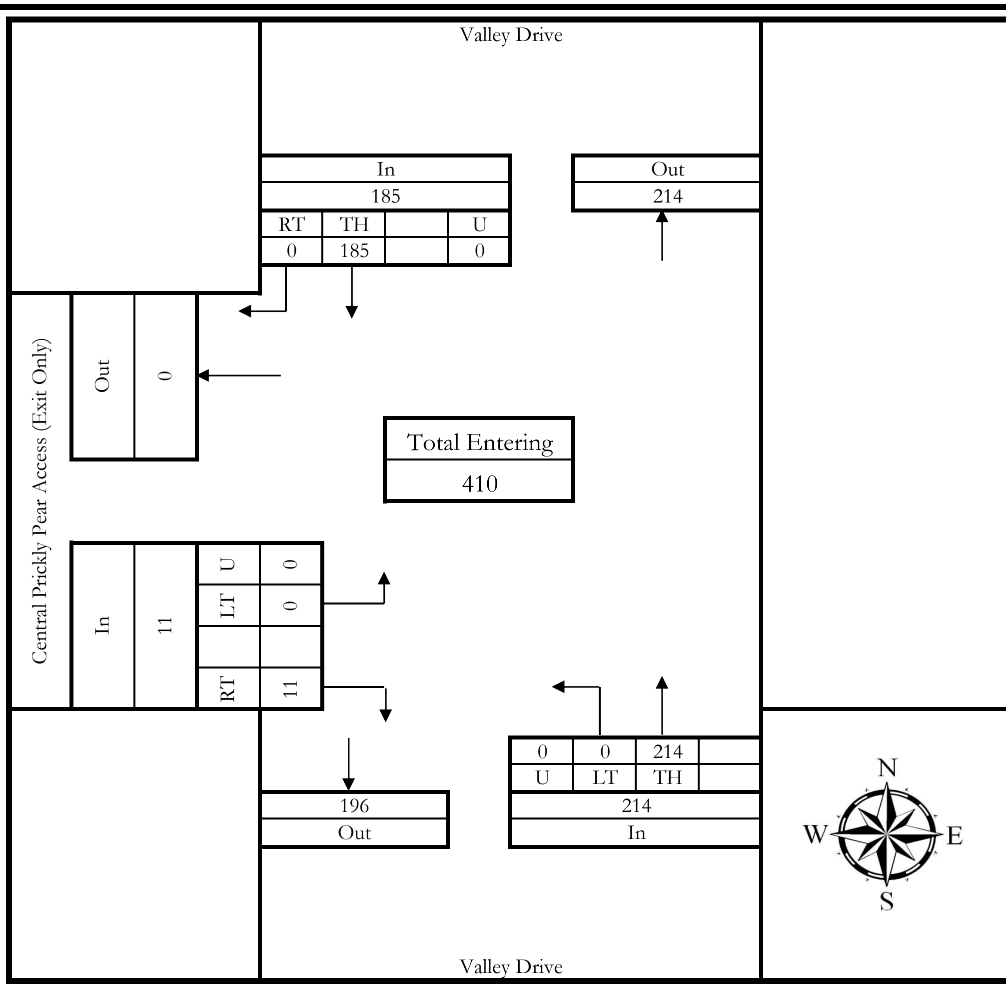
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Valley Drive & Central Prickly Pear Access (Exit Only)
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Morning Peak Hour (7:30 - 8:30 AM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Valley Drive	East/West Street:	Central Prickly Pear Access (Exit Only)

Vehicle Volumes and Adjustments

	Valley Drive Southbound					Valley Drive Northbound					Central Prickly Pear Access (Exit Only) Eastbound					Central Prickly Pear Access (Exit Only) Westbound					Int. Total
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
7:30 AM	0	57	0	0	57	0	30	0	0	30	1	0	0	0	1					0	88
7:45 AM	0	57	0	0	57	0	73	0	0	73	6	0	0	0	6					0	136
8:00 AM	0	47	0	0	47	0	87	0	0	87	1	0	0	0	1					0	135
8:15 AM	0	24	0	0	24	0	24	0	0	24	3	0	0	0	3					0	51
Grand Total	0	185	0	0	185	0	214	0	0	214	11	0	0	0	11	0	0	0	0	0	410
Medium Truck %	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	54.5	0.0	0.0	0.0	54.5					0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0					0.0	
Total Truck %	0.0	0.5	0.0	0.0	0.5	0.0	0.9	0.0	0.0	0.9	54.5	0.0	0.0	0.0	54.5					0.0	
Total %	0.0	45.1	0.0	0.0	45.1	0.0	52.2	0.0	0.0	52.2	2.7	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	100.0
PHF	0.81	0.81	0.81			0.74	0.74	0.74			0.46	0.46	0.46								0.76



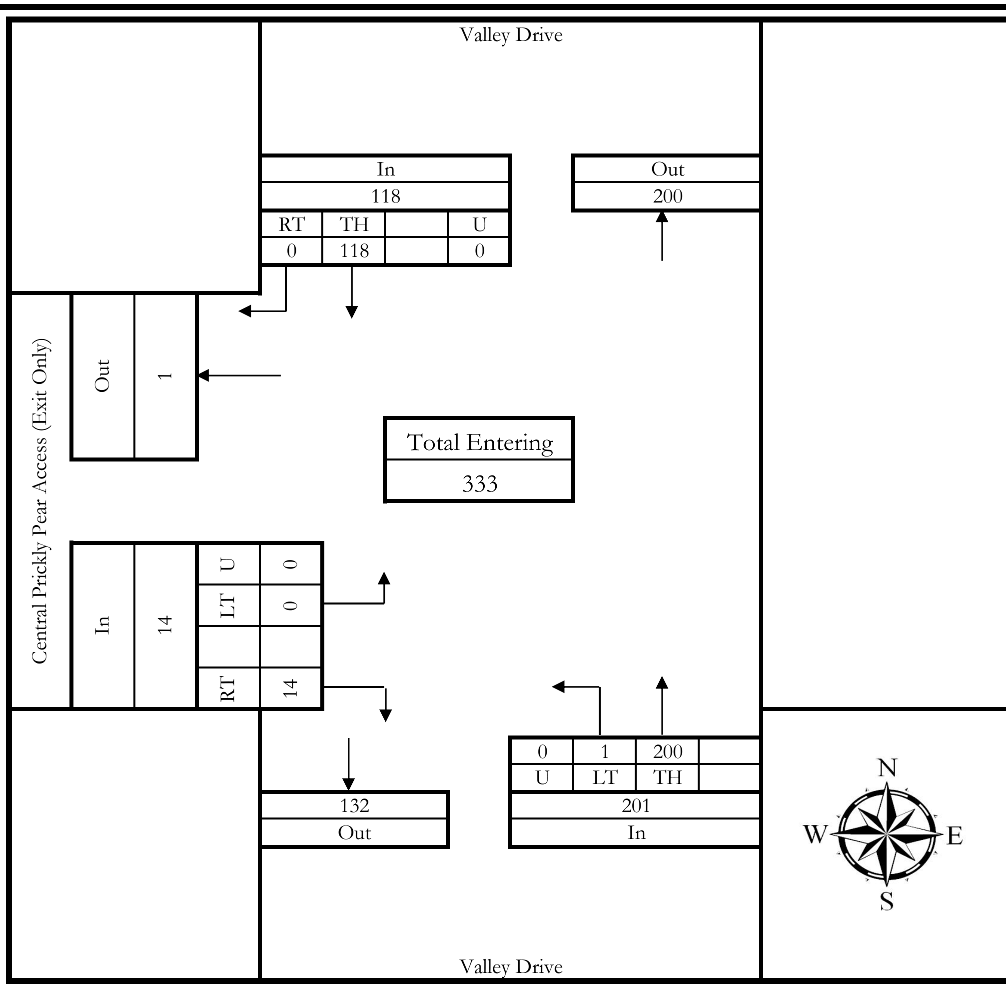
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Valley Drive & Central Prickly Pear Access (Exit Only)
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	After School Peak Hour (2:45 - 3:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Valley Drive	East/West Street:	Central Prickly Pear Access (Exit Only)

Vehicle Volumes and Adjustments

	Valley Drive Southbound					Valley Drive Northbound					Central Prickly Pear Access (Exit Only) Eastbound					Central Prickly Pear Access (Exit Only) Westbound					Int. Total
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
2:45 PM	0	24	0	0	24	0	33	1	0	34	1	0	0	0	1					0	59
3:00 PM	0	28	0	0	28	0	42	0	0	42	2	0	0	0	2					0	72
3:15 PM	0	40	0	0	40	0	89	0	0	89	8	0	0	0	8					0	137
3:30 PM	0	26	0	0	26	0	36	0	0	36	3	0	0	0	3					0	65
Grand Total	0	118	0	0	118	0	200	1	0	201	14	0	0	0	14	0	0	0	0	0	333
Medium Truck %	0.0	0.8	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	28.6	0.0	0.0	0.0	28.6					0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0					0.0	
Total Truck %	0.0	0.8	0.0	0.0	0.8	0.0	1.0	0.0	0.0	1.0	28.6	0.0	0.0	0.0	28.6					0.0	
Total %	0.0	35.4	0.0	0.0	35.4	0.0	60.1	0.3	0.0	60.4	4.2	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	100.0
PHF	0.73	0.73	0.73			0.56	0.56	0.56			0.44	0.44	0.44								0.61



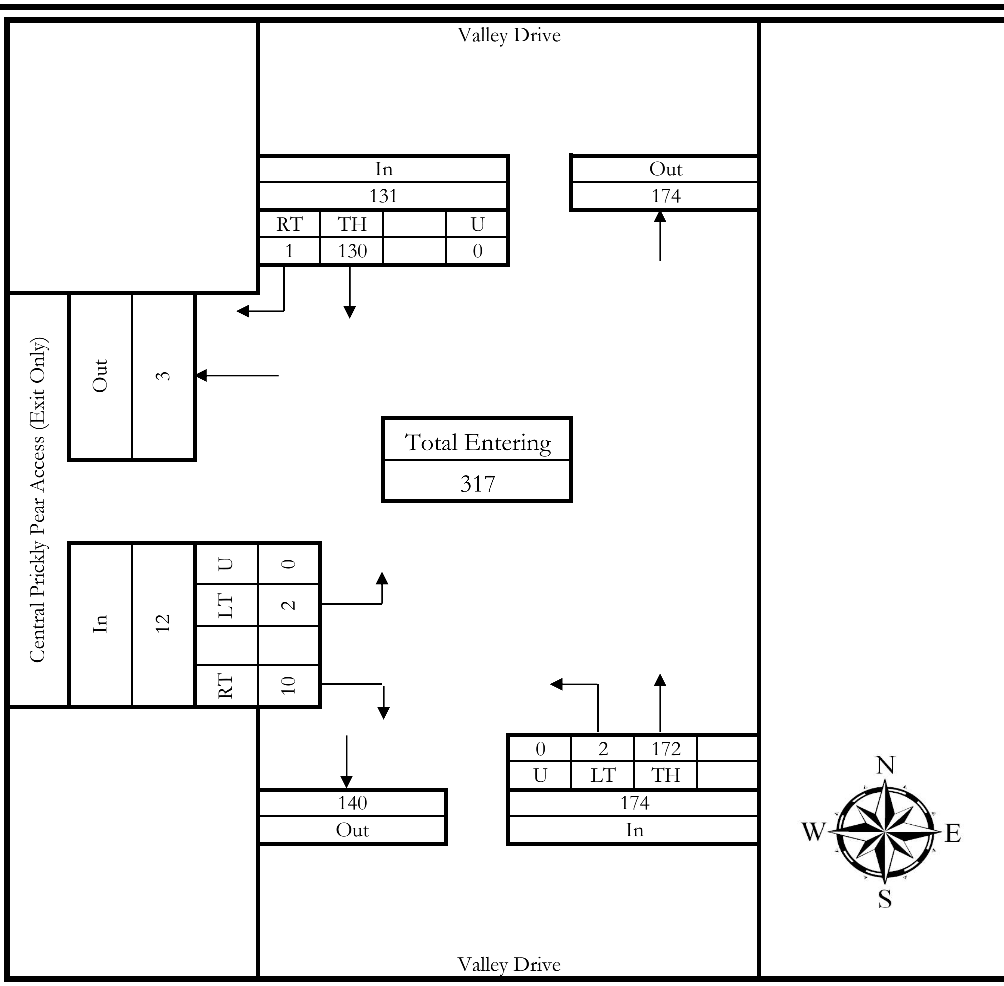
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Valley Drive & Central Prickly Pear Access (Exit Only)
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Evening Peak Hour (4:45 - 5:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Valley Drive	East/West Street:	Central Prickly Pear Access (Exit Only)

Vehicle Volumes and Adjustments

	Valley Drive Southbound					Valley Drive Northbound					entral Prickly Pear Access (Exit Only Eastbound					entral Prickly Pear Access (Exit Only Westbound					Int. Total
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
4:45 PM	0	38	0	0	38	0	33	0	0	33	3	0	0	0	3					0	74
5:00 PM	1	25	0	0	26	0	55	1	0	56	5	0	1	0	6					0	88
5:15 PM	0	40	0	0	40	0	44	0	0	44	2	0	1	0	3					0	87
5:30 PM	0	27	0	0	27	0	40	1	0	41	0	0	0	0	0					0	68
Grand Total	1	130	0	0	131	0	172	2	0	174	10	0	2	0	12	0	0	0	0	0	317
Medium Truck %	0.0	0.8	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	16.7					0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0					0.0	
Total Truck %	0.0	0.8	0.0	0.0	0.8	0.0	0.6	0.0	0.0	0.6	20.0	0.0	0.0	0.0	16.7					0.0	
Total %	0.3	41.0	0.0	0.0	41.3	0.0	54.3	0.6	0.0	54.9	3.2	0.0	0.6	0.0	3.8	0.0	0.0	0.0	0.0	0.0	100.0
PHF	0.81	0.81	0.81			0.99	0.99	0.99			1.00	1.00	1.00								0.91



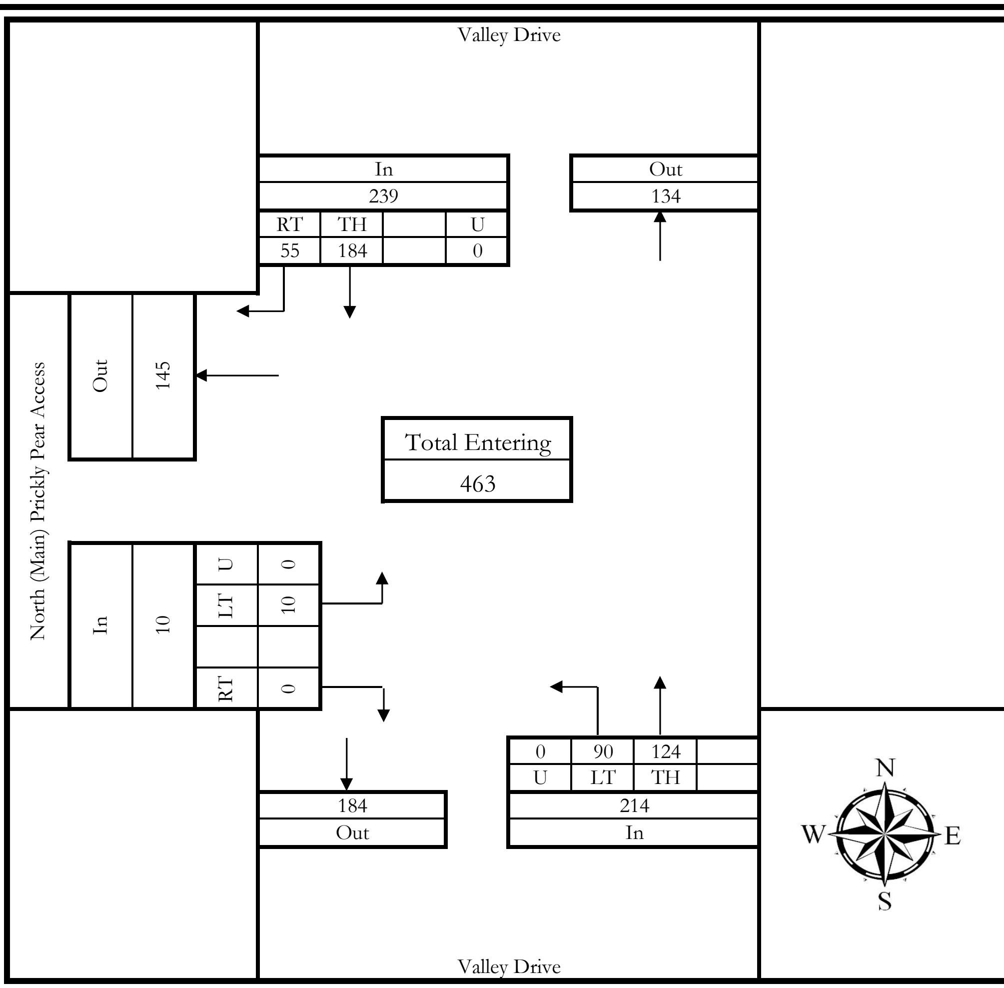
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Valley Drive & North (Main) Prickly Pear Access
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Morning Peak Hour (7:30 - 8:30 AM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Valley Drive	East/West Street:	North (Main) Prickly Pear Access

Vehicle Volumes and Adjustments

	Valley Drive Southbound					Valley Drive Northbound					North (Main) Prickly Pear Access Eastbound					North (Main) Prickly Pear Access Westbound					Int. Total
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
7:30 AM	17	59	0	0	76	0	21	8	0	29	0	0	0	0	0					0	105
7:45 AM	18	56	0	0	74	0	37	37	0	74	0	0	4	0	4					0	152
8:00 AM	15	46	0	0	61	0	46	39	0	85	0	0	0	0	0					0	146
8:15 AM	5	23	0	0	28	0	20	6	0	26	0	0	6	0	6					0	60
Grand Total	55	184	0	0	239	0	124	90	0	214	0	0	10	0	10	0	0	0	0	0	463
Medium Truck %	0.0	0.5	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.5	0.0	0.0	0.0	0.0	0.0					0.0	
Total Truck %	0.0	0.5	0.0	0.0	0.4	0.0	0.0	1.1	0.0	0.5	0.0	0.0	0.0	0.0	0.0					0.0	
Total %	11.9	39.7	0.0	0.0	51.6	0.0	26.8	19.4	0.0	46.2	0.0	0.0	2.2	0.0	2.2	0.0	0.0	0.0	0.0	0.0	100.0
PHF	0.80	0.80	0.80			0.73	0.73	0.73			0.63	0.63	0.63								0.76



SANDERSON STEWART

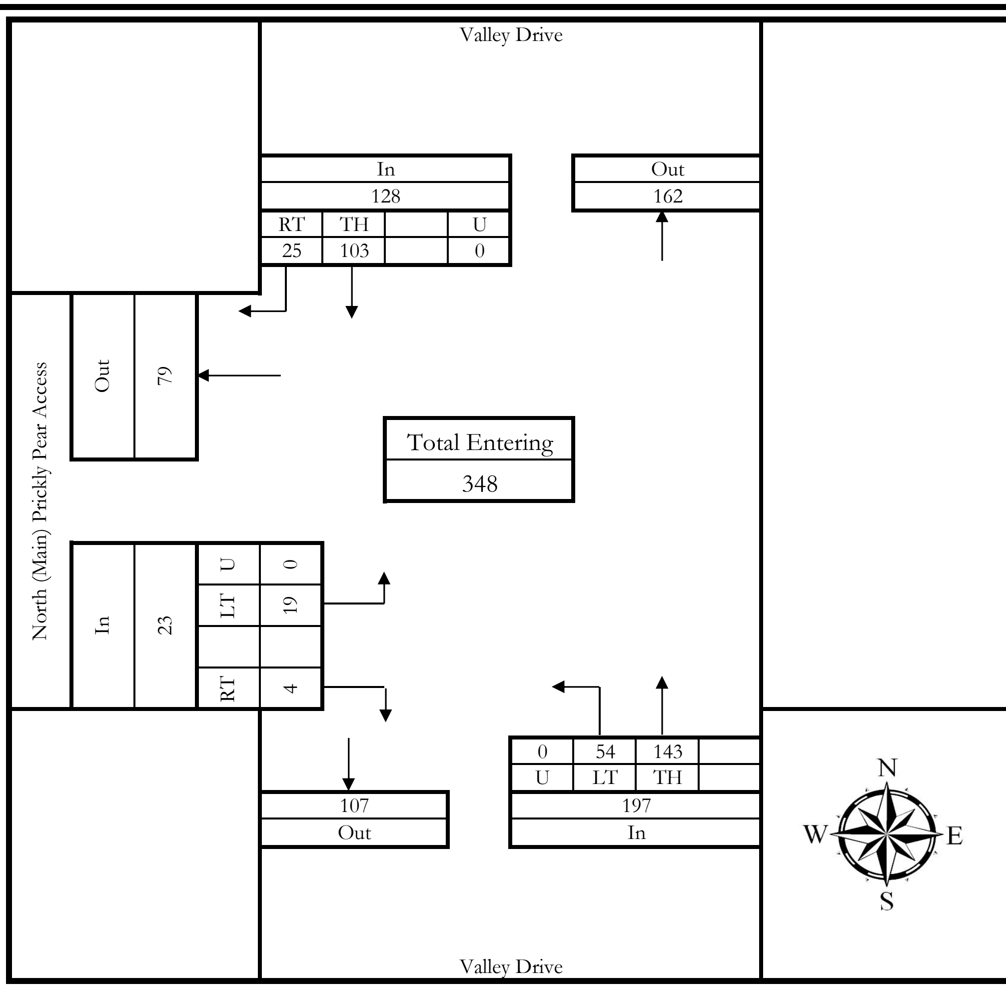
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Valley Drive & North (Main) Prickly Pear Access
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	After School Peak Hour (2:45 - 3:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Valley Drive	East/West Street:	North (Main) Prickly Pear Access

Vehicle Volumes and Adjustments

	Valley Drive Southbound					Valley Drive Northbound					North (Main) Prickly Pear Access Eastbound					North (Main) Prickly Pear Access Westbound					Int.
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Total
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
2:45 PM	6	21	0	0	27	0	23	9	0	32	0	0	0	0	0					0	59
3:00 PM	12	25	0	0	37	0	18	23	0	41	0	0	0	0	0					0	78
3:15 PM	6	31	0	0	37	0	69	19	0	88	3	0	13	0	16					0	141
3:30 PM	1	26	0	0	27	0	33	3	0	36	1	0	6	0	7					0	70
Grand Total	25	103	0	0	128	0	143	54	0	197	4	0	19	0	23	0	0	0	0	0	348
Medium Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0					0.0	
Total Truck %	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0					0.0	
Total %	7.2	29.6	0.0	0.0	36.8	0.0	41.1	15.5	0.0	56.6	1.1	0.0	5.5	0.0	6.6	0.0	0.0	0.0	0.0	0.0	100.0
PHF	0.87	0.87	0.87			0.56	0.56	0.56			0.36	0.36	0.36								0.62



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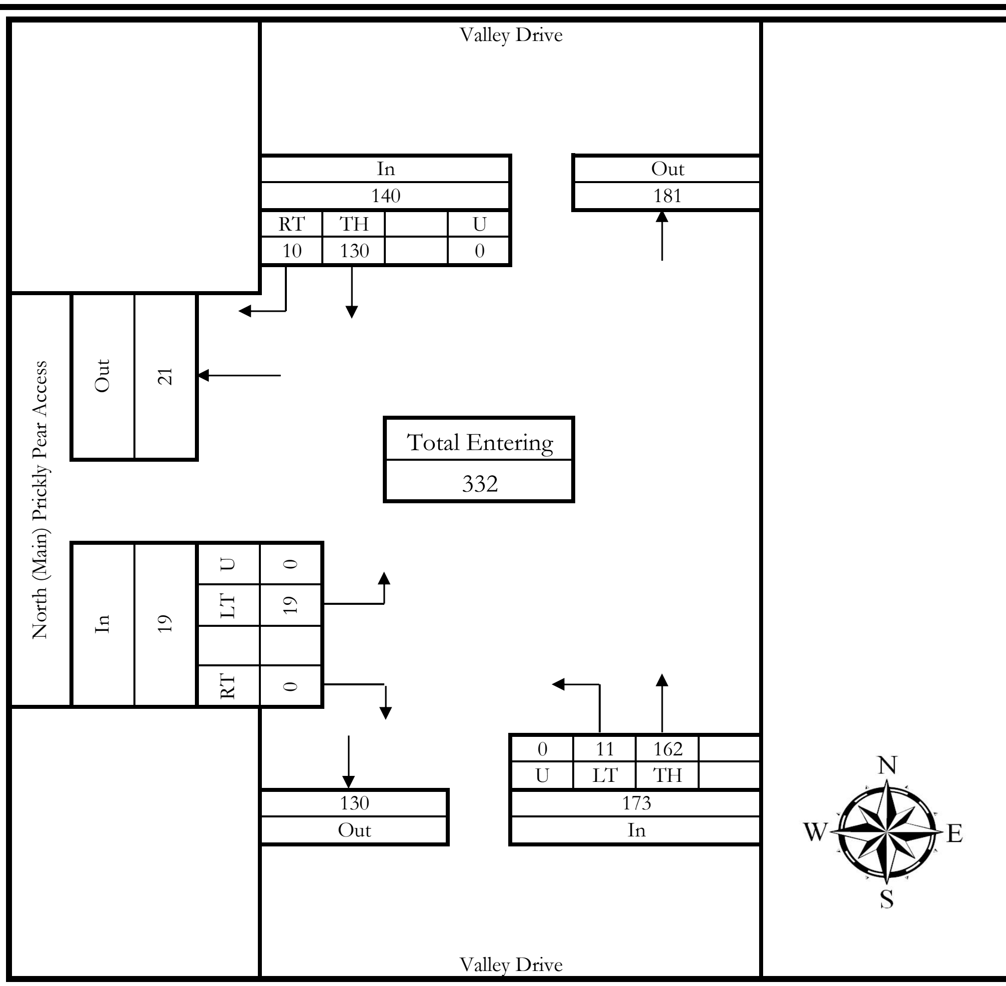
INTERSECTION TURNING MOVEMENT COUNT SUMMARY

General Information

Counted By:	Andrew Johnson	Intersection:	Valley Drive & North (Main) Prickly Pear Access
Agency/Company:	Sanderson Stewart		
Date Performed:	Wednesday, April 3, 2019	Jurisdiction:	City of East Helena/MDT
Count Time Period:	Evening Peak Hour (4:45 - 5:45 PM)		
Project Number:	19011	Project Description:	Montana Ave/Valley Dr Corridor Study
North/South Street:	Valley Drive	East/West Street:	North (Main) Prickly Pear Access

Vehicle Volumes and Adjustments

	Valley Drive Southbound					Valley Drive Northbound					North (Main) Prickly Pear Access Eastbound					North (Main) Prickly Pear Access Westbound					Int. Total
Start Time	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	Right	Thru	Left	U-turn	Total	
Factor	0.92	0.92	0.92	0.92		0.92	0.92	0.92	0.92		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		
4:45 PM	5	38	0	0	43	0	30	3	0	33	0	0	4	0	4					0	80
5:00 PM	3	24	0	0	27	0	51	5	0	56	0	0	7	0	7					0	90
5:15 PM	2	41	0	0	43	0	41	3	0	44	0	0	7	0	7					0	94
5:30 PM	0	27	0	0	27	0	40	0	0	40	0	0	1	0	1					0	68
Grand Total	10	130	0	0	140	0	162	11	0	173	0	0	19	0	19	0	0	0	0	0	332
Medium Truck %	0.0	0.8	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					0.0	
Heavy Truck %	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0					0.0	
Total Truck %	0.0	0.8	0.0	0.0	0.7	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0					0.0	
Total %	3.0	39.2	0.0	0.0	42.2	0.0	48.8	3.3	0.0	52.1	0.0	0.0	5.7	0.0	5.7	0.0	0.0	0.0	0.0	0.0	100.0
PHF	0.80	0.80	0.80			0.98	0.98	0.98			0.68	0.68	0.68								0.88



CAPACITY CALCULATIONS – EXISTING CONDITIONS (2019)

APPENDIX F

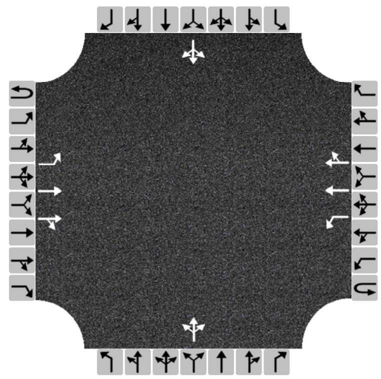
ENDURING COMMUNITY DESIGN

SANDERSON STEWART

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	US 12 & S Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	US Hwy 12
Analysis Year	2019	North/South Street	S Montana Avenue
Time Analyzed	AM Peak	Peak Hour Factor	0.89
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	T	TR		L	T	TR			LTR				LTR	
Volume, V (veh/h)		86	212	0		0	746	14		0	0	0		8	0	208
Percent Heavy Vehicles (%)		1				0				0	0	0		0	0	1
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.12				4.10				7.50	6.50	6.90		6.80	6.50	6.92
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)		2.21				2.20				3.50	4.00	3.30		3.50	4.00	3.31

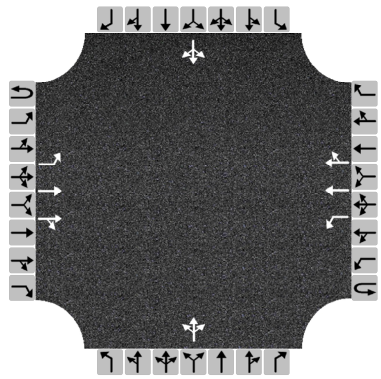
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)		97				0					0				243	
Capacity, c (veh/h)		788				1341					0				531	
v/c Ratio		0.12				0.00									0.46	
95% Queue Length, Q_{95} (veh)		0.4				0.0									2.5	
Control Delay (s/veh)		10.2				7.7					5.0				17.5	
Level of Service, LOS		B				A					A				C	
Approach Delay (s/veh)	3.0				0.0				5.0				17.5			
Approach LOS									A				C			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	US 12 & S Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	US Hwy 12
Analysis Year	2019	North/South Street	S Montana Avenue
Time Analyzed	Noon Peak	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	T	TR		L	T	TR			LTR				LTR	
Volume, V (veh/h)	1	116	449	0		0	362	8		0	0	0		7	0	87
Percent Heavy Vehicles (%)	0	2				0				0	0	0		0	0	1
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)	6.4	4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.40	4.14				4.10				7.50	6.50	6.90		6.80	6.50	6.92
Base Follow-Up Headway (sec)	2.5	2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.50	2.22				2.20				3.50	4.00	3.30		3.50	4.00	3.31

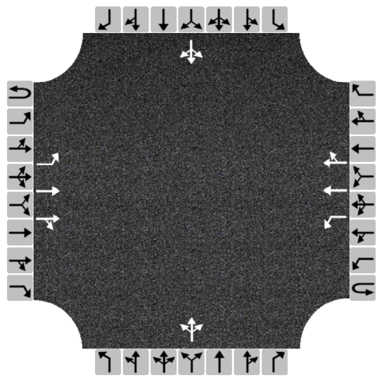
Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)		130				0					0				105	
Capacity, c (veh/h)		1139				1076					0				684	
v/c Ratio		0.11				0.00									0.15	
95% Queue Length, Q_{95} (veh)		0.4				0.0									0.5	
Control Delay (s/veh)		8.6				8.3					5.0				11.2	
Level of Service, LOS		A				A					A				B	
Approach Delay (s/veh)	1.8				0.0				5.0				11.2			
Approach LOS									A				B			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	US 12 & S Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	US Hwy 12
Analysis Year	2019	North/South Street	S Montana Avenue
Time Analyzed	PM Peak	Peak Hour Factor	0.88
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	T	TR		L	T	TR			LTR				LTR	
Volume, V (veh/h)		179	691	0		0	354	13		0	0	0		9	0	74
Percent Heavy Vehicles (%)		1				0				0	0	0		0	0	1
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				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.12				4.10				7.50	6.50	6.90		6.80	6.50	6.92
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)		2.21				2.20				3.50	4.00	3.30		3.50	4.00	3.31

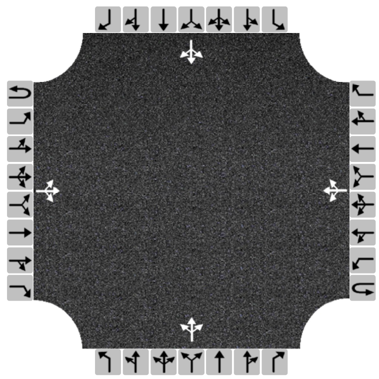
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		203				0					0				94	
Capacity, c (veh/h)		1146				843					0				544	
v/c Ratio		0.18				0.00									0.17	
95% Queue Length, Q_{95} (veh)		0.6				0.0									0.6	
Control Delay (s/veh)		8.8				9.3					5.0				13.0	
Level of Service, LOS		A				A					A				B	
Approach Delay (s/veh)	1.8				0.0				5.0				13.0			
Approach LOS									A				B			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	East Main Street
Analysis Year	2019	North/South Street	South Montana Avenue
Time Analyzed	AM Peak	Peak Hour Factor	0.75
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		17	66	15		24	61	78		8	83	14		61	158	21
Percent Heavy Vehicles (%)		12				0				13	1	0		5	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)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

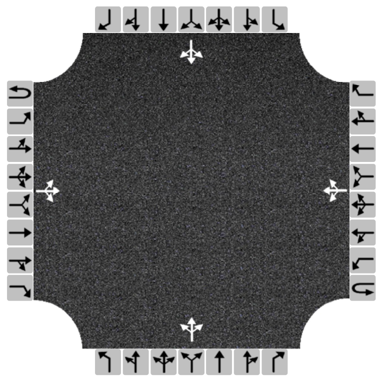
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		23				32					141				320	
Capacity, c (veh/h)		1331				1495					530				536	
v/c Ratio		0.02				0.02					0.27				0.60	
95% Queue Length, Q_{95} (veh)		0.1				0.1					1.1				4.3	
Control Delay (s/veh)		7.8				7.5					14.3				21.6	
Level of Service, LOS		A				A					B				C	
Approach Delay (s/veh)	1.5				1.3				14.3				21.6			
Approach LOS									B				C			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	East Main Street
Analysis Year	2019	North/South Street	South Montana Avenue
Time Analyzed	Noon Peak	Peak Hour Factor	0.76
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		16	94	12		7	85	67		8	78	17		37	78	14
Percent Heavy Vehicles (%)		0				0				13	4	0		3	0	7
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Approach	Eastbound				Westbound				Northbound				Southbound			
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.10				4.10				7.23	6.54	6.20		7.13	6.50	6.27
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)		2.20				2.20				3.62	4.04	3.30		3.53	4.00	3.36

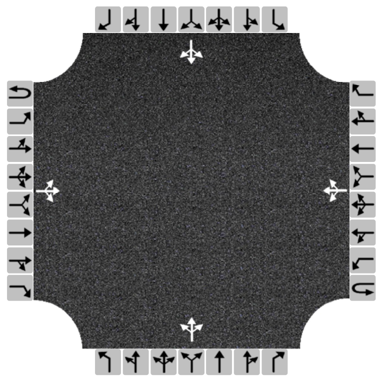
Delay, Queue Length, and Level of Service

Approach	Eastbound				Westbound				Northbound				Southbound			
Flow Rate, v (veh/h)		21				9					136				170	
Capacity, c (veh/h)		1384				1456					558				542	
v/c Ratio		0.02				0.01					0.24				0.31	
95% Queue Length, Q_{95} (veh)		0.0				0.0					1.0				1.4	
Control Delay (s/veh)		7.6				7.5					13.5				14.7	
Level of Service, LOS		A				A					B				B	
Approach Delay (s/veh)	1.1				0.4				13.5				14.7			
Approach LOS									B				B			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	East Main Street
Analysis Year	2019	North/South Street	South Montana Avenue
Time Analyzed	PM Peak	Peak Hour Factor	0.87
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		21	91	15		17	59	45		14	119	21		31	58	18
Percent Heavy Vehicles (%)		0				0				7	2	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

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.10				4.10				7.17	6.52	6.20		7.10	6.50	6.20
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)		2.20				2.20				3.56	4.02	3.30		3.50	4.00	3.30

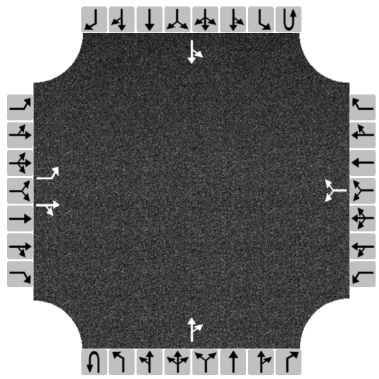
Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)		24				20					177				124	
Capacity, c (veh/h)		1480				1478					603				580	
v/c Ratio		0.02				0.01					0.29				0.21	
95% Queue Length, Q_{95} (veh)		0.0				0.0					1.2				0.8	
Control Delay (s/veh)		7.5				7.5					13.4				12.9	
Level of Service, LOS		A				A					B				B	
Approach Delay (s/veh)	1.3				1.2				13.4				12.9			
Approach LOS									B				B			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	East Lewis Street
Analysis Year	2019	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	AM Peak	Peak Hour Factor	0.71
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration		L		TR			LR					TR		LT		
Volume, V (veh/h)		26	11	124		6		36			148	1		38	150	
Percent Heavy Vehicles (%)		0	0	0		17		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		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.27		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.65		3.30						2.20		

Delay, Queue Length, and Level of Service

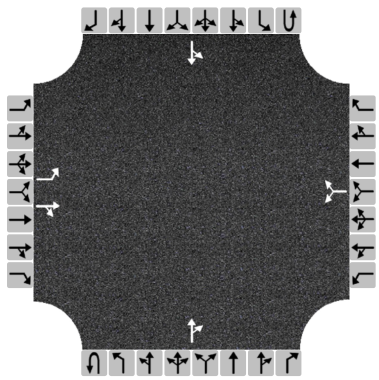
Flow Rate, v (veh/h)		37		190			59							54		
Capacity, c (veh/h)		405		779			661							1374		
v/c Ratio		0.09		0.24			0.09							0.04		
95% Queue Length, Q_{95} (veh)		0.3		1.0			0.3							0.1		
Control Delay (s/veh)		14.8		11.1			11.0							7.7		
Level of Service, LOS		B		B			B							A		
Approach Delay (s/veh)	11.7				11.0								1.8			
Approach LOS	B				B											

HCS7 Two-Way Stop-Control Report

General Information / Site Information

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	East Lewis Street
Analysis Year	2019	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	Noon Peak	Peak Hour Factor	0.61
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration		L		TR			LR					TR		LT		
Volume, V (veh/h)		15	5	53		6		27			156	4		11	113	
Percent Heavy Vehicles (%)		0	0	0		17		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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		7.1	6.5	6.2		7.1		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.27		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.65		3.30						2.20		

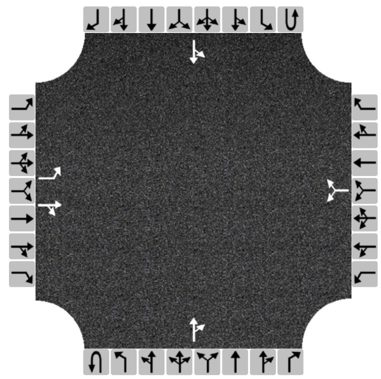
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)		25		95			54							18		
Capacity, c (veh/h)		451		808			657							1313		
v/c Ratio		0.06		0.12			0.08							0.01		
95% Queue Length, Q_{95} (veh)		0.2		0.4			0.3							0.0		
Control Delay (s/veh)		13.5		10.0			11.0							7.8		
Level of Service, LOS		B		B			B							A		
Approach Delay (s/veh)	10.8				11.0								0.8			
Approach LOS	B				B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	East Lewis Street
Analysis Year	2019	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	PM Peak	Peak Hour Factor	0.85
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration		L		TR			LR					TR		LT		
Volume, V (veh/h)		0	0	4		4		25			150	8		17	115	
Percent Heavy Vehicles (%)		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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		7.1	6.5	6.2		7.1		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.10		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.50		3.30						2.20		

Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)		0		5			34							20		
Capacity, c (veh/h)		564		919			812							1402		
v/c Ratio		0.00		0.01			0.04							0.01		
95% Queue Length, Q_{95} (veh)		0.0		0.0			0.1							0.0		
Control Delay (s/veh)		11.4		8.9			9.6							7.6		
Level of Service, LOS		B		A			A							A		
Approach Delay (s/veh)	8.9				9.6								1.1			
Approach LOS	A				A											

HCS7 Two-Way Stop-Control Report

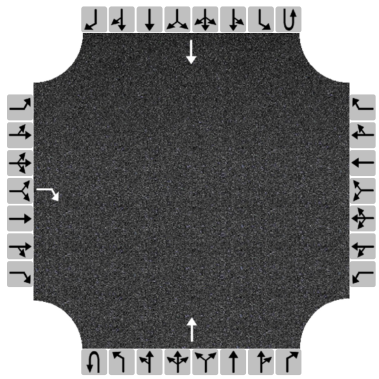
General Information

Analyst	Audrey Stoltzfus
Agency/Co.	Sanderson Stewart
Date Performed	4/17/2019
Analysis Year	2019
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	East Helena Corridor Study

Site Information

Intersection	Valley & Central Access
Jurisdiction	City of East Helena/MDT
East/West Street	Central Access-Exit Only
North/South Street	Valley Drive
Peak Hour Factor	0.76
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	1	0	0	0	1	0
Configuration				R							T				T	
Volume, V (veh/h)				11							207				178	
Percent Heavy Vehicles (%)				55												
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)				6.2												
Critical Headway (sec)				6.75												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.80												

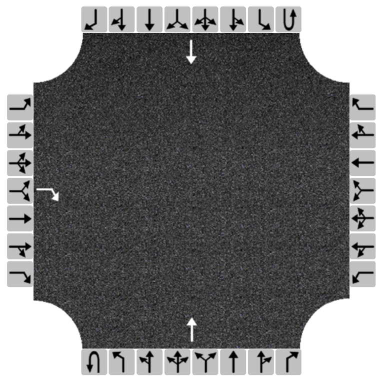
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				14												
Capacity, c (veh/h)				690												
v/c Ratio				0.02												
95% Queue Length, Q_{95} (veh)				0.1												
Control Delay (s/veh)				10.3												
Level of Service, LOS				B												
Approach Delay (s/veh)	10.3															
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Central Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	Central Access-Exit Only
Analysis Year	2019	North/South Street	Valley Drive
Time Analyzed	Noon Peak	Peak Hour Factor	0.61
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	1	0	0	0	1	0
Configuration				R							T				T	
Volume, V (veh/h)				14							195				115	
Percent Heavy Vehicles (%)				29												
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)				6.2												
Critical Headway (sec)				6.49												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.56												

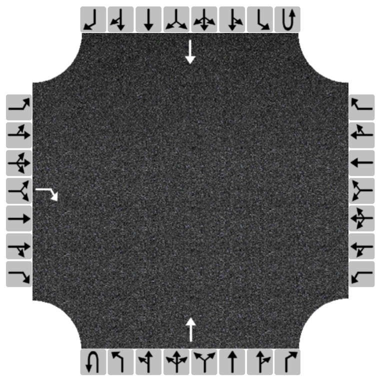
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				23												
Capacity, c (veh/h)				789												
v/c Ratio				0.03												
95% Queue Length, Q_{95} (veh)				0.1												
Control Delay (s/veh)				9.7												
Level of Service, LOS				A												
Approach Delay (s/veh)	9.7															
Approach LOS	A															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Central Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	Central Access-Exit Only
Analysis Year	2019	North/South Street	Valley Drive
Time Analyzed	PM Peak	Peak Hour Factor	0.91
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	1	0	0	0	1	0
Configuration				R							T				T	
Volume, V (veh/h)				12							174				131	
Percent Heavy Vehicles (%)				20												
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)				6.2												
Critical Headway (sec)				6.40												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.48												

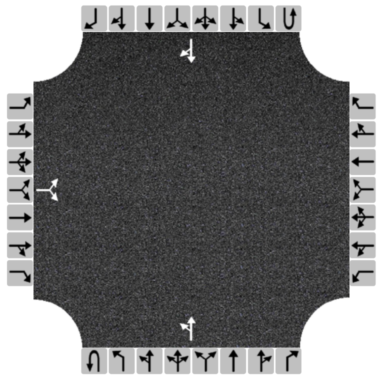
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				13												
Capacity, c (veh/h)				858												
v/c Ratio				0.02												
95% Queue Length, Q_{95} (veh)				0.0												
Control Delay (s/veh)				9.3												
Level of Service, LOS				A												
Approach Delay (s/veh)	9.3															
Approach LOS	A															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	North (Main) Access
Analysis Year	2019	North/South Street	Valley Drive
Time Analyzed	AM Peak	Peak Hour Factor	0.76
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		10		0						87	121				178	52
Percent Heavy Vehicles (%)		0		0						1						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Approach	Eastbound				Westbound				Northbound				Southbound			
Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.40		6.20						4.11						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.21						

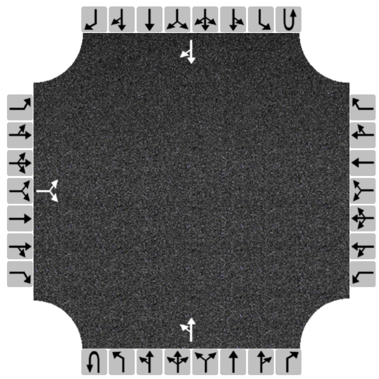
Delay, Queue Length, and Level of Service

Approach	Eastbound				Westbound				Northbound				Southbound			
Flow Rate, v (veh/h)			13							114						
Capacity, c (veh/h)			395							1264						
v/c Ratio			0.03							0.09						
95% Queue Length, Q_{95} (veh)			0.1							0.3						
Control Delay (s/veh)			14.4							8.1						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	14.4								3.9							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	North (Main) Access
Analysis Year	2019	North/South Street	Valley Drive
Time Analyzed	Noon Peak	Peak Hour Factor	0.62
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		19		4						53	139				99	24
Percent Heavy Vehicles (%)		0		0						0						
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)		6.40		6.20						4.10						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.20						

Delay, Queue Length, and Level of Service

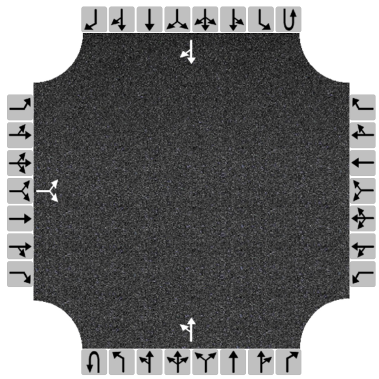
Flow Rate, v (veh/h)			37							85						
Capacity, c (veh/h)			492							1386						
v/c Ratio			0.08							0.06						
95% Queue Length, Q_{95} (veh)			0.2							0.2						
Control Delay (s/veh)			12.9							7.8						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	12.9								2.5							
Approach LOS	B															

 HCS7™ TWSC Version 7.1 Generated: 4/17/2019 4:41:08 PM
Valley_&_North_Main_Access_Noon.xtw

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	4/17/2019	East/West Street	North (Main) Access
Analysis Year	2019	North/South Street	Valley Drive
Time Analyzed	PM Peak	Peak Hour Factor	0.88
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		19		0						11	162				130	10
Percent Heavy Vehicles (%)		0		0						0						
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)		6.40		6.20						4.10						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.20						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			22							12						
Capacity, c (veh/h)			636							1433						
v/c Ratio			0.03							0.01						
95% Queue Length, Q_{95} (veh)			0.1							0.0						
Control Delay (s/veh)			10.9							7.5						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	10.9								0.5							
Approach LOS	B															

AUXILIARY TURN LANE WARRANT CALCULATIONS

APPENDIX G

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

TURN LANE WARRANTS		US Hwy 12 & Montana Avenue			Main Street & Montana Avenue			Montana Ave/Valley Dr & Lewis Street			Valley Drive & North Prickly Pear Access			Valley Drive & Bandera Drive			Valley Drive & Plant Road		
		AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM
2019	NB Right-Turn Lane							NO	NO	NO				NO	NO	NO			
	NB Left-Turn Lane										NO	NO	NO				NO	NO	NO
	SB Right-Turn Lane										NO	NO	NO				NO	NO	NO
	SB Left-Turn Lane							NO	NO	NO				NO	NO	NO			
	EB Right-Turn Lane	NO	NO	NO	NO	NO	NO												
	EB Left-Turn Lane				NO	NO	NO												
	WB Right-Turn Lane	NO	NO	NO	NO	NO	NO												
	WB Left-Turn Lane				NO	NO	NO												

TURN LANE WARRANTS		US Hwy 12 & Montana Avenue			Main Street & Montana Avenue			Montana Ave/Valley Dr & Lewis Street			Valley Drive & North Prickly Pear Access			Valley Drive & Highland Meadows South			Valley Drive & Highland Meadows North			Valley Drive & South HS Bus/Visitor			Valley Drive & South HS Student Parking			Valley Drive & Bandera Drive			Valley Drive & Plant Road		
		AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM	AM	After School	PM
2040	NB Right-Turn Lane							NO	NO	NO																NO	NO	NO			
	NB Left-Turn Lane										YES	YES	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	SB Right-Turn Lane										YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	SB Left-Turn Lane							YES	NO	NO																NO	NO	NO			
	EB Right-Turn Lane	NO	NO	NO	NO	NO	NO																								
	EB Left-Turn Lane				NO	NO	NO																								
	WB Right-Turn Lane	NO	NO	NO	YES	NO	NO																								
	WB Left-Turn Lane				NO	NO	NO																								

Existing Traffic Volumes (2019) - Right-Turn Lanes at Unsignalized Intersections on 2-Lane Highways

Approach	Time	Total DHV (veh/hr)	Right-Turn Volume During DHV (veh/hr, one direction)	Required Right-Turn Volume for Warranted Lane	Warranted Right-Turn Lane? (Y/N)	Speed Limit at Approach	Adjustment
Main & Montana EB	AM weekday	100	15	107	N	25	0
	After School	127	13	103	N	25	0
	PM weekday	133	16	102	N	25	0
Main & Montana WB	AM weekday	170	80	117	N	25	20
	After School	163	68	118	N	25	20
	PM weekday	127	46	123	N	25	20
Montana/Valley & Lewis NB	AM weekday	155	1	99	N	25	0
	After School	165	4	98	N	25	0
	PM weekday	163	9	98	N	25	0
Valley & N Prickly Pear SB	AM weekday	239	55	108	N	35	20
	After School	128	25	103	N	35	0
	PM weekday	137	0	102	N	35	0
Valley & Bandera NB	AM weekday	125	4	103	N	35	0
	After School	175	10	97	N	35	0
	PM weekday	166	12	98	N	35	0
Valley & Plant SB	AM weekday	215	1	91	N	35	0
	After School	121	1	104	N	35	0
	PM weekday	144	0	101	N	35	0

For 4 lane highway

Existing Traffic Volumes (2019) - Right-Turn Lanes at Unsignalized Intersections on 4-Lane Highways

Approach	Time	Total DHV (veh/hr)	Right-Turn Volume During DHV (veh/hr, one direction)	Required Right-Turn Volume for Warranted Lane	Warranted Right-Turn Lane? (Y/N)	Speed Limit at Approach	Adjustment
US 12 & Montana EB	AM weekday	362	0	90	N	45	0
	After School	687	0	77	N	45	0
	PM weekday	1056	0	50	N	45	0
US 12 & Montana WB	AM weekday	923	16	60	N	45	0
	After School	446	8	90	N	45	0
	PM weekday	443	13	90	N	45	0

Future Traffic Volumes (2040) - Right-Turn Lanes at Unsignalized Intersections on 2-Lane Highways

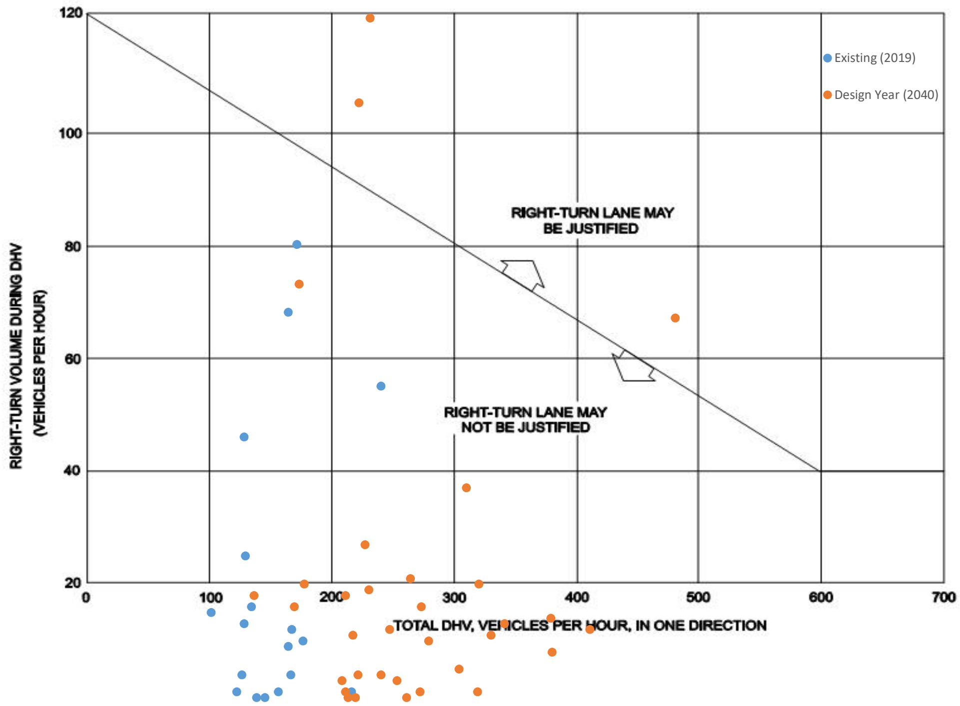
Approach	Time	Total DHV (veh/hr)	Right-Turn Volume During DHV (veh/hr, one direction)	Required Right-Turn Volume for Warranted Lane	Warranted Right-Turn Lane? (Y/N)	Speed Limit at Approach	Adjustment
Main & Montana EB	AM weekday	135	18	102	N	25	0
	After School	168	16	98	N	25	0
	PM weekday	176	20	97	N	25	0
Main & Montana WB	AM weekday	230	120	109	Y	25	20
	After School	221	105	111	N	25	20
	PM weekday	172	73	117	N	25	20
Montana/Valley & Lewis NB	AM weekday	271	1	84	N	25	0
	After School	303	5	80	N	25	0
	PM weekday	329	11	76	N	25	0
Valley & N Prickly Pear SB	AM weekday	480	67	56	Y	35	0
	After School	309	37	79	N	35	0
	PM weekday	260	0	85	N	35	0
Valley & Highland South SB	AM weekday	410	12	65	N	35	0
	After School	272	16	84	N	35	0
	PM weekday	229	19	89	N	35	0
Valley & Highland North SB	AM weekday	378	14	70	N	35	0
	After School	263	21	85	N	35	0
	PM weekday	226	27	90	N	35	0
Valley & S HS Bus/Visitor SB	AM weekday	379	8	69	N	35	0
	After School	252	3	86	N	35	0
	PM weekday	212	0	92	N	35	0
Valley & South HS Student SB	AM weekday	340	13	75	N	35	0
	After School	216	11	91	N	35	0
	PM weekday	207	3	92	N	35	0
Valley & Bandera NB	AM weekday	239	4	88	N	35	0
	After School	278	10	83	N	35	0
	PM weekday	246	12	87	N	35	0
Valley & Bandera SB	AM weekday	319	20	77	N	35	0
	After School	210	18	92	N	35	0
	PM weekday	220	4	91	N	35	0
Valley & Plant SB	AM weekday	318	1	78	N	35	0
	After School	210	1	92	N	35	0
	PM weekday	218	0	91	N	35	0

For 4 lane highway

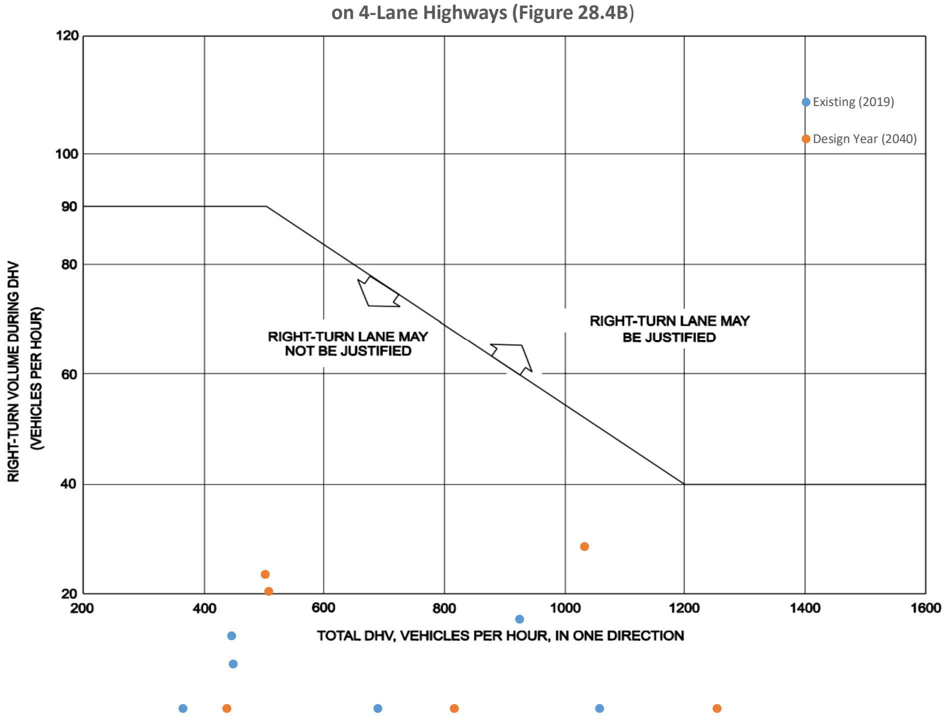
Existing Traffic Volumes (2019) - Right-Turn Lanes at Unsignalized Intersections on 4-Lane Highways

Approach	Time	Total DHV (veh/hr)	Right-Turn Volume During DHV (veh/hr, one direction)	Required Right-Turn Volume for Warranted Lane	Warranted Right-Turn Lane? (Y/N)	Speed Limit at Approach	Adjustment
US 12 & Montana EB	AM weekday	435	0	90	N	45	0
	After School	814	0	68	N	45	0
	PM weekday	1252	0	36	N	45	0
US 12 & Montana WB	AM weekday	1031	29	52	N	45	0
	After School	505	21	90	N	45	0
	PM weekday	499	24	90	N	45	0

Guidelines for Right-Turn Lanes at Unsignalized Intersections
on 2-Lane Highways (Figure 28.4A)



Guidelines for Right-Turn Lanes at Unsignalized Intersections
on 4-Lane Highways (Figure 28.4B)



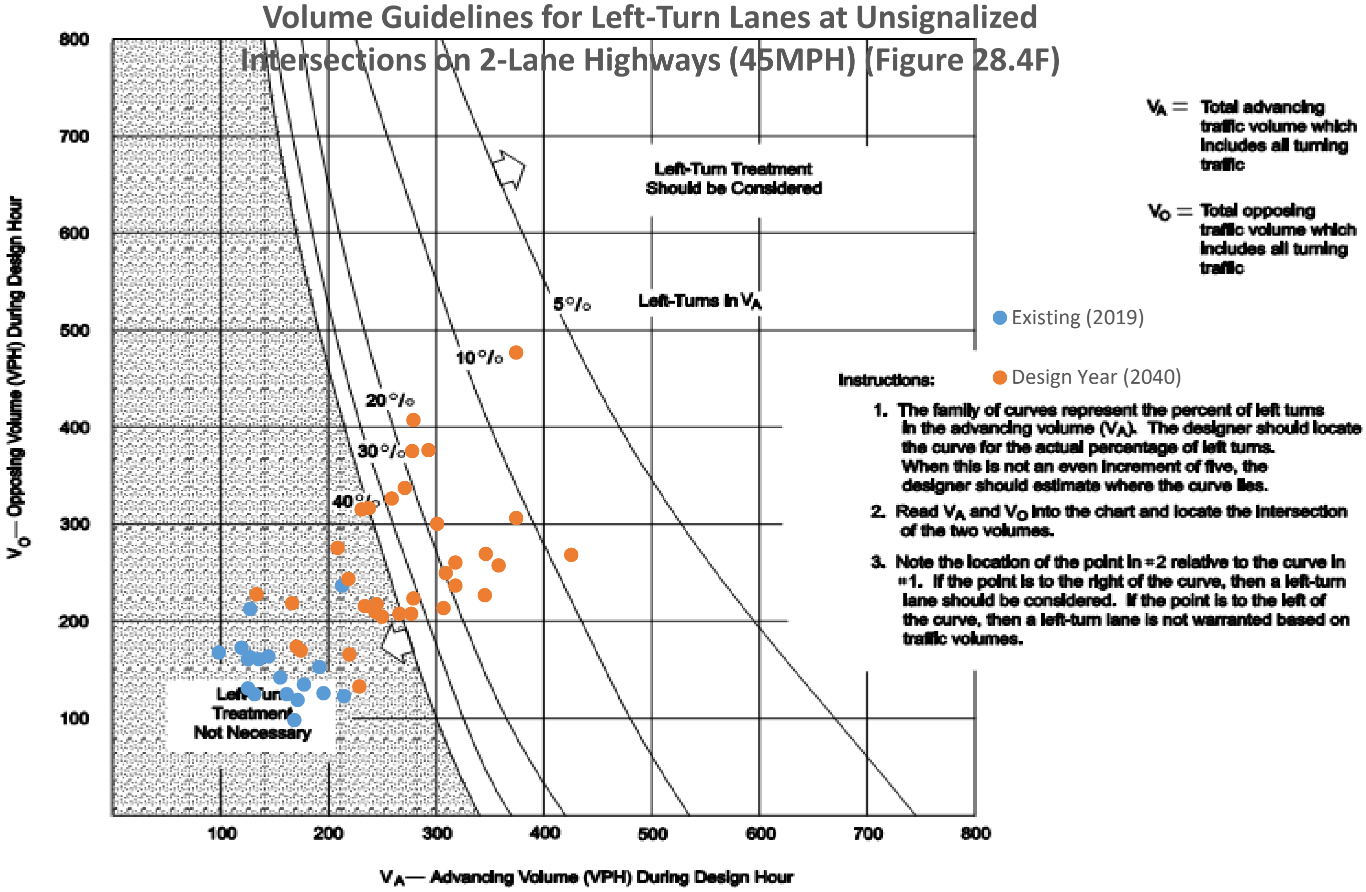
Existing Traffic Volumes (2019) - Left-Turn Lanes at Unsignalized Intersections on 2-Lane Highways

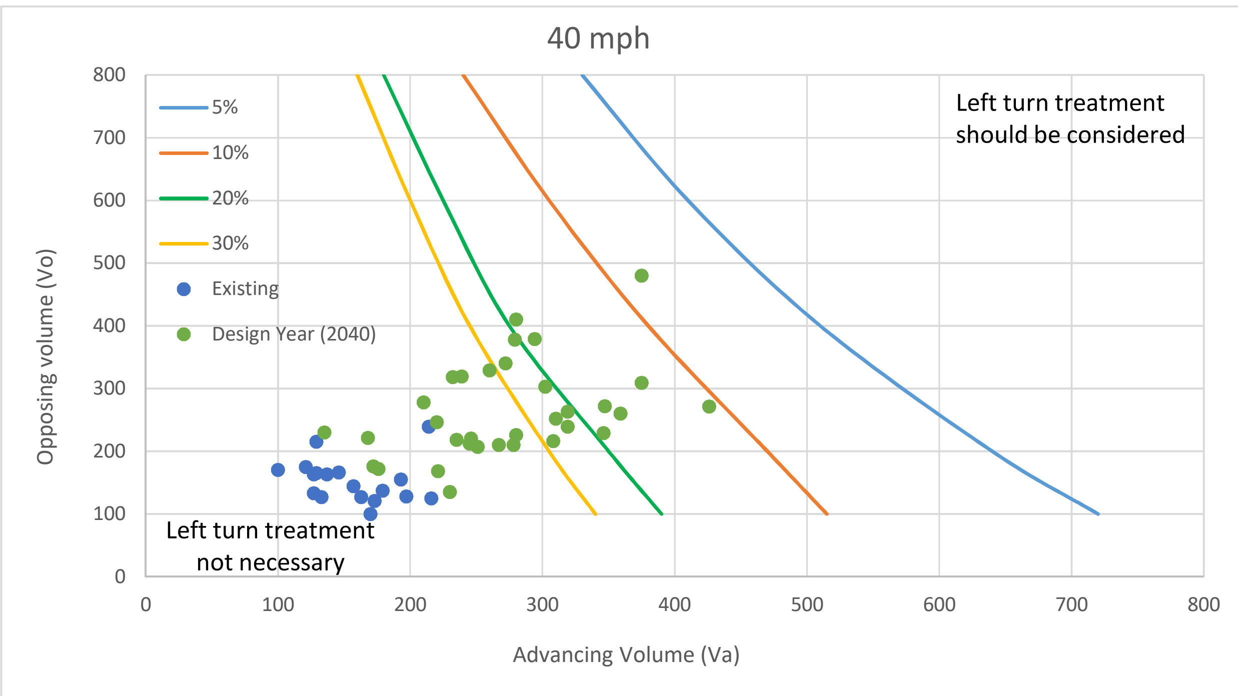
Approach	Time	Va = Total advancing traffic volume	Val = Total left-turn volume in advancing traffic	Percent left-turns in Va	Vo = Total opposing traffic volume	Warranted Left-Turn Lane? (Y/N)	Speed Limit at Approach
Main & Montana EB	AM weekday	100	18	18.0%	170	N	25
	After School	127	18	14.2%	163	N	25
	PM weekday	133	23	17.3%	127	N	25
Main & Montana WB	AM weekday	170	26	15.3%	100	N	25
	After School	163	7	4.3%	127	N	25
	PM weekday	127	18	14.2%	133	N	25
Montana/Valley & Lewis SB	AM weekday	193	38	19.7%	155	N	25
	After School	129	12	9.3%	165	N	25
	PM weekday	137	18	13.1%	163	N	25
Valley & N Prickly Pear NB	AM weekday	214	90	42.1%	239	N	35
	After School	197	54	27.4%	128	N	35
	PM weekday	179	0	0.0%	137	N	35
Valley & Bandera SB	AM weekday	216	4	1.9%	125	N	35
	After School	121	7	5.8%	175	N	35
	PM weekday	146	18	12.3%	166	N	35
Valley & Plant NB	AM weekday	129	2	1.6%	215	N	35
	After School	173	0	0.0%	121	N	35
	PM weekday	157	0	0.0%	144	N	35

Future Traffic Volumes (2040) - Left-Turn Lanes at Unsignalized Intersections on 2-Lane Highways

Approach	Time	Va = Total advancing traffic volume	Val = Total left-turn volume in advancing traffic	Percent left-turns in Va	Vo = Total opposing traffic volume	Warranted Left-Turn Lane? (Y/N)	Speed Limit at Approach
Main & Montana EB	AM weekday	135	35	25.9%	230	N	25
	After School	168	35	20.8%	221	N	25
	PM weekday	176	41	23.3%	172	N	25
Main & Montana WB	AM weekday	230	32	13.9%	135	N	25
	After School	221	9	4.1%	168	N	25
	PM weekday	172	22	12.8%	176	N	25
Montana/Valley & Lewis SB	AM weekday	426	76	17.8%	271	Y	25
	After School	302	45	14.9%	303	N	25
	PM weekday	260	33	12.7%	329	N	25
Valley & N Prickly Pear NB	AM weekday	375	98	26.1%	480	Y	35
	After School	375	62	16.5%	309	Y	35
	PM weekday	359	0	0.0%	260	N	35
Valley & Highland South NB	AM weekday	280	24	8.6%	410	N	35
	After School	347	43	12.4%	272	N	35
	PM weekday	346	77	22.3%	229	Y	35
Valley & Highland North NB	AM weekday	279	16	5.7%	378	N	35
	After School	319	29	9.1%	263	N	35
	PM weekday	280	51	18.2%	226	N	35
Valley & S HS Bus/Visitor NB	AM weekday	294	27	9.2%	379	N	35
	After School	310	10	3.2%	252	N	35
	PM weekday	245	0	0.0%	212	N	35
Valley & South HS Student NB	AM weekday	272	46	16.9%	340	N	35
	After School	308	41	13.3%	216	N	35
	PM weekday	251	8	3.2%	207	N	35
Valley & Bandera NB	AM weekday	239	31	13.0%	319	N	35
	After School	278	27	9.7%	210	N	35
	PM weekday	246	6	2.4%	220	N	35
Valley & Bandera SB	AM weekday	319	4	1.3%	239	N	35
	After School	210	7	3.3%	278	N	35
	PM weekday	220	18	8.2%	246	N	35
Valley & Plant NB	AM weekday	232	2	0.9%	318	N	35
	After School	267	0	0.0%	210	N	35
	PM weekday	235	0	0.0%	218	N	35

Volume Guidelines for Left-Turn Lanes at Unsignalized Intersections on 2-Lane Highways (45MPH) (Figure 28.4F)




40 mph
Opposing volume (Vo)
Advancing Volume (Va)
0
100
200
300
400
500
600
700
800
5%
10%
20%
30%
Existing
Design Year (2040)
Left turn treatment should be considered
Left turn treatment not necessary

TRAFFIC SIGNAL WARRANT CALCULATIONS

APPENDIX H

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

TRAFFIC SIGNAL WARRANTS		Existing Conditions (2019)			Design Year (2040)		
		Main Street & Montana Avenue	US Hwy 12 & Montana Avenue		Main Street & Montana Avenue	US Hwy 12 & Montana Avenue	
		100% RTs	100% RTs	50% RTs	100% RTs	100% RTs	50% RTs
1. Eight-Hour Vehicular Volume		x	✓	x	x	✓	✓
2. Four-Hour Vehicular Volume		x	✓	x	x	✓	✓
3. Peak Hour		x	✓	✓	✓	✓	✓
4. Pedestrian Volume		--	--	--	--	--	--
5. School Crossing		--	--	--	--	--	--
6. Coordinated Signal System		x	x	x	x	x	x
7. Crash History		x	x	x	x	x	x
8. Roadway Network		x	x	x	x	x	x
9. Intersection Near a Grade Crossing		--	--	--	--	--	--
Signals Warranted	**Yes**		✓			✓	✓
	No	**x**		**x**	**x**		

Warrant 1: Eight-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	8	1	9	6	15	8
1:00	6	1	2	1	3	6
2:00	10	2	4	4	8	10
3:00	2	3	1	1	2	3
4:00	2	6	3	1	4	6
5:00	7	31	4	11	15	31
6:00	17	71	10	29	39	71
7:00	73	173	77	132	209	173
8:00	62	164	64	108	172	164
9:00	43	60	72	67	139	60
10:00	42	77	54	68	122	77
11:00	53	69	83	77	160	69
12:00	73	83	90	69	159	83
13:00	61	69	92	88	180	69
14:00	97	67	94	90	184	97
15:00	106	149	126	146	272	149
16:00	101	98	118	87	205	101
17:00	165	113	123	120	243	165
18:00	81	64	82	78	160	81
19:00	65	56	60	51	111	65
20:00	50	40	61	51	112	50
21:00	27	26	34	22	56	27
22:00	17	11	27	13	40	17
23:00	11	11	12	7	19	11
TOTAL	**1179**	**1445**	**1302**	**1327**	**2629**	**1593**

Condition A - Minimum Vehicular Volume (100% Columns):
Major Street Total > 500 and Higher Minor Street Total > 150 for 8 hours? **No (0 hrs)**

Condition B - Interruption of Continuous Traffic (100% Columns):
Major Street Total > 750 and Higher Minor Street Total > 75 for 8 hours? **No (0 hrs)**

Combination of Conditions A & B (80% Columns):
Major Street Total > 400 and Higher Minor Street Total > 120 for 8 hours? **No (0 hrs)**

Major Street Total > 600 and Higher Minor Street Total > 60 for 8 hours? **No (0 hrs)**

Warrant 1 Satisfied? **No**

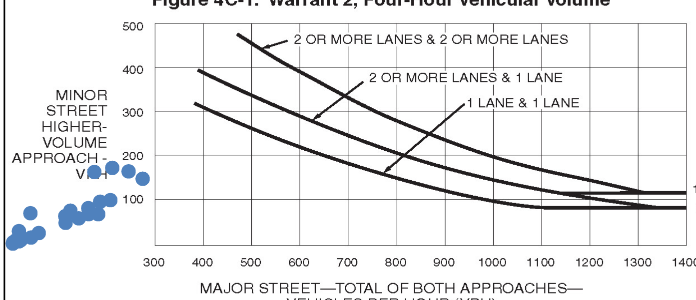
Warrant 2: Four-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	8	1	9	6	15	8
1:00	6	1	2	1	3	6
2:00	10	2	4	4	8	10
3:00	2	3	1	1	2	3
4:00	2	6	3	1	4	6
5:00	7	31	4	11	15	31
6:00	17	71	10	29	39	71
7:00	73	173	77	132	209	173
8:00	62	164	64	108	172	164
9:00	43	60	72	67	139	60
10:00	42	77	54	68	122	77
11:00	53	69	83	77	160	69
12:00	73	83	90	69	159	83
13:00	61	69	92	88	180	69
14:00	97	67	94	90	184	97
15:00	106	149	126	146	272	149
16:00	101	98	118	87	205	101
17:00	165	113	123	120	243	165
18:00	81	64	82	78	160	81
19:00	65	56	60	51	111	65
20:00	50	40	61	51	112	50
21:00	27	26	34	22	56	27
22:00	17	11	27	13	40	17
23:00	11	11	12	7	19	11
TOTAL	**1179**	**1445**	**1302**	**1327**	**2629**	**1593**

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of 4 hours (100% thresholds)?	**No (0 hrs)**
Warrant 2 Satisfied?	**No**

Warrant 3: Peak Hour

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

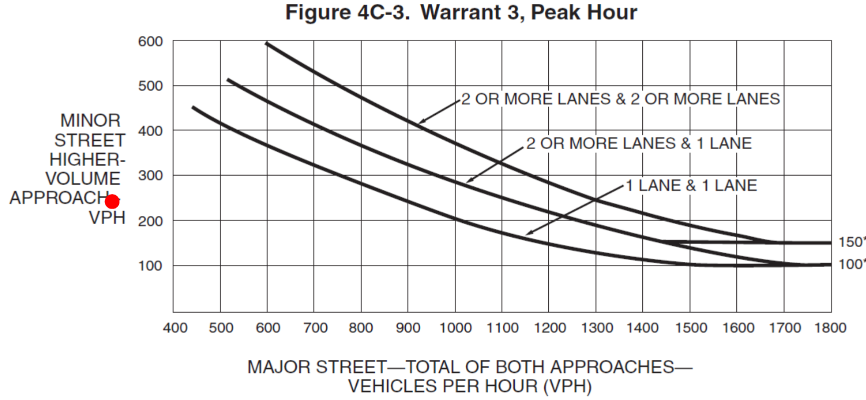
AM Peak Hour	**7:30-8:30 AM**
High Minor Total Stopped Time Delay (hrs)	**1.47**
Total Volume of Major Approaches (vehs)	**270**
High Minor Approach Volume (vehs)	**245**
Total Entering Volume (vehs)	**621**
After School Peak Hour	**2:45-3:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.54**
Total Volume of Major Approaches (vehs)	**290**
High Minor Approach Volume (vehs)	**133**
Total Entering Volume (vehs)	**528**
PM Peak Hour	**4:45-5:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.59**
Total Volume of Major Approaches (vehs)	**260**
High Minor Approach Volume (vehs)	**158**
Total Entering Volume (vehs)	**529**

Category A: Peak Period: AM

Total stopped time delay for minor approach > 4 veh-hrs?	**No (1.47)**
High minor approach volume > 100 for peak hour?	**Yes (245)**
Total entering volume > 800 for peak hour?	**No (621)**
Category A warrant satisfied?	**No**

Category B:

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of one hour (100% thresholds)?	**No**
Warrant 3 Satisfied?	**No**

Warrant 4: Pedestrian Volume

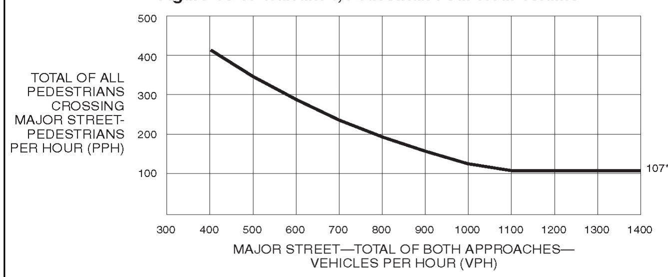
General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

This warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

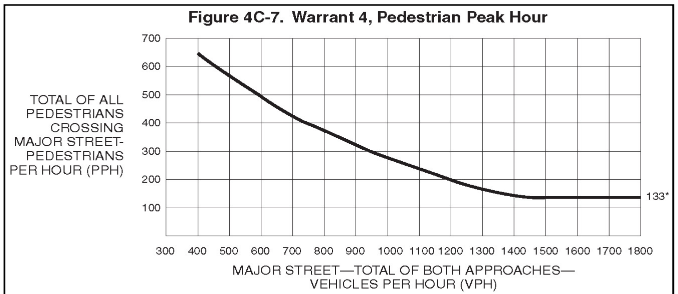
Hour Begin	Major Street Total Traffic	Pedestrian Volume Crossing Major Street
0:00	15	
1:00	3	
2:00	8	
3:00	2	
4:00	4	
5:00	15	
6:00	39	
7:00	209	
8:00	172	
9:00	139	
10:00	122	
11:00	160	
12:00	159	
13:00	180	
14:00	184	
15:00	272	
16:00	205	
17:00	243	
18:00	160	
19:00	111	
20:00	112	
21:00	56	
22:00	40	
23:00	19	
TOTAL	**2,629**	**0**

Figure 4C-5. Warrant 4, Pedestrian Four-Hour Volume



*Note: 107 pph applies as the lower threshold volume.

Figure 4C-7. Warrant 4, Pedestrian Peak Hour



*Note: 133 pph applies as the lower threshold volume.

For each of any 4 hours of an average day, do the plotted points representing representing the vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-5? **N/A**

For 1 hour of an average day, does the plotted point representing vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-7? **N/A**

Warrant 4 Satisfied? **N/A**

General Information	
Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Warrant 5: School Crossing

This warrant is intended for application where the fact that school children (elementary through high school students) cross the major street is the principle reason to consider installing a traffic signal. This warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless it can be shown that the proposed traffic signal would not restrict the progressive movement of traffic.

Is the number of adequate gaps in the major crossing traffic steam during the primary crossing period less than the number of minutes in that crossing period? **N/A**

Do 20 or more students cross at this location during the highest crossing hour? **N/A**

Warrant 5 Satisfied? **N/A**

Warrant 6: Coordinated Signal System

This warrant is intended for application where installation of a traffic signal would help to provide proper platooning of vehicles and therefore provide progressive movement in a coordinated signal system.

Are any adjacent traffic signals located so far away that they do not provide a necessary degree of platooning and/or progressive operation? **N/A**

Warrant 6 Satisfied? **No**

Warrant 7: Crash Experience

This warrant is intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal

Have adequate trials of alternatives failed to reduce the crash frequency? **N/A**

Have 5 or more crashes, of types susceptible to correction by a signal, occurred within a 12-month period? **No**

Is Condition A criterion met for 80% columns of Warrant 1 met? **No**

Is Condition B criterion met for 80% columns of Warrant 1 met? **No**

Are observed pedestrian volumes equal to or greater than 80% of what is required for Warrant 4? **No**

Warrant 7 Satisfied? **No**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Warrant 8: Roadway Network

This warrant is intended for application where installation of a traffic signal could be justified in order to encourage concentration and organization of traffic flow on a roadway network

Do two or more of the intersecting routes at this location have at least one of the following characteristics:

A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or
B. It includes rural or suburban highways outside, entering, or traversing a City; or
C. It appears as a major route on an official plan.

No

Does this intersection have an existing or immediately projected total entering volume of a least 1000 vehicles during a weekday typical peak hour and have a 5-year projected traffic volume that meets one or more of Warrants 1, 2, and 3 during an average weekday? **No**

Does this intersection have an existing or immediately projected total entering volume of at least 1000 vph for each of any 5 hours of a Saturday or Sunday? **N/A**

Warrant 8 Satisfied? **No**

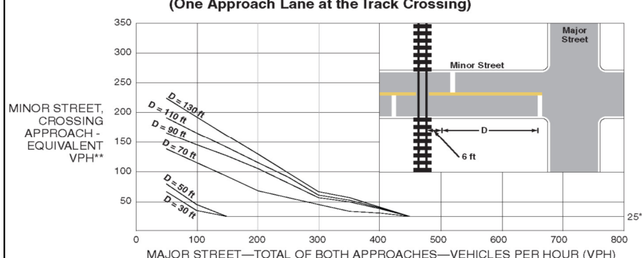
Warrant 9: Intersection Near a Grade Crossing

This warrant is intended for application where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic signal.

Does a grade crossing exist on an approach controlled by a STOP or YIELD sign whereby the center of the track nearest to the intersection is within 140 feet of the stop or yield line?

No

Figure 4C-9. Warrant 9, Intersection Near a Grade Crossing
(One Approach Lane at the Track Crossing)



* 25 vph applies as the lower threshold volume
** VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

During the highest traffic volume hour during which the rail traffic uses the crossing, does the plotted point representing vehicles per hour on the major street and the corresponding vehicles per hour on the minor-street approach that crosses the track fall above the applicable curve in Figure 4C-9 or 4C-10 (whichever is applicable) for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance? **N/A**

Warrant 9 Satisfied? **N/A**

Warrant 1: Eight-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	14	2	12	8	20	14
1:00	11	2	3	1	4	11
2:00	18	4	5	5	10	18
3:00	4	6	1	1	2	6
4:00	4	12	4	1	5	12
5:00	12	60	5	15	20	60
6:00	30	137	13	39	52	137
7:00	129	335	102	179	281	335
8:00	109	317	85	146	231	317
9:00	76	116	96	91	187	116
10:00	74	149	72	92	164	149
11:00	93	133	110	104	214	133
12:00	129	160	120	93	213	160
13:00	107	133	122	119	241	133
14:00	171	130	125	122	247	171
15:00	187	288	168	198	366	288
16:00	178	190	157	118	275	190
17:00	291	219	164	162	326	291
18:00	143	124	109	106	215	143
19:00	114	108	80	69	149	114
20:00	88	77	81	69	150	88
21:00	48	50	45	30	75	50
22:00	30	21	36	18	54	30
23:00	19	21	16	9	25	21
TOTAL	**2079**	**2794**	**1731**	**1795**	**3526**	**2987**

Condition A - Minimum Vehicular Volume (100% Columns):
Major Street Total > 500 and Higher Minor Street Total > 150 for 8 hours? **No (0 hrs)**

Condition B - Interruption of Continuous Traffic (100% Columns):
Major Street Total > 750 and Higher Minor Street Total > 75 for 8 hours? **No (0 hrs)**

Combination of Conditions A & B (80% Columns):
Major Street Total > 400 and Higher Minor Street Total > 120 for 8 hours? **No (0 hrs)**

Major Street Total > 600 and Higher Minor Street Total > 60 for 8 hours? **No (0 hrs)**

Warrant 1 Satisfied? **No**

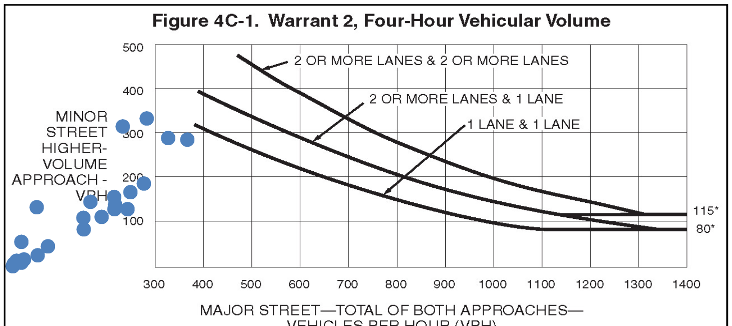
Warrant 2: Four-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	14	2	12	8	20	14
1:00	11	2	3	1	4	11
2:00	18	4	5	5	10	18
3:00	4	6	1	1	2	6
4:00	4	12	4	1	5	12
5:00	12	60	5	15	20	60
6:00	30	137	13	39	52	137
7:00	129	335	102	179	281	335
8:00	109	317	85	146	231	317
9:00	76	116	96	91	187	116
10:00	74	149	72	92	164	149
11:00	93	133	110	104	214	133
12:00	129	160	120	93	213	160
13:00	107	133	122	119	241	133
14:00	171	130	125	122	247	171
15:00	187	288	168	198	366	288
16:00	178	190	157	118	275	190
17:00	291	219	164	162	326	291
18:00	143	124	109	106	215	143
19:00	114	108	80	69	149	114
20:00	88	77	81	69	150	88
21:00	48	50	45	30	75	50
22:00	30	21	36	18	54	30
23:00	19	21	16	9	25	21
TOTAL	**2079**	**2794**	**1731**	**1795**	**3526**	**2987**

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of 4 hours (100% thresholds)?	**No (0 hrs)**
Warrant 2 Satisfied?	**No**

Warrant 3: Peak Hour

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

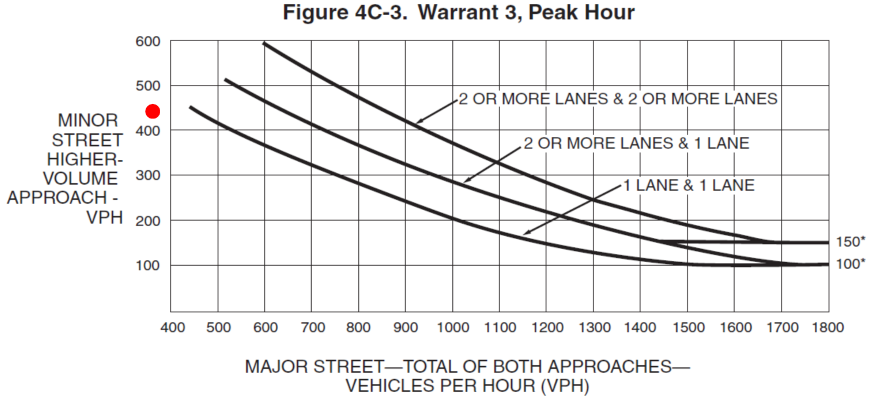
AM Peak Hour	**7:30-8:30 AM**
High Minor Total Stopped Time Delay (hrs)	**83.17**
Total Volume of Major Approaches (vehs)	**365**
High Minor Approach Volume (vehs)	**445**
Total Entering Volume (vehs)	**980**
After School Peak Hour	**2:45-3:45 PM**
High Minor Total Stopped Time Delay (hrs)	**5.83**
Total Volume of Major Approaches (vehs)	**389**
High Minor Approach Volume (vehs)	**280**
Total Entering Volume (vehs)	**863**
PM Peak Hour	**4:45-5:45 PM**
High Minor Total Stopped Time Delay (hrs)	**1.92**
Total Volume of Major Approaches (vehs)	**348**
High Minor Approach Volume (vehs)	**285**
Total Entering Volume (vehs)	**853**

Category A: Peak Period: AM

Total stopped time delay for minor approach > 4 veh-hrs?	**Yes (83.17)**
High minor approach volume > 100 for peak hour?	**Yes (445)**
Total entering volume > 800 for peak hour?	**Yes (980)**
Category A warrant satisfied?	**Yes**

Category B:

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of one hour (100% thresholds)?	**No**
Warrant 3 Satisfied?	**Yes**

Warrant 4: Pedestrian Volume

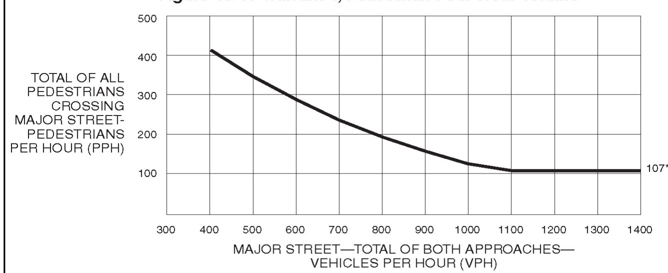
General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

This warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

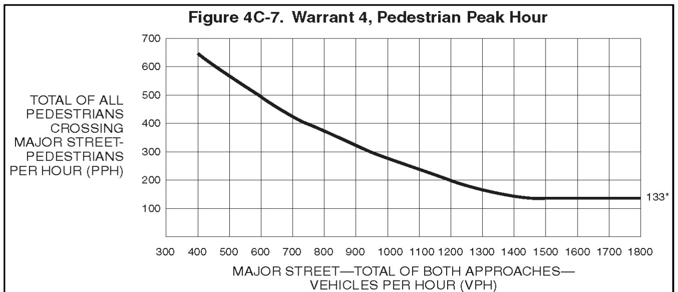
Hour Begin	Major Street Total Traffic	Pedestrian Volume Crossing Major Street
0:00	20	
1:00	4	
2:00	10	
3:00	2	
4:00	5	
5:00	20	
6:00	52	
7:00	281	
8:00	231	
9:00	187	
10:00	164	
11:00	214	
12:00	213	
13:00	241	
14:00	247	
15:00	366	
16:00	275	
17:00	326	
18:00	215	
19:00	149	
20:00	150	
21:00	75	
22:00	54	
23:00	25	
TOTAL	**3,526**	**0**

Figure 4C-5. Warrant 4, Pedestrian Four-Hour Volume



*Note: 107 pph applies as the lower threshold volume.

Figure 4C-7. Warrant 4, Pedestrian Peak Hour



*Note: 133 pph applies as the lower threshold volume.

For each of any 4 hours of an average day, do the plotted points representing representing the vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-5? **N/A**

For 1 hour of an average day, does the plotted point representing vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-7? **N/A**

Warrant 4 Satisfied? **N/A**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Warrant 5: School Crossing

This warrant is intended for application where the fact that school children (elementary through high school students) cross the major street is the principle reason to consider installing a traffic signal. This warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless it can be shown that the proposed traffic signal would not restrict the progressive movement of traffic.

Is the number of adequate gaps in the major crossing traffic steam during the primary crossing period less than the number of minutes in that crossing period? **N/A**

Do 20 or more students cross at this location during the highest crossing hour? **N/A**

Warrant 5 Satisfied? **N/A**

Warrant 6: Coordinated Signal System

This warrant is intended for application where installation of a traffic signal would help to provide proper platooning of vehicles and therefore provide progressive movement in a coordinated signal system.

Are any adjacent traffic signals located so far away that they do not provide a necessary degree of platooning and/or progressive operation? **N/A**

Warrant 6 Satisfied? **No**

Warrant 7: Crash Experience

This warrant is intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal

Have adequate trials of alternatives failed to reduce the crash frequency? **N/A**

Have 5 or more crashes, of types susceptible to correction by a signal, occurred within a 12-month period? **No**

Is Condition A criterion met for 80% columns of Warrant 1 met? **No**

Is Condition B criterion met for 80% columns of Warrant 1 met? **No**

Are observed pedestrian volumes equal to or greater than 80% of what is required for Warrant 4? **No**

Warrant 7 Satisfied? **No**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Warrant 8: Roadway Network

This warrant is intended for application where installation of a traffic signal could be justified in order to encourage concentration and organization of traffic flow on a roadway network

Do two or more of the intersecting routes at this location have at least one of the following characteristics:

A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or
B. It includes rural or suburban highways outside, entering, or traversing a City; or
C. It appears as a major route on an official plan.

No

Does this intersection have an existing or immediately projected total entering volume of a least 1000 vehicles during a weekday typical peak hour and have a 5-year projected traffic volume that meets one or more of Warrants 1, 2, and 3 during an average weekday? **No**

Does this intersection have an existing or immediately projected total entering volume of at least 1000 vph for each of any 5 hours of a Saturday or Sunday? **N/A**

Warrant 8 Satisfied? **No**

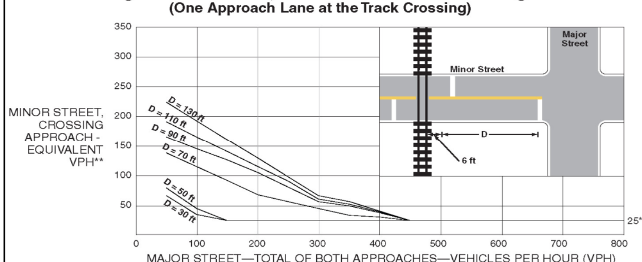
Warrant 9: Intersection Near a Grade Crossing

This warrant is intended for application where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic signal.

Does a grade crossing exist on an approach controlled by a STOP or YIELD sign whereby the center of the track nearest to the intersection is within 140 feet of the stop or yield line?

No

Figure 4C-9. Warrant 9, Intersection Near a Grade Crossing (One Approach Lane at the Track Crossing)



* 25 vph applies as the lower threshold volume
** VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

During the highest traffic volume hour during which the rail traffic uses the crossing, does the plotted point representing vehicles per hour on the major street and the corresponding vehicles per hour on the minor-street approach that crosses the track fall above the applicable curve in Figure 4C-9 or 4C-10 (whichever is applicable) for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance? **N/A**

Warrant 9 Satisfied? **N/A**

Warrant 1: Eight-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	32	56	143	199	32
6:00	0	67	145	440	585	67
7:00	0	173	281	942	1223	173
8:00	0	131	327	629	956	131
9:00	1	67	325	452	777	67
10:00	0	71	354	415	769	71
11:00	0	71	427	438	865	71
12:00	1	64	482	402	884	64
13:00	0	70	488	361	849	70
14:00	0	66	579	390	969	66
15:00	0	103	708	472	1180	103
16:00	0	86	919	441	1360	86
17:00	0	80	996	401	1397	80
18:00	0	56	581	294	875	56
19:00	0	37	370	204	574	37
20:00	0	28	293	181	474	28
21:00	0	0	0	0	0	0
22:00	0	0	0	0	0	0
23:00	0	0	0	0	0	0
TOTAL	**2**	**1202**	**7331**	**6605**	**13936**	**1202**

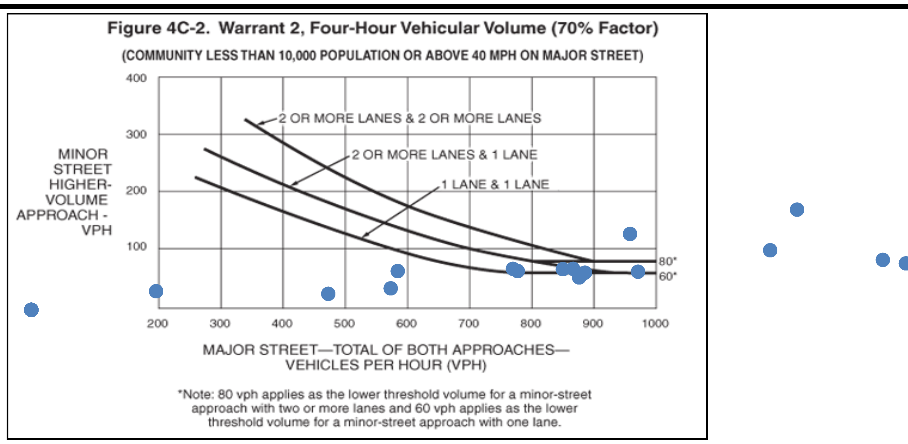
Condition A - Minimum Vehicular Volume (100% Columns):	
Major Street Total > 420 and Higher Minor Street Total > 105 for 8 hours?	**No (2 hrs)**
Condition B - Interruption of Continuous Traffic (100% Columns):	
Major Street Total > 630 and Higher Minor Street Total > 53 for 8 hours?	**Yes (12 hrs)**
Combination of Conditions A & B (80% Columns):	
Major Street Total > 336 and Higher Minor Street Total > 84 for 8 hours?	**No (4 hrs)**
Major Street Total > 504 and Higher Minor Street Total > 42 for 8 hours?	**Yes (13 hrs)**
Warrant 1 Satisfied?	**Yes**

Warrant 2: Four-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	32	56	143	199	32
6:00	0	67	145	440	585	67
7:00	0	173	281	942	1223	173
8:00	0	131	327	629	956	131
9:00	1	67	325	452	777	67
10:00	0	71	354	415	769	71
11:00	0	71	427	438	865	71
12:00	1	64	482	402	884	64
13:00	0	70	488	361	849	70
14:00	0	66	579	390	969	66
15:00	0	103	708	472	1180	103
16:00	0	86	919	441	1360	86
17:00	0	80	996	401	1397	80
18:00	0	56	581	294	875	56
19:00	0	37	370	204	574	37
20:00	0	28	293	181	474	28
21:00	0	0	0	0	0	0
22:00	0	0	0	0	0	0
23:00	0	0	0	0	0	0
TOTAL	**2**	**1202**	**7331**	**6605**	**13936**	**1202**



Meets warrant criteria on graph for minimum of 4 hours (100% thresholds)? **Yes (7 hrs)**

Warrant 2 Satisfied? **Yes**

Warrant 3: Peak Hour

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

AM Peak Hour	**7:30-8:30 AM**
High Minor Total Stopped Time Delay (hrs)	**1.08**
Total Volume of Major Approaches (vehs)	**1285**
High Minor Approach Volume (vehs)	**223**
Total Entering Volume (vehs)	**1508**

After School Peak Hour	**2:45-3:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.30**
Total Volume of Major Approaches (vehs)	**1133**
High Minor Approach Volume (vehs)	**96**
Total Entering Volume (vehs)	**1229**

PM Peak Hour	**4:45-5:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.30**
Total Volume of Major Approaches (vehs)	**1507**
High Minor Approach Volume (vehs)	**84**
Total Entering Volume (vehs)	**1591**

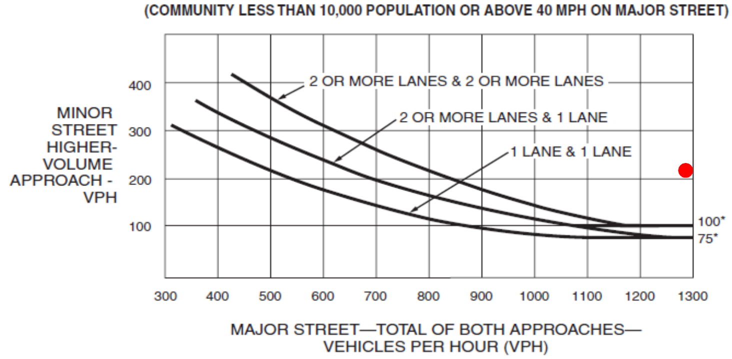
Category A: Peak Period: AM

Total stopped time delay for minor approach > 4 veh-hrs?	**No (1.08)**
High minor approach volume > 100 for peak hour?	**Yes (223)**
Total entering volume > 800 for peak hour?	**Yes (1508)**
Category A warrant satisfied?	**No**

Category B:

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of one hour (100% thresholds)?	**Yes**
Warrant 3 Satisfied?	**Yes**

Warrant 4: Pedestrian Volume

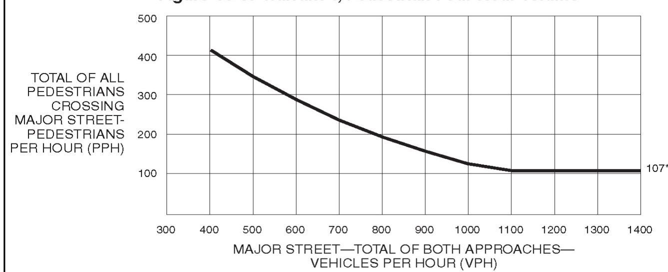
General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

This warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

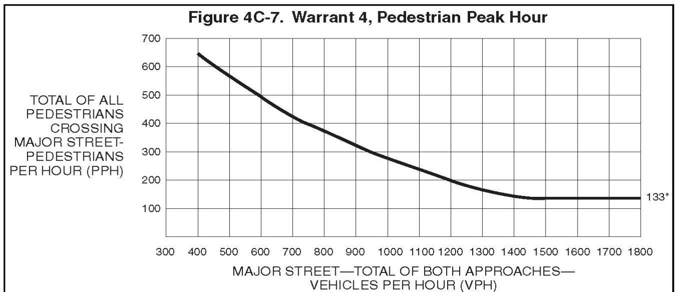
Hour Begin	Major Street Total Traffic	Pedestrian Volume Crossing Major Street
0:00	0	
1:00	0	
2:00	0	
3:00	0	
4:00	0	
5:00	199	
6:00	585	
7:00	1223	
8:00	956	
9:00	777	
10:00	769	
11:00	865	
12:00	884	
13:00	849	
14:00	969	
15:00	1180	
16:00	1360	
17:00	1397	
18:00	875	
19:00	574	
20:00	474	
21:00	0	
22:00	0	
23:00	0	
TOTAL	**13,936**	**0**

Figure 4C-5. Warrant 4, Pedestrian Four-Hour Volume



*Note: 107 pph applies as the lower threshold volume.

Figure 4C-7. Warrant 4, Pedestrian Peak Hour



*Note: 133 pph applies as the lower threshold volume.

For each of any 4 hours of an average day, do the plotted points representing representing the vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-5? **N/A**

For 1 hour of an average day, does the plotted point representing vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-7? **N/A**

Warrant 4 Satisfied? **N/A**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Warrant 5: School Crossing

This warrant is intended for application where the fact that school children (elementary through high school students) cross the major street is the principle reason to consider installing a traffic signal. This warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless it can be shown that the proposed traffic signal would not restrict the progressive movement of traffic.

Is the number of adequate gaps in the major crossing traffic steam during the primary crossing period less than the number of minutes in that crossing period? **N/A**

Do 20 or more students cross at this location during the highest crossing hour? **N/A**

Warrant 5 Satisfied? **N/A**

Warrant 6: Coordinated Signal System

This warrant is intended for application where installation of a traffic signal would help to provide proper platooning of vehicles and therefore provide progressive movement in a coordinated signal system.

Are any adjacent traffic signals located so far away that they do not provide a necessary degree of platooning and/or progressive operation? **N/A**

Warrant 6 Satisfied? **No**

Warrant 7: Crash Experience

This warrant is intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal

Have adequate trials of alternatives failed to reduce the crash frequency? **N/A**

Have 5 or more crashes, of types susceptible to correction by a signal, occurred within a 12-month period? **No**

Is Condition A criterion met for 56% columns of Warrant 1 met? **No**

Is Condition B criterion met for 56% columns of Warrant 1 met? **Yes**

Are observed pedestrian volumes equal to or greater than 80% of what is required for Warrant 4? **No**

Warrant 7 Satisfied? **No**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Warrant 8: Roadway Network

This warrant is intended for application where installation of a traffic signal could be justified in order to encourage concentration and organization of traffic flow on a roadway network

Do two or more of the intersecting routes at this location have at least one of the following characteristics:

A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or
B. It includes rural or suburban highways outside, entering, or traversing a City; or
C. It appears as a major route on an official plan.

No

Does this intersection have an existing or immediately projected total entering volume of a least 1000 vehicles during a weekday typical peak hour and have a 5-year projected traffic volume that meets one or more of Warrants 1, 2, and 3 during an average weekday? **No**

Does this intersection have an existing or immediately projected total entering volume of at least 1000 vph for each of any 5 hours of a Saturday or Sunday? **N/A**

Warrant 8 Satisfied? **No**

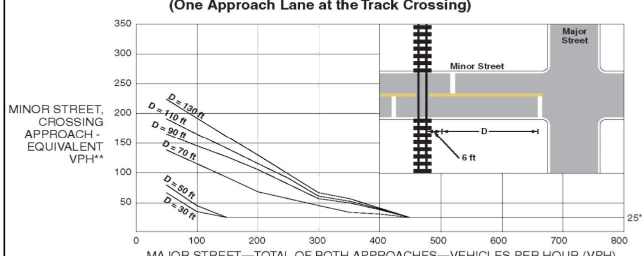
Warrant 9: Intersection Near a Grade Crossing

This warrant is intended for application where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic signal.

Does a grade crossing exist on an approach controlled by a STOP or YIELD sign whereby the center of the track nearest to the intersection is within 140 feet of the stop or yield line?

No

Figure 4C-9. Warrant 9, Intersection Near a Grade Crossing (One Approach Lane at the Track Crossing)



* 25 vph applies as the lower threshold volume
** VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

During the highest traffic volume hour during which the rail traffic uses the crossing, does the plotted point representing vehicles per hour on the major street and the corresponding vehicles per hour on the minor-street approach that crosses the track fall above the applicable curve in Figure 4C-9 or 4C-10 (whichever is applicable) for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance? **N/A**

Warrant 9 Satisfied? **N/A**

Warrant 1: Eight-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019) 50% RTs

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	20	56	143	199	20
6:00	0	37	145	440	585	37
7:00	0	87	281	942	1223	87
8:00	0	71	327	629	956	71
9:00	1	36	325	452	777	36
10:00	0	38	354	415	769	38
11:00	0	38	427	438	865	38
12:00	1	33	482	402	884	33
13:00	0	37	488	361	849	37
14:00	0	37	579	390	969	37
15:00	0	55	708	472	1180	55
16:00	0	46	919	441	1360	46
17:00	0	45	996	401	1397	45
18:00	0	31	581	294	875	31
19:00	0	19	370	204	574	19
20:00	0	16	293	181	474	16
21:00	0	0	0	0	0	0
22:00	0	0	0	0	0	0
23:00	0	0	0	0	0	0
TOTAL	**2**	**646**	**7331**	**6605**	**13936**	**646**

Condition A - Minimum Vehicular Volume (70% Columns):
Major Street Total > 420 and Higher Minor Street Total > 105 for 8 hours? **No (0 hrs)**

Condition B - Interruption of Continuous Traffic (70% Columns):
Major Street Total > 630 and Higher Minor Street Total > 53 for 8 hours? **No (3 hrs)**

Combination of Conditions A & B (56% Columns):
Major Street Total > 336 and Higher Minor Street Total > 84 for 8 hours? **No (1 hr)**

Major Street Total > 504 and Higher Minor Street Total > 42 for 8 hours? **No (5 hrs)**

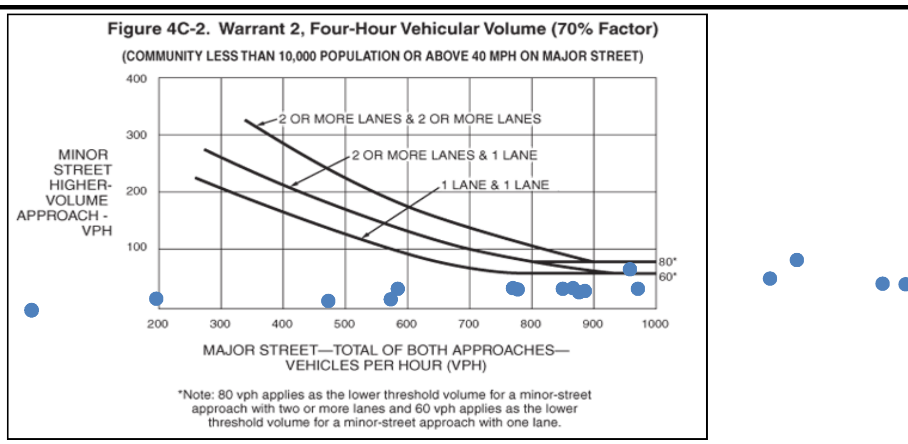
Warrant 1 Satisfied? **No**

Warrant 2: Four-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019) 50% RTs

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	20	56	143	199	20
6:00	0	37	145	440	585	37
7:00	0	87	281	942	1223	87
8:00	0	71	327	629	956	71
9:00	1	36	325	452	777	36
10:00	0	38	354	415	769	38
11:00	0	38	427	438	865	38
12:00	1	33	482	402	884	33
13:00	0	37	488	361	849	37
14:00	0	37	579	390	969	37
15:00	0	55	708	472	1180	55
16:00	0	46	919	441	1360	46
17:00	0	45	996	401	1397	45
18:00	0	31	581	294	875	31
19:00	0	19	370	204	574	19
20:00	0	16	293	181	474	16
21:00	0	0	0	0	0	0
22:00	0	0	0	0	0	0
23:00	0	0	0	0	0	0
TOTAL	**2**	**646**	**7331**	**6605**	**13936**	**646**



Meets warrant criteria on graph for minimum of 4 hours (100% thresholds)? **No (2 hrs)**

Warrant 2 Satisfied? **No**

Warrant 3: Peak Hour

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019) 50% RTs

AM Peak Hour	**7:30-8:30 AM**
High Minor Total Stopped Time Delay (hrs)	**0.48**
Total Volume of Major Approaches (vehs)	**1285**
High Minor Approach Volume (vehs)	**116**
Total Entering Volume (vehs)	**1401**
After School Peak Hour	**2:45-3:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.17**
Total Volume of Major Approaches (vehs)	**1133**
High Minor Approach Volume (vehs)	**52**
Total Entering Volume (vehs)	**1185**
PM Peak Hour	**4:45-5:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.19**
Total Volume of Major Approaches (vehs)	**1499**
High Minor Approach Volume (vehs)	**47**
Total Entering Volume (vehs)	**1546**

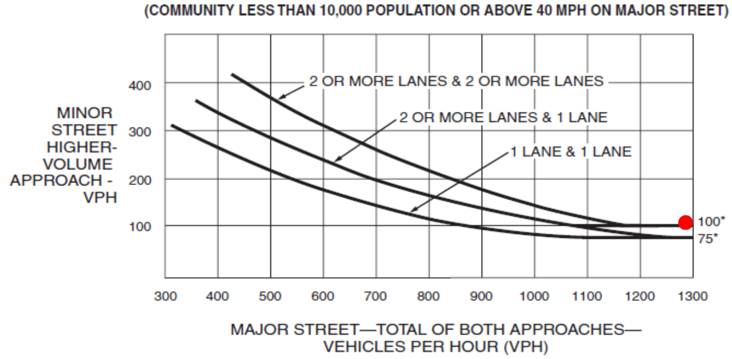
Category A: Peak Period: AM

Total stopped time delay for minor approach > 4 veh-hrs?	**No (0.48)**
High minor approach volume > 100 for peak hour?	**Yes (116)**
Total entering volume > 800 for peak hour?	**Yes (1401)**
Category A warrant satisfied?	**No**

Category B:

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of one hour (100% thresholds)?	**Yes**
Warrant 3 Satisfied?	**Yes**

Warrant 4: Pedestrian Volume

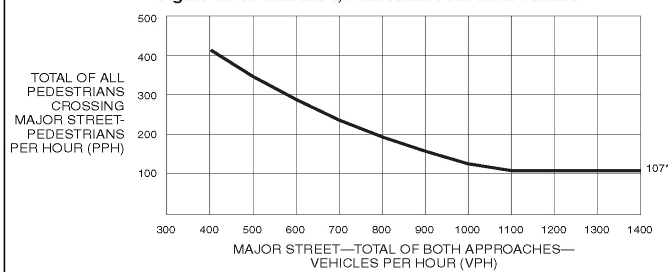
General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019) 50% RTs

This warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

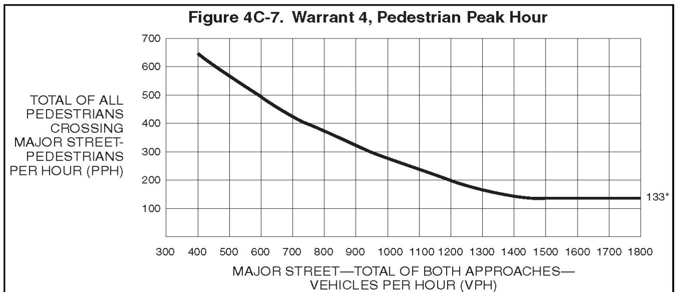
Hour Begin	Major Street Total Traffic	Pedestrian Volume Crossing Major Street
0:00	0	
1:00	0	
2:00	0	
3:00	0	
4:00	0	
5:00	199	
6:00	585	
7:00	1223	
8:00	956	
9:00	777	
10:00	769	
11:00	865	
12:00	884	
13:00	849	
14:00	969	
15:00	1180	
16:00	1360	
17:00	1397	
18:00	875	
19:00	574	
20:00	474	
21:00	0	
22:00	0	
23:00	0	
TOTAL	**13,936**	**0**

Figure 4C-5. Warrant 4, Pedestrian Four-Hour Volume



*Note: 107 pph applies as the lower threshold volume.

Figure 4C-7. Warrant 4, Pedestrian Peak Hour



*Note: 133 pph applies as the lower threshold volume.

For each of any 4 hours of an average day, do the plotted points representing representing the vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-5? **N/A**

For 1 hour of an average day, does the plotted point representing vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-7? **N/A**

Warrant 4 Satisfied? **N/A**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019) 50% RTs

Warrant 5: School Crossing

This warrant is intended for application where the fact that school children (elementary through high school students) cross the major street is the principle reason to consider installing a traffic signal. This warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless it can be shown that the proposed traffic signal would not restrict the progressive movement of traffic.

Is the number of adequate gaps in the major crossing traffic steam during the primary crossing period less than the number of minutes in that crossing period? **N/A**

Do 20 or more students cross at this location during the highest crossing hour? **N/A**

Warrant 5 Satisfied? **N/A**

Warrant 6: Coordinated Signal System

This warrant is intended for application where installation of a traffic signal would help to provide proper platooning of vehicles and therefore provide progressive movement in a coordinated signal system.

Are any adjacent traffic signals located so far away that they do not provide a necessary degree of platooning and/or progressive operation? **N/A**

Warrant 6 Satisfied? **No**

Warrant 7: Crash Experience

This warrant is intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal

Have adequate trials of alternatives failed to reduce the crash frequency? **N/A**

Have 5 or more crashes, of types susceptible to correction by a signal, occurred within a 12-month period? **No**

Is Condition A criterion met for 56% columns of Warrant 1 met? **No**

Is Condition B criterion met for 56% columns of Warrant 1 met? **No**

Are observed pedestrian volumes equal to or greater than 80% of what is required for Warrant 4? **No**

Warrant 7 Satisfied? **No**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019) 50% RTs

Warrant 8: Roadway Network

This warrant is intended for application where installation of a traffic signal could be justified in order to encourage concentration and organization of traffic flow on a roadway network

Do two or more of the intersecting routes at this location have at least one of the following characteristics:

A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or
B. It includes rural or suburban highways outside, entering, or traversing a City; or
C. It appears as a major route on an official plan.

No

Does this intersection have an existing or immediately projected total entering volume of a least 1000 vehicles during a weekday typical peak hour and have a 5-year projected traffic volume that meets one or more of Warrants 1, 2, and 3 during an average weekday? **No**

Does this intersection have an existing or immediately projected total entering volume of at least 1000 vph for each of any 5 hours of a Saturday or Sunday? **N/A**

Warrant 8 Satisfied? **No**

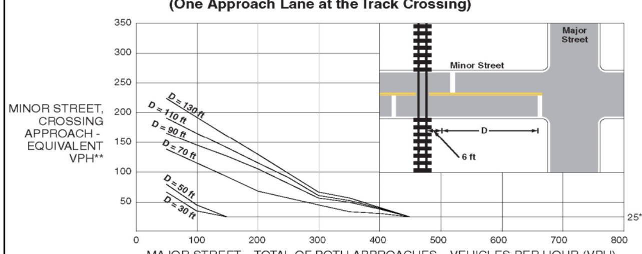
Warrant 9: Intersection Near a Grade Crossing

This warrant is intended for application where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic signal.

Does a grade crossing exist on an approach controlled by a STOP or YIELD sign whereby the center of the track nearest to the intersection is within 140 feet of the stop or yield line?

No

Figure 4C-9. Warrant 9, Intersection Near a Grade Crossing (One Approach Lane at the Track Crossing)



* 25 vph applies as the lower threshold volume
** VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

During the highest traffic volume hour during which the rail traffic uses the crossing, does the plotted point representing vehicles per hour on the major street and the corresponding vehicles per hour on the minor-street approach that crosses the track fall above the applicable curve in Figure 4C-9 or 4C-10 (whichever is applicable) for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance? **N/A**

Warrant 9 Satisfied? **N/A**

Warrant 1: Eight-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	55	67	161	228	55
6:00	0	115	172	494	666	115
7:00	0	296	334	1058	1392	296
8:00	0	224	389	706	1095	224
9:00	1	115	387	507	894	115
10:00	0	122	421	466	887	122
11:00	0	122	508	492	1000	122
12:00	1	110	573	451	1024	110
13:00	0	120	580	405	985	120
14:00	0	113	689	438	1127	113
15:00	0	176	842	530	1372	176
16:00	0	147	1093	495	1588	147
17:00	0	137	1185	450	1635	137
18:00	0	96	691	330	1021	96
19:00	0	63	440	229	669	63
20:00	0	48	349	203	552	48
21:00	0	0	0	0	0	0
22:00	0	0	0	0	0	0
23:00	0	0	0	0	0	0
TOTAL	**2**	**2059**	**8720**	**7415**	**16135**	**2059**

Condition A - Minimum Vehicular Volume (100% Columns):
Major Street Total > 420 and Higher Minor Street Total > 105 for 8 hours? **Yes (12 hrs)**

Condition B - Interruption of Continuous Traffic (100% Columns):
Major Street Total > 630 and Higher Minor Street Total > 53 for 8 hours? **Yes (14 hrs)**

Combination of Conditions A & B (80% Columns):
Major Street Total > 336 and Higher Minor Street Total > 84 for 8 hours? **Yes (13 hrs)**

Major Street Total > 504 and Higher Minor Street Total > 42 for 8 hours? **Yes (13 hrs)**

Warrant 1 Satisfied? **Yes**

Warrant 2: Four-Hour Vehicular Volume

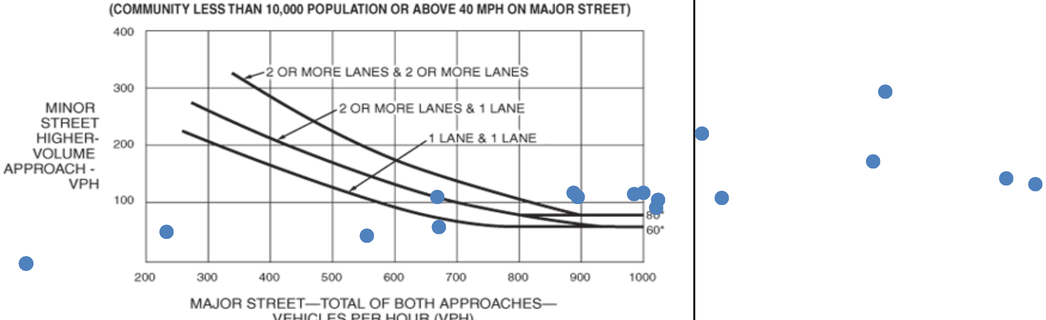
General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	55	67	161	228	55
6:00	0	115	172	494	666	115
7:00	0	296	334	1058	1392	296
8:00	0	224	389	706	1095	224
9:00	1	115	387	507	894	115
10:00	0	122	421	466	887	122
11:00	0	122	508	492	1000	122
12:00	1	110	573	451	1024	110
13:00	0	120	580	405	985	120
14:00	0	113	689	438	1127	113
15:00	0	176	842	530	1372	176
16:00	0	147	1093	495	1588	147
17:00	0	137	1185	450	1635	137
18:00	0	96	691	330	1021	96
19:00	0	63	440	229	669	63
20:00	0	48	349	203	552	48
21:00	0	0	0	0	0	0
22:00	0	0	0	0	0	0
23:00	0	0	0	0	0	0
TOTAL	**2**	**2059**	**8720**	**7415**	**16135**	**2059**

Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of 4 hours (100% thresholds)?	**Yes (12 hrs)**
Warrant 2 Satisfied?	**Yes**

Warrant 3: Peak Hour

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

AM Peak Hour	**7:30-8:30 AM**
High Minor Total Stopped Time Delay (hrs)	**29.06**
Total Volume of Major Approaches (vehs)	**1466**
High Minor Approach Volume (vehs)	**348**
Total Entering Volume (vehs)	**1814**
After School Peak Hour	**2:45-3:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.97**
Total Volume of Major Approaches (vehs)	**1319**
High Minor Approach Volume (vehs)	**182**
Total Entering Volume (vehs)	**1501**
PM Peak Hour	**4:45-5:45 PM**
High Minor Total Stopped Time Delay (hrs)	**1.36**
Total Volume of Major Approaches (vehs)	**1751**
High Minor Approach Volume (vehs)	**159**
Total Entering Volume (vehs)	**1910**

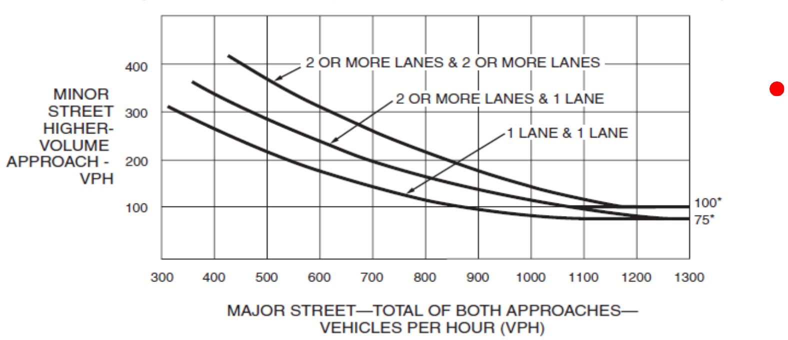
Category A: Peak Period: AM

Total stopped time delay for minor approach > 4 veh-hrs?	**Yes (29.06)**
High minor approach volume > 100 for peak hour?	**Yes (348)**
Total entering volume > 800 for peak hour?	**Yes (1814)**
Category A warrant satisfied?	**Yes**

Category B:

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of one hour (100% thresholds)?	**Yes**
Warrant 3 Satisfied?	**Yes**

Warrant 4: Pedestrian Volume

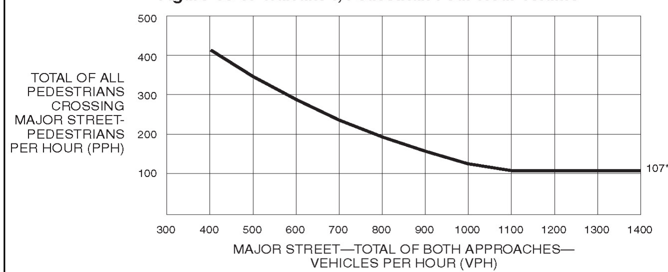
General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

This warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

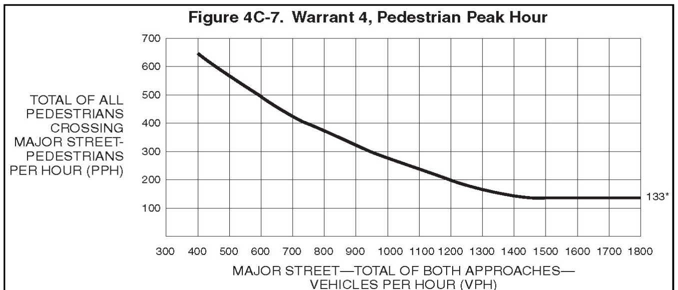
Hour Begin	Major Street Total Traffic	Pedestrian Volume Crossing Major Street
0:00	0	
1:00	0	
2:00	0	
3:00	0	
4:00	0	
5:00	228	
6:00	666	
7:00	1392	
8:00	1095	
9:00	894	
10:00	887	
11:00	1000	
12:00	1024	
13:00	985	
14:00	1127	
15:00	1372	
16:00	1588	
17:00	1635	
18:00	1021	
19:00	669	
20:00	552	
21:00	0	
22:00	0	
23:00	0	
TOTAL	**16,135**	**0**

Figure 4C-5. Warrant 4, Pedestrian Four-Hour Volume



*Note: 107 pph applies as the lower threshold volume.

Figure 4C-7. Warrant 4, Pedestrian Peak Hour



*Note: 133 pph applies as the lower threshold volume.

For each of any 4 hours of an average day, do the plotted points representing representing the vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-5? **N/A**

For 1 hour of an average day, does the plotted point representing vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-7? **N/A**

Warrant 4 Satisfied? **N/A**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Warrant 5: School Crossing

This warrant is intended for application where the fact that school children (elementary through high school students) cross the major street is the principle reason to consider installing a traffic signal. This warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless it can be shown that the proposed traffic signal would not restrict the progressive movement of traffic.

Is the number of adequate gaps in the major crossing traffic steam during the primary crossing period less than the number of minutes in that crossing period? **N/A**

Do 20 or more students cross at this location during the highest crossing hour? **N/A**

Warrant 5 Satisfied? **N/A**

Warrant 6: Coordinated Signal System

This warrant is intended for application where installation of a traffic signal would help to provide proper platooning of vehicles and therefore provide progressive movement in a coordinated signal system.

Are any adjacent traffic signals located so far away that they do not provide a necessary degree of platooning and/or progressive operation? **N/A**

Warrant 6 Satisfied? **No**

Warrant 7: Crash Experience

This warrant is intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal

Have adequate trials of alternatives failed to reduce the crash frequency? **N/A**

Have 5 or more crashes, of types susceptible to correction by a signal, occurred within a 12-month period? **No**

Is Condition A criterion met for 56% columns of Warrant 1 met? **Yes**

Is Condition B criterion met for 56% columns of Warrant 1 met? **Yes**

Are observed pedestrian volumes equal to or greater than 80% of what is required for Warrant 4? **No**

Warrant 7 Satisfied? **No**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Warrant 8: Roadway Network

This warrant is intended for application where installation of a traffic signal could be justified in order to encourage concentration and organization of traffic flow on a roadway network

Do two or more of the intersecting routes at this location have at least one of the following characteristics:

A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or
B. It includes rural or suburban highways outside, entering, or traversing a City; or
C. It appears as a major route on an official plan.

No

Does this intersection have an existing or immediately projected total entering volume of a least 1000 vehicles during a weekday typical peak hour and have a 5-year projected traffic volume that meets one or more of Warrants 1, 2, and 3 during an average weekday? **No**

Does this intersection have an existing or immediately projected total entering volume of at least 1000 vph for each of any 5 hours of a Saturday or Sunday? **N/A**

Warrant 8 Satisfied? **No**

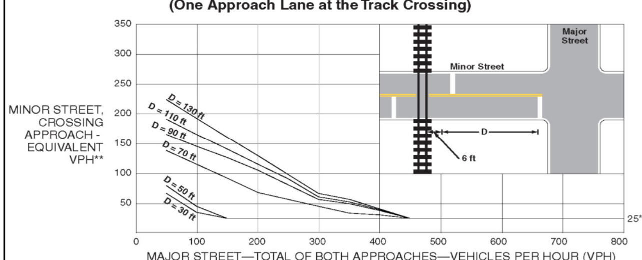
Warrant 9: Intersection Near a Grade Crossing

This warrant is intended for application where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic signal.

Does a grade crossing exist on an approach controlled by a STOP or YIELD sign whereby the center of the track nearest to the intersection is within 140 feet of the stop or yield line?

No

Figure 4C-9. Warrant 9, Intersection Near a Grade Crossing (One Approach Lane at the Track Crossing)



* 25 vph applies as the lower threshold volume
** VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

During the highest traffic volume hour during which the rail traffic uses the crossing, does the plotted point representing vehicles per hour on the major street and the corresponding vehicles per hour on the minor-street approach that crosses the track fall above the applicable curve in Figure 4C-9 or 4C-10 (whichever is applicable) for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance? **N/A**

Warrant 9 Satisfied? **N/A**

Warrant 1: Eight-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040) 50% SB RTs

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	35	67	161	228	35
6:00	0	65	172	494	666	65
7:00	0	153	334	1058	1392	153
8:00	0	125	389	706	1095	125
9:00	1	63	387	507	894	63
10:00	0	67	421	466	887	67
11:00	0	67	508	492	1000	67
12:00	1	58	573	451	1024	58
13:00	0	65	580	405	985	65
14:00	0	65	689	438	1127	65
15:00	0	97	842	530	1372	97
16:00	0	81	1093	495	1588	81
17:00	0	79	1185	450	1635	79
18:00	0	55	691	330	1021	55
19:00	0	33	440	229	669	33
20:00	0	28	349	203	552	28
21:00	0	0	0	0	0	0
22:00	0	0	0	0	0	0
23:00	0	0	0	0	0	0
TOTAL	**2**	**1136**	**8720**	**7415**	**16135**	**1136**

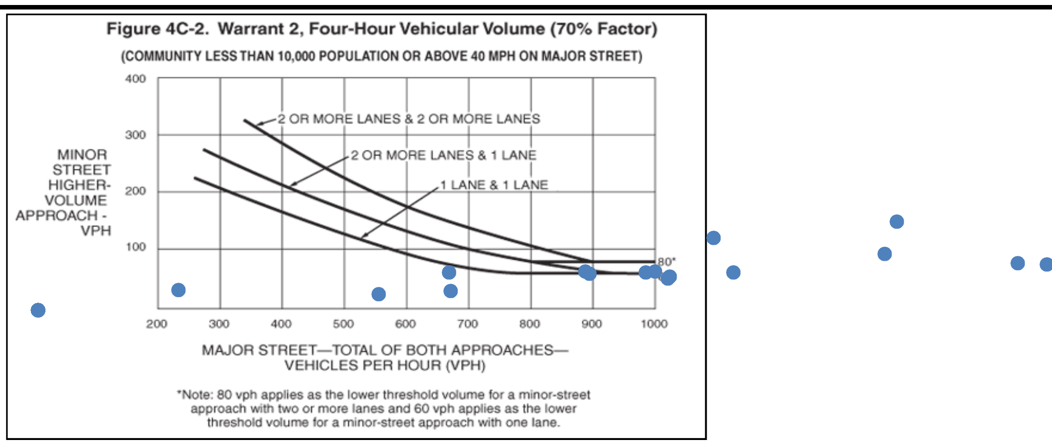
Condition A - Minimum Vehicular Volume (70% Columns):	
Major Street Total > 420 and Higher Minor Street Total > 105 for 8 hours?	**No (2 hrs)**
Condition B - Interruption of Continuous Traffic (70% Columns):	
Major Street Total > 630 and Higher Minor Street Total > 53 for 8 hours?	**Yes (13 hrs)**
Combination of Conditions A & B (56% Columns):	
Major Street Total > 336 and Higher Minor Street Total > 84 for 8 hours?	**No (3 hrs)**
Major Street Total > 504 and Higher Minor Street Total > 42 for 8 hours?	**Yes (13 hrs)**
Warrant 1 Satisfied?	**Yes**

Warrant 2: Four-Hour Vehicular Volume

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040) 50% SB RTs

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Higher Volume Minor Approach
	NB	SB	EB	WB		
0:00	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	35	67	161	228	35
6:00	0	65	172	494	666	65
7:00	0	153	334	1058	1392	153
8:00	0	125	389	706	1095	125
9:00	1	63	387	507	894	63
10:00	0	67	421	466	887	67
11:00	0	67	508	492	1000	67
12:00	1	58	573	451	1024	58
13:00	0	65	580	405	985	65
14:00	0	65	689	438	1127	65
15:00	0	97	842	530	1372	97
16:00	0	81	1093	495	1588	81
17:00	0	79	1185	450	1635	79
18:00	0	55	691	330	1021	55
19:00	0	33	440	229	669	33
20:00	0	28	349	203	552	28
21:00	0	0	0	0	0	0
22:00	0	0	0	0	0	0
23:00	0	0	0	0	0	0
TOTAL	**2**	**1136**	**8720**	**7415**	**16135**	**1136**



Meets warrant criteria on graph for minimum of 4 hours (100% thresholds)? **Yes (9 hrs)**

Warrant 2 Satisfied? **Yes**

Warrant 3: Peak Hour

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040) 50% SB RTs

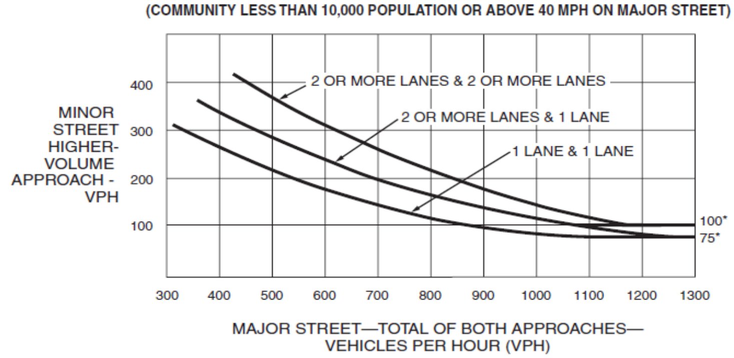
AM Peak Hour	**7:30-8:30 AM**
High Minor Total Stopped Time Delay (hrs)	**2.93**
Total Volume of Major Approaches (vehs)	**1466**
High Minor Approach Volume (vehs)	**187**
Total Entering Volume (vehs)	**1653**
After School Peak Hour	**2:45-3:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.57**
Total Volume of Major Approaches (vehs)	**1319**
High Minor Approach Volume (vehs)	**102**
Total Entering Volume (vehs)	**1421**
PM Peak Hour	**4:45-5:45 PM**
High Minor Total Stopped Time Delay (hrs)	**0.87**
Total Volume of Major Approaches (vehs)	**1751**
High Minor Approach Volume (vehs)	**88**
Total Entering Volume (vehs)	**1839**

Category A: Peak Period: AM

Total stopped time delay for minor approach > 4 veh-hrs?	**No (2.93)**
High minor approach volume > 100 for peak hour?	**Yes (187)**
Total entering volume > 800 for peak hour?	**Yes (1653)**
Category A warrant satisfied?	**No**

Category B:

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)
(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

Meets warrant criteria on graph for minimum of one hour (100% thresholds)?	**Yes**
Warrant 3 Satisfied?	**Yes**

Warrant 4: Pedestrian Volume

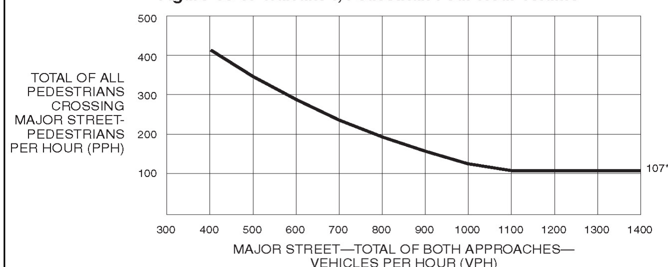
General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040) 50% SB RTs

This warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

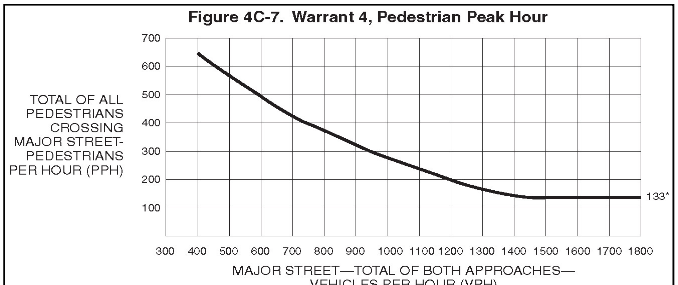
Hour Begin	Major Street Total Traffic	Pedestrian Volume Crossing Major Street
0:00	0	
1:00	0	
2:00	0	
3:00	0	
4:00	0	
5:00	228	
6:00	666	
7:00	1392	
8:00	1095	
9:00	894	
10:00	887	
11:00	1000	
12:00	1024	
13:00	985	
14:00	1127	
15:00	1372	
16:00	1588	
17:00	1635	
18:00	1021	
19:00	669	
20:00	552	
21:00	0	
22:00	0	
23:00	0	
TOTAL	**16,135**	**0**

Figure 4C-5. Warrant 4, Pedestrian Four-Hour Volume



*Note: 107 pph applies as the lower threshold volume.

Figure 4C-7. Warrant 4, Pedestrian Peak Hour



*Note: 133 pph applies as the lower threshold volume.

For each of any 4 hours of an average day, do the plotted points representing representing the vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-5? **N/A**

For 1 hour of an average day, does the plotted point representing vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street fall above the curve in Figure 4C-7? **N/A**

Warrant 4 Satisfied? **N/A**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040) 50% SB RTs

Warrant 5: School Crossing

This warrant is intended for application where the fact that school children (elementary through high school students) cross the major street is the principle reason to consider installing a traffic signal. This warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless it can be shown that the proposed traffic signal would not restrict the progressive movement of traffic.

Is the number of adequate gaps in the major crossing traffic steam during the primary crossing period less than the number of minutes in that crossing period? **N/A**

Do 20 or more students cross at this location during the highest crossing hour? **N/A**

Warrant 5 Satisfied? **N/A**

Warrant 6: Coordinated Signal System

This warrant is intended for application where installation of a traffic signal would help to provide proper platooning of vehicles and therefore provide progressive movement in a coordinated signal system.

Are any adjacent traffic signals located so far away that they do not provide a necessary degree of platooning and/or progressive operation? **N/A**

Warrant 6 Satisfied? **No**

Warrant 7: Crash Experience

This warrant is intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal

Have adequate trials of alternatives failed to reduce the crash frequency? **N/A**

Have 5 or more crashes, of types susceptible to correction by a signal, occurred within a 12-month period? **No**

Is Condition A criterion met for 56% columns of Warrant 1 met? **No**

Is Condition B criterion met for 56% columns of Warrant 1 met? **Yes**

Are observed pedestrian volumes equal to or greater than 80% of what is required for Warrant 4? **No**

Warrant 7 Satisfied? **No**

General Information

Agency/Company:	Sanderson Stewart
Date:	6/3/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	45 mph
Major Street (Approach Lanes):	US Hwy 12 (2 lanes)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040) 50% SB RTs

Warrant 8: Roadway Network

This warrant is intended for application where installation of a traffic signal could be justified in order to encourage concentration and organization of traffic flow on a roadway network

Do two or more of the intersecting routes at this location have at least one of the following characteristics:

A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or
B. It includes rural or suburban highways outside, entering, or traversing a City; or
C. It appears as a major route on an official plan.

No

Does this intersection have an existing or immediately projected total entering volume of a least 1000 vehicles during a weekday typical peak hour and have a 5-year projected traffic volume that meets one or more of Warrants 1, 2, and 3 during an average weekday? **No**

Does this intersection have an existing or immediately projected total entering volume of at least 1000 vph for each of any 5 hours of a Saturday or Sunday? **N/A**

Warrant 8 Satisfied? **No**

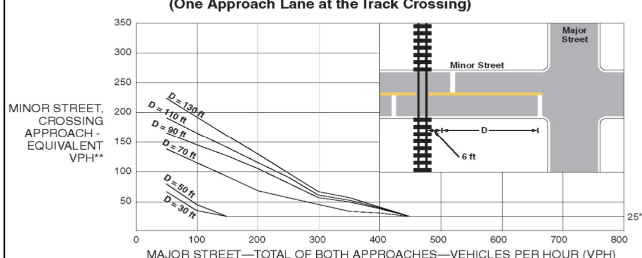
Warrant 9: Intersection Near a Grade Crossing

This warrant is intended for application where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic signal.

Does a grade crossing exist on an approach controlled by a STOP or YIELD sign whereby the center of the track nearest to the intersection is within 140 feet of the stop or yield line?

No

Figure 4C-9. Warrant 9, Intersection Near a Grade Crossing (One Approach Lane at the Track Crossing)



* 25 vph applies as the lower threshold volume
** VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

During the highest traffic volume hour during which the rail traffic uses the crossing, does the plotted point representing vehicles per hour on the major street and the corresponding vehicles per hour on the minor-street approach that crosses the track fall above the applicable curve in Figure 4C-9 or 4C-10 (whichever is applicable) for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance? **N/A**

Warrant 9 Satisfied? **N/A**

MUTCD Multi-Way Stop Control Warrant

General Information

Agency/Company:	Sanderson Stewart
Date:	7/16/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Existing (2019)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Minor Street Total (Both Approaches)
	NB	SB	EB	WB		
0:00	8	1	9	6	15	9
1:00	6	1	2	1	3	7
2:00	10	2	4	4	8	12
3:00	2	3	1	1	2	5
4:00	2	6	3	1	4	8
5:00	7	31	4	11	15	38
6:00	17	71	10	29	39	88
7:00	73	173	77	132	209	246
8:00	62	164	64	108	172	226
9:00	43	60	72	67	139	103
10:00	42	77	54	68	122	119
11:00	53	69	83	77	160	122
12:00	73	83	90	69	159	156
13:00	61	69	92	88	180	130
14:00	97	67	94	90	184	164
15:00	106	149	126	146	272	255
16:00	101	98	118	87	205	199
17:00	165	113	123	120	243	278
18:00	81	64	82	78	160	145
19:00	65	56	60	51	111	121
20:00	50	40	61	51	112	90
21:00	27	26	34	22	56	53
22:00	17	11	27	13	40	28
23:00	11	11	12	7	19	22
TOTAL	**1179**	**1445**	**1302**	**1327**	**2629**	**2624**

Condition C.1./C.2.

Major Street Total > 300 and Minor Street Total > 200 for 8 hours?	**No (0 hrs)**
Minor approach delay of at least 30 seconds/vehicle during peak hour?	**No**

Condition C.3 (70% of traffic demand values if 85th %-ile speed > 40 mph)

Major Street Total > 210 and Higher Minor Street Total > 140 for 8 hours?	**N/A**

Condition D. (80% of B, C.1, C.2)

4 or more crashes in a 12-month period susceptible to correction by AWSC	**No (1 crash)**
Major Street Total > 240 and Minor Street Total > 160 for 8 hours?	**No (2 hrs)**
Minor approach delay of at least 24 seconds/vehicle during peak hour?	**No**
Warrant 1 Satisfied?	**No**

MUTCD Multi-Way Stop Control Warrant

General Information

Agency/Company:	Sanderson Stewart
Date:	7/16/2019
Project Number:	19011
Project Description:	East Helena Corridor Study
Jurisdiction:	City of East Helena/MDT
Major Street Speed Limit:	25 mph
Major Street (Approach Lanes):	Main Street (1 lane)
Minor Street (Approach Lanes):	Montana Avenue (1 lane)
Analysis Year/Case:	Design Year (2040)

Hour Begin	Avg. Entering Volume				Major Street Total (Both Approaches)	Minor Street Total (Both Approaches)
	NB	SB	EB	WB		
0:00	14	2	12	8	20	16
1:00	11	2	3	1	4	13
2:00	18	4	5	5	10	22
3:00	4	6	1	1	2	10
4:00	4	12	4	1	5	16
5:00	12	60	5	15	20	72
6:00	30	137	13	39	52	167
7:00	129	335	102	179	281	464
8:00	109	317	85	146	231	426
9:00	76	116	96	91	187	192
10:00	74	149	72	92	164	223
11:00	93	133	110	104	214	226
12:00	129	160	120	93	213	289
13:00	107	133	122	119	241	240
14:00	171	130	125	122	247	301
15:00	187	288	168	198	366	475
16:00	178	190	157	118	275	368
17:00	291	219	164	162	326	510
18:00	143	124	109	106	215	267
19:00	114	108	80	69	149	222
20:00	88	77	81	69	150	165
21:00	48	50	45	30	75	98
22:00	30	21	36	18	54	51
23:00	19	21	16	9	25	40
TOTAL	**2079**	**2794**	**1731**	**1795**	**3526**	**4873**

Condition C.1./C.2.	
Major Street Total > 300 and Minor Street Total > 200 for 8 hours?	**No (2 hr)**
Minor approach delay of at least 30 seconds/vehicle during peak hour?	**Yes**
Condition C.3 (70% of traffic demand values if 85th %-ile speed > 40 mph)	
Major Street Total > 210 and Higher Minor Street Total > 140 for 8 hours?	**N/A**
Condition D. (80% of B, C.1, C.2)	
4 or more crashes in a 12-month period susceptible to correction by AWSC	**No (1 crash)**
Major Street Total > 240 and Minor Street Total > 160 for 8 hours?	**No (6 hrs)**
Minor approach delay of at least 24 seconds/vehicle during peak hour?	**Yes**
Warrant 1 Satisfied?	**No**

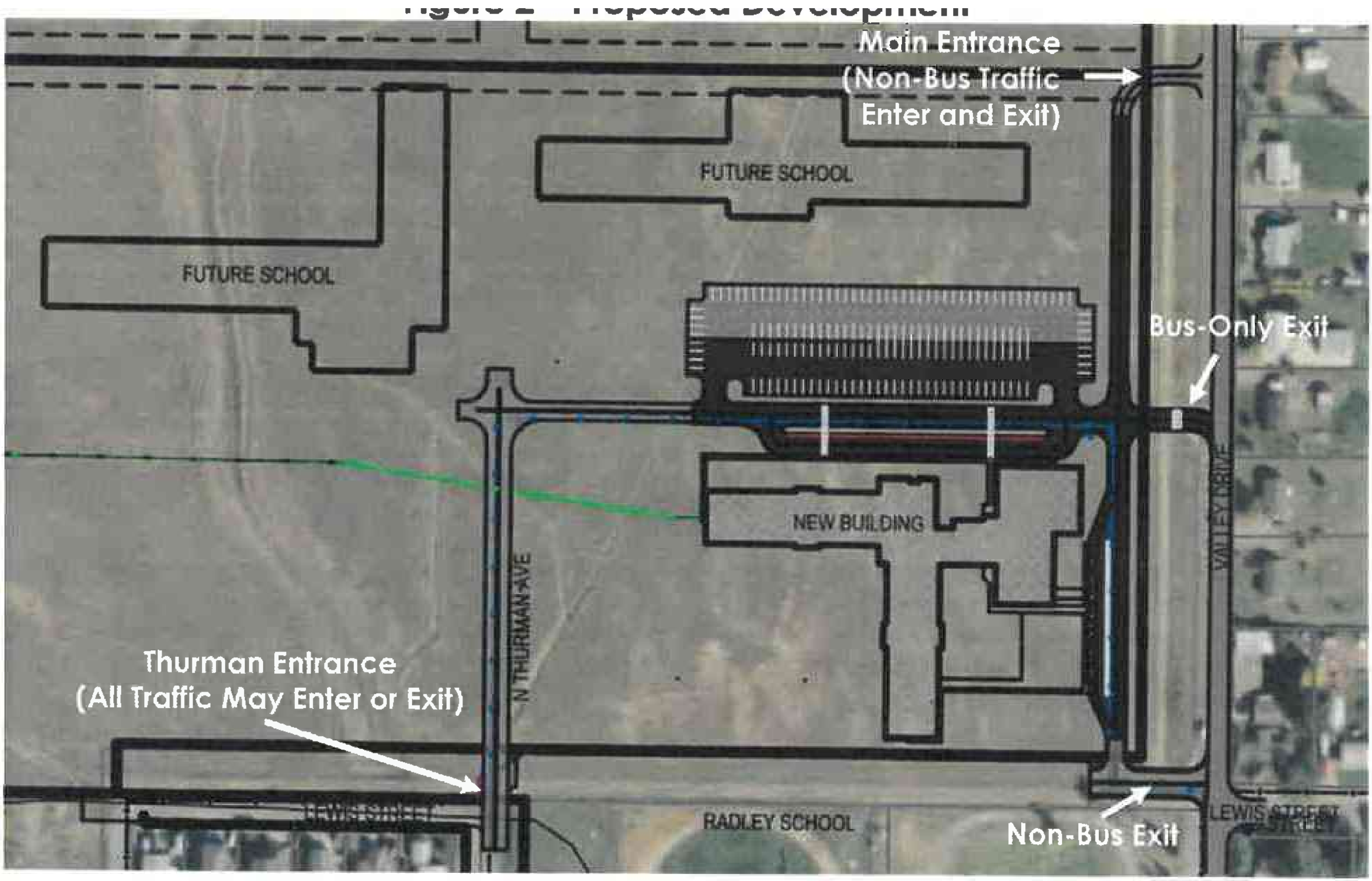
DEVELOPMENT SITE PLANS

APPENDIX I

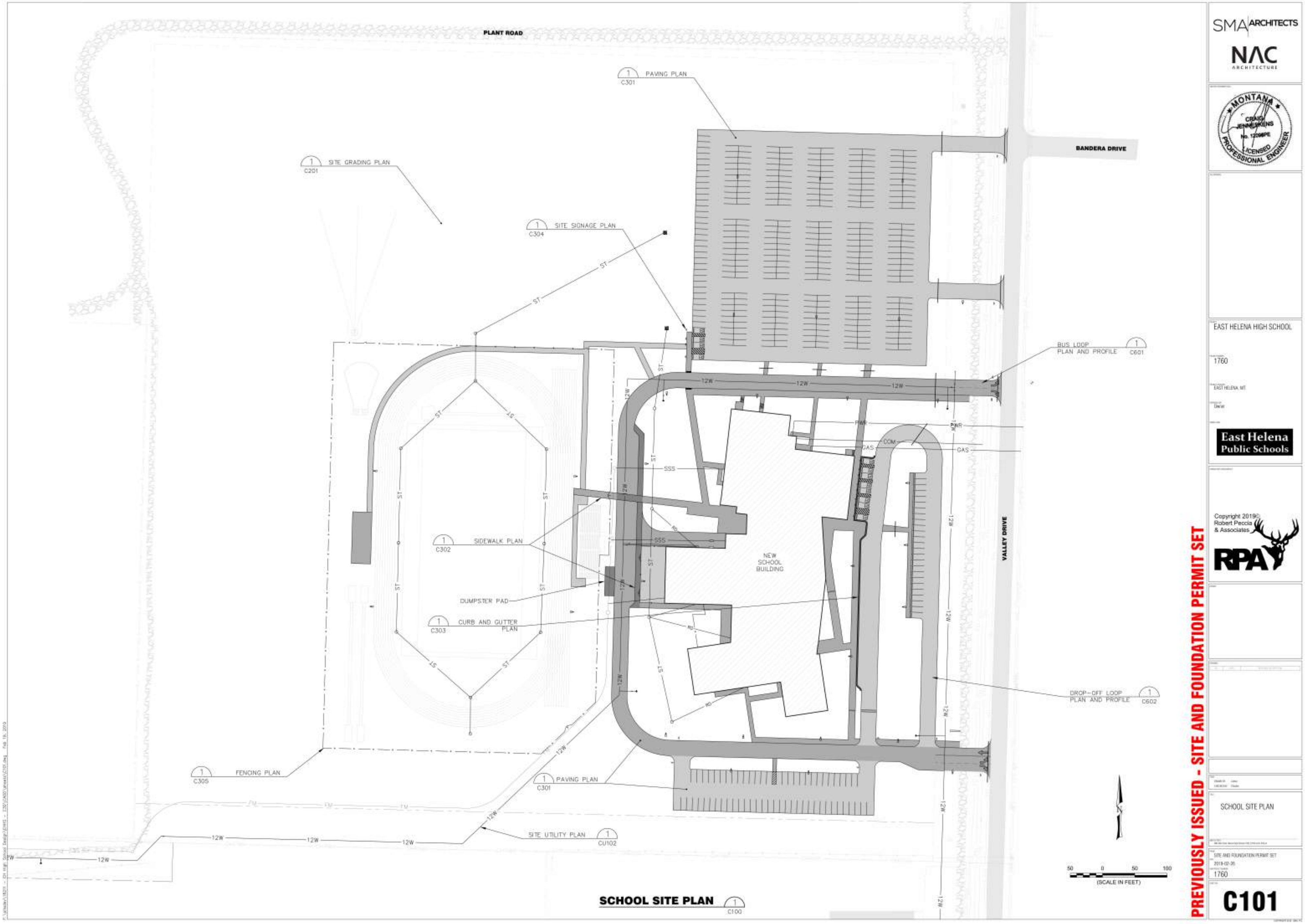
ENDURING COMMUNITY DESIGN

SANDERSON STEWART

Prickly Pear Elementary School



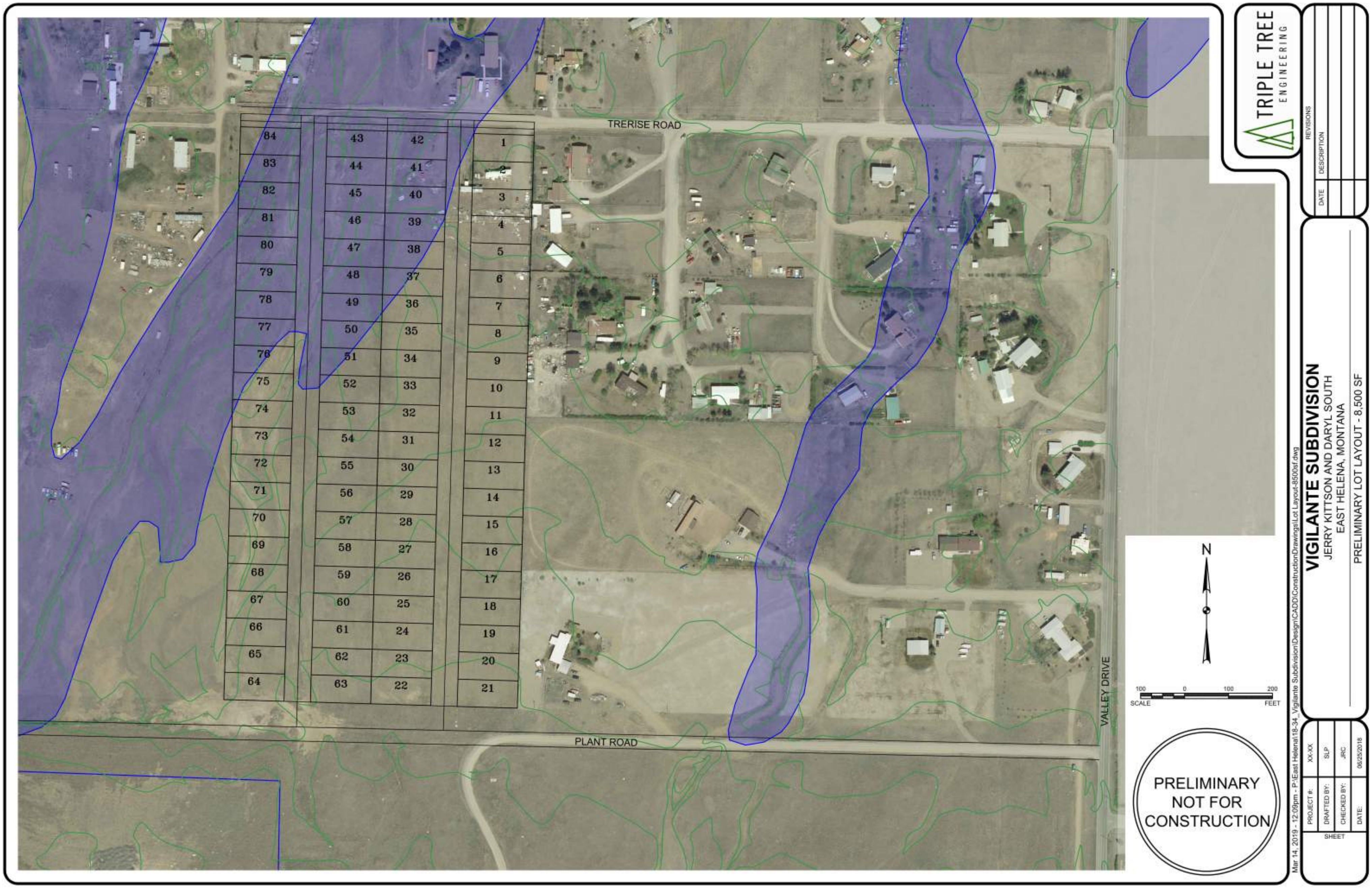
East Helena High School



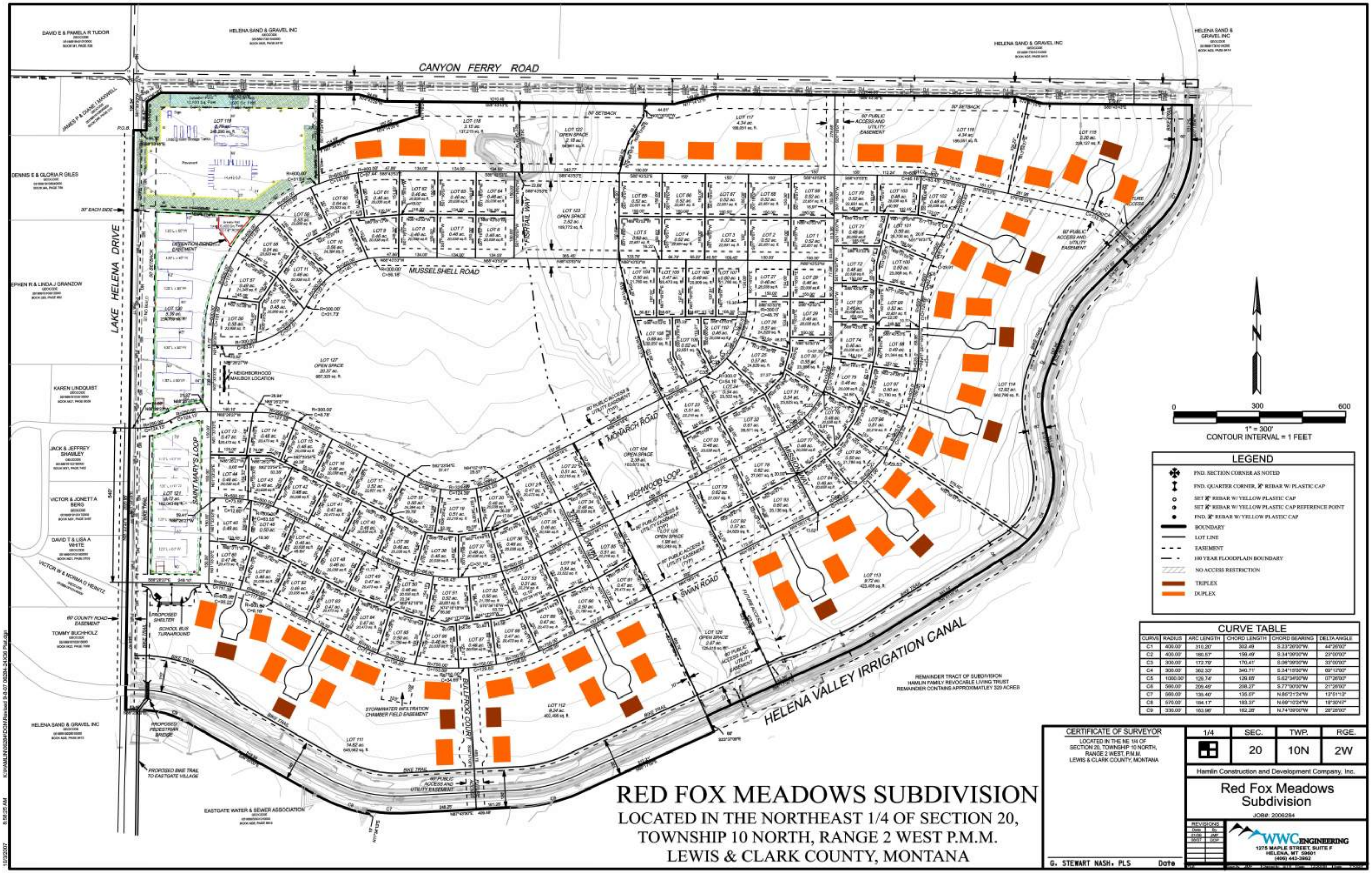
Highland Meadows Subdivison

Figure 2 – Highland Meadows Subdivision

Vigilante Subdivision



Red Fox Meadows Subdivision



CURVE TABLE

CURVE	RADIUS	ARC LENGTH	CHORD LENGTH	CHORD BEARING	DELTA ANGLE
C1	400.00'	310.20'	302.49	S.23°26'00"W	44°26'00"
C2	400.00'	160.57'	159.49'	S.34°09'00"W	23°00'00"
C3	300.00'	172.79'	170.41'	S.06°09'00"W	33°00'00"
C4	300.00'	362.30'	340.71'	S.24°15'00"W	69°12'00"
C5	1000.00'	129.74'	129.65'	S.62°34'00"W	07°26'00"
C6	560.00'	209.49'	208.27'	S.77°00'00"W	21°26'00"
C7	560.00'	135.40'	135.07'	N.85°21'24"W	13°51'13"
C8	570.00'	184.17'	183.37'	N.69°10'24"W	18°30'47"
C9	330.00'	163.96'	162.28'	N.74°09'00"W	28°28'00"

CAPACITY CALCULATIONS – DESIGN YEAR (2040)

APPENDIX J

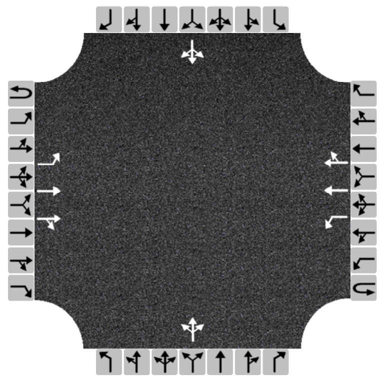
ENDURING COMMUNITY DESIGN

SANDERSON STEWART

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	US 12 & S Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	US Hwy 12
Analysis Year	2040	North/South Street	S Montana Avenue
Time Analyzed	AM Peak future	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	T	TR		L	T	TR			LTR				LTR	
Volume, V (veh/h)		152	283	0		0	1002	29		0	0	0		26	0	322
Percent Heavy Vehicles (%)		1				0				0	0	0		0	0	1
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.12				4.10				7.50	6.50	6.90		6.80	6.50	6.92
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)		2.21				2.20				3.50	4.00	3.30		3.50	4.00	3.31

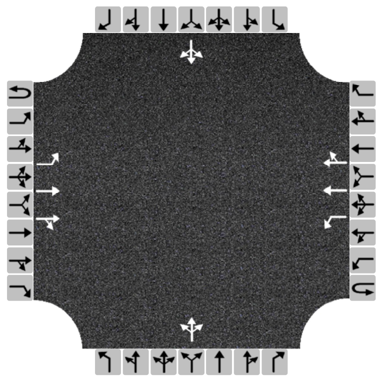
Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)		165				0					0				378	
Capacity, c (veh/h)		625				1264					0				339	
v/c Ratio		0.26				0.00									1.12	
95% Queue Length, Q_{95} (veh)		1.1				0.0									35.6	
Control Delay (s/veh)		12.8				7.8					5.0				300.6	
Level of Service, LOS		B				A					A				F	
Approach Delay (s/veh)	4.5				0.0				5.0				300.6			
Approach LOS									A				F			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	US 12 & S Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	US Hwy 12
Analysis Year	2040	North/South Street	S Montana Avenue
Time Analyzed	After School Peak future	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	T	TR		L	T	TR			LTR				LTR	
Volume, V (veh/h)		212	602	0		0	484	21		0	0	0		21	0	161
Percent Heavy Vehicles (%)		2				0				0	0	0		0	0	1
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				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.14				4.10				7.50	6.50	6.90		6.80	6.50	6.92
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				2.20				3.50	4.00	3.30		3.50	4.00	3.31

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		230				0					0				198	
Capacity, c (veh/h)		1017				943					0				451	
v/c Ratio		0.23				0.00									0.44	
95% Queue Length, Q_{95} (veh)		0.9				0.0									2.3	
Control Delay (s/veh)		9.6				8.8					5.0				19.2	
Level of Service, LOS		A				A					A				C	
Approach Delay (s/veh)	2.5				0.0				5.0				19.2			
Approach LOS									A				C			

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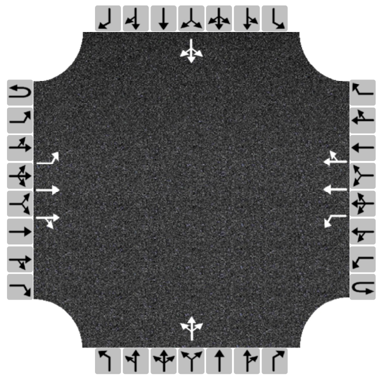
HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	US 12 & S Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	US Hwy 12
Analysis Year	2040	North/South Street	S Montana Avenue
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	1	0		0	1	0
Configuration		L	T	TR		L	T	TR			LTR				LTR	
Volume, V (veh/h)		325	927	0		0	475	24		0	0	0		17	0	142
Percent Heavy Vehicles (%)		1				0				0	0	0		0	0	1
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				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.12				4.10				7.50	6.50	6.90		6.80	6.50	6.92
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)		2.21				2.20				3.50	4.00	3.30		3.50	4.00	3.31

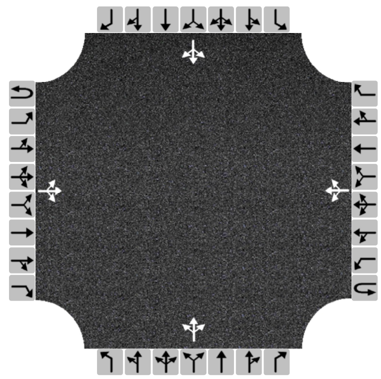
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		353				0					0				172	
Capacity, c (veh/h)		1030				696					0				311	
v/c Ratio		0.34				0.00									0.55	
95% Queue Length, Q_{95} (veh)		1.6				0.0									3.5	
Control Delay (s/veh)		10.3				10.2					5.0				30.7	
Level of Service, LOS		B				B					A				D	
Approach Delay (s/veh)	2.7				0.0				5.0				30.7			
Approach LOS									A				D			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	AM Peak future	Peak Hour Factor	0.80
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		35	82	18		32	78	120		10	143	17		111	287	47
Percent Heavy Vehicles (%)		12				0				13	1	0		5	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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.22				4.10				7.23	6.51	6.20		7.15	6.50	6.20
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)		2.31				2.20				3.62	4.01	3.30		3.54	4.00	3.30

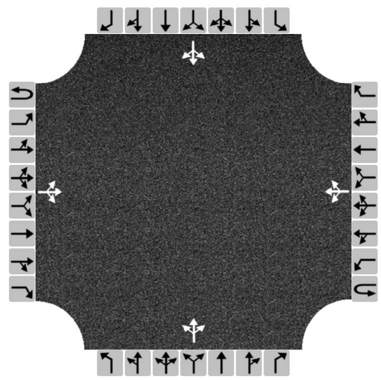
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)		44				40					212				557	
Capacity, c (veh/h)		1261				1476					388				413	
v/c Ratio		0.03				0.03					0.55				1.35	
95% Queue Length, Q_{95} (veh)		0.1				0.1					3.5				82.1	
Control Delay (s/veh)		8.0				7.5					25.3				672.8	
Level of Service, LOS		A				A					D				F	
Approach Delay (s/veh)	2.3				1.3				25.3				672.8			
Approach LOS									D				F			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	After School Peak future	Peak Hour Factor	0.80
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		35	117	16		9	107	105		10	163	21		81	166	33
Percent Heavy Vehicles (%)		0				0				13	4	0		3	0	7
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)		4.10				4.10				7.23	6.54	6.20		7.13	6.50	6.27
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)		2.20				2.20				3.62	4.04	3.30		3.53	4.00	3.36

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		44				11					242				350	
Capacity, c (veh/h)		1311				1425					438				390	
v/c Ratio		0.03				0.01					0.55				0.90	
95% Queue Length, Q_{95} (veh)		0.1				0.0					3.6				15.0	
Control Delay (s/veh)		7.8				7.5					23.3				75.0	
Level of Service, LOS		A				A					C				F	
Approach Delay (s/veh)	1.9				0.4				23.3				75.0			
Approach LOS									C				F			

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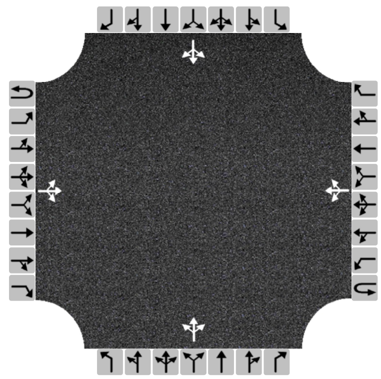
HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		41	115	20		22	77	73		18	241	26		54	135	31
Percent Heavy Vehicles (%)		0				0				7	2	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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.10				4.10				7.17	6.52	6.20		7.10	6.50	6.20
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)		2.20				2.20				3.56	4.02	3.30		3.50	4.00	3.30

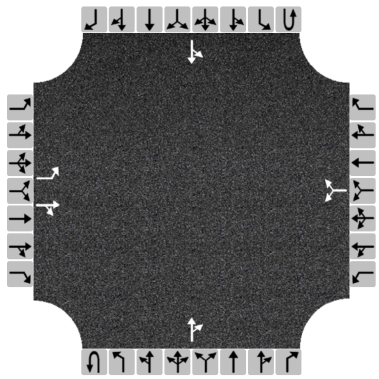
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)		45				24					310				240	
Capacity, c (veh/h)		1428				1447					494				423	
v/c Ratio		0.03				0.02					0.63				0.57	
95% Queue Length, Q_{95} (veh)		0.1				0.1					4.8				3.8	
Control Delay (s/veh)		7.6				7.5					24.3				24.5	
Level of Service, LOS		A				A					C				C	
Approach Delay (s/veh)	2.0				1.1				24.3				24.5			
Approach LOS									C				C			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Lewis Street
Analysis Year	2040	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	AM Peak future	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration		L		TR			LR					TR		LT		
Volume, V (veh/h)		34	12	129		7		73			270	1		76	350	
Percent Heavy Vehicles (%)		0	0	0		17		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		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.27		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.65		3.30						2.20		

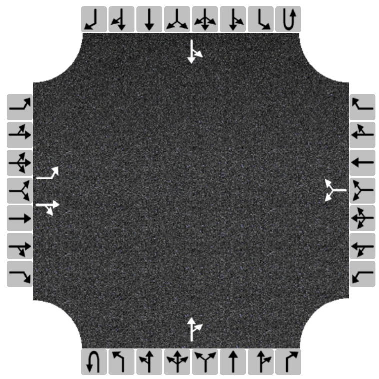
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		45		188			106							101		
Capacity, c (veh/h)		156		518			468							1209		
v/c Ratio		0.29		0.36			0.23							0.08		
95% Queue Length, Q_{95} (veh)		1.2		1.7			0.9							0.3		
Control Delay (s/veh)		37.5		15.9			14.9							8.2		
Level of Service, LOS		E		C			B							A		
Approach Delay (s/veh)	20.1				14.9								2.2			
Approach LOS	C				B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Lewis Street
Analysis Year	2040	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration		L		TR			LR					TR		LT		
Volume, V (veh/h)		25	6	60		7		58			298	5		45	257	
Percent Heavy Vehicles (%)		0	0	0		17		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		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.27		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.65		3.30						2.20		

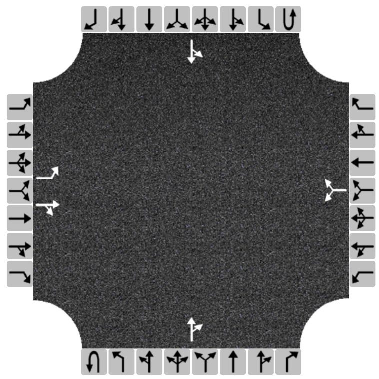
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		38		101			100							69		
Capacity, c (veh/h)		168		563			455							1106		
v/c Ratio		0.23		0.18			0.22							0.06		
95% Queue Length, Q_{95} (veh)		0.9		0.7			0.8							0.2		
Control Delay (s/veh)		32.6		12.8			15.1							8.5		
Level of Service, LOS		D		B			C							A		
Approach Delay (s/veh)	18.2				15.1								1.8			
Approach LOS	C				C											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Lewis Street
Analysis Year	2040	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration		L		TR			LR					TR		LT		
Volume, V (veh/h)		1	0	5		5		40			318	11		33	227	
Percent Heavy Vehicles (%)		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		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.10		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.50		3.30						2.20		

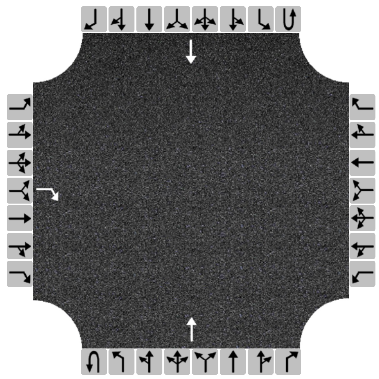
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		1		5			48							36		
Capacity, c (veh/h)		330		797			634							1212		
v/c Ratio		0.00		0.01			0.08							0.03		
95% Queue Length, Q_{95} (veh)		0.0		0.0			0.2							0.1		
Control Delay (s/veh)		15.9		9.5			11.1							8.1		
Level of Service, LOS		C		A			B							A		
Approach Delay (s/veh)	10.6				11.1								1.3			
Approach LOS	B				B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Central Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Central Access-Exit Only
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	1	0	0	0	1	0
Configuration				R							T				T	
Volume, V (veh/h)				13							375				416	
Percent Heavy Vehicles (%)				55												
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)				6.2												
Critical Headway (sec)				6.75												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.80												

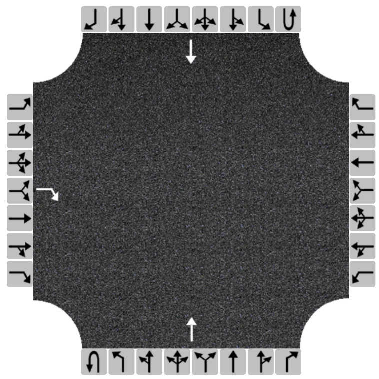
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				17												
Capacity, c (veh/h)				442												
v/c Ratio				0.04												
95% Queue Length, Q_{95} (veh)				0.1												
Control Delay (s/veh)				13.5												
Level of Service, LOS				B												
Approach Delay (s/veh)	13.5															
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Central Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Central Access-Exit Only
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	1	0	0	0	1	0
Configuration				R							T				T	
Volume, V (veh/h)				16							378				289	
Percent Heavy Vehicles (%)				29												
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)				6.2												
Critical Headway (sec)				6.49												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.56												

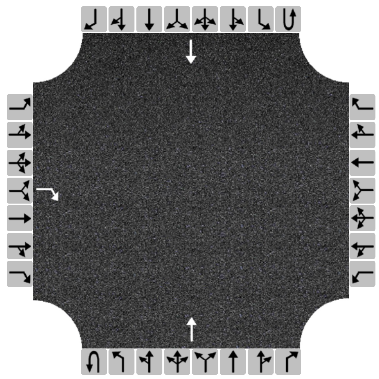
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				25												
Capacity, c (veh/h)				561												
v/c Ratio				0.04												
95% Queue Length, Q_{95} (veh)				0.1												
Control Delay (s/veh)				11.7												
Level of Service, LOS				B												
Approach Delay (s/veh)	11.7															
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Central Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Central Access-Exit Only
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	1	0	0	0	1	0
Configuration				R							T				T	
Volume, V (veh/h)				0							359				260	
Percent Heavy Vehicles (%)				0												
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)				6.2												
Critical Headway (sec)				6.20												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.30												

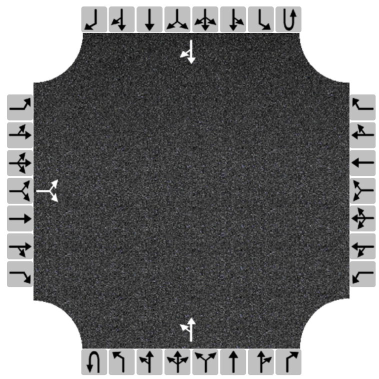
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)				0												
Capacity, c (veh/h)				761												
v/c Ratio				0.00												
95% Queue Length, Q_{95} (veh)				0.0												
Control Delay (s/veh)				9.7												
Level of Service, LOS				A												
Approach Delay (s/veh)																
Approach LOS																

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North (Main) Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		12		2						98	277				413	67
Percent Heavy Vehicles (%)		0		0						1						
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)		6.40		6.20						4.11						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.21						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			19							131						
Capacity, c (veh/h)			192							949						
v/c Ratio			0.10							0.14						
95% Queue Length, Q_{95} (veh)			0.3							0.5						
Control Delay (s/veh)			25.8							9.4						
Level of Service, LOS			D							A						
Approach Delay (s/veh)	25.8								3.7							
Approach LOS	D															

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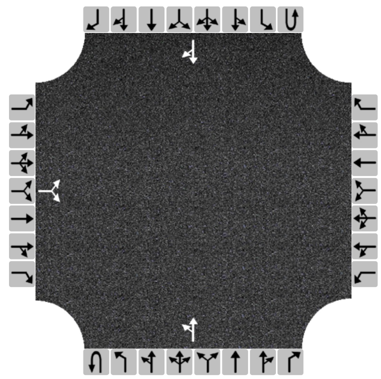
HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North (Main) Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		21		6						62	313				272	37
Percent Heavy Vehicles (%)		0		0						0						
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)		6.40		6.20						4.10						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.20						

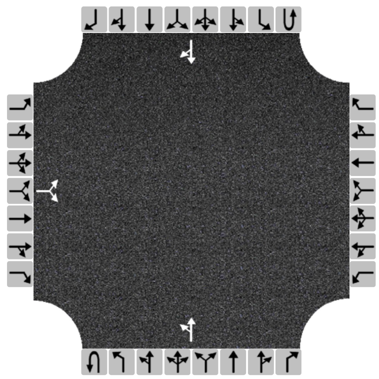
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			41							95						
Capacity, c (veh/h)			247							1098						
v/c Ratio			0.17							0.09						
95% Queue Length, Q_{95} (veh)			0.6							0.3						
Control Delay (s/veh)			22.5							8.6						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	22.5								2.3							
Approach LOS	C															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North (Main) Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		0		0						0	359				260	0
Percent Heavy Vehicles (%)		0		0						0						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.40		6.20						4.10						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.20						

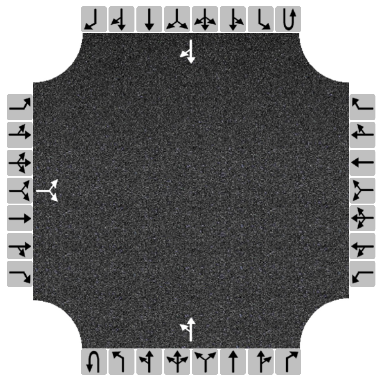
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)			0							0						
Capacity, c (veh/h)			0							1291						
v/c Ratio										0.00						
95% Queue Length, Q_{95} (veh)										0.0						
Control Delay (s/veh)			5.0							7.8						
Level of Service, LOS			A							A						
Approach Delay (s/veh)	5.0								0.0							
Approach LOS	A															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland South
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows South
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		23		69						24	256				398	12
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

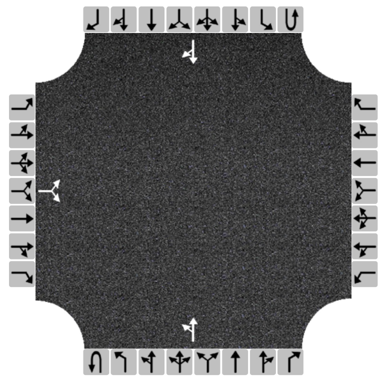
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			123							32						
Capacity, c (veh/h)			406							1016						
v/c Ratio			0.30							0.03						
95% Queue Length, Q_{95} (veh)			1.3							0.1						
Control Delay (s/veh)			17.7							8.7						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	17.7								1.1							
Approach LOS	C															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland South
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows South
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		15		43						43	304				256	16
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

Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)			89							66						
Capacity, c (veh/h)			415							1134						
v/c Ratio			0.21							0.06						
95% Queue Length, Q_{95} (veh)			0.8							0.2						
Control Delay (s/veh)			16.0							8.4						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	16.0								1.6							
Approach LOS	C															

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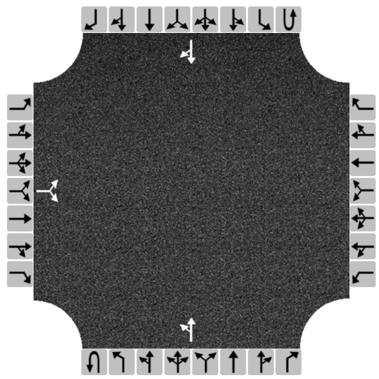
HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland South
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows South
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		11		44						77	269				210	19
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

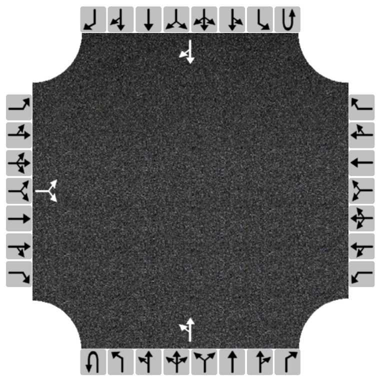
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			60							84						
Capacity, c (veh/h)			624							1309						
v/c Ratio			0.10							0.06						
95% Queue Length, Q_{95} (veh)			0.3							0.2						
Control Delay (s/veh)			11.4							7.9						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	11.4								2.2							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland North
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows North
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		31		46						16	263				364	14
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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

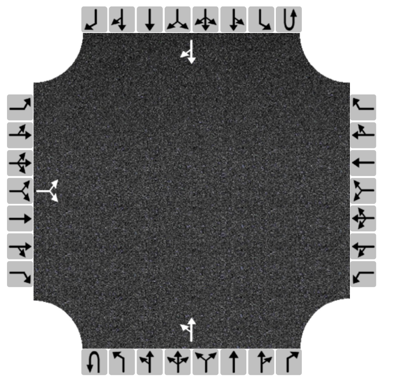
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)			102							21						
Capacity, c (veh/h)			385							1054						
v/c Ratio			0.27							0.02						
95% Queue Length, Q_{95} (veh)			1.1							0.1						
Control Delay (s/veh)			17.7							8.5						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	17.7								0.7							
Approach LOS	C															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland North
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows North
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		20		30						29	290				242	21
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

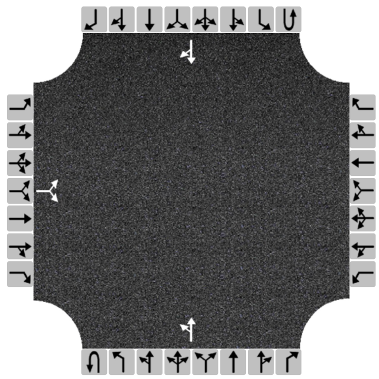
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			77							45						
Capacity, c (veh/h)			386							1148						
v/c Ratio			0.20							0.04						
95% Queue Length, Q_{95} (veh)			0.7							0.1						
Control Delay (s/veh)			16.7							8.3						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	16.7								1.1							
Approach LOS	C															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland North
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows North
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		16		30						51	229				199	27
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

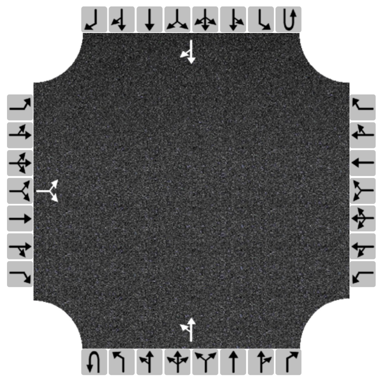
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			50							55						
Capacity, c (veh/h)			601							1314						
v/c Ratio			0.08							0.04						
95% Queue Length, Q_{95} (veh)			0.3							0.1						
Control Delay (s/veh)			11.5							7.9						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	11.5								1.7							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & S HS Bus/Visitor
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	South HS Bus/Visitor
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		3		7						27	267				371	8
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

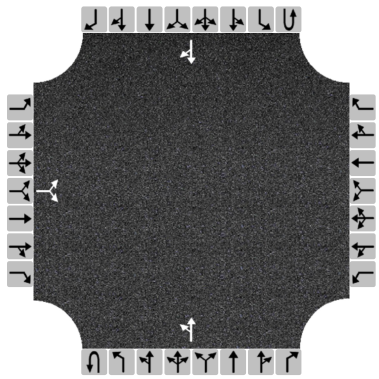
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			13							36						
Capacity, c (veh/h)			399							1053						
v/c Ratio			0.03							0.03						
95% Queue Length, Q_{95} (veh)			0.1							0.1						
Control Delay (s/veh)			14.3							8.5						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	14.3								1.1							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & S HS Bus/Visitor
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	South HS Bus/Visitor
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		6		14						10	300				249	3
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

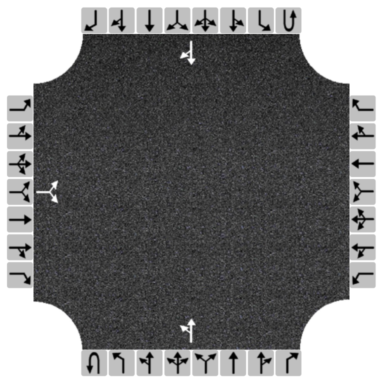
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			31							15						
Capacity, c (veh/h)			459							1164						
v/c Ratio			0.07							0.01						
95% Queue Length, Q_{95} (veh)			0.2							0.0						
Control Delay (s/veh)			13.4							8.1						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	13.4								0.4							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & S HS Bus/Visitor
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	South HS Bus/Visitor
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		6		14						0	245				212	0
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)			22							0						
Capacity, c (veh/h)			664							1331						
v/c Ratio			0.03							0.00						
95% Queue Length, Q_{95} (veh)			0.1							0.0						
Control Delay (s/veh)			10.6							7.7						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	10.6								0.0							
Approach LOS	B															

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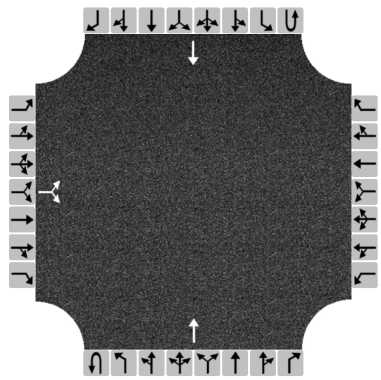
HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley Dr & N HS Bus Loop
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North HS Bus Loop Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR								T				T	
Volume, V (veh/h)		2		6							270				373	
Percent Heavy Vehicles (%)		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		6.2												
Critical Headway (sec)		7.13		6.23												
Base Follow-Up Headway (sec)		3.5		3.3												
Follow-Up Headway (sec)		3.53		3.33												

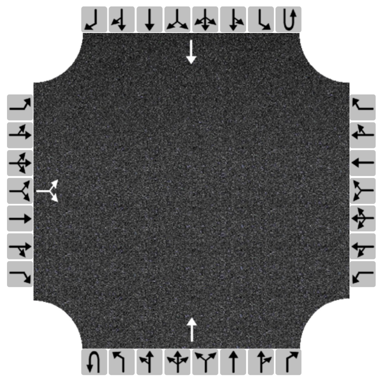
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			11													
Capacity, c (veh/h)			442													
v/c Ratio			0.02													
95% Queue Length, Q_{95} (veh)			0.1													
Control Delay (s/veh)			13.3													
Level of Service, LOS			B													
Approach Delay (s/veh)	13.3															
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & N HS Bus Loop
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North HS Bus Loop Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR								T				T	
Volume, V (veh/h)		2		6							306				246	
Percent Heavy Vehicles (%)		3		3												
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)		7.1		6.2												
Critical Headway (sec)		7.13		6.23												
Base Follow-Up Headway (sec)		3.5		3.3												
Follow-Up Headway (sec)		3.53		3.33												

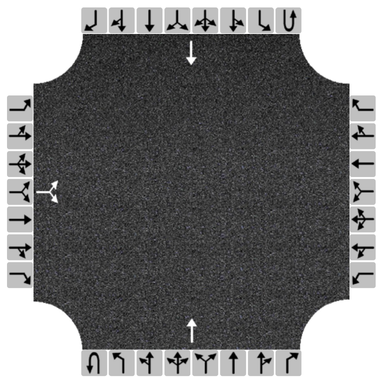
Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)			12													
Capacity, c (veh/h)			495													
v/c Ratio			0.02													
95% Queue Length, Q_{95} (veh)			0.1													
Control Delay (s/veh)			12.5													
Level of Service, LOS			B													
Approach Delay (s/veh)	12.5															
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & N HS Bus Loop
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North HS Bus Loop Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR								T				T	
Volume, V (veh/h)		0		0							251				212	
Percent Heavy Vehicles (%)		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		6.2												
Critical Headway (sec)		7.13		6.23												
Base Follow-Up Headway (sec)		3.5		3.3												
Follow-Up Headway (sec)		3.53		3.33												

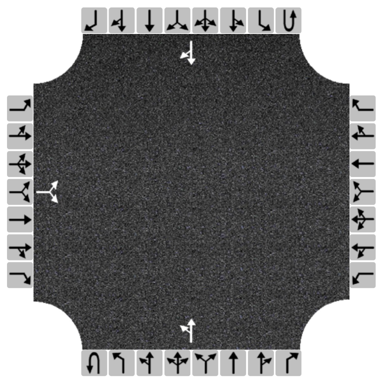
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			0													
Capacity, c (veh/h)			0													
v/c Ratio																
95% Queue Length, Q_{95} (veh)																
Control Delay (s/veh)			5.0													
Level of Service, LOS			A													
Approach Delay (s/veh)	5.0															
Approach LOS	A															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & S HS Student Lot
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	South HS Student Parking
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		13		46						46	226				327	13
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

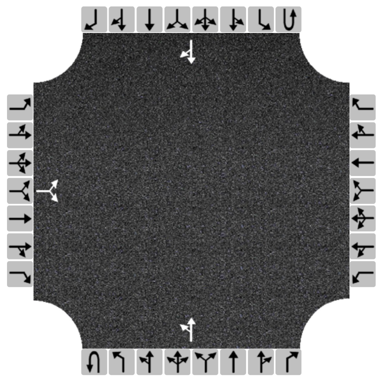
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			78							61						
Capacity, c (veh/h)			471							1101						
v/c Ratio			0.17							0.06						
95% Queue Length, Q_{95} (veh)			0.6							0.2						
Control Delay (s/veh)			14.2							8.5						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	14.2								1.9							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & S HS Student Lot
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	South HS Student Parking
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		11		41						41	267				205	11
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

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

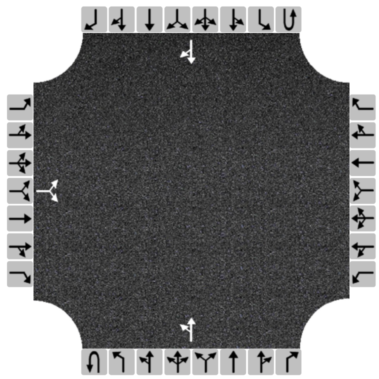
Delay, Queue Length, and Level of Service

	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Flow Rate, v (veh/h)			80							63						
Capacity, c (veh/h)			522							1220						
v/c Ratio			0.15							0.05						
95% Queue Length, Q_{95} (veh)			0.5							0.2						
Control Delay (s/veh)			13.2							8.1						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	13.2								1.5							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & S HS Student Lot
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	South HS Student Parking
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		3		8						8	243				204	3
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			12							9						
Capacity, c (veh/h)			688							1336						
v/c Ratio			0.02							0.01						
95% Queue Length, Q_{95} (veh)			0.1							0.0						
Control Delay (s/veh)			10.3							7.7						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	10.3								0.3							
Approach LOS	B															

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Valley_&_South_HS_Student_PM_2040.xtw

HCS7 Two-Way Stop-Control Report

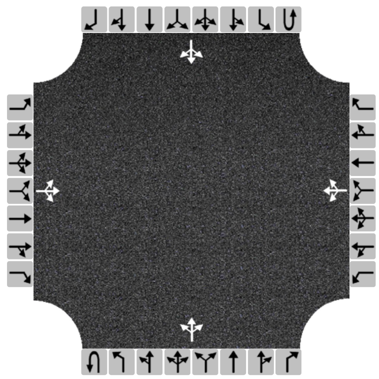
General Information

Analyst	Audrey Stoltzfus
Agency/Co.	Sanderson Stewart
Date Performed	5/31/2019
Analysis Year	2040
Time Analyzed	AM Peak future
Intersection Orientation	North-South
Project Description	East Helena Corridor Study

Site Information

Intersection	Valley Dr & Bandera Dr
Jurisdiction	City of East Helena/MDT
East/West Street	Bandera Dr/N High School
North/South Street	Valley Drive
Peak Hour Factor	0.75
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		20	6	31		14	6	8		31	204	4		4	295	20
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	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)		7.13	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		

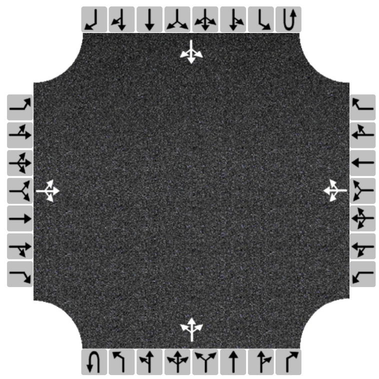
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			76				38			41				5		
Capacity, c (veh/h)			415				341			1133				1279		
v/c Ratio			0.18				0.11			0.04				0.00		
95% Queue Length, Q_{95} (veh)			0.7				0.4			0.1				0.0		
Control Delay (s/veh)			15.6				16.9			8.3				7.8		
Level of Service, LOS			C				C			A				A		
Approach Delay (s/veh)	15.6				16.9				1.4				0.1			
Approach LOS	C				C											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley Dr & Bandera Dr
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Bandera Dr/N High School
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		18	8	27		4	8	8		27	241	10		7	185	18
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	Undivided															

Critical and Follow-up Headways

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)			82				30			42				11		
Capacity, c (veh/h)			415				371			1240				1166		
v/c Ratio			0.20				0.08			0.03				0.01		
95% Queue Length, Q_{95} (veh)			0.7				0.3			0.1				0.0		
Control Delay (s/veh)			15.8				15.6			8.0				8.1		
Level of Service, LOS			C				C			A				A		
Approach Delay (s/veh)	15.8				15.6				1.1				0.4			
Approach LOS	C				C											

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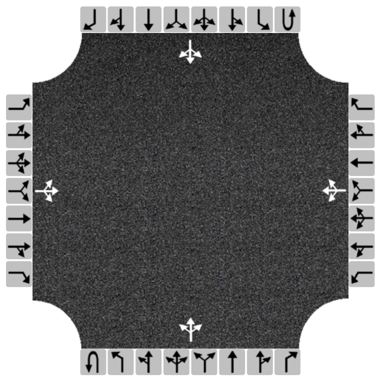
HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley Dr & Bandera Dr
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Bandera Drive
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		4	1	6		3	1	3		6	228	12		18	198	4
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	Undivided															

Critical and Follow-up Headways

Movement	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
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		

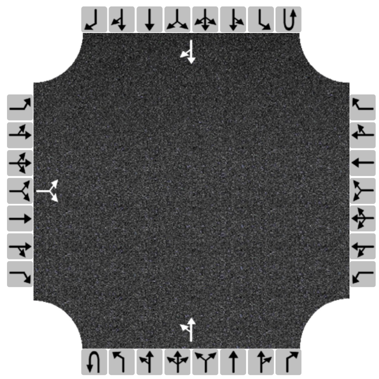
Delay, Queue Length, and Level of Service

Movement	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)			12				7			7				20		
Capacity, c (veh/h)			608				545			1343				1296		
v/c Ratio			0.02				0.01			0.01				0.02		
95% Queue Length, Q_{95} (veh)			0.1				0.0			0.0				0.0		
Control Delay (s/veh)			11.0				11.7			7.7				7.8		
Level of Service, LOS			B				B			A				A		
Approach Delay (s/veh)	11.0				11.7				0.2				0.8			
Approach LOS	B				B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley Dr & Plant Rd
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Plant Road
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future	Peak Hour Factor	0.80
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		1		2						2	230				317	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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

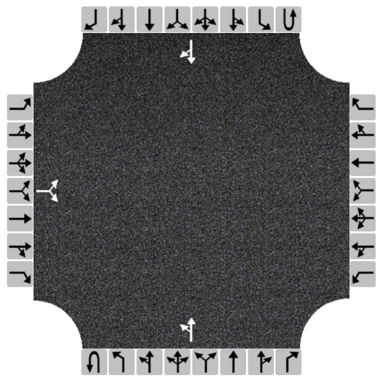
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)			3							2						
Capacity, c (veh/h)			512							1155						
v/c Ratio			0.01							0.00						
95% Queue Length, Q_{95} (veh)			0.0							0.0						
Control Delay (s/veh)			12.1							8.1						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	12.1								0.1							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley Dr & Plant Rd
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Plant Road
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School Peak future	Peak Hour Factor	0.80
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		1		1						0	267				209	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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

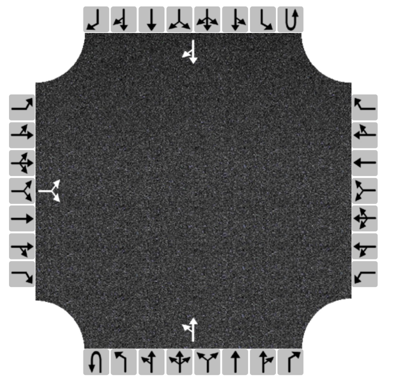
Flow Rate, v (veh/h)			2							0						
Capacity, c (veh/h)			539							1295						
v/c Ratio			0.00							0.00						
95% Queue Length, Q_{95} (veh)			0.0							0.0						
Control Delay (s/veh)			11.7							7.8						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	11.7								0.0							
Approach LOS	B															

HCS7 Two-Way Stop-Control Report

General Information / Site Information

Analyst	Audrey Stoltzfus	Intersection	Valley Dr & Plant Rd
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Plant Road
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		1		2						0	235				218	0
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			3							0						
Capacity, c (veh/h)			657							1323						
v/c Ratio			0.00							0.00						
95% Queue Length, Q_{95} (veh)			0.0							0.0						
Control Delay (s/veh)			10.5							7.7						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	10.5								0.0							
Approach LOS	B															

DESIGN YEAR CAPACITY CALCULATIONS – MITIGATION IMPROVEMENTS

APPENDIX K

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	152	283	1002	29	26	322
Future Volume (veh/h)	152	283	1002	29	26	322
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No	No		No	
Adj Sat Flow, veh/h/ln	1885	1811	1870	1870	1900	1885
Adj Flow Rate, veh/h	171	318	1126	33	29	362
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Percent Heavy Veh, %	1	6	2	2	0	1
Cap, veh/h	419	2177	1531	45	302	423
Arrive On Green	0.10	0.63	0.43	0.43	0.17	0.17
Sat Flow, veh/h	1795	3532	3619	103	1810	1598
Grp Volume(v), veh/h	171	318	567	592	29	362
Grp Sat Flow(s),veh/h/ln	1795	1721	1777	1852	1810	1598
Q Serve(g_s), s	2.0	1.7	11.9	11.9	0.6	7.5
Cycle Q Clear(g_c), s	2.0	1.7	11.9	11.9	0.6	7.5
Prop In Lane	1.00			0.06	1.00	1.00
Lane Grp Cap(c), veh/h	419	2177	772	804	302	423
V/C Ratio(X)	0.41	0.15	0.74	0.74	0.10	0.85
Avail Cap(c_a), veh/h	742	3332	1048	1092	302	423
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	7.8	3.3	10.6	10.6	15.8	15.7
Incr Delay (d2), s/veh	0.6	0.0	1.8	1.7	0.1	15.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.2	3.3	3.4	0.2	1.8
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	8.4	3.4	12.3	12.3	16.0	31.3
LnGrp LOS	A	A	B	B	B	C
Approach Vol, veh/h		489	1159		391	
Approach Delay, s/veh		5.1	12.3		30.2	
Approach LOS		A	B		C	

Timer - Assigned Phs	4	6	7	8
Phs Duration (G+Y+Rc), s	32.9	12.0	8.9	24.0
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	43.5	7.5	12.5	26.5
Max Q Clear Time (g_c+I1), s	3.7	9.5	4.0	13.9
Green Ext Time (p_c), s	2.0	0.0	0.3	5.6

Intersection Summary	
HCM 6th Ctrl Delay	14.0
HCM 6th LOS	B

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	171	318	1159	29	362
v/c Ratio	0.28	0.10	0.71	0.11	0.65
Control Delay	3.2	1.5	14.0	23.3	18.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	3.2	1.5	14.0	23.3	18.1
Queue Length 50th (ft)	0	0	97	6	69
Queue Length 95th (ft)	30	21	237	30	153
Internal Link Dist (ft)		419	420	421	
Turn Bay Length (ft)	225			50	
Base Capacity (vph)	664	3035	2141	309	605
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.26	0.10	0.54	0.09	0.60

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	212	602	484	21	21	161
Future Volume (veh/h)	212	602	484	21	21	161
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No	No		No	
Adj Sat Flow, veh/h/ln	1870	1856	1781	1781	1900	1885
Adj Flow Rate, veh/h	236	669	538	23	23	179
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	3	8	8	0	1
Cap, veh/h	610	2027	960	41	245	440
Arrive On Green	0.14	0.58	0.29	0.29	0.14	0.14
Sat Flow, veh/h	1781	3618	3396	141	1810	1598
Grp Volume(v), veh/h	236	669	275	286	23	179
Grp Sat Flow(s),veh/h/ln	1781	1763	1692	1756	1810	1598
Q Serve(g_s), s	2.4	3.1	4.3	4.3	0.3	2.8
Cycle Q Clear(g_c), s	2.4	3.1	4.3	4.3	0.3	2.8
Prop In Lane	1.00			0.08	1.00	1.00
Lane Grp Cap(c), veh/h	610	2027	491	510	245	440
V/C Ratio(X)	0.39	0.33	0.56	0.56	0.09	0.41
Avail Cap(c_a), veh/h	1192	4708	1225	1271	553	712
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	5.5	3.5	9.3	9.3	11.8	9.2
Incr Delay (d2), s/veh	0.4	0.1	1.0	1.0	0.2	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.1	1.0	1.0	0.1	2.7
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	5.9	3.6	10.3	10.3	11.9	9.8
LnGrp LOS	A	A	B	B	B	A
Approach Vol, veh/h		905	561		202	
Approach Delay, s/veh		4.2	10.3		10.0	
Approach LOS		A	B		B	

Timer - Assigned Phs	4	6	7	8
Phs Duration (G+Y+Rc), s	22.4	8.7	8.8	13.5
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	41.5	9.5	14.5	22.5
Max Q Clear Time (g_c+I1), s	5.1	4.8	4.4	6.3
Green Ext Time (p_c), s	4.6	0.3	0.5	2.7

Intersection Summary	
HCM 6th Ctrl Delay	6.9
HCM 6th LOS	A

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	236	669	561	23	179
v/c Ratio	0.27	0.20	0.35	0.05	0.24
Control Delay	2.2	1.1	9.3	15.4	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	2.2	1.1	9.3	15.4	2.9
Queue Length 50th (ft)	0	0	28	3	1
Queue Length 95th (ft)	37	46	110	23	26
Internal Link Dist (ft)		419	420	421	
Turn Bay Length (ft)	225			50	
Base Capacity (vph)	1172	3351	2594	731	1049
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.20	0.20	0.22	0.03	0.17

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	325	927	475	24	17	142
Future Volume (veh/h)	325	927	475	24	17	142
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No	No		No	
Adj Sat Flow, veh/h/ln	1885	1870	1826	1826	1900	1885
Adj Flow Rate, veh/h	369	1053	540	27	19	161
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Percent Heavy Veh, %	1	2	5	5	0	1
Cap, veh/h	689	2166	928	46	220	512
Arrive On Green	0.20	0.61	0.28	0.28	0.12	0.12
Sat Flow, veh/h	1795	3647	3454	168	1810	1598
Grp Volume(v), veh/h	369	1053	278	289	19	161
Grp Sat Flow(s),veh/h/ln	1795	1777	1735	1796	1810	1598
Q Serve(g_s), s	4.0	5.5	4.6	4.6	0.3	2.5
Cycle Q Clear(g_c), s	4.0	5.5	4.6	4.6	0.3	2.5
Prop In Lane	1.00			0.09	1.00	1.00
Lane Grp Cap(c), veh/h	689	2166	479	496	220	512
V/C Ratio(X)	0.54	0.49	0.58	0.58	0.09	0.31
Avail Cap(c_a), veh/h	1271	4516	1063	1101	460	724
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	5.7	3.6	10.4	10.4	13.0	8.6
Incr Delay (d2), s/veh	0.6	0.2	1.1	1.1	0.2	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.1	1.2	1.2	0.1	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	6.4	3.8	11.6	11.5	13.2	8.9
LnGrp LOS	A	A	B	B	B	A
Approach Vol, veh/h		1422	567		180	
Approach Delay, s/veh		4.5	11.5		9.4	
Approach LOS		A	B		A	

Timer - Assigned Phs				4		6	7	8
Phs Duration (G+Y+Rc), s				24.9		8.6	11.2	13.7
Change Period (Y+Rc), s				4.5		4.5	4.5	4.5
Max Green Setting (Gmax), s				42.5		8.5	17.5	20.5
Max Q Clear Time (g_c+I1), s				7.5		4.5	6.0	6.6
Green Ext Time (p_c), s				8.3		0.2	0.9	2.6

Intersection Summary			
HCM 6th Ctrl Delay			6.7
HCM 6th LOS			A

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	369	1053	567	19	161
v/c Ratio	0.43	0.32	0.50	0.06	0.23
Control Delay	2.9	1.3	11.7	16.9	3.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	2.9	1.3	11.7	16.9	3.2
Queue Length 50th (ft)	0	0	32	2	2
Queue Length 95th (ft)	56	77	116	21	26
Internal Link Dist (ft)		419	420	421	
Turn Bay Length (ft)	225			50	
Base Capacity (vph)	1158	3359	2300	502	1034
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.32	0.31	0.25	0.04	0.16

Intersection Summary

MOVEMENT SUMMARY

Site: 101 [US 12 & Montana AM 2040]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
East: US Hwy 12												
6	T1	1089	2.1	0.478	8.3	LOS A	2.9	72.6	0.43	0.29	0.43	33.6
16	R2	32	0.0	0.478	8.0	LOS A	2.8	71.4	0.42	0.28	0.42	32.7
Approach		1121	2.0	0.478	8.3	LOS A	2.9	72.6	0.43	0.29	0.43	33.6
North: S Montana Avenue												
7	L2	28	0.0	0.689	23.2	LOS C	4.8	120.4	0.83	1.08	1.68	27.4
14	R2	350	0.5	0.689	23.2	LOS C	4.8	120.4	0.83	1.08	1.68	26.6
Approach		378	0.5	0.689	23.2	LOS C	4.8	120.4	0.83	1.08	1.68	26.7
West: US Hwy 12												
5	L2	165	0.9	0.182	4.3	LOS A	0.8	20.2	0.11	0.04	0.11	33.8
2	T1	308	5.5	0.182	4.3	LOS A	0.8	20.2	0.11	0.03	0.11	35.1
Approach		473	3.9	0.182	4.3	LOS A	0.8	20.2	0.11	0.03	0.11	34.6
All Vehicles		1972	2.2	0.689	10.2	LOS B	4.8	120.4	0.43	0.38	0.59	32.3

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [US 12 & Montana Noon 2040]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
East: US Hwy 12												
6	T1	526	8.4	0.263	6.0	LOS A	1.1	29.2	0.38	0.27	0.38	34.6
16	R2	23	0.0	0.263	5.6	LOS A	1.1	28.7	0.37	0.26	0.37	33.8
Approach		549	8.1	0.263	6.0	LOS A	1.1	29.2	0.38	0.27	0.38	34.6
North: S Montana Avenue												
7	L2	23	0.0	0.228	6.5	LOS A	0.9	22.7	0.54	0.52	0.54	34.3
14	R2	175	1.1	0.228	6.5	LOS A	0.9	22.7	0.54	0.52	0.54	33.1
Approach		198	1.0	0.228	6.5	LOS A	0.9	22.7	0.54	0.52	0.54	33.3
West: US Hwy 12												
5	L2	230	1.4	0.334	5.8	LOS A	1.8	45.2	0.12	0.04	0.12	33.5
2	T1	654	2.8	0.334	5.7	LOS A	1.8	45.2	0.12	0.03	0.12	34.4
Approach		885	2.4	0.334	5.7	LOS A	1.8	45.2	0.12	0.04	0.12	34.2
All Vehicles		1632	4.1	0.334	5.9	LOS A	1.8	45.2	0.26	0.17	0.26	34.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [US 12 & Montana PM 2040]

New Site
Site Category: (None)
Roundabout

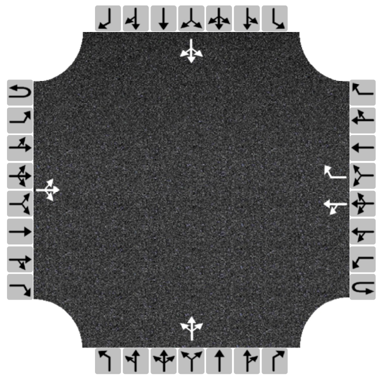
Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
East: US Hwy 12												
6	T1	516	4.7	0.280	6.6	LOS A	1.2	30.8	0.47	0.40	0.47	34.4
16	R2	26	0.0	0.280	6.2	LOS A	1.2	30.3	0.46	0.39	0.46	33.5
Approach		542	4.5	0.280	6.6	LOS A	1.2	30.8	0.47	0.40	0.47	34.4
North: S Montana Avenue												
7	L2	18	0.0	0.195	6.0	LOS A	0.8	19.0	0.52	0.48	0.52	34.6
14	R2	154	1.3	0.195	6.0	LOS A	0.8	19.0	0.52	0.48	0.52	33.4
Approach		173	1.2	0.195	6.0	LOS A	0.8	19.0	0.52	0.48	0.52	33.5
West: US Hwy 12												
5	L2	353	0.9	0.508	8.1	LOS A	3.6	92.2	0.14	0.04	0.14	32.5
2	T1	1008	1.9	0.508	7.9	LOS A	3.6	92.2	0.14	0.04	0.14	33.3
Approach		1361	1.6	0.508	8.0	LOS A	3.6	92.2	0.14	0.04	0.14	33.1
All Vehicles		2076	2.3	0.508	7.4	LOS A	3.6	92.2	0.26	0.17	0.26	33.5

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	AM Peak future turn lanes	Peak Hour Factor	0.80
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	1		0	1	0		0	1	0
Configuration			LTR			LT		R			LTR				LTR	
Volume, V (veh/h)		35	82	18		32	78	120		10	143	17		111	287	47
Percent Heavy Vehicles (%)		12				0				13	1	0		5	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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.22				4.10				7.23	6.51	6.20		7.15	6.50	6.20
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)		2.31				2.20				3.62	4.01	3.30		3.54	4.00	3.30

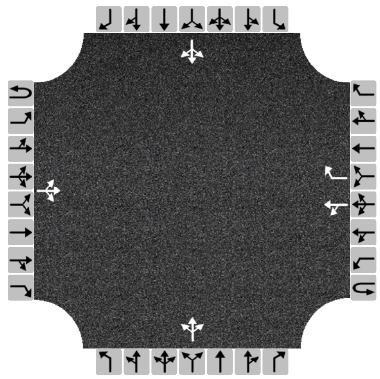
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)		44				40					212				557	
Capacity, c (veh/h)		1261				1476					476				472	
v/c Ratio		0.03				0.03					0.45				1.18	
95% Queue Length, Q_{95} (veh)		0.1				0.1					2.4				56.9	
Control Delay (s/veh)		8.0				7.5					18.6				378.8	
Level of Service, LOS		A				A					C				F	
Approach Delay (s/veh)	2.3				1.1				18.6				378.8			
Approach LOS									C				F			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	After School future turn	Peak Hour Factor	0.80
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	1		0	1	0		0	1	0
Configuration			LTR			LT		R			LTR				LTR	
Volume, V (veh/h)		35	117	16		9	107	105		10	163	21		81	166	33
Percent Heavy Vehicles (%)		0				0				13	4	0		3	0	7
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)		4.10				4.10				7.23	6.54	6.20		7.13	6.50	6.27
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)		2.20				2.20				3.62	4.04	3.30		3.53	4.00	3.36

Delay, Queue Length, and Level of Service

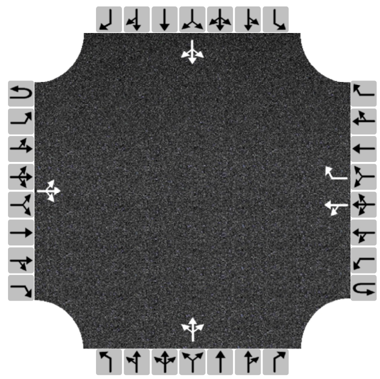
Flow Rate, v (veh/h)		44				11					242				350	
Capacity, c (veh/h)		1311				1425					513				445	
v/c Ratio		0.03				0.01					0.47				0.79	
95% Queue Length, Q_{95} (veh)		0.1				0.0					2.6				9.3	
Control Delay (s/veh)		7.8				7.5					18.2				40.9	
Level of Service, LOS		A				A					C				E	
Approach Delay (s/veh)	1.9				0.3				18.2				40.9			
Approach LOS									C				E			

HCS7 Two-Way Stop-Control Report

General Information / Site Information

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Maint St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	PM Peak future turn lanes	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	1		0	1	0		0	1	0
Configuration			LTR			LT		R			LTR				LTR	
Volume, V (veh/h)		41	115	20		22	77	73		18	241	26		54	135	31
Percent Heavy Vehicles (%)		0				0				7	2	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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.10				4.10				7.17	6.52	6.20		7.10	6.50	6.20
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)		2.20				2.20				3.56	4.02	3.30		3.50	4.00	3.30

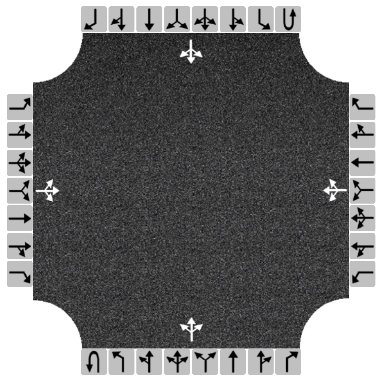
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)		45				24					310				240	
Capacity, c (veh/h)		1428				1447					544				460	
v/c Ratio		0.03				0.02					0.57				0.52	
95% Queue Length, Q_{95} (veh)		0.1				0.1					3.9				3.2	
Control Delay (s/veh)		7.6				7.5					20.3				21.3	
Level of Service, LOS		A				A					C				C	
Approach Delay (s/veh)	2.0				1.0				20.3				21.3			
Approach LOS									C				C			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Main St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	6/5/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	AM Peak future	Peak Hour Factor	0.80
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		35	82	18		32	78	120		10	143	17		111	287	47
Percent Heavy Vehicles (%)		12	5	14		0	2	3		13				5		
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)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

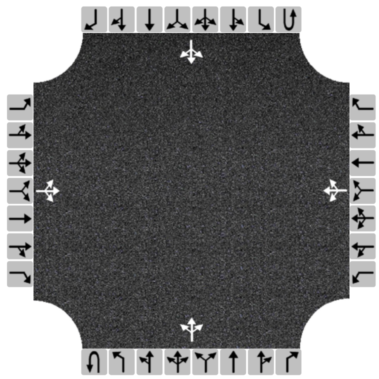
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			168				288			12				139		
Capacity, c (veh/h)			191				328			1083				1357		
v/c Ratio			0.88				0.88			0.01				0.10		
95% Queue Length, Q_{95} (veh)			11.2				13.0			0.0				0.3		
Control Delay (s/veh)			120.2				77.4			8.4				8.0		
Level of Service, LOS			F				F			A				A		
Approach Delay (s/veh)	120.2				77.4				0.6				2.8			
Approach LOS	F				F											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Main St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	6/5/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	After School Peak future	Peak Hour Factor	0.80
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		35	117	16		9	107	105		10	163	21		81	166	33
Percent Heavy Vehicles (%)		0	6	8		0	4	5		13				3		
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)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

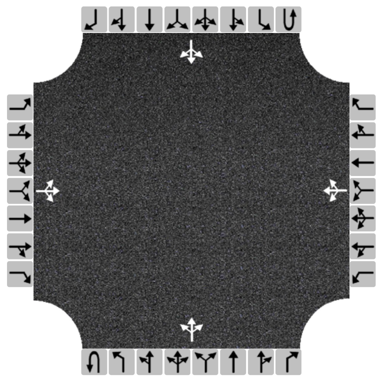
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			210				276			12				101		
Capacity, c (veh/h)			284				442			1254				1331		
v/c Ratio			0.74				0.62			0.01				0.08		
95% Queue Length, Q_{95} (veh)			7.1				4.7			0.0				0.2		
Control Delay (s/veh)			51.2				26.4			7.9				7.9		
Level of Service, LOS			F				D			A				A		
Approach Delay (s/veh)	51.2				26.4				0.5				2.8			
Approach LOS	F				D											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Main St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	6/5/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Time Analyzed	PM Peak future	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		41	115	20		22	77	73		18	241	26		54	135	31
Percent Heavy Vehicles (%)		0	0	0		0	0	3		7				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	6.23		4.17				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	3.33		2.26				2.20		

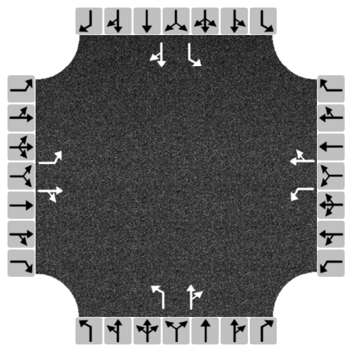
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			192				187			20				59		
Capacity, c (veh/h)			366				448			1367				1284		
v/c Ratio			0.52				0.42			0.01				0.05		
95% Queue Length, Q_{95} (veh)			3.2				2.1			0.0				0.1		
Control Delay (s/veh)			25.5				18.7			7.7				7.9		
Level of Service, LOS			D				C			A				A		
Approach Delay (s/veh)	25.5				18.7				0.6				2.3			
Approach LOS	D				C											

HCS7 All-Way Stop Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Main St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	7/15/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Analysis Time Period (hrs)	1.00	Peak Hour Factor	0.80
Time Analyzed	AM Peak future		
Project Description	East Helena Corridor Study		

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	35	82	18	32	78	120	10	143	17	111	287	47
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	44	125		40	248		13	200		139	418	
Percent Heavy Vehicles	2	2		2	2		2	2		2	2	

Departure Headway and Service Time

Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.039	0.111		0.036	0.220		0.011	0.178		0.123	0.371	
Final Departure Headway, hd (s)	7.66	7.03		7.44	6.52		7.29	6.72		6.81	6.21	
Final Degree of Utilization, x	0.093	0.244		0.083	0.448		0.025	0.373		0.262	0.720	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, ts (s)	5.36	4.73		5.14	4.22		4.99	4.42		4.51	3.91	

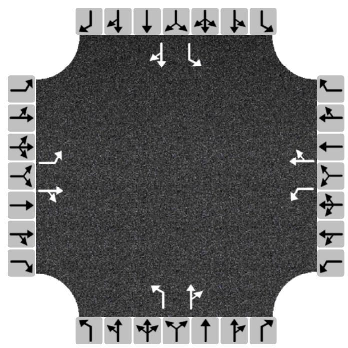
Capacity, Delay and Level of Service

Flow Rate, v (veh/h)	44	125		40	248		13	200		139	418	
Capacity	470	512		484	552		494	536		529	580	
95% Queue Length, Q_{95} (veh)	0.3	1.0		0.3	2.4		0.1	1.8		1.1	7.1	
Control Delay (s/veh)	11.1	12.0		10.8	14.5		10.2	13.4		11.9	24.4	
Level of Service, LOS	B	B		B	B		B	B		B	C	
Approach Delay (s/veh)	11.8			14.0			13.2			21.3		
Approach LOS	B			B			B			C		
Intersection Delay, s/veh | LOS	16.9						C					

HCS7 All-Way Stop Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Main St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	7/15/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Analysis Time Period (hrs)	1.00	Peak Hour Factor	0.80
Time Analyzed	After School Peak future		
Project Description	East Helena Corridor Study		

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	35	117	16	9	107	105	10	163	21	81	166	33
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	44	166		11	265		13	230		101	249	
Percent Heavy Vehicles	2	2		2	2		2	2		2	2	

Departure Headway and Service Time

Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.039	0.148		0.010	0.236		0.011	0.204		0.090	0.221	
Final Departure Headway, hd (s)	7.18	6.60		7.08	6.23		7.03	6.45		6.88	6.26	
Final Degree of Utilization, x	0.087	0.305		0.022	0.459		0.024	0.412		0.194	0.433	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, ts (s)	4.88	4.30		4.78	3.93		4.73	4.15		4.58	3.96	

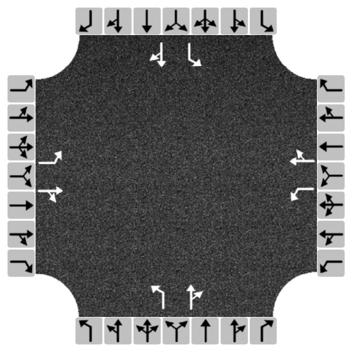
Capacity, Delay and Level of Service

Flow Rate, v (veh/h)	44	166		11	265		13	230		101	249	
Capacity	501	545		508	577		512	558		523	575	
95% Queue Length, Q_{95} (veh)	0.3	1.3		0.1	2.5		0.1	2.1		0.7	2.3	
Control Delay (s/veh)	10.6	12.2		9.9	14.2		9.9	13.7		11.2	13.7	
Level of Service, LOS	B	B		A	B		A	B		B	B	
Approach Delay (s/veh)	11.9			14.0			13.5			13.0		
Approach LOS	B			B			B			B		
Intersection Delay, s/veh | LOS	13.1						B					

HCS7 All-Way Stop Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Main St & Montana Ave
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	7/15/2019	East/West Street	East Main Street
Analysis Year	2040	North/South Street	South Montana Avenue
Analysis Time Period (hrs)	1.00	Peak Hour Factor	0.92
Time Analyzed	PM Peak future		
Project Description	East Helena Corridor Study		

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	41	115	20	22	77	73	18	241	26	54	135	31
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	L	TR		L	TR		L	TR		L	TR	
Flow Rate, v (veh/h)	45	147		24	163		20	290		59	180	
Percent Heavy Vehicles	2	2		2	2		2	2		2	2	

Departure Headway and Service Time

Initial Departure Headway, hd (s)	3.20	3.20		3.20	3.20		3.20	3.20		3.20	3.20	
Initial Degree of Utilization, x	0.040	0.130		0.021	0.145		0.017	0.258		0.052	0.160	
Final Departure Headway, hd (s)	6.82	6.22		6.84	6.00		6.46	5.89		6.56	5.92	
Final Degree of Utilization, x	0.084	0.254		0.045	0.272		0.035	0.475		0.107	0.297	
Move-Up Time, m (s)	2.3	2.3		2.3	2.3		2.3	2.3		2.3	2.3	
Service Time, ts (s)	4.52	3.92		4.54	3.70		4.16	3.59		4.26	3.62	

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)	45	147		24	163		20	290		59	180	
Capacity	528	579		526	600		557	611		549	608	
95% Queue Length, Q_{95} (veh)	0.3	1.0		0.1	1.1		0.1	2.7		0.4	1.3	
Control Delay (s/veh)	10.2	11.0		9.9	10.9		9.4	13.9		10.0	11.1	
Level of Service, LOS	B	B		A	B		A	B		B	B	
Approach Delay (s/veh)	10.8			10.8			13.6			10.9		
Approach LOS	B			B			B			B		
Intersection Delay, s/veh | LOS	11.8						B					

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	35	82	18	32	78	120	10	143	17	111	287	47
Future Volume (veh/h)	35	82	18	32	78	120	10	143	17	111	287	47
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	44	102	22	40	98	150	12	179	21	139	359	59
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	246	332	72	355	148	227	606	979	115	791	933	153
Arrive On Green	0.22	0.22	0.22	0.22	0.22	0.22	0.60	0.60	0.60	0.60	0.60	0.60
Sat Flow, veh/h	1132	1491	322	1267	667	1020	969	1643	193	1182	1567	257
Grp Volume(v), veh/h	44	0	124	40	0	248	12	0	200	139	0	418
Grp Sat Flow(s),veh/h/ln	1132	0	1812	1267	0	1687	969	0	1836	1182	0	1824
Q Serve(g_s), s	1.8	0.0	2.8	1.3	0.0	6.6	0.3	0.0	2.4	3.0	0.0	6.0
Cycle Q Clear(g_c), s	8.5	0.0	2.8	4.2	0.0	6.6	6.3	0.0	2.4	5.4	0.0	6.0
Prop In Lane	1.00		0.18	1.00		0.60	1.00		0.10	1.00		0.14
Lane Grp Cap(c), veh/h	246	0	403	355	0	375	606	0	1094	791	0	1087
V/C Ratio(X)	0.18	0.00	0.31	0.11	0.00	0.66	0.02	0.00	0.18	0.18	0.00	0.38
Avail Cap(c_a), veh/h	485	0	787	623	0	732	606	0	1094	791	0	1087
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	21.4	0.0	16.1	17.8	0.0	17.5	6.9	0.0	4.5	5.8	0.0	5.2
Incr Delay (d2), s/veh	0.3	0.0	0.4	0.1	0.0	2.0	0.1	0.0	0.4	0.5	0.0	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	1.1	0.4	0.0	2.5	0.1	0.0	0.8	0.7	0.0	1.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.7	0.0	16.5	17.9	0.0	19.5	7.0	0.0	4.9	6.3	0.0	6.3
LnGrp LOS	C	A	B	B	A	B	A	A	A	A	A	A
Approach Vol, veh/h		168			288			212			557	
Approach Delay, s/veh		17.9			19.3			5.0			6.3	
Approach LOS		B			B			A			A	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		34.0		15.5		34.0		15.5				
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s		29.5		21.5		29.5		21.5				
Max Q Clear Time (g_c+I1), s		8.3		10.5		8.0		8.6				
Green Ext Time (p_c), s		1.2		0.6		3.3		1.4				
Intersection Summary												
HCM 6th Ctrl Delay			10.7									
HCM 6th LOS			B									

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	44	126	40	248	13	200	139	418
v/c Ratio	0.27	0.36	0.17	0.58	0.02	0.17	0.19	0.36
Control Delay	20.2	16.8	17.3	13.5	4.8	4.7	5.6	6.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	16.8	17.3	13.5	4.8	4.7	5.6	6.0
Queue Length 50th (ft)	10	25	9	25	1	16	13	41
Queue Length 95th (ft)	27	51	25	59	7	44	37	94
Internal Link Dist (ft)		418		421		421		420
Turn Bay Length (ft)	50		50		50		50	
Base Capacity (vph)	388	802	549	819	589	1164	744	1160
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.16	0.07	0.30	0.02	0.17	0.19	0.36

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	35	117	16	9	107	105	10	163	21	81	166	33
Future Volume (veh/h)	35	117	16	9	107	105	10	163	21	81	166	33
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	44	146	20	11	134	131	12	204	26	101	208	41
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	265	383	53	352	207	202	720	925	118	738	863	170
Arrive On Green	0.24	0.24	0.24	0.24	0.24	0.24	0.57	0.57	0.57	0.57	0.57	0.57
Sat Flow, veh/h	1114	1610	221	1220	868	849	1131	1626	207	1151	1517	299
Grp Volume(v), veh/h	44	0	166	11	0	265	12	0	230	101	0	249
Grp Sat Flow(s),veh/h/ln	1114	0	1831	1220	0	1718	1131	0	1833	1151	0	1817
Q Serve(g_s), s	1.7	0.0	3.5	0.4	0.0	6.5	0.2	0.0	2.9	2.2	0.0	3.2
Cycle Q Clear(g_c), s	8.2	0.0	3.5	3.9	0.0	6.5	3.4	0.0	2.9	5.1	0.0	3.2
Prop In Lane	1.00		0.12	1.00		0.49	1.00		0.11	1.00		0.16
Lane Grp Cap(c), veh/h	265	0	436	352	0	409	720	0	1043	738	0	1033
V/C Ratio(X)	0.17	0.00	0.38	0.03	0.00	0.65	0.02	0.00	0.22	0.14	0.00	0.24
Avail Cap(c_a), veh/h	586	0	963	703	0	903	720	0	1043	738	0	1033
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	19.7	0.0	14.9	16.5	0.0	16.0	5.9	0.0	5.0	6.2	0.0	5.0
Incr Delay (d2), s/veh	0.3	0.0	0.5	0.0	0.0	1.7	0.0	0.0	0.5	0.4	0.0	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	1.4	0.1	0.0	2.4	0.1	0.0	0.9	0.5	0.0	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.0	0.0	15.4	16.5	0.0	17.7	5.9	0.0	5.4	6.6	0.0	5.6
LnGrp LOS	B	A	B	B	A	B	A	A	A	A	A	A
Approach Vol, veh/h		210			276			242			350	
Approach Delay, s/veh		16.4			17.7			5.5			5.9	
Approach LOS		B			B			A			A	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		31.0		15.6		31.0		15.6				
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s		26.5		24.5		26.5		24.5				
Max Q Clear Time (g_c+I1), s		5.4		10.2		7.1		8.5				
Green Ext Time (p_c), s		1.4		0.9		1.8		1.5				
Intersection Summary												
HCM 6th Ctrl Delay			10.8									
HCM 6th LOS			B									

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	44	166	11	265	13	230	101	249
v/c Ratio	0.22	0.40	0.04	0.58	0.02	0.21	0.15	0.23
Control Delay	16.8	16.6	13.4	15.3	5.6	5.8	6.2	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.8	16.6	13.4	15.3	5.6	5.8	6.2	5.7
Queue Length 50th (ft)	9	34	2	38	1	22	10	23
Queue Length 95th (ft)	25	62	10	72	7	55	30	58
Internal Link Dist (ft)		405		422		421		416
Turn Bay Length (ft)	50		50		50		50	
Base Capacity (vph)	485	973	642	958	661	1080	672	1074
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.17	0.02	0.28	0.02	0.21	0.15	0.23

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	41	115	20	22	77	73	18	241	26	54	135	31
Future Volume (veh/h)	41	115	20	22	77	73	18	241	26	54	135	31
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	45	125	22	24	84	79	20	262	28	59	147	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	279	282	50	298	161	152	851	1024	109	754	905	209
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.62	0.62	0.62	0.62	0.62	0.62
Sat Flow, veh/h	1223	1549	273	1241	887	834	1203	1661	178	1089	1469	340
Grp Volume(v), veh/h	45	0	147	24	0	163	20	0	290	59	0	181
Grp Sat Flow(s),veh/h/ln	1223	0	1821	1241	0	1720	1203	0	1838	1089	0	1809
Q Serve(g_s), s	1.5	0.0	3.2	0.8	0.0	3.8	0.3	0.0	3.2	1.2	0.0	1.9
Cycle Q Clear(g_c), s	5.4	0.0	3.2	4.0	0.0	3.8	2.2	0.0	3.2	4.4	0.0	1.9
Prop In Lane	1.00		0.15	1.00		0.48	1.00		0.10	1.00		0.19
Lane Grp Cap(c), veh/h	279	0	332	298	0	313	851	0	1133	754	0	1115
V/C Ratio(X)	0.16	0.00	0.44	0.08	0.00	0.52	0.02	0.00	0.26	0.08	0.00	0.16
Avail Cap(c_a), veh/h	701	0	959	726	0	906	851	0	1133	754	0	1115
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	18.9	0.0	16.2	18.0	0.0	16.5	4.1	0.0	3.9	4.9	0.0	3.7
Incr Delay (d2), s/veh	0.3	0.0	0.9	0.1	0.0	1.3	0.1	0.0	0.5	0.2	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	1.3	0.2	0.0	1.5	0.1	0.0	0.9	0.2	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.2	0.0	17.2	18.1	0.0	17.8	4.2	0.0	4.4	5.1	0.0	4.0
LnGrp LOS	B	A	B	B	A	B	A	A	A	A	A	A
Approach Vol, veh/h		192			187			310			240	
Approach Delay, s/veh		17.6			17.9			4.4			4.2	
Approach LOS		B			B			A			A	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		32.0		12.6		32.0		12.6				
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s		27.5		23.5		27.5		23.5				
Max Q Clear Time (g_c+I1), s		5.2		7.4		6.4		6.0				
Green Ext Time (p_c), s		1.9		0.8		1.3		0.9				
Intersection Summary												
HCM 6th Ctrl Delay			9.8									
HCM 6th LOS			A									

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	45	147	24	163	20	290	59	181
v/c Ratio	0.20	0.42	0.11	0.42	0.02	0.23	0.08	0.15
Control Delay	17.3	17.9	15.8	12.7	4.3	4.7	4.6	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.3	17.9	15.8	12.7	4.3	4.7	4.6	4.0
Queue Length 50th (ft)	10	30	5	19	2	26	5	14
Queue Length 95th (ft)	30	67	19	57	8	64	18	38
Internal Link Dist (ft)		410		426		421		419
Turn Bay Length (ft)	50		50		50		50	
Base Capacity (vph)	622	939	631	921	816	1254	738	1241
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.16	0.04	0.18	0.02	0.23	0.08	0.15

Intersection Summary

MOVEMENT SUMMARY

Site: 101 [Montana & Main AM 2040]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: S Montana Ave												
3	L2	13	12.5	0.213	6.0	LOS A	1.0	25.1	0.47	0.36	0.47	34.5
8	T1	179	1.2	0.213	5.6	LOS A	1.0	25.1	0.47	0.36	0.47	34.8
18	R2	21	0.0	0.213	5.6	LOS A	1.0	25.1	0.47	0.36	0.47	33.8
Approach		213	1.7	0.213	5.6	LOS A	1.0	25.1	0.47	0.36	0.47	34.6
East: E Main St												
1	L2	40	0.0	0.272	6.0	LOS A	1.4	34.6	0.45	0.33	0.45	34.4
6	T1	98	1.6	0.272	6.0	LOS A	1.4	34.6	0.45	0.33	0.45	34.2
16	R2	150	2.5	0.272	6.1	LOS A	1.4	34.6	0.45	0.33	0.45	33.2
Approach		288	1.8	0.272	6.0	LOS A	1.4	34.6	0.45	0.33	0.45	33.7
North: N Montana Ave												
7	L2	139	4.8	0.477	8.4	LOS A	3.2	81.7	0.47	0.30	0.47	32.9
4	T1	359	0.0	0.477	8.2	LOS A	3.2	81.7	0.47	0.30	0.47	32.9
14	R2	59	0.0	0.477	8.2	LOS A	3.2	81.7	0.47	0.30	0.47	32.1
Approach		556	1.2	0.477	8.3	LOS A	3.2	81.7	0.47	0.30	0.47	32.8
West: E Main St												
5	L2	44	11.1	0.229	7.6	LOS A	0.9	24.8	0.59	0.56	0.59	33.0
2	T1	103	4.5	0.229	7.3	LOS A	0.9	24.8	0.59	0.56	0.59	33.2
12	R2	23	13.3	0.229	7.7	LOS A	0.9	24.8	0.59	0.56	0.59	32.1
Approach		169	7.4	0.229	7.5	LOS A	0.9	24.8	0.59	0.56	0.59	33.0
All Vehicles		1225	2.3	0.477	7.2	LOS A	3.2	81.7	0.48	0.35	0.48	33.4

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Montana & Main Noon 2040]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: S Montana Ave												
3	L2	13	12.5	0.248	6.4	LOS A	1.2	29.9	0.48	0.37	0.48	34.2
8	T1	204	3.8	0.248	6.1	LOS A	1.2	29.9	0.48	0.37	0.48	34.5
18	R2	26	0.0	0.248	6.0	LOS A	1.2	29.9	0.48	0.37	0.48	33.6
Approach		243	3.8	0.248	6.1	LOS A	1.2	29.9	0.48	0.37	0.48	34.4
East: E Main St												
1	L2	11	0.0	0.273	6.1	LOS A	1.3	34.2	0.47	0.35	0.47	34.6
6	T1	134	3.4	0.273	6.3	LOS A	1.3	34.2	0.47	0.35	0.47	34.4
16	R2	131	4.4	0.273	6.3	LOS A	1.3	34.2	0.47	0.35	0.47	33.4
Approach		276	3.7	0.273	6.3	LOS A	1.3	34.2	0.47	0.35	0.47	33.9
North: N Montana Ave												
7	L2	101	2.6	0.304	6.0	LOS A	1.6	41.6	0.39	0.25	0.39	33.9
4	T1	208	0.0	0.304	6.0	LOS A	1.6	41.6	0.39	0.25	0.39	33.9
14	R2	41	7.1	0.304	6.2	LOS A	1.6	41.6	0.39	0.25	0.39	32.8
Approach		350	1.6	0.304	6.0	LOS A	1.6	41.6	0.39	0.25	0.39	33.8
West: E Main St												
5	L2	44	0.0	0.221	5.8	LOS A	1.0	25.8	0.48	0.38	0.48	34.2
2	T1	146	5.2	0.221	6.0	LOS A	1.0	25.8	0.48	0.38	0.48	34.0
12	R2	20	7.7	0.221	6.1	LOS A	1.0	25.8	0.48	0.38	0.48	33.0
Approach		210	4.4	0.221	6.0	LOS A	1.0	25.8	0.48	0.38	0.48	34.0
All Vehicles		1079	3.2	0.304	6.1	LOS A	1.6	41.6	0.45	0.33	0.45	34.0

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Montana & Main PM 2040]

New Site
Site Category: (None)
Roundabout

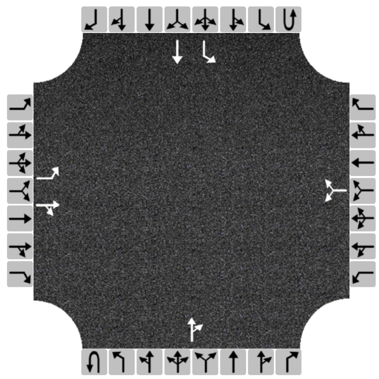
Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: S Montana Ave												
3	L2	20	6.7	0.288	6.3	LOS A	1.5	37.6	0.44	0.32	0.44	34.4
8	T1	262	1.6	0.288	6.1	LOS A	1.5	37.6	0.44	0.32	0.44	34.5
18	R2	28	0.0	0.288	6.1	LOS A	1.5	37.6	0.44	0.32	0.44	33.5
Approach		310	1.8	0.288	6.1	LOS A	1.5	37.6	0.44	0.32	0.44	34.4
East: E Main St												
1	L2	24	0.0	0.192	5.5	LOS A	0.9	22.1	0.48	0.38	0.48	34.7
6	T1	84	0.0	0.192	5.5	LOS A	0.9	22.1	0.48	0.38	0.48	34.6
16	R2	79	2.2	0.192	5.6	LOS A	0.9	22.1	0.48	0.38	0.48	33.5
Approach		187	0.9	0.192	5.5	LOS A	0.9	22.1	0.48	0.38	0.48	34.1
North: N Montana Ave												
7	L2	59	0.0	0.198	4.7	LOS A	1.0	24.6	0.31	0.17	0.31	34.8
4	T1	147	0.0	0.198	4.7	LOS A	1.0	24.6	0.31	0.17	0.31	34.7
14	R2	34	0.0	0.198	4.7	LOS A	1.0	24.6	0.31	0.17	0.31	33.7
Approach		239	0.0	0.198	4.7	LOS A	1.0	24.6	0.31	0.17	0.31	34.6
West: E Main St												
5	L2	45	0.0	0.175	4.9	LOS A	0.8	20.6	0.40	0.27	0.40	34.8
2	T1	125	0.0	0.175	4.9	LOS A	0.8	20.6	0.40	0.27	0.40	34.7
12	R2	22	0.0	0.175	4.9	LOS A	0.8	20.6	0.40	0.27	0.40	33.7
Approach		191	0.0	0.175	4.9	LOS A	0.8	20.6	0.40	0.27	0.40	34.6
All Vehicles		927	0.8	0.288	5.4	LOS A	1.5	37.6	0.41	0.28	0.41	34.4

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Lewis Street
Analysis Year	2040	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	AM Peak future turn lanes	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	1	1	0
Configuration		L		TR			LR					TR		L	T	
Volume, V (veh/h)		34	12	129		7		73			270	1		76	350	
Percent Heavy Vehicles (%)		0	0	0		17		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		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.27		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.65		3.30						2.20		

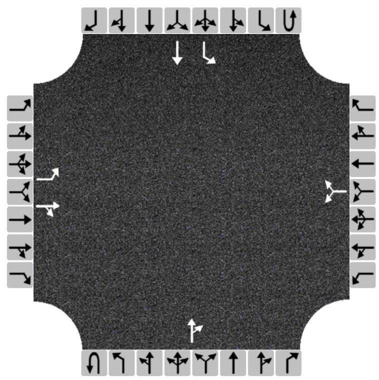
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		45		188			106							101		
Capacity, c (veh/h)		159		521			473							1209		
v/c Ratio		0.28		0.36			0.22							0.08		
95% Queue Length, Q_{95} (veh)		1.2		1.7			0.9							0.3		
Control Delay (s/veh)		36.4		15.8			14.8							8.2		
Level of Service, LOS		E		C			B							A		
Approach Delay (s/veh)	19.8				14.8								1.5			
Approach LOS	C				B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Lewis Street
Analysis Year	2040	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	After School future turn	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	1	1	0
Configuration		L		TR			LR					TR		L	T	
Volume, V (veh/h)		25	6	60		7		58			298	5		45	257	
Percent Heavy Vehicles (%)		0	0	0		17		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		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.27		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.65		3.30						2.20		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		38		101			100							69		
Capacity, c (veh/h)		171		565			457							1106		
v/c Ratio		0.22		0.18			0.22							0.06		
95% Queue Length, Q_{95} (veh)		0.8		0.7			0.8							0.2		
Control Delay (s/veh)		32.1		12.8			15.1							8.5		
Level of Service, LOS		D		B			C							A		
Approach Delay (s/veh)	18.0				15.1								1.3			
Approach LOS	C				C											

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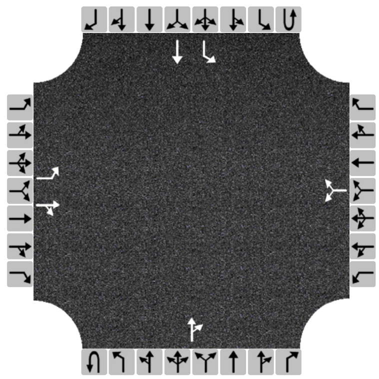
Montana_Valley_&_Lewis_Noon_2040_turn_lanes.xtw

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Montana/Valley & Lewis
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	East Lewis Street
Analysis Year	2040	North/South Street	N Montana Ave/Valley Dr
Time Analyzed	PM Peak future turn lanes	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	0	0	0	0	1	0	0	1	1	0
Configuration		L		TR			LR					TR		L	T	
Volume, V (veh/h)		1	0	5		5		40			318	11		33	227	
Percent Heavy Vehicles (%)		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		6.2						4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.10		6.20						4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5		3.3						2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.50		3.30						2.20		

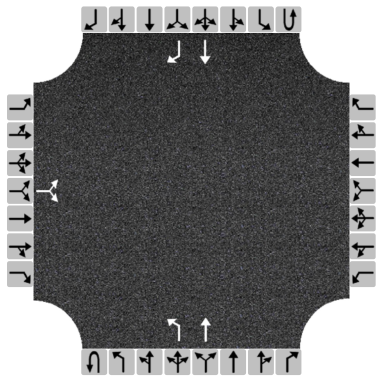
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		1		5			48							36		
Capacity, c (veh/h)		331		797			635							1212		
v/c Ratio		0.00		0.01			0.08							0.03		
95% Queue Length, Q_{95} (veh)		0.0		0.0			0.2							0.1		
Control Delay (s/veh)		15.9		9.5			11.1							8.1		
Level of Service, LOS		C		A			B							A		
Approach Delay (s/veh)	10.6				11.1								1.0			
Approach LOS	B				B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North (Main) Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future turn lanes	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	1	1	0	0	0	1	1
Configuration			LR							L	T				T	R
Volume, V (veh/h)		12		2						98	277				413	67
Percent Heavy Vehicles (%)		0		0						1						
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)		6.40		6.20						4.11						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.21						

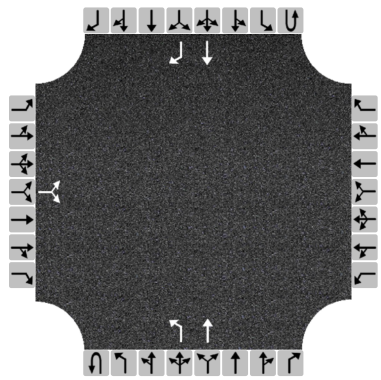
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			19							131						
Capacity, c (veh/h)			204							949						
v/c Ratio			0.09							0.14						
95% Queue Length, Q_{95} (veh)			0.3							0.5						
Control Delay (s/veh)			24.5							9.4						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	24.5								2.5							
Approach LOS	C															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North (Main) Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School future turn	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	1	1	0	0	0	1	1
Configuration			LR							L	T				T	R
Volume, V (veh/h)		21		6						62	313				272	37
Percent Heavy Vehicles (%)		0		0						0						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.40		6.20						4.10						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.20						

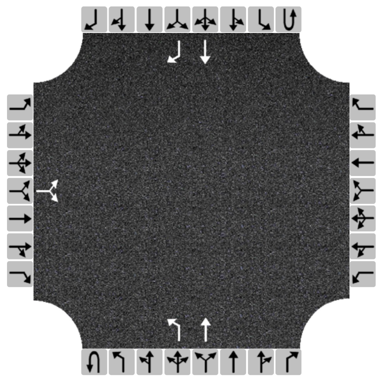
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)			41							95						
Capacity, c (veh/h)			256							1098						
v/c Ratio			0.16							0.09						
95% Queue Length, Q_{95} (veh)			0.6							0.3						
Control Delay (s/veh)			21.7							8.6						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	21.7								1.4							
Approach LOS	C															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & North Access
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	North (Main) Access
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future turn lanes	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	1	1	0	0	0	1	1
Configuration			LR							L	T				T	R
Volume, V (veh/h)		0		0						0	359				260	0
Percent Heavy Vehicles (%)		0		0						0						
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)		6.40		6.20						4.10						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.50		3.30						2.20						

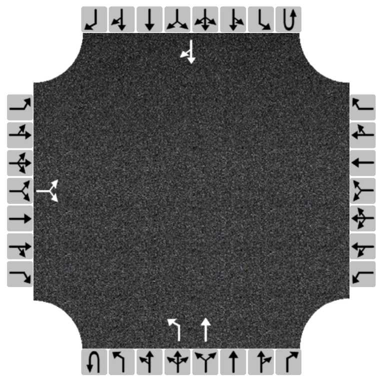
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			0							0						
Capacity, c (veh/h)			0							1291						
v/c Ratio										0.00						
95% Queue Length, Q_{95} (veh)										0.0						
Control Delay (s/veh)			5.0							7.8						
Level of Service, LOS			A							A						
Approach Delay (s/veh)	5.0								0.0							
Approach LOS	A															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland South
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows South
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	AM Peak future turn lane	Peak Hour Factor	0.75
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		23		69						24	256				398	12
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

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

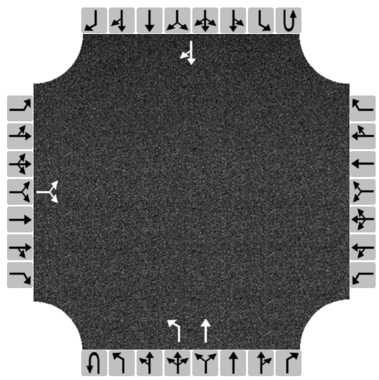
Delay, Queue Length, and Level of Service

	EB U	EB L	EB T	EB R	WB U	WB L	WB T	WB R	NB U	NB L	NB T	NB R	SB U	SB L	SB T	SB R
Flow Rate, v (veh/h)			123							32						
Capacity, c (veh/h)			407							1016						
v/c Ratio			0.30							0.03						
95% Queue Length, Q_{95} (veh)			1.3							0.1						
Control Delay (s/veh)			17.7							8.7						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	17.7								0.7							
Approach LOS	C															

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland South
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows South
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	After School future turn	Peak Hour Factor	0.65
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		15		43						43	304				256	16
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			89							66						
Capacity, c (veh/h)			418							1134						
v/c Ratio			0.21							0.06						
95% Queue Length, Q_{95} (veh)			0.8							0.2						
Control Delay (s/veh)			15.9							8.4						
Level of Service, LOS			C							A						
Approach Delay (s/veh)	15.9								1.0							
Approach LOS	C															

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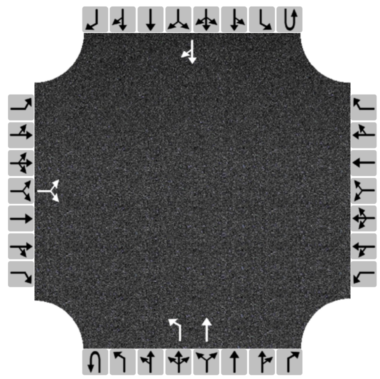
Valley_&_Highland_South_Noon_2040_turn_lanes.xtw

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Audrey Stoltzfus	Intersection	Valley & Highland South
Agency/Co.	Sanderson Stewart	Jurisdiction	City of East Helena/MDT
Date Performed	5/31/2019	East/West Street	Highland Meadows South
Analysis Year	2040	North/South Street	Valley Drive
Time Analyzed	PM Peak future turn lanes	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	1.00
Project Description	East Helena Corridor Study		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		11		44						77	269				210	19
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)		7.1		6.2						4.1						
Critical Headway (sec)		7.13		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			60							84						
Capacity, c (veh/h)			626							1309						
v/c Ratio			0.10							0.06						
95% Queue Length, Q_{95} (veh)			0.3							0.2						
Control Delay (s/veh)			11.4							7.9						
Level of Service, LOS			B							A						
Approach Delay (s/veh)	11.4								1.8							
Approach LOS	B															

DESIGN ALTERNATIVE COST ESTIMATES

APPENDIX L

ENDURING COMMUNITY DESIGN

SANDERSON STEWART

Date: October 21, 2019
Project No: 19011

Engineer's Opinion of Probable Cost
for
Montana Ave./Valley Dr. Corridor Study/PER
ALTERNATIVE #1 - BASELINE CONSTRUCTION

SCHEDULE 1 - STREET IMPROVEMENTS

Item No.	Quantity	Unit	Description	Unit Price		Subtotal
101	1	LS	Mobilization/Demobilization	$165,135.20	=	$165,135.20
102	1	LS	Taxes, Bonds, Insurance	$41,283.80	=	$41,283.80
103	1	LS	Stormwater Management and Erosion Control	$30,000.00	=	$30,000.00
104	1	LS	Traffic Control During Construction	$50,000.00	=	$50,000.00
105	50	DAY	Changeable Message Sign (Per Day Per Sign)	$120.00	=	$6,000.00
106	3,600	CY	Strip, Stockpile and Replace Topsoil	$10.00	=	$36,000.00
107	23,650	CY	Unclassified Excavation (includes subexcavation)	$12.00	=	$283,800.00
108	23,550	SY	Remove and Dispose of Asphalt Pavement	$4.50	=	$105,975.00
109	100	SY	Remove and Dispose of Concrete Sidewalks and Driveways	$20.00	=	$2,000.00
110	30	EA	Remove and Dispose of Signs	$100.00	=	$3,000.00
111	5	EA	Remove and Dispose of Large Trees	$2,500.00	=	$12,500.00
112	1,000	LF	Remove and Dispose of Fence	$4.00	=	$4,000.00
113	1	LS	Remove and Dispose of Landscape and Miscellaneous Surface Features	$10,000.00	=	$10,000.00
114	7,300	CY	Imported Fill	$22.00	=	$160,600.00
115	5,200	CY	1 1/2-inch Minus Crushed Base Course (4-inch section)	$32.00	=	$166,400.00
116	17,750	CY	3-inch Minus Sub-base Course (18 1/2-inch section)	$17.00	=	$301,750.00
117	34,600	SY	Asphalt Surface Course (3-inch section)	$14.00	=	$484,400.00
118	1	LS	Gravel Shoulders/Swales	$40,000.00	=	$40,000.00
119	875	SY	4-inch Concrete Sidewalk	$75.00	=	$65,625.00
120	340	SY	6-inch Concrete (Sidewalk/Valley Gutter)	$95.00	=	$32,300.00
121	4,050	SY	Asphalt Multi-use Trail (2-inch section)	$12.00	=	$48,600.00
122	220	SF	Detectable Warning Panel	$32.00	=	$7,040.00
123	25	EA	Adjust Water Valve	$350.00	=	$8,750.00
124	4	EA	Adjust Existing Manhole (Include Replacement of Top Section if Necessary)	$1,000.00	=	$4,000.00
125	6	EA	Adjust Existing Fiberoptic Manhole (Include Replacement of Top Section if Necessary)	$1,000.00	=	$6,000.00
126	40	GAL	White Epoxy Pavement Markings	$300.00	=	$12,000.00
127	50	GAL	Yellow Epoxy Pavement Markings	$300.00	=	$15,000.00
128	40	EA	New Sign on New Post	$300.00	=	$12,000.00
129	2	EA	Rectangular Rapid Flash Beacon Systems	$20,000.00	=	$40,000.00
130	2	EA	School Zone Flasher Assembly (Solar Power)	$12,000.00	=	$24,000.00

131	1	LS	Drainage Ditch Grading	$25,000.00	=	$25,000.00
132	3,600	SY	Erosion Control Blanket	$6.00		$21,600.00
133	6	EA	Culvert Replacements	$1,800.00	=	$10,800.00
134	5	AC	Re-seeding of Disturbed Areas	$1,500.00	=	$7,500.00
135	1,000	SF	Non-Trench Asphalt Surface Restoration	$5.00	=	$5,000.00
136	1,000	SF	Non-Trench Concrete Surface Restoration	$8.00	=	$8,000.00
137	200	SF	Non-Trench Concrete Sidewalk Restoration	$6.50	=	$1,300.00
138	1,000	SF	Non-Trench Landscape and Miscellaneous Surface Restoration	$2.00	=	$2,000.00
139	25	EA	Relocate Mailbox	$450.00	=	$11,250.00

TOTAL FOR SCHEDULE 1 - STREET IMPROVEMENTS	=	$2,270,609.00
15% CONTINGENCY	=	$340,591.35
TOTAL (CONSTRUCTION ONLY) WITH 15% CONTINGENCY	=	$2,611,200.35
ADMINISTRATIVE COSTS (TOTAL PROJECT)		
Engineering Survey, Geotechnical Investigation, & Design (10%)	=	$261,120.00
Bidding & Construction Administration (6%)	=	$156,672.00
Materials Testing (1%)	=	$26,112.00
Construction Staking (1.2%)	=	$31,334.00
SUBTOTAL OF ADMINISTRATVE COSTS	=	$475,238.00
TOTAL ESTIMATED PROJECT COST (DESIGN & CONSTRUCTION)	=	$3,086,438.35

Notes:

Quantity estimates are based on a 15% design concept
Mobilization and Insurance is based on percentage of total cost (8% and 2%, respectively)
All Items are complete and in place.
Sanderson Stewart cannot warrant that any opinions of probable cost provided by Sanderson Stewart will not vary from actual costs
City of East Helena and DEQ permitting fees are not included in this estimate
Private utility relocation fees are not included in this estimate

Date: October 21, 2019
Project No: 19011

Engineer's Opinion of Probable Cost
for
Montana Ave./Valley Dr. Corridor Study/PER
ALTERNATIVE #2 - STORM DRAIN UPGRADE

SCHEDULE 1 - STORM DRAIN IMPROVEMENTS

Item No.	Quantity	Unit	Description	Unit Price		Subtotal
101	1	LS	Mobilization/Demobilization	$53,576.00	=	$53,576.00
102	1	LS	Taxes, Bonds, Insurance	$13,394.00	=	$13,394.00
103	1	LS	Stormwater Management and Erosion Control	$10,000.00	=	$10,000.00
104	1	LS	Traffic Control During Construction	$20,000.00	=	$20,000.00
105	1	LS	Groundwater Dewatering	$10,000.00	=	$10,000.00
106	10	HR	Exploratory Excavation (Small Crew)	$250.00	=	$2,500.00
107	10	HR	Exploratory Excavation (Large Crew)	$500.00	=	$5,000.00
108	150	CY	Petroleum Hydrocarbon Impacted Soil Removal	$50.00	=	$7,500.00
109	5	DAY	Contaminated Groundwater Treatment	$1,500.00	=	$7,500.00
110	10	EA	Relocate Fire Hydrant	$2,700.00		$27,000.00
111	1	EA	Connect to Existing Storm Drain Manhole/Inlet Combo	$1,200.00	=	$1,200.00
112	10	EA	New 48-inch Storm Drain Manhole	$4,800.00	=	$48,000.00
113	1,600	LF	24-inch Storm Drain Installation	$75.00	=	$120,000.00
114	1,575	LF	18-inch Storm Drain Installation	$60.00	=	$94,500.00
115	400	LF	15-inch Storm Drain Installation	$50.00	=	$20,000.00
116	1,775	LF	12-inch Storm Drain Installation	$45.00	=	$79,875.00
117	37	EA	Type II Curb Inlet	$2,400.00	=	$88,800.00
118	10	EA	Bentonite Cut-Off Walls	$1,000.00	=	$10,000.00
119	30	EA	Underground Utility Crossing	$500.00	=	$15,000.00
120	10	EA	Underground Utility Crossings (18-inch and Greater Utilities & Fiber)	$750.00	=	$7,500.00
121	2,275	CY	Type 2 Bedding	$27.00	=	$61,425.00
122	5,350	LF	Geotextile Trench Fabric	$6.00	=	$32,100.00
123	1	LS	Pavement Markings Trench Restoration (Includes Temporary Striping)	$1,000.00	=	$1,000.00
124	1	LS	Landscape & Miscellaneous Surface Trench Restoration	$800.00	=	$800.00
125	125	LF	Asphalt Restoration	$100.00	=	$12,500.00
126	1,350	LF	Open-cut Drainage Swale to Prickly Pear Creek with Erosion Control Blanket	$10.00	=	$13,500.00
127	0.5	AC	Re-seeding of Disturbed Areas	$1,500.00	=	$750.00
			TOTAL FOR SCHEDULE 1 - STORM DRAIN IMPROVEMENTS		=	**$762,670.00**

SCHEDULE 2 - STREET IMPROVEMENTS

Item No.	Quantity	Unit	Description	Unit Price		Subtotal
201	1	LS	Mobilization/Demobilization	$241,814.00	=	$241,814.00
202	1	LS	Taxes, Bonds, Insurance	$60,453.50	=	$60,453.50
203	1	LS	Stormwater Management and Erosion Control	$25,000.00	=	$25,000.00
204	1	LS	Traffic Control During Construction	$50,000.00	=	$50,000.00
205	75	DAY	Changeable Message Sign (Per Day Per Sign)	$120.00	=	$9,000.00
206	3,600	CY	Strip, Stockpile and Replace Topsoil	$10.00	=	$36,000.00
207	28,000	CY	Unclassified Excavation (includes subexcavation)	$12.00	=	$336,000.00
208	24,900	SY	Remove and Dispose of Asphalt Pavement	$4.50	=	$112,050.00
209	900	SY	Remove and Dispose of Concrete Sidewalks and Driveways	$12.00	=	$10,800.00
210	30	EA	Remove and Dispose of Signs	$100.00	=	$3,000.00
211	5	EA	Remove and Dispose of Large Trees	$2,500.00	=	$12,500.00
212	1,000	LF	Remove and Dispose of Fence	$4.00	=	$4,000.00
213	1	LS	Remove and Dispose of Landscape and Miscellaneous Surface Features	$10,000.00	=	$10,000.00
214	10,900	CY	Imported Fill	$22.00	=	$239,800.00
215	4,250	CY	1 1/2-inch Minus Crushed Base Course (4-inch section)	$32.00	=	$136,000.00
216	19,600	CY	3-inch Minus Sub-base Course (18 1/2-inch section)	$17.00	=	$333,200.00
217	36,200	SY	Asphalt Surface Course (3-inch section)	$14.00	=	$506,800.00
218	4,400	LF	Concrete Curb and Gutter	$22.00	=	$96,800.00
219	6,750	SY	4-inch Concrete Sidewalk/Multi-use Trail	$75.00	=	$506,250.00
220	300	SY	6-inch Driveable Concrete (Drive Approaches and Bulbouts)	$95.00	=	$28,500.00
221	5,250	SF	Concrete Fillet and Valley Gutter	$17.00	=	$89,250.00
222	400	SF	Detectable Warning Panel	$32.00	=	$12,800.00
223	30	EA	Adjust Water Valve	$350.00	=	$10,500.00
224	6	EA	Adjust Existing Manhole (Include Replacement of Top Section if Necessary)	$1,000.00	=	$6,000.00
225	6	EA	Adjust Existing Fiberoptic Manhole (Include Replacement of Top Section if Necessary)	$1,000.00	=	$6,000.00
226	40	GAL	White Epoxy Pavement Markings	$300.00	=	$12,000.00
227	50	GAL	Yellow Epoxy Pavement Markings	$300.00	=	$15,000.00
228	40	EA	New Sign on New Post	$300.00	=	$12,000.00
229	20	EA	Street Lighting (includes all infrastructure)	$9,500.00	=	$190,000.00
230	2	EA	Rectangular Rapid Flash Beacon Systems	$20,000.00	=	$40,000.00
231	2	EA	School Zone Flasher Assembly (Solar Power)	$12,000.00	=	$24,000.00
232	12,850	SF	Boulevard Landscape Improvements	$3.50	=	$44,975.00
233	2,000	LF	Irrigation Sleeves Under Sidewalks/Driveways	$6.00	=	$12,000.00
234	1	LS	Drainage Ditch Grading	$25,000.00	=	$25,000.00
235	3,600	SY	Erosion Control Blanket	$6.00		$21,600.00
236	6	EA	Culvert Replacements	$1,800.00	=	$10,800.00
237	5	AC	Re-seeding of Ditches and Slopes	$1,500.00	=	$7,500.00

238	1,000	SF	Non-Trench Asphalt Surface Restoration	$5.00	=	$5,000.00
239	1,000	SF	Non-Trench Concrete Surface Restoration	$8.00	=	$8,000.00
240	200	SF	Non-Trench Concrete Sidewalk Restoration	$6.50	=	$1,300.00
241	1,000	SF	Non-Trench Landscape and Miscellaneous Surface Restoration	$2.00	=	$2,000.00
242	25	EA	Relocate Mailbox	$450.00	=	$11,250.00

TOTAL FOR SCHEDULE 2 - STREET IMPROVEMENTS	=	$3,324,942.50
TOTAL (CONSTRUCTION ONLY) FOR SCHEDULES 1 & 2	=	$4,087,612.50
15% CONTINGENCY	=	$613,141.88
TOTAL (CONSTRUCTION ONLY) WITH 15% CONTINGENCY	=	$4,700,754.38
ADMINISTRATIVE COSTS (TOTAL PROJECT)		
Engineering Survey, Geotechnical Investigation, & Design (10%)	=	$470,075.00
Bidding & Construction Administration (6%)	=	$282,045.00
Materials Testing (1%)	=	$47,008.00
Construction Staking (1.2%)	=	$56,409.00
SUBTOTAL OF ADMINISTRATVE COSTS	=	$855,537.00
TOTAL ESTIMATED PROJECT COST (DESIGN & CONSTRUCTION)	=	$5,556,291.38

Notes:

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