



NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program

Triangle Expressway

2018 Third Quarter Report

1 S. Wilmington Street
Raleigh, NC 27601



Last Updated:
October 15, 2018

CONSULTANT CERTIFICATION OF COMPLETION

September 11, 2018

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


NCTA Triangle Expressway Roadway Maintenance Performance Rating Program; Q3, FY 2018 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, 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 2018 Third Quarter Assessment of the Triangle Expressway.

The overall 2018 third quarter maintenance rating of the Triangle Expressway was 96.4, 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 2018 Third Quarter Assessment		
Element	MRP Rating	Target Rating
Road Surface	99.2	85.0
Unpaved Shoulders and Ditches	97.1	85.0
Drainage	96.1	85.0
Roadside	94.9	85.0
Traffic Control Devices	94.6 ¹	85.0
Overall MRP Performance Rating	96.4¹	90.0

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces as well as highway lighting functionality.

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 93.3.

Table 2: MRP Rolling Element Results					
Element	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Rolling Rating
Road Surface	98.9	98.5	99.2	99.2	99.0
Unpaved Shoulders and Ditches	97.9	97.8	96.8	97.1	97.4
Drainage	87.6	87.7	97.3	96.1	92.2
Roadside	92.5	92.2	91.3	94.9	92.7
Traffic Control Devices	82.4	83.8	91.1 ¹	94.6 ¹	87.5 ²
Overall MRP Performance Rating	91.1	91.3	94.8¹	96.4¹	93.3²

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces as well as highway lighting functionality.

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.

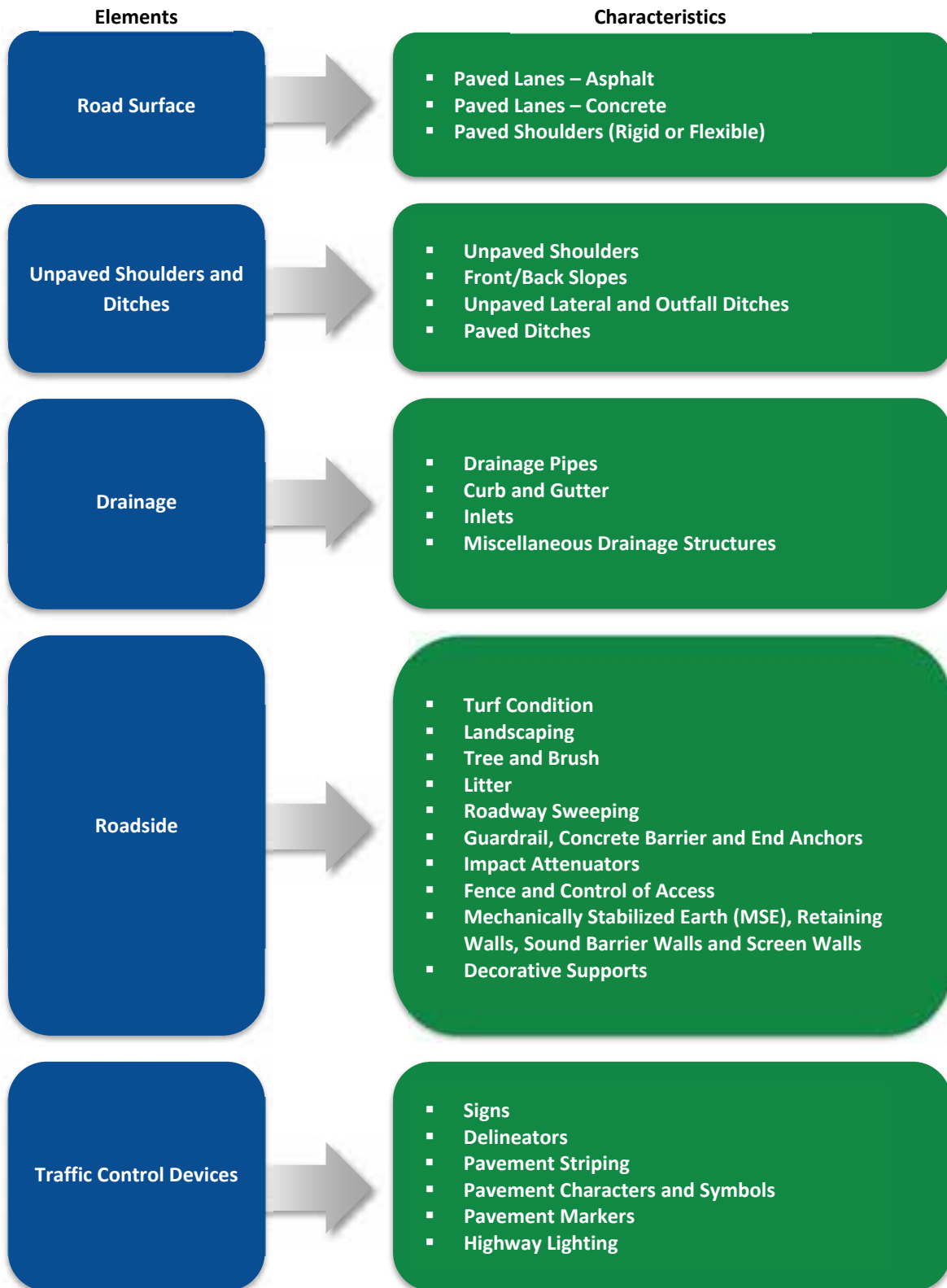
The NCTA performance standards, threshold criteria and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff and consultants.

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 V4*, 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 V4*. 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 NC-147 in Durham to the NC-55 Bypass near Holly Springs (**Figure 2**). It includes a one-mile segment on NC-540 extending north from the NC-540 / NC-147 interchange to the NC-54 interchange. The Triangle Expressway consists of eleven 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, roadway assets are continuously being added or modified. 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.

Table 3 presents the updated number of assets that are currently available for inspections.

Table 3: Asset Inventory		
Assets	Total Inventory	2018 Eligible Inventory
Barriers	588	579
Curb and Gutter	243	241
Decorative Supports	279	277
Drainage	1172	1158
Misc. Drainage	170	163
Fences	435	418
Highway Lighting	397	397
Impact Attenuators	45	45
Inlets	1053	1042
Linear Segments	694	678
Plant Beds	266	261
Paved Ditches	2	2
Pavement Symbols	617	488
Signs	1101	1091
Tree and Brush	564	549
Turf	1009	994
Walls	84	81

6.0 MRP Third Quarter Assessment

6.1 Quarterly Results

The overall 2018 third quarter maintenance rating of the Triangle Expressway was 96.4, meeting NCTA's target overall rating of 90. All elements assessed achieved ratings above the target rating of 85 established for element groups. All individual characteristics assessed achieved ratings above their target rating of 80.

During the third quarter, NCTA led a restriping project to improve the condition of pavement striping, characters, symbols, and markers on concrete surfaces throughout Triangle Expressway. Due to this ongoing project, the Pavement Striping, Pavement Characters and Symbols, and Pavement Markers characteristics were only inspected on asphalt pavement surfaces along the facility. Consequently, the rating obtained for these characteristics, as well as the rating obtained for Traffic Control Devices and overall third quarter rating ignores the condition of pavement striping, characters, symbols, and markers on concrete surfaces throughout Triangle Expressway. Once this project is completed later this fall, the Pavement Striping, Pavement Characters and Symbols, and Pavement Marker characteristics rating for the entire facility will resume and will be included in the Traffic Control Devices element rating and overall scoring.

The NCTA's highway lighting system was included in the Council of State contract to replace all highway lighting statewide with LED technology. The contractor for that contract anticipates completing the changeover on the Triangle Expressway in FY 2019, at which point maintenance and replacement of the LEDs will occur under that contract for the next 15 years. NCTA will continue to be responsible for maintenance of the lighting infrastructure but lighting functionality will no longer be included in the MRP survey. During the third quarter, Highway Lighting assets were assessed during the day for missing or damaged parts but were not inspected at night for functionality. This modified method of assessment for Highway Lighting will continue throughout the 15-year contract period.

It is important to note that these results are only representative of the third 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 third quarter MRP performance ratings for elements and characteristics are presented in **Table 4** and **Table 5**, respectively.

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Table 4: MRP Element Results for Q3 2018	
Element	Q3 2018 MRP Rating
Road Surface	99.2
Unpaved Shoulders and Ditches	97.1
Drainage	96.1
Roadside	94.9
Traffic Control Devices	94.6 ¹
Overall MRP Performance Rating	96.4¹

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces as well as highway lighting functionality.

Table 5: MRP Characteristic Results for Q3 2018						
Road Surface	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Paved Lanes Asphalt	18	18	9	162	162	100
Paved Lanes Concrete	26	26	9	234	234	100
Paved Shoulder	43	44	5	215	220	98
Element Total				611	616	99.2
Unpaved Shoulders and Ditches	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Unpaved Shoulder	41	44	9	369	396	93
Front/Back Slopes	44	44	6	264	264	100
Lateral and Outfall Ditches, Unpaved	44	44	6	264	264	100
Ditches, Paved	2	2	5	10	10	100
Element Total				907	934	97.1
Drainage	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Drainage Pipes	34	34	7	238	238	100
Curb and Gutter	28	29	6	168	174	97
Inlets	34	34	7	238	238	100
Misc. Drainage Structure	25	31	4	100	124	81
Element Total				744	774	96.1
Roadside	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Turf Condition	53	62	7	371	434	85
Landscaping	24	25	4	96	100	96
Trees and Brush	31	31	4	124	124	100
Litter	44	44	4	176	176	100
Roadway Sweeping	44	44	5	220	220	100
Guardrail, Concrete Barrier and End Anchors	29	31	9	261	279	94
Impact Attenuators	11	11	9	99	99	100
Fence, Control Access	31	33	7	217	231	94
Retaining Walls and Sound Barrier Walls	15	16	5	75	80	94
Decorative Supports	27	27	5	135	135	100
Graffiti and Stain Removal	44	44	4	176	176	100
Element Total				1950	2054	94.9

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Traffic Control Devices	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q3 Rating
Signs	37	37	7	259	259	100
Delineators	39	44	3	117	132	89
Pavement Striping	17	18	8	136	144	94 ¹
Pavement Characters and Symbols	31	31	7	217	217	100 ¹
Pavement Markers	18	18	9	162	162	100 ¹
Highway Lighting	43	50	6	258	300	86 ²
Element Total				1149	1214	94.6³

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

² Excludes nighttime functionality as a metric for Highway Lighting.

³ Excludes Pavement Striping, Pavement Characters and Symbols, Pavement Markers, and Highway Lighting functionality characteristics.

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 the target ratings.

6.2 Analysis and Recommendations

Elements

During the third quarter, all elements exceeded NCTA's threshold criteria of 85. Traffic Control Devices (94.6) experienced an increase in rating by three points. However, this increase may be attributed to removing Highway Lighting functionality as a performance metric in this quarter's inspection. Road Surface (99.2), Unpaved Shoulder/Ditches (97.1), and Drainage (96.1) continued to obtain ratings higher than 95, while Roadside (94.9) experienced an increase in rating over three points. This increase is mostly attributed to the growth and propagation of warm season grasses during the summer months resulting in the improvement on Turf Condition.

Characteristics

This quarter all characteristics met the NCTA target threshold criteria of 80. Turf Condition showed the largest improvement, increasing by 16 points from the previous quarter to a score of 85. The characteristic that scored the lowest this quarter was Miscellaneous Drainage with a score of 81. 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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Turf Condition (85 rating – 9 of the 62 assets failed). All 9 turf areas that did not pass the inspection were due to bare ground conditions. Two examples of these turf areas are presented in **Figure 3**.

Figure 3: Turf Areas



To continue to improve the Turf Condition rating, it is recommended that the maintenance provider continue the established aggressive schedule for seeding and fertilization cycles of bare ground areas throughout the rest of the summer season and possibly into early fall. Some areas will require scarifying of the soil as these areas are heavily compacted and inundated with aggregate. Additionally, as part of the 2018 mowing cycle the maintenance provider should continue to closely monitor mowing heights to avoid turf scalping pursuant to the NCTA Roadway and Facility Maintenance Standards V4, 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.
- 6) Chemical applications:
 - a. Winter:

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- 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.

Miscellaneous Drainage (81 rating – 6 of the 31 assets failed). Out of the 6 miscellaneous drainage structures that did not pass the inspection, 2 were obstructed and 4 had missing rodent screens. Two of these structures are presented in **Figure 4**.

Figure 4: Miscellaneous Drainage



In accordance with *NCTA Roadway and Facility Maintenance Standards V4*, 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. Edge drains are a critical component of extending the life cycle of pavements as they provide a means for water to drain from the subgrade and base.

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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.

7.0 Current Rolling MRP Rating

The rolling maintenance rating of the Triangle Expressway was 93.3, exceeding NCTA's target overall rating of 90. All rolling element ratings met or exceeded the target rating of 85. Also, all but two characteristic ratings met or exceeded the target rating of 80. Ratings for Miscellaneous Drainage Structure, and Highway Lighting were 77 and 75 respectively.

The cumulative rolling results are presented in **Tables 6 and 7**. These results are a collection of the four quarterly inspections conducted throughout the year. It should be noted that similarly to the second and third quarter results, the overall rolling rating and the rolling rating for Traffic Control Devices excludes the second and third quarter ratings obtained for the Pavement Striping, Pavement Characters and Symbols, and Pavement Marker characteristics due to the restriping project. Also, the rolling rating for Traffic Control Devices starting in the third quarter excludes nighttime functionality as a metric for Highway Lighting.

Table 6: MRP Rolling Element Results					
Element	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Rolling Rating
Road Surface	98.9	98.5	99.2	99.2	99.0
Unpaved Shoulders and Ditches	97.9	97.8	96.8	97.1	97.4
Drainage	87.6	87.7	97.3	96.1	92.2
Roadside	92.5	92.2	91.3	94.9	92.7
Traffic Control Devices	82.4	83.8	91.1 ¹	94.6 ¹	87.5 ²
Overall MRP Performance Rating	91.1	91.3	94.8¹	96.4¹	93.3²

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces as well as highway lighting functionality.

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

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Table 7: MRP Rolling Element Results					
Road Surface	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Rolling Rating
Paved Lanes Asphalt	100	95	100	100	99
Paved Lanes Concrete	100	100	100	100	100
Paved Shoulder	97	100	98	98	98
Element Total	98.9	98.5	99.2	99	99.0
Unpaved Shoulders and Ditches	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Rolling Rating
Unpaved Shoulder	100	97	98	95	98
Front/Back Slopes	100	100	98	95	98
Lateral and Outfall Ditches, Unpaved	100	97	98	100	99
Ditches, Paved	100	100	100	100	100
Element Total	100.0	97.9	97.8	96.8	98.1
Drainage	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Rolling Rating
Drainage Pipes	94	91	100	100	96
Curb and Gutter	79	90	97	97	91
Inlets	94	97	97	100	97
Misc. Drainage Structure	74	59	94	81	77
Element Total	87.6	87.7	97.3	96.1	92.2
Roadside	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Rolling Rating
Turf Condition	84	79	69	85	80
Landscaping	88	100	96	96	95
Trees and Brush	100	100	100	100	100
Litter	100	100	100	100	100
Roadway Sweeping	97	100	100	100	99
Guardrail, Concrete Barrier and End Anchors	100	90	97	94	95
Impact Attenuators	100	100	100	100	100
Fence, Control Access	90	91	94	94	92
Retaining Walls and Sound Barrier Walls	73	88	94	94	87
Decorative Supports	100	92	89	100	95
Graffiti and Stain Removal	100	100	100	100	100
Element Total	92.5	92.2	91.3	94.9	92.7
Traffic Control Devices	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Rolling Rating
Signs	89	97	97	100	96
Delineators	80	100	95	89	92
Pavement Striping	68	77	100 ¹	94 ¹	81 ¹
Pavement Characters and Symbols	90	90	90 ¹	100 ¹	93 ¹
Pavement Markers	97	84	95 ¹	100 ¹	92 ¹
Highway Lighting	68	68	78	86 ²	75 ²
Element Total	82.4	83.8	91.1¹	94.6³	87.5³

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

² Excludes nighttime functionality as a metric for Highway Lighting.

³ Excludes Pavement Striping, Pavement Characters and Symbols, Pavement Markers, and Highway Lighting functionality characteristics.

8.0 Green Level Historic District Signs

Four Green Level Historic District signs and surrounding landscaped areas were installed as part of the Triangle Expressway construction project. The sign located at the intersection of Green Level Church Road and Green Level West has been removed for a Town of Cary development project. Currently, NCDOT is maintaining the remaining three 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. *Figure 5* shows these signs.

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



9.0 Conclusion

This report represents the 2018 third quarter rating assessment of the Triangle Expressway. The NCTA's target ratings are 90 overall, 85 for elements, and 80 for characteristics. The third quarter 2018 overall rating was **96.4** and the rolling rating was **93.3**, both ratings met the target rating of 90.

All third quarter and rolling element ratings and characteristic ratings met or exceeded the target rating of 85. With the cumulative rolling assessment Miscellaneous Drainage Structure and Highway Lighting did not meet the target rating of 80, obtaining a rating of 77 and 75, respectively.

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. Additionally, while Turf Condition improved, the bare areas seeding/fertilization program efforts should also continue during the late summer and early fall season as needed. Further efforts should include scarifying the soil surface and removing heavy aggregate layers to allow seed germination.

All Green Level Historic District signs inspected during the third quarter were found to be in good condition. Also, the landscaped areas surrounding the signs are being well maintained; preserving sign visibility and aesthetic appearance.

Appendix A

Triangle Expressway 2018 Third Quarter Asset Assessment Locations

Appendix A: Triangle Expressway 2018 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 2018 Third Quarter Asset Assessment Locations

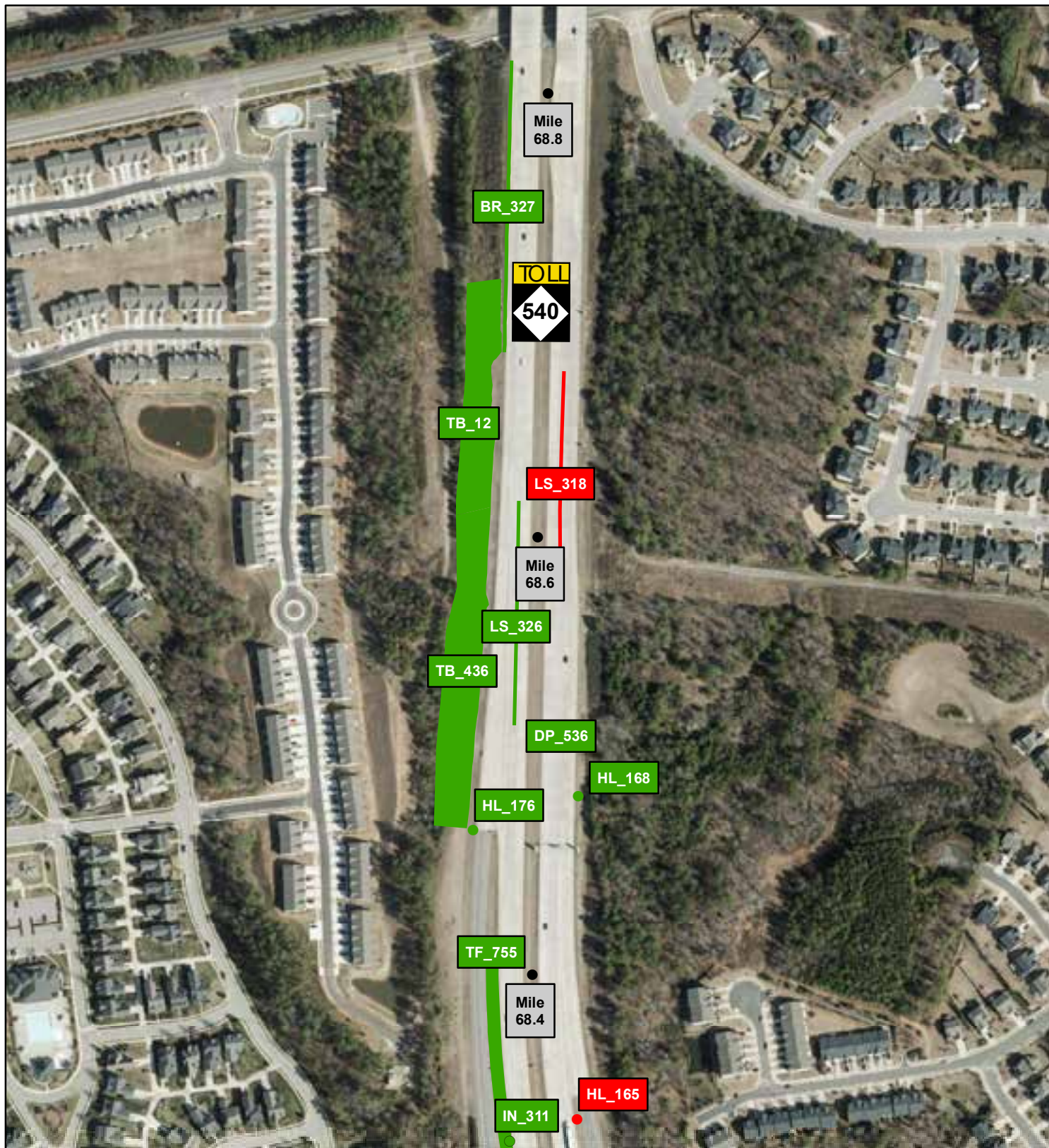


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

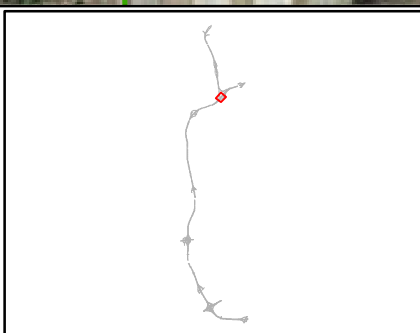


Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

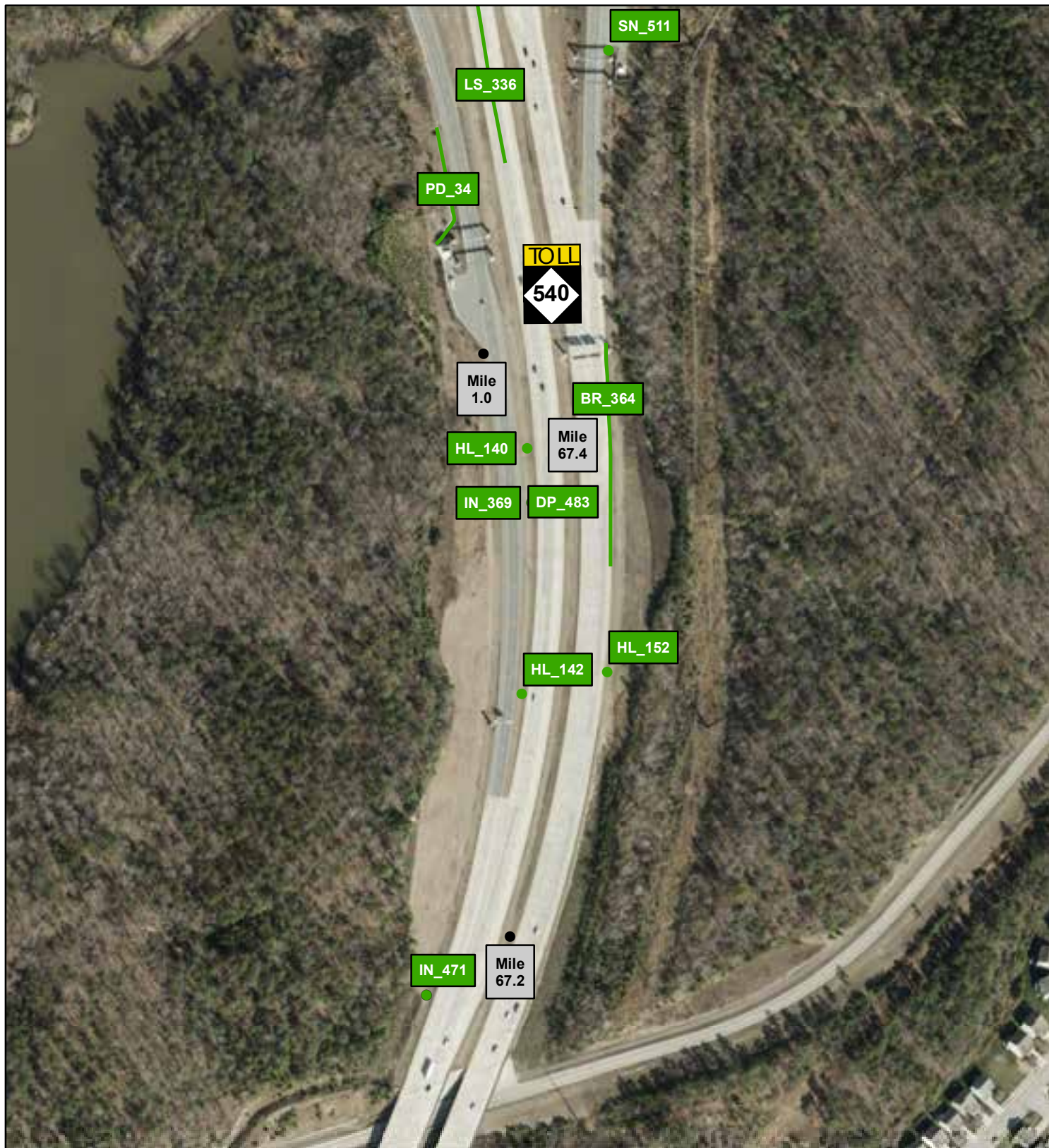
- Failing Asset
- Passing Asset



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Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



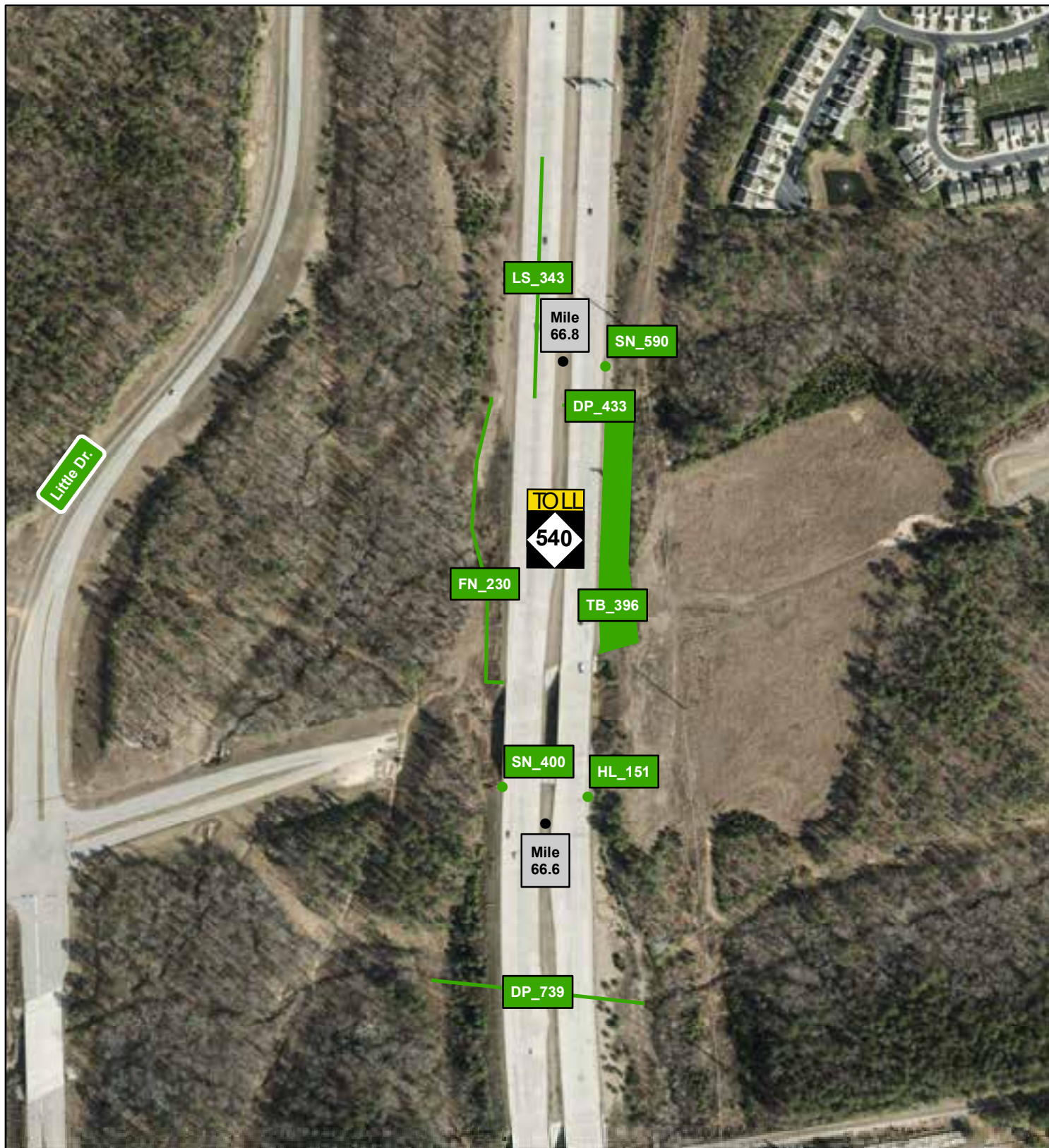
Legend

- Failing Asset
- Passing Asset





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Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

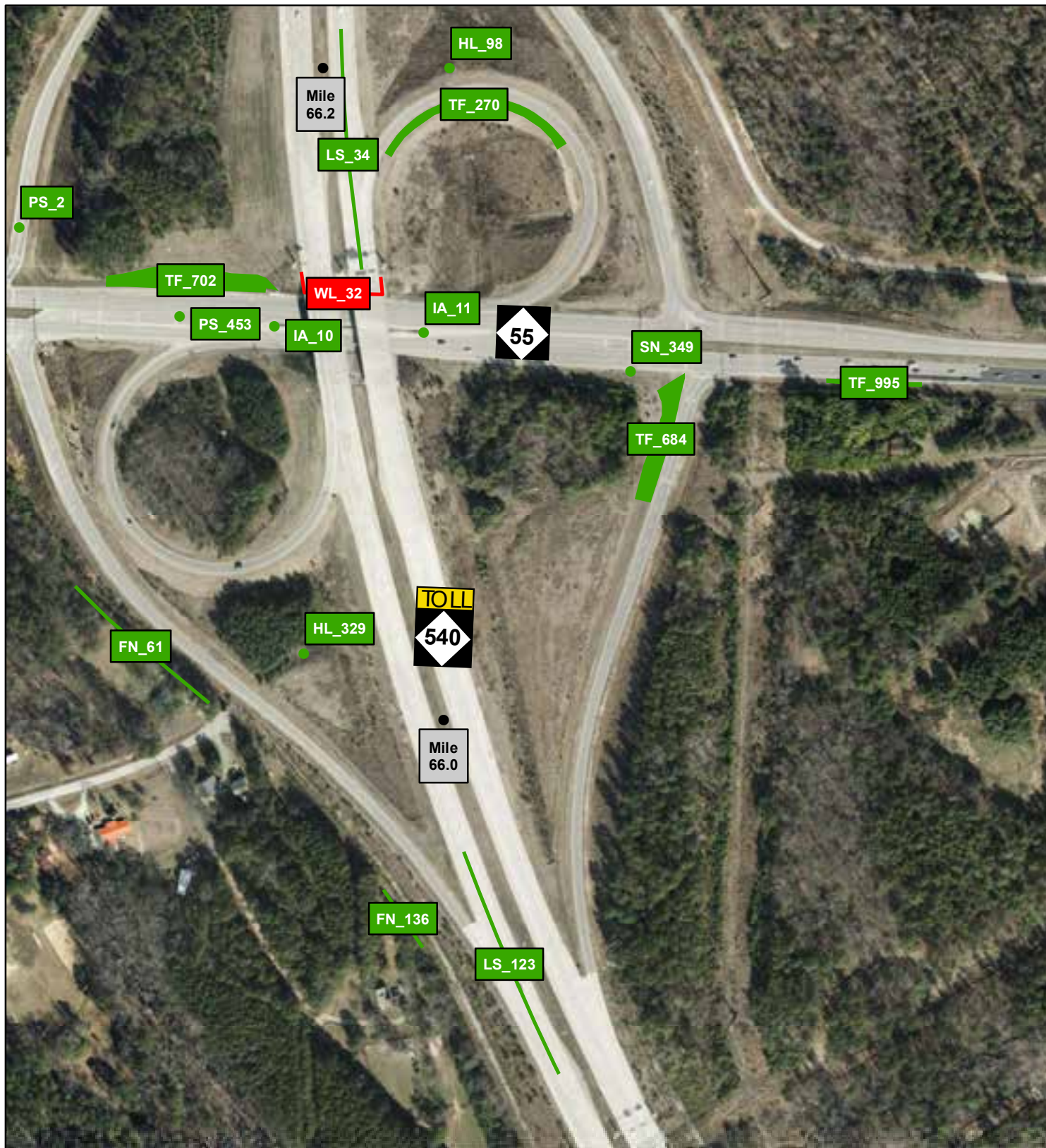


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset





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Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

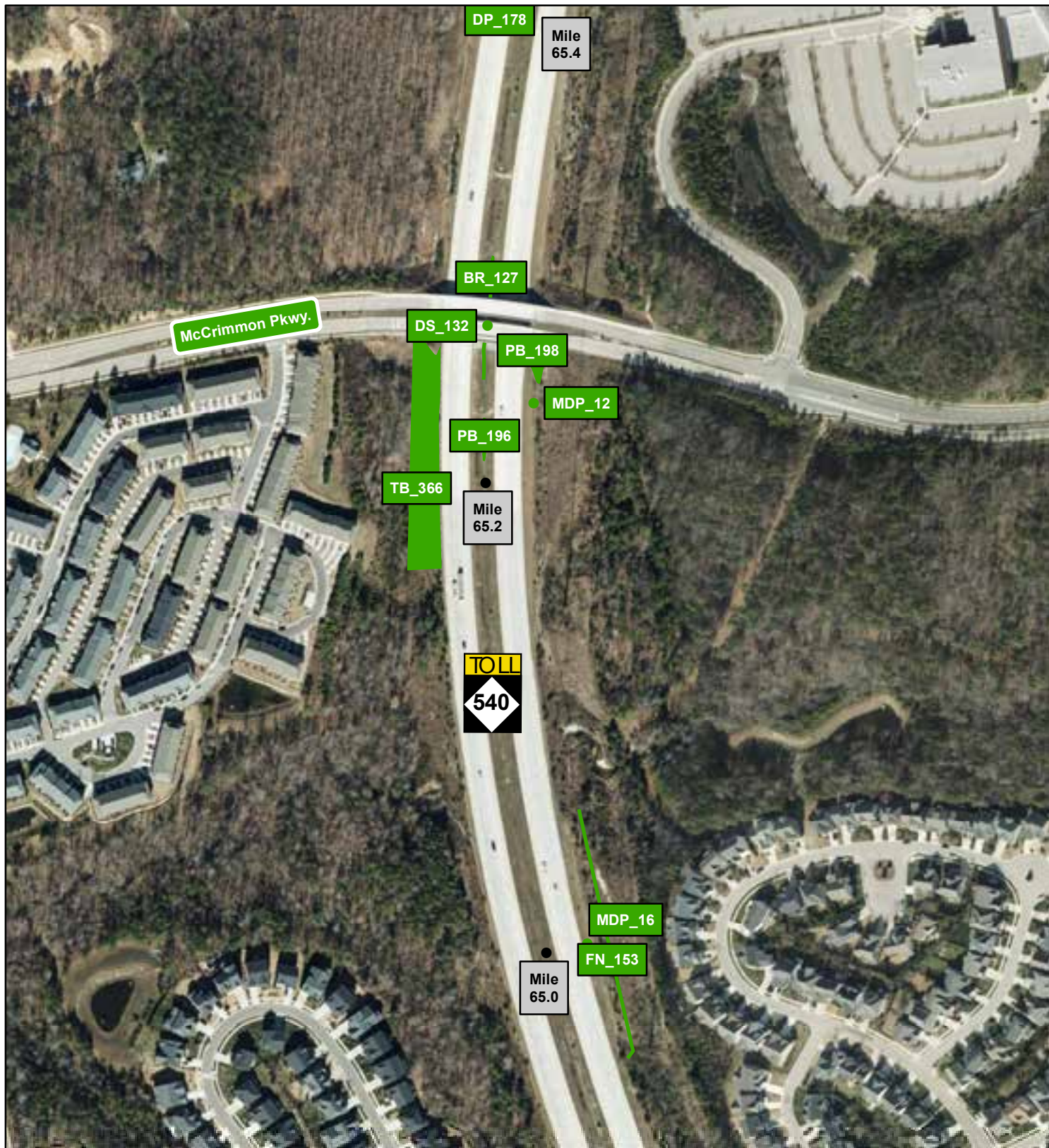


Legend

-  Failing Asset
-  Passing Asset

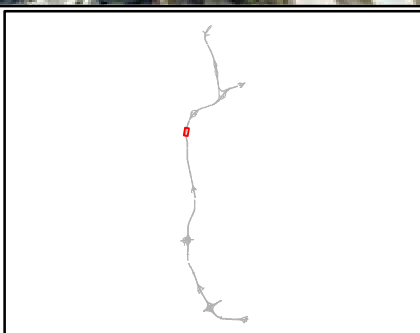


Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

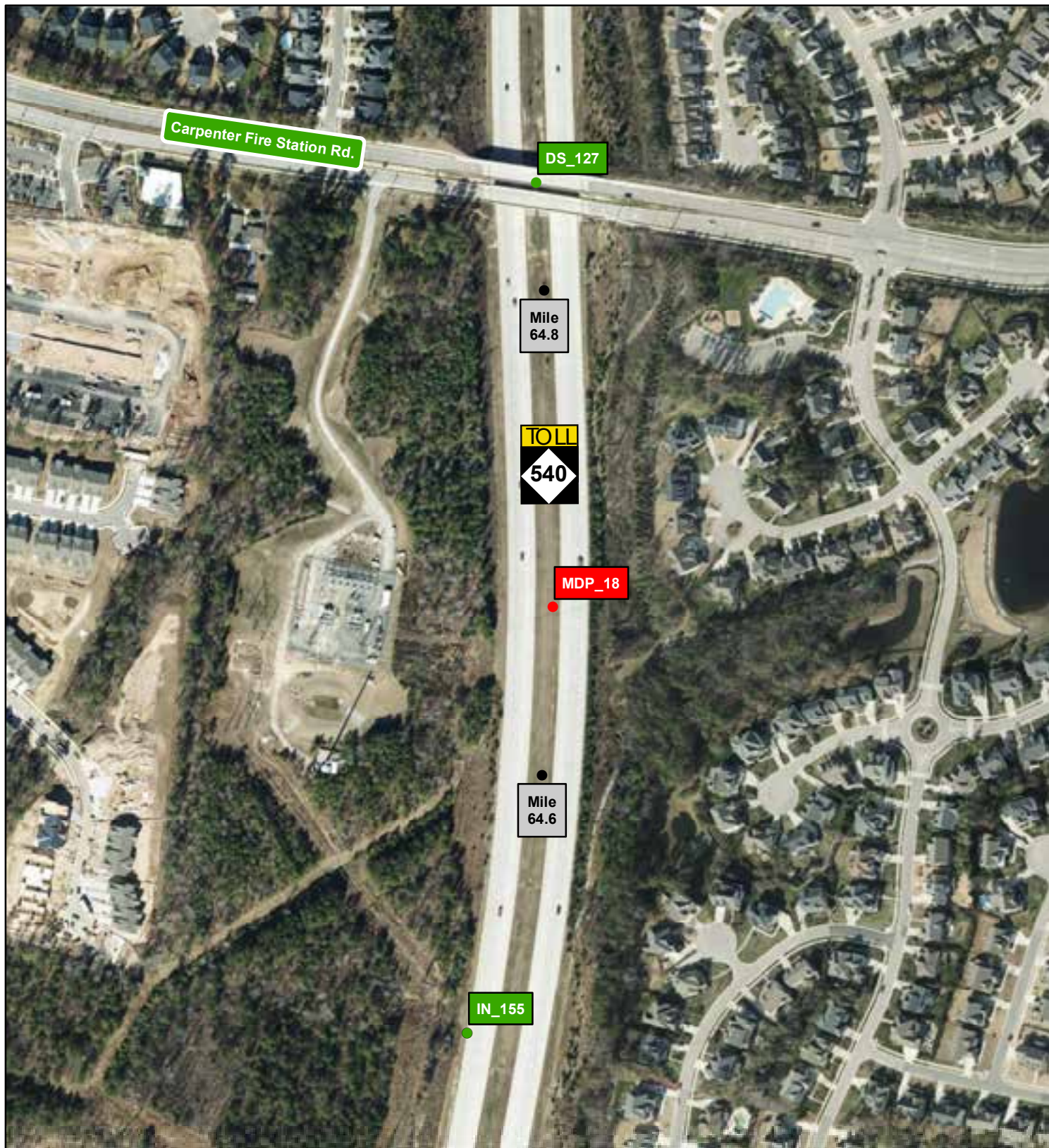








A10

Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

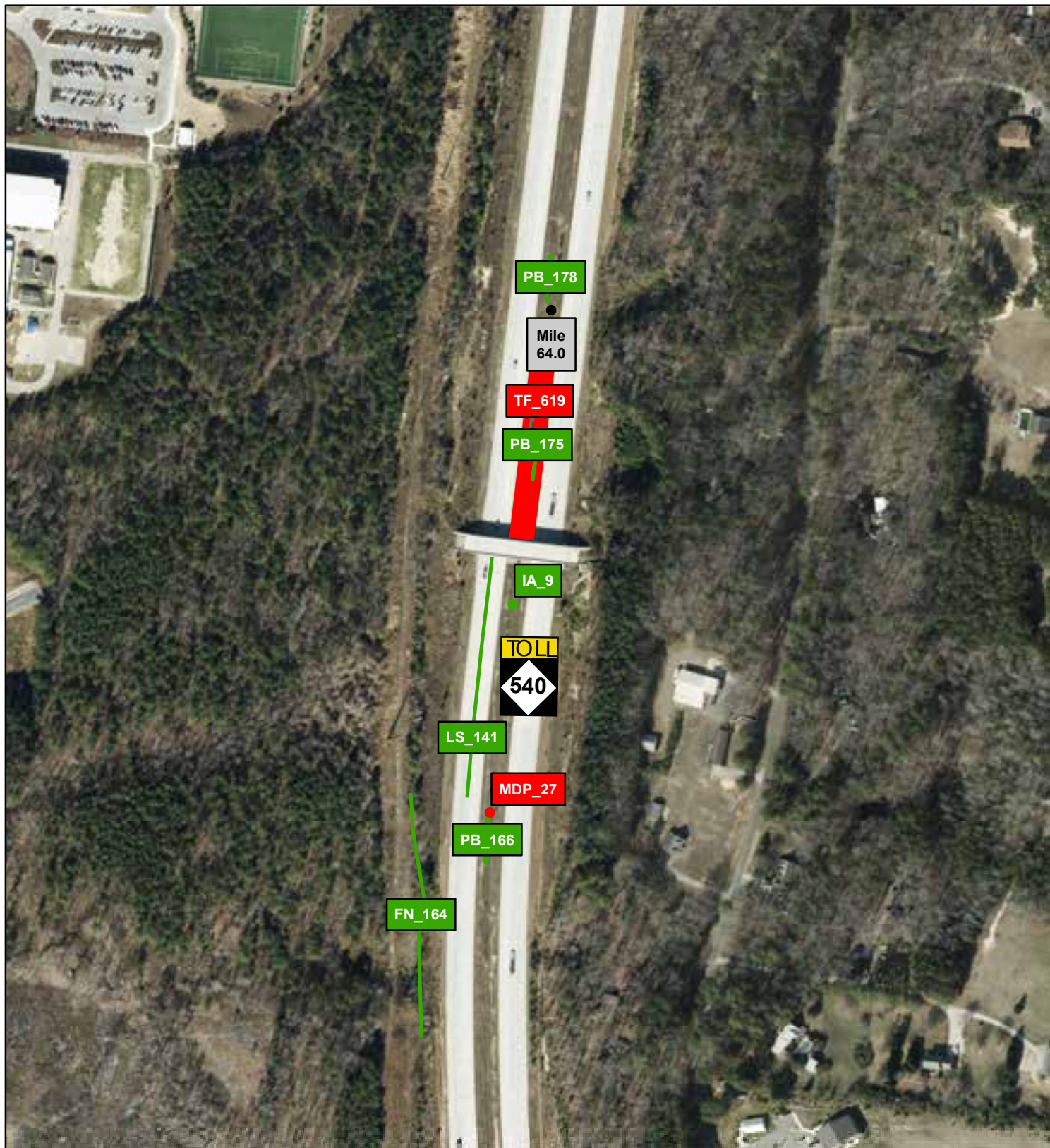


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

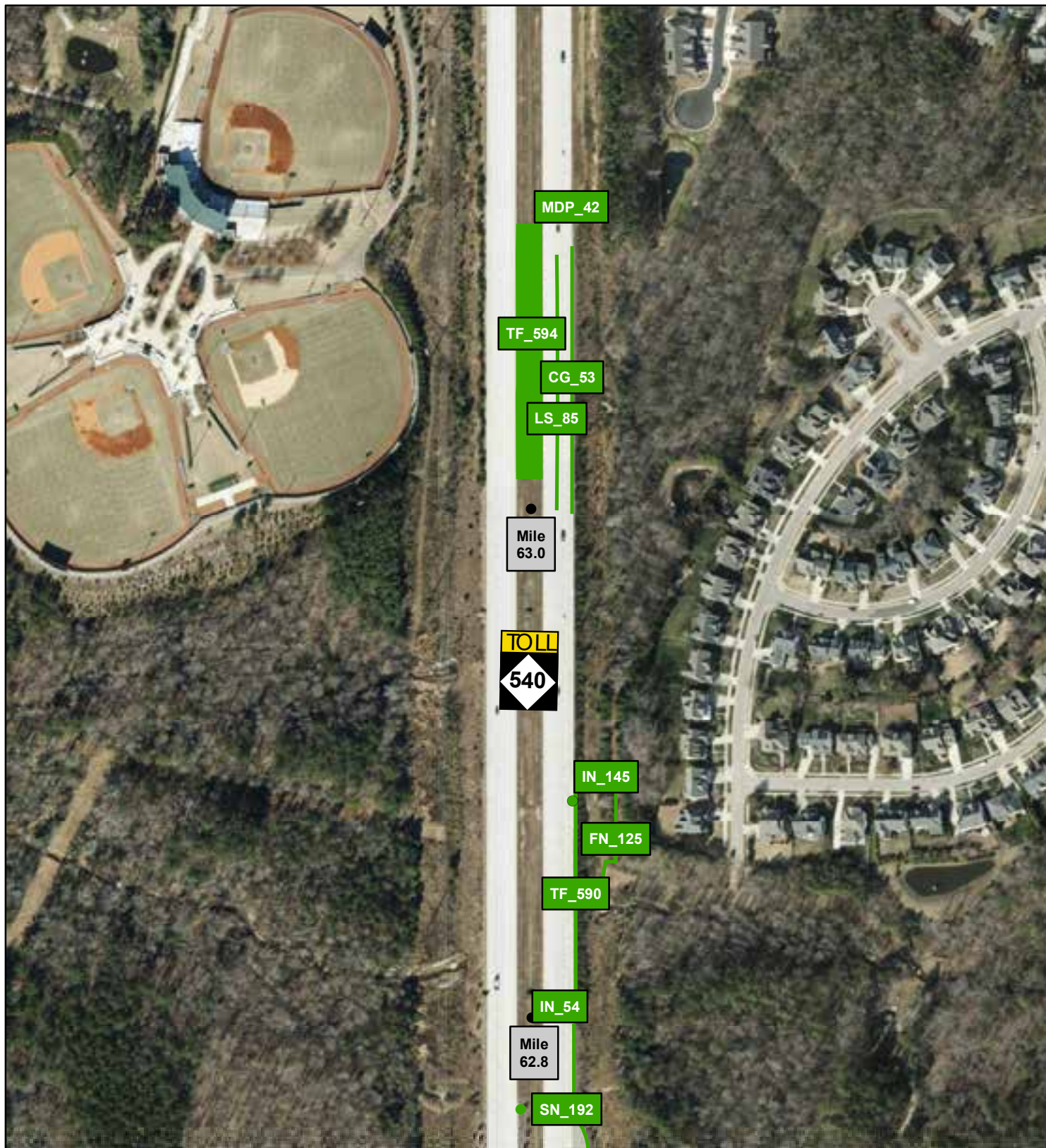


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

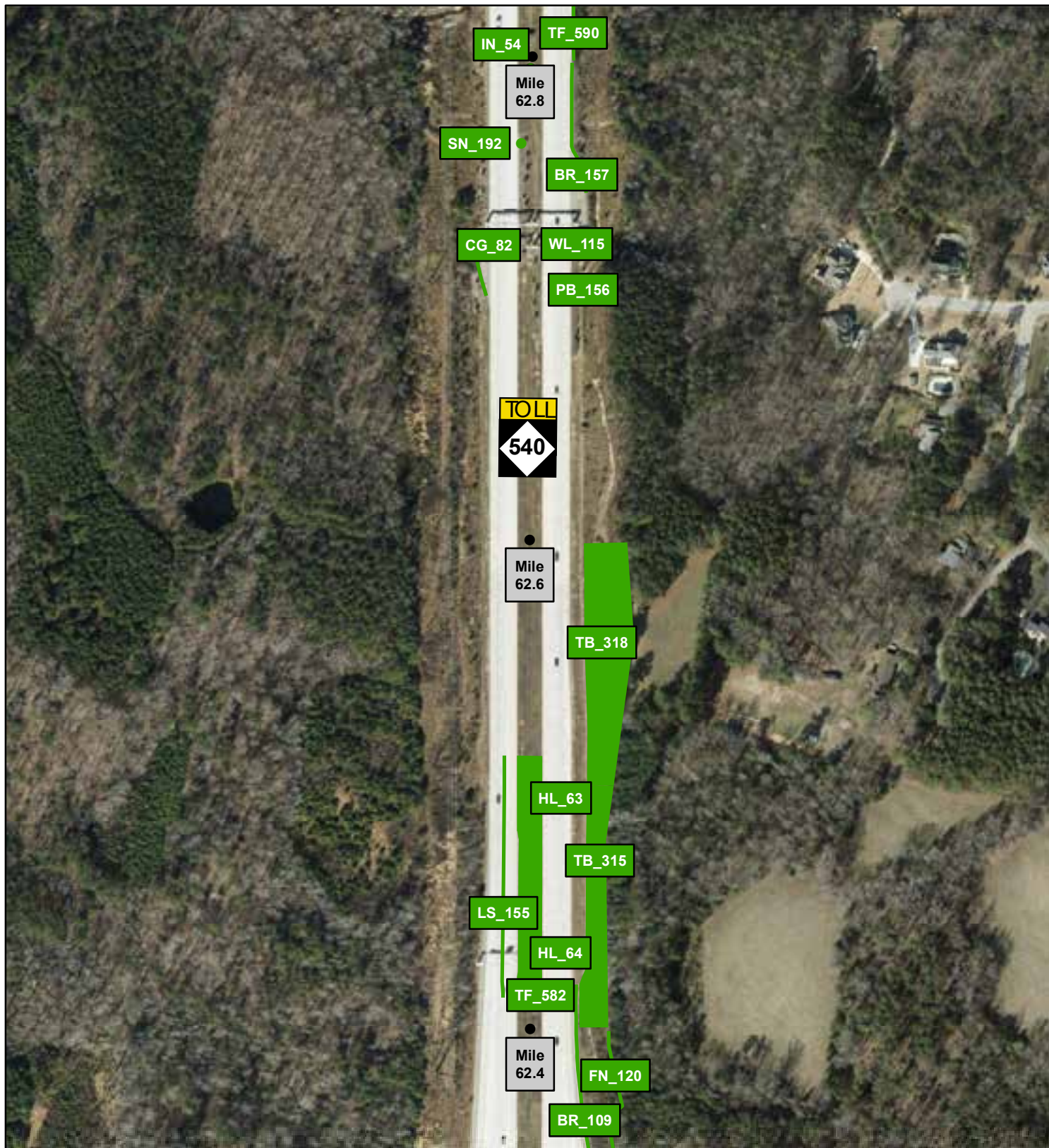


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

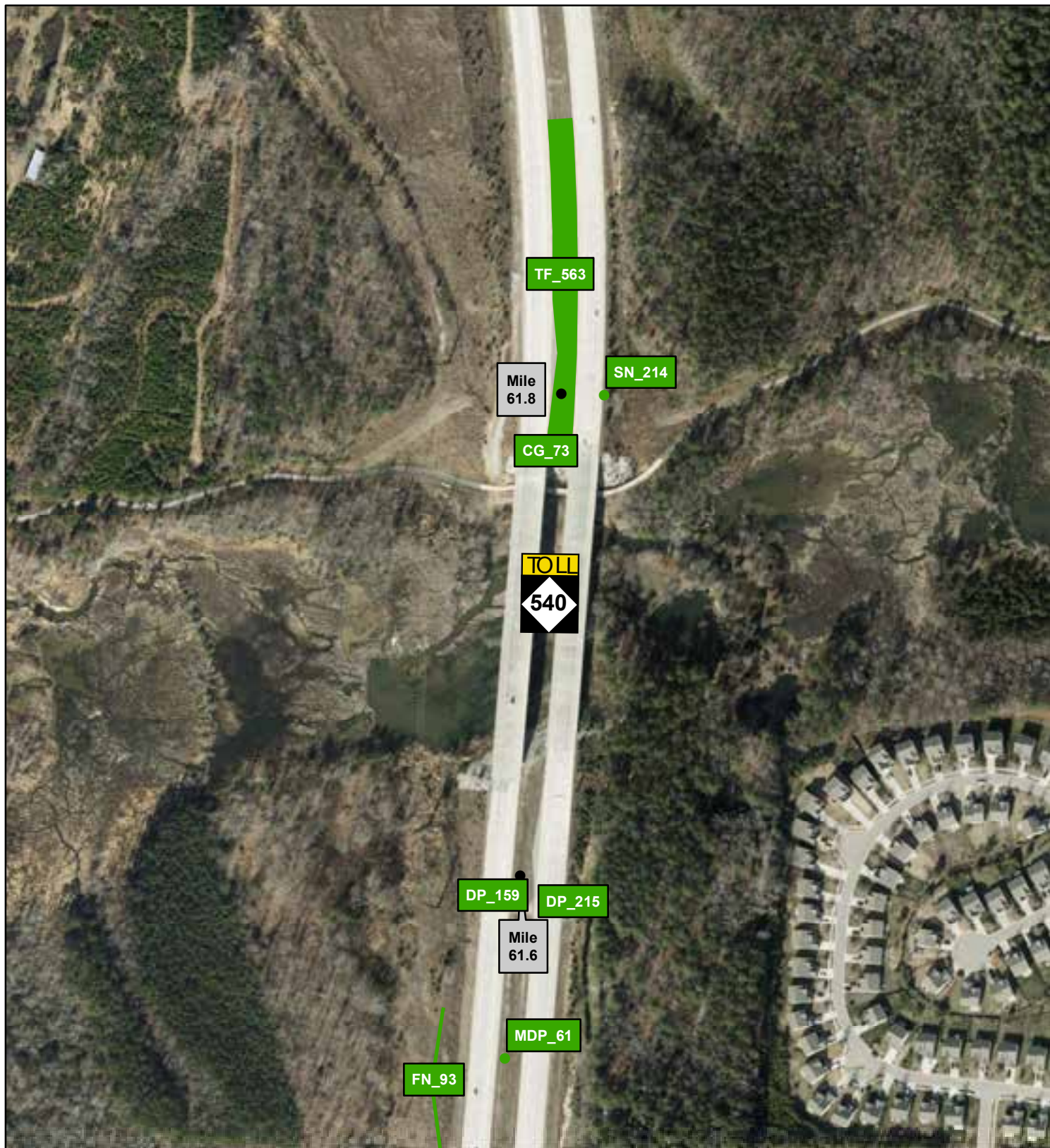


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

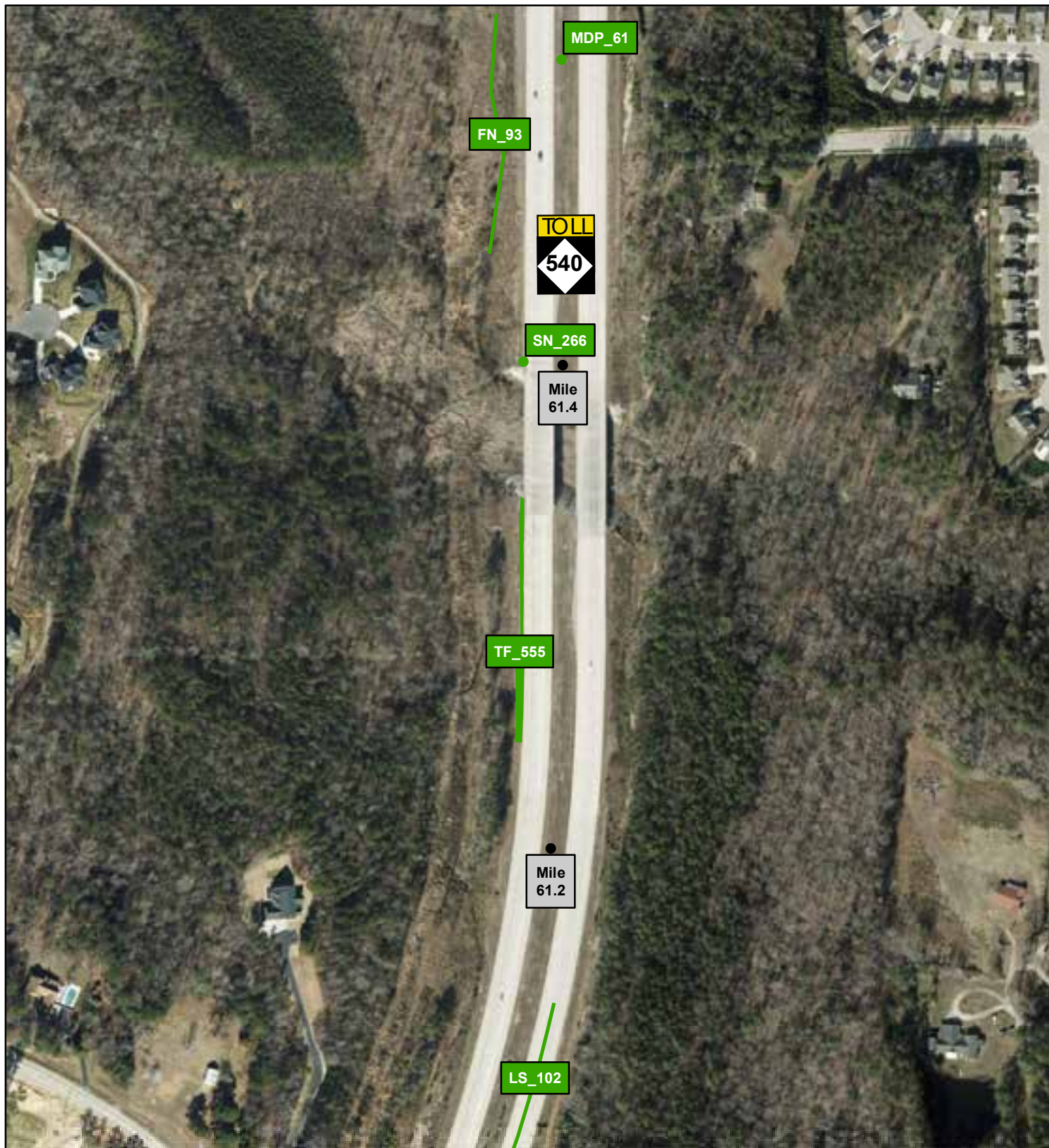


Legend



-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

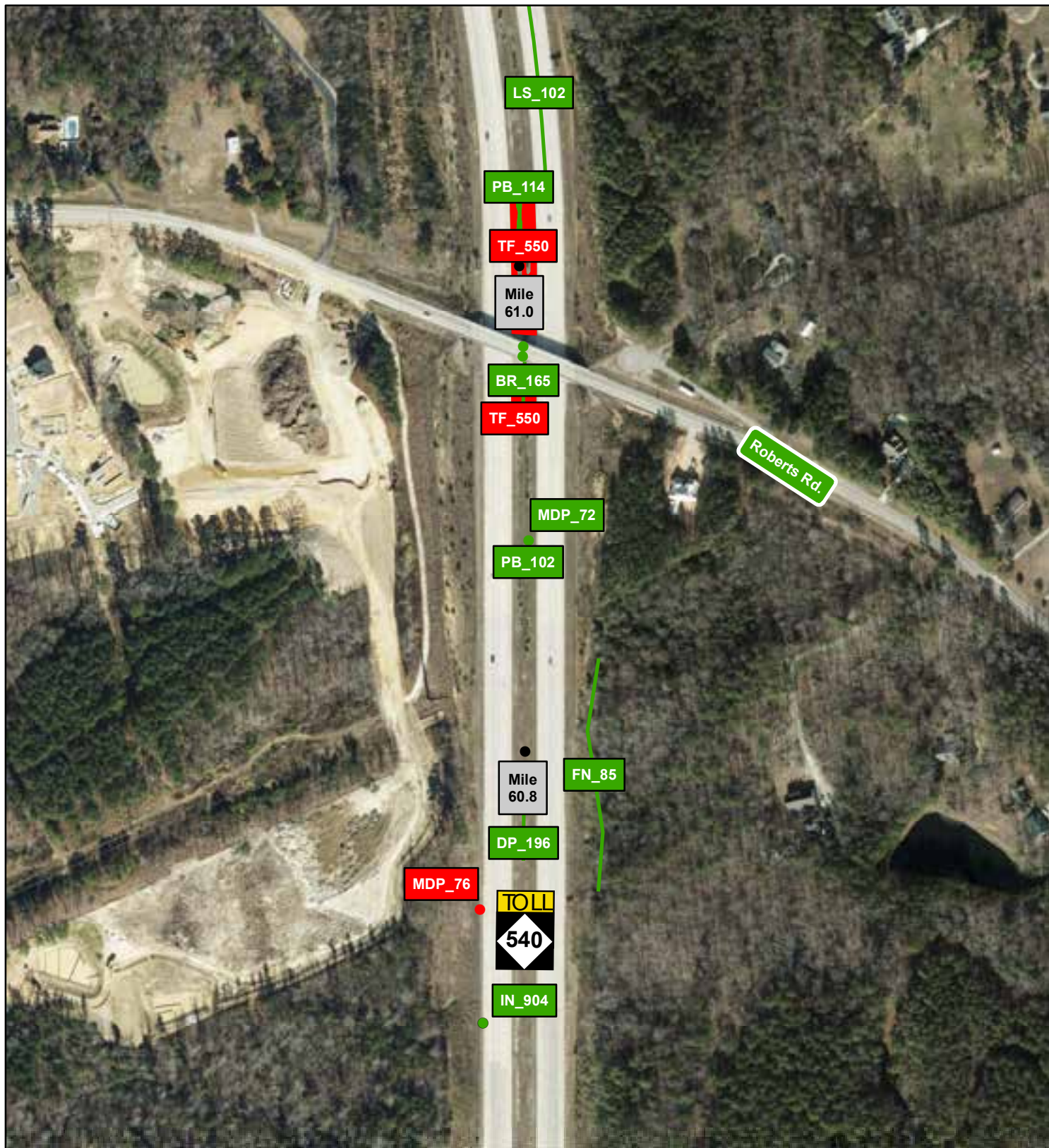


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

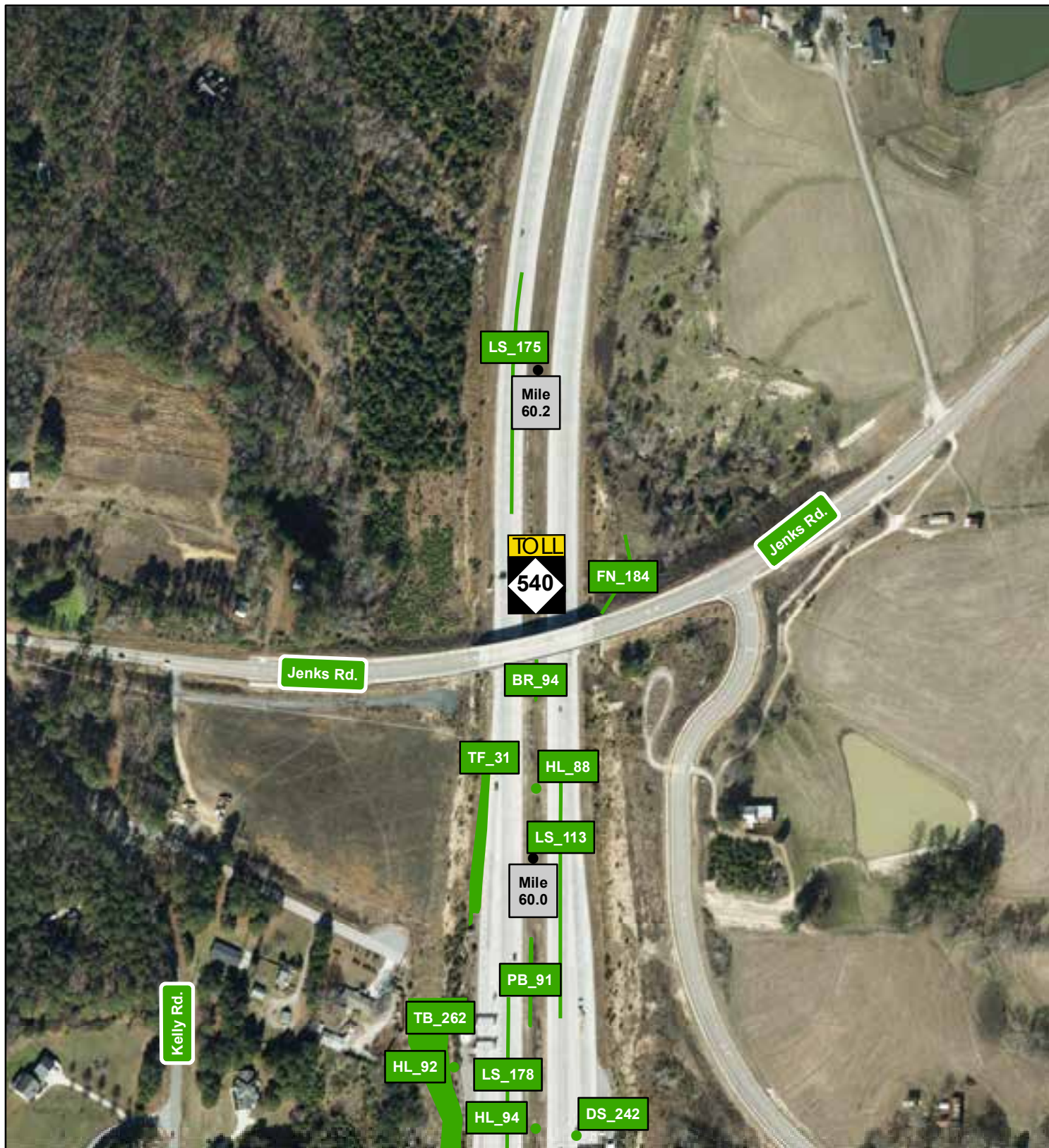


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

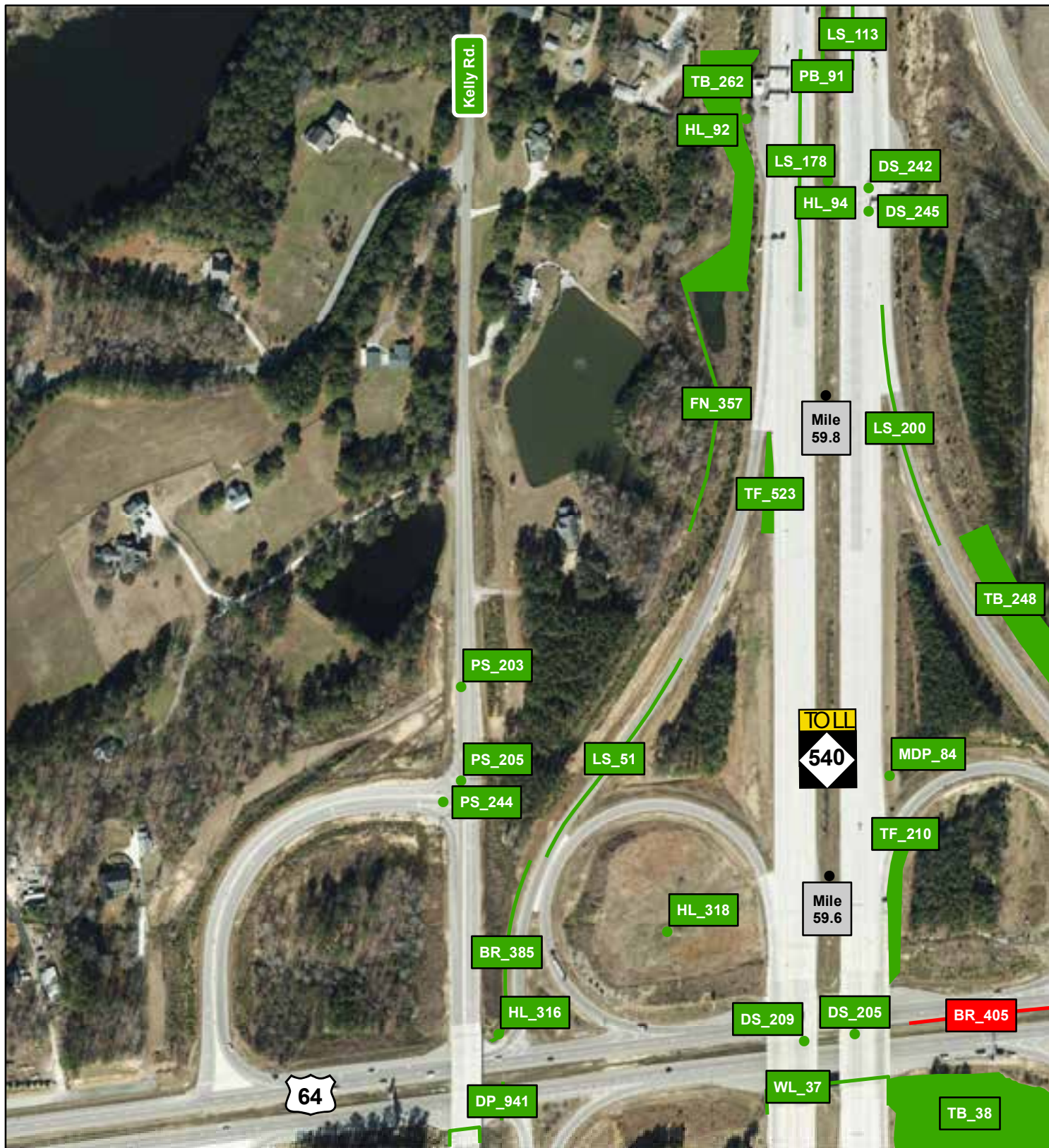


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

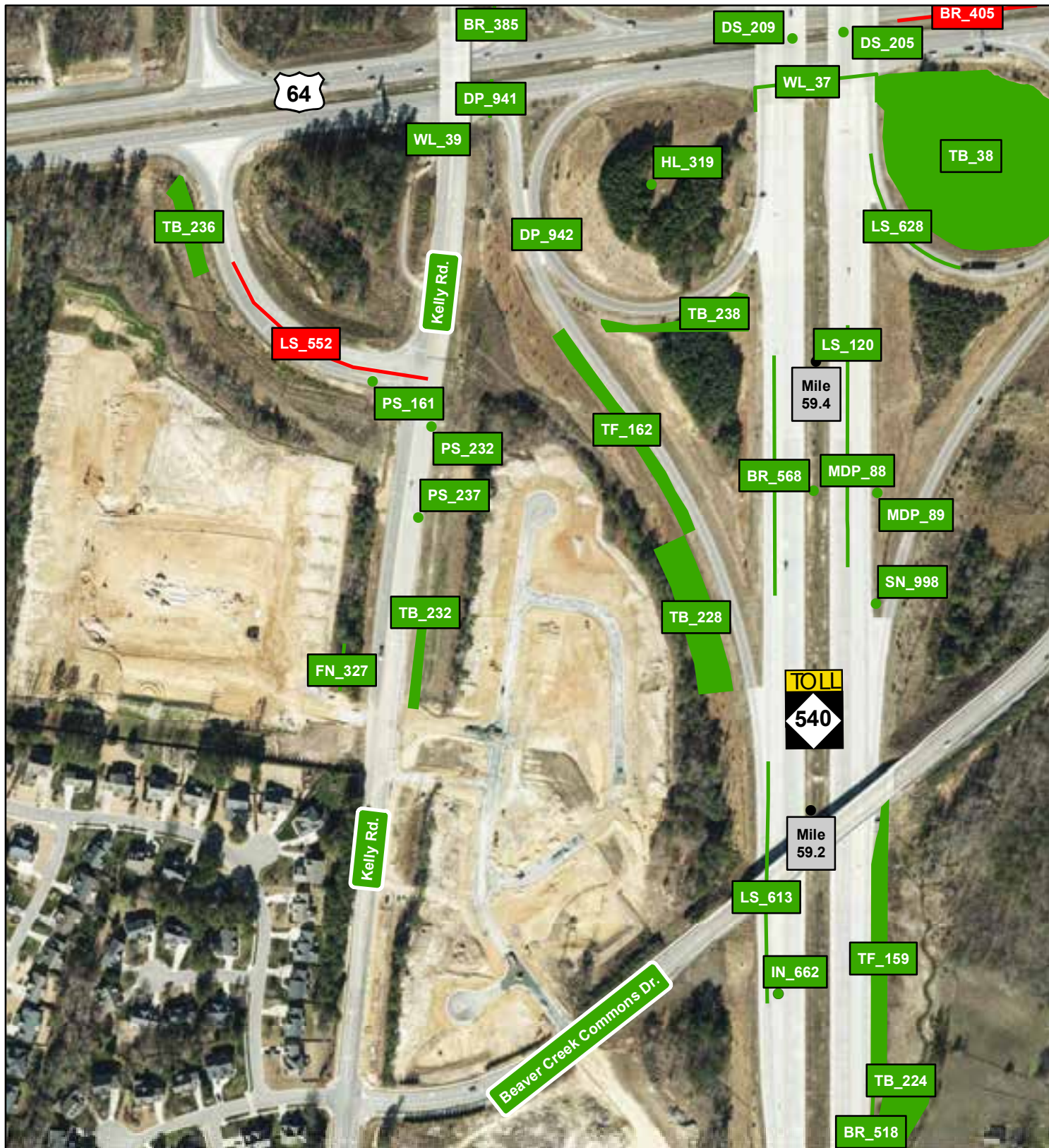


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

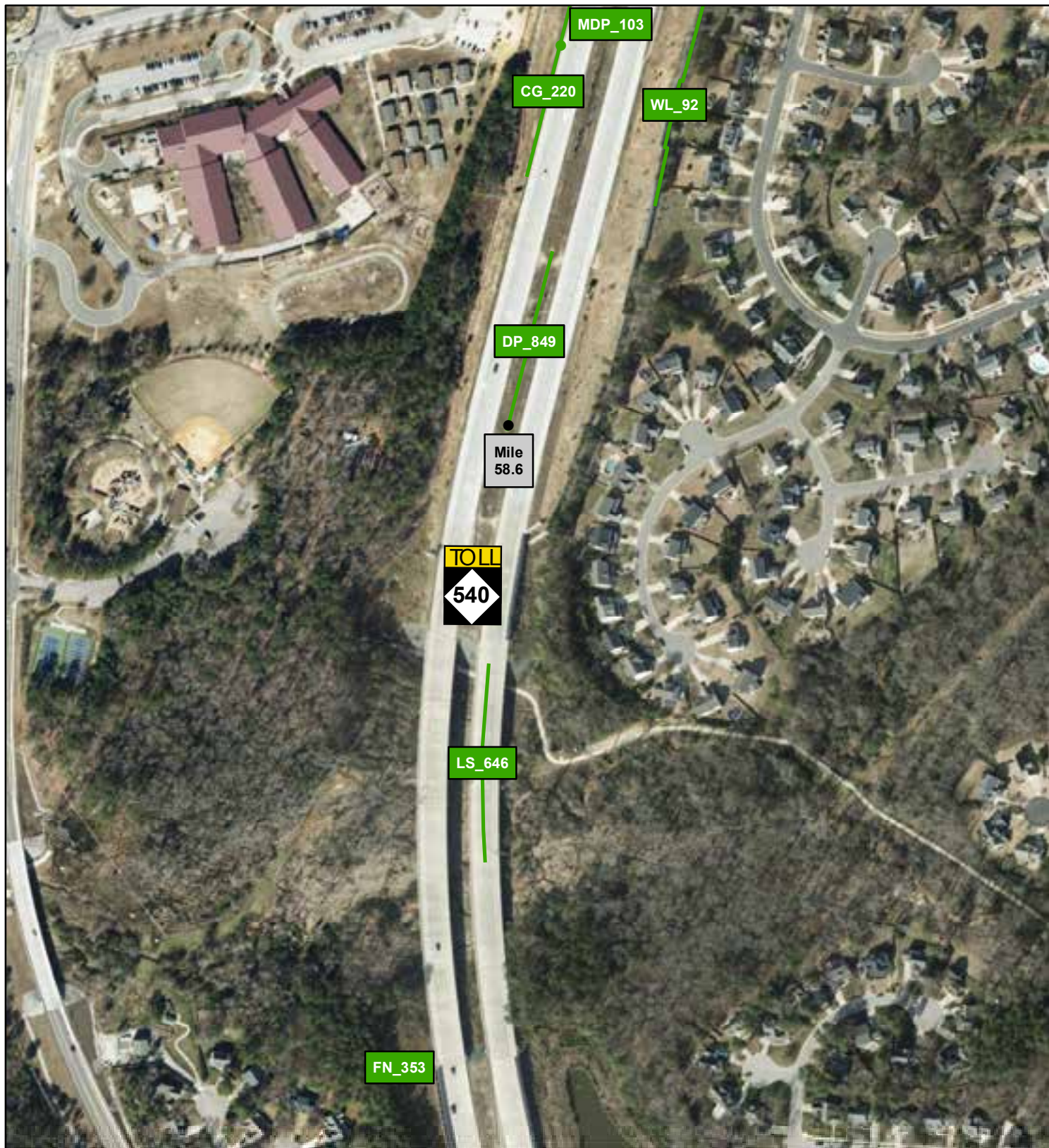


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

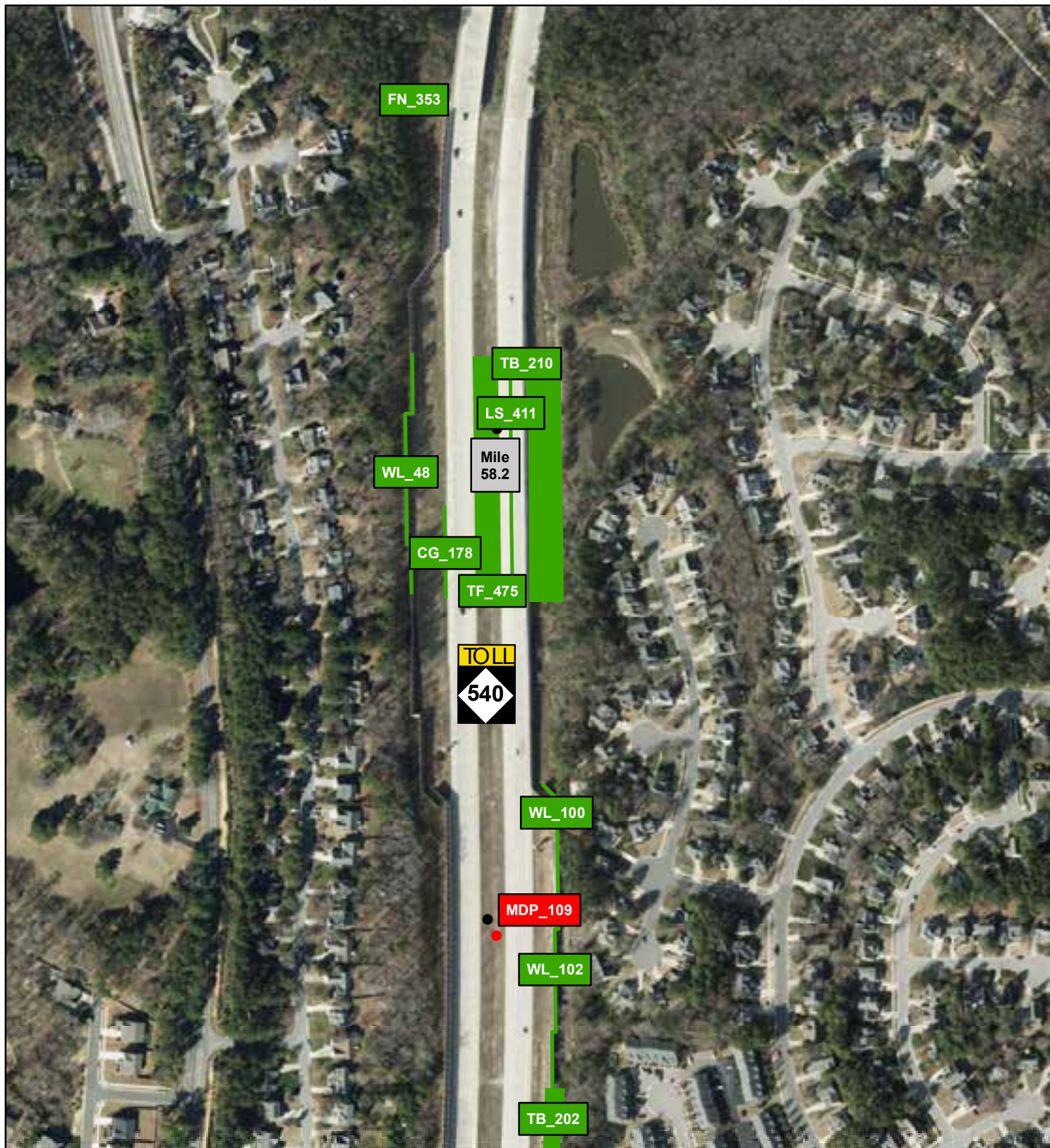


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

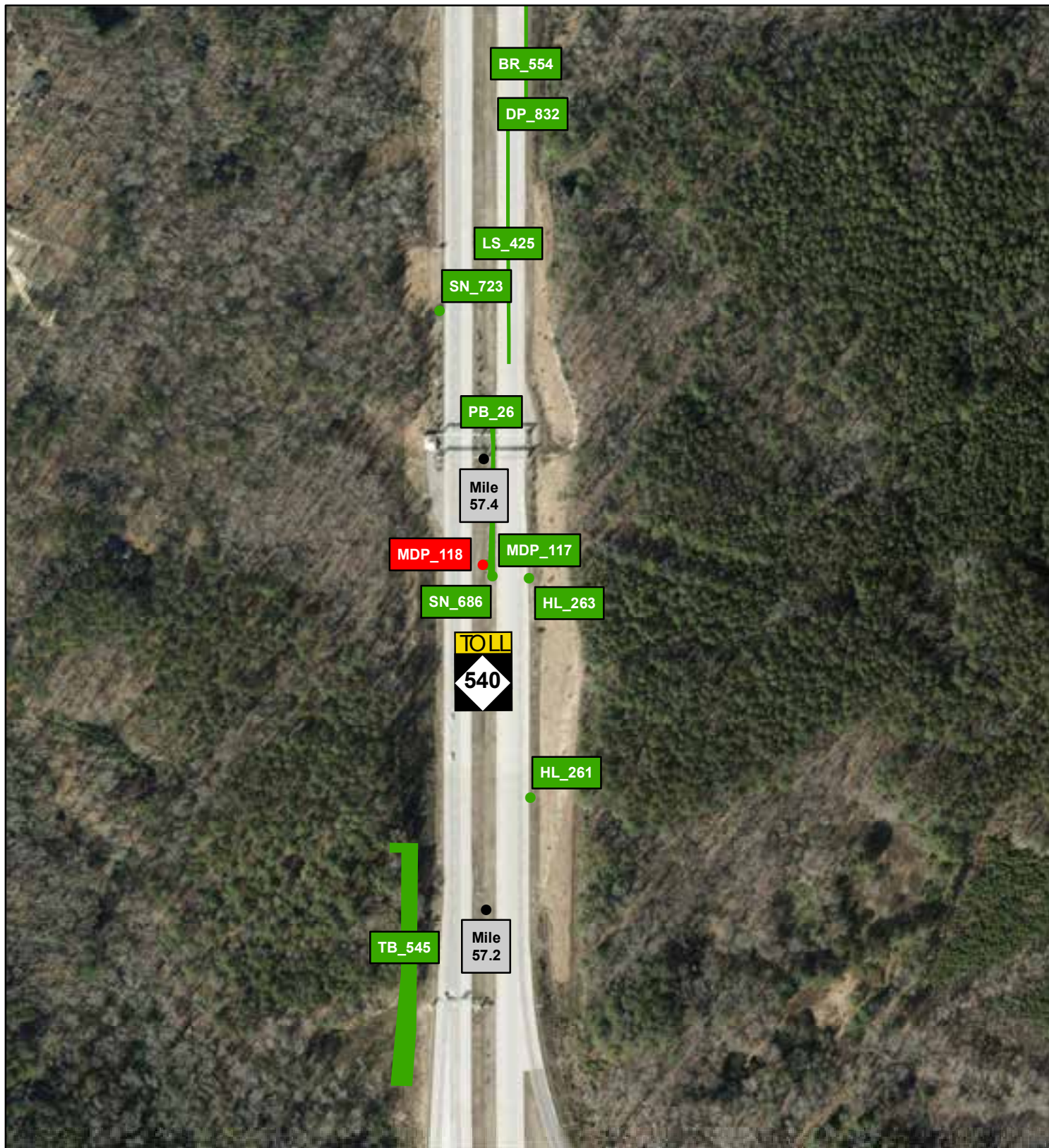


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

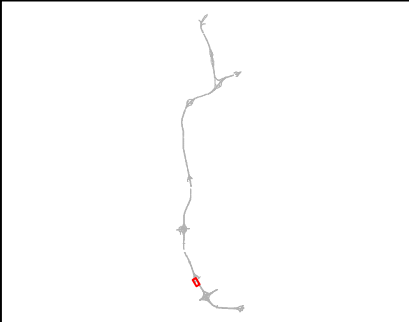


Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

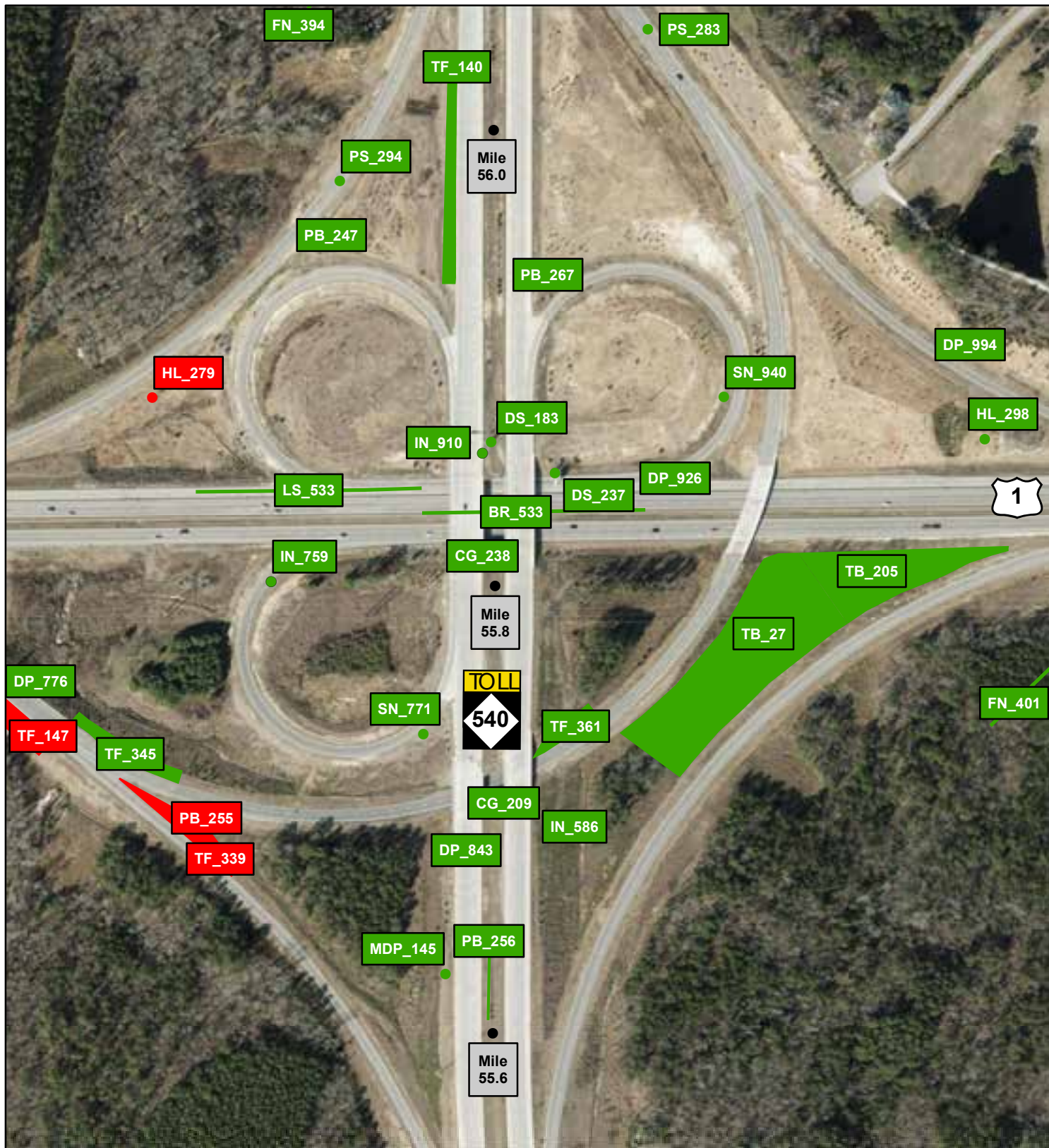


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend



-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

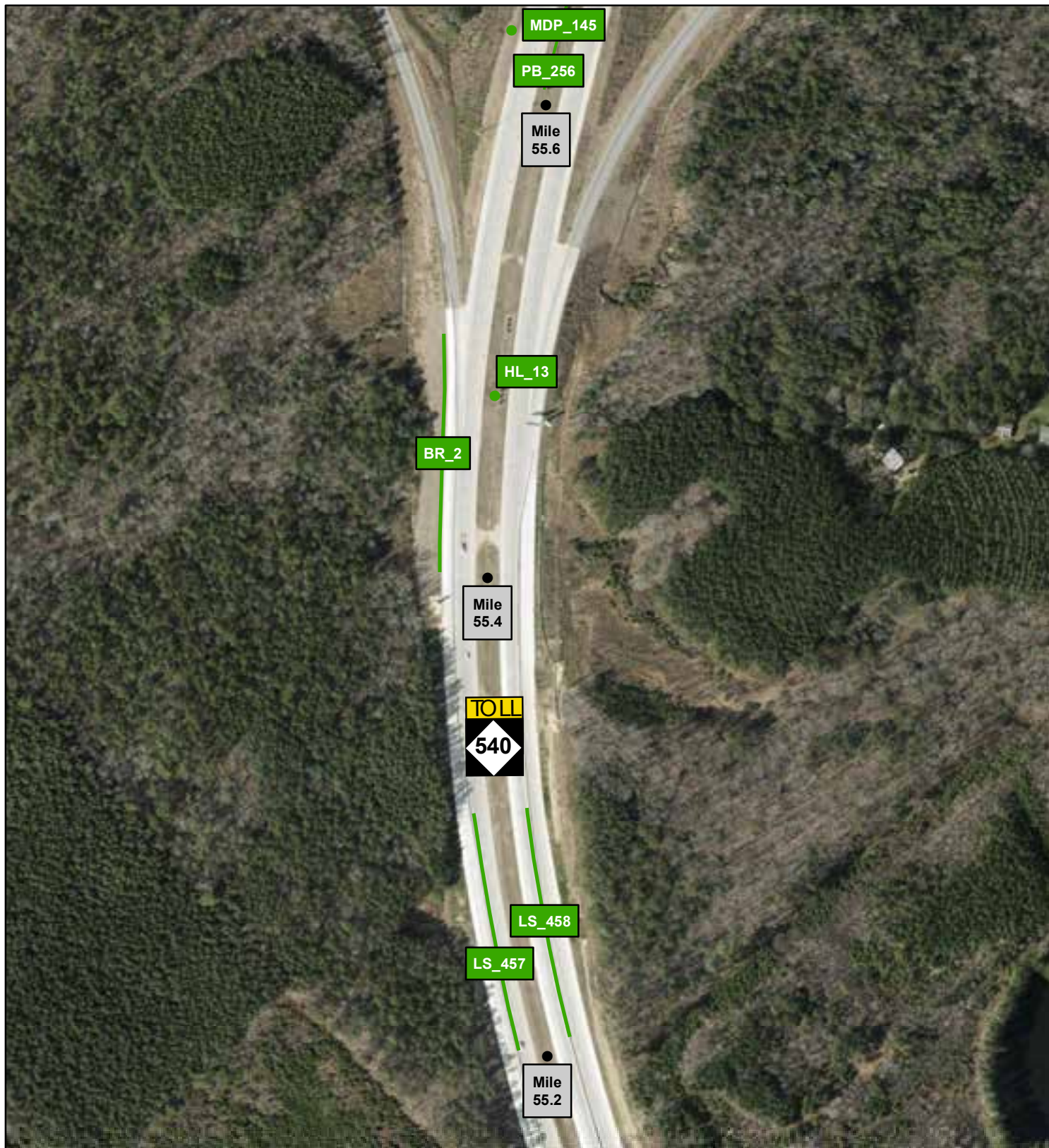


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



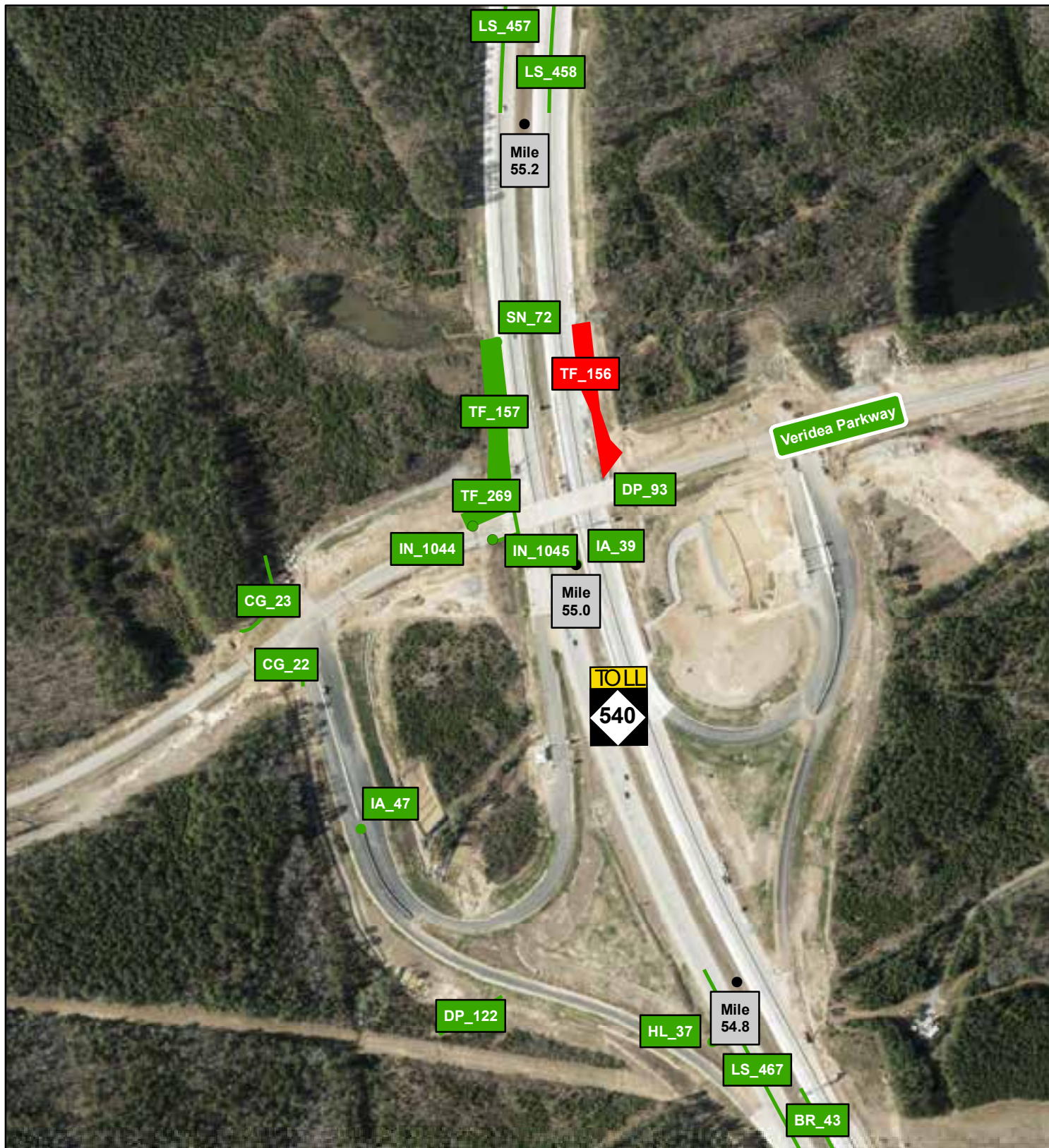
Legend

- Failing Asset
- Passing Asset



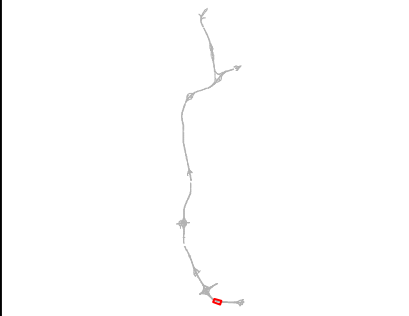
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Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

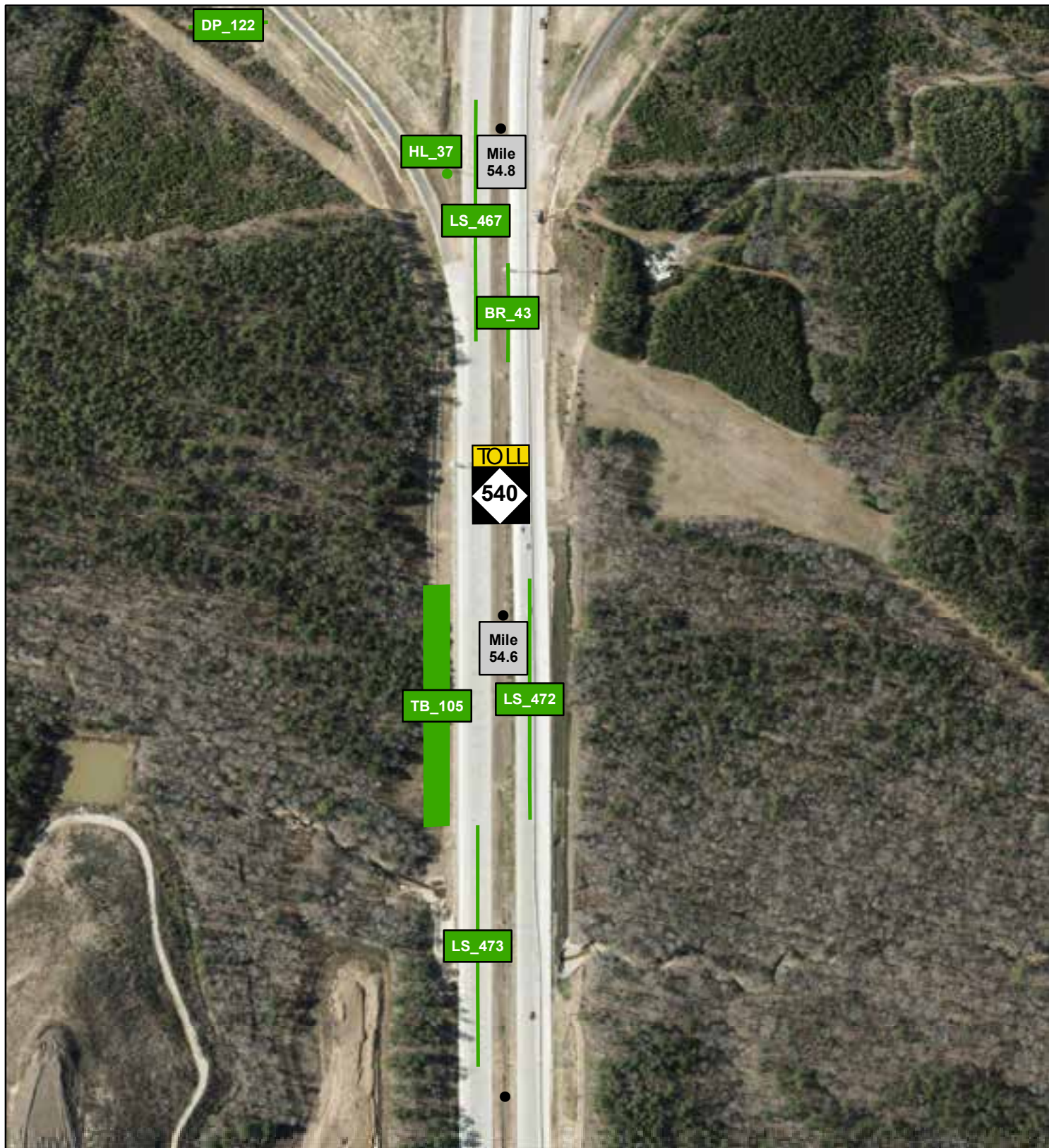


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend



-  Failing Asset
-  Passing Asset

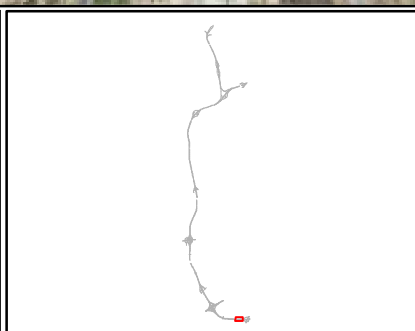


Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

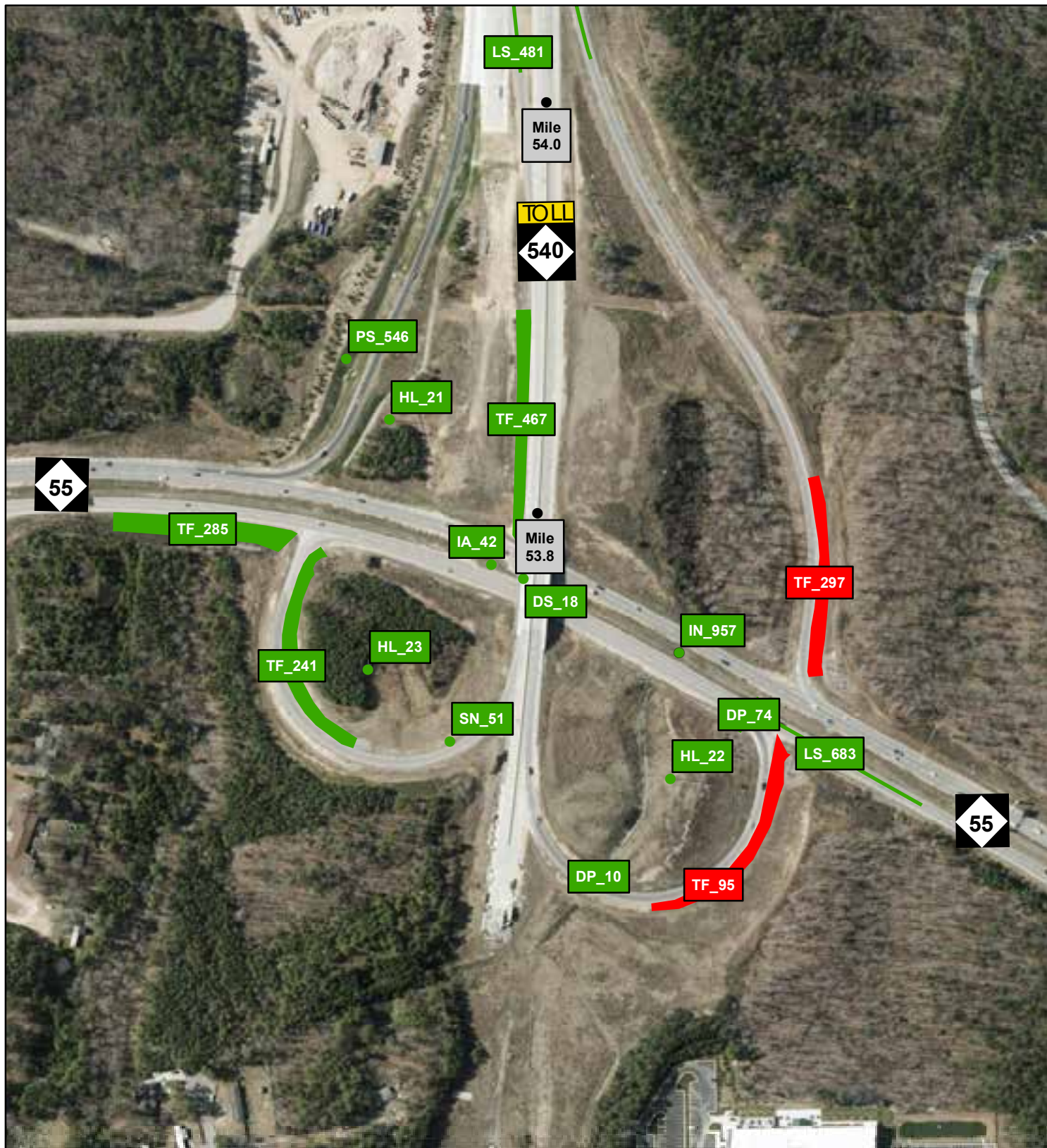


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

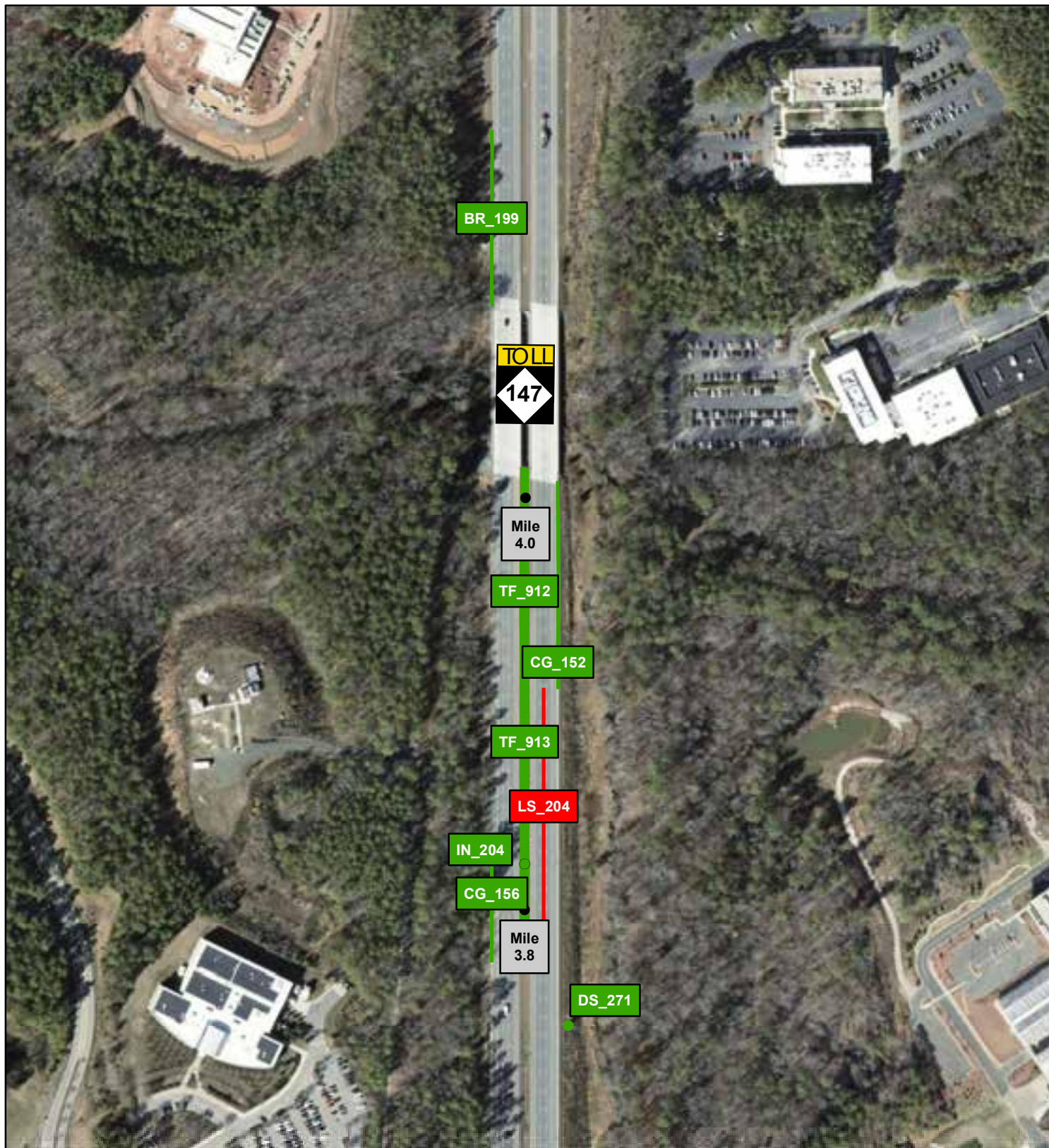


Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

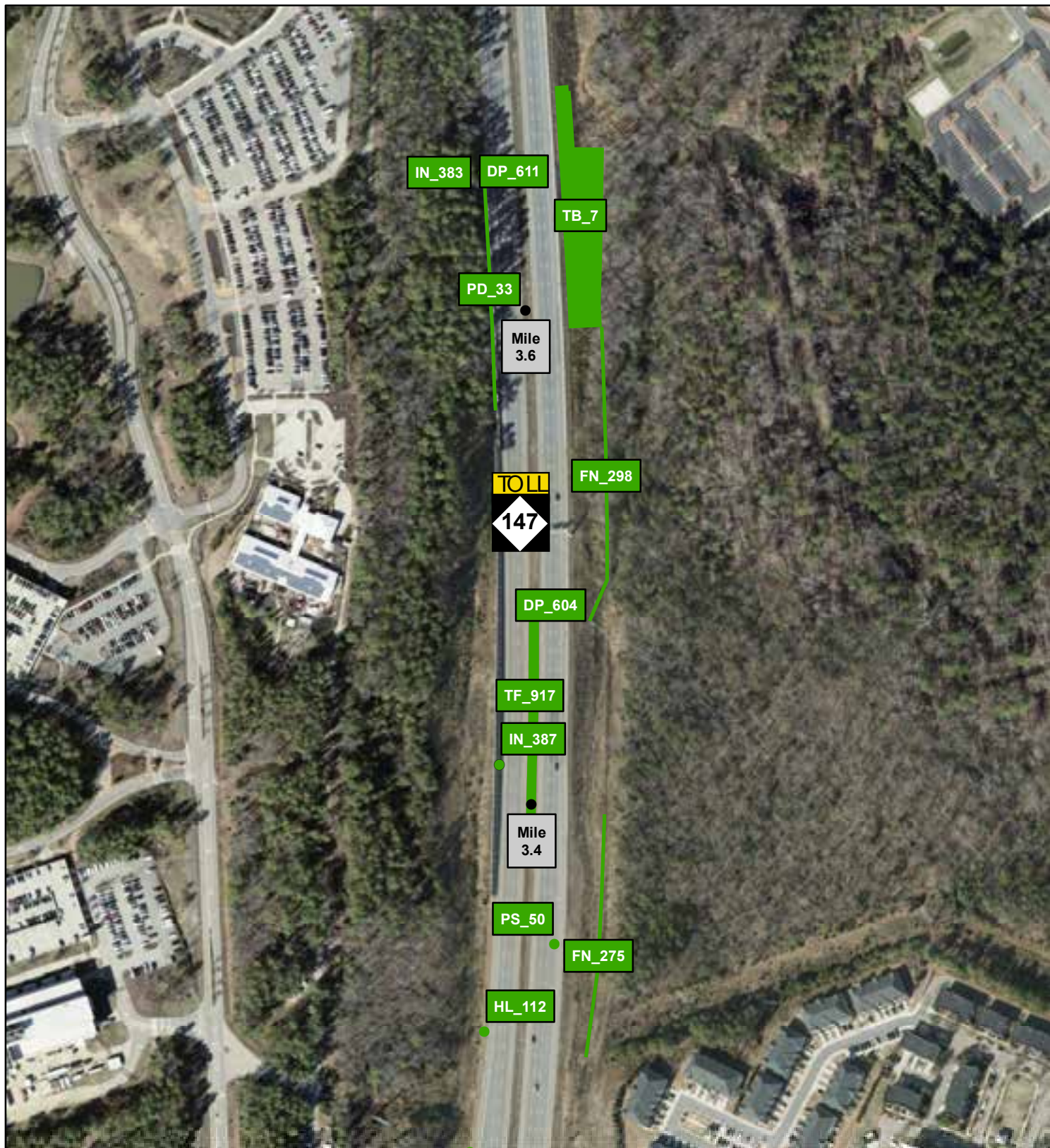


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

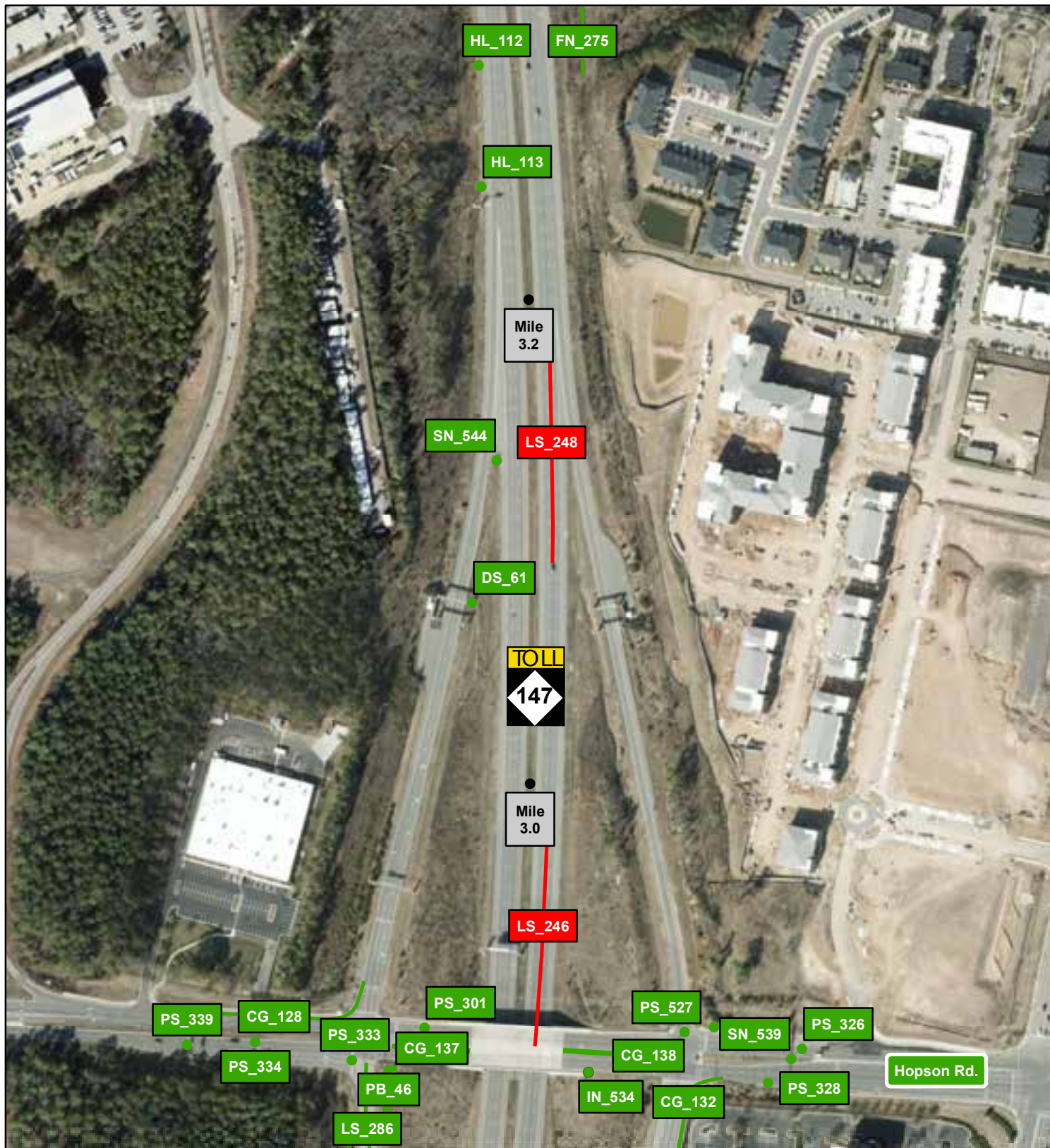


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

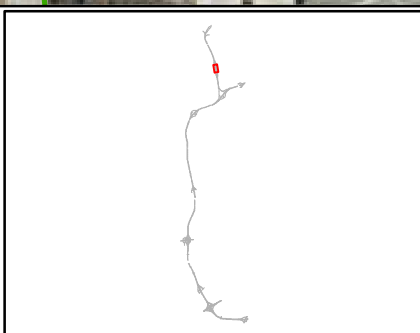


Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset







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Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

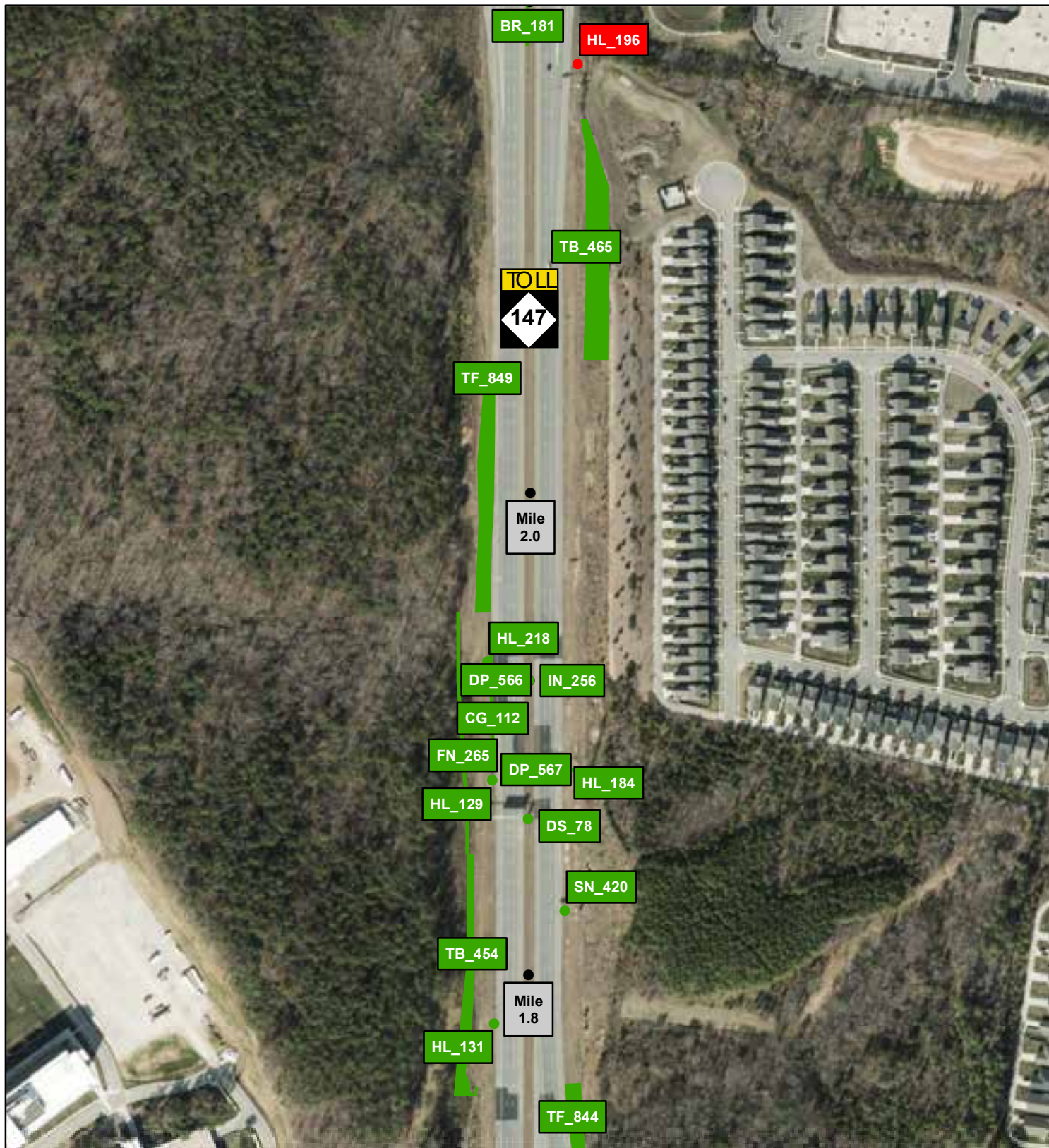


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations

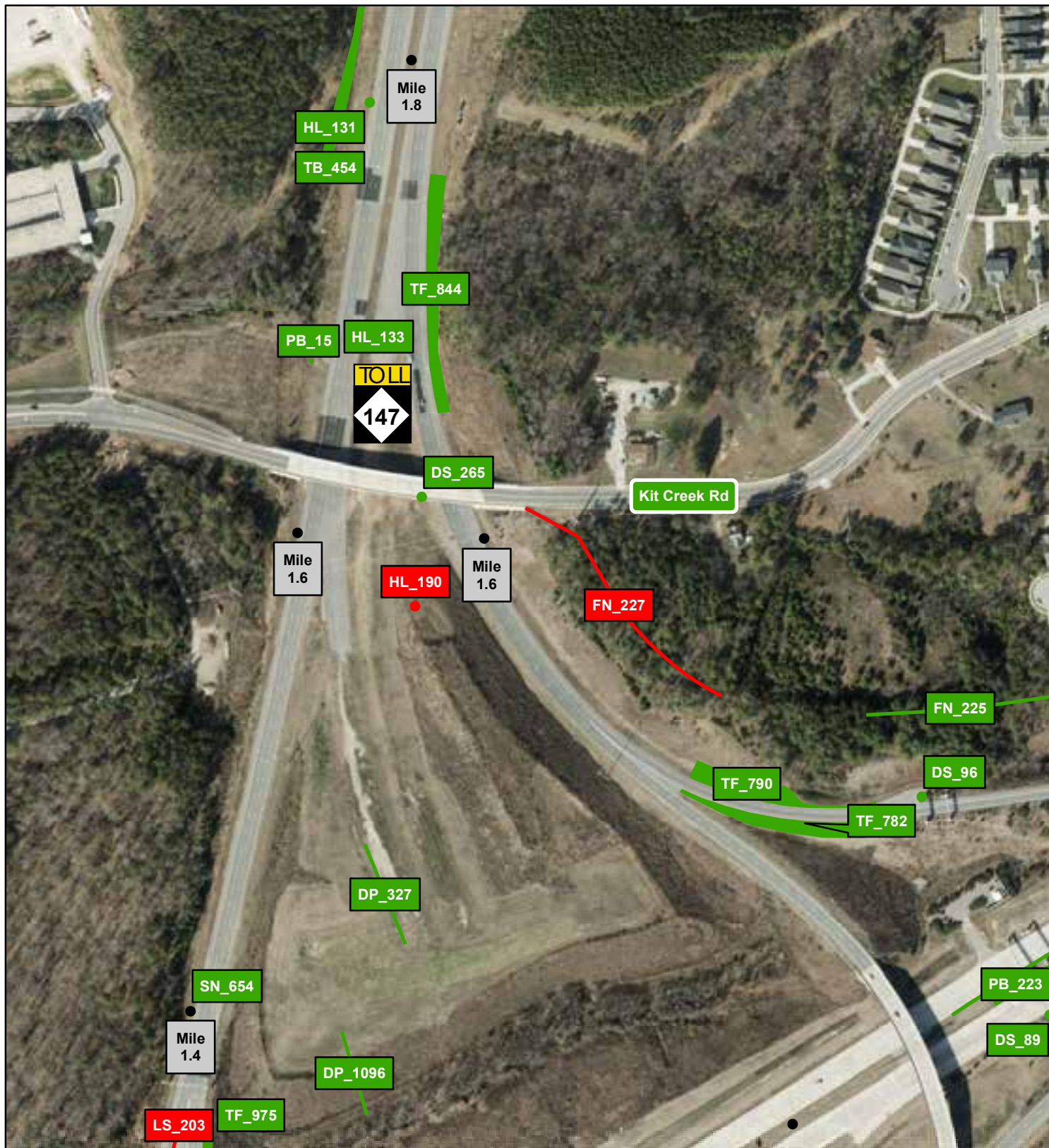


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend



- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Third Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix B

Triangle Expressway 2018 Third Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2018 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. 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)..... 8
Graffiti (GR) 9
Highway Lighting (HL) 10
Impact Attenuators (IA) 12
Inlets (IN) 13
Landscaping (PB) 14
Paved Lanes – Asphalt (LS)..... 15
Paved Lanes – Concrete (LS) 16
Paved Shoulders (LS) 17
Unpaved Shoulders (LS)..... 18
Front/Back Slopes (LS) 19
Unpaved Lateral and Outfall Ditches (LS) 20
Litter (LS)..... 21
Roadway Sweeping (LS) 22
Pavement Striping (LS)..... 23
Pavement Markers (LS)..... 24
Delineators (LS) 25
Paved Ditches (PD) 26
Pavement Words and Symbols (PS) 27
Signs (SN) 28
Tree and Brush (TB) 29
Turf Condition (TF) 30
MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL) 33

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.

Guardrail, Concrete Barrier and End Anchors (BR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Guardrail	BR_405	Functional Damage		A21, A22, A23
2	Guardrail	BR_503	Functional Damage		A34

Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Berm Gutter	CG_180	Material Accumulation		A22





Decorative Supports (DS)

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


Drainage Pipes (DP)

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

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Drain	MDP_18	Obstruction		A11
2	Shoulder Drain	MDP_27	Obstruction		A12
3	Shoulder Drain	MDP_76	Missing Rodent Screen		A19
4	Shoulder Drain	MDP_109	Missing Rodent Screen		A26

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Shoulder Drain	MDP_118	Missing Rodent Screen		A28
6	Shoulder Drain	MDP_149	Missing Rodent Screen		A29, A30

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_227	Fence Height		A3
2	Woven	FN_319	Fence Height		A22

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	High Mast	HL_121	Part Damage		A46
2	Single Roadway	HL_161	Missing Part		A3, A4
3	Single Roadway	HL_165	Part Damage		A2, A3
4	High Mast	HL_190	Part Damage		A48

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Double Roadway	HL_196	Part Damage		A46, A47
6	Single Roadway	HL_199	Missing Part		A46
7	High Mast	HL_279	Missing Part		A32, A33


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
This asset did not produce any failures.					

Landscaping (PB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Plant Bed	PB_255	Weeds		A32

Paved Lanes – Asphalt (LS)

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




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		A16
2	Asphalt	LS_544	Shoulder Drop-Off		A29
3	Asphalt	LS_552	Shoulder Drop-Off		A23

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
This asset did not produce any failures.					

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	Asphalt	LS_203	Line Missing	 A photograph showing a section of an asphalt road. A white dashed line is visible on the right side of the road, but it appears to be missing or faded in the center of the lane. The background shows some greenery and a utility pole.	A4

Pavement Markers (LS)

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

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_204	Nighttime Reflectivity	Not Available for Nighttime Failure	A42
2	Asphalt	LS_246	Nighttime Reflectivity	Not Available for Nighttime Failure	A44, A45
3	Asphalt	LS_248	Nighttime Reflectivity	Not Available for Nighttime Failure	A44
4	Asphalt	LS_259	Nighttime Reflectivity	Not Available for Nighttime Failure	A41
5	Concrete	LS_318	Nighttime Reflectivity, Missing Delineators		A2

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
This asset did not produce any failures.					

Tree and Brush (TB)

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


Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Turf	TF_83	Bare Ground		A22
2	Turf	TF_95	Bare Ground		A39
3	Turf	TF_147	Bare Ground		A32, A33
4	Turf	TF_156	Bare Ground		A36


Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_297	Bare Ground		A39
6	Turf	TF_339	Bare Ground		A32, A33
7	Turf	TF_550	Bare Ground		A19
8	Turf	TF_619	Bare Ground		A12

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Turf	TF_822	Bare Ground		A1

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

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Bridge Wall	WL_32	Paint Scale		A7, A8