I-73 Alternatives Analysis

Model Development and Calibration

A roadway travel demand model was developed to support traffic analyses undertaken as part of the I-73 Corridor Environmental Impact Study (EIS). As an initial step in the model development process, a meeting was held with involved agencies (the Waccamaw COG, Florence County and SCDOT) and consultant study team members. This meeting produced several recommendations that were incorporated into the model building task, including:

- Existing data sources were to be used to the extent possible.
- 2030 was to be used as the forecast year, 2005 as the base year. The forecasting process should also include procedures to estimate intermediate year 2010 and 2020 volumes to support life cycle economic analysis.
- TransCad model application software was to be used to develop and apply the I-73 model. Use of TransCad would require the conversion of the existing statewide model, Grand Strand Area Transportation Study (GSATS) model and Florence Area Transportation Study (FLATS) model from TRANPLAN to TransCad.
- The initial forecasts would use currently available demographic forecasts developed as part of the ongoing statewide, GSATS and FLATS modeling work. As updated forecasts become available they would be incorporated in final I-73 corridor demand forecasts.
- The models should be able to identify corridor work commute, other resident, non-resident and truck trips.
- Discussions should be held with NCDOT staff to determine if a model had been developed to estimate traffic in the I-74 corridor and, if such a model exists, could it be incorporated in the I-73 corridor. (No such model was found to exist).

Data Sources

Several existing data sources were used in the model development and calibration process. These included:

- The version of the South Carolina statewide traffic model most recently used in the 2003 SCDOT I-73 Feasibility Study. This model included a road network covering all of South Carolina, estimates of population for approximately 400 analysis zones and total vehicle trip tables for five year increments from 2005 through 2025. The trip tables included estimates of external traffic traveling to, from and through the state.
- The current version of the GSATS urban area model. This model is designed to estimate peak season travel demands. It includes a road network, land use estimates and total vehicle trip tables at five year increments through year 2030.
- The current version of the FLATS urban area model. It includes a road network, demographic data and trip tables for 2000 and 2025.

Figure 1 shows the coverage area of each of these models.

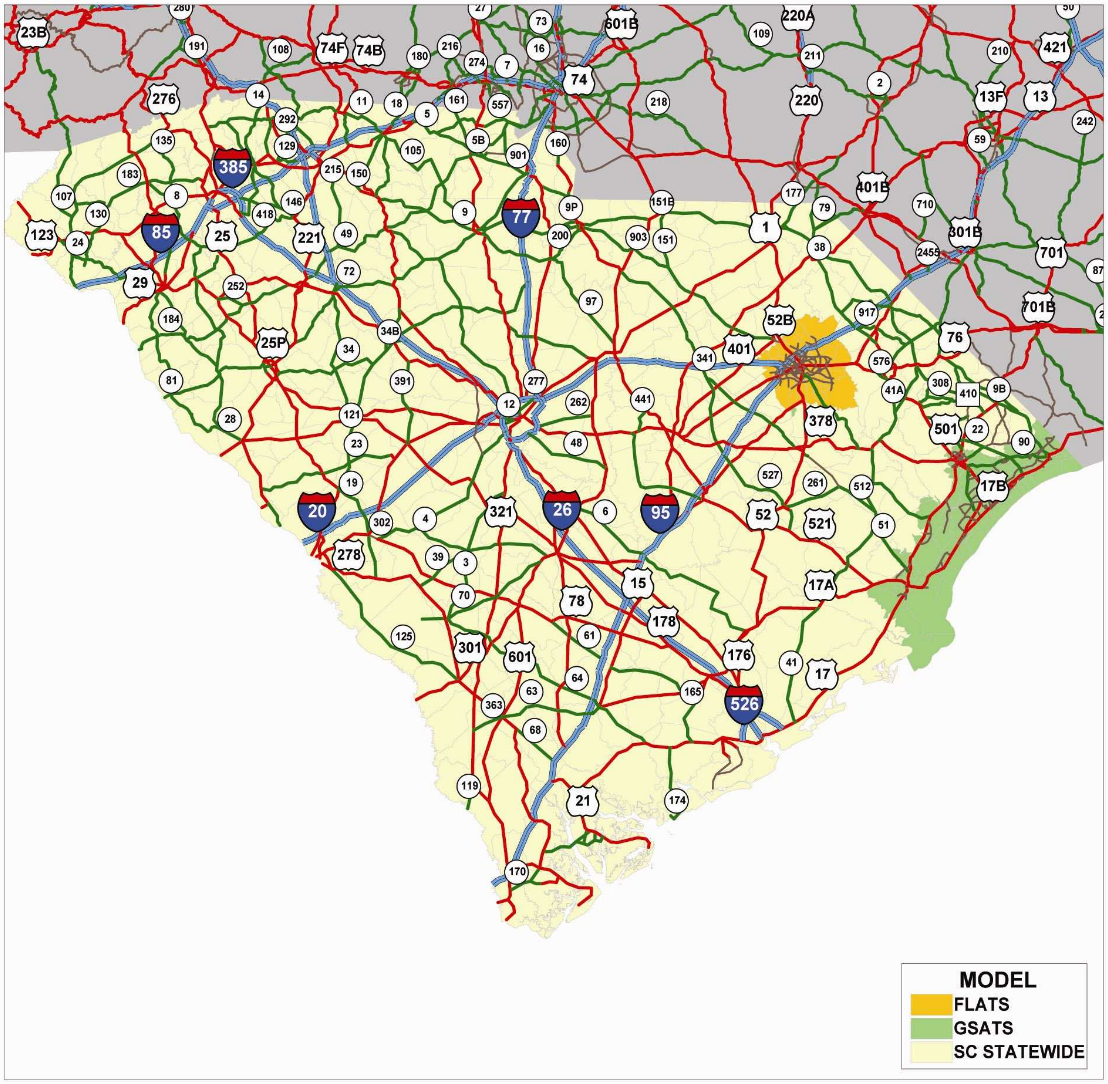


Figure1: FLATS and GSATS Coverage Areas

Other data that was used in model development included traffic counts obtained from SCDOT and the National Highway System data bases maintained by the U.S. Department of Transportation (to define the highway system for North Carolina which was included in this study's road network).

Finally, a series of roadside travel surveys was undertaken to determine the travel characteristics (trip origins and destinations, travel purpose, resident/non-resident percentages) in the I-73 corridor. The four locations included U.S. Route 378 west of Conway, U.S. Route 501 west of Aynor, S.C. Route 9 west of Green Sea and US 701 between Loris, South Carolina and Tabor City, North Carolina.

The table below shows the number of surveys obtained at each location on each survey day. Only outbound vehicles were surveyed. The surveys at U.S. Route 378, S.C. Route 9 and US 701 were conducted using 'face-to-face' survey techniques (interviewers asked questions and recorded answers from drivers of stopped vehicles). The high traffic volumes precluded use of 'face-to-face' survey techniques on U.S. Route 501. At this location a mail-back survey technique was employed (vehicle drivers were given a pre-addressed, pre-paid survey form to complete and mail). Samples of survey forms are contained in Appendix A of this report.

Classified by vehicle type, 24 hour traffic counts were conducted at each location for a one week period overlapping with the survey days. These data were used in later survey data factoring to observed traffic count control totals and in model validation.

Table 1: Completed Travel Surveys

Summer (August 2004) Completed Surveys					
Day	**US 378**	**SC 9**	**US 701**	**US 501**	**Total**
Thursday	536	944	888	401	2,769
Saturday	1,094	1,438	974	516	4,022
Sunday	0	1,330	901	0	2,231
Total	1,630	3,712	2,763	917	9,022
Winter (February/March 2005) Completed Surveys					
Day	**US 378**	**SC 9**	**US 701**	**US 501**	**Total**
Thursday	728	759	1,038	396	2,921
Saturday	539	773	895	478	2,685
Sunday	902	847	978	412	3,139
Total	2,169	2,379	2,911	1,286	8,745
Completed Surveys - Totals					
Day	**US 378**	**SC 9**	**US 701**	**US 501**	**Total**
Thursday	1,264	1,703	1,926	797	5,690
Saturday	1,633	2,211	1,869	994	6,707
Sunday	902	2,177	1,879	412	5,370
Total	3,799	6,091	5,674	2,203	17,767

A total of 17,767 surveys were obtained. Summer Sunday surveys had to be cancelled at two locations, U.S. Route 378 and U.S. Route 501, due to tropical storm Gaston. It was not possible to reschedule these surveys, as this was the last weekend of the summer tourist season.

Survey Data Expansion

Survey data to traffic count expansion factors were calculated to provide factors representing several periods including:

- Average summer day (peak season)
- Average non-summer day
- Average annual day

Different expansion factors were calculated for three vehicle types: cars, buses and trucks. A series of steps was used to calculate the factors, including:

1- Hourly factor = hourly count at the survey location / surveys completed during the survey
2- Survey day factor = total daily (24 hour) count at the survey location / sum of surveys * hourly factors
3- Average weekday factor = average weekday (Monday-Friday) traffic count over survey period / total daily (24 hour) traffic count for survey day (Thursday) * surveys * survey day factor
4- Average summer day factor = Average summer day (June-July-August) SCDOT traffic count /average summer survey day volume (5 weekdays + Saturday + Sunday volumes)*surveys*survey day factor (summer)
5- Average non-summer day factor = Average non-summer day (remaining 9 months) SCDOT traffic count / average non-summer survey day volume (5 weekdays + Saturday + Sunday volumes)*surveys*survey day factor (non-summer)
6- Average annual day factor = 0.25*summer day factor + 0.75*non-summer day factor

All the above factors were inserted into the survey data records so that trip tables could be built representing each of the three periods.

Model Assembly

The individual model network and trip table data sets were translated from TRANPLAN to TransCad. Then model networks and trip tables were merged. Finally, trips from the statewide model passing through the survey stations were replaced with the survey data trip tables.

Network Merging – No North Carolina Statewide Traffic Model was found to exist. Therefore, the South Carolina statewide model network was first supplemented with network links for the entire state of North Carolina. Connecting roads along the state boundary were attached so that a two state continuous network was obtained. North Carolina Census Civil Divisions (CCDs) were used to define analysis zones within the state (about 1,000 zones). External zones were defined for major roads crossing the northern boundary of North Carolina.

Road networks for the two urban area models were overlaid on the statewide network and statewide network links within the urban areas removed. Connections were then established for roads crossing the urban area model network boundaries. The urban area zone schemes replaced the statewide model zone schemes within the urban model coverage areas.

Network editing was then undertaken to align the ‘stick’ network link representation with actual curvature along roadways. Extensive checking of network connections, coded speeds and capacities was then performed to ensure the network provided a reasonably accurate representation of the region’s roadway system.

Trip Table Merging – The three existing base year trip tables were first brought to a common year, estimated Year 2005. This was performed by interpolating between each model’s base and design years. External trips from the urban models were removed to avoid double representing them since they were also present in the statewide models.

An initial set of traffic assignments was developed and reviewed to detect any unresolved network and trip table recoding errors.

Incorporation of Survey Data – Reported survey data origins and destinations were coded to the zone scheme used in the consolidated study area. Trips ending within South Carolina were coded to the appropriate statewide or urban area zone code. Trips ending in North Carolina were coded to the appropriate county. Trips ending outside North or South Carolina were coded to the most likely external station for entering the region (based on the most direct routing from the state to South Carolina).

Special analysis techniques were used to identify trips in the initial statewide model trip table crossing the survey station links. These trips were extracted from the statewide trip tables and replaced with the expanded trips from the surveys.

The model was run again and the results examined to determine how well the Year 2005 traffic estimates compared with the available 2004 traffic counts.

Model Validation/Calibration

The urban and statewide models had all recently been validated against base year conditions by others. Therefore, the calibration/validation work for this project was focused on a comparison of traffic across the survey station locations (which were selected to intercept most trips that would be potential users of I-73).

Initial comparisons of traffic assignments and available 2004 counts found some understatement of observed traffic volumes. Survey data reports of origins and destinations were reviewed and it was found that in some cases respondents had reported the same origin and destination (in effect reporting a round trip rather than a one way trip). In these cases origins or destinations were recoded based on the location of the survey station with respect to the reported origin/destination location, the known direction of travel (always outbound from the Grand Strand area), reported residence and the relative size (in terms of population) of potential origins/destinations on the other side of the survey station from the reported location.

The revised survey trip tables were reassigned and the resulting assignments again compared to traffic counts. While origin-destination recoding improved the comparison, it did not completely resolve the underestimation problem. Traffic assignments were further examined to determine the routings estimated by the network model to travel between reported origins and destinations. In some cases it was found that trips were making use of the secondary road system (particularly in North Carolina for longer distance trips) to effectively bypass the survey station locations or to enter the corridor on different stations than the ones they were surveyed on. It was not believed that long distance travelers would make extensive use of secondary roads for large portion of their trip, particularly when interstate highways were available at similar (but, according to the coded network, slightly longer) travel times. Some adjustments were then made to secondary road coded speeds (generally, changing 55 or 60 MPH speeds to 45 or 50) to encourage use of the higher functional class facilities.

A third round of traffic assignments was then undertaken and generally acceptable comparisons with traffic counts were achieved. Table 2 below shows the final comparisons.

Table 2: Observed 2004 Versus Estimated Model 2005 Survey Traffic (AADT)

Location	Observed	Estimated
US 378	4,600	5,500
SC 9	4,000	3,900
US 701	7,600	8,600
US 501	23,900	24,300

Source: Observed: 2004 Traffic Counts (adjusted to AADT)
Estimated: Calibrated TransCad Model

Alternative Evaluation

Alternatives for the proposed alignments for I-73 were modeled using the roadway travel demand model developed as described in the Model Development and Calibration section. This network, combined with 2005 and 2030 trip tables, formed the basis of the "No-build" alternative. In addition to the No-build alternative, separate networks were created to model eight specific alignments for I-73. The eight specific alternative alignments for I-73 focused on the potential alignment of I-73 between I-95 and S.C. Route 22 north of Conway.

In all alignment alternatives, I-73 was coded as a four-lane rural interstate route with a free-flow speed of 70 miles per hour and combined (two-way) capacity of 58,600 vehicles per day.

I-73 Alignment Alternatives

Eight alignment alternatives were developed and added to the No-build network. All alternatives began at I-95 and terminated at S.C. Route 22. Certain portions of an individual alignment may be a part of other alignment alternatives. For example, the northern portion of the Alternative 1 alignment (between I-95 and U.S. Route 76) was identical to the same sections in Alternatives 3 and 5. The middle portion of Alternative 1 between U.S. Route 76 and U.S. Route 501 was similar to the same section in Alternatives 2, 5 and 8, and the southern portion of Alternative 1 between U.S. Route 501 and SC22 was similar to the southern section of Alternatives 4 and 8.

Alternatives 1 through 8 are shown in Figures 2 through 9.

2005 Average Daily Traffic Assignments

Traffic assignments were developed for the Year 2005 No-build Alternative and the eight I-73 Alternatives using the 2005 trip tables. The 2005 Traffic Assignments for the No-build Condition and Alternatives 1 through 8 are shown in Figures 10 through 18.

The assignment results were reviewed to assess the impact of each of the I-73 alternatives when compared to the No-build Alternative. Selected traffic assignment link volumes are summarized in the following table.

Route	Location	No-build	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt.6	Alt. 7	Alt. 8
I-95	North of SC 34	46,300	46,400	46,600	46,400	47,200	46,400	46,300	46,300	46,300
I-95	South of SC 34	44,700	47,000	48,200	47,700	47,400	47,700	48,300	46,500	48,000
I-73	South of I-95	-	5,400	6,000	7,200	4,600	6,600	4,600	1,900	5,000
I-73	North of US 76	-	10,100	10,200	11,100	5,900	11,600	9,400	4,600	10,600
I-73	South of US 76	-	8,900	10,200	14,000	11,600	9,400	17,600	14,400	10,400
I-73	North of SC 22	-	23,700	11,600	12,600	24,700	11,300	16,200	14,600	24,500
SC 38	South of I-95	12,600	9,700	9,500	9,800	11,500	9,900	10,300	13,500	10,300
SC 34	South of I-95	5,900	3,800	2,000	3,000	4,100	3,000	2,300	4,100	2,000
SC 9	North of SC 41	1,900	1,700	900	900	1,400	1,300	800	1,200	1,000
SC 9	South of US 76	3,700	2,800	1,900	1,600	2,200	2,200	1,500	1,900	2,100
US 501	South of SC 38	7,100	300	2,500	1,200	1,900	100	2,500	3,800	2,200
US 501	North of SC 41	12,100	14,100	14,400	10,600	12,000	14,400	7,200	9,700	14,300
US 501	South of SC 41	13,800	15,100	15,300	11,400	13,000	15,200	7,900	10,600	15,400
US 501	North of SC 22	23,900	10,200	23,600	21,500	10,200	23,500	18,100	20,400	10,200
US 378	East of SC 41	11,100	5,200	5,100	5,300	5,200	5,000	5,200	5,400	5,500

The comparison of the 2005 traffic assignments indicate that the I-73 alternatives that start further south on I-95 and cross U.S. Route 76 closer to Marion (Alternatives 4 and 7) would carry the least amount of traffic between I-95 and U.S. Route 76. Also, the I-73 Alternatives that end closer to S.C. Route 22/U.S. Route 501 (Alternatives 1, 4, and 8) would carry substantially more traffic than those that end nearer to US 701, and would also result in greater reduction in traffic volumes on U.S. Route 501 north of S.C. Route 22.

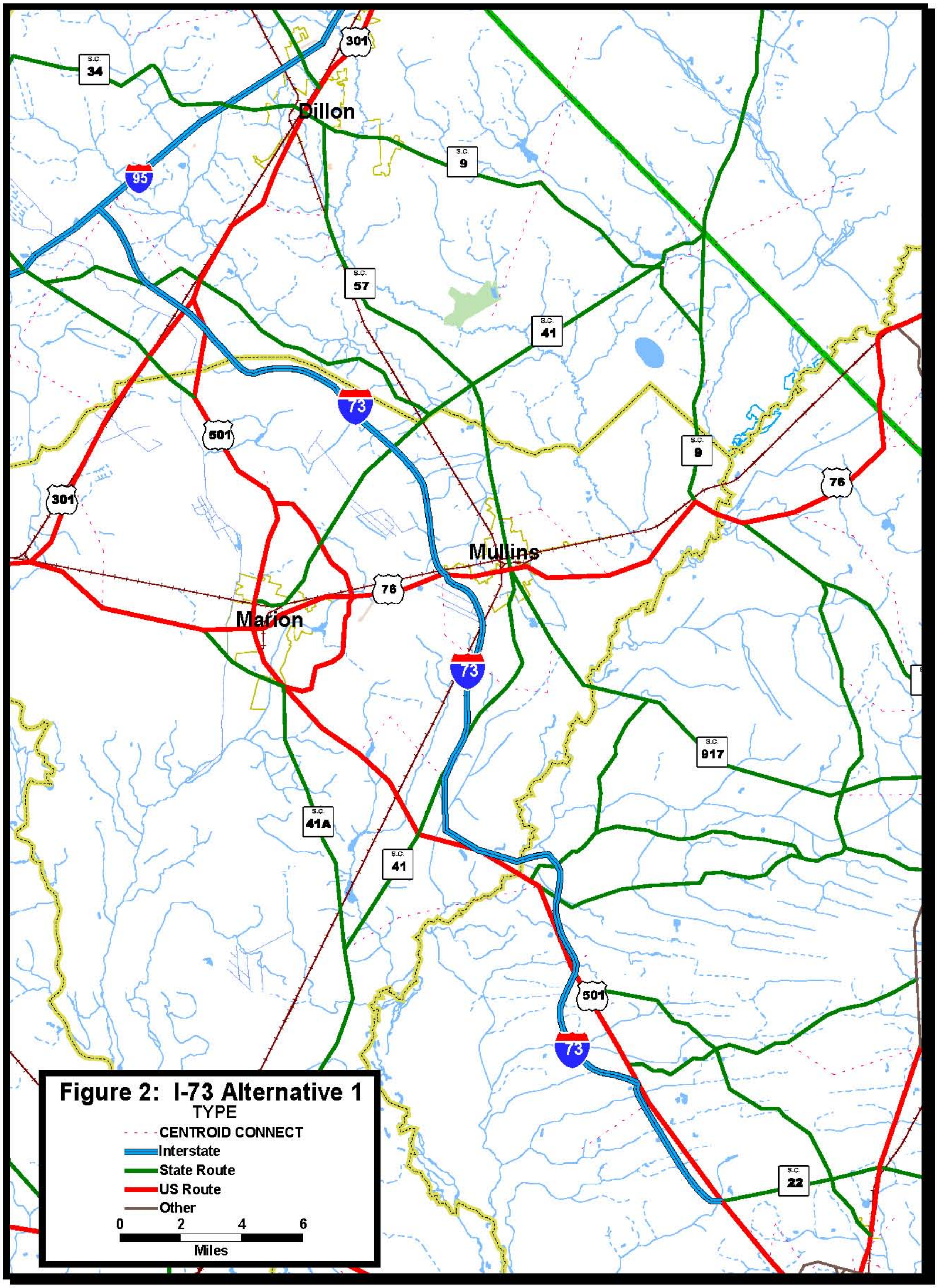


Figure 2: I-73 Alternative 1

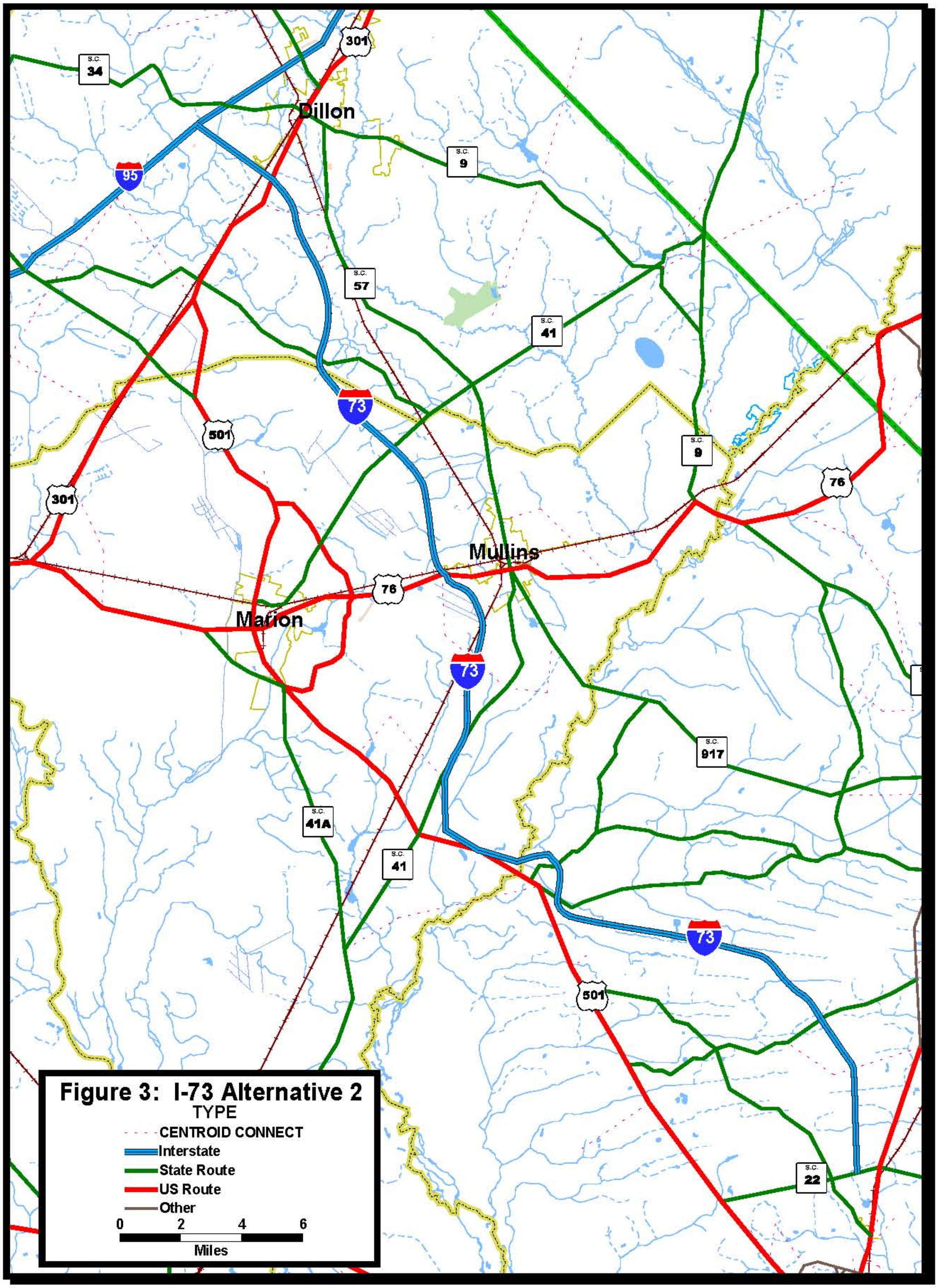


Figure 3: I-73 Alternative 2

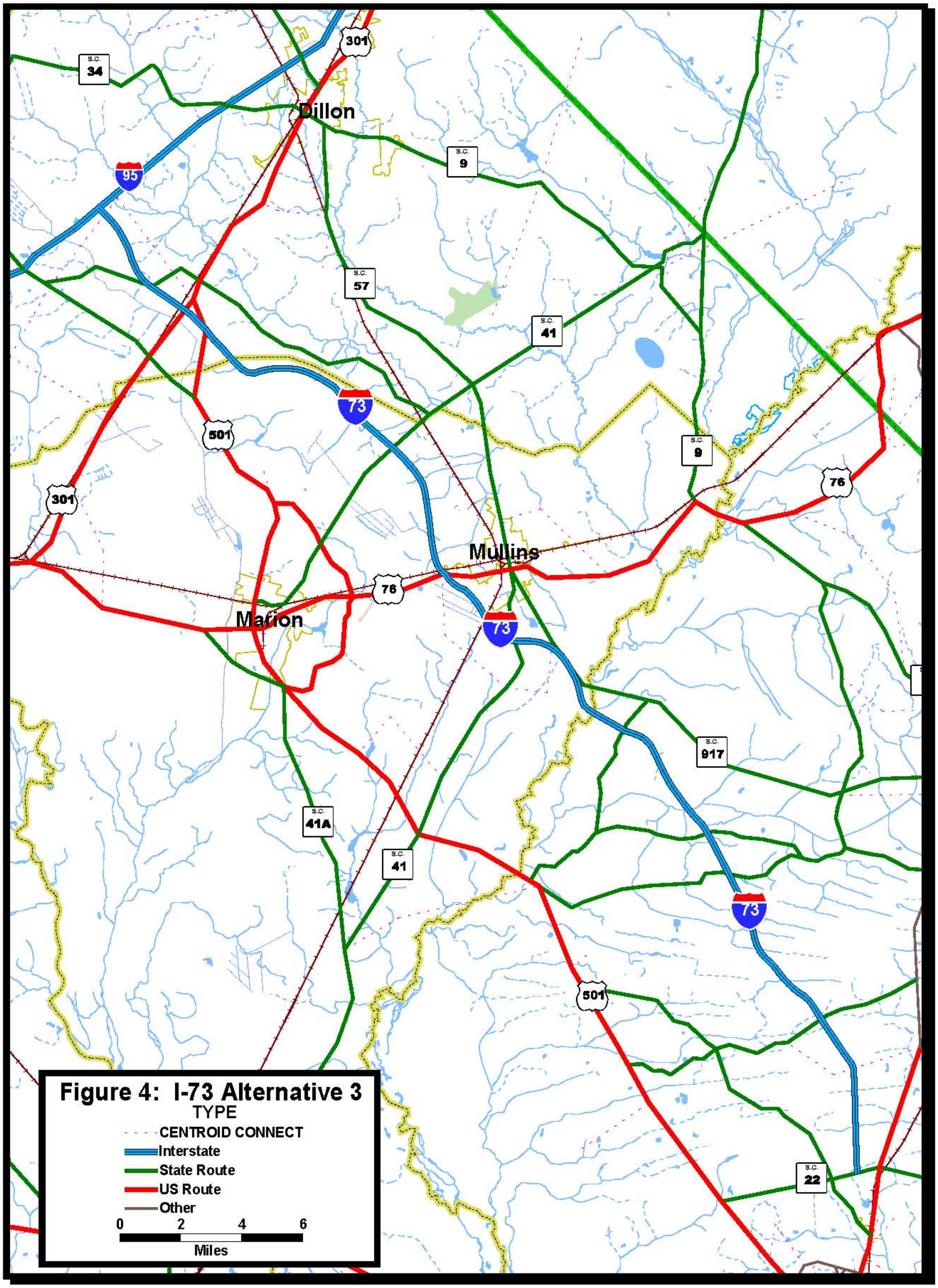


Figure 4: I-73 Alternative 3

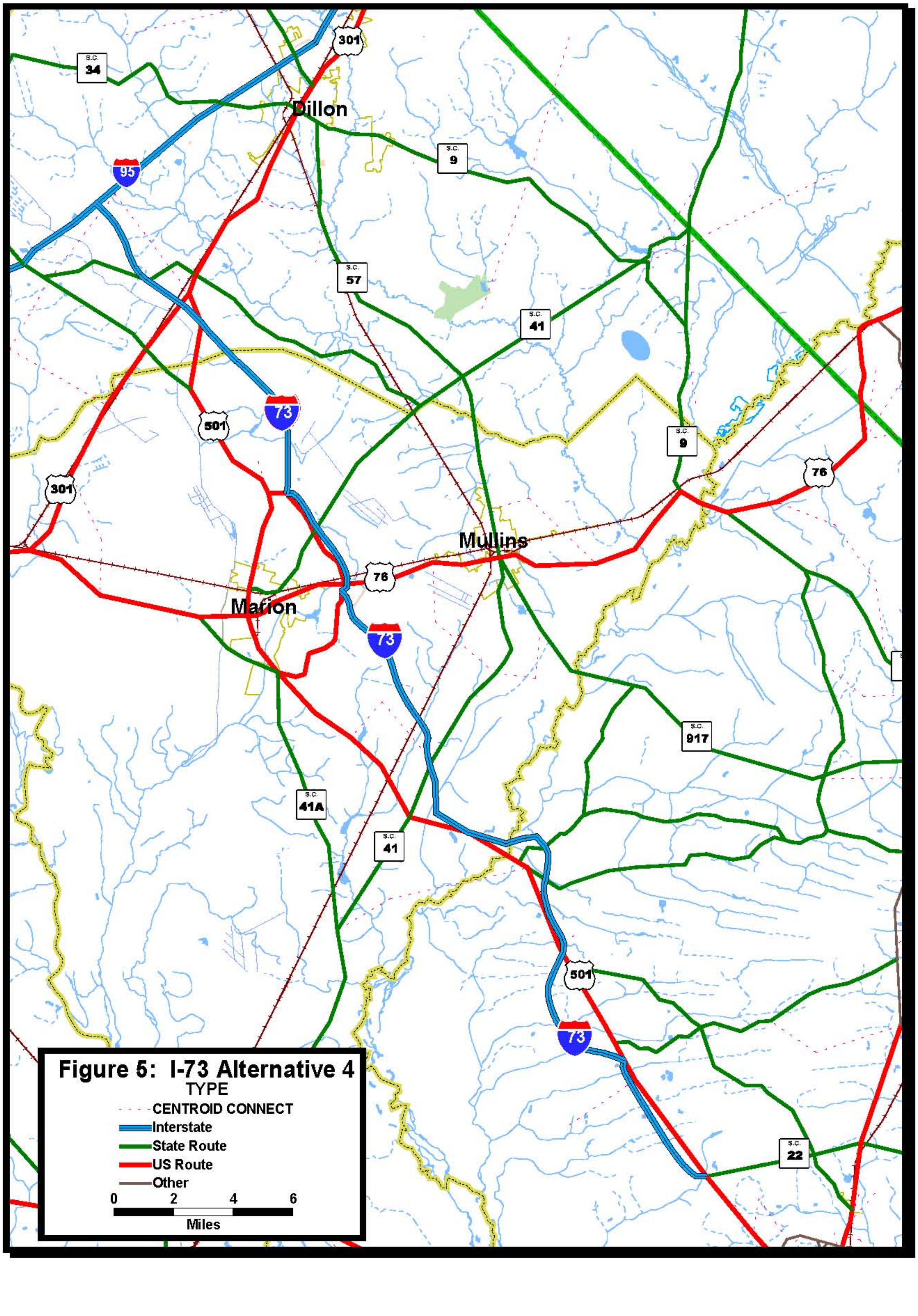


Figure 5: I-73 Alternative 4

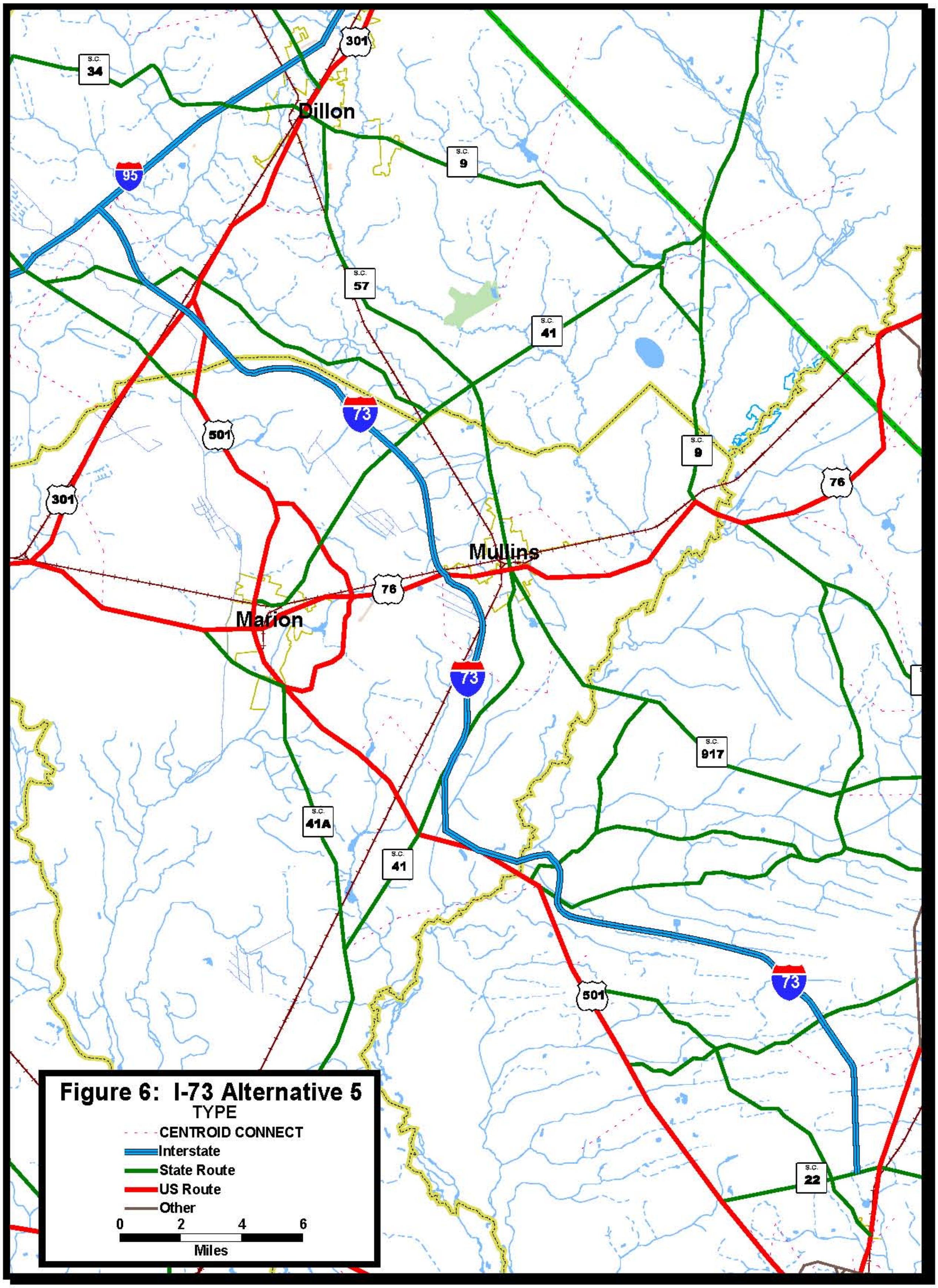
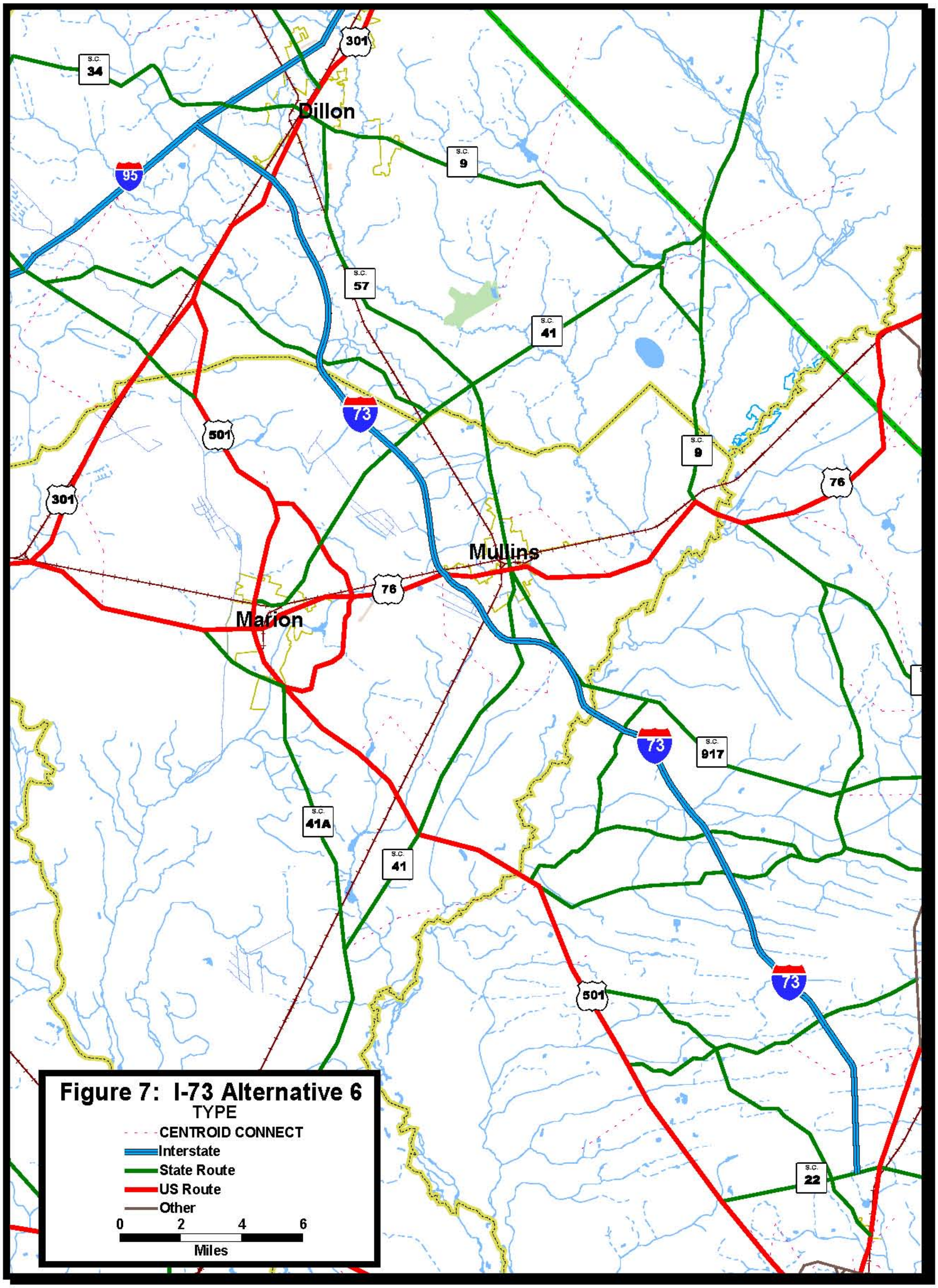


Figure 6: I-73 Alternative 5


Dillon
Mullins
Marion
S.C. 34
301
95
S.C. 9
S.C. 57
S.C. 41
73
501
S.C. 9
76
301
76
S.C. 917
S.C. 41A
S.C. 41
501
S.C. 22
Figure 7: I-73 Alternative 6
TYPE
CENTROID CONNECT
Interstate
State Route
US Route
Other
0
2
4
6
Miles

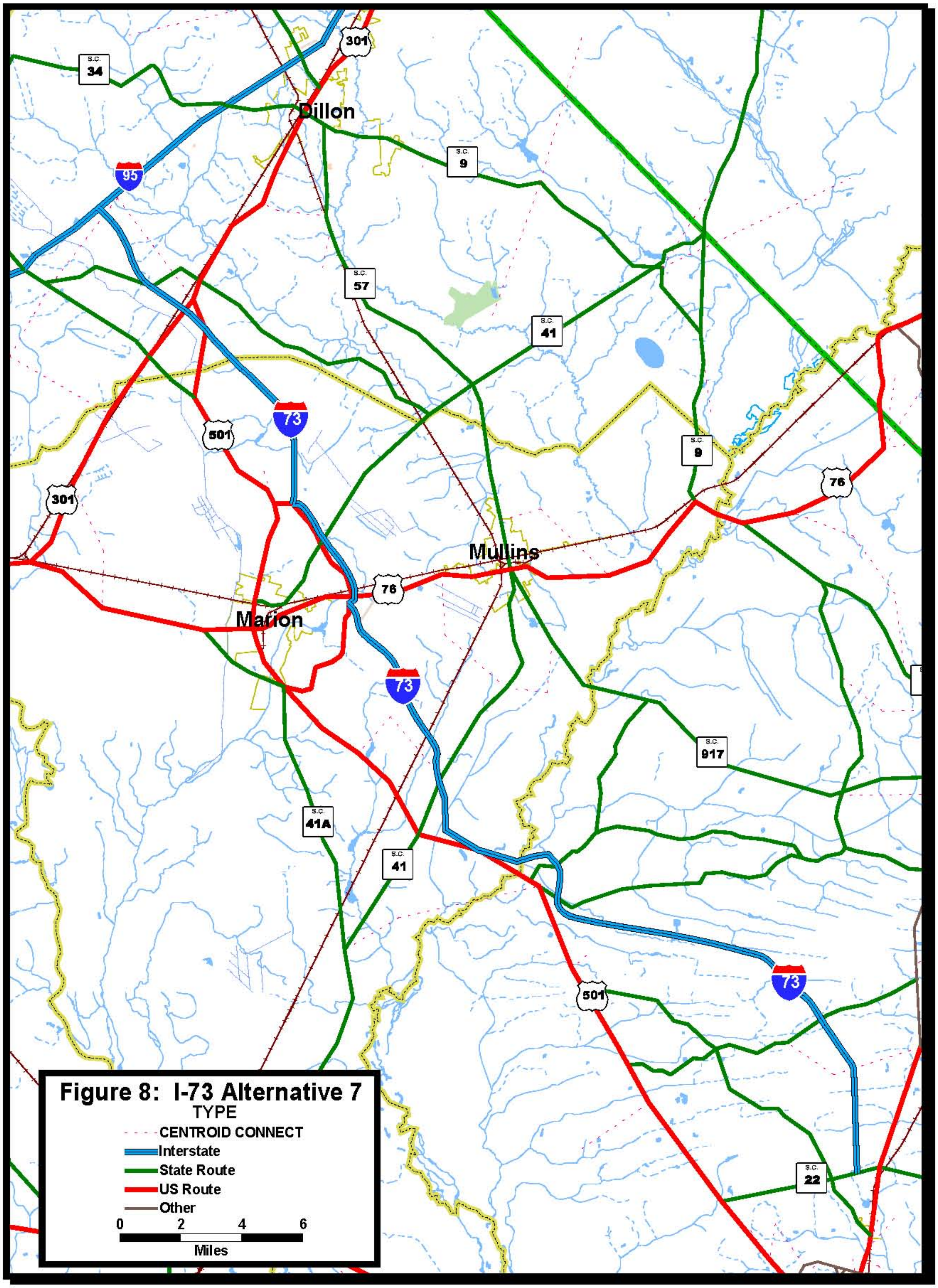


Figure 8: I-73 Alternative 7

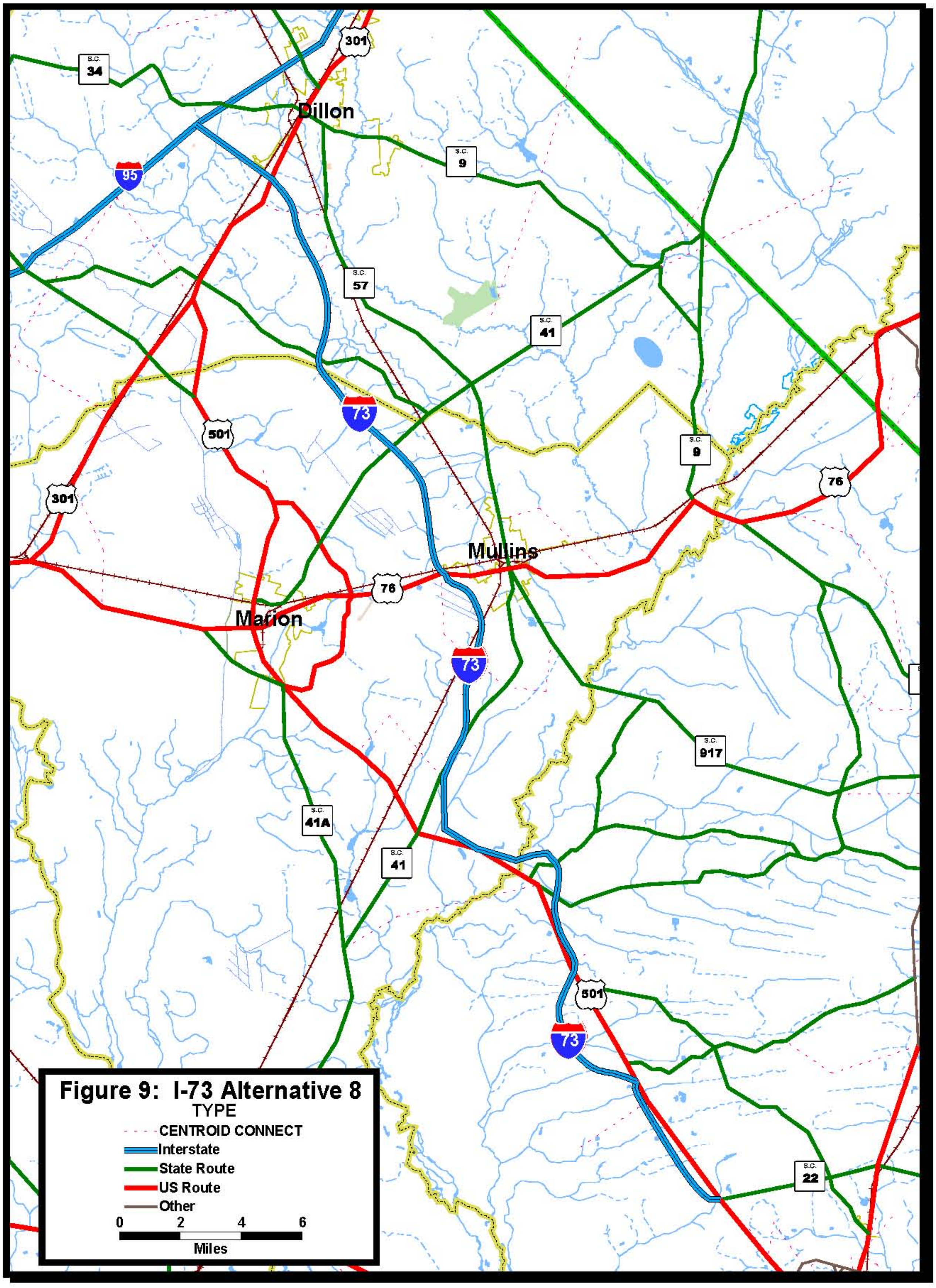


Figure 9: I-73 Alternative 8

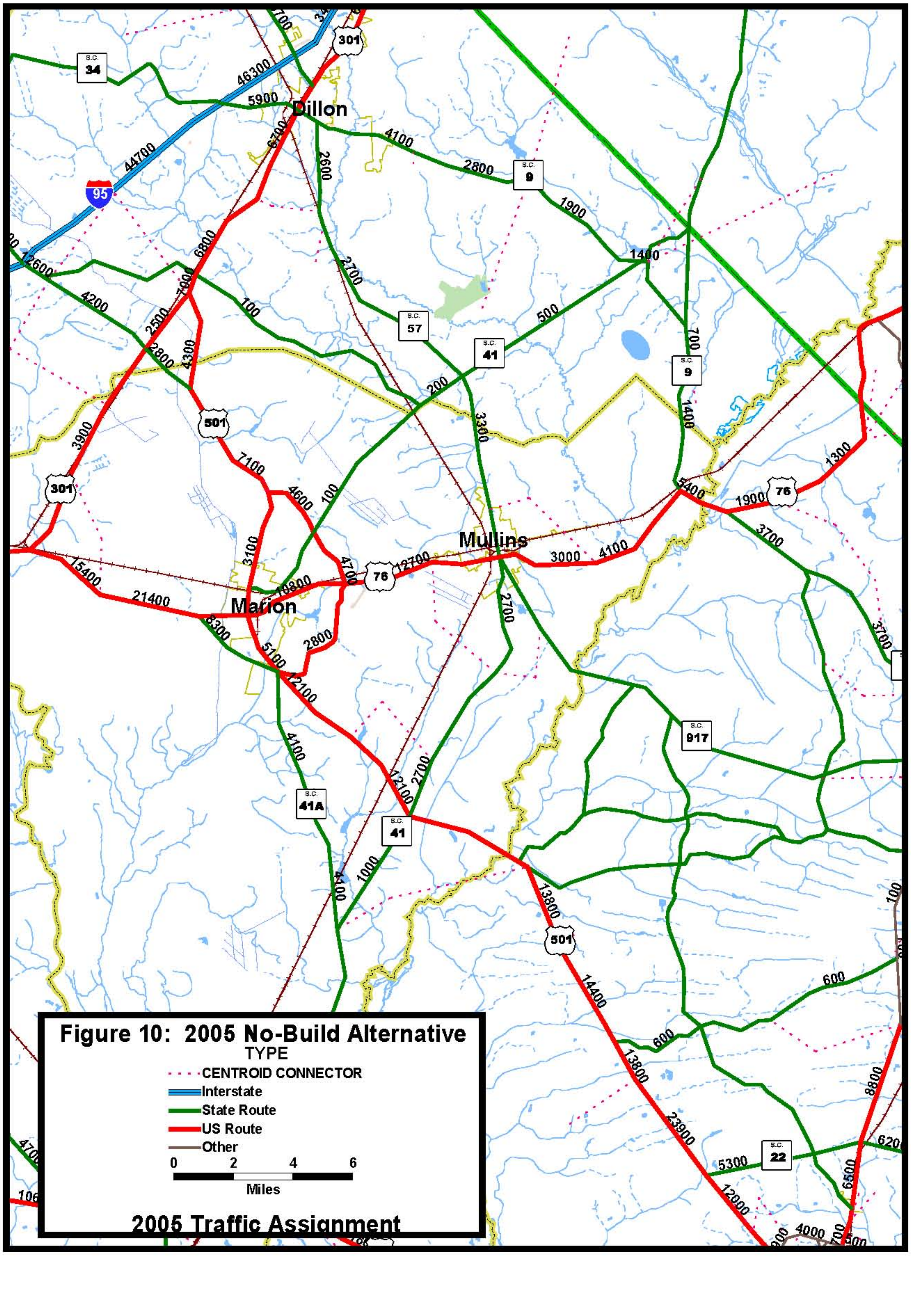


Figure 10: 2005 No-Build Alternative

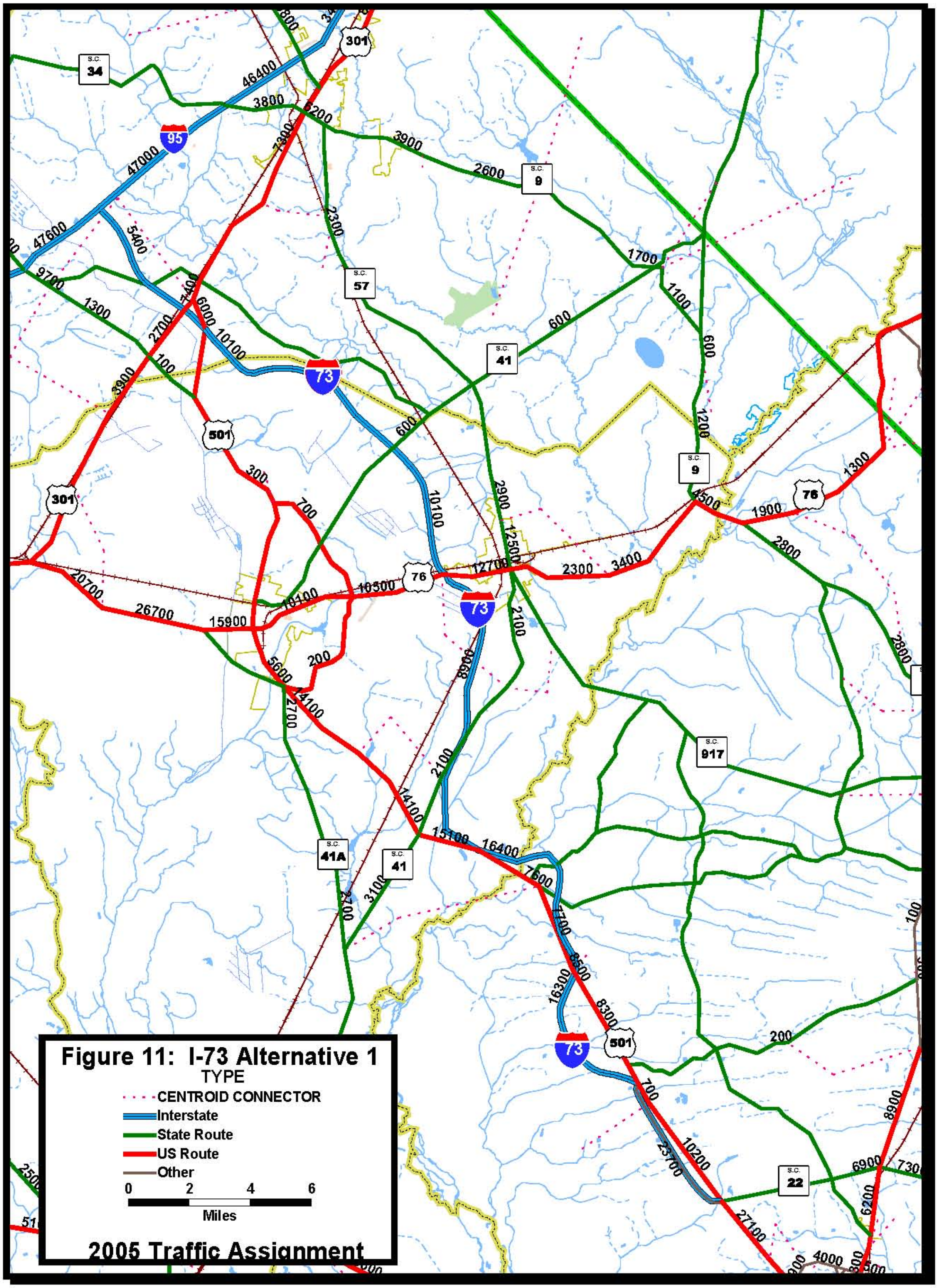


Figure 11: I-73 Alternative 1
TYPE
CENTROID CONNECTOR
Interstate
State Route
US Route
Other
0 2 4 6
Miles
2005 Traffic Assignment

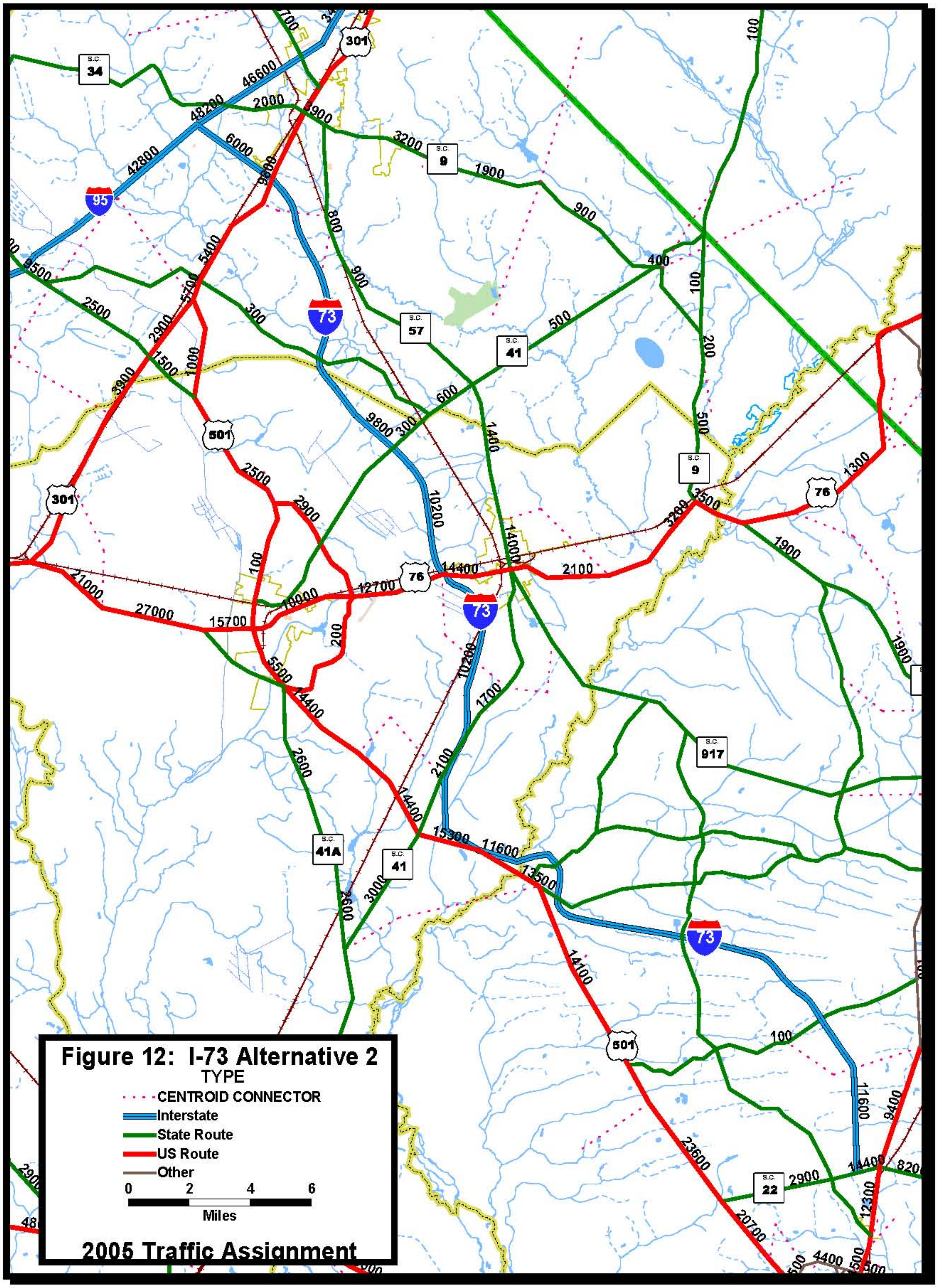


Figure 12: I-73 Alternative 2
TYPE
CENTROID CONNECTOR
Interstate
State Route
US Route
Other
0
2
4
6
Miles
2005 Traffic Assignment

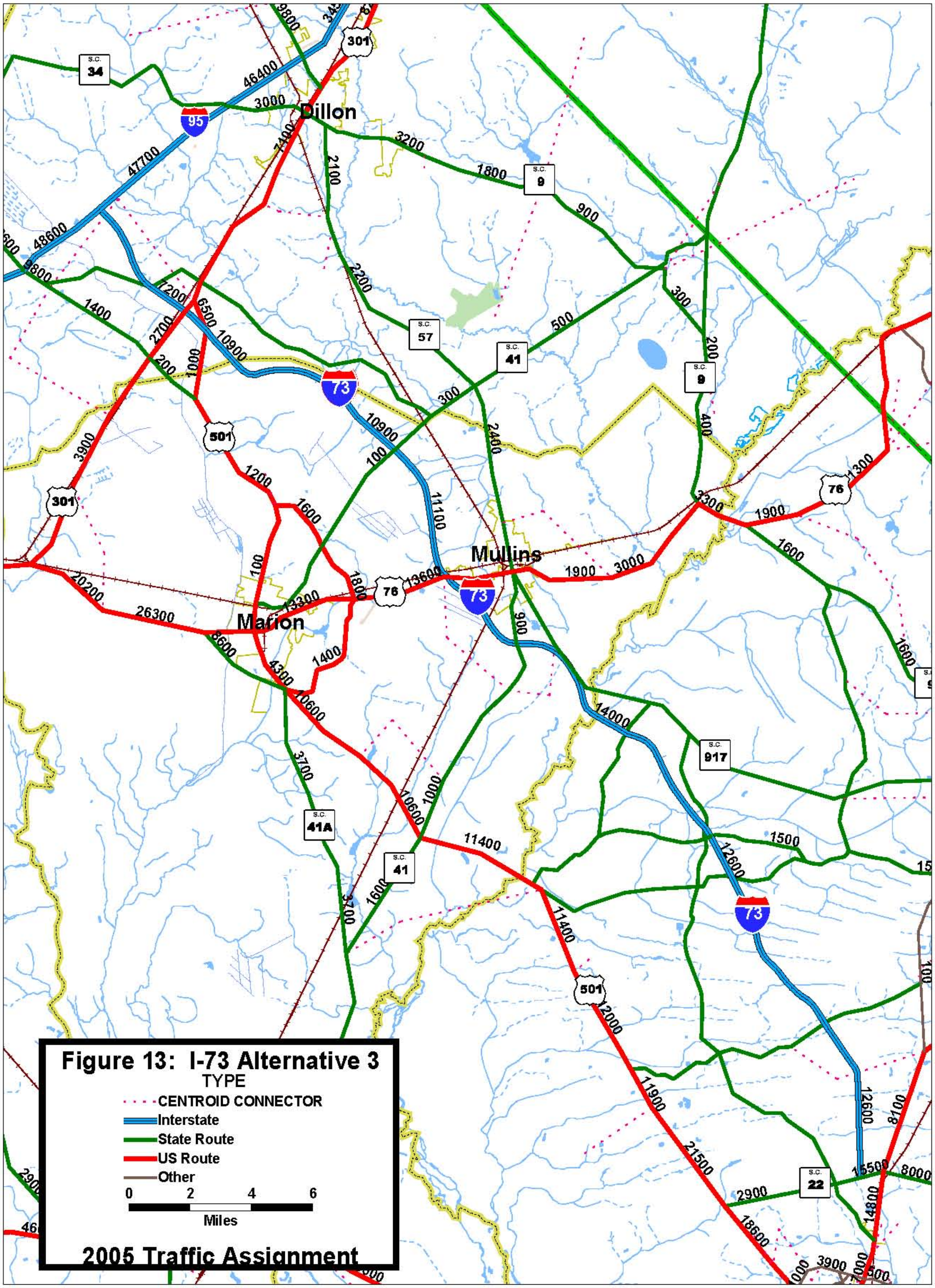


Figure 13: I-73 Alternative 3

2005 Traffic Assignment

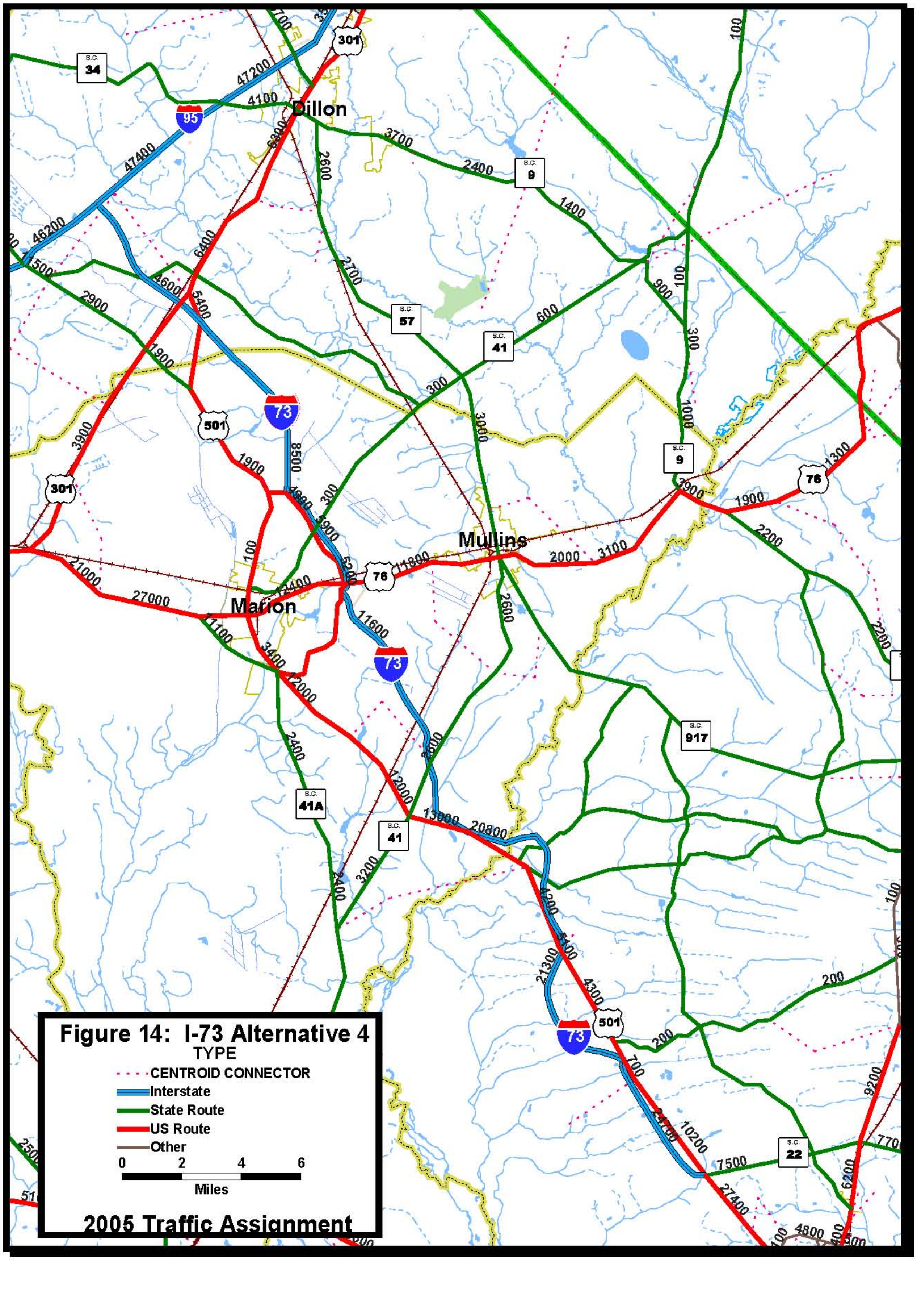


Figure 14: I-73 Alternative 4

2005 Traffic Assignment

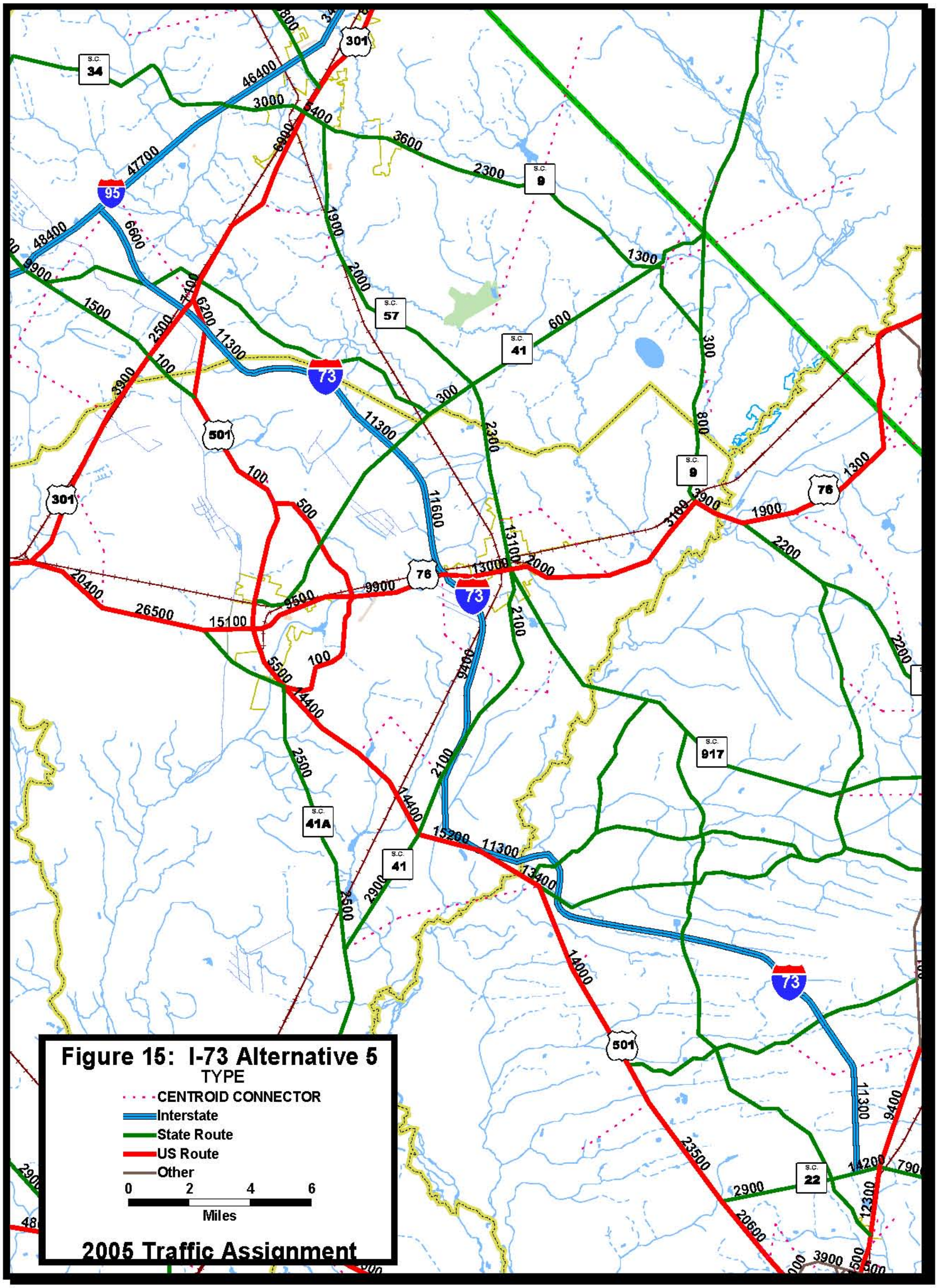


Figure 15: I-73 Alternative 5
TYPE
CENTROID CONNECTOR
Interstate
State Route
US Route
Other
0
2
4
6
Miles
2005 Traffic Assignment

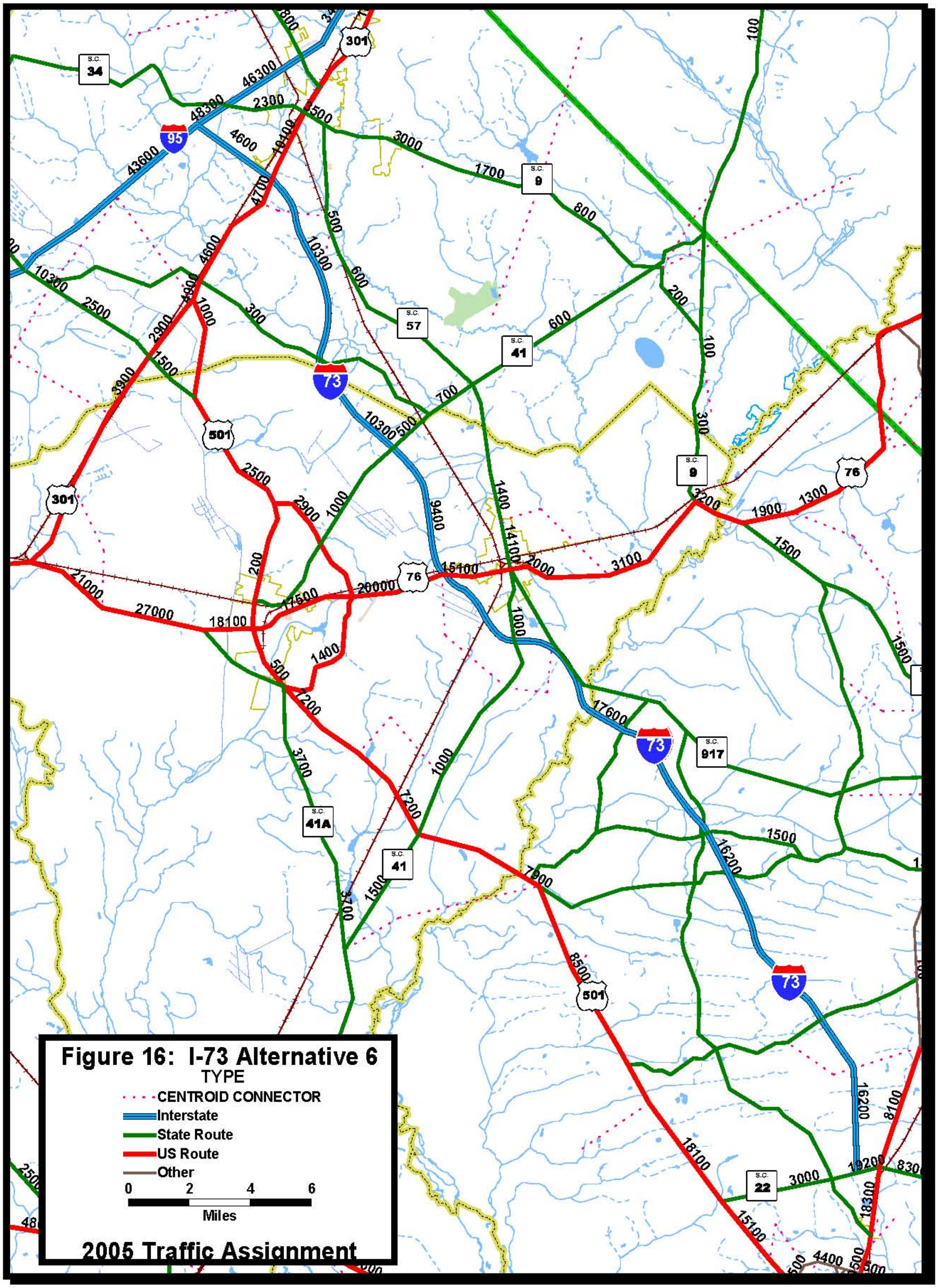


Figure 16: I-73 Alternative 6

2005 Traffic Assignment

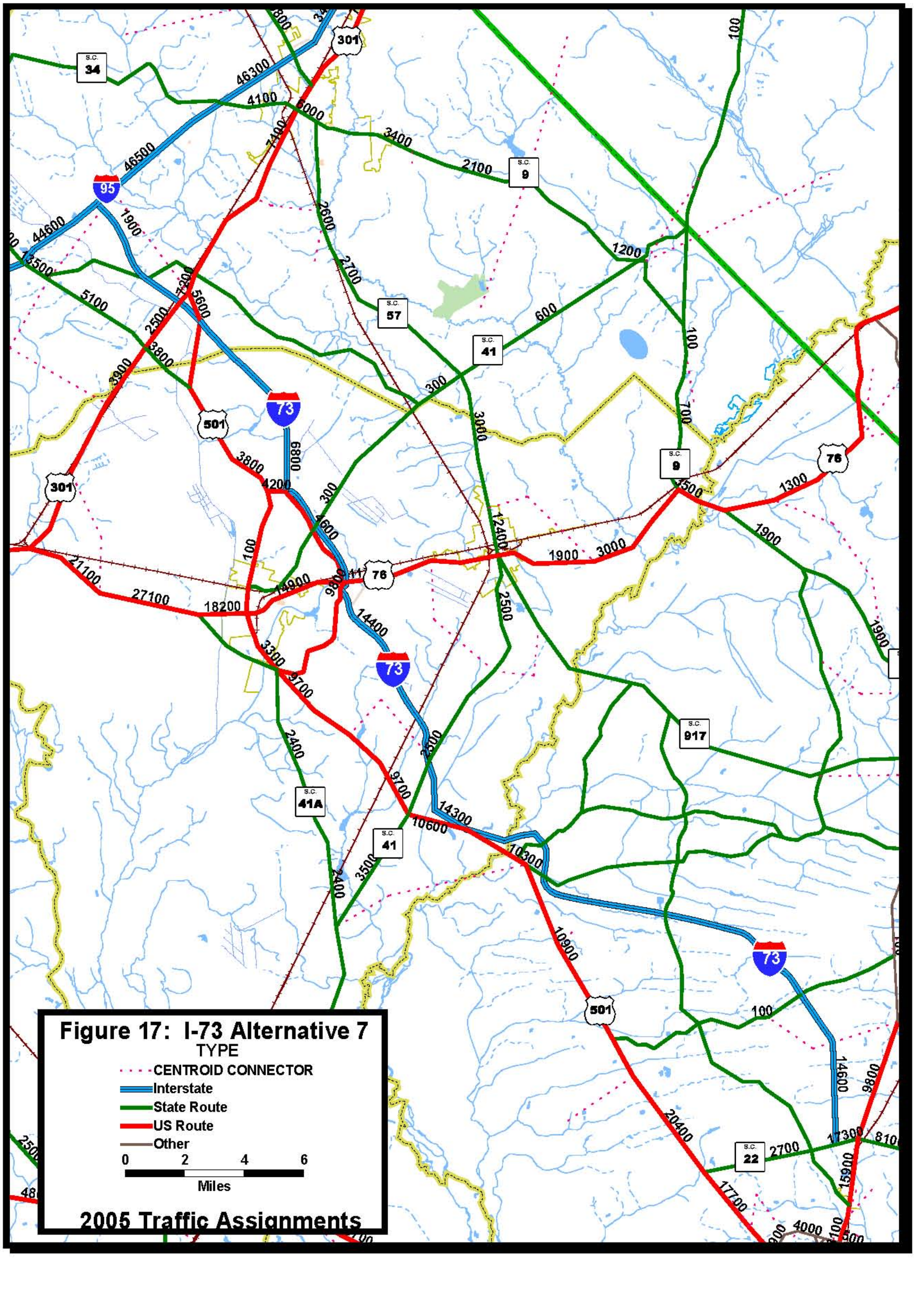


Figure 17: I-73 Alternative 7

2005 Traffic Assignments

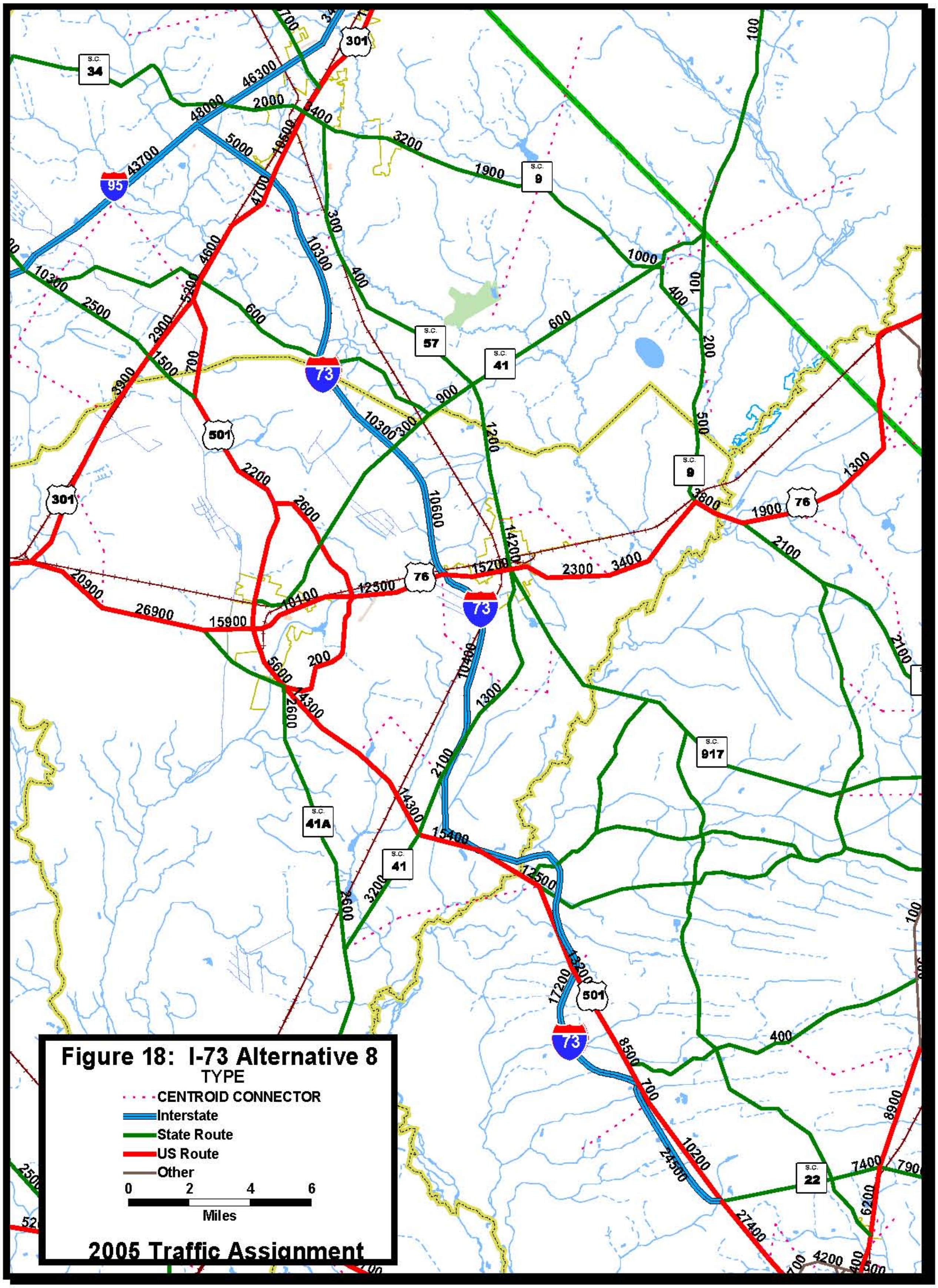


Figure 18: I-73 Alternative 8

2005 Traffic Assignment