



NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program

Triangle Expressway

2017 Second Quarter Report

1 S. Wilmington Street
Raleigh, NC 27601



Last Updated:
July 28, 2017

CONSULTANT CERTIFICATION OF COMPLETION

July 28, 2017

Dennis Jernigan, P.E.
NCTA, Director of Highway Operations
1 South Wilmington Street
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NCTA Triangle Expressway Roadway Maintenance Performance Rating Program; Q2, 2017 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 2017 Second Quarter Assessment of the Triangle Expressway.

The overall 2017 second quarter maintenance rating of the Triangle Expressway is 92.7, which is above 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 2017 Second Quarter Assessment		
Element	MRP Rating	Target Rating
Road Surface	100.0	85.0
Unpaved Shoulders and Ditches	95.5	85.0
Drainage	92.3	85.0
Roadside	87.4	85.0
Traffic Control Devices	88.5	85.0
Overall MRP Performance Rating	92.7	90.0

This report also provides a rolling rating of the latest four quarterly inspections of the Triangle Expressway. As presented in **Table 2**, the current rolling maintenance rating of the Triangle Expressway is 93.2.

Table 2: MRP Rolling Element Results					
Element	Q3 2016 Rating	Q4 2016 Rating	Q1 2017 Rating	Q2 2017 Rating	Rolling Rating
Road Surface	99.1	97.7	97.8	100.0	98.5
Unpaved Shoulders and Ditches	100.0	100.0	95.6	95.5	98.2
Drainage	87.9	93.8	86.7	92.3	90.1
Roadside	90.0	93.7	90.3	87.4	90.5
Traffic Control Devices	90.5	88.3	91.4	88.5	89.7
Overall MRP Performance Rating	93.4	93.9	92.7	92.7	93.2

In addition, the report provides findings of the Green Level Historic District signs inspection. Due to construction work during this quarter, only three of the four sign locations were inspected. These three sign locations were only inspected for landscape appearance, because of missing signs due to vandalism. All landscaped areas at the sign locations were found to be well maintained.

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.

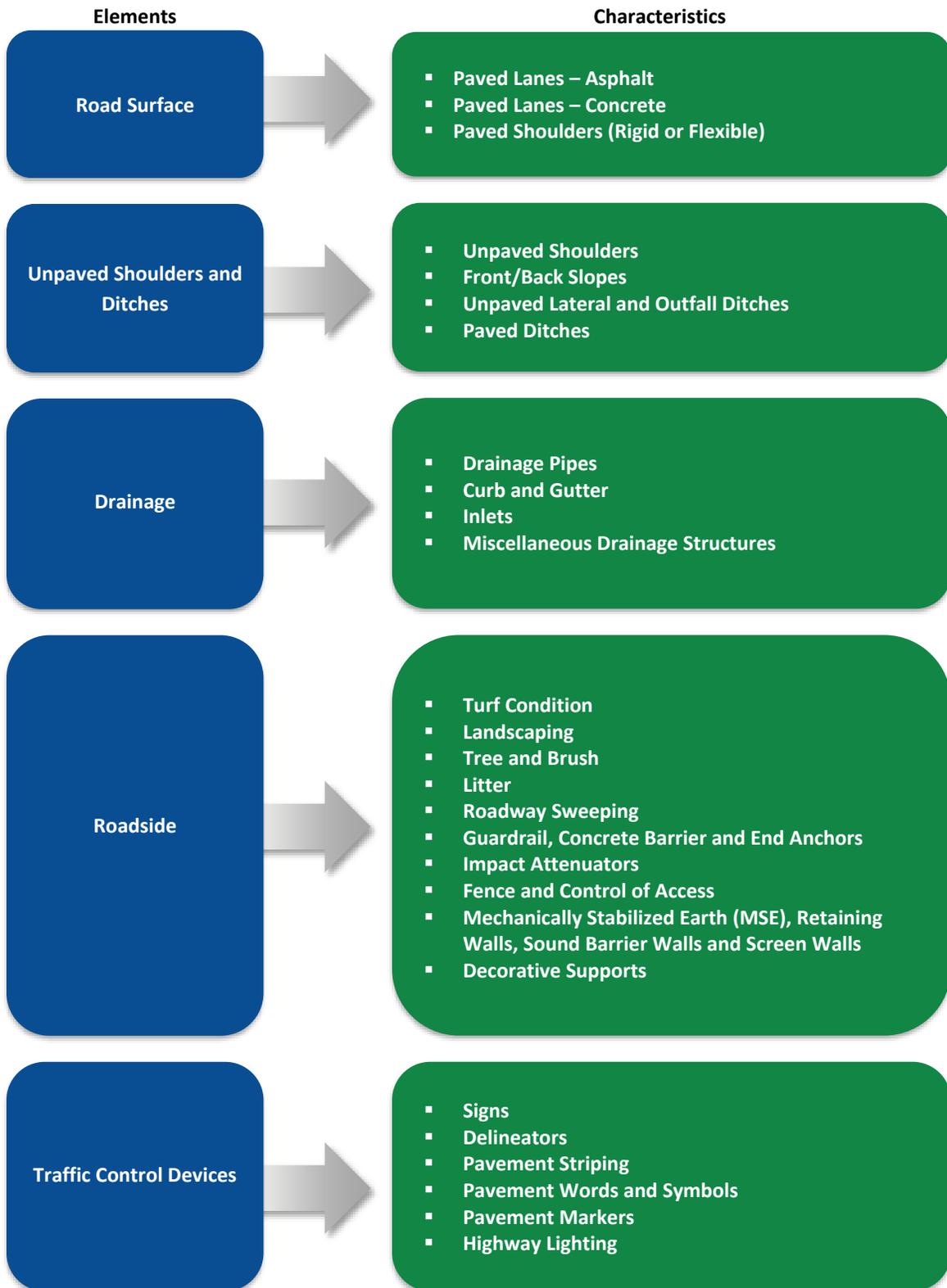
The NCTA performance standards, threshold criteria and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff and consultants.

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, a 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:

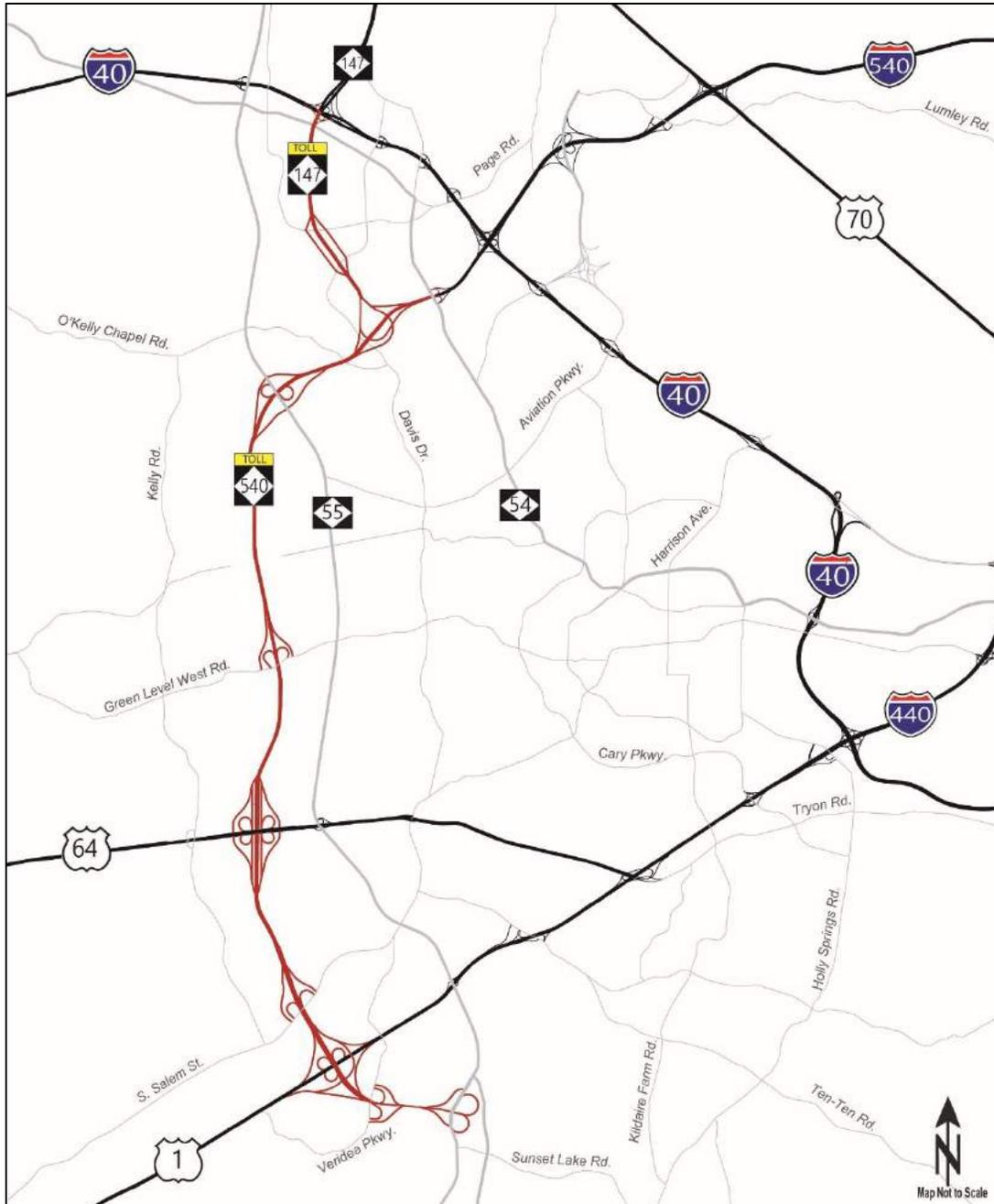
Road Surface =	25%
Unpaved Shoulders =	13%
Drainage =	15%
Roadside =	17%
Traffic Control Devices =	30%
<hr/>	
Total	100%

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, all assets located on Toll NC-540, south of US-1 and north of NC-55 Bypass, continued to be temporarily removed from the inventory due to the Access 540 Construction Project. **Table 3** presents the number of assets that were eligible for inspection during the quarter.

Table 3: Asset Inventory		
Assets	Total Inventory	2017 Eligible Inventory
Barriers	581	531
Curb and Gutter	235	215
Decorative Supports	243	220
Drainage	1135	1045
Misc. Drainage	181	159
Fences	431	376
Highway Lighting	315	291
Impact Attenuators	39	35
Inlets	968	900
Linear Segments	585	522
Plant Beds	267	257
Paved Ditches	2	1
Pavement Symbols	525	493
Signs	968	878
Tree and Brush	565	508
Turf	1010	920
Walls	83	78

With the completion of the Access 540 Project, NCTA plans to add to the inventory all assets removed due to construction work. An updated list of eligible assets will be considered during the third and fourth quarter inspections. In addition, all new assets located in the Veridea Parkway interchange will be added to the inventory by January 2018.

6.0 MRP SECOND QUARTER ASSESSMENT

6.1 Quarterly Results

The overall 2017 second quarter maintenance rating of the Triangle Expressway is 92.7, exceeding NCTA's target overall rating of 90. All elements assessed achieved ratings above the target rating of 85. Paved Ditches (0), Miscellaneous Drainage (72), Turf Condition (54), and Highway Lighting (78) are the characteristics that scored below the target rating of 80. It is important to note that these results are only representative of the second quarter sample, one of the four surveys to provide an intermediate snapshot of seasonal conditions. Therefore, they are not a statistically valid representation of the assets; only the total of all four quarterly inspections, reported 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 2017	
Element	Q2 2017 MRP Rating
Road Surface	100.0
Unpaved Shoulders and Ditches	95.5
Drainage	92.3
Roadside	87.4
Traffic Control Devices	88.5
Overall MRP Performance Rating	92.7

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Table 5: MRP Characteristic Results for Q2 2017						
Road Surface	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Paved Lanes Asphalt	12	12	9	108	108	100
Paved Lanes Concrete	12	12	9	108	108	100
Paved Shoulder	24	24	5	120	120	100
Element Total				336	336	100.0
Unpaved Shoulders and Ditches	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Unpaved Shoulder	22	24	9	198	216	92
Front/Back Slopes	24	24	6	144	144	100
Lateral and Outfall Ditches, Unpaved	24	24	6	144	144	100
Ditches, Paved	0	1	5	0	5	0
Element Total				486	509	95.5
Drainage	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Drainage Pipes	34	34	7	238	238	100
Curb and Gutter	21	24	6	126	144	88
Inlets	33	34	7	231	238	97
Misc. Drainage Structure	21	29	4	84	116	72
Element Total				679	736	92.3
Roadside	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Turf Condition	28	52	7	196	364	54
Landscaping	25	25	4	100	100	100
Trees and Brush	30	30	4	120	120	100
Litter	24	24	4	96	96	100
Roadway Sweeping	24	24	5	120	120	100
Guardrail, Concrete Barrier and End Anchors	30	31	9	270	279	97
Impact Attenuators	8	8	9	72	72	100
Fence, Control Access	26	28	7	182	196	93
Retaining Walls and Sound Barrier Walls	14	14	5	70	70	100
Decorative Supports	22	24	5	110	120	92
Graffiti and Stain Removal	23	24	4	92	96	96
Element Total				1428	1633	87.4
Traffic Control Devices	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q2 Rating
Signs	33	36	7	231	252	92
Delineators	17	17	3	51	51	100
Pavement Striping/Marking	21	24	8	168	192	88
Words and Symbols	29	30	7	203	210	97
Pavement Markers	21	24	9	189	216	88
Highway Lighting	31	40	6	186	240	78
Element Total				1028	1161	88.5

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

6.2 Analysis and Recommendations

Elements

During the second quarter, all elements exceeded NCTA's threshold criteria of 85. Road Surface (100) and Unpaved Shoulder/Ditches (96) continued to obtain ratings higher than 95, while Drainage (92) obtained a rating just above 90. Roadside (87) and Traffic Control Devices (89) were the only elements that obtained a rating lower than 90.

Drainage (92) was the element that experienced the highest increase in rating compared to the previous quarter. The rating obtained for this element was 5 points higher than the rating obtained during the first quarter of 2017. This increase in the Drainage rating is mostly related to higher ratings obtained for Miscellaneous Drainage Structures, which increased by 17 points after increasing the frequency of routine patrols to every two months.

Roadside (87) and Traffic Control Devices (89) were the two elements that experienced a decrease in rating compared to the previous quarter. During this quarter, the rating obtained for Roadside (87) was 3 points lower than the previous quarter due to a lower rating obtained for Turf (54). Similarly, the rating obtained for Traffic Control Devices (89) was 2 points lower than the previous quarter due to lower ratings obtained for Pavement Striping/Marking (88) and Pavement Markers (88).

Recommendations to improve the most critical characteristic ratings and therefore continue to meet or exceed NCTA's threshold criteria are provided in the following sections.

Characteristics

This quarter all but four characteristics, Paved Ditches (0), Miscellaneous Drainage Structure (72), Turf Condition (54), and Highway Lighting (78) met the NCTA target threshold criteria of 80. It should be noted that there is only one paved ditch on Triangle Expressway, which is inspected quarterly. Such low inventory causes a single failure to have more weight in the overall rating of the characteristic. A description of the characteristics' conditions and future work planning recommendations are provided below. Pictures of the failures are included in **Appendix B**.

Paved Ditches (0 rating – 1 of the 1 asset failed): During this inspection, the paved ditch failed for material accumulation, as presented in **Figure 3**.

Figure 3: Paved Ditch Failure



To prevent future paved ditch material accumulation failures, it is recommended that the maintenance provider inspect this asset regularly, pursuant to the *NCTA Roadway and Facility Maintenance Standards V4*, referenced below. During each inspection, it is also recommended that the maintenance provider remove any debris accumulation observed.

Maintenance Program:

- 1) Ditch lines shall be inspected by routine patrols. Evidence of undermining or erosion/siltation shall be scheduled for repair within the annual work program.
- 2) Finished work shall conform to the lines and grades of the typical section in the area where the work is being performed.
- 3) Grade site(s) to meet adjacent contours and provide flow for surface drainage.

Maintenance and Evaluation Standards:

Ditches Paved do not meet the maintenance standards when any of the following criteria is observed:

- 1) Accumulation of material greater than 25% of the depth of the ditch.
- 2) Undermining or erosion is present at either end or along the parallel edges that threatens the structural integrity.
- 3) Settlement or misalignment greater than 2 inches.
- 4) More than 10% of the surface area has cracking exceeding 0.5 inches in width.

Miscellaneous Drainage (72 rating – 8 of the 29 assets failed): Out of the 8 miscellaneous drainage failures, 5 occurred due to obstruction and 3 occurred due to erosion. Two of the failing miscellaneous drainage structures are presented in **Figure 4**.

Figure 4: Miscellaneous Drainage Failures



In accordance with *NCTA Roadway and Facility Maintenance Standards V4*, referenced below, it is recommended that the maintenance provider plan annual cleaning of these drainage features to remove any debris or overgrown vegetation. It is also recommended that the maintenance provider continues to follow the new routine patrol schedule and that repairs of any erosion and soil buildup problems along the ditch line near and adjacent to the outlets be scheduled as soon as possible. Shoulder/Under drains are a critical component of extending the life cycle of pavements as they provide a means for water to drain away from the subgrade and base.

Miscellaneous Drainage Maintenance Program Standards:

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

Miscellaneous Drainage Evaluation Standards:

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

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

It should be noted that some of the obstruction failures are a result of inadequate gradient flow away from the edge drain outlets. To avoid affecting the natural flow of water near the drainage features and potential pavement failures, it is recommended that outlet elevations be checked against the outflow ditch elevations to ensure positive drainage. Appropriate grading of the ditch line may be necessary to provide positive flow.

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Turf Condition (54 rating – 24 of the 52 assets failed): Out of the 24 turf failures, 18 occurred due to high grass and 6 occurred due to bare ground. Two of the failing turf areas are presented in **Figure 5**.

Figure 5: Turf Failures



High grass was the dominant failure observed during this quarterly inspection. This was due to the inspection taking place days prior to the beginning of the mowing cycle scheduled for the month of May. To continue to improve Turf's rating, it is recommended that the maintenance provider continue the seeding process of bare ground areas with warm season grasses during the summer. In addition, it is recommended that the maintenance provider continue to monitor mowing heights during the 2017 mowing cycle 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:
 - i. Apply limestone.
 - ii. Apply fertilizer.
 - b. Spring:

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- 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 2% of the vegetation exceeds a uniform height of 12 inches. Minimum height not less than 4 inches.
- 2) More than 25% of the undesirable vegetation is present within the mowing limits of the area.
- 3) Noxious weeds present.
- 4) More than 50 cumulative SF of bare ground is present in the turf evaluation area.

Highway Lighting (78 rating – 9 of the 40 assets failed): Out of the 40 highway lights inspected, 3 failed due to functional damage, 3 failed due to damaged parts, and 3 failed due to missing parts. Two of the failing highway lights are presented in **Figure 6**.

Figure 6: Highway Lighting Failures



To increase this asset's rating, it is recommended that all non-functioning or 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.

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.
- 2) Perform cleaning of glassware at the same time as any routine maintenance function or diagnostic action is performed.

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- 3) Replace any light poles damaged by traffic within 5 days or within 14 days if any foundations need pouring.

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. (N)
- 3) More than 10% of the poles are damaged or missing.
- 4) Rodent screen protection is not in place.

Other Characteristics: During this quarter, lower ratings were obtained for Pavement Striping/Marking (88), and Pavement Markers (88). These ratings are most likely an indication that pavement striping and symbols, as well as pavement markers installed over four years ago are reaching the end of their life cycle. The lifespan of epoxy paint and reflective pavement markers (RPM's) is estimated to be between 3 to 5 years.

In addition, pavement striping inspections (retro-reflectivity tests) were conducted during the months of March, April, and May throughout the facility. These tests were conducted using mobile retroreflectometers (LTL) to detect pavement striping segments that are not meeting the required reflectivity level of 100 mcd/lux/m². The test revealed that white skip lines on Toll NC-540 are not meeting the required minimum reflectivity levels.

Based on the results obtained from the second quarter inspections and the results from the retro-reflectivity tests, NCTA started preparations in the budget and work schedule to replace pavement marker lenses and pavement striping throughout the facility.

7.0 CURRENT ROLLING MRP RATING

The current rolling maintenance rating of the Triangle Expressway is 93.2, exceeding NCTA's target overall rating of 90. All element ratings exceeded the target rating of 85. Also, all but four characteristics' ratings met or exceeded the target rating of 80. Ratings for Paved Ditches, Miscellaneous Drainage Structure, Turf Condition, and Highway Lighting are 75, 67, 70, and 74, 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.

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Table 6: MRP Rolling Characteristic Results					
Road Surface	Q3 2016 Rating	Q4 2016 Rating	Q1 2017 Rating	Q2 2017 Rating	Rolling Rating
Paved Lanes Asphalt	100	95	100	100	98
Paved Lanes Concrete	100	100	100	100	100
Paved Shoulder	98	98	94	100	97
Element Total	99.1	97.7	97.8	100.0	98.5
Unpaved Shoulders and Ditches	Q3 2016 Rating	Q4 2016 Rating	Q1 2017 Rating	Q2 2017 Rating	Rolling Rating
Unpaved Shoulder	100	100	94	92	97
Front/Back Slopes	100	100	94	100	99
Lateral and Outfall Ditches, Unpaved	100	100	100	100	100
Ditches, Paved	100	100	100	0	75
Element Total	100.0	100.0	95.6	95.5	98.2
Drainage	Q3 2016 Rating	Q4 2016 Rating	Q1 2017 Rating	Q2 2017 Rating	Rolling Rating
Drainage Pipes	97	100	91	100	97
Curb and Gutter	92	100	92	88	93
Inlets	88	91	97	97	93
Misc. Drainage Structure	64	78	55	72	67
Element Total	87.9	93.8	86.7	92.3	90.1
Roadside	Q3 2016 Rating	Q4 2016 Rating	Q1 2017 Rating	Q2 2017 Rating	Rolling Rating
Turf Condition	63	83	75	54	70
Landscaping	100	100	96	100	99
Trees and Brush	100	100	100	100	100
Litter	100	100	97	100	99
Roadway Sweeping	100	100	100	100	100
Guardrail, Concrete Barrier and End Anchors	100	100	97	97	98
Impact Attenuators	100	100	100	100	100
Fence, Control Access	96	88	79	93	89
Retaining Walls and Sound Barrier Walls	100	85	100	100	96
Decorative Supports	96	100	100	92	97
Graffiti and Stain Removal	100	100	100	96	99
Element Total	90.0	93.7	90.3	87.4	90.5
Traffic Control Devices	Q3 2016 Rating	Q4 2016 Rating	Q1 2017 Rating	Q2 2017 Rating	Rolling Rating
Signs	85	91	89	92	89
Delineators	93	97	96	100	96
Pavement Striping/Marking	98	91	97	88	94
Words and Symbols	100	100	100	97	99
Pavement Markers	95	79	97	88	89
Highway Lighting	66	81	73	78	74
Element Total	90.5	88.3	91.4	88.5	89.7

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Table 7: MRP Rolling Element Results					
Element	Q3 2016 Rating	Q4 2016 Rating	Q1 2017 Rating	Q2 2017 Rating	Rolling Rating
Road Surface	99.1	97.7	97.8	100.0	98.5
Unpaved Shoulders and Ditches	100.0	100.0	95.6	95.5	98.2
Drainage	87.9	93.8	86.7	92.3	90.1
Roadside	90.0	93.7	90.3	87.4	90.5
Traffic Control Devices	90.5	88.3	91.4	88.5	89.7
Overall MRP Performance Rating	93.4	93.9	92.7	92.7	93.2

8.0 GREEN LEVEL HISTORIC DISTRICT SIGNS

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

8.1 Analysis and Recommendations

As part of each quarterly inspection, assessors visit the four Green Level Historic District signs to conduct a visual inspection of each sign and ensure they are in good standing. During this quarter, the sign located near the intersection of Green Level Church Road and Green Level West Road was excluded from the inspection inventory due construction work in the area. The three signs included in the inspection inventory were only inspected for landscape appearance because two of the three signs were vandalized and the other sign was temporarily removed to be used as a sample to replace the vandalized signs. All landscaped areas at the location of the signs were found to be well maintained (*Figure 7*).

It should be noted that as of July 24th, 2017, three of the four Green Level Historic District signs have been replaced.

Figure 7: Green Level West Historic District Signs, Landscape Areas



9.0 CONCLUSION

This report presents the 2017 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 2017 overall rating is **92.7** and the current rolling rating is **93.2**, both ratings are above the target rating of 90.

All second quarter and rolling element ratings were above the target rating of 85. During the second quarter assessment, all but four characteristics met or exceeded the target rating of 80. These four characteristics are Paved Ditches (0), Miscellaneous Drainage Structure (72), Turf Condition (54), and Highway Lighting (78). Similarly, based on the cumulative rolling assessment Paved Ditches (75), Miscellaneous Drainage Structure (67), Turf Condition (70), and Highway Lighting (74) fell below NCTA's target rating.

To improve the quarterly and rolling ratings, it is recommended that the maintenance provider continue to conduct routine patrols of miscellaneous drainage structures every two months, in addition to removing annually any debris or overgrown vegetation that may impair outflow from the outlets. It is also recommended that all erosion soil buildup problems identified along the ditch line near and adjacent to the outlets be corrected. Additionally, it is recommended that outlet elevations be checked against the outflow ditch elevations to ensure positive drainage and prevent drain outlets from backing up with water. Applicable grading of the ditch line may be necessary to provide positive flow.

Also, it is recommended that the maintenance provider repair and/or replace all damaged highway lights and that paved ditches be inspected and cleaned regularly. In addition, mowing heights should continue to be closely monitored during each mowing cycle, and bare areas seeding/fertilization efforts should be continued to promote new growth.

Routine attention and planning should continue to be given to the nighttime visibility program. While the rating for Pavement Striping/Marking (88) and Pavement Markers (88) continue to meet/exceed the target rating, lower rating scores and retro-reflectivity tests have shown that pavement markers and pavement striping throughout the facility are approaching the end of their life cycle. Preparations made in the budget and work schedule for the replacement of pavement marker lenses and pavement striping would help meet NCTA's target rating for the Roadside element and improve nighttime visibility and safety for its customers.

This quarter, only three of the four Green Level Historic District sign locations were inspected due to construction work. The three sign locations were only inspected for landscape appearance because of missing signs due to vandalism. All landscaped areas at each location were found to be well maintained. NCTA is currently working towards replacing all Green Level Historic District signs.

Appendix A

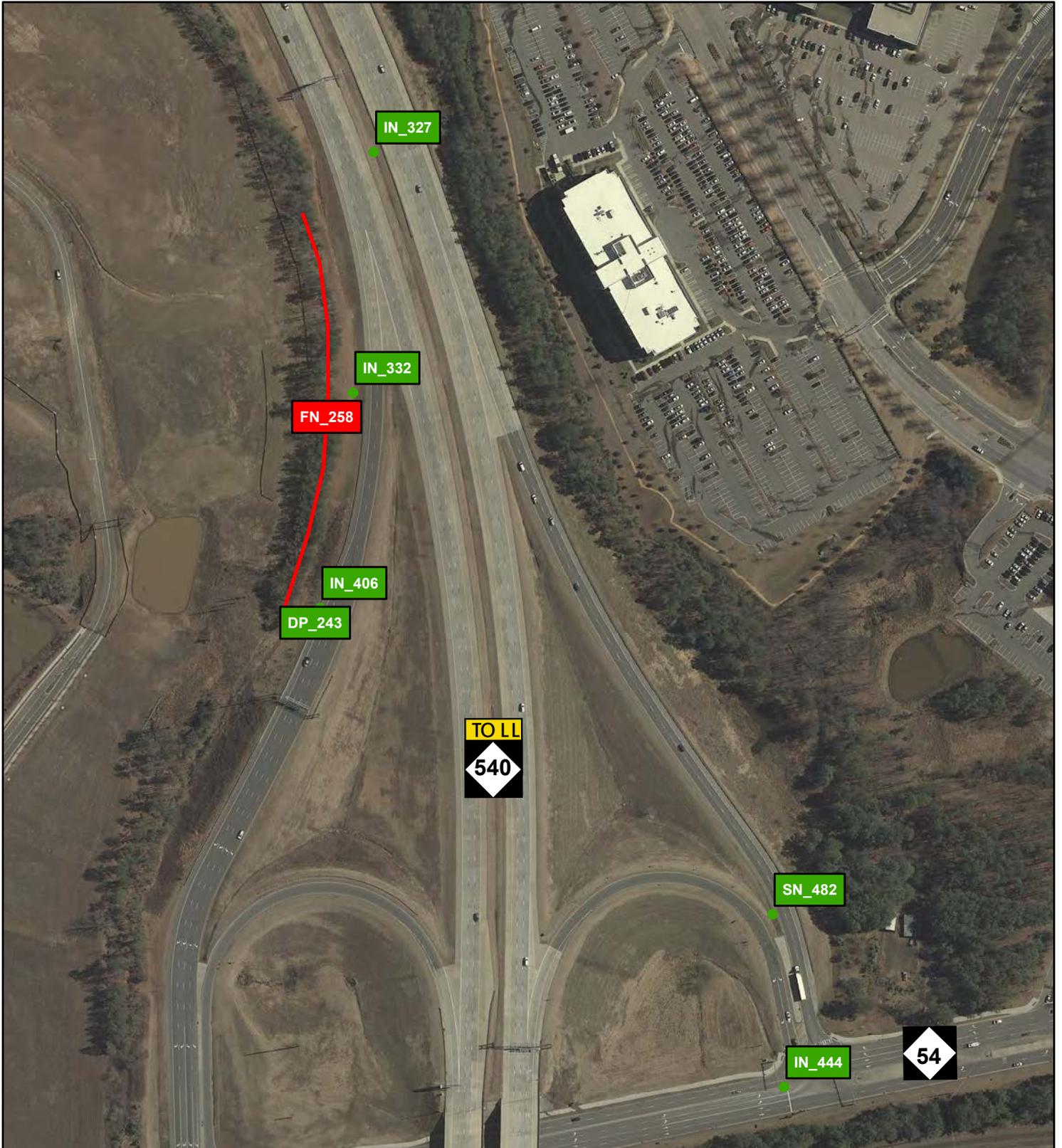
Triangle Expressway 2017 Second Quarter Asset Assessment Locations

Appendix A: Triangle Expressway 2017 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 2017 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

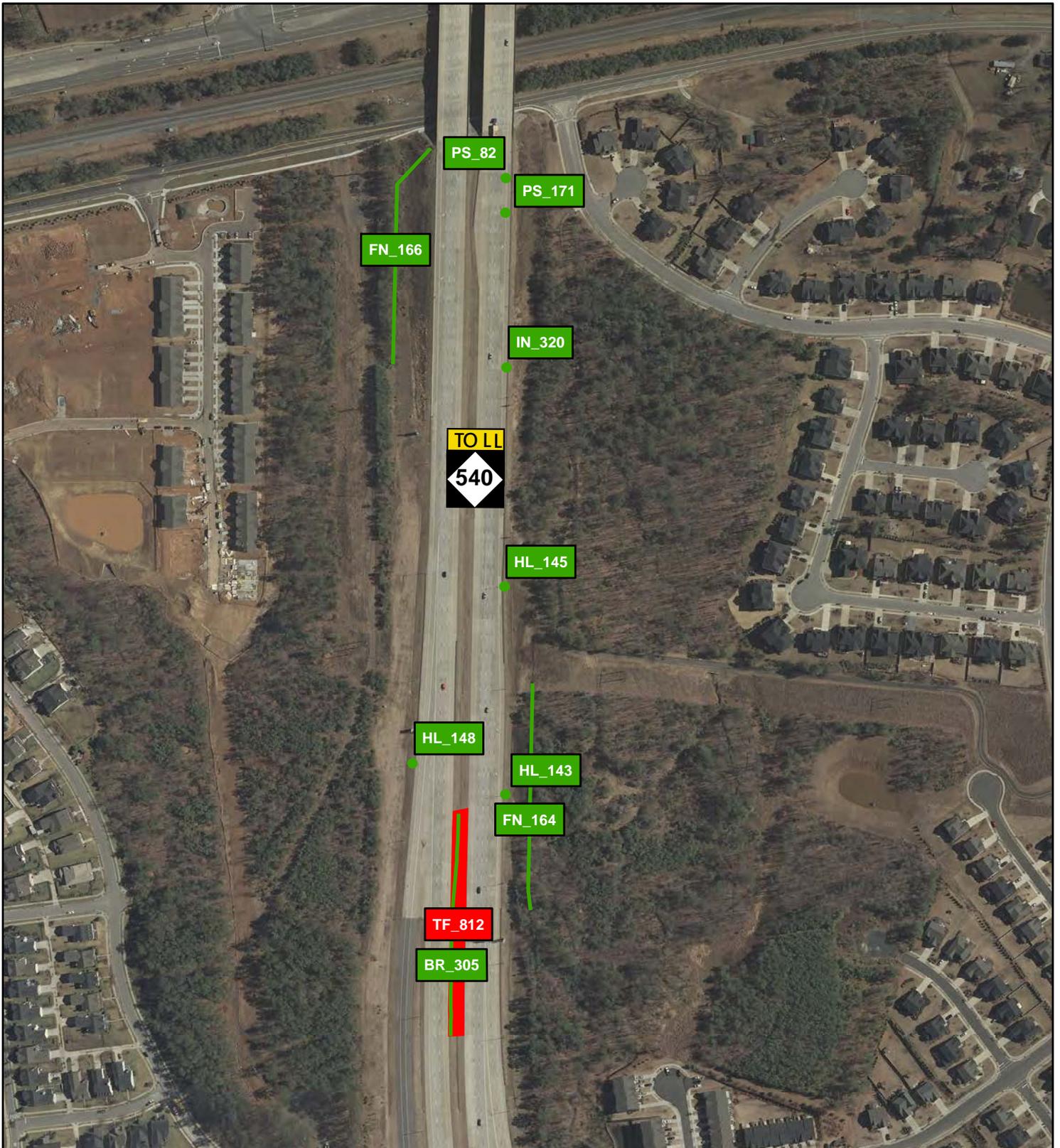


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

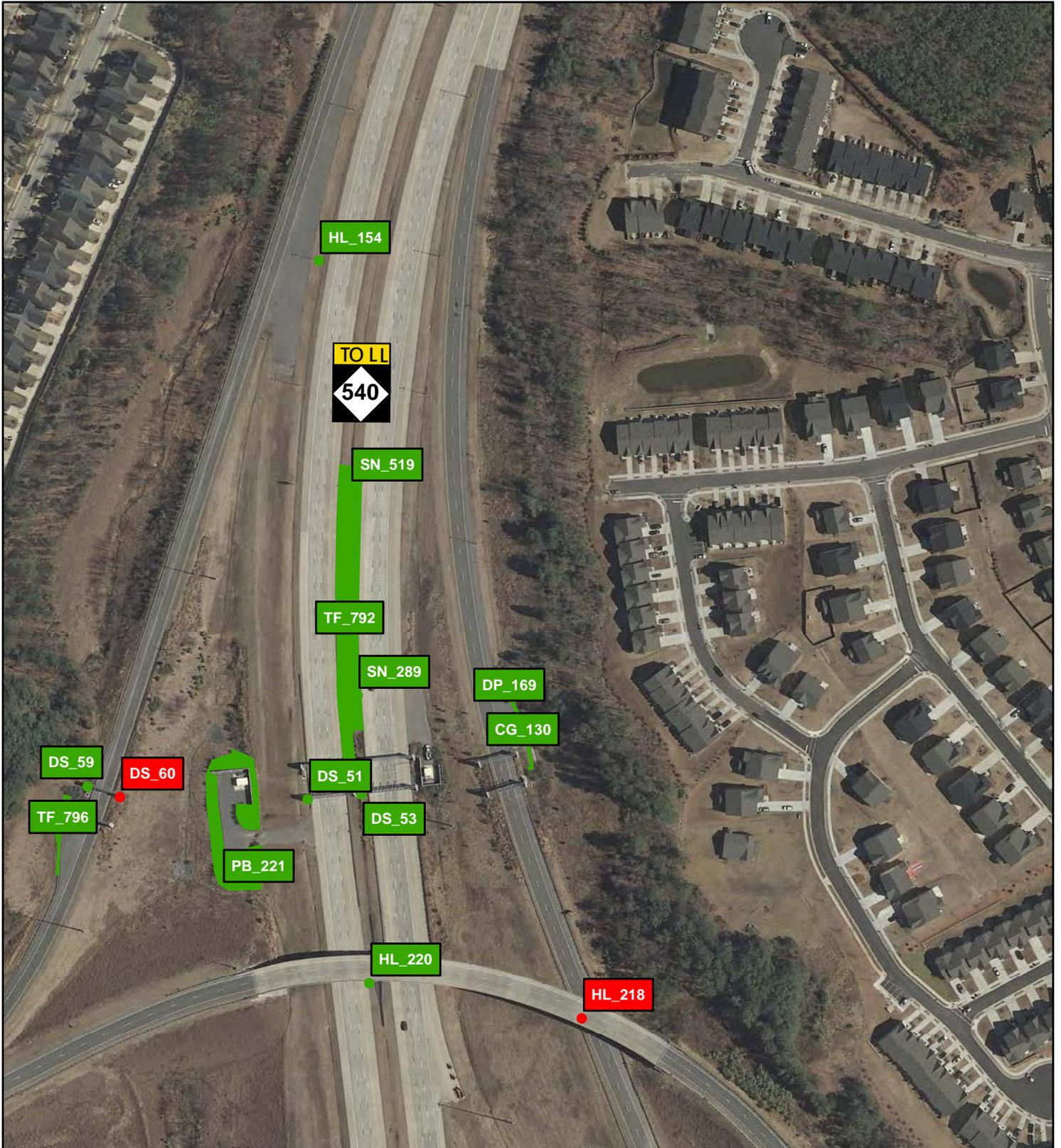


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

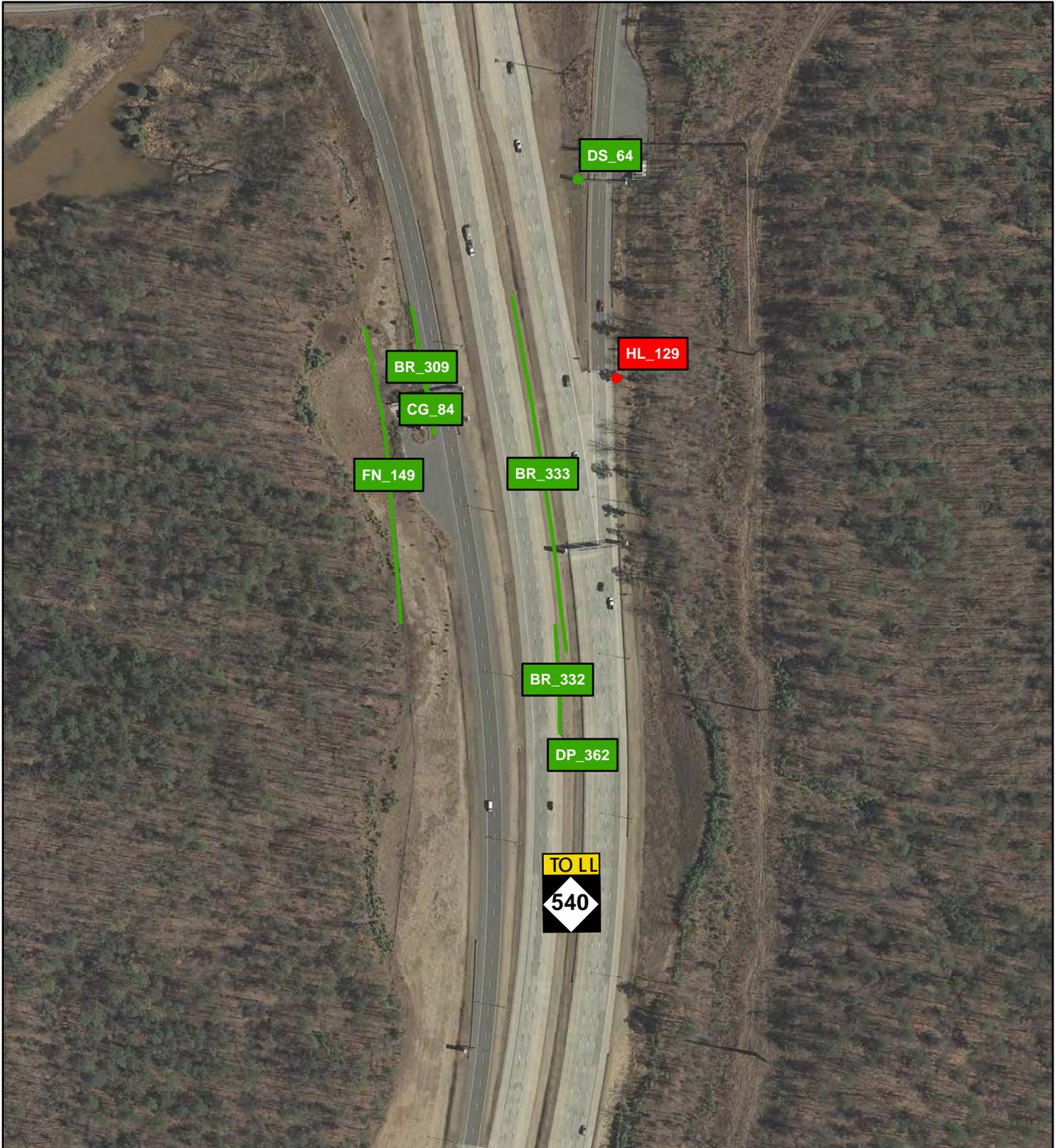


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

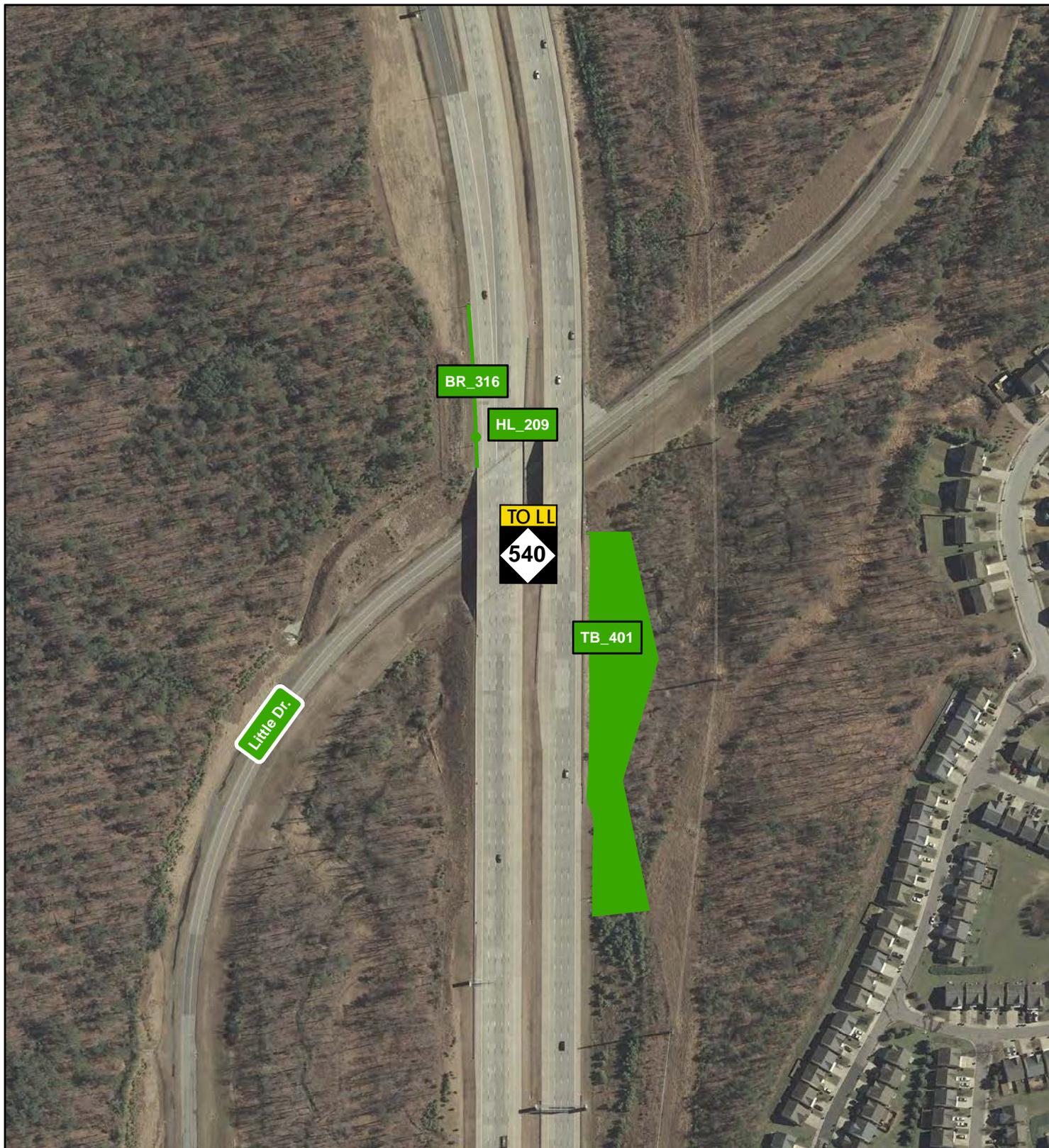


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

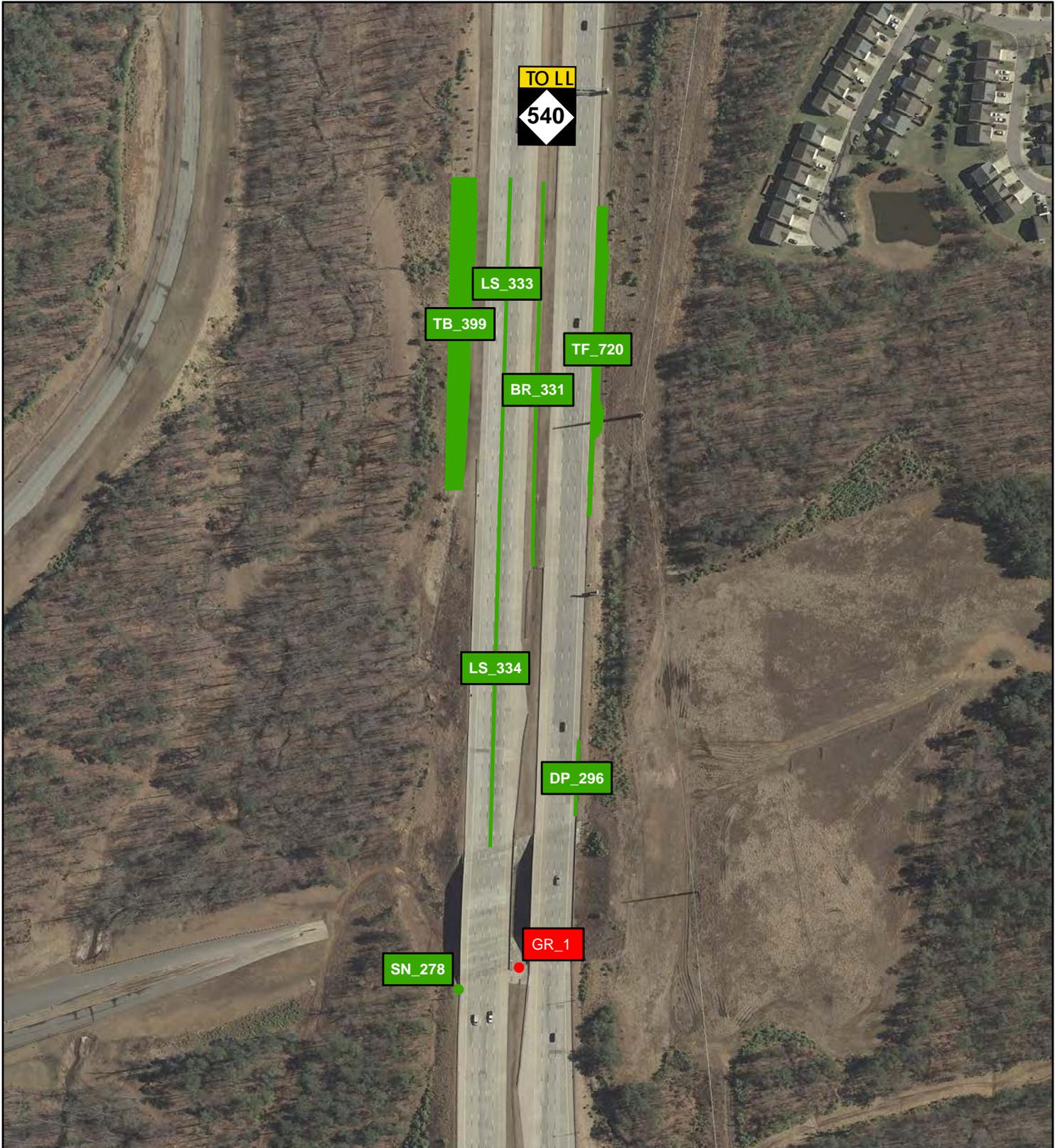


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

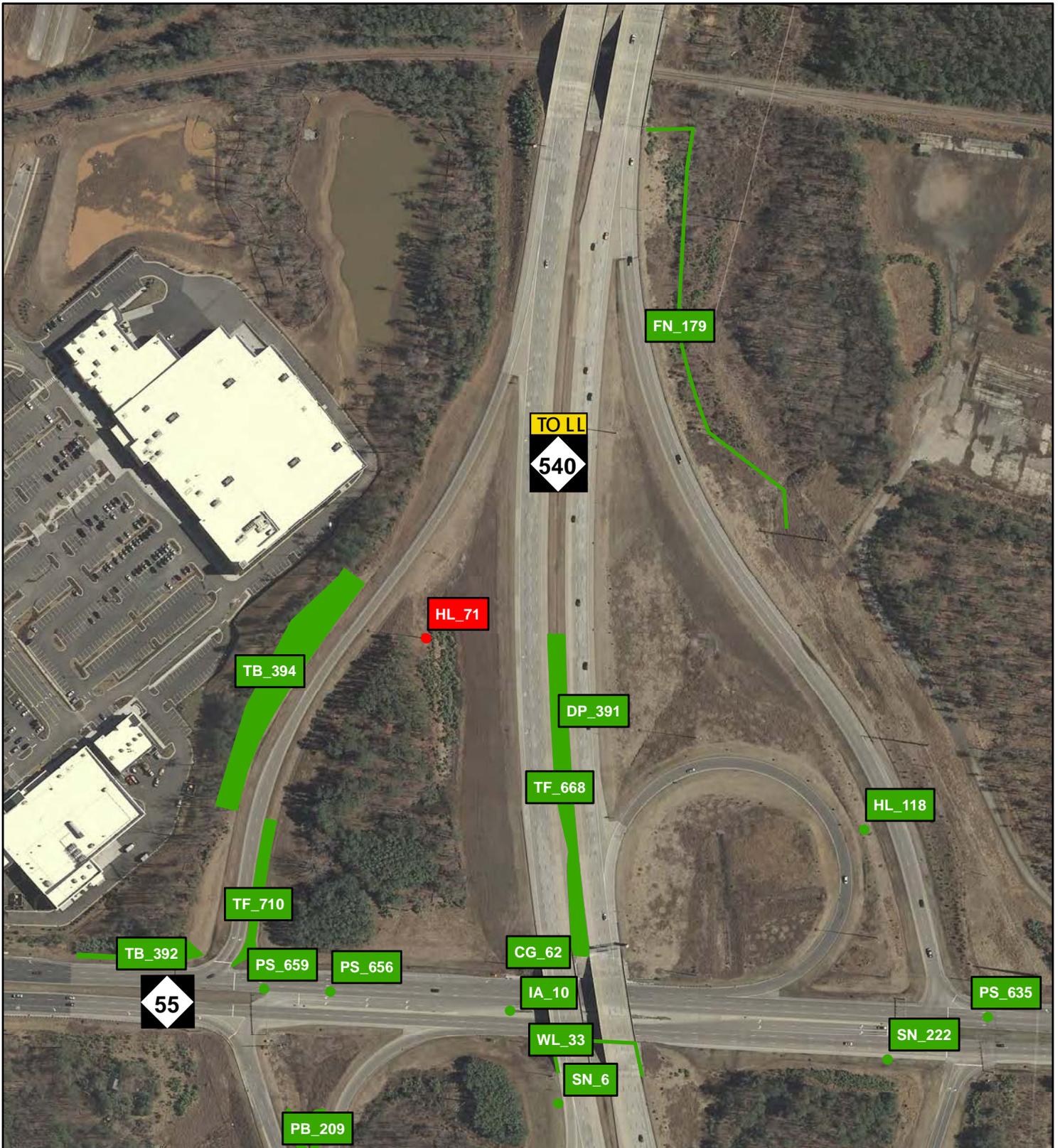


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

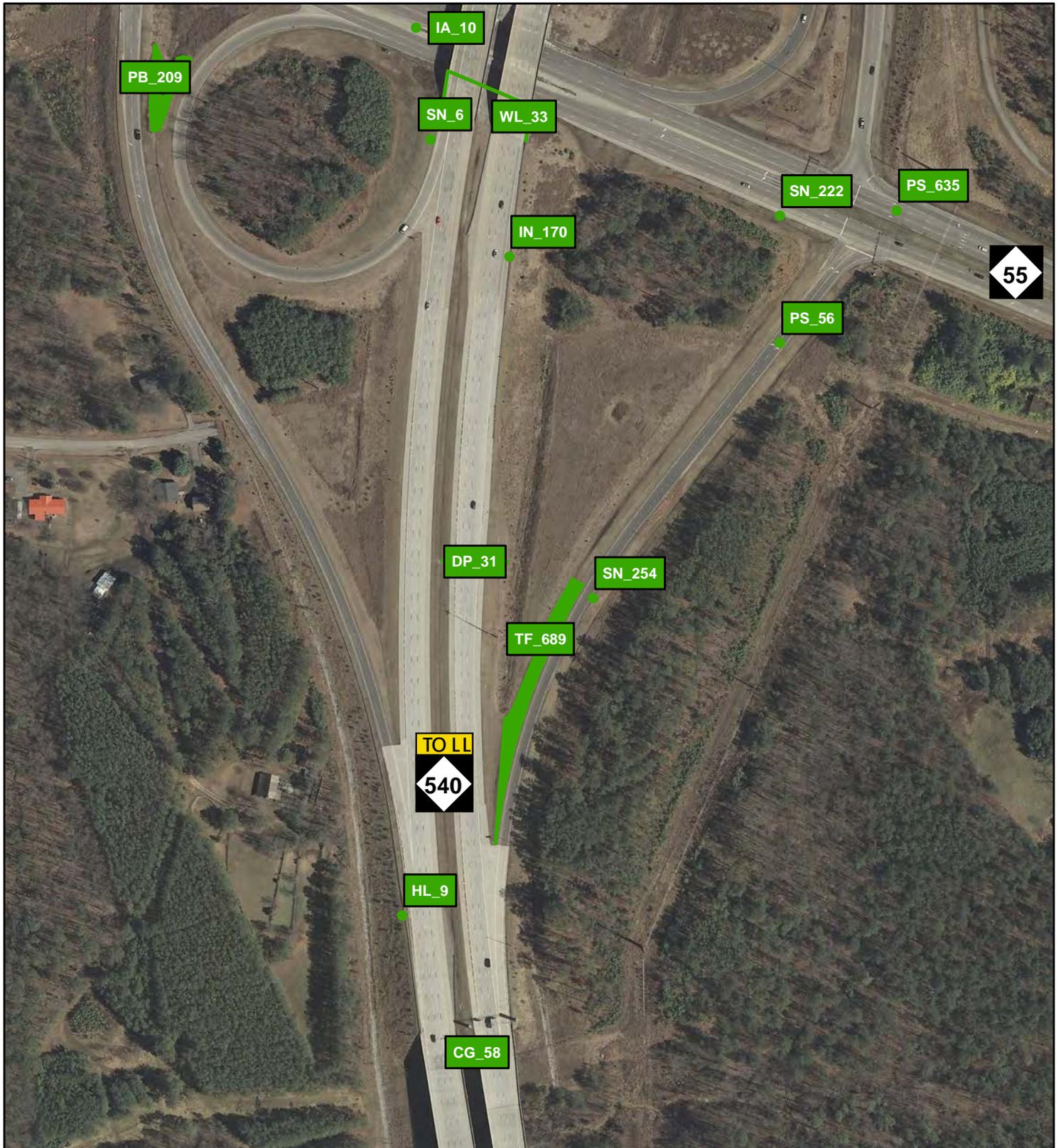


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

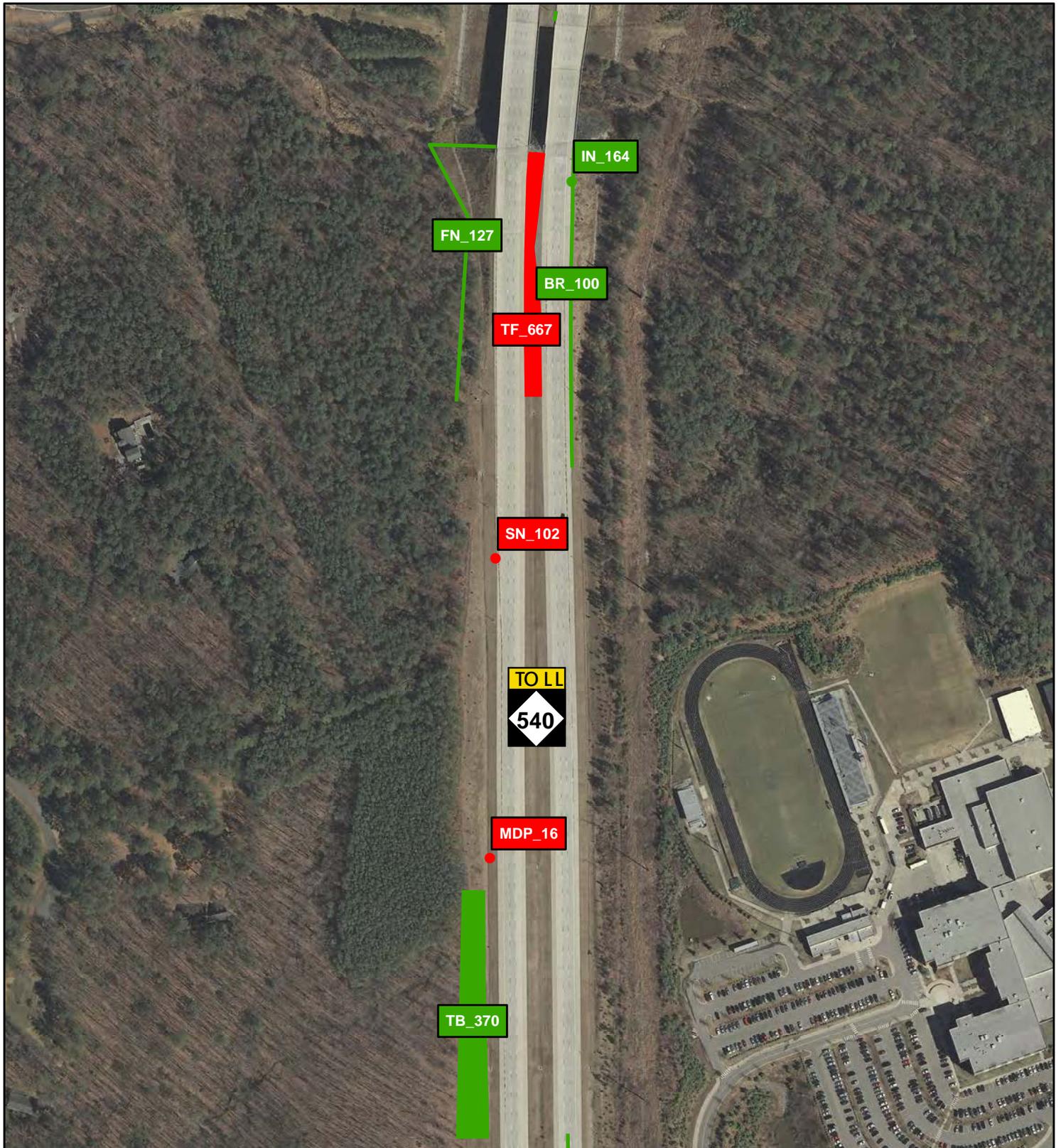


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

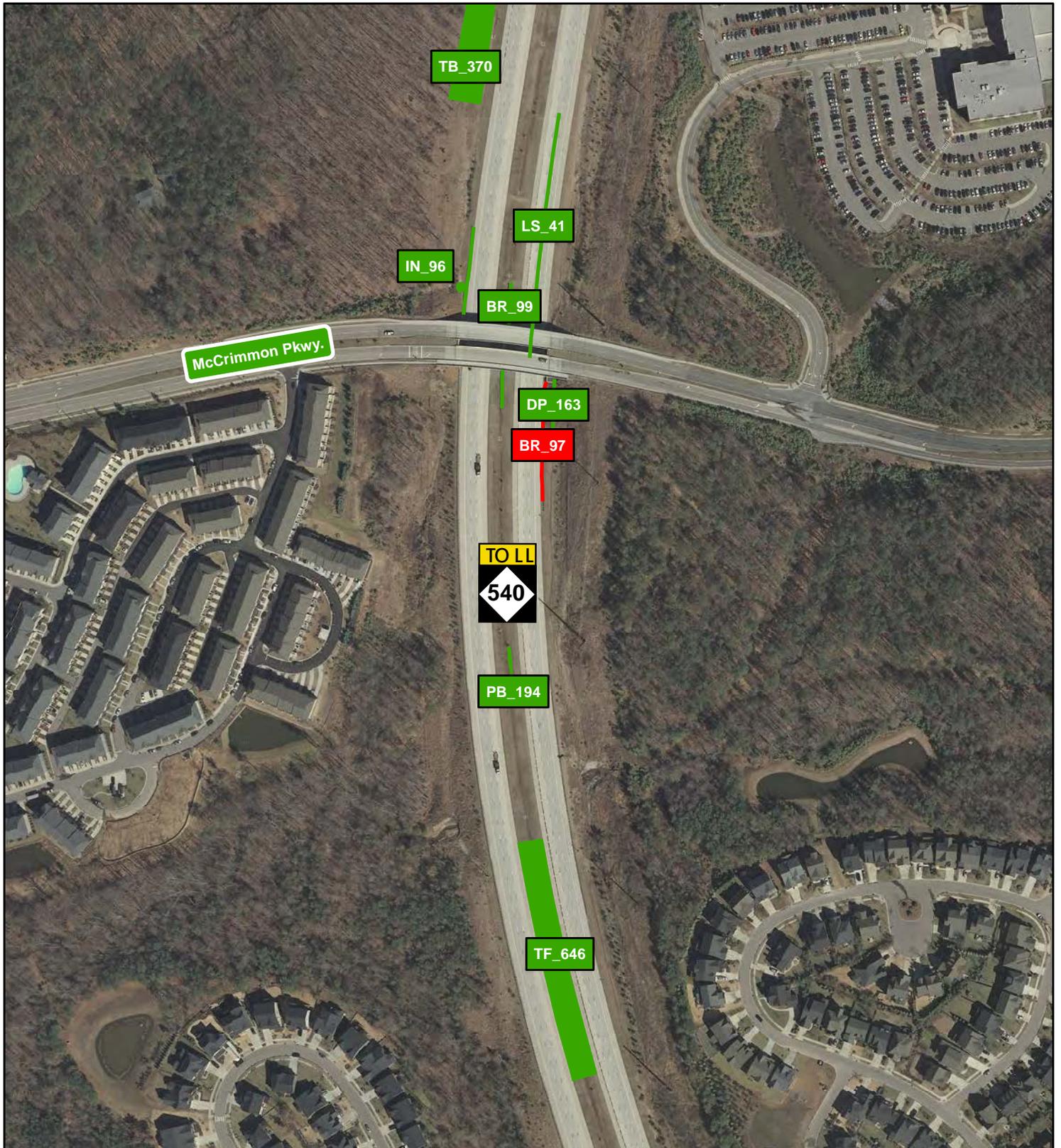


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

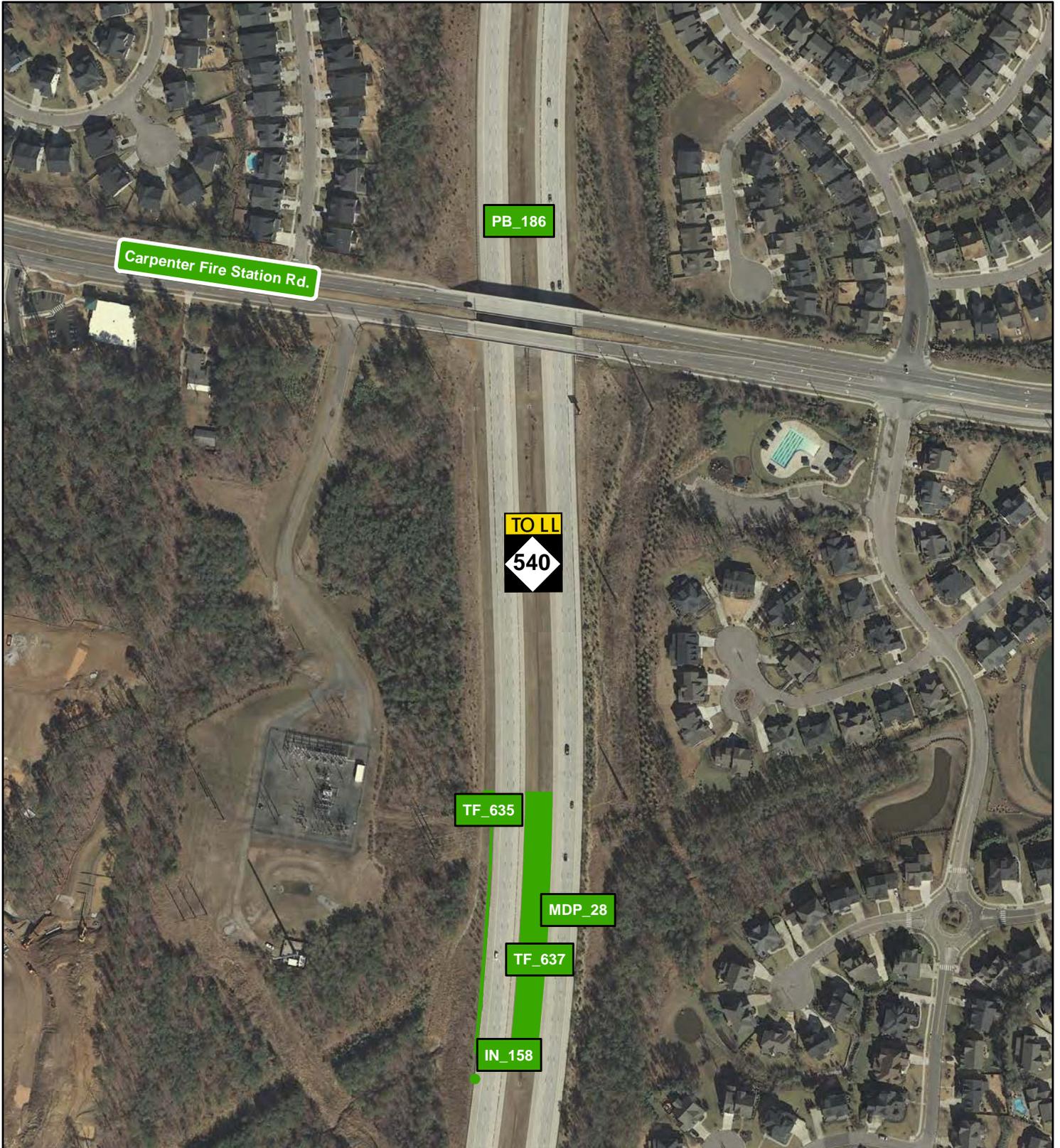


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

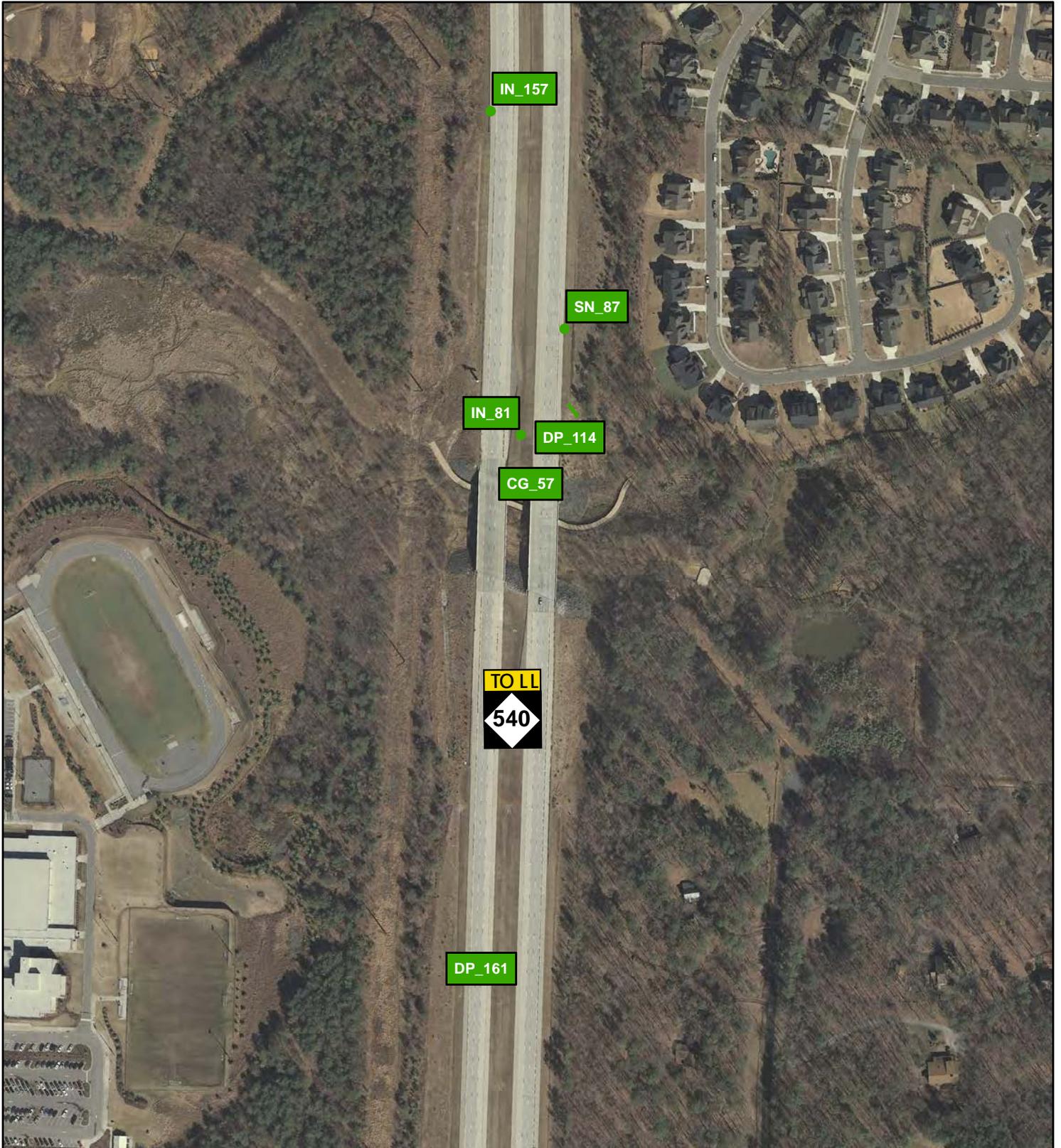


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

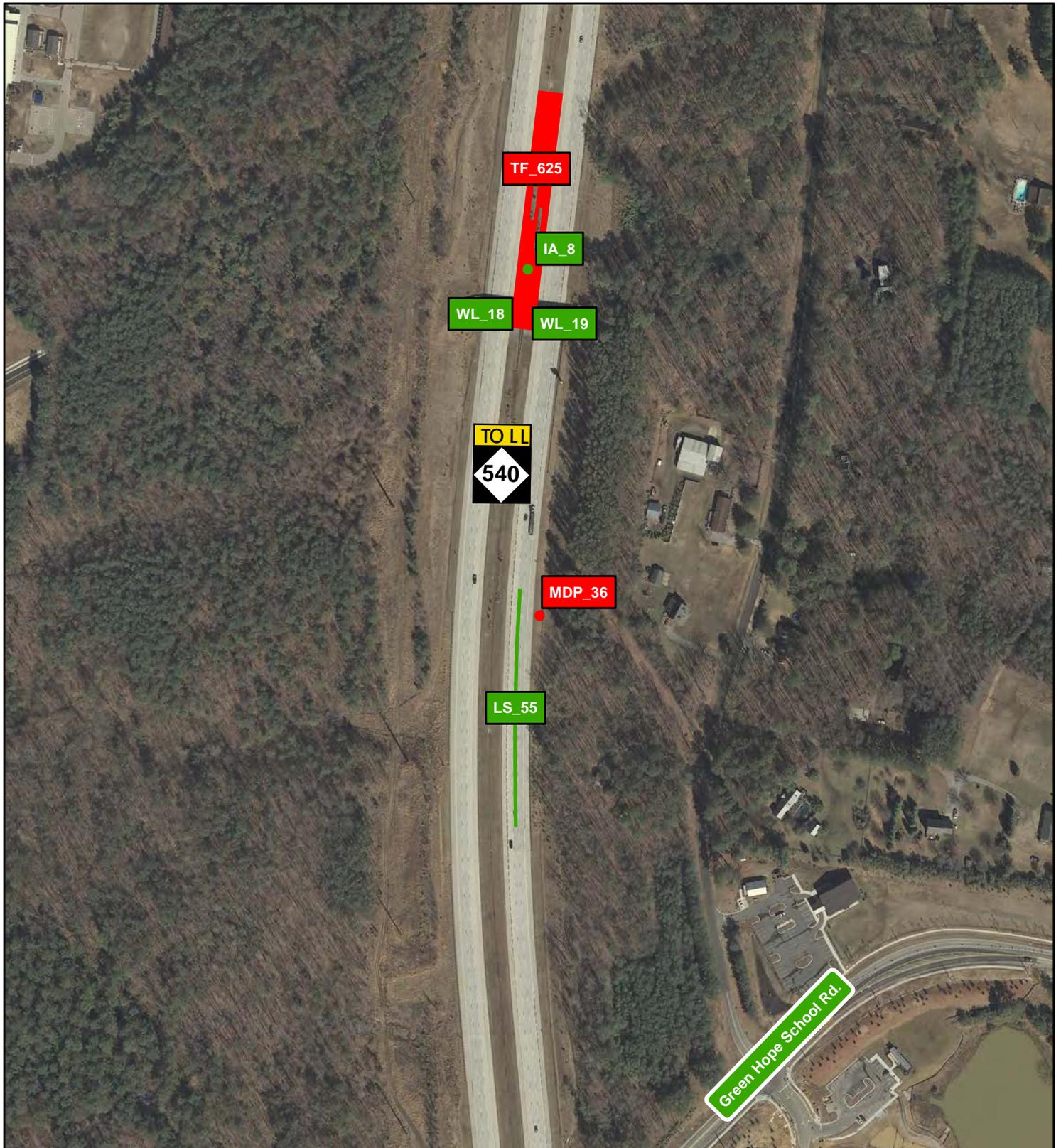


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations



Legend

 Failing Asset

 Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

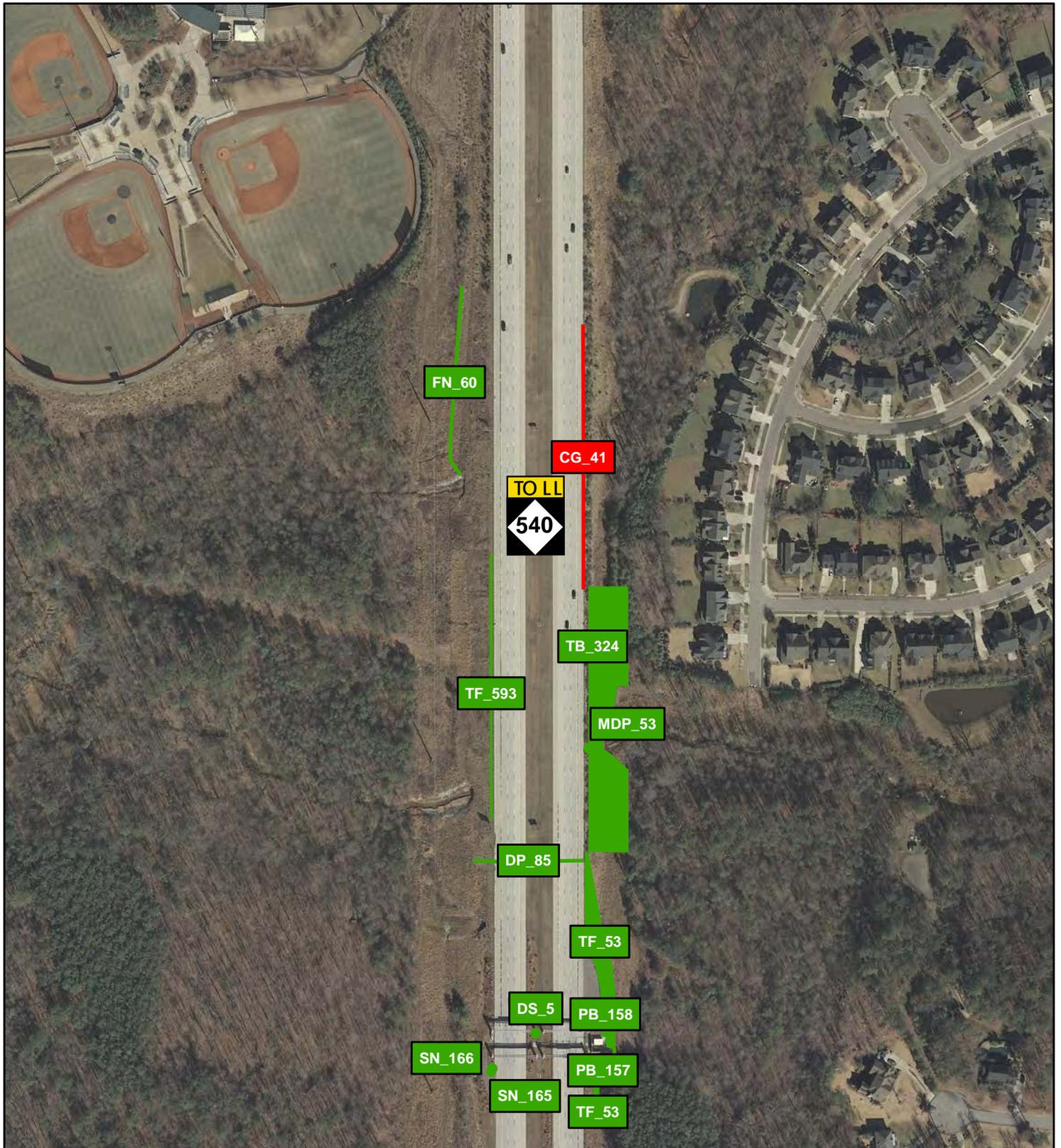


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

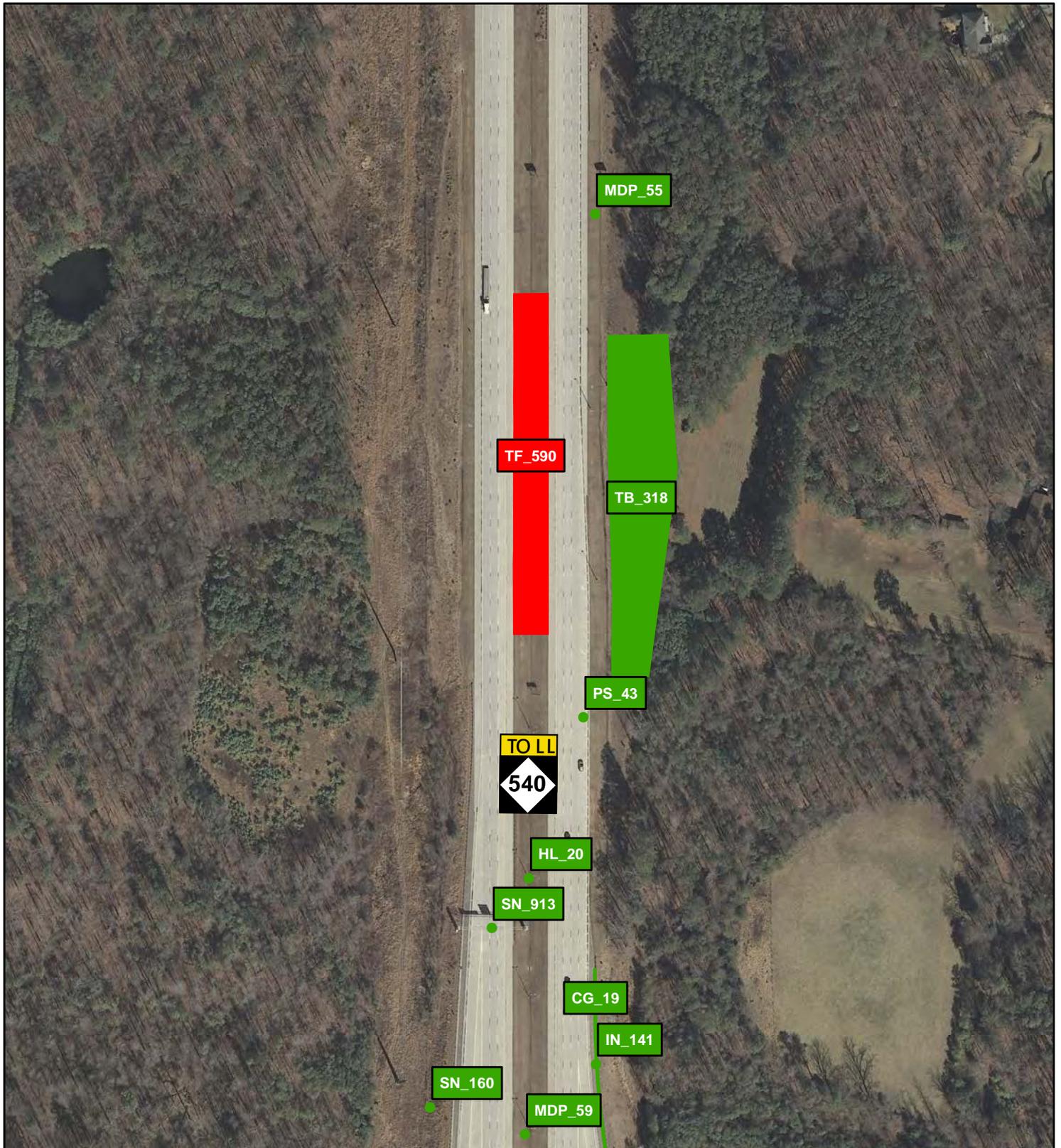


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

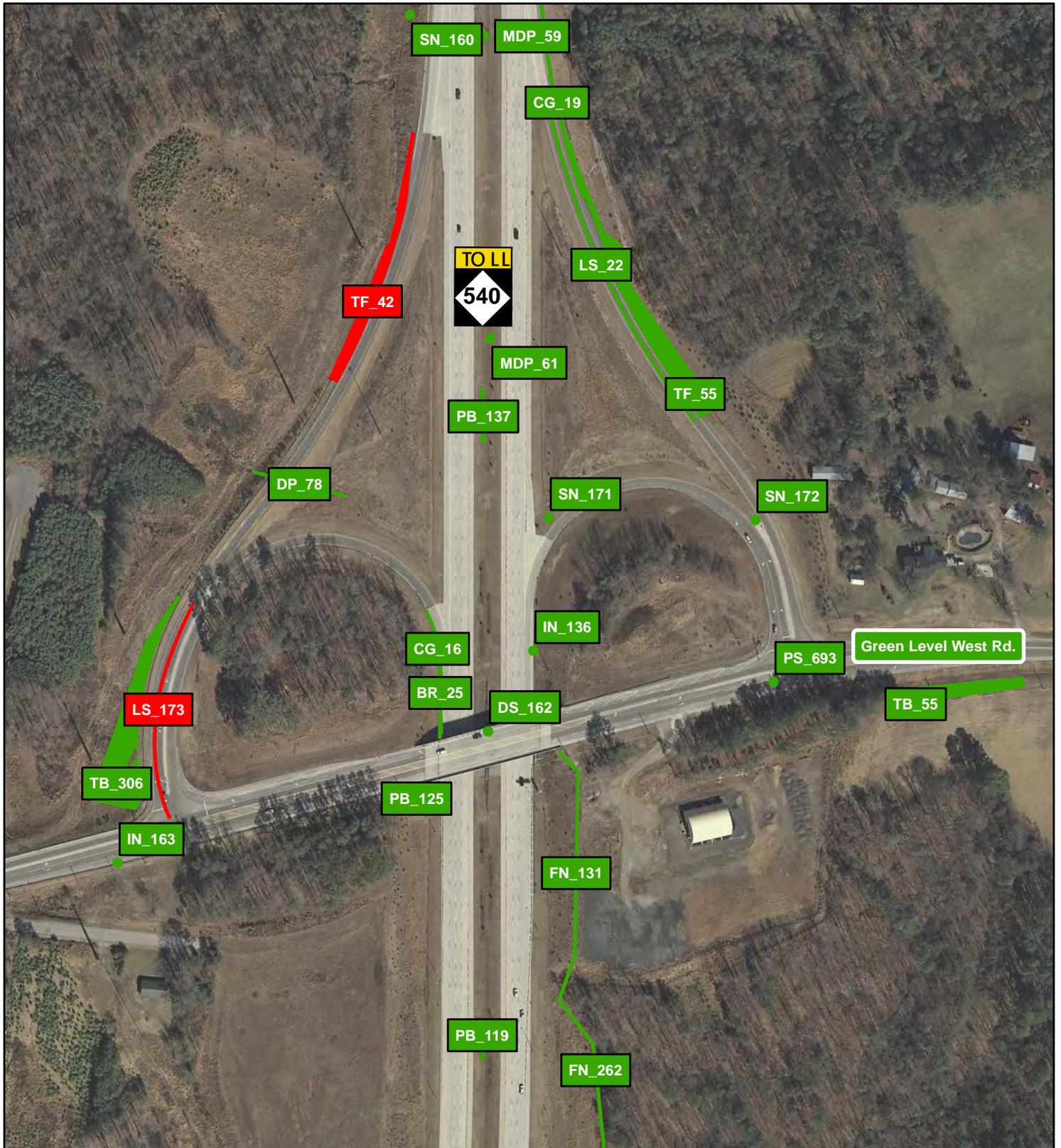


Legend

-  Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

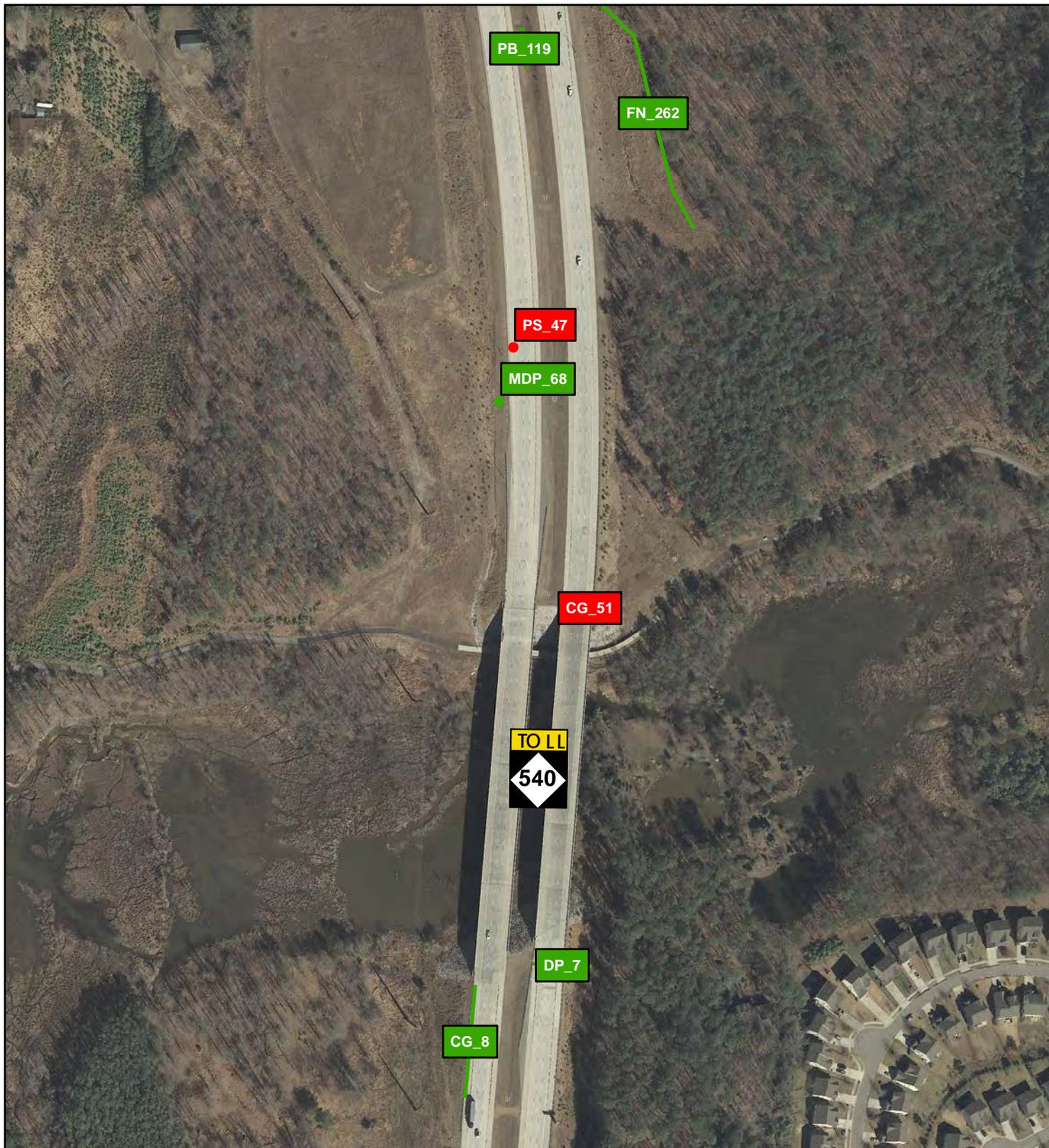


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

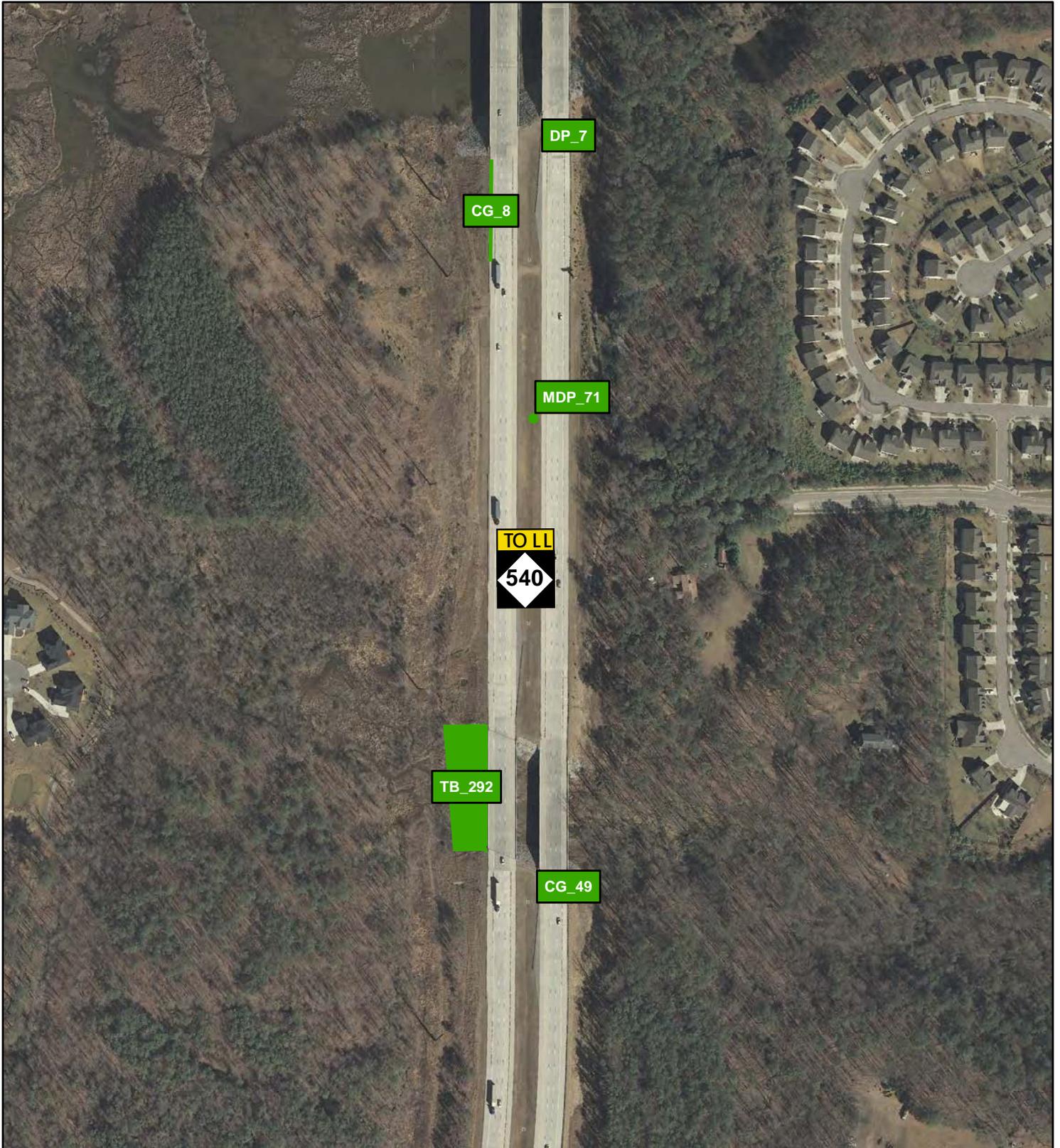


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

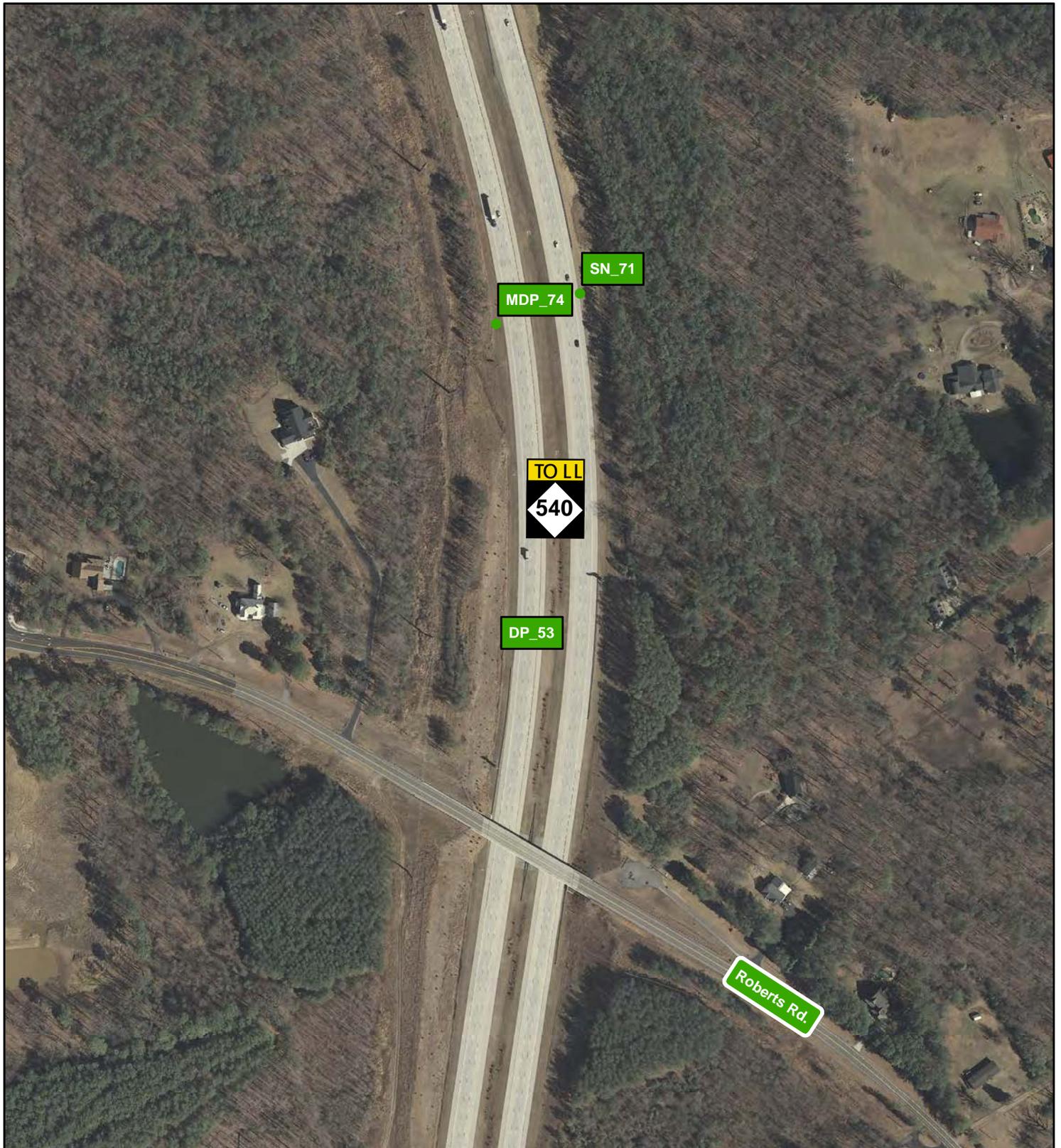


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

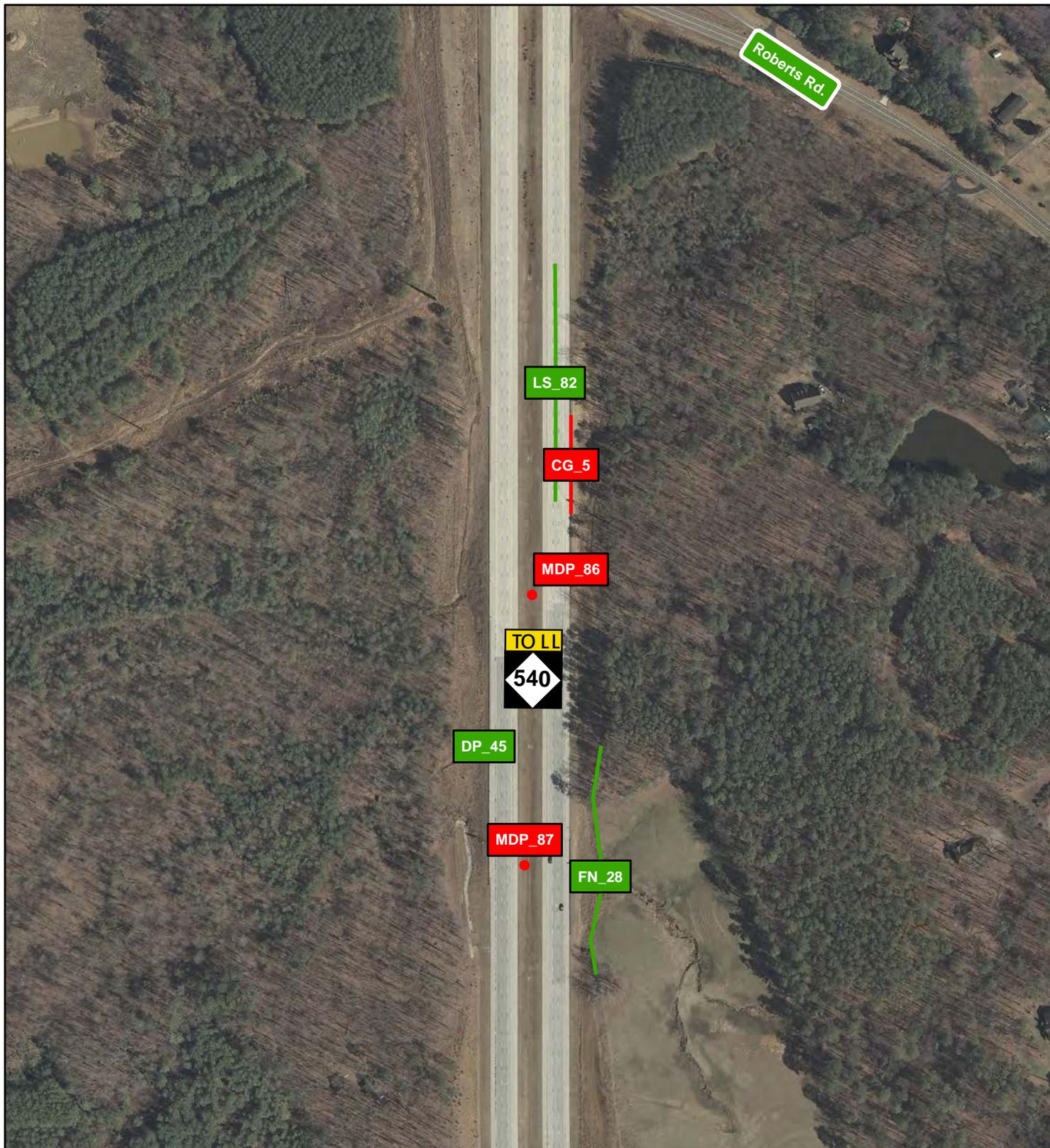


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

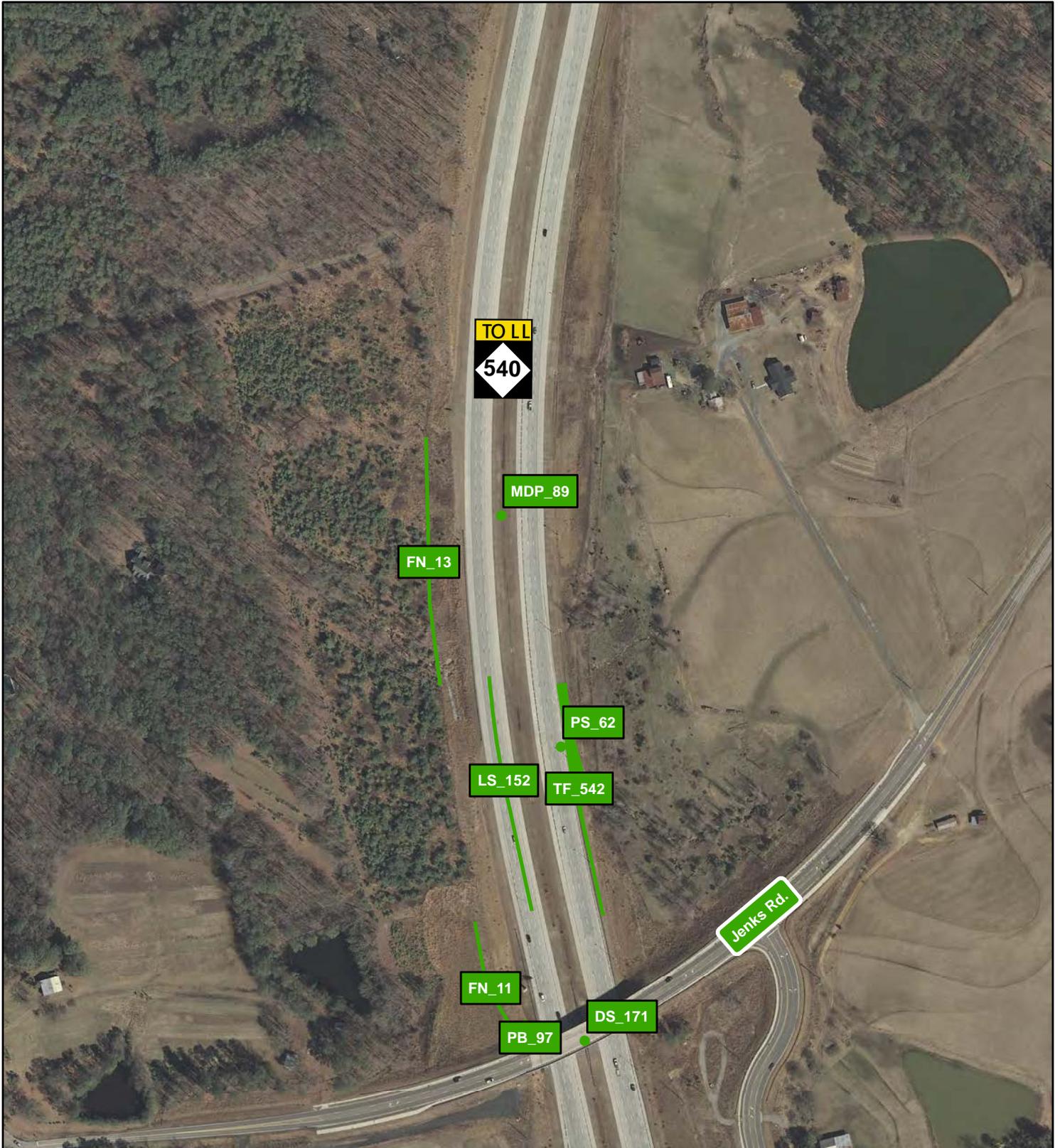


Legend

-  Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

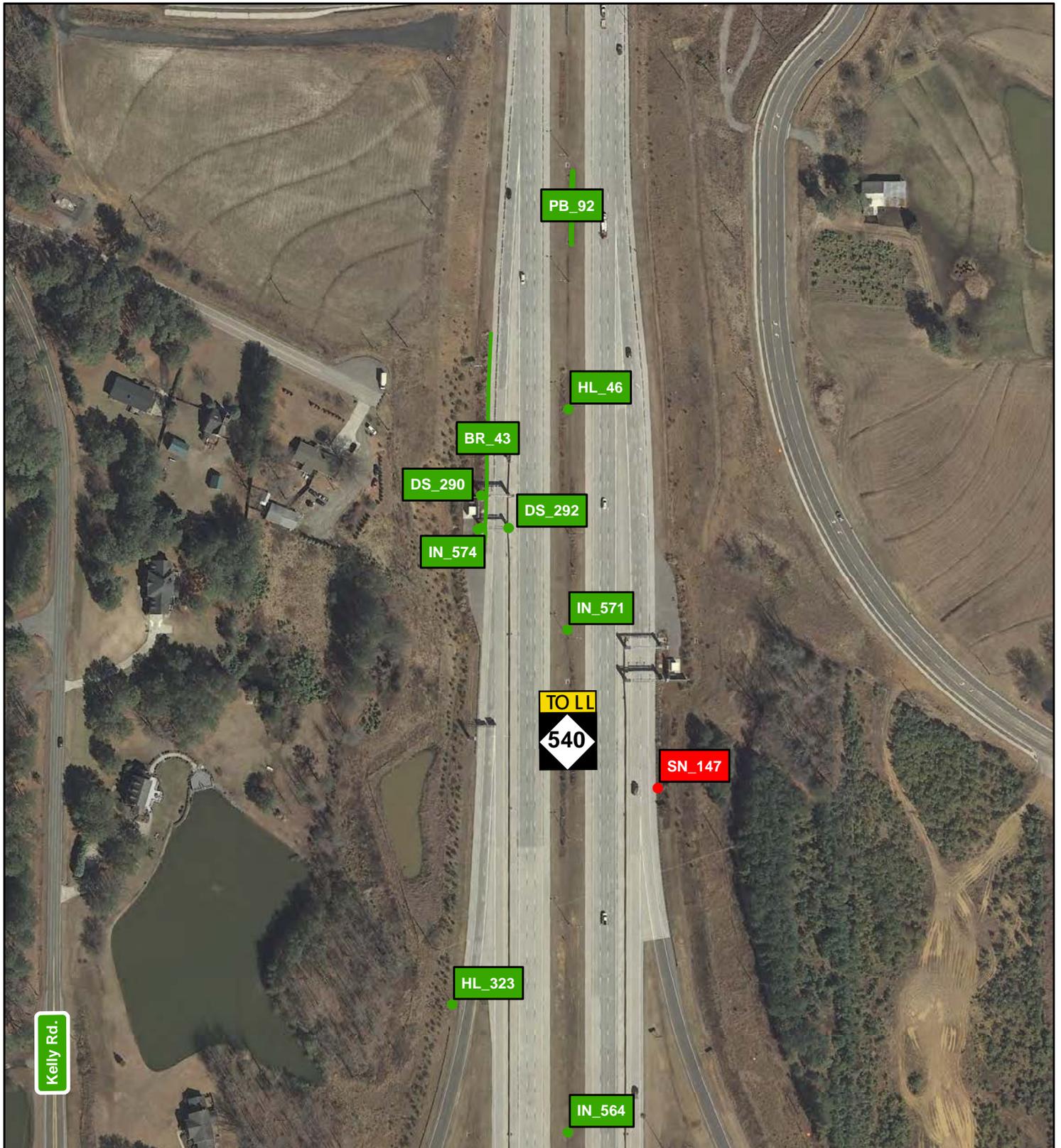


Legend

-  Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

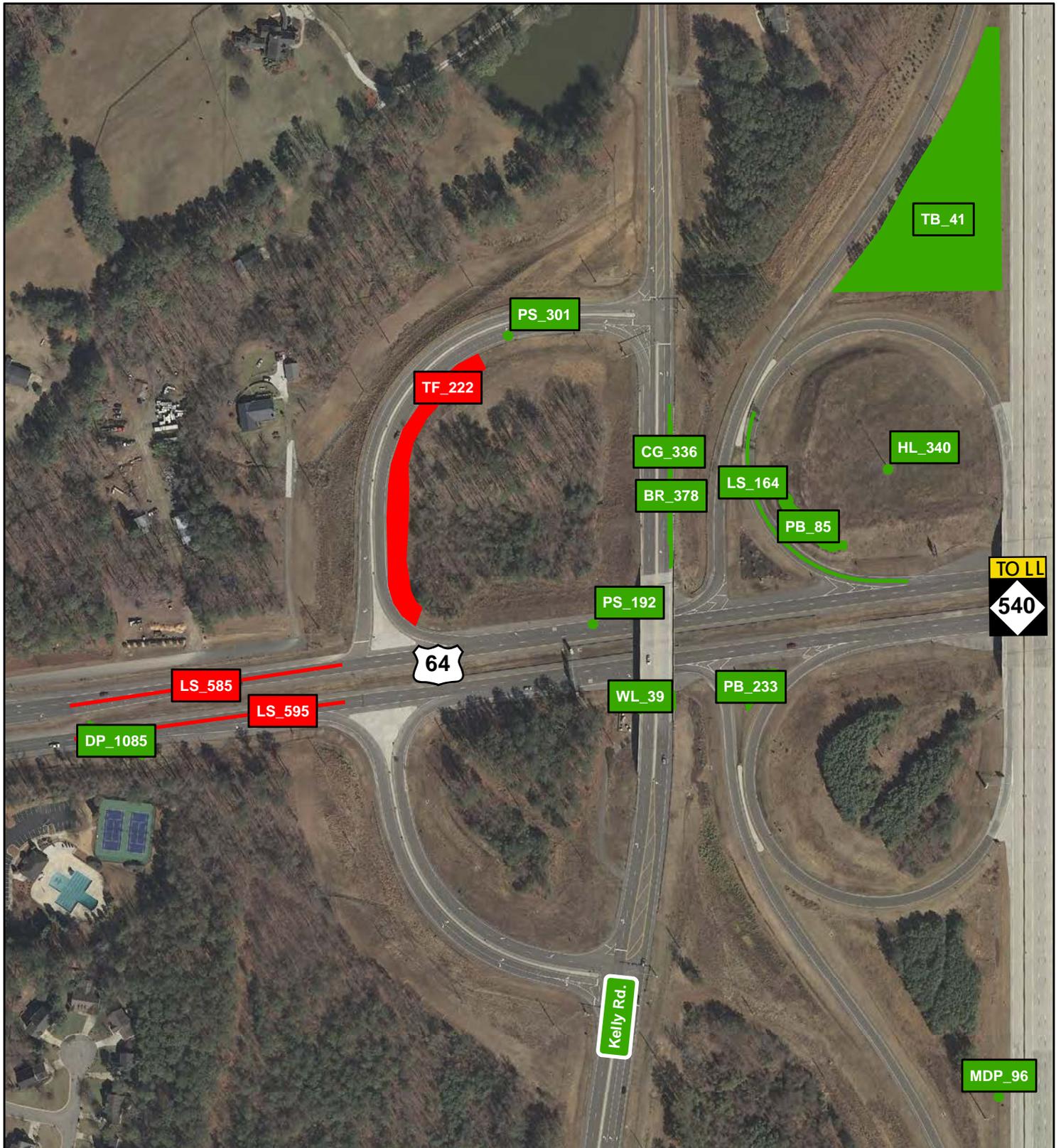


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

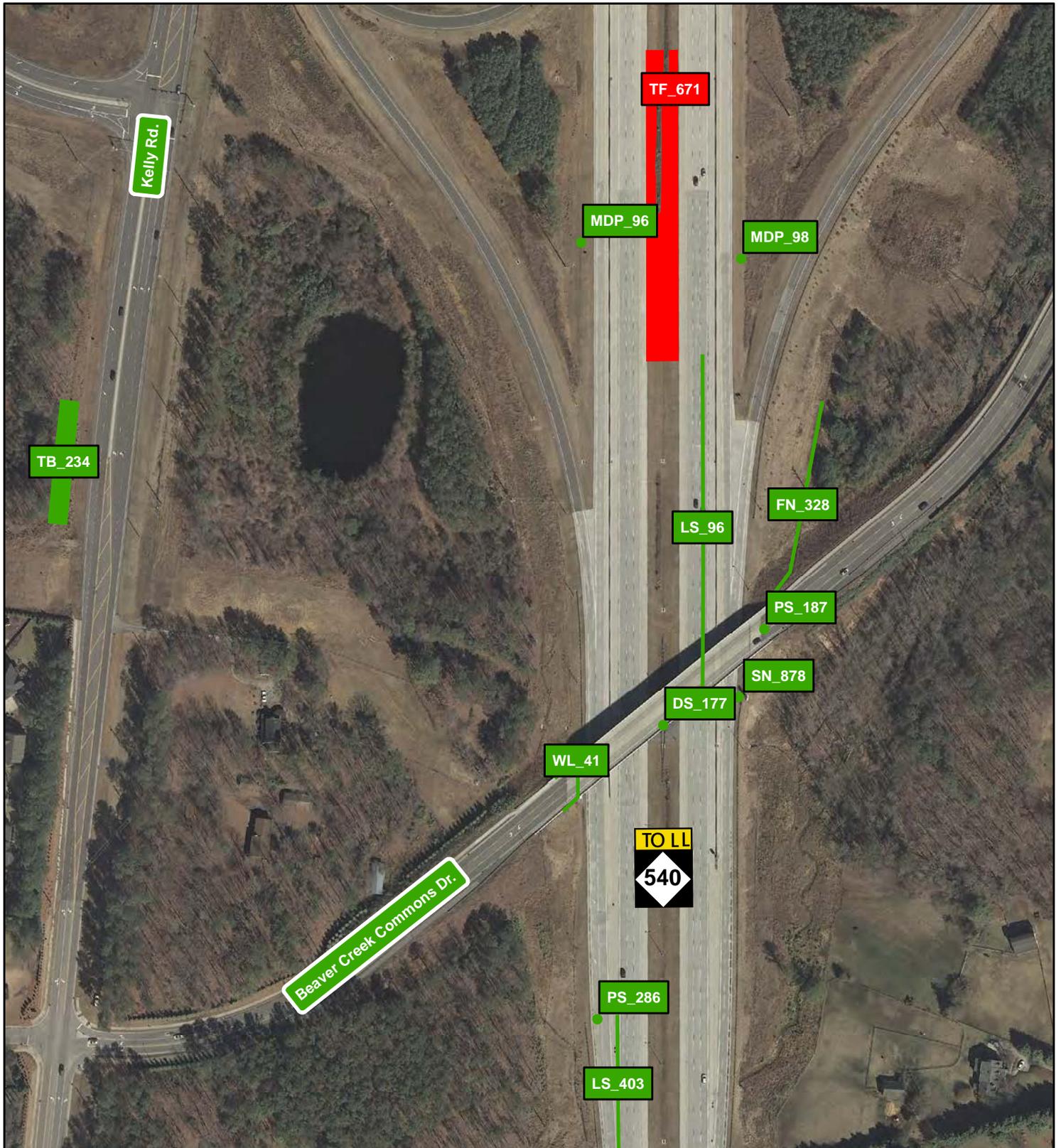


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

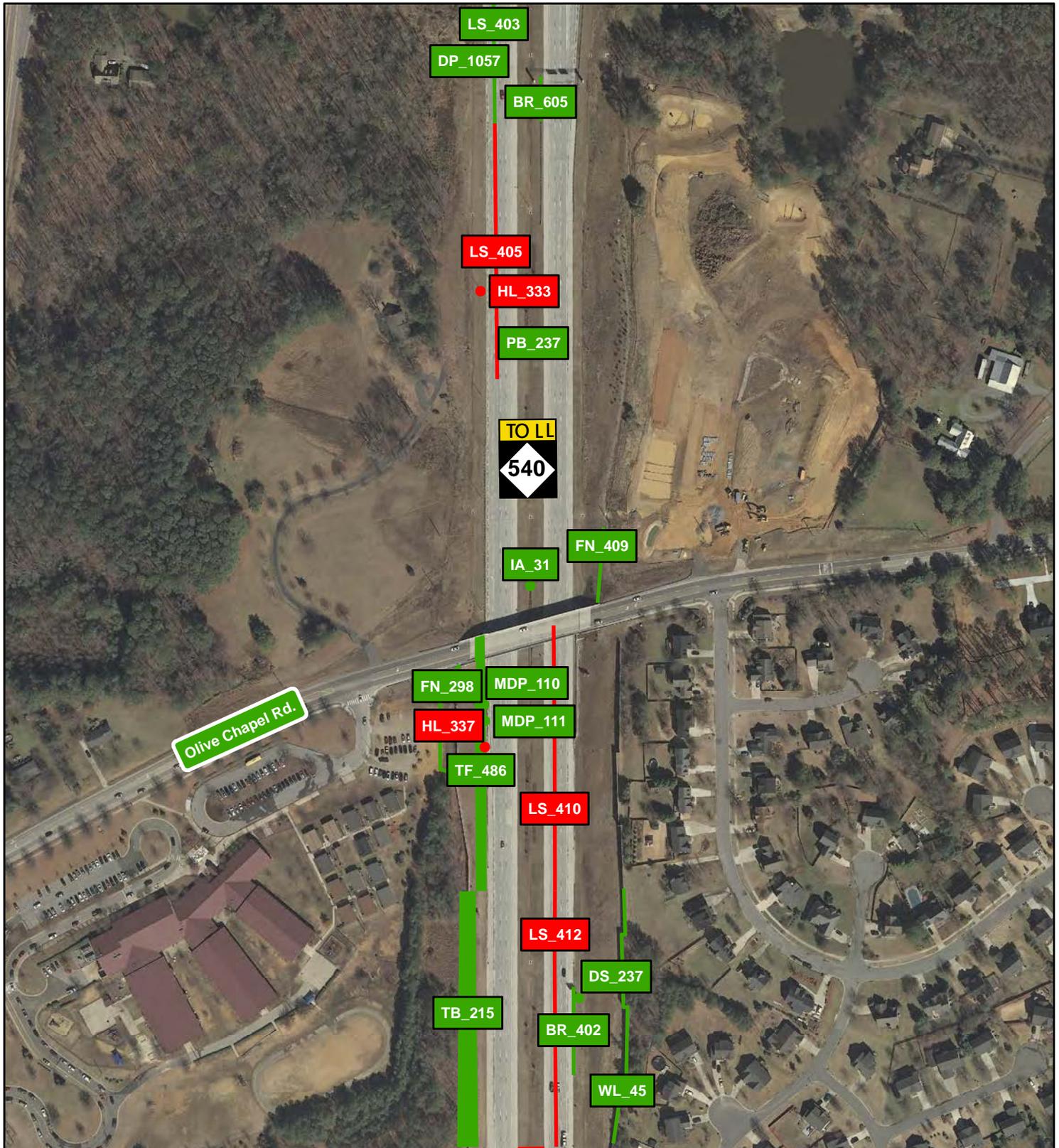


Legend

-  Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

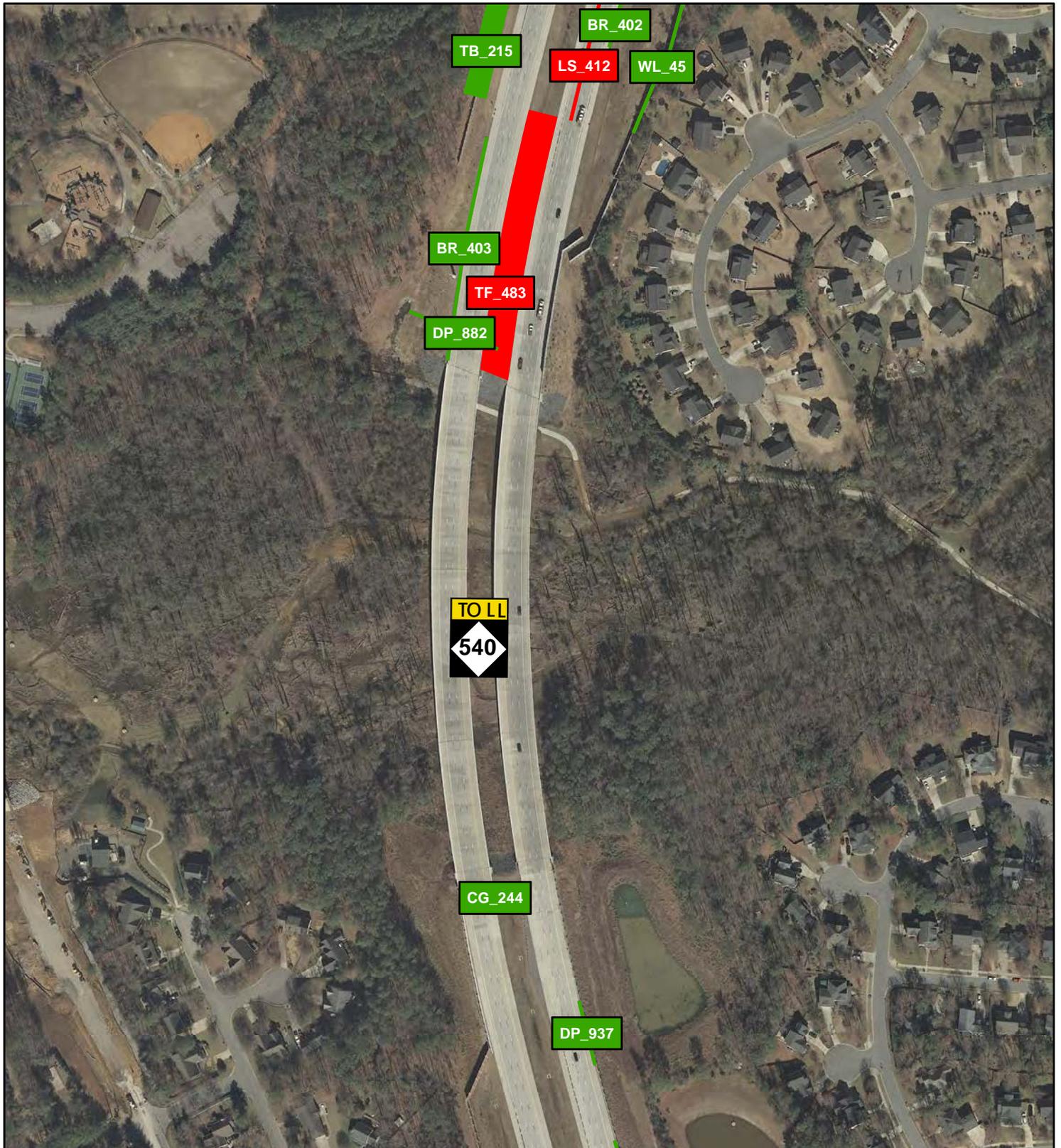


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

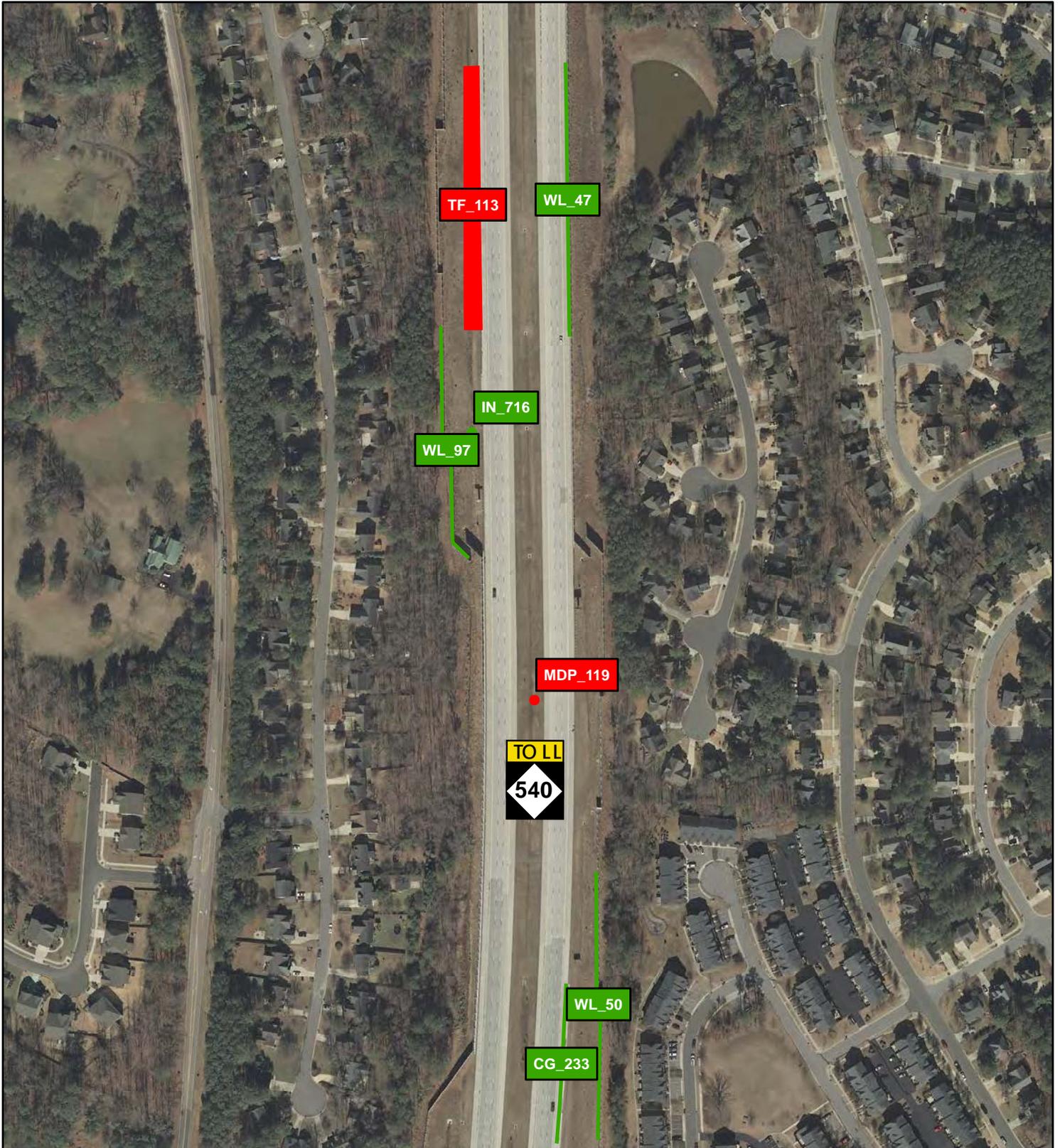


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

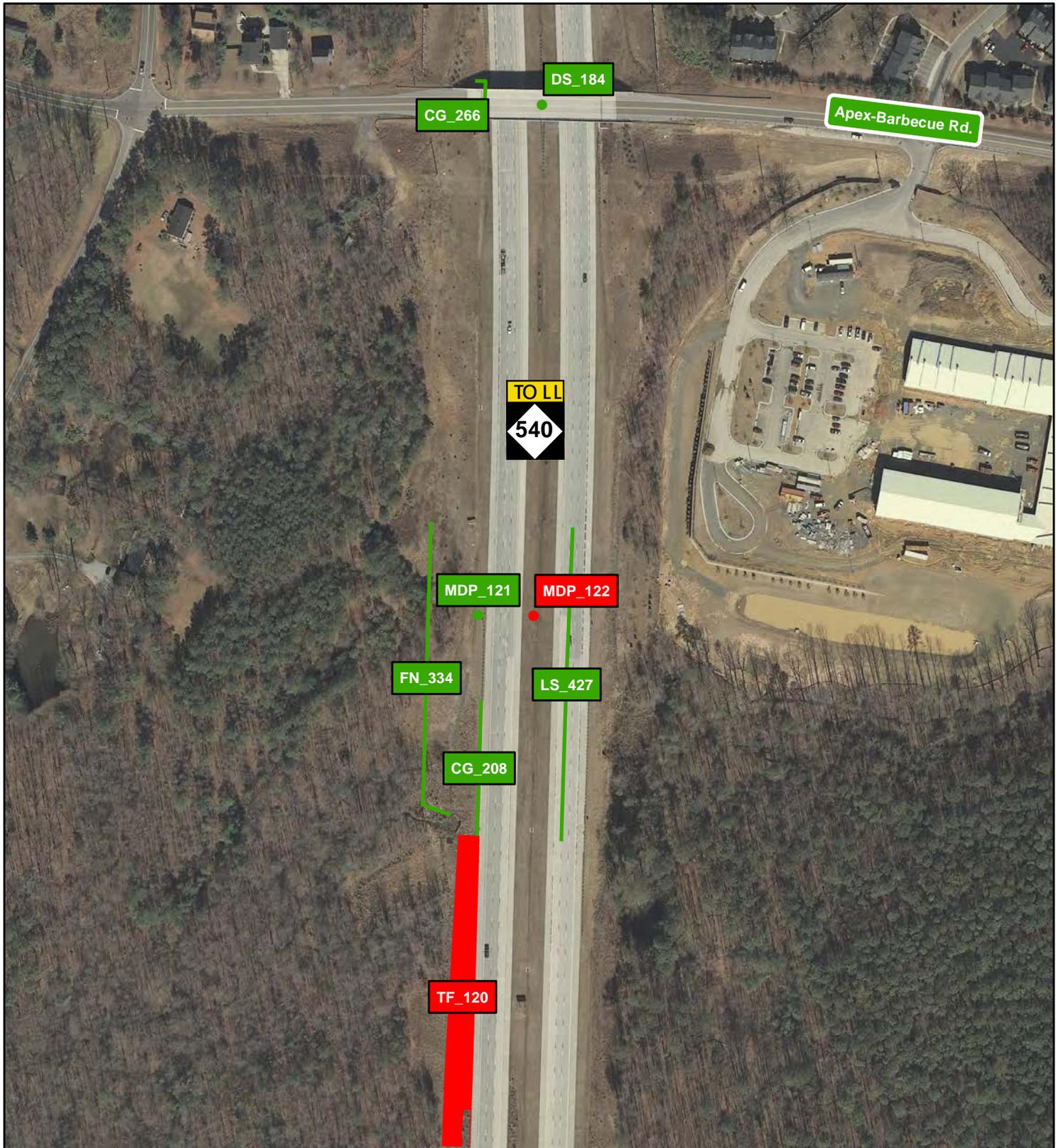


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

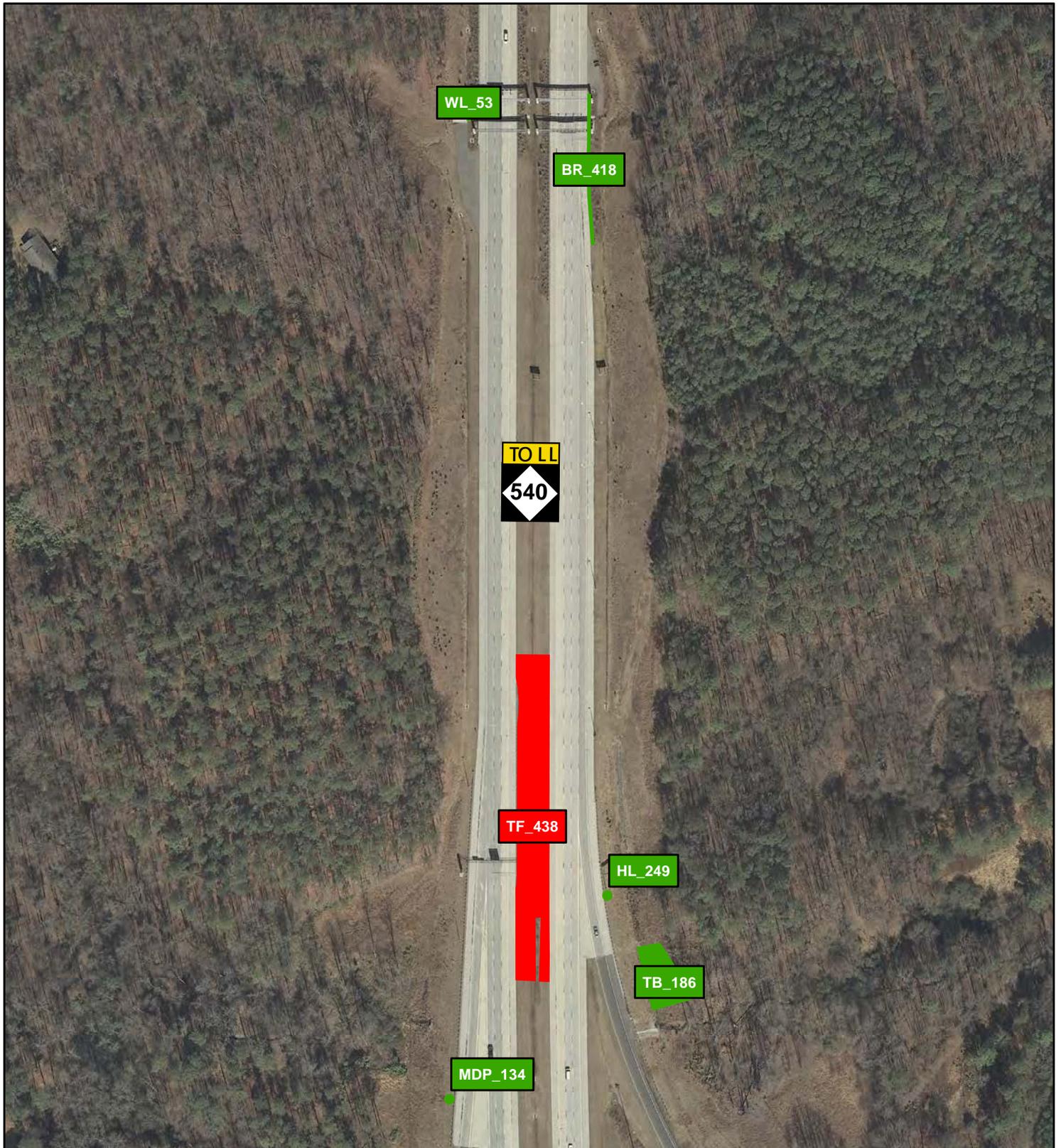


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

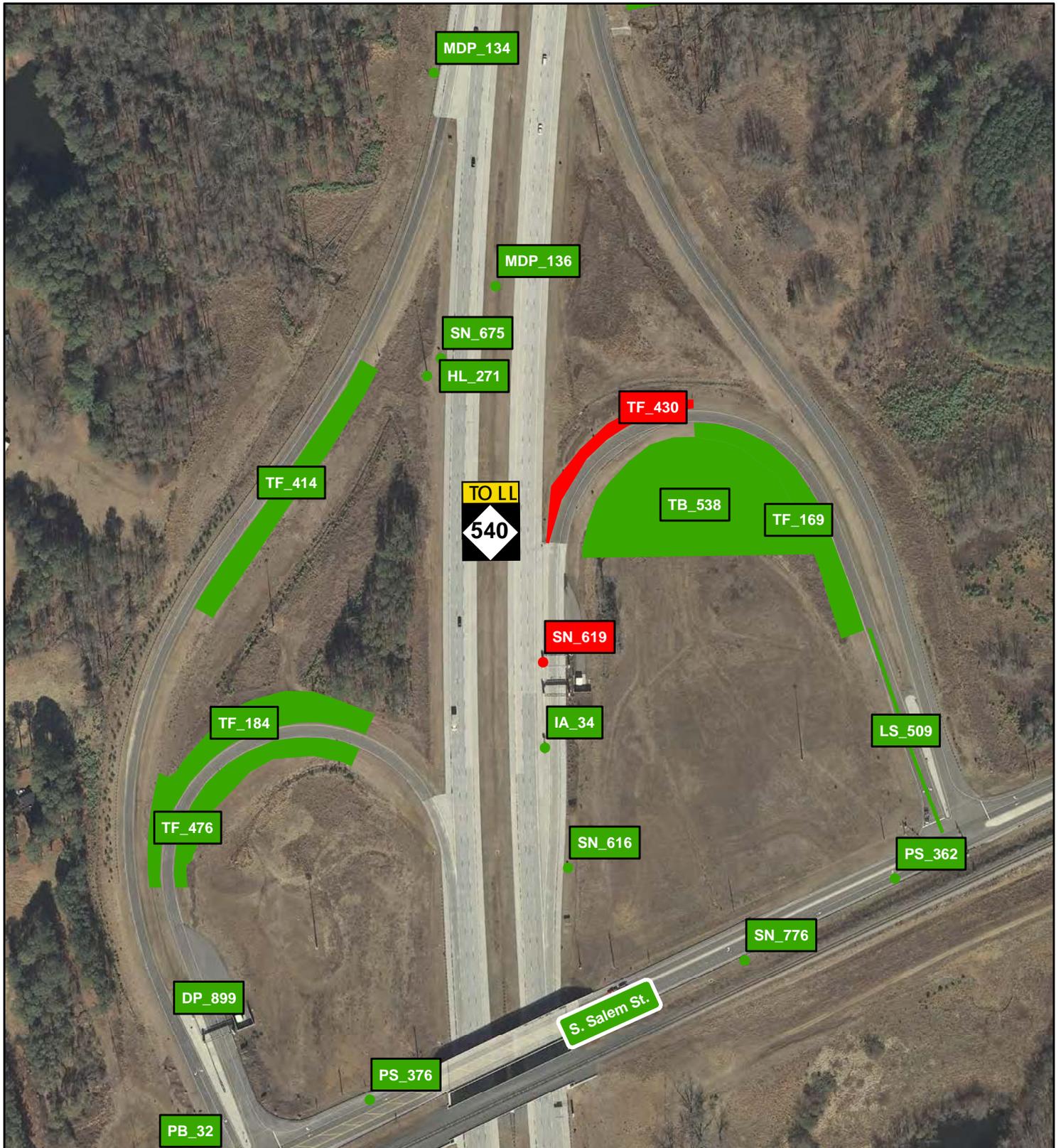


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

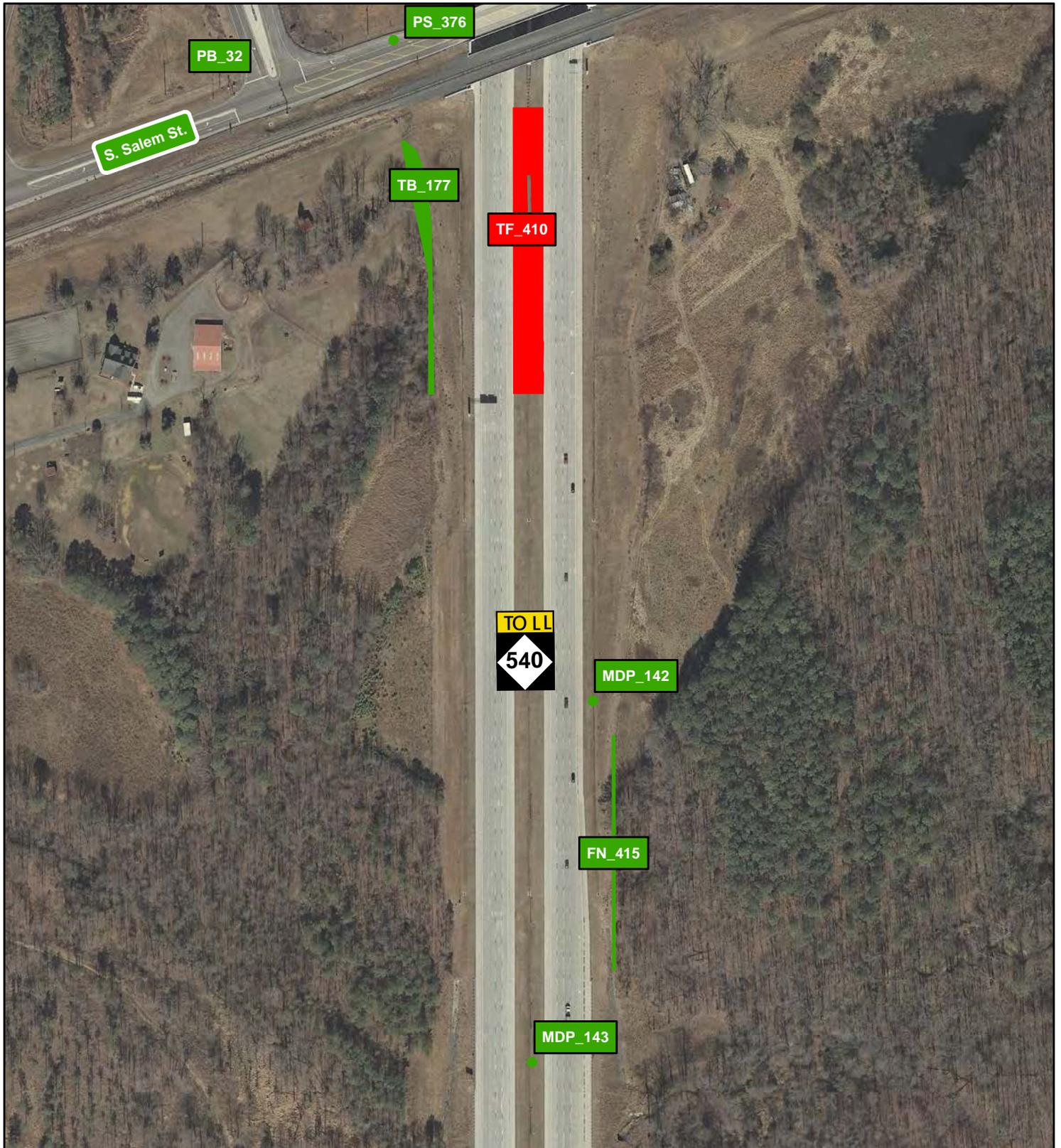


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

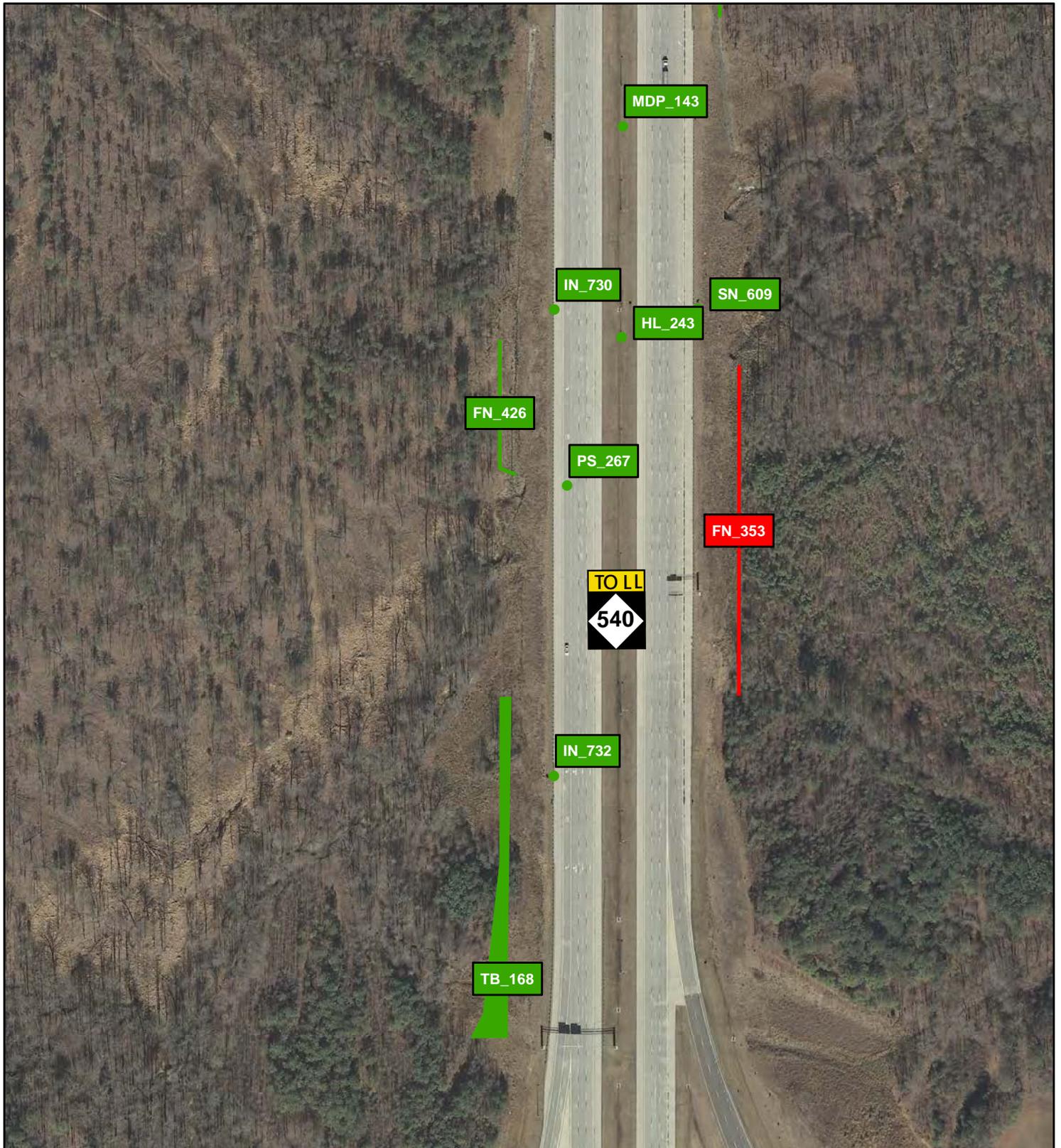


Legend

-  Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

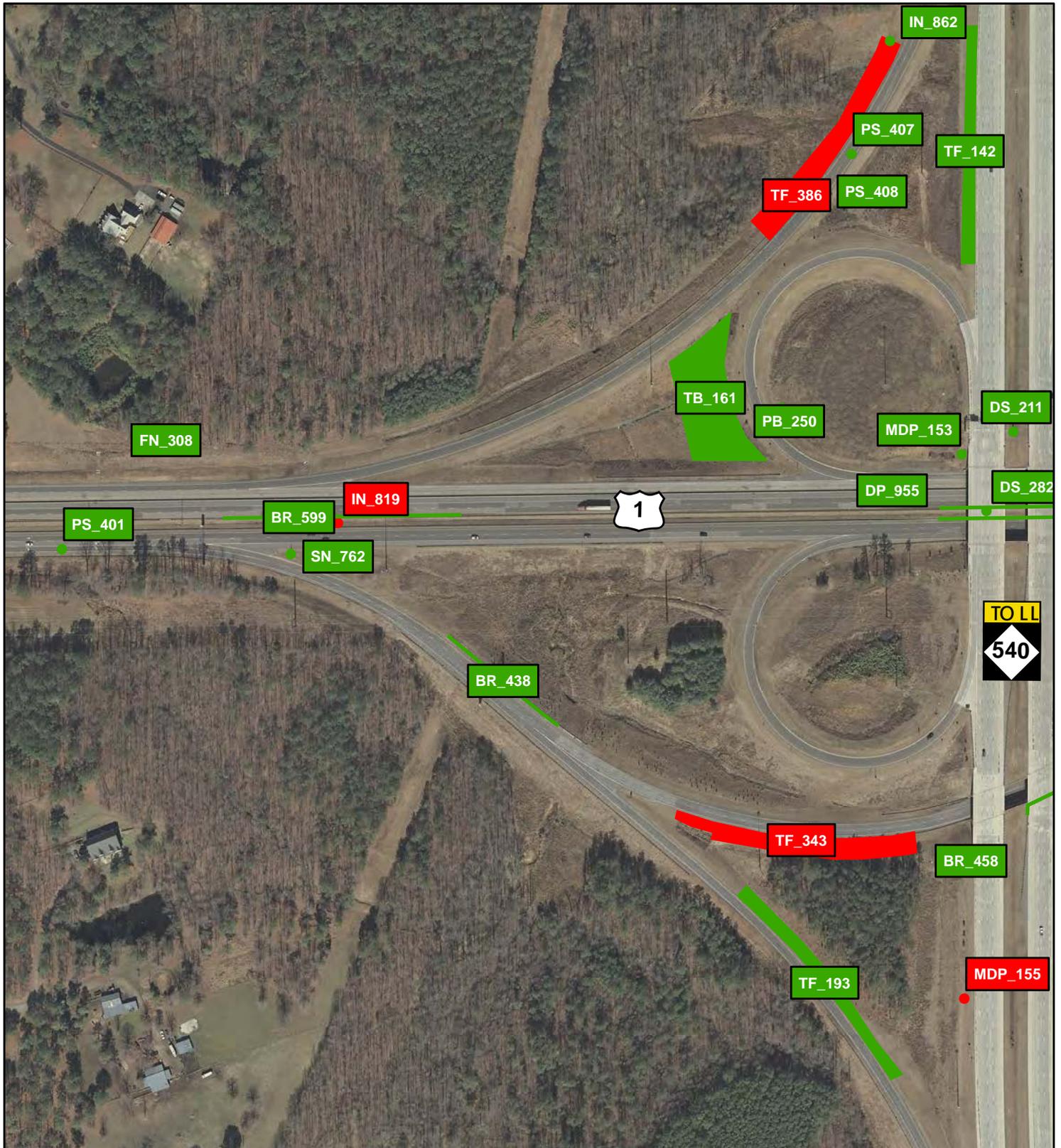


Legend

-  Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

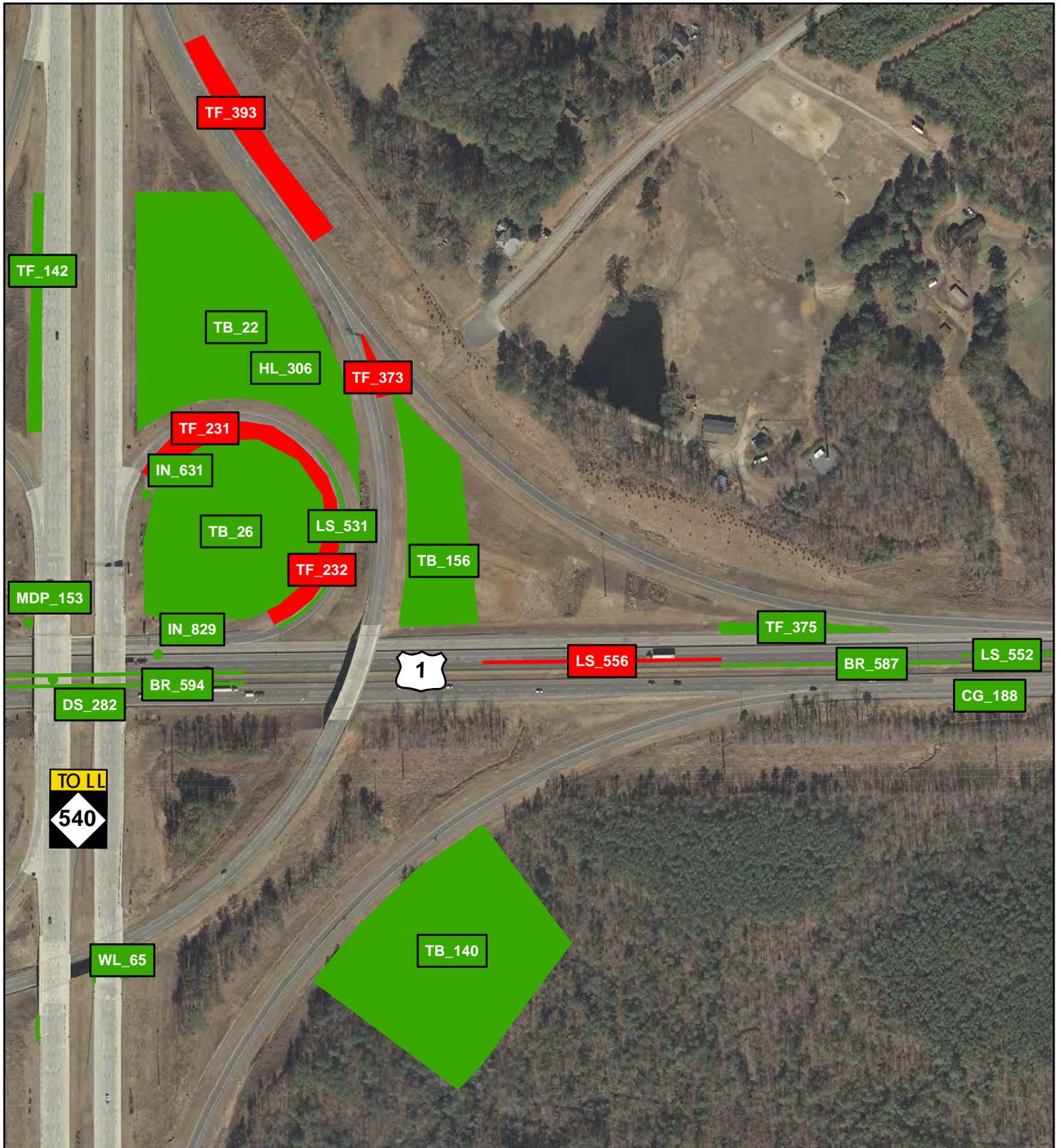


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

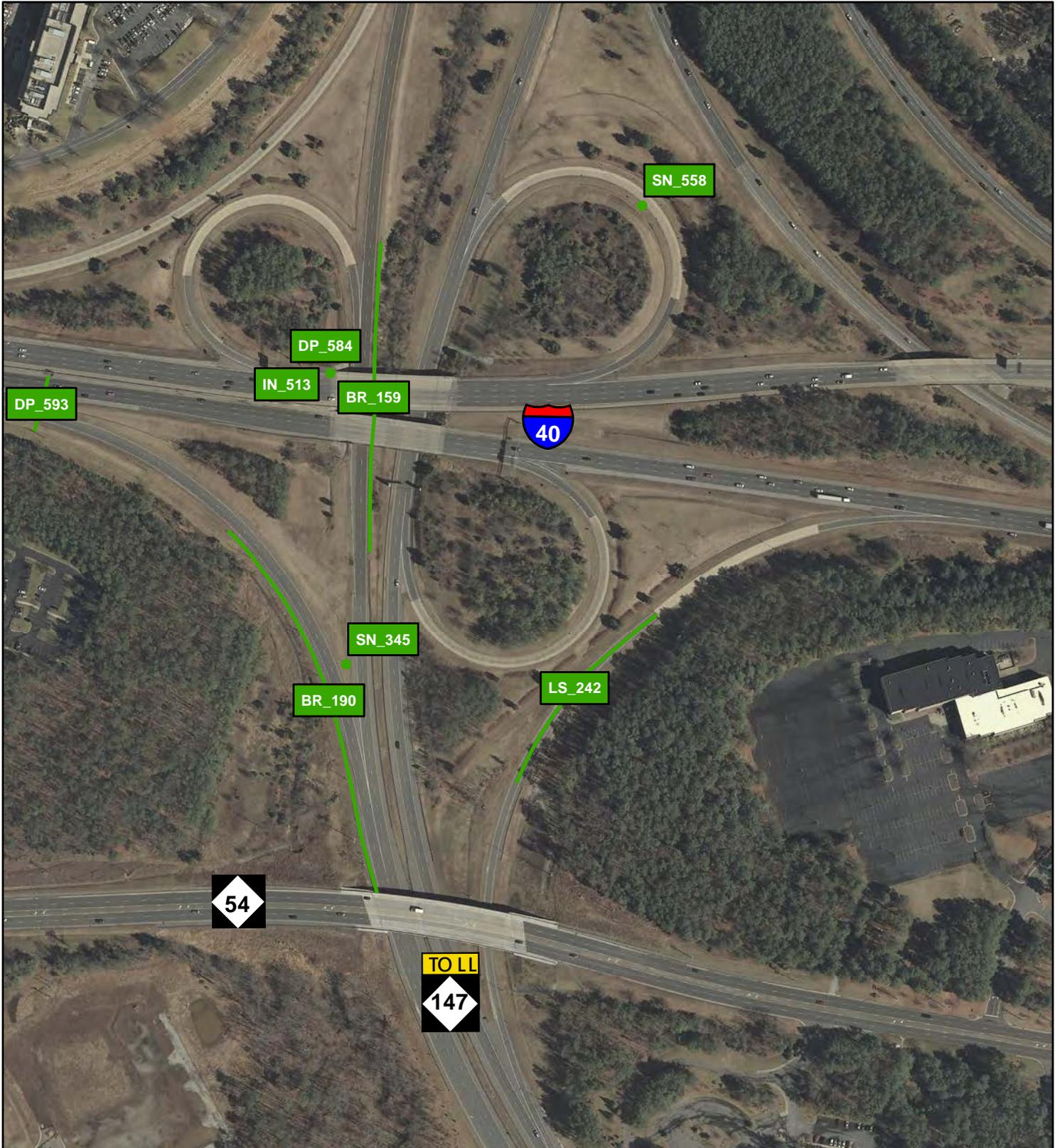


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

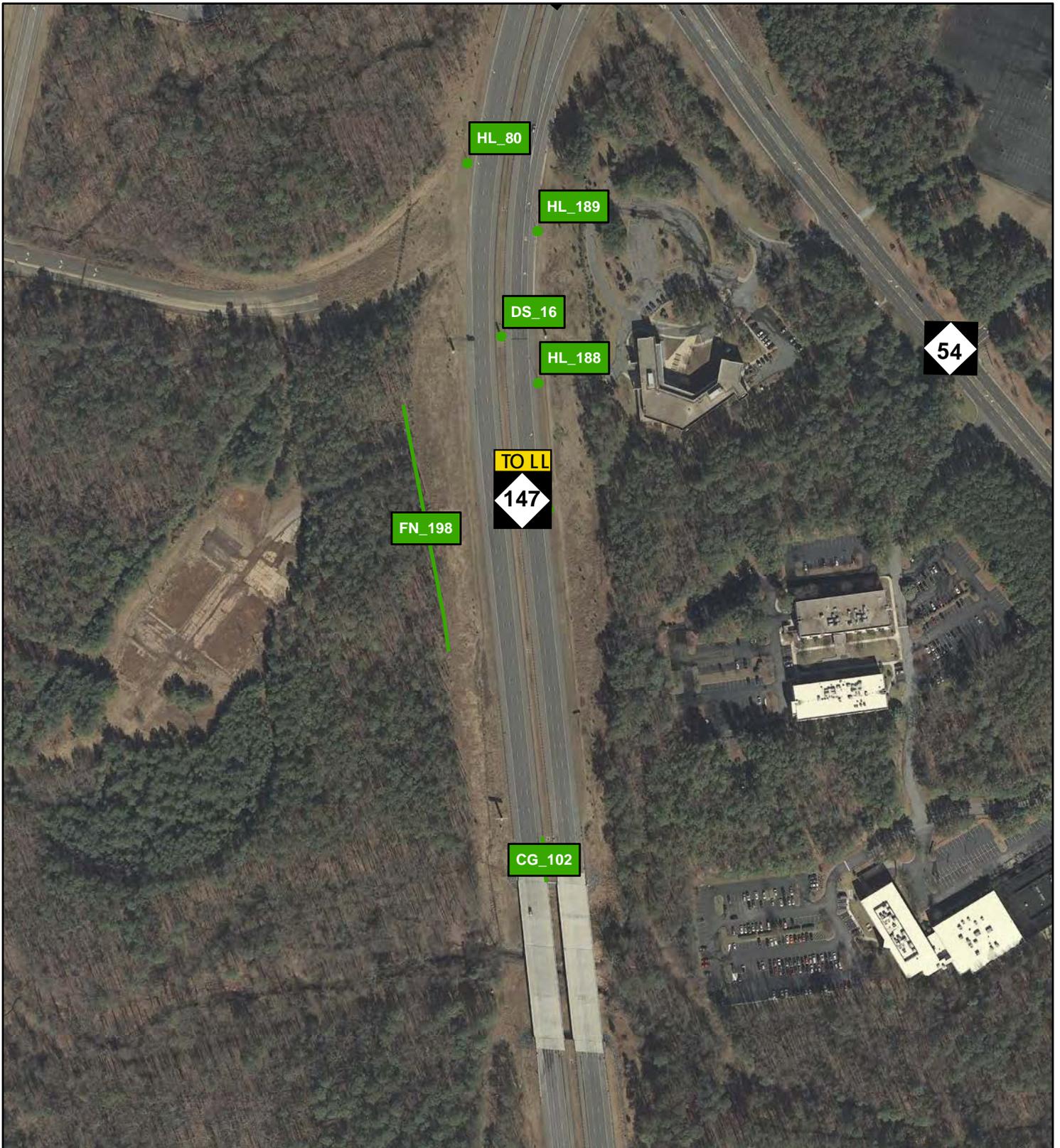


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

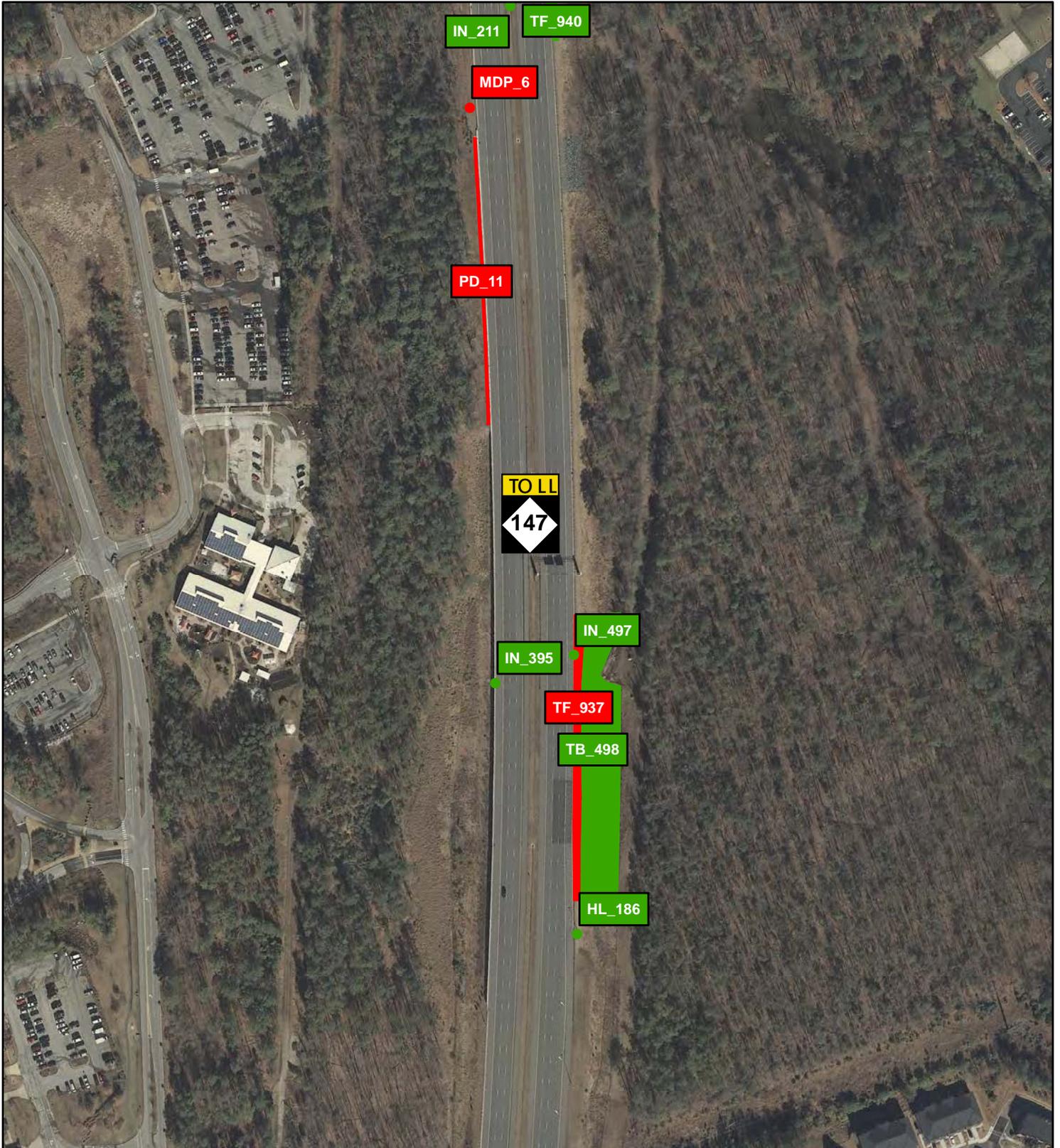


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

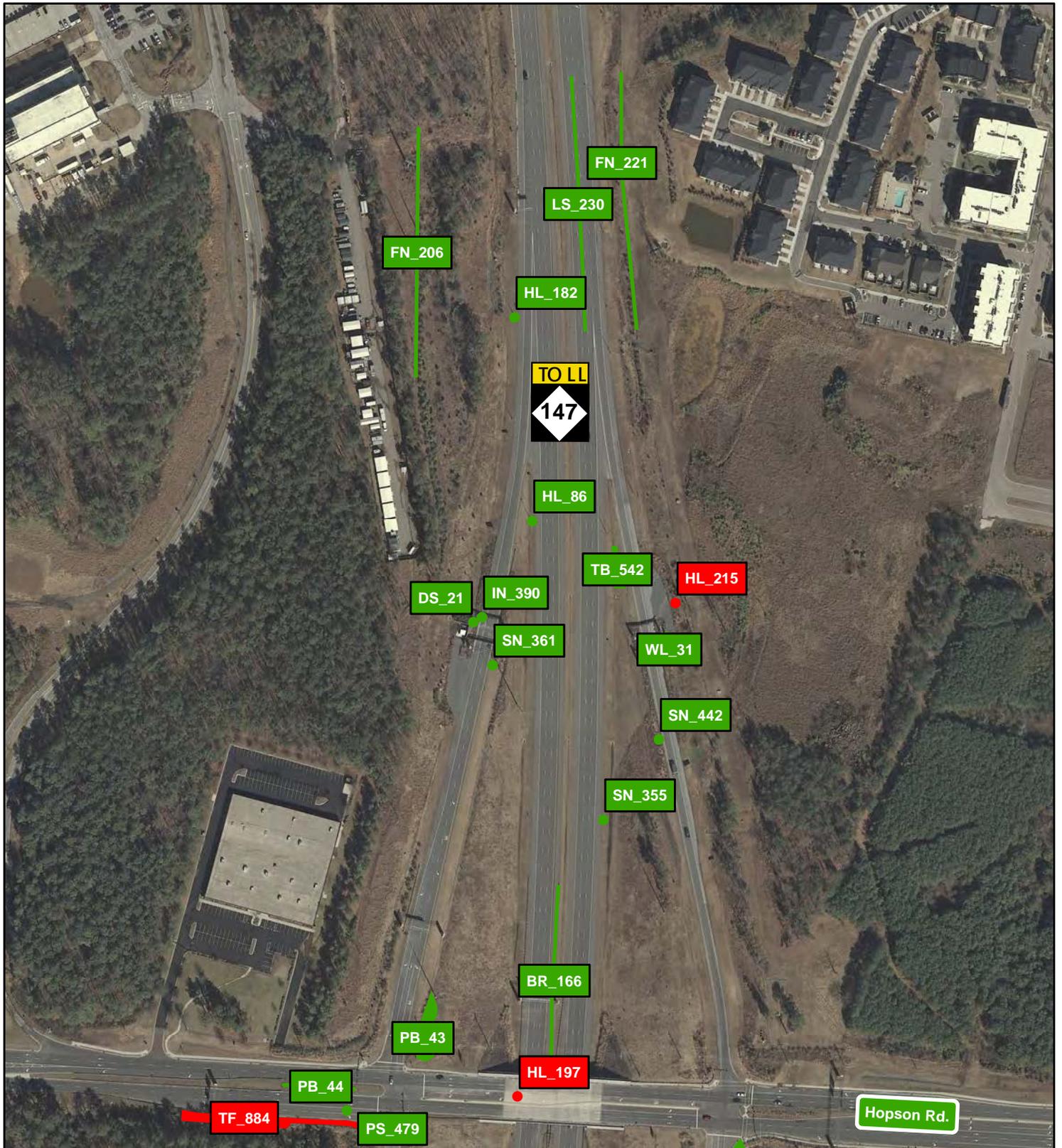


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

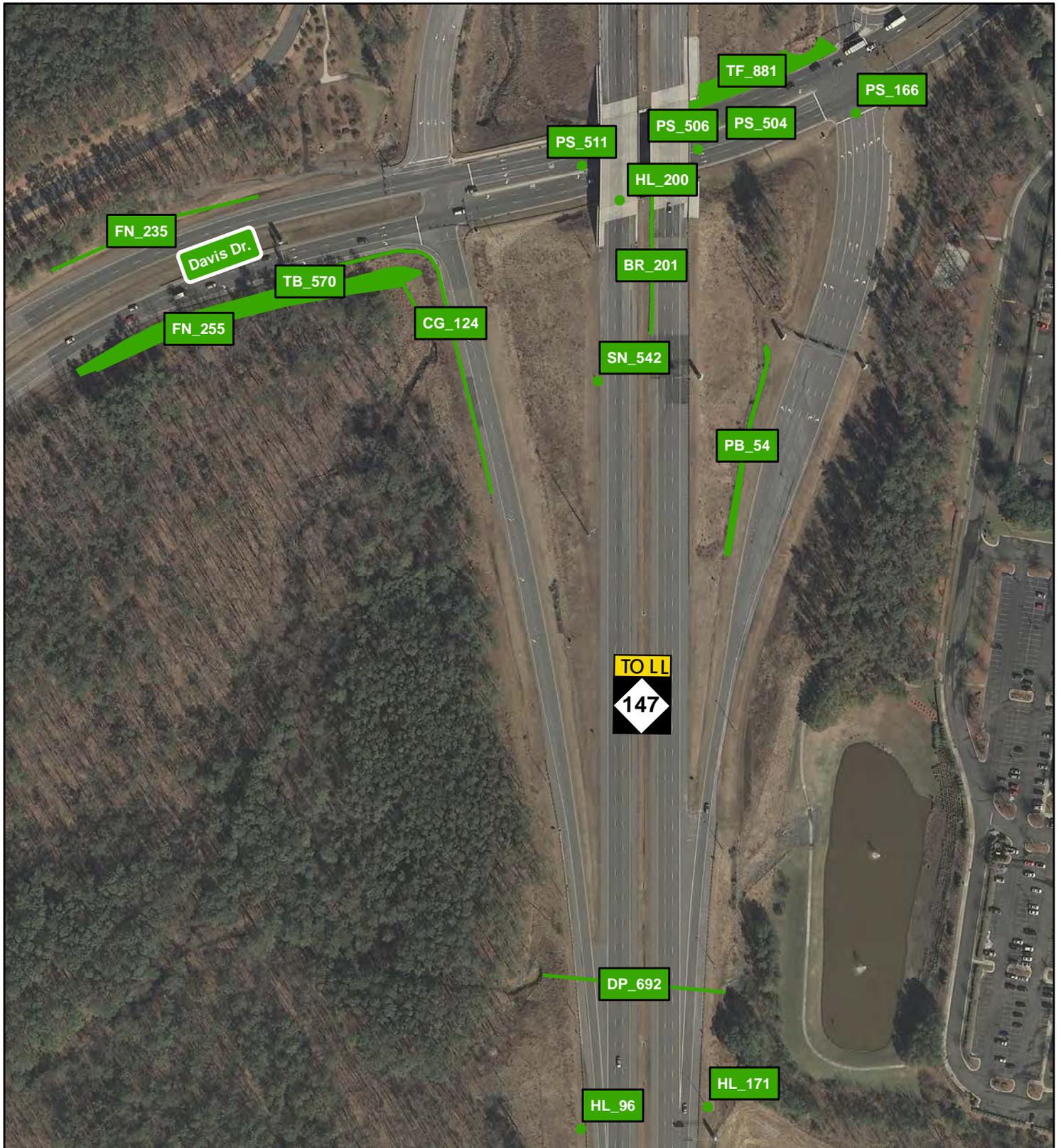


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

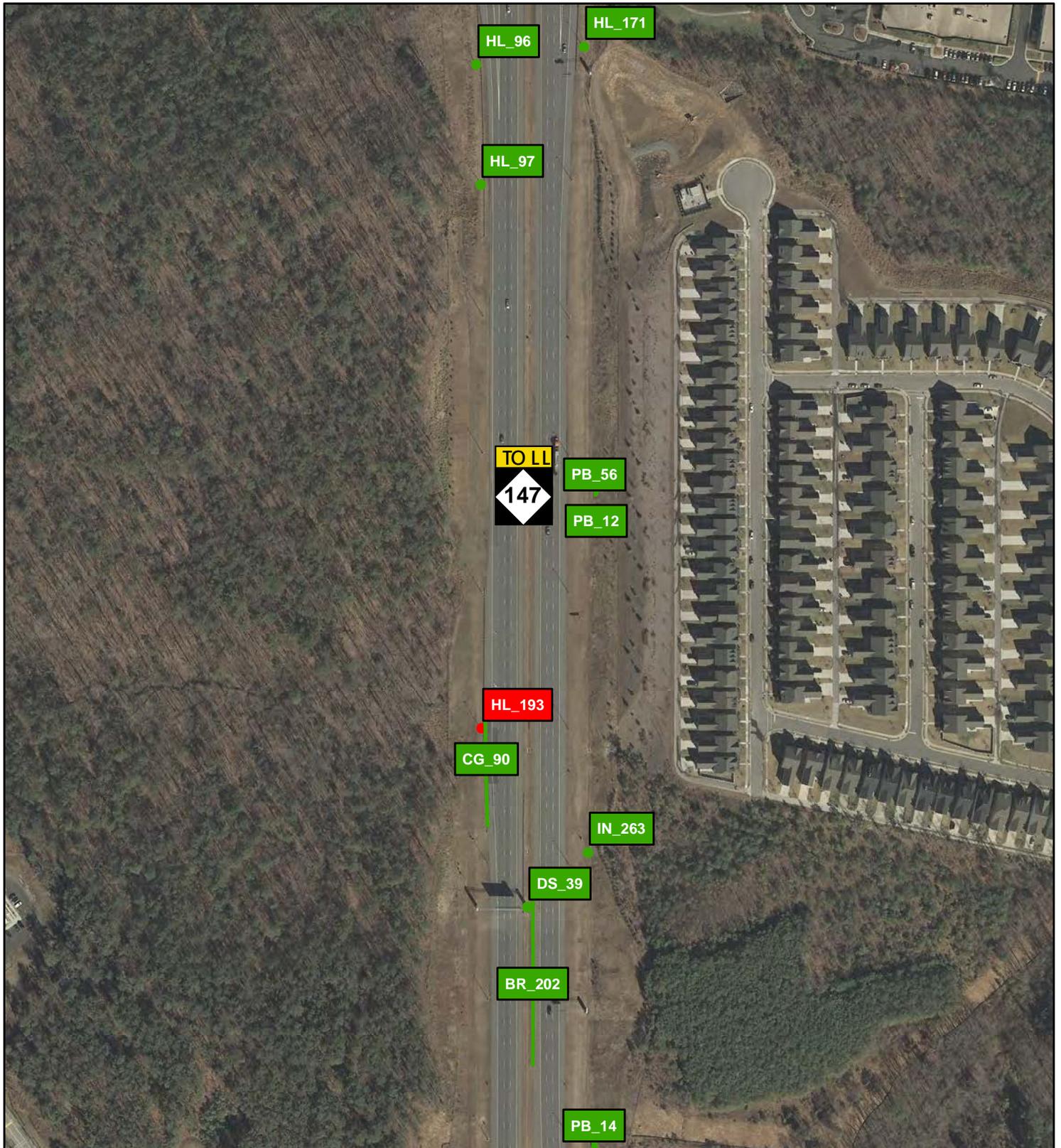


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations

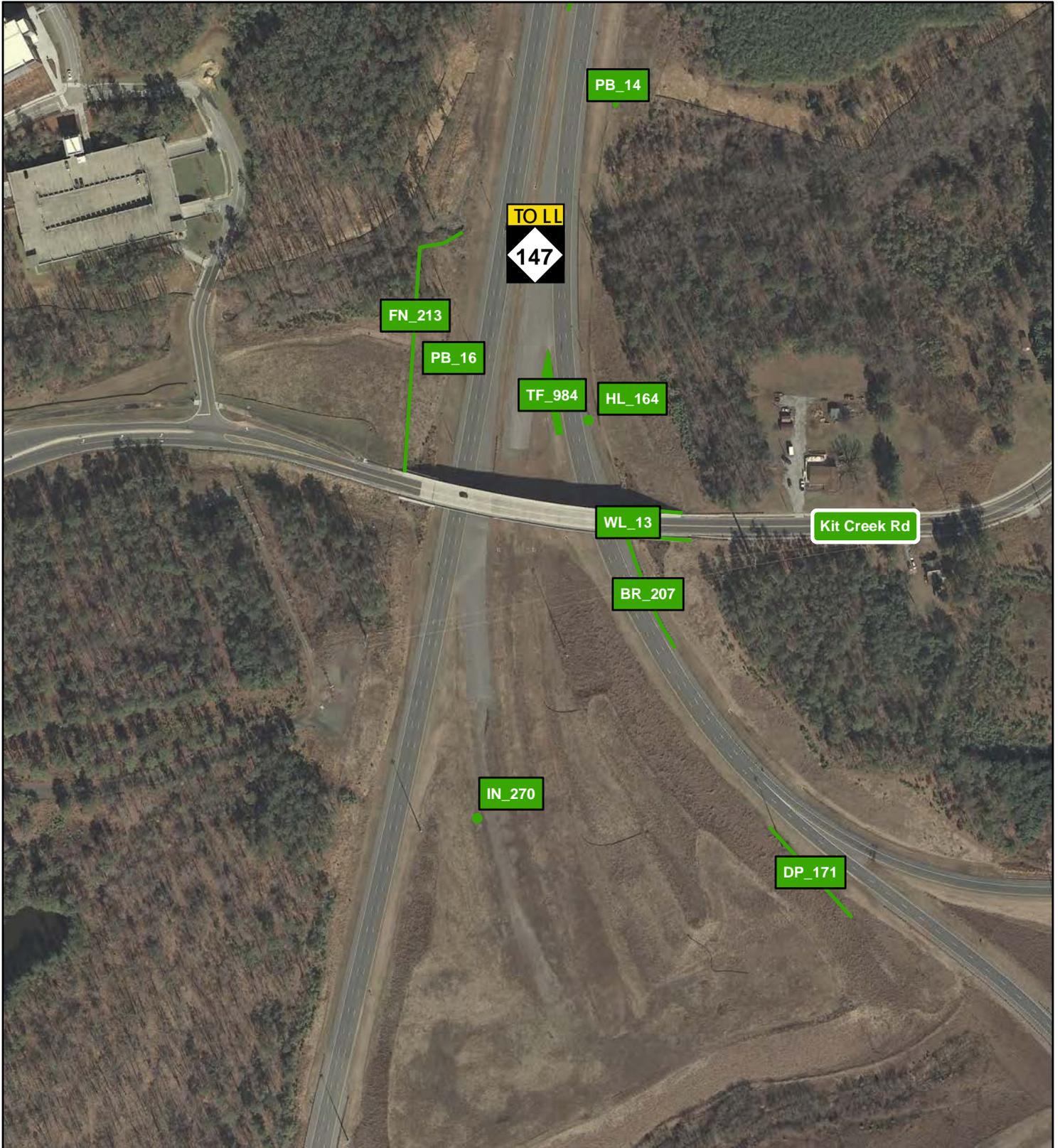


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2017 Second Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset



Appendix B

Triangle Expressway 2017 Second Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2017 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) 9
Graffiti (GR) 10
Highway Lighting (HL) 11
Impact Attenuators (IA) 13
Inlets (IN)..... 14
Landscaping (PB) 15
Paved Lanes – Asphalt (LS)..... 16
Paved Lanes – Concrete (LS) 17
Paved Shoulders (LS)..... 18
Unpaved Shoulders (LS) 19
Front/Back Slopes (LS) 20
Unpaved Lateral and Outfall Ditches (LS) 21
Litter (LS) 22
Roadway Sweeping (LS) 23
Pavement Striping (LS)..... 24
Pavement Markers (LS)..... 25
Delineators (LS) 26
Paved Ditches (PD)..... 27
Pavement Words and Symbols (PS)..... 28
Signs (SN) 29
Tree and Brush (TB) 30
Turf Condition (TF) 31
MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL)..... 38

The Inventory ID and GIS Reference Page number correspond to the maps provided in Appendix A, to allow for the quick location of particular asset failures. Photos of failures are provided when applicable.

Guardrail, Concrete Barrier and End Anchors (BR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Guardrail	BR_97	Functional Damage		A13

Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Valley	CG_5	Misalignment		A24
2	Valley	CG_41	Misalignment		A18
3	Valley	CG_51	Material Accumulation		A21

Decorative Supports (DS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Gantry Support	DS_60	Vegetation		A5
2	Overhead Sign Support	DS_255	Paint Scaling		A28

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_6	Obstruction		A42
2	Shoulder Drain	MDP_16	Obstruction		A12
3	Shoulder Drain	MDP_36	Obstruction		A16
4	Shoulder Drain	MDP_86	Erosion		A24

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Shoulder Drain	MDP_87	Obstruction	 A photograph showing a concrete shoulder drain partially blocked by a dense clump of tall green grass and weeds.	A24
6	Shoulder Drain	MDP_119	Erosion	 A photograph showing a concrete shoulder drain with significant soil erosion on either side, and tall grasses growing in the eroded areas.	A32
7	Shoulder Drain	MDP_122	Obstruction	 A photograph showing a concrete shoulder drain with a metal grate, heavily obstructed by tall green grass and weeds.	A33
8	Shoulder Drain	MDP_155	Erosion	 A photograph showing a concrete shoulder drain with a metal grate, surrounded by a deep, eroded channel in the soil with tall grasses growing in it.	A38

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_258	Hole Height		A2
2	Woven	FN_353	Fence Height		A37

Graffiti (GR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Bridge Wall	GR_1	Graffiti		A9

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	High Mast	HL_71	Missing Part		A10
2	Single Roadway	HL_129	Functional Damage	Not Available for Nighttime Failure.	A7
3	Single Roadway	HL_193	Part Damage		A46
4	Underpass Lighting	HL_197	Functional Damage	Not Available for Nighttime Failure.	A43, A44
5	High Mast	HL_206	Missing Part		A6
6	Single Roadway	HL_215	Part Damage		A43
7	Underpass Lighting	HL_218	Functional Damage	Not Available for Nighttime Failure.	A5

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
8	Single Roadway	HL_333	Part Damage		A30
9	Single Roadway	HL_337	Functional Damage, Part Damage, Missing Part		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_819	Surface Damage		A38

Landscaping (PB)

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

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	Asphalt	LS_173	Shoulder Drop Off		A20
2	Asphalt	LS_585	Shoulder Drop Off		A27

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	Concrete	LS_405	Missing Line		A30
2	Concrete	LS_410	Missing Line		A30
3	Concrete	LS_412	Missing Line		A30, A31

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_556	Marker Reflectivity	Not Available for Nighttime Failure.	A39
2	Asphalt	LS_592	Missing Markers		A28
3	Asphalt	LS_595	Missing Markers, Continuous Markers		A27

Delineators (LS)

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

Paved Ditches (PD)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	PD_11	Material Accumulation		A42

Pavement Words and Symbols (PS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Merge Left	PS_47	Day Time Assessment		A21

Signs (SN)

#	Sign Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Mile Post	SN_102	Sign Support, Missing Part		A12
2	Wrong Way	SN_147	Height Requirement		A26
3	Do Not Enter	SN_619	Missing Part		A35

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_42	Bare Ground		A20
2	Turf	TF_80	Height		A28
3	Turf	TF_93	Height		A28
4	Turf	TF_113	Height		A32

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_120	Height		A33
6	Turf	TF_222	Height, Bare Ground	 	A27
7	Turf	TF_231	Bare Ground		A39

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
8	Turf	TF_232	Bare Ground		A39
9	Turf	TF_343	Height		A38
10	Turf	TF_373	Bare Ground		A39
11	Turf	TF_386	Height, Bare Ground		A38

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
12	Turf	TF_393	Bare Ground		A39
13	Turf	TF_410	Height, Bare Ground		A36
14	Turf	TF_430	Height		A35

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
15	Turf	TF_438	Height		A34
16	Turf	TF_483	Height		A31
17	Turf	TF_590	Height		A19
18	Turf	TF_625	Height		A16

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
19	Turf	TF_667	Height		A12
20	Turf	TF_671	Bare Ground		A29
21	Turf	TF_812	Height		A4
22	Turf	TF_884	Height		A43, A44

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
23	Turf	TF_937	Height		A42
25	Turf	TF_983	Height		A6

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

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