Washington Parkway Cost/Benefit Study

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Prepared for

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TABLE OF CONTENTS

TABLE OF FIGURES

1.0 INTRODUCTION

For years, regional transportation planners have envisioned an east/west route north of Red Hills Parkway to provide a more direct connection been Ivins, Santa Clara and western St. George on the west and Washington and Hurricane to the east. The corridor has had several different names such as the Northern Corridor, Great Northern Corridor and most recently the Washington Parkway. Although the names have changed, the primary purpose of the corridor has always been to reduce pressure on several key corridors such as Bluff St. and St. George Blvd. that are experiencing high levels of congestion and are expected to experience increased congestion in the future as the east/west travel demand increases.

The Dixie Metropolitan Planning Organization (DMPO) in conjunction with the Utah Department of Transportation (UDOT), and Washington County are exploring several alternative corridor alignments in order to determine which route provides the greatest congestion relief. In addition, the MPO expects this analysis to also benefit the Bureau of Land Management in its efforts to identify a north transportation route as required by federal law. The purpose of this report is to detail the process that was taken in analyzing the affects, potential benefits and relative costs of the various corridors under 2040 conditions from a traffic perspective.

2.0 TRAVEL DEMAND MODEL

The primary tool used to perform the study was the DMPO Travel Demand Model (TDM). Travel demand models are computer-based mathematical models that are embedded with equations that replicate an individual's decision making process when it comes to travel. The "who", "when", "why" and "how" of travel are calculated within the TDM and used to predict travel behavior under various scenarios.

The DMPO recently switched model platforms from QRS II, a more basic TDM software tailored to smaller areas, to CUBE, a much more sophisticated software that is currently used by the various other Utah based MPO's in addition to UDOT's statewide TDM. The DMPO's CUBE TDM was utilized for this study.

In order to predict travel behavior TDMs require two main inputs; land use information represented in traffic analysis zones (see below), and transportation networks represented by links and nodes in the model's master network.

2.1 TRAFFIC ANALYSIS ZONES

For the DMPO TDM, the Washington County area was broken up into smaller geographical parts called traffic analysis zones (TAZ) (see Figure 1). TAZs are used to define socioeconomic data within a specific geographical area. TAZ's incorporate variables such as the number of households, auto availability, income and employment that are used to estimate the amount of activity an area is expected to generate.

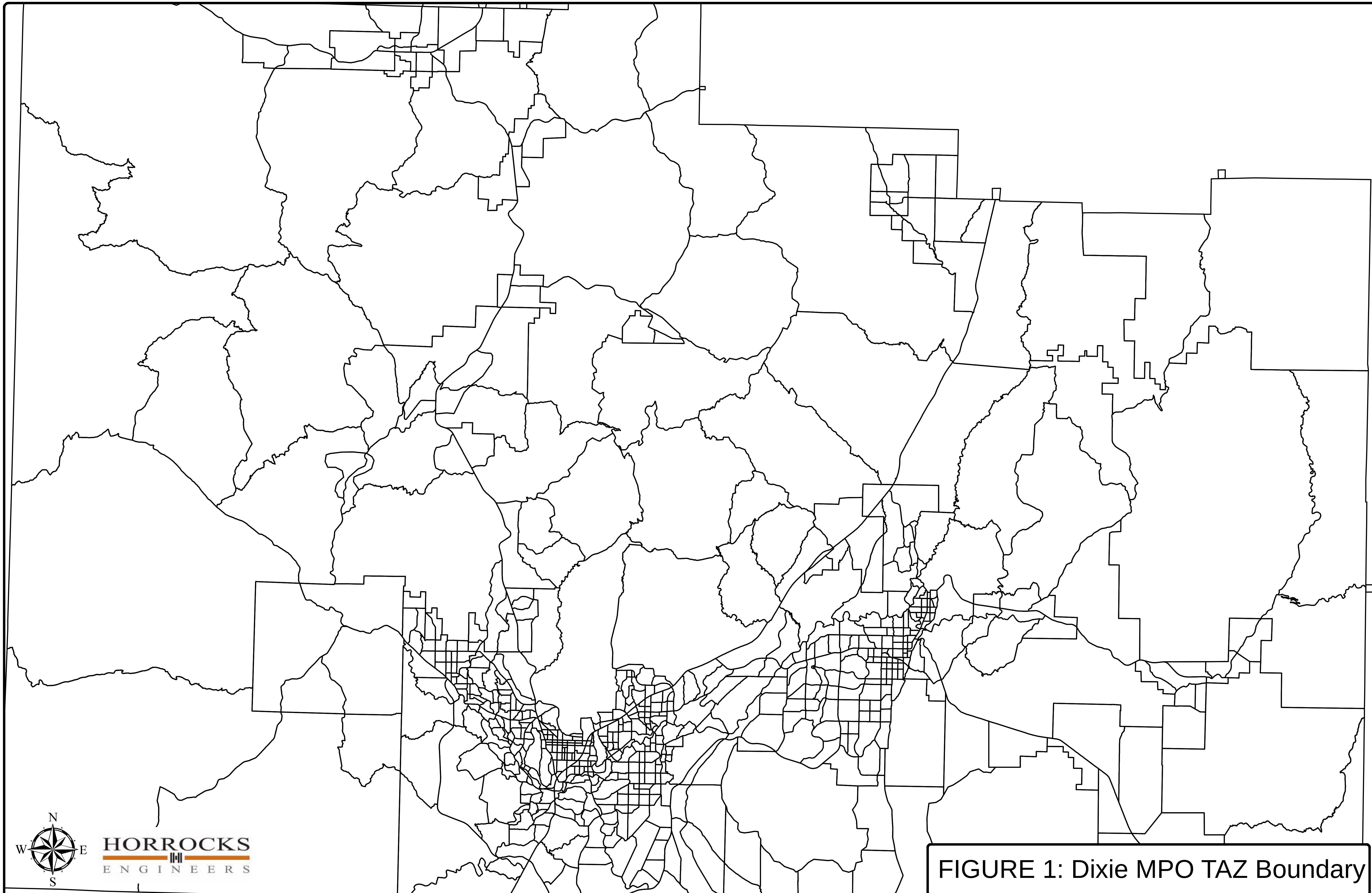

FIGURE 1: Dixie MPO TAZ Boundary

2.2 TRANSPORTATION NETWORKS

The second main component that a TDM uses is a transportation network divided into roadway and transit. Streets are represented in the network by links while intersections are represented by nodes (see Figure 2). Attributes that are used to represent roadways include number of lanes, speed and classification. Attributes used to represent the Transit network include stop locations, frequency of service and cost.

2.3 FOUR-STEP PROCESS

Once the key model inputs are established, the TDM uses a 4-step process (the most common method nationwide) to forecast traffic. The four basic phases are:

1) Trip Generation – Trip generation calculates the number of trip productions and trip attractions that are expected to occur within a TAZ. Trip productions and attractions are divided into trip purposes which include home-based work, home-based other and non home-based trips. The amount of trips and trip types that a TAZ generates is based on land-use data that includes number of households, persons-per-household, auto availability, total employees, employment type, etc.

2) Trip Distribution – Trip distribution determines where the trips are going. Trip productions and attractions from different TAZ's are linked together using a gravity model to form origin-destination patterns. The gravity model states that the trip attraction between two zones is proportional to the size of the zones (number of households/employees) and the distance between them.

3) Mode Choice – The method of travel (mode) used in reaching a trip's destination is determined in step three. Looking at factors such as cost, convenience and travel time it is determined if the trip will be made by walking, transit or vehicle.

4) Trip Assignment – The route the trip will take to reach its destination is then determined. Link attributes contained in the highway network such as capacity and travel speed are used to determine the shortest travel path to a destination. The trips are then assigned to the roadway network.

Each step of the process is calibrated using a base year model that corresponds to observed travel behavior measured in the field. Base model forecasts are checked against observed traffic counts to ensure reasonable accuracy. Once the model is developed so that it replicates existing travel behavior, it is then used to evaluate future scenarios and alternatives.

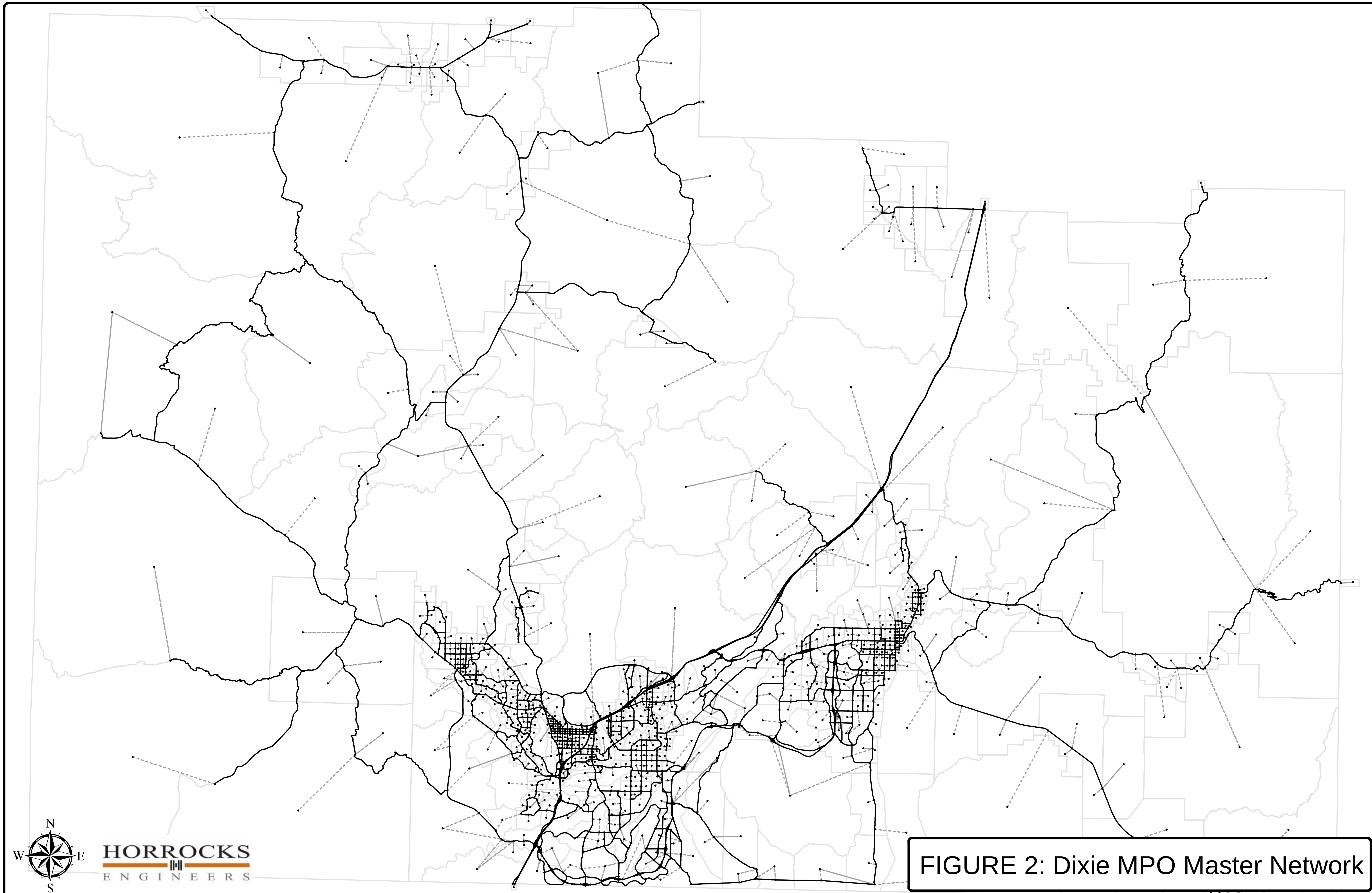

FIGURE 2: Dixie MPO Master Network

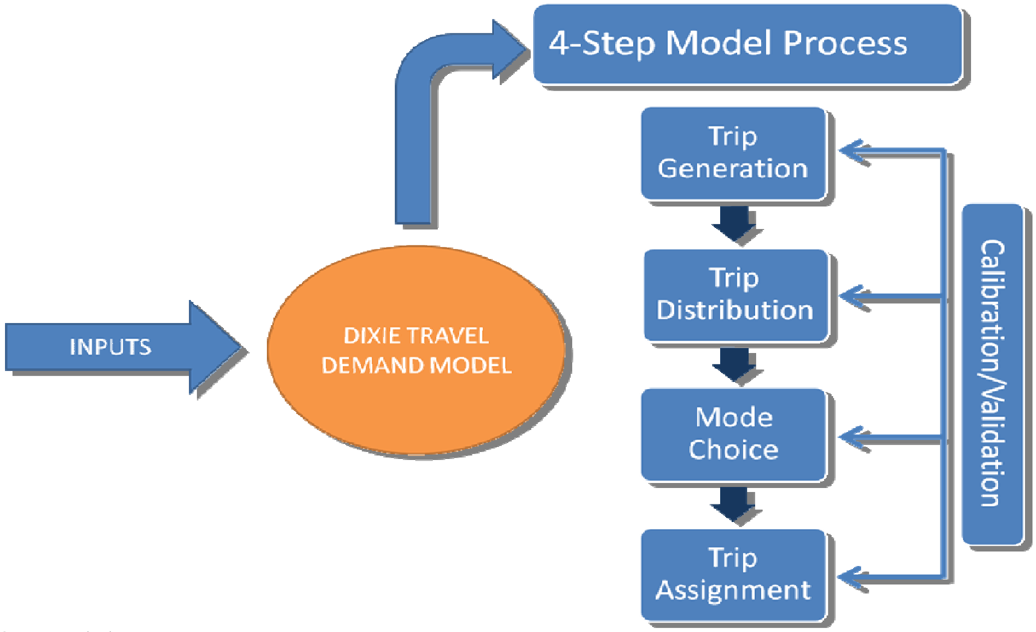

Figure 3: Model Process

3.0 DATA SOURCES

In forecasting traffic it's important to understand where the information is coming from that is being input into the model. The following figure shows the sources for the major input categories.

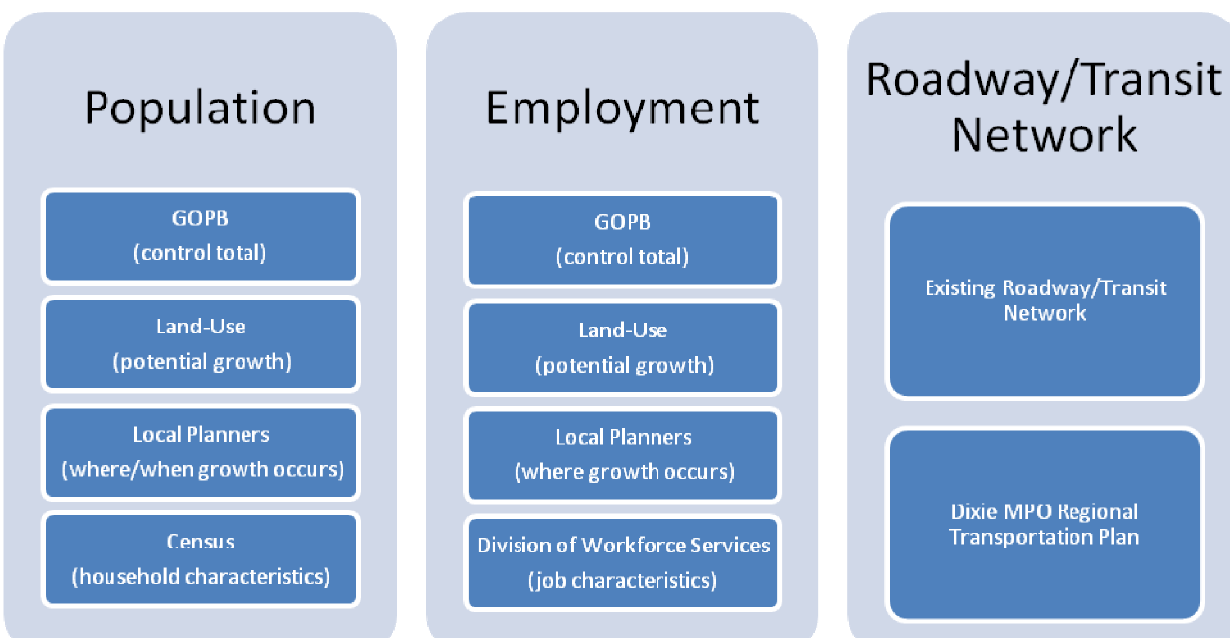

Figure 4: Data Sources

Governor's Office of Planning and Budget (GOPB) – The GOPB sets the control totals for population and employment for Washington County. The GOPB is currently forecasting a population increase of nearly 400,000 over the next thirty years (see figure 5).

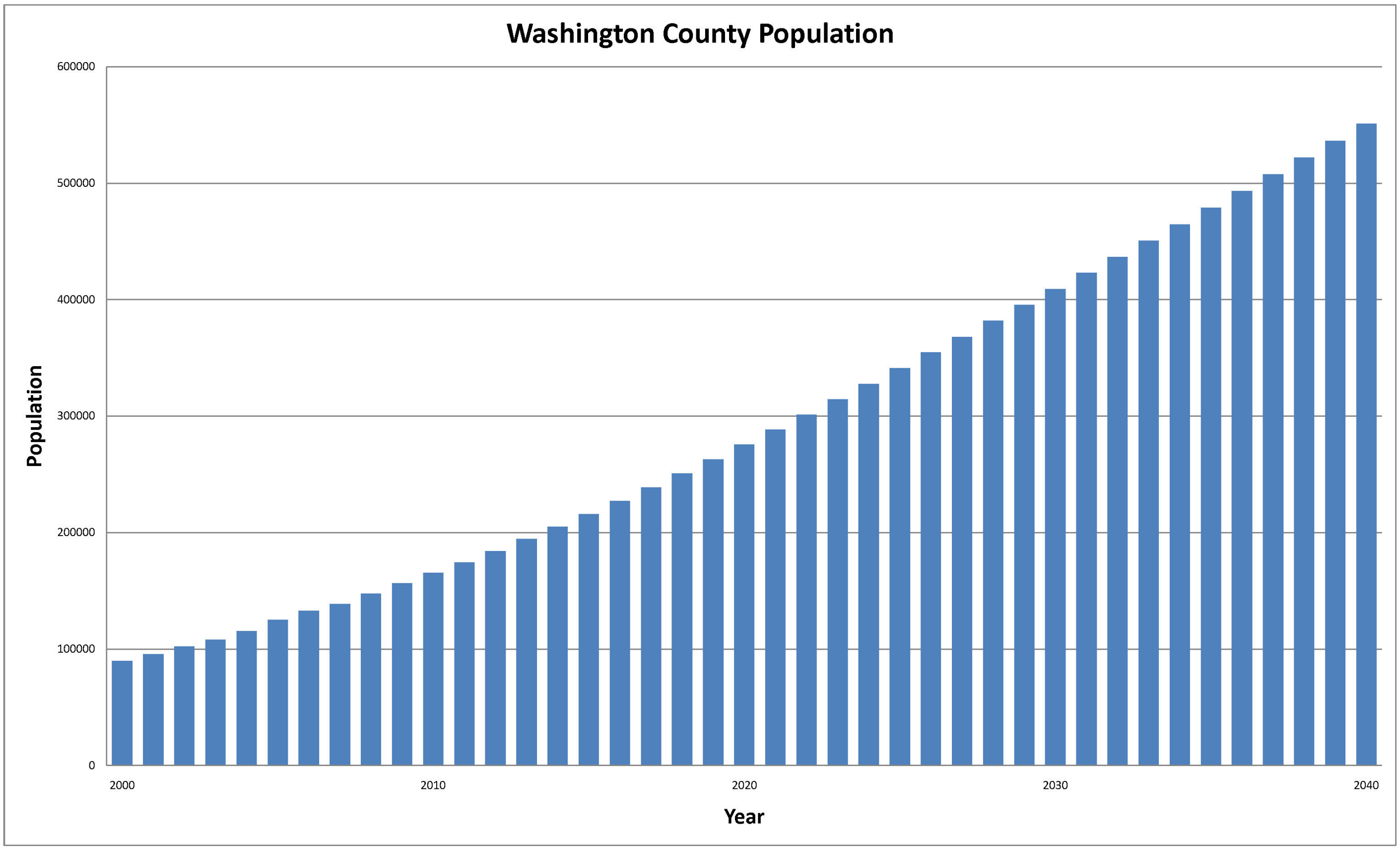

Figure 5: GOPB Population Forecasts

Land-Use Plans – City and County land-use plans determine the population and employment densities for the different areas and where these will occur.

Local Planners – Information obtained from local planners was utilized to determine the timing of when the various areas are expected to develop. Figures 6 and 7 show dot density maps for population and employment for 2010 and 2040 conditions. 2040 conditions show substantial growth in the St. George South Block area, Washington Fields, and Hurricane City in addition to an increase in density to already urbanized areas.

Census – Information obtained from the U.S. Census Bureau was used to provide household characteristic information such as size, income and auto availability.

Division of Workforce Services (DWS) – Information obtained from the DWS was used to provide information on the location and types of employment in Washington County.

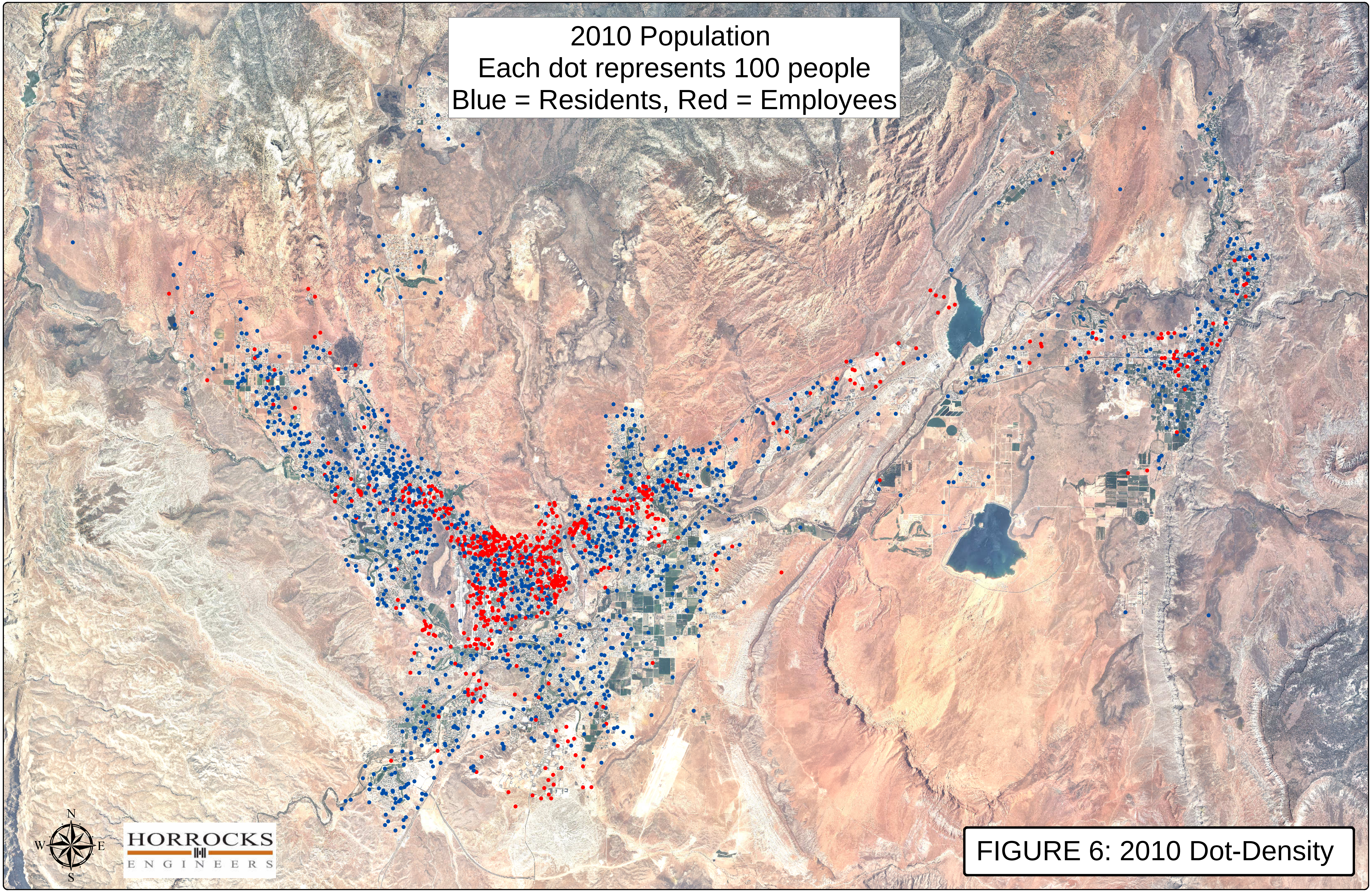

FIGURE 6: 2010 Dot-Density

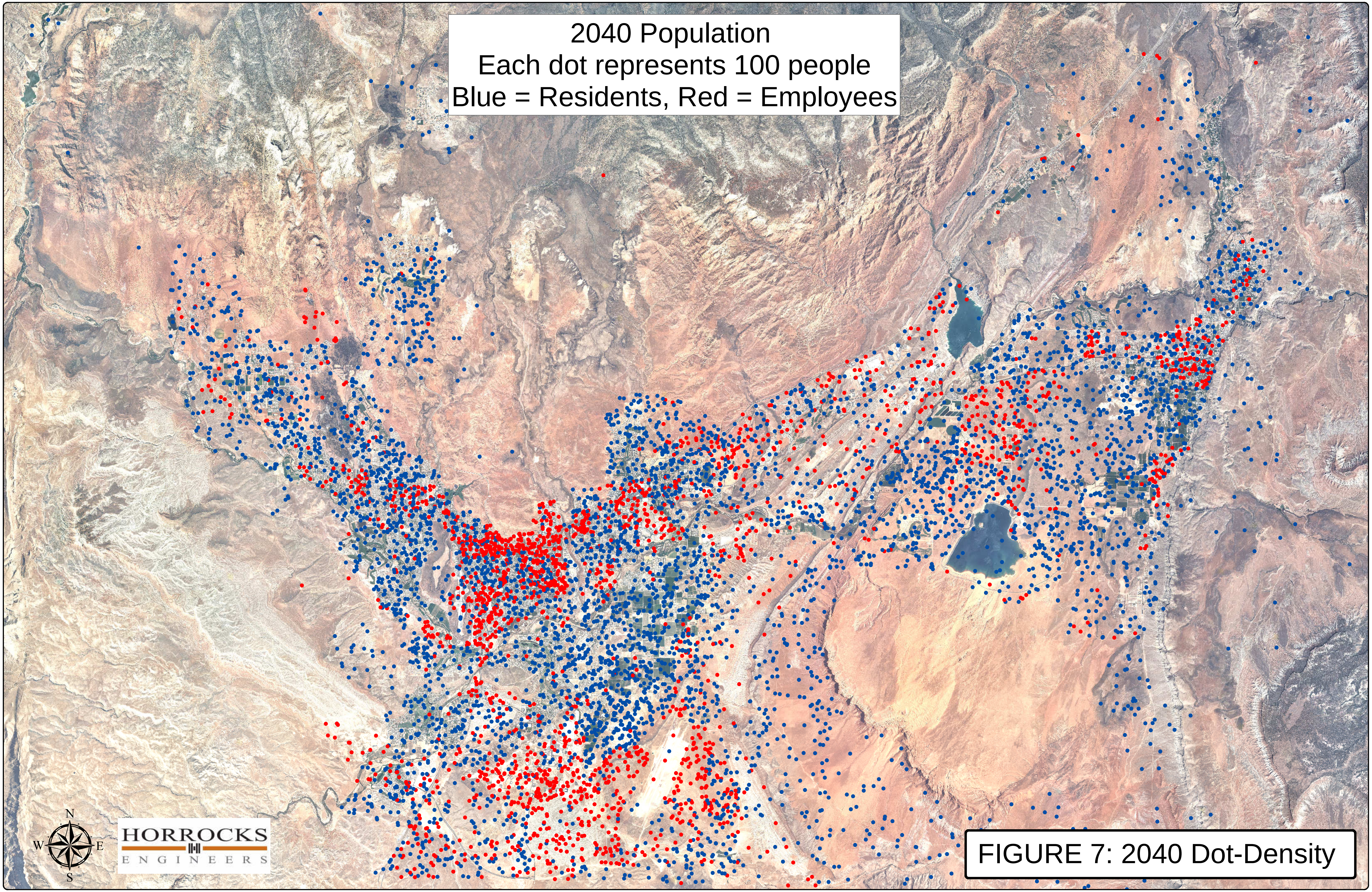

FIGURE 7: 2040 Dot-Density

Dixie MPO Regional Transportation Master-Plan (RTP) – The Dixie MPO RTP was used to determine what roadway projects would be built in the future. Currently the RTP designates a Washington Parkway extension that comes off Red Hills Pkwy. and ties into the Exit 13 interchange. However, because this is one of the potential alternatives being evaluated in this study this corridor alignment was not included in the no-build scenario. Projects such as the Western Corridor, Bluff St. widening, I-15 crossing at Mall Dr., I-15 widening, in addition to many other local improvements were included in the base conditions of the study.

3.1 District-to-District Travel Demand

A district is a combination of several TAZ's that are created to be able to evaluate travel characteristics of larger areas. The following figures 8 and 9 detail the person-trip travel demand from District 1 (the area covering Ivins, Santa Clara, West St. George and the Ledges area) to the surrounding districts in 2010 and 2040 as calculated in the trip distribution step of the 4-step process described earlier.

Figure 9, in addition to showing the overall 2040 travel demand to and from District 1, shows the relative growth between 2010 and 2040. The figure shows a large increase in travel demand between District 1 and the districts to the east.

3.3 Volume-to-Capacity Ratios

Volume-to-capacity ratio (V/C) is the proportion of traffic demand flow relative to the capacity of the transportation facility. Once the V/C ratio exceeds 1.0, the physical capacity of the roadway has been surpassed. In order to achieve favorable traffic conditions, traffic planners generally try to keep a roadway within 90% of its physical capacity.

Figure 10 details the 2040 V/C ratio for the PM Peak hour. The figure shows segments of the Bluff St., St. George Blvd., Red Cliff Dr., and Red Hills Parkway corridors as being over capacity. These are high-profile corridors that provide the primary backbone for the St. George urbanized area transportation network. Simply expanding streets such as Bluff St., Red Cliffs Dr. and St. George Blvd. to accommodate future travel is exceedingly difficult due to right-of-way, physical constraints and costs. Reducing congestion on these corridors is one of the primary purposes of providing an additional east/west route.

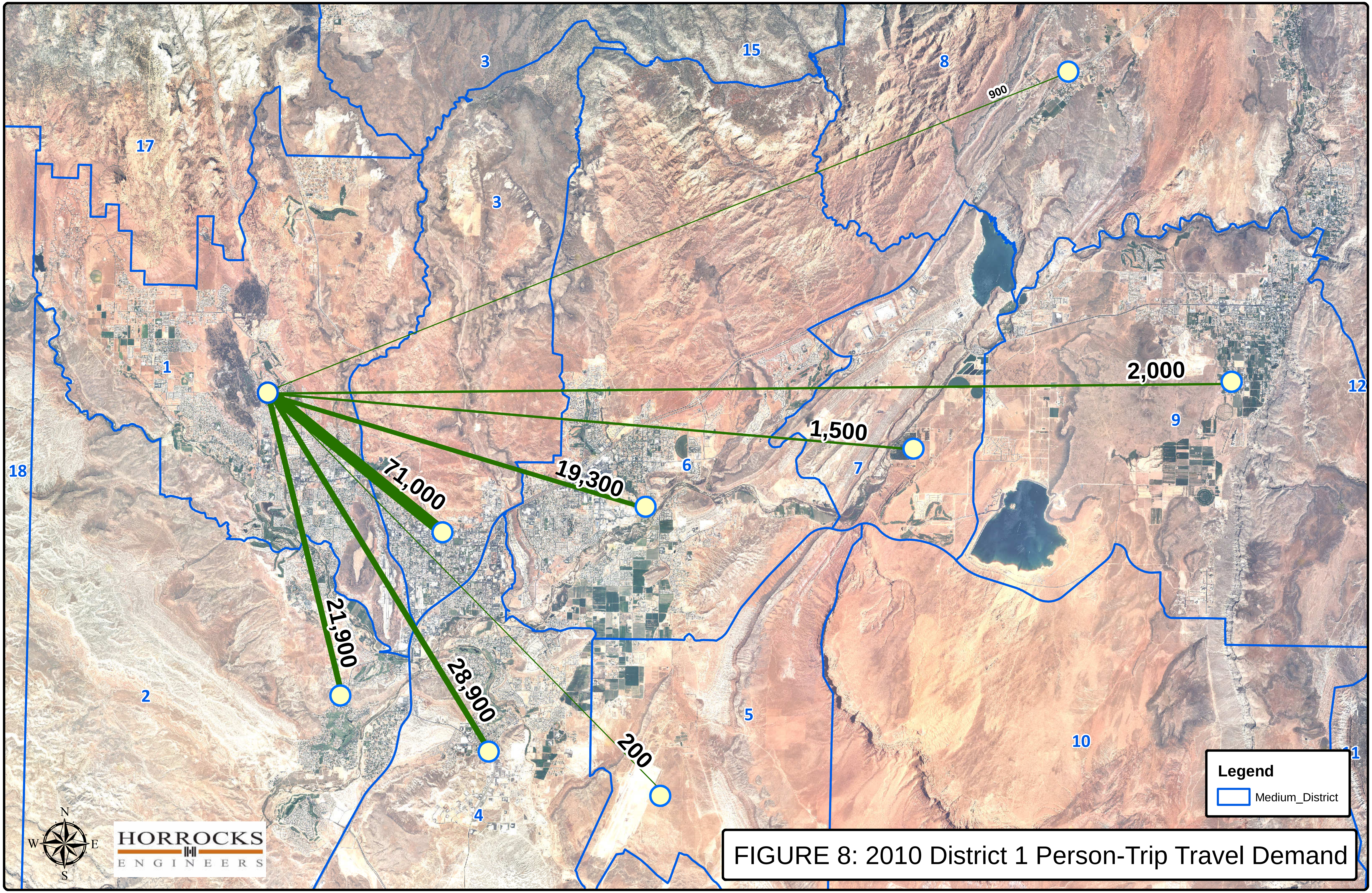

FIGURE 8: 2010 District 1 Person-Trip Travel Demand

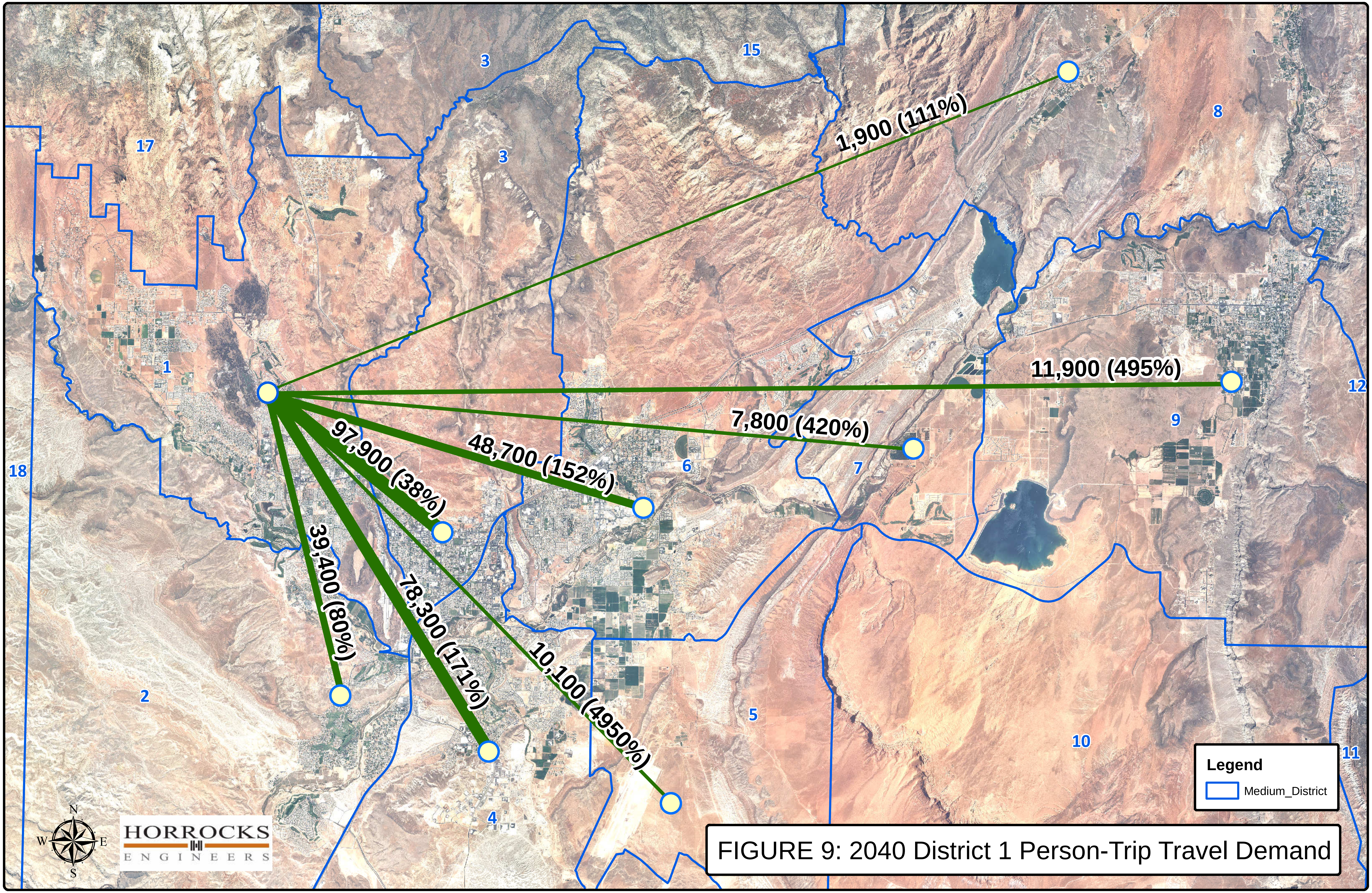

FIGURE 9: 2040 District 1 Person-Trip Travel Demand

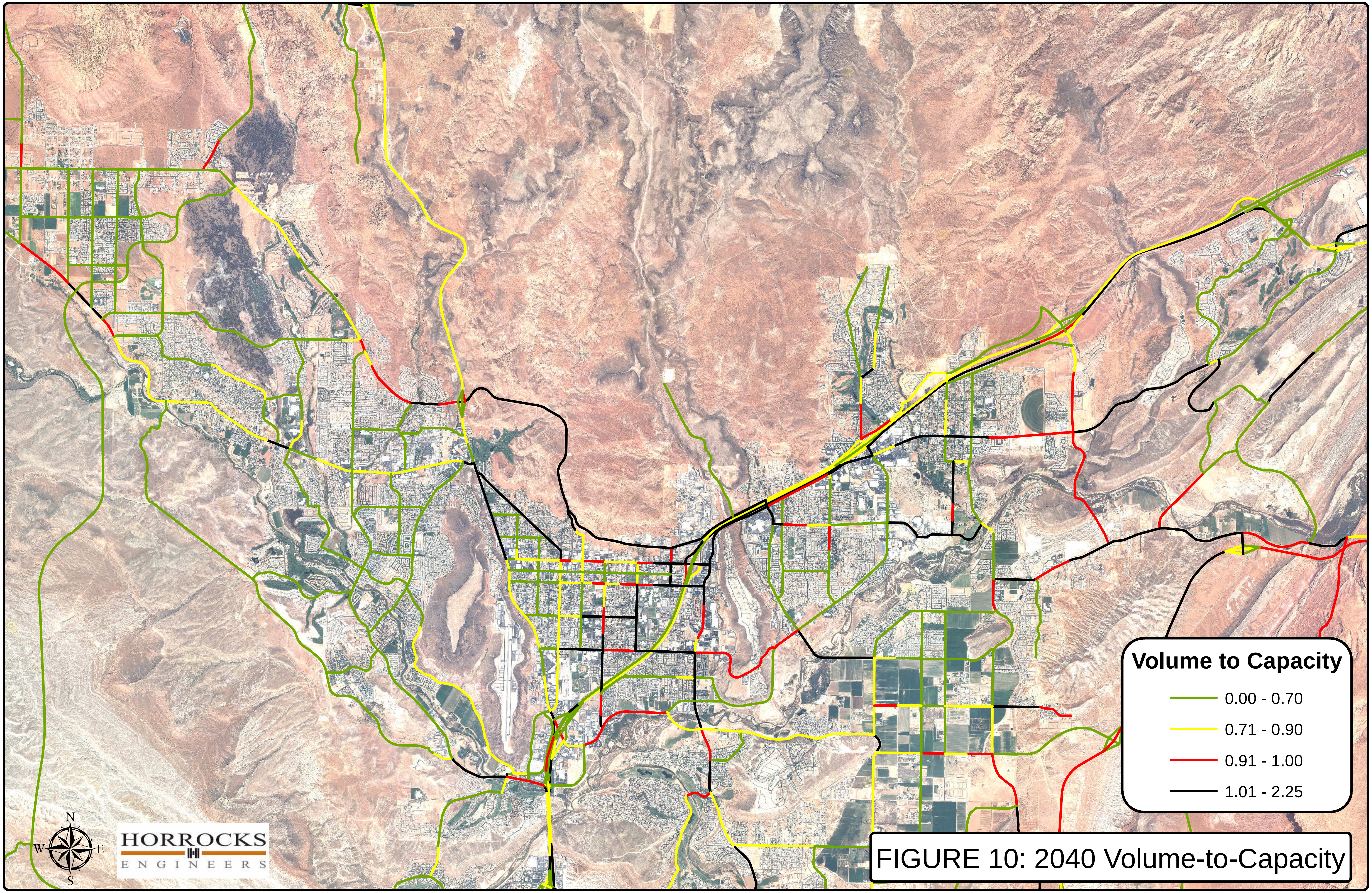

FIGURE 10: 2040 Volume-to-Capacity

4.0 WASHINGTON PARKWAY ALTERNATIVES

The following alternatives were developed for evaluation as shown in Figure 11:

Option #1 provides a direct connection between the Ledges area and the city of Leeds. The majority of the route follows an existing dirt road that runs east/west and eventually ties into Oak Grove Road.

Option #2 provides a direct connection between the Ledges area and the Exit 13 interchange. The route partially follows the Old Turkey Farm Rd. then heads east tying into Washington Parkway.

Option #3 extends the current Washington Parkway west past T-Bone Mesa, tying into Red Hills Parkway.

Option #4 extends Skyline Dr. east thru the Green Springs Golf Course driving range tying into Greens Springs Dr.

Option #5 provides a direct connection between the Ledges area and the Middleton area. The route follows the Old Turkey Farm Rd. south to Middleton Dr.

Option #6 is a combination of Options 2 and 5.

4.1 Area of Influence

A select-link analysis was performed for the different corridors to determine the origin and destination of trips that are expected to use the various routes. Figures 12 thru 17 show the number of trips that are generated in a particular TAZ that are expected to use the various Washington Parkway alternatives.

Option #1 showed a very limited area of influence, as there were no TAZ’s that generated more than 100 trips that were expected to use that alternative. Option #2 showed a high level of influence for travel between the Ledges area and Washington/Western Hurricane. Option #3 had the largest overall area of influence with significant trips occurring from Ivins, Santa Clara, the Ledges, Washington and Hurricane. Option #4 was similar to Option #3, but not as intense and didn’t extend as far east or west as Option #3 did. Option #5 was similar to Option #2 with a high amount of travel coming from the Ledges area to the eastern St. George/Washington area. Option #6 also showed a high amount of travel going between the Ledges area and eastern St. George/Washington/western Hurricane.

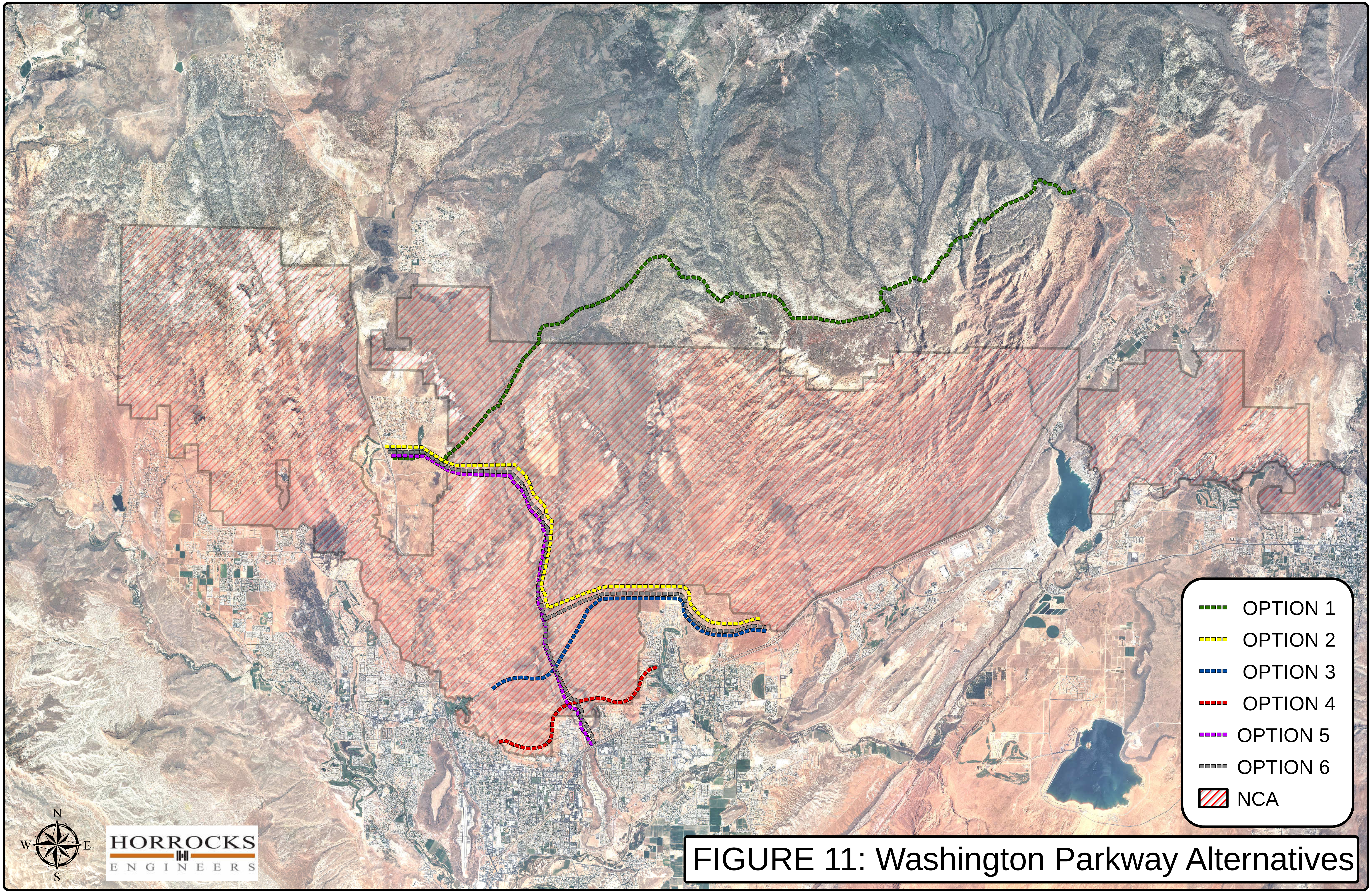

FIGURE 11: Washington Parkway Alternatives

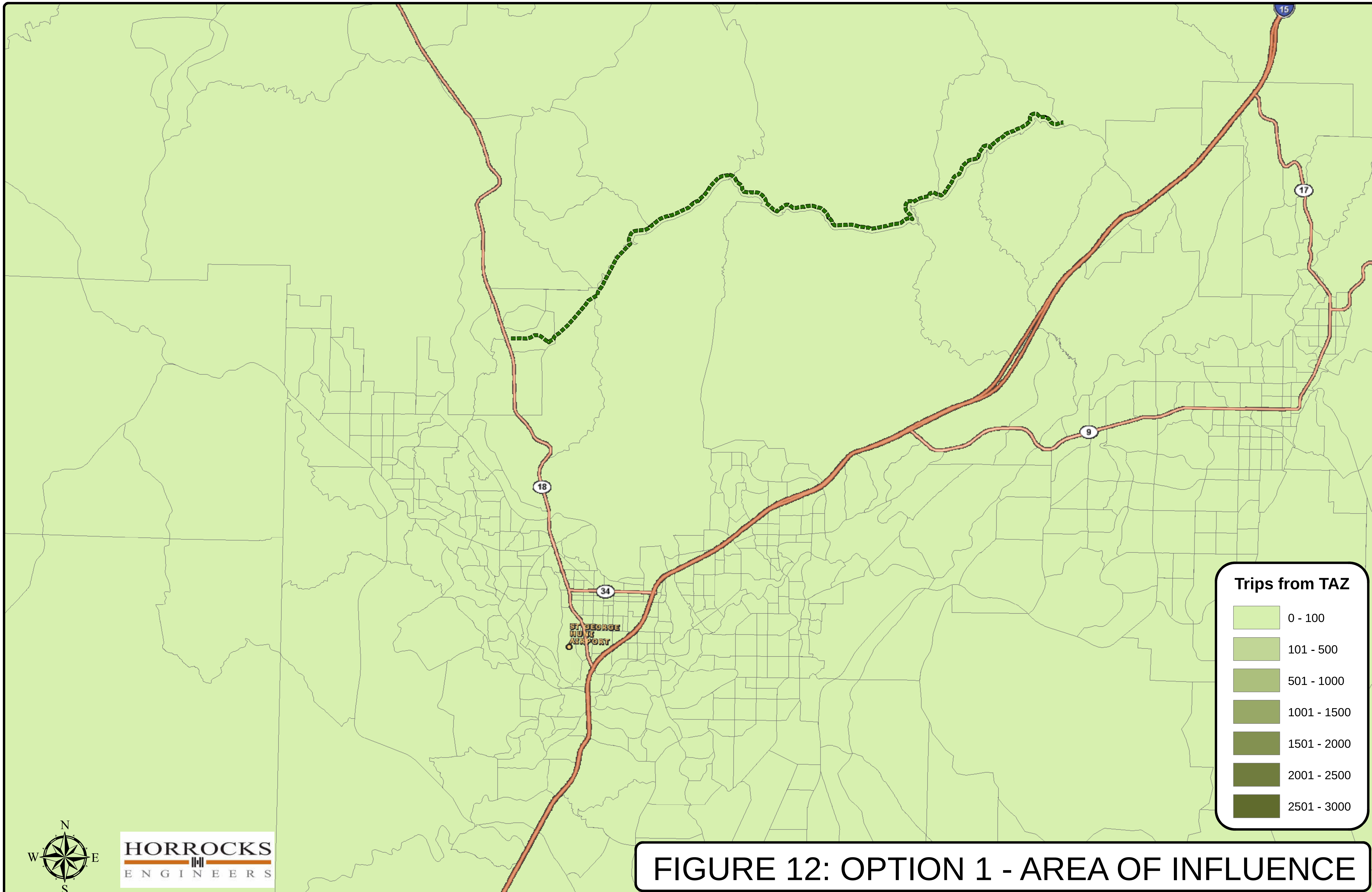

FIGURE 12: OPTION 1 - AREA OF INFLUENCE

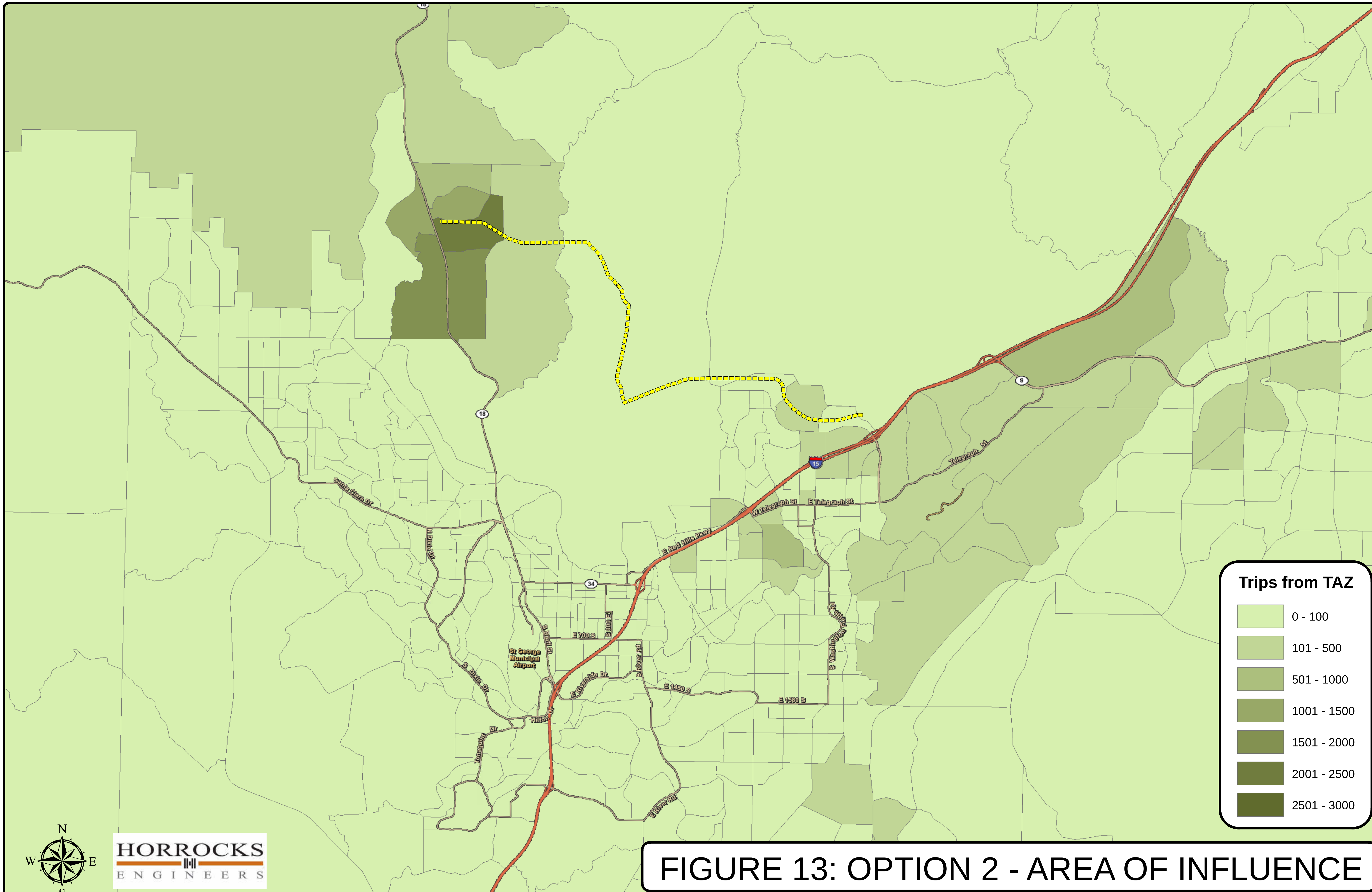

FIGURE 13: OPTION 2 - AREA OF INFLUENCE

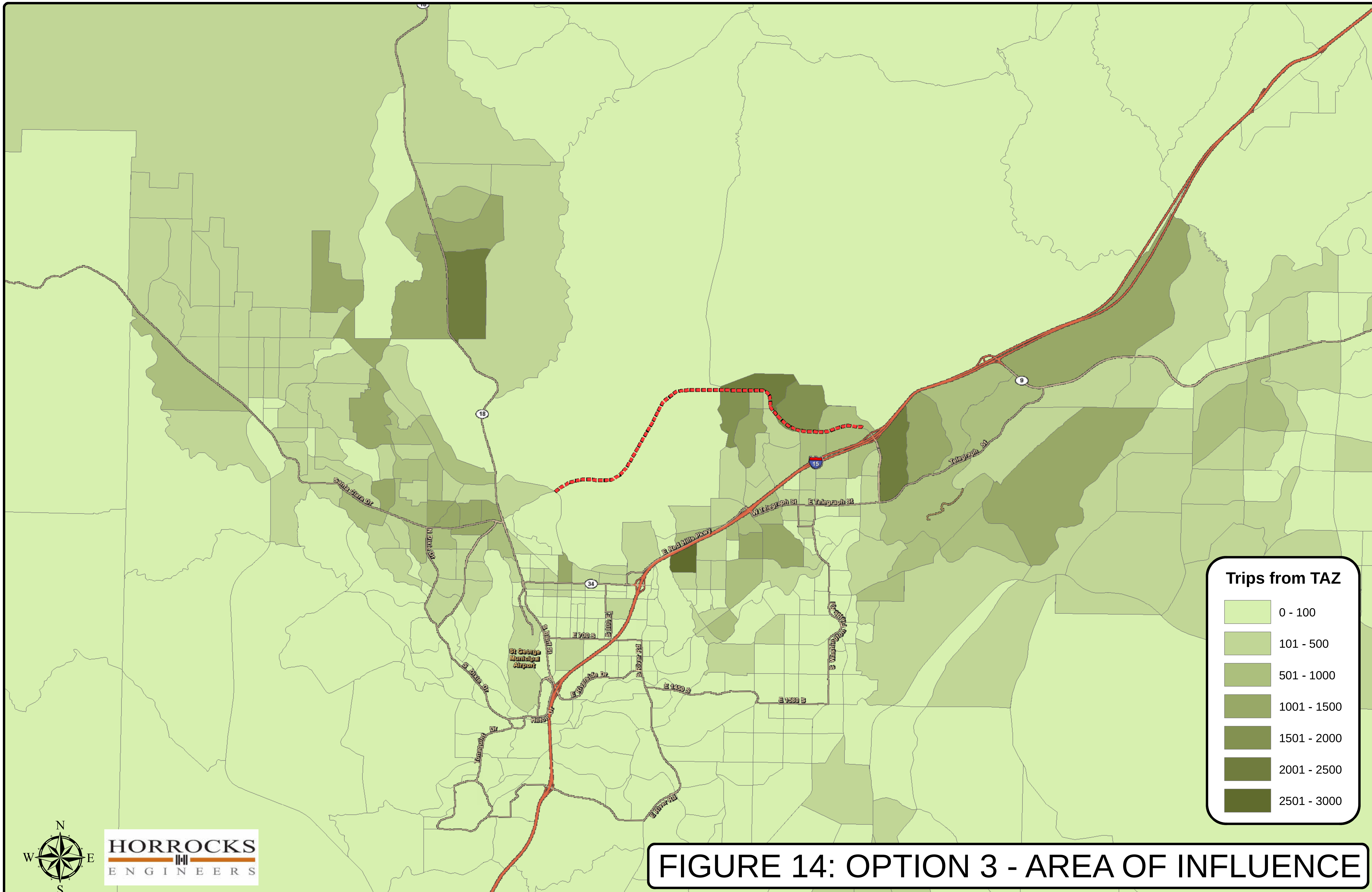

FIGURE 14: OPTION 3 - AREA OF INFLUENCE

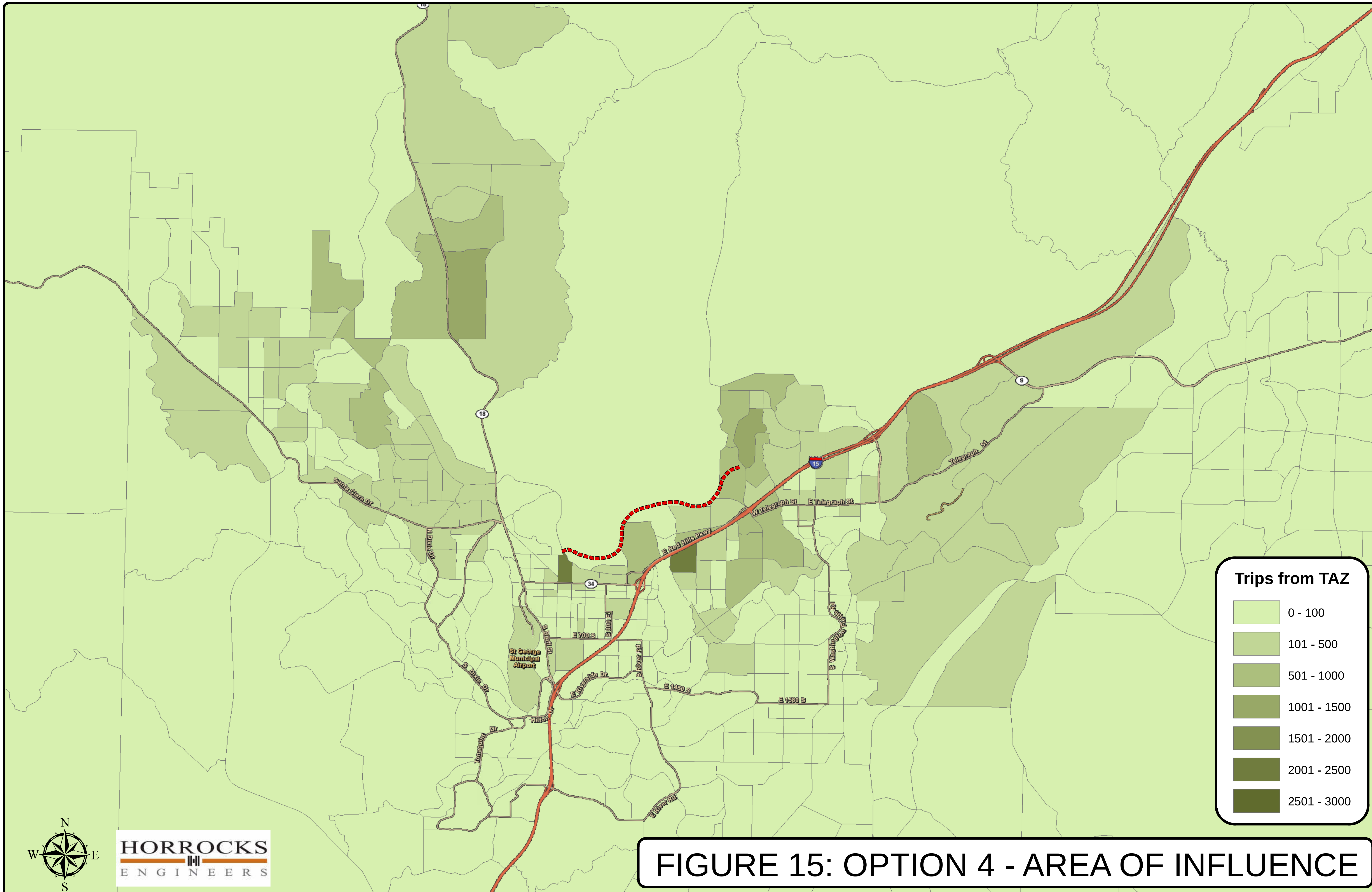

FIGURE 15: OPTION 4 - AREA OF INFLUENCE

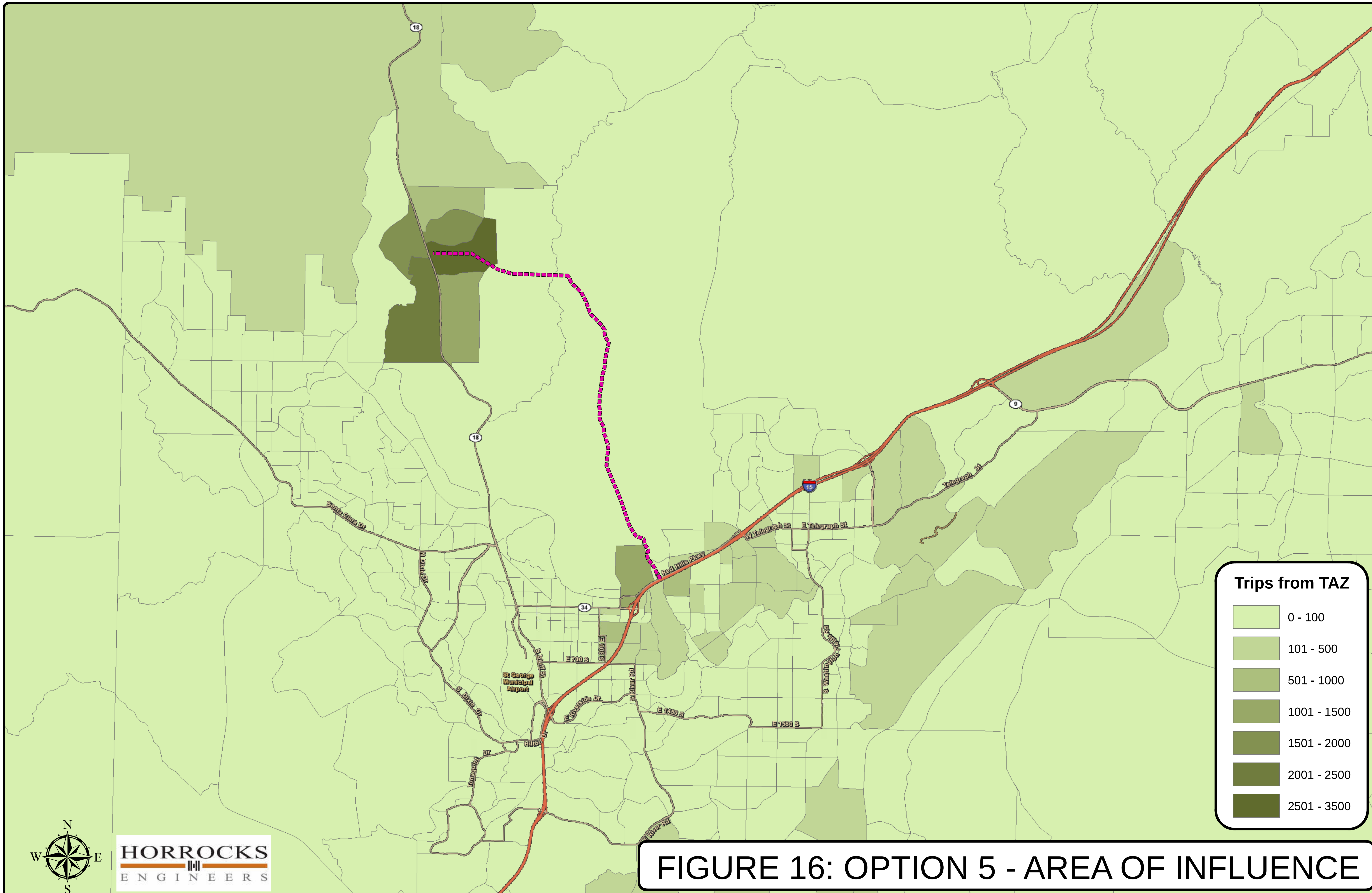

FIGURE 16: OPTION 5 - AREA OF INFLUENCE

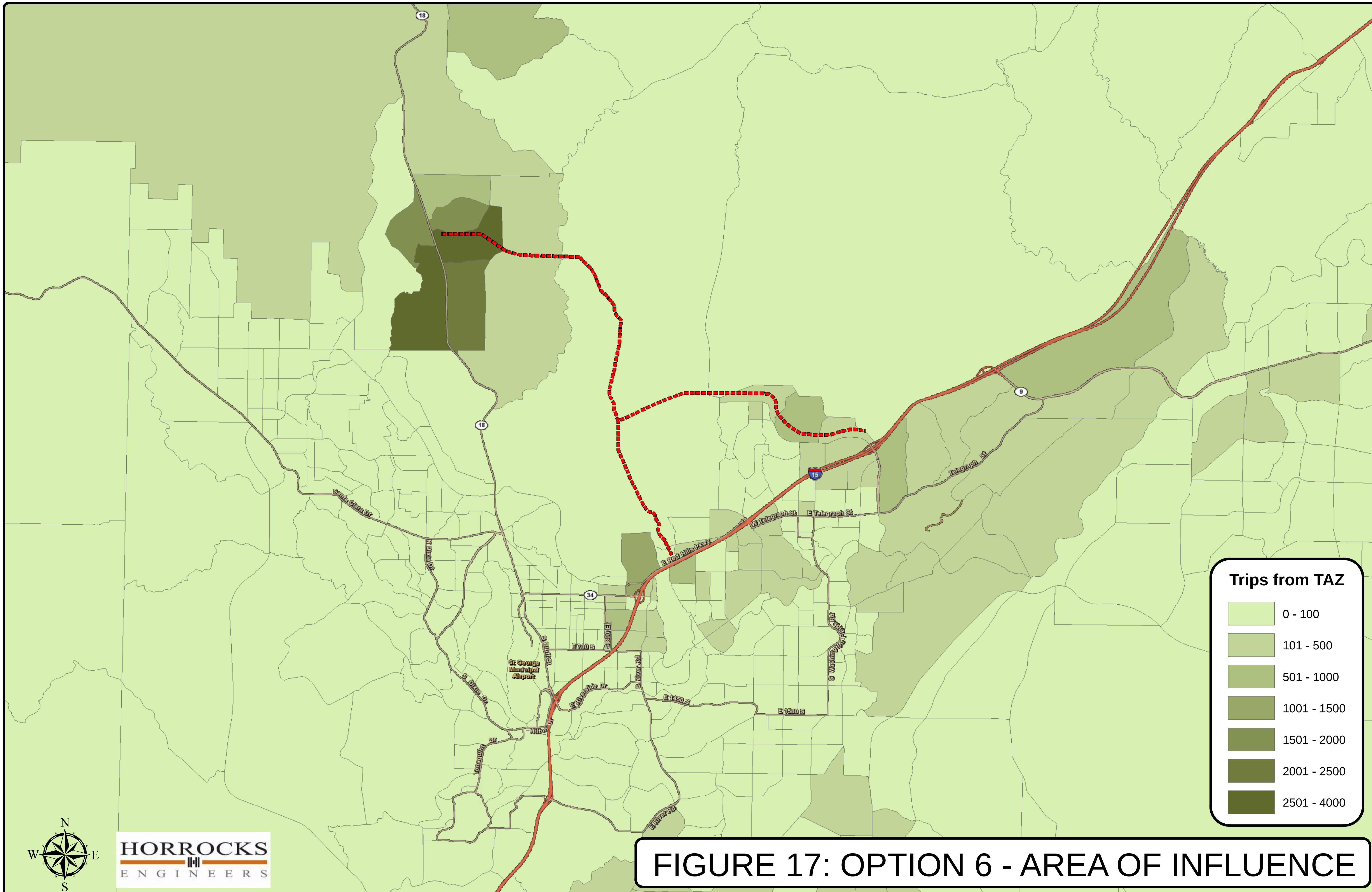

FIGURE 17: OPTION 6 - AREA OF INFLUENCE

4.2 *Shift in Travel Patterns*

Figures 18 thru 23 detail the expected shift in travel patterns for each of the alignments. The figures also show the expected 2040 daily traffic volumes that are expected to use the corridor.

Option #1, with 300 vehicles per day (vpd), showed little overall shift in daily travel patterns. No link showed more than 1,000 vpd shift in traffic.

Option #2, with 13,000 vpd, shifted approximately 11,000 vpd off of SR-18 between the Ledges interchange and Red Hills Parkway. Option #2 showed a more modest reduction in traffic from St. George Blvd., Red Hills Parkway and Red Cliffs Dr., ranging between 1,000 to 5,000 vpd.

Option #3, with traffic ranging between 32,000 to 46,000 vpd, pulled the highest overall amount of traffic from adjacent corridors. Option #3 showed trip reductions ranging from 5,000 to 19,000 vpd from St. George Blvd., Red Hills Parkway and Red Cliffs Dr. Option #3 did show a significant increase in traffic on Red Hills Parkway between SR-18 and Option #3 of the Washington Parkway and Old Turkey Farm Road.

Option #4, with traffic ranging from 11,000 to 24,000 vpd, primarily split Red Hills Parkway traffic at Skyline Dr., pulling approximately 15,000 vpd off of Red Hills Parkway. Trip Reductions on Bluff St., St George Blvd. and Red Cliffs Dr. ranged between 1,000 to 2,000 vpd.

Option #5, with 16,000 vpd, shifted approximately 14,000 vpd off of SR-18 between the Ledges interchange and Red Hills Parkway. Option #5, like Option #2, showed a more modest reduction in traffic on St. George Blvd., Red Hills Parkway and Red Cliffs Dr., ranging between 1,000 to 7,000 vpd.

Option #6, with 20,000 vpd, shifted approximately 17,000 vpd off of SR-18 between the Ledges interchange and Red Hills Parkway. Option #6 showed trip reductions on St. George Blvd., Red Hills Parkway and Red Cliffs Dr. ranging between 1,000 to 8,000 vpd.

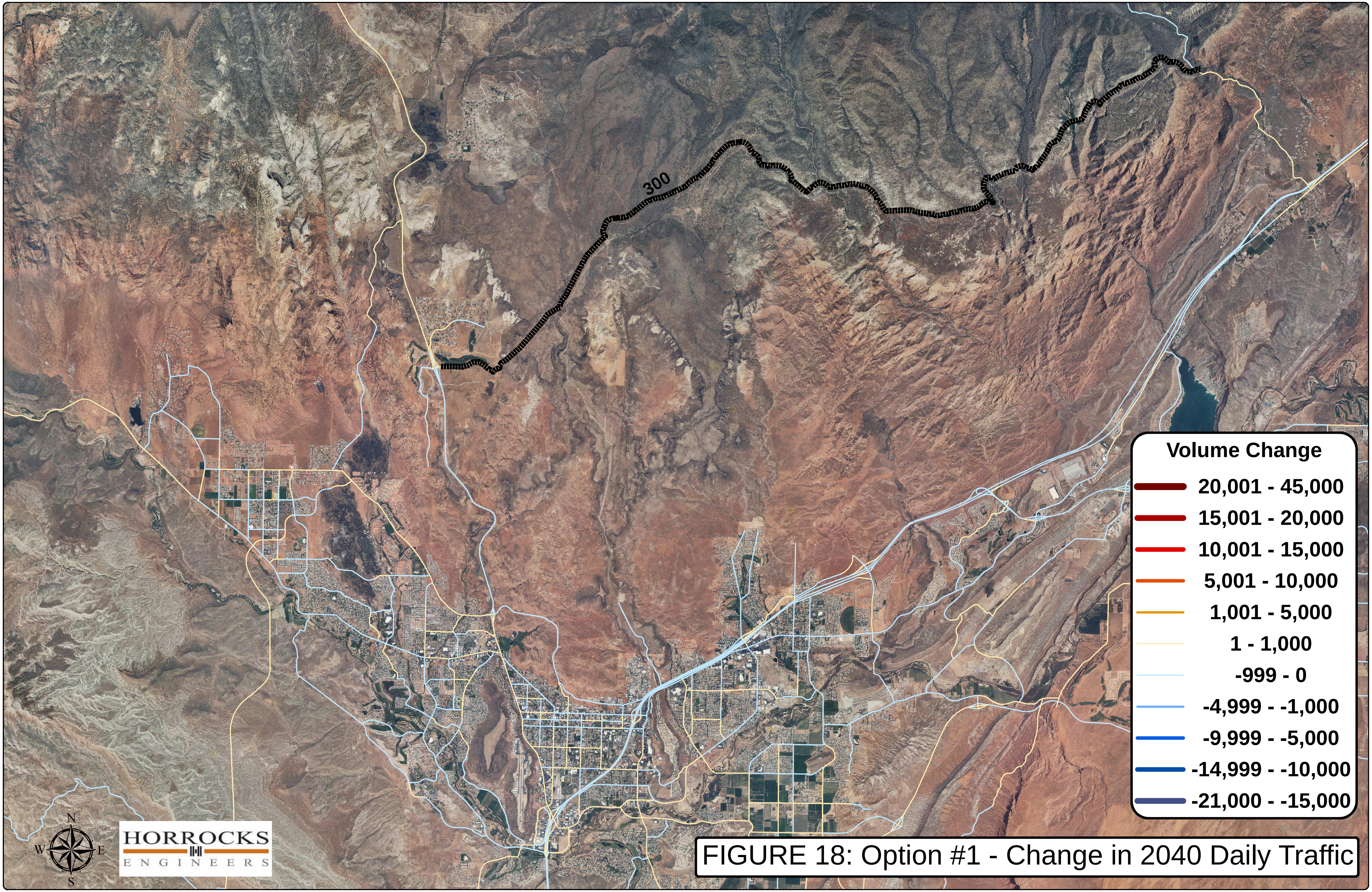

FIGURE 18: Option #1 - Change in 2040 Daily Traffic

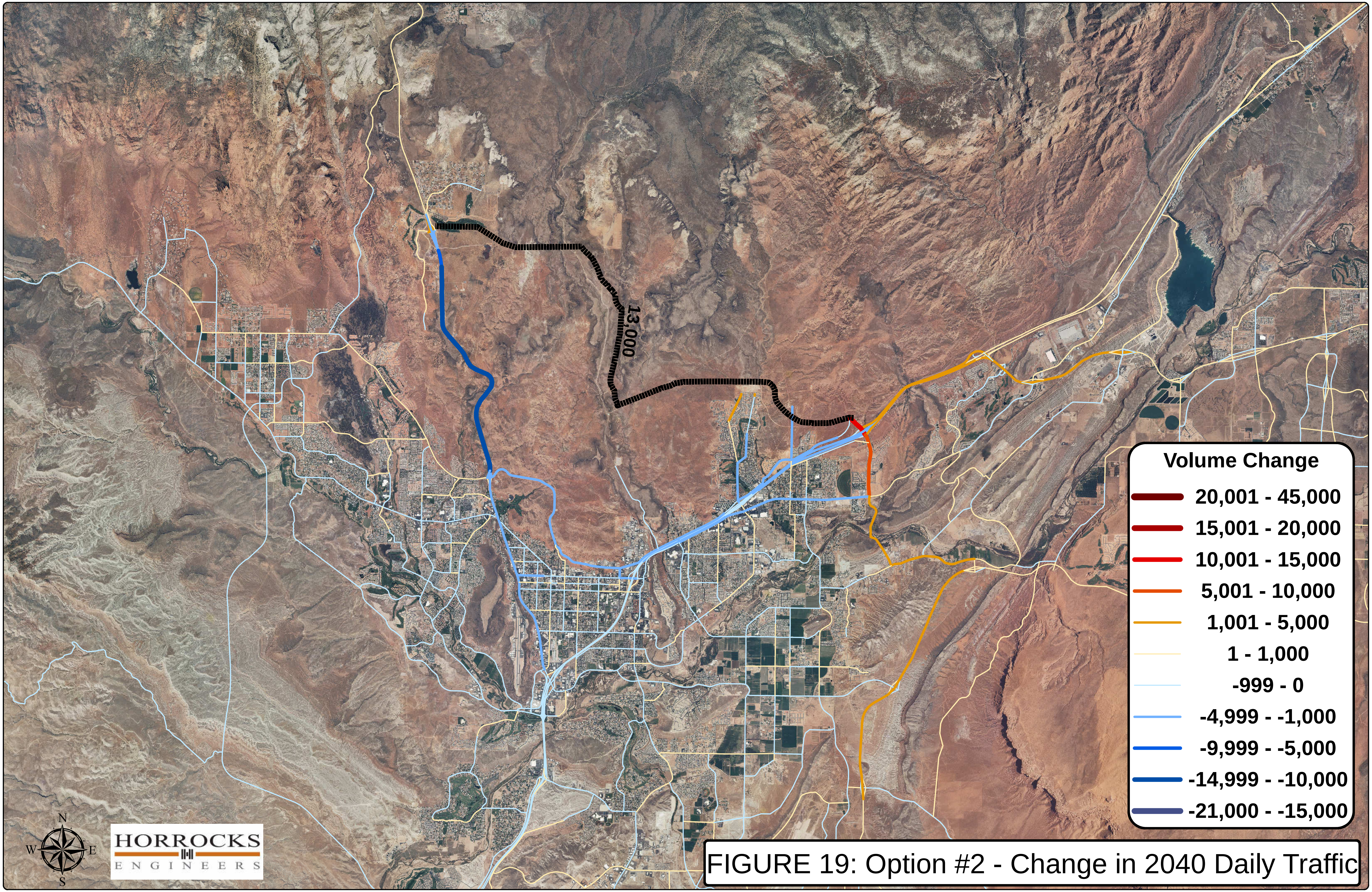

FIGURE 19: Option #2 - Change in 2040 Daily Traffic

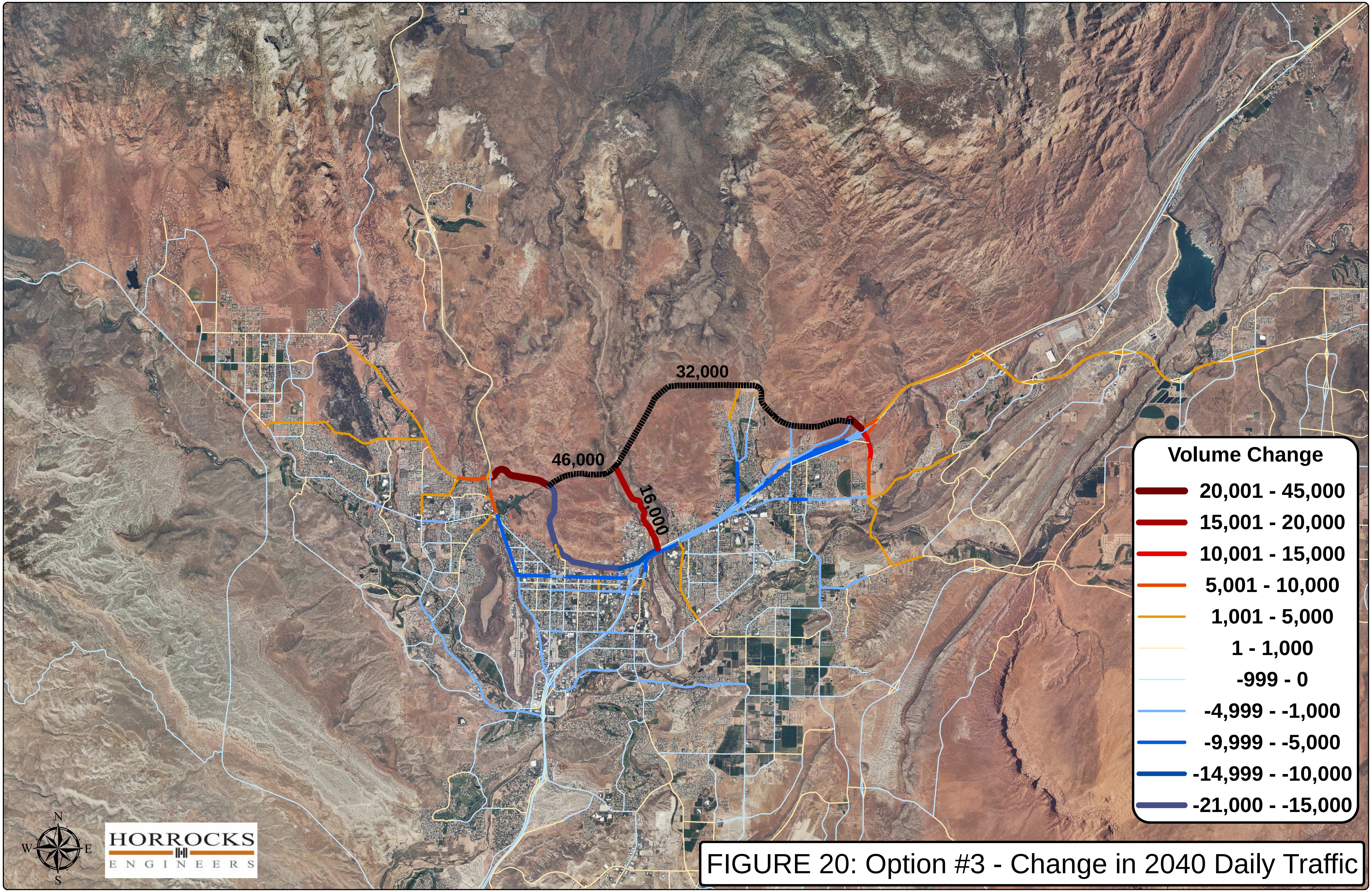

FIGURE 20: Option #3 - Change in 2040 Daily Traffic

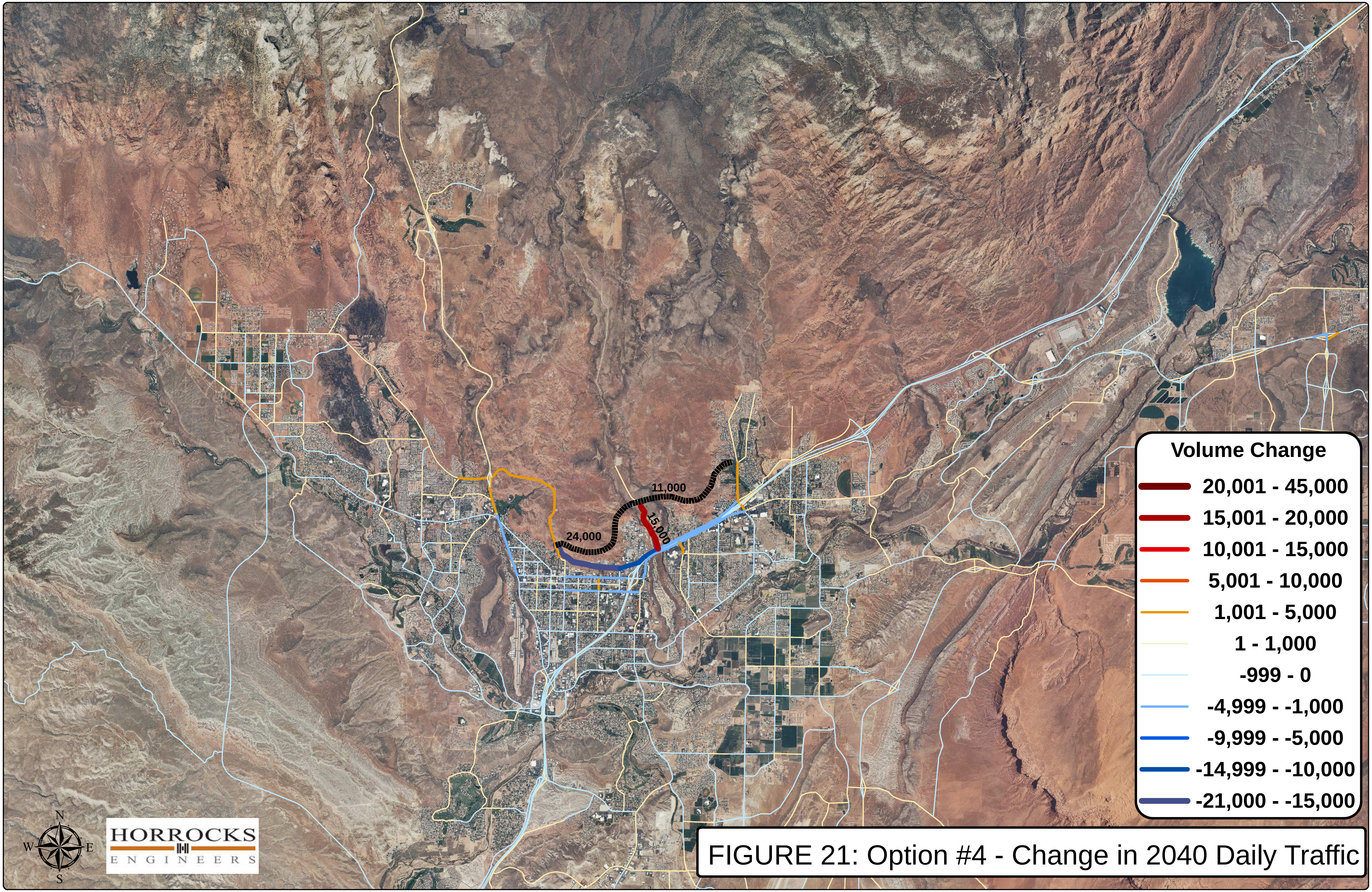

FIGURE 21: Option #4 - Change in 2040 Daily Traffic

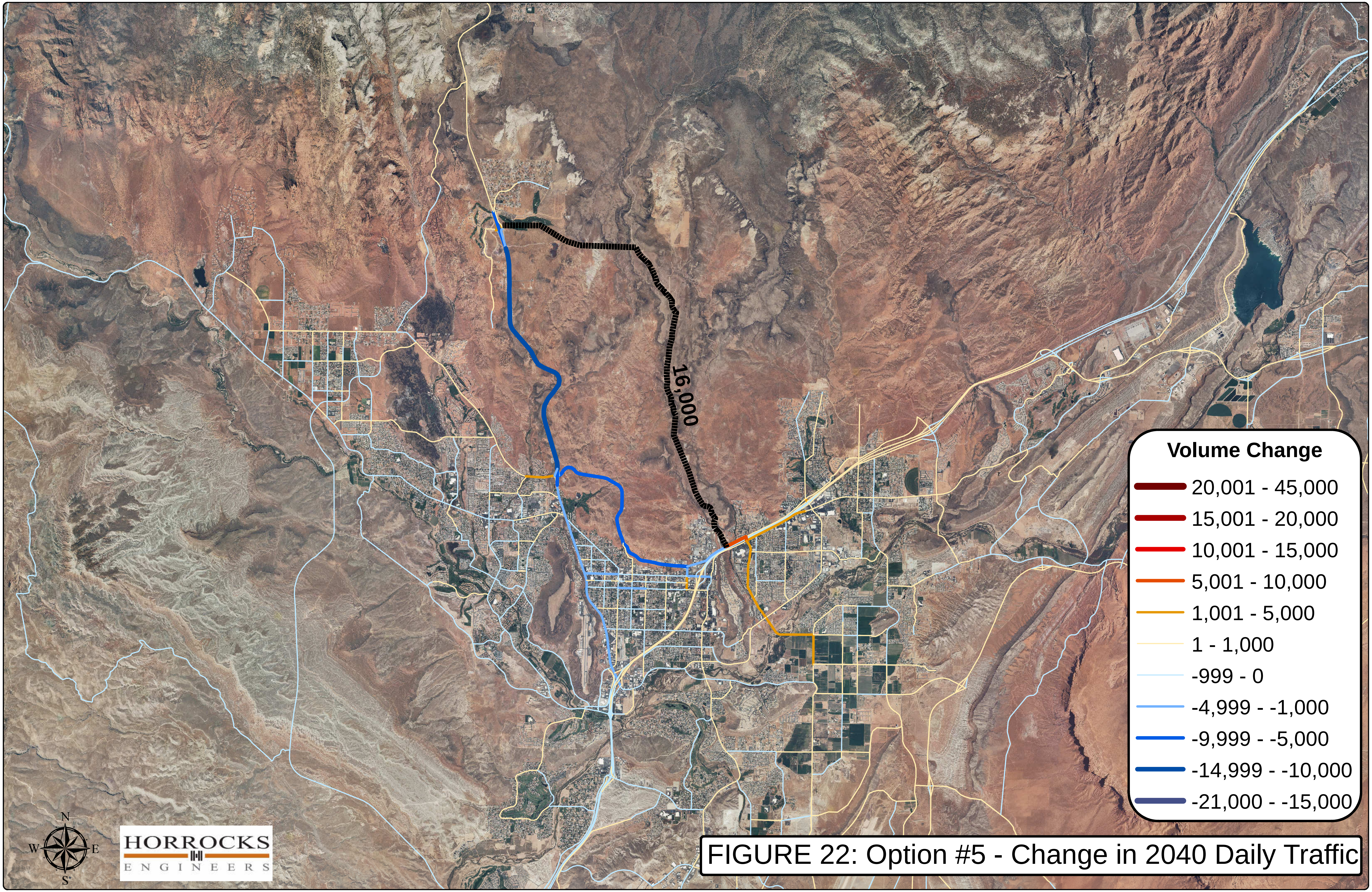

FIGURE 22: Option #5 - Change in 2040 Daily Traffic

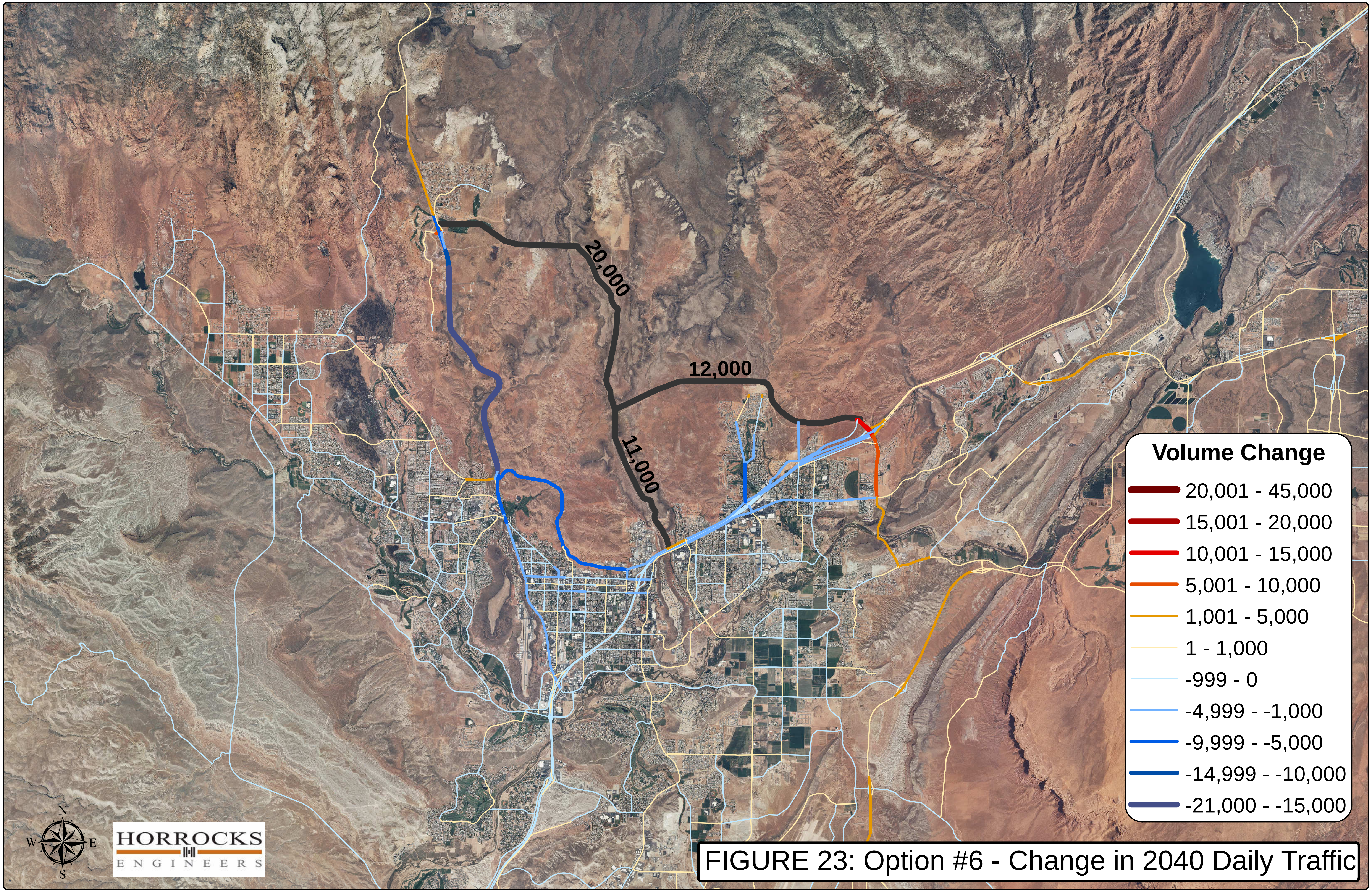

FIGURE 23: Option #6 - Change in 2040 Daily Traffic

4.3 Traffic Analysis

Tables 1 thru 6 detail the comparison of each of the alternatives on several of the high profile corridors in the study area that are expected to experience the highest levels of congestion.

Table 1: 2040 SR- 18: Sunset Blvd. to St. George Blvd.

	No Build	Option #1	Option #2	Option #3	Option #4	Option #5	Option #6
Volume	72,000	71,800	68,900	63,500	70,500	67,200	66,200
Volume Change	-	-200	-3,100	-8,500	-1,500	-4,800	-5,800
% Change	-	0%	-4%	-12%	-2%	-7%	-8%
PM Peak Hour V/C	1.19	1.19	1.14	1.09	1.17	1.14	1.11

As shown in the above table, Option #3 provided the largest decrease in traffic for SR-18 between Sunset Blvd. and St. George Blvd., lowering traffic volumes by approximately 12%. Option #1 provided minimal traffic reductions, below 1% of the daily traffic. The remaining options provided between 4% to 8% decrease. No option reduced traffic enough to bring PM Peak hour travel demand below the roadway's capacity.

Table 2: 2040 St George Blvd: 1000 E to SB Ramp Intersection

	No Build	Option #1	Option #2	Option #3	Option #4	Option #5	Option #6
Volume	67,000	66,900	64,600	58,300	65,300	64,600	64,400
Volume Change	-	-100	-2,400	-8,700	-1,700	-2,400	-2,600
% Change	-	0%	-4%	-13%	-3%	-4%	-4%
PM Peak Hour V/C	1.39	1.38	1.33	1.13	1.28	1.33	1.33

As shown in the above table, Option #3 provided the largest decrease in traffic for St. George Blvd. between 1000 E and the I-15 SB Ramp intersection, lowering traffic volumes by approximately 13%. Option #1 provided minimal traffic reductions, below 1% of the daily traffic. The remaining options provided between 3% to 4% decrease. No option reduced traffic enough to bring PM Peak hour travel demand below the roadway's capacity.

Table 3: 2040 Red Cliffs Dr: North of St. George Blvd.

	No Build	Option #1	Option #2	Option #3	Option #4	Option #5	Option #6
Volume	62,000	61,900	60,300	57,000	61,000	61,000	59,800
Volume Change	-	-100	-1,700	-5,000	-1,000	-1,000	-2,200
% Change	-	0%	-3%	-8%	-2%	-2%	-4%
PM Peak Hour V/C	1.33	1.33	1.23	1.19	1.31	1.30	1.22

As shown in the above table, Option #3 provided the largest decrease in traffic on Red Cliffs Dr. just north of St. George Blvd., lowering traffic volumes by approximately 8%. Option #1 provided minimal traffic reductions, below 1% of the daily traffic. The remaining options provided between 2% to 4% decrease. No option reduced traffic enough to bring PM Peak hour travel demand below the roadway's capacity.

Table 4: 2040 I-15: Between Exits 10 and 13

	No Build	Option #1	Option #2	Option #3	Option #4	Option #5	Option #6
Volume	125,000	124,700	122,500	113,800	124,100	124,700	122,300
Volume Change	-	-300	-2,500	-11,200	-900	-300	-2,700
% Change	-	0%	-2%	-9%	-1%	0%	-2%
PM Peak Hour V/C	1.06	1.06	1.05	0.97	1.05	1.06	1.05

As shown in the above table, Option #3 provided the largest decrease in traffic on I-15 between Exits 10 and 13, lowering traffic volumes by approximately 9%, bringing this segment of roadway below its physical capacity. The remaining options provided minimal traffic reductions ranging between 0% and 2%.

Table 5: 2040 Red Hills Pkwy.: SR-18 to Skyline Dr.

	No Build	Option #1	Option #2	Option #3	Option #4	Option #5	Option #6
Volume	43,000	42,800	38,200	64,800	46,500	36,000	35,400
Volume Change	-	-200	-4,800	21,800	3,500	-7,000	-7,600
% Change	-	0%	-11%	51%	8%	-16%	-18%
PM Peak Hour V/C	1.04	1.03	0.96	1.34	1.13	0.95	0.94

As shown in the above table, Option #6 provided the largest decrease in traffic on Red Hills Parkway between SR-18 and Skyline Dr., lowering traffic volumes by approximately 18%. Option #1 provided minimal traffic reductions, below 1% of the daily traffic. Options #3 and #4 are expected to increase traffic on this segment of roadway with Option #3 increasing traffic by approximately 50%. The remaining options provided between 11% and 16% decrease. Options #2, #5 and #6 reduced traffic enough to bring PM Peak hour travel demand below the roadway's capacity. In order for Options #3 and #4 to operate at an acceptable level, Red Hills Parkway would need to be widened.

Table 6: 2040 Red Hills Pkwy.: Skyline Dr. to 1000 E

	No Build	Option #1	Option #2	Option #3	Option #4	Option #5	Option #6
Volume	42,000	41,900	37,200	23,500	26,600	34,500	34,100
Volume Change	-	-100	-4,800	-18,500	-15,400	-7,500	-7,900
% Change	-	0%	-11%	-44%	-37%	-18%	-19%
PM Peak Hour V/C	1.23	1.22	1.13	0.77	0.79	1.06	1.05

As shown in the above table, Option #3 provided the largest decrease in traffic on Red Hills Pkwy. between Skyline Dr. and 1000 E, lowering traffic volumes by approximately 44%. Option

#4 also showed significant trip reductions on this segment of roadway reducing traffic by 37%. Both Options #3 and #4 reduced traffic enough that Red Hills Pkwy. would be expected to operate at favorable conditions. Option #1 provided minimal traffic reductions, below 1% of the daily traffic. The remaining options provided between 11% and 19% decrease.

4.4 Cost Estimates

The process for compiling the cost estimates consisted of creating a conceptual horizontal alignment of the proposed roadways. From the conceptual alignments, the pavement widths were determined and an asphalt, untreated base course and granular borrow depth were assumed. From the information about the pavement section, the quantity of pavement materials could be determined. To determine the cut/fill quantities, 3' of fill and 3' of cut along the alignment were assumed. The identifications of drainage features were determined from an on-site analysis. Traveling the proposed alignments and examining the terrain allowed educated guesses of where bridge structures could be located and where major drainage features would be needed.

The following table summarizes the cost estimates for each alternative:

Table 7: Cost Estimates

Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
$57,000,000	$89,000,000	$56,000,000	$35,000,000	$47,000,000	$107,000,000

Options #3 and #4 include partial widening of Red Hills Parkway to a six-lane facility between the Washington Parkway corridor alternative and SR-18. Full details of the cost estimates can be found in the appendix.

5.0 Cost/Benefit

Table 8 summarizes the cost/benefit analysis for the study. The table reports the reduction in overall network delay for the six different options. Delay is the difference between free-flow travel time and actual travel time. Network delay for each of the alignment options, in addition to the no-build scenario, were calculated using the DMPO CUBE TDM. The difference in network delay from the no-build scenario and each of the options is reported below.

User cost per vehicle hour was calculated from rates taken from the I-15 CORE project in Utah County. The following are the rates that were used:

Passenger Vehicles = $15.5/hr
Box Trucks = $56/hr
Tractor Trailer Trucks = $102/hr

96% of vehicles were assumed to be passenger vehicles, with box trucks accounting for 2% of trucks and tractor trailer trucks accounting for the remaining 2%. The weighted average of the three rates equals $18.04/hr, which was rounded to $18/hr for calculation purposes.

Table 8: Cost/Benefit Summary

Network	Project Cost	Delay Change from No-Build (Hours)	User Cost Per Vehicle Hour	2040 Daily Savings Due to Delay Reduction	2040 Yearly Savings Due to Delay Reduction	Cost/Benefit for 2040
Option 1	$57,000,000	-281	$18	$5,059	1,846,534	30.87
Option 2	$89,000,000	-1,670	$18	$30,064	10,973,327	8.11
Option 3	$56,000,000	-2,983	$18	$53,695	19,598,769	2.86
Option 4	$35,000,000	-1,585	$18	$28,525	10,411,587	3.36
Option 5	$47,000,000	-1,306	$18	$23,506	8,579,682	5.48
Option 6	$107,000,000	-1,856	$18	$33,403	12,192,075	8.78

As shown in the above table, Option #3 provided the overall largest delay reduction between the six options. Option #3 also provided the highest cost benefit relative to its delay with a one year cost/benefit ratio of 2.86.

In addition to user cost savings due to delay reductions, decreasing congestion has also been shown to reduce accidents, improve air quality, and stimulate economic growth. Although these are quantifiable benefits, quantifying these benefits was outside the scope of this study.

6.0 Summary

Option #3 provided the highest benefit relative to its cost with respect to traffic congestion relief. None of the options reduced traffic on Bluff St., St. George Blvd. and Red Cliffs Dr. to the point that congestion on these corridors was eliminated. However, Option #3 did show the largest overall trip reductions that would make them more manageable.

In order to fully meet the 2040 travel demand on these corridors, a combination of several traffic reducing measures are needed in addition to the Washington Parkway corridor including:

- A more robust transit network
- High-capacity intersections
- Alternative corridors
- An emphasis on land-use planning that reduces trip lengths (Vision Dixie).