Toquerville Transportation Master Plan

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TABLE OF CONTENTS

FIGURES

TABLES

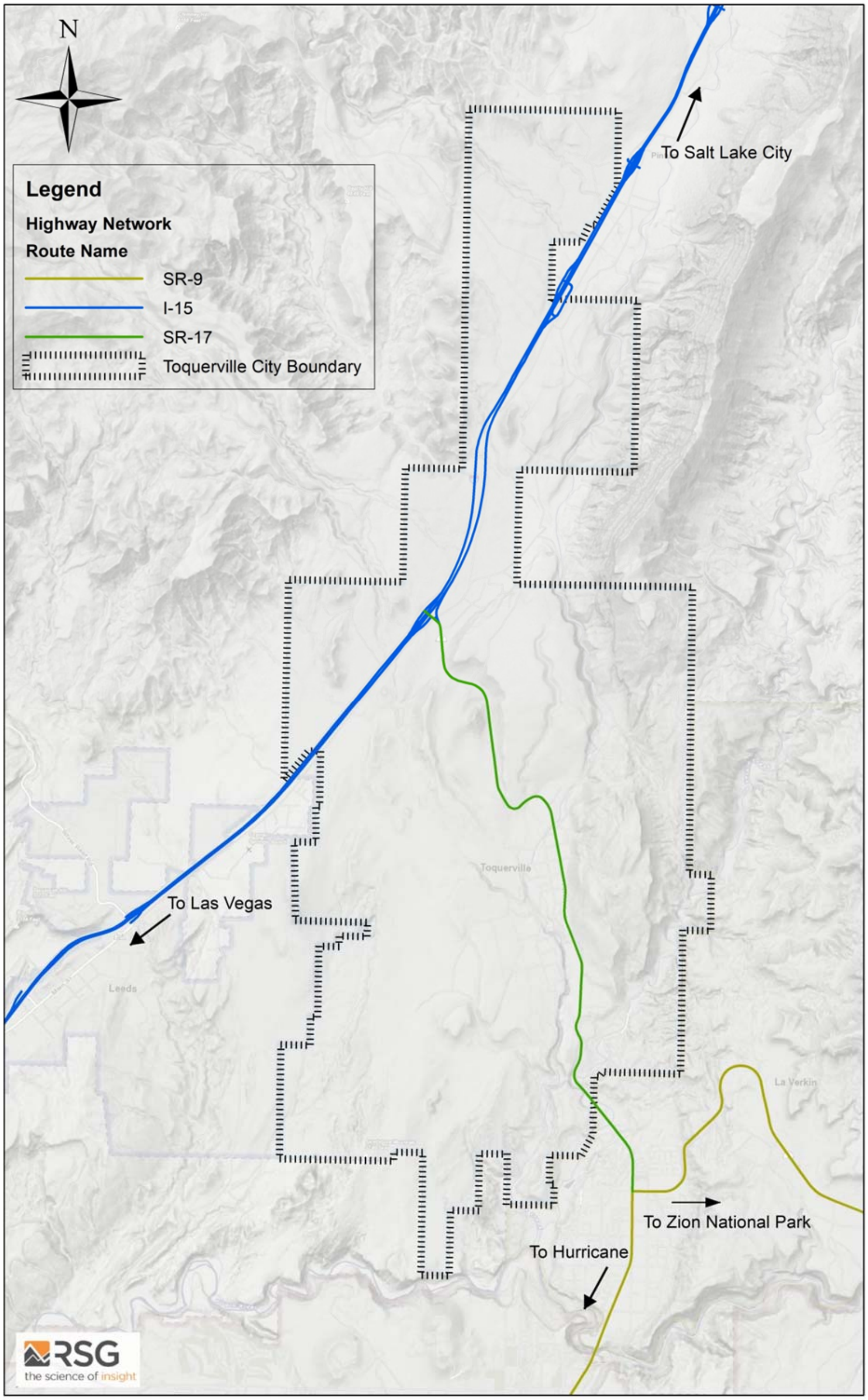

Figure 1. Vicinity Map Introduction

1.1. BACKGROUND

Toquerville City is a picturesque city nestled amongst a black lava rock capped mountain and natural springs in Southwestern Utah. The city is celebrated for its breathtaking scenery, outdoor appeal, and backcountry adventures. The population has grown from only 19 families in the late 1800s to near 2000 residents. Toquerville has become a bed and breakfast community to visitors of Zion National Park and has seasonal population increases. Toquerville has remained a friendly, safe and clean community and kept its sense of place as a unique place in the world for its beauty and small town feel. Detailed maps of the study area and city limits are shown throughout the study.

1.2. STUDY NEEDS

Toquerville City is located on SR-17, one of the primary routes to Zion National Park. Visitation to Zion National Park is growing astronomically and creating an increase in commuter and seasonal traffic. The city's population and commercial property also continues to increase at a steady rate, resulting in increased traffic. Transportation facilities not designed to accommodate these increased volumes can create safety problems, congestion and delay for both motorized and non-motorized travel. For Toquerville to maintain its unique community character to serve its residents, importance must be placed on being proactive with the transportation system. Transportation concerns that will be addressed in this plan that have been identified by Toquerville City include the following:

- Street Classification
- Future Corridor Needs
- Roadway Design
- Transportation Guidelines

1.3. TRANSPORTATION PLANNING PURPOSE

The purpose of this study is to develop a transportation master plan for Toquerville City. The primary objective of the study is to establish a reliable transportation network to guide future developments and wisely utilize funds for needed improvements.

1.3.1. COMMUNITY PLANNING

The planning process requires a target or goal. The community vision as outlined in the City's General Plan serves as this target and defines the planning process. This includes a master planning process that helps overall community planning and enhances the understanding of the relationship between individual community elements. The best example of this is the interrelationship between transportation and land use. An expensive cycle of incremental road improvements and land use changes will occur unless these two elements are planned in a coordinated fashion. Proper planning allows early implementation of the ultimate transportation facilities necessary to accommodate the ultimate land use adjacent to the roadway. The residents of Toquerville are very active in the community planning process and this plan was to give them the opportunity to voice their opinions and be a part of the planning process.

1.3.2. ECONOMIC VIABILITY

Traffic congestion is a major concern in Toquerville with the increased demand. Tourists will not come to Zion if it is difficult or dangerous to reach. The transportation system is the lifeline for economic viability; much like the human body's circulatory system provides blood to organs and muscles. Arterial blood clots can be fatal to the body and roadway and parking congestion can be fatal to a community's economic health. Means to provide revenue for future improvements to roadway issues will be briefly explored in this report.

1.3.3. SAFETY OF CITIZENS

Traffic congestion leads to dangerous driving behaviors and increased accident rates for vehicles and pedestrians. Approximately 40,000 people die every year in vehicle accidents in the United States, which makes traffic accidents the third leading cause of death in this country. It is the leading cause of death for people under the age of 30. Utah averages about one fatal car accident per day as reported by the Utah Highway Safety Office. Roadways that are planned and designed correctly can reduce the accident rate by as much as 30%. This plan will look at ways to improve safety for the traveling public through improvements to the roadway system.

1.3.4. QUALITY OF LIFE FOR CITIZENS

Quality of life includes many factors and some of the factors that are important to the citizens in Toquerville include but are not limited to, preservation of rural environment and scenic views, preservation of the natural night sky, air quality, safety, and ability to use multi-modal means of transportation. A poorly planned transportation system diminishes all of these elements. There are three reasons for planning improvements to the transportation system:

1. *Mobility* – Alleviate existing or anticipated traffic congestion
2. *Safety* – Improve safety for drivers, pedestrians, and bicyclists
3. *Access* – Provide access routes to newly developed portions of the City

1.3.5. LEGAL BASIS FOR DEVELOPMENT EXACTION

Due to the decrease in funding available from federal and state sources, local governments are asking land developers to pay for the infrastructure necessary to support proposed development projects. A long-range plan is the legal basis for these exactions and impact fees. Legal challenges will be minimized if the estimated roadway construction costs are based on the community vision and system plans that support the vision.

1.3.6. UDOT COORDINATION

UDOT is responsible for the safe and efficient operation of state roads, even if they pass through cities. SR-17 is the major transportation facility through Toquerville and UDOT has been involved in the planning process to ensure these roadways are being planned to meet their requirements. Coordination with UDOT is essential in obtaining federal and state funds to construct transportation facilities. This coordination will also help the town to qualify their projects in the State Transportation Improvement Program (STIP). Lack of overall planning and coordination leads to haphazard results and poor circulation along transportation corridors.

1.4. STUDY PROCESS

The study process for the Toquerville City Transportation Master Plan is depicted in Figure 2. Study Flow Chart. The goal of this procedure is to identify the need, opportunities, and constraints for establishing and implementing the transportation plans. This process involves the participation of the city and public for guidance, review, evaluation and recommendations in developing the transportation plans.

Figure 2. Study Flow Chart

The first component of the study process is to gather the existing and future traffic, infrastructure, population, and employment conditions. Coordination with the local officials and Dixie Metropolitan Planning Organization (DMPO) will insure that the data is accurate and that assumptions are valid.

The second component of the study process is to analyze the data that has been gathered. Population and employment forecasts are developed and a traffic model is built. The location and concept formulation of projects is developed during this component.

The third component of the study process is to present and obtain approval from the planning commission and city council. Comments from these two bodies are incorporated into the study's final report. Transportation projects that are recommended for the short-term and long-range needs are discussed and finalized. The master plan is then adopted.

1.5. STUDY GOALS

Toquerville's goals for the transportation system are listed below:

- Formalize a Transportation Master Plan
- Develop an Official Street Map delineating roadway functional classification
- Create a plan to reduce future congestion and to maintain the small town atmosphere

- Create a working transportation model that can be readily updated

2. EXISTING CONDITIONS

An inventory and evaluation of existing conditions was conducted to identify current transportation problems and uses that influence the transportation facilities and area wide system. This information is used as a baseline to identify deficiencies and as an instrument to measure required improvements.

2.1. LAND USE

It is essential to analyze and recommend roadway improvements based on an understanding of the historical land use patterns within the study area. Land use obviously develops along transportation corridors and typically follows future use plans identified by the city. Toquerville has a unique network in that everything feeds off SR-17 which is the main lifeline through city.

Toquerville is comprised of both commercial and residential areas. The current Land Use Plan can be viewed in Toquerville City's General Plan. All undeveloped lands adjacent to SR-17 are viable areas to consider for both residential and commercial development. Toquerville City has a specific strategy to have both residential and commercial development along SR-17.

2.2. ENVIRONMENTAL

Southern Utah is rich with cultural, historic, geologic and other natural features. Tourism in Southern Utah accounts for a great deal of industry for many communities. Much of this tourism is based on features defined by natural and physical environments. Toquerville has some of the most pristine views in all of Utah. Along with this unique landscape are issues of sensitive species, natural environmental and geologic concerns.

Some of the environmental concerns facing Toquerville include archaeological sites, geological sites, soil conditions, and water drainage and flooding areas.

Threatened and endangered species and their habitat are protected by the National Environmental Policy Act (NEPA). Developments in these areas are typically off limits, although in past history development has been allowed to encroach in these sensitive areas. Development that poses an impact to these areas will require an Environmental Impact Statement (EIS).

Natural drainage areas can be incorporated into many developments, which usually do not create an impact to the feature. The impact is usually felt by the development by the discovery that certain land is undevelopable and usually remains as an open space feature. Environmental concerns should be addressed when looking at an area for any type of improvement to the transportation system. Specific issues for Toquerville will not be discussed here, as they are more related to specific projects as they are built.

2.3. SOCIO-ECONOMIC DATA

Table 1 shows the year 2010 census socioeconomic data for Toquerville. Historical growth rates have been identified for this study, because past growth is usually a good indicator of what might occur in the future.

Table 2 identifies the population growth over the past 60 years for the State of Utah, Washington County, and Toquerville City. The table identifies that population change in Washington County has changed drastically. The growth in the State has gained between 18 percent and 38 percent during the past 60 years. Toquerville City's population change has grown over the last 60 years with a significant increase between 1990 and 2010.

Table 1. 2010 Census Data - Toquerville

Population	Housing units
1370	444

Table 2. Population Data

Year	State of Utah	Washington County	Toquerville City
1950	688,862	9,836	219
1960	890,627	10,271	197
1970	1,059,273	13,669	185
1980	1,461,037	26,065	277
1990	1,722,850	48,560	488
2000	2,233,169	90,354	910
2010	2,763,885	138,115	1370

2.4. STREET SYSTEM INVENTORY

Due to the limited roadway network that currently exists in Toquerville, there was not much data that needed to be gathered to analyze the system. The data that was collected was mostly visual observations and coordination with local administration. This data is used for analyzing the existing conditions and to help in developing the future conditions. All of the roadways in Toquerville are 2-lane roads. Most of them are between 22 and 28 feet of pavement. SR-17 which is owned and maintained by UDOT is wider than 28' through the heart of Toquerville but is still a 2-lane roadway.

2.4.1. ANALYSES OF EXISTING ROADWAYS AND INTERSECTIONS

The daily capacity for each roadway was estimated based on engineering judgement and descriptions found in the Highway Capacity Manual (Transportation Research Board, National Research Council, *Highway Capacity Manual*, Washington, DC, National Academy of Sciences, 2010). Streets with daily traffic volumes forecasted to exceed the estimated capacity levels have been identified including potential mitigation measures. Detailed traffic analysis is included in Chapter 3.

2.5. TRAFFIC ACCIDENT DATA

Jones & DeMille reviewed reported accident data from 2010 to 2016. Out of a 113 accidents on SR-17, 57 of those accidents occurred within populated areas of Toquerville. Because Toquerville's main corridor is the state highway, a total of 10 (out of 113 during 2010 – 2016) accidents were due to local street traffic intersecting the highway. An evident trend was shown when commercial/large truck accidents were queried. The results showed all accidents for these type of vehicles occurred between milepost 3.7 to 4.1. All of which were classified as geometry related due to the dramatic horizontal curve present within this roadway section.

2.6. BICYCLE AND PEDESTRIAN TRAFFIC

A separate study is recommended in order to see how this could benefit Toquerville City. An Active Transportation Plan should accompany this study to outline the goals, plans, and policies regarding bicycle and pedestrian traffic.

2.7. REVENUE SOURCES

Maintenance of the existing transportation facilities and construction of new facilities come primarily from revenue sources that include the Toquerville City general fund, federal funds, and State Class C funds. Financing for local transportation projects consists of a combination of federal, state, and local revenues. However, this total is not entirely available for transportation improvement projects, since annual operating and maintenance costs must be deducted from the total revenue. In addition, the City is limited in their ability to subsidize the transportation budget from general fund revenues.

2.7.1. STATE CLASS B AND C PROGRAM

The distribution of Class B and C Program monies is established by state legislation and is administered by the State Department of Transportation. Revenues for the program are derived from state fuel taxes, registration fees, driver license fees, inspection fees, and transportation permits. Seventy-five percent of the funds derived from the taxes and fees are kept by the Utah Department of Transportation for their construction and maintenance programs. The remaining twenty-five percent is made available to counties and cities.Class B and C funds are allocated to each City and county by a formula based on population, road mileage, and land area. Class B funds are given to counties, and Class C funds are given to cities. Table 3 below identifies the method used to allocate B and C funds.

Table 3. Apportionment Method of Class B and C Funds

Based on	Of
50%	Roadway Mileage
50%	Total Population

Class B and C funds can be used for maintenance and construction of highways; however thirty percent of the funds must be used for construction or maintenance projects that exceed $40,000. Class B and C funds can also be used for matching federal funds or to pay the principal, interest, premiums, and reserves for issued bonds.

2.7.2. FEDERAL FUNDS

There are federal monies that are available to cities and counties through the federal-aid program. The funds are administered by the Utah Department of Transportation. In order to be eligible, a project must be listed on the five-year Statewide Transportation Improvement Program (STIP).

The Surface Transportation Program (STP) provides funding for any road that is functionally classified as a collector street or higher. STP funds can be used for a range of projects including rehabilitation and new construction. Fifty percent of the STP funds are allocated to urban and rural areas of the state based on population. Thirty percent can be used in any area of the State, at the discretion of the State Transportation Commission. The remaining twenty percent must be spent on highway safety projects and transportation enhancements. Transportation enhancements include 10 categories ranging from historic preservation, bicycle and pedestrian facilities, and water runoff mitigation. The amount of money available for projects specifically in the study area varies each year depending on the planned projects in UDOT’s Region Four.

2.7.3. IMPACT FEES

Toquerville City does currently collect impact fees for transportation improvements. These fees can be found in the Impact Fee Facility Plan & Analysis for the City of Toquerville. The impact fees will assist in building the necessary roadway improvements to handle the increased growth and mitigate congestion that is currently being realized on the roadways in city.

2.7.4. LOCAL FUNDS

Toquerville City, like most cities, has utilized general fund revenues in its transportation program. Other options available to improve the City's transportation facilities could involve some type of bonding arrangement, either through the creation of a redevelopment district or a special improvement district. These districts are organized for the purpose of funding a single, specific project that benefits an identifiable group of properties. Another source is through general obligation bonding arrangements for projects felt to be beneficial to the entire entity issuing the bonds.

2.7.5. PRIVATE SOURCES

Private interests often provide sources of funding for transportation improvements. Developers construct the local streets within the subdivisions and often dedicate right-of-way and participate in the construction of collector or arterial streets adjacent to their developments. Developers can also be considered as a possible source of funds for projects because of the impacts of the development, such as the need for traffic signals or street widening.

3. FUTURE GROWTH

3.1. BACKGROUND

3.1.1. ZION NATION PARK VISITATION

The City of Toquerville is located on SR-17, one of the primary routes to Zion National Park. Zion has had a steady growth in annual visitation, but over the last few years has experienced exponential growth, reaching the milestone of over 4 million visitors in 2016. With increased visitation has come increased vehicular traffic on SR-17. Figure 3 shows both Zion visitation as well as annual average daily traffic (AADT) on SR-17 in the Toquerville area.

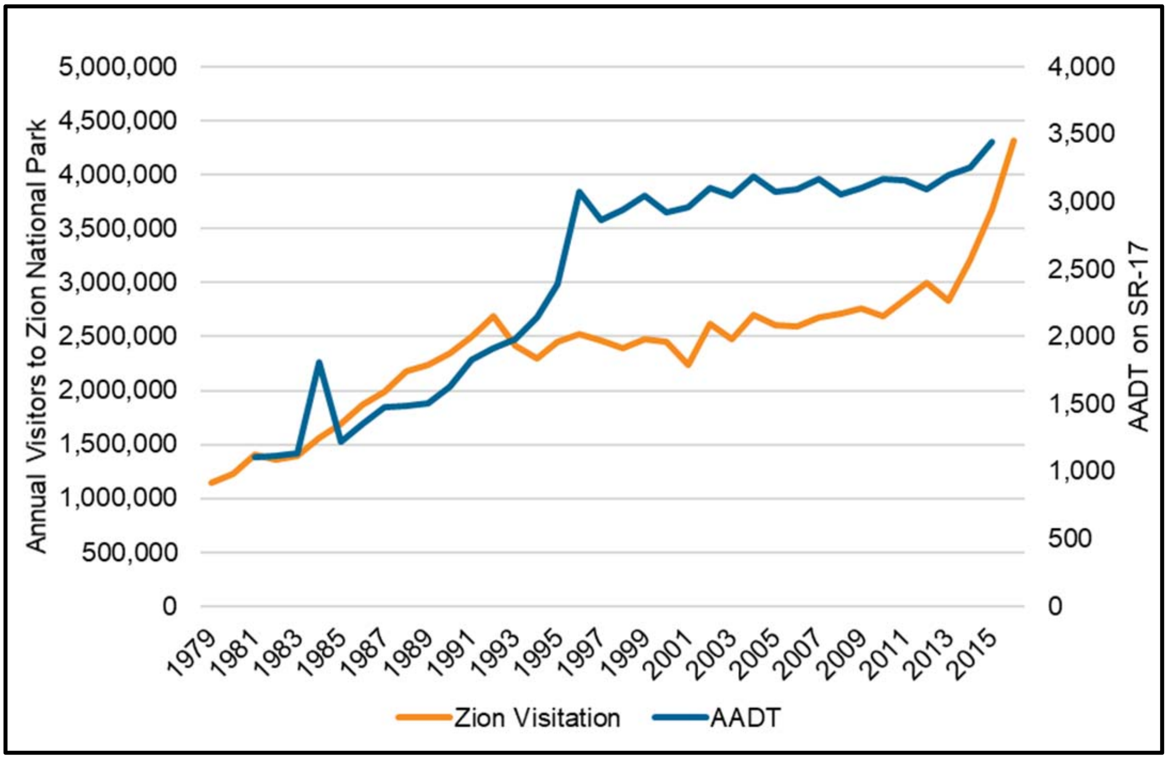

Figure 3. Zion National Park Annual Visitation and AADT on SR-17

3.1.2. BYPASS CORRIDOR

In response to growth in traffic on SR-17, the City has proposed a 3-mile bypass road that would connect to SR-17 at approximately MP 4.2 (about 1 mile northwest of Old Church Road), and at approximately MP 1.1 (about 700 feet north of South Zions Parkway), passing around the west side of Toquerville. Figure 4 shows conceptual linework[1] for the proposed road.

The proposed bypass road would have a fairly high design speed of 55 mph which would allow for a posted speed limit of 45 to 50 mph. The bypass road would also have limited, but at-grade, access at major intersections. Direct business or residential accesses would be prohibited. According to the city, much of the right-of-way for this bypass road has already been acquired. One proposed option is that the road be constructed in one phase. If this doesn't occur, the city believes that the road will be constructed in small segments as the west side develops. This distinction is discussed in greater detail below.

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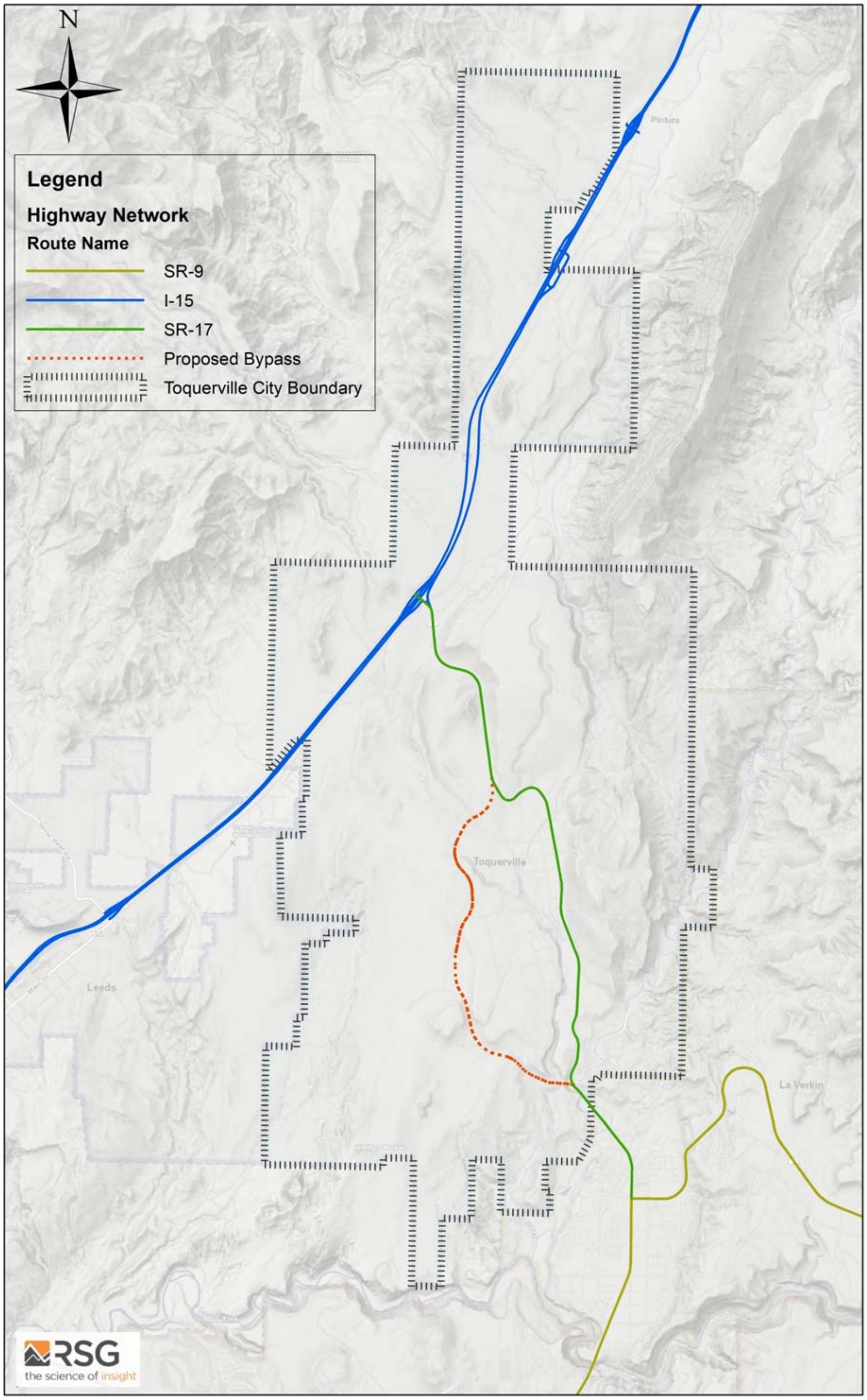
[1] The alignment for the bypass is conceptual and the roadway still needs to be designed. In design, this alignment may change to meet design standards. The bypass connections to SR-17 will need to be designed which may affect other roadway accesses near these connections. AADT is projected to increase and SR-17 south of the bypass, which includes a bridge, will exceed capacity. As discussed in section 3.4.4 SR-17 will need to be widened to add additional lanes.

Figure 4. Bypass Corridor on West Side of Toquerville



3.1.3. DATA COLLECTION

Resource Systems Group (RSG), the sub consultant for traffic modeling, collected traffic volume counts on SR-17 north of Toquerville between Thursday, August 3, and Sunday, August 6, 2017. Traffic volumes by time of day are shown in Figure 5.

UDOT reported an average annual daily traffic (AADT) of 3,040 vehicles per day in 2015. Figure 6 shows the daily traffic volumes in August 2017 compared to the 2015 AADT value. Two factors at play are: recent growth in Zion National Park visitation between 2015 and 2017, and the 2015 data is an estimate of traffic during the entire year, whereas the August 2017 data represent peak summer conditions. The August data also show there appears to be little difference between weekday and weekend volume during the peak season.

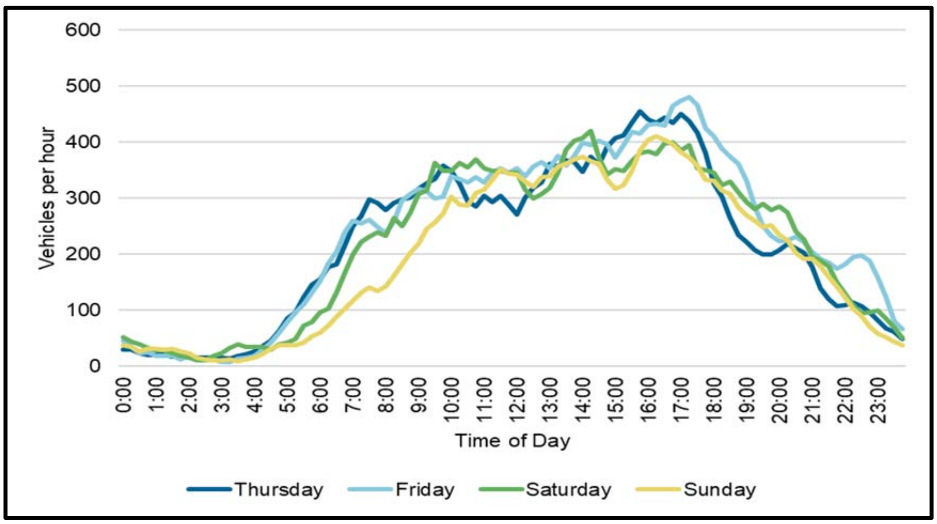


Figure 5. Traffic Variation on SR-17 by Time of Day, August 3-August 6, 2017

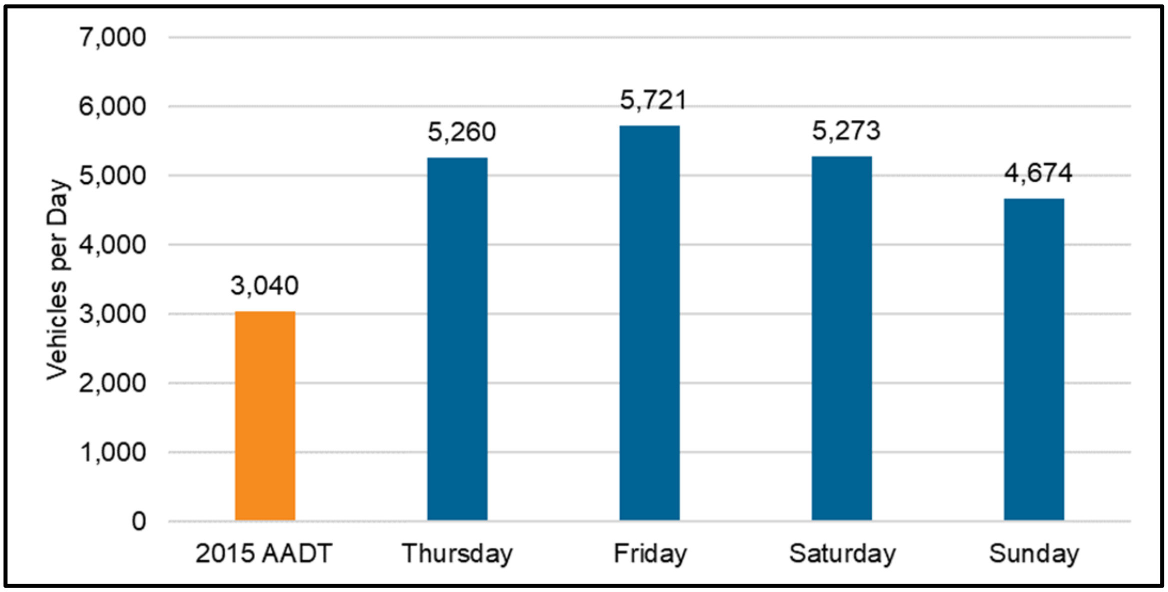


Figure 6. Daily Traffic Volumes in August 2017 Compared to 2015 AADT

3.1.4. TRAVEL DEMAND MODEL REFINEMENTS

RSG used Version 2 of the Dixie Metropolitan Planning Organization (DMPO) travel demand model (with subsequent updates by DMPO current as of June 16, 2017). Version 2 was used by DMPO in the development of the 2015-2040 Regional Transportation Plan. All travel demand modeling work was done in Citilabs Cube 6.4.2. The model includes a base year (2012) and three future years, 2025, 2035, and 2040, which corresponds to the Regional Transportation Plan (RTP) phases, Phase I, II, and III, respectively.

The DMPO model is intended for regional planning purposes and not necessarily refined for work on municipal level transportation master plans. Therefore, RSG evaluated the current model structure and performed several model refinements to assist in producing more accurate forecasts. Model refinements included updated traffic analysis zone (TAZ) structure, updated socioeconomic inputs (land use) to reflect current planning efforts by the City of Toquerville, and updated highway network to account for all collector and above roads, including the proposed bypass road.

3.1.4.1. TAZ STRUCTURE

The DMPO model included limited TAZs in the Toquerville area, many of which were too large and unrefined on the west edge of the city for a detailed roadway analysis. RSG split TAZs to better follow the topography, current and planned roads, and to better match land use patterns. Figure 7 shows the old and new TAZ structure for the Toquerville area.

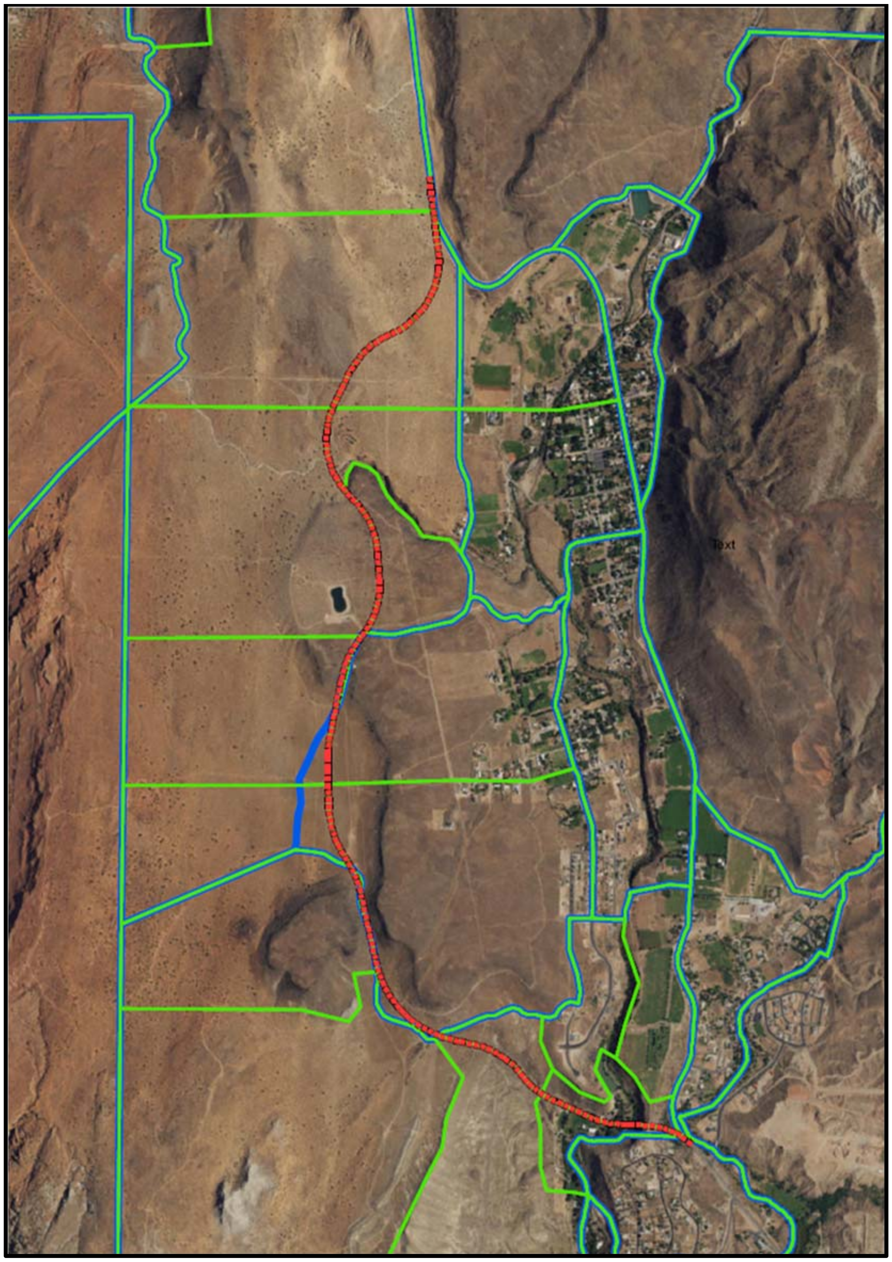


Figure 7. TAZ Refinements to DMPO Model

3.2. GIS GROWTH MODELING APPROACH

Effectively planning for the future needs of a City requires insight into how its population is expected to change over time. Changes in population influence how and where people live, work, and recreate across the landscape, driving development patterns and transportation needs. To better understand Toquerville City's future development and transportation needs, demographic data were incorporated into a Geographic Information System (GIS) model to estimate future population, household, and employment growth and distribution patterns within the City over the next 30 years.

Base demographic data for the model were obtained from the Governor's Office of Management and Budget (GOMB). The data included population, household, and employment counts for Toquerville City from the 2010 Census, as well as population projections for the City at each decade interval out to the year 2060. Household and employment projections for the same time intervals were only available at the county level.

Calculating population, household, and employment projections for years between the base data's decade intervals required interpolation using basic assumptions. Population projections were interpolated by applying the annualized average population growth for Toquerville City between one decade interval and the next, assuming constant growth between decades. Household and employment projection calculations were performed in a similar manner, using 2010 Census information for base year numbers and applying rates of change from county-level data for the projections. This assumes employment levels and household sizes in Toquerville City will change in the same direction and at the same rate as Washington County overall. It is important to note that while the population of Toquerville is projected to grow throughout the forecast period, the average household size is projected to decrease until approximately 2040 when it begins to stabilize.

Once completed, the demographic projections were incorporated in a GIS model to estimate where housing growth may occur within the City for the study period. The projected number of households was used as a proxy for the number of housing units required to house the City's projected population for a given year, which was calculated by dividing the City's projected population by the projected average household size. Using GIS, a point feature layer was developed to show the approximate locations of housing units for each year of interest. A base-level housing location layer for the current year was developed by placing a point feature within each parcel containing an existing residential structure. Housing location points were then added to the GIS in direct correlation with the number of projected households for each year of interest to represent a likely buildout scenario.

Several assumptions were made when placing household location points when modeling future growth patterns within the City. First, growth is most likely to first occur in already-developed or planned subdivisions. Second, topography will severely limit any additional housing developments to the east of already-developed areas of the City. Third, the majority of housing growth will occur on the west side of incorporated area of the City, with growth generally moving from the north to the south along the proposed bypass corridor. Lastly, larger parcels within the already-developed portions of the City will gradually fill in as demand for new housing increases over time. This can be seen in the figure on the following page.

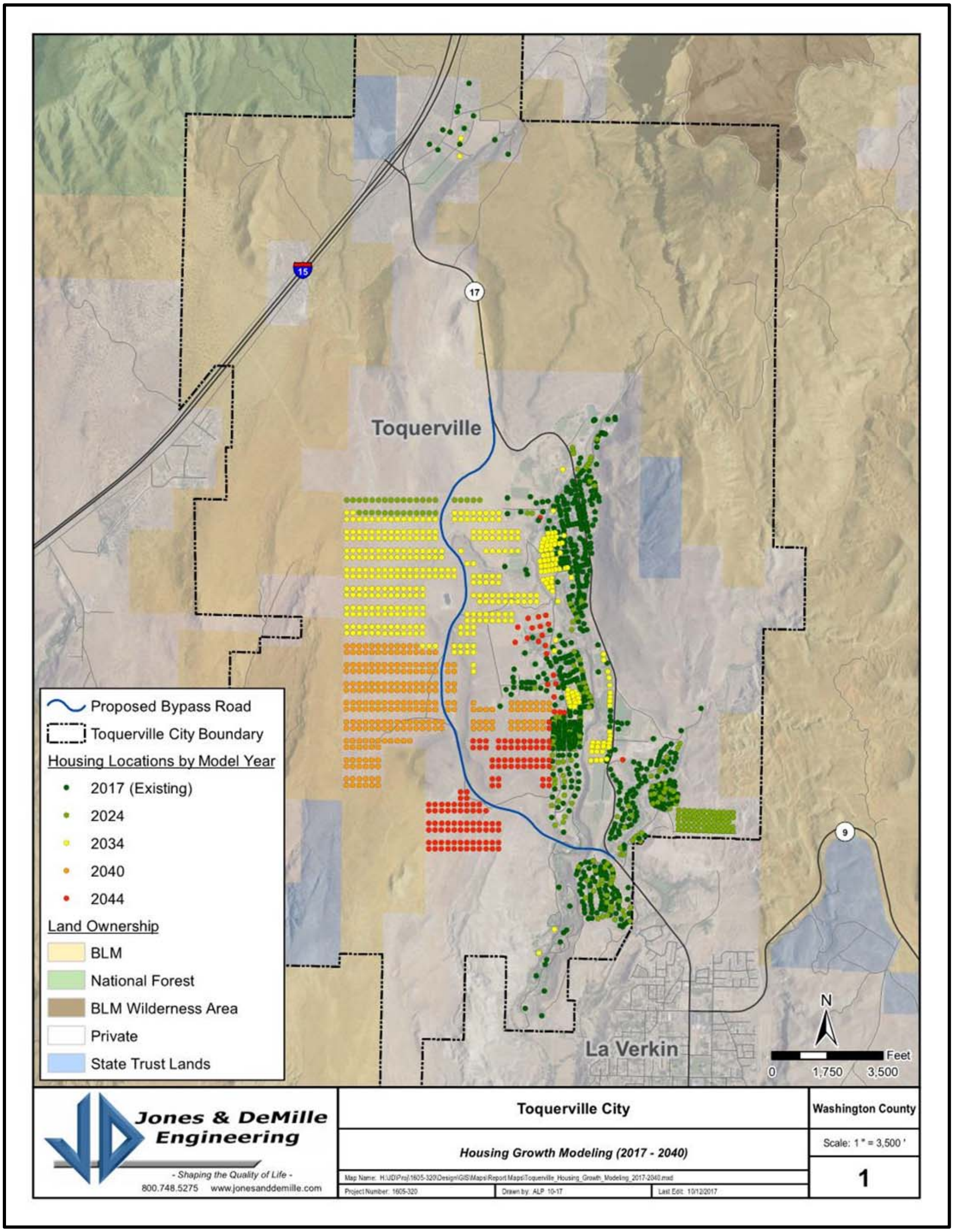


Figure 8. Housing Growth Model

3.3. LAND USE AND TRANSPORTATION

Coordination between land use and transportation is critical for the future development of Toquerville City. Street classification and development of streets can guide both desirable and undesirable land uses. The same holds true for land use development. It forces the street classification in advance that could be in opposition to the goals of the transportation plan. Therefore, it is imperative that the goals of land use and transportation are coordinated with each other to support and augment one another and not oppose each other.

The current version of the DMPO model projects a total of nearly 2,500 households but less than 800 jobs by year 2040. RSG discussed land use assumptions with Jones and DeMille, who worked in close coordination with city staff to estimate future land use in Toquerville. Jones and DeMille provided households and commercial acreage by phase. We estimated that approximately 70% of commercial land would be useable (accounting for roads and other infrastructure such as open space). Table 4 shows conversion factors used to convert commercial acreage to jobs.

Table 4. Commercial Land Use Conversion Factors

Land Use Type	Proportion of Commercial	Floor-to-area Ratio (FAR)[1]	Employees per 1,000 sq ft
Retail	50%	0.25	2
Restaurant	30%	0.25	3
Office	10%	0.3	3
Hotel	10%	0.5	2

1. Conversion of acreage to square footage of buildings.

For the Build analysis, we assumed that the Bypass Corridor would be constructed in one phase, therefore the Bypass Corridor is included in each Build scenario. In the No Build scenarios, the Bypass Corridor is expanded incrementally from the north to the south as shown in Figure 9. Therefore, portions of this road are included in the 2025 and 2035 No Build scenarios, but 100% is included in the 2040 scenario. The basis for this assumption is that portions of the Bypass Corridor would be constructed with on-going development. Based on conversations with the consultant team, this would most likely occur from north to south. Figure 9 shows which portions built in each phase.

Table 5 shows the assumed households and employment for the original model and the newly created No Build and Build models for each horizon year. Households and employment are also shown in Figure 10 and Figure 11, respectively. It is assumed there will be more commercial development (employment) due to the plans for the bypass and reservoir and less residential growth (households) than the original DMPO model.

Table 5. Land Use Assumptions

Horizon Year	Households			Employment		
	Original Model	No Build	Build	Original Model	No Build	Build
2012	494			131		
2025	1,008	692	692	299	1,283	1,861
2035	1,838	1,094	1,094	541	3,825	5,443
2040	2,468	1,335	1,482	727	5,212	6,483

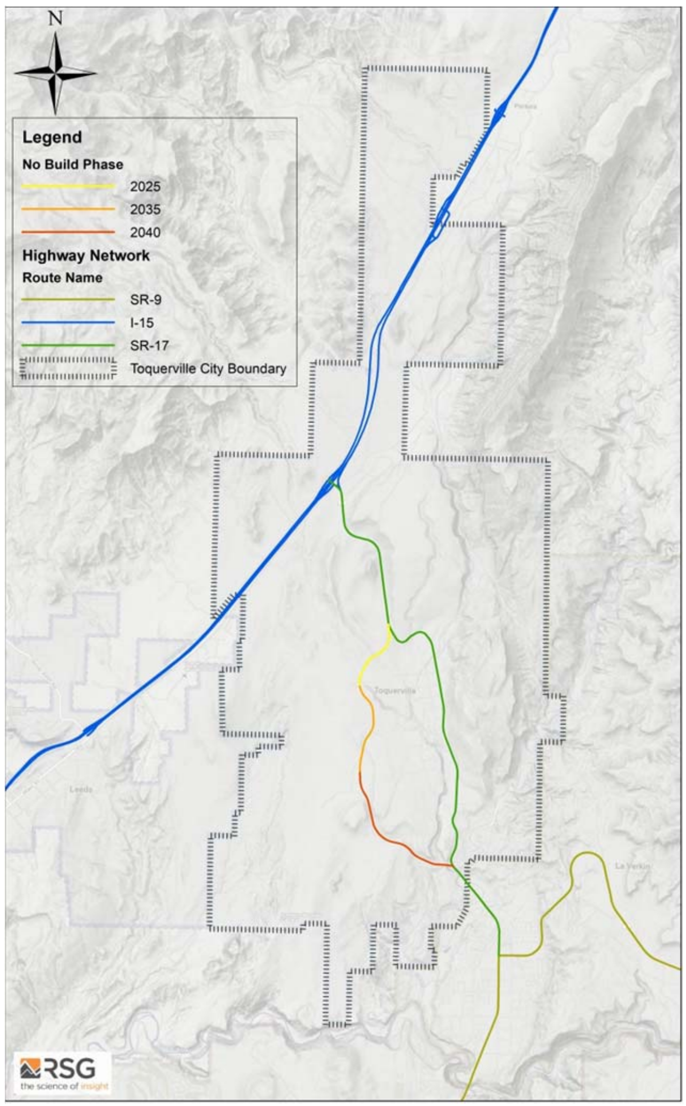


Figure 9. Bypass Corridor by Phase

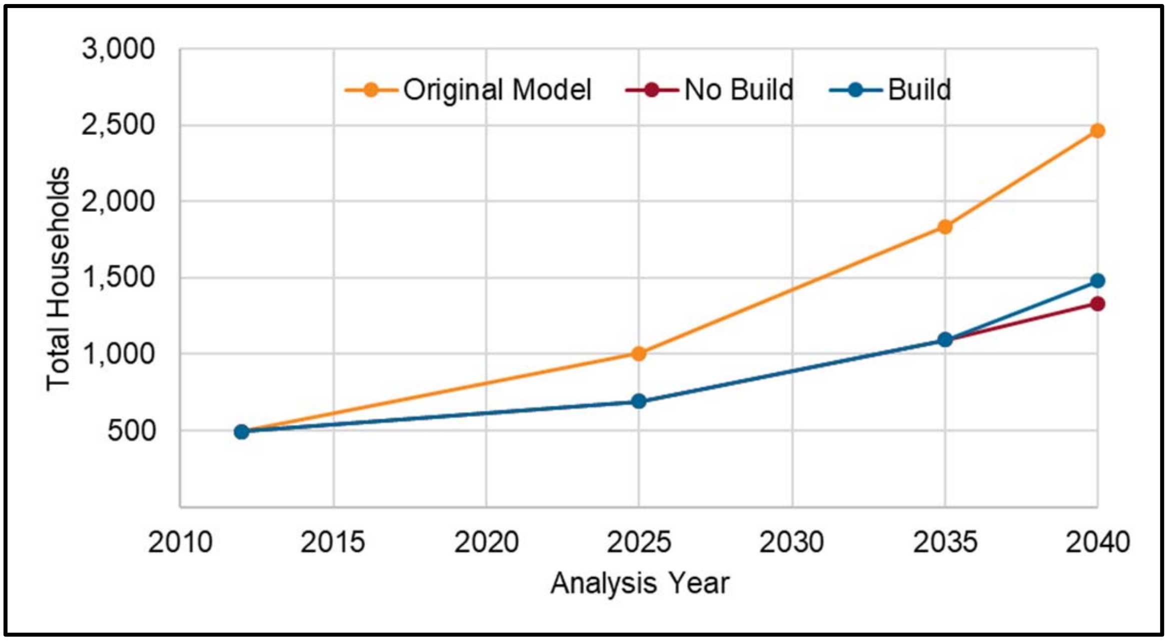


Figure 10. Households by Year for Each Model

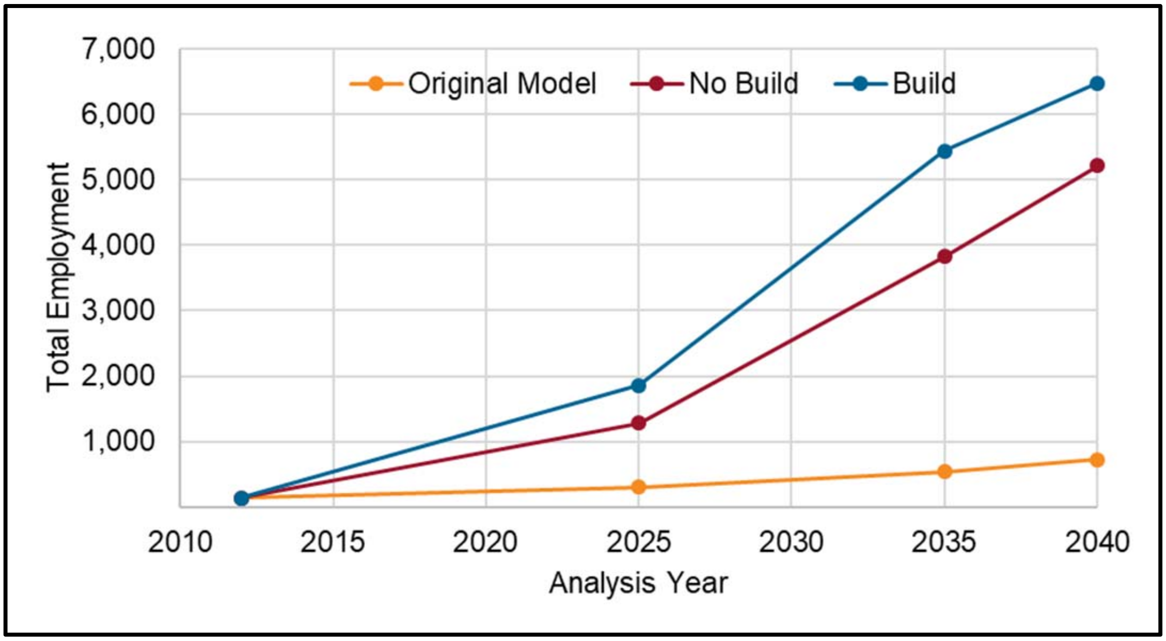


Figure 11. Total Employment by Year for Each Model

3.3.1. FUNCTIONAL STREET CLASSIFICATION

Functional street classification is a subjective means to identify how a roadway functions and operates when a combination of the roadway's characteristics are evaluated. These characteristics include; roadway configuration, right-of-way, traffic volume, carrying capacity, property access, speed limit, roadway spacing, and length of trips using the roadway. Four primary classifications were used in classifying selected roadways in Toquerville. These classifications are: Arterial, Collector, Residential Local, and Residential Minor. Arterials provide a higher degree of traffic mobility with limited property access and often connect to the freeway system. Collectors provide a balance between mobility and property access trips. Residential streets and roads serve property access based trips and these trips are generally shorter in length. Traffic from residential roads is gathered on to the collector system and channeled to the arterials.

SR-17, the major route through Toquerville, is classified as an Arterial. The proposed Bypass Corridor will be functionally classified as an Arterial. Westfield Road, Springs Drive, Zions Parkway, Shangri-La, and Cholla Drive are functionally classified as collectors. The proposed Old Church Road that would connect to the Bypass Corridor will be functionally classified as a Collector. A map of the streets and their classifications is shown in the maps at the end of this section.

Included on these maps are city boundaries, land designations, and future proposed roadways. These features are discussed on the next several pages. The roadway cross-sections for new development have not changed from what is currently in place. This does not mean that every existing roadway in city will have to be reconstructed to meet these standards. This effort is to develop a standard section that will meet the City's needs and be used for future development plans. All new roadways will be required to meet this standard as approved by the city council.

The design of the individual roadway elements depends on the intended use of the facility. Roads with higher design volumes and speeds need more travel lanes and wider right-of-way than low volume, low speed roads. The high use roadway type should include wider shoulders and medians, separate turn lanes, dedicated bicycle lanes, careful placement of on street parking, and control of driveway access. On most of the cross sections an additional area beyond the curb line is provided to accommodate landscape buffers, sidewalks, and drainage facilities.

3.3.1.1. RESIDENTIAL STREETS

Residential streets provide access to abutting land uses and service local traffic movement. Due to low traffic speeds and relatively small traffic volumes on the street, parking is usually allowed on the street and bicycles are allowed without a separate travel lane. The cross-sections for residential streets include options for both private and public roads. The private roads include a 30-foot minimum right-of-way. The public roads also have a right-of-way of 30-feet but differ in the elements that comprise each roadway. These cross sections allow one travel lane in each direction, parking, and curb and gutter and sidewalk.

3.3.1.2. COLLECTORS

Collector streets provide for traffic movement between local streets and arterial streets and provide access to abutting land uses. The collector roadway is a two-lane section with 36-feet minimum of right-of-way. No delineated bicycle facilities are planned on these roadways and they share the roadway with the vehicles. The increased width of this type of roadway versus that of the local streets allows for the development of on-street parking and sidewalks on both sides of the roadway. This type of roadway allows for higher speeds and increased traffic volumes with more capacity than a local street. These roadways are included as part of the overall trails network and accommodating bicyclists will need to be part of the roadways.

3.3.1.3. ARTERIALS

Arterial streets provide major through traffic movement between geographic areas. These roadways typically have some form of access control that limits the location of driveways. The arterial roadway is a 2-lane section with a minimum of 60 feet of right-of-way. The only arterial in city is SR-17 and is owned and maintained by UDOT. The actual right-of-way width on this roadway varies from 60 feet to over 100 feet. UDOT is in the process of revising the cross section of this roadway to include bike lanes on each side of the roadway, one travel lane in each direction, and parking on one side of the roadway. The section also includes areas for pedestrian facilities, curb, gutter, light poles, drainage facilities, and traffic calming features.

3.3.2. ROADWAY CROSS SECTIONS

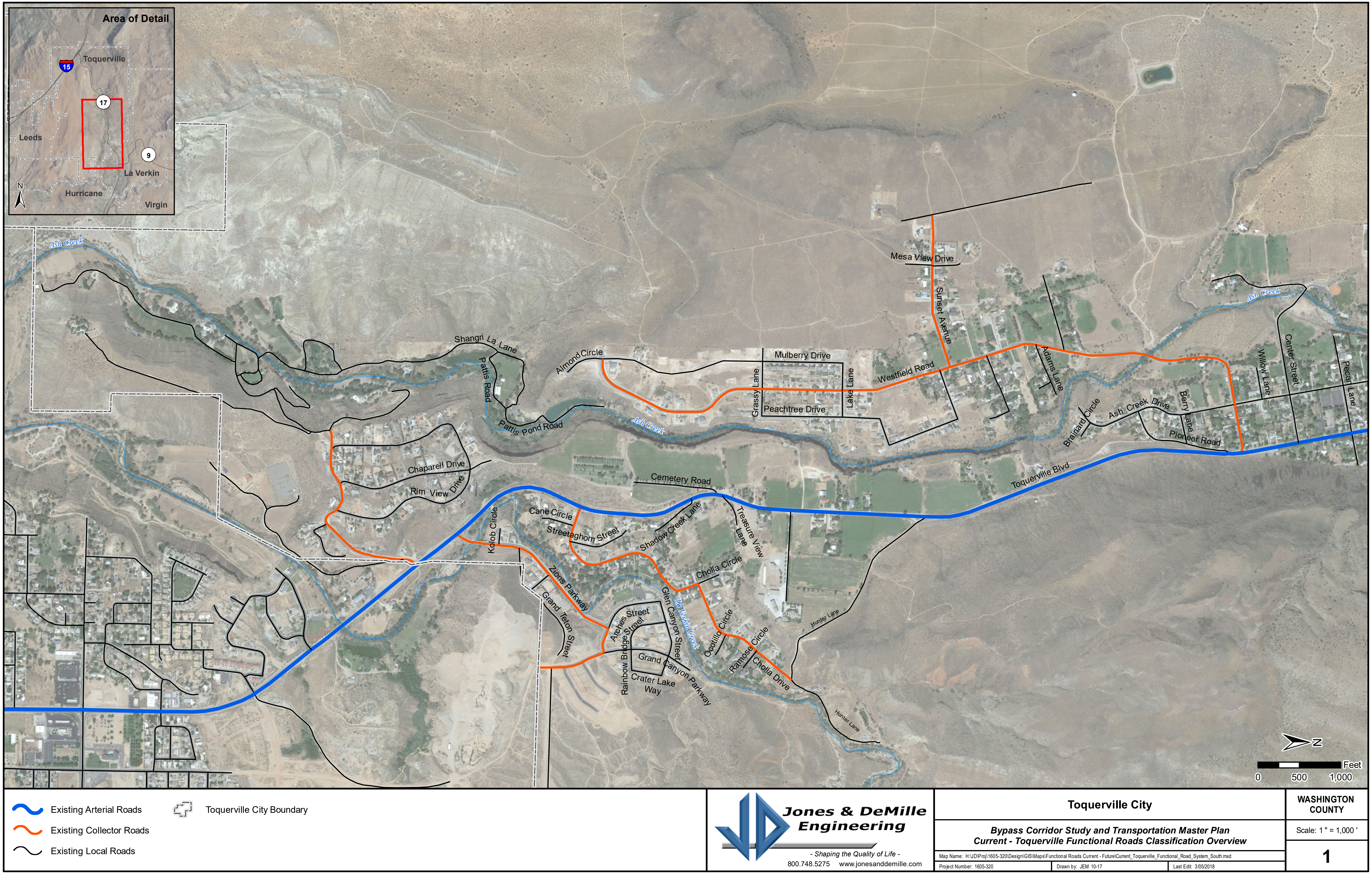
Cross sections are the combination of the individual design elements that constitute the design of the roadway. Cross section elements include the pavement surface for driving, parking lanes, and bike lanes, curb and gutter, sidewalks and additional bike path and landscape areas. Right-of-way is the total land area needed to provide for the cross section elements. The roadway cross-sections for Toquerville City are found in the City’s Design Standards.

3.3.3. THE CENTRAL CORE OF TOQUERVILLE

Toquerville City has developed a downcity core along SR-17. The downcity core is important for a couple of reasons. It identifies a place or an identity for a community. It is important that the downcity area keep that through keeping traffic and speed down.

Figure 12. Classification of Roads- Current North

Figure 13. Classification of Roads- Current South



3.4. ROADWAYS

The model done by RSG mainly looks at how a Bypass Corridor could help relieve traffic from SR-17. Other roads were studied that would connect to the Bypass Corridor in order to effectively move the flow of traffic to the Bypass Corridor which includes Old Church Road, Westfield Road, and Sunset Road.

The DMPO model included a previous alignment for the Bypass Corridor, however, limited collector class roads were included in the highway network. RSG added additional roads deemed to be significant for this transportation master plan, as well as additional TAZ connectors given the refined TAZ structure. Figure 14 shows the old and new roadway network structure.

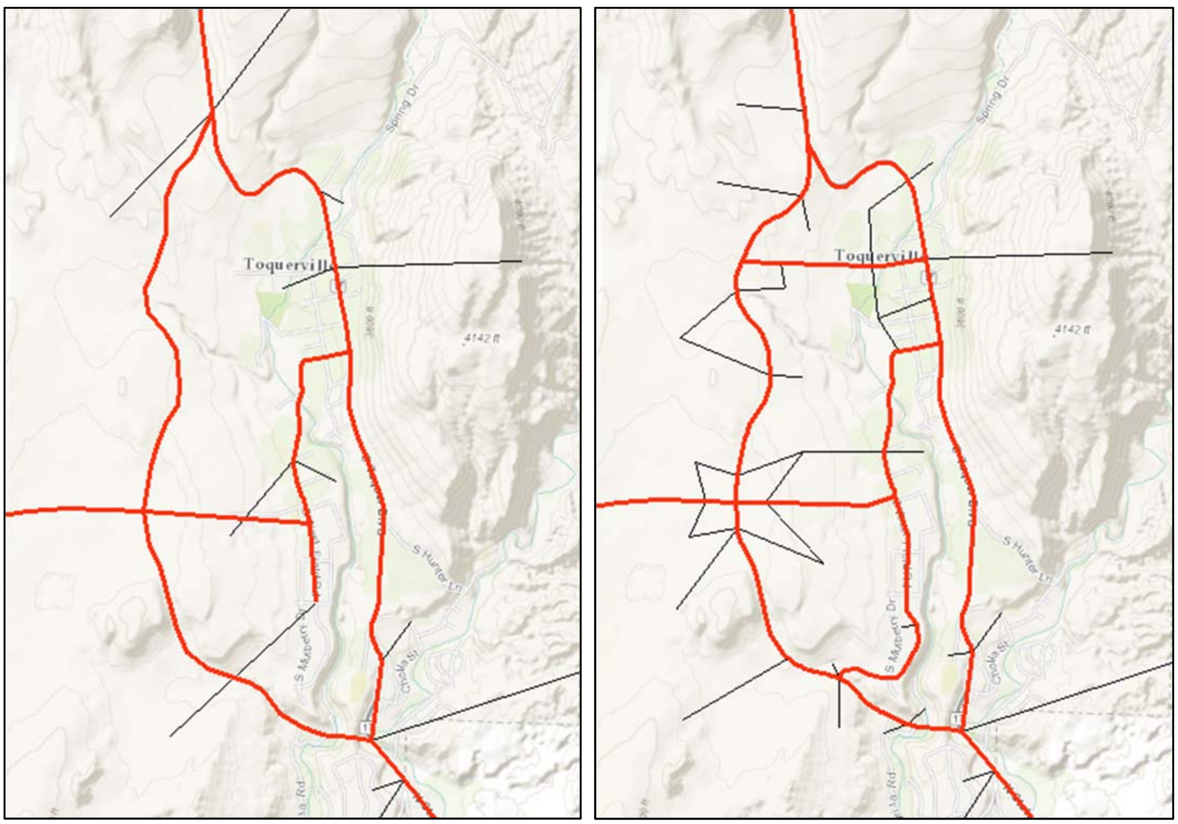


Figure 14. Old and New Roadway Network in Toquerville Area

As shown in Figure 14, new (or modified) roads include:

- ***Bypass Corridor*** This linework was updated to include more recent conceptual plans. The Bypass Corridor was modeled as a Principal Arterial which has an assumed free flow speed of 40 – 48 MPH. The Bypass Corridor was modeled with two lanes in each direction of travel.
- ***Old Church Road*** from the Bypass Corridor over to SR-17. Most of Old Church Road already exists as a two-lane street. This road was modeled as a Minor Collector with one lane in each direction of travel. A Minor Collector is assumed to have a free flow speed of 26 – 32 MPH.
- ***Westfield Road*** extension down to the Bypass Corridor. This road was modeled as a Minor Collector with one lane in each direction of travel. A Minor Collector is assumed to have a free flow speed of 26 – 32 MPH.

3.4.1. BASE FORECASTS

Base year (2012) traffic volumes for each roadway were compared against historical traffic counts obtained from UDOT in order to determine base year error. The DMPO travel demand model reflects average weekday daily traffic (AWDT) during a spring time condition. As such it does not take into account recreational traffic from Zion National Park, or the variation of traffic on weekdays or weekends. Making a direct comparison is difficult because the model counts represent a spring AWDT, while UDOT data are estimated AADTs. Furthermore, UDOT counts are not available for all road segments of interest. In a typical urban area, AWDT is normally 5 to 10% larger than AADT. However, in areas with more recreational traffic, AADT can often be larger than AWDT. In this case, it is difficult to know whether springtime AWDT or AADT would be larger.

Data from the count RSG conducted showed similar traffic volumes on the weekdays and weekends. RSG obtained historical traffic volumes from a UDOT continuous count station (CCS) on SR-9 west of Hurricane (CCS #402). Data from this CCS shows the ratio of AWDT to AADT has been approximately 1.06 over the last few years. Assuming this same ratio applied to 2012 AADT data, the 2012 AWDT would have been approximately 2,900 vehicles per day compared to approximately 3,700 vehicles per day in the DMPO model. Because these volumes are fairly close, no adjustments were made future 2025, 2035, or 2040 volumes.

Figure 15, Figure 16, and Figure 17 show No Build and Build AWDTs for SR-17 north of Toquerville, in Toquerville, and south of Toquerville, respectively. Figure 18 and Figure gure 19 show No Build and Build AWDTs for the north and south ends of the Bypass Corridor, respectively.

3.4.2. SR-17 NORTH OF TOQUERVILLE

North of Toquerville, SR-17 is expected to exceed the capacity of a two-lane road (typically considered to be 10,000 to 15,000 vehicles per day) between 2025 and 2035, regardless of whether the Bypass Corridor is constructed. A widening project for this portion of SR-17 is currently planned for Phase II of the RTP (2025-2035). It is recommended this project stay on the RTP for this phase.

3.4.3. SR-17 IN TOQUERVILLE

In Toquerville, SR-17 is expected to exceed the capacity of a two-lane road within the next few years if no Bypass Corridor is constructed. With a Bypass Corridor in place, the AWDT on SR-17 is not expected to increase much more that current levels. Therefore, the Bypass Corridor is recommended to be constructed in later Phase I or early Phase II (near 2025).

3.4.4. SR-17 SOUTH OF TOQUERVILLE

South of Toquerville, SR-17 is expected to exceed the capacity of a three-lane road (typically considered to be 15,000 vehicles per day) regardless of whether the Bypass Corridor is constructed. A widening project for this portion of SR-17 is currently planned for Phase II of the RTP (2025-2035). It is recommend this project stay on the RTP for this phase.

3.4.5. BYPASS CORRIDOR

The Bypass Corridor is anticipated to have an AWDT of 20,000 to 25,000 vehicles per day in the future assuming it is connected on both ends. It is recommended to preserve the right-of-way in order to construct the Bypass Corridor as a five-lane cross section (two travel lanes in each direction and a center median for left-turn lanes at major intersections).

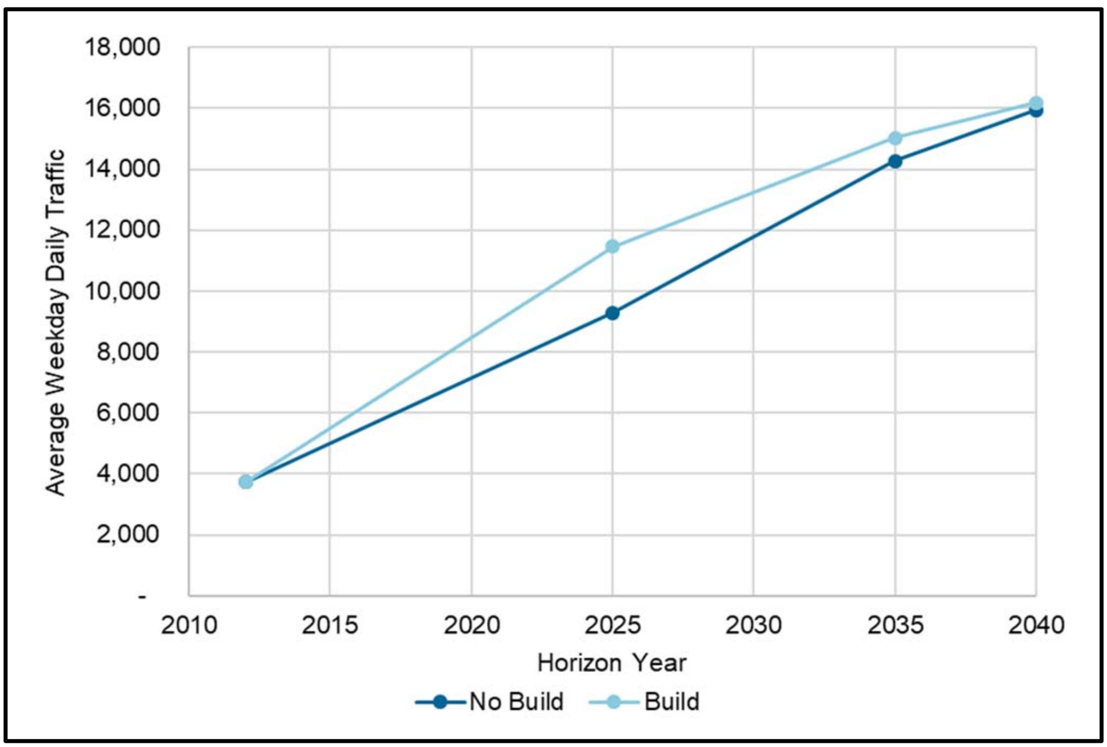


Figure15. AWDT on SR-17 North of Toquerville

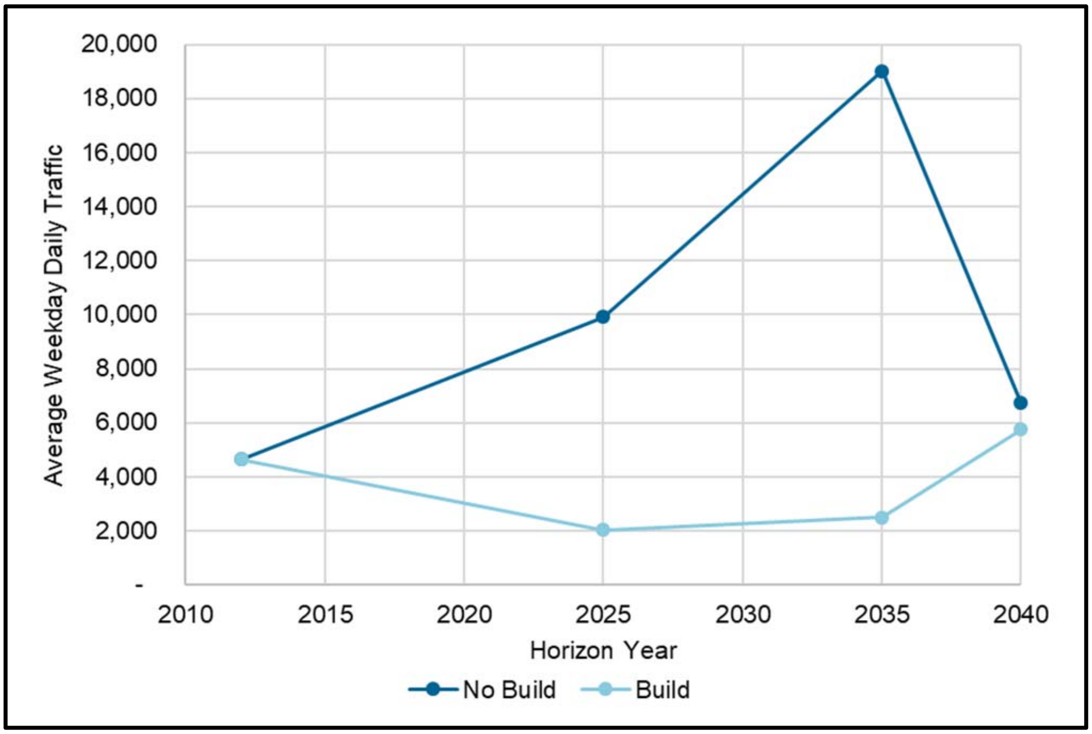


Figure 16. AWDT on SR-17 in Toquerville

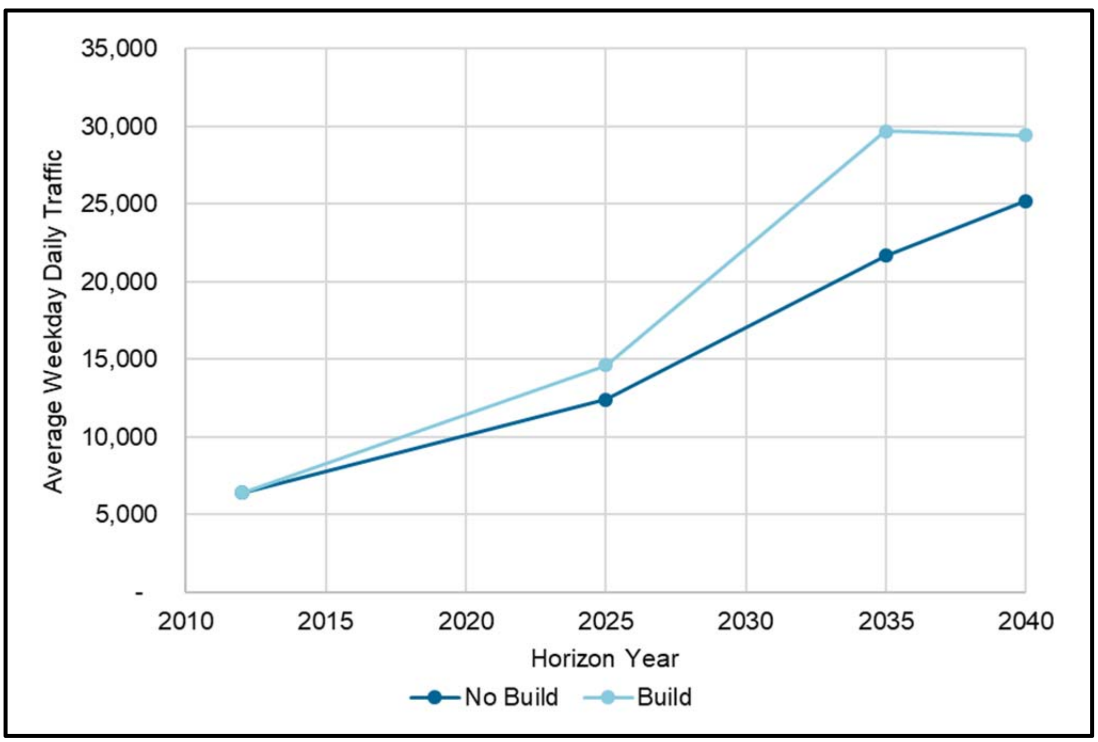


Figure 17. AWDT on SR-17 South of Toquerville

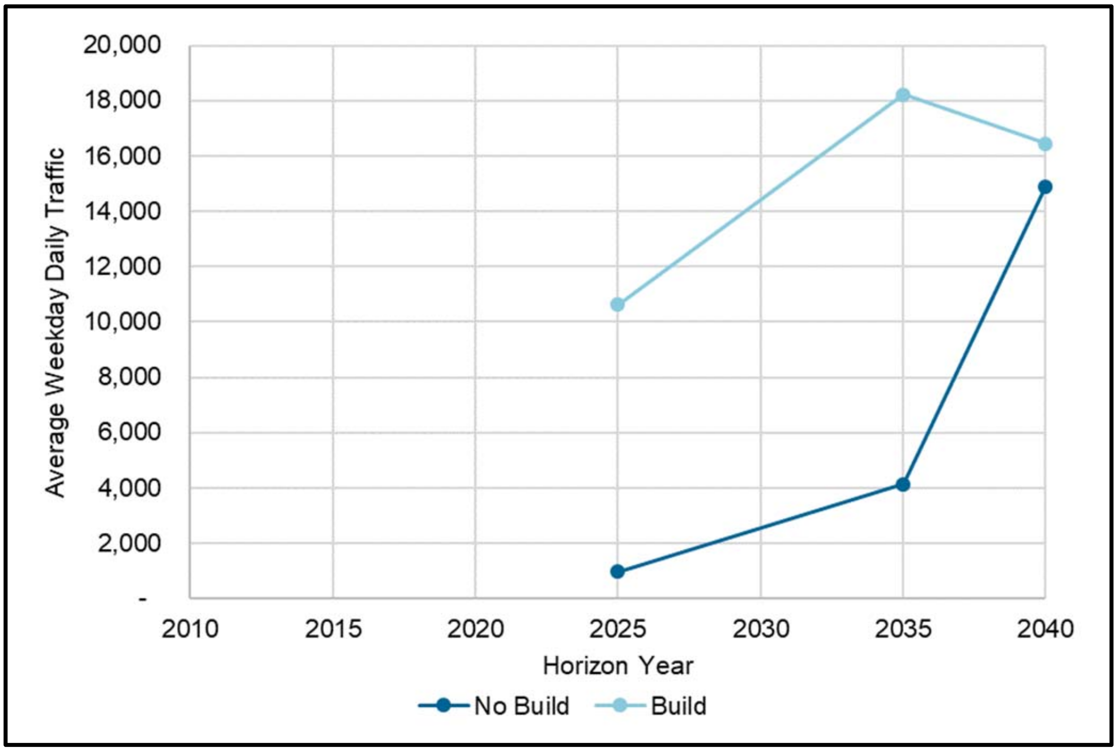


Figure 18. AWDT on North End of Bypass Corridor

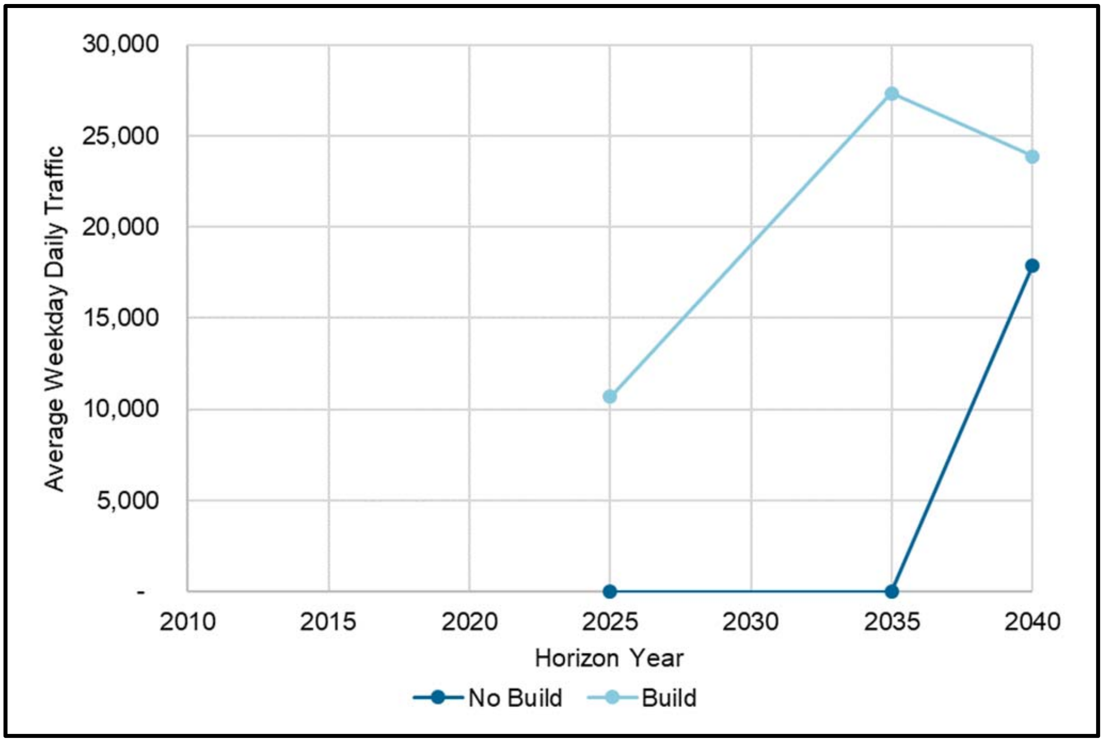


Figure 19. AWDT on South End of Bypass Corridor

3.5. SEASONAL FORECASTS

Due to the current set-up of the DMPO travel demand model, the previous forecasts represent typical weekday volumes during springtime. The model does not account for recreation trips, such as those to and from Zion National Park, that tend to be significant during the summer months. Given the overwhelming popularity of the park, these trips are also becoming more significant during the shoulder seasons. Enhancing the model to account for these trips was beyond the scope of this project, therefore, off-model calculations were made to estimate weekday and weekend conditions during peak seasons.

First, RSG determined the difference between August 2017 counts and 2015 AADT (the most recent AADT data from UDOT). Then, RSG evaluated converting model AWDT (springtime) to peak summer month AWDT, and converting peak summer month AWDT to peak summer month weekend daily traffic. Because there are no continuous count stations (CCSs) on SR-17, RSG obtained data from other sources to help determine these conversions. Finally, growth projections were applied to the base AWDT calculated by the DMPO model.

3.5.1. PEAK SUMMER WEEKDAY RECREATION TRIPS

Recreation trips were estimated by subtracting the 2015 AADT (3,040) from the August 2017 estimated AWDT (5,037[1]) which results in 1,997 vehicles per day. Visitation data from Zion National Park shows that July is usually the busiest month.[2] The August weekday daily recreation trips (1,997) were therefore multiple by the ratio of July to August visitation at Zion National Park for 2016 (1,997 x 1.25 = 2,507 daily trips).

3.5.2. PEAK SUMMER WEEKEND RECREATION TRIPS

RSG collected traffic data from CCSs near several other recreational destinations in Utah including Bear Lake, Big and Little Cottonwood Canyons, Moab/Arches, and Ogden Canyon. In all cases, the weekend traffic was at least 30% higher than weekday, with some locations close to double. However, the data collected on SR-17 in August 2017 showed weekend traffic levels were actually lower than on weekdays.[3] A CCS on SR-9, west of Hurricane has a similar pattern of lower weekend traffic during the peak month. Two CCSs near Kanab, which would capture recreation traffic to Lake Powell and both the north and south rims of the Grand Canyon also had similar weekday/weekend traffic levels. A final check included collecting CCS data from a Montana site just outside of West Yellowstone.[4] This data showed

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[1] This was calculated based on partial data for Monday and Wednesday, and full data on Thursday and Friday.
[2] https://www.nps.gov/zion/learn/management/upload/ZION-VISITATION-2007-2017-5.pdf
[3] One possible reason for this pattern is that Zion National Park is located further from large metropolitan areas, such as Las Vegas, Phoenix, and Salt Lake City, than many of the other recreational areas and visits to this park could be longer, thus requiring travel on non-weekend days.
[4] CCS #A-018

nearly identical weekday and weekend traffic patterns despite the proximity to a large national park. Therefore, we conclude that weekend traffic on SR-17 is not significantly higher than weekday traffic during peak summer months.

3.5.3. RECREATIONAL TRIP GROWTH

Growth could continue during all months, including peak summer months, and/or growth could increase during the off-peak seasons (spring and fall) as people avoid the most congested periods. In fact, the latter has already started occurring in recent years as spring months see nearly as many visitors as summer months as shown in Figure 20. So far in 2017, April and May visitations were only 10% less than July, as compared to 2007 through 2013 when April visitations were roughly 25% less than July. This could be because the park has an effective “peak capacity” and travelers are learning that they need to visit during other months to better enjoy the park. Therefore, in the future, peak traffic conditions on SR-17 could occur for several months out of the year and not just during the summer season.

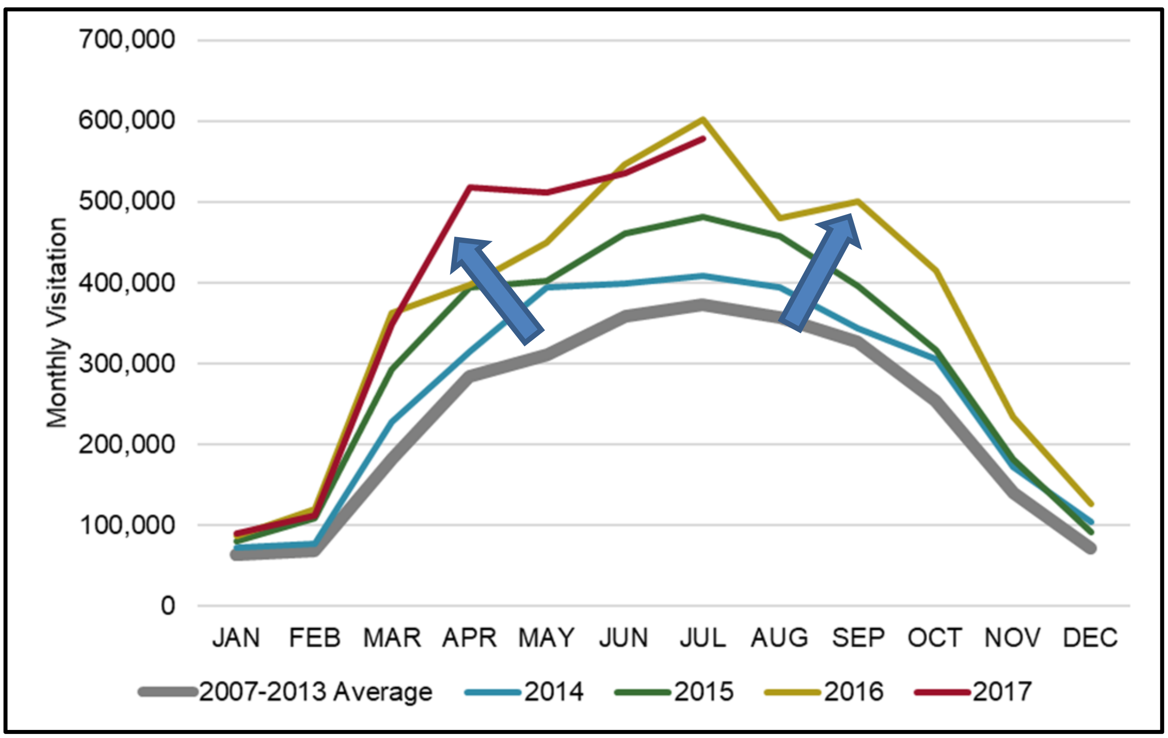


Figure 20. Recent Zion National Park Monthly Visitation Trends

Three sensitivity scenarios were analyzed including the following:

- ***No Growth (0% through 2050)*** – This scenario assumes that Zion National Park is effectively at capacity and recreational traffic will not be higher than it currently is today.
- ***Moderate Growth (20% through 2050)*** – This scenario assumes a dampened growth rate occurs, at roughly half the rate of historical growth as shown in Figure 21.
- ***High Growth (40% through 2050)*** – This scenario assumes continued increase in visitation is accommodated by Zion National Park, and the high growth rates continue as shown in Figure 22.

Figure 23 shows the projected future recreational traffic based on these three sensitivity scenarios. Figure 24 shows estimated forecasts including base weekday traffic plus estimated recreational traffic on SR-17 assuming the Bypass Corridor is not constructed. During peak months, which will now occur during multiple months of the year, the average daily traffic will exceed two-lane capacity as early as 2020. Figure 25 shows base weekday traffic and recreational traffic on the Bypass Corridor in the Build Scenario. The daily traffic volumes are anticipated to get as high as 30,000 vehicles per day, which is close to the upper end of the capacity of a five-lane cross section. It should be noted that the Zion National Park visitation sensitivity tests do not significantly alter the overall traffic volumes, nor the recommendations.

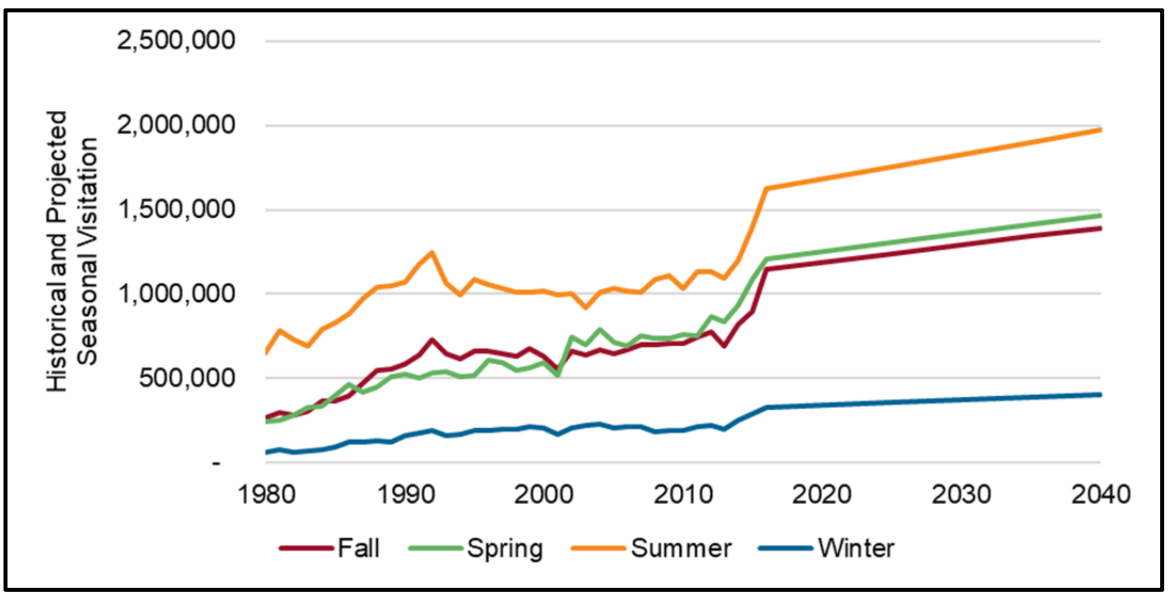


Figure 21. Historical and Projected Visitation Assuming Moderate Growth

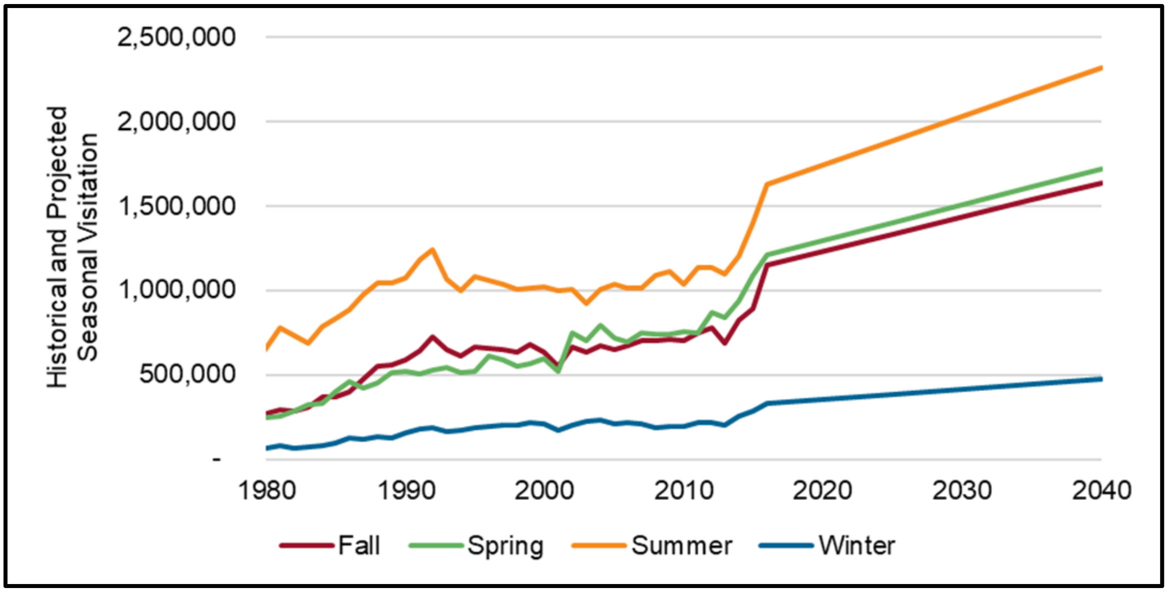


Figure 22. Historical and Projected Visitation Assuming High Growth

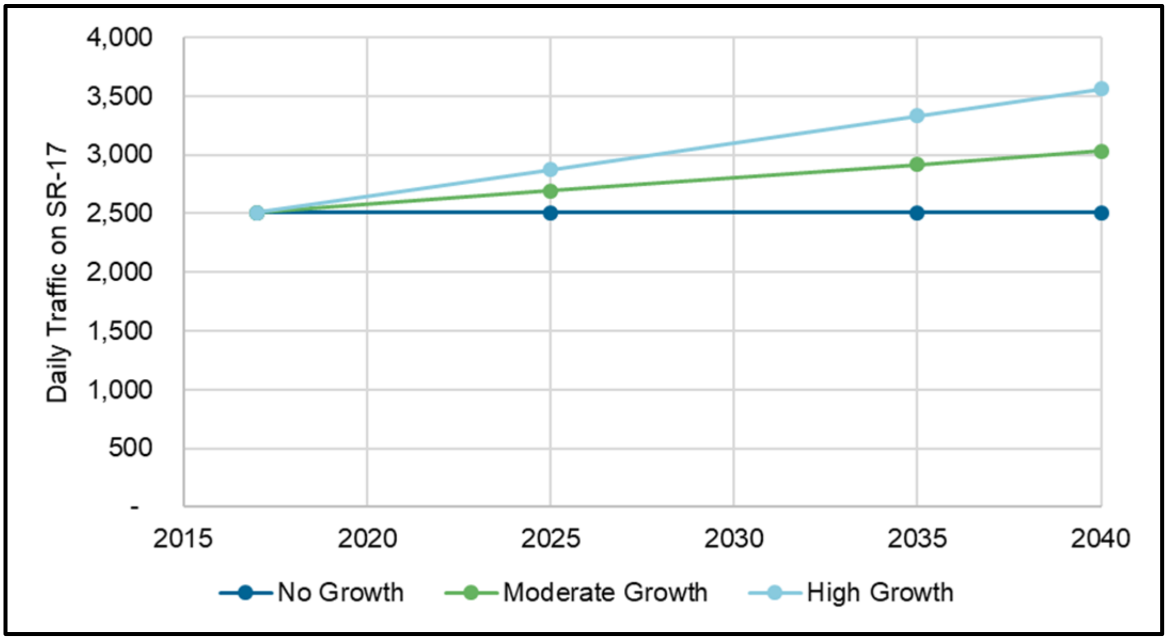


Figure 23. Projected Peak Season Daily Recreational Traffic on SR-17

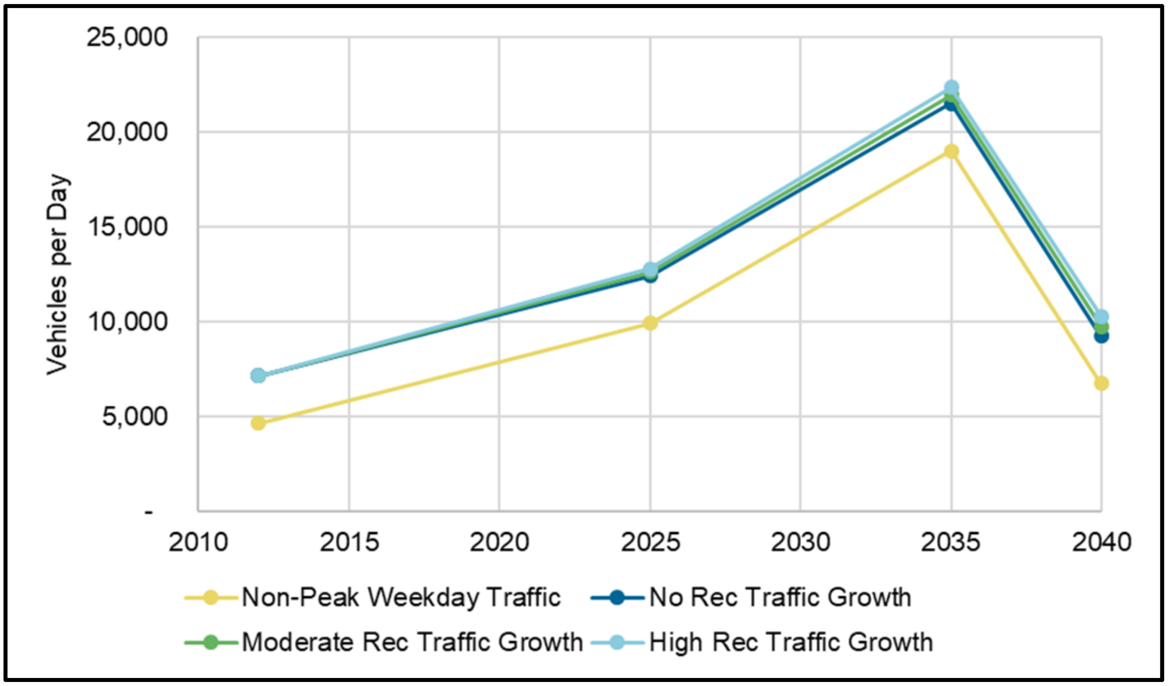


Figure 24. Base Weekday Traffic plus Recreational Traffic on SR-17 (No-Build Scenario)

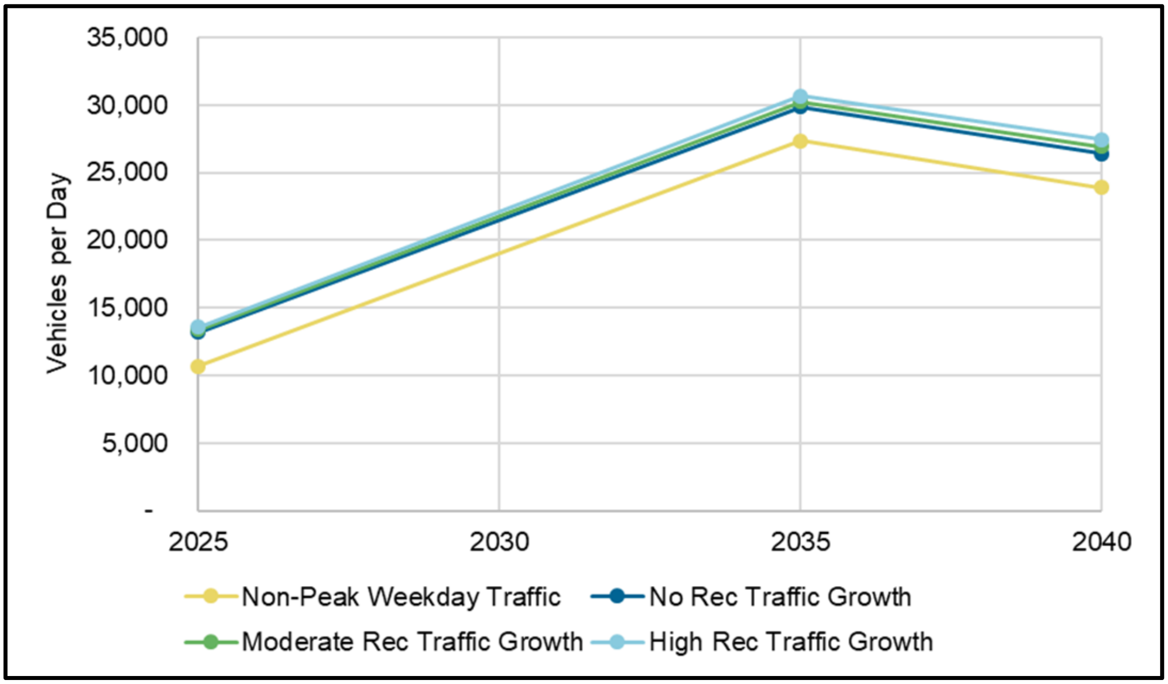


Figure 25. Base Weekday Traffic plus Recreational Traffic on Bypass Corridor (Build Scenario)

3.5.4. FUTURE TOQUERVILLE CITY ROADWAY SYSTEM

Roadway projects are selected based on the analysis provided in the previous sections. The recommended improvements to the roadway system include any new projects that will preserve critical transportation corridors or enhance the operation of the existing transportation network. The recommended roadway plan for Toquerville is presented in terms of functional classifications:

- Arterial Roads
- Collector Roads
- Local Roads

The Proposed Future Roadway System is shown in the figures at the end of this section. These figures are schematic in nature and do not show actual road alignments or curves. The focus of the plan is for local roadways. Very little detail is shown for the residential and residential private roadways to allow flexibility as development occurs between the collectors. Some local roads are shown on the map to emphasize or justify the layout of the roadways in that vicinity. Minimum acceptable roundabout spacing on an arterial is typically one-quarter mile, but varies based on the UDOT classification of the roadway. At some locations, additional right-of-way may be necessary on roadways above and beyond what is shown on the Proposed Future Roadway System Map to accommodate for future auxiliary lanes, such as acceleration, deceleration, and turn lanes.

The following roadways are proposed future roadways and can be found in the Future Roadway System Map:

Future Arterial Roadways:

- North of Toquerville, SR-17 is expected to exceed the capacity of a two-lane road between 2025 and 2035, regardless of whether the Bypass Corridor is constructed. A widening project for this portion of SR-17 is currently planned for Phase II of the RTP (2025-2035). It is recommended this project stay on the RTP for this phase.
- South of Toquerville, SR-17 is expected to exceed the capacity of a three-lane road regardless of whether the Bypass Corridor is constructed. A widening project for this portion of SR-17 is currently planned for Phase II of the RTP (2025-2035). It is recommend this project stay on the RTP for this phase.
- The Bypass Corridor is anticipated to have an AWDT of at least 25,000 vehicles per day in the future assuming it is connected on both ends. It is recommended to preserve the right-of-way in order to construct the Bypass Corridor as a five-lane cross section (two travel lanes in each direction and a center median for left-turn lanes at major intersections). The Bypass Corridor is recommended to be constructed in later Phase I or early Phase II (near 2025).

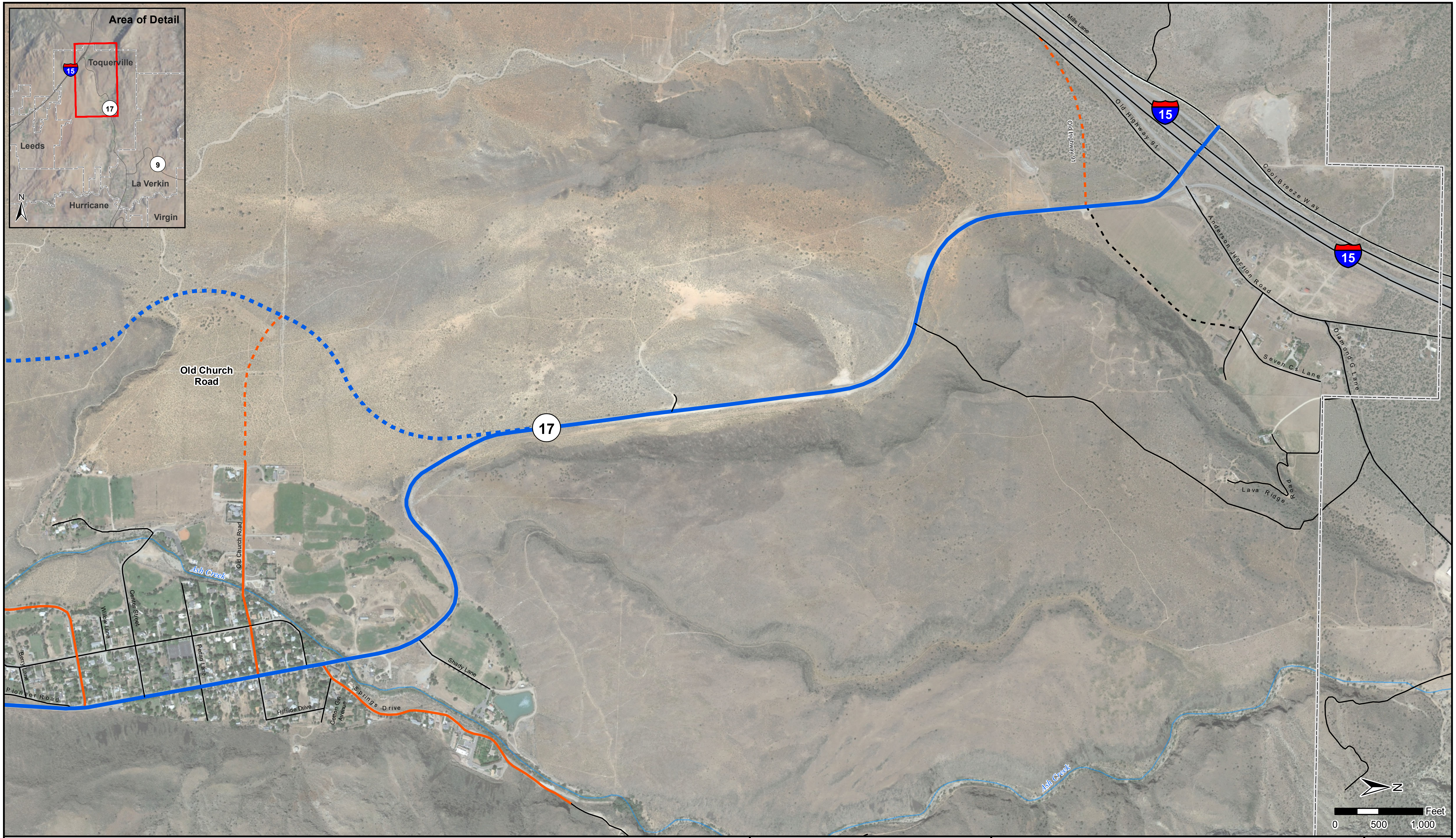
Future Collector Roadways:

- Westfield Road and Old Church Road will continue from its current location through undeveloped land and eventually connect to the Bypass Corridor. This is recommended to be constructed once the Bypass Corridor is finished.
- Sunset Avenue will continue from its current location through undeveloped land and eventually connect to the Bypass Corridor and continue west to connect to Old Hwy 91. This is recommended to be constructed once the Bypass Corridor is finished.
- The intersection of Old Highway 91 with SR-17 will need a realignment once UDOT improves Anderson Junction and development increases in the area. Old Highway 91 will be realigned to intersect SR-17 further south by turning east before it reaches SR-17.

Future Local Roadways:

- West Field Tank Road originates from Westfield Road near the crossing of Ash Creek and will connect to the Bypass Corridor. This is recommended to be constructed once the Bypass Corridor is finished.
- Hunter Lane originates from SR-17 and connects to the northeast end of Cholla Drive. This is currently a dirt road that will need to be paved as development increases.
- The Anderson Junction Road intersection with SR-17 will change once UDOT improves Anderson Junction and Development increases in the area. 7 C's Lane will continue southwest and connect to SR-17. This will remove traffic from the existing Anderson Junction turnoff which is unsafe due to its location near the off ramp of I-15.

Figure 26 Future Roads North



Existing Arterial Roads
Existing Collector Roads
Existing Local Roads
Future Arterial Roads
Future Collector Roads
Future Local Roads
Toquerville City Boundary

Jones & DeMille Engineering
- Shaping the Quality of Life -
800.748.5275 www.jonesanddemille.com

Toquerville City

WASHINGTON COUNTY

Bypass Corridor Study and Transportation Master Plan
Future - Toquerville Functional Road Classification Overview (South)

Scale: 1 " = 1,000 '

Map Name: H:\JD\Proj\1605-320\Design\GIS\Maps\Functional Roads Current - Future\As pages\Future_Toquerville_Functional_Road_System_North.mxd
Project Number: 1605-320 Drawn by: JEM 10-17 Last Edit: 12/22/2017

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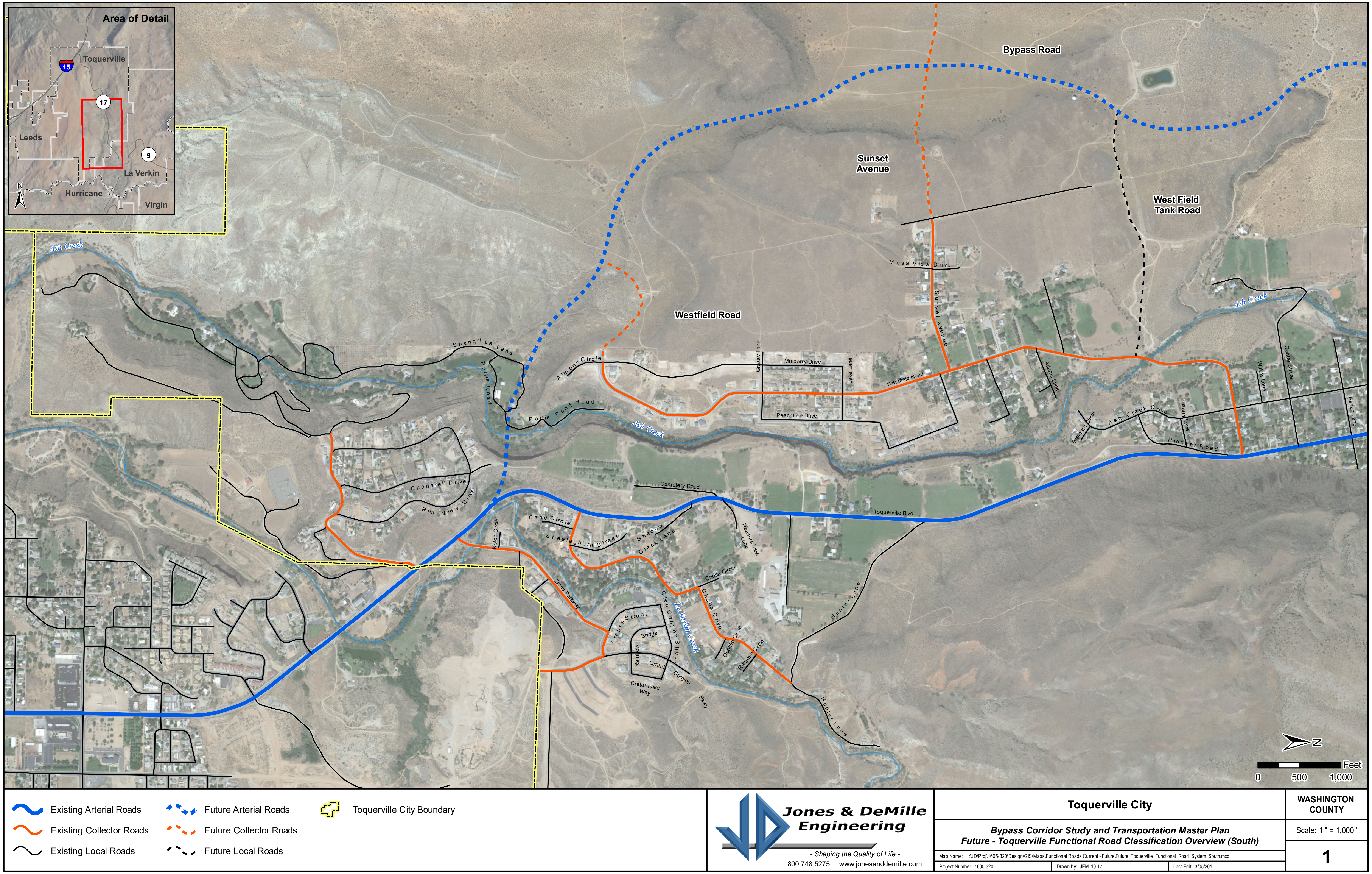
Figure 27 Future Roads South



4. TRANSPORTATION GUIDELINES AND POLICIES

Toquerville City may require a Traffic Impact Study (TIS) for any new development when the following guidelines indicate that a TIS is needed. The following sections are to be used to establish uniform guidelines for when a TIS is required and how the study is to be conducted, based on suggested guidelines established by the Institute of Transportation Engineers (ITE) and the American Public Works Association (APWA).

A TIS is a specialized study of the impacts that a certain type and size of development will have on the surrounding transportation system. It is specifically concerned with the generation, distribution, and assignment of traffic to and from the “new development”. The term “new development” also includes properties that are being redeveloped.

4.1.1. TIS REQUIREMENTS

A complete TIS shall be performed if any of the following situations are proposed:

- All new developments or additions to existing developments, which are expected to generate more than 100 new peak hour vehicle trips
- In some cases, a development that generates less than 100 new peak hour trips should require a TIS if it affects local “problem” areas. These would include high accident locations, currently congested areas, or areas of critical local concern
- All applications for rezoning when there is a significant increase in traffic volume
- All applications for annexation
- Any change in the land use or density that will change the site traffic generation by more than 15 percent, where at least 100 new peak hour trips are involved
- Any change in the land use that will cause the directional distribution of site traffic to change by more than 20 percent
- When the original TIS is more than 2 years old, access decisions are still outstanding, or changes in development have occurred in the site environs; and
- When development agreements are necessary to determine “fair share” contributions to major roadway improvements

The specific analysis requirements and level of detail are set forth in the following sections.

4.1.1.1. CATEGORY I

A Category I TIS should be required for all developments which generate one hundred (100) or more new peak hour trips, but less than five hundred (500) trips, during the morning, afternoon or Saturday peak hour. Peak hour trips will be determined by the latest edition ITE Trip Generation Manual. In addition to the above threshold requirements, a Category I TIS may also be required by the City for any specific traffic problems or concerns such as:

- Proposed or existing offset intersections,
- Situation with a high number of traffic accidents,
- Driveway conflicts with adjacent developments,
- Nearby intersections that have reached their capacity,
- Proposed property rezones when there is a significant potential increase in traffic volumes, and
- When the original TIS is more than two years old, or where the proposed traffic volumes in the original TIS increase by more than twenty percent.

For a Category I TIS, the study horizon should include the opening year of the development, and build-out of the entire development, if applicable. The minimum study area should include site access drives, affected signalized intersections and major unsignalized street intersections.

4.1.1.2. CATEGORY II

A Category II TIS should be required for all developments, which generate from five hundred (500) to one thousand (1,000) peak hour trips during the morning, afternoon or Saturday peak hour. The study horizon should include the opening year of the development, year of completion for each phase of the development, if applicable, and five years after the development's completion. The minimum study area should include the site access drives and all signalized intersections and major unsignalized street intersections within one-half mile of the development.

4.1.1.3. CATEGORY III

A Category III TIS should be required for all developments, which generate above one thousand (1,000) peak hour trips during the morning, afternoon or Saturday peak hour. The study horizon shall be for the year of completion for each phase of the development, the year of its completion, five years after the development's completion and ten years after the development's completion. The minimum study area shall include the site access drives and all signalized intersections and major unsignalized street intersections within one-half mile of the development.

4.1.2. INITIAL WORK ACTIVITY

A developer, or their agent, should first estimate the number of vehicular trips to be generated by the proposed development to determine if a TIS may be required and if so, to determine the applicable category. The City must give concurrence on the number of trips to be generated by the proposed development. The developer may, if desired, request that the City assist in estimating the number of trips for the purpose of determining whether a TIS is required for the proposed development.

The City or designated representative shall make the final decision on requiring a TIS and determining whether the study falls within Category I, II or III.

If a study is determined to be required by the City, the developer should prepare for submittal to the City, for review and approval, a draft table of contents for the TIS. The table of contents will be sufficiently detailed to explain the proposed area of influence for the study, intersections and roadways to be analyzed, and level of detail for gathering of traffic volume information and preparation of level of service analyses. There should also be included in the draft a proposed trip distribution for site traffic. After approval of the draft table of contents and trip distribution by the City, the actual TIS work activities may begin.

The Traffic Impact Study Scope of Work agreement between the developer and his/her traffic engineer should conform to the pre-approved draft table of contents. The findings, conclusions and recommendations contained within the TIS document should be prepared in accordance with appropriate professional Civil Engineering Canons.

4.1.3. QUALIFICATIONS FOR PREPARING TIS DOCUMENTS

The TIS should be conducted and prepared under the direction of a Professional Engineer (Civil) licensed to practice in the State of Utah. The subject engineer should have special training and experience in traffic engineering and be a member of the Institute of Transportation Engineers (ITE). The final report shall be sealed, signed and dated.

4.1.4. ANALYSIS APPROACH AND METHODS

The traffic study approach and methods should be guided by the following criteria:

4.1.4.1. STUDY AREA, HORIZON, AND TIME PERIOD

The minimum study area should be determined by project type and size in accordance with the criteria previously outlined. The extent of the study area may be either enlarged or decreased, depending on special conditions as determined by the City. The study horizon years should be determined by project type and size, in accordance with the criteria outlined in Sections 4.1.1.1 – 4.1.1.3.

Both the morning and afternoon weekday peak hours should be analyzed, unless the proposed project is expected to generate no trips, or a very low number of trips, during either the morning or evening peak periods. If this is the case, the requirement to analyze one or both of these periods may be waived by the City.

Where the peak traffic hour in the study area occurs during a different time period than the normal morning or afternoon peak travel periods (for example mid-day), or occurs on a weekend, or if the proposed project has unusual peaking characteristics, these additional peak hours should also be analyzed.

4.1.4.2. SEASONAL ADJUSTMENTS

When directed by the City, traffic volumes for the analysis hours should be adjusted for the peak season, in cases where seasonal traffic data is available.

4.1.4.3. DATA COLLECTION REQUIREMENTS

All data should be collected in accordance with the latest edition of the ITE Manual of Traffic Engineering Studies, or as directed by the City.

- **Turning Movement Counts:** Manual turning movement counts should be obtained for all existing cross-street intersections to be analyzed during the morning, afternoon and Saturday peak periods (as applicable). Turning movement counts may be required during other periods as directed by the City. Turning movement counts may be extrapolated from existing turning movement counts, no more than two years old, with the concurrence of the City.
- **Daily Traffic Volumes:** The current and projected daily traffic volumes should be presented in the report. If available, daily count data from the local agencies may be extrapolated to a maximum of two years with the concurrence of the City. Where daily count data is not available, mechanical counts will be required at locations agreed upon by the City.
- **Roadway and Intersection Geometrics:** Roadway geometric information should be obtained. This includes, but is not limited to, roadway width, number of lanes, turning lanes, vertical grade, location of nearby driveways, and lane configuration at intersections.
- **Traffic Control Devices:** The location and type of traffic controls should be identified at all locations to be analyzed.

4.1.5. TRIP GENERATION

The latest edition of ITE's Trip Generation Manual should be used for selecting trip generation rates. Other rates may be used with the approval of the City in cases where Trip Generation does not include trip rates for a specific land use category, or includes only limited data, or where local trip rates have been shown to differ from the ITE rates. Site traffic should be generated for daily, AM, PM and Saturday peak hour periods (as applicable). Adjustments made for "pass-by", “diverted-link” or "mixed-use" traffic volumes shall follow the methodology outlined in the latest edition of the ITE Trip Generation Manual or the ITE Trip Generation Handbook. A "pass-by" traffic volume discount for commercial centers should not exceed twenty-five percent unless approved by the City. A trip generation table should be prepared by phase showing proposed land use, trip rates, and vehicle trips for daily and peak hour periods and appropriate traffic volume adjustments, if applicable.

4.1.6. TRIP DISTRIBUTION AND ASSIGNMENT

Projected trips should be distributed and added to the projected non-site traffic on the roadways and intersection under study. The specific assumptions and data sources used in deriving trip distribution and assignment should be documented in the report and reviewed with the City. Future traffic volumes should be estimated using information from transportation models, or applying an annual growth rate to the base-line traffic volumes. The future traffic volumes should be representative of the horizon year for project development. If the annual growth rate method is used, the City must give prior approval to the growth rate used. In addition, any nearby proposed development projects currently under review by the City (“on-line”) should be taken into consideration when forecasting future traffic volumes. The increase in traffic from proposed "on-line" projects should be compared to the increase in traffic by applying an annual growth rate.

If modeling information is unavailable, the greatest traffic increase from either the "on-line” developments, the application of an annual growth rate or a combination of an annual growth rate and "on-line" developments, should be used to forecast the future traffic volumes.

The site-generated traffic should be assigned to the street network in the study area based on the approved trip distribution percentages. The site traffic should be combined with the forecasted traffic volumes to show the total traffic conditions estimated at development completion. A "figure" should be prepared showing daily and peak period turning movement volumes for each traffic study intersection. In addition, a "figure" should be prepared showing the base-line volumes with site-generated traffic added to the street network. This “figure” should be prepared showing the base-line volumes with site-generated traffic added to the street network. This "figure" will represent site specific traffic impacts to existing conditions.

4.1.7. CAPACITY ANALYSIS

Level of service (LOS), a rating given from A-F of traffic flow, shall be computed for signalized and unsignalized intersections in accordance with the latest edition of the Highway Capacity Manual. The intersection LOS should be calculated for each of the following conditions (if applicable):

- Existing peak hour traffic volumes ("figure" required).
- Existing peak hour traffic volumes including site-generated traffic ("figure" required).
- Future traffic volumes not including site traffic ("figure" required).
- Future traffic volumes including site traffic ("figure" required).
- LOS results for each traffic volume scenario ("table" required).

The LOS table should include LOS results for AM, PM and Saturday peak periods, if applicable. The table shall show LOS conditions with corresponding vehicle delays for signalized intersections, and LOS conditions for the critical movements at unsignalized intersections. For signalized intersections, the LOS conditions and average vehicle delay shall be provided for each approach and the intersection as a whole. If the new development is scheduled to be completed in phases, the TIS will, if directed by the City, include an LOS analysis for each separate development phase in addition to the TIS for each horizon year. The incremental increases in site traffic from each phase should be included in the LOS analysis for each preceding year of development completion. A "figure" will be required for each horizon year of phased development.

4.1.8. ROUNDABOUT NEEDS

A roundabout needs study should be conducted for all intersections that encounter significant delay and are in need of capacity improvements. If the warrants are not met for the base year, they should be evaluated for each year in the five-year horizon. Roundabout needs studies should be conducted by a method pre-approved by the City.

Speed Considerations

Vehicle speed is used to estimate safe stopping and cross corner sight distances. In general, the posted speed limit represents the 85th percentile speed. The design speed of the roadway should be used to calculate safe stopping and cross corner sight distances.

Improvement Analysis

The roadways and intersections within the study area should be analyzed, with and without the proposed development to identify any projected impacts in regard to LOS and safety. Where the highway will operate at LOS C (Stable traffic flow) or better without the development, the traffic impact of the development on the roadways and intersections within the study area should be mitigated to LOS D (approaching unstable traffic flow) for arterial and collector streets and LOS C on all other streets during peak hours of travel. Mitigation to LOS D on other streets may be acceptable with the concurrence of the City.

4.1.9. TIS REPORT FORMAT

This section provides the format requirements for the general text arrangement of a TIS.

Deviations from this format must receive prior approval of the City.

I. INTRODUCTION AND SUMMARY

1. Purpose of Report and Study Objectives
2. Executive Summary
   - Site Location and Study Area
   - Development Description
   - Principal Findings
   - Conclusions
   - Recommendations

II. PROPOSED DEVELOPMENT

1. Off-Site Development
2. Description of On-Site Development
   - Land Use and Intensity
   - Location
   - Site Plan
   - Zoning
   - Development Phasing and Timing

III. STUDY AREA CONDITIONS

1. Study Area
   - Area of Significant Traffic Impact
   - Influence Area
2. Land Use
   - Existing Land Use and Zoning
   - Anticipated Future Development
3. Site Accessibility
   - Existing and Future Area Roadway System
   - Traffic Volumes and Conditions
   - Access Geometrics
   - Other as applicable

IV. ANALYSIS OF EXISTINC CONDITIONS

1. Physical Characteristics
   - Roadway Characteristics
   - Traffic Control Devices
   - Pedestrian/Bicycle Facilities

2. Traffic Volumes
    - Daily, Morning, Afternoon and Saturday Peak Periods (as applicable)
3. Level of Service
    - Morning, Afternoon and Saturday Peak Hour (as applicable)
4. Safety

V. PROJECTED TRAFFIC

1. Site Traffic Forecasts (each horizon year)
    - Trip Generation
    - Mode Split
    - Pass-by Traffic (if applicable)
    - Trip Distribution
    - Trip Assignment
2. Non-Site Traffic Forecasting (each horizon year)
    - Projections of Non-site (Background) Traffic (methodology for the projections shall receive prior approval of City)
3. Total Traffic (each horizon year)

VI. TRAFFIC AND IMPROVEMENT ANALYSIS

1. Site Access
2. Capacity and Level of Service Analysis
    - Without Project (for each horizon year including any programmed improvements)
    - With Project (for each horizon year, including any programmed improvements)
3. Roadway Improvements
    - Improvements Programmed to Accommodate Non-site (Background) Traffic
    - Additional Alternative Improvements to Accommodate Site Traffic
4. Traffic Safety
    - Sight Distance
    - Acceleration/Deceleration Lanes, Left-Turn Lanes
    - Adequacy of Location and Design of Driveway Access
5. Pedestrian Considerations
6. Speed Considerations
7. Traffic Control Needs
8. Traffic Signal Needs (base plus each year, in five-year horizon)
9. Site Circulation and Parking

VII. FINDINGS

1. Site Accessibility
2. Traffic Impacts
3. Need for Improvements
4. Compliance with Applicable Local Codes

VIII. RECOMMENDATIONS/CONCLUSIONS

1. Site Access/Circulation Plan
2. Roadway Improvements
   - On-Site
   - Off-Site
   - Phasing (as applicable)
3. Transportation System Management Actions (as applicable)
4. Other

IX. APPENDICES

1. Existing Traffic Volume Summary
2. Trip Generation/Trip Distribution Analysis
3. Capacity Analyses Worksheets
4. Traffic Signal Needs Studies
5. Accident Data and Summaries

X. FIGURES AND TABLES

1. The following items shall be documented in the text or Appendices
   - Site Location
   - Site Plan
   - Existing Transportation System
   - Existing Peak Hour Turning Volumes
   - Estimated Site Traffic Generation
   - Directional Distribution of Site Traffic
   - Site Traffic
   - Non-Site Traffic
   - Total Future Traffic
   - Projected Levels of Service
   - Recommended Improvements

(For Category 1, many of the items may be documented within the text. For other categories the items shall be included in figures and/or tables that are legible.)

XI. DESIGN STANDARD REFERENCE

1. Design in accordance with current *Toquerville City Standards*.
2. Conduct capacity analysis in accordance with the latest edition of the *Highway Capacity Manual.*

4.2. PUBLIC TRANSPORTATION

Not part of this study but public Transport could alleviate future traffic. Preliminary results suggested it would not be a good option due to the cost to benefit ratio.

4.3. ROADWAY STANDARDS

All streets shall be designed to conform to the Engineering standards and technical design requirements contained within Toquerville City Standards. The standards outlined in that document can be supplemented by this master plan, AASHTO (American Association of State Highways Transportation Officials), A Policy on Geometric Design of Highways and Streets, and the MUTCD (Manual on Uniform Traffic Control Devices). In cases of conflict, a determination shall be made by the City, whose determinations shall be final.

4.3.1. SAFE TRANSPORTATION SYSTEM

A goal of Toquerville City should be to establish and maintain a safe transportation system. This should be a high priority and the City should work diligently to meet applicable safety standards. This can be best accomplished by:

- Require all major developments to provide adequate access for emergency vehicles.
- Provide safe pedestrian street crossings, particularly near schools and recreation areas.
- Encourage development of school routing and recreation plans that minimize vehicle/pedestrian conflicts.
- Establish speed limits based on traffic engineering analysis. Enforce speed limits, especially near schools, in residential areas and downcity commercial areas.
- Provide guidance for vehicles on streets through striping, raised medians and islands, reduction of roadside obstructions, and other traffic engineering solutions.
- Require all roadway features to meet minimum design standards established by the American Association of State Highway and Transportation Officials (AASHTO). All signs, pavement markings and traffic signals must meet standards established by the Manual of Uniform Traffic Control Devices (MUTCD). Exceptions can be granted by the City on a case-by-case basis for those designs that demonstrate innovative superiority over the existing standards.
- Maintain optimal walkway conditions for walking, wheelchairs and strollers by:
    - Repairing cracks and bumps,
    - Minimizing slopes,
    - Maintaining visibility at corners,
    - Avoiding abruptly ending walkways,
    - Reducing speed and traffic,
    - Keeping walkways clear of poles and other objects,
    - Avoiding poor drainage and standing water on sidewalks, and
    - Providing curb cuts and ramps that comply with the Americans with Disabilities Act (ADA).
- Provide adequate emergency access and/or turnarounds on all dead-end streets or cul-de-sacs.

4.3.2. STREET DESIGN

All streets shall be designed to conform to the standards and technical design requirements contained within the *Toquerville City Design Standards*. The standards outlined in this document can be supplemented by AASHTO*, A Policy on Geometric Design of Highways and Streets*. In cases of conflict, a determination shall be made by the City, whose determinations shall be final.

Some of the basic elements of street design are outlined in this section. For the full text on Street Design issues, please refer to the *Toquerville City Design Standards* within the *Toquerville City Ordinances*.

4.3.2.1. STREET CROSS-SECTION STANDARDS

The requirements for the street cross-section configurations are shown in Table 6. These requirements are based on traffic capacity, design speed, projected traffic, system continuity and overall safety. All new developments shall use street cross-sections with 30 feet or more of right-of-way. Access to multi-family or commercial developments shall use street cross-sections with 36 feet or more of right-of-way. The roadway cross-sections for Toquerville City are found in the *Design Standards*. An arterial cross section is shown there for SR-9, which is governed and maintained by UDOT. This cross section varies in the right-of-way width.

Alternate road cross-sections incorporating the use of a landscape buffer may be permitted, if applicable safety and traffic standards are met and approved by the City Engineer.

Table 6. Street Cross-Section Configurations

Classification	Type	Design Volume (ADT)	Dwelling Units	Maximum Grade (%)	Right-of- Way[3] (ft)	Pavement Width[1] (ft)	Sidewalk Width (feet)	Recommended Design Speed (mph)
Private	Private	<50	1-10	15	30	22	N/A	15
Minor Local[2]	Public	1-250	1-25	15	30	22	4	25
Residential	Public	251-500	26-50	15	30	28	5	25
Collector	Public	500-1,000	50-100	12	36	32	5	25
Arterial	Public	>1,000	>100	8	≥60	≥25	6	≥30
Commercial Local	Comm.	NA	NA	8	36	32	5	25
Industrial Local	Ind.	NA	NA	6	36	32	5	25

1. Parking has been limited to one side of the road on an arterial street.
2. The smallest street maintained by the City shall be a 30′ right of way.
3. Sidewalk widths for commercial areas will be determined on a case by case basis, according to each individual site and the surrounding area.
4. The minimum right-of-way and pavement width is shown. Each may be increased when required by a traffic impact study.

4.3.2.2. ROADWAY NETWORK DESIGN

New roadway networks shall be designed in accordance with the general planning concepts, guidelines, and objectives provided in this section. The "Quality of Life" for residents should be a primary concern when designing a residential roadway network with safety as the overriding factor in design. An emphasis on proper street hierarchy should be adhered to, namely, local streets should access collectors; collectors should access arterials; etc. An emphasis on access management should provide careful control of the location, design, and operation of all driveways, median openings, and street connections to a roadway. For more information on access management, refer to the Access Management section of this document.

Residential streets should be designed in a curvilinear method in order to reduce or eliminate long straight stretches of residential roadways, which encourage speeding and cut-through traffic. Substantial increases in average daily traffic, due to development on adjacent property on established streets not originally design to accommodate such increases, should be avoided. Drainage methods should concentrate on meeting the drainage needs while not impeding the movement of traffic. Roads should be designed to lie within existing topographic features without causing unnecessary cuts and fills.

A reduction in the use of cul-de-sacs should be emphasized in order to provide greater traffic circulation. Cul-de-sacs should only be allowed where topography and/or natural barriers prohibit the design of through streets. Circulation is of the utmost importance; long blocks and excessive dead-end streets should be avoided. Stopping sight distance must be considered at all intersections and curves to ensure the safety of the public, in accordance with AASHTO standards. Pedestrian and bicycle traffic should be considered in the planning and design of all developed streets. All street grades shall have a maximum grade as shown in Table 6.

4.3.2.3. IMPROVEMENT REQUIREMENTS

All improvements, including but not limited to the following, shall be constructed in accordance with the standard specifications and drawings unless otherwise approved. Required curb, gutter and sidewalk shall be constructed. Driveways shall be constructed in approved locations only. All streets, public or private, shall be surfaced to grade, with asphalt concrete pavement to the required minimum width and thickness in accordance with the Toquerville City Design Standards. No cross gutters shall be allowed across collector or arterial streets. On commercial and industrial streets, cross gutters are generally not allowed and require approval by the City for use. When new construction occurs, handicap ramps shall be constructed at all street intersections, unless otherwise approved, in accordance with the standard drawings. In addition, when a project occurs where existing improvements are in place, handicap ramps shall be upgraded to meet current standards. Raised medians on public roadways shall be approved by the City. Design and construction shall be in accordance with applicable standards. Developments shall construct the minimum number of accesses needed to adequately address the needs of the development and only at approved locations.

Adequate drainage facilities shall be installed to properly conduct runoff from the roadway. Sub-drains and surface drainage facilities shall be designed in accordance with the approved drainage study. The above required improvements are not all inclusive. Other improvements needed to complete the development in accordance with current engineering and planning standard practice may be required by the City.

4.3.2.4. CONNECTED STREET SYSTEM OR GRID SYSTEM

When designing residential roadways, block lengths without an intervening collector roadway shall not exceed eight hundred feet (800’) in length unless approval has been granted by the City (cul-de-sacs are not considered an intervening connecting street). Collectors and higher functional classification roadways shall not be permanently dead-ended or end in a cul-de-sac unless approval has been granted by the City. Stub streets are required to serve adjacent undeveloped properties as directed by the City. Interconnectivity is an integral part of the transportation system in Toquerville and reduces the traffic on the major roadways that are accessing adjoining properties. Bicycle/pedestrian easements or access ways are required at the end of cul-de-sacs or between residential areas and parks, schools, churches, or other activity centers as directed by the City.

5. ACCESS MANAGEMENT

This section will define and describe some of the aspects of Access Management for roadways and why it is so important. Access management is the practice of coordinating the location, number, spacing and design of access points to minimize site access conflicts and maximize the traffic capacity of a roadway. Uncoordinated growth along some of the region’s major travel corridors has resulted in strip development and a proliferation of access points. In most instances, each individual development along the corridor has its own access driveway. Numerous access points along the corridor create conflicts between turning and through traffic which causes delays and accidents. Though Access Management is generally used on roads that are larger and have more volume, it can have impacts on those roads that are defined as residential as well.

5.1. DEFINITION

Access management involves providing (or managing) access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity, and speed. (Source: Policy on the geometric Design of highways and Streets, AASHTO, 2010).

5.1.1. ACCESS MANAGEMENT TECHNIQUES

There are many techniques that can be used in access management. The most common techniques are signal spacing, street spacing, access spacing, and interchange to crossroad access spacing. There are various distances for each spacing dependent upon the roadway type being accessed and the accessing roadway. The Utah Department of Transportation has developed an access management program. More information can be gathered from the UDOT website and from the Access Management Program Coordinator.

5.1.2. ACCESS MANAGEMENT

Access management is the process in which access is provided from the street network to adjacent land development while preserving traffic flow on the roadway system. Safety, capacity, and speed are determining factors on how land development is accessed by a roadway. Managing access is achieved by controlling the location, design, and operation of driveways, median openings, and street connections. In addition, auxiliary lanes (turn lanes or by-pass lanes) are also used to divert traffic out of the through traffic stream to improve the traffic flow and improve safety.

Roadways are classified for access control based upon their importance to local and regional mobility. No facility can move traffic well and provide unlimited access at the same time. Figure 28 shows the relationship between mobility, access and the functional classification of streets. For example, the strictest access control is applied to roadways that serve through traffic or regional trips. The least access control is given to local streets and residential areas that serve local traffic and short trips. In many cases, accidents and congestion are the result of streets trying to serve both mobility and access at the same time.

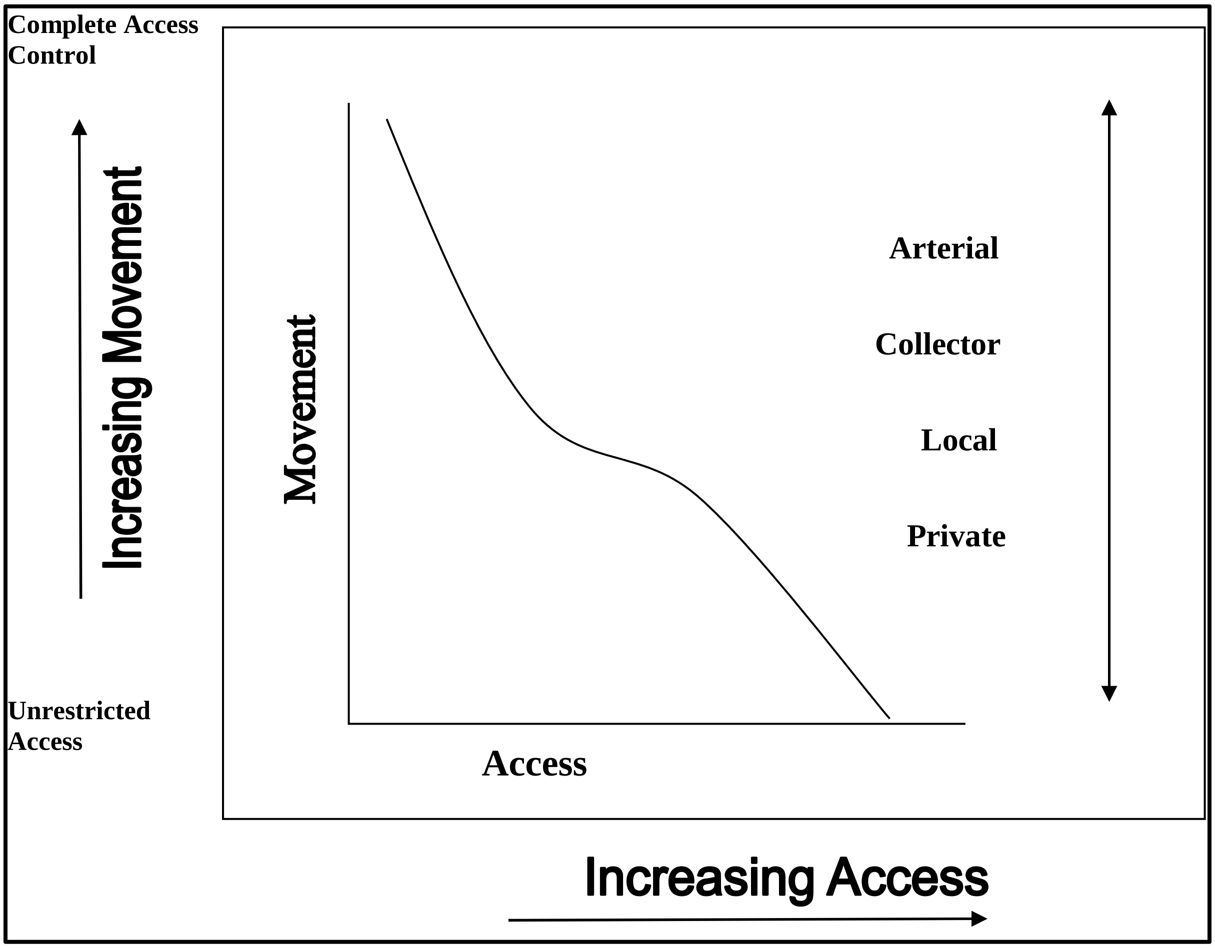


Figure 28. Movement vs. Access

5.1.3. BENEFITS OF ACCESS MANAGEMENT

A good access management program will accomplish the following:

- Limit the number of conflict points at driveway locations
- Separate conflict areas
- Reduce the interference of through traffic
- Provide sufficient spacing for at-grade, signalized intersections
- Provide adequate onsite circulation and storage.

The American Association of State Highway and Transportation Officials (AASHTO) states “the number of accidents is disproportionately higher at driveways than at other intersections…thus their design and location merits special consideration.” Fewer direct accesses, greater separation of driveways, and better driveway design and location are the basic elements of access management. With good access management, the following are some of the recognizable benefits:

- Improving overall roadway safety
- Reducing the total number of vehicle trips
- Decreasing interruptions in traffic flow
- Minimizing traffic delays and congestion
- Maintaining roadway capacity
- Extending the useful life of roads
- Avoiding costly highway projects
- Improving air quality
- Encouraging compact development patterns
- Improving access to adjacent land uses
- Enhancing pedestrian and bicycle facilities

5.1.4. GENERAL ACCESS MANAGEMENT PRINCIPALS

The following access management guidelines and policies shall be adhered to within Toquerville City.

- Conflicts at intersections and driveways should be separated and the number reduced as much as possible.
- A “time-space” perspective should guide (a) the location, timing, and coordination of traffic signals; (b) the placement of access; and (c) the design and operation of intersections. Optimum progressive travel speeds along arterial roadways should be determined and maintained.
- Unsignalized access should be located so as not to interfere with queues or maneuvering areas of signalized intersections and positioned to take advantage of gaps in, or less dense, traffic flows.
- Interference between through traffic and site traffic should be addressed by incorporating additional traffic lanes to accommodate turning vehicles and through vehicles. Adequate on-site storage and driveway dimensions should be designed to accommodate the traffic demand entering and exiting the site. Fewer, properly placed, and adequately designed driveways are preferable to a larger number of inadequately designed driveways, especially when spaced at least 500 feet apart. In all cases, the integrity of mainline traffic operations must not be compromised.

5.2. ACCESS MANAGEMENT TECHNIQUES

There are many techniques that can be used in access management. Specific techniques for access management are discussed in this section. Not all techniques will apply to every situation. Therefore, it is up to the City to determine what will work best based in each situation. The Utah Department of Transportation has developed an access management program. More information can be gathered from the UDOT website and from the Access Management Program Coordinator.

5.2.1. NUMBER OF ACCESS POINTS

Controlling the number of access points or driveways from a site to a roadway reduces potential conflicts between vehicles, pedestrian, and bicycles. Each parcel should normally be allowed one access point, and shared accesses are preferred where possible.

5.2.2. TRAFFIC CONTROL DEVICES

Uniform or near uniform spacing of traffic control devices is essential for efficient traffic flow. As a minimum, traffic control devices should be spaced no closer than one-quarter mile (1,320 feet).

5.2.3. UNSIGNALIZED DRIVEWAYS

Unsignalized driveways are much more common than signalized driveways. Sound traffic engineering criteria indicates that 500 feet or more should be provided between full movement unsignalized accesses.

5.2.4. RIGHT-IN/RIGHT-OUT ACCESSES

Restricted access movement can provide for additional access to promote economic development with minimal impact to the facility. This type of access should be spaced to allow for a minimum of traffic conflicts and provide distance for deceleration and acceleration of traffic in and out of the access.

5.2.5. REDIDENTIAL LOTS

The number of accesses on residential lots shall be based on the following:

- Number of Driveways: residential lots shall not have more than two (2) driveways, unless approved by the City Engineer. Circular driveways are considered one access. If a lot has a circular driveway then only a maximum of one more additional access may be granted.
- Width: No driveway shall be more than 25 feet in width, unless approved by the City Engineer. In no event shall the combined width of such driveways exceed 46 feet or 50% of the entire lot frontage, whichever is less.
- Corner Lots: access to corner lots should be from the lesser-classified road at the greatest distance possible from the intersection and should not be less than the distances shown in Table 14.

5.2.6. COMMERCIAL LOTS

Commercial lots or developments are not limited to one access per lot and should be addressed on a case-by-case basis but not to exceed the access frontage requirements as stated in this plan and as outlined in the City's design standards. Additional accesses must be approved by the City upon completion of a circulation plan or Traffic Impact Study provided to the City indicating that more than one access is required to adequately handle the developments traffic volumes and further indicating that the additional access will not be detrimental to traffic flow on the adjacent street network. The spacing requirement based on the functional class of the facility is shown in the table below. Table 7 shows the spacing requirements based on the functional class of the roadway facility for street intersection spacing. Table 8 shows the requirements based on the functional class of the roadway facility for driveway access spacing.

Table 7. Street Intersection Separation Distances Based on Functional Class

Functional Class	Minimum Roundabout (ft)	Minimum Full Movement (ft)	Minimum Right-In/ Right-Out (ft)
Private	1320	150	-
Residential	1320	150	-
Collector	1320	250	150
Arterial	1320	500**	250
Commercial Local	1320	400	200
Industrial Local	2640	500	250

****Bypass corridor will be limited access. No more than 5 local road intersections.**

Table 8. Driveway Access Separation Distances Based on Functional Class

Functional Class	Minimum Full Movement (ft)	Minimum Right-In/Right-Out (ft)
Private	75	-
Residential	75	-
Collector	125	-
Arterial	660**	330
Commercial Local	400	200
Industrial Local	500	250

****Bypass corridor will be limited access. No more than 5 local road intersections.**

Access spacing shall be measured from center of access.

Major collector and arterial roadways will have limited access. Where multiple parcels are consolidated, accesses shall also be consolidated according to City design and spacing standards. Temporary access may be granted to undeveloped property prior to completion of a final development plan if access is needed for construction or preliminary site access. Temporary accesses are subject to removal, relocation, or redesign after final development plan approval.

5.2.7. OFFSET DISTANCE

Offset distance is the distance from the center of an access to the center of the next access on the opposite side of the road. On undivided roadways, access on opposite sides of the road should be aligned. Where alignment is not possible, driveways should be offset based on the values set in Table 9 below.

Table 9. Minimum Offset Distance between Driveways on Opposite Sides of Undivided Roadways

Functional Class	Minimum Offset* (feet)
Private	-
Residential	-
Collector	150
Arterial	600 ft. for speed of 45 or greater, 300 for all other speeds**
Commercial Local	200
Industrial Local	220

* Distance in table is measured from center to center of driveway

** Bypass corridor intersection spacing varies. No more than 5 local road intersections planned.

5.2.8. CORNER SPACING

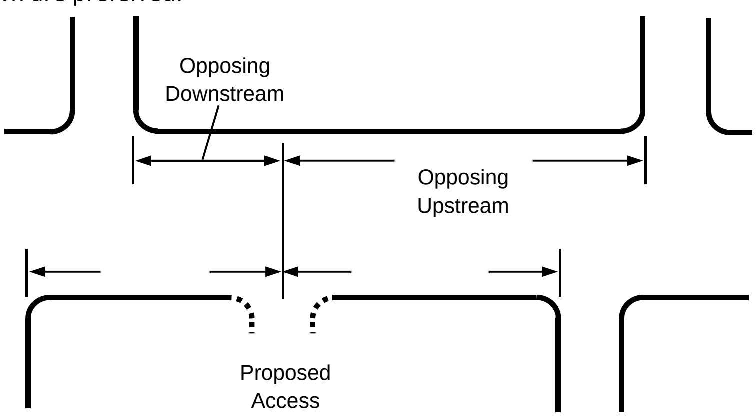
Providing adequate corner spacing improves traffic flow and roadway safety by ensuring that the traffic turning into the driveway does not interfere with the function of the intersection. Access to corner lots should be from the lesser-classified road at the greatest distance possible from the intersection, and should not be less than the distances shown in Table 10. This distance is measured from the PC (point of curve) of the corner curve. A 25-foot radius is considered the minimum where the existing radius is less than 25 feet.

Table 10. Access Distance from Corner According to Facility Type

Facility Type	Upstream Distance on Major Roadway (feet)	Downstream Distance on Major Roadway (feet)
Private	50 [2]	50 [2]
Rural Residential	50 [2]	50 [2]
P Street	50 [2]	50 [2]
Major Local	50	50
Minor Collector	100	75
Major Collector	175	150
Arterial	200	185
Commercial Local	100	-
Industrial Local	100	-

NOTES:

1. All access points shall be approved by the City. Distances shown may be adjusted by the City on a case-by-case basis. Exceptions can only be approved by the City upon submittal of proper traffic justification.
2. Distances shown are preferred.



5.2.9. MEDIANS

Medians are used to control and manage left turns and crossing movements as well as separating traffic moving in opposite directions. Restricting left turning movements reduces the conflicts between through and turning traffic, resulting in improved safety. Studies have shown that the installation of a non-traversable median will reduce crashes by 30% over that of a two way left turn lane (TWLTL).

The need for a median can be identified through an engineering review (a traffic study assessing the impact of a proposed project) and should be considered on any roadway that has a speed limit greater than 40 mph. Medians can improve pedestrian safety by providing a refuge area for the pedestrian.

Medians can also add to the overall aesthetics of a roadway corridor or a development by incorporating landscaping or other items of visual interest. However, care should be taken to maintain sight distance around the intersection/access locations. Ground cover plantings should be planted within 350 feet of an intersection/access opening. Care should be taken to select landscape material that will not intrude into the roadway and to locate materials such that they will not cause a safety problem. Trees should be selected that will not be larger than 4 inches in diameter when mature.

Two way left turn lanes should only be used to retrofit areas of existing development and should be limited to roadways with less than 18,000 ADT. In areas with greater than 18,000 ADT, consideration should be given to a raised median with appropriately spaced median openings. Table 11 shows typical guidelines for spacing of unsignalized restricted medial openings.

Table 11. Guidelines for Spacing of Unsignalized Restricted Median Openings

Functional Classification	Spacing of Median Openings (ft)*		
	Urban	Suburban	Rural
Collector	330	500	660
Arterial	500	660	800

*Values are for estimating, exact values shall be based on an engineering study

*Values based on UDOT State Highway Access Management Standards. Table 7.4-1

A 14-foot median is desirable in order to provide for an adequate left turn lane at intersections.

5.2.10. WIDTH OF ACCESS POINTS

In addition to limiting the number of access points, the width of the access point should be restricted based on the use of the site. Residential lot driveways should be limited to a maximum throat width of 32 feet at the back of the dive approach. The maximum width for a commercial or industrial site entrance with two-way traffic should be limited to 44 feet. The width includes 12 feet for right out, 12 feet for left out, 16 feet for an ingress lane, and two-2 foot shoulders. The width of the entrance should be determined based on the type of use for the site, the type of traffic (cars vs. 18 wheel trucks), and the projected volume of traffic.

5.2.11. TURNING RADIUS

The turning radius of a driveway or access road affects both the flow and safety of through traffic as well as vehicles entering and exiting the roadway. The size of the turning radius affects the speed at which vehicles can exit the flow of traffic and enter a driveway. The large the turning radius, the greater the speed at which a vehicle can turn into a site.

The speed of the roadway, the anticipated type and volume of the traffic, pedestrian safety, and the type of use proposed for the site should be considered when evaluating the turning radius. Table 12 shows the turning radii for accesses based on vehicle type.

Table 12. Turning Radius Center of Lane at Access Locations

Vehicle Type	Turning Radius
Passenger Cars	30 feet Minimum
18 Wheel Trucks	50 feet Minimum

5.2.12. THROAT LENGTH

Throat length is the length of the driveway that is controlled internally from turning traffic, measured from the intersection with the road. Driveways should be designed with adequate throat length to accommodate queuing of the maximum number of vehicles as defined by the peak period of operation in the traffic study. This will prevent potential conflicts between traffic entering the site and internal traffic flow. Table 13 shows the minimum driveway throat length at a roundabout access.

Table 13. Minimum Driveway Throat Length at Roundabout Accesses

Number of Egress Lanes	Minimum Throat Length
2	50 feet
3	150 feet
4	200feet

5.2.13.SHARED ACCESS

Access points can be shared between adjacent parcels to minimize the potential for conflict between turning and through traffic. Interconnections between sites can eliminate the need for additional curb cuts, thereby preserving the capacity of the roadway. This is particularly important for commercial/industrial sites and should be used to encourage the development of interconnectivity between parcels. Future roadway rights-of-way should also be preserved to promote interconnected access to vacant parcels.

5.2.14.ALIGNMENT OF ACCESS POINTS

Accesses represent points of conflict for vehicles, bicycles, and pedestrians. To minimize the potential conflicts and improve safety, intersections and driveways shall be aligned opposite each other wherever possible and roadways intersect at a 90 degree angle.

5.2.15.SIGHT DISTANCE

Sight distance is the length of the road that is visible to the driver. A minimum safe sight distance should be required for access points based on the roadway classification. It is essential to provide sufficient intersection sight distance at the driveway point for vehicles using a driveway to see oncoming traffic and judge the gap to safely make their movement. Intersection sight distance varies depending on the design speed of the roadway to be entered and assumes a passenger car can turn right or left into a two-lane highway and attain 85 percent of the design speed without being overtaken by an approaching vehicle that reduces speed to 85 percent of the design speed. Table 14 gives intersection sight distance requirements for passenger cars.

Table 14. Intersection/Driveway Sight Distance

Posted Speed Limit	Sight Distance Required * (feet)					
	Left Turn			Through and Right Turn		
MPH	2 lanes	3 lanes	5 lanes	2 lanes	3 lanes	5 lanes
30	335	355	375	290	310	335
35	390	415	440	335	365	390
40	445	475	500	385	415	445
45	500	530	565	430	465	500
50	555	590	625	480	515	555
55	610	650	690	530	570	610
60	665	710	750	575	620	665
65	720	765	815	625	670	720

*Driver eye is 15 feet measured from the traveled way

5.2.16.TURNING LANES

Turning lanes remove the turning traffic from the through travel lanes. Left turning lanes are used to separate the left turning traffic from the through traffic. Right turn lanes reduce traffic delays caused by the slowing of turning vehicles. These lanes are generally used in high traffic areas on arterial and collector roadways. A traffic impact study will determine the need for turning lanes or tapers. Table 15 shows the minimum guidelines for storage length of turning lanes based on speed.

Table 15. Turning Lanes Storage Length (100 Feet Minimum)

Intersection	Length
Unsignalized Intersection	2 times the number of cars likely to arrive in a 2 minute period during peak hour*
Future Signalized Intersection	10% of the peak hour design year volume expressed in feet*

*Assumes 25 feet per vehicle
* 2004 AASHTO Geometric Design of Highways and Streets

Turning lanes shall normally be a minimum of 12 feet in width. Any exception will require approval from the City Engineer. Right turn lanes require an additional 12 feet of pavement to accommodate the lane.

The provision for left turn lanes is important from both capacity and safety perspective, where left turns would otherwise share the use of a through lane. Shared use of a through lane will dramatically reduce capacity, especially when opposing traffic is heavy. Left turn lanes shall be provided at signalized intersections.

Right turn lane remove the speed differences in the main travel lanes. This helps to reduce the number and severity of rear-end collisions. Right turn lanes also increase capacity of signalized intersections and may allow more efficient traffic signal phasing. Table 16 provides typical warrants, based on posted speed and traffic volumes for when auxiliary lanes are to be installed.

Table 16. Guidelines for Left Turn and Right Turn Lanes on Two Lane Highways

Minimum levels for installation auxiliary lanes on rural two lane roads				
Speed	Left Turn Lane	Right Turn Lane	Right Turn Acceleration Lane	Left Turn Acceleration Lane
40 mph and less	25 vph	50 vph	-	-
45 mph and greater	10 vph	25 vph	50 vph	*

Farm access excluded
* Optional for 50 mph and less; for 55 mph as required by the City Engineer
vph = vehicles per hour in any one hour period in passenger car equivalents

A separate turning lane consists of a taper plus a full width auxiliary lane. Taper length will vary based on speed. A length of 90 feet for speeds below 45 mph, 140 feet for speeds of 45 and 50 mph, and 180 feet for speeds over 50 mph. If a two lane turn lane is to be provided, it is recommended that a 10:1 taper be used to develop the dual lanes. The taper will allow for additional storage during short duration surges in traffic volumes.

5.2.17.PEDESTRIAN AND BICYCLE ACCESS

All new development and redevelopment of existing sites should address pedestrian and bicycle access to and within the site.

5.2.18.ROUNDABOUTS

Several communities in the United States are beginning to embrace the concept of “roundabouts”. A roundabout is an intersection control measure used extensively in Europe for many years. A roundabout is composed of a circular, raised, center island with deflecting islands on the intersecting streets to direct traffic movement around the circle. Traffic circulates in a counter-clockwise direction making right turns onto the intersecting streets. There are no traffic signals; rather, entering traffic yields to vehicles already in the roundabout.

Roundabouts can reduce delays because the stop signal phase (when vehicles entering the intersection are unable to move) is eliminated. Roundabouts can also improve safety because the number of potential impact points and the numb of conflict points at a four-way intersection.

Development of a roundabout should occur as a result of an intersection study by a qualified Traffic Engineer and when the minimum capacity and design criteria can be met. The Federal Highway Administration (FHWA) has prepared a design guide for modern roundabouts in the United States. A single-lane roundabout can accommodate up to 1,800 vehicles per hour.

5.2.19. WHERE TO USE ACCESS MANAGEMENT

Access Management shall be used on all roadways within Toquerville City. Roadway access management strategies extend the useful life of roads at little or no cost to taxpayers. Access management can be used as an inexpensive way to improve performance on a major roadway that is increasing in volume. Access management should be used on new roadways and roadways that are to be improved so as to prolong the usefulness of the roadway.

5.3. APPENDIX 1- GLOSSARY OF ACRONYMS

- AADT (Annual Average Daily Traffic)
- AASHTO (American Association of State Highway and Transportation Officials)
- APWA (American Public Works Association)
- AWDT (Average Weekday Daily Traffic)
- CCS (Continuous Count Station)
- DMPO (Dixie Metropolitan Planning Organization)
- EIS (Environmental Impact Statement)
- GIS (Geographic Information Systems)
- GOMB (Governor's office of Management and Budget)
- ITE (Institute of Transportation Engineers)
- LOS (Level of Service)
    - LOS A- Free Flow Traffic
    - LOS B- Reasonably Free Flow Traffic
    - LOS C- Stable Flow Traffic
    - LOS D- Approaching Unstableflow traffic
    - LOS E- Unstable Flow Traffic At Capacity
    - LOS F- Forced Or Breakdown Flow Of Traffic.
- MUTCD (Manual on Uniform Traffic Control Devices)
- NEPA (National Environmental Policy Act)
- RSG (Resource Systems Group)
- RTP (Regional Transportation Plan)
- STIP (State Transportation Improvement Program)
- TAZ (Traffic Analysis Zone)
- TIS (Traffic Impact Study)