ATTACHMENT B

Major Investment Study (MIS)

Commuter Rail Transit Evaluation Results

Final Report May 31, 2019

Wake Transit Plan

Durham County Transit Plan

GO FORWARD

A COMMUNITY INVESTMENT IN TRANSIT

Table of Contents

List of Tables

List of Figures

1 Introduction

The Major Investment Study is a high-level study to begin to further refine the Commuter Rail Transit (CRT) project as identified in the Wake and Durham Transit Plans. The purpose of this document is to develop and evaluate potential scenarios for the CRT service proposed between West Durham and East Garner. The MIS developed CRT station candidate zones and service scenarios along the corridor, described in detail in Section 2. The CRT scenarios were evaluated against metrics developed in the MIS CRT Evaluation Framework.[1] The evaluation framework groups the metrics into three broad categories:

- Travel Time Comparisons: These metrics calculate the travel time difference between CRT and travel modes of bus and auto along the CRT corridor,
- Station Area Characteristics: These metrics show the socioeconomic profiles of potential station areas, as well as pedestrian and transit access, and
- Ridership Characteristics: These metrics show how changing potential station areas and train frequency can affect ridership.

This report provides detailed results of each of the evaluation metrics grouped by these three categories.

Key Findings of Evaluation Process:

The evaluation of the CRT operating scenarios and station candidate zones resulted in the following findings:

- While this study looked at the FTA measures and criteria, the project will need additional evaluation that can be used for FTA scoring. That will be accomplished in the next phase of studies. However, this study did produce results that support future analysis,
- Travel times for CRT in the corridor are faster and more reliable than longer distance driving and bus routes,
- The operating scenario providing service every 30 minutes in the peak periods and limited service in the off-peak periods of mid-day and evening service was the most productive among the scenarios studied,
- All 16 potential candidate station zones are appropriate for further analysis,
- Ridership results are consistent with similar statistics for recent commuter rail systems, and
- Additional analysis is needed to refine ridership estimates and to identify infrastructure required to support the CRT operating plans studied in this evaluation.

It should be noted that the Durham-Orange Light Rail project was discontinued after the CRT evaluation work was complete, so the findings of this study assumed the presence of the

[1] The MIS CRT Evaluation Framework in Task 9 CRT System Level Guidelines and Evaluation was approved by the Core Technical Team (CTT) in December 2018.

Durham-Orange LRT. The LRT-related network changes will be addressed in the next phase of studies.

ADJUSTMENT TO THE EVALUATION FRAMEWORK

The project team made a few adjustments to the methodology described in the evaluation framework. Table 1 describes how the methodology used to produce the evaluation results differs from the approved evaluation framework included in the Task 9 report. The adjustments do not materially change the adopted evaluation framework. These changes were made either in response to requests from the Core Technical Team (CTT) or to better differentiate between the scenarios.

Table 1 | Evaluation Framework

Category	Prioritization Metric	Evaluation Methodology	Data Source	Adjustment
Travel Time Competitiveness	Transit time competitiveness with bus	Calculate the change in average speed in the corridor by comparing existing bus speeds to anticipated CRT speed. Example output: 1.3 mph improvement	Existing bus speeds operating in mixed traffic and projected CRT speeds to be developed as part of the MIS based on station spacing, dwell time, and rail running times.	Revised to use the difference in minutes between CRT travel time and bus time
	Travel time competitiveness with automobile	This measure compares CRT travel time to automobile travel times. Example output: 5 minutes	Congested peak period auto travel times from Triangle Regional Model (TRM) V6 and the real travel times on roadways. CRT speeds based on station spacing, dwell times, and rail running times. One-way transit travel trip times are averaged.	Revised to use the difference in minutes between CRT travel time and auto time
Connectivity	Connections to frequent transit	Determine the number of planned routes that will operate at least every 15 minutes that can provide a transfer opportunity at the CRT stations.[2]	*Wake County Transit Plan* and *Durham County Transit Plan* network shapefile.	None

[2] One half-mile is considered a reasonable walking distance to transit stations. Guerra, Erick, Cervero, Robert, and Tischler, Daniel. The Half Mile Circle: Does it Best Represent Transit Station Catchments? UC Berkley Center for Future Urban transport, 2011: https://escholarship.org/uc/item/68r764df

Category	Prioritization Metric	Evaluation Methodology	Data Source	Adjustment
		Example output: 5 frequent transit routes connecting		
	Ease of Access*	Calculate the intersection density within ½ mile† of stations, excluding interstates and ramps. Example output: 50 road intersections within a ½ mile network buffer	Road network shapefile	Revised to use the number of intersections within ½ mile of stations, excluding interstates and ramps.
Equity	Affordable housing access*	Calculate the ratio of legally binding affordability-restricted housing units to all housing units within ½ mile† of each station location. Example output: 21% affordable units	TJCOG (http://www.preservationdatabase.org/) Durham and Wake County parcel data	Include 1/2 mile straight-line access buffer around potential station candidate zones.

* These metrics are based on inputs to the FTA CIG evaluation process.

† All calculations of half-mile buffers will be completed using the road network to measure distance rather than straight-line distance. This will more accurately capture what is within one half-mile of the corridor, an acceptable walking distance to premium transit.

Category	Prioritization Metric	Evaluation Methodology	Data Source	Adjustment
	Minority access	Calculate the ratio of minority residents to all residents living within ½ mile† of station. Definition of minority will be consistent with TRM definition. Example output: 36% minority residents	Recent (2012-2016) 5-year ACS data (block group)	Both the ½ mile street network and the 1-mile straight-line access buffer around potential station candidate zones
	Low-income households	Calculate the ratio of low-income households within ½ mile of station. Example output: 5% low-income households	Recent (2012-2016) 5-year ACS data (block group)	Both the ½ mile street network and the 1-mile straight-line access buffer around potential station candidate zones
	Transit dependent access*	Calculate the ratio of zero vehicle households to all households located	Recent (2012-2016) 5-year ACS data (block group)	Both the ½ mile street network and the 1-mile straight-line access buffer around potential station candidate zones

Category	Prioritization Metric	Evaluation Methodology	Data Source	Adjustment
		within ½ mile† of station. Example output: 15% zero vehicle households		
Ridership	Boardings/Vehicle Revenue Hour*	Calculate the CRT boardings per vehicle revenue hour. Example output: 45 boardings/vehicle revenue hour	TRMV6 model and CRT service operating planning scenarios	None
Transit-Supportive Land Use	Total people + jobs served*	Calculate the total number of residents and jobs within ½ mile† of stations. Example output: 110,800 people + jobs	2045 projections from TRM v6	None

* These metrics are based on inputs to the FTA CIG evaluation process.

† All calculations of half-mile buffers will be completed using the road network to measure distance rather than straight-line distance. This will more accurately capture what is within one half-mile of the corridor, an acceptable walking distance to premium transit.

Category	Prioritization Metric	Evaluation Methodology	Data Source	Adjustment
	Concentration of people + jobs*	Calculate the number of residents and jobs within ½† mile of stations divided by the ½ mile network buffer around the stations. Example output: 17,100 people + jobs per square mile	2045 projections from TRM v6	None
Sustainability	Environmental impact	Quantitative assessment of potential negative impacts on existing features due to construction of CRT infrastructure. Example output: The sum of potential impacts created by CRT infrastructure	GIS layer of EMS stations, fire stations, hospitals, libraries, parks, police departments, schools, cemeteries, places of worship, utility lines, waterways/floodplains, wetlands, biodiversity & wildlife habitat, hazardous waste sites, water resources & water supplies, historic properties, and public open spaces	Removed from the station rating matrix but maintained narrative discussion on environmental features. Maps illustrating the environmental screening and associated narrative are included in Appendix A.

† All calculations of half-mile buffers will be completed using the road network to measure distance rather than straight-line distance. This will more accurately capture what is within one half-mile of the corridor, an acceptable walking distance to premium transit.

Category	Prioritization Metric	Evaluation Methodology	Data Source	Adjustment
Parking Access	Parking opportunities	A preliminary, qualitative evaluation of constrained land uses or usable space surrounding each station that could be potentially used to provide parking. Example output: 200 acres of properties available for parking opportunities	This is not a measurement of parking demand at stations. This evaluation could be conducted during a later project development phase.	Changed from Regional Access to Parking Access; no change for parking opportunities.
	Typical parking cost	Calculate the CBD typical cost per day near stations. Example output: $8.5 for daily maximum parking cost	TRM v6 parking inventory data	None

2 Corridor Scenarios for MIS Study

Seven CRT scenarios were evaluated based on three dimensions: location/number of stations, service periods (AM Peak, Midday, PM Peak, and Evening), and frequency of service (trains per hour during each service period).

2.1 POTENTIAL STATION CANDIDATE ZONES

During this phase of CRT planning, specific station locations are not identified and are subject to future studies to determine the actual location of the station platforms. In this phase, the term "station candidate zone" is used to identify generalized locations for potential CRT stations. In future phases, alternative sites for the stations within the candidate zone (or additional candidate zones) will be identified and evaluated in terms of physical design constraints, access to local land uses, and operational analysis with the other rail services within the corridor.

Three proposed CRT station scenarios were used as part of the MIS analysis (Table 2):

Limited Stations (10): Stations at locations spaced farther apart to reduce travel time, including West Durham, Downtown Durham, East Durham, MetroCenter RTP, Morrisville, Downtown Cary, West Raleigh, Raleigh Union Station, Garner, and East Garner.

Moderate Stations (12): Bethesda and NC State were added to of the above 10 stations.

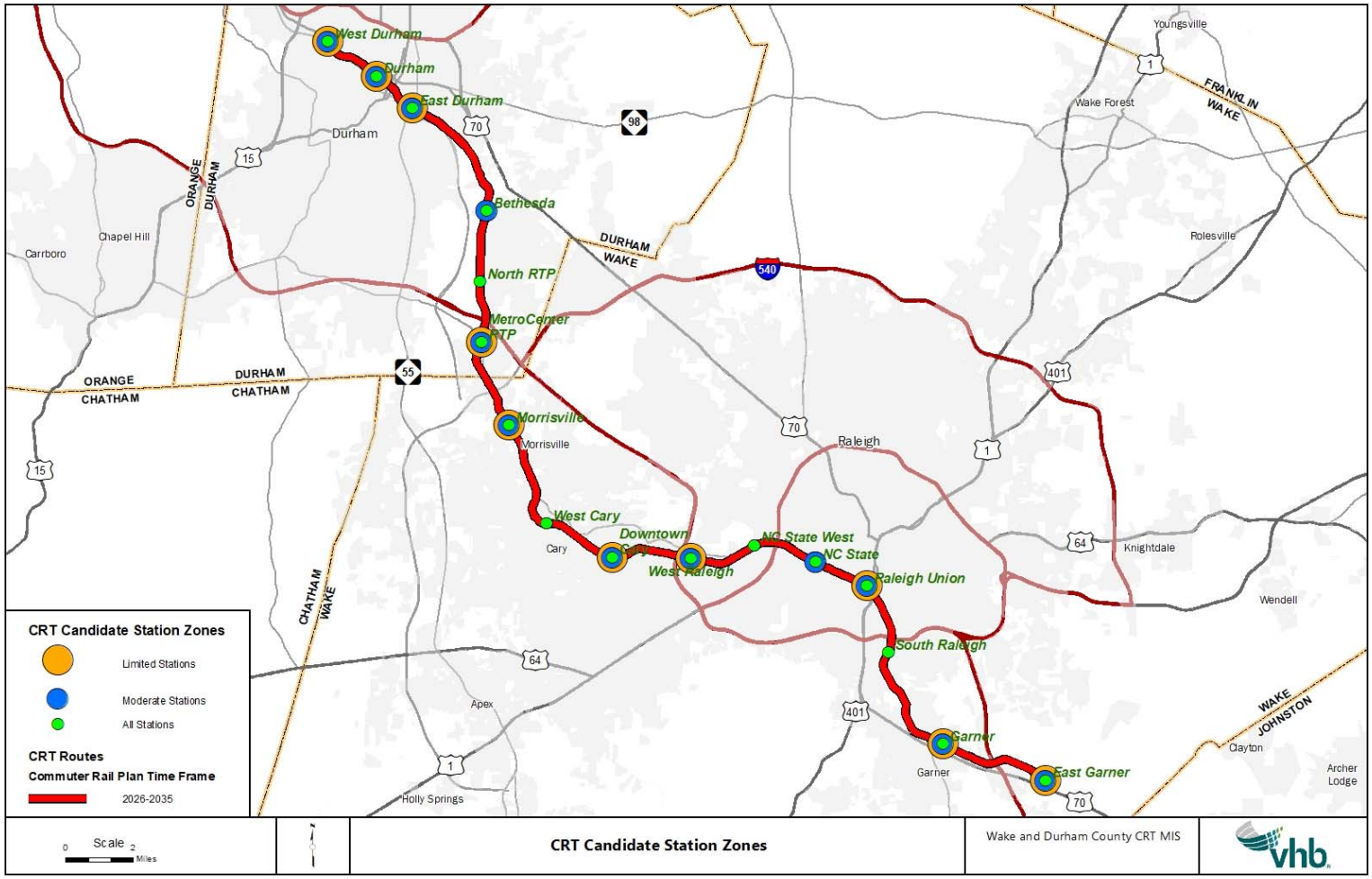
All Stations (16): Four stations were added including North RTP, West Cary, NC State West, and South Raleigh.

Table 2 | Preliminary Station List*

Station Name (EB)	Mile Post	Limited Stations (10)	Moderate Stations (12)	All Stations (16)
West Durham	0.1	√	√	√
Downtown Durham	1.9	√	√	√
East Durham	3.3	√	√	√
Bethesda	7.4		√	√
North RTP	9.7			√
MetroCenter RTP	11.6	√	√	√
Morrisville	14.2	√	√	√
West Cary	17.5			√
Downtown Cary	19.8	√	√	√
West Raleigh	22.4	√	√	√
NC State West	24.3			√
NC State	26.5		√	√
Raleigh Union Station	28.1	√	√	√
South Raleigh	30.3			√
Garner	33.5	√	√	√
East Garner	37.0	√	√	√

* The stations listed here are not to be considered final stations

Figure 1 | Potential CRT Candidate Station Zones*



* The stations shown on the map are not to be considered as final stations

2.2 SERVICE SPAN

Three service span scenarios are proposed for weekday services for the purpose of the MIS analysis:

Minimum service span: Peak period service (6 to 10 AM and 3 to 7 PM) only

Medium service span: Peak periods and limited midday (10 AM to 3 PM) and limited evening service (7 PM to Midnight)

Maximum service span: All-day service (6 AM to Midnight)

2.3 SERVICE FREQUENCY

Three levels of service frequency were studied (Table 3):

Minimum frequency: Operating eight round trips per day, which includes four morning round trips and four afternoon round trips, also called 4-0-4-0.

Medium frequency: Operating 20 round trips per day, which includes eight morning round trips, two midday round trips, eight afternoon round trips, and two evening round trips, also called 8-2-8-2.

Maximum frequency: Operating 24 round trips per day, which includes eight morning round trips, four midday round trips, eight afternoon round trips, and four evening round trips, also called 8-4-8-4.

Table 3 | Service Frequency and Service Period

	Service Period				
	AM	**Midday**	**PM**	**Evening**	**Total**
Minimum	4	0	4	0	8
Medium	8	2	8	2	20
Maximum	8	4	8	4	24

2.4 SERVICE SCENARIOS

Seven scenarios were studied based on a combination of station/locations, service periods, and frequency of service, and were selected for further ridership forecast, which are shown in Table 4.

Table 4 | CRT Scenarios

Scenario	Description	Stations	AM Peak Round Trips	PM Peak Round Trips	Off Peak Round Trips	Total Round Trips
1A	Minimum Service	16	4	4	0	8
1B	Minimum Service	12	4	4	0	8
2A	Medium Service	16	8	8	4	20
2B	Medium Service	12	8	8	4	20
2C	Medium Service	10	8	8	4	20
3A	Maximum Service	16	8	8	8	24
3B	Maximum Service	12	8	8	8	24

3 Results

The MIS CRT scenarios were evaluated based on metrics developed in the MIS CRT Evaluation Framework. The evaluation results are summarized in this section.

3.1 COMMUTER RAIL TRAVEL TIME COMPETITIVENESS

Travel time savings is a primary feature of successful CRT systems in the U.S. This metric measures the travel time difference between CRT and bus or auto. A negative value indicates that there would be travel time savings by taking Commuter Rail rather than bus or auto. A positive value suggests taking Commuter Rail will take more time than taking bus or auto.

The CRT travel time is estimated based on the following assumptions:

- The number of stations (10, 12, or 16) and station locations
- 60 second dwell at each station
- Maximum authorized speed of 79 mph
- Typical Commuter Rail acceleration and deceleration rates, and anticipated speed limitations due to track configuration

For the travel time competitiveness evaluation, the 16-station CRT travel time scenario is used to compare with the bus and auto travel time, as this scenario represents the longest possible CRT travel time in all the proposed station scenarios (Table 5). The CRT travel times for different numbers of stations (10, 12, and 16) were used in the TRM v6 model process.

Table 5 | CRT Travel Time – East Garner to West Durham Station Candidate Zones

	Number of Stations		
	All (16)	Moderate (12)	Limited (10)
Travel Time (minutes)	65	57	53

Due to a large number of possible combinations of station pairs, only six stations were selected to calculate the travel time competitiveness metrics, including two terminal stations (West Durham and East Garner), and four intermediate stations (Downtown Durham, MetroCenter RTP, Downtown Cary, and Raleigh Union Station). The CRT travel time between any two of these selected stations were derived from the Run Time Table (Table 6) for each travel direction.

Table 6 | Proposed CRT Travel Time by Station (EB and WB)

Station Name (Eastbound)	Total Run Time (H:MM)	Station Name (Westbound)	Total Run Time (H:MM)
West Durham	0:00	East Garner	0:00
Downtown Durham	0:04	Garner	0:05
East Durham	0:07	South Raleigh	0:11
Bethesda	0:13	Raleigh Union Station	0:15
North RTP	0:17	NC State	0:18
MetroCenter RTP	0:21	NC State West	0:22
Morrisville	0:25	West Raleigh	0:26
West Cary	0:31	Downtown Cary	0:30
Downtown Cary	0:35	West Cary	0:34
West Raleigh	0:39	Morrisville	0:40
NC State West	0:43	MetroCenter RTP	0:44
NC State	0:47	North RTP	0:48
Raleigh Union Station	0:50	Bethesda	0:52
South Raleigh	0:54	East Durham	0:58
Garner	1:00	Downtown Durham	1:01
East Garner	1:05	West Durham	1:05

Travel Time Competitiveness with Bus

The bus travel time is collected using the GoTriangle trip planner, assuming the trip departure time at 8:00 AM Monday, based on the existing bus services, as of November 2018. The total bus travel time includes time on board, the transfer time between trips, and with/without walk time between bus stops and CRT stations. There is no existing bus service between Downtown Garner and East Garner, so Downtown Garner was used for calculation. Also, there is no eastbound bus service in the morning from all other calculated stations to Downtown Garner, so the bus travel time in the afternoon was used.

Findings

The results of the CRT/existing bus travel time differences are shown in Table 7 (without walk time between bus stops and CRT stations) and Table 8 (with walk time between bus stops and CRT stations). A negative number in the tables indicates travel time savings for CRT versus the bus or auto travel times. It should be noted that this study did not identify specific station locations, therefore the bus travel time (with walk time between bus stops and CRT stations) is only an estimate, and Table 7 (without walk time) should be focused to understand the CRT travel time competitiveness with bus.

Table 7 | CRT/Bus Travel Time Difference (without walk time)

CRT travel time - Bus time (without walk time)						
	West Durham	Downtown Durham	MetroCenter RTP	Downtown Cary	Raleigh Union Station	Downtown Garner
West Durham		-4	-34	-71	-24	-82
Downtown Durham	-6		-23	-61	-15	-72
MetroCenter RTP	-31	-17		-26	-15	-62
Downtown Cary	-37	-23	-18		-9	-36
Raleigh Union Station	-36	-18	-16	-25		-32
Downtown Garner	-77	-42	-59	-35	-14	

Table 8 | CRT/Bus Travel Time Difference (with walk time)

CRT travel time - Bus time (with walk time)						
	West Durham	Downtown Durham	MetroCenter RTP	Downtown Cary	Raleigh Union Station	Downtown Garner
West Durham		-15	-41	-76	-39	-104
Downtown Durham	-13		-31	-68	-31	-96
MetroCenter RTP	-37	-26		-32	-26	-85
Downtown Cary	-43	-32	-25		-19	-59
Raleigh Union Station	-47	-29	-31	-40		-55
Downtown Garner	-99	-69	-82	-57	-36	

For all the station pairs, the CRT travel time is shorter than the bus travel time, which shows significant travel time savings when the CRT service is available, especially between West Durham and Downtown Garner in both the westbound and eastbound directions during the AM peak period. From Downtown Garner to West Durham in the morning, it could take a total of two hours and 39 minutes with three transfers (Routes 102 to 100 to 300 to 11) including a 22-minute walk from the proposed Downtown Garner station to the nearest existing bus stop (Vandora Springs Road at Beichler Road). By taking CRT from Downtown Garner to West Durham, the trip would only take 60 minutes, resulting in 99 minutes of travel time savings. The other significant travel time saving would be traveling to Downtown Cary from West Durham. By bus, it would take one hour and 52 minutes with 2 transfers (Routes 11 to DRX to 300) and a 5-minute walk. Travelers would have to get to Downtown Raleigh for a transfer. By CRT, the trip would only take 35 minutes, resulting in 76 minutes of time savings.

Travel Time Competitiveness with Automobile

The auto travel time is calculated using the Google Trip Planner, based on the existing road network, which yields a range of existing travel times, assuming the trip departure time at 8:00 AM Monday. This travel time calculation is based on the existing roadway network. The commuter rail travel time is based on the run time of the 16-station scenario. It should be noted that the highway travel times are highly variable due to incidents and varying levels of congestion. While not a specific measure, the reliability of travel times for CRT versus a congested highway network is a benefit of commuter rail service.

Findings

The results of the CRT/auto travel time differences are shown in Table 9 and Table 10 for the uncongested and congested range of auto time estimated by Google, respectively. CRT travel times are mostly higher than the uncongested auto travel time but lower than the congested auto travel time. A negative value in the table indicates that the CRT has a net travel time savings over the auto travel times.

Table 9 | CRT/Auto Travel Time Difference (Uncongested Auto Time)

CRT Travel Time – Uncongested Auto Time						
	West Durham	**Downtown Durham**	**MetroCenter RTP**	**Downtown Cary**	**Raleigh Union Station**	**East Garner**
West Durham		-1	5	9	15	25
Downtown Durham	-2		3	7	16	21
MetroCenter RTP	1	-1		0	5	18
Downtown Cary	7	5	-2		-1	10
Raleigh Union Station	10	6	3	-3		-1
East Garner	20	16	9	4	-3	

Table 10 | CRT/Auto Travel Time Difference (Congested Auto Time)

CRT Travel Time – Congested Auto Time						
	West Durham	**Downtown Durham**	**MetroCenter RTP**	**Downtown Cary**	**Raleigh Union Station**	**East Garner**
West Durham		-5	-3	-5	-5	10
Downtown Durham	-4		-5	-9	-4	6
MetroCenter RTP	-14	-11		-10	-11	4
Downtown Cary	-15	-19	-16		-15	0
Raleigh Union Station	-25	-24	-21	-20		-7
East Garner	-20	-19	-26	-25	-20	

3.2 STATION CANDIDATE ZONE EVALUATION

Station Buffer Methodology

During this phase of CRT planning, specific station locations are not identified and are subject to future studies to determine the actual location of the station platforms. In this phase, the term "station candidate zone" is used to identify generalized locations for potential CRT stations. In future phases, alternative sites for the stations within the candidate zone (or additional candidate zones) will be identified and evaluated in terms of physical design constraints, access to local land uses, and operational analysis with the other rail services within the corridor.

Two types of buffers are used to generate evaluation metrics around station candidate zones (Figure 2).

½ Mile buffer using the roadway network: Used for connectivity, equity, and transit-supportive land use metrics; a network buffer represents the maximum distance that can be traveled along a road network, which is usually irregular in shape.

1 Mile straight-line buffer: Used for equity measures only to capture impacts over a larger geographic area around station candidate zones; a straight-line buffer is a circle showing the area that is within a pre-defined distance.

Figure 2 | Station Candidate Zones Buffer

The proposed CRT station candidate zones are evaluated using most of the identified metrics in the evaluation framework except for the metrics of Speed & Travel Time Competitiveness and Ridership. The evaluation results are presented in a 1 to 3 rating scale in which 3 represents better performance and 1 represents worse performance relative to each other station candidate zone. The purpose of the station candidate zone evaluation is not to rank all the proposed stations, but to provide an evaluation of strengths and weaknesses against each metric.

Connections to Frequent Transit

CRT functions best if the investment will create and strengthen connections and access to other transit routes. In particular, connections to frequent routes (defined as those that operate at least every 15 minutes) are important because riders experience minimal wait times when transferring.

This metric will indicate the degree to which each CRT station candidate zone will integrate with the 2045 adopted Transit Network (headway less than or equal to 15 minutes). For each CRT station candidate

zone, the number of planned high-frequency routes operating within the one half-mile distance of the station was identified and rated from 1 to 3, with 1 being the least connectivity and 3 being the most connectivity (Table 11).

Table 11 | Frequent Transit Connectivity

Frequent Transit Connectivity	Rating
More than 5 routes	3
4 to 5 routes	2
3 or fewer routes	1

Findings

The number of high-frequency transit routes that are currently operating or would operate within one half-mile of each CRT station candidate zone is shown in Table 12. West Durham, Downtown Durham, NC State, and Raleigh Union Station are expected to be served by eight or more high-frequency transit routes. The East Durham station candidate zone will have four high-frequency transit routes, followed by the other station candidate zones.

Table 12 | Connections to High Frequent Transit Routes by Station

Station	Number of Connecting High-Frequency Transit Routes	Rating
West Durham	8	3
Downtown Durham	9	3
East Durham	4	2
Bethesda	0	1
North RTP	0	1
MetroCenter RTP	1	1
Morrisville	1	1
West Cary	1	1
Downtown Cary	2	1
West Raleigh	1	1
NC State West	3	1
NC State	11	3
Raleigh Union	11	3
South Raleigh	0	1
Garner	1	1
East Garner	1	1

Ease of Access

Most transit riders begin and/or end their trip as pedestrians, walking some distance to or from the bus stop or commuter rail station area. Ridership on CRT is likely to be higher in places where people can easily and conveniently access the station candidate zone from the surrounding neighborhood. Intersection density is a common way to measure the density of the road network surrounding the corridor and, therefore, the number of pedestrian and bicycle connections. Areas where the street network is made of small blocks are easier for pedestrians and bicyclists to traverse because destinations can be accessed without out-of-direction travel. Areas with large blocks and circuitous roadways are less accessible because they often do not provide a direct path to a destination.

This metric measures the number of intersections within a one half-mile of each CRT station candidate zone to identify the pedestrian accessibility of the area surrounding each station. The one half-mile buffer is measured using the street network, not straight-line distance to incorporate natural and built barriers into the analysis.

Table 13 | Intersections within One Half-Mile Network Buffer of Stations

Number of Intersections within a ½-mile network buffer	Rating
More than 78	3
54 to 78	2
53 or fewer	1

Findings

The number of intersections is used to measure the accessibility of the road network surrounding each station candidate zone, which is used to indicate potential pedestrian and bicycle connections. For each station candidate zone, the number of intersections within a one half-mile buffer surrounding the station was identified and rated from 1 to 3 in which 1 is the worst and 3 is the best performance. Table 14 shows four station candidate zones with the most intersections at 92 or more. NC State has 68 intersections within a one half-mile buffer, rating as 2, while the other 11 station candidate zones have 55 or fewer intersections.

Table 14 | Road Intersections by Station Candidate Zone

Station	Number of Intersections within a ½-mile network buffer	Rating
West Durham	54	2
Downtown Durham	137	3
East Durham	157	3
Bethesda	9	1
North RTP	4	1
MetroCenter RTP	31	1
Morrisville	13	1
West Cary	28	1
Downtown Cary	118	3
West Raleigh	55	2
NC State West	23	1
NC State	68	2
Raleigh Union Station	92	3
South Raleigh	29	1
Garner	54	2
East Garner	21	1

Equity

Wake and Durham Counties are committed to investing in public transit in a way that promotes regional equity and access to opportunities. The CRT service design and operations practices will not result in discrimination on the basis of race, color, or national origin, as required by Federal law, as described in Federal Transit Administration (FTA) Circular 4702.1B, "Title VI Requirements and Guidelines for Federal Transit Administration Recipients," effective October 1, 2012. The potential station candidate zones were analyzed to determine access from legally binding affordability-restricted (LBAR) housing and minority, low-income, and transit-dependent populations. Data sources and mapping were coordinated with the Capital Area Metropolitan Planning Organization (CAMPO), Durham-Chapel Hill-Carrboro MPO (DCHC MPO), and the Triangle J Council of Governments (TJCOG).

Affordable Housing Access

Locating CRT near affordable housing units can have significant long-term benefits for residents, lowering their transportation costs and connecting them to greater regional job accessibility. The FTA *Guidelines for Land Use and Economic Development Effects* refer to LBAR as units with a lien, deed of trust, or other legal instrument attached to a property and/or housing structure that restricts the cost of the housing units to be affordable to renters and/or owners with incomes below 60% of the area median income for a defined period of time.

The evaluation of LBAR housing near the station candidate areas was based on LBAR housing units located within one half-mile, based on the street network buffer.[4] The LBAR map in the Appendix shows LBAR housing units located within one half-mile of the street network and straight-line buffer. In this section of the report, only the one half-mile results are presented for the affordable housing measure.

LBAR housing units are located in the Durham City half-mile street network zones (West, Downtown, and East Durham) as well as Downtown Cary, Raleigh (West Raleigh, NC State West, NC State, and South Raleigh), and Downtown Garner half-mile street network zones.

Table 15 | LBAR Housing Ratio within One Half-Mile Street Network Buffer of Stations

Affordable Housing	Rating
40.30%	3
8.2% to 13.1%	2
2.2% or less	1

Findings

Table 16 | Ratio of Affordable Housing by Station Candidate Zone

Station	Affordable Housing (%) within ½-mile network buffer	Rating
West Durham	1.9	1
Downtown Durham	11.7	2
East Durham	40.3	3
Bethesda	0	1
North RTP	0	1
MetroCenter RTP	0	1
Morrisville	0	1
West Cary	0	1
Downtown Cary	8.2	2
West Raleigh	0	1
NC State West	0	1
NC State	2.2	1
Raleigh Union Station	10.4	2
South Raleigh	0	1
Garner	13.1	2

[4] LBAR data was extracted from TJCOG, Durham County, and Wake County shapefiles.

East Garner	0	1

Minority Access

Minority access measured the ratio of minority households within both the half-mile road network buffer and one-mile straight-line buffer (see map in Appendix B). Based on block group data from the American Community Survey (ACS), pockets with greater than 80.1% minority populations are located in east Durham, east Raleigh, and east Garner.[5] Overall, the commuter rail corridor mainly includes pockets of 20% to 50% and 50.1% to 80% minority populations.

The findings per station candidate zone below were based on the percent of minority population within the buffer and the coverage of the buffer by a minority population. This high-level analysis did not include identifying the type of minority population in each station candidate zone.

Table 17 | Minority Population Ratios

Minority Access	Rating[6]
Any portion of the buffer including areas with >80% minority populations Or ≥ half the buffer area with >50% minority populations	3
≥ half the buffer area with 20% to 50% minority populations	2
< half the buffer area with <50% minority populations	1

[5] ACS 5-Year Estimates (2012-2016).

[6] Based on high-level, desk-top analysis.

Findings

Table 18 | Minority Access by Station Candidate Zone

Station	Minority Access	
	½-mile road network buffer	1-mile straight-line buffer
West Durham	3	3
Downtown Durham	3	3
East Durham	3	3
Bethesda	3	3
North RTP	3	3
MetroCenter RTP	3	3
Morrisville	3	3
West Cary	2	2
Downtown Cary	2	2
West Raleigh	3	2
NC State West	2	2
NC State	1	2
Raleigh Union Station	2	3
South Raleigh	3	3
Garner	3	3
East Garner	3	3

Low-Income Access

Poverty thresholds for households are defined per Census guidelines based on household size and reported income, which includes: 1) household size of fewer than four people and household income of less than $15,000; 2) household size between four and six people and household income of less than $25,000; or 3) household size of seven or more people and household income under $35,000.

Low-income access measured the ratio of low-income households within both the half-mile road network buffer and one-mile straight-line buffer (see map in Appendix B). Based on block group data from the ACS, the only area within the commuter rail corridor with greater than 80.1% poverty is located in the City of Durham.[7] Populations with 20%-80% poverty are mainly found in and around Raleigh and Durham. The Town of Garner contains a pocket of 20%-50% and a pocket of 50.1%-80% poverty populations.

The findings per station candidate zone below were based on the percent of low-income population within the buffer and the coverage of the buffer by a low-income population.

[7] ACS 5-Year Estimates (2012-2016).

Table 19 | Ratio of Population Living in Poverty

Low-Income Access	Rating[8]
Any portion of the buffer including areas with >80% poverty populations Or ≥ half the buffer area with >50% poverty populations	3
≥ half the buffer area with 20% - 50% poverty populations	2
≥ half the buffer area with <20% poverty populations	1

Findings

Table 20 | Low-Income Access by Station Candidate Zone

Station	Low-Income Households	
	½-mile road network buffer	1-mile straight-line buffer
West Durham	2	3
Downtown Durham	2	2
East Durham	3	2
Bethesda	1	1
North RTP	1	1
MetroCenter RTP	1	1
Morrisville	1	1
West Cary	1	1
Downtown Cary	1	1
West Raleigh	2	1
NC State West	2	2
NC State	2	2
Raleigh Union Station	2	2
South Raleigh	1	2
Garner	1	1
East Garner	1	1

[8] Based on high-level, desk-top analysis.

Transit-Dependent Access

CRT can be particularly beneficial to households that do not have regular access to a vehicle by providing a reliable and fast connection throughout the region. Zero-vehicle households can also align with low-income households that may be more likely to use transit. The FTA uses the ratio of zero-vehicle households in a corridor to evaluate eligibility for potential CRT funding.

Based on block group data from the ACS, the areas with greater than 20% zero-car households are located mainly in and around the Raleigh and Durham city limits (see map in Appendix B).[9] The Town of Garner has a small area of 20% to 50% zero-car households. The findings per station candidate zone below were based on the percent of zero-care households within the buffer and the coverage of the buffer by zero-car households.

Table 21 | Ratio of Zero-Car Households

Transit-Dependent Access	Rating[10]
Any portion of the buffer including areas with >50% zero car populations	3
≥ half the buffer area with 20% - 50% zero car populations	2
< half the buffer area with <50% zero car populations	1

[9] ACS 5-Year Estimates (2012-2016).

[10] Based on high-level, desk-top analysis.

Findings

Table 22 | Transit-Dependent Access by Station Candidate Zone

Station	Transit-Dependent Access	
	½-mile road network buffer	1-mile straight-line buffer
West Durham	1	1
Downtown Durham	2	2
East Durham	2	3
Bethesda	1	1
North RTP	1	1
MetroCenter RTP	1	1
Morrisville	1	1
West Cary	1	1
Downtown Cary	1	1
West Raleigh	1	1
NC State West	1	3
NC State	3	3
Raleigh Union Station	1	3
South Raleigh	1	3
Garner	1	1
East Garner	1	1

Total People + Jobs Served

The number of people living and working along transit corridors can indicate potential ridership levels and likelihood of sustaining the investment over time. Total population and employment indicate the degree to which transit-supportive land uses are in place. The evaluation assesses the total combined population and jobs projected within a one half-mile buffer of each station in 2045. The one half-mile buffer is measured using the street network, not straight-line distance, to incorporate natural and built barriers into the analysis. Station candidate zones with a larger number of combined population and jobs within the buffer have a higher rating.

Table 23 | Total People + Jobs Served

Total People + Jobs	Rating
More than 15,116	3
9,320 to 15,116	2
Fewer than 9,320	1

Findings

Table 24 shows the projected 2045 population and jobs within a one half-mile of each CRT station candidate zone. Three station candidate zones—Downtown Durham, NC State, and Raleigh Union Station—have combined populations and numbers of jobs greater than 15,116. East Durham and Downtown Cary each have combined populations and numbers of jobs greater than 10,000, with a rating of 2. The other station candidate zones all have relatively low total projected 2045 populations and numbers of jobs, totaling fewer than 7,000 for each zone.

Table 24 | Total Projected 2045 Population and Jobs within One Half-Mile of Station

Station	Total People + Jobs	Rating
West Durham	6,184	1
Downtown Durham	33,253	3
East Durham	11,655	2
Bethesda	290	1
North RTP	603	1
MetroCenter RTP	5,141	1
Morrisville	2,834	1
West Cary	1,493	1
Downtown Cary	10,216	2
West Raleigh	6,586	1
NC State West	5,839	1
NC State	20,670	3
Raleigh Union Station	40,085	3
South Raleigh	2,217	1
Garner	1,192	1
East Garner	865	1

Concentration of People + Jobs Served

While the total number of people and jobs is important to understand the scale of the impact of a CRT station candidate zone, this concentration metric ensures that station candidate zones with dense development are considered positively, even if the total number of people and jobs may not be as high as a longer, less dense corridor. This analysis assesses the combined density of population and jobs per acre projected within a one half-mile buffer of each station by 2045. The one half-mile buffer is measured using the street network, not straight-line distance, to incorporate natural and built barriers into the analysis. Station candidate zones with a higher density of combined population and jobs per acre receive a higher rating.

Table 25 | Concentration of People + Jobs Served

Concentration of People + Jobs	Rating
More than 49	3
32 to 49	2
Fewer than 32	1

Findings

Table 26 shows the projected 2045 population and jobs per acre within one half-mile of each station. Downtown Durham, NC State, and Raleigh Union Station have a combined density of more than 49 residents and jobs per acre. West Raleigh has a combined density of 35 residents and jobs per acre, which is higher than the density of the 11 other station candidate zones.

Table 26 | Projected 2045 Population and Jobs per Acre within One Half-Mile of Station

Station	Concentration of People + Jobs	Rating
West Durham	23	1
Downtown Durham	75	3
East Durham	31	1
Bethesda	7	1
North RTP	6	1
MetroCenter RTP	20	1
Morrisville	15	1
West Cary	10	1
Downtown Cary	26	1
West Raleigh	35	2
NC State West	25	1
NC State	61	3
Raleigh Union Station	146	3
South Raleigh	16	1
Garner	6	1
East Garner	5	1

Parking Opportunities

Parking access is evaluated through parking opportunities and parking cost. Parking opportunities are a preliminary, qualitative evaluation of available land uses or usable space surrounding each station candidate zone that could be used to provide parking. Available land was identified based on Wake and

Durham Counties parcel data and includes properties defined as vacant or with a structure value less than $20,000.[11]

As illustrated on the map in Appendix A, eastern Durham County—from the Bethesda region south the to the MetroCenter RTP region—contains the most potentially available land. The west Durham region within the commuter rail corridor has the least amount of potentially available land. Morrisville, west Cary, and Garner regions contain the most available land in Wake County. The area surrounding NC State University has the least potentially available land in Wake County. The findings in Table 28 for the station candidate zones were based on the acres of available land using a one half-mile buffer.

Table 27 | Parking Opportunities (Acres)

Parking Opportunities (Acres)	Rating
More than 229	3
162 to 229	2
Fewer than 162	1

Findings

Table 28 | Parking Opportunities (Acres) by Station Candidate Zone

Station	Parking Opportunities	Rating
West Durham	28.5	1
Downtown Durham	70.9	1
East Durham	99.3	1
Bethesda	327	3
North RTP	200.6	2
MetroCenter RTP	211.6	2
Morrisville	231.3	3
West Cary	143.3	1
Downtown Cary	84.9	1
West Raleigh	114.1	1
NC State West	64.5	1
NC State	30.9	1
Raleigh Union Station	77.9	1
South Raleigh	103	1
Garner	221.6	2
East Garner	576.8	3

[11] Properties defined as vacant in Durham County with a subcategory listed as utilities or protective overlay districts were excluded from the list of available land.

Parking Cost

Parking cost was represented using the daily maximum cost near station candidate zones.

Table 29 | Daily Maximum Parking Cost

Daily Maximum Cost ($)	Rating
Less than $3	1
$3 to $8.50	2
More than $8.50	3

Findings

Table 30 | Daily Maximum Parking Cost by Station Candidate Zone

Station	Daily Maximum Cost ($)	Rating
West Durham	$8	2
Downtown Durham	$13.75	3
East Durham	$0	1
Bethesda	$0	1
North RTP	$0	1
MetroCenter RTP	$0	1
Morrisville	$0	1
West Cary	$0	1
Downtown Cary	$0	1
West Raleigh	$0	1
NC State West	$0	1
NC State	$15	3
Raleigh Union Station	$12	3
South Raleigh	$0	1
Garner	$0	1
East Garner	$0	1

Station Evaluation Summary

The purpose of the station evaluation is not to rank all the proposed stations but to provide an understanding of their strength and weakness for each evaluation metric. Table 31 shows a summary of the ratings of all stations against each metric. The results show that express and limited-express stations generally have higher ratings for most of the metrics, especially for Downtown Durham, East Durham, Raleigh Union Station, and NC State. These four stations have a greater amount of people and jobs than others along the alignment, have more transit-dependent residents living nearby, are more likely to have existing affordable housing sited nearby, and also have higher parking costs. All of these characteristics are strongly associated with more transit ridership in the Triangle region and in other metropolitan areas.

Table 31 | Station Candidate Zones Rating Matrix

	Connectivity (1/2-Mile Road Network Buffer)		**Equity** (1/2-Mile Road Network Buffer and 1-Mile Straight-Line Buffer)							**Transit Supportive Land Use** (1/2-Mile Road Network Buffer)		**Parking Access**	
Station	Transit Connectivity	Ease of Access	Affordable Housing	Minority Access		Low-Income Households		Transit Dependent Access		Total People + Jobs	Concentration of People + Jobs	Parking Opportunities	Parking Cost
				½-Mile Buffer	1-Mile Buffer	½-Mile Buffer	1-Mile Buffer	½-Mile Buffer	1-Mile Buffer				
West Durham	3	2	1	3	3	2	3	1	1	1	1	1	2
Downtown Durham	3	3	2	3	3	2	2	2	2	3	3	1	3
East Durham	2	3	3	3	3	3	2	2	3	2	1	1	1
Bethesda	1	1	1	3	3	1	1	1	1	1	1	3	1
North RTP	1	1	1	3	3	1	1	1	1	1	1	2	1
MetroCenter RTP	1	1	1	3	3	1	1	1	1	1	1	2	1
Morrisville	1	1	1	3	3	1	1	1	1	1	1	3	1
West Cary	1	1	1	2	2	1	1	1	1	1	1	1	1
Downtown Cary	1	3	2	2	2	1	1	1	1	2	1	1	1
West Raleigh	1	2	1	3	2	2	1	1	1	1	2	1	1
NC State West	1	1	1	2	2	2	2	1	3	1	1	1	1
NC State	3	2	1	1	2	2	2	3	3	3	3	1	3
Raleigh Union Station	3	3	2	2	3	2	2	1	3	3	3	1	3
South Raleigh	1	1	1	3	3	1	2	1	3	1	1	1	1
Garner	1	2	2	3	3	1	1	1	1	1	1	2	1
East Garner	1	1	1	3	3	1	1	1	1	1	1	3	1

3.3 RIDERSHIP

➲ Boardings per Revenue Hour

Methodology

TRM v6, the most recent version of the TRM, was used to develop the ridership evaluation measure. Before applying the model, it was decided by the Project Management Team (PMT) and CTTs that the base model would use the 2035 Metropolitan Transportation Plan (MTP). However, to reflect the long-term demands of transit in the region, the adopted 2045 land use and socio-economic data were used, while using the 2035 transportation and transit network. It should be noted that the Durham-Orange Light Rail project was discontinued after the CRT evaluation work were complete, so the findings of this study assumed the presence of the Durham-Orange LRT. The LRT-related network changes will be addressed in the next phase of studies.

There were two basic steps required before the model could be applied for the multiple CRT scenarios. The first of these was to run the model exactly as provided by CAMPO to confirm that the results of the model runs made for this evaluation were consistent with previous runs of the model by CAMPO. After confirming that these runs of the model were consistent with the CAMPO runs, a second set of runs were made to modify the 2035 MTP networks to reflect the Wake Transit proposal for the CRT. Edits to the network included:

- Removing the Apex to Wake Forest CRT line,
- Moving the CRT stations to reflect the 16 locations used in this MIS,
- Adjusted the station-to-station CRT travel times and speeds to reflect link-specific speeds rather than the same average speed used for all links in the 2035 MTP network, and
- Coded the stations with park-and-ride as defined in the MIS scenarios definitions.

This last set of runs produced results for the CRT scenario with all 16 stations and the 8-2-8-2 operating plan. These runs again produced overall ridership results that were consistent with those in the previous model runs done by CAMPO in the long-range transportation planning process in terms of order of magnitude of ridership and profiles of ridership at each of the 16 stations.

Findings

TRM runs were made for multiple station and operating scenarios, ranging from limited peak-period-only service to all-day service. These are represented by the 4-0-4-0, 8-2-8-2, and 8-4-8-4 scenarios. In addition, there were two major station scenarios, one with 16 stations and a second with 12 stations. The resulting ridership analysis focuses on the relative performance between the scenarios and is not designed to generate specific estimates of future ridership that would be used to support or not support the Commuter Rail project's implementation. This analysis of ridership will be developed in more detail in future studies in which additional level of effort will be devoted to the ridership forecasts. It is possible to draw several key conclusions of the results produced by the TRM v6 model runs for the various scenarios.

Boardings/Vehicle Revenue Hour of Service Evaluation

The evaluation measure for ridership is boardings/vehicle revenue hour of service. This measure was chosen to evaluate the relative performance of the scenarios and not produce a specific estimate of daily ridership. The refinement of the ridership estimates will be done in future phases of the study. The measure selected reflects both the overall daily ridership and the level of service provided. It is also consistent with data reported in the National Transit Database (NTD) and can be compared with the same measure from existing commuter rail systems. In this measure the term "vehicle revenue hour of service" is defined as the number of commuter rail passenger car (defined as a vehicle) hours of revenue service. This is not the number of train hours as a train is comprised of multiple passenger cars or vehicles.

During the commuter rail peer review task, a summary of multiple commuter rail systems was developed. This included the Boardings/Vehicle Revenue Hour of Service. The measure ranged from a low of 21 for the A-Train in Denton, Texas, to a high of 64 for the MetroRail in Austin, Texas. For purposes of this analysis, it is assumed that the number of passenger cars or vehicles for each of the scenarios is three vehicles per train.

Four model runs were used to develop the ridership measure for the commuter rail scenarios. The four runs were selected to evaluate both the operating scenarios (trains/day) and the number of stations.

Findings

Table 32 | Boardings/Vehicle Revenue Hour of Service

Scenario	Operating Plan	Trains/Day	Number of Stations	Boardings/Vehicle Revenue Hour of Service
1A	4-0-4-0	16	16	84
2A	8-2-8-2	40	16	49
3A	8-4-8-4	48	16	46
2B	8-2-8-2	40	12	51

Table 32 presents the boardings/vehicle revenue hour of service for each of the four scenarios, representing a range of service levels and station locations. The scenarios all measure within the range of existing commuter rail systems, and excluding Scenario 1A, the results for the other three scenarios are grouped around 45 to 50 boardings/vehicle revenue hour of service. Scenario 1A has a higher value that is largely driven by the relatively low number of trains per day as compared to the other three scenarios.

In addition to the evaluation measures described above, there are several observations regarding the evaluation of ridership in this task. These include:

- The TRM v6 appears to be sensitive to the coding of the scenarios, including the connections between local bus service and the CRT. The TRM v6 had a significant percentage of boardings for the CRT coming from bus transfer as opposed to auto access (park-and-ride).
- Correcting the coding of the park-and-ride locations did shift the mode of access from bus transfer to auto. However, bus transfers remained the predominant mode of access. Further analysis of the mode of access needs to be done in future ridership estimates using TRM v6.

- While the ridership measure (boardings/vehicle revenue hour) for Scenario 1A was the highest, the actual ridership levels (total boardings) for this scenario dropped by approximately a third as compared to the Scenario 2A, where the service frequency was higher. For future consideration of Scenario 1A, the actual capital and operating costs for the scenarios will have to be prepared.
- While the evaluation measure (boardings/vehicle revenue hour) for Scenarios 2A and 2B were approximately the same (49 and 51, respectively), the overall ridership (total boardings) did drop for Scenario 2B in which the number of stations was reduced from 16 to 12 stations. This indicates that any ridership gain from reduced travel times is offset by the ridership lost with the reduced number of stations.

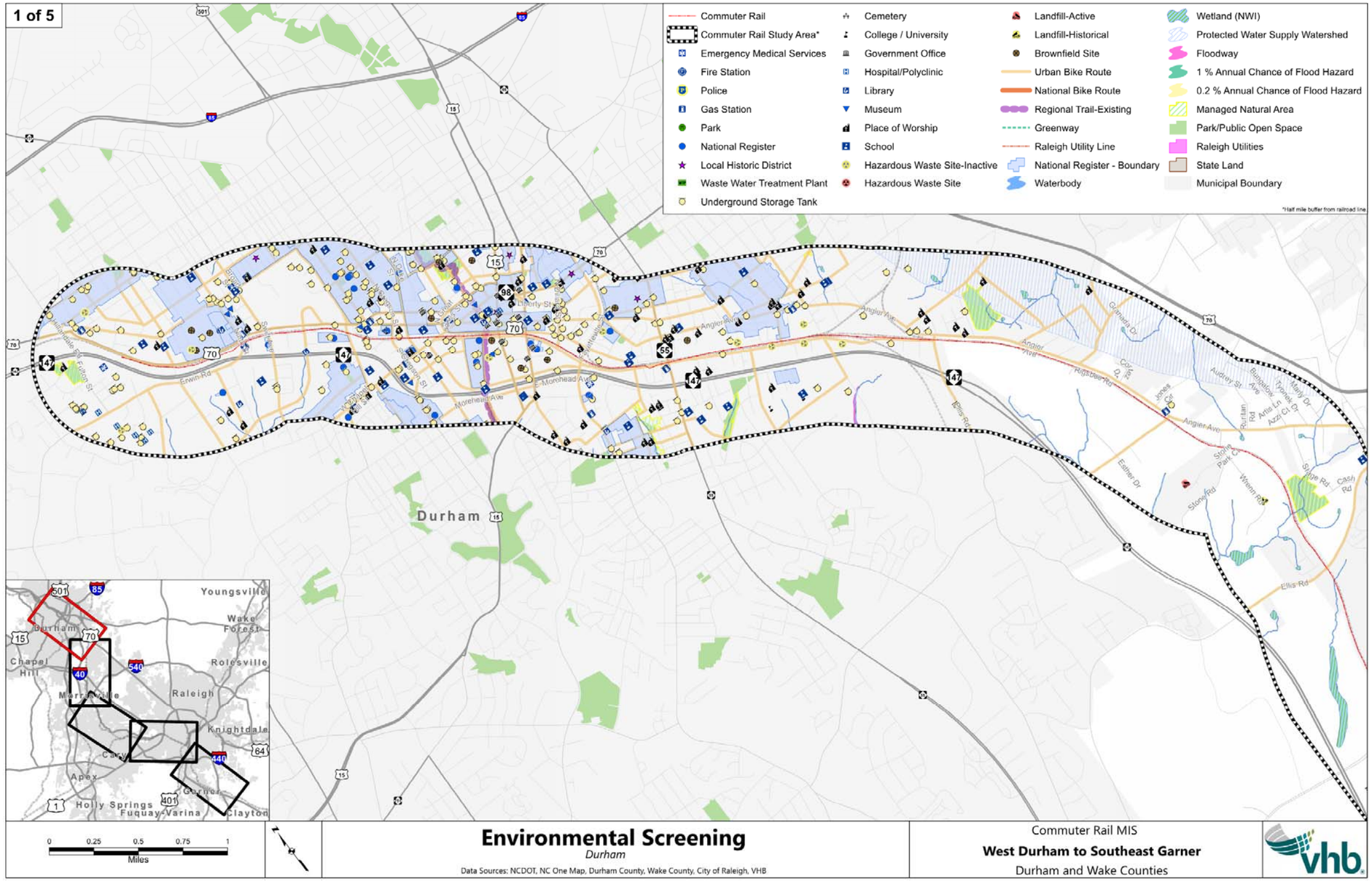
4. Conclusion

This Major Investment Study is conducted to further refine the Commuter Rail Transit (CRT) project as identified in the Wake Transit Plan. The purpose of this document is to develop and evaluate potential scenarios for the CRT service proposed between West Durham and East Garner.

The evaluation of the CRT operating scenarios and station candidate zones resulted in the following key findings:

- While this study looked at the FTA measures and criteria, the project will need additional evaluation that can be used for FTA scoring. That will be accomplished in the next phase of studies. However, this study did produce results that support further analysis,
- Travel times for CRT in the corridor are faster and more reliable than longer distance driving and bus routes,
- The operating scenario providing service every 30 minutes in the peak periods and limited service in the off-peak periods of mid-day and evening service was the most productive among the scenarios studied,
- All 16 potential candidate station zones are appropriate for further analysis. In future phases, alternative sites for the stations within the candidate zone (or additional candidate zones) will need to be identified and evaluated in terms of physical design constraints, access to local land uses, and operational analysis with the other rail services within the corridor,
- Ridership results are consistent with similar statistics for recent commuter rail systems, and
- Additional analysis is needed to refine ridership estimates and to identify infrastructure required to support the CRT operating plans studied in this evaluation.

Appendix A – Environmental Screening, LBAR, and Available Land Maps



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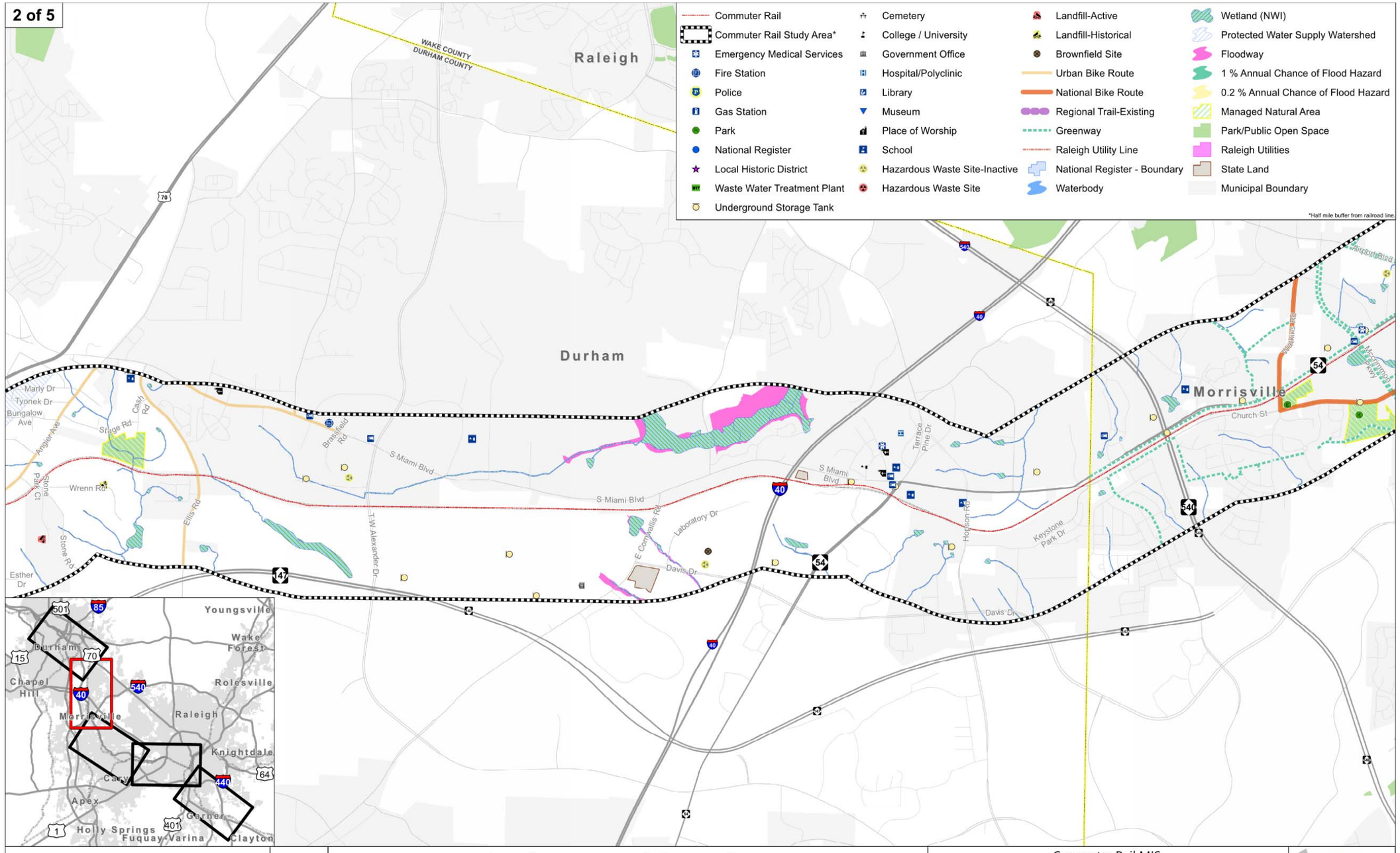


0 0.25 0.5 0.75 1 Miles

Environmental Screening

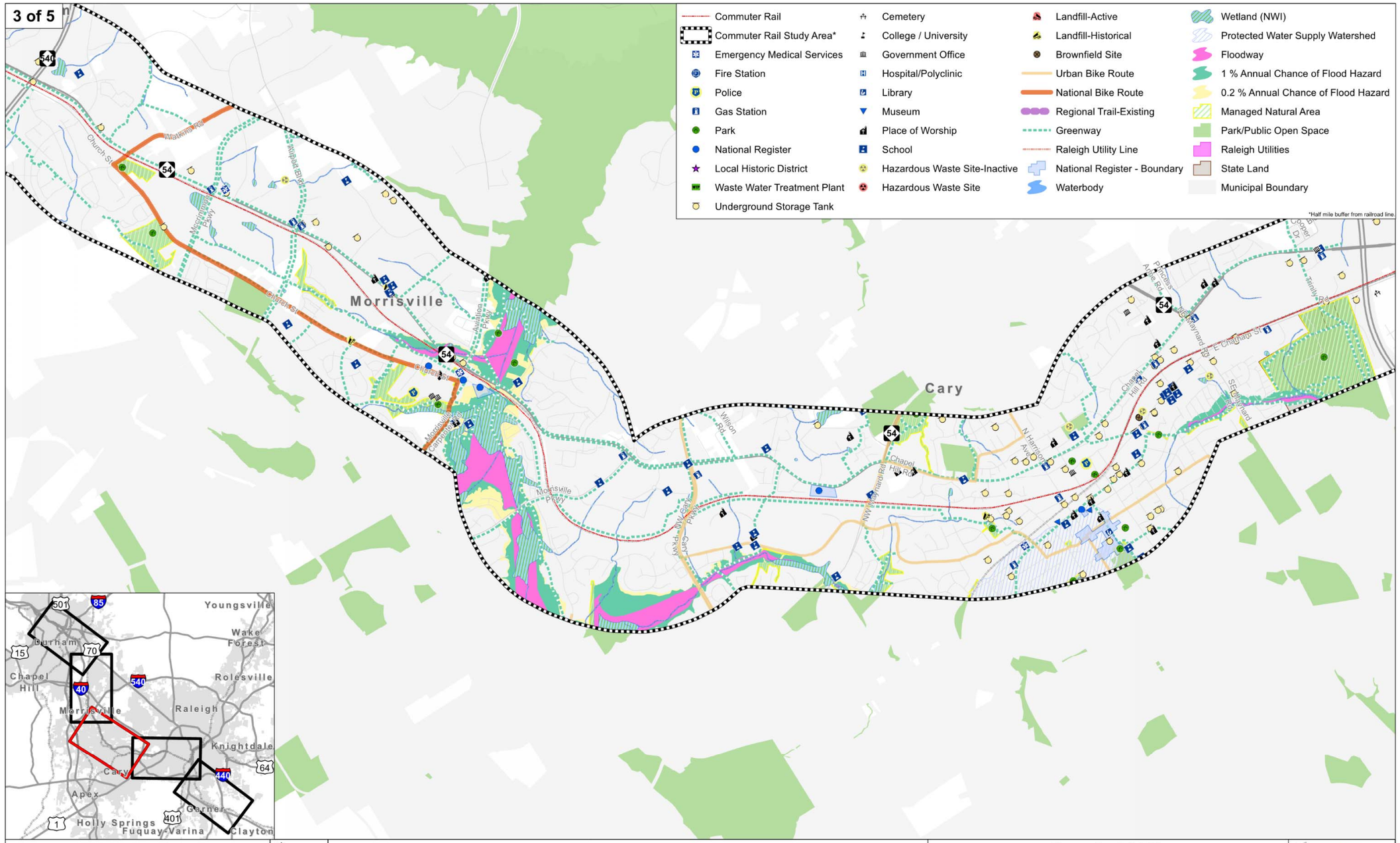
Durham and Morrisville

Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB

Commuter Rail MIS

West Durham to Southeast Garner

Durham and Wake Counties



Environmental Screening

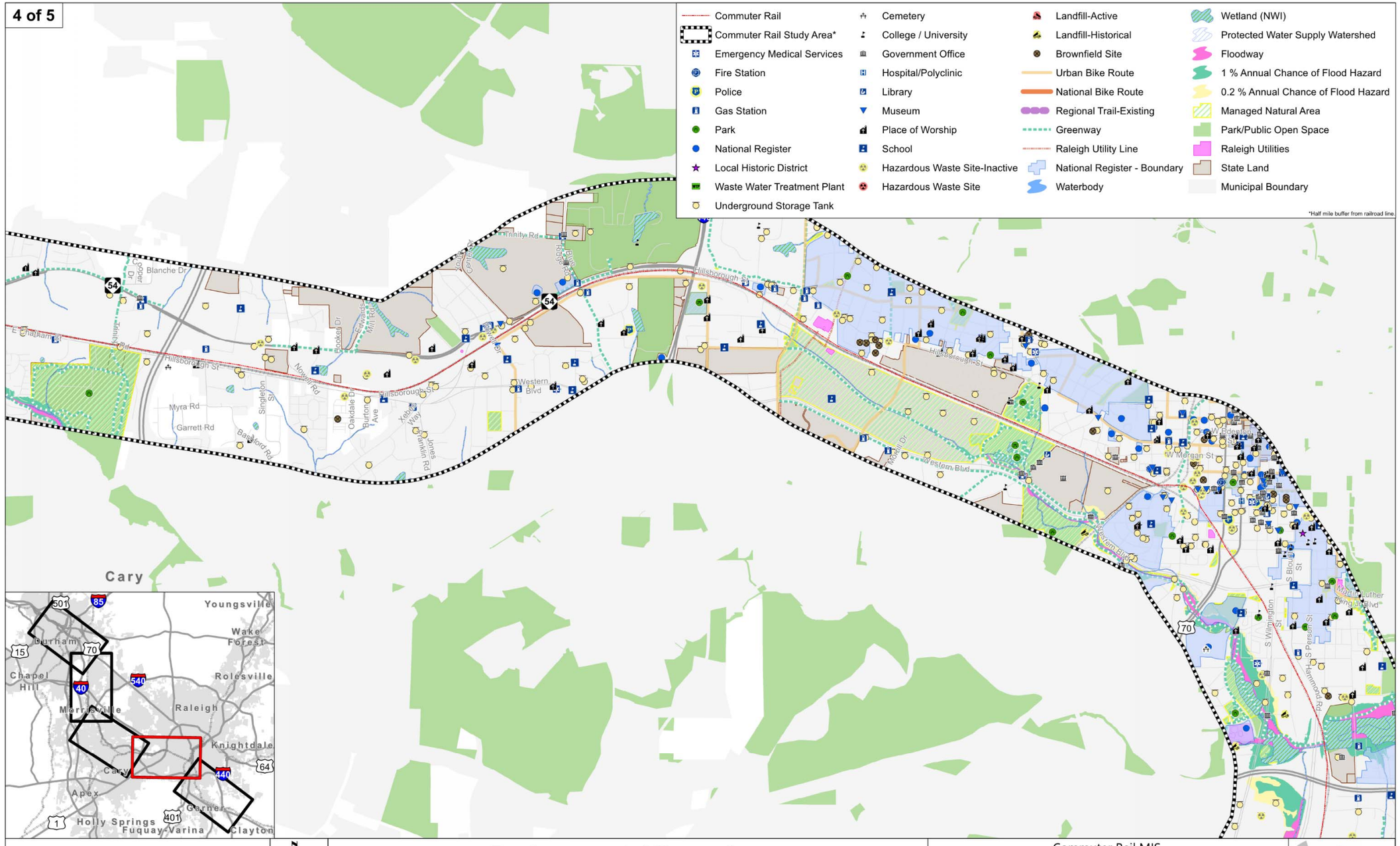
Morrisville and Cary

Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB

Commuter Rail MIS

West Durham to Southeast Garner

Durham and Wake Counties



Environmental Screening

Cary and Raleigh

Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB

Commuter Rail MIS

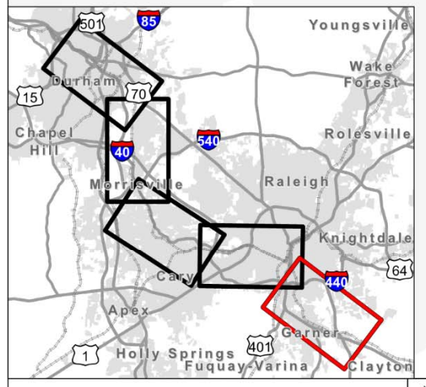
West Durham to Southeast Garner

Durham and Wake Counties

5 of 5

- Commuter Rail
- Commuter Rail Study Area*
- Emergency Medical Services
- Fire Station
- Police
- Gas Station
- Park
- National Register
- Local Historic District
- Waste Water Treatment Plant
- Underground Storage Tank
- Cemetery
- College / University
- Government Office
- Hospital/Polyclinic
- Library
- Museum
- Place of Worship
- School
- Hazardous Waste Site-Inactive
- Hazardous Waste Site
- Landfill-Active
- Landfill-Historical
- Brownfield Site
- Urban Bike Route
- National Bike Route
- Regional Trail-Existing
- Greenway
- Raleigh Utility Line
- National Register - Boundary
- Waterbody
- Wetland (NWI)
- Protected Water Supply Watershed
- Floodway
- 1 % Annual Chance of Flood Hazard
- 0.2 % Annual Chance of Flood Hazard
- Managed Natural Area
- Park/Public Open Space
- Raleigh Utilities
- State Land
- Municipal Boundary

*Half mile buffer from railroad line.



0 0.25 0.5 0.75 1 Miles

Environmental Screening

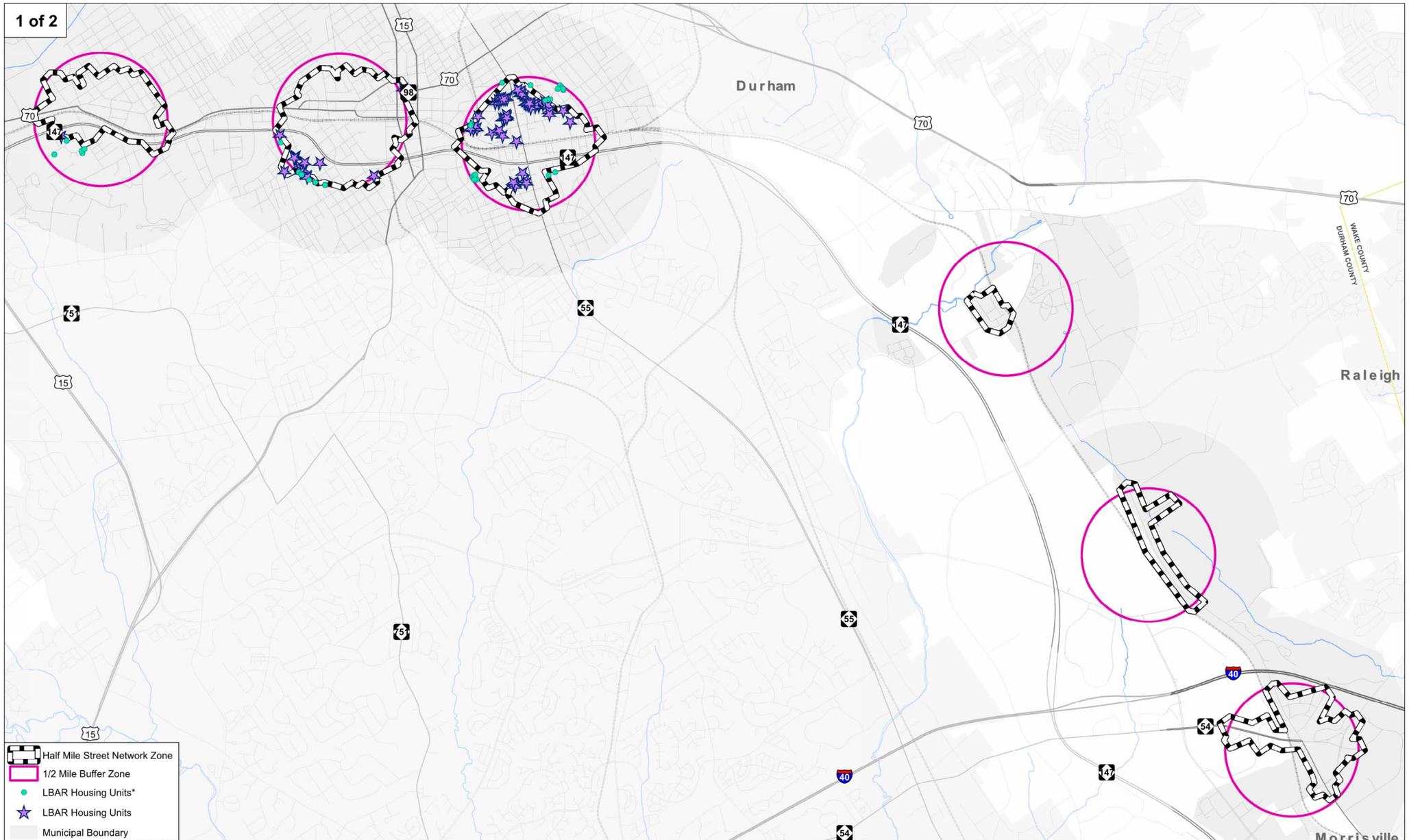
Raleigh and Garner

Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB

Commuter Rail MIS

West Durham to Southeast Garner

Durham and Wake Counties



Legally Binding Affordably Restricted (LBAR) Housing

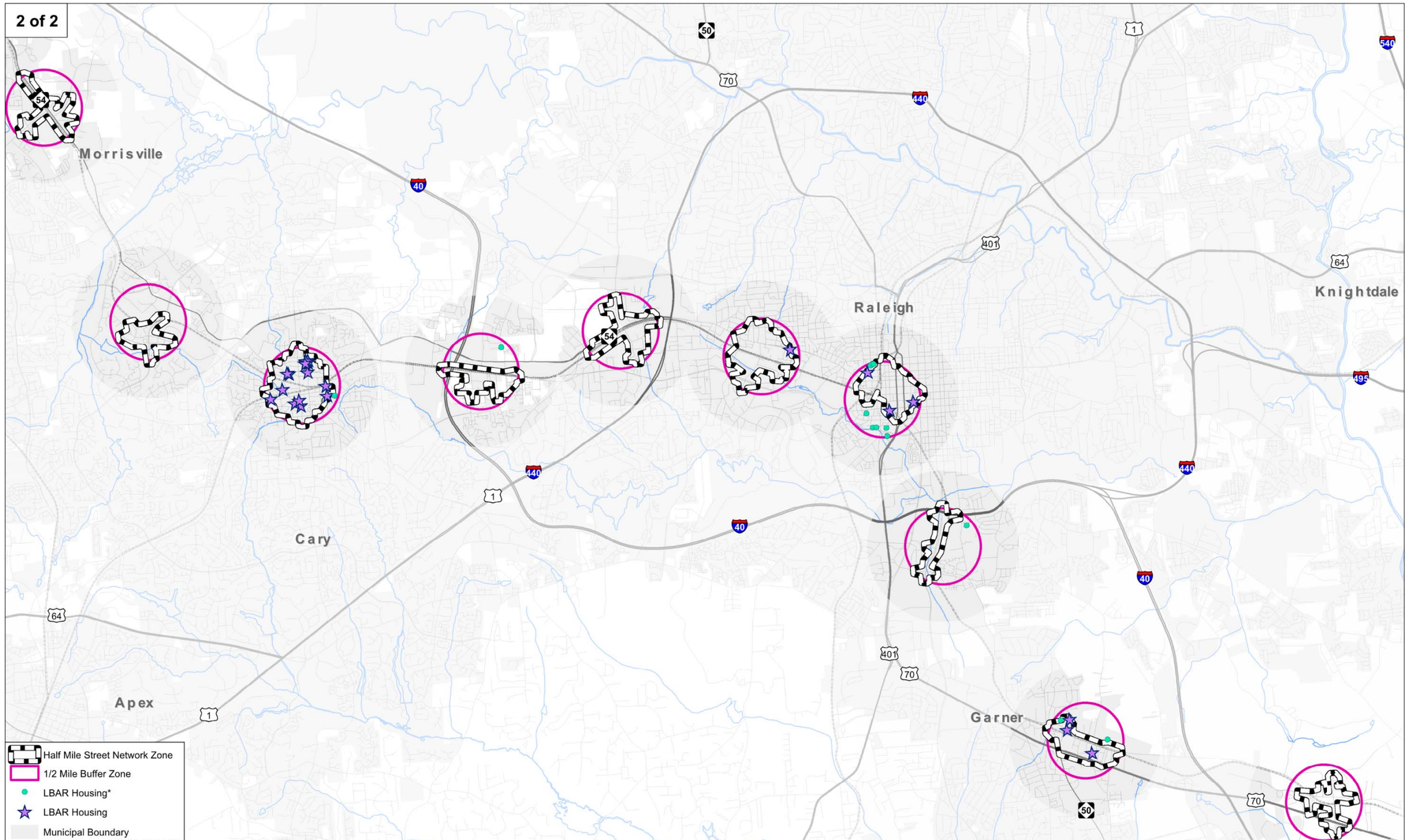
Durham County

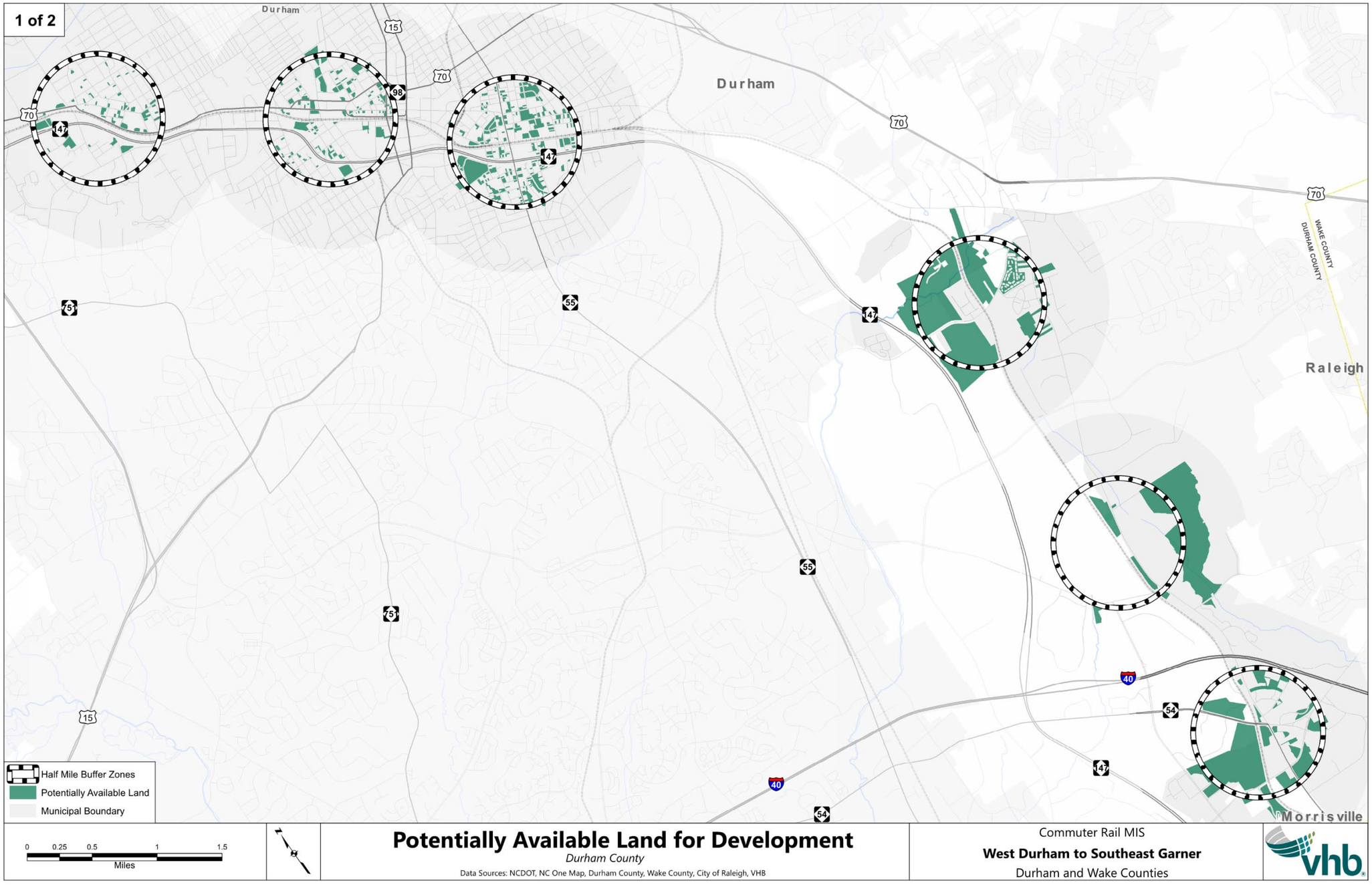
Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB

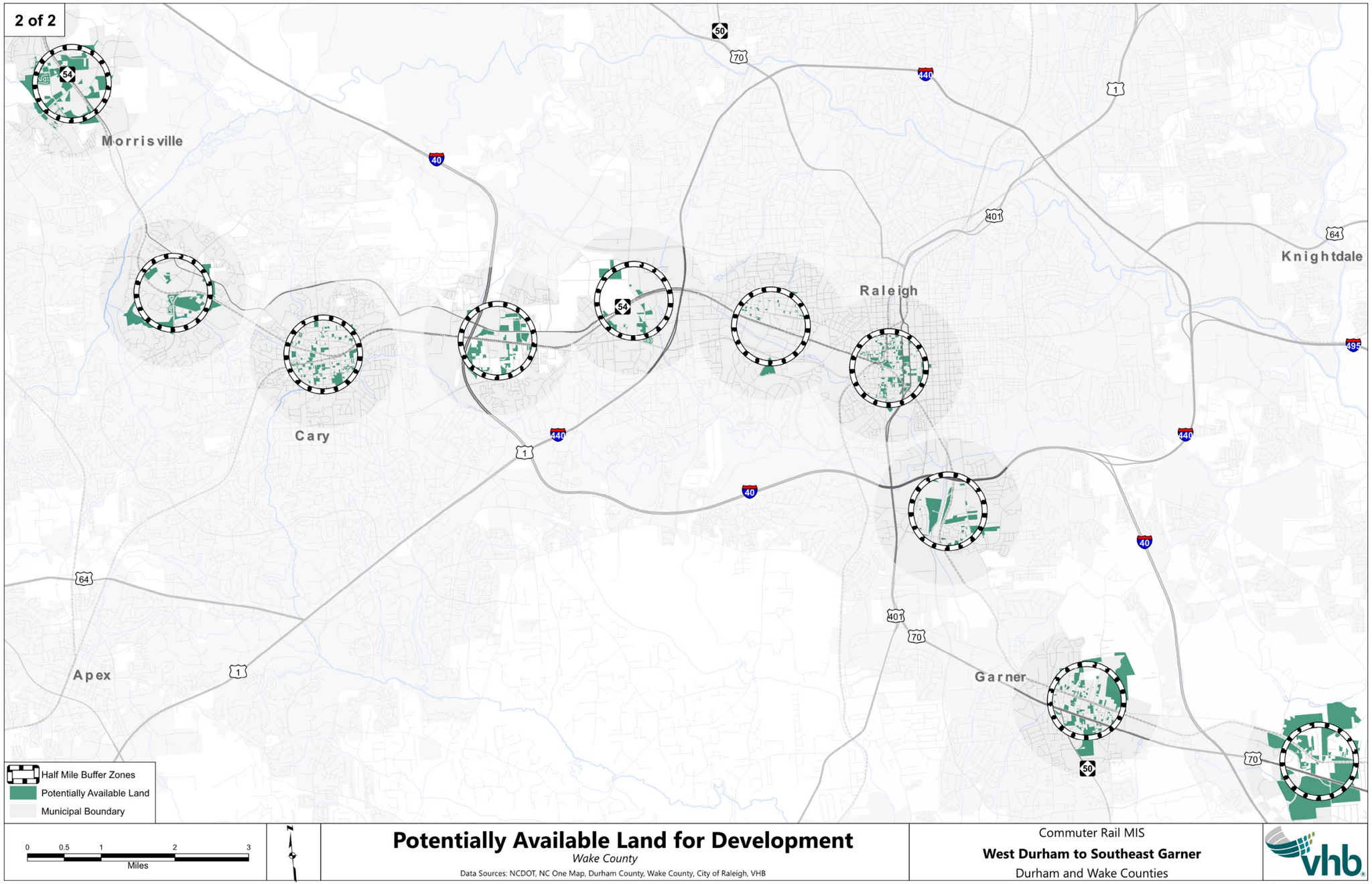
Commuter Rail MIS

West Durham to Southeast Garner

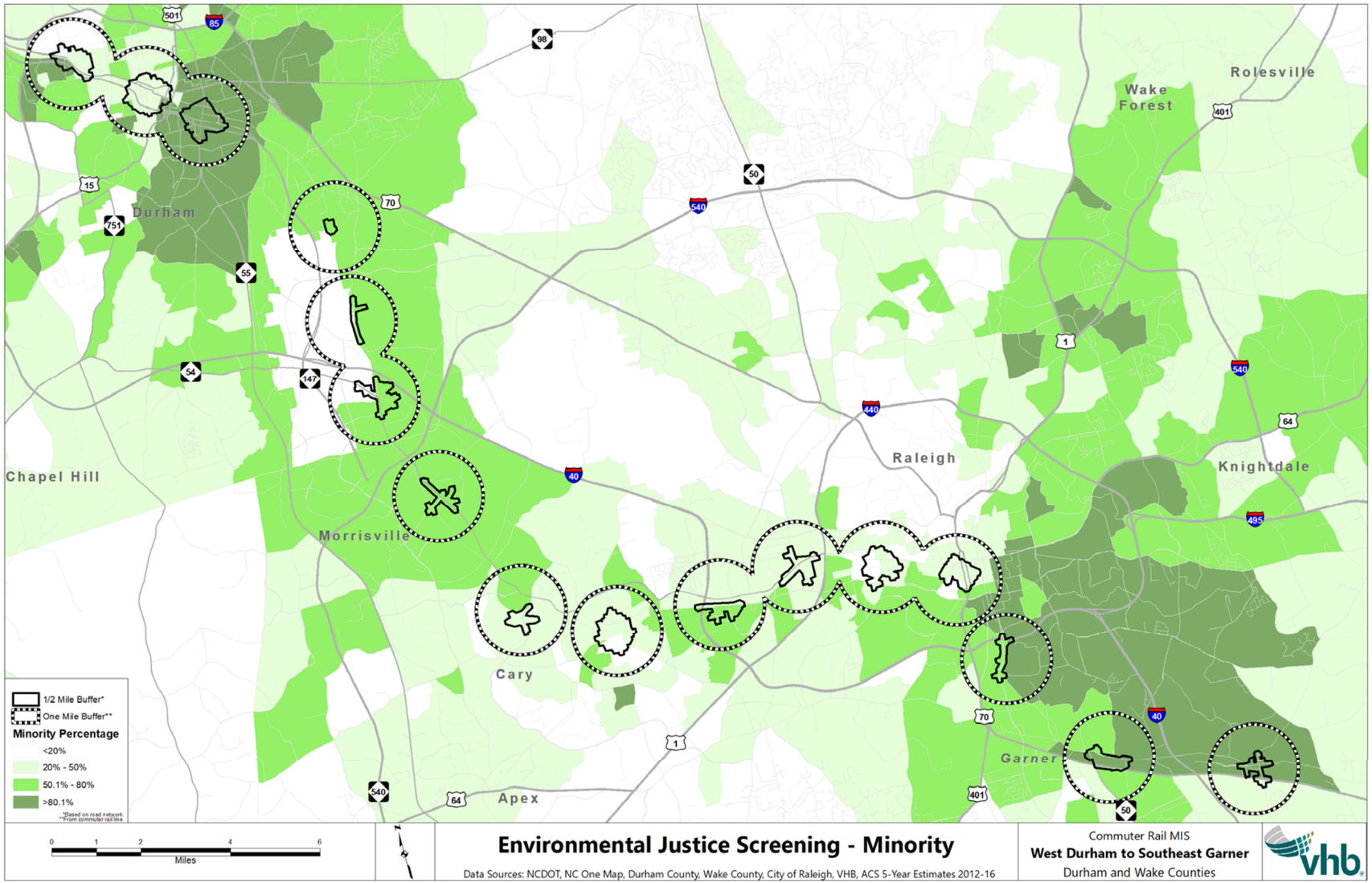
Durham and Wake Counties

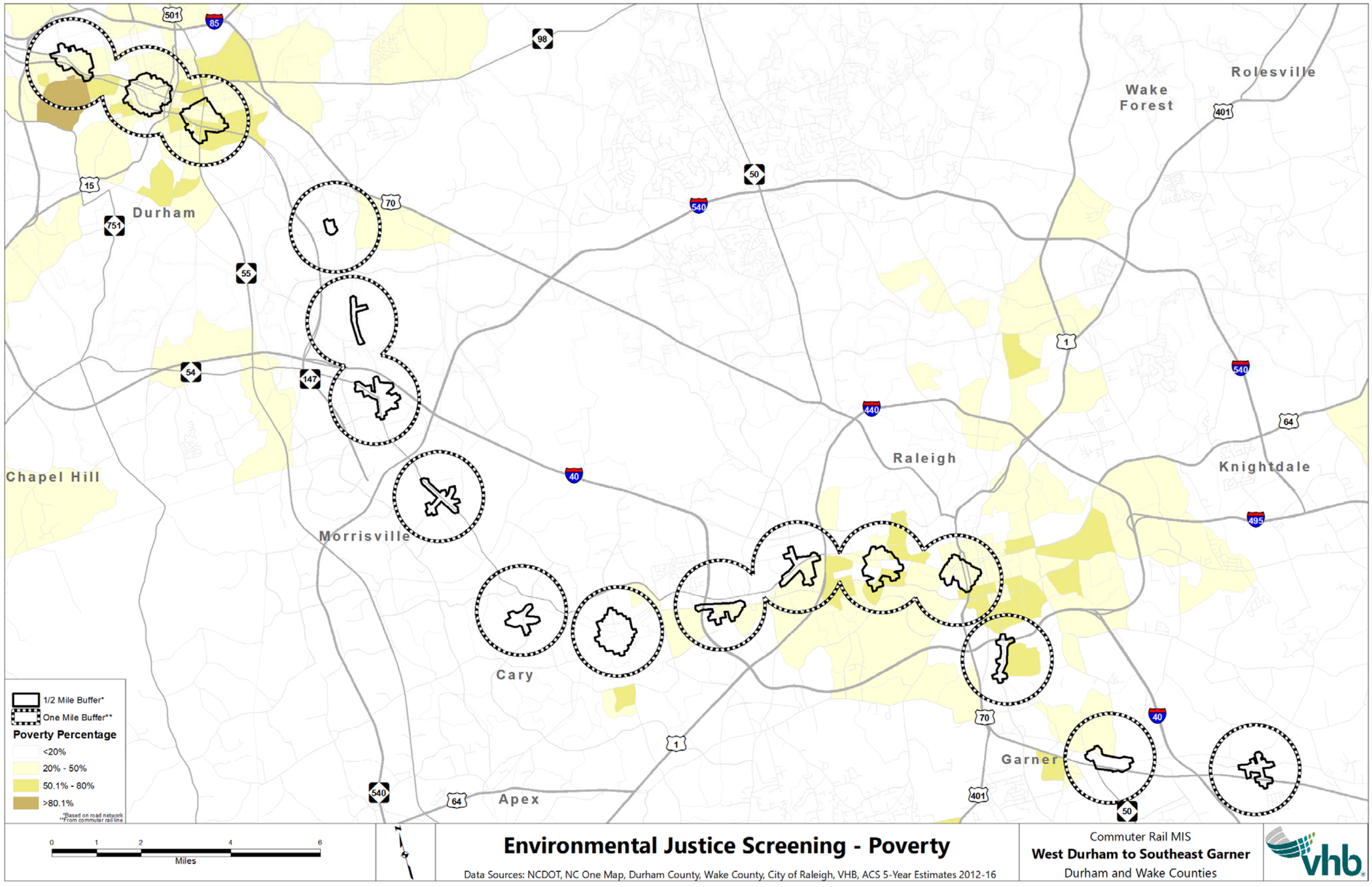

2 of 2
Morrisville
Cary
Apex
Raleigh
Garner
Knightdale
Half Mile Street Network Zone
1/2 Mile Buffer Zone
LBAR Housing*
LBAR Housing
Municipal Boundary
*Located between the two zones.
0 0.5 1 2 3
Miles
Legally Binding Affordably Restricted (LBAR) Housing
Wake County
Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB
Commuter Rail MIS
West Durham to Southeast Garner
Durham and Wake Counties
vhb

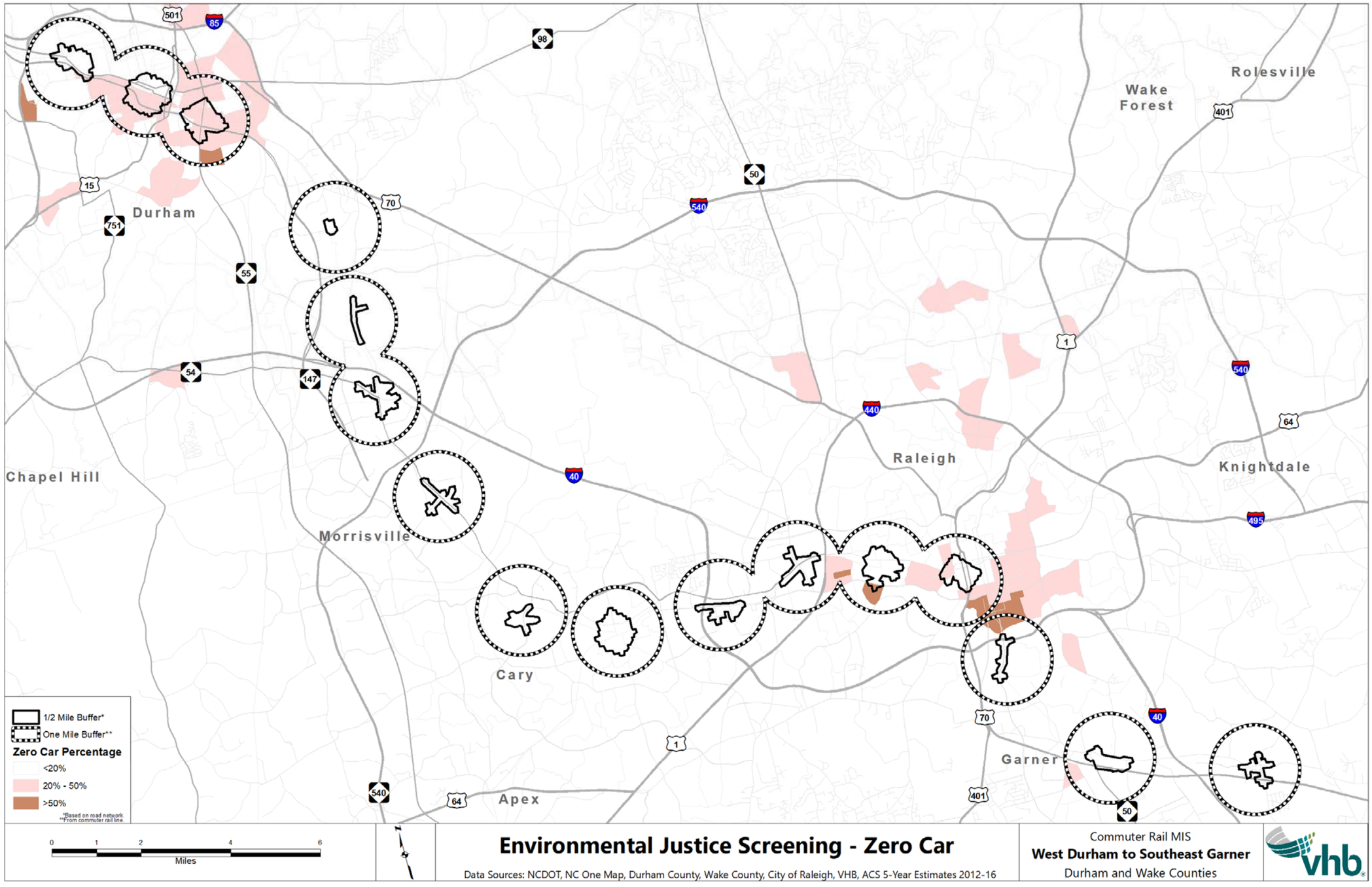

1 of 2
Durham
Durham
Raleigh
Morrisville
WAKE COUNTY
DURHAM COUNTY
Half Mile Buffer Zones
Potentially Available Land
Municipal Boundary
0 0.25 0.5 1 1.5
Miles
Potentially Available Land for Development
Durham County
Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB
Commuter Rail MIS
West Durham to Southeast Garner
Durham and Wake Counties
vhb


2 of 2
Morrisville
Cary
Raleigh
Knightdale
Apex
Garner
Half Mile Buffer Zones
Potentially Available Land
Municipal Boundary
0 0.5 1 2 3
Miles
Potentially Available Land for Development
Wake County
Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB
Commuter Rail MIS
West Durham to Southeast Garner
Durham and Wake Counties
vhb

Appendix B – Equity Maps




Durham
Chapel Hill
Morrisville
Cary
Raleigh
Wake Forest
Rolesville
Knightdale
Garner
Apex
1/2 Mile Buffer*
One Mile Buffer**
Poverty Percentage
<20%
20% - 50%
50.1% - 80%
>80.1%
*Based on road network
**From commuter rail line
0 1 2 4 6
Miles
Environmental Justice Screening - Poverty
Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB, ACS 5-Year Estimates 2012-16
Commuter Rail MIS
West Durham to Southeast Garner
Durham and Wake Counties
vhb


Durham
Chapel Hill
Morrisville
Cary
Raleigh
Wake Forest
Rolesville
Knightdale
Garner
Apex
501
85
98
15
751
70
55
54
147
50
540
40
1
440
64
495
401
1/2 Mile Buffer*
One Mile Buffer**
Zero Car Percentage
<20%
20% - 50%
>50%
*Based on road network
**From commuter rail line.
0 1 2 4 6
Miles
Environmental Justice Screening - Zero Car
Data Sources: NCDOT, NC One Map, Durham County, Wake County, City of Raleigh, VHB, ACS 5-Year Estimates 2012-16
Commuter Rail MIS
West Durham to Southeast Garner
Durham and Wake Counties
vhb