



NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program

Triangle Expressway

2018 Second Quarter Report

1 S. Wilmington Street
Raleigh, NC 27601



Last Updated:
July 27, 2018

CONSULTANT CERTIFICATION OF COMPLETION

July 13, 2018

Dennis Jernigan, P.E.
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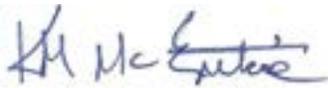
NCTA Triangle Expressway Roadway Maintenance Performance Rating Program; Q2, FY 2018 Rating

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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Maintenance Rating Program for the Triangle Expressway

Second Quarter, April – June 2018

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 Second Quarter Assessment of the Triangle Expressway.

The overall 2018 second quarter maintenance rating of the Triangle Expressway was 94.8, meeting the NCTA target rating of 90. As shown in **Table 1**, all elements assessed achieved a rating greater than the target rating of 85.

Table 1: MRP Element Results for the 2018 Second Quarter Assessment		
Element	MRP Rating	Target Rating
Road Surface	99.2	85.0
Unpaved Shoulders and Ditches	96.8	85.0
Drainage	97.3	85.0
Roadside	91.3	85.0
Traffic Control Devices	91.1 ¹	85.0
Overall MRP Performance Rating	94.8¹	90.0

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

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 91.7.

Table 2: MRP Rolling Element Results					
Element	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Rolling Rating
Road Surface	98.1	98.9	98.5	99.2	98.7
Unpaved Shoulders and Ditches	100.0	97.9	97.8	96.8	98.1
Drainage	83.2	87.6	87.7	97.3	89.0
Roadside	90.4	92.5	92.2	91.3	91.6
Traffic Control Devices	85.2	82.4	83.8	91.1 ¹	84.4 ²
Overall MRP Performance Rating	90.9	91.1	91.3	94.8¹	91.7²

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

² Excludes the second quarter rating for Pavement Striping/Marking, Characters and Symbols, and Pavement Markers characteristics.

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

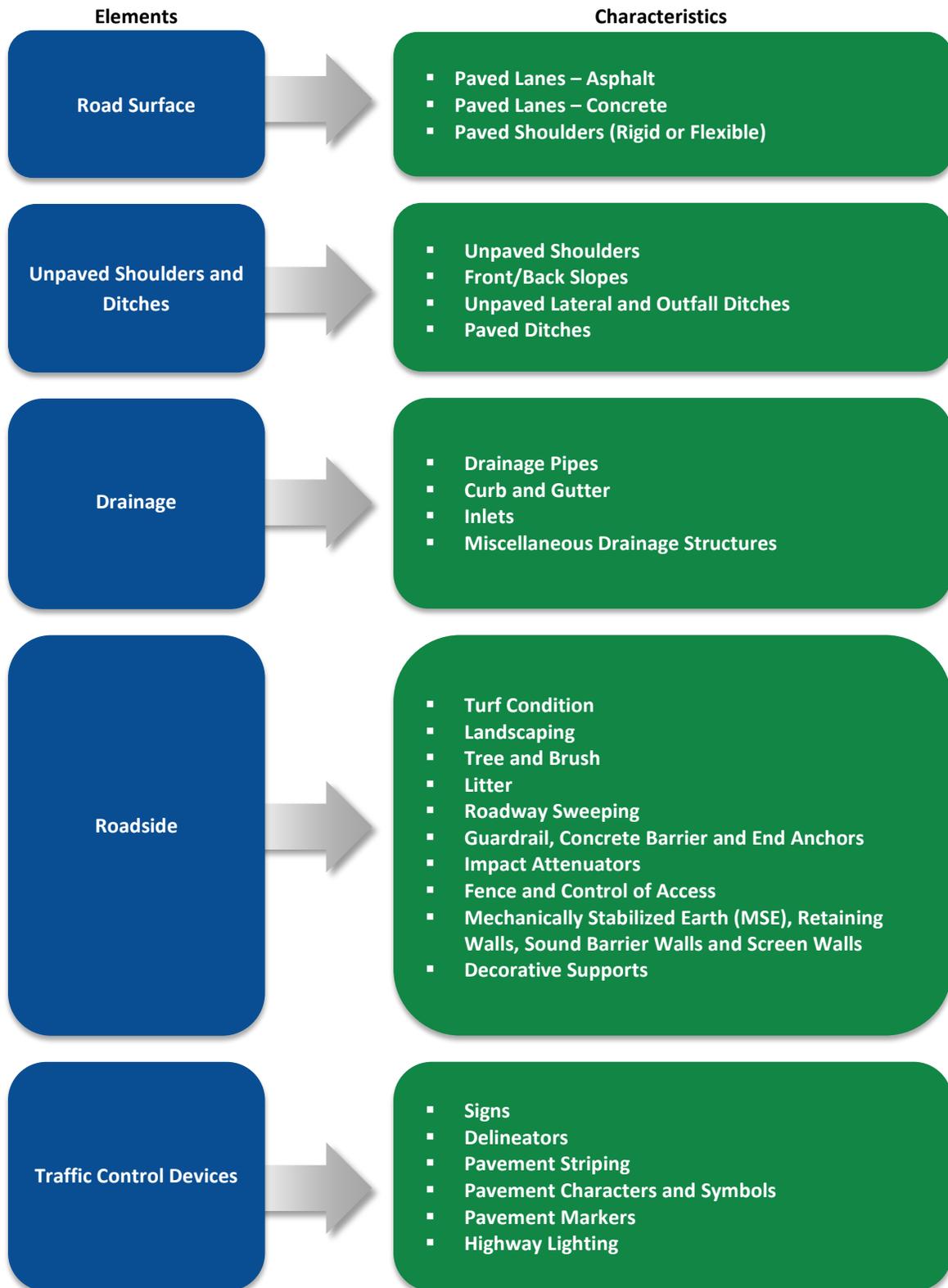
The NCTA performance standards, threshold criteria and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff and consultants.

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 all-electronic toll collection zones.

Figure 2: Triangle Expressway Map



5.0 Triangle Expressway Asset Inventory Update

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

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 Project. Additionally, other assets were added to the inventory as part of the completion of the Access 540 Project. **Table 3** presents the updated number of assets that are currently available for inspections.

Table 3: Asset Inventory		
Assets	Total Inventory	Q2 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 Second Quarter Assessment

6.1 Quarterly Results

The overall 2018 second quarter maintenance rating of the Triangle Expressway was 94.8, meeting NCTA’s target overall rating of 90. All elements assessed achieved ratings above the target rating of 85. Turf Condition (69) and Highway Lighting (78) are the characteristics that scored below the target rating of 80.

During the second quarter, NCTA led a restriping project to improve the condition of pavement striping, characters, symbols, and pavement markers on concrete surfaces throughout the Triangle Expressway. Due to this ongoing project, the Pavement Striping/Marking, Characters and Symbols, and Pavement Markers characteristics were set to only be inspected on asphalt pavement surfaces along the facility. Consequently, the rating obtained for these characteristics ignores the condition of pavement striping, characters, symbols, and pavement markers on the facility’s concrete surfaces.

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

Table 4: MRP Element Results for Q2 2018	
Element	Q2 2018 MRP Rating
Road Surface	99.2
Unpaved Shoulders and Ditches	96.8
Drainage	97.3
Roadside	91.3
Traffic Control Devices	91.1 ¹
Overall MRP Performance Rating	94.8¹

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

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Table 5: MRP Characteristic Results for Q2 2018						
Road Surface	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Paved Lanes Asphalt	20	20	9	180	180	100
Paved Lanes Concrete	24	24	9	216	216	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	Q2 Rating
Unpaved Shoulder	42	44	9	378	396	95
Front/Back Slopes	42	44	6	252	264	95
Lateral and Outfall Ditches, Unpaved	44	44	6	264	264	100
Ditches, Paved	2	2	5	10	10	100
Element Total				904	934	96.8
Drainage	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Drainage Pipes	34	34	7	238	238	100
Curb and Gutter	28	29	6	168	174	97
Inlets	33	34	7	231	238	97
Misc. Drainage Structure	29	31	4	116	124	94
Element Total				753	774	97.3
Roadside	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Turf Condition	43	62	7	301	434	69
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	30	31	9	270	279	97
Impact Attenuators	11	11	9	99	99	100
Fence, Control Access	32	34	7	224	238	94
Retaining Walls and Sound Barrier Walls	15	16	5	75	80	94
Decorative Supports	24	27	5	120	135	89
Graffiti and Stain Removal	44	44	4	176	176	100
Element Total				1881	2061	91.3
Traffic Control Devices	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Signs	36	37	7	252	259	97
Delineators	36	38	3	108	114	95
Pavement Striping/Marking	20	20	8	160	160	100 ¹
Characters and Symbols	28	31	7	196	217	90 ¹
Pavement Markers	19	20	9	171	180	95 ¹
Highway Lighting	39	50	6	234	300	78
Element Total				1121	1230	91.1¹

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

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 second quarter, all elements exceeded NCTA's threshold criteria of 85. Traffic Control Devices (91.1) experienced an increase in rating by over 7 points. However, it should be noted that this element's second quarter rating excludes the condition of all pavement striping, characters, symbols, and pavement markers on concrete pavement surfaces due to the restriping project. Road Surface (99.2) and Unpaved Shoulder/Ditches (96.8) continued to obtain ratings higher than 95, while Roadside (91.3) obtained a rating just above 90. During this quarter, Drainage (97.3) also experienced an increase in rating of over 9 points. This increase is mostly attributed to a significant improvement on the condition of shoulder underdrains.

Characteristics

This quarter all but two characteristics, Turf Condition (69) and Highway Lighting (78) met the NCTA target threshold criteria of 80. A description of the characteristics' conditions and future work planning recommendations are provided below. Pictures of all characteristic failures are included in **Appendix B**.

Turf Condition (69 rating – 19 of the 62 assets failed). All 19 turf areas that did not pass the inspection had bare ground conditions. Two of these turf areas are presented in **Figure 3**.

Figure 3: Turf Areas



To improve the Turf Condition rating, it is recommended that the maintenance provider follow an aggressive schedule for seeding and fertilization cycles of bare ground areas throughout the rest of the summer season. 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 and follow the maintenance program pursuant to the NCTA Roadway and Facility Maintenance Standards V4 for turf maintenance, copied below.

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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:
 - 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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Highway Lighting (78 rating – 11 of the 50 assets failed). Out of the 11 highway lights that did not pass inspection, 7 had functional damage, 3 had damaged parts, and 1 had missing parts. Two of these highway lights are presented in **Figure 4**.

Figure 4: Highway Lighting



All highway lighting fixtures on Triangle Expressway have been scheduled to be replaced with LED fixtures starting in June 2018. This work is part of the new NCDOT lighting maintenance contract that would transfer the responsibility of lighting functionality maintenance to a private maintenance provider for the next 15 years. Therefore, starting in July 2018 lighting functionality will no longer be part of the NCTA MRP; highway lights will only be assessed for missing or damaged parts.

To increase future highway lighting ratings, it is recommended that all damaged highway lights noted during the inspection be repaired and/or replaced in accordance with the *NCTA Roadway and Facility Maintenance Standards V4*, referenced below. Additional care should be taken to ensure all access panels are properly secured to prevent rodent and other animal intrusion.

Highway Lighting Maintenance Program Standards:

- 1) Perform night patrol once a month and identify any outages. A monthly “Lighting Outage Report” shall be submitted by the maintenance provider to the NCTA by the 30th of each month. All bulb outages must be replaced within 48 hours.
Note: This maintenance standard will become part of the new NCDOT highway lighting contract. The maintenance provider will be responsible for it starting in July 2018.
- 2) Perform cleaning of glassware at the same time as any routine maintenance function or diagnostic action is performed.
Note: This maintenance standard will become part of the new NCDOT highway lighting contract. The maintenance provider will be responsible for it starting in July 2018.
- 3) Replace any light poles damaged by traffic within 5 days or within 14 days if any foundations need pouring.

Maintenance Rating Program for the Triangle Expressway

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Highway Lighting Maintenance and Evaluation Standards:

Highway and Sign Lighting do not meet the maintenance standards when any of the following criteria is observed:

- 1) Any electrical inspection plate, access panel cover, exposed electrical wire, or pull box cover are not properly secured in place.
- 2) More than 10% of the total luminaries are not functioning during nighttime observation.
Note: This evaluation criteria will be removed from the maintenance program standards in July 2018.
- 3) More than 10% of the poles are damaged or missing.
- 4) Rodent screen protection is not in place.

7.0 Current Rolling MRP Rating

The rolling maintenance rating of the Triangle Expressway was 91.7, exceeding NCTA's target overall rating of 90. Most elements assessed exceeded the target rating of 85. Traffic Control Devices (84.4) was the only element that received a rolling rating lower than 85. This is mostly attributed to the low rolling rating obtained for Highway Lighting and the low ratings obtained for Pavement Striping/Marking during the past three quarters. These characteristics were two of four that did not meet the target characteristic rolling rating of 80. Ratings for Miscellaneous Drainage Structure, Turf Condition, Pavement Marking, and Highway Lighting were 75, 79, 78, and 69, 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 the overall rolling rating and the rolling rating for Traffic Control Devices excludes the second quarter ratings obtained for the Pavement Striping/Marking, Characters and Symbols, and Pavement Marker characteristics due to the restriping project.

Table 6: MRP Rolling Element Results					
Element	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Rolling Rating
Road Surface	98.1	98.9	98.5	99.2	98.7
Unpaved Shoulders and Ditches	100.0	97.9	97.8	96.8	98.1
Drainage	83.2	87.6	87.7	97.3	89.0
Roadside	90.4	92.5	92.2	91.3	91.6
Traffic Control Devices	85.2	82.4	83.8	91.1 ¹	84.4 ²
Overall MRP Performance Rating	90.9	91.1	91.3	94.8¹	91.7²

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

² Excludes the second quarter rating for Pavement Striping/Marking, Characters and Symbols, and Pavement Markers characteristics.

Maintenance Rating Program for the Triangle Expressway

Second Quarter, April – June 2018

Table 7: MRP Rolling Characteristic Results					
Road Surface	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Rolling Rating
Paved Lanes Asphalt	100	100	95	100	98
Paved Lanes Concrete	100	100	100	100	100
Paved Shoulder	95	97	100	98	98
Element Total	98.1	98.9	98.5	99.2	98.7
Unpaved Shoulders and Ditches	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Q2 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	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Rolling Rating
Drainage Pipes	97	94	91	100	96
Curb and Gutter	88	79	90	97	89
Inlets	74	94	97	97	90
Misc. Drainage Structure	71	74	59	94	75
Element Total	83.2	87.6	87.7	97.3	89.0
Roadside	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Rolling Rating
Turf Condition	80	84	79	69	79
Landscaping	88	88	100	96	93
Trees and Brush	100	100	100	100	100
Litter	97	100	100	100	99
Roadway Sweeping	100	97	100	100	99
Guardrail, Concrete Barrier and End Anchors	94	100	90	97	95
Impact Attenuators	100	100	100	100	100
Fence, Control Access	87	90	91	94	91
Retaining Walls and Sound Barrier Walls	75	73	88	94	83
Decorative Supports	96	100	92	89	94
Graffiti and Stain Removal	100	100	100	100	100
Element Total	90.4	92.5	92.2	91.3	91.6
Traffic Control Devices	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Q2 2018 Rating	Rolling Rating
Signs	86	89	97	97	92
Delineators	94	80	100	95	93
Pavement Striping/Marking	87	68	77	100 ¹	78 ²
Characters and Symbols	93	90	90	90 ¹	91 ²
Pavement Markers	95	97	84	95 ¹	91 ²
Highway Lighting	60	68	68	78	69
Element Total	85.2	82.4	83.8	91.1¹	84.4³

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

² Excludes the second quarter ratings

³ Excludes the second quarter rating for Pavement Striping/Marking, Characters and Symbols, and Pavement Markers 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. 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. During the second quarter, Town of Cary and NCTA reached an agreement to remove the sign located at the intersection of Green Level Church Road and Green Level West Road from the inventory. Therefore, as of June 2018 both agencies are now only responsible for maintaining three Green Level Historic District signs.

8.1 Analysis and Recommendations

As part of each quarterly inspection, an assessment team visits the Green Level Historic District signs to conduct a visual inspection of each sign and ensure they are in good standing. During this quarter, 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 two of these signs.

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



9.0 Conclusion

This report presents the 2018 second quarter rating assessment of the Triangle Expressway. The NCTA's target ratings are 90 overall, 85 for elements, and 80 for characteristics. The second quarter 2018 overall rating was **94.8** and the rolling rating was **91.7**, both ratings met the target rating of 90.

All second quarter element ratings met or exceeded the target rating of 85. However, only one of five rolling element ratings did not meet the target rating. Traffic Control Devices only obtained a rolling rating of 84.4. Additionally, during the second quarter assessment two characteristics did not meet the target rating of 80. These characteristics are Turf (69) and Highway Lighting (78). Also, during the cumulative rolling assessment Miscellaneous Drainage Structure, Turf Condition, Pavement Striping/Making, and Highway Lighting did not meet the target rating of 80, obtaining a rating of 75, 79, 78, and 69, 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. It is also recommended that the maintenance provider repair and/or replace all defects in highway lights. Additionally, the pavement striping/marking replacement cycle should be completed as scheduled, and soil scarification and bare areas seeding/fertilization efforts should also continue during the summer season to promote new turf growth.

All Green Level Historic District signs inspected during the second 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

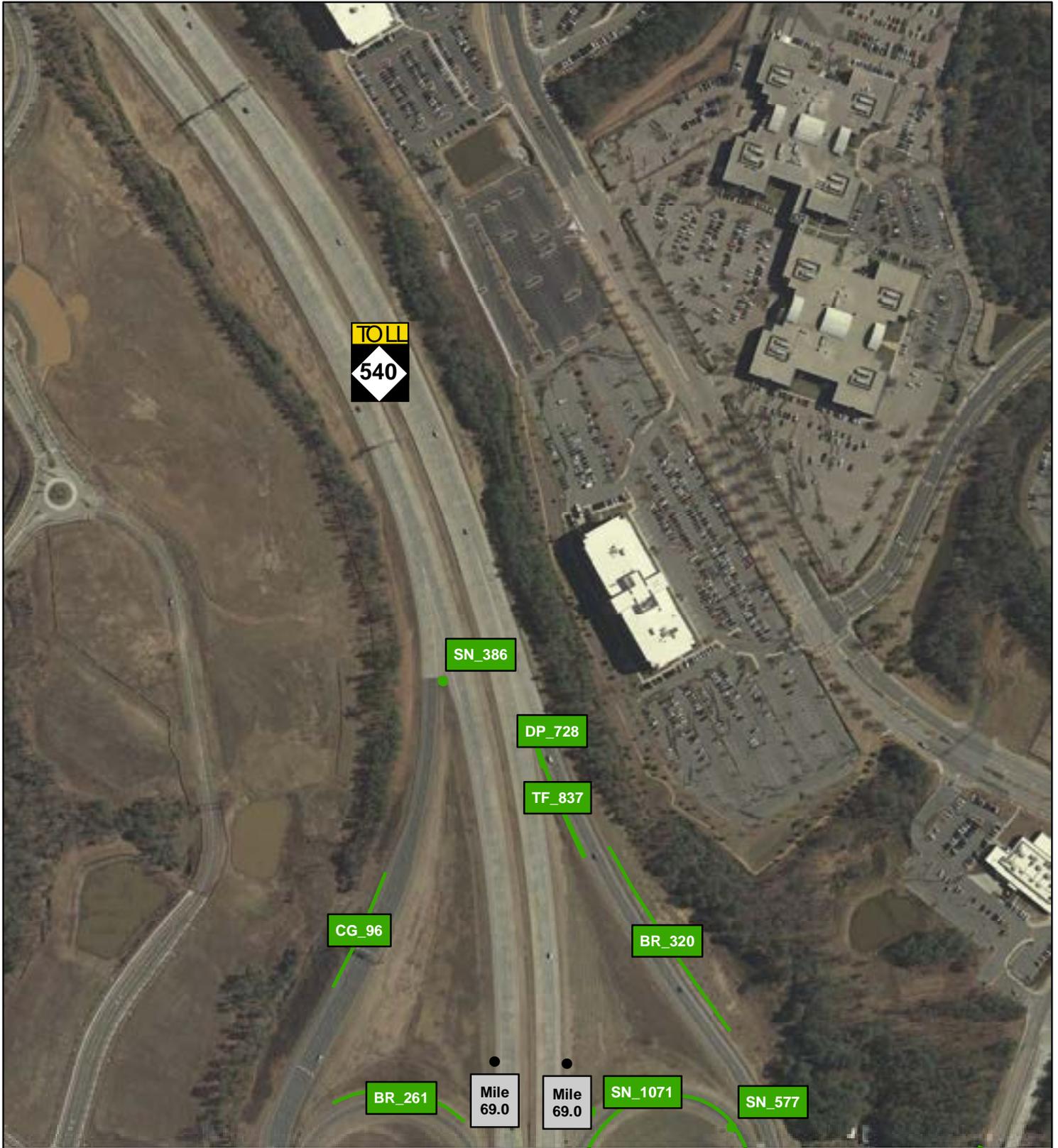
Triangle Expressway 2018 Second Quarter Asset Assessment Locations

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

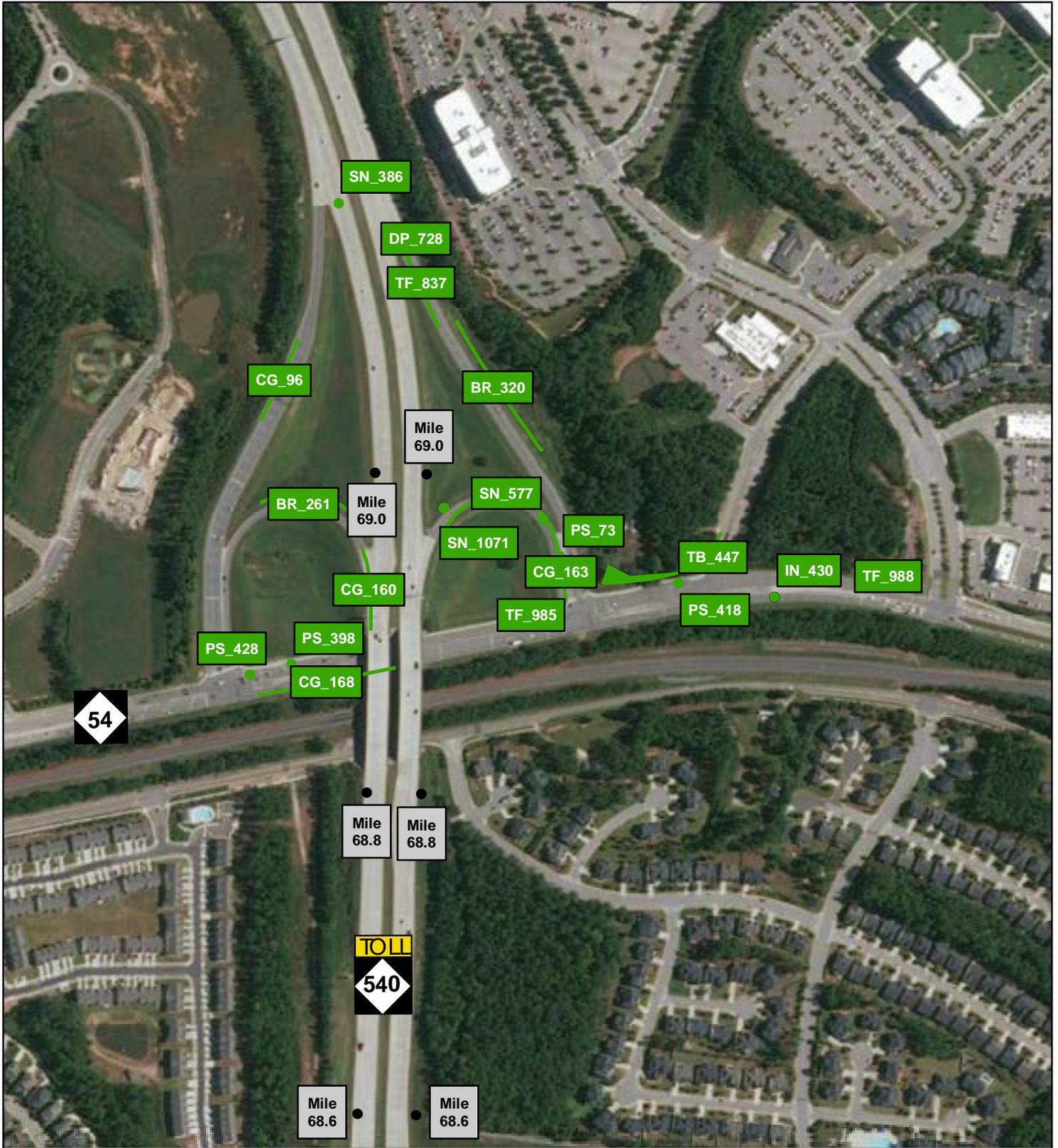


Legend

-  Failing Asset
-  Passing Asset

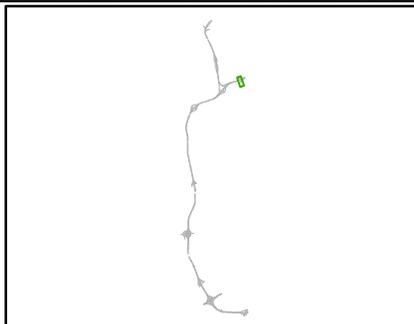


Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

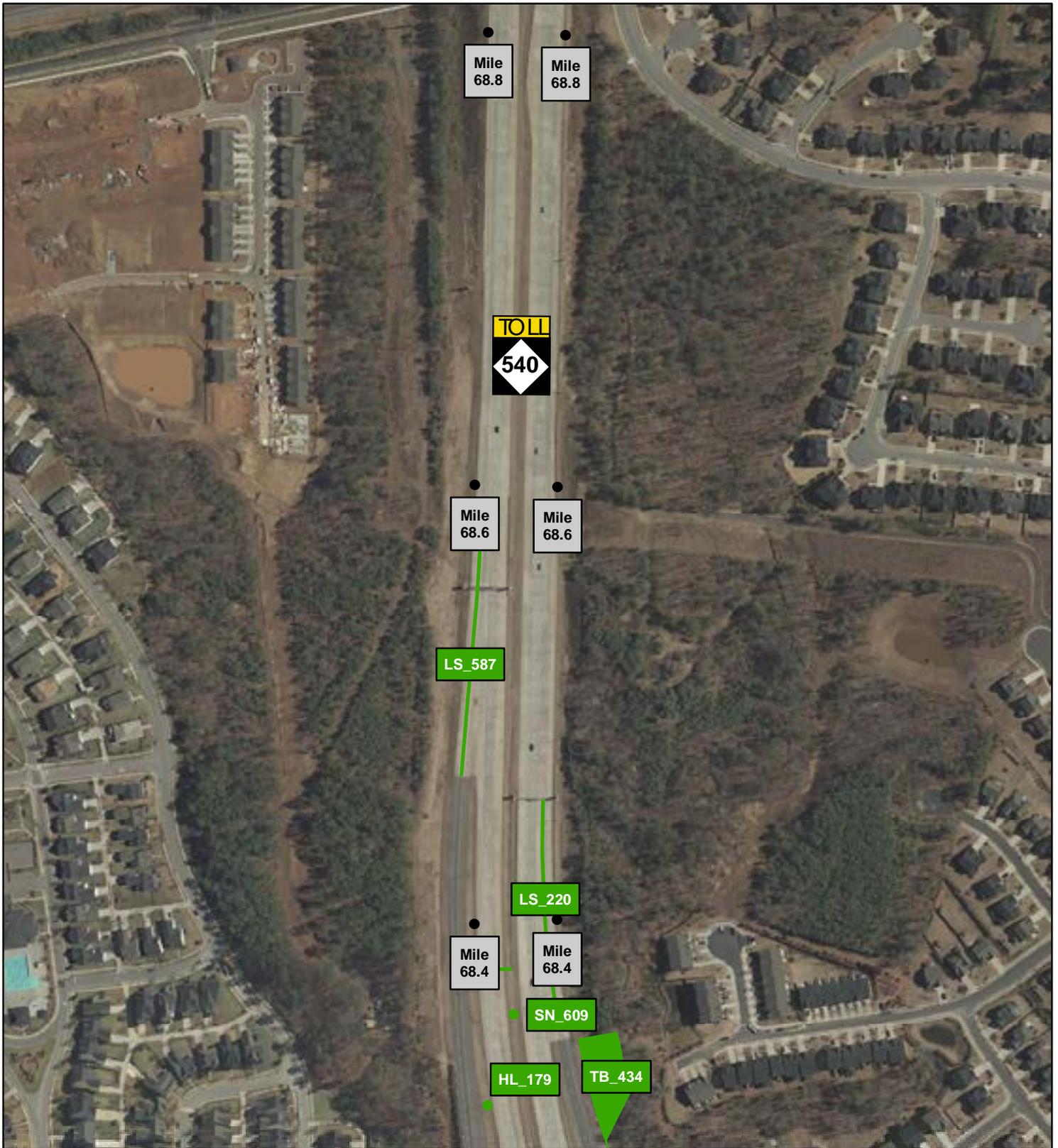


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

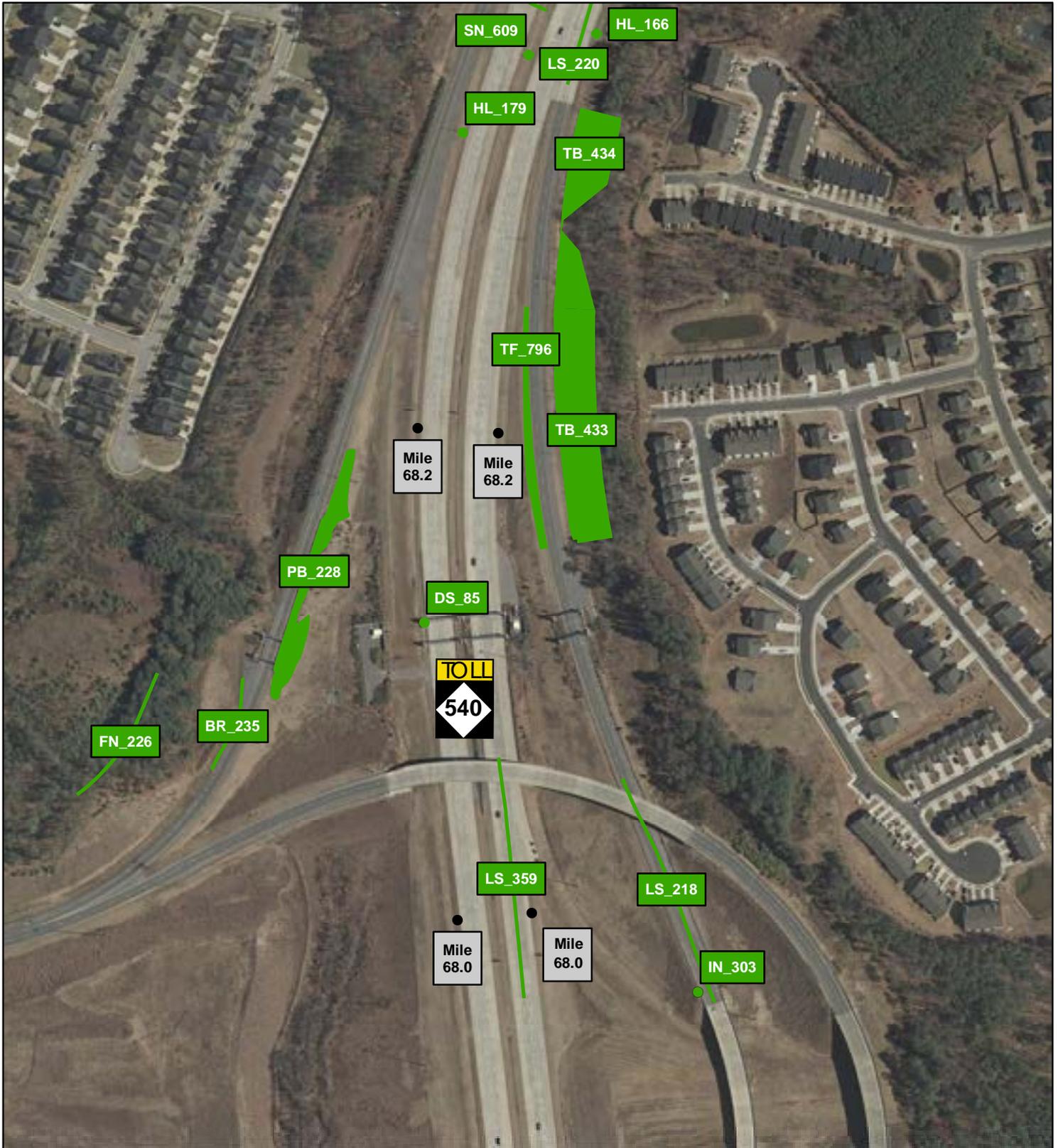


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

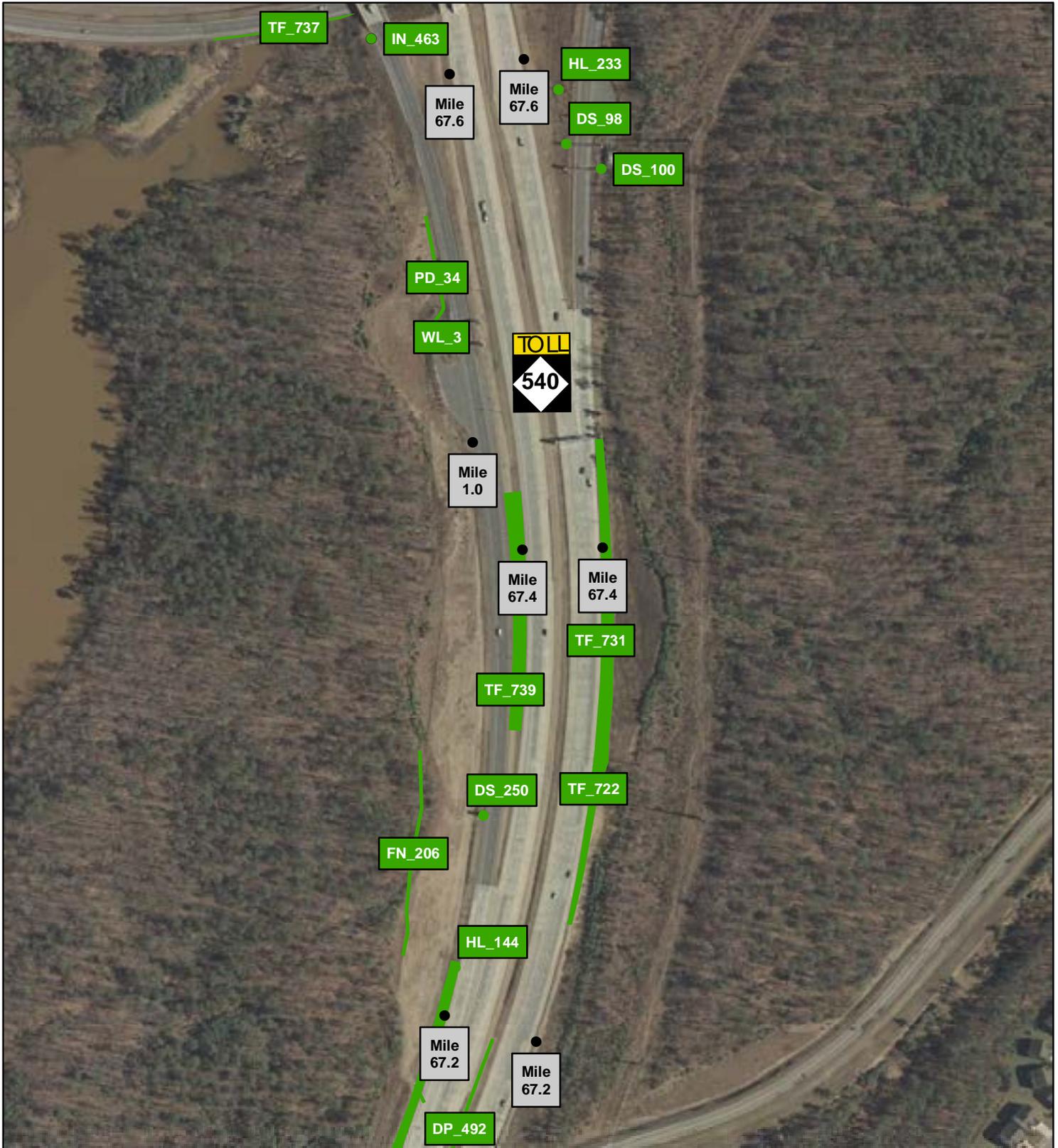


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

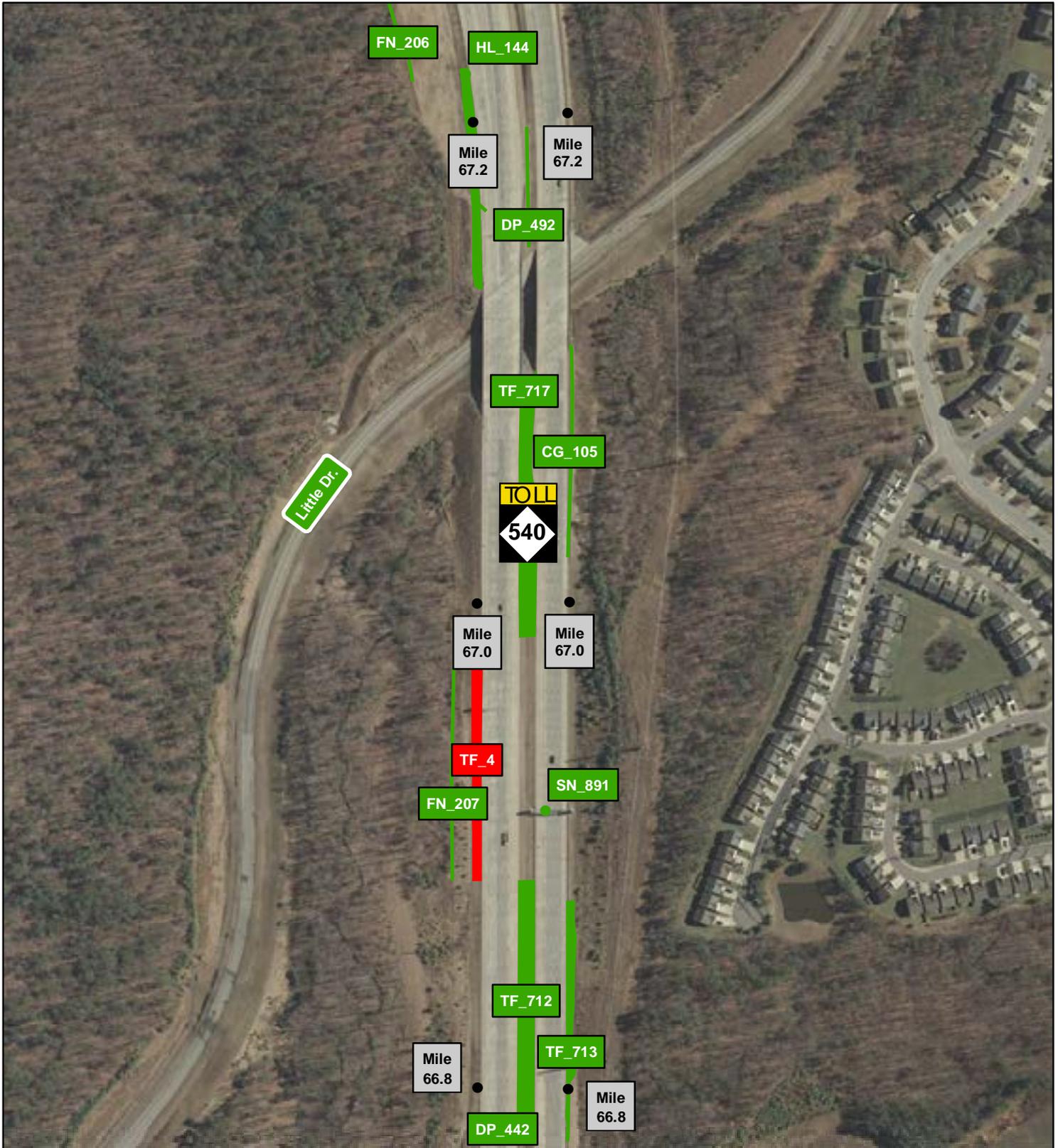


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

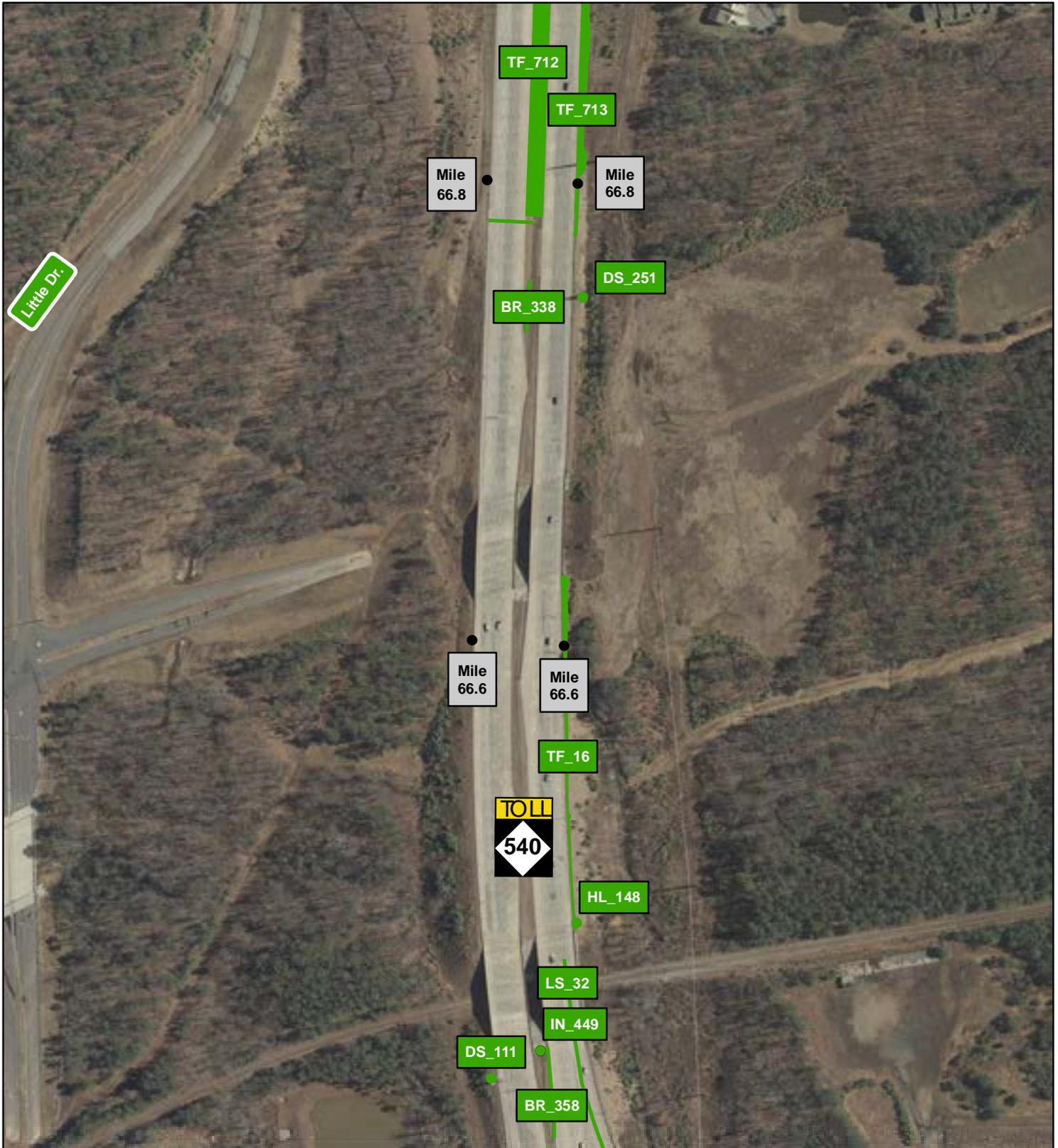


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

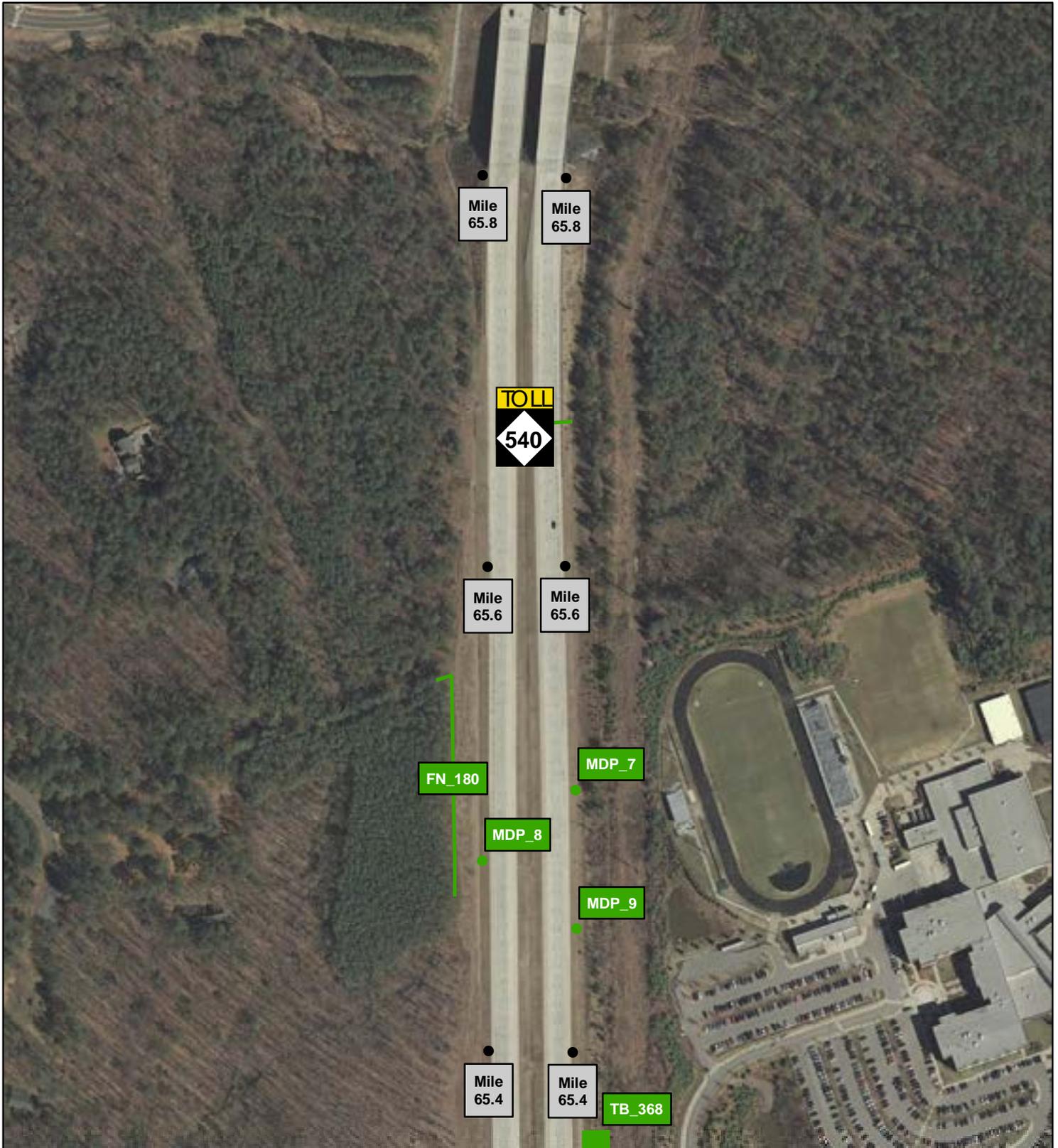


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

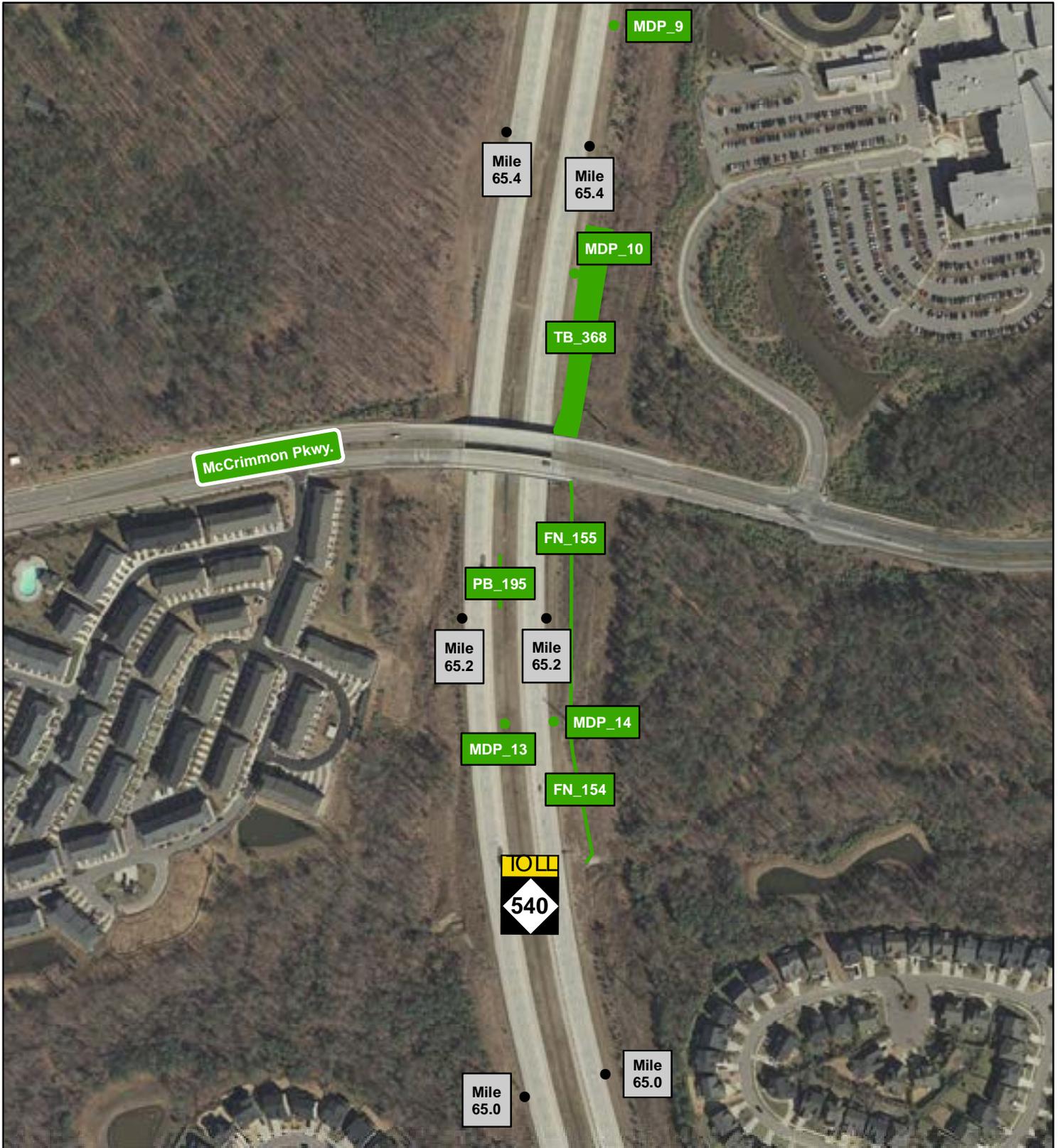


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

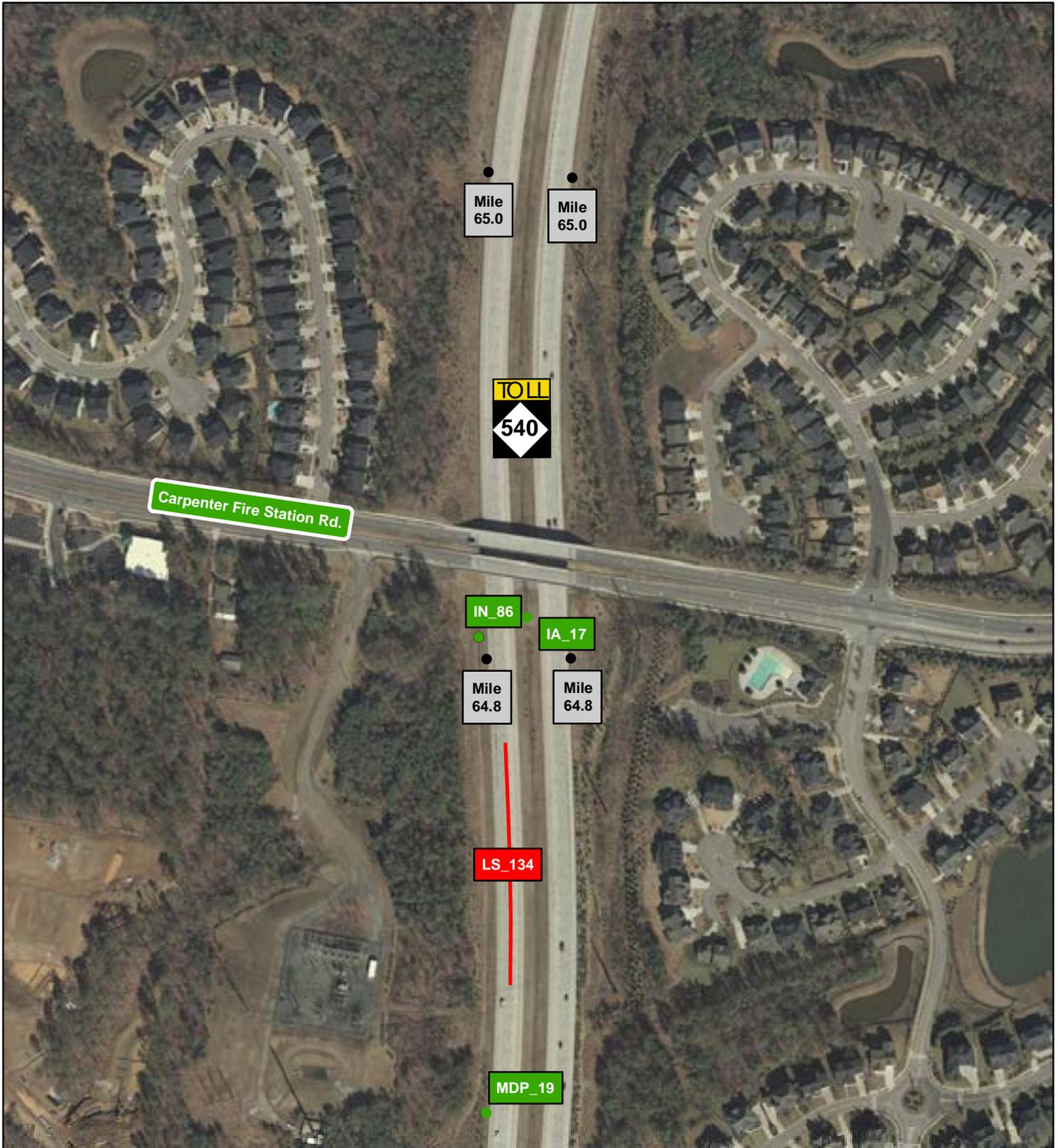


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

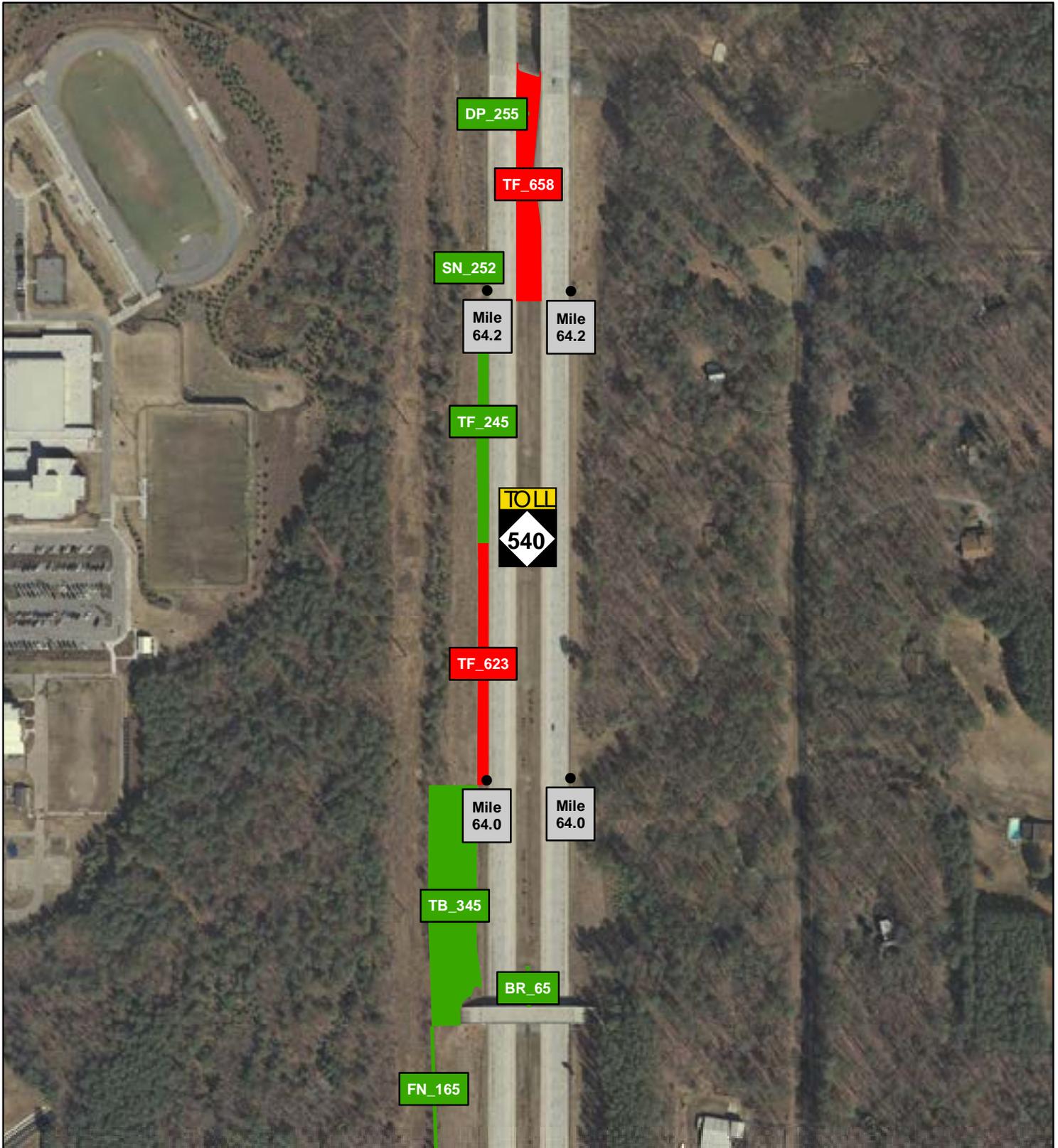


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

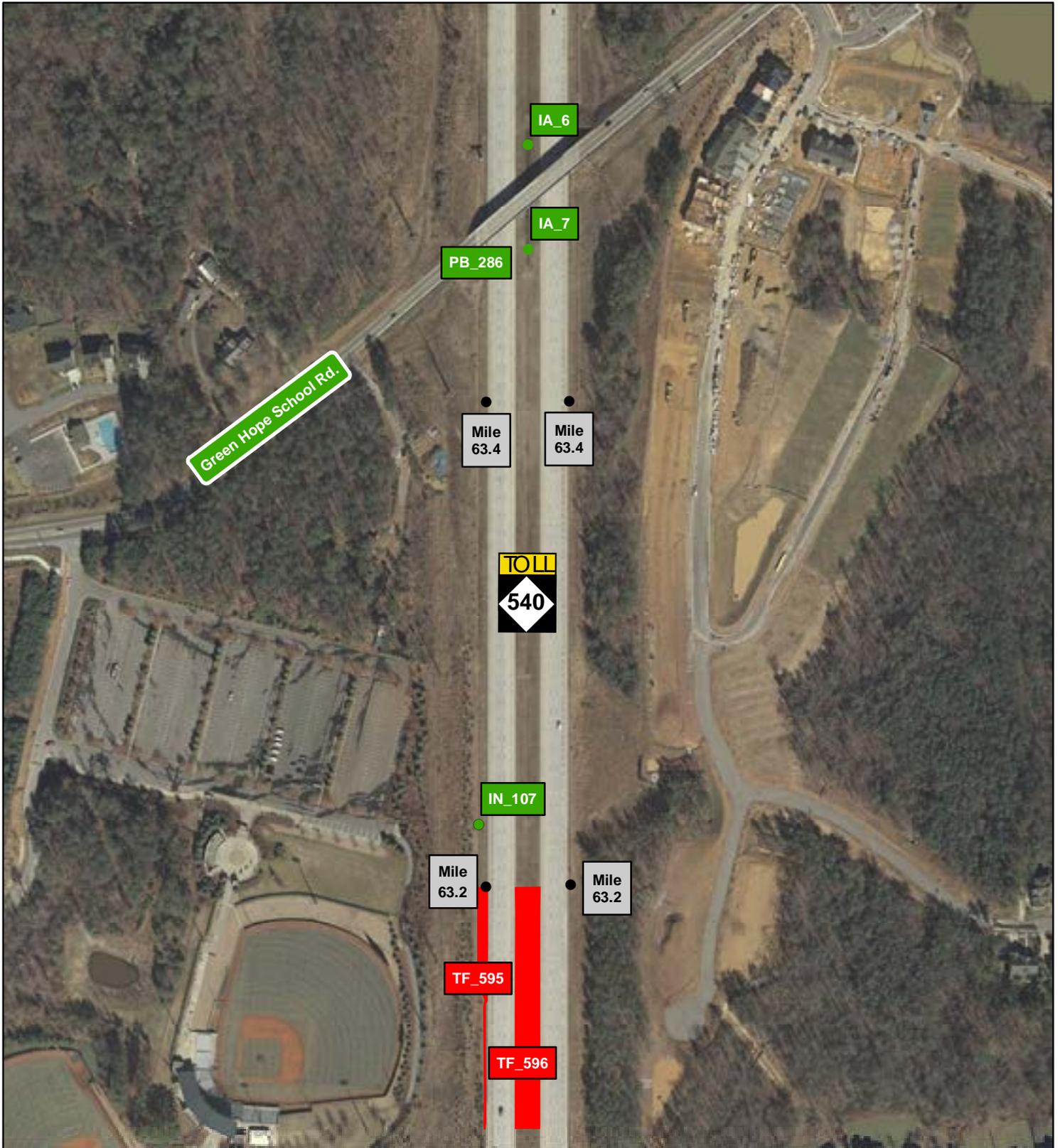


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

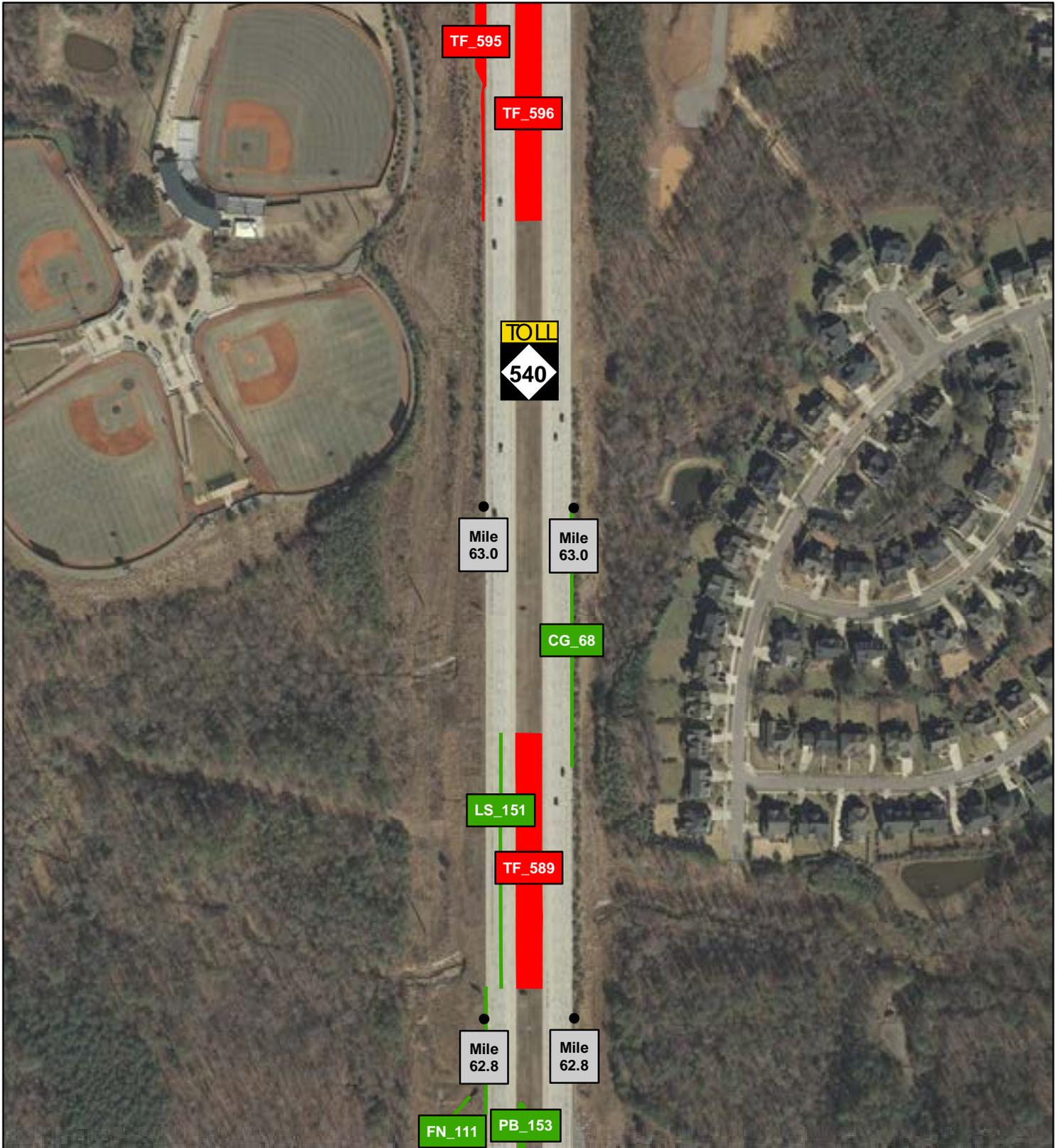


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

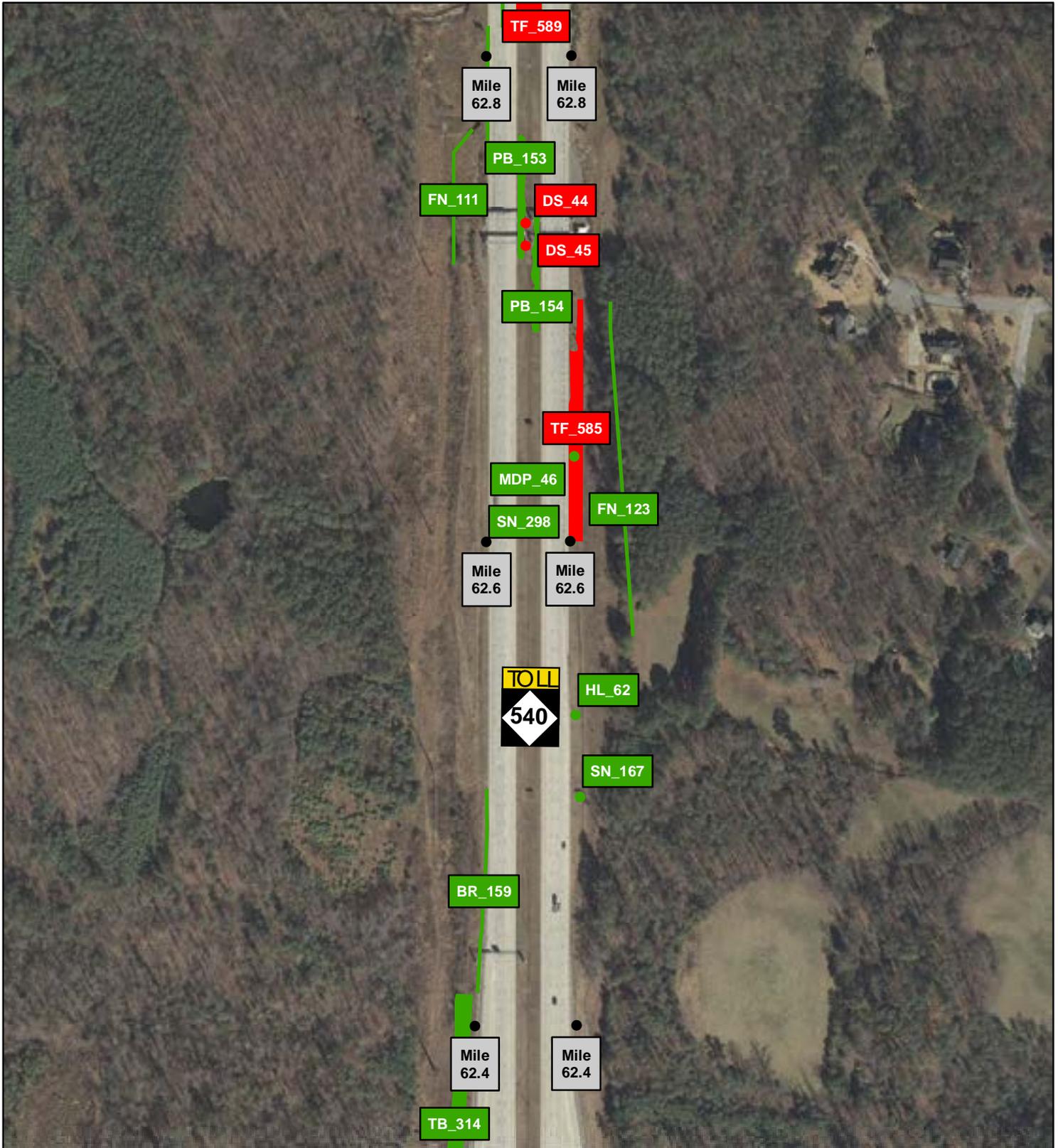


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

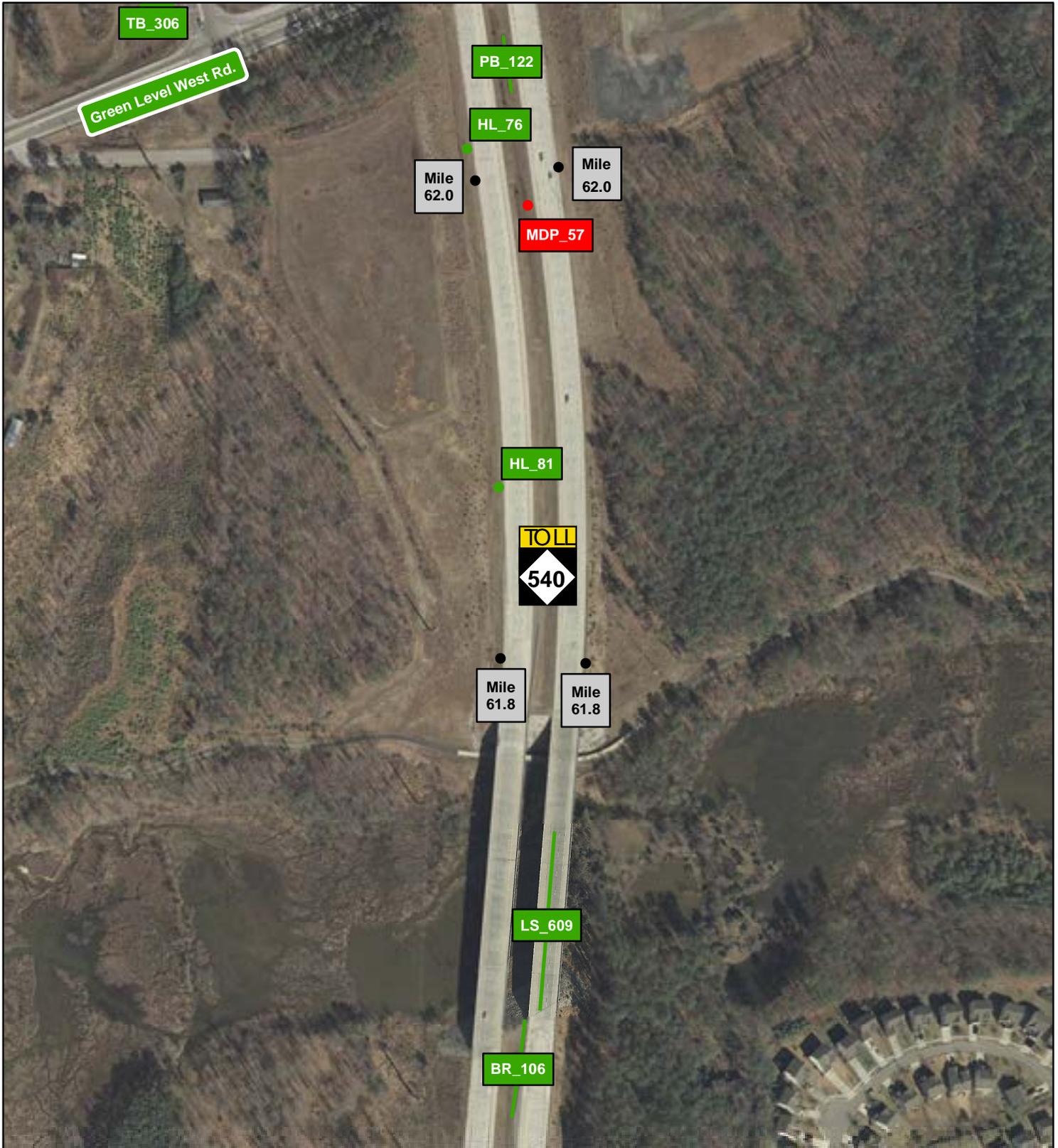


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

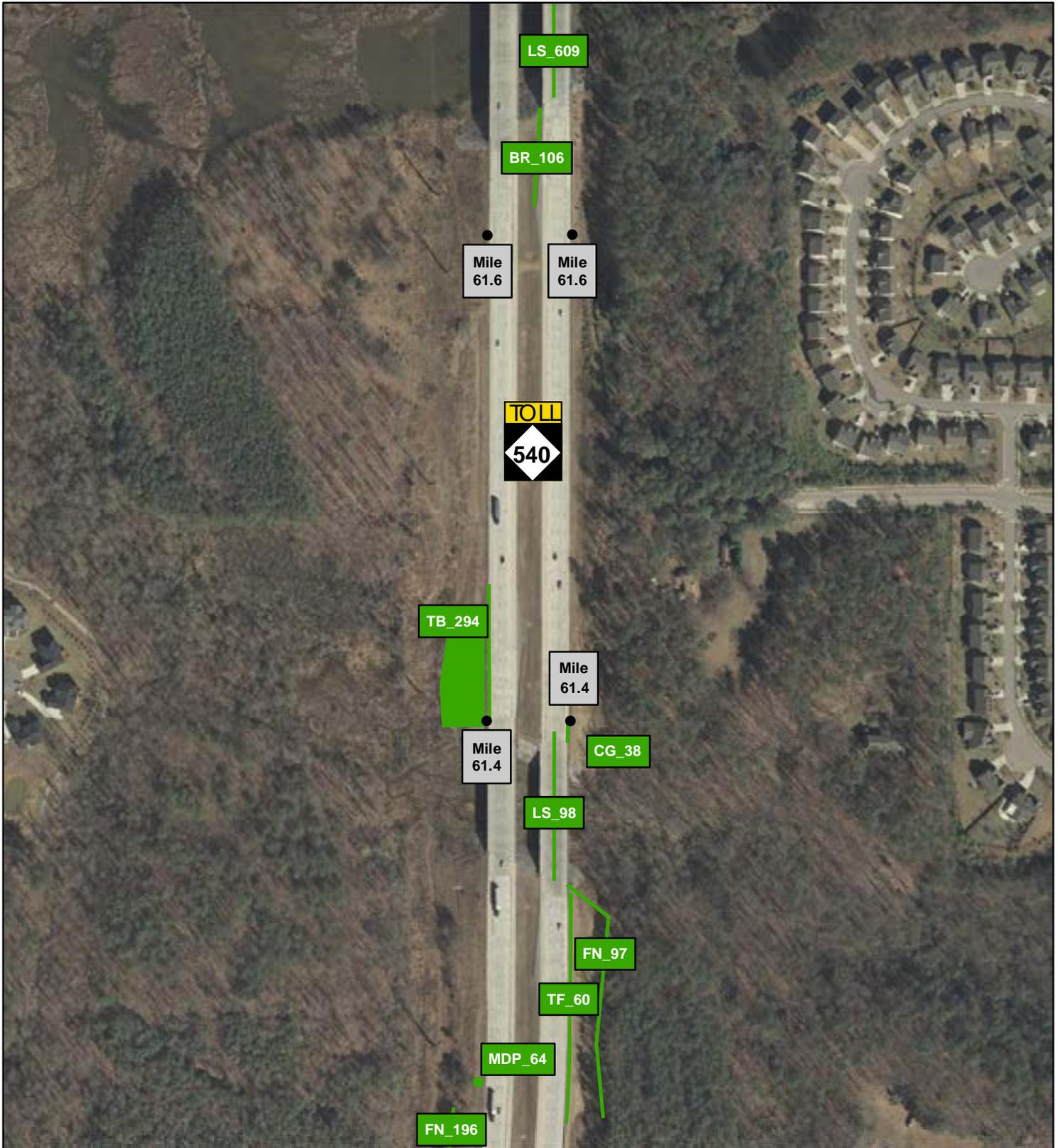


Legend

-  Failing Asset
-  Passing Asset

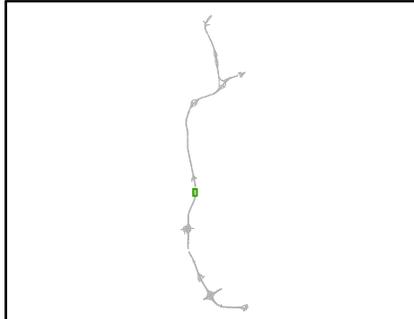


Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

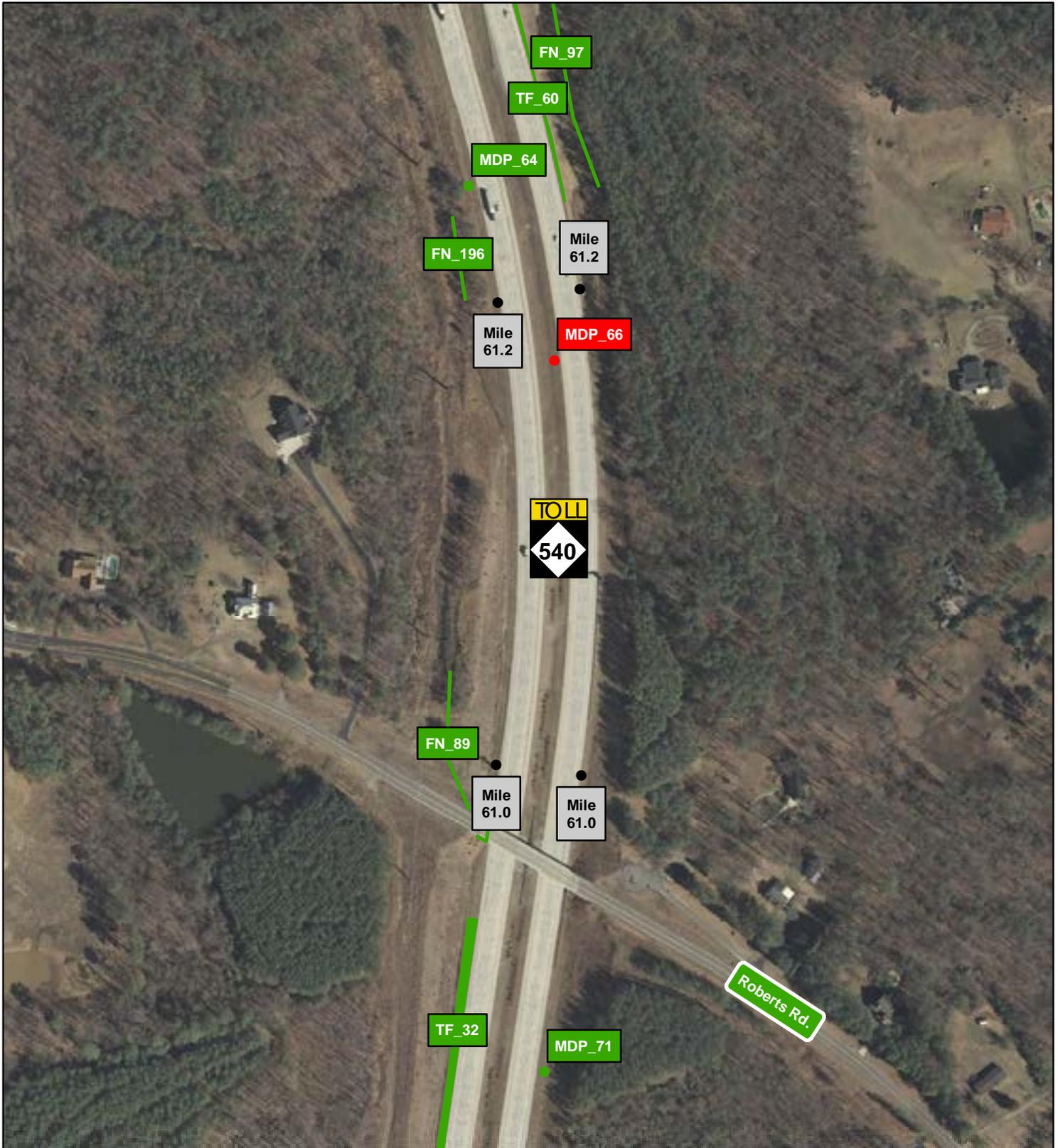


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

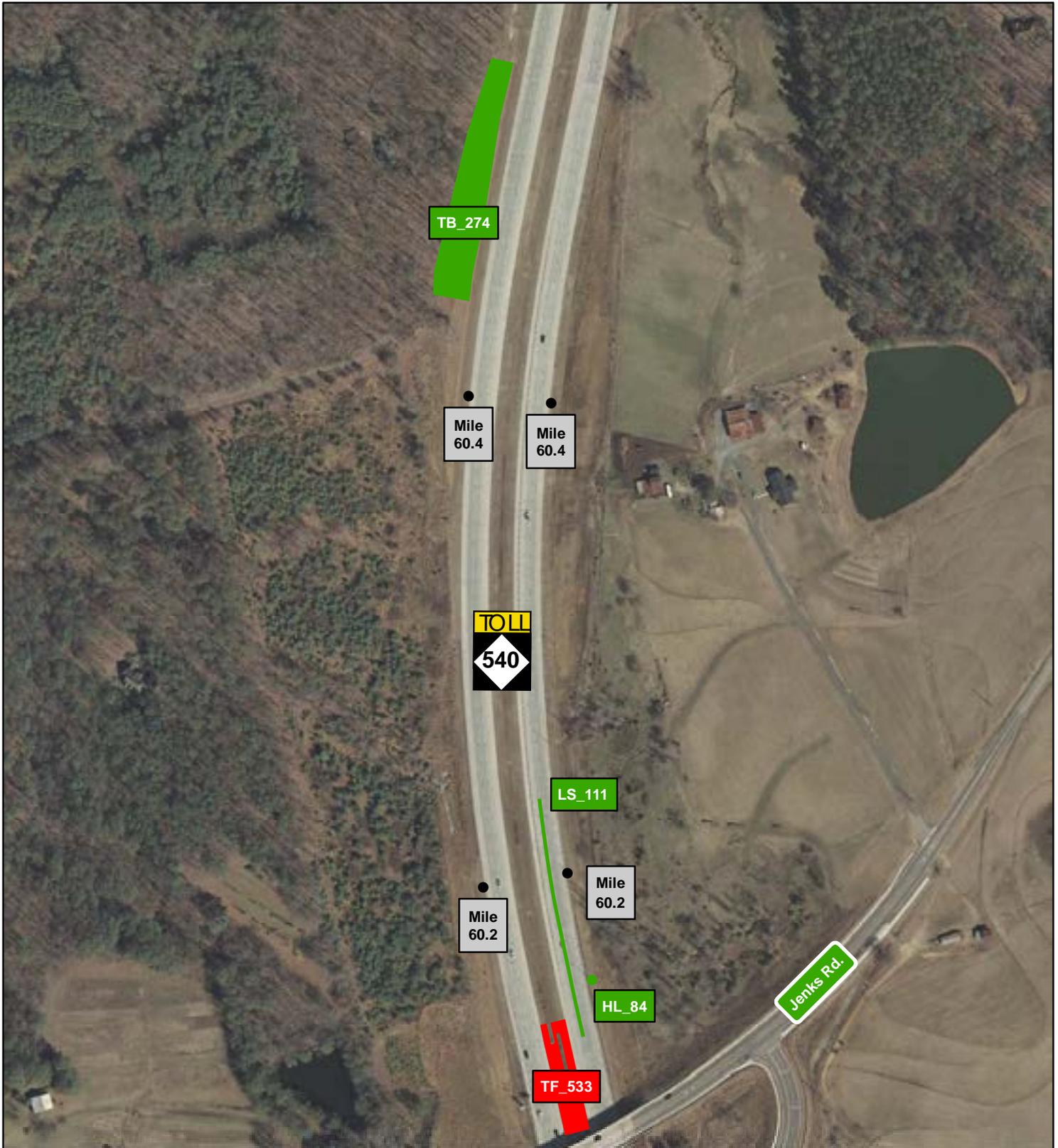


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-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

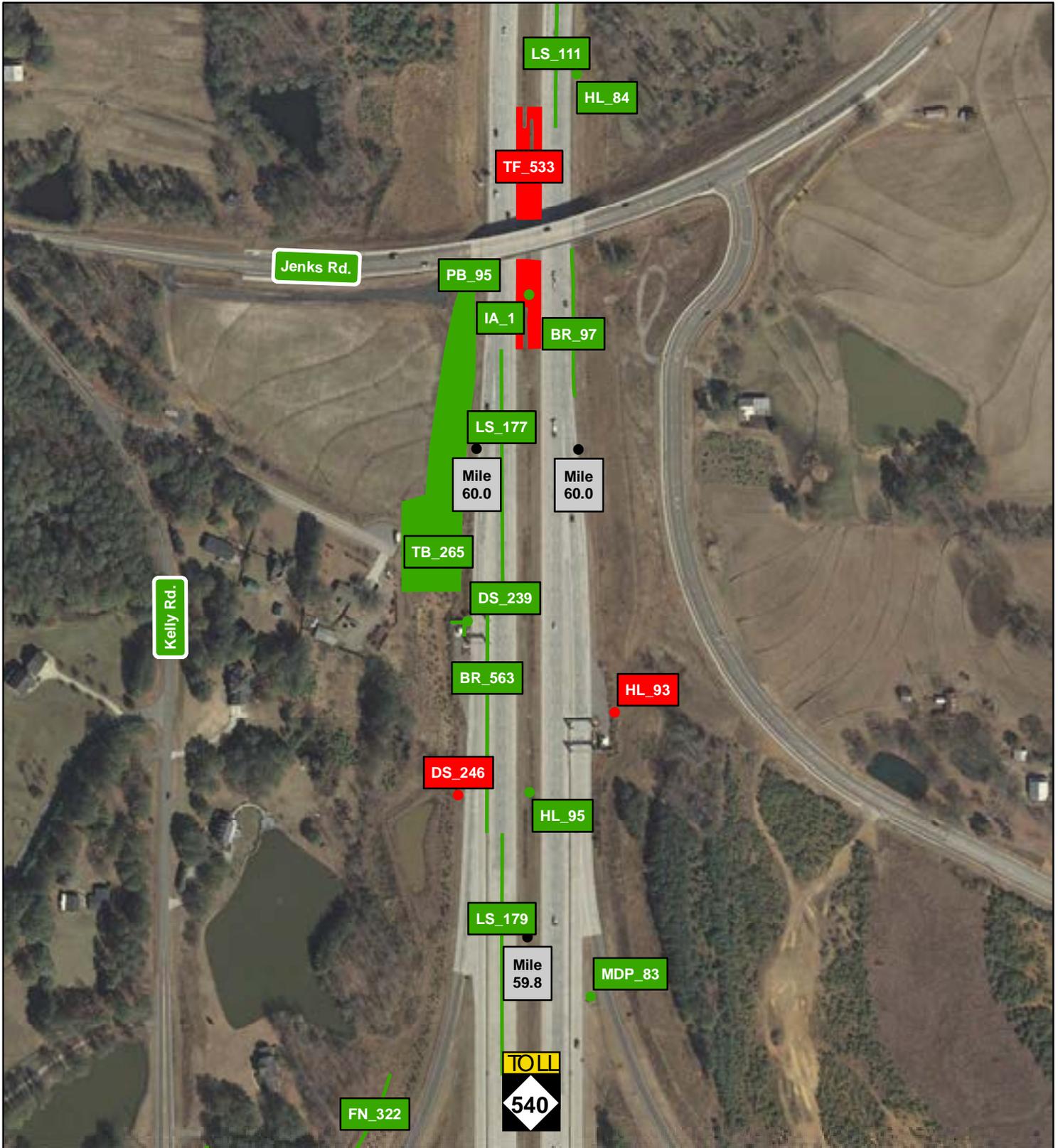


Legend

-  Failing Asset
-  Passing Asset

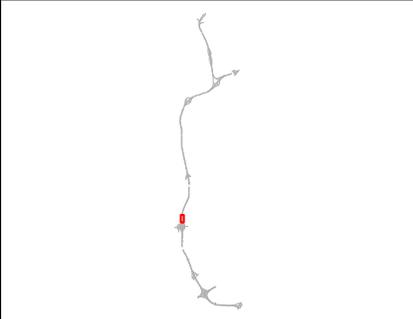


Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

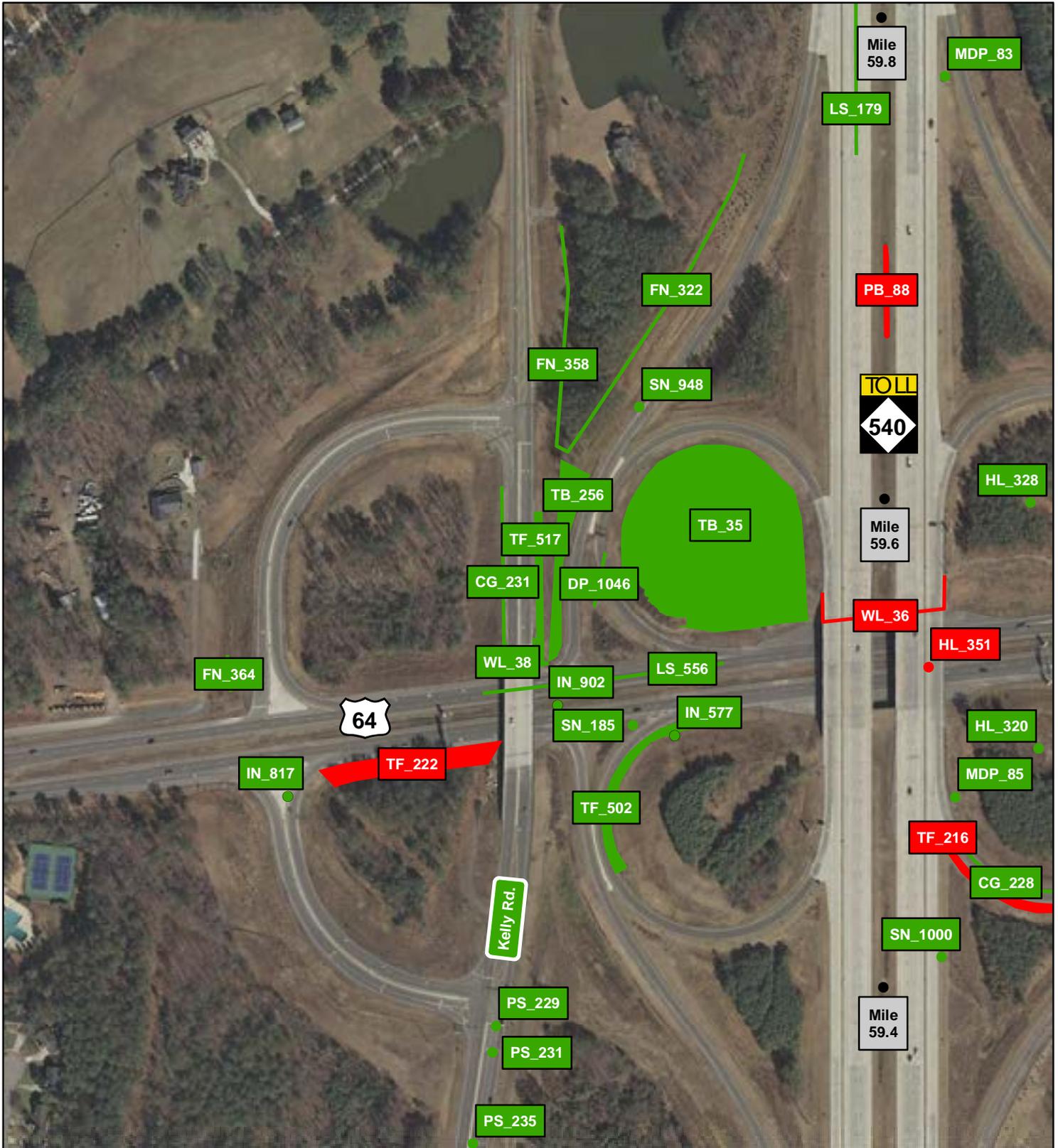


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

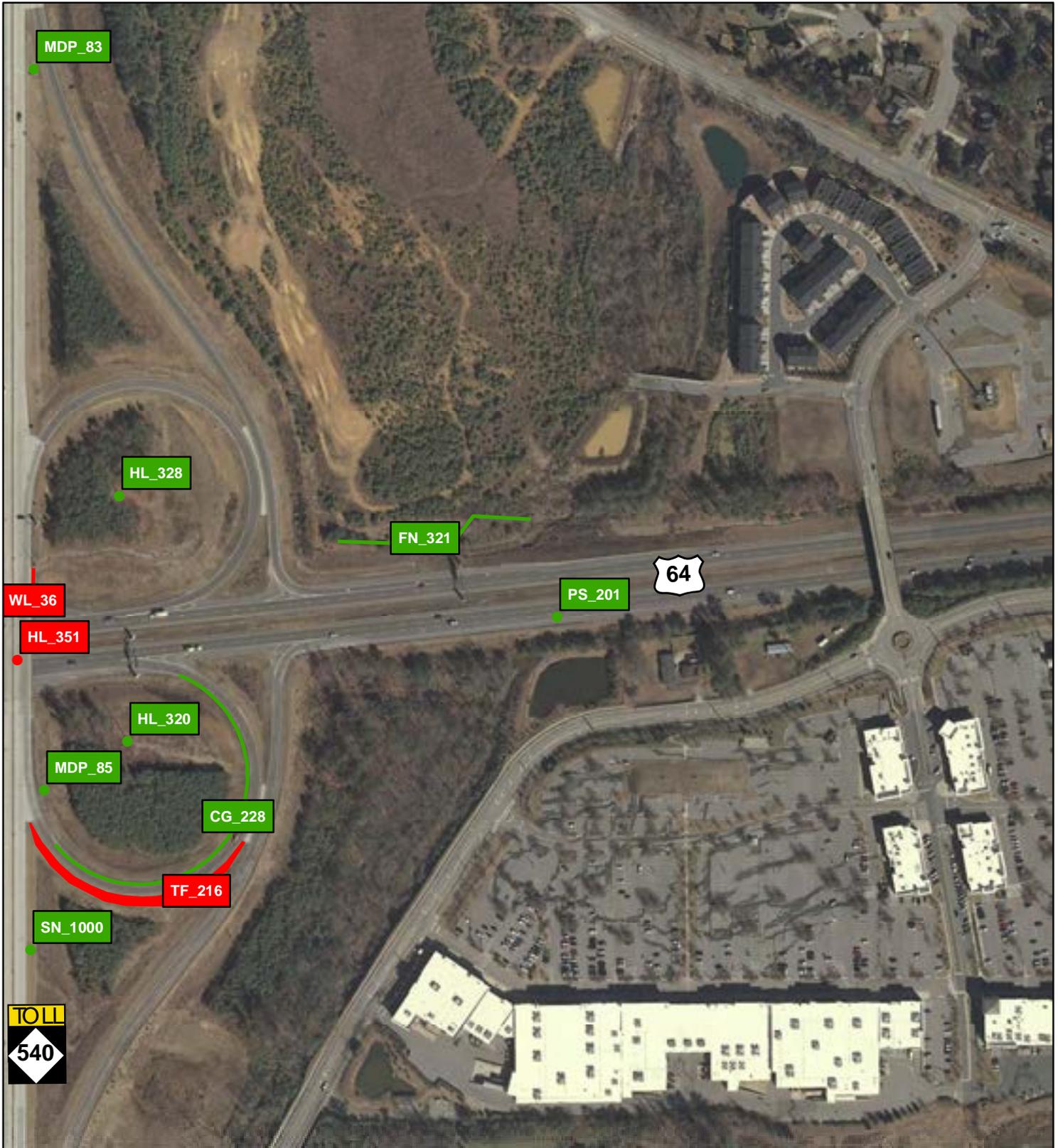


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

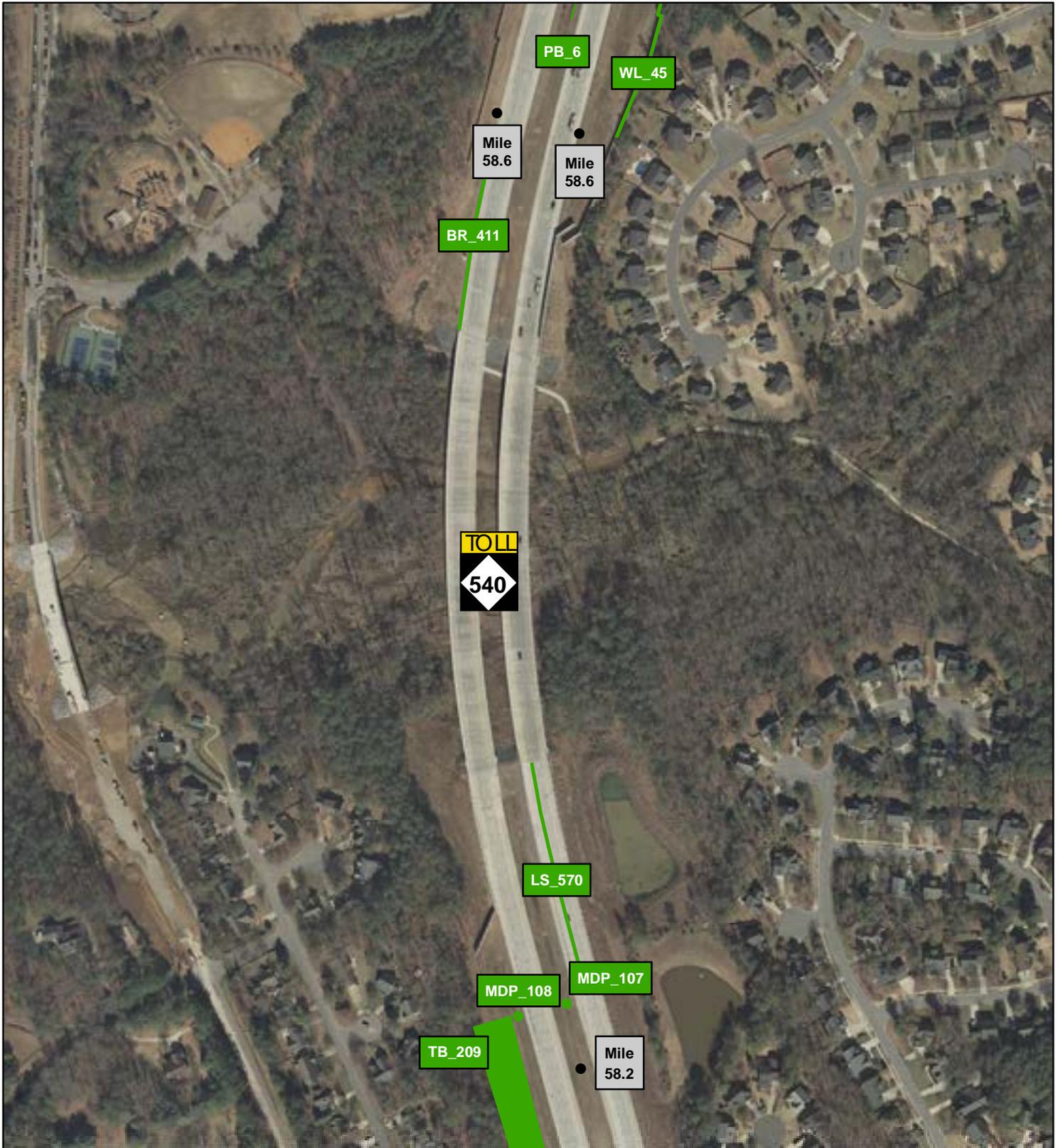


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

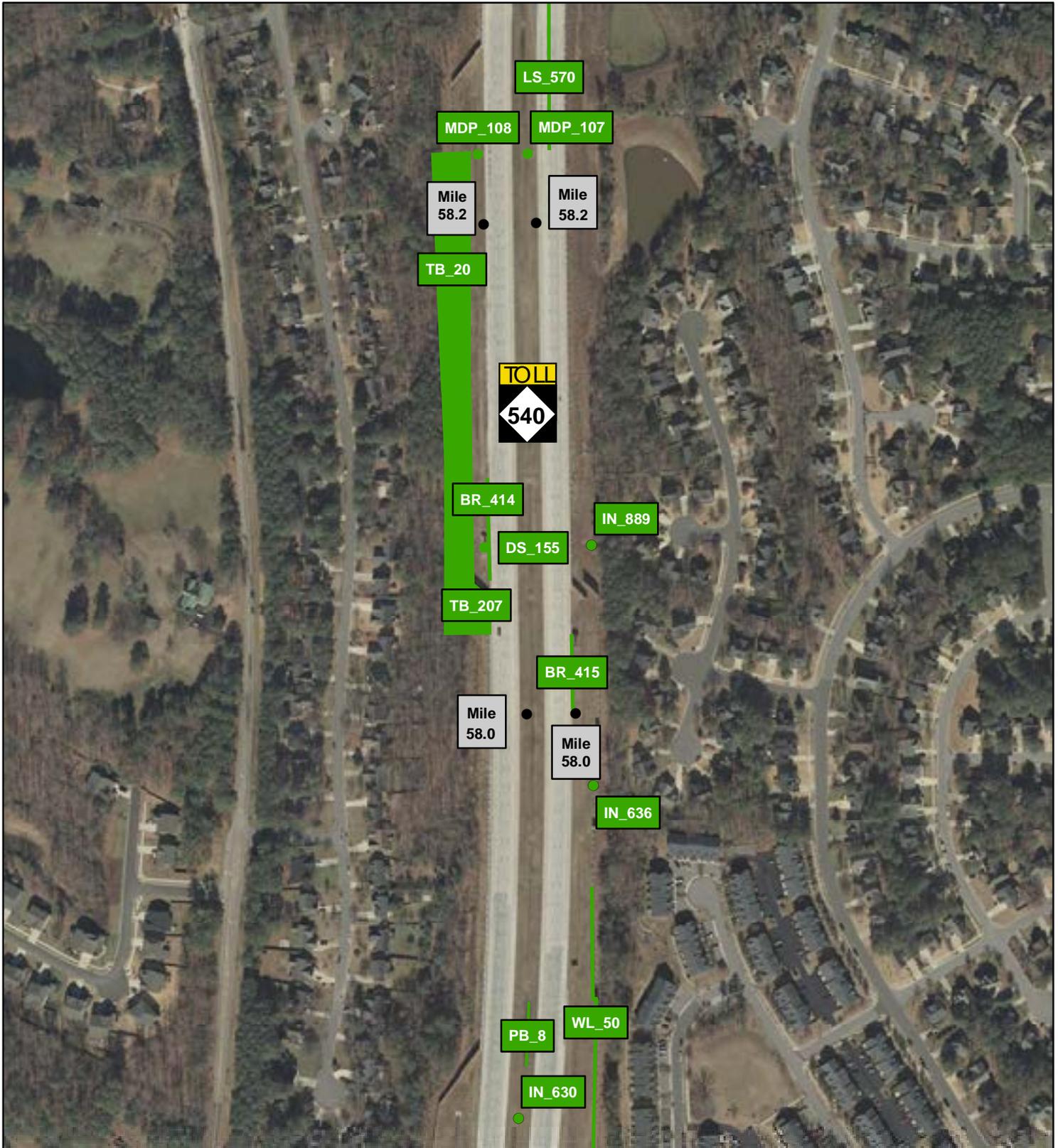


Legend

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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

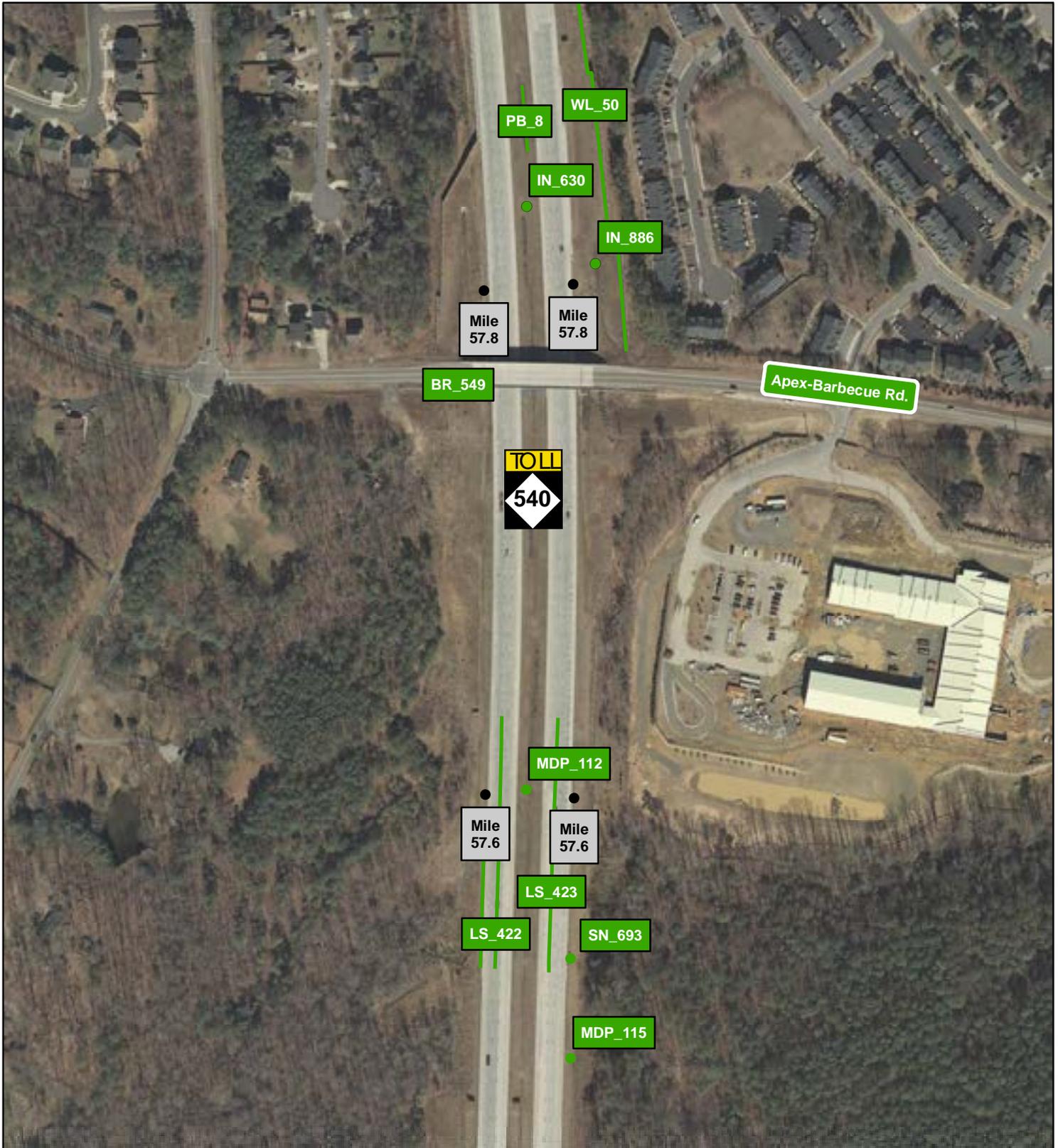


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

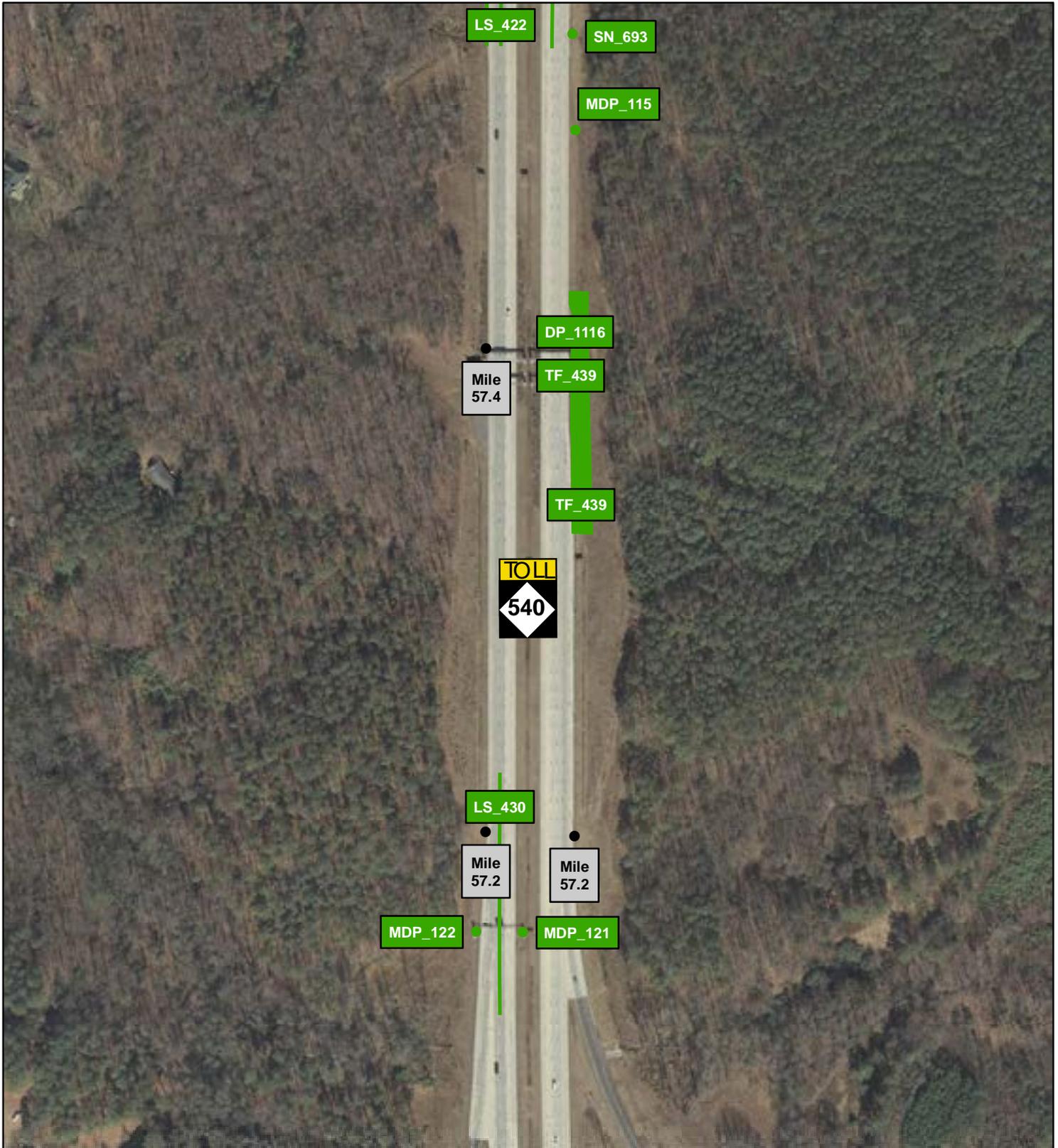


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- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

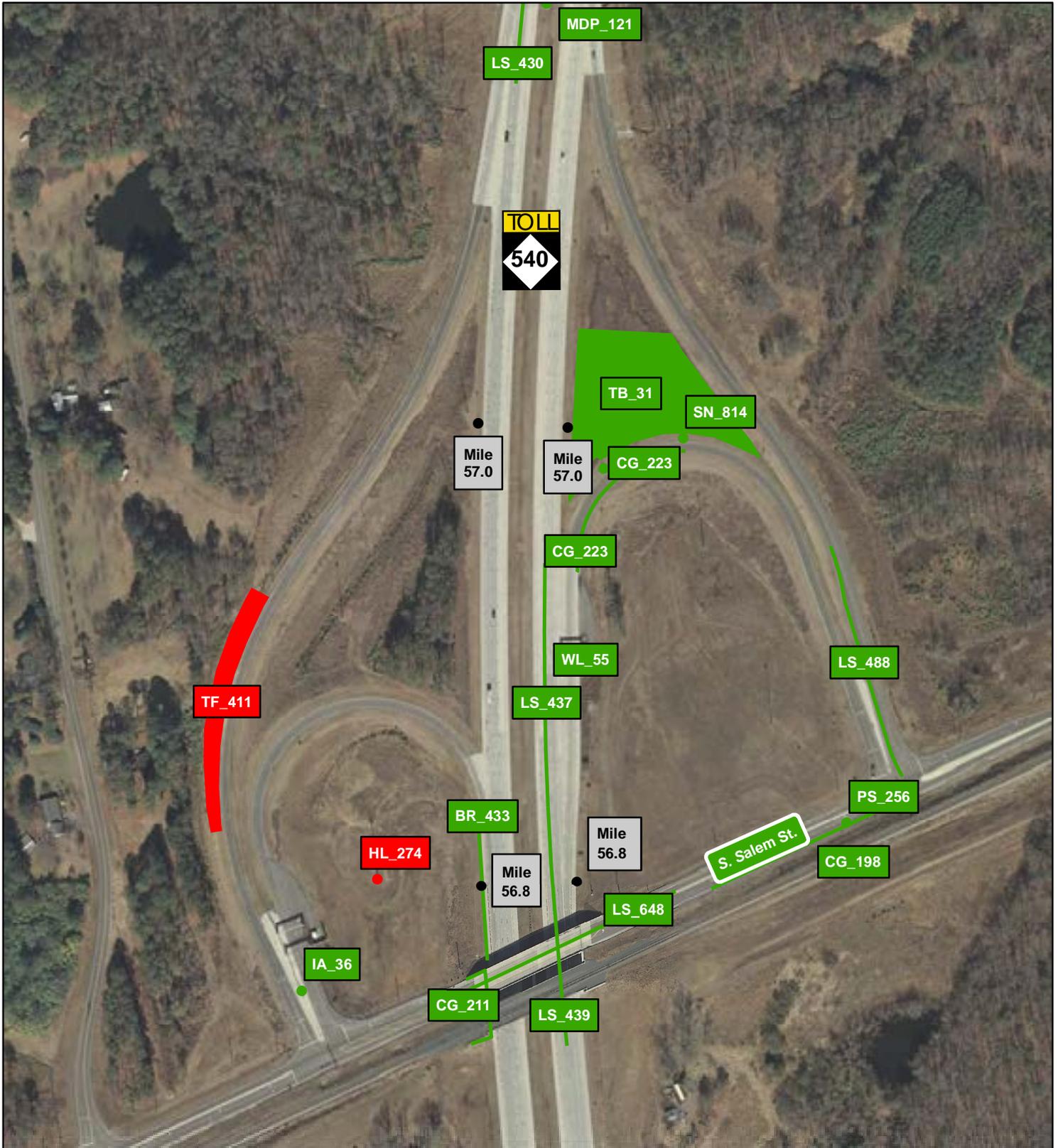


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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

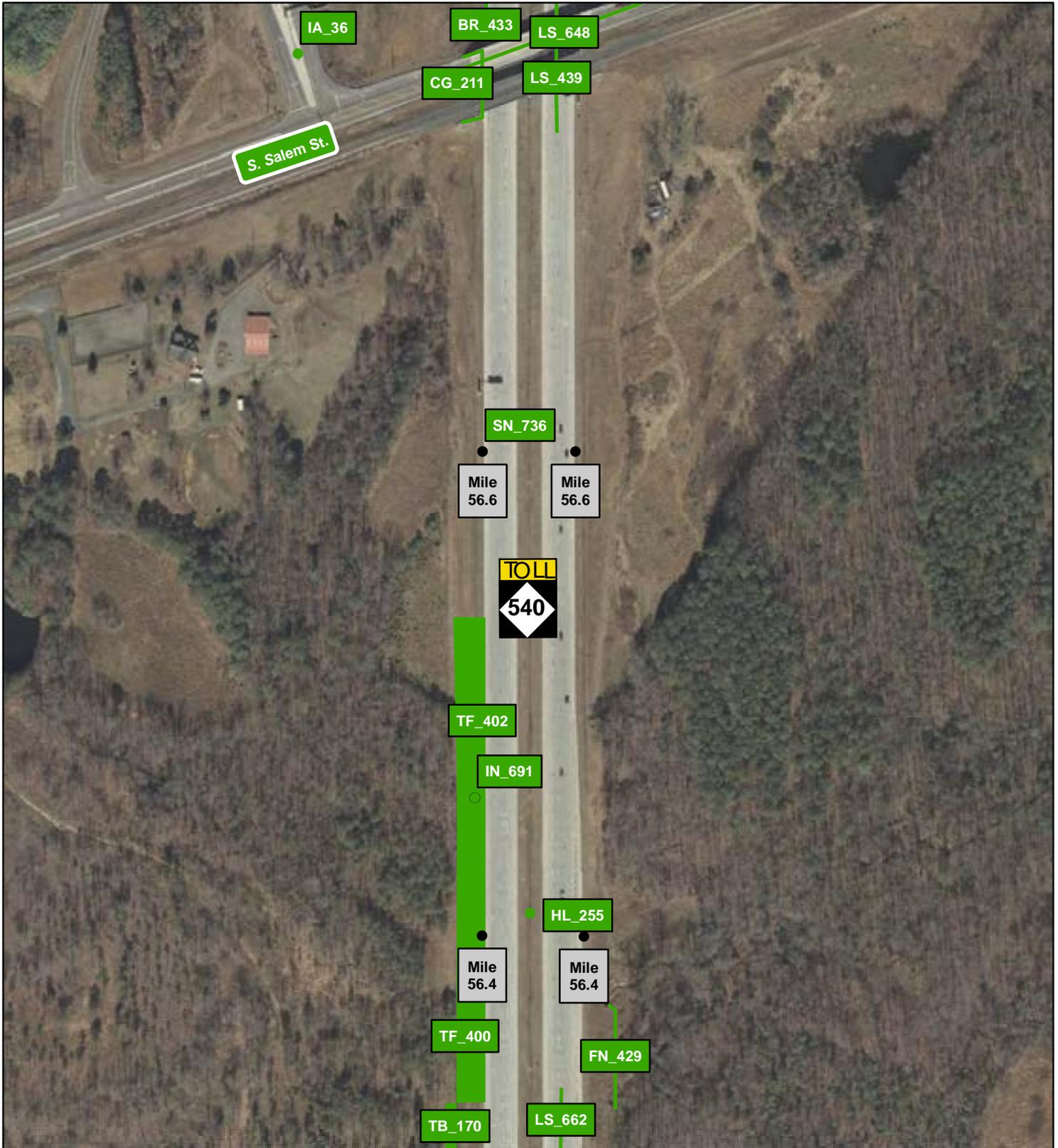


Legend

- Failing Asset
- Passing Asset

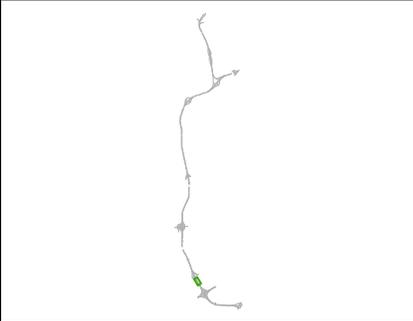


Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

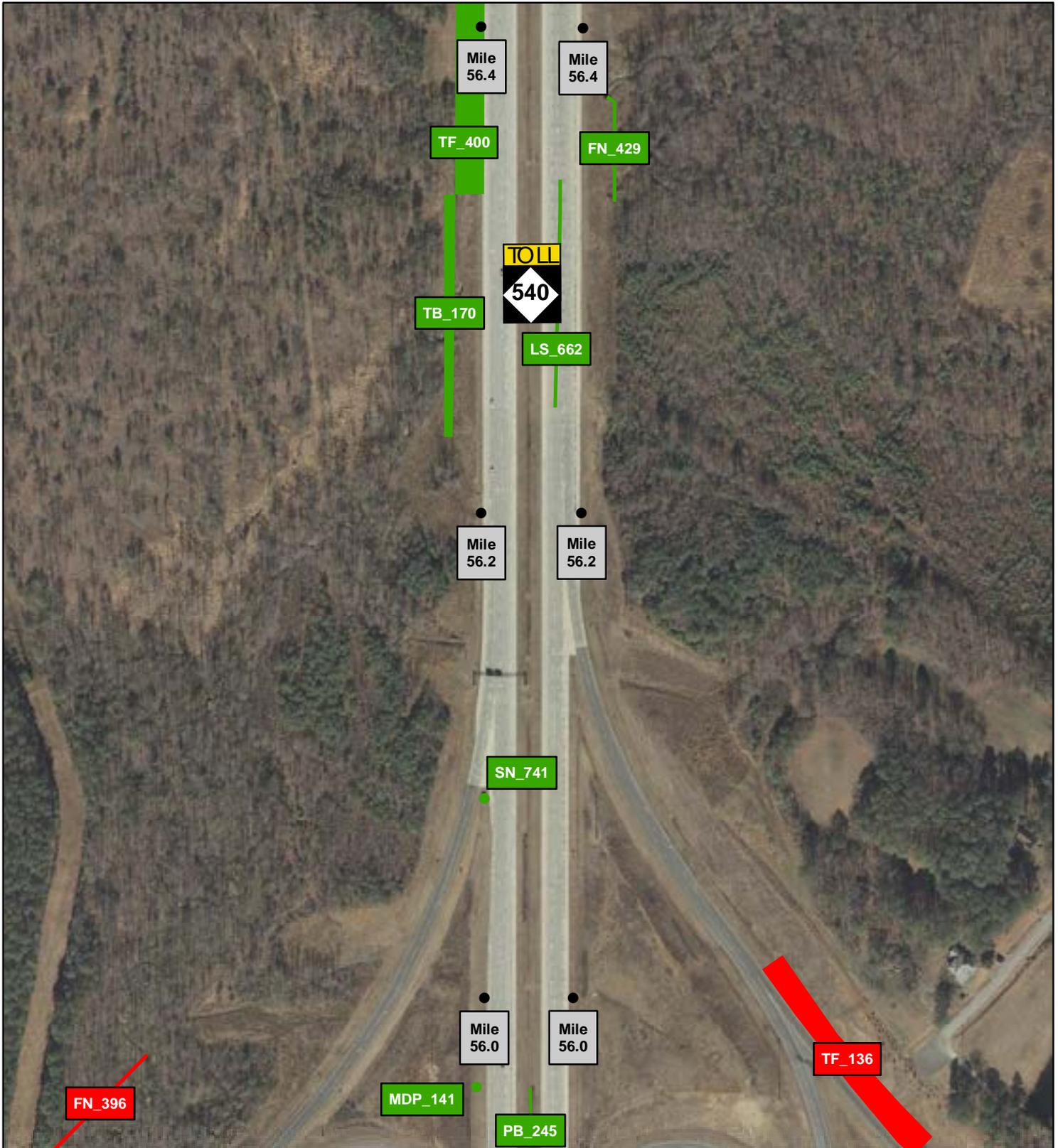


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

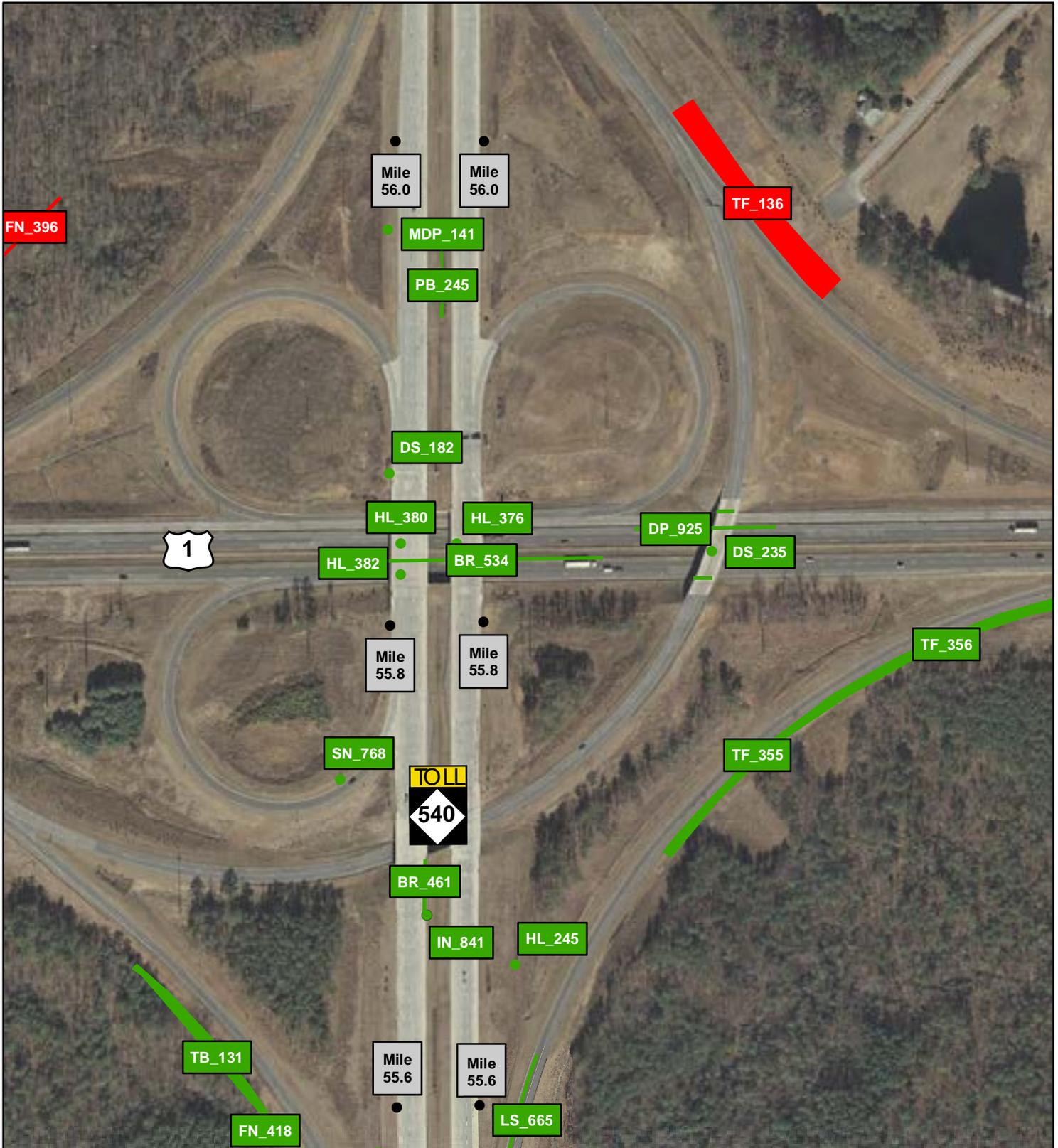


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

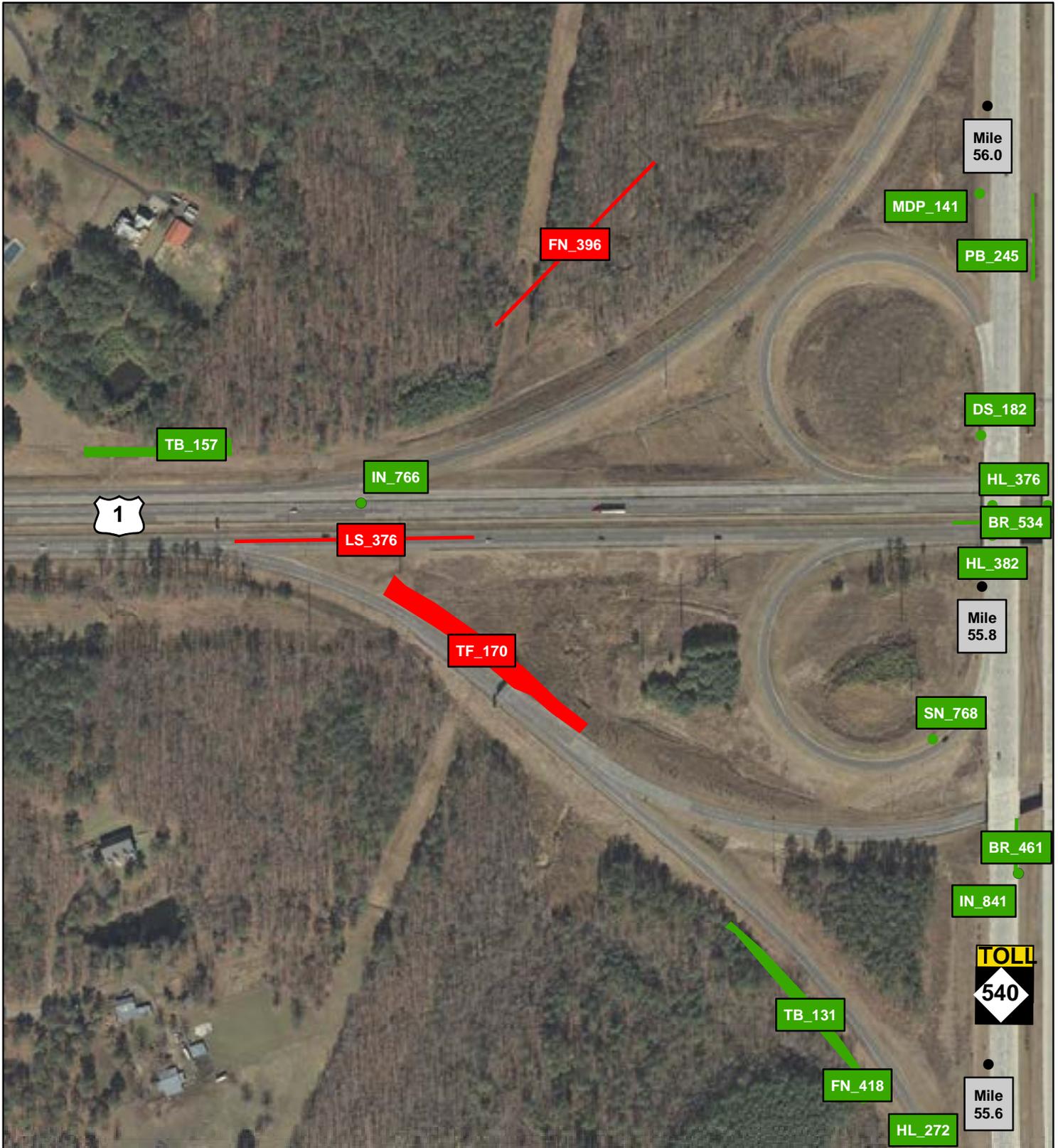


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



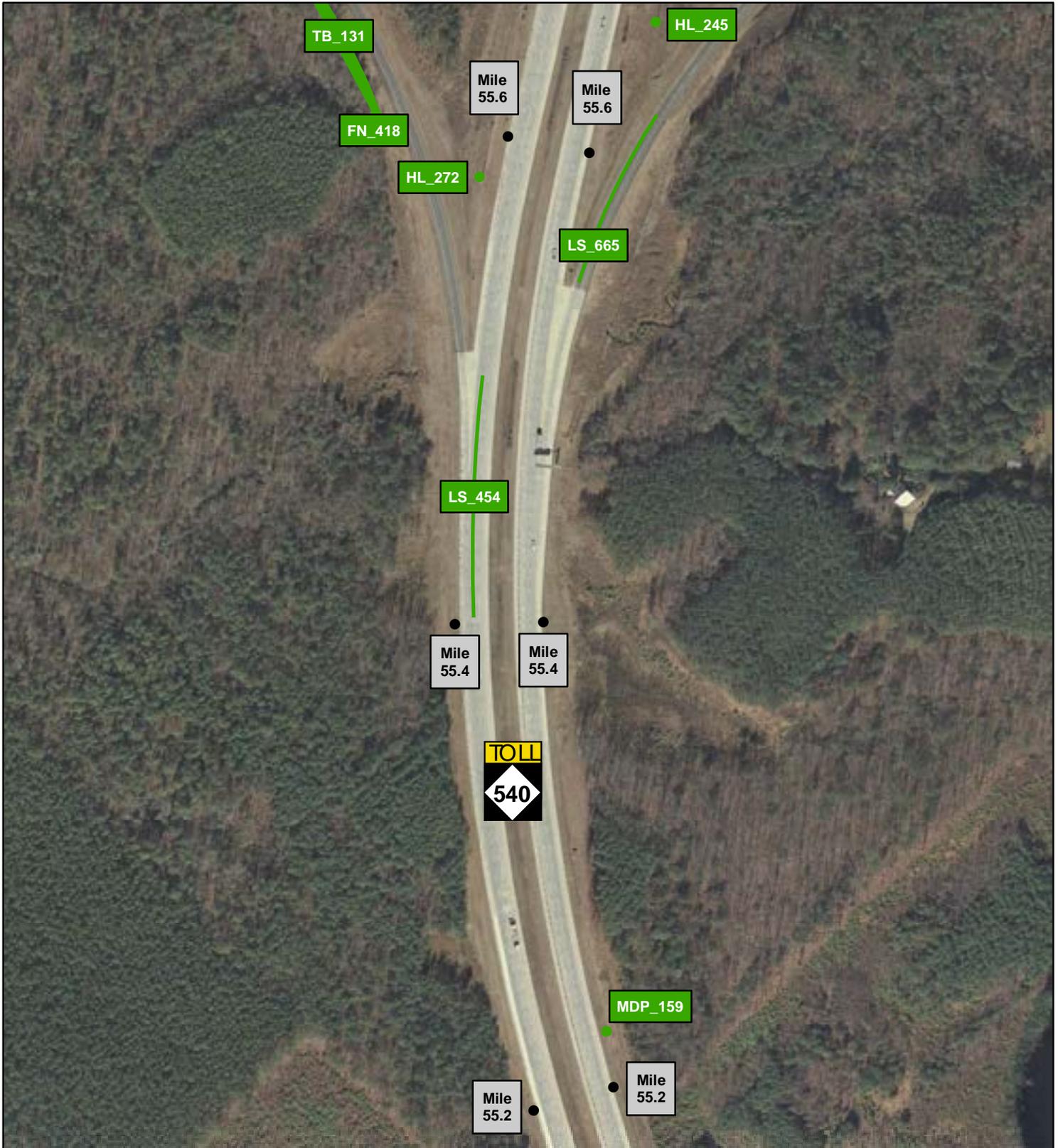
Legend

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 NORTH CAROLINA
Turnpike Authority

Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

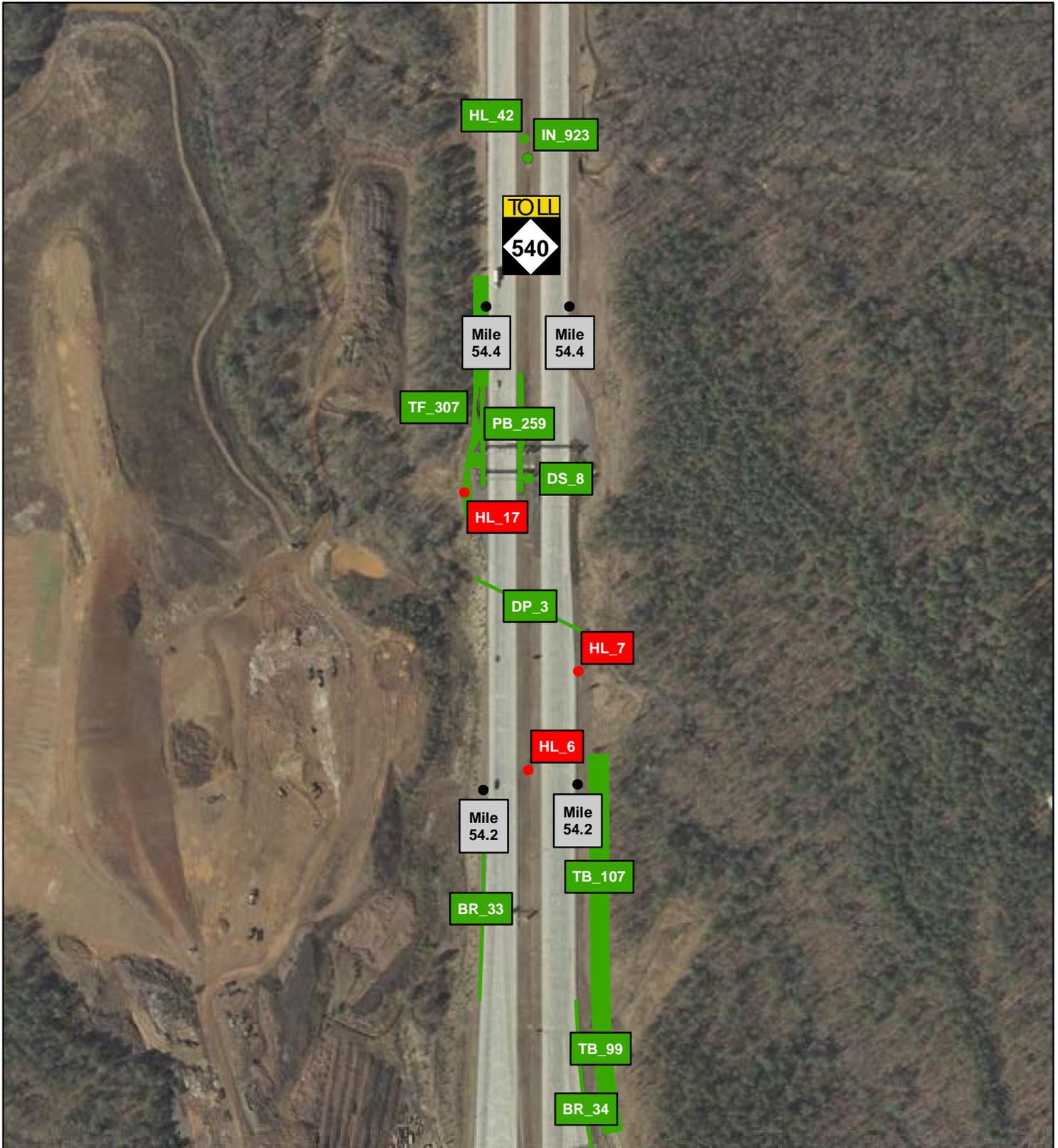


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

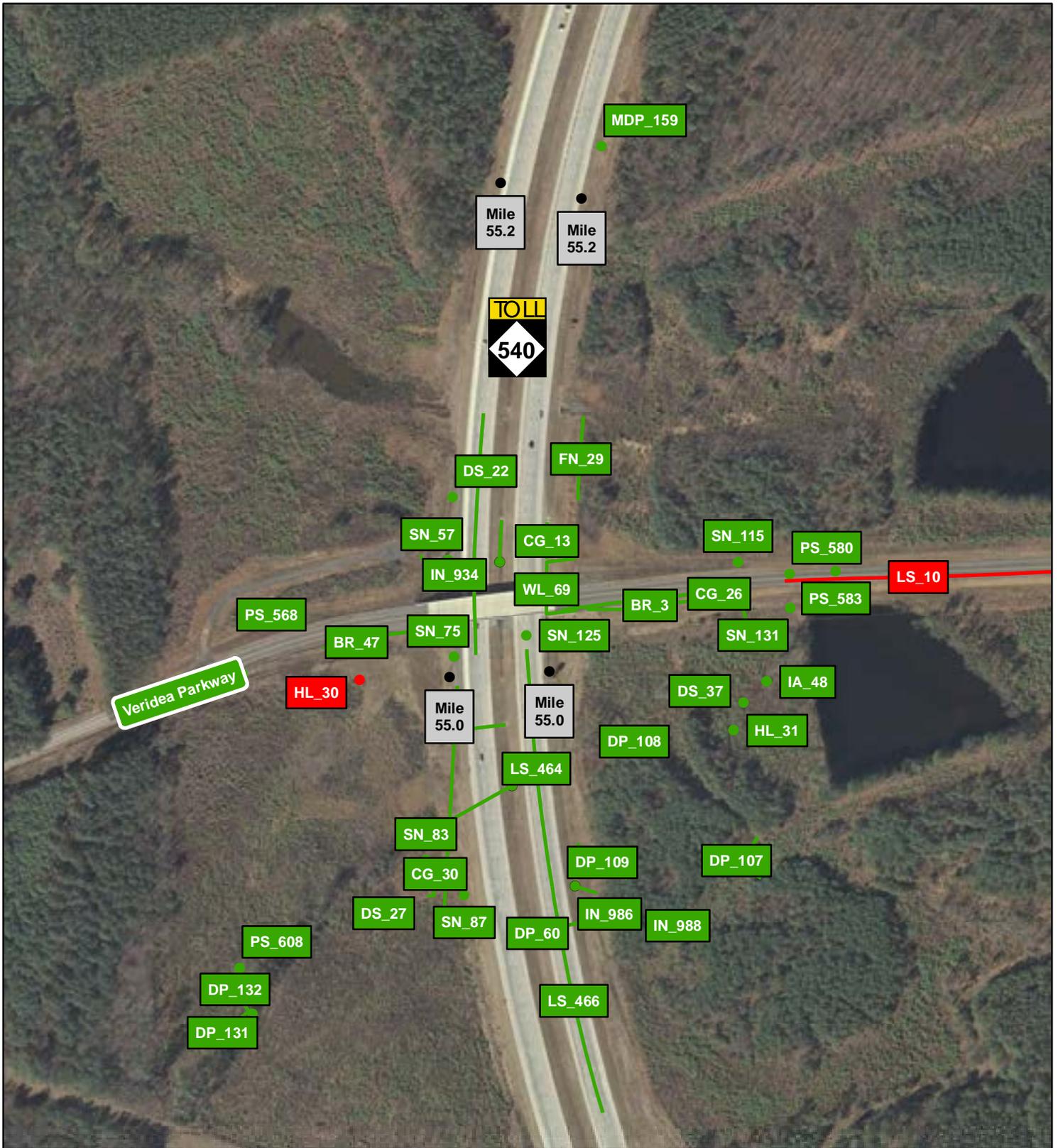


Legend

-  Failing Asset
-  Passing Asset

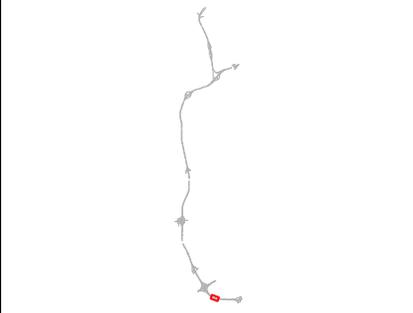


Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

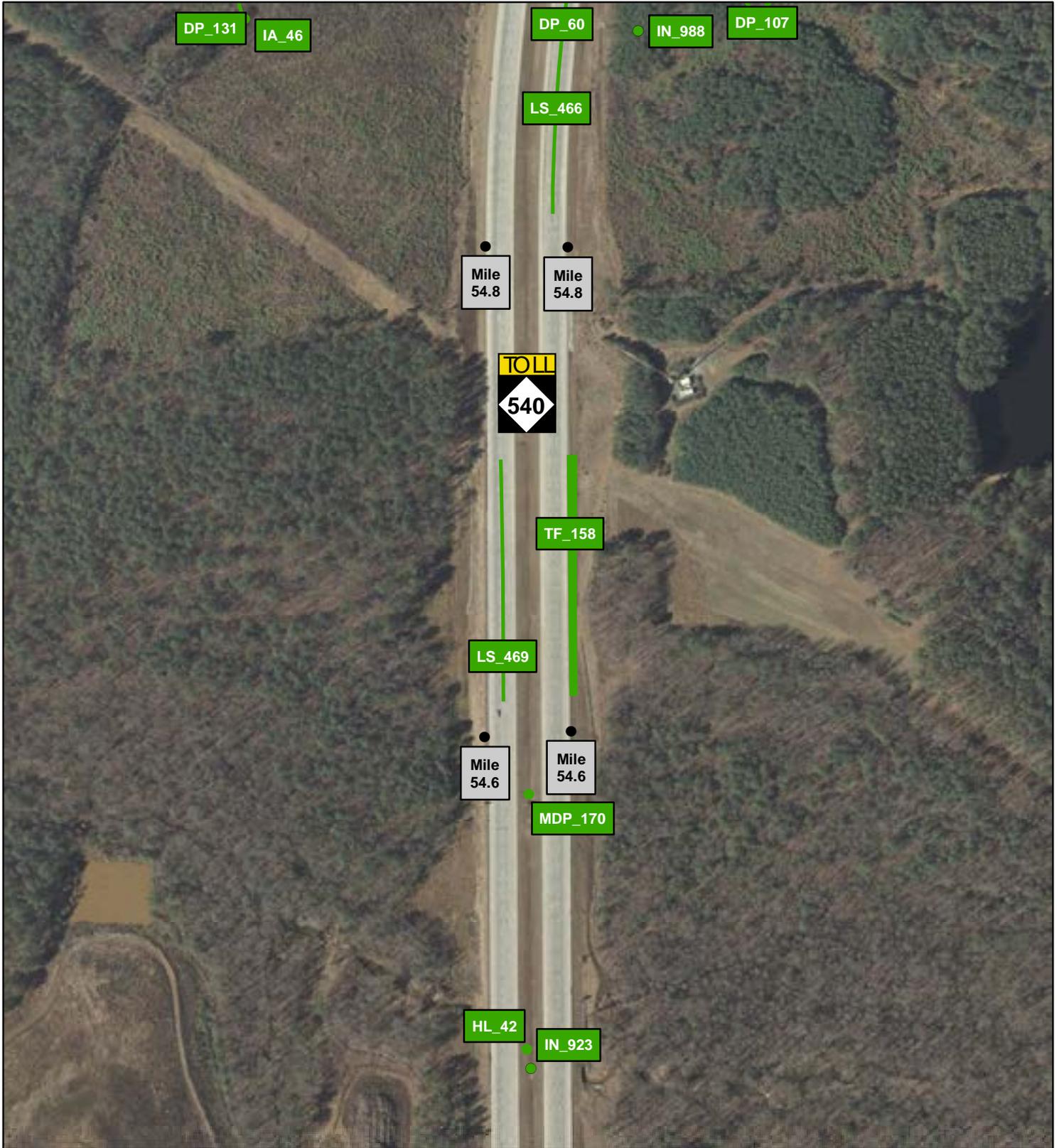


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

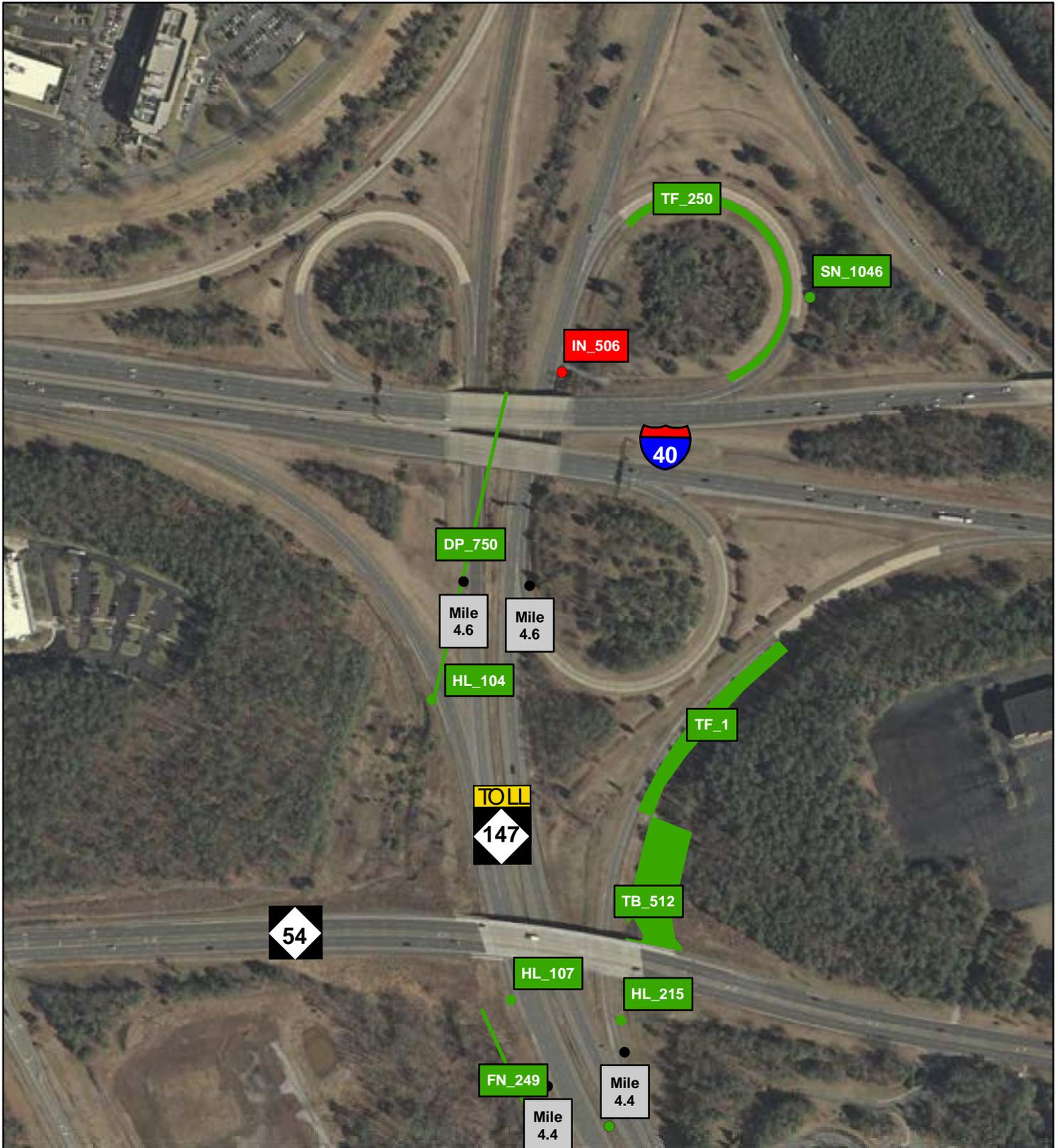


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

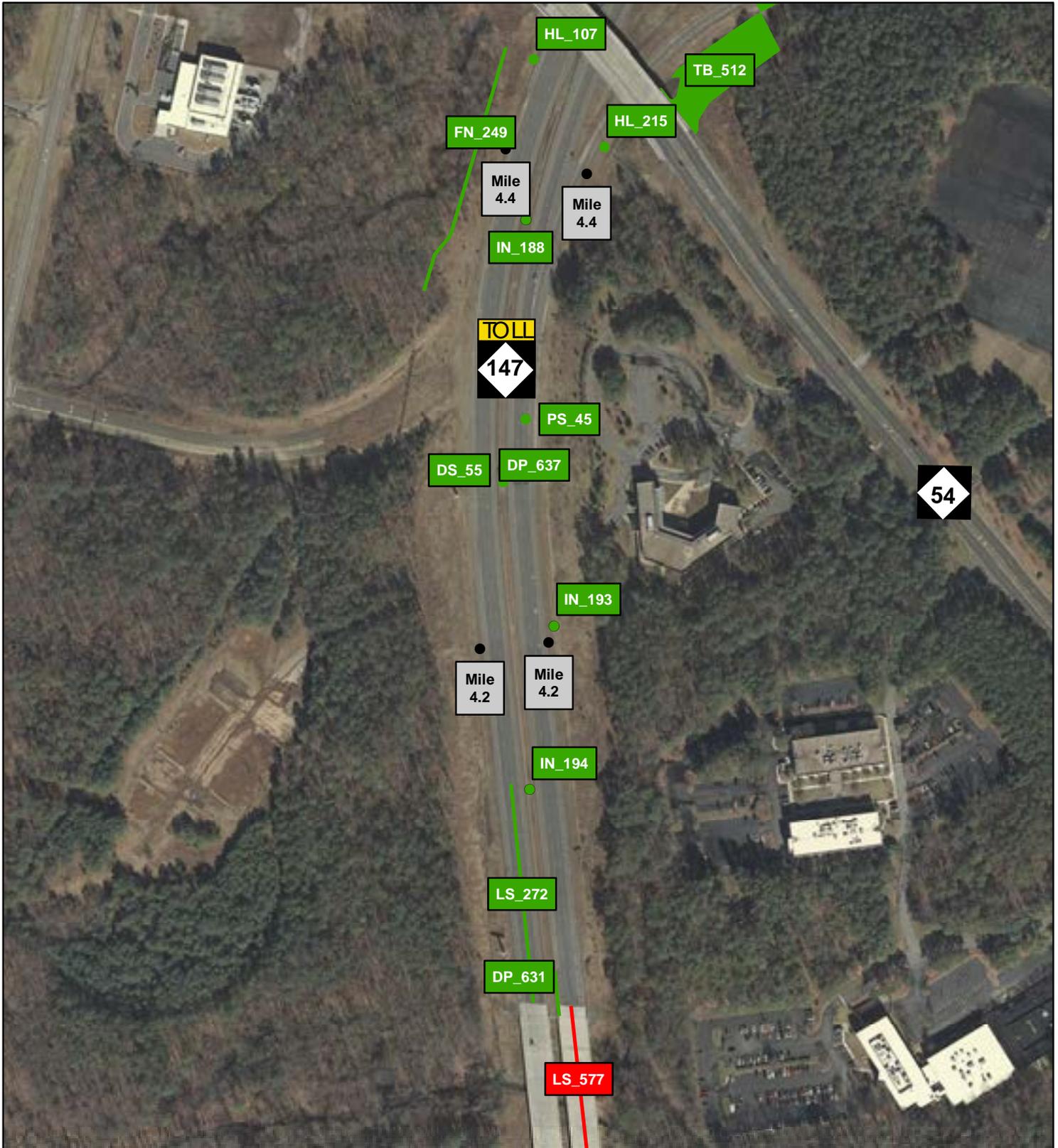


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

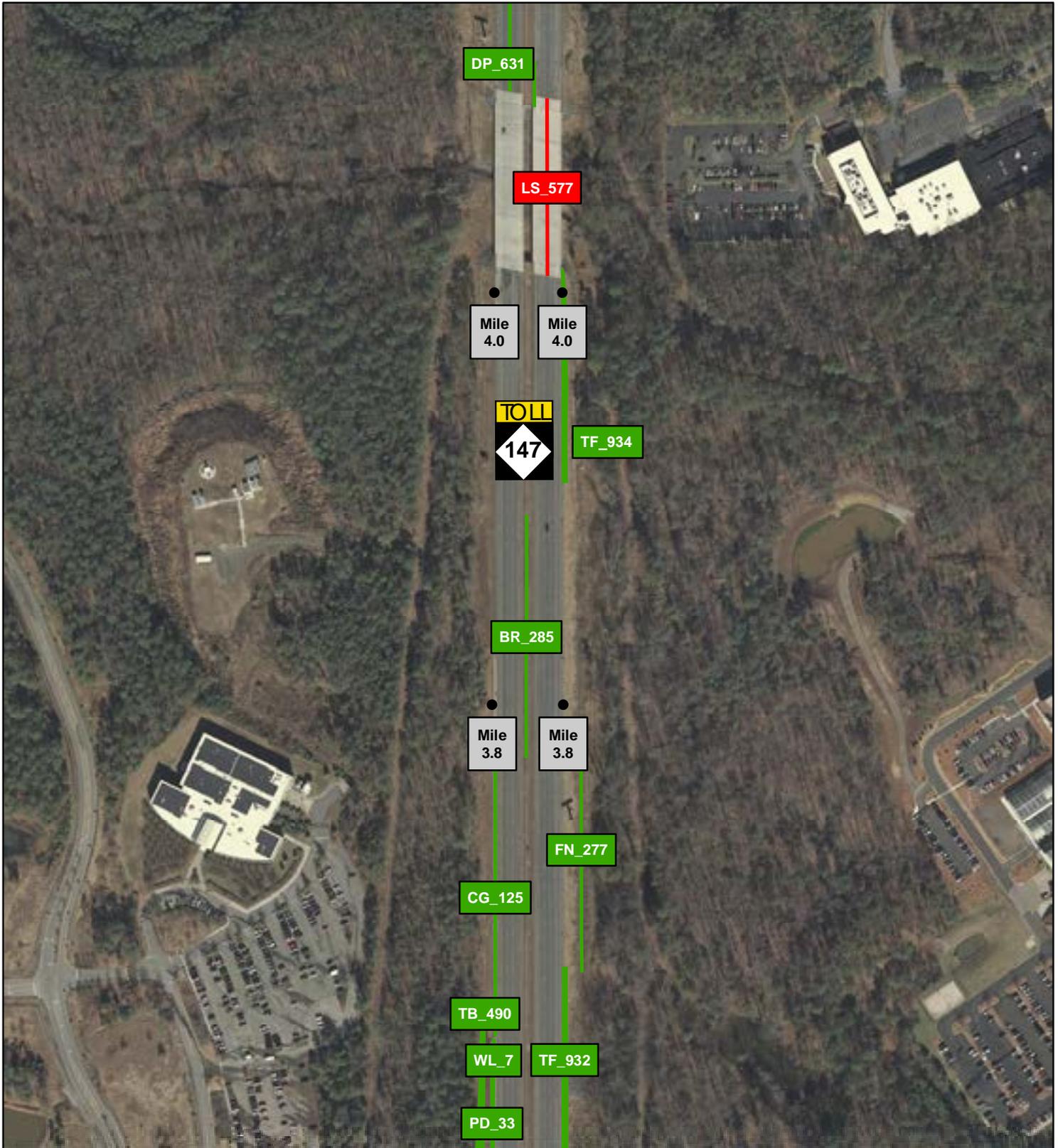


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

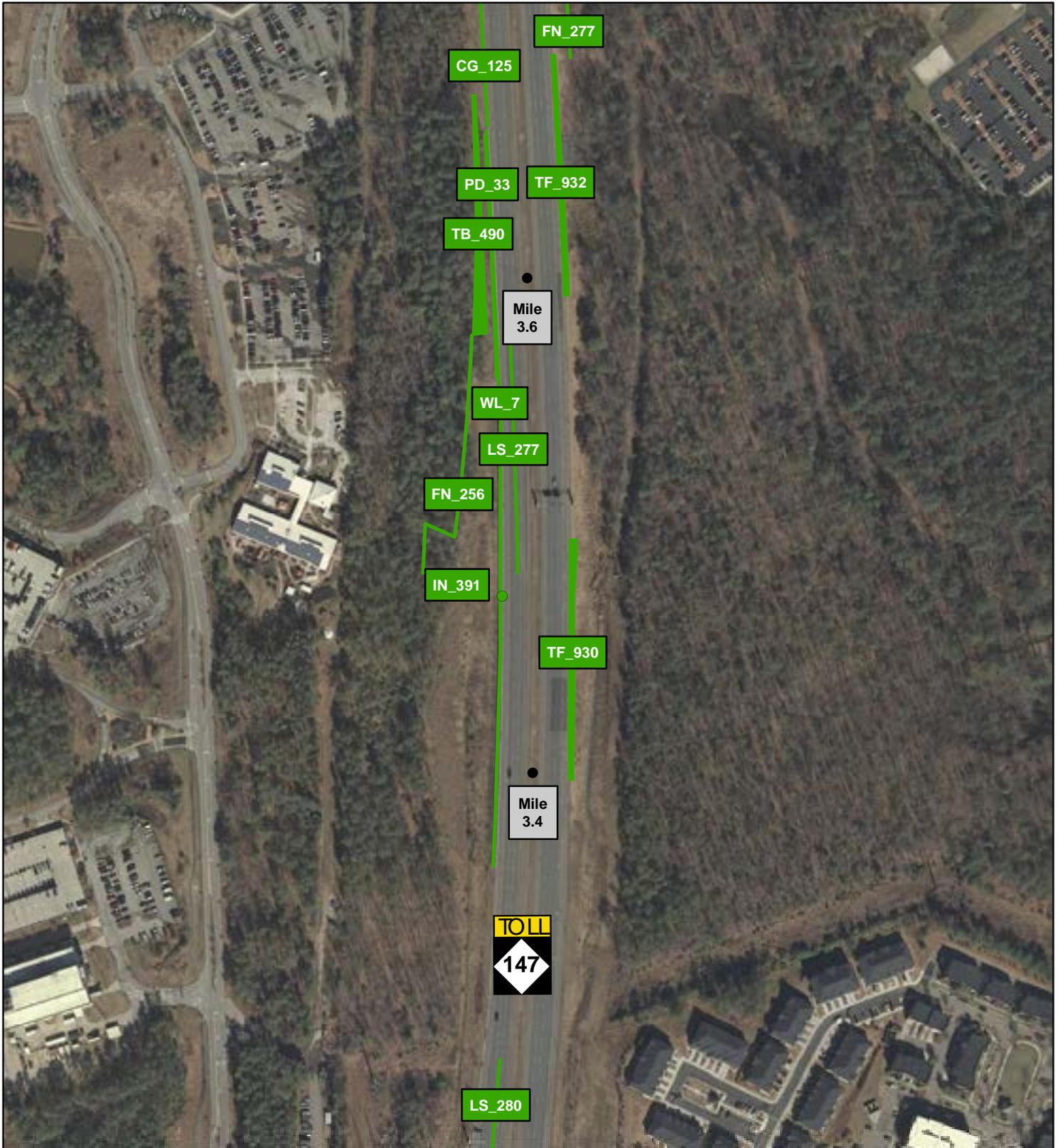


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



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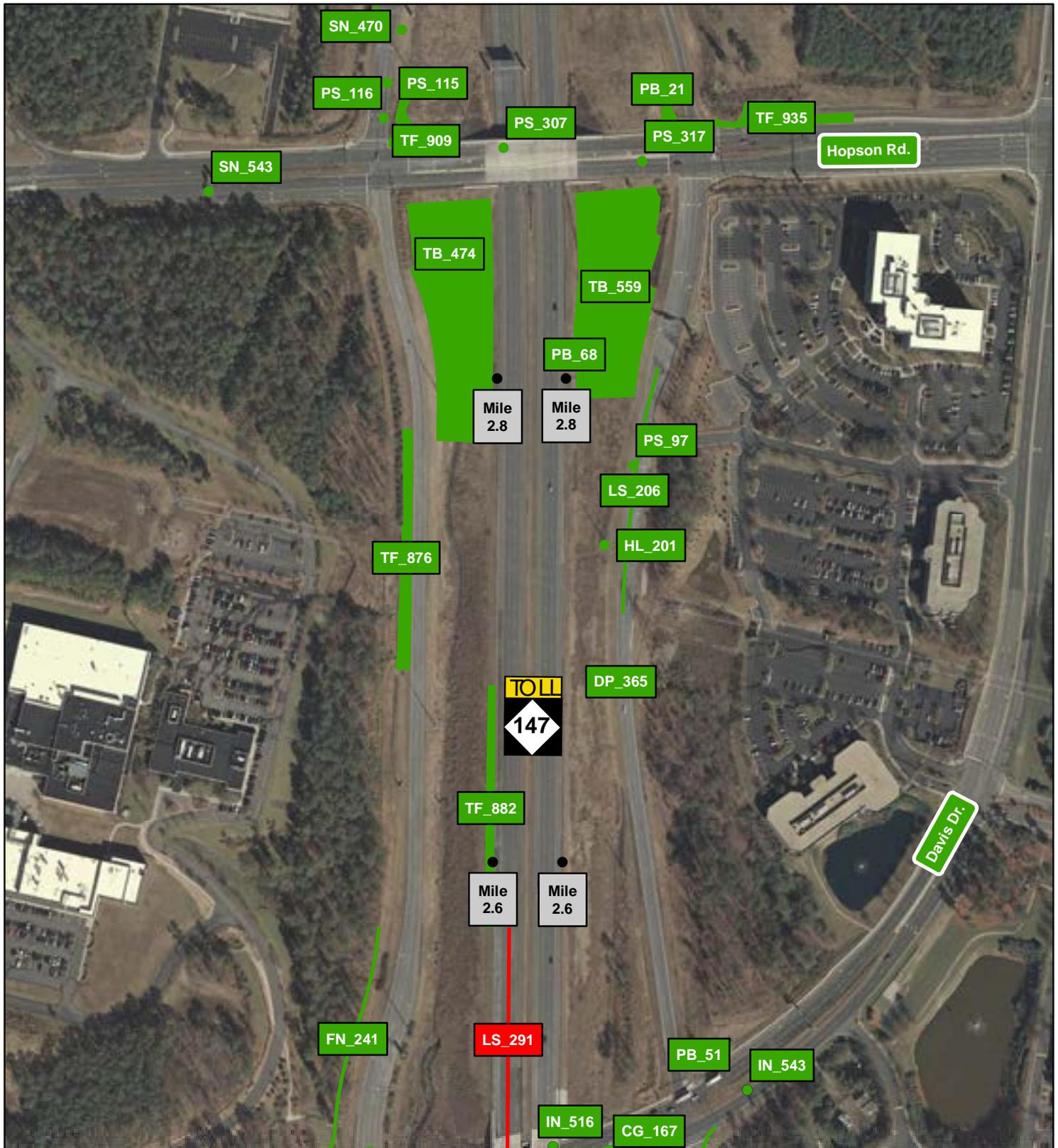


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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

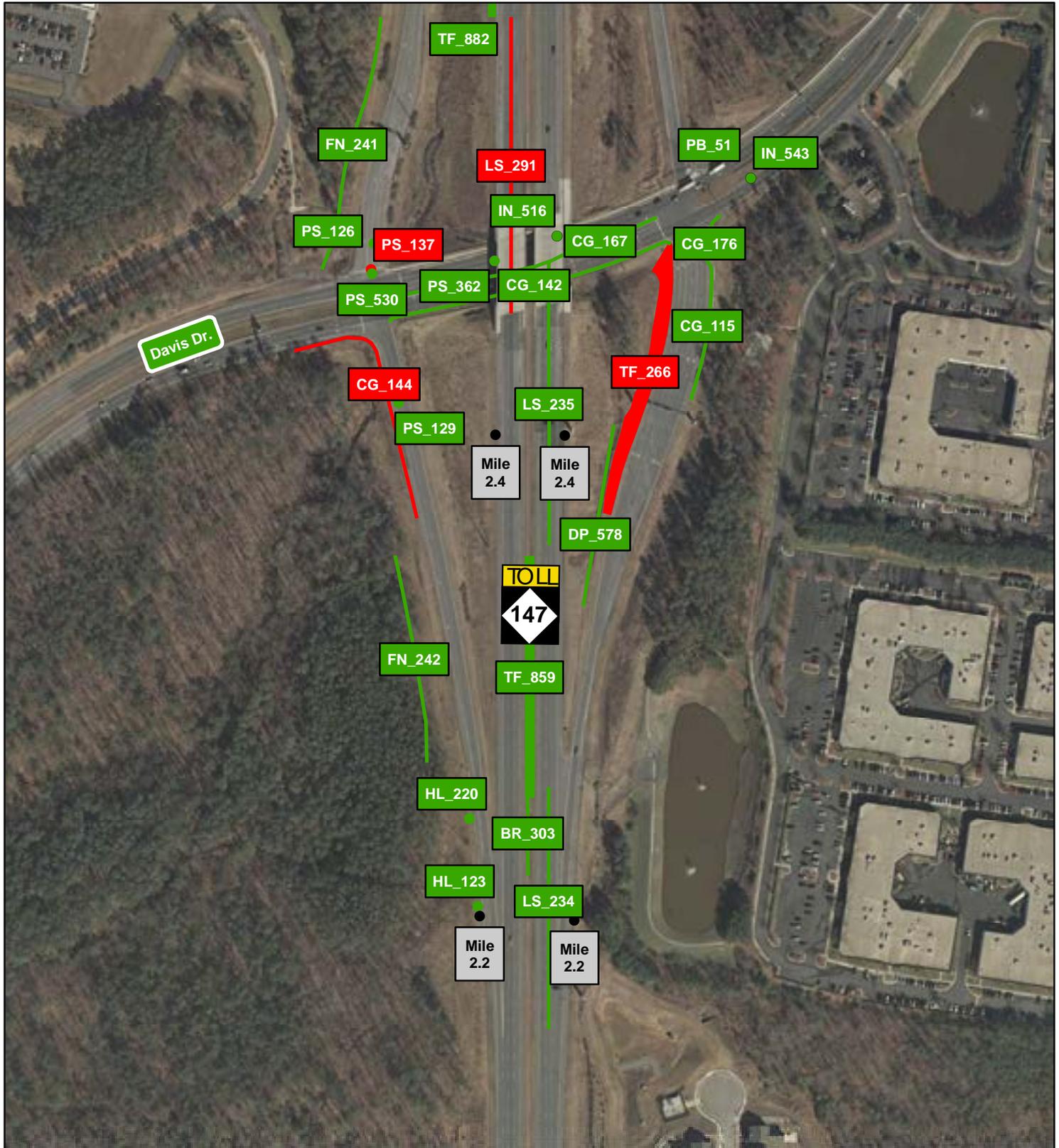


Legend

- Failing Asset
- Passing Asset

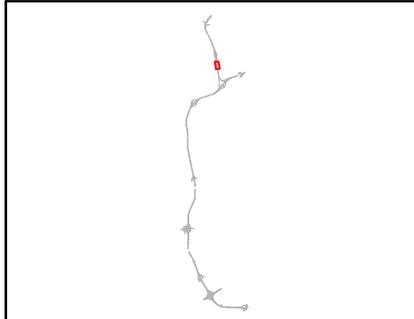


Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

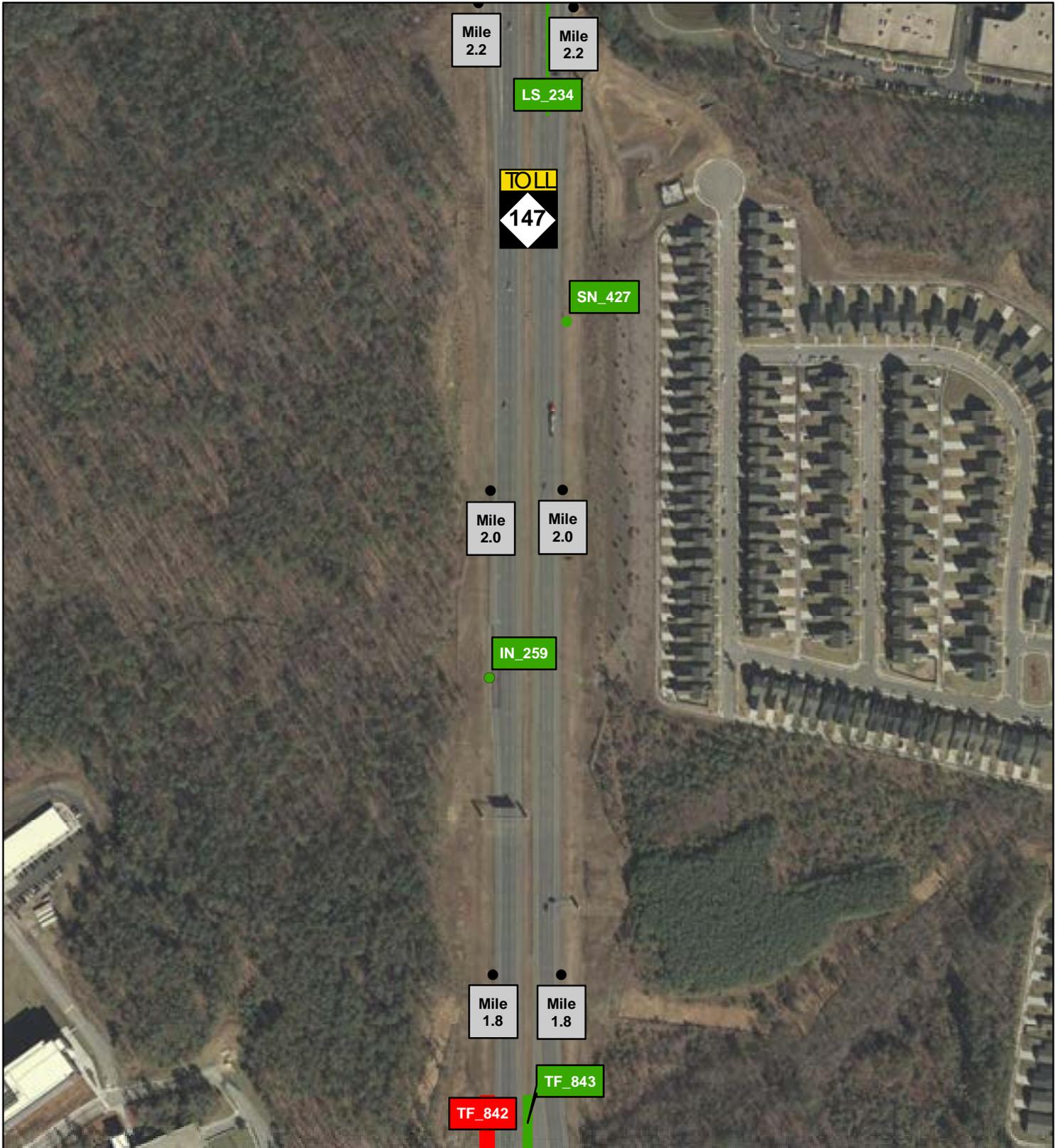


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations

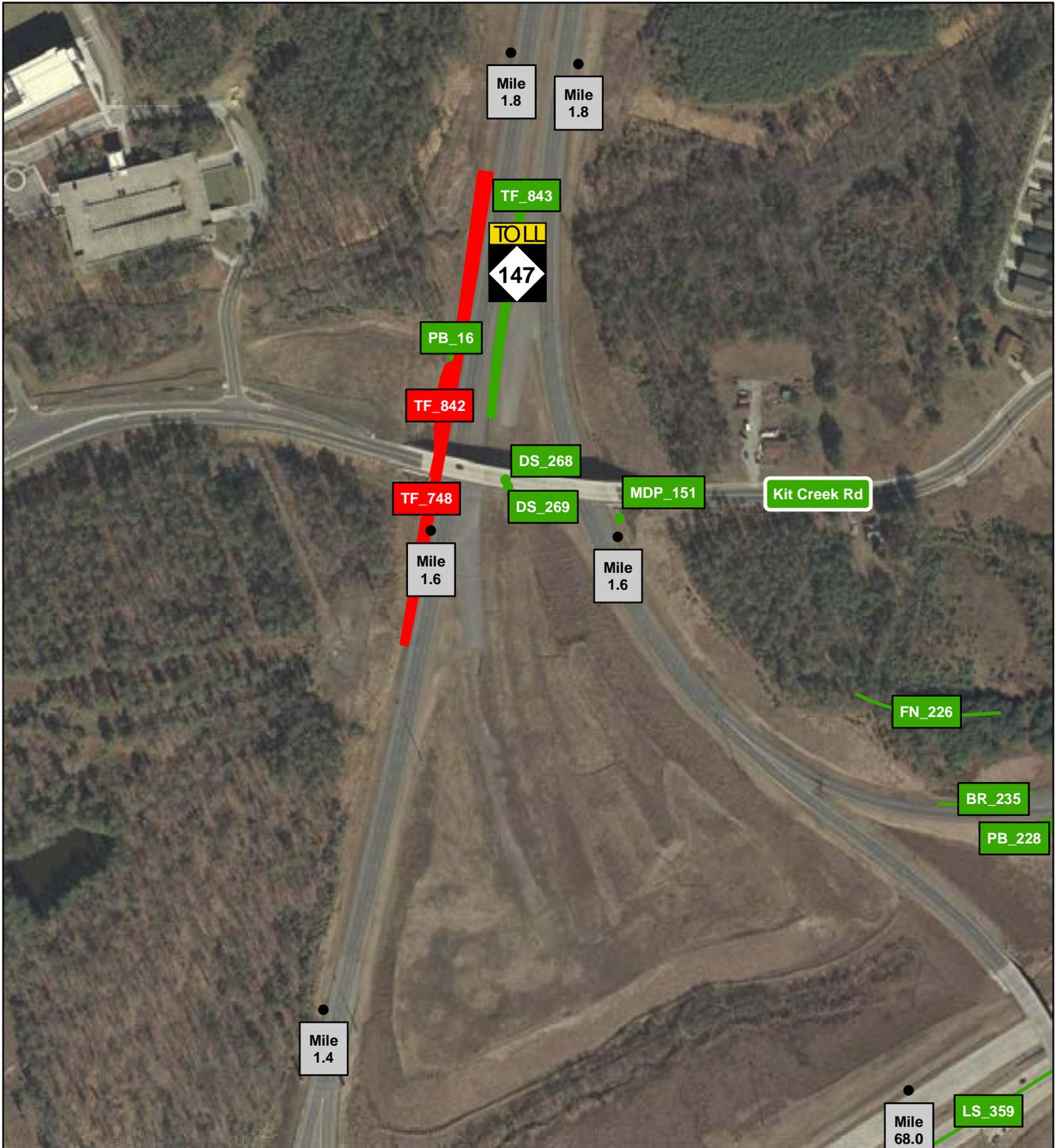


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix B

Triangle Expressway 2018 Second Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2018 Second 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)	3
Curb and Gutter (CG).....	4
Decorative Supports (DS)	5
Drainage Pipes (DP).....	6
Misc. Drainage Structure (MDP).....	7
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).....	35

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_132	Functional Damage		A10, A11

Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Berm Gutter	CG_144	Misalignment		A57

Decorative Supports (DS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Gantry Support	DS_44	Paint Scaling		A20
2	Gantry Support	DS_45	Paint Scaling		A20
3	Overhead Sign Support	DS_246	Paint Scaling		A27

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_57	Obstruction		A21, A22
2	Shoulder Drain	MDP_66	Missing Rodent Screen		A24

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_26	Hole Height		A49
2	Woven	FN_396	Fence Height, Hole Height, Open Gate		A39, A40, A41

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	Double Roadway	HL_6	Functional Damage	Not Available for Nighttime Failure.	A45
2	Single Roadway	HL_7	Functional Damage	Not Available for Nighttime Failure.	A45
3	Single Roadway	HL_17	Functional Damage	Not Available for Nighttime Failure.	A45
4	High Mast	HL_30	Missing Part		A46
5	Double Roadway	HL_93	Part Damage		A27
6	Single Roadway	HL_205	Functional Damage	Not Available for Nighttime Failure.	A55
7	High Mast	HL_274	Functional Damage	Not Available for Nighttime Failure.	A37
8	Double Roadway	HL_308	Part Damage		A31

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Single Roadway	HL_311	Part Damage, Functional Damage		A32
10	Single Roadway	HL_337	Part Damage		A51
11	Underpass Lighting	HL_351	Functional Damage	Not Available for Nighttime Failure.	A28, A29, A30

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_506	Erosion, Surface Damage	 The 'Photo' column contains two vertically stacked photographs. Both show a metal grate inlet set into a concrete surface. The top photo shows a significant amount of erosion and surface damage around the inlet, with exposed aggregate and uneven ground. The bottom photo shows a similar view, highlighting the extent of the surface degradation.	A50

Landscaping (PB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Plant Bed	PB_88	Weeds		A28, A29

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
1	Asphalt	LS_291	Paved Shoulder Crack		A56, A57

Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_10	Shoulder Drop-Off	 A photograph showing a road with a white line marking. The asphalt shoulder on the right side of the road is missing, dropping off into a grassy area.	A46
2	Concrete	LS_399	Shoulder Drop-Off	 A photograph showing a road with a white line marking. A person's legs and feet are visible on the right side of the road, standing on a concrete shoulder that is dropping off into a grassy area.	A31, A32

Front/Back Slopes (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_10	Slope Deviation		A46
2	Concrete	LS_134	Slope Deviation		A14, A15

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
This asset did not produce any failures.					

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_10	Missing Markers		A46

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_376	Missing Delineators		A41, A42
2	Concrete	LS_577	Missing Delineators		A52, A53

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
1	Stop Bar	PS_34	Nighttime Reflectivity	Not Available for Nighttime Failure	A21
2	Stop Bar	PS_137	Nighttime Reflectivity, Daytime Assesment		A57
3	Yield	PS_449	Nighttime Reflectivity, Daytime Assessment		A10, A11

Signs (SN)

#	Sign Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Mile Marker	SN_19	Height Requirement		A48, A49

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_4	Bare Ground		A8
2	Turf	TF_136	Bare Ground		A39, A40, A43
3	Turf	TF_170	Bare Ground		A41, A42
4	Turf	TF_216	Bare Ground		A28, A29, A30

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_222	Bare Ground		A28, A29
6	Turf	TF_266	Bare Ground		A57
7	Turf	TF_292	Bare Ground		A48, A49
8	Turf	TF_411	Bare Ground		A37

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Turf	TF_533	Bare Ground		A26, A27
10	Turf	TF_585	Bare Ground		A20
11	Turf	TF_589	Bare Ground		A19, A20
12	Turf	TF_595	Bare Ground		A18, A19

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
13	Turf	TF_596	Bare Ground		A18, A19
14	Turf	TF_623	Bare Ground		A16
15	Turf	TF_658	Bare Ground		A15, A16
16	Turf	TF_748	Bare Ground		A59

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
17	Turf	TF_842	Bare Ground		A58, A59
18	Turf	TF_991	Bare Ground		A10, A11
19	Turf	TF_993	Bare Ground		A10, A11

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

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	WL_36	Paint Scale		A28, A29, A30