



NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program

Triangle Expressway

2019 First Quarter Report

1 S. Wilmington Street
Raleigh, NC 27601



Last Updated:
April 26, 2019

CONSULTANT CERTIFICATION OF COMPLETION

April 26, 2019

Dennis Jernigan, P.E.
Director of Highway Operations, NCTA
1 South Wilmington Street
Raleigh, NC 27601

NCTA Triangle Expressway Roadway Maintenance Performance Rating Program; Q1, FY 2019 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 the two companies are operating as the Triangle Expressway Roadway and Facility Maintenance Performance Rating Program Consultants.

I know of my own personal knowledge, and hereby certify, that the work 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, Inc.

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
Principal

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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 2019 First Quarter Assessment of the Triangle Expressway.

The overall 2019 first quarter maintenance rating of the Triangle Expressway was 93.7, meeting 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 2019 First Quarter Assessment		
Element	MRP Rating	Target Rating
Road Surface	96.0	85.0
Unpaved Shoulders and Ditches	97.4	85.0
Drainage	91.3	85.0
Roadside	92.8	85.0
Traffic Control Devices	92.1	85.0
Overall MRP Performance Rating	93.7	90.0

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 95.5.

Table 2: MRP Rolling Element Results					
Element	Q2 2018 Rating	Q3 2018 Rating	Q4 2018 Rating	Q1 2019 Rating	Rolling Rating
Road Surface	99.2	99.2	99.2	96.0	98.3
Unpaved Shoulders and Ditches	96.8	97.1	99.0	97.4	98.1
Drainage	97.3	96.1	92.8	91.3	94.4
Roadside	91.3	94.9	97.1	92.8	94.2
Traffic Control Devices	91.1 ¹	94.6 ¹	95.1	92.1	93.4 ²
Overall MRP Performance Rating	94.8¹	96.4¹	96.6	93.7	95.5²

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces.

² Excludes the second and third quarter ratings for characteristics listed above.

In addition, the report provides findings of the Green Level Historic District signs inspection. This quarter, all three signs inspected 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.

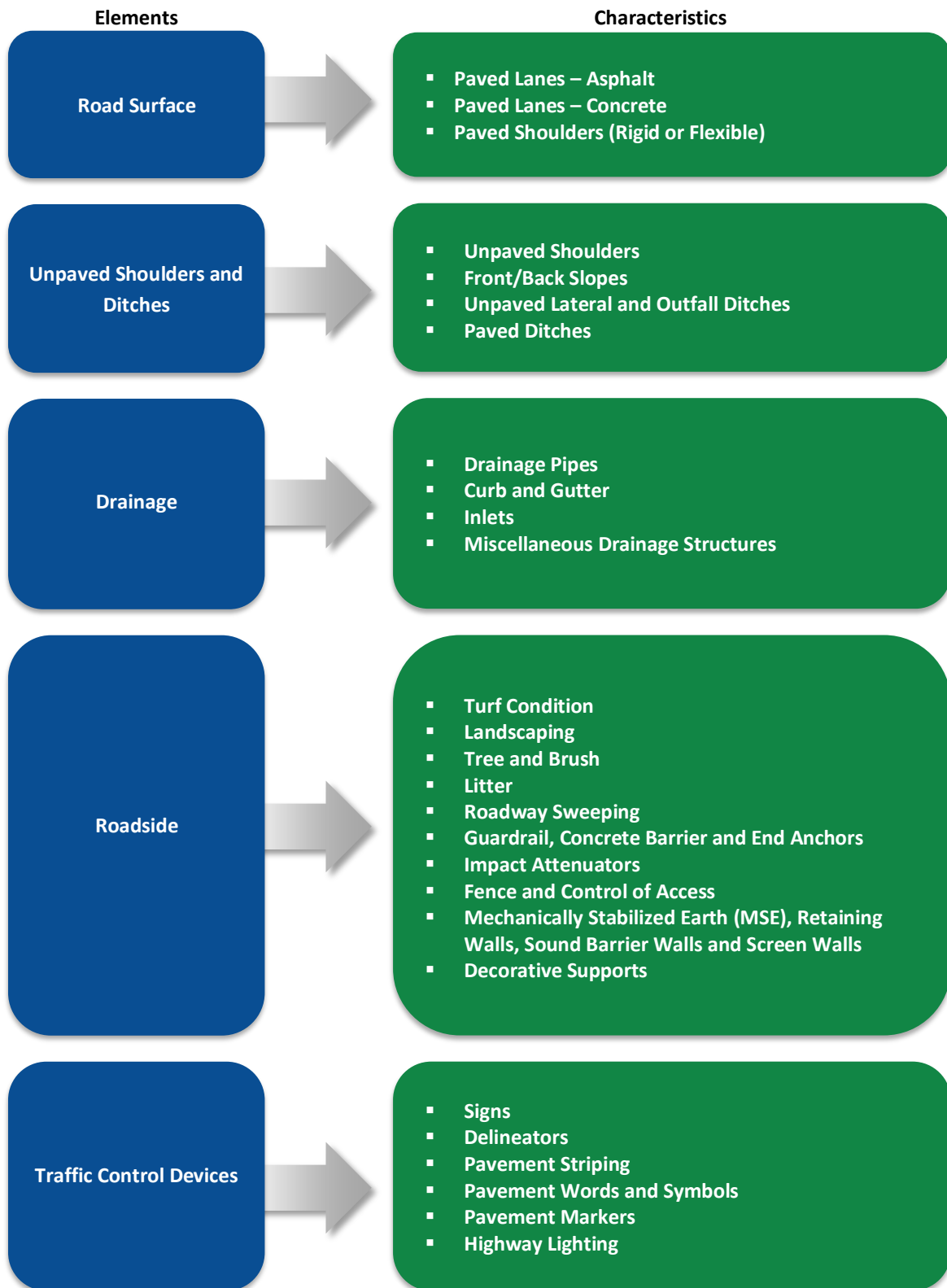
The NCTA performance standards, threshold criteria, and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff, and consultants.

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 can be seen in **Figure 1**:

Figure 1: Maintenance Elements and Characteristics



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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.

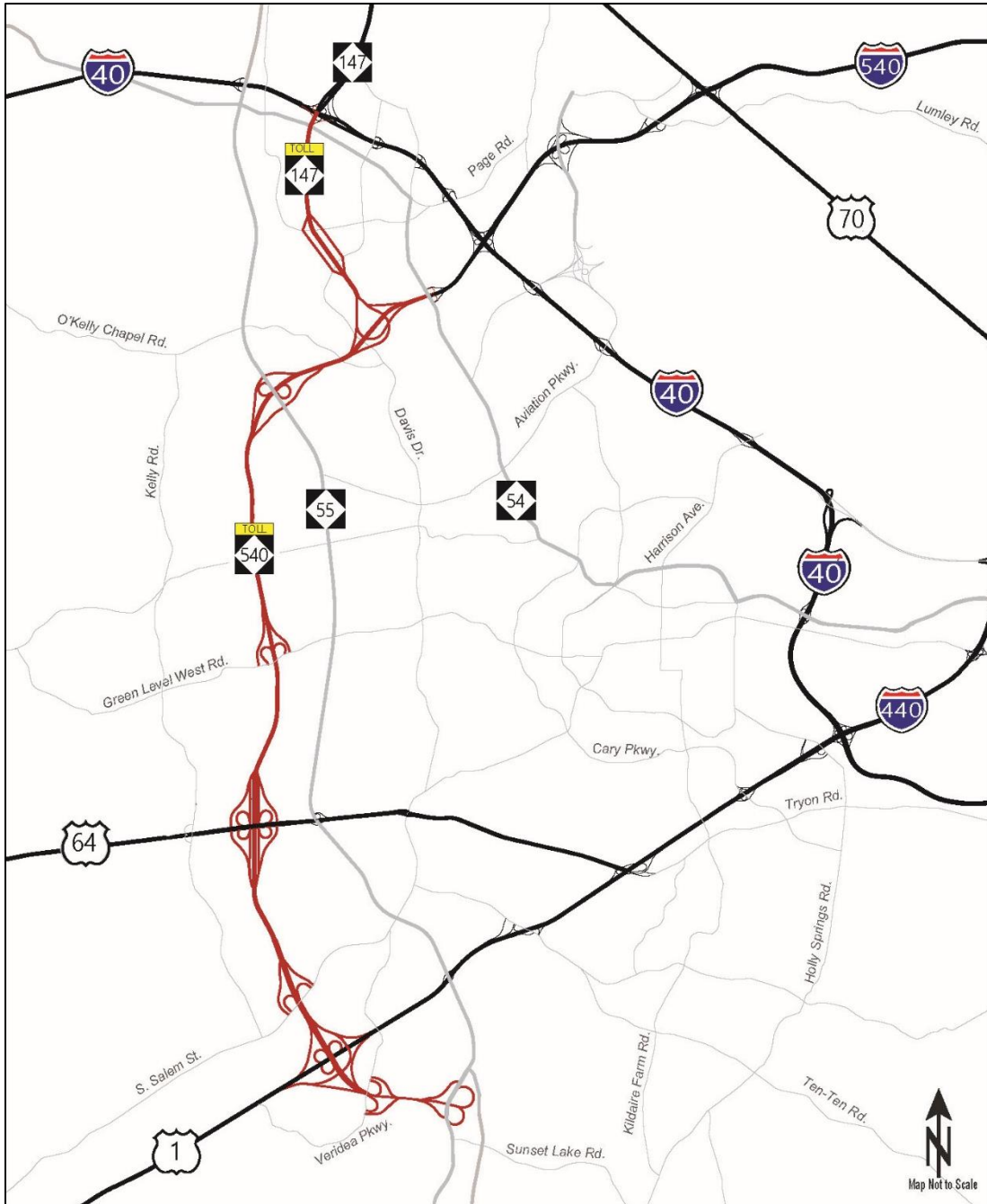
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4.0 TRIANGLE EXPRESSWAY DESCRIPTION

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 eleven interchanges and twenty all-electronic toll collection zones.

Figure 2: Triangle Expressway Map



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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 North from Green Level West Road to Carpenter Fire Station Road were removed from the inventory due to the Morrisville Parkway Interchange construction project. Also, in this quarter, assets on Exit 67 Ramp from Toll NC 540 North to Toll NC 147 North were removed from the inventory while repair work is ongoing. **Table 3 presents** the updated number of assets that are currently available for inspections.

Table 3: Asset Inventory		
Assets	Total Inventory	2019 Eligible Inventory
Barriers	704	738
Curb and Gutter	373	394
Decorative Supports	269	279
Drainage	1129	1174
Misc. Drainage	196	212
Fences	464	498
Highway Lighting	387	397
Impact Attenuators	45	47
Inlets	1042	1091
Linear Segments	730	767
Plant Beds	246	266
Paved Ditches	2	2
Pavement Symbols	610	610
Signs	1091	1101
Tree and Brush	530	586
Turf	987	1037
Walls	84	86

6.0 MRP FIRST QUARTER ASSESSMENT

6.1 Quarterly Results

The overall 2019 first quarter maintenance rating of the Triangle Expressway was 93.7, meeting NCTA’s target overall rating of 90. All elements assessed achieved ratings above the target rating of 85 established for element groups. Miscellaneous Drainage (65) and Turf Condition (76) are the characteristics that scored below the target rating of 80.

It is important to note that these results are only representative of the first 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 at the end of each calendar year, provides a 95% confidence level in statistical sampling. The first quarter MRP performance ratings for elements and characteristics are presented in **Table 4** and **Table 5**, respectively.

Table 4: MRP Element Results for Q1 2019	
Element	Q1 2019 MRP Rating
Road Surface	96.0
Unpaved Shoulders and Ditches	97.4
Drainage	91.3
Roadside	92.8
Traffic Control Devices	92.1
Overall MRP Performance Rating	93.7

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Table 5: MRP Characteristic Results for Q1 2019

Road Surface	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q1 Rating
Paved Lanes Asphalt	12	14	9	108	126	86
Paved Lanes Concrete	18	18	9	162	162	100
Paved Shoulder	32	32	5	160	160	100
Element Total				430	448	96.0
Unpaved Shoulders and Ditches	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q1 Rating
Unpaved Shoulder	30	32	9	270	288	94
Front/Back Slopes	32	32	6	192	192	100
Lateral and Outfall Ditches, Unpaved	32	32	6	192	192	100
Ditches, Paved	2	2	5	10	10	100
Element Total				664	682	97.4
Drainage	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q1 Rating
Drainage Pipes	33	34	7	224	238	97
Curb and Gutter	27	28	6	162	168	96
Inlets	33	34	7	231	238	97
Misc. Drainage Structure	22	34	4	88	136	65
Element Total				705	780	91.3
Roadside	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q1 Rating
Turf Condition	25	33	7	175	231	76
Landscaping	23	24	4	92	96	96
Trees and Brush	28	30	4	112	120	93
Litter	28	32	4	112	128	88
Roadway Sweeping	31	32	5	155	160	97
Guardrail, Concrete Barrier and End Anchors	32	32	9	288	288	100
Impact Attenuators	9	9	9	81	81	100
Fence, Control Access	26	29	7	182	203	90
Retaining Walls and Sound Barrier Walls	14	14	5	70	70	100
Decorative Supports	23	25	5	115	125	92
Graffiti and Stain Removal	44	44	4	176	176	100
Element Total				1558	1678	92.8
Traffic Control Devices	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q1 Rating
Signs	32	34	7	224	238	94
Delineators	19	22	3	57	66	86
Pavement Striping/Marking	32	32	8	256	256	100
Words and Symbols	31	31	7	217	217	100
Pavement Markers	27	32	9	243	288	84
Highway Lighting	23	28	6	138	168	82
Element Total				1135	1233	92.1

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

6.2 Analysis and Recommendations

Elements

During the first quarter, all elements exceeded NCTA's threshold criteria of 85. Road Surface (96.0) and Unpaved Shoulder/Ditches (97.4) both continued to obtain a rating higher than 95. All other elements, continued exceeding a score higher than 90.

Road Surface (96.0) experienced a decrease in rating compared to the previous quarter. The rating for this element was 3.2 points lower than the fourth quarter rating. The decrease was predominately due to lower ratings for Paved Asphalt Lanes (86). Repaving of all asphalt lanes is scheduled to be performed this Summer.

Drainage (91.3) experienced a decrease in rating of 1.5 points. Roadside (93.1) experienced a decrease in rating of 4.3 points primarily due to the lower ratings for Turf Condition (76) and Litter (88). Traffic Control Devices (92.1) experienced a decrease of 3.0 points primarily due to a lower rating for Pavement Markers (82) which could be attributed to plowing operations during recent snow events removing many raised reflective markers from the roadway.

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

Characteristics

This quarter all but two characteristics, Miscellaneous Drainage Structure (65) and Turf Condition (76), 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**.

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Miscellaneous Drainage (65 rating – 22 of the 34 assets passed): Out of the 12 miscellaneous drainage structures that did not pass inspection, 7 were obstructed and 5 had a missing or damaged screen at the outlet. Two of the miscellaneous drainage structures (shoulder underdrains) that did not pass inspection are presented in **Figure 3**.

Figure 3: Miscellaneous Drainage Inspection Results Sample



In accordance with *NCTA Roadway and Facility Maintenance Standards V6*, referenced below, the maintenance provider shall plan annual cleaning of these drainage features to remove any debris or overgrown vegetation. It is also recommended that the maintenance provider continue to follow the routine patrol schedule and repair any erosion or soil buildup problems along the ditch line near the outlets. Given the subsurface Triassic soil conditions encountered on this project, the edge drain system is a critical component of maintaining the design life of pavements as it provides a conduit to channel water away from the subgrade and base.

Miscellaneous Drainage Maintenance Program Standards:

- 1) Miscellaneous Drainage Structures shall be inspected during routine patrols.
- 2) Clear all outlets to edge drains annually.
- 3) Schedule cleanouts and repairs during inspections.

Miscellaneous Drainage Evaluation Standards:

Miscellaneous Drainage Structures do not meet the maintenance standards when any of the following criteria is observed:

- 1) More than 50% of the structure (length and depth) is obstructed or blocked.
- 2) End protection has deteriorations, erosions, washouts or buildups adversely affecting the natural flow of water.

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To avoid affecting the natural flow of water near the drainage features and reducing the design life of pavement performance, it is recommended that outlet elevations be checked against the outflow ditch elevations to ensure positive drainage. Appropriate grading of the ditch line may be necessary to provide positive flow.

Turf Condition (76 rating – 25 of the 33 assets passed). All 8 turf areas that did not pass the inspection had bare ground conditions. Two of these turf areas are presented in **Figure 4**.

Figure 4: Turf 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. As part of their routine, the maintenance provider should closely monitor mowing heights during the 2019 mowing cycle pursuant to the NCTA Roadway and Facility Maintenance Standards V6, referenced below.

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, sign posts, light poles, and ITS device poles.

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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.

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7.0 CURRENT ROLLING MRP RATING

The rolling maintenance rating of the Triangle Expressway was 95.5, exceeding NCTA’s target overall rating of 90. All elements exceeded NCTA’s rolling rating threshold criteria of 85. Also, all but one characteristic ratings met or exceeded the target rating of 80. The rolling rating for Miscellaneous Drainage Structure was 76 with a rating below the target rating of 80 in Q4 2018 and Q1 2019.

The 2018/2019 results are presented in **Tables 6 and 7**. These results are a collection of the four quarterly inspections conducted in the last year.

Table 6: MRP Element Results for 2019					
Element	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	Q1 2019 RATING	ROLLING RATING
Road Surface	99.2	99.2	99.2	96.0	98.6
Unpaved Shoulders and Ditches	96.8	97.1	99.0	97.4	97.6
Drainage	97.3	96.1	92.8	91.3	94.4
Roadside	91.3	94.9	97.1	92.8	94.1
Traffic Control Devices	91.1 ¹	94.6 ¹	95.1	92.1	93.4 ²
Overall MRP Performance Rating	94.8¹	96.4¹	96.6	93.7	95.5²

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces.

² Excludes the second and third quarter ratings for characteristics listed above.

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Table 7: MRP Rolling Element Results					
Road Surface	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	Q1 2019 RATING	ROLLING RATING
Paved Lanes Asphalt	100	100	100	86	97
Paved Lanes Concrete	100	100	100	100	100
Paved Shoulder	98	98	98	100	98
Element Total	99.2	99	99.2	96.0	98.6
Unpaved Shoulders and Ditches	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	Q1 2019 RATING	ROLLING RATING
Unpaved Shoulder	95	93	98	94	95
Front/Back Slopes	95	100	100	100	99
Lateral and Outfall Ditches, Unpaved	100	100	100	100	100
Ditches, Paved	100	100	100	100	100
Element Total	96.8	97.1	99.0	97.4	97.6
Drainage	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	Q1 2019 RATING	ROLLING RATING
Drainage Pipes	100	100	100	97	99
Curb and Gutter	97	97	97	96	97
Inlets	97	100	97	97	98
Misc. Drainage Structure	94	81	65	65	76
Element Total	97.3	96.1	92.8	91.3	94.4
Roadside	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	Q1 2019 RATING	ROLLING RATING
Turf Condition	69	85	90	76	81
Landscaping	96	96	100	96	97
Trees and Brush	100	100	100	93	98
Litter	100	100	100	88	98
Roadway Sweeping	100	100	100	97	99
Guardrail, Concrete Barrier and End Anchors	97	94	100	100	98
Impact Attenuators	100	100	100	100	100
Fence, Control Access	94	94	95	90	93
Retaining Walls and Sound Barrier Walls	94	94	100	100	97
Decorative Supports	89	100	96	92	94
Graffiti and Stain Removal	100	100	100	100	100
Element Total	91.3	94.9	97.1	92.8	94.1
Traffic Control Devices	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	Q1 2019 RATING	ROLLING RATING
Signs	97	100	97	94	97
Delineators	95	89	100	86	93
Pavement Striping/Marking	100	94	98	100	98
Words and Symbols	90 ¹	100 ¹	100	100	98 ²
Pavement Markers	95 ¹	100 ¹	91	84	91 ²
Highway Lighting	78	86	90	82	84
Element Total	91.1¹	94.6¹	95.1	92.1	93.4²

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces.

² Excludes 2018 second and third quarter ratings for characteristics listed above.

8.0 GREEN LEVEL HISTORIC DISTRICT SIGNS

The three 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 three Green Level Historic District signs to conduct a visual inspection of each sign and ensure they are in good standing. The three signs included in the inspection inventory were found to be in good condition, with the landscaped areas being well maintained. Construction activities were identified adjacent to the eastbound sign on Green Level West Road (3 of 3); however, the plant bed was not disturbed. **Figure 4** shows these signs.

Figure 5: Green Level West Historic District Signs, Landscape Areas



9.0 CONCLUSION

This report presents the 2019 first quarter assessment of the Triangle Expressway. The NCTA's target ratings are 90 overall, 85 for elements, and 80 for characteristics. The first quarter 2019 overall rating was 93.7 and the rolling rating was 95.5, both ratings met the target rating of 90.

All element ratings were above the target ratings for the quarter and rolling assessment. During the first quarter assessment, all but two characteristics met or exceeded the target rating of 80. Those characteristics were Miscellaneous Drainage (65) and Turf Condition (76). Miscellaneous Drainage, with a rolling rating of 76 averaged from the last four quarter assessments, was the only characteristic that did not meet the rolling rating target of 80.

To improve the ratings, it is recommended that the maintenance provider conduct routine patrols and maintenance of shoulder underdrains by removing any debris or overgrown vegetation that may impede the flow of water. It is also recommended that outlet elevations be checked against the outflow ditch elevations to ensure positive drainage and prevent drain outlets from backing up with water. Applicable grading of the ditch line may be necessary to provide positive flow. Additionally, bare areas seeding/fertilization program efforts should also continue during the spring and summer seasons to promote new turf growth.

To continue to improve upon characteristic ratings that have scored a rating below 80 in the last four quarters, it was recommended that the maintenance provider address wall paint scaling issues. A painting contract is currently being developed and will be let soon. This contract will alleviate further deterioration of this asset and maintain the facility's intended aesthetics.

This quarter, the three Green Level Historic District signs inspected were found to be in good standing condition. Additionally, the landscaped areas surrounding the signs were found to be well maintained.

Appendix A

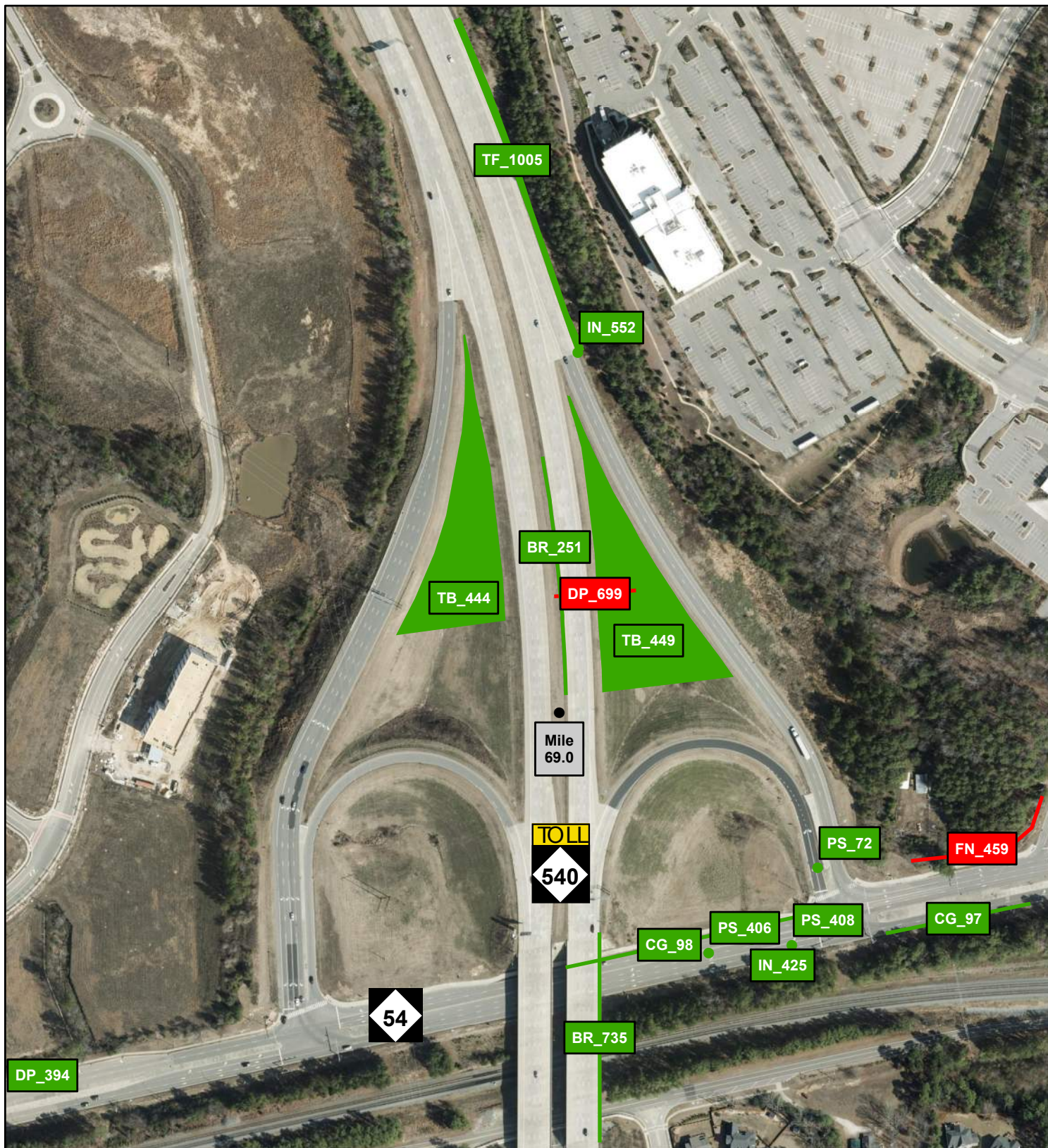
Triangle Expressway 2019 First Quarter Asset Assessment Locations

Appendix A: Triangle Expressway 2019 First 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 2019 First Quarter Asset Assessment Locations

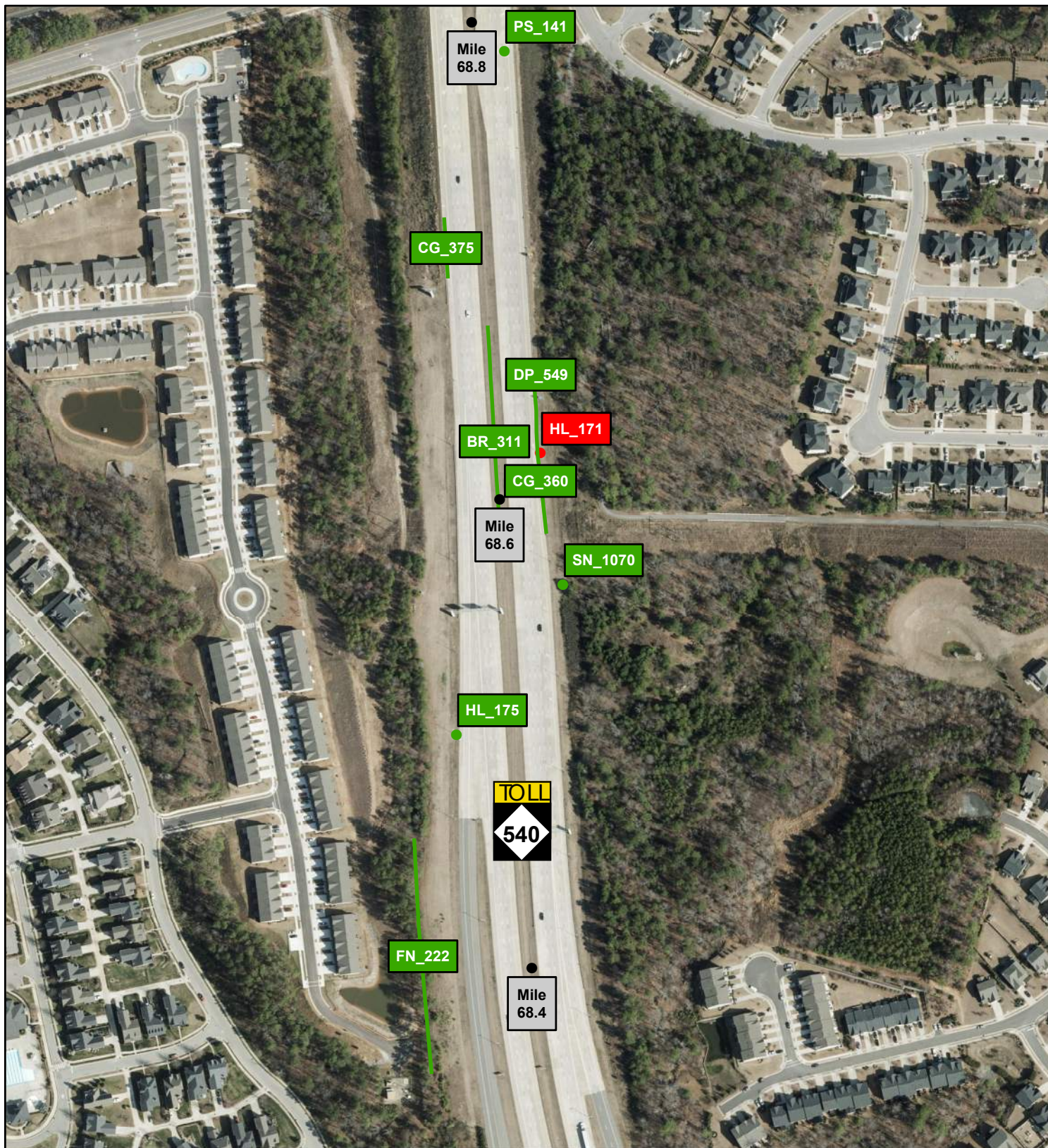


Legend



- Failing Asset
- Passing Asset

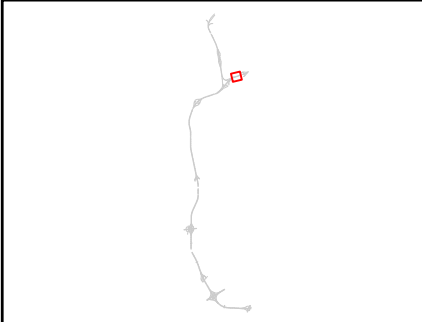


Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

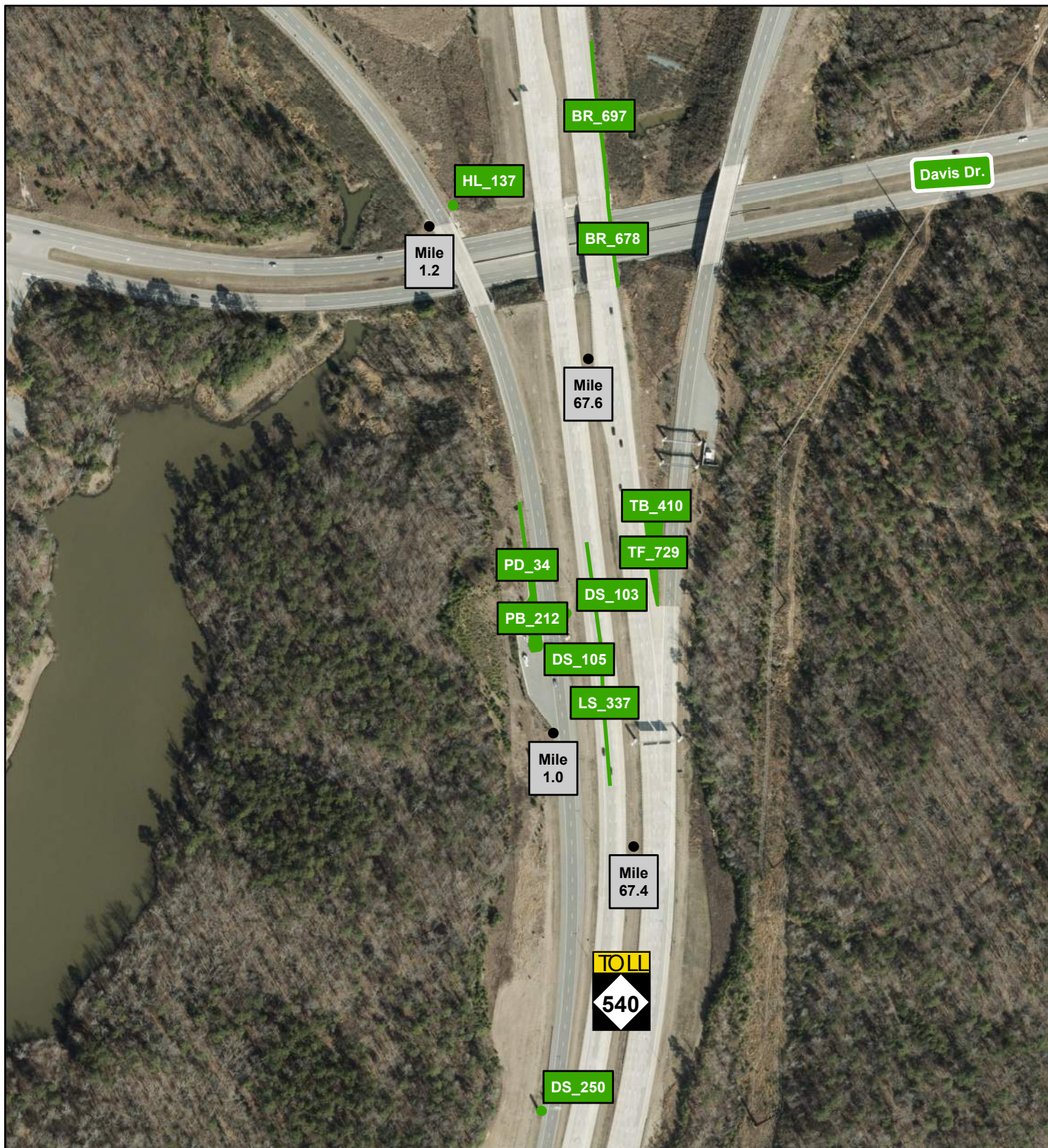


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

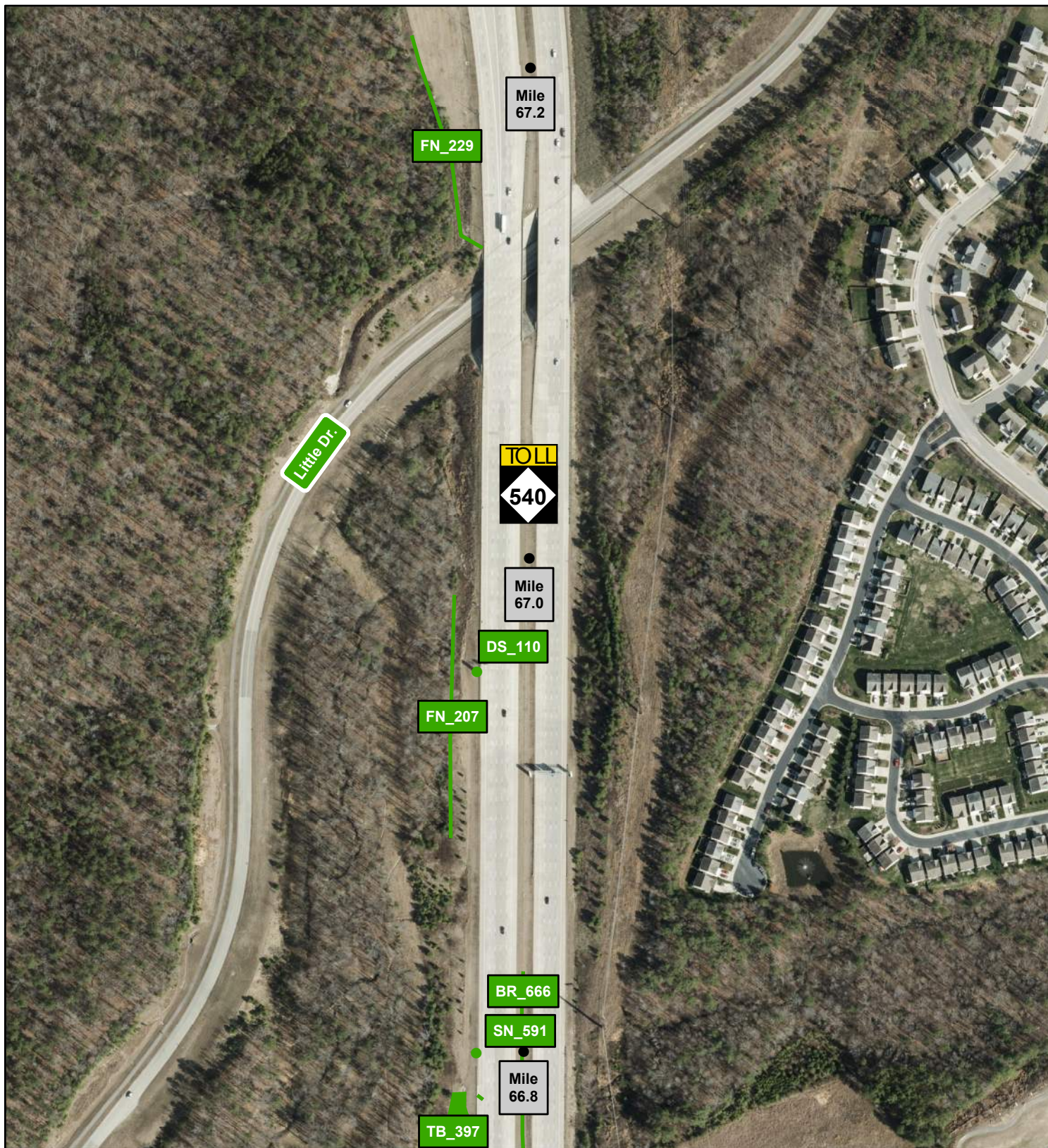


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

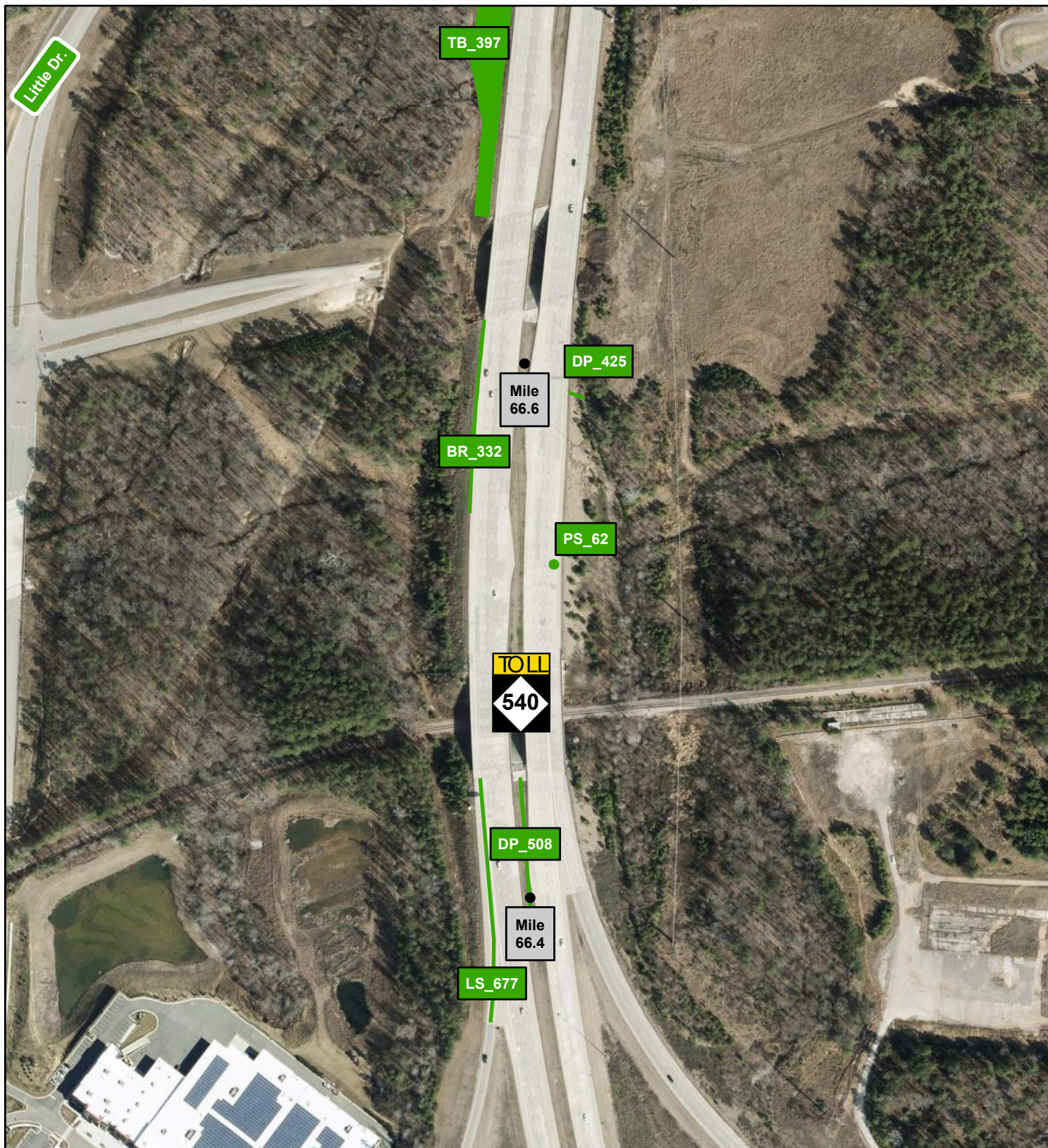


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

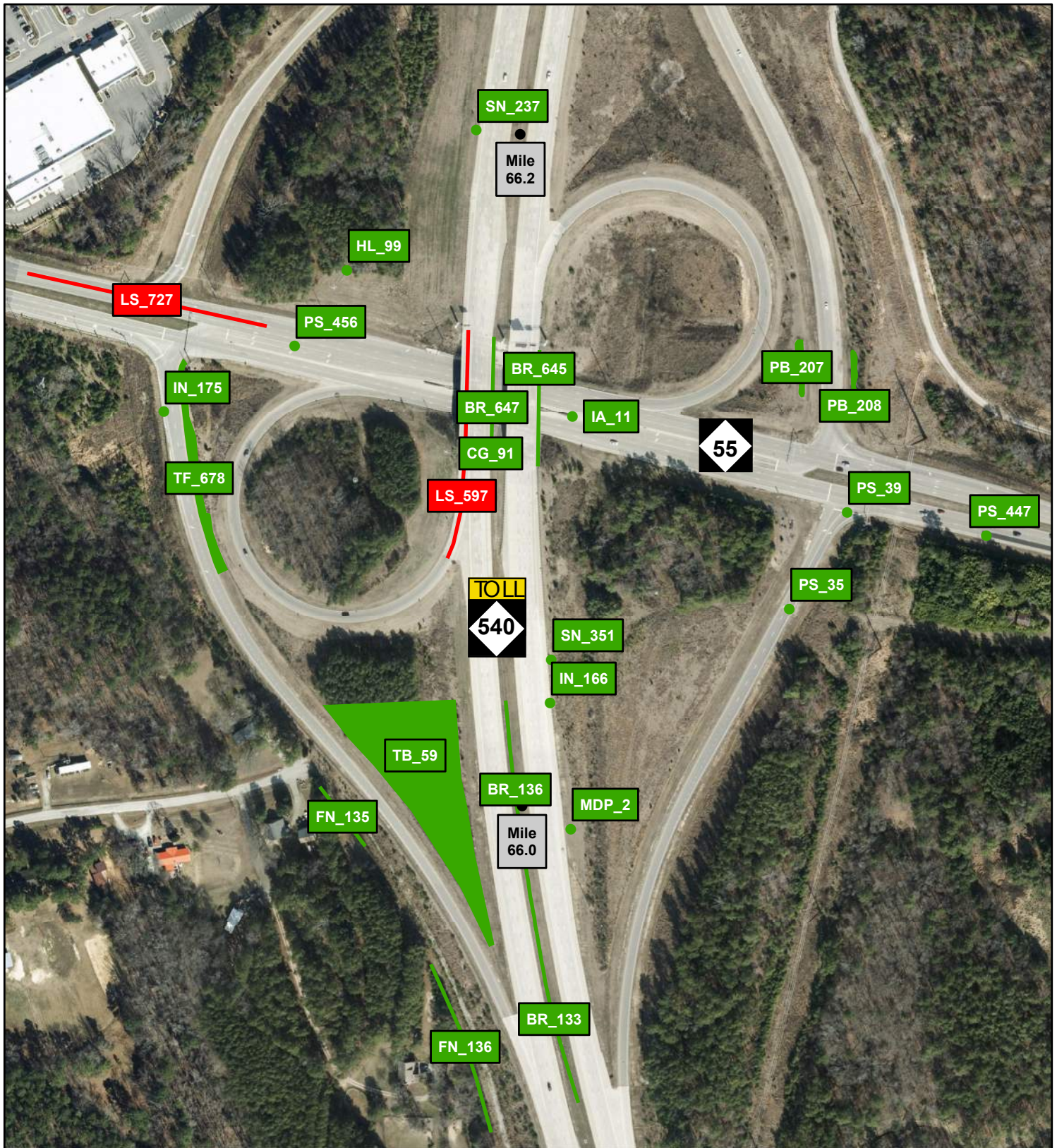


Legend

- Failing Asset
- Passing Asset

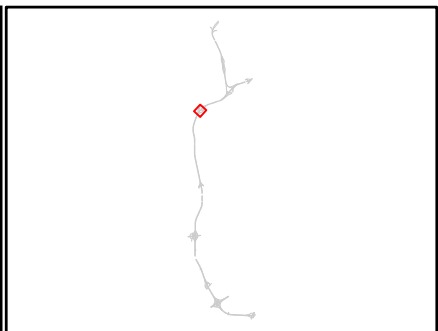


Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

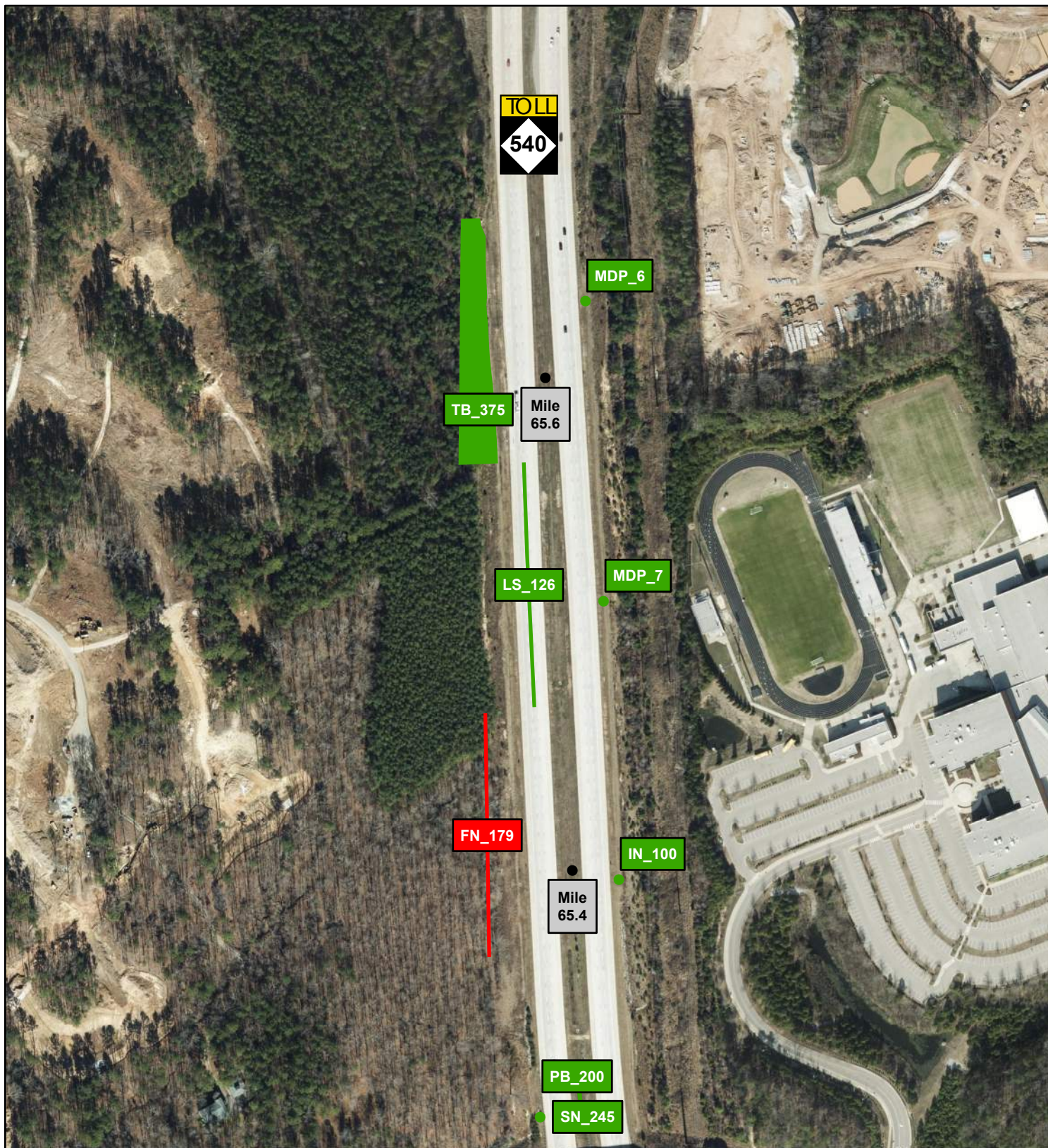








A7

Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

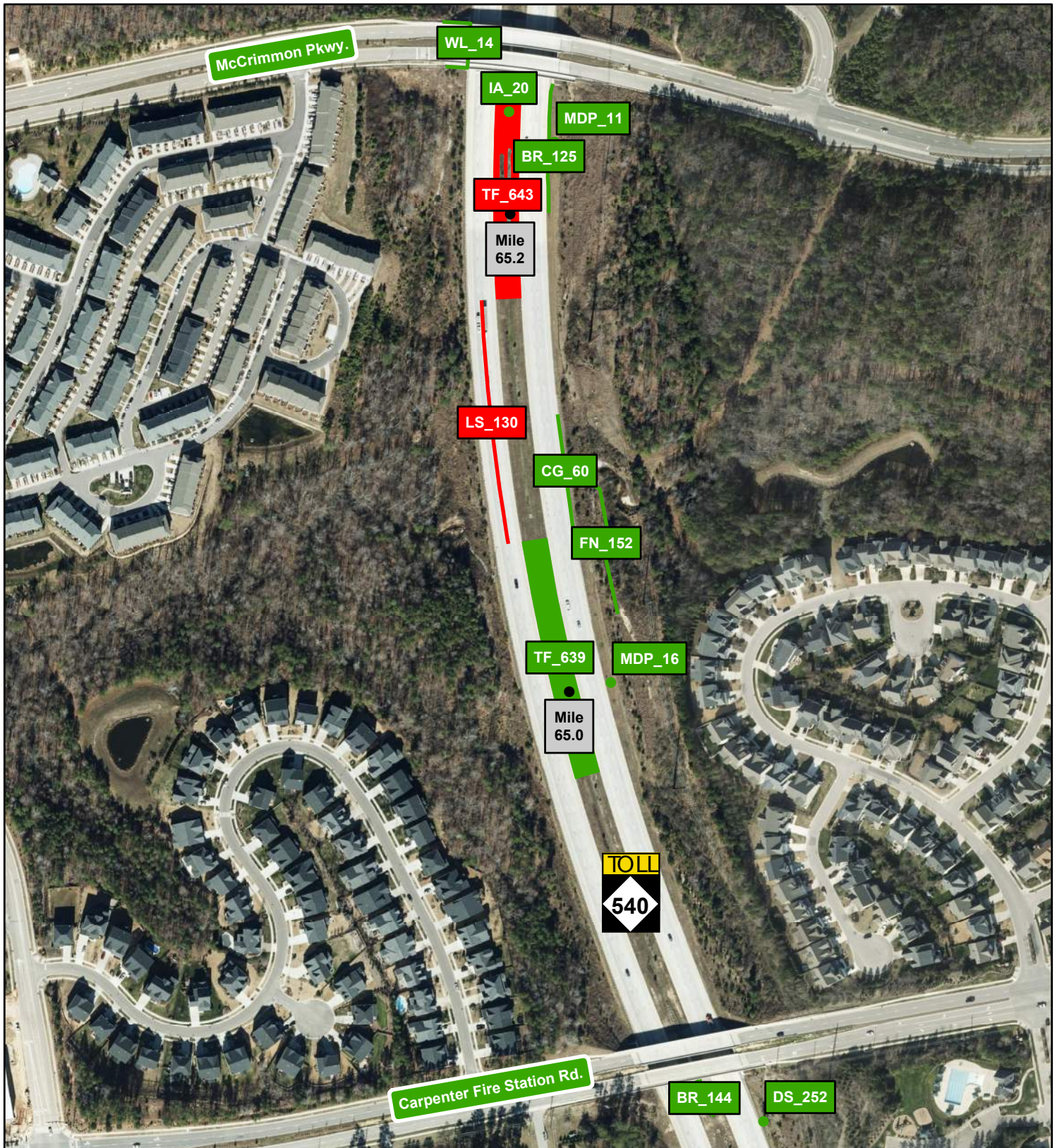


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

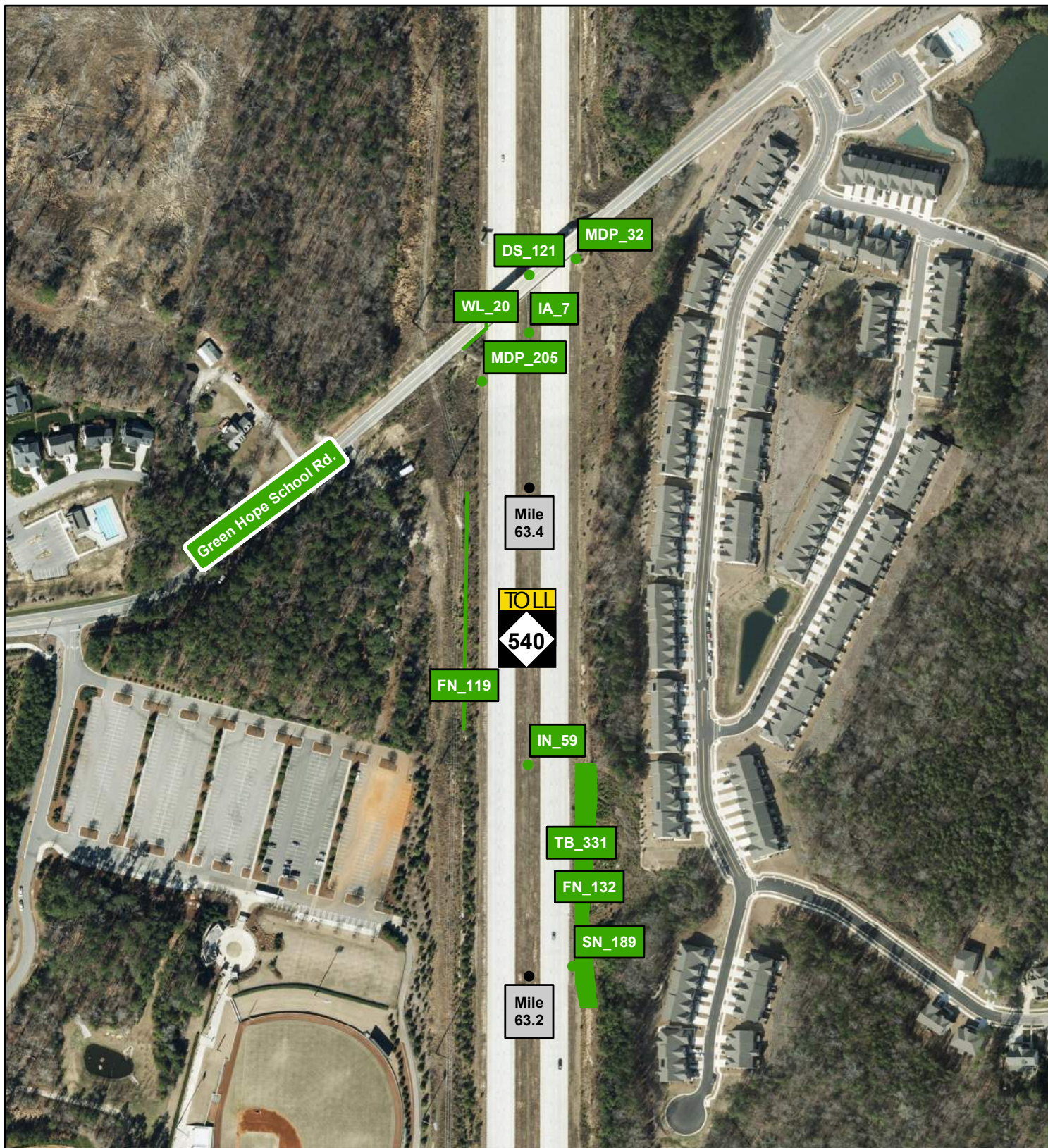


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

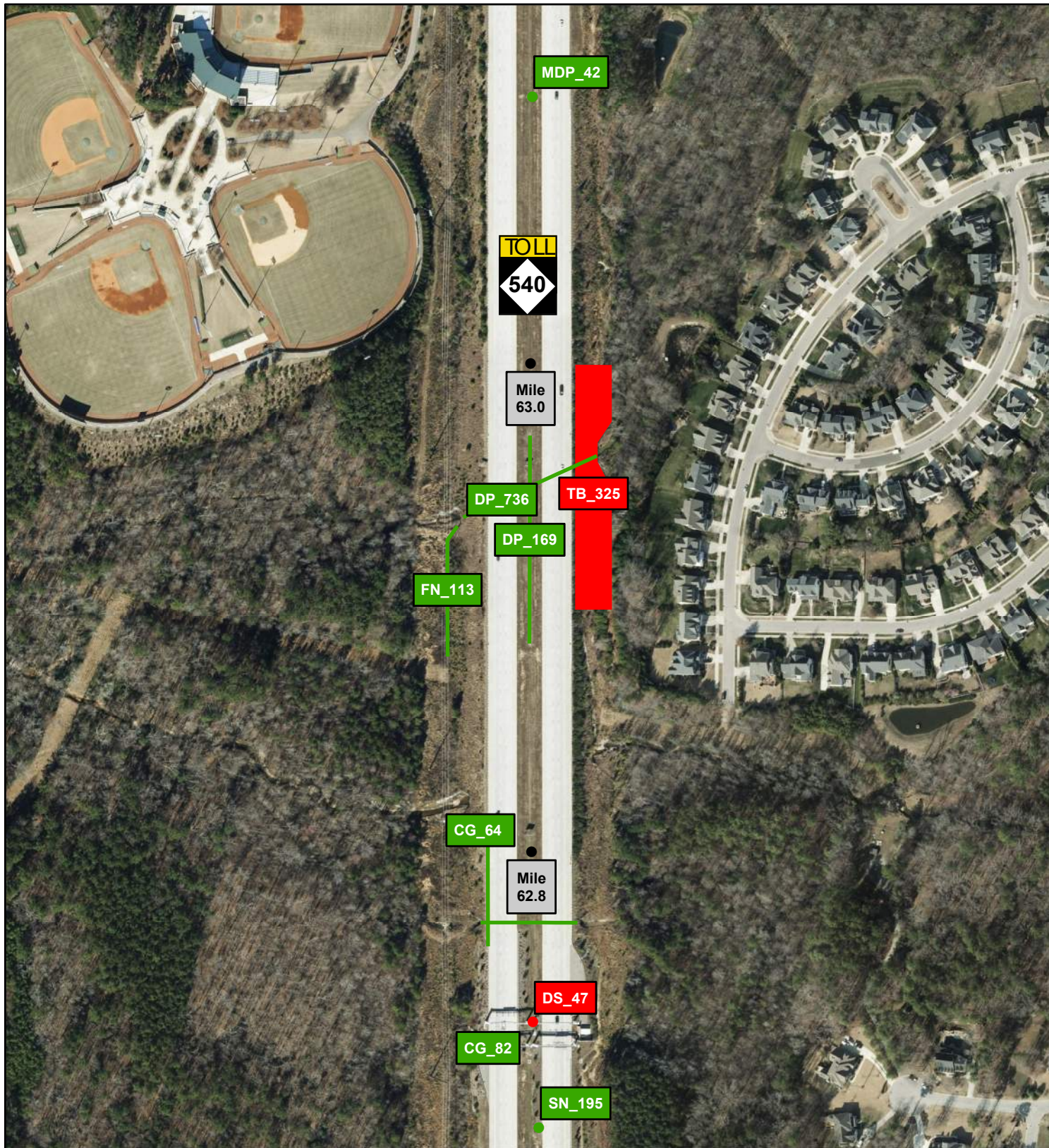


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

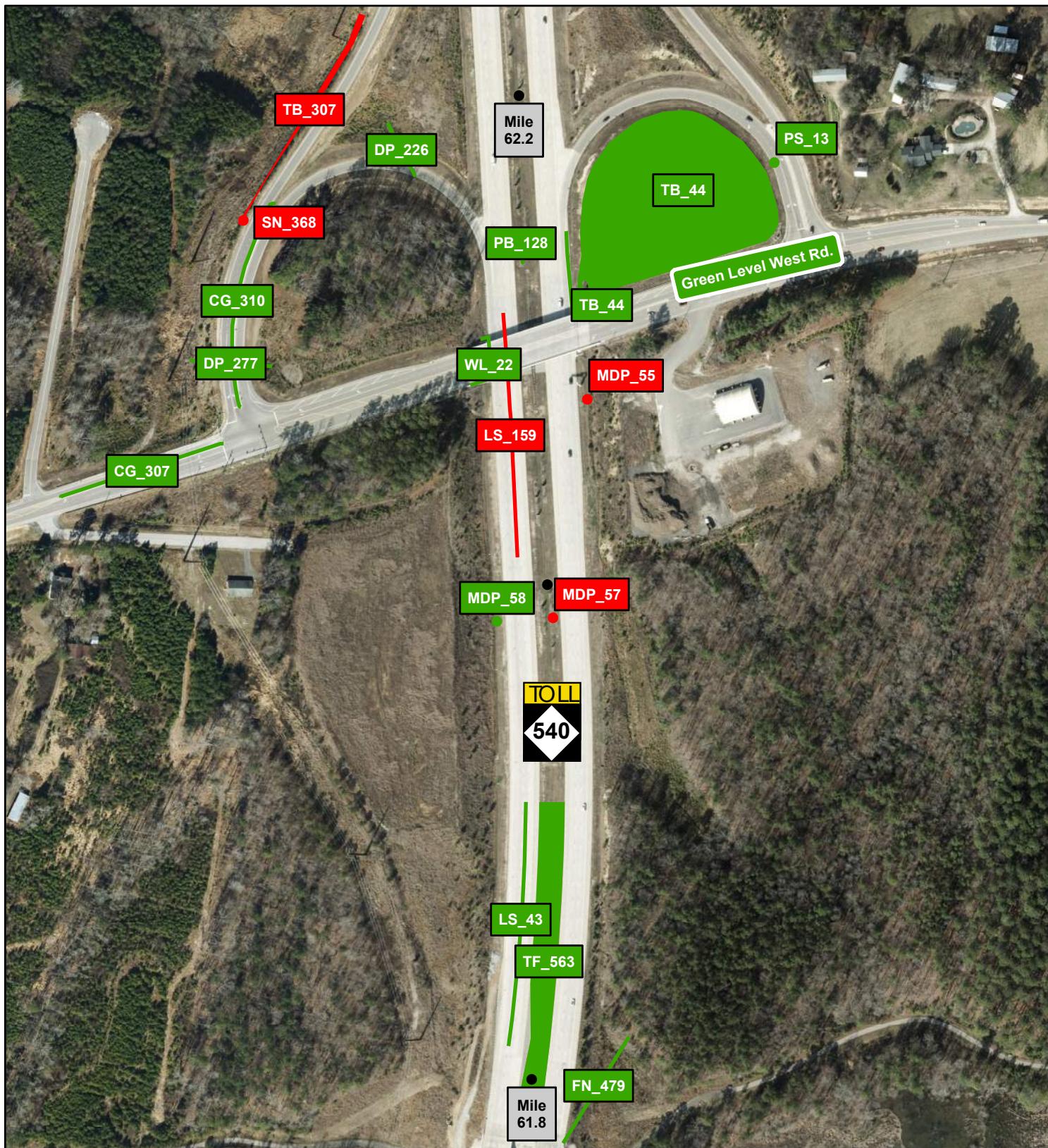


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

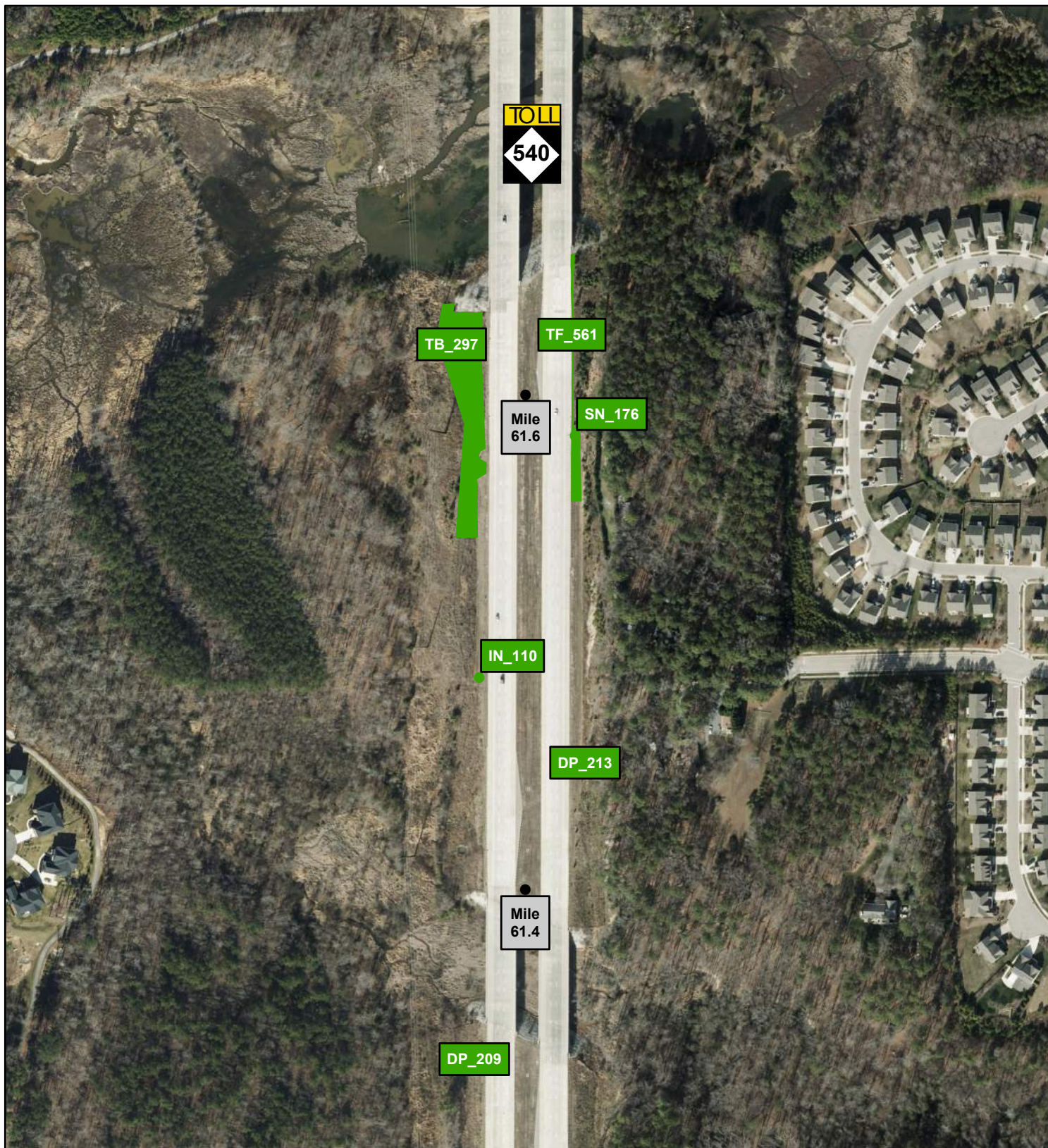


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

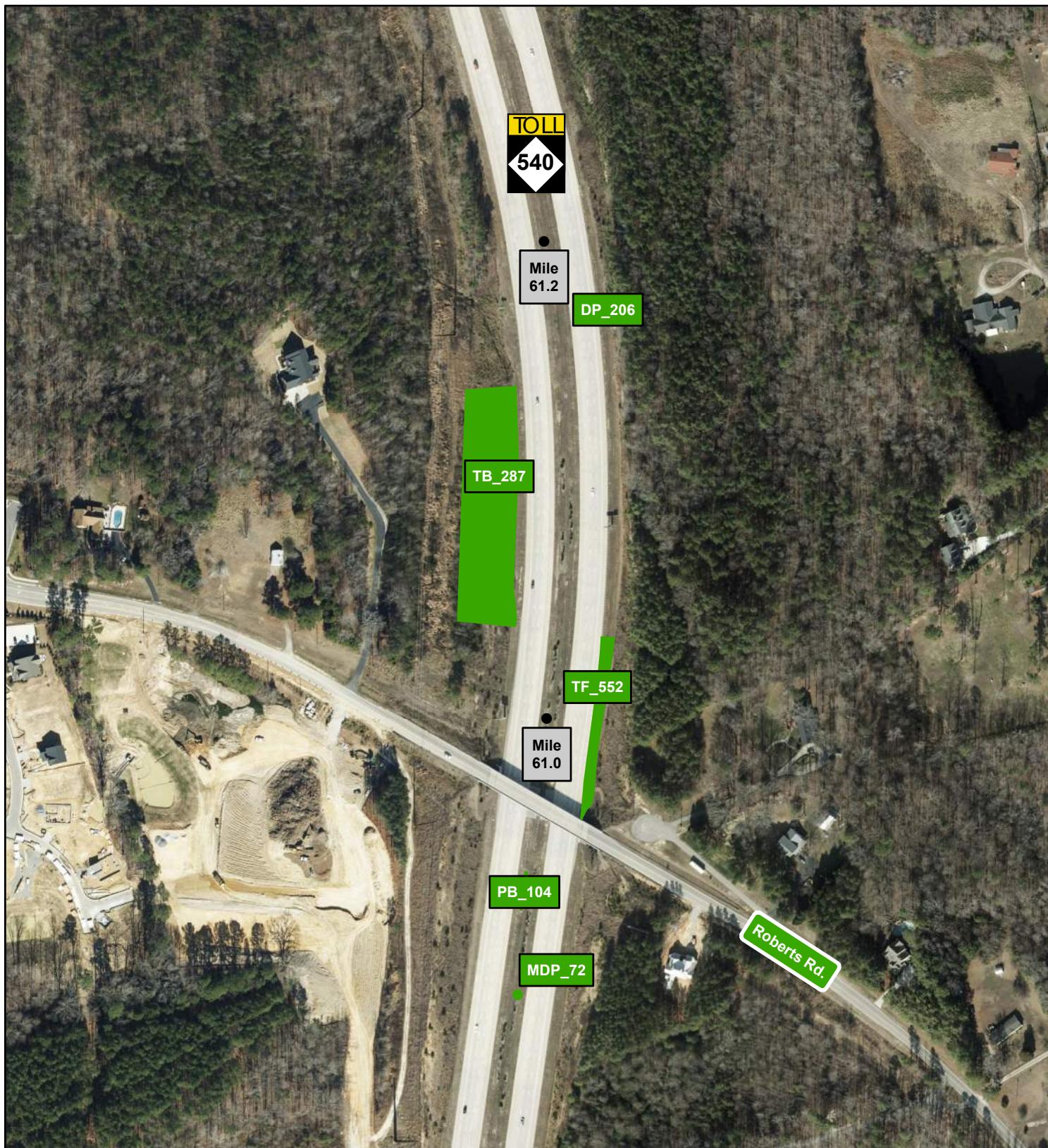


Legend



-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset

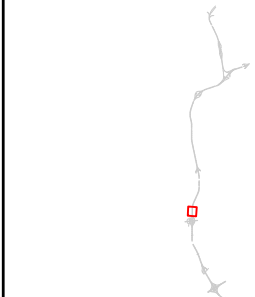


Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

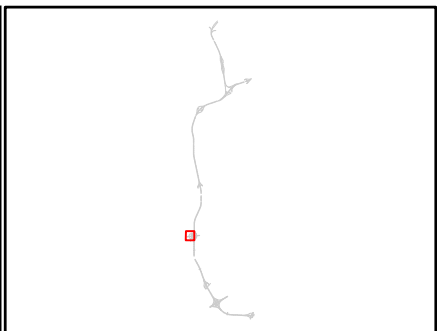


Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



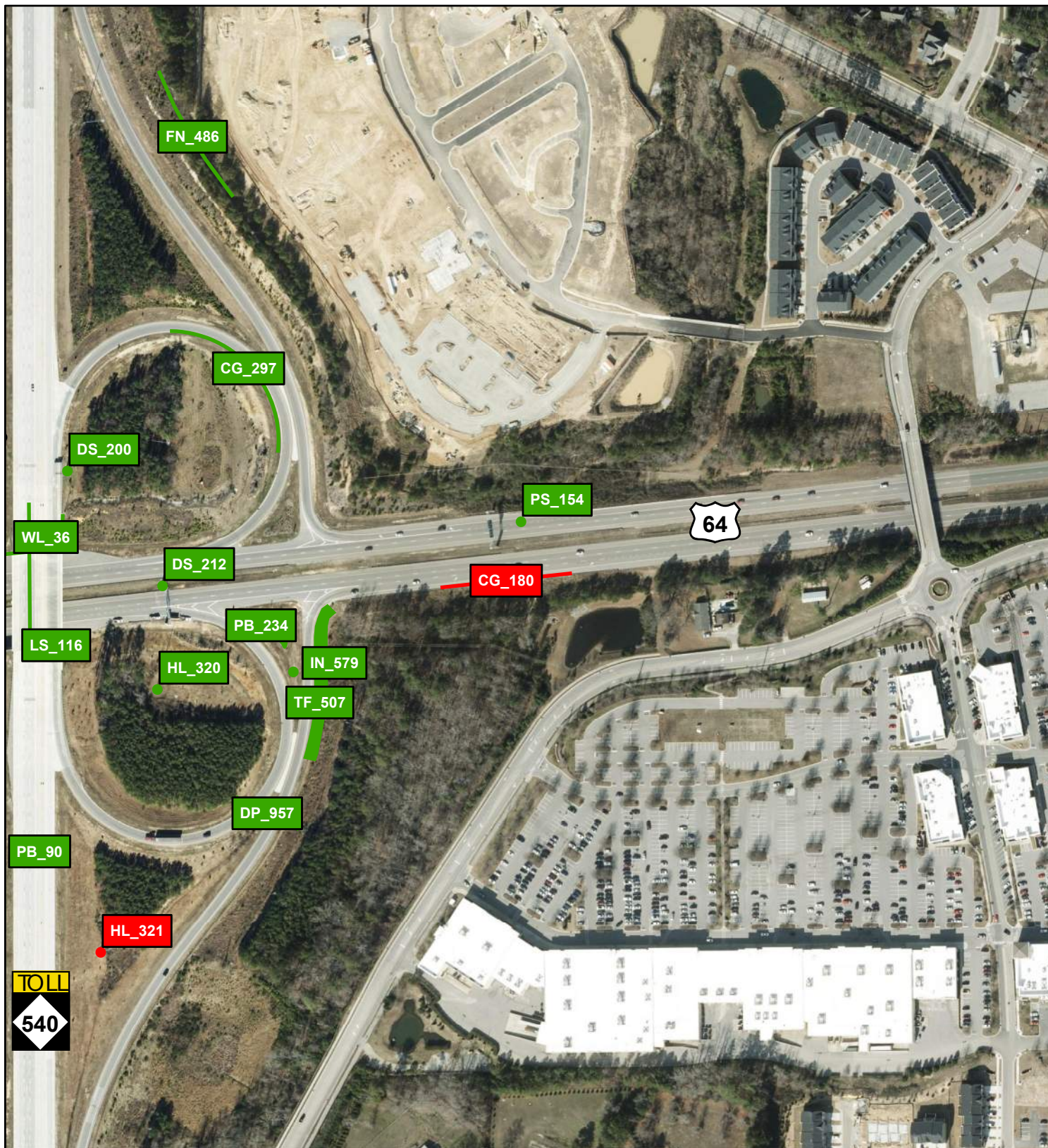




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Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

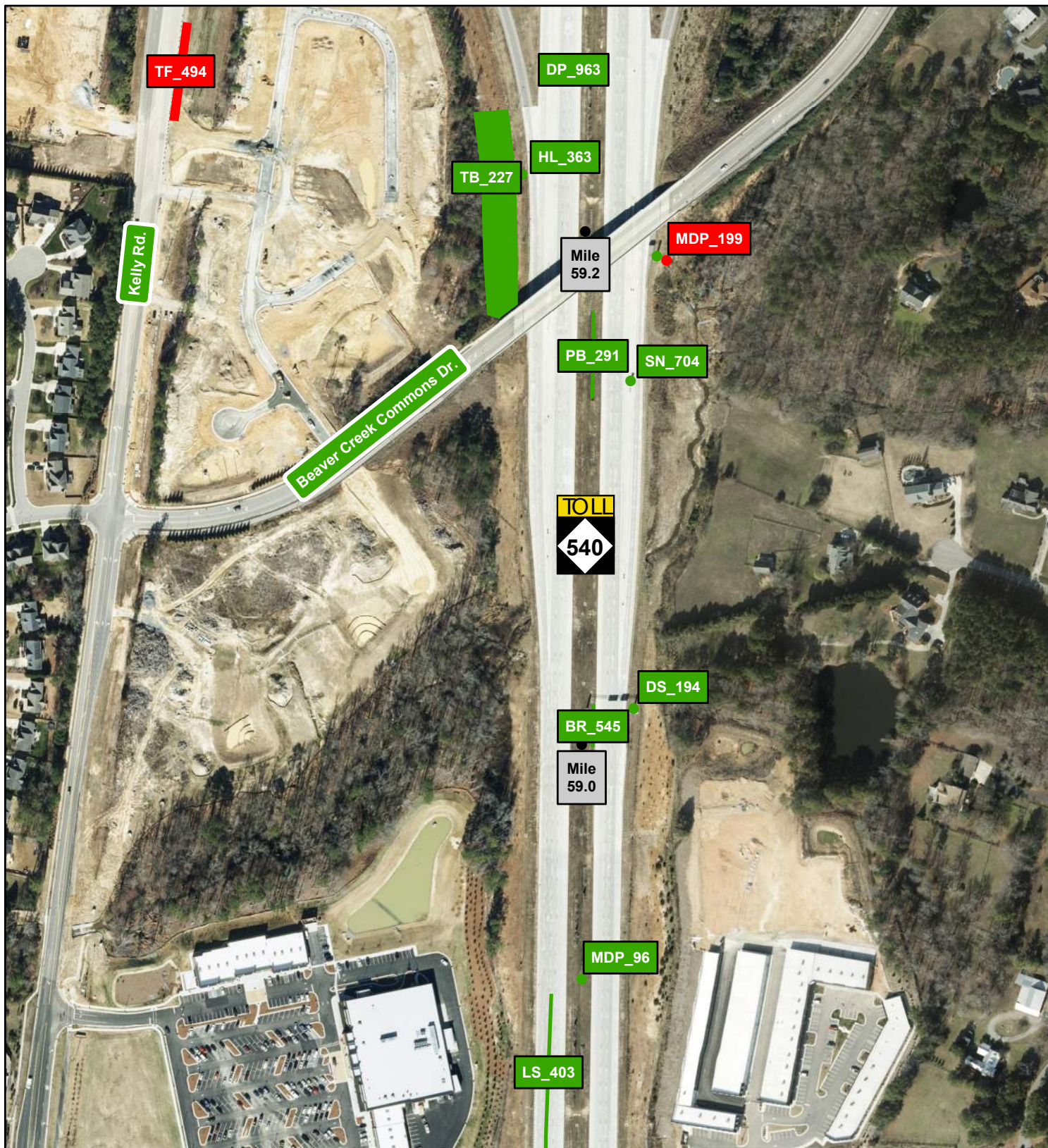


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

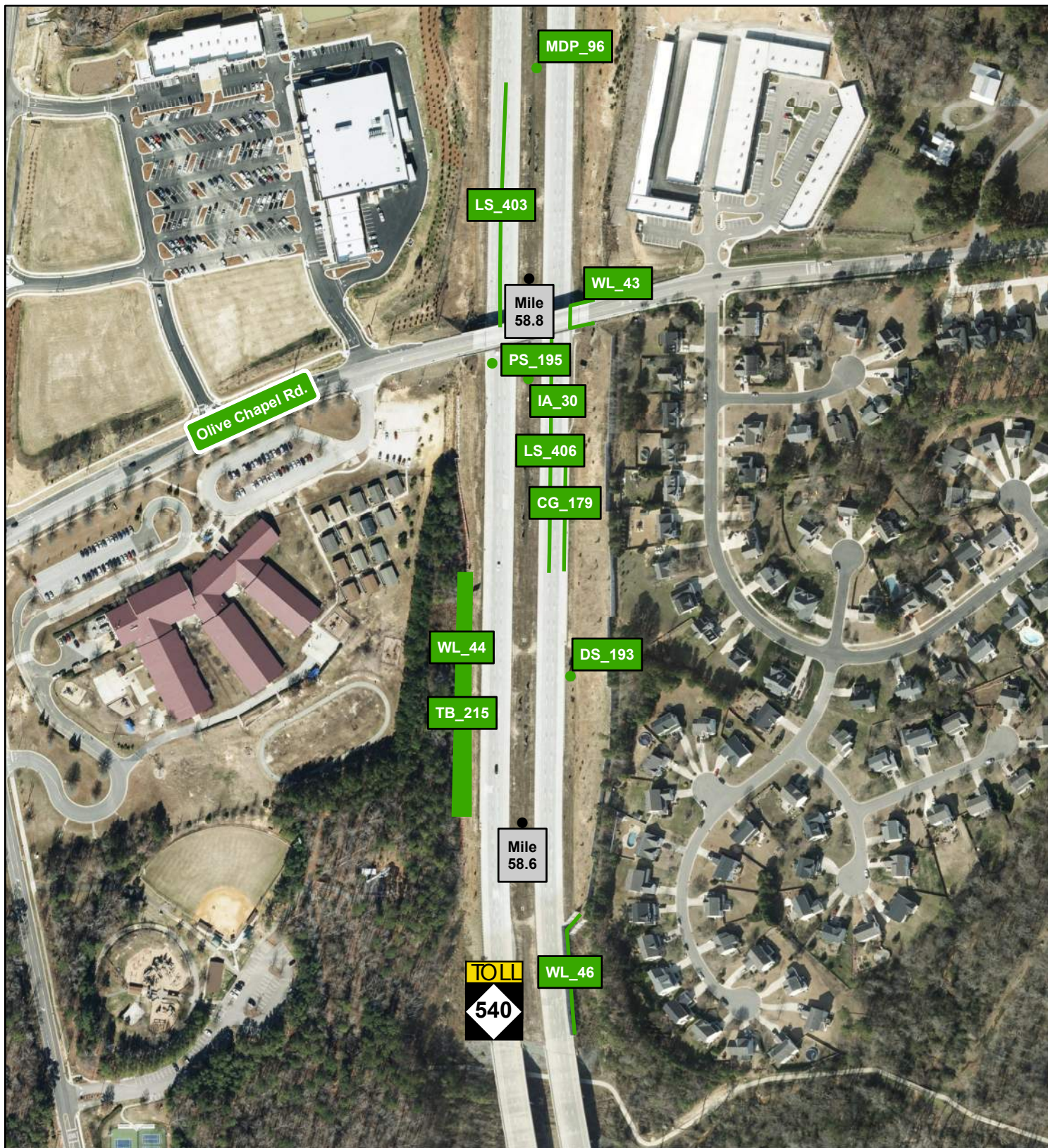


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

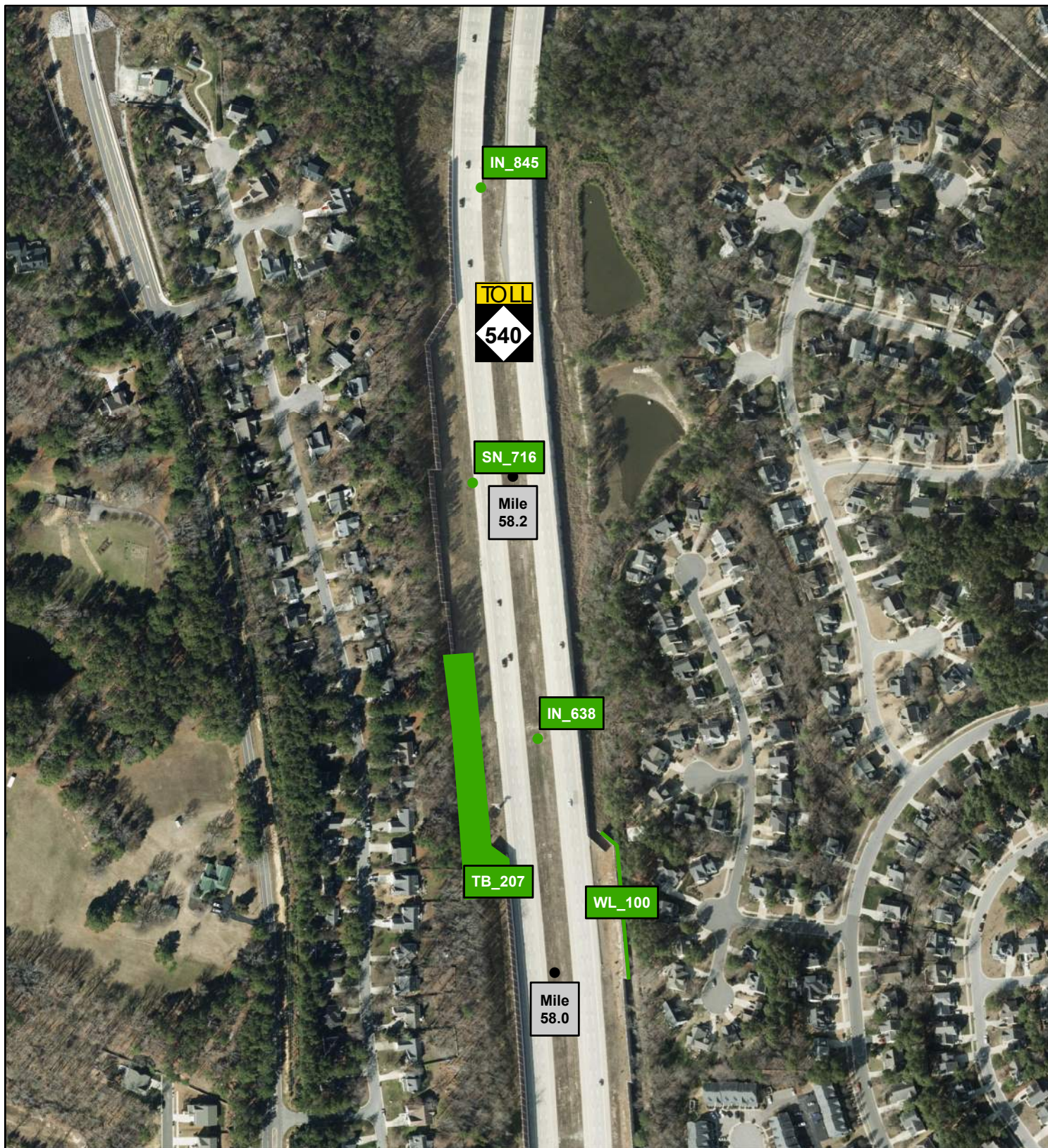


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

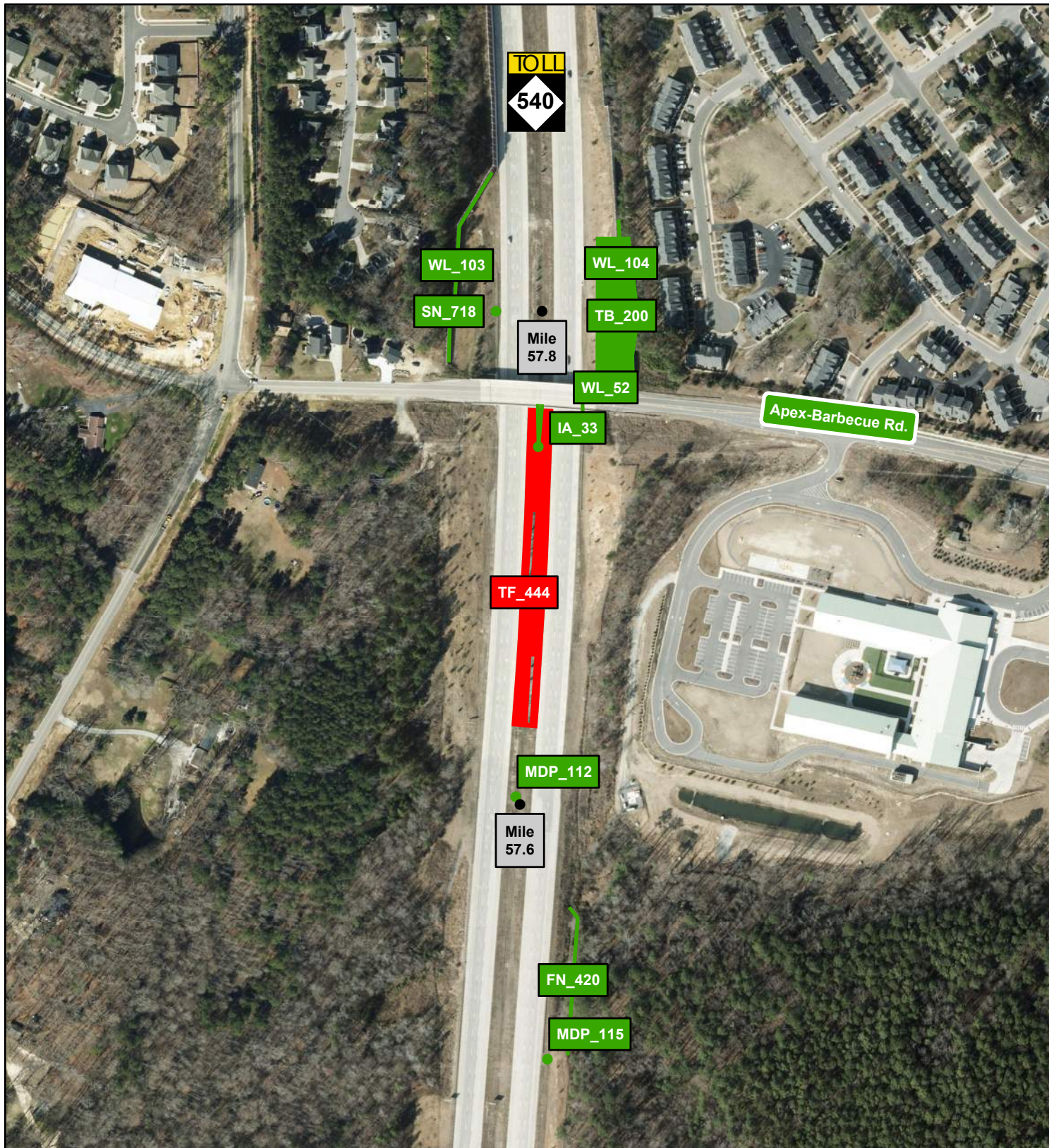


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

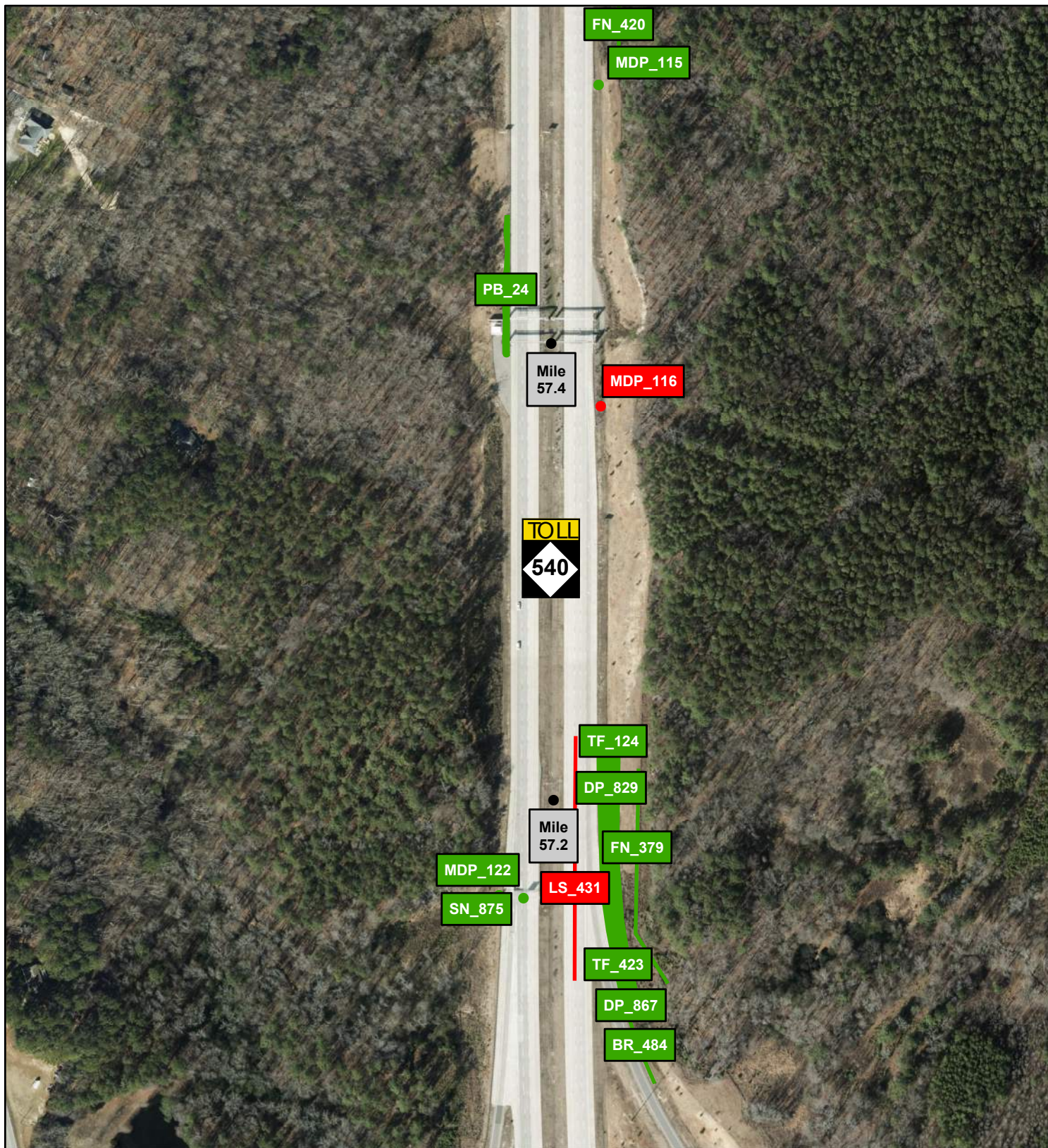


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

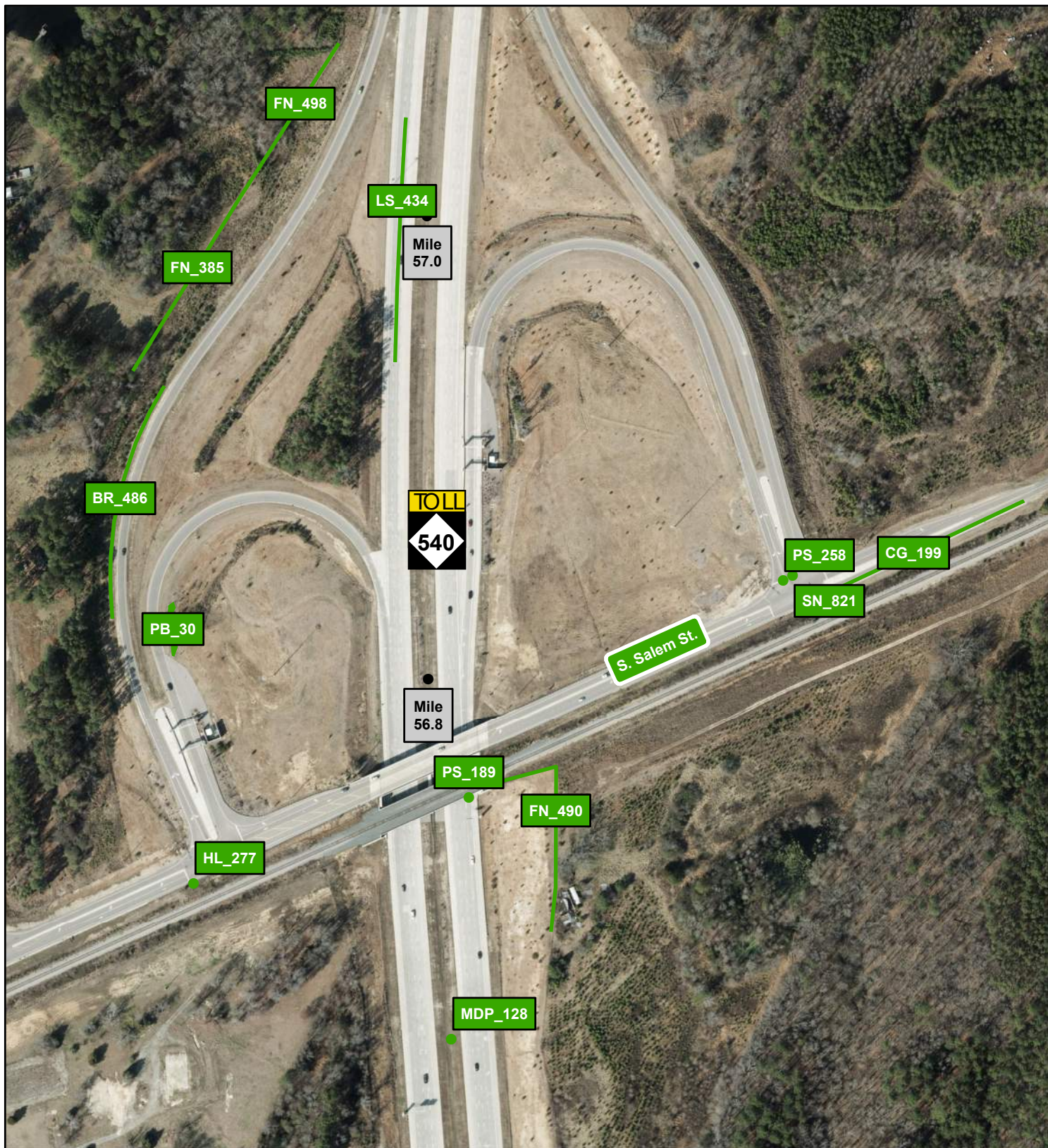


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

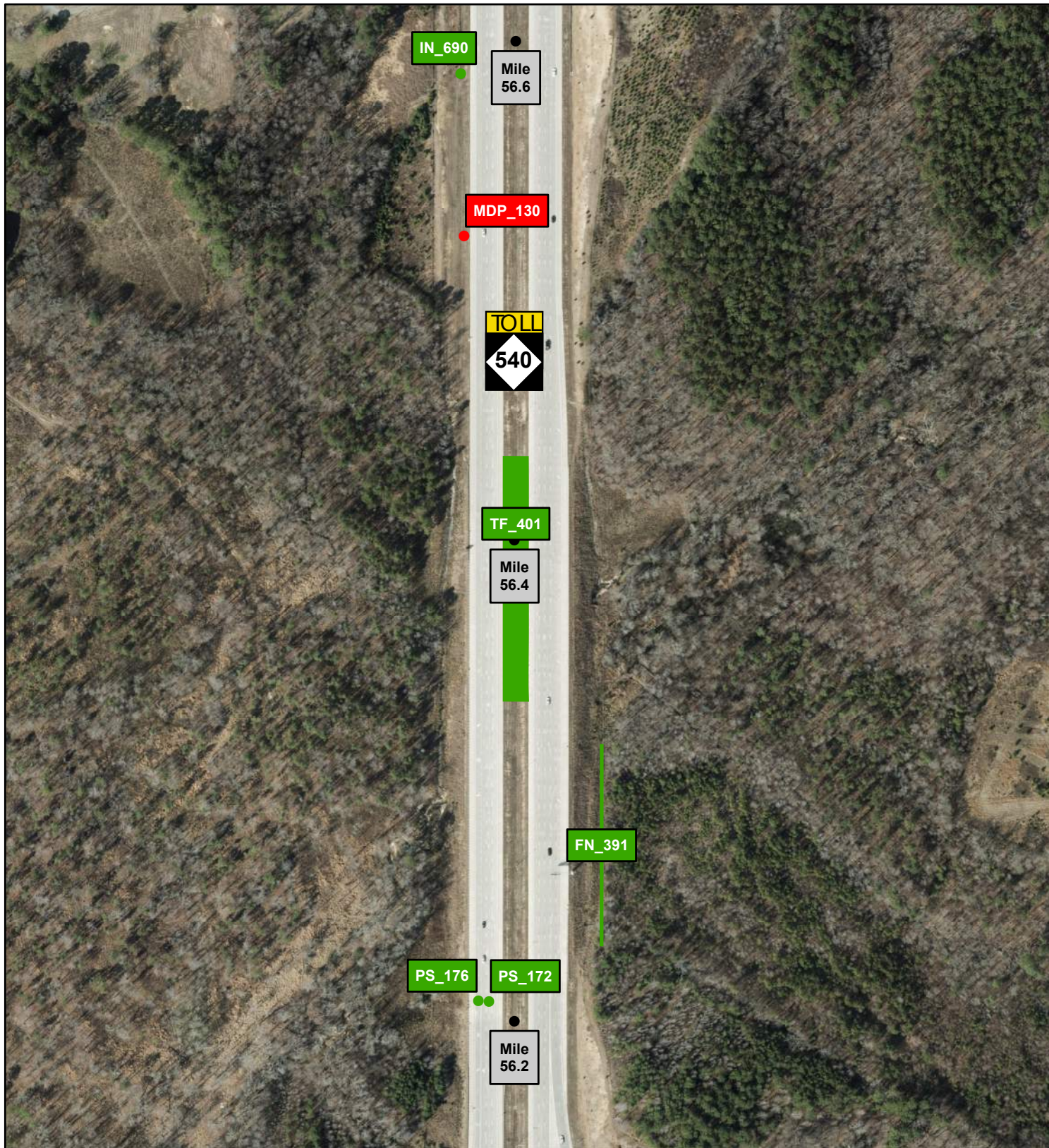


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend



-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

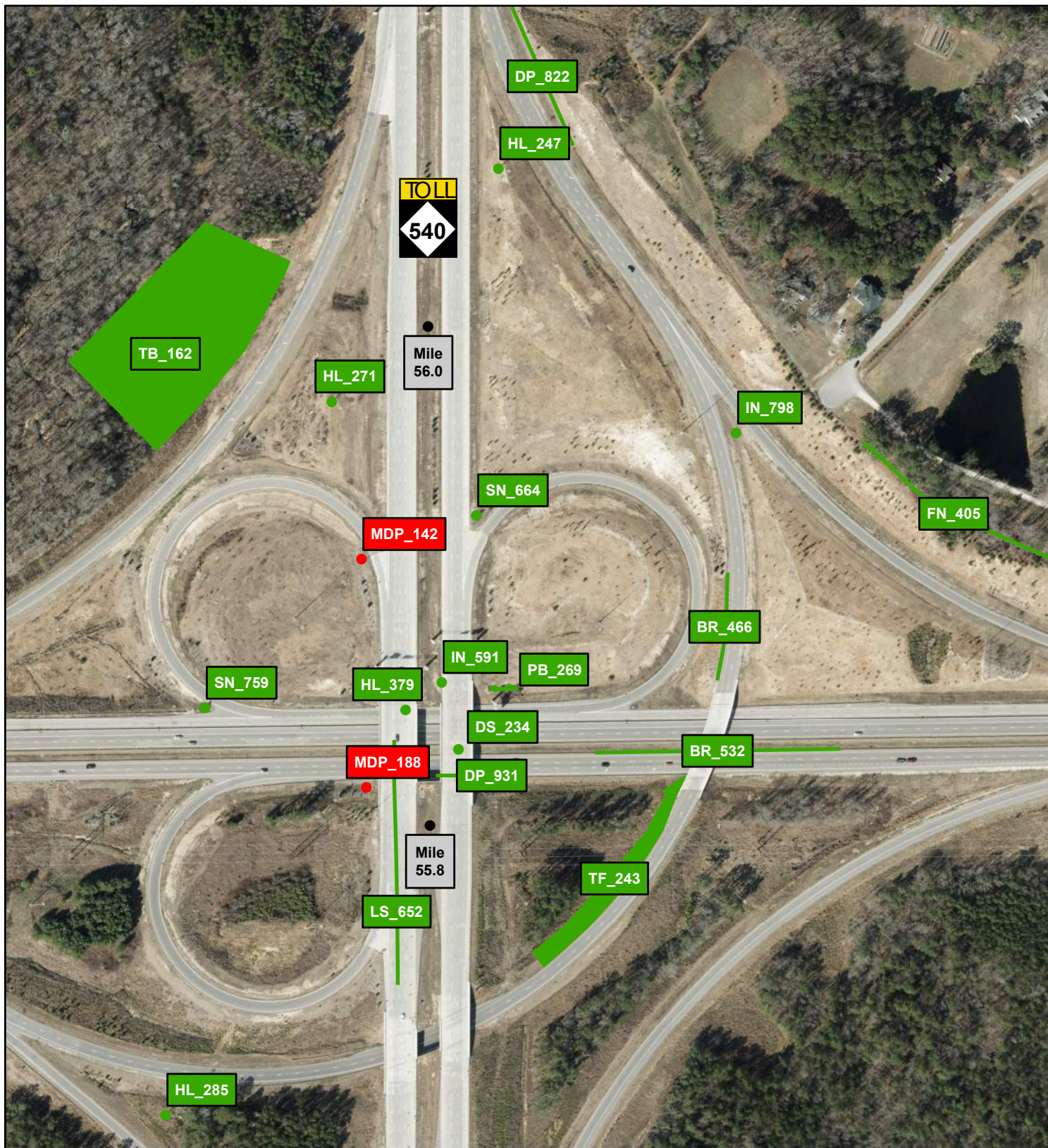


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



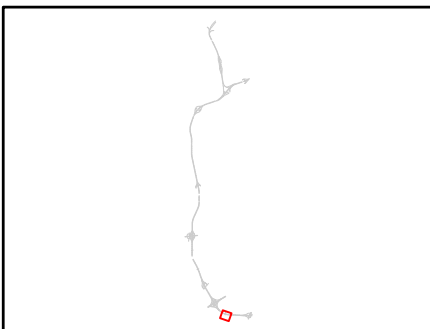
 NORTH CAROLINA
Turnpike Authority

Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

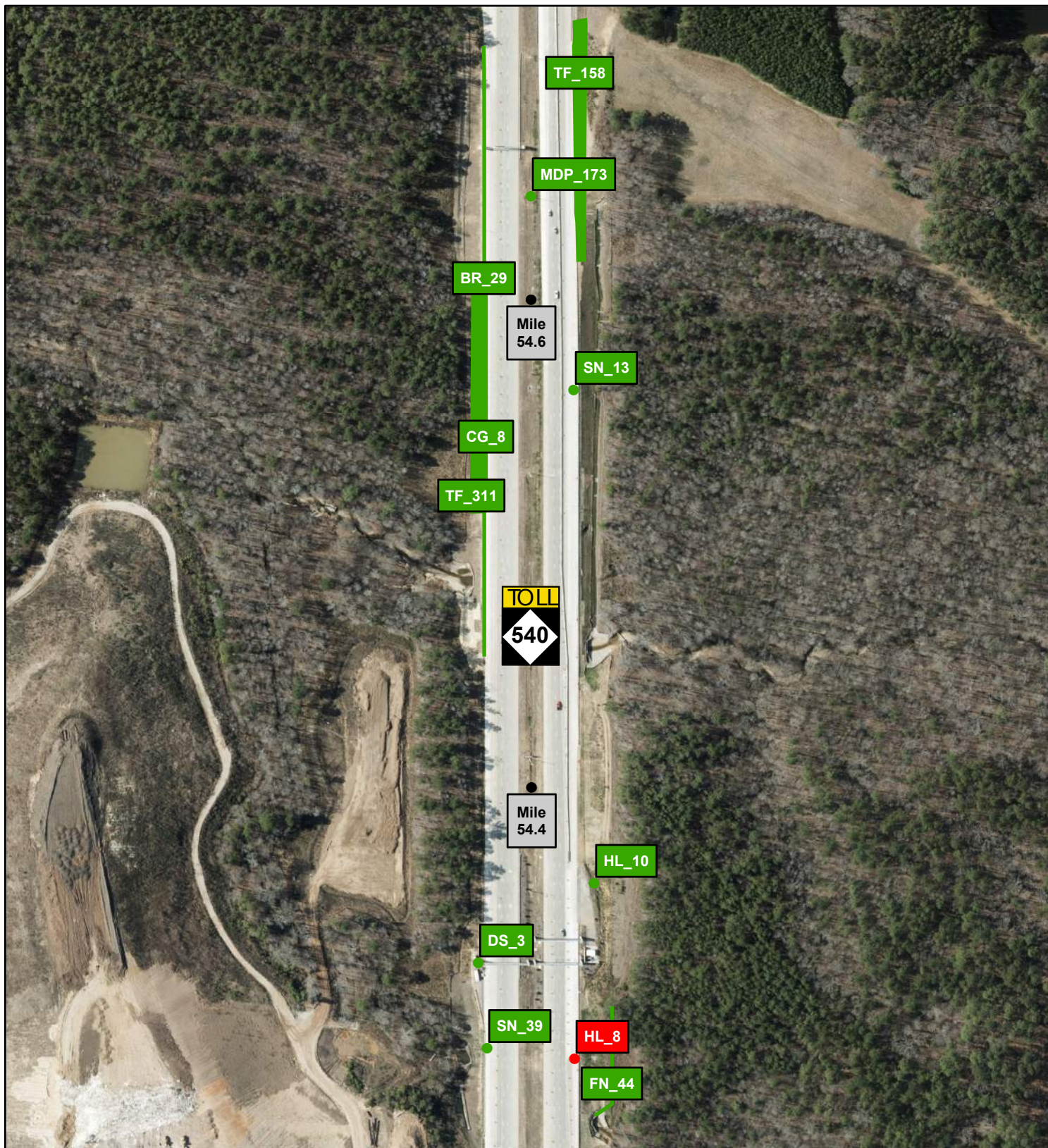


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

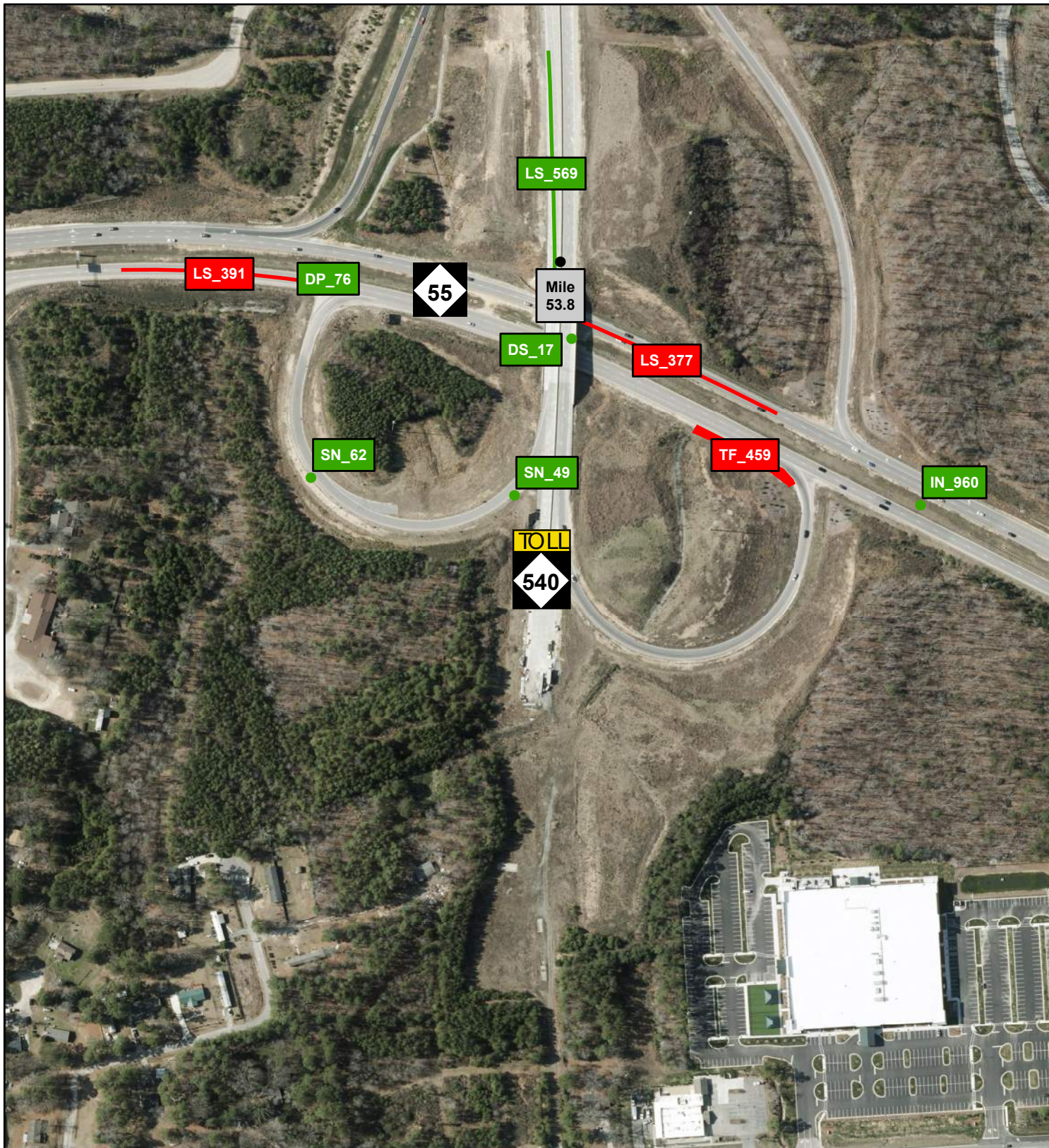


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



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Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

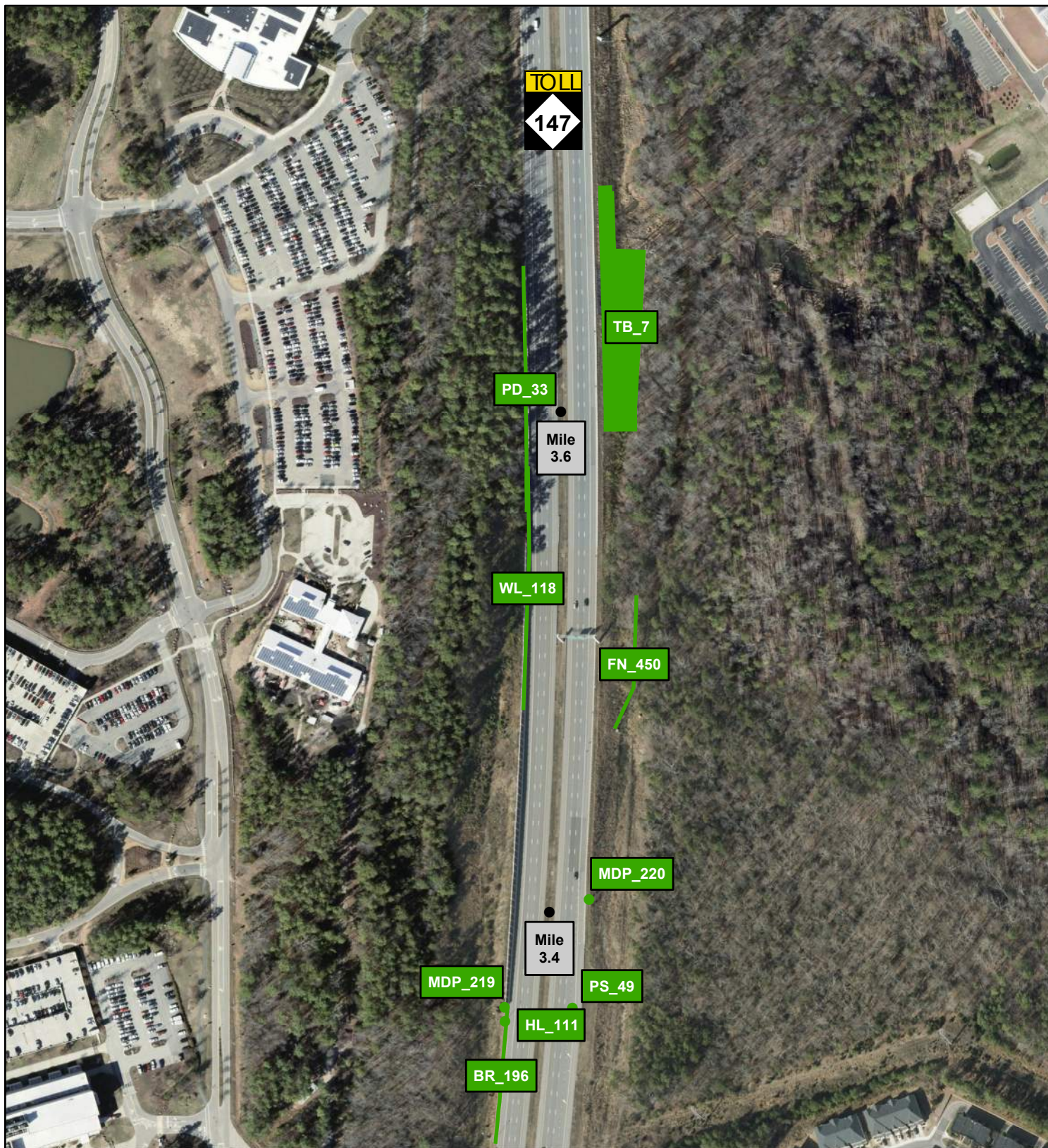


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

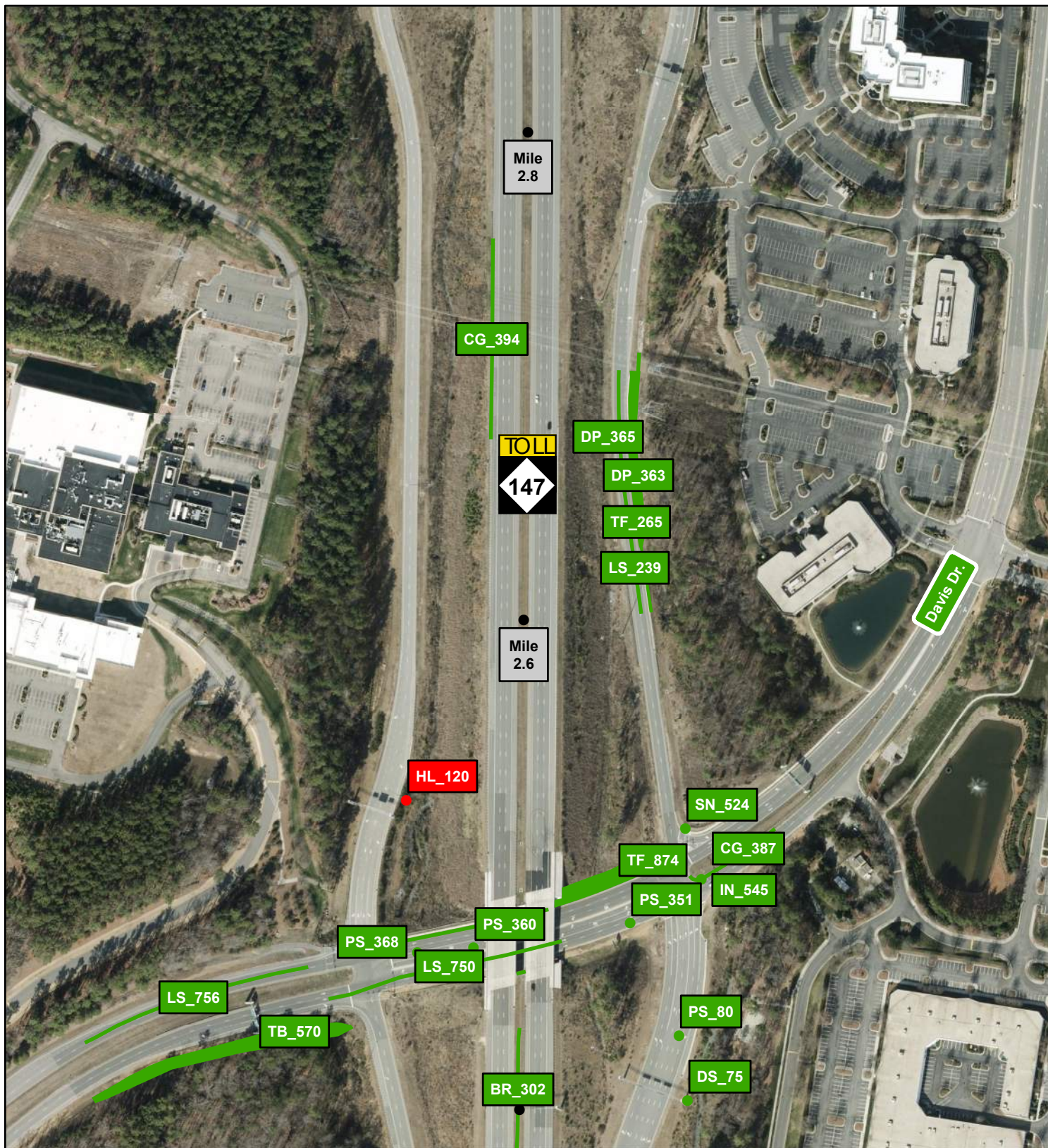


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

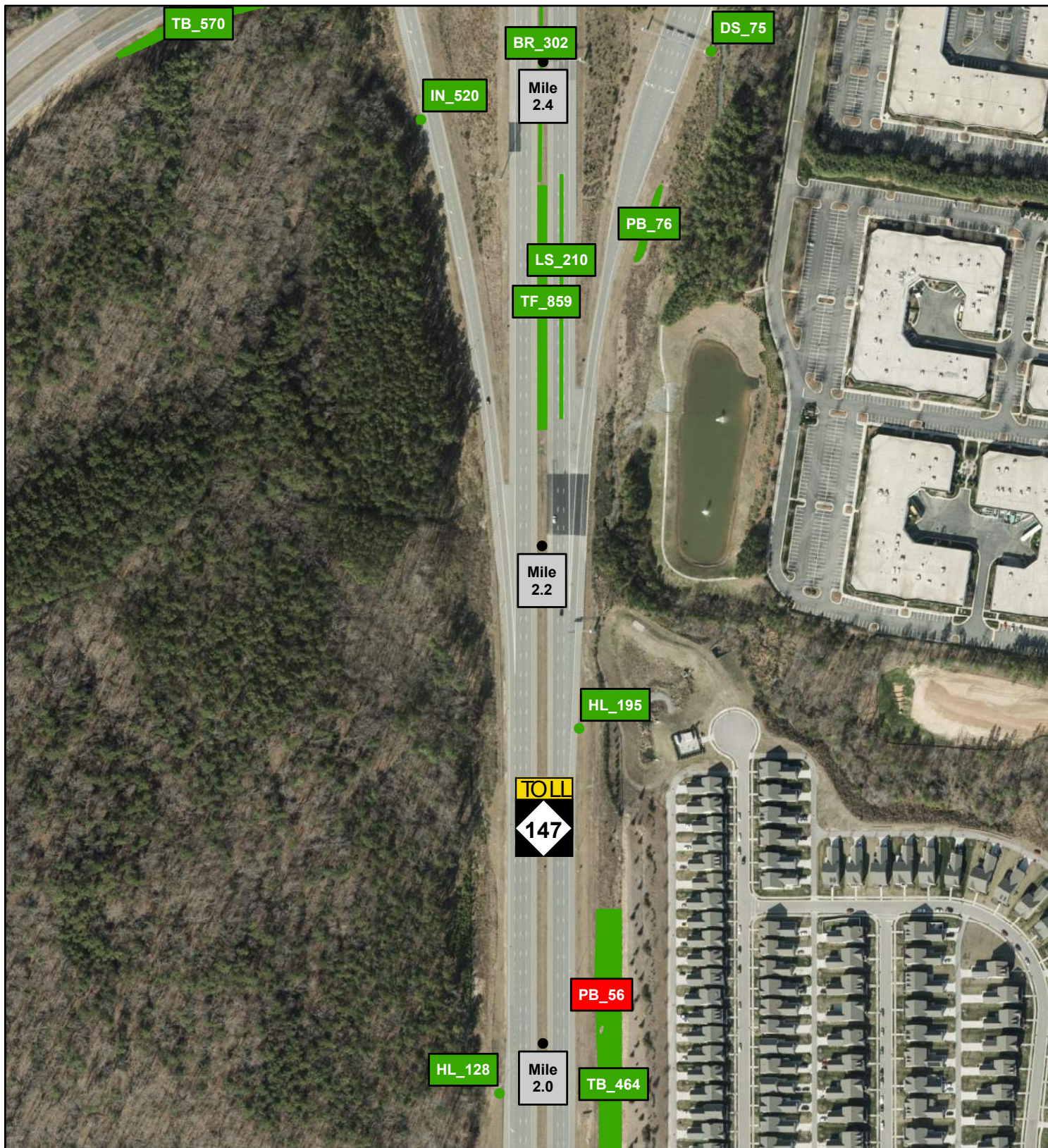


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations

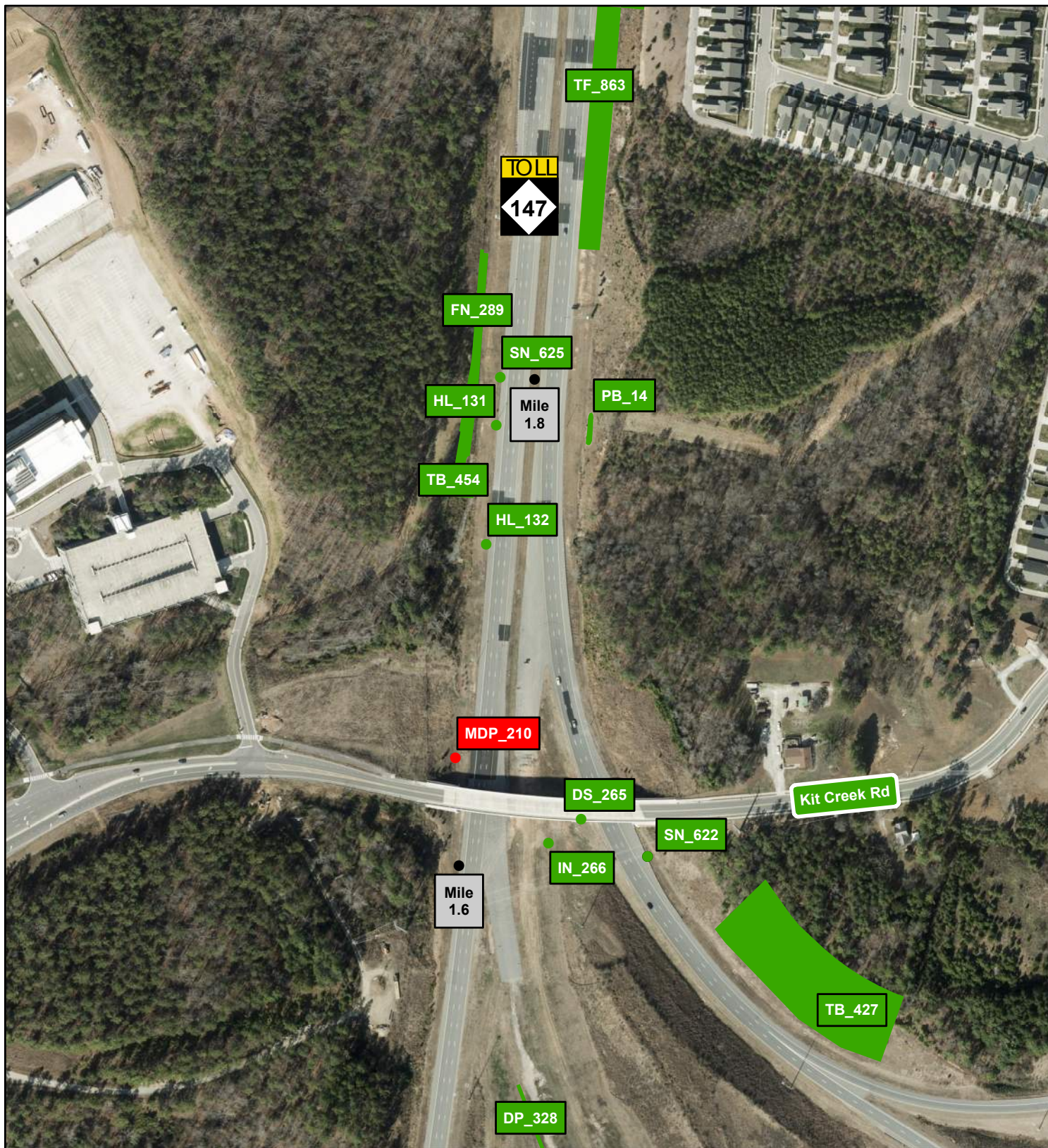


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2019 First Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix B

Triangle Expressway 2019 First Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2019 First 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 map packet provided in Appendix A, to allow for the quick location of particular asset failures. Photos of failures are provided when applicable.

All assets and their respective prefixes are listed below:

Guardrail, Concrete Barrier and End Anchors (BR)..... 2

Curb and Gutter (CG)..... 3

Decorative Supports (DS)..... 4

Drainage Pipes (DP) 5

Misc. Drainage Structure (MDP)..... 6

Fence and Control of Access (FN)..... 9

Graffiti (GR)..... 10

Highway Lighting (HL) 11

Impact Attenuators (IA) 13

Inlets (IN) 14

Landscaping (PB) 15

Paved Lanes – Asphalt (LS)..... 16

Paved Lanes – Concrete (LS) 17

Paved Shoulders (LS) 18

Unpaved Shoulders (LS)..... 19

Front/Back Slopes (LS) 20

Unpaved Lateral and Outfall Ditches (LS) 21

Litter (LS)..... 22

Roadway Sweeping (LS) 23

Pavement Striping (LS)..... 24

Pavement Markers (LS)..... 25

Delineators (LS) 26

Paved Ditches (PD) 27

Pavement Words and Symbols (PS)..... 28

Signs (SN) 29

Tree and Brush (TB) 30


Turf Condition (TF) 31

MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL)..... 33



Guardrail, Concrete Barrier and End Anchors (BR)

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


Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Berm	CG_180	Material Accumulation		A18





Decorative Supports (DS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Gantry Support	DS_47	Paint Scaling		A11
2	Overhead Sign Support	DS_50	Paint Scaling		A12





Drainage Pipes (DP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Cross Pipe	DP_699	Pipe Damage		A1





Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Drain	MDP_45	Obstruction		A12
2	Shoulder Drain	MDP_49	Missing Rodent Screen		A12
3	Shoulder Drain	MDP_55	Erosion/Missing Rodent Screen		A13
4	Shoulder Drain	MDP_57	Obstruction		A13



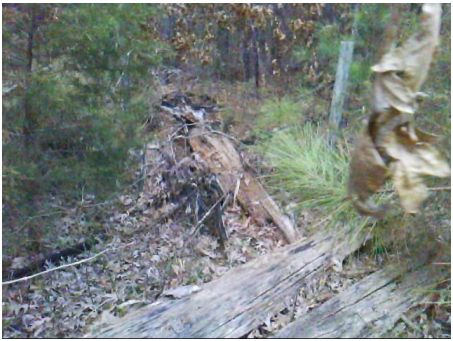
Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Shoulder Drain	MDP_116	Obstruction/ Missing Rodent Screen		A23
6	Shoulder Drain	MDP_130	Missing Rodent Screen		A25
7	Shoulder Drain	MDP_142	Obstruction		A27
8	Shoulder Drain	MDP_153	Missing Rodent Screen		A16

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Shoulder Drain	MDP_188	Missing Rodent Screen		A27
10	Shoulder Drain	MDP_199	Obstruction/Missing Rodent Screen		A19
11	Shoulder Drain	MDP_210	Missing Rodent Screen		A39
12	Shoulder Drain	MDP_215	Obstruction		A36

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_179	Fence Hole		A8
2	Woven	FN_430	Fence Hole		A26
3	Woven	FN_459	Fence Hole		A1


Graffiti (GR)

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

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Single Roadway	HL_8	Part Damage		A30, A31
2	High Mast	HL_120	Part Damage		A37
3	Single Roadway	HL_171	Part Damage		A2
4	High Mast	HL_232	Part Damage		A3


Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	High Mast	HL_321	Part Damage		A18

Impact Attenuators (IA)

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



Inlets (IN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Inlets	IN_373	Obstruction		A33

Landscaping (PB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Plant Bed	PB_56	Vegetation Health		A38

Paved Lanes – Asphalt (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_554	Pavement Cracking		A17
2	Asphalt	LS_727	Pavement Cracking		A7



Paved Lanes – Concrete (LS)

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

Paved Shoulders (LS)

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

Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_159	Shoulder Drop-Off		A13
2	Asphalt	LS_391	Shoulder Build-Up		A32





Front/Back Slopes (LS)

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


Unpaved Lateral and Outfall Ditches (LS)

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

Litter (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_377	Litter		A32
2	Asphalt	LS_391	Litter		A32
3	Concrete	LS_431	Litter		A23
4	Asphalt	LS_727	Litter		A7





Roadway Sweeping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_391	Material Accumulation		A32



Pavement Striping (LS)

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

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_377	Missing Markers		A32
2	Asphalt	LS_391	Missing Markers		A32
3	Asphalt	LS_554	Missing Markers		A17
4	Asphalt	LS_727	Nighttime Reflectivity	Not available for Nighttime failure.	A7
5	Asphalt	LS_759	Missing Markers		A36

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_130	Missing Delineators		A9
2	Asphalt	LS_377	Nighttime Reflectivity	Not available for Nighttime failure.	A32
3	Asphalt	LS_391	Missing Delineators		A32



Paved Ditches (PD)

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



Pavement Words and Symbols (PS)

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


Signs (SN)

#	Sign Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Mile Post	SN_368	Visibility		A13
2	Chevron	SN_1041	Missing		A33


Tree and Brush (TB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Tree and Brush	TB_307	Clearance		A13
2	Tree and Brush	TB_325	Clearance		A11

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Turf	TF_103	Bare Ground		A17
2	Turf	TF_249	Bare Ground		A33
3	Turf	TF_338	Bare Ground		A28
4	Turf	TF_444	Bare Ground		A22

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_459	Bare Ground		A32
6	Turf	TF_494	Bare Ground		A19
7	Turf	TF_643	Bare Ground		A9
8	Turf	TF_1026	Bare Ground		A29

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

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