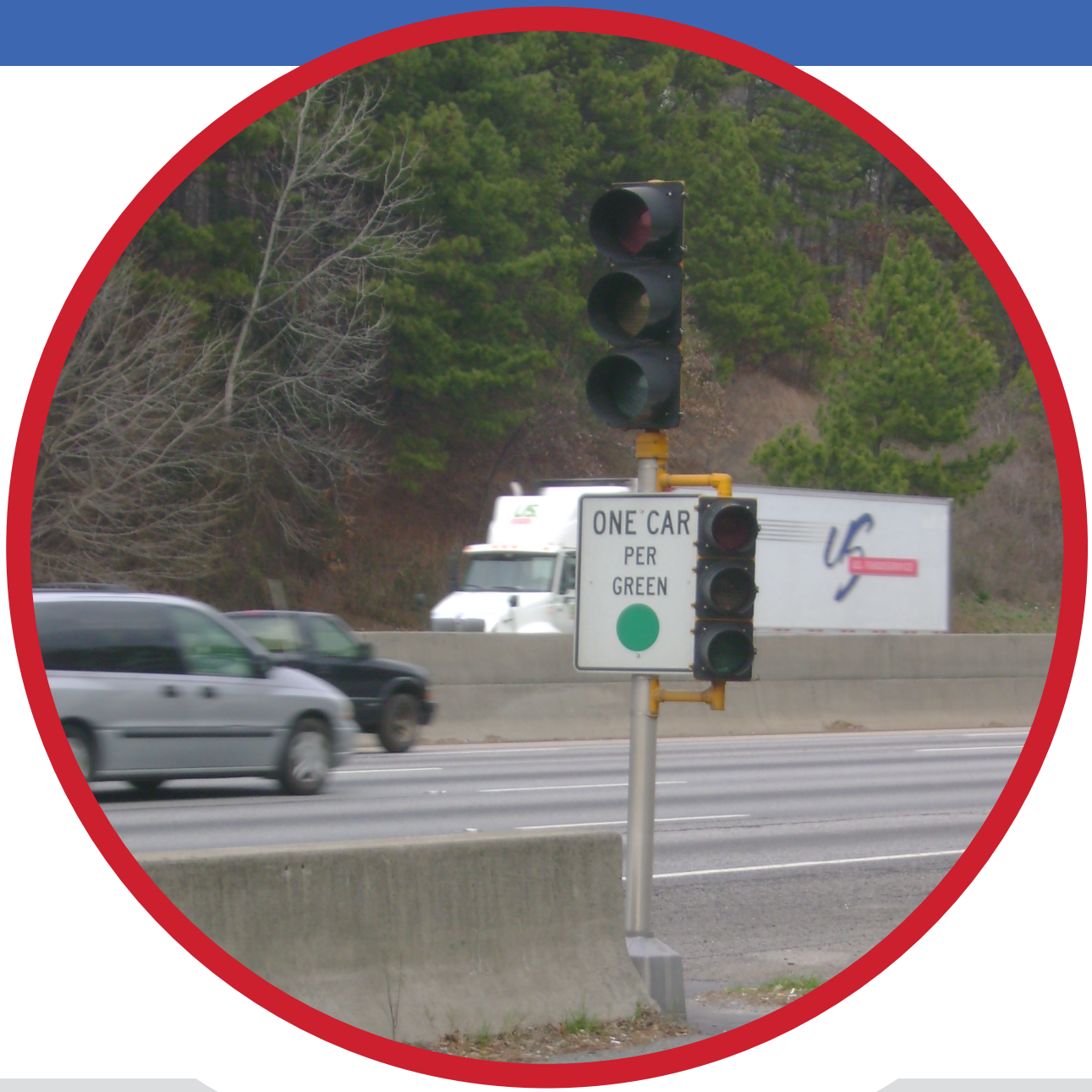
Executive Summary



M-0468 Ramp Metering Feasibility Study for Cabarrus, Gaston, Iredell and Mecklenburg Counties

1. Executive Summary

1.1. The Need for Ramp Metering

North Carolina's roadways are becoming more and more congested, especially on the interstate system within the major metropolitan areas. The Metrolina region, which consists of routes and cities within Cabarrus, Gaston, Iredell, and Mecklenburg counties, is one of the most heavily congested areas of the state. Not only does the Metrolina region have tremendous traffic challenges day to day, they are home to several major league sporting teams/events such as the Carolina Panthers, Charlotte Hornets, and Charlotte Motor Speedway (NASCAR) as well as home to the state's largest body of freshwater, Lake Norman. All of these venues/events contribute to increased traffic to an already congested region.

In an effort to mitigate the congestion in the region, NCDOT realizes that the solution can't be to build their way out of it. The state is looking for more innovative solutions to tackle both the day to day and event generated traffic on the regions roadways. One innovative solution is the installation of ramp metering technology on the entrance ramps of limited access highways. This technology regulates the flow of vehicles entering the freeways according to current traffic conditions. Detectors installed on the mainline of the freeways and entrance ramps monitors traffic and notifies ramp traffic of available gaps. By regulating when the ramp traffic can merge into the mainline traffic, it helps to maintain travel speeds and capacity and mitigates the potential for crashes where the entrance ramps meet the freeway.

NCDOT contracted with Atkins to conduct a feasibility study for the implementation of ramp metering in the Metrolina region. The study's final recommendations were based on tasks that included: Data Collection, Screening and Detailed Analysis, National Research, Legal and Regulatory Review, Typical Design Criteria, Typical Cost Estimates, Performance Measures, and an Implementation Plan. This project included implementation recommendations for the Metrolina region with guidance on typical design criteria and estimated costs.

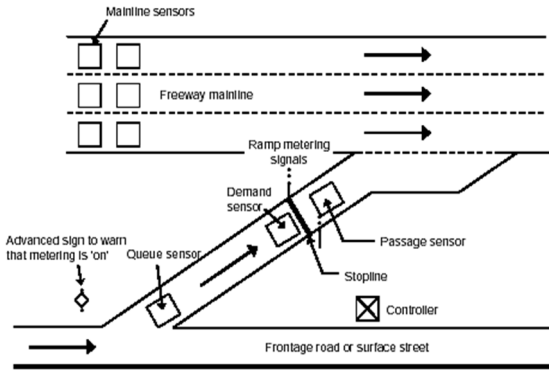
1.2. Data Collection

The project study began with 249 sites, 47 of those were freeway to freeway (F2F) sites, in Cabarrus, Gaston, Iredell, and Mecklenburg Counties on sections of I-77, I-85, I-277, I-485, and US 74 (Independence Blvd.). During the Detailed Analysis phase, two additional sites were added at the request of the City of Charlotte for evaluation bringing the total sites to 251. Initially, traffic congestion data and basic geometric data was collected to ascertain whether sites are freeway-to-freeway ramps and to determine if they have an appropriate level of traffic congestion. The data collected at each site included recording the condition of the pavement/shoulders at a site, documenting any lateral impediments (i.e. – guardrail, barrier way, frontage roads, etc.), the geometric data for the ramp (i.e. - length of ramp, number of lanes, width of the lanes, etc.), drainage structures in the ramp area, vegetation, horizontal and vertical grades, and locations of signs and power sources in the area. Crash data was also collected for each site to ascertain the types and locations of incidents on the ramps as well as the merge area with the freeway.

This initial data was organized into a master database, designed to accommodate the additional data collected, analyses performed and any other relevant data collected over the course of this project.

1.3. National Research

The *National Research Report*, which is an updated version of the Durham and Wake Counties report, summarizes the state of ramp metering systems throughout the United States as well as deployments in Europe. The report discusses the types of ramp meter operations available for deployment (fixed, local traffic responsive, system-wide traffic responsive, and adaptive), the operations strategies available that dictate the timing and capacity of the ramp meters (single lane/one car, single lane/multiple cars, and dual lane) the technology used for each type of deployment, the criteria used for selecting a site for ramp metering installations, estimated costs for implementation, and design standards for the various types of ramp meter installations.



Conceptual Ramp Metering Detector Configurations

The desired outcome of the national research was to leverage lessons learned and successes from our transportation peers around the nation/world. These lessons learned and success stories will assist NCDOT with making informative decisions for a success deployment of ramp metering in North Carolina.

Additionally, the research included the measures of effectiveness or benefits that ramp meters have provided to those areas.

1.4. Legal and Legislative Review

In early 2013, a thorough review of North Carolina state law and local regulations was conducted to ascertain if there are any restrictions on the implementation of ramp metering and whether any changes were needed to North Carolina state laws and NCDOT policies. The effort also summarizes the experiences of other states with regard to legal and regulatory issues.

The requirements of the most current (2009) *Manual of Uniform Traffic Control Devices* (MUTCD) were evaluated to assess any impacts on the implementation of ramp metering.

The review identified some potential issues with the enforcement of the ramp meters during non-operational periods. The review recommended several alternatives to address these issues. In 2014, legislation was passed that outlined two-section signal heads (red and green balls) will be used at ramp meter signals.

1.5. Screening and Detailed Analysis

The analysis of the candidate study sites (See Figure 1) consisted of a three-step review and analysis process that examined a higher level of detail to evaluate their suitability for ramp metering.

1. Create a master list of all sites in study area
2. Initial screening of the data that would identify suitable sites for further analysis
3. Identification of any factors that would reclassify sites as suitable in the future

This process provided a cost effective means to evaluate and eliminate sites that were not suitable without further collecting unnecessary data.

The creation of a Master List of all potential ramp meter sites within the study area was the initial step of the screening and detailed analysis. During this step, Atkins reviewed the geometric data of the ramps/merges and categorized each site as freeway-to-freeway, direct, semi-direct and indirect ramp types. A complete inventory of the geometric features was conducted, including number of lanes, lane additions and deletions, ramp lengths, grades, shoulder and lane widths, and observations of traffic flow.

After NCDOT's review of the Master List, it was agreed that two F2F sites would be included for further analysis. This provided the Department a better appreciation of the particular issues, safety concerns, associated costs, and potential for future improvements at these locations, and would provide a baseline for further evaluation and consideration in the future.

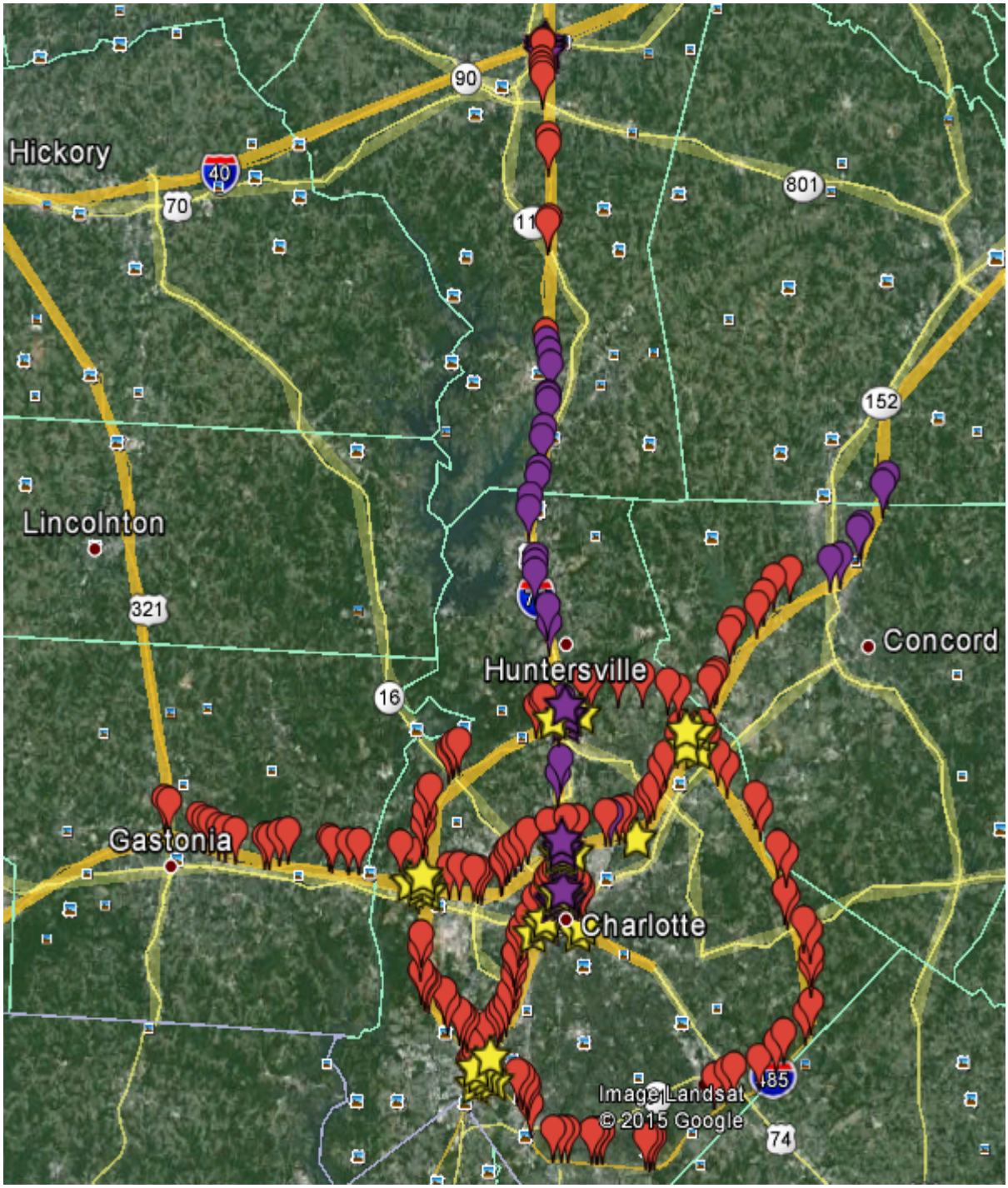


Figure 1. Potential Ramp Meter Locations

After the Master List was created, the second step was to perform an initial screening of the data. This step identified sites that were deemed suitable for a more detailed analysis. Atkins utilized the bottleneck ranking application from the Vehicle Probe Project (VPP) software suite developed by the University of Maryland CATT Lab to determine if a bottleneck is causing congestion at any of the eligible ramp meter sites. The bottleneck ranking application is an algorithm that compares the current speed to the free flow speed at night to determine if a bottleneck is causing congestion. If the current speed fell below 60% of the free flow speed, the location was flagged as a potential bottleneck. Each location was observed for 5 minutes, and if the speed stayed below 60%, the bottleneck was confirmed to be the cause of congestion. The bottleneck is not considered to be cleared until conditions have risen above the 60% threshold and the speed remains above the 60% threshold for a minimum of 10 minutes. Data for the suitable ramp meter sites was collected using this approach in both the spring and fall of 2015 for a period of at least one month.

Many of the bottleneck locations that were identified coincided with the merge area of an entrance ramp into the mainline traffic, suggesting that the merge area could be the cause of congestion. Entrance ramps adjacent to the bottleneck and the associated congestion spilling back upstream were considered "congested" and were identified and recorded in the Master List. There were 112 "congested" candidate sites and 51 "significant" bottlenecks identified.

The final step of the screening and detailed analysis of potential sites process was to identify any factors that would obviously rule a potential ramp meter site out as a suitable location in the future. The three main reasons for ruling out sites were:

- Site subject to congestion that could be attributed to lane closures for current roadway project
- Site upstream of a primary site already ruled out due to it being freeway-to-freeway site
- Site at the back of, or beyond the back of, congestion

At the conclusion of the screening analysis, 51 sites advanced for detailed analysis. The detailed analysis included:

- Collecting and analyzing traffic flow data to identify whether volumes at each site were within acceptable limits for ramp metering
- Collecting data concerning the locations and type of traffic signals
- Verifying that the period of congestion coincided with the period of suitable volumes
- Analyzing crash data
- Conducting field visits to each site
- Investigating the cause of congestion
- Quantifying the amount of congestion in the vicinity of the site
- Grouping sites by the congestion source

1.6. Typical Design Criteria

For the 51 sites carried forward from the Screening Analysis/Detailed Analysis, a site summary was prepared that summarized the data collected and analyzed with recommendations as to whether a site should be carried forward for further analysis or eliminated. Following the detailed review, the sites were categorized as follows:

- Feasible (30 sites): These sites have good characteristics and demonstrated potential to reduce observed congestion and will be advanced to the next phase of the study. (See Figure 2)
- Review in Future (7 sites): In some locations with more than one site in proximity, upstream sites may no longer be congested once the downstream sites have been implemented. In this case, the site would be reviewed and evaluated at a future time. (See Figure 3)
- Not Feasible (14 sites): A critical reason for the site not being suitable for ramp metering has been identified, such as very low entrance ramp volumes. (See Figure 4)

This Typical Design Criteria task included the development of recommended standards for site selection, locating the ramp meter, design criteria, operational strategies, and the design standards. For the actual field design, the standards identified the geometric layout, signalization design, signing, and pavement markings. Guidance was provided on the appropriate use of the standards and typical designs details. Seven typical details were developed showing conceptual designs for the following configurations:

- Single lane ramp meter
- Two lane ramp meter
- Three Lane Ramp Meter
- Single lane ramp meter with transit bypass
- Single lane freeway-to-freeway ramp meter
- Two lane freeway-to-freeway ramp meter
- Optional enforcement features

During the development of the *Typical Design Criteria Report*, the actual design specifications were evaluated along with impacts to those specifications. Both the physical site characteristics and traffic congestion were analyzed for both the ramp and the mainline. Consideration also had to be given to potential improvements at each location that could impact the traffic volumes, i.e. – changes to roadway layout, changes to number of lanes on freeway, changes to speed limits, etc.

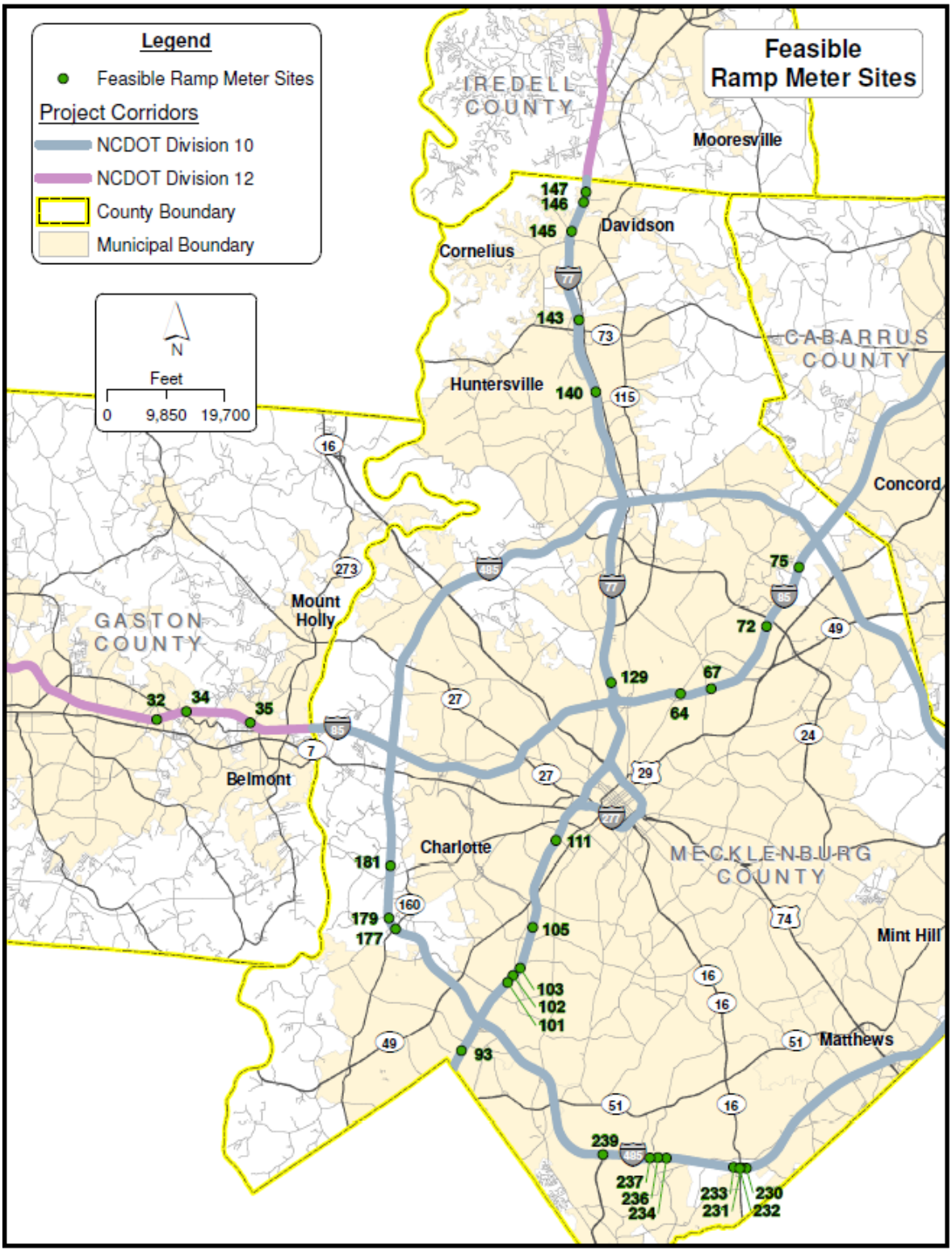


Figure 2. Feasible Ramp Meter Sites

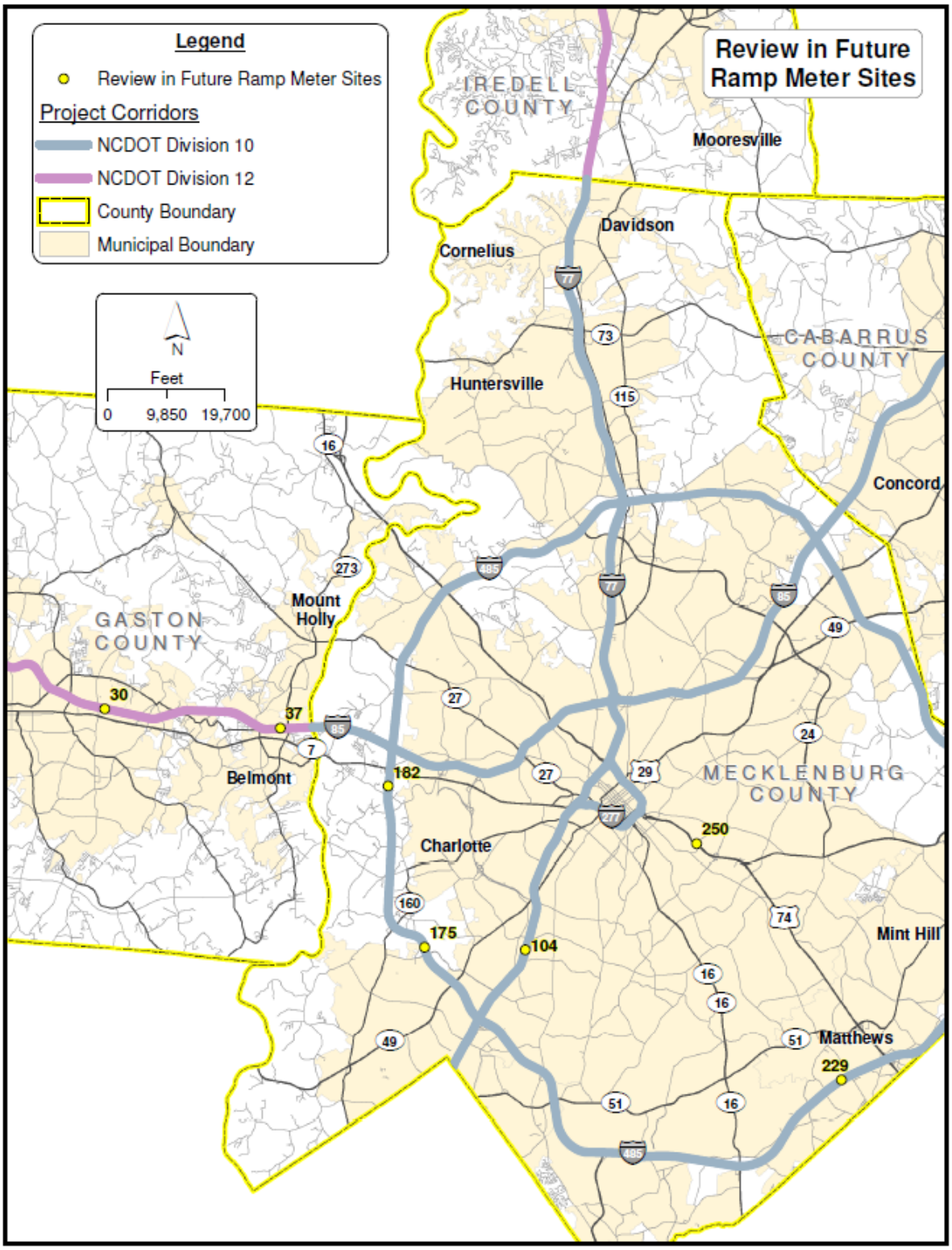


Figure 3. Review in Future Ramp Meter Sites

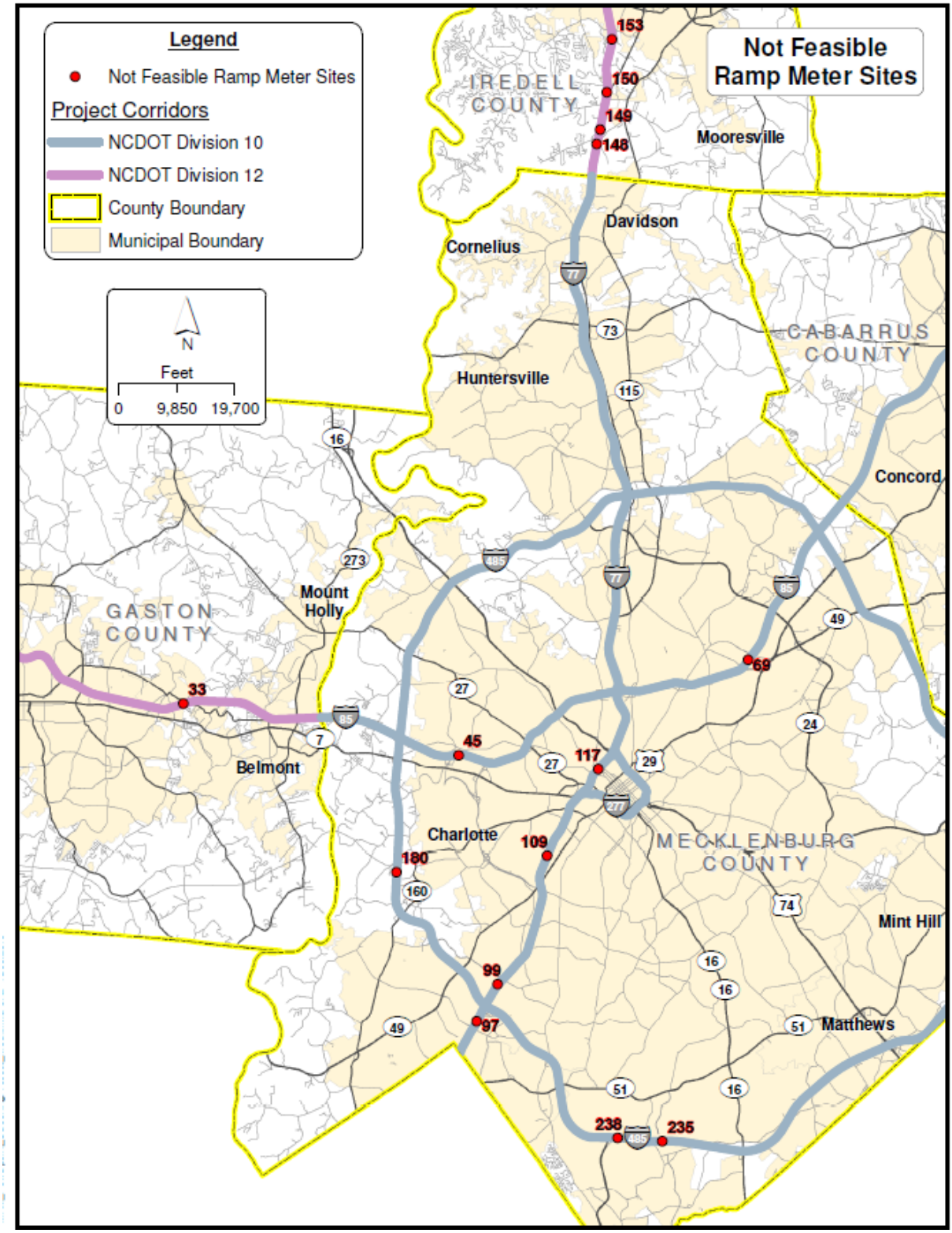


Figure 4. Not Feasible Ramp Meter Sites

1.7. Typical Cost Estimates

Estimated costs were developed utilizing the typical design criteria outlined above. At the time the report was drafted, there were forty-three sites that were recommended for single lane ramp meter implementation and eight sites that were recommended for two lane ramp meter implementation. Each site cost estimate encompassed the same basic engineering cost items, with a couple exceptions, as well as the capital, design, traffic control, and construction administration costs. Engineering costs associated with each site included the following categories:

- Geometric construction (pavement, drainage, structures, and guardrail)
- Signal displays and supports
- Detection
- Controllers
- Traffic control and signing
- Pavement markings

The report also identified general program costs that included the procurement/ integration of the central control software and controller firmware, system maintenance, and training. A cost was also included that incorporated the annual operations and maintenance costs of the ramp metering systems as well as hosting and server costs.

Each typical ramp configuration included assumptions of typical quantities. In the implementation plan, more specific costs were developed for each of the 51 sites that address the specific conditions and recommended solutions.

1.8. Performance Measures

At the completion of the Detailed Analysis and Cost Estimates, the list of viable sites was narrowed down to 38 sites suitable for ramp metering based off of specific characteristics that make them unfeasible. These 38 sites were then evaluated to determine if each site has sufficient estimated benefits versus the estimated costs to ascertain if they are financially viable. In this study, only reduction in delay (vehicle-hours) was used due to availability of data. Other studies have found benefits such as trip reliability, crash reduction, and air emissions can be realized.

A range of delay reductions (10%, 15% and 20%) were evaluated. The results of this analysis show that there is a wide range of estimated annual financial savings due to the delay reduction, from $9,429 per year to $4,750,227 per year for the 20% reduction scenario.

1.9. Implementation Plan

In the Implementation Plan, a site specific cost estimate was developed for the recommended improvement at each of the 38 sites. These improvements include:

- Single lane ramp
- Two lane ramp

The implementation plan considered planned projects in NCDOT's State Transportation Improvement Program (STIP) and their potential impacts on ramp metering and whether ramp metering might mitigate existing traffic congestion. There were also some projects that aren't currently 'managed' by the state but by a private developer that were also considered due to the transportation impacts it could have on traffic in the southwest area of Charlotte. As an example, the River District Project will build a multi-use development on 1,400 acres west of Charlotte Douglas International Airport towards the Catawba River. The site is located in the vicinity of I-485 and West Blvd. and is projected to add 120,000 vehicle trips per day to the area.

Each candidate site was analyzed to determine if it produced a positive benefit-cost ratio (BCR) greater than 1.0, indicating financial feasibility. During this analysis, the 20% reduction in travel time, five- and ten-year horizon years were studied to confirm this.

Of the 38 ramp meter sites, 33 sites have a benefit cost ratio greater than 1.0 in the five-year BCR analysis and 34 sites have a benefit cost ratio greater than 1.0 in the ten-year BCR analysis. Using the 20% delay reduction, the benefit-cost ratios of all 38 sites in the five-year analysis ranged from 67.10 to 0.00, with an average BCR of 14.96. As we did for the five-year analysis, the 20% delay reduction showed the benefit-cost ratios of all 38 sites in the ten-year analysis ranged from 110.72 to 0.00, with an average BCR of 26.00.

The first year rate of return (FYRR) for each site was also calculated during the development of the implementation plan. It refers to the benefits returned after all expenses have been 'paid back' that normally occurs during the first year of the project. A percentage greater than 0% indicates a positive return in the first year.

The benefit cost analysis over a ten-year period for each site resulted in the following list of recommended sites for ramp metering shown in Table 1. The shading shown in the table represents the classification of the site. Green designates a 'feasible' site, yellow designates a 'review in future' site, and red denotes a site that is 'not feasible'.

Table 1. Benefit Cost Analysis over Ten-Year Period for Each Site

Log	Freeway	Cross Street	Exit	Direction	County	Ten Year Total Costs	Ten Year Total Benefits	Ten year BCR	FYRR
102	I-77	Nations Ford Rd	4	SB	Mecklenburg	$237,201	$26,261,662	110.72	1516%
129*	I-77	I-85 SB	13	NB	Mecklenburg	$467,856	$47,506,707	101.54	1108%
105	I-77	Tyvola Rd	5	NB	Mecklenburg	$260,930	$23,642,601	90.61	1170%
111	I-77	Remount Rd	8	SB	Mecklenburg	$241,370	$18,505,656	76.67	1010%
145	I-77	US 21 (Catawba Ave)	28	NB	Mecklenburg	$253,218	$17,365,283	68.58	873%
93	I-77	Westinghouse Blvd	1A	SB	Mecklenburg	$663,195	$42,402,512	63.94	621%
147	I-77	Goodrum Rd / Griffith St	30	NB	Mecklenburg	$292,913	$14,029,769	47.9	543%
143	I-77	NC 73 (Sam Furr Rd)	25	NB	Mecklenburg	$291,050	$10,386,340	35.69	380%
67	I-85	Sugar Creek Rd	41	NB	Mecklenburg	$278,775	$9,716,756	34.86	376%
104	I-77	Tyvola Rd	5	SB	Mecklenburg	$342,180	$12,561,271	36.71	370%
234	I-485	Rea Rd	59	Outer	Mecklenburg	$280,314	$8,339,499	29.75	306%
233	I-485	NC 16 (Providence Rd)	57	Inner	Mecklenburg	$322,220	$9,319,823	28.92	277%
35	I-85	Belmont-Mt. Holly Rd	26	SB	Gaston	$262,458	$7,368,856	28.08	292%
230	I-485	NC 16 (Providence Rd)	57	Outer	Mecklenburg	$349,183	$8,669,728	24.83	216%
232	I-485	NC 16 (Providence Rd)	57	Outer	Mecklenburg	$244,539	$5,454,540	22.31	221%
231	I-485	NC 16 (Providence Rd)	57	Inner	Mecklenburg	$309,669	$6,447,238	20.82	174%
103	I-77	Nations Ford Rd	4	NB	Mecklenburg	$268,012	$5,248,933	19.58	172%

Log	Freeway	Cross Street	Exit	Direction	County	Ten Year Total Costs	Ten Year Total Benefits	Ten year BCR	FYRR
179	I-485	Steele Creek Rd	4	Inner	Mecklenburg	$294,368	$4,468,653	15.18	103%
237	I-485	Rea Rd	59	Inner	Mecklenburg	$280,779	$3,801,741	13.54	84%
236	I-485	Rea Rd	59	Inner	Mecklenburg	$281,998	$3,328,980	11.8	61%
101	I-77	Arrowood Rd	3	NB	Mecklenburg	$294,827	$3,023,996	10.26	37%
34	I-85	McAdenville Rd	23	NB	Gaston	$245,687	$2,495,389	10.16	46%
37	I-85	Beatty Dr / Park St	27	SB	Gaston	$291,700	$2,830,504	9.7	30%
097*	I-77	I-485	1B	SB	Mecklenburg	$576,144	$5,537,711	9.61	10%
140	I-77	Gilead Rd	23	NB	Mecklenburg	$310,022	$2,439,181	7.87	4%
32	I-85	S Main St	22	NB	Gaston	$222,099	$1,666,535	7.5	13%
177	I-485	Steele Creek Rd	4	Inner	Mecklenburg	$315,328	$2,385,718	7.57	-1%
64	I-85	Graham St	40	SB	Mecklenburg	$280,895	$1,987,216	7.07	-4%
146	I-77	Goodrum Rd / Griffith St	30	SB	Mecklenburg	$268,759	$1,618,415	6.02	-17%
239	I-485	US 521 (Johnston Rd)	61	Outer	Mecklenburg	$279,970	$1,234,084	4.41	-40%
182	I-485	US 74 / US 29 (Wilkinson Blvd)	9	Outer	Mecklenburg	$352,255	$895,548	2.54	-68%
181	I-485	West Blvd	6	Inner	Mecklenburg	$293,146	$656,116	2.24	-70%
75	I-85	Mallard Creek Rd	46	NB	Mecklenburg	$305,762	$570,048	1.86	-75%
229	I-485	E John St	52	Inner	Mecklenburg	$286,919	$437,154	1.52	-79%
175	I-485	Arrowood Rd	3	Inner	Mecklenburg	$685,263	$673,485	0.98	-89%
72	I-85	Harris Blvd	45	SB	Mecklenburg	$273,055	$167,920	0.61	-92%
30	I-85	Cox Rd	21	NB	Gaston	$276,847	$94,294	0.34	-95%
250	US-74	Briar Creek Road/Television Lane	244	WB	Mecklenburg	$276,344	$0	0	-100%

The recommended sites for ramp metering were then filtered further based on the following criteria:

- Does ramp metering site provide the “pay back” of the system costs within five years? (i.e. produces a five-year benefit to cost ratio greater than 1.0)
- Is there a STIP project in the next five years that could impact ramp meter implementation?
- Is the site a freeway-to-freeway site?

After applying this criteria, the final list of potential ramp meter sites was narrowed down to 21 viable locations as shown in Table 2.

For implementation, NCDOT may elect to deploy ramp metering technology on a site per site basis, as shown in Table 2, or they can choose to deploy in logical groups. Atkins is recommending that deployment of ramp metering be deployed in groups as outlined in Table 3 below. The groups are listed in priority order.

The 21 sites were then analyzed based on the best ‘bang for the buck.’ The analysis looked at how many sites were going to be implemented within each group, the sites individual rankings within the group, and what the total and average costs per site/group were.

Table 3 presents the sites recommended for implementation in priority order based on a group and Table 4 presents the sites recommended for implementation based on location and direction.

NCDOT may elect to implement based on groups, locations/direction, or they may elect to not deploy ramp metering projects in any of the order that they are ranked, due to other considerations and constraints.

Table 2. Final Recommended Ramp Meter Sites

Log	Freeway	Cross Street	Exit	Direction	County	Ten Year Total Costs	Ten Year Total Benefit	Ten Year BCR	FYRR
032	I-85	S Main St	22	NB	Gaston	$222,099	$1,666,535	7.50	13%
034	I-85	McAdenville Rd	23	NB	Gaston	$245,687	$2,495,389	10.16	46%
035	I-85	Belmont-Mt. Holly Rd	26	SB	Gaston	$262,458	$7,368,856	28.08	292%
064	I-85	Graham St	40	SB	Mecklenburg	$280,895	$1,987,216	7.07	-4%
067	I-85	Sugar Creek Rd	41	NB	Mecklenburg	$278,775	$9,716,756	34.86	376%
093	I-77	Westinghouse Blvd	1A	SB	Mecklenburg	$663,195	$42,402,512	63.94	621%
101	I-77	Arrowood Rd	3	NB	Mecklenburg	$294,827	$3,023,996	10.26	37%
102	I-77	Nations Ford Rd	4	SB	Mecklenburg	$237,201	$26,261,662	110.72	1516%
103	I-77	Nations Ford Rd	4	NB	Mecklenburg	$268,012	$5,248,933	19.58	172%
105	I-77	Tyvola Rd	5	NB	Mecklenburg	$260,930	$23,642,601	90.61	1170%
111	I-77	Remount Rd	8	SB	Mecklenburg	$241,370	$18,505,656	76.67	1010%
145	I-77	US 21 (Catawba Ave)	28	NB	Mecklenburg	$253,218	$17,365,283	68.58	873%
146	I-77	Goodrum Rd / Griffith St	30	SB	Mecklenburg	$268,759	$1,618,415	6.02	-17%
147	I-77	Goodrum Rd / Griffith St	30	NB	Mecklenburg	$292,913	$14,029,769	47.90	543%
177	I-485	Steele Creek Rd	4	Inner	Mecklenburg	$315,328	$2,385,718	7.57	-1%

Log	Freeway	Cross Street	Exit	Direction	County	Ten Year Total Costs	Ten Year Total Benefit	Ten Year BCR	FYRR
179	I-485	Steele Creek Rd	4	Inner	Mecklenburg	$294,368	$4,468,653	15.18	103%
181	I-485	West Blvd	6	Inner	Mecklenburg	$293,146	$656,116	2.24	-70%
234	I-485	Rea Rd	59	Outer	Mecklenburg	$280,314	$8,339,499	29.75	306%
236	I-485	Rea Rd	59	Inner	Mecklenburg	$281,998	$3,328,980	11.80	61%
237	I-485	Rea Rd	59	Inner	Mecklenburg	$280,779	$3,801,741	13.54	84%
239	I-485	US 521 (Johnston Rd)	61	Outer	Mecklenburg	$279,970	$1,234,084	4.41	-40%

Table 3. Recommended Ramp Meter Group Sites

Priority	Group	Direction	Sites	Site Rankings	Ten Year Individual Costs	Ten Year Total Costs	Ten Year Individual Benefits	Ten Year Total Benefits	Average Costs/Site for Group	Ten Year BCR	Combined BCR
1	3 (I-77 South)	NB	101	21	$294,827	$2,588,254	$3,023,996	$119,085,360	$431,376	10.26	46.01
		NB	103	17	$268,012		$5,248,933			19.58	
		NB	105	3	$260,930		$23,642,601			90.61	
		SB	93	6	$663,195		$42,402,512			63.94	
		SB	102	1	$237,201		$26,261,662			110.72	
		SB	111	4	$241,370		$18,505,656			76.67	
		-	Central	-	$622,720		-			-	
2	4 (I-77 North)	NB	145	5	$253,218	$1,438.610	$17,365,283	$33,013,467	$479,537	68.58	22.96
		NB	147	7	$292,913		$14,029,769			47.9	
		SB	146	29	$268,759		$1,618,415			6.02	
		-	Central	-	$622,720		-			-	
3	6 (I-485 Southeast)	Inner	236	20	$281,998	$1,745,780	$3,323,980	$16,704,304	$436,445	11.80	9.57
		Inner	237	19	$280,779		$3,801,741			13.54	
		Outer	234	11	$280,314		$8,339,499			29.75	
		Outer	239	30	$279,970		$1,234,084			4.41	
		-	Central	-	$622,720		-			-	
4	1 (I-85 South Gaston County)	NB	32	26	$222,099	$1,352,955	$1,666,535	$11,530,779	$450,985	7.50	8.52
		NB	34	22	$245,687		$2.495.389			10.16	
		SB	35	13	$262,458		$7,368,856			28.08	
		-	Central	-	$622,720		-			-	
5	5 (I-485 Southwest)	Inner	177	27	$315,328	$1,525,563	$2.385,718	$7,510,487	$508,521	7.57	4.92
		Inner	179	18	$294,368		$4,468,653			15.18	
		Inner	181	32	$293,146		$656,116			2.24	
		-	Central	-	$622,720		-			-	
6	2 (I-85 North Mecklenburg County)	NB	67	9	$278,775	$1,182,390	$9,716,756	$11,703,971	$591,195	34.86	9.90
		SB	64	28	$280,895		$1,987,216			7.07	
		-	Central	-	$622,720		-			-	

Table 4. Recommended Ramp Meter Location/Direction Sites

Group	Direction	Sites	Site Rankings	Ten Year Individual Costs	Ten Year Total Costs	Ten Year Individual Benefits	Ten Year Total Benefits	Average Costs/Site for Group	Ten Year BCR	Combined BCR	Priority
3 (I-77 South)	NB	101	21	$294,827	$1,446,489	$3,023,996	$31,915,530	$482,163	10.26	22.06	3
	NB	103	17	$268,012		$5,248,933			19.58		
	NB	105	3	$260,930		$23,642,601			90.61		
	-	Central	-	$622,720		-			-		
	SB	93	6	$663,195	$1,764,486	$42,402,512	$87,169,830	$588,162	63.94	49.40	1
	SB	102	1	$237,201		$26,261,662			110.71		
	SB	111	4	$241,370		$18,505,656			76.67		
	-	Central	-	$622,720		-			-		
4 (I-77 North)	NB	145	5	$253,218	$1,168,851	$17,365,283	$31,395,052	$584,426	68.58	26.86	2
	NB	147	7	$292,913		$14,029,769			47.90		
	-	Central		$622,720		-			-		
	SB	146	29	$268,759	$891,479	$1,618,415	$1,618,415	$891,479	6.02	1.82	10
	-	Central	-	$622,720		-			-		
6 (I-485 Southeast)	Inner	236	20	$281,998	$1,185,497	$3,323,980	$7,125,721	$592,749	11.79	6.01	7
	Inner	237	19	$280,779		$3,801,741			13.54		
	-	Central	-	$622,720		-					
	Outer	234	11	$280,314	$1,183,004	$8,339,499	$9,573,583	$591,502	29.75	8.09	6
	Outer	239	30	$279,970		$1,234,084			4.41		
	-	Central	-	$622,720		-			-		
1 (I-85 South Gaston County)	NB	32	26	$222,099	$1,090,506	$1,666,535	$4,161,924	$545,253	7.50	3.82	9
	NB	34	22	$245,687		$2,495,389			10.16		
	-	Central	-	$622,720		-					
	SB	35	13	$262,458	$885,178	$7,368,856	$7,368,856	$885,178	28.08	8.32	5
	-	Central	-	$622,720		-			-		
5 (I-485 Southwest)	Inner	177	27	$315,328	$1,525,562	$2,385,718	$7,510,487	$508,521	7.57	4.92	8
	Inner	179	18	$294,368		$4,468,653			15.18		
	Inner	181	32	$293,146		$656,116			2.24		
	-	Central	-	$622,720		-			-		
2 (I-85 North Mecklenburg County)	NB	67	9	$278,775	$1,182,390	$9,716,756	$11,703,972	$591,195	34.86	9.90	4
	SB	64	28	$280,895		$1,987,216			7.07		
	-	Central	-	$622,720		-			-		

The steering committee for the Metrolina Ramp Metering Project was comprised of the following partners:

- North Carolina Department of Transportation (NCDOT)
    - Mobility and Safety
        - ITS Section
        - Traffic Systems Operations
        - Congestion Management
        - Field Operations Section (Western Region/Metrolina Region)
    - Division 10
    - Division 12
    - Transportation Planning Branch
- Federal Highway Administration (FHWA)
- Charlotte Regional Transportation Planning Organization (CRTPO)
- City of Charlotte Department of Transportation (CDOT)
- Gaston-Cleveland-Lincolnton Metropolitan Planning Organization (GCLMPO)
- City of Gastonia
- Cabarrus-Rowan Metropolitan Planning Organization (CRMPO)
- City of Concord
- Rocky River Rural Planning Organization
- Atkins

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