APPENDIX C OUTLINE:

Overview
Study Scope and Approach
BLOS Regression Equation
BLOS Grades
BLOS Table Summary
BLOS Maps

APPENDIX C: Bicycle Level of Service Analysis (BLOS)

OVERVIEW

One of this study's tasks was the development of a special indicator to monitor the quality of bicycle travel conditions along arterial and collector streets. The study team selected the Bicycle Level of Service (BLOS)1 model as the quality of service indicator. The BLOS model (version 2.0) was applied for analyzing Spartanburg's arterial and collector roadways only. The BLOS model was developed through a national research project for arterial and collector streets. The BLOS model has been applied in many jurisdictions to measure and monitor bicycle travel conditions.

The Bicycle Level of Service Model is based on the proven research documented in Transportation Research Record 1578 published by the Transportation Research Board of the National Academy of Sciences. It was developed with a background of over 150,000 miles of evaluated urban, suburban, and rural roads and streets across North America. Many urban planning agencies and state highway departments are using this established method of evaluating their roadway networks.

The model has also been applied in Richmond and the Northern Virginia region (VDOT), Anchorage AK, Baltimore MD, Birmingham AL, Buffalo NY, Gainesville FL, Greensboro NC, Houston TX, Lexington KY, Philadelphia PA, Sacramento CA, Springfield MA, Tampa FL, Washington, DC, Winston-Salem NC, and by the Delaware Department of Transportation (DelDOT), Florida Department of Transportation (FDOT), New York State Department of Transportation (NYDOT), Maryland Department of Transportation (MDOT) and many others. Widespread application of the original form of the BLOS Model has provided several refinements. Application of the BLOS Model in the metropolitan area of Philadelphia resulted in the final definition of the three effective width cases for evaluating roadways with on-street parking.

Application of the BLOS Model in the rural areas surrounding the greater Buffalo region resulted in refinements to the "low traffic volume roadway width adjustment". A 1997 statistical enhancement to the Model (during statewide application in Delaware) resulted in better quantification of the effects of high speed truck traffic [see the SPt(1+10.38HV)2 term]. As a result, Version 2.0 has the highest correlation coefficient (R2 = 0.77) of any form of the Bicycle LOS Model.

---

1 Landis, Bruce W. et.al. "Real-Time Human Perceptions: Toward a Bicycle Level of Service" Transportation Research Record 1578, Transportation Research Board, Washington, DC 1997

STUDY SCOPE AND APPROACH

The study took on the task of developing Bicycle Level of Service (BLOS) for the first time in the Spartanburg area. The consultant team was responsible for compiling and verifying input data for the entire study area's network of arterial and collector streets, developing a GIS-based database to store input data, computing BLOS scores, and preparing BLOS maps to document problem areas and to identify opportunities for improvements.

The BLOS analysis utilized GIS as the main database platform and focused on utilizing existing data resources and avoided new data collection whenever possible. The BLOS results helped determine locations needing bicycle improvements and assisted in the preparation of the bicycle suitability map.

The BLOS model (version 2.0) was applied for analyzing Spartanburg's arterial and collector roadways only. The BLOS model is not applicable for freeways.

The following data sets, among others, were obtained and utilized in the BLOS model (Version 2.0):

- Street center lines with attribute data
- Historical Annual Average Daily Traffic (AADT) Counts
- Pavement Condition Data for State-maintained roadways
- Arterial and collector speed limits

In addition, the Consultant team used aerial maps and Google Street views to verify geometric and other attribute data needed for the BLOS model. The results of the BLOS analysis were mapped to document current bicycle travel conditions and to identify causes of poor conditions.

BLOS REGRESSION EQUATION

Bicycle Level of Service (BLOS) was developed as a linear regression model by transportation researchers. The BLOS regression equation (version 2.0) provides a discomfort and inconvenience score for bicycle travel by taking into account four prevailing roadway and traffic conditions:

1. Peak traffic flow in the outside lane
2. Speed of traffic and percent of heavy traffic
3. Pavement surface condition
4. Pavement width available for bicycling

The first three variables are impact scores and reflect perceived challenges to bicycling. The fourth variable is a benefit score and reflects perceived opportunities to bicycling.

The BLOS regression equation is presented below (colored text in the equation corresponds to the descriptions that follow):

$$\begin{aligned} BLOS = {} & 0.507 \times \ln(Vol15/Ln) \\ & + 0.199 \times SPt\,(1+10.38HV)2 \\ & + 7.066 \times (1/PR5)2 - 0.005 \times (We)2 \\ & + 0.76 \end{aligned}$$

Where,

Vol15 Directional traffic volume during peak 15-minute time period

= (ADT x D x Kd) / (4 x PHF)

Where, ADT = Average daily traffic
D = Directional factor
Kd = Peak to Daily factor
PHF = Peak hour factor (1.0 assumed)

Ln Number of directional through lanes

SPt Effective Speed Limit

= 1.1199 x Ln(SPp – 20) + 0.8103

Where, SPp = posted speed limit

HV Percentage of heavy vehicles

PR5 Pavement condition rating based on FHWA's 5-point scale

We Average effective width of outside through lane

= Wv – (10 ft x % OSPA), for Wl = 0
= Wv + Wl (1 - 2 x % OSPA), for Wl > 0 and Wps = 0
= Wv + Wl – 2 (10 x % OSPA), for Wl > 0 and Wps > 0 and has a bike lane

Where, Wv = Effective width as a function of traffic volume
= Wt if ADT > 4,000 vehicles per day
= Wt (2 - 0.00025 x ADT) if ADT ≤ 4,000 vehicles per day and the street is undivided and unstriped

Wt = total width of outside lane (and shoulder) pavement
Wl = width of paving between the outside lane stripe and the edge of pavement
OSPA = percentage of segment with occupied on-street parking
Wps = width of pavement striped for on-street parking

The first part of the BLOS equation measures the impacts of peak hour vehicular traffic flow on bicyclists. Roads with high traffic volume on the outside lane would receive high BLOS score, indicating low suitability for bicycle travel. The second part of the BLOS equation measures the impacts of speed of travel and percent of heavy traffic (buses and trucks) on bicycle travel environment. Roads with high posted speed limit and high number of trucks and buses would receive high BLOS score, indicating low suitability for bicycle travel. Similarly, the third part of the BLOS equation measures the impact of pavement surface condition on bicycle ride quality and assigns high BLOS score for roadways with deteriorated pavements. These first three parts of the BLOS score and a constant term are added together to compute the raw BLOS score. The final BLOS score is computed by subtracting the benefits score (fourth term in the BLOS equation) based on pavement width available for bicycling from the raw score. Roadways with striped bike lanes, wide outside lanes, paved shoulders, or low on-street parking volumes would receive discounts from the raw BLOS score, resulting in low BLOS values or good level of service.

BLOS GRADES

Bicycle Level of Service (BLOS) was developed as a linear regression model by transportation researchers. The BLOS regression equation (version 2.0) provides a discomfort and inconvenience score for bicycle travel by taking into account four prevailing roadway and traffic conditions:

The BLOS scale uses six letter grades, A through F, to describe the quality of a roadway segment for bicycle travel from best to worst conditions based on user perception. This is depicted in Table C.1.

TABLE C.1 BICYCLE LEVEL OF SERVICE DEFINITION

BLOS Grade	BLOS Score	Description
A	<=1.5	Excellent bicycle environment
B	1.5 - 2.5	Good bicycle environment
C	2.5 - 3.5	Fair bicycle environment (acceptable to experienced and novice bicyclists)
D	3.5 - 4.5	Poor environment (acceptable to experienced bicyclists)
E	4.5 - 5.5	Deficient environment (Unacceptable to experienced and novice bicyclists)
F	> 5.5	Unsafe environment (Unsuitable for any bicycle travel)

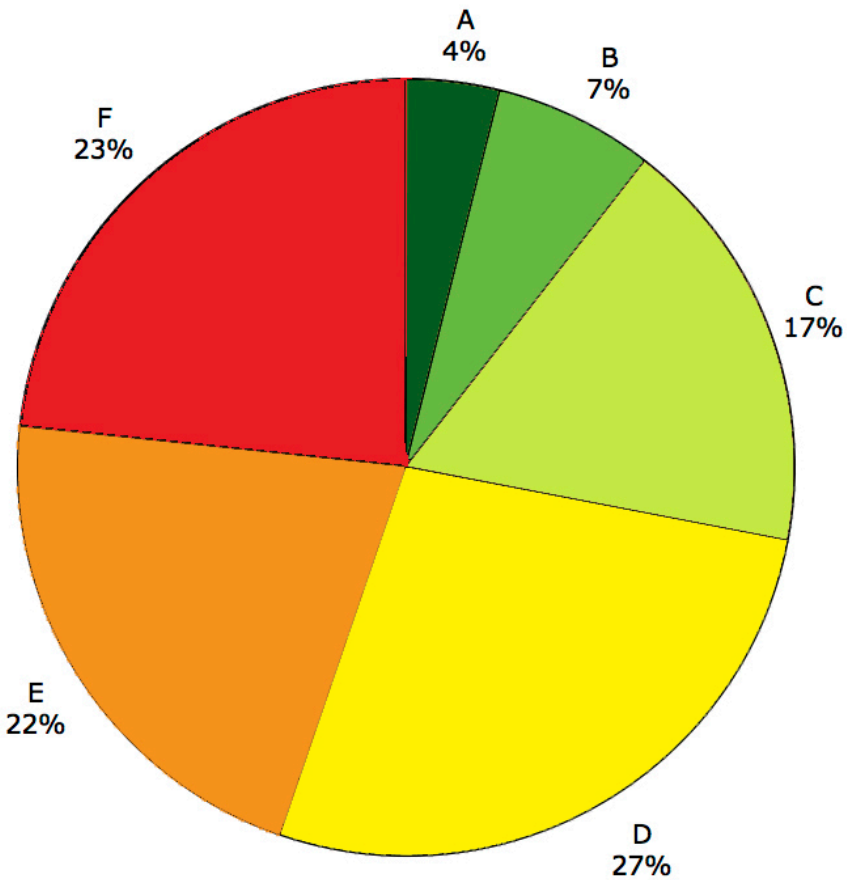
In urban areas like the City of Spartanburg, it is desirable to have a long range target of achieving BLOS C or better on bicycle network routes. This high service standard would ensure that bicycling is a viable, efficient and safe mode of travel for work, recreational and school trips.

BLOS TABLE SUMMARY

TABLE C.2 SPARTANBURG COUNTY BICYCLE LEVEL OF SERVICE (BLOS) SUMMARY FOR STUDY NETWORK ROADWAYS

BLOS Grade	*Miles*	*% Measured Miles*
A	32.1	3.9
B	55.3	6.7
C	142.1	17.4
D	221.1	27.2
E	175.1	21.5
F	188.3	23.2
Totals	*813*	*100.0*

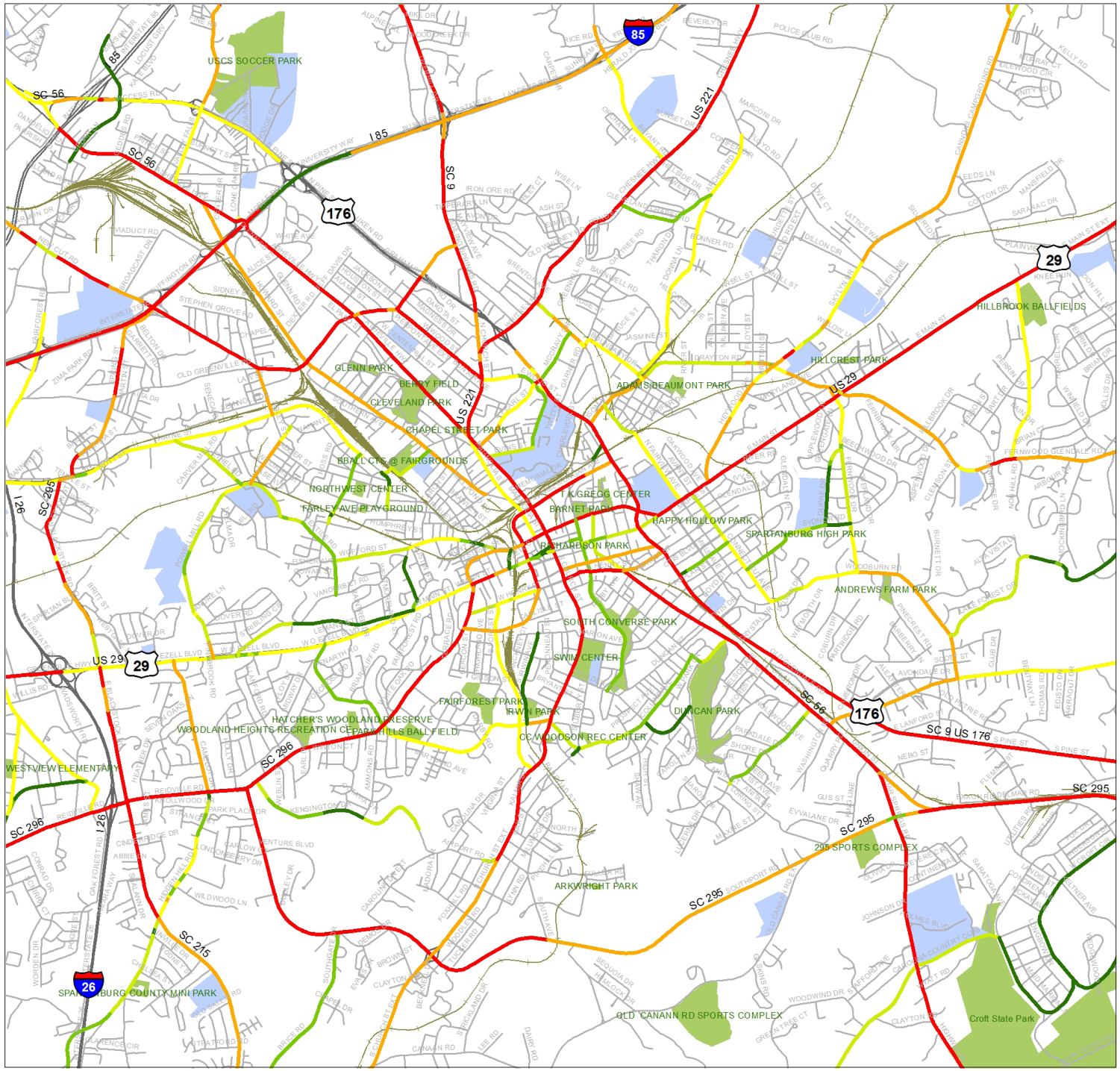
CHART C.1 SPARTANBURG COUNTY BICYCLE LEVEL OF SERVICE (BLOS) SUMMARY FOR STUDY NETWORK ROADWAYS



BLOS MAPS

The most common letter grade for Spartanburg County's arterials and major collectors was a "D." 72% of the measured roadways received a BLOS score of "D" or below. Only 3.9% received a score of "A." Maps C.1 and C.2 show BLOS for the City of Spartanburg and Spartanburg County.

MAP C.1
METRO SPARTANBURG: *BICYCLE LEVEL OF SERVICE (BLOS)*



Miles
0 0.5 1

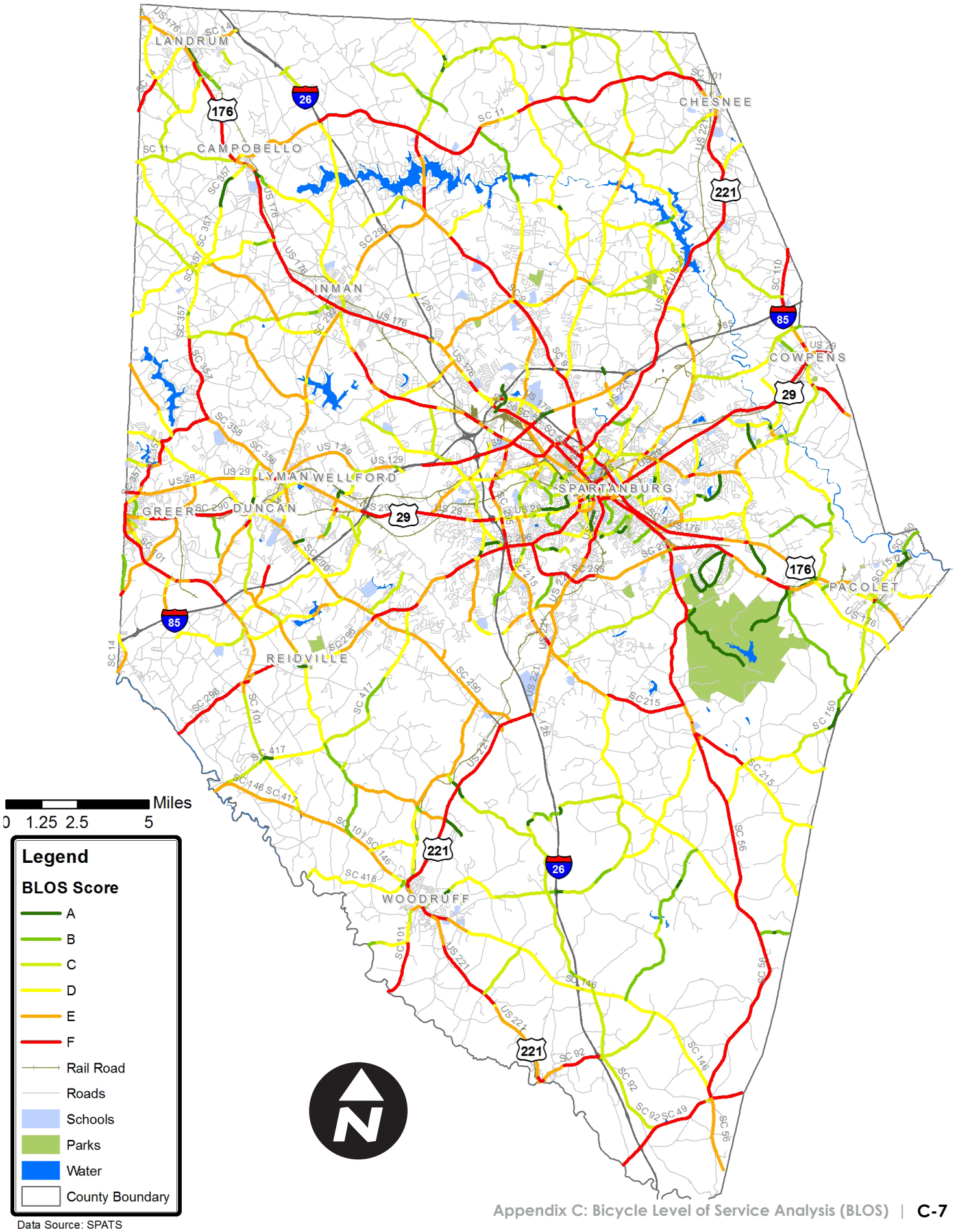
Legend

BLOS Score

- A
- B
- C
- D
- E
- F
- Rail Road
- Roads
- Parks
- Schools

Data Source: SPATS

MAP C.2 SPARTANBURG COUNTY AND MUNICIPALITIES: *BICYCLE LEVEL OF SERVICE (BLOS)*



Data Source: SPATS