

# Maintenance Rating Program

Triangle Expressway

November 12, 2021

2021 Third Quarter Report



## CONSULTANT CERTIFICATION OF COMPLETION

November 12, 2021

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### NCTA Triangle Expressway Roadway Maintenance Performance Rating Program; Q3, FY 2021 Rating

This is to certify that I, Ken M. McEntire, PE am an authorized official representative of the company The Kercher Group, Inc., which is a subconsultant to HNTB North Carolina, P.C. Collaboratively; we are working as the Triangle Expressway Roadway and Facility Maintenance Performance Rating Program Consultants.

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been independently performed in accordance with, and in conformity to, the *NCTA Roadway and Facility Maintenance Performance Standards*.

Sincerely,

The Kercher Group, a Division of Mott MacDonald

A handwritten signature in blue ink that reads "Ken M. McEntire". The signature is written in a cursive style with a large initial "K" and "M".

Ken M. McEntire, PE  
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# 1.0 Executive Summary

The North Carolina Turnpike Authority (NCTA) Maintenance Rating Program (MRP) is a maintenance evaluation program for roadway features and toll facilities on the NCTA system. This report presents results from the 2021 Third Quarter Assessment of the Triangle Expressway.

The overall 2021 Third quarter maintenance rating of the Triangle Expressway was **93.0**, above the NCTA target rating of **90**. As shown in **Table 1**, all five elements assessed achieved a rating greater than the target rating of 85.

**Table 1: MRP Element Results for the 2021 Third Quarter Assessment**

Element	MRP Rating	Target Rating
Road Surface	100.0 <sup>1</sup>	85.0
Unpaved Shoulders and Ditches	96.8	85.0
Drainage	92.5	85.0
Roadside	91.6	85.0
Traffic Control Devices	86.5 <sup>1</sup>	85.0
<b>Overall MRP Performance Rating</b>	<b>93.0<sup>1</sup></b>	<b>90.0</b>

<sup>1</sup>Excludes asphalt surface pavement condition as well as markers, striping, and symbols on mainline NC-147 and all ramps/loops.

This report also provides a rolling rating of the latest four quarterly inspections of the Triangle Expressway. As presented in **Table 2**, the rolling maintenance rating of the Triangle Expressway was **92.1**.

**Table 2: MRP Rolling Element Results**

Element	Q4 2020 Rating	Q1 2021 Rating	Q2 2021 Rating	Q3 2021 Rating	Rolling Rating
Road Surface	96.2 <sup>1</sup>	90.5 <sup>1</sup>	96.8 <sup>1</sup>	100.0 <sup>1</sup>	96.1 <sup>2</sup>
Unpaved Shoulders and Ditches	98.8	99.3	99.3	96.8	98.5
Drainage	87.6	88.6	94.0	92.5	90.7
Roadside	89.1	90.6	95.5	91.6	91.7
Traffic Control Devices	85.2 <sup>1</sup>	82.2 <sup>1</sup>	92.5 <sup>1</sup>	86.5 <sup>1</sup>	86.9 <sup>2</sup>
<b>Overall MRP Performance Rating</b>	<b>90.7<sup>1</sup></b>	<b>88.9<sup>1</sup></b>	<b>95.2<sup>1</sup></b>	<b>93.0<sup>1</sup></b>	<b>92.1<sup>2</sup></b>

<sup>1</sup>Excludes asphalt surface pavement condition as well as markers, striping, and symbols on mainline NC-147 and all ramps/loops.

<sup>2</sup>Excludes quarter ratings for elements listed above.

In addition, the report provides findings of the Green Level Historic District signs inspection. This quarter, two signs were inspected. Both signs were found to be in good physical condition, and the landscaped areas around the signs were maintained in accordance with NCTA MRP standards.

## 2.0 Introduction

The NCTA MRP is a comprehensive planning, measuring, and managing process that provides a means for communicating to managers, stakeholders and customers the impacts of policy and budget decisions on program service delivery.

Using outcome-based performance measures and the service level scale (0 through 100), the inspection results are rated against established thresholds criteria. The program analysis is accomplished using sampling procedures that capture the level of service being provided for individual assets. The evaluation procedure is based on the establishment of threshold conditions that quantify the maximum defect allowed on assets. Over time, the results can be charted to identify work needs and subsequent necessary actions.

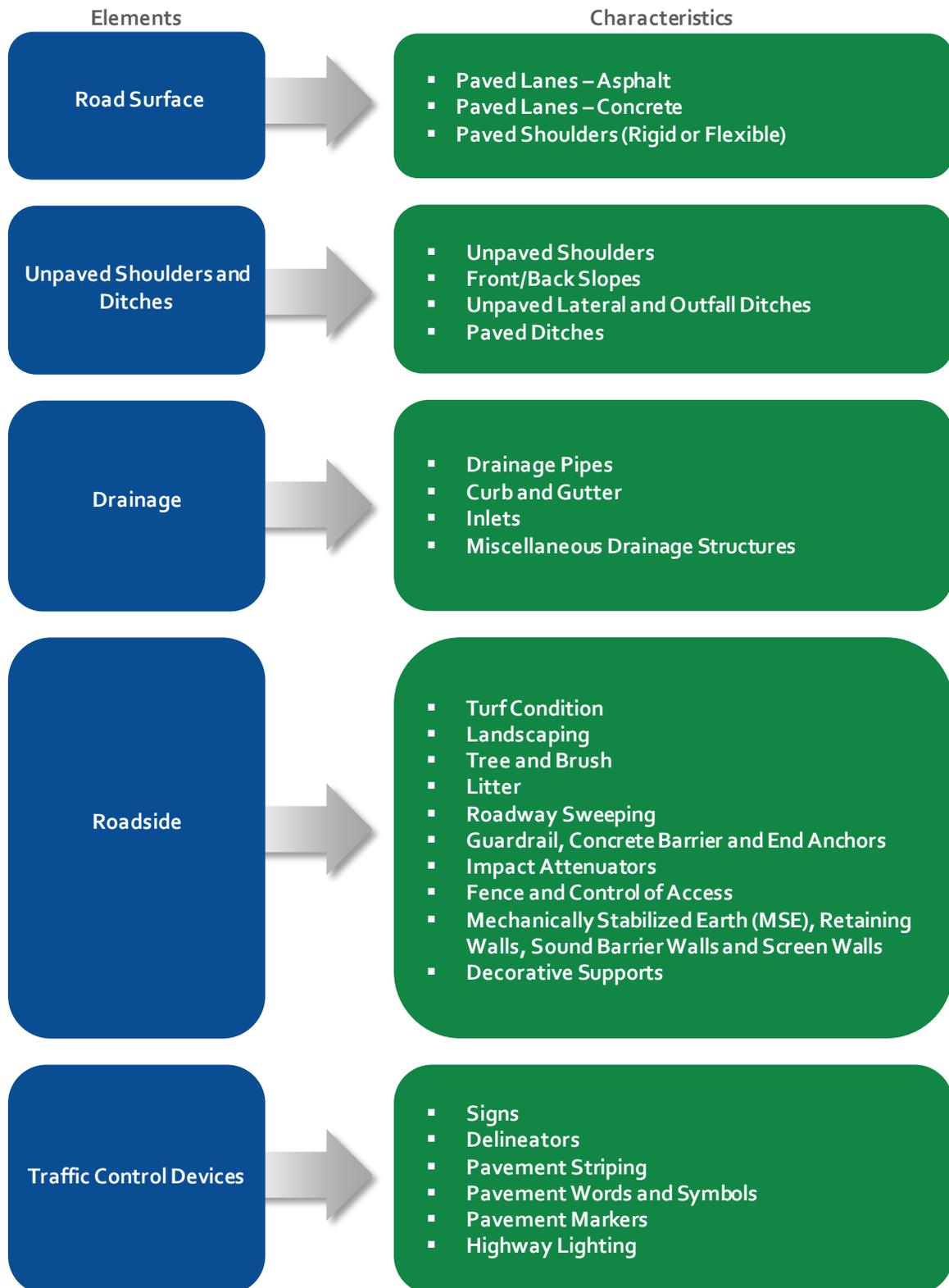
The NCTA performance standards, threshold criteria, and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff, and consultants.

Using field survey information, a maintenance matrix can be developed to show the ties between maintenance activities and the characteristics of various roadway features. The purpose of this evaluation is to provide information that can be used to schedule and prioritize routine maintenance activities and provide uniform maintenance conditions that meet established objectives.

## 3.0 MRP Procedure

Per the *NCTA Roadway and Facility Maintenance Performance Standards V6*, roadway assets or characteristics on NCTA facilities have been grouped into elements. These elements and corresponding characteristics are shown in **Figure 1:**

Figure 1: Maintenance Elements and Characteristics



A weighting system has been established to identify the importance of each element and characteristic. This system consists of two weighting factors: one that accounts for the importance of individual characteristics within a given maintenance element (1-9), and one that accounts for the importance of the maintenance elements to the total rating (by % of score). This two-factor system reveals deficiencies among characteristics and elements.

The program analysis is accomplished using statistically valid, random sampling procedures that capture the level of service for individual characteristics, with a 95% confidence level in sampling. The sample characteristics selected are evaluated during quarterly inspections, which are performed during the months of February, May, August, and November to account for dynamic changes in assets during the various seasons. The evaluation process is completed using electronic data collection tablets and is based on established threshold conditions described in the NCTA Roadway and Facility Maintenance Standards V6. Those characteristics that meet or exceed the threshold are coded as PASSING; those that do not meet the threshold are coded as NOT PASSING.

When the evaluation process is completed, the number of PASSING samples and total sample are multiplied by the weighted values (1-9) to determine the actual and possible rating points for characteristics and elements. MRP ratings for elements and characteristics are then calculated as the ratio of the actual rating points to possible rating points. The MRP ratings represent the maintenance level of service currently being provided, as they define the percent of characteristics and elements that meet the maintenance condition standard. For instance, an MRP rating of 83 signifies that 83 percent of the inspected elements/characteristics met the standard.

The overall MRP rating is determined by calculating the sum of the elements' ratings multiplied by the following weighted factors:

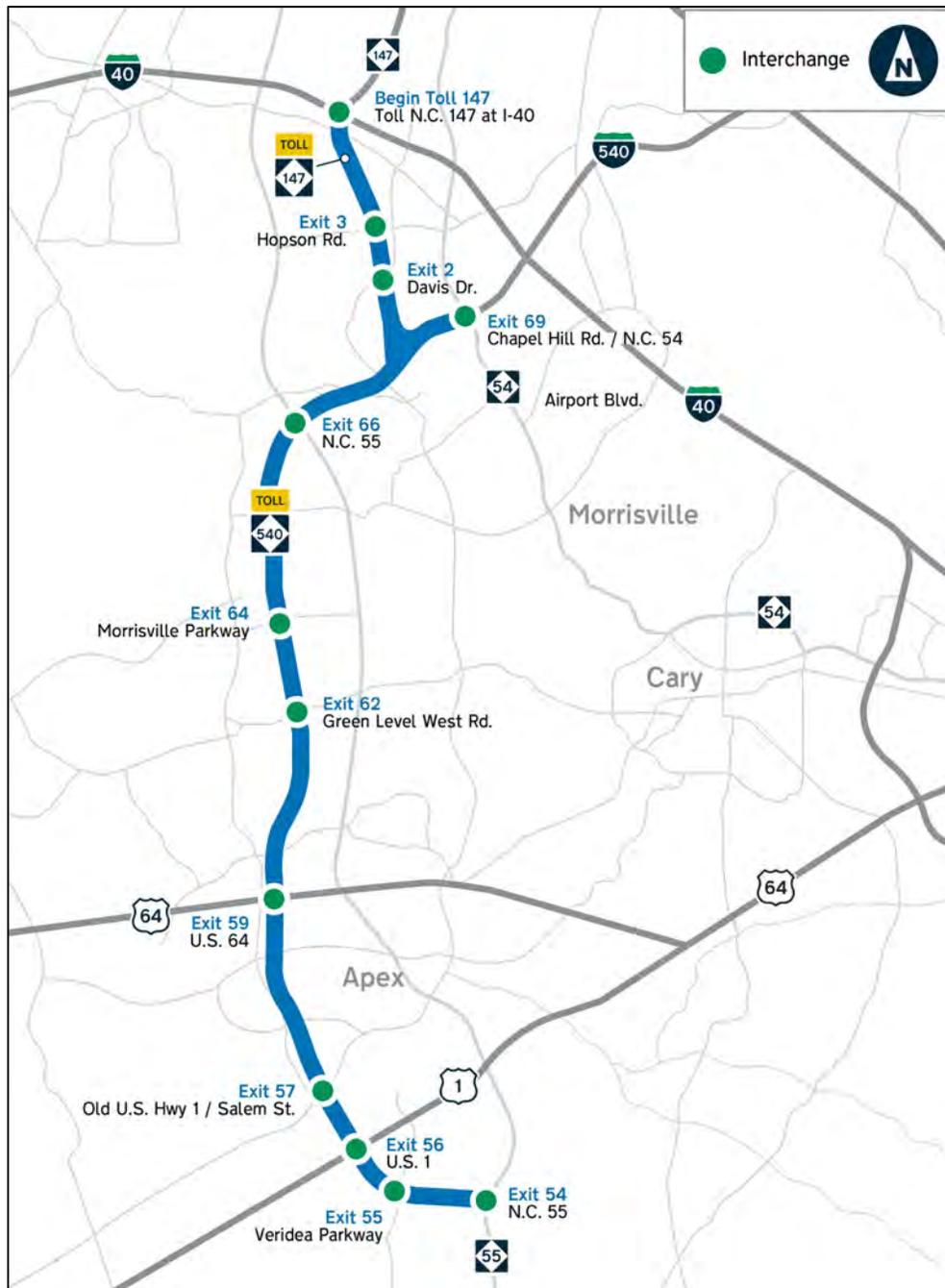
Road Surface =	25%
Unpaved Shoulders =	13%
Drainage =	15%
Roadside =	17%
Traffic Control Devices =	30%
<hr/>	
Total	100%

The NCTA's overall target rating is 90, with elements scoring 85 or higher, and characteristics 80 or higher. In addition to quarterly ratings, the cumulative rolling annual rating is calculated each quarter. This rating is obtained by adding the ratings of the latest four quarterly inspections to compensate for the likelihood of uneven sample sizes.

## 4.0 Triangle Expressway Description

The Triangle Expressway extends for approximately 18.8 miles from the interchange of I-40 and Toll NC-147 in Durham to the NC-55 Bypass near Holly Springs (*Figure 2*). It includes a one-mile segment on Toll NC-540 extending north from the Toll NC-540 / Toll NC-147 interchange to the NC-54 interchange. The Triangle Expressway consists of twelve interchanges and twenty-two all-electronic toll collection zones.

Figure 2: Triangle Expressway Map



## 5.0 Triangle Expressway Asset Inventory Update

Through normal day-to-day maintenance activities and the construction of special projects, roadside assets are continuously being added or modified on the roadway. NCTA coordinates closely with NCDOT Division 5 Maintenance and conducts routine field visits to maintain an accurate asset inventory and ensure the validity of the MRP survey.

During this quarter assets on Toll NC 540 exit ramps to and from NC-55 Bypass were removed from the inventory due to the Complete 540 construction project. **Table 3** presents the updated number of assets that are currently available for inspections.

**Table 3: Asset Inventory**

Assets	Total Inventory	2021 Eligible Inventory
Barriers	799	627
Curb and Gutter	428	397
Decorative Supports	305	298
Drainage	1179	1131
Misc. Drainage	211	200
Fences	508	484
Highway Lighting	435	431
Impact Attenuators	47	45
Inlets	1126	1080
Linear Segments	795	737
Plant Beds	266	261
Paved Ditches	2	2
Pavement Symbols	652	593
Signs	1221	1169
Tree and Brush	603	569
Turf	1074	978
Walls	88	84

## 6.0 MRP Third Quarter Assessment

### 6.1 Quarterly Results

The overall 2021 third quarter maintenance rating of the Triangle Expressway was 93.0, above NCTA’s target overall rating of 90. All elements assessed achieved quarter ratings above the target rating of 85 established for element groups. Furthermore, all characteristics achieved a quarter score above the target rating of 80.

Last year, NCTA let a resurfacing project to improve asphalt pavement condition as well as the condition of pavement striping, characters, symbols, and markers on mainline NC-147 and asphalt surface ramps/loops throughout Triangle Expressway. Due to this ongoing project, the Paved Lanes Asphalt, Paved Shoulder, Pavement Striping, Pavement Characters and Symbols, and Pavement Markers characteristics were only inspected on pavement surfaces not included in the resurfacing project contract. Once this project is completed, the characteristics rating for the entire facility will resume and will be included in the Road Surface element rating, Traffic Control Devices element rating and overall scoring.

It is important to note that these results are only representative of the second quarter sample, one of the four surveys to provide an intermediate snapshot of seasonal conditions. Therefore, they are not a statistically valid representation of the assets; only the total of all four quarterly inspections, reported as the rolling rating, provide a 95% confidence level in statistical sampling. The second quarter MRP performance ratings for elements and characteristics are presented in *Table 4* and *Table 5*, respectively.

**Table 4: MRP Element Results for Q3 2021**

Element	MRP Rating
Road Surface	100.0 <sup>1</sup>
Unpaved Shoulders and Ditches	96.8
Drainage	92.5
Roadside	91.6
Traffic Control Devices	86.5 <sup>1</sup>
<b>Overall MRP Performance Rating</b>	<b>93.0<sup>1</sup></b>

<sup>1</sup>Excludes asphalt surface pavement condition as well as markers, striping, and symbols on mainline NC-147 and all ramps/loops.

Table 5: MRP Characteristics Results for Q3 2021

Road Surface	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Paved Lanes Asphalt	4	4	9	36	36	100 <sup>1</sup>
Paved Lanes Concrete	29	29	9	261	261	100
Paved Shoulder	33	33	5	165	165	100 <sup>1</sup>
<b>Element Total</b>				<b>462</b>	<b>462</b>	<b>100.0<sup>1</sup></b>
Unpaved Shoulders and Ditches	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Unpaved Shoulder	37	40	9	333	360	93
Front/Back Slopes	40	40	6	240	240	100
Lateral and Outfall Ditches, Unpaved	40	40	6	240	240	100
Ditches, Paved	2	2	5	10	10	100
<b>Element Total</b>				<b>823</b>	<b>850</b>	<b>96.8</b>
Drainage	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Drainage Pipes	29	32	7	203	224	91
Curb and Gutter	29	29	6	174	174	100
Inlets	36	38	7	252	266	95
Misc. Drainage Structure	24	30	4	96	120	80
<b>Element Total</b>				<b>725</b>	<b>784</b>	<b>92.5</b>
Roadside	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Turf Condition	44	59	7	308	413	75
Landscaping	26	26	4	104	104	100
Trees and Brush	32	32	4	128	128	100
Litter	38	40	4	152	160	95
Roadway Sweeping	40	40	5	200	200	100
Guardrail, Concrete Barrier, and End Anchors	31	32	9	279	288	97
Impact Attenuators	9	9	9	81	81	100
Fence, Control Access	27	29	7	189	203	93
Retaining Walls and Sound Barrier Walls	11	16	5	55	80	69
Decorative Supports	27	27	5	135	135	100
Graffiti and Stain Removal	43	44	4	172	176	98
<b>Element Total</b>				<b>1803</b>	<b>1968</b>	<b>91.6</b>
Traffic Control Devices	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Signs	28	32	7	196	224	88
Delineators	32	40	3	96	120	80
Pavement Striping/Marking	23	33	8	184	264	70 <sup>1</sup>
Words and Symbols	26	30	7	182	210	87 <sup>1</sup>
Pavement Markers	33	33	9	297	297	100 <sup>1</sup>
Highway Lighting	38	42	6	228	252	90
<b>Element Total</b>				<b>1183</b>	<b>1367</b>	<b>86.5<sup>1</sup></b>

<sup>1</sup>Excludes asphalt surface pavement condition as well as markers, striping, and symbols on mainline NC-147 and all ramps/loops.

Additionally, **Appendix A** includes maps that present the location of all assets assessed during the third quarter. **Appendix B** includes a list of the individual assets that did not achieve their target ratings.

## 6.2 Quarterly Analysis and Recommendations

### Elements

During the third quarter, all elements exceeded NCTA's quarter score threshold criteria of 85. All elements except for Traffic Control Devices received a quarter score above 90.

Road Surface (100.0) experienced an increase in rolling rating 1.0 point higher than the previous quarter's rolling rating. Asphalt resurfacing is ongoing and scheduled to be complete in September of this year.

Unpaved Shoulders and Ditches (96.8) experienced a slight decrease in rolling rating. The rating for this element was 0.1 points lower than the previous quarter rolling rating. All characteristics within this element continued scoring above 90.

Drainage (92.5) experienced an increase in rolling rating of 0.8 points. Both Drainage Pipes (91) and Misc. Drainage Pipes (80) rolling ratings decreased from last quarter though continued scoring above the target rating.

Roadside (91.8) decreased 0.2 points from the previous quarter's rolling rating. Turf Condition (75) and Retaining Walls and Sound Barrier Walls (69) both experienced decreases in rolling ratings.

Traffic Control Devices (86.5) experienced a 0.6 point increase in rolling rating from the previous quarter. Pavement Striping/Marking (70) and Delineators (80) characteristic rolling ratings both decreased from last quarter rolling rating. Repaving and subsequent striping of all asphalt lanes is scheduled to be complete in Fall 2021.

Recommendations to improve specific critical characteristic ratings are provided in the following sections.

### Characteristics

This quarter, all but three characteristics, Turf Condition (75), Retaining Walls and Sound Barrier Walls (69), and Pavement Striping/Marking (70), met the NCTA target threshold criteria of 80. A description of the characteristics' conditions and future work planning recommendations are provided below. Pictures of all characteristic failures are included in **Appendix B**.

Turf Condition (75 rating – 44 of the 59 assets passed): All 15 of the turf sections that did not pass inspection were due to bare ground. Two of the sections that did not pass inspection are presented in *Figure 3*.

**Figure 3: Turf Condition Inspection Results Sample**



To continue to improve the Turf Condition rating, it is recommended that the maintenance provider continue with an aggressive schedule for seeding and fertilization cycles of bare ground areas during the spring and early summer. Some areas will require scarifying of the soil as these areas are heavily compacted and inundated with aggregate.

**Turf Maintenance Program:**

- 1) Roadside mowing should occur as often as necessary to always conform to the evaluation standard. Mowing shall be in accordance with the NCTA approved mowing patterns and must not exceed the mowing lines identified by the approved stakes. These stakes are identified with a 15- inch white top. The maintenance provider shall review and confirm clarity to the NCTA (in writing) for strict adherence to the approved mowing pattern prior to each mowing season.
- 2) Turf grass shall be cut to a height of six inches (6) with a maximum tolerance of two (2) inches plus or minus.
- 3) Maintain roadway mowing 5 feet behind guardrail, unless otherwise specified by landscaping stakes.
- 4) Where landscaping has been established, or around the natural enhancement areas, mowing shall conform to the established contours with smooth flowing transitions.
- 5) Roadside trimming shall occur around all traffic appurtenances including, but not limited to guardrail, signposts, light poles, and ITS device poles.
- 6) Chemical applications:
  - a. Winter:
    - i. Apply limestone.
    - ii. Apply fertilizer.
  - b. Spring:
    - i. Apply pre- and post- emergent broadleaf weed control in accordance with the manufacturer's recommendations in April.
    - ii. Bare ground areas shall be scheduled for seeding as necessary.
  - c. Fall:

- i. Apply post-emergence herbicides to select locations in accordance with the manufacturer's recommendations in August.
- ii. Bare ground areas shall be seeded in the fall as needed.

**Turf Maintenance and Evaluation Standards:**

Turf does not meet the maintenance standards when any of the following criteria is observed:

- 1) More than 25% of the undesirable vegetation is present within the mowing limits of the area.
- 2) Noxious weeds present.
- 3) More than 50 cumulative SF of bare ground is present in the turf evaluation area.

Retaining Walls and Sound Barrier Walls (69 rating – 11 of the 16 assets passed): Out of the 5 retaining wall and sound barrier wall structures that did not pass inspection, 4 had unsealed joints and 1 exhibited spalling and unwanted vegetation growth. Two of the wall segments that did not pass inspection are presented in **Figure 4**.

**Figure 4: Retaining and Sound Barrier Walls Inspection Results Sample**



In accordance with NCTA Roadway and Facility Maintenance Standards V6, referenced below, it is recommended that the maintenance provider plan for and schedule joint repairs within the annual work program and that unwanted vegetation is removed upon observation.

**Retaining Walls and Sound Barrier Walls Maintenance Program Standards:**

- 1) Walls shall be inspected during daily patrols.
- 2) Unwanted vegetation and graffiti (see graffiti standard) shall be scheduled for removal.
- 3) Minor wall or column damage shall be scheduled for repair within the annual work program.
- 4) Staining damage shall be scheduled for repair within the annual work program.
- 5) Any structural damage that poses a safety risk shall be scheduled immediately upon observation. Mitigate any safety hazard upon observation.

**Standards Maintenance and Evaluation Standards:**

MSE/retaining walls, sound barrier walls, and screen walls do not meet the maintenance standards when any of the following criteria is observed:

- 1) More than 10% of exposed surface is covered with unwanted vegetation.
- 2) Any single spall 1 inch deep or greater or cumulative spalls in excess of 1 inch deep over 5 SF.
- 3) More than 25% of weep holes within the sample section are not functioning properly.
- 4) Unsealed cracks or joints greater than 0.25 inches in width.

Pavement Striping (70 rating – 23 of the 33 assets passed): There were 10 pavement striping/marketing segments that did not pass inspection, these segments were identified as missing more than 10% of any line segment in the sections, not meeting the required line width, or not reflecting during the nighttime inspection. Two of the pavement striping and marking segments that did not pass inspection are presented in **Figure 5**.

**Figure 5: Pavement Striping Inspection Results Sample**



To maintain a well-defined lane delineation throughout the Triangle Expressway, it is recommended that the maintenance provider consider scheduling pavement striping/marketing replacement cycles in accordance with the NCTA Roadway and Facility Maintenance Standards V6, referenced below.

**Maintenance Program:**

- 1) Pavement striping is observed daily and inspected every 4 months for compliance to the standard.
- 2) Worn or missing markings are evaluated for compliance annually, and generally are scheduled on a 3-to-5-year replacement cycle depending on the material.

**Maintenance and Evaluation Standards:**

Pavement Striping/Marking does not meet the maintenance standards when any of the following criteria is observed:

- 1) More than 10% of the length of any line is less than 5.4 inches wide.
- 2) More than 10% of each line is not visible at a distance of 160 feet during nighttime observation.
- 3) More than 10% of the length of any line is missing.
- 4) More than 10% of the length of any line is covered by soil, grass, or debris.

Pavement striping/markings were last installed along Toll NC-540 in the Summer of 2018. Pavement striping/markings were included in the asphalt pavement resurfacing contract which is to be completed in Fall 2021. Replacement of concrete pavement striping and snowplowable pavement markers is scheduled to be performed in Spring 2022.

## 7.0 Current Rolling MRP Rating

The rolling maintenance rating of the Triangle Expressway was 92.1, exceeding NCTA’s target overall rating of 90. All elements exceeded NCTA’s rolling rating threshold criteria of 85. Forty-five of the forty-eight characteristic ratings met or exceeded the target rating of 80.

The 2020/2021 results are presented in *Exhibit 1* and *Table 6*. These results are a collection of the four quarterly inspections conducted in the last year.

**Exhibit 1: MRP Element Results for 2020/2021**

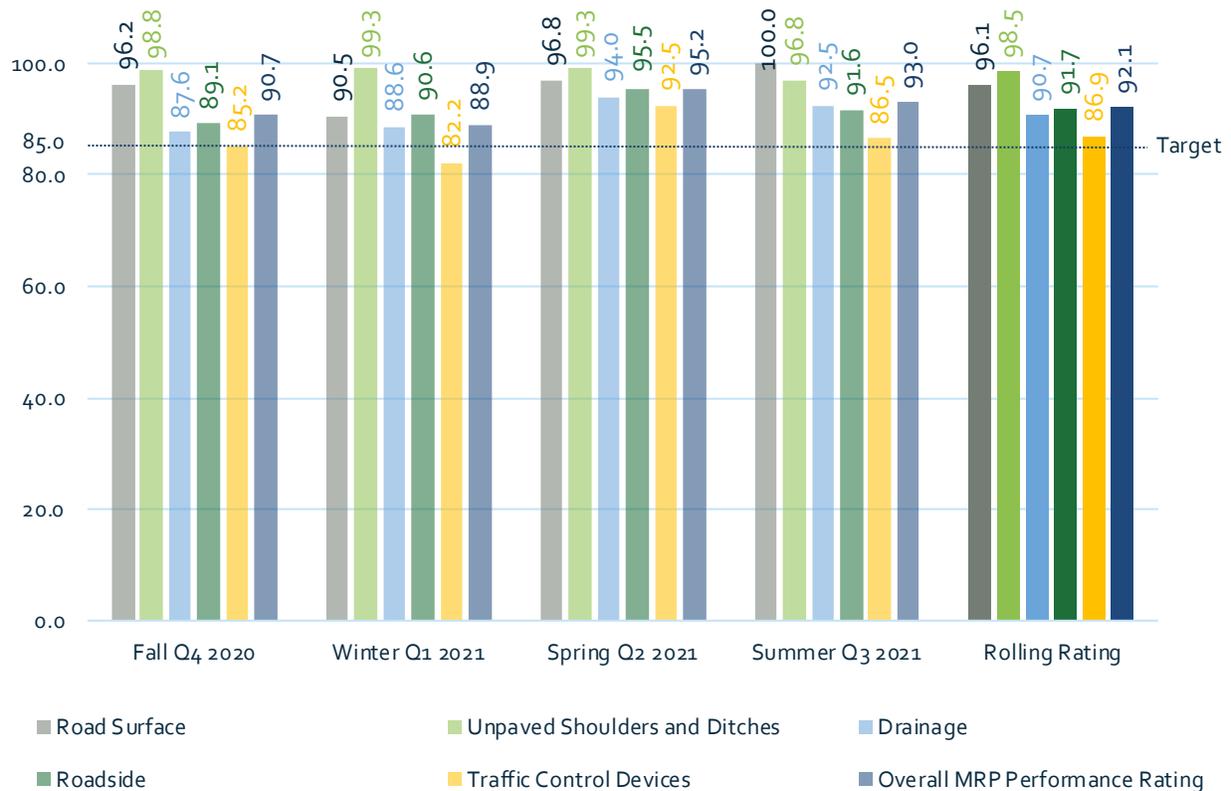


Table 6: MRP Rolling Element Results

Road Surface	Q4 2020 Rating	Q1 2021 Rating	Q2 2021 Rating	Q3 2021 Rating	Rolling Rating
Paved Lanes Asphalt	100 <sup>1</sup>	88 <sup>1</sup>	95 <sup>1</sup>	100 <sup>1</sup>	94 <sup>2</sup>
Paved Lanes Concrete	96	84	95	100	95
Paved Shoulder	96 <sup>1</sup>	100 <sup>1</sup>	100 <sup>1</sup>	100 <sup>1</sup>	99 <sup>2</sup>
<b>Element Total</b>	<b>96.2<sup>1</sup></b>	<b>90.5<sup>1</sup></b>	<b>96.8<sup>1</sup></b>	<b>100.0<sup>1</sup></b>	<b>96.1<sup>2</sup></b>
Unpaved Shoulders and Ditches	Q4 2020 Rating	Q1 2021 Rating	Q2 2021 Rating	Q3 2021 Rating	Rolling Rating
Unpaved Shoulder	97	100	100	93	97
Front/Back Slopes	100	98	100	100	99
Lateral and Outfall Ditches, Unpaved	100	100	98	100	99
Ditches, Paved	100	100	100	100	100
<b>Element Total</b>	<b>98.8</b>	<b>99.3</b>	<b>99.3</b>	<b>96.8</b>	<b>98.5</b>
Drainage	Q4 2020 Rating	Q1 2021 Rating	Q2 2021 Rating	Q3 2021 Rating	Rolling Rating
Drainage Pipes	88	88	97	91	91
Curb and Gutter	93	93	100	100	96
Inlets	86	92	93	95	92
Misc. Drainage Structure	83	75	83	80	80
<b>Element Total</b>	<b>87.6</b>	<b>88.6</b>	<b>94.0</b>	<b>92.5</b>	<b>90.7</b>
Roadside	Q4 2020 Rating	Q1 2021 Rating	Q2 2021 Rating	Q3 2021 Rating	Rolling Rating
Turf Condition	62	81	91	75	77
Landscaping	92	85	96	100	93
Trees and Brush	97	97	100	100	98
Litter	97	88	98	95	94
Roadway Sweeping	100	100	100	100	100
Guardrail, Concrete Barrier, and End Anchors	97	97	93	97	96
Impact Attenuators	100	100	100	100	100
Fence, Control Access	90	80	91	93	88
Retaining Walls and Sound Barrier Walls	93	94	94	69	87
Decorative Supports	100	100	100	100	100
Graffiti and Stain Removal	93	95	100	98	97
<b>Element Total</b>	<b>89.1</b>	<b>90.6</b>	<b>95.5</b>	<b>91.6</b>	<b>91.7</b>
Traffic Control Devices	Q4 2020 Rating	Q1 2021 Rating	Q2 2021 Rating	Q3 2021 Rating	Rolling Rating
Signs	94	89	91	88	91
Delineators	88	75	93	80	84
Pavement Striping/Marking	65 <sup>1</sup>	74 <sup>1</sup>	90 <sup>1</sup>	70 <sup>1</sup>	76 <sup>2</sup>
Words and Symbols	87 <sup>1</sup>	81 <sup>1</sup>	86 <sup>1</sup>	87 <sup>1</sup>	85 <sup>2</sup>
Pavement Markers	96 <sup>1</sup>	93 <sup>1</sup>	100 <sup>1</sup>	100 <sup>1</sup>	98 <sup>2</sup>
Highway Lighting	78	78	93	90	85
<b>Element Total</b>	<b>85.2<sup>1</sup></b>	<b>82.2<sup>1</sup></b>	<b>92.5<sup>1</sup></b>	<b>86.5<sup>1</sup></b>	<b>86.9<sup>2</sup></b>

<sup>1</sup>Excludes asphalt surface pavement condition as well as markers, striping, and symbols on mainline NC-147 and all ramps/loops.

<sup>2</sup>Excludes the indicated quarter ratings for characteristics listed above.

## 8.0 Green Level Historic District Signs

Green Level Historic District signs and surrounding landscaped areas were installed as part of the Triangle Expressway construction project. Currently, NCDOT is maintaining the Green Level Historic District Signs and the Town of Cary is providing maintenance to the landscaped areas surrounding these signs.

### 8.1 Analysis and Recommendations

As part of each quarterly inspection, an assessment team visits the two remaining Green Level Historic District signs to conduct a visual inspection of each sign and ensure they are in good standing. The two signs included in the inspection inventory were found to be in good condition. One of the two landscaped areas were well maintained while the other appeared overgrown, partially obscuring the sign text. **Figure 6** shows the two signs assessed.

Figure 6: Green Level West Historic District Signs, Landscape Areas



## 9.0 Conclusion

This report presents the 2021 second quarter assessment of the Triangle Expressway. The NCTA's target ratings are 90 for the rolling rating, 90 for the overall quarter rating, 85 for elements, and 80 for characteristics. The third quarter 2021 overall rating was 93.0 and the rolling rating was 92.1, both ratings met the target rating of 90.

All element ratings were above the target ratings for the quarter and rolling assessment. During the third quarter assessment, all but three characteristics met or exceeded the target rating of 80. The characteristics that received quarter scores less than 80 includes Turf Condition (75), Retaining Walls and Sound Barrier Walls (69), and Pavement Striping/Marking (70). Repaving of asphalt surfaces, which includes the replacement of Pavement Markers, Pavement Striping, and Words/Symbols, began in 2020 and is set to be completed in Fall 2021.

To maintain/improve the condition ratings, it is recommended that the pavement striping/marketing replacement cycles are completed as planned in the capital budget. Replacement of pavement striping/marketing is scheduled to be performed in Spring 2022. Also, bare areas seeding/fertilization program efforts should continue during the winter and spring seasons to promote new turf growth.

This quarter, the two Green Level Historic District signs inspected were found to be in good condition. The landscaped area surrounding one of the two signs was found to be overgrown and in need of maintenance. The landscape area around the other sign on Green Level Church Road was found to be well maintained.

# **Appendix A**

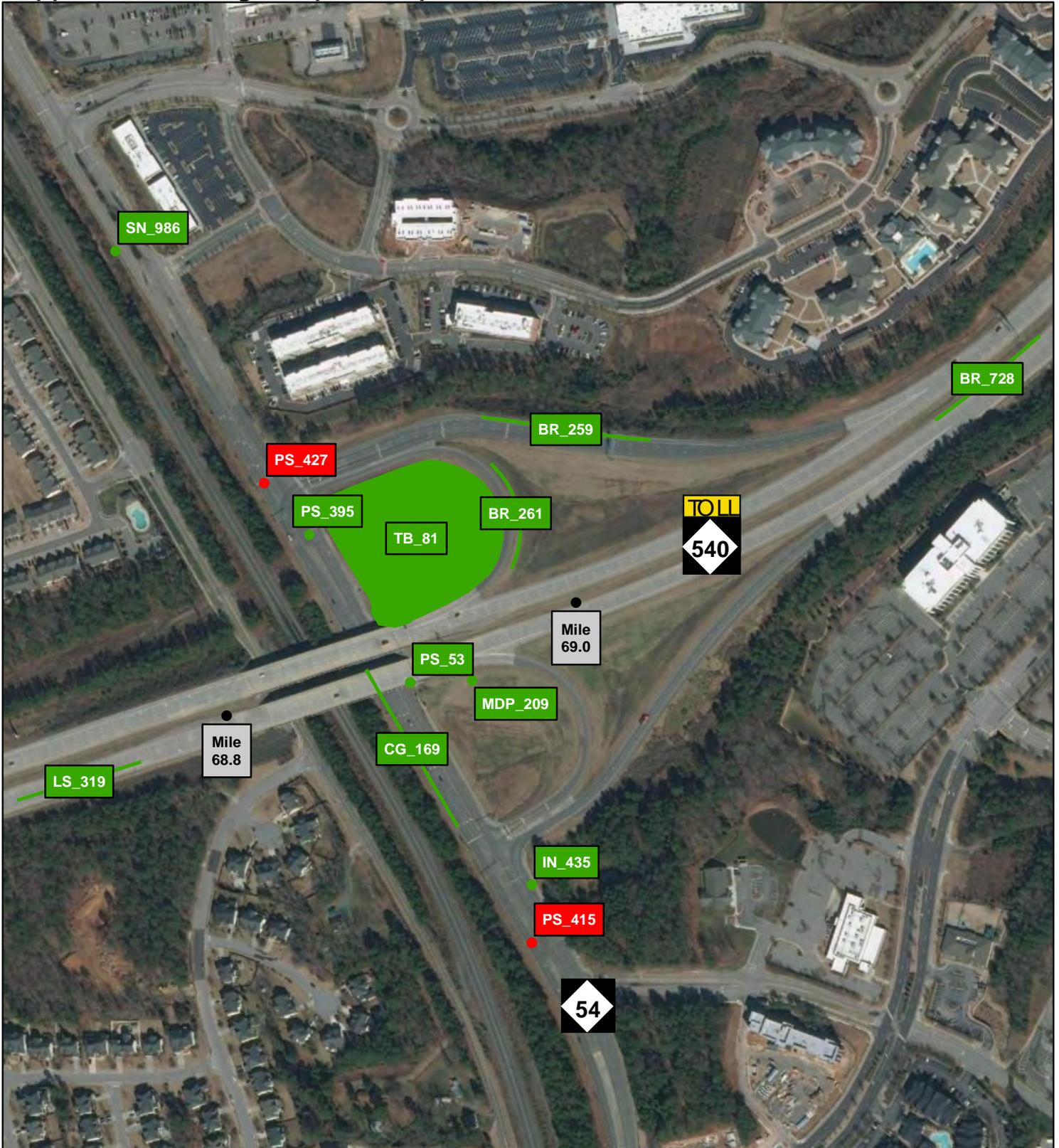
**Triangle Expressway 2021 Third Quarter Asset Assessment Locations**

## Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations

Provided below are a series of maps outlining the assets that were a part of this quarter's sample and their corresponding result. Assets are defined by an Inventory ID, which is a unique identifier given to each individual asset. The components that make up the Inventory ID are an asset specific prefix along with a number, such as LS\_1. All assets and their respective prefixes are listed below:

- Guardrail, Concrete Barrier and End Anchors – BR
- Curb and Gutter – CG
- Decorative Supports – DS
- Drainage Pipes – DP
- Misc. Drainage Structures – MDP
- Fence and Control of Access – FN
- Graffiti - GF
- Highway Lighting – HL
- Impact Attenuators – IA
- Inlets – IN
- Landscaping – PB
- Linear Samples – LS
  - Paved Lanes – Asphalt
  - Paved Lanes – Concrete
  - Paved Shoulders
  - Unpaved Shoulders
  - Front/Back Slopes
  - Unpaved Lateral and Outfall Ditches
  - Litter
  - Roadway Sweeping
  - Pavement Striping/Markings
  - Pavement Markers
  - Delineators
- Paved Ditches – PD
- Pavement Words and Symbols – PS
- Signs – SN
- Tree and Brush – TB
- Turf Condition – TF
- MSE/Retaining Walls, Sound Barrier Walls, and Screen Walls – WL

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations

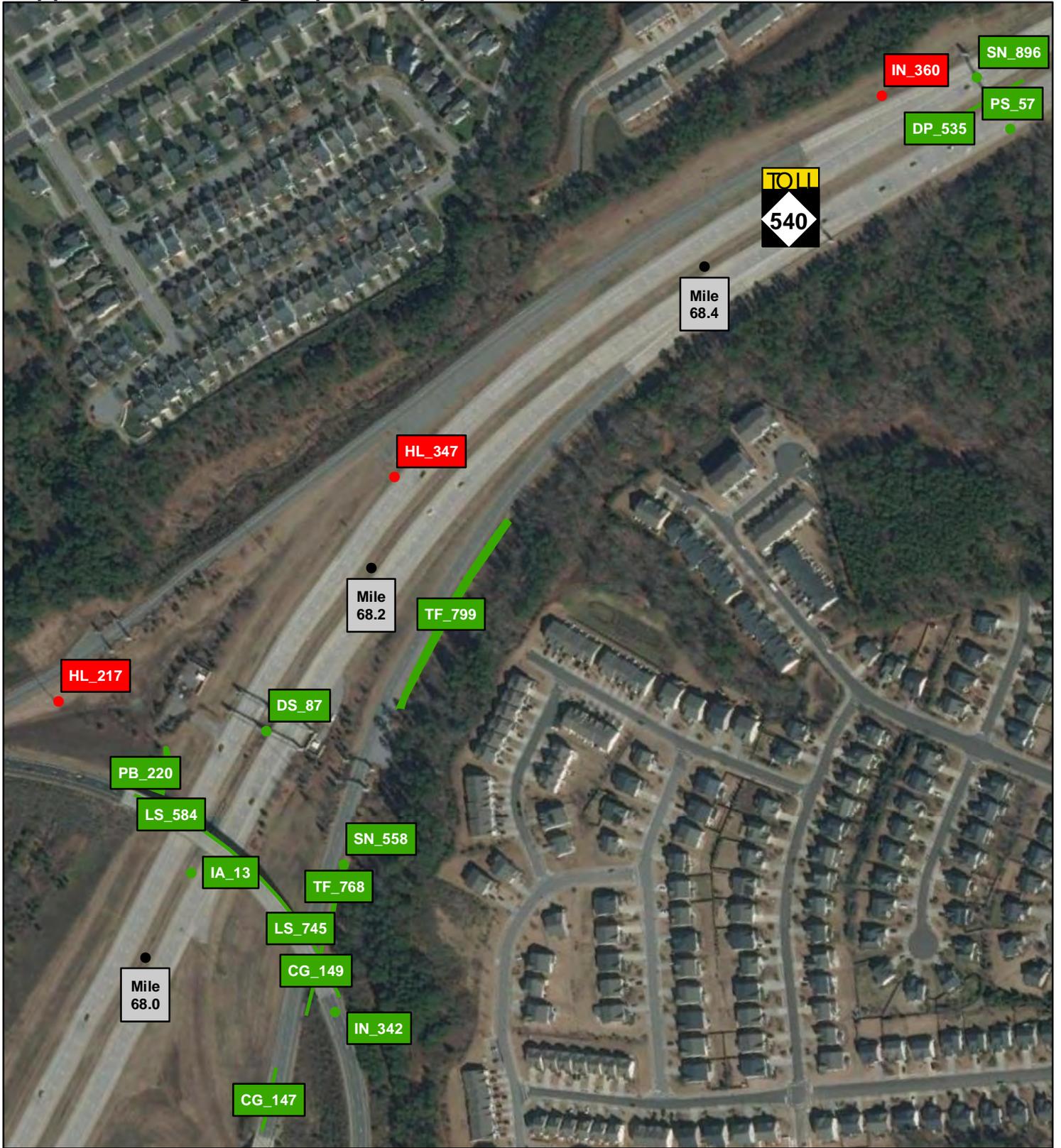


## Legend

- Failing Asset
- Passing Asset

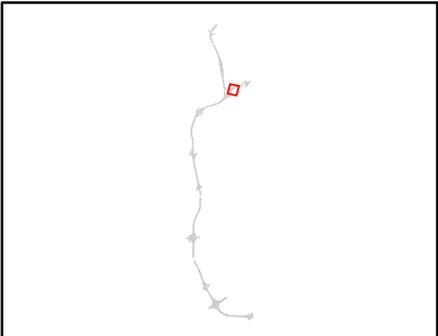


# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

- Failing Asset
- Passing Asset



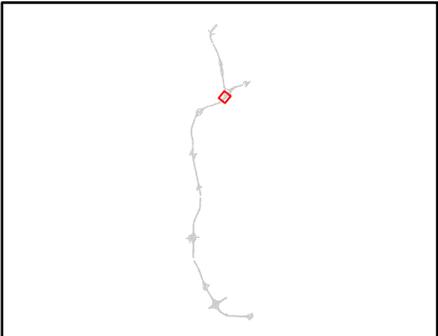
A2

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

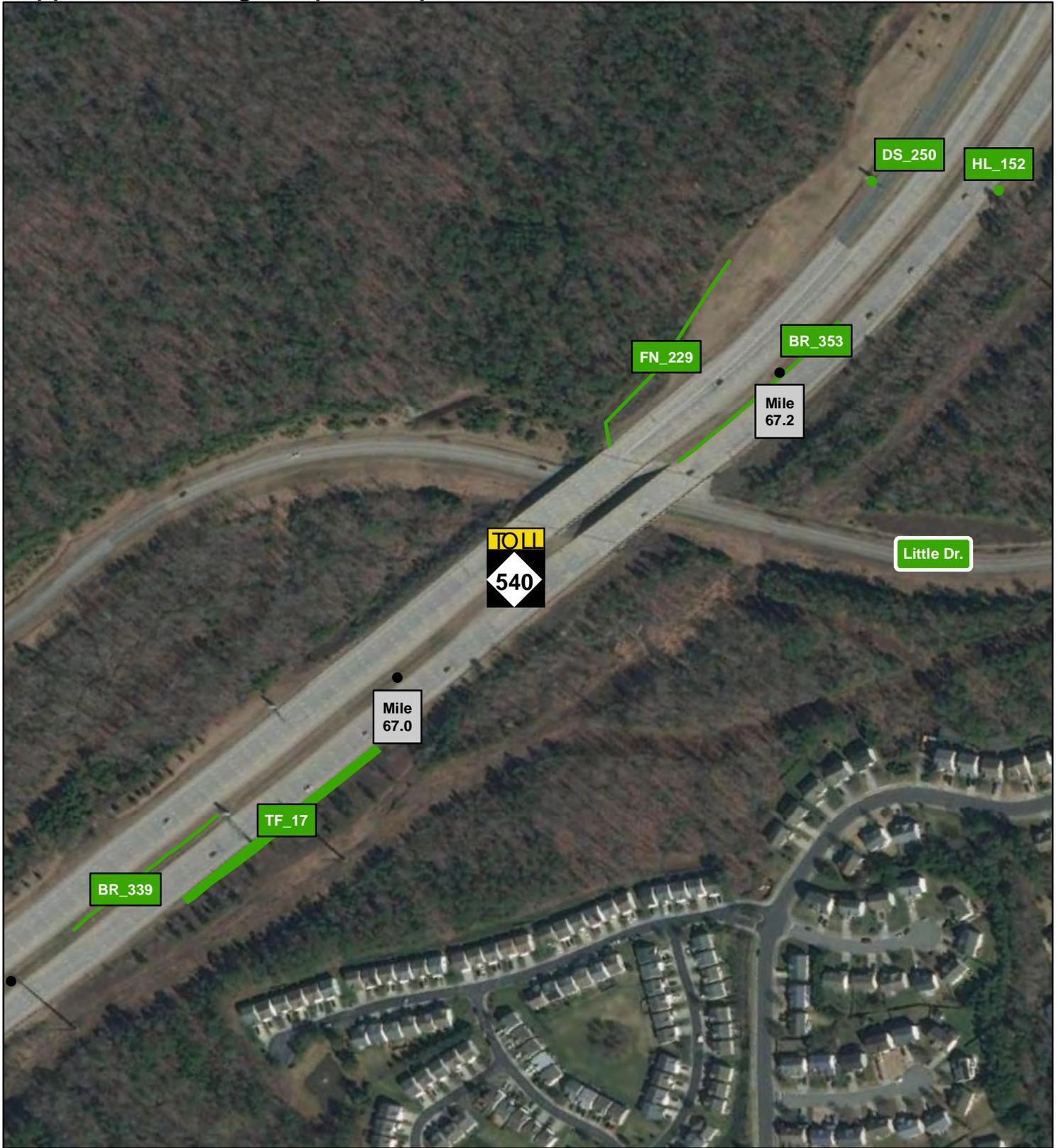
-  Failing Asset
-  Passing Asset



NORTH CAROLINA  
**Turnpike Authority**

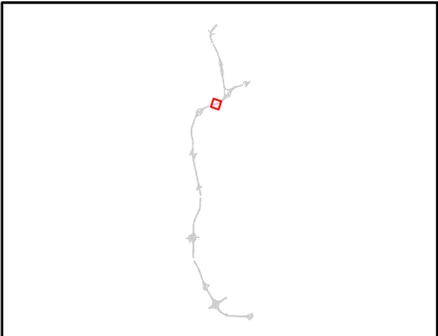
A3

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

-  Failing Asset
-  Passing Asset


NORTH CAROLINA  
**Turnpike Authority**

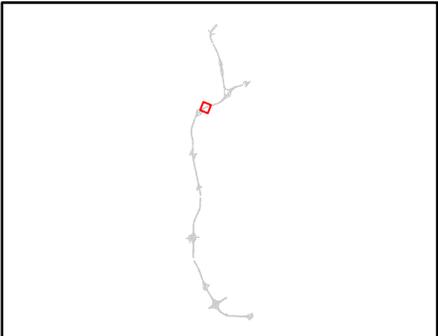
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# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

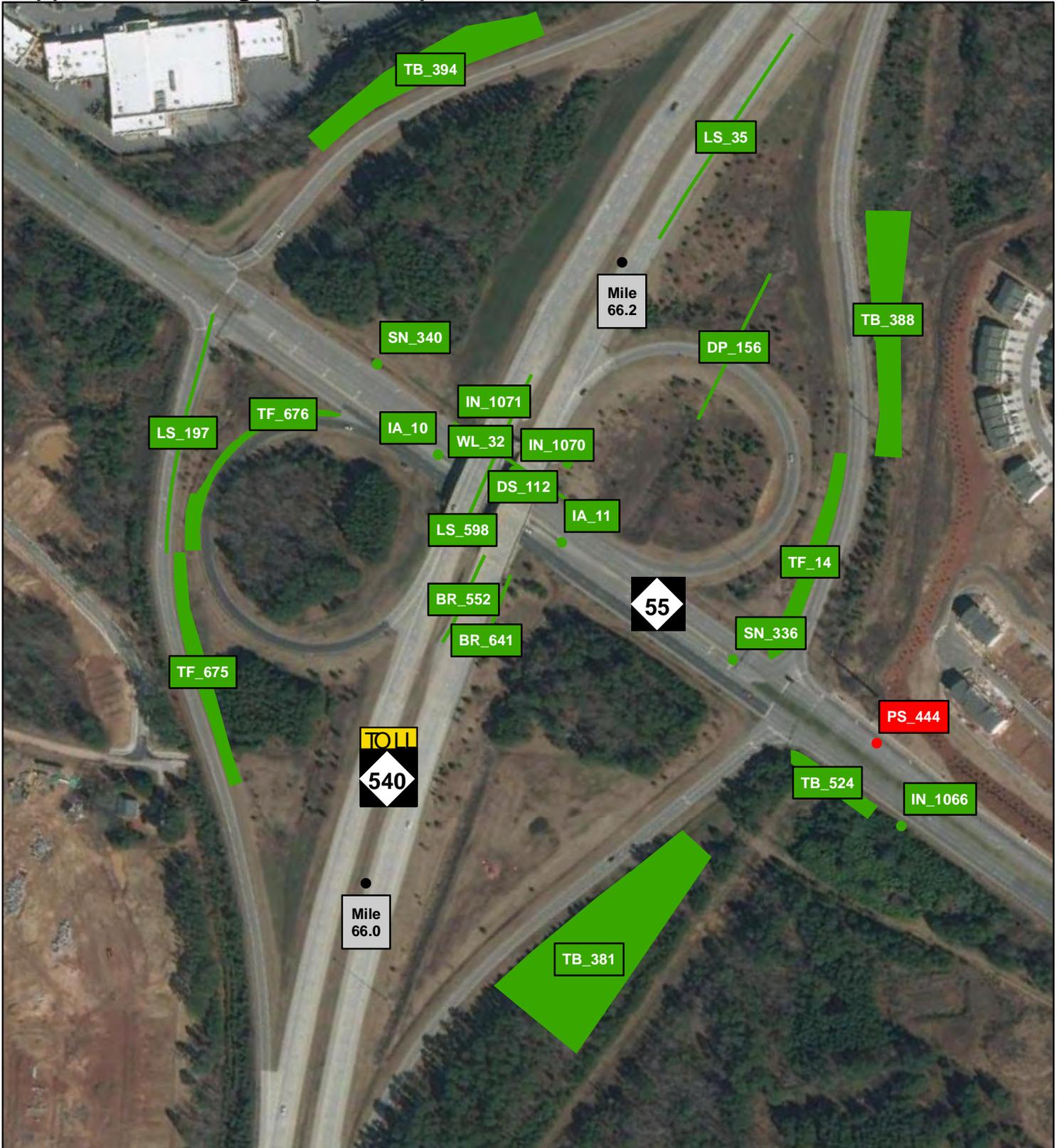
-  Failing Asset
-  Passing Asset


NORTH CAROLINA  
**Turnpike Authority**

A5

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations

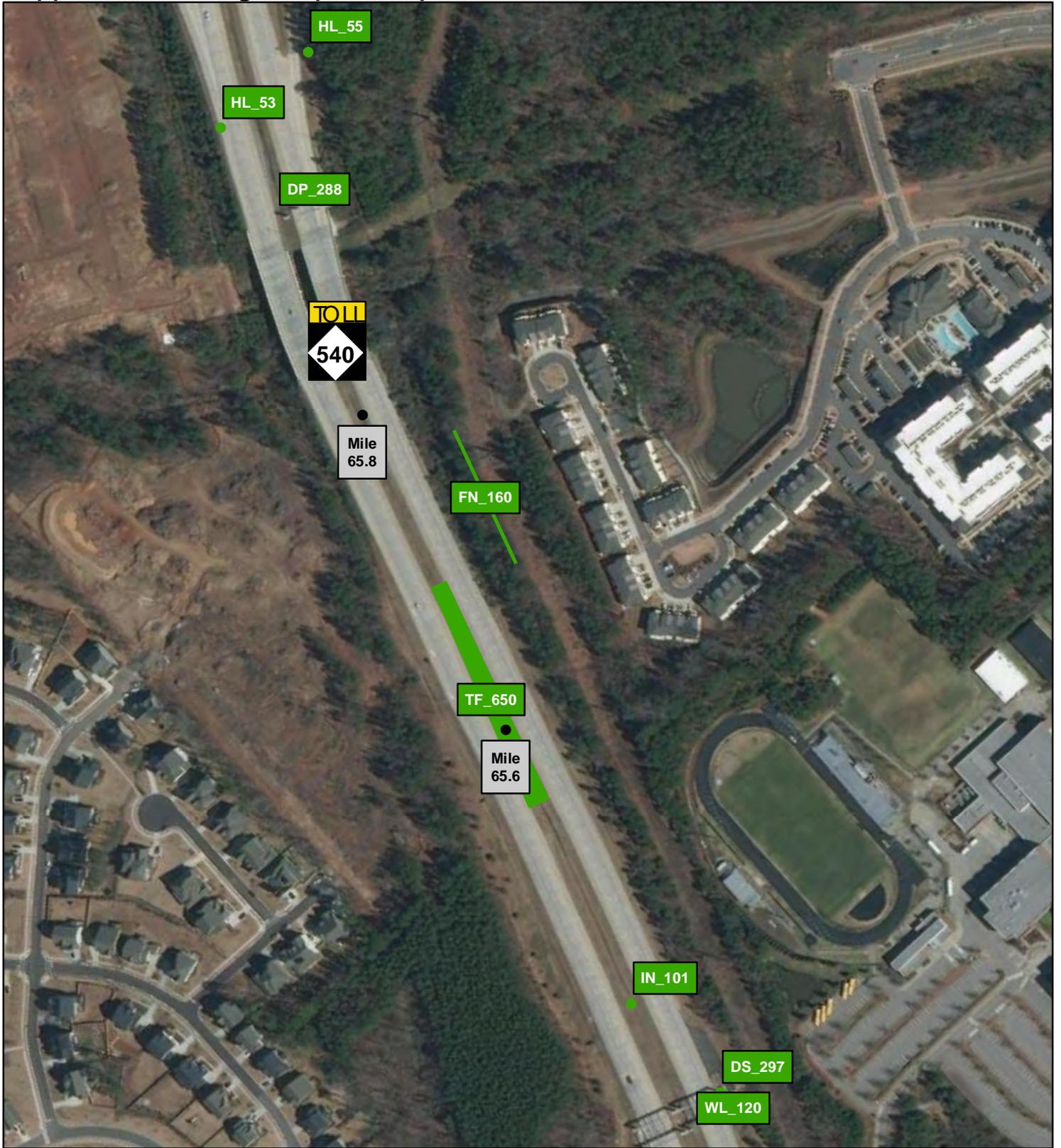


## Legend

- Failing Asset
- Passing Asset

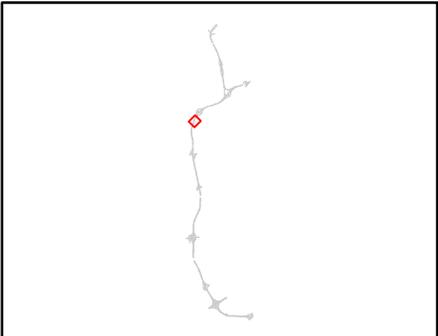


# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

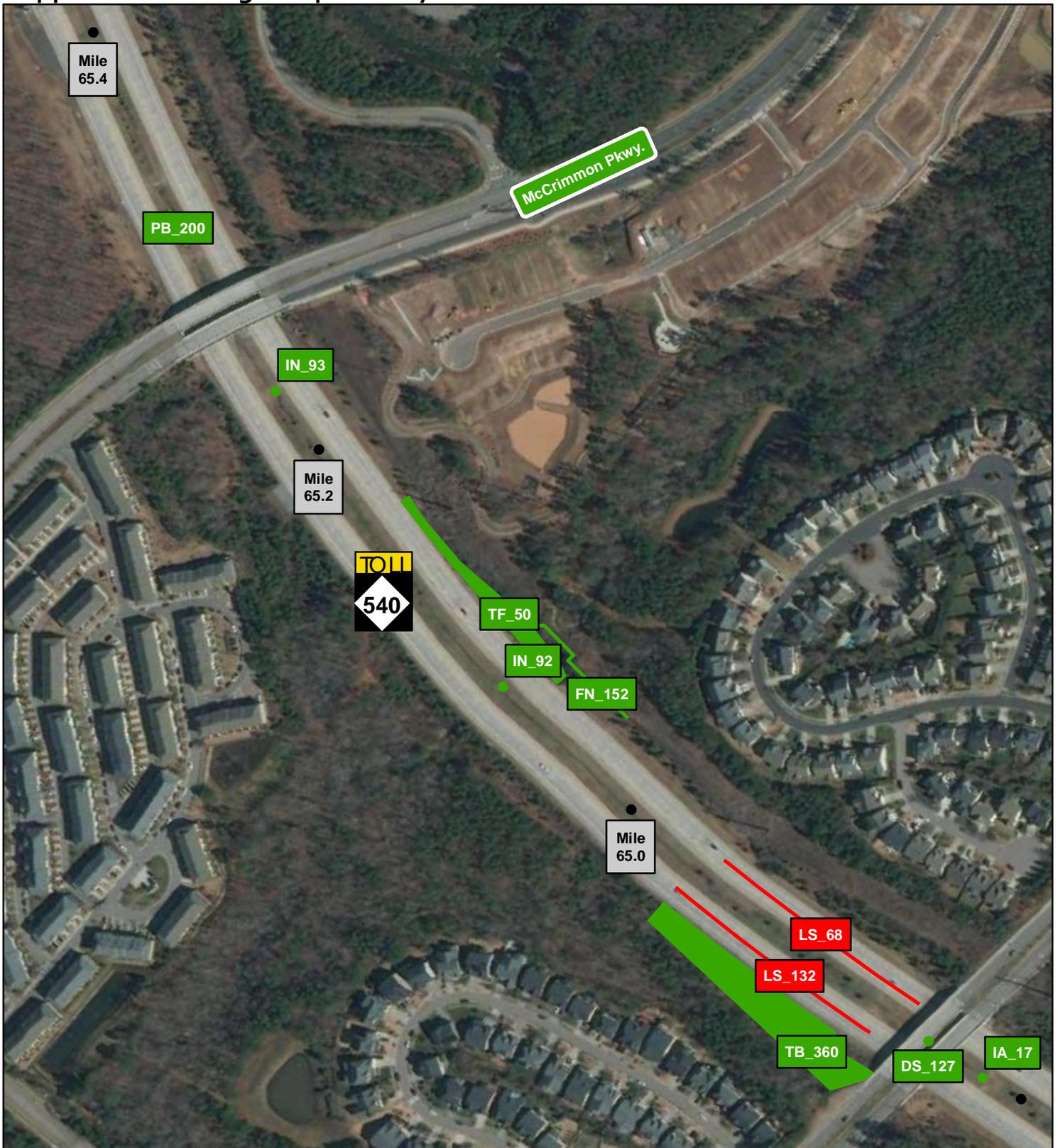
-  Failing Asset
-  Passing Asset


NORTH CAROLINA  
**Turnpike Authority**

A7

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations

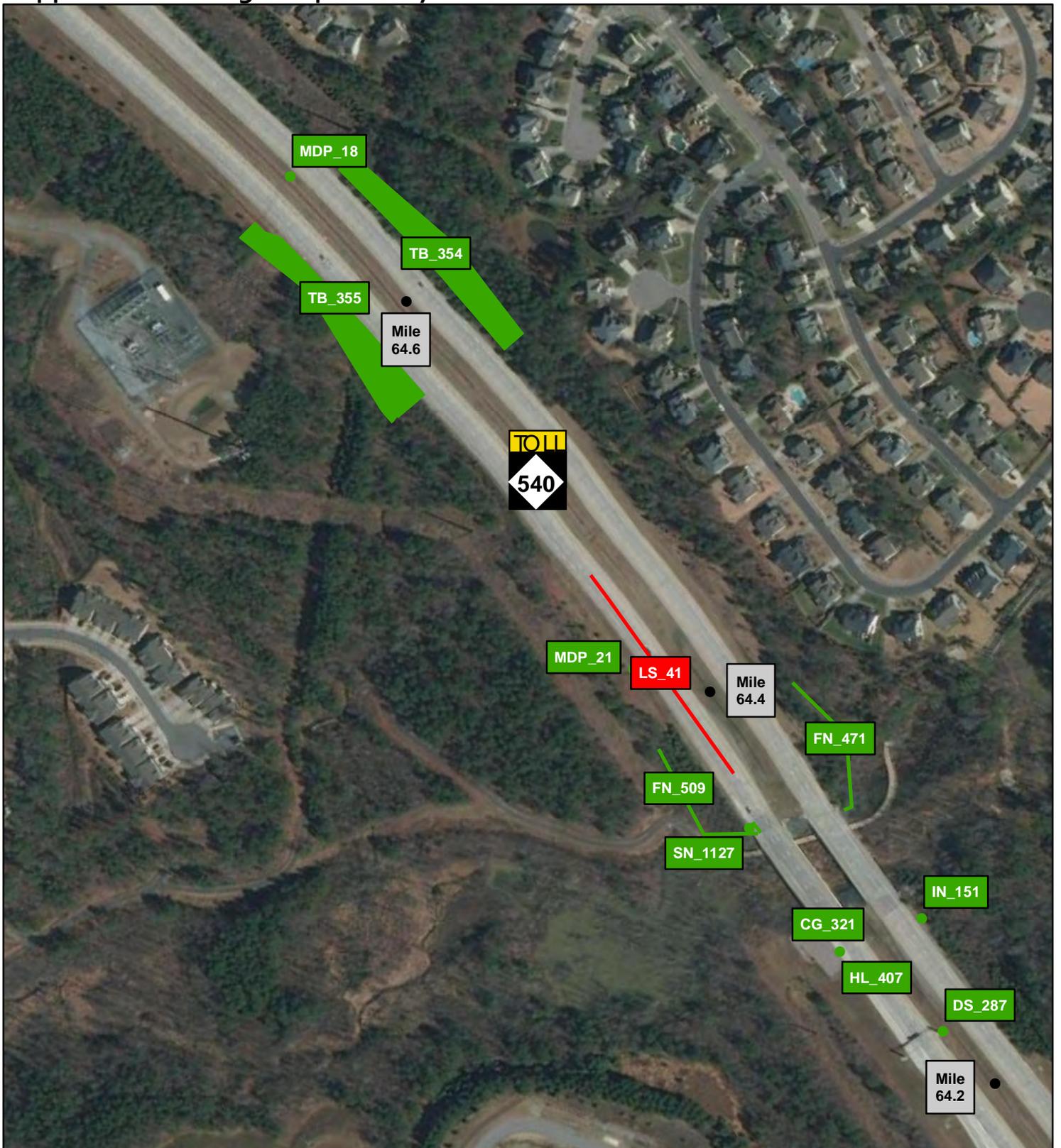


## Legend

-  Failing Asset
-  Passing Asset

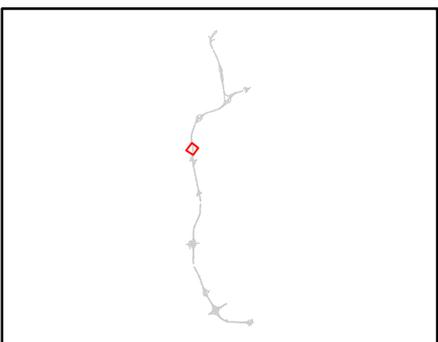


# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

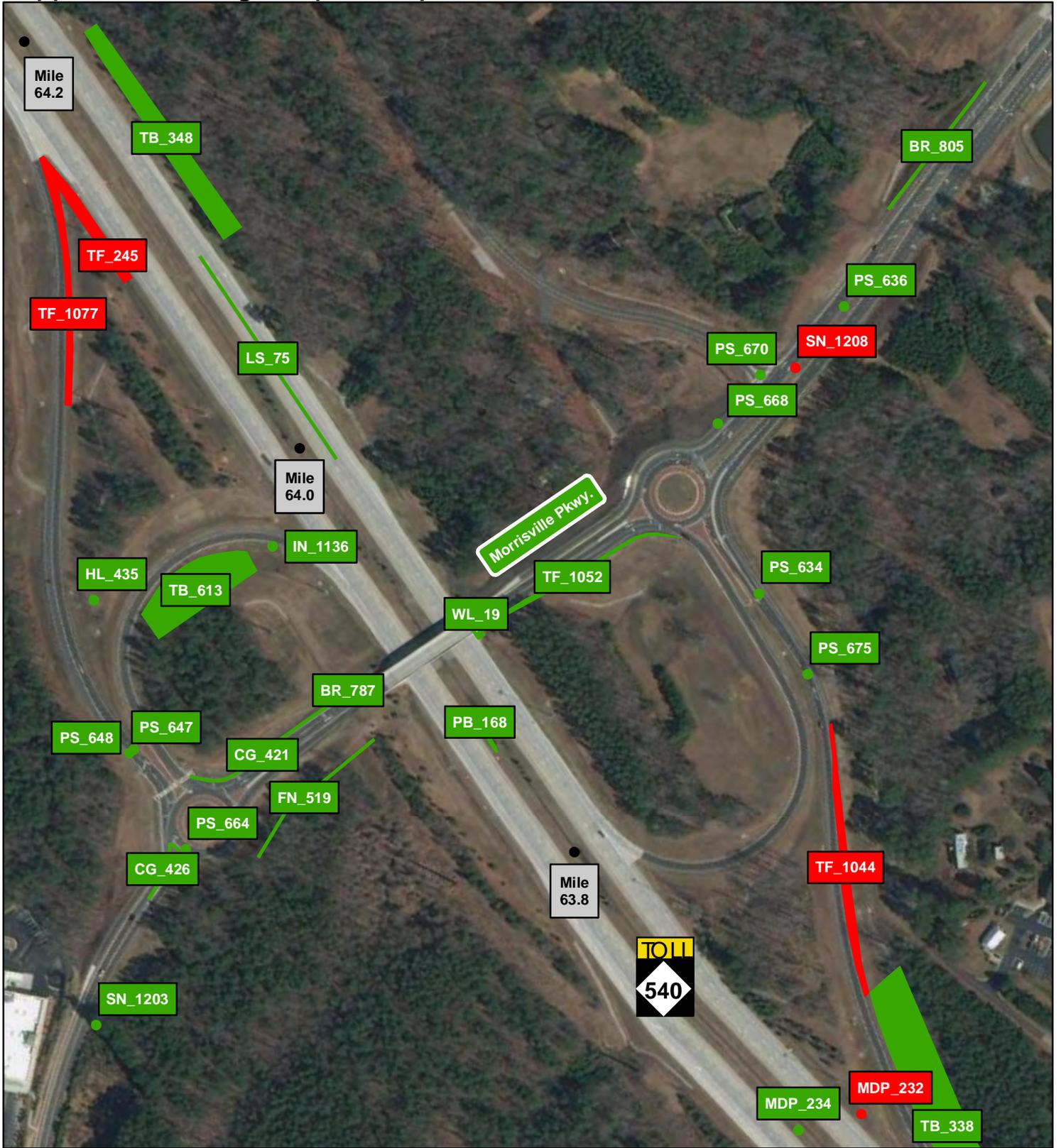
- Failing Asset
- Passing Asset



NORTH CAROLINA  
**Turnpike Authority**

A9

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

- Failing Asset
- Passing Asset



# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations

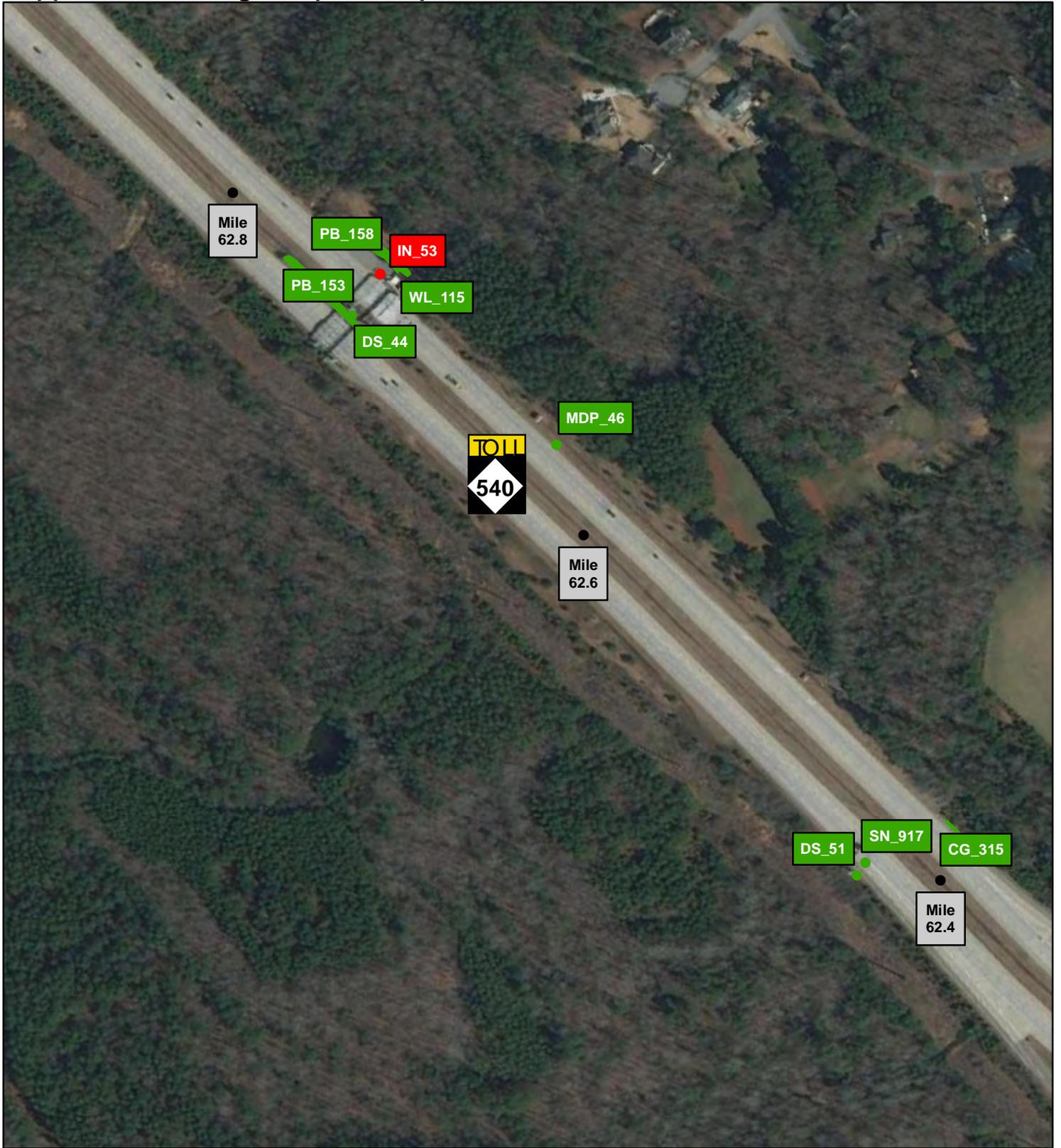


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-  Failing Asset
-  Passing Asset

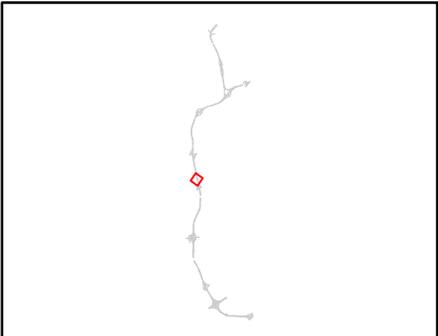


# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

-  Failing Asset
-  Passing Asset


NORTH CAROLINA  
**Turnpike Authority**

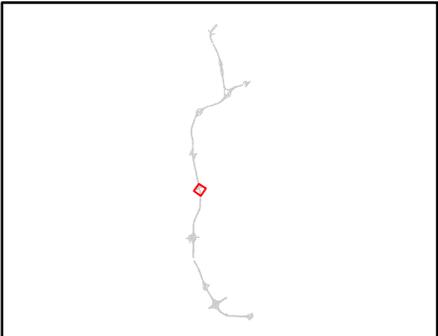
A12

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

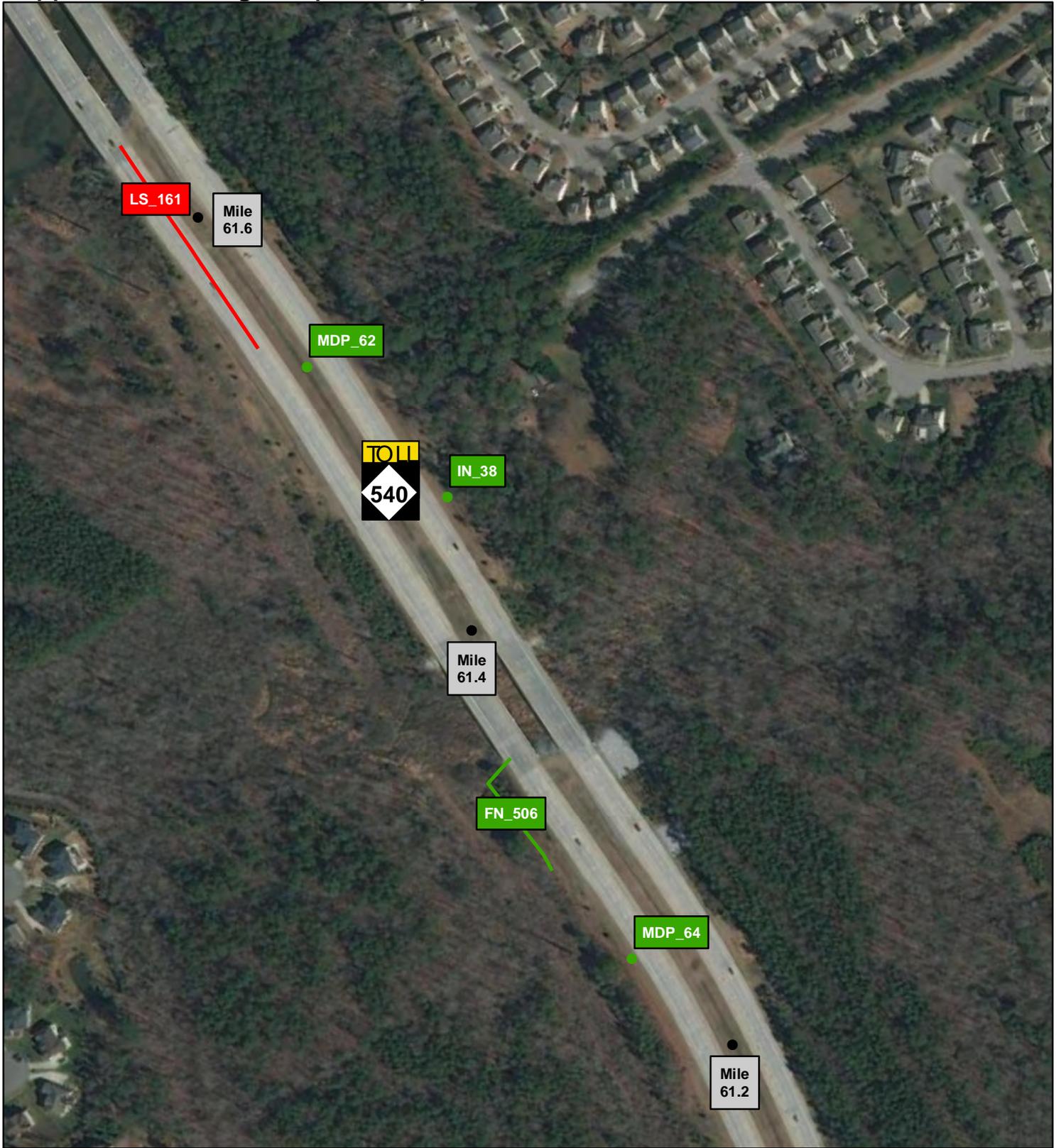
- Failing Asset
- Passing Asset



NORTH CAROLINA  
**Turnpike Authority**

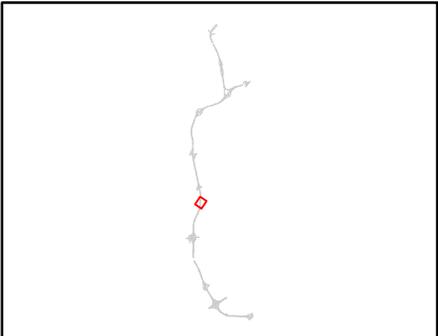
A13

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



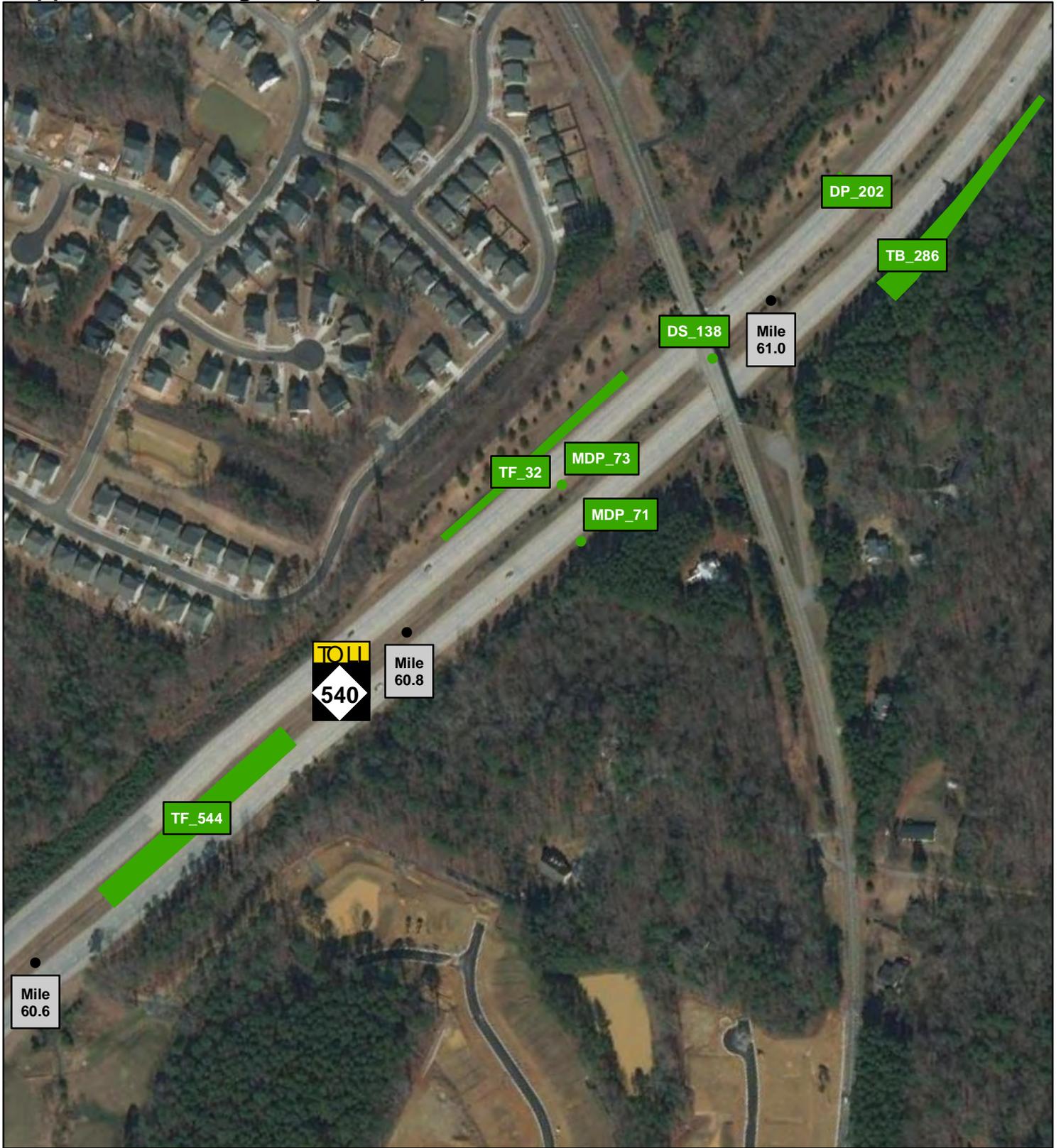
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-  Failing Asset
-  Passing Asset

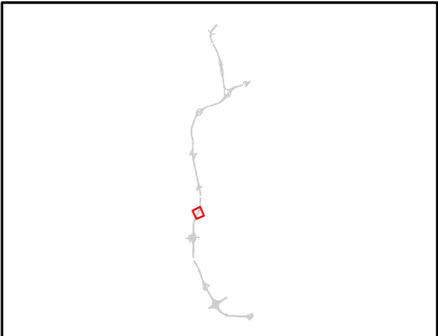

A14

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



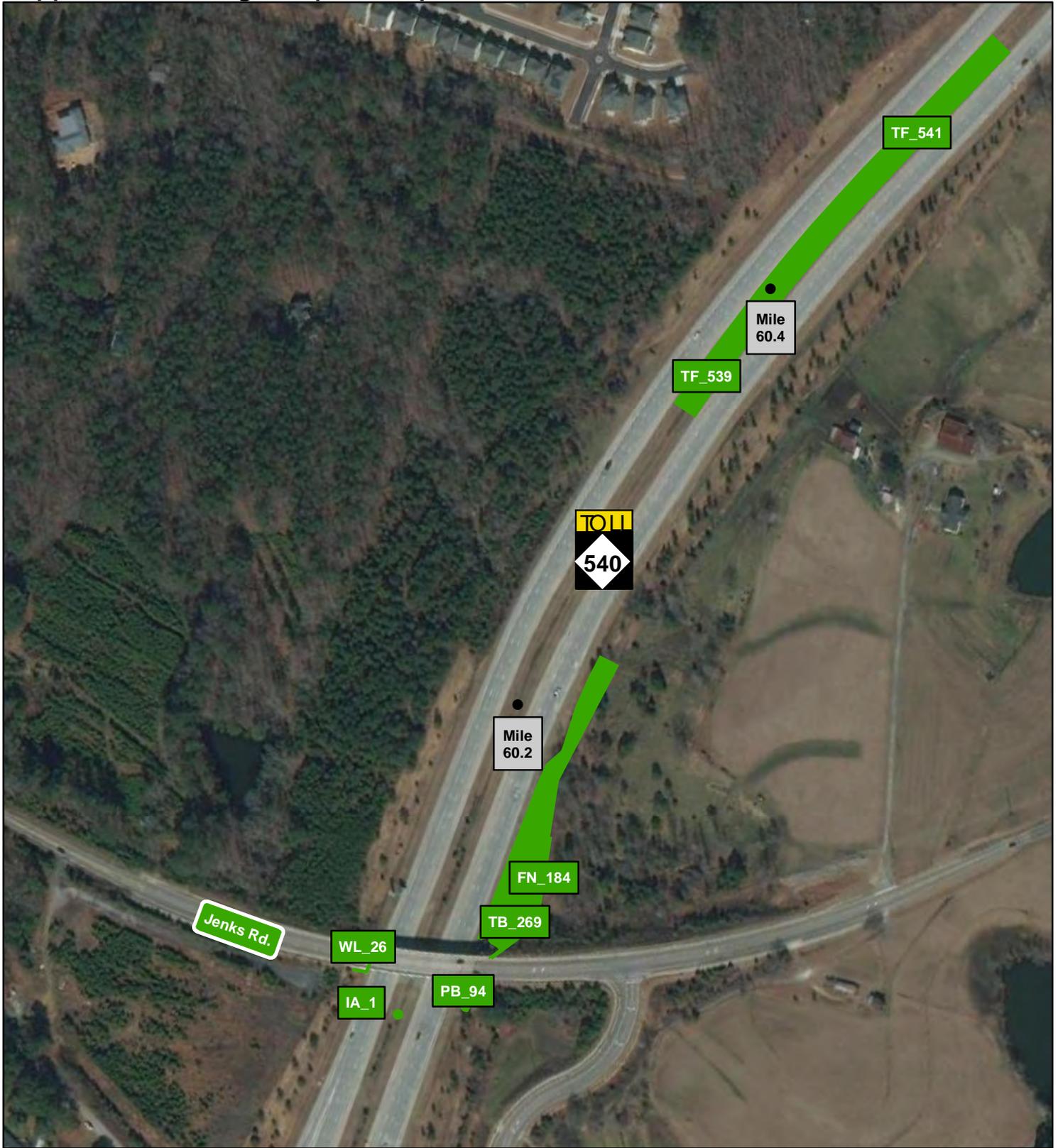
## Legend

-  Failing Asset
-  Passing Asset


A15

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

-  Failing Asset
-  Passing Asset

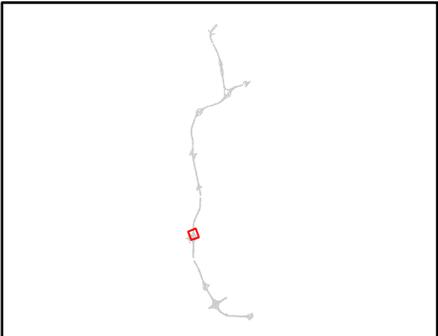


# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



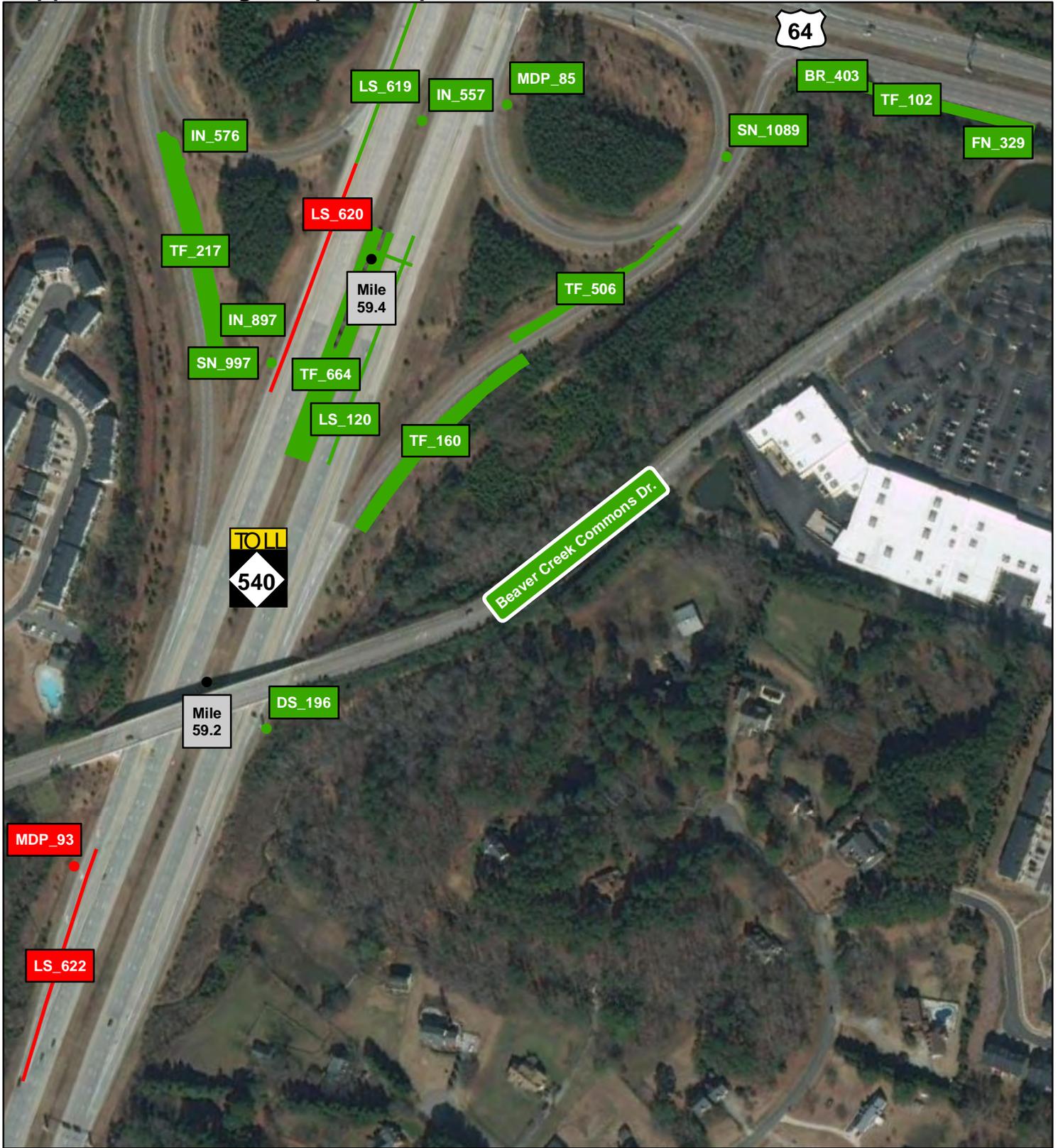
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- Failing Asset
- Passing Asset



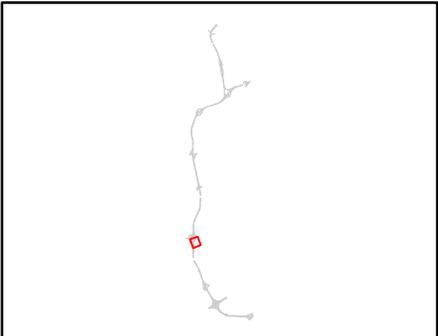
A north arrow pointing upwards and the logo for the North Carolina Turnpike Authority, featuring a stylized road and the text 'NORTH CAROLINA Turnpike Authority'.

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

- Failing Asset
- Passing Asset

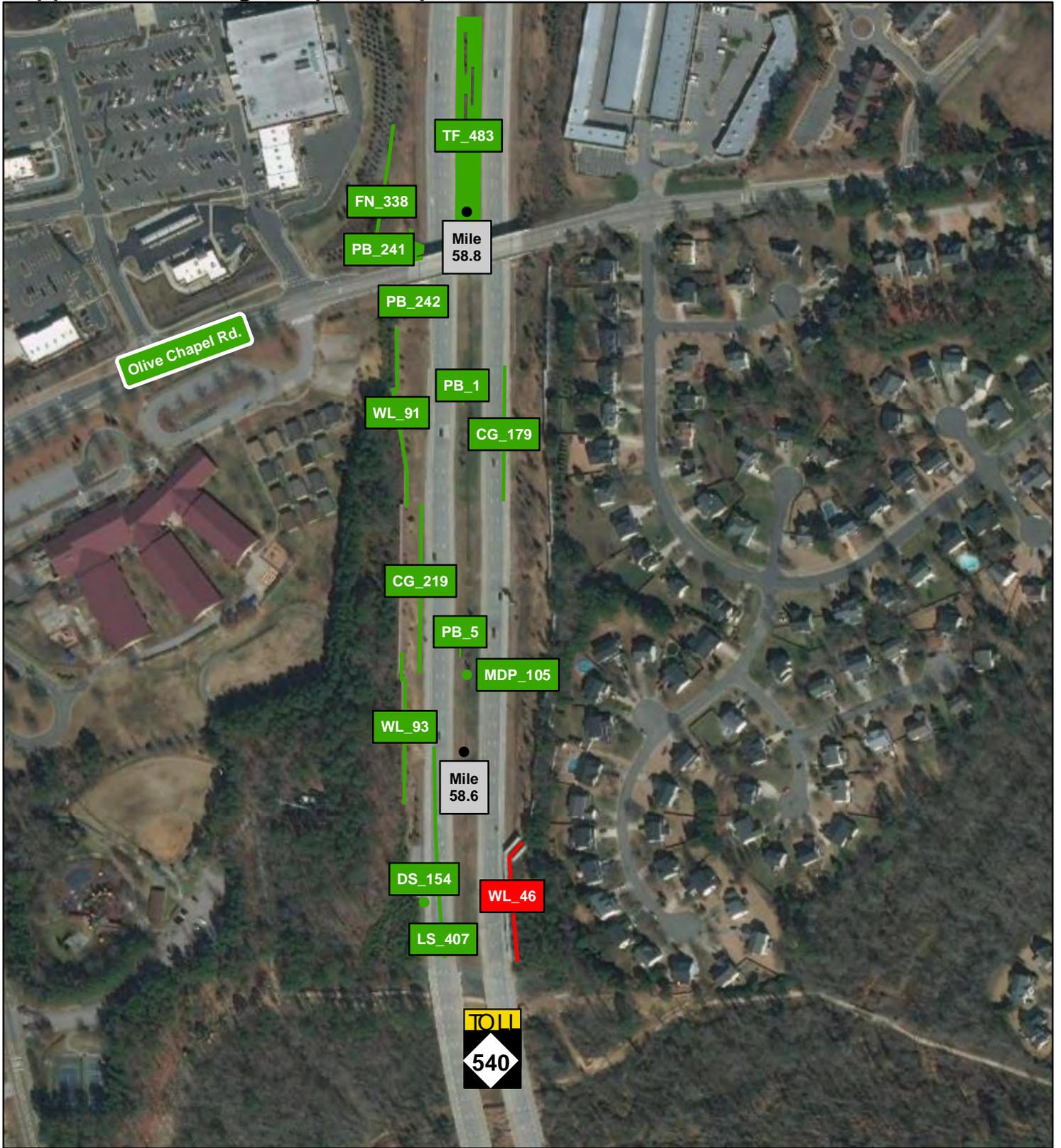






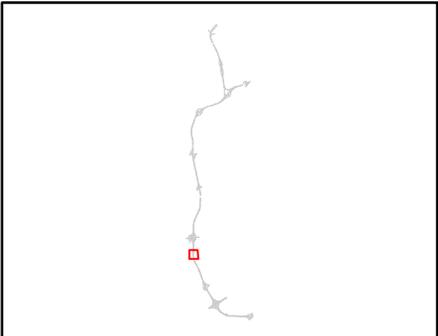
A18

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

-  Failing Asset
-  Passing Asset

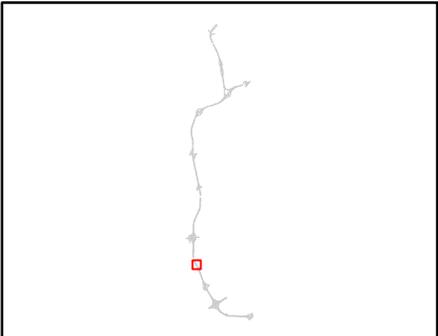

A19

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



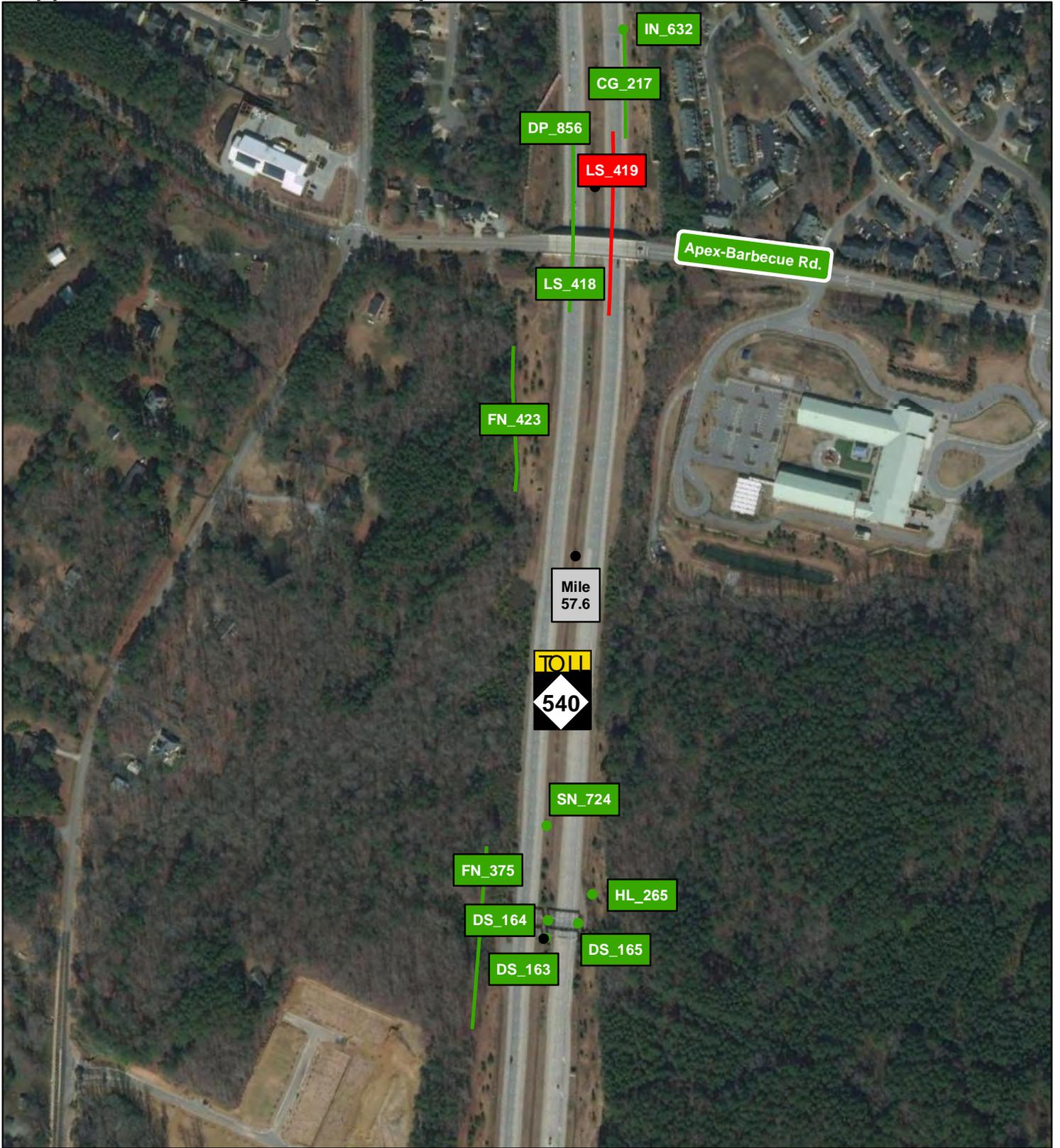
## Legend

-  Failing Asset
-  Passing Asset


A20

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

-  Failing Asset
-  Passing Asset

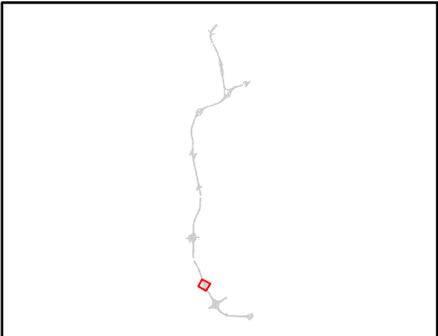


# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

-  Failing Asset
-  Passing Asset




**NORTH CAROLINA Turnpike Authority**

A22

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

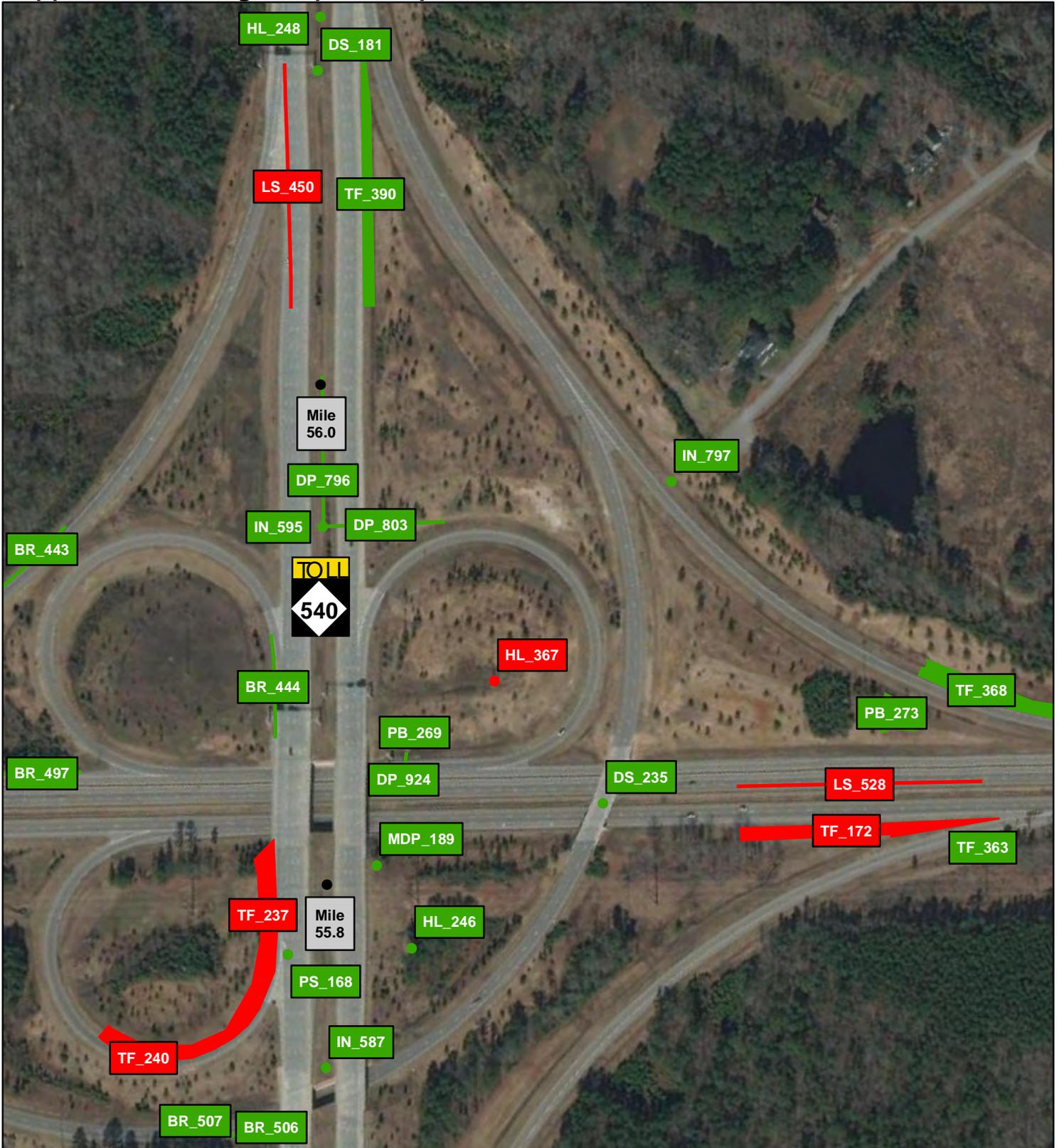
-  Failing Asset
-  Passing Asset



**NORTH CAROLINA**  
**Turnpike Authority**

A23

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations

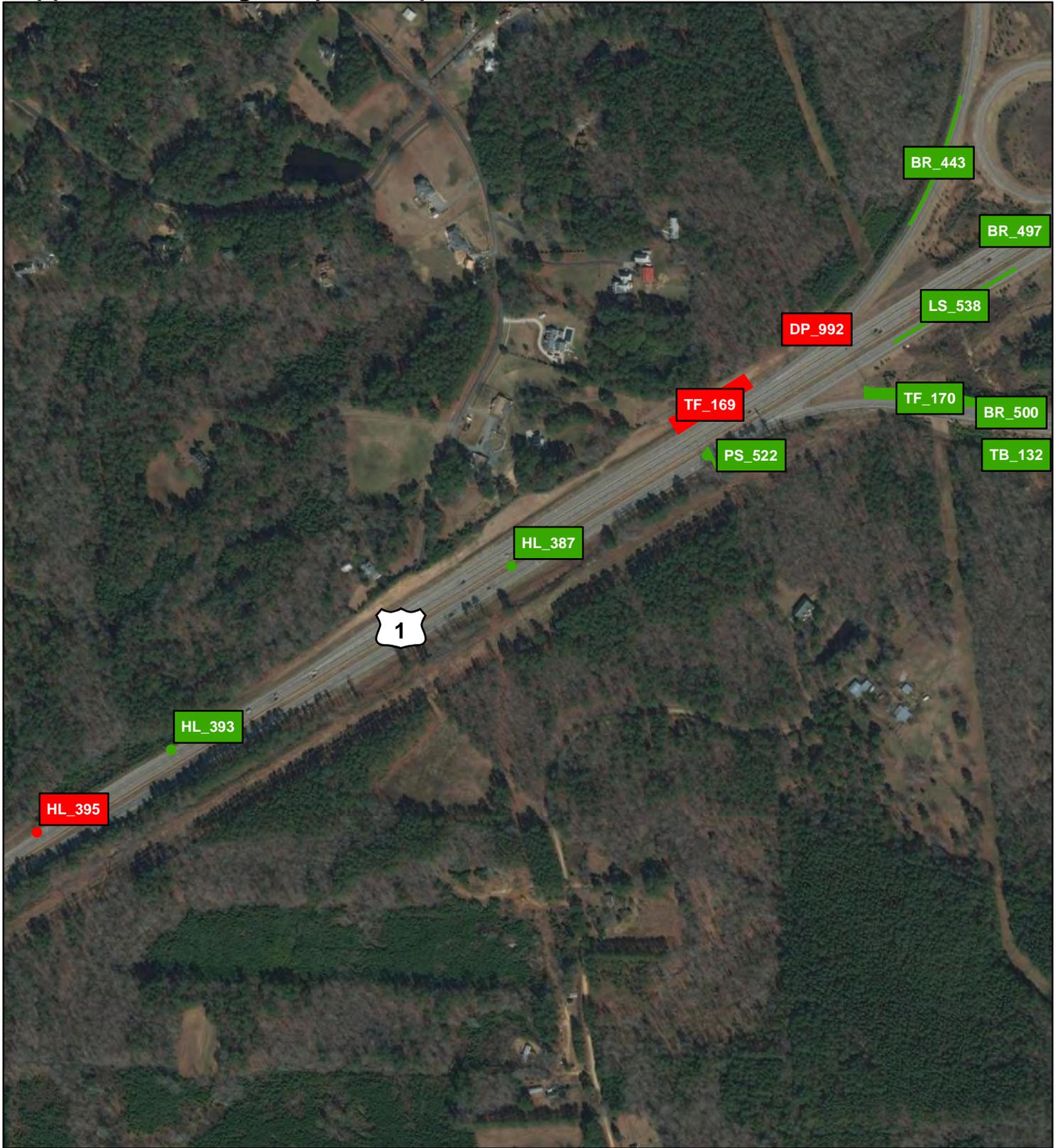


## Legend

- Failing Asset
- Passing Asset

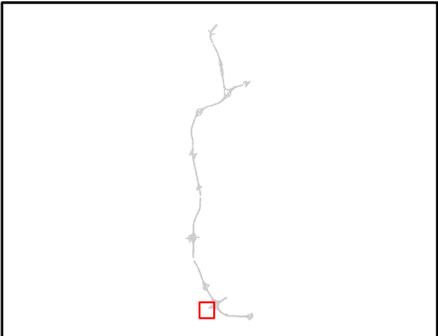


# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

-  Failing Asset
-  Passing Asset



  
NORTH CAROLINA  
Turnpike Authority

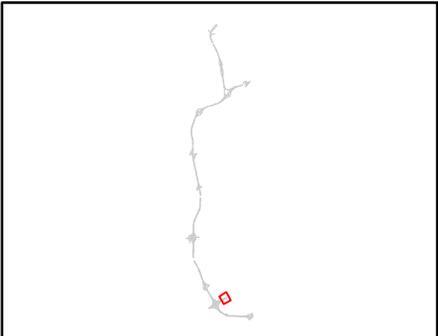
A25

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

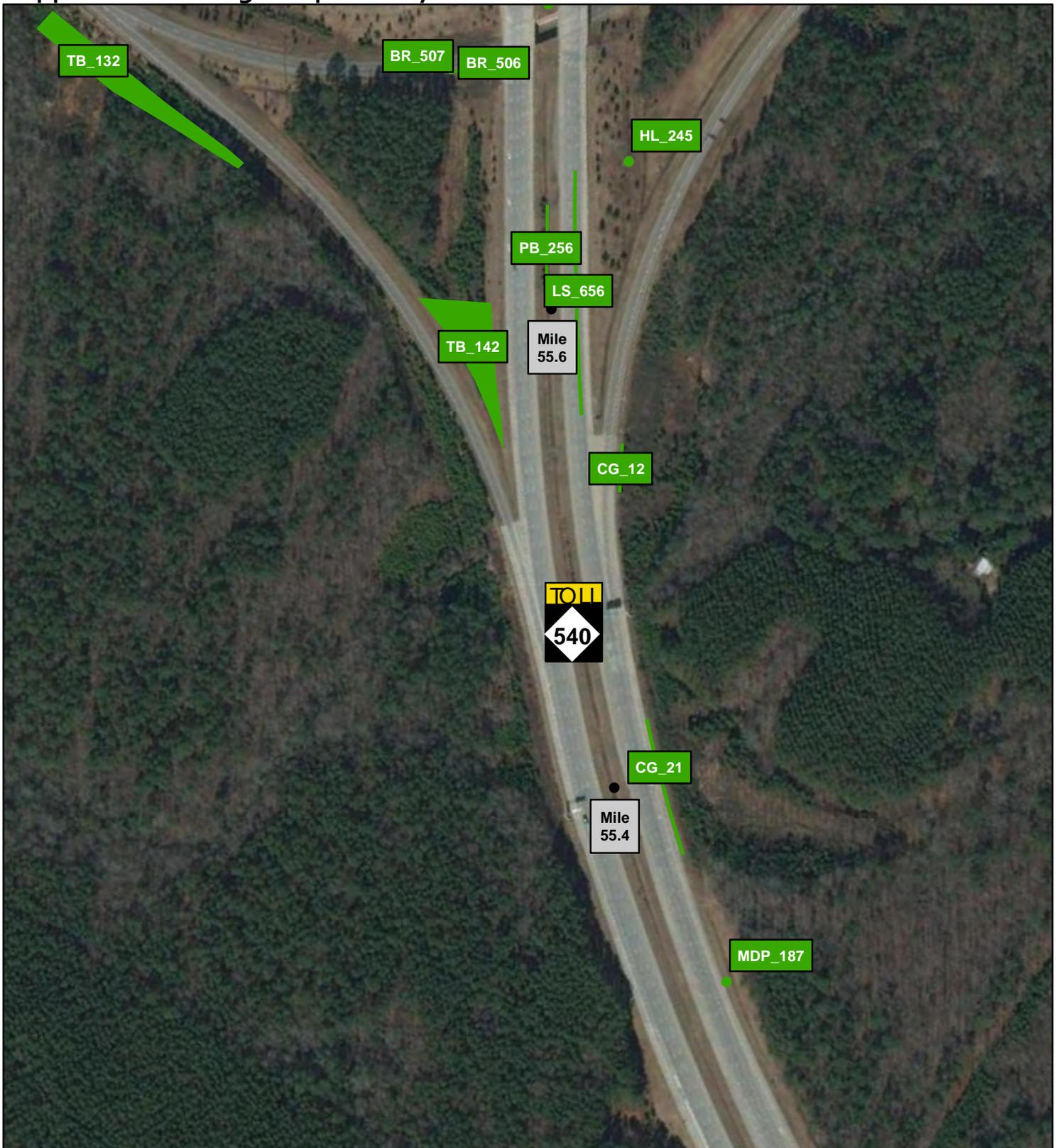
-  Failing Asset
-  Passing Asset


NORTH CAROLINA  
**Turnpike Authority**

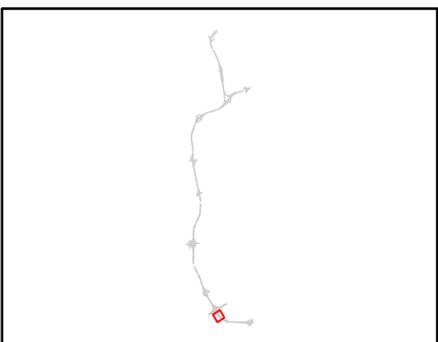
A26

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

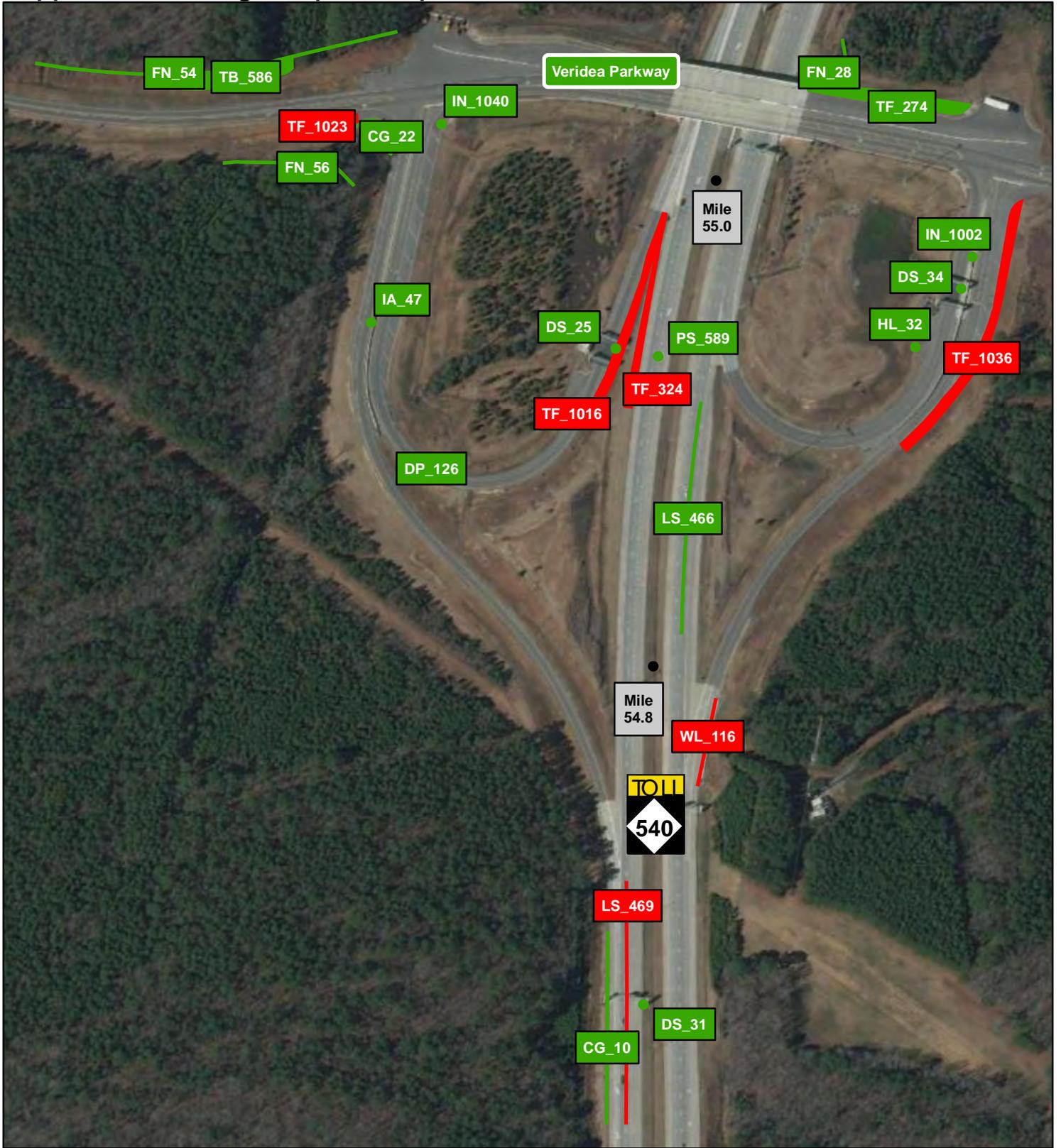
-  Failing Asset
-  Passing Asset



NORTH CAROLINA  
**Turnpike Authority**

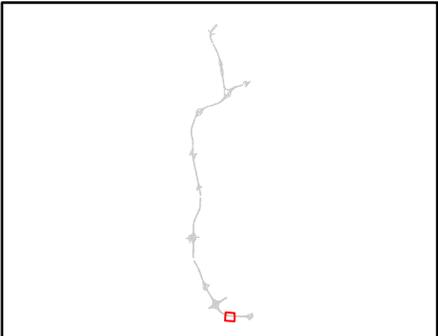
A27

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



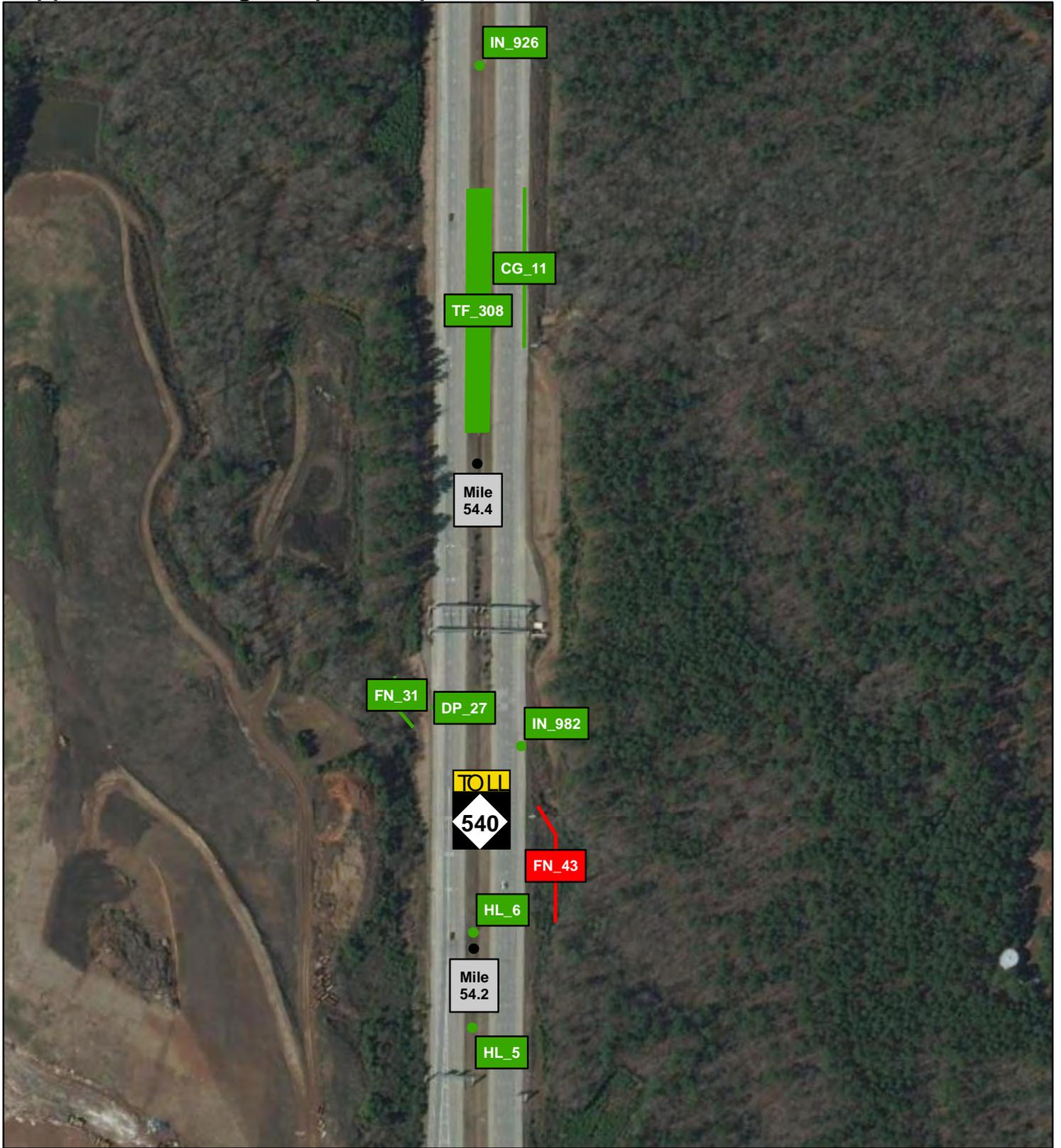
## Legend

- Failing Asset
- Passing Asset



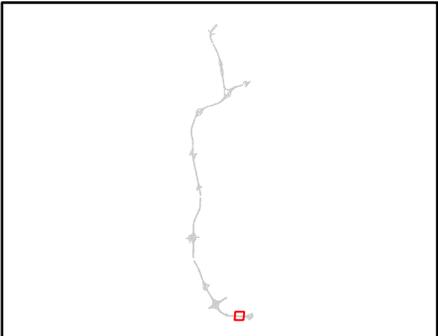
A north arrow pointing towards the top right of the page. Below it is the logo for the North Carolina Turnpike Authority, featuring a stylized road and the text "NORTH CAROLINA Turnpike Authority".

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

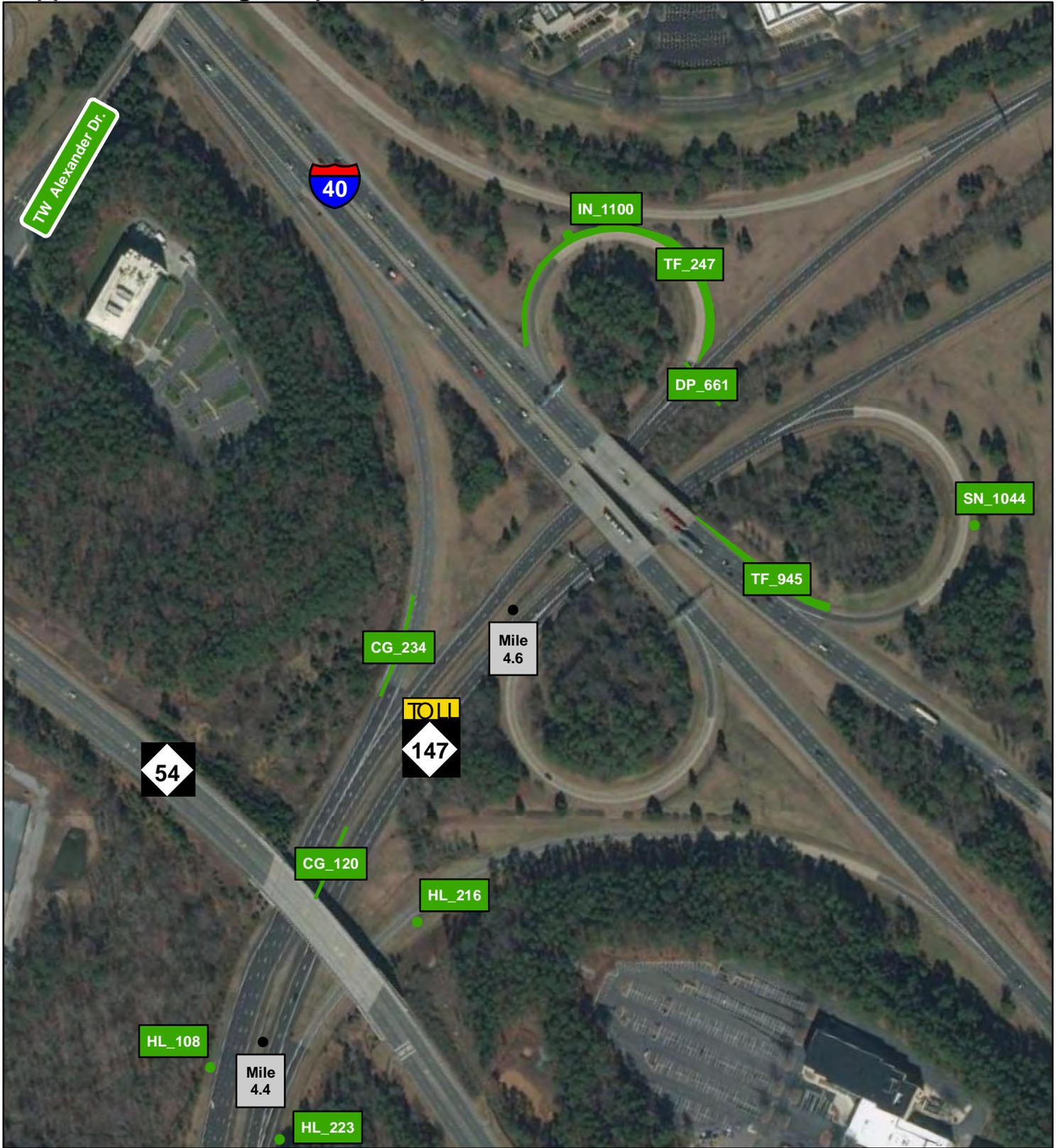
-  Failing Asset
-  Passing Asset



**NORTH CAROLINA**  
**Turnpike Authority**

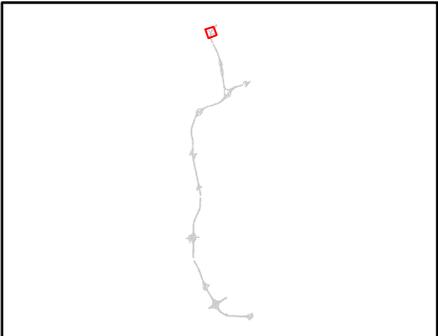
A29

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

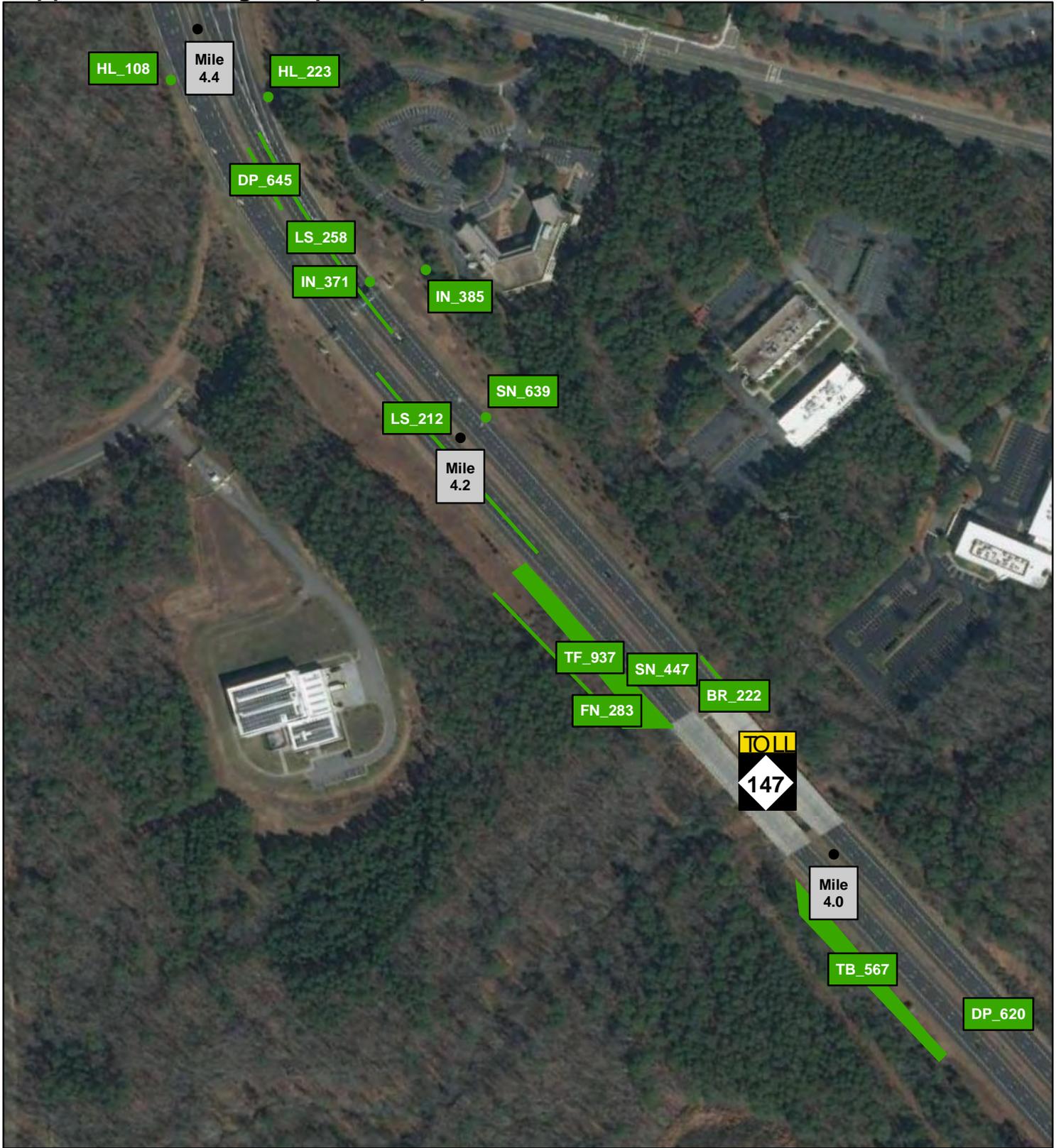
- Failing Asset
- Passing Asset



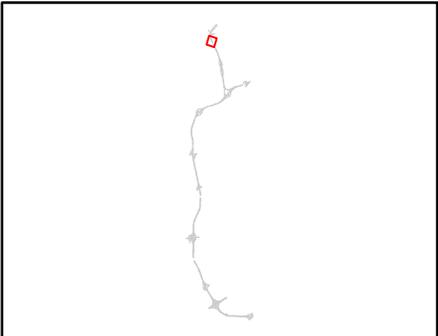

A30

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

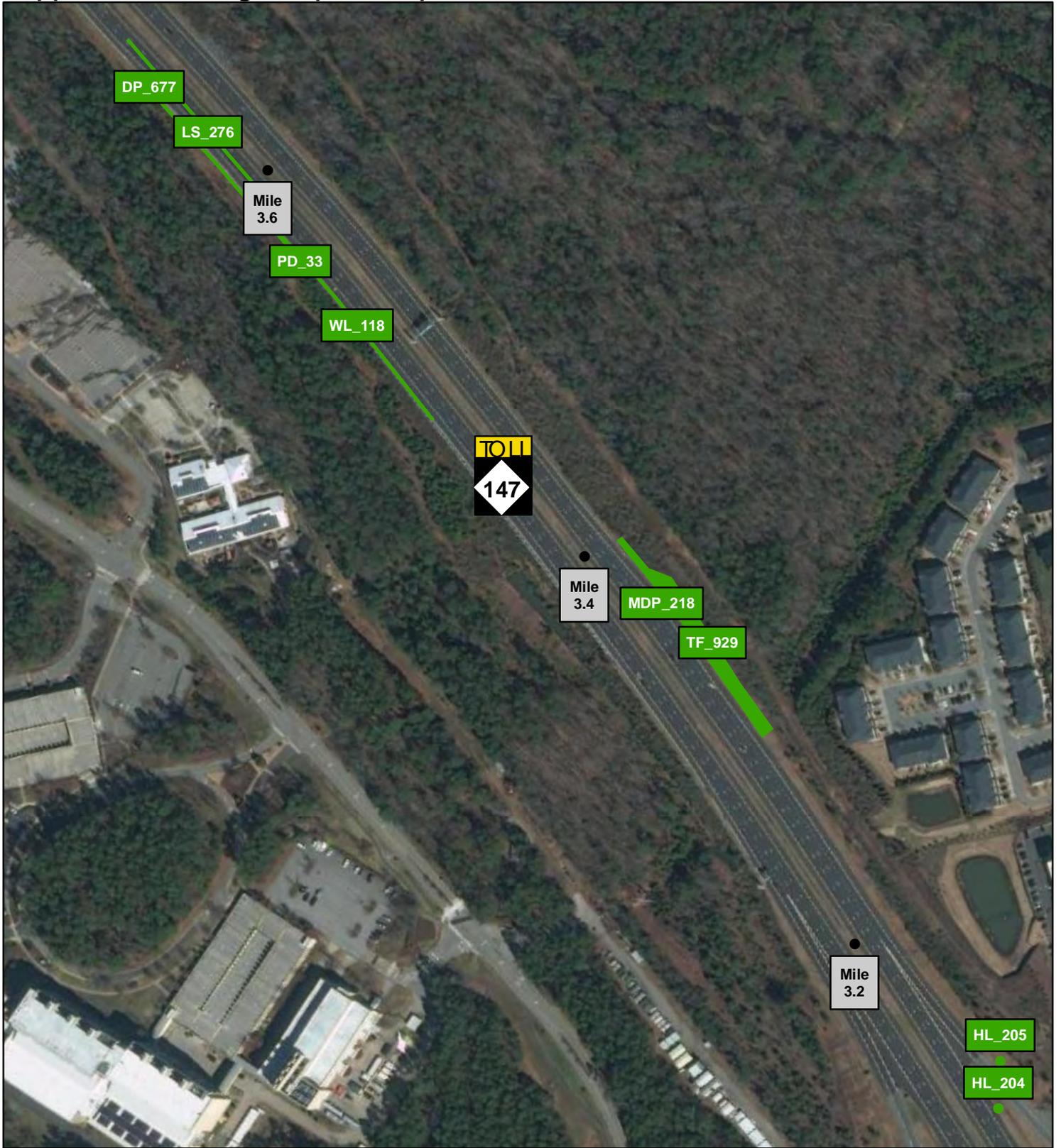
-  Failing Asset
-  Passing Asset


NORTH CAROLINA  
**Turnpike Authority**

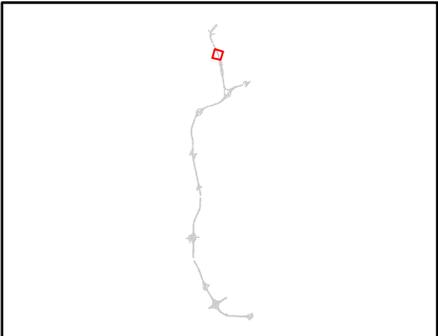
A31

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

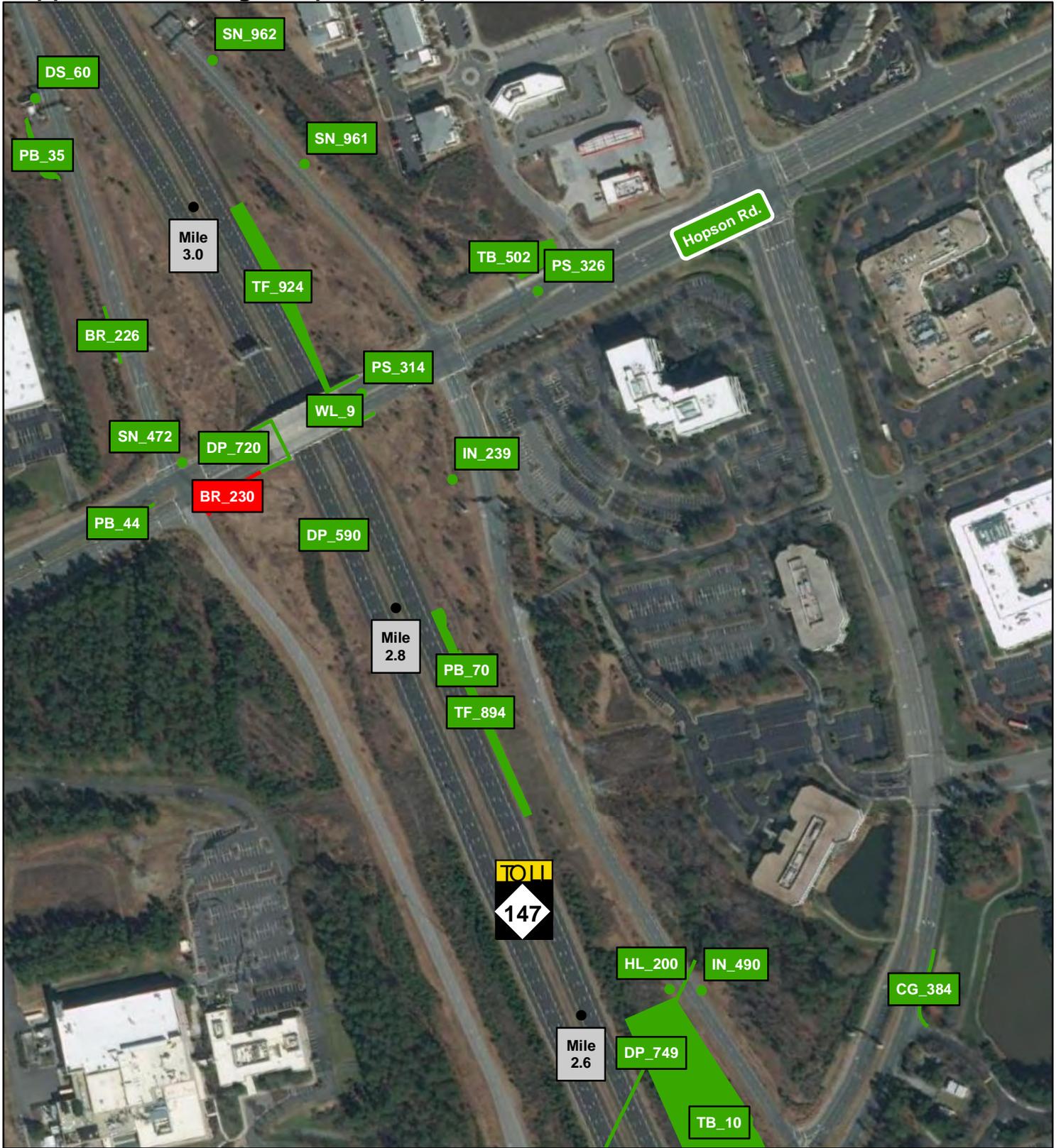
-  Failing Asset
-  Passing Asset



NORTH CAROLINA  
**Turnpike Authority**

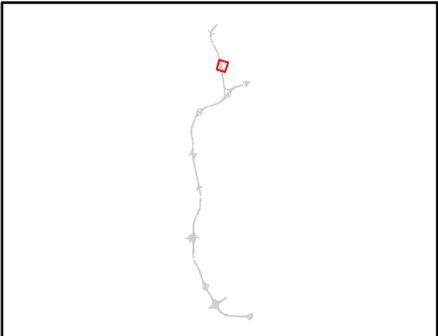
A32

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

- Failing Asset
- Passing Asset



NORTH CAROLINA  
**Turnpike Authority**

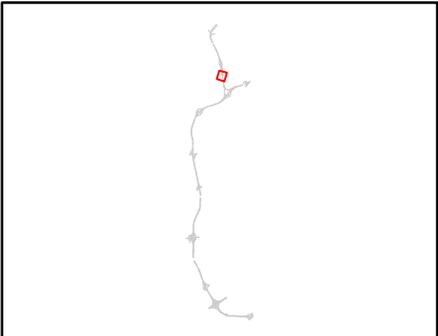
A33

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

- Failing Asset
- Passing Asset



A34

# Appendix A: Triangle Expressway 2021 Third Quarter Asset Assessment Locations



## Legend

- Failing Asset
- Passing Asset







A35

## **Appendix B**

**Triangle Expressway 2021 Third Quarter Table Results of Assets Failing MRP**

## Appendix B: Triangle Expressway 2021 Third Quarter Table Results of Assets Failing MRP

Provided below are a series of tables outlining the existing failures that occurred throughout the facility. Assets are defined by an Inventory ID, which is a unique identifier given to each individual asset. The components that make up the Inventory ID are an asset specific prefix along with a number, such as LS\_1. The Inventory ID and GIS Reference Page number correspond to the provided map packets and allow for quick location of particular asset failures. Photos of failures were provided when applicable.

All assets and their respective prefixes are listed below:

Guardrail, Concrete Barrier and End Anchors (BR).....	1
Curb and Gutter (CG).....	2
Decorative Supports (DS).....	3
Drainage Pipes (DP).....	4
Misc. Drainage Structure (MDP).....	5
Fence and Control of Access (FN).....	7
Graffiti (GR).....	8
Highway Lighting (HL).....	9
Impact Attenuators (IA).....	10
Inlets (IN).....	11
Landscaping (PB).....	12
Paved Lanes – Asphalt (LS).....	13
Paved Lanes – Concrete (LS).....	13
Paved Shoulders (LS).....	13
Unpaved Shoulders (LS).....	14
Front/Back Slopes (LS).....	15
Unpaved Lateral and Outfall Ditches (LS).....	15
Litter (LS).....	16
Roadway Sweeping (LS).....	16
Pavement Striping (LS).....	17
Pavement Markers (LS).....	20
Delineators (LS).....	21
Delineators (LS).....	22
Paved Ditches (PD).....	23
Pavement Words and Symbols (PS).....	24
Signs (SN).....	25
Tree and Brush (TB).....	26
Turf Condition (TF).....	27
MSE/Retaining Walls, Sound Barrier Walls, and Screen Walls (WL).....	31

## Guardrail, Concrete Barrier and End Anchors (BR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Guardrail	BR_230	Functional Damage		A33

## Curb and Gutter (CG)

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#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Decorative Supports (DS)

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#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Drainage Pipes (DP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Drain	DP_236	Obstruction		A11
2	Drain	DP_432	Obstruction		A5
3	Drain	DP_992	Obstruction		A25

## Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Drain	MDP_32	Obstruction		A11
2	Shoulder Drain	MDP_36	Obstruction		A11
3	Shoulder Drain	MDP_55	Rodent Screen		A13
4	Shoulder Drain	MDP_93	Obstruction		A18

## Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Shoulder Drain	MDP_151	Rodent Screen		A35
6	Shoulder Drain	MDP_232	Rodent Screen		A10

## Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_43	Fence Hole		A29
2	Woven	FN_350	Fence Hole		A20

## Graffiti (GR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete Barrier	GR_1	Graffiti	 A photograph showing a concrete barrier on a highway. The barrier is light-colored and has some graffiti on it. In the background, there are trees, a road with cars, and a clear sky.	A5

## Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	High Mast	HL_217	Rodent Screen		A2
2	Single Roadway	HL_347	Missing Parts		A2
3	High Mast	HL_367	Rodent Screen		A24
4	Single Roadway	HL_395	Missing Parts		A25

## Impact Attenuators (IA)

---

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Inlets (IN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Inlet	IN_53	Obstruction		A12
2	Inlet	IN_360	Obstruction		A2

## Landscaping (PB)

---

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

### Paved Lanes – Asphalt (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

### Paved Lanes – Concrete (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

### Paved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_419	Elevation Deviation		A21
2	Concrete	LS_450	Drop Off		A24
3	Concrete	LS_620	Drop Off		A18

## Front/Back Slopes (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Unpaved Lateral and Outfall Ditches (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Litter (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_295	Litter – 3CF		A34
2	Concrete	LS_415	Litter – 3CF		A20

## Roadway Sweeping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

## Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_41	Line Missing, Nighttime Visibility		A9
2	Concrete	LS_68	Line Missing		A8
3	Concrete	LS_94	Line Missing, Nighttime Visibility		A13
4	Concrete	LS_132	Line Missing		A8

## Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Concrete	LS_160	Line Missing, Nighttime Visibility		A13
6	Concrete	LS_161	Line Missing, Nighttime Visibility		A14
7	Concrete	LS_419	Line Missing		A21
8	Concrete	LS_437	Line Missing, Nighttime Visibility		A22

## Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Concrete	LS_450	Line Width		A24
10	Concrete	LS_622	Line Missing		A18

## Pavement Markers (LS)

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#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_41	Missing		A9
2	Concrete	LS_132	Missing		A8
3	Asphalt	LS_367	Missing		A26
4	Concrete	LS_415	Missing		A20

## Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Concrete	LS_469	Missing		A28
6	Asphalt	LS_523	Missing & Nighttime Reflectivity		A26
7	Asphalt	LS_528	Missing & Nighttime Reflectivity		A24
8	Concrete	LS_673	Missing		A22

## Paved Ditches (PD)

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#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Pavement Words and Symbols (PS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Merge Left	PS_26	Daytime Assessment		A13
2	Left Turn	PS_415	Nighttime Reflectivity		A1
3	Stop Bar	PS_427	Daytime Assessment & Nighttime Reflectivity		A1
4	Thru Lane	PS_444	Daytime Assessment & Nighttime Reflectivity		A6

## Signs (SN)

#	Sign Type	Object ID	Failure Type	Photo	GIS Reference Page
1	One Way	SN_521	Height Requirement, Sign Support		A34
2	Mile Post	SN_735	Lateral Clearance		A22
3	Other	SN_1029	Sign Support		A35
4	Wrong Way	SN_1208	Height Requirement		A10

**Tree and Brush (TB)**

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#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
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This asset did not produce any failures.

## Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Turf	TF_82	Bare Ground		A17
2	Turf	TF_169	Bare Ground		A25
3	Turf	TF_172	Bare Ground		A24
4	Turf	TF_237	Bare Ground		A24

# Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_240	Bare Ground		A24
6	Turf	TF_245	Bare Ground		A10
7	Turf	TF_324	Bare Ground		A28
8	Turf	TF_425	Bare Ground		A22

## Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Turf	TF_656	Bare Ground		A13
10	Turf	TF_844	Bare Ground		A35
11	Turf	TF_1016	Bare Ground		A28
12	Turf	TF_1023	Bare Ground		A28

### Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
13	Turf	TF_1036	Bare Ground		A28
14	Turf	TF_1044	Bare Ground		A10
15	Turf	TF_1077	Bare Ground		A10

## MSE/Retaining Walls, Sound Barrier Walls, and Screen Walls (WL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Bridge Wall	WL_11	Unsealed Cracks/Joints		A34
2	Sound Wall	WL_46	Unsealed Cracks/Joints, Vegetation		A19
3	Sound Wall	WL_98	Unsealed Cracks/Joints		A20
4	Sound Wall	WL_102	Spalling		A20

## MSE/Retaining Walls, Sound Barrier Walls, and Screen Walls (WL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Retaining Wall	WL_116	Unsealed Joints/Cracks		A28