



NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program

Triangle Expressway

2015 Fourth Quarter and Annual Report

1 S. Wilmington Street
Raleigh, NC 27601



Last Updated:
January 29, 2016

CONSULTANT CERTIFICATION OF COMPLETION

January 29, 2016

Mr. Andy Lelewski, PE
NCTA Director of Toll Road Operations
1 South Wilmington Street
Raleigh, NC 27601

NCTA Triangle Expressway Roadway Maintenance Performance Rating Program; Q4, 2015 Rating

This is to certify that I, Ken M. McEntire, PE am an authorized official representative of the company Asset Management Associates, PLLC, 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,

A handwritten signature in blue ink that reads "Ken M. McEntire". The signature is written in a cursive style with a horizontal line underlining the name.

Ken M. McEntire, PE

Asset Management Associates, PLLC
126 North Salem Street, Suite 206
Apex, NC 27502

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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 2015 Fourth Quarter Assessment of the Triangle Expressway.

The overall 2015 fourth quarter maintenance rating of the Triangle Expressway is 92.8, 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 with the exception of Drainage (83.8).

Table 1: MRP Element Results for the 2015 Fourth Quarter Assessment		
ELEMENT	MRP RATING	TARGET RATING
Road Surface	97.9	85.0
Unpaved Shoulders	97.8	85.0
Drainage	83.8	85.0
Roadside	90.5	85.0
Traffic Control Devices	92.2	85.0
Overall MRP Performance Rating	92.8	90.0

This report also provides a summary and analysis of the 2015 Annual Assessment of the Triangle Expressway, which takes into account the results of all four quarterly inspections conducted in 2015 during the months February, May, August, and November. The summation of these results produces the annual rating which is considered to be a statistically valid representation of the assets' conditions with a 95% confidence level in statistical sampling.

The overall 2015 annual maintenance rating of the Triangle Expressway is 93.2, which is above the NCTA target rating of 90. As shown in **Table 2**, all annual element ratings were also above the target rating of 85.

Table 2: MRP Element Results for the 2015 Annual Assessment					
ELEMENT	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	Q4 2015 RATING	2015 ANNUAL RATING
Road Surface	98.8	97.6	98.9	97.9	98.3
Unpaved Shoulders	100.0	96.6	100.0	97.8	98.6
Drainage	93.0	93.4	93.5	83.8	90.9
Roadside	88.1	86.6	86.3	90.5	87.9
Traffic Control Devices	84.4	96.8	89.0	92.2	90.6
Overall MRP Performance Rating	92.0	94.7	93.1	92.8	93.2

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In addition, the report provides findings of the Green Level Historic District signs inspections. This quarter, all Green Level Historic District signs were found to be in good physical condition, and the landscaped areas around the signs were 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 through the use of 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.

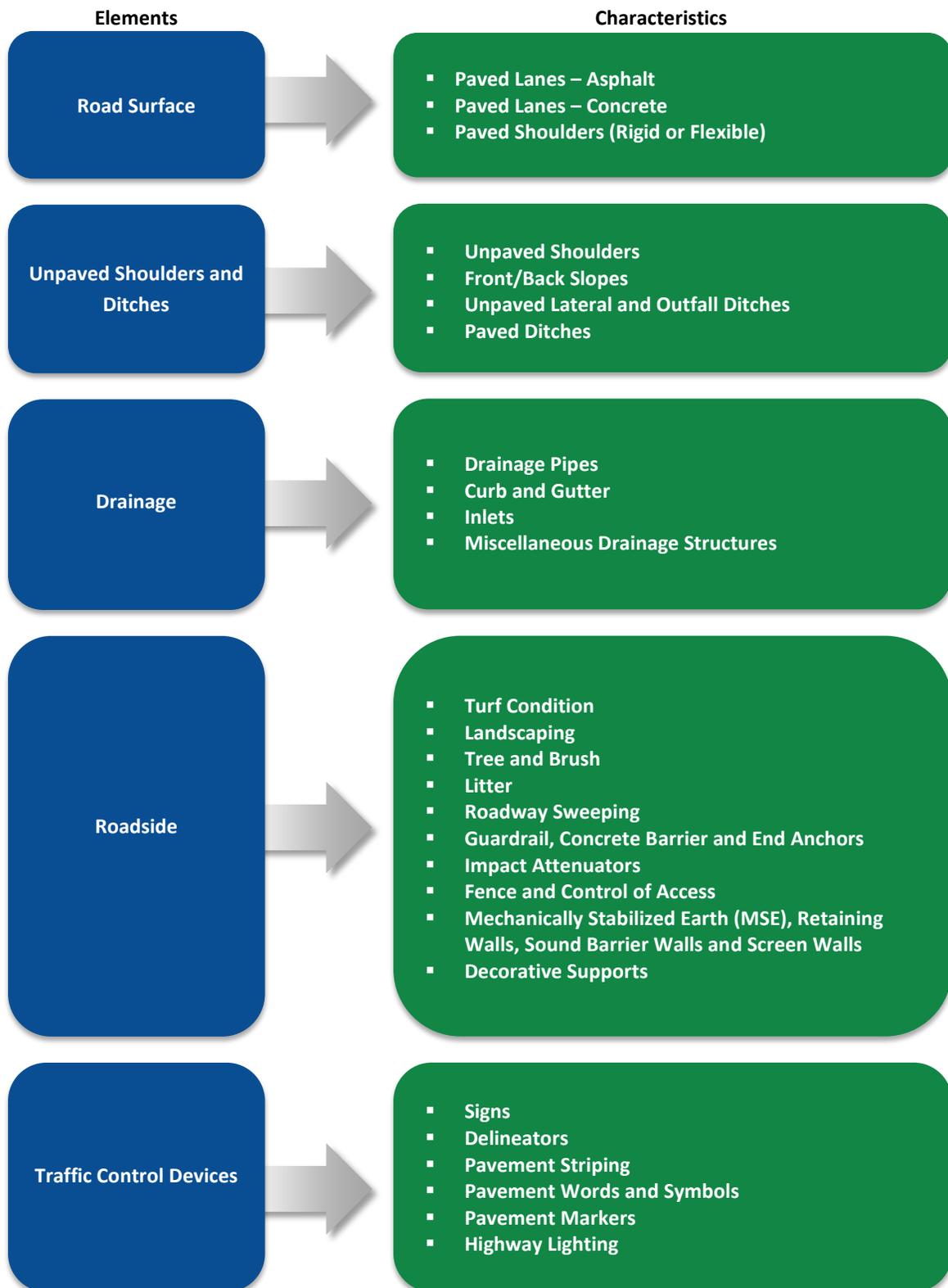
The NCTA performance standards, threshold criteria and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff and consultants.

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 through the use of 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 summing the elements MRP rating multiplied by the following weighted factors:

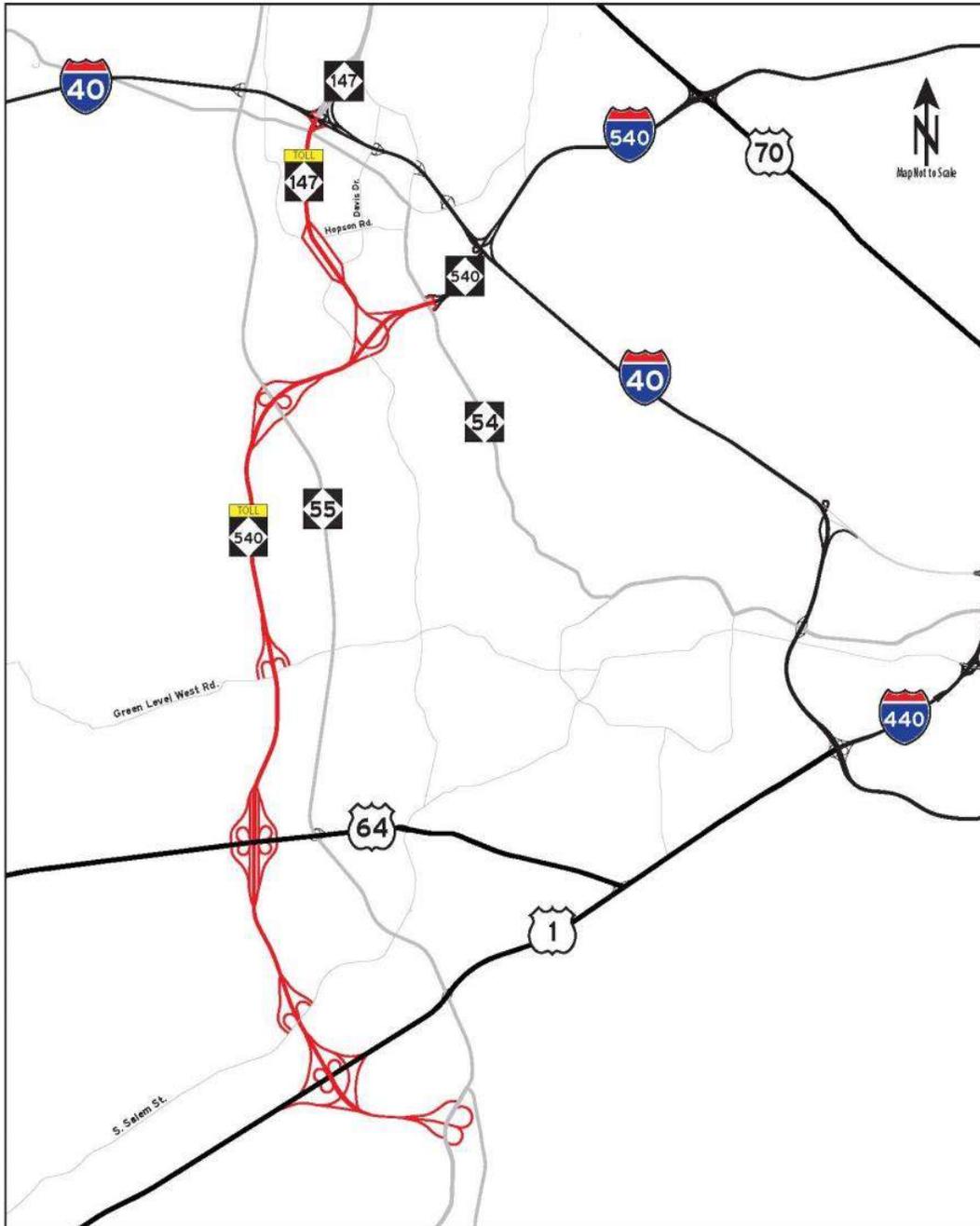
Road Surface =	25%
Unpaved Shoulders =	13%
Drainage =	15%
Roadside =	17%
Traffic Control Devices =	30%
<hr/>	
Total =	100%

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 ten interchanges and eighteen 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 Maintenance and conducts routine field visits to maintain an accurate asset inventory and ensure the validity of the MRP.

During the fourth quarter no assets were removed or added to the inventory.

6.0 MRP ASSESSMENT

6.1 Quarterly Results

The overall 2015 fourth quarter maintenance rating of the Triangle Expressway is 92.8, and is above the overall target rating of 90. Most element ratings are above the target rating of 85, with the exception of Drainage (83.8). Also, three characteristics scored below the target rating of 80 including: Miscellaneous Drainage (63), Turf (66) and Highway Lighting (78). It is important to note that these results are only representative of the fourth quarter sample, one of the four surveys conducted 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 in Section 7, will provide a 95% confidence level in statistical sampling. The fourth quarter MRP performance ratings for elements and characteristics are presented in **Table 3** and **Table 4**, respectively.

Table 3: MRP Element Results for the 2015 Fourth Quarter Assessment	
ELEMENT	Q4 2015 MRP RATING
Road Surface	97.9
Unpaved Shoulders	97.8
Drainage	83.8
Roadside	90.5
Traffic Control Devices	92.2
Overall MRP Performance Rating	92.8

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Table 4: MRP Characteristic Results for the 2015 Fourth Quarter Assessment						
ROAD SURFACE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q4 RATING
Paved Lanes Asphalt	57	58	9	513	522	98
Paved Lanes Concrete	60	60	9	540	540	100
Paved Shoulders	55	59	5	275	295	93
Element Total				1328	1357	97.9
UNPAVED SHOULDERS AND DITCHES	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q4 RATING
Unpaved Shoulders	56	59	9	504	531	95
Front/Back Slopes	59	59	6	354	354	100
Lateral and Outfall Ditches, Unpaved	59	59	6	354	354	100
Paved Ditches	2	2	5	10	10	100
Element Total				1222	1249	97.8
DRAINAGE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q4 RATING
Drainage Pipes	28	33	7	196	231	85
Curb and Gutter	21	25	6	126	150	84
Inlets	32	34	7	224	238	94
Misc. Drainage Structures	20	32	4	80	128	63
Element Total				626	747	83.8
ROADSIDE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q4 RATING
Turf Condition	49	74	7	343	518	66
Landscaping	31	32	4	124	128	97
Trees and Brush	31	31	4	124	124	100
Litter	59	59	4	236	236	100
Roadway Sweeping	59	59	5	295	295	100
Guardrails and Concrete Barriers	31	31	9	279	279	100
Impact Attenuators	9	9	9	81	81	100
Fence and Control Access	26	29	7	182	203	90
Retaining, Sound and Screen Walls	18	19	5	90	95	95
Decorative Supports	22	25	5	110	125	88
Graffiti and Stain Removal	59	59	4	236	236	100
Element Total				2100	2320	90.5
TRAFFIC CONTROL DEVICES	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q4 RATING
Signs	28	32	7	196	224	88
Delineators	42	48	3	126	144	88
Pavement Striping/Marking	59	59	8	472	472	100
Words and Symbols	30	30	7	210	210	100
Pavement Markers	53	59	9	477	531	90
Highway Lighting	21	27	6	126	162	78
Element Total				1607	1743	92.2

Additionally, **Appendix A** shows maps of all the assets that were assessed during the fourth quarter. **Appendix B** shows a list of the individual assets that failed the MRP.

6.2 Analysis and Recommendations

Elements

Drainage is the only element of five that fell below NCTA's target threshold criteria of 85. The fourth quarter rating for Drainage (83.8) is 9.7 points lower than the third quarter rating (93.5). This element's low rating for the fourth quarter is attributed to a decrease of 25 points in the rating of Miscellaneous Drainage Structures (63). Recommendations to improve this rating are provided in the following section. In addition, it is recommended that the maintenance provider continue to monitor closely other characteristics within the Drainage element group that met the maintenance rating expectations, but obtained lower ratings for this reporting period:

- Drainage Pipes (85), 6 points lower than the third quarter rating (91)
- Curb and Gutter (84), 8 points lower than the third quarter rating (92)

Characteristics

This quarter, most characteristics satisfied the NCTA target threshold criteria of 80 with the exception of Miscellaneous Drainage Structure (63), Turf Condition (66) and Highway Lighting (78). This section describes conditions of these characteristics and presents recommended future work planning to raise the ratings. Pictures of the failures are included in **Appendix B**.

Miscellaneous Drainage (63 rating – 12 of the 32 assets failed). Out of the 12 miscellaneous drainage structures that failed, 11 failed because of obstruction and 1 failed because of erosion. Two of the failing miscellaneous drainage structures are presented in **Figure 3**.

Figure 3: Miscellaneous Drainage Structures Failures



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Many of the obstructions are a result of inadequate gradient flow away from the edge drain outlets. In order to avoid affecting the natural flow of water near the drainage features, 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. It is also recommended that the maintenance provider plan routine (once per year in accordance with the *NCTA Roadway and Facility Maintenance Standards V4* referenced below) cleaning of these drainage features to remove any debris or overgrown vegetation.

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

Turf Condition (66 rating – 25 of the 74 assets failed). Out of the 74 turf areas inspected, 22 failed due to bare ground and 3 failed due to overgrown turf area. Two of the failing turf areas can be seen in the **Figure 4**.

Figure 4: Turf Failures



In order to reduce overgrown turf areas throughout the facility, it is recommended that mowing cycles and mowing heights continue to be closely monitored. Special attention should be placed in turf areas behind guardrails, where the *NCTA Roadway and Facility Maintenance Standards V4* require that no vegetation grow taller than 8 inches within five feet from the back of guardrail.

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As per the NCDOT Division 5 Landscape Unit Plan presented during the second quarter, the hydro-seeding process of selected bare ground areas with warm season grasses began during the third quarter. As of this report, positive results have been observed in all tested areas; grass is growing and establishing well. Based on these results, the NCDOT Division 5 Landscape Unit is planning to reseed all bare ground spots with centipede grass using a drill seeding method. This reseeding effort is expected to start during the spring of 2016. Additionally, the landscape unit is planning to fertilize the entire facility twice during the summer of 2016, in June and August. It is important to recognize that results from these efforts may not be immediate as it may take several years for the turf to be fully established.

Highway Lighting (78 rating – 6 of the 27 assets failed). Out of the 27 highway lights inspected, 3 failed for functional damage and 3 failed for missing or damaged parts. Two of the failing highway lights can be seen in the *Figure 5*.

Figure 5: Highway Lighting Failures



In order to avoid future functional damage, it is recommended that all damaged or missing parts noted be repaired and/or replaced in accordance with the NCTA Maintenance Program Standards, 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.
- 3) Replace any light poles damaged by traffic within 5 days or within 14 days if any foundations needed pouring.

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

7.0 ANNUAL 2015 RATING

The overall annual maintenance rating of the Triangle Expressway is 93.2, exceeding NCTA's target overall rating of 90. Additionally, all element ratings are above the target rating of 85. All characteristics' ratings meet or exceed the target rating of 80, with the exception of Turf Condition which obtained a rating of 54.

The annual results are presented in **Tables 5 and 6**. These results are a collection of the four quarterly inspections conducted throughout 2015.

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Table 5: MRP Characteristic Results for the 2015 Annual Assessment						
ROAD SURFACE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	2015 MRP
Paved Lanes Asphalt	162	163	9	1458	1467	99
Paved Lanes Concrete	189	189	9	1701	1701	100
Paved Shoulder	222	235	5	1110	1175	94
Element Total				4269	4343	98.3
UNPAVED SHOULDERS AND DITCHES	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	2015 MRP
Unpaved Shoulder	230	235	9	2070	2115	98
Front/Back Slopes	232	235	6	1392	1410	99
Lateral and Outfall Ditches, Unpaved	234	235	6	1404	1410	100
Ditches, Paved	8	8	5	40	40	100
Element Total				4906	4975	98.6
DRAINAGE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	2015 MRP
Drainage Pipes	121	135	7	847	945	90
Curb and Gutter	92	99	6	552	594	93
Inlets	131	135	7	917	945	97
Misc. Drainage Structure	102	128	4	408	512	80
Element Total				2724	2996	90.9
ROADSIDE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	2015 MRP
Turf Condition	161	296	7	1127	2072	54
Landscaping	123	128	4	492	512	96
Trees and Brush	124	124	4	496	496	100
Litter	234	235	4	936	940	100
Roadway Sweeping	232	235	5	1160	1175	99
Guardrail, Concrete Barrier and End Anchors	121	123	9	1089	1107	98
Impact Attenuators	35	36	9	315	324	97
Fence, Control Access	110	116	7	770	812	95
Retaining Walls and Sound Barrier Walls	66	76	5	330	380	87
Decorative Supports	96	100	5	480	500	96
Graffiti and Stain Removal	236	236	4	944	944	100
Element Total				8139	9262	87.9
TRAFFIC CONTROL DEVICES	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	2015 MRP
Signs	128	133	7	896	931	96
Delineators	156	177	3	468	531	88
Pavement Striping/Marking	223	235	8	1784	1880	95
Words and Symbols	118	120	7	826	840	98
Pavement Markers	197	235	9	1773	2115	84
Highway Lighting	91	108	6	546	648	84
Element Total				6293	6945	90.6

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Table 6: MRP Element Results for the 2015 Annual Assessment					
ELEMENT	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	Q4 2015 RATING	2015 ANNUAL RATING
Road Surface	98.8	97.6	98.9	97.9	98.3
Unpaved Shoulders	100.0	96.6	100.0	97.8	98.6
Drainage	93.0	93.4	93.5	83.8	90.9
Roadside	88.1	86.6	86.3	90.5	87.9
Traffic Control Devices	84.4	96.8	89.0	92.2	90.6
Overall MRP Performance Rating	92.0	94.7	93.1	92.8	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 to ensure they are in good standing. During this quarterly inspection, all signs were found to be in good condition, with the landscaped areas being well maintained. **Figure 6** shows two of these signs.

Figure 6: Green Level West Historic District Signs



9.0 CONCLUSION

This report presents the 2015 fourth quarter and 2015 annual rating assessment of the Triangle Expressway. The NCTA's target ratings are 90 overall, 85 for elements and 80 for characteristics. The fourth quarter 2015 overall rating is 92.8 and the 2015 annual rating is 93.2; both ratings are above the target rating of 90.

Most element ratings are above the target rating for the annual assessment. However, the Drainage element failed to meet the target rating for the fourth quarter assessment. Drainage experienced a decline in rating due to lower scores for Miscellaneous Drainage Structures, Drainage Pipes and Curb and Gutter. Most characteristics' quarterly ratings exceeded the target rating of 80 with the exception of Miscellaneous Drainage (63), Turf Condition (66) and Highway Lighting (78). Also, based on the annual assessment ratings, only Turf Condition (54) fell below the threshold.

It is recommended that outlet elevations be checked against the outflow ditch elevations to ensure positive drainage and prevent edge drain outlets from backing up with water. Appropriate grading of the ditch line may be necessary to provide positive flow. It is also recommended that the maintenance provider plan to remove any debris or overgrown vegetation that may impair outflow from the shoulder drain outlets on a routine basis (once per year in accordance with *NCTA Roadway and Facility Maintenance Standards V4*).

Turf Condition is continuing to fail for both the quarterly and annual ratings, and needs the most attention. It is recommended that the maintenance provider continue to closely monitor mowing cycles and mowing heights to prevent overgrown turf. It is also recommended that the NCDOT Division 5 Landscape Unit proceed with their reseeding and fertilization planning effort for 2016.

Routine attention and planning should be given to the nighttime visibility program. While the rating for Pavement Striping, Pavement Markers and Delineators exceeded the target rating for both the 2015 fourth quarter and annual rating, replacements should be scheduled routinely (annually for Delineators and Pavement Markers, and very three to five years for Pavement Striping) in order to maintain their nighttime effectiveness and reflectivity. Preparations should be made in the budget and work schedule for this maintenance work.

All Green Level Historic District signs inspected during the fourth 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

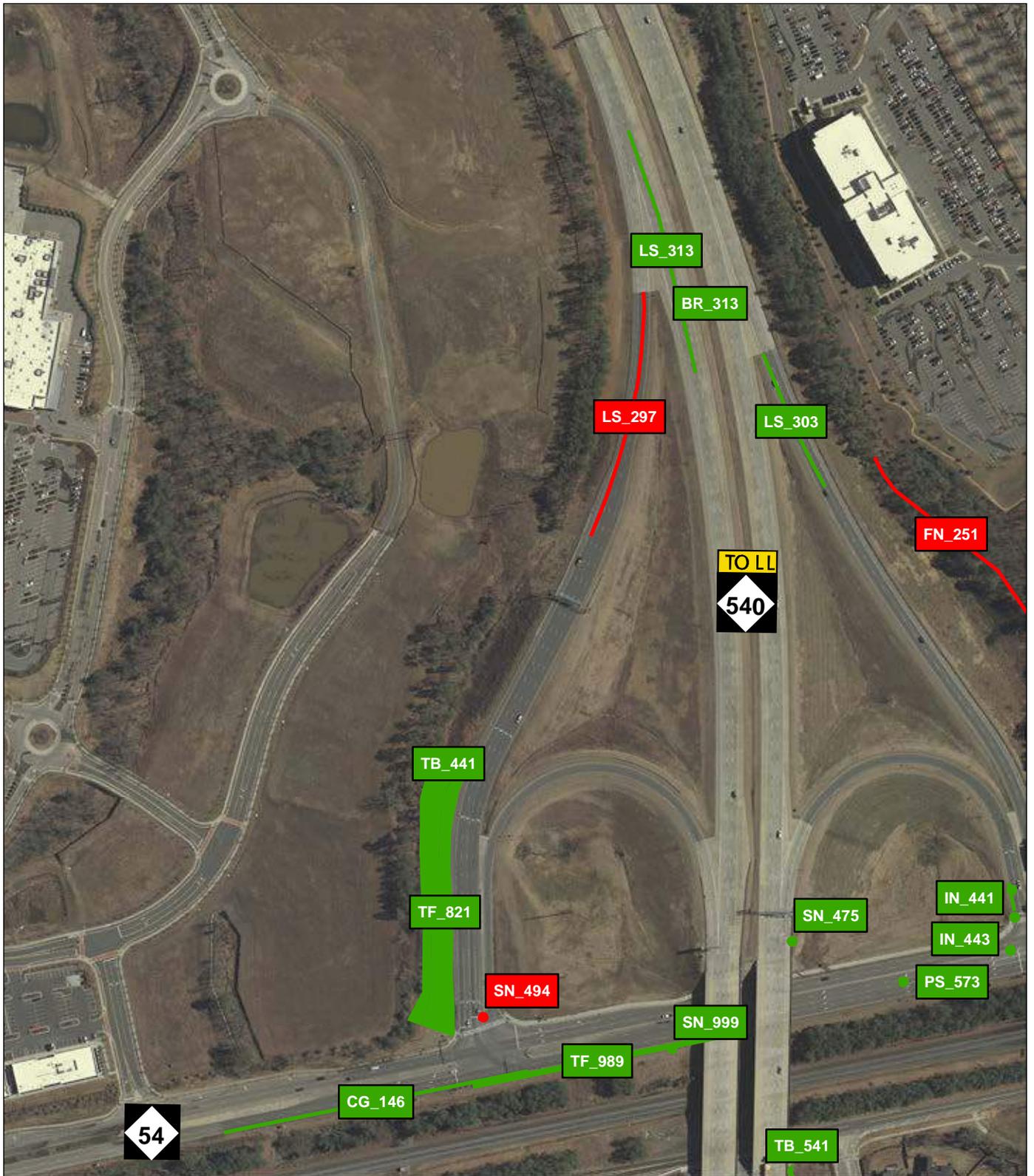
Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

Appendix A: Triangle Expressway 2015 Fourth 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 2015 Fourth Quarter Asset Assessment Locations

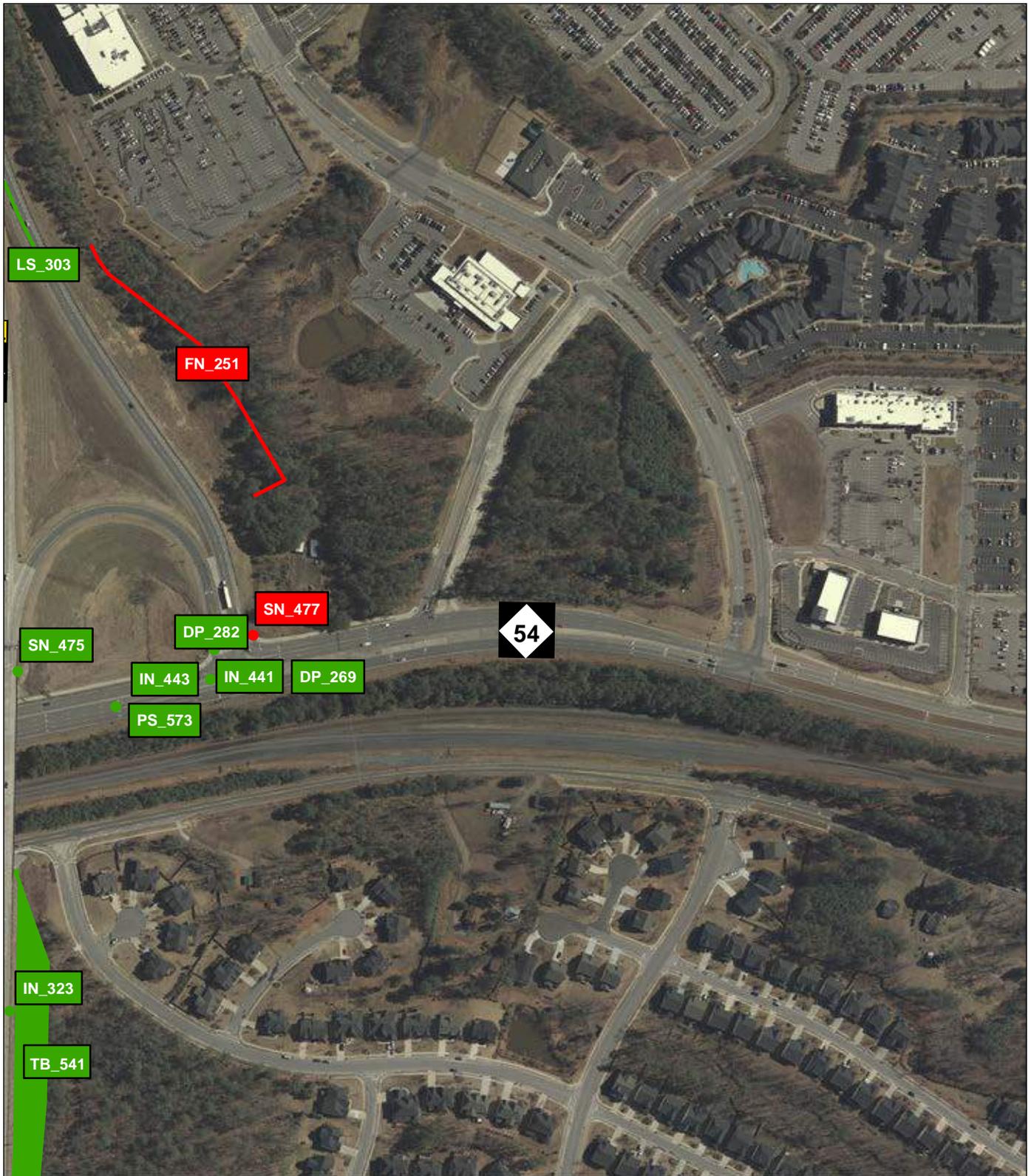


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

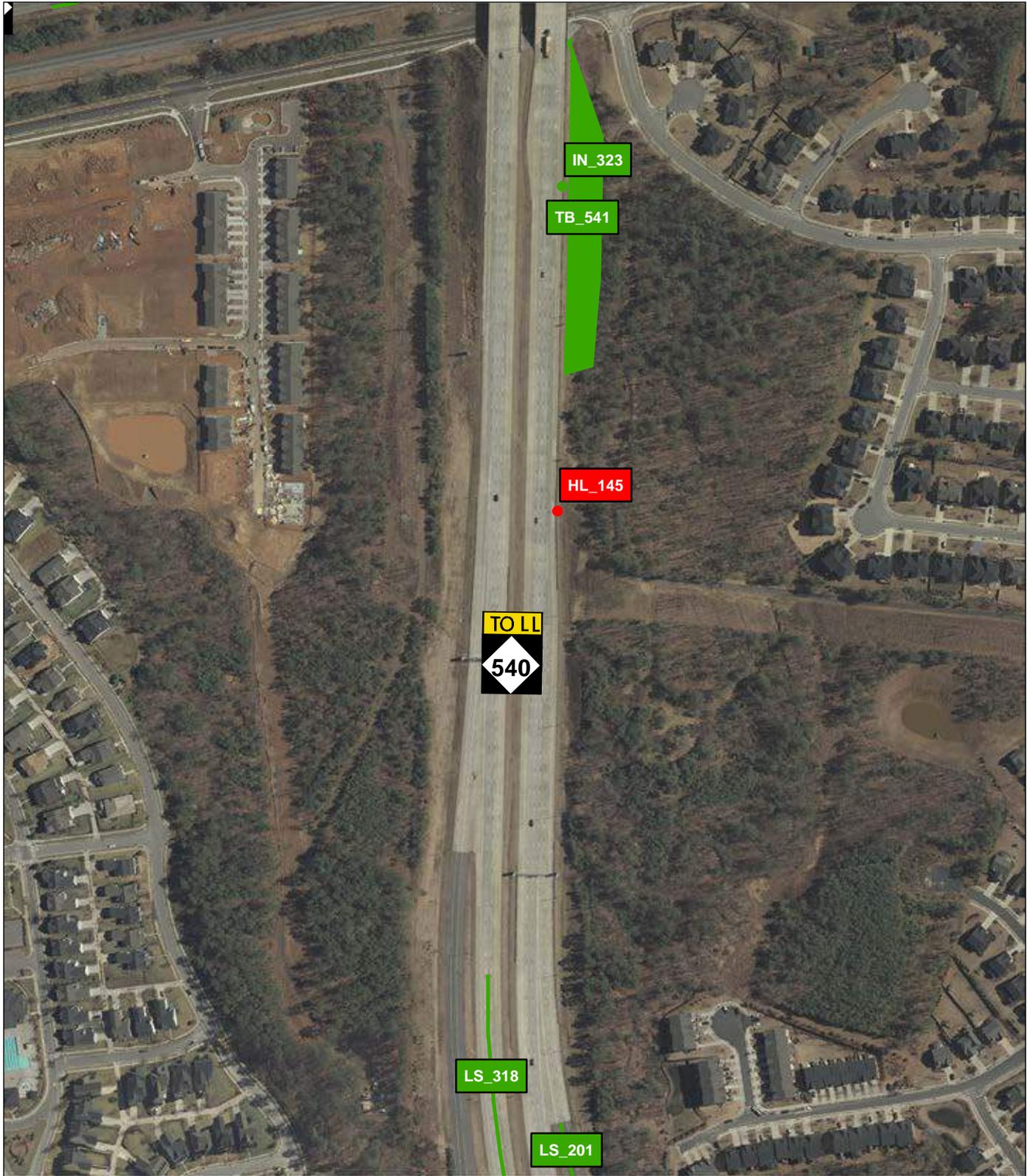


Legend

-  Passing Asset
-  Failing Asset



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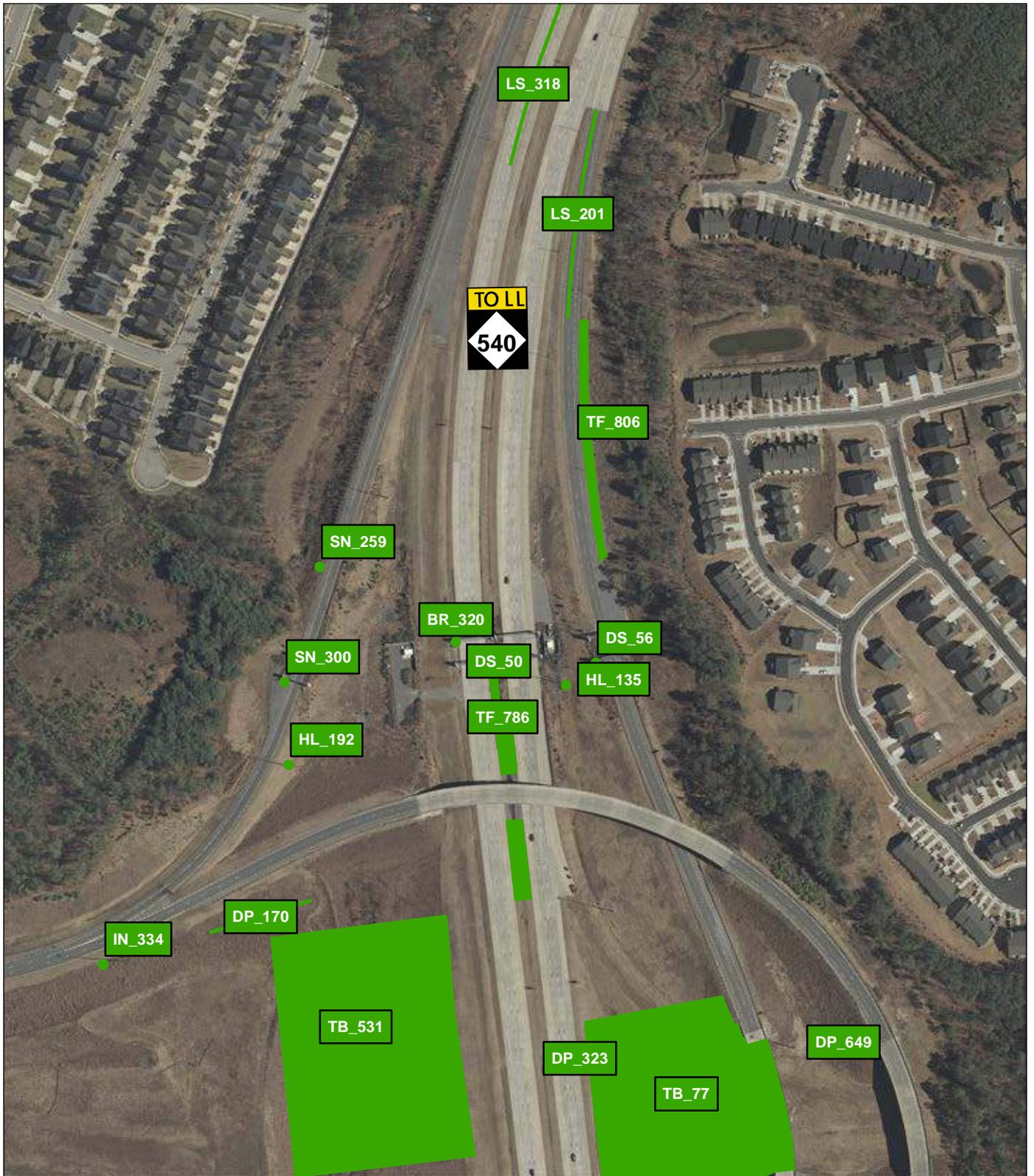


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

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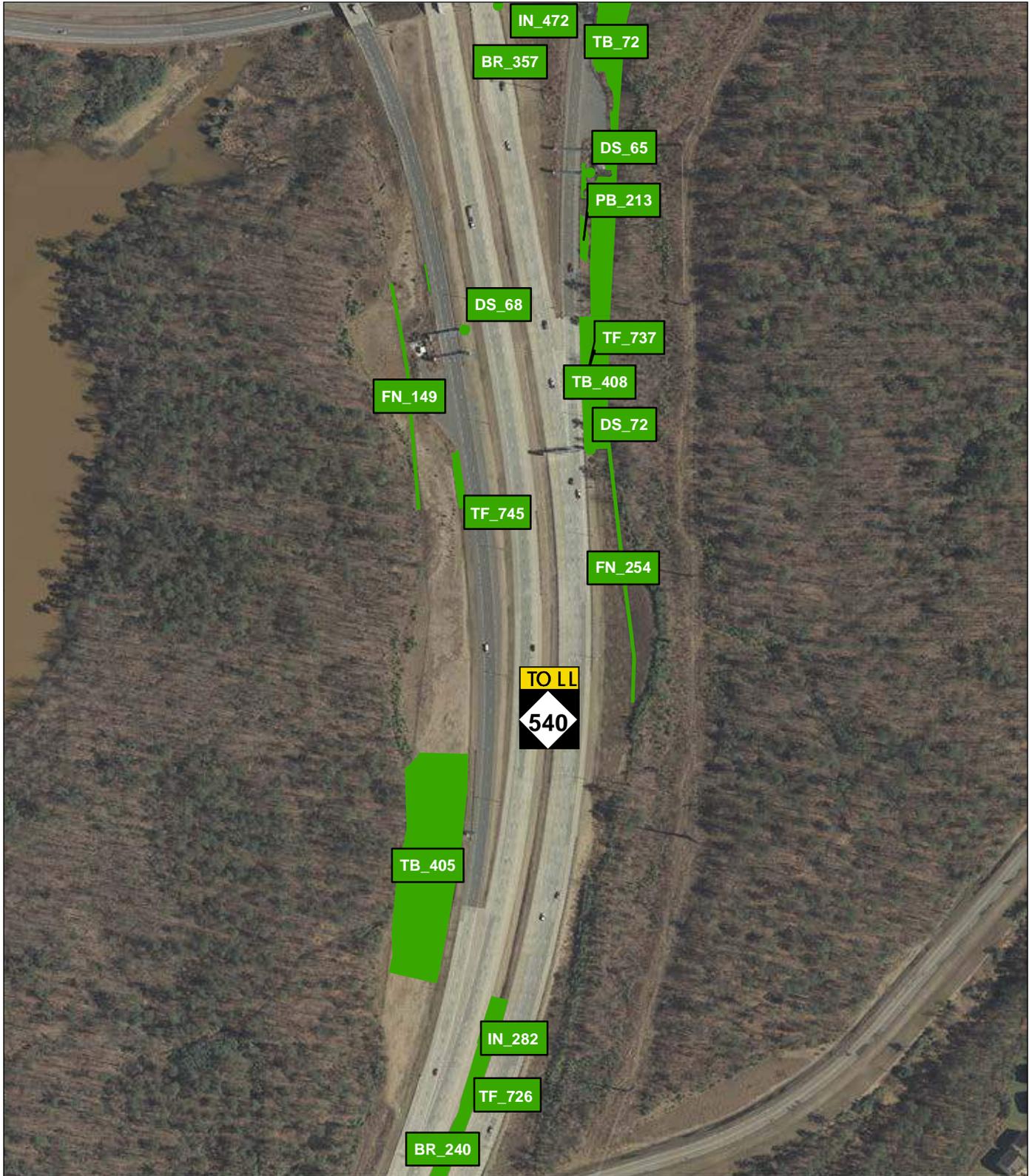


Legend

- Passing Asset
- Failing Asset

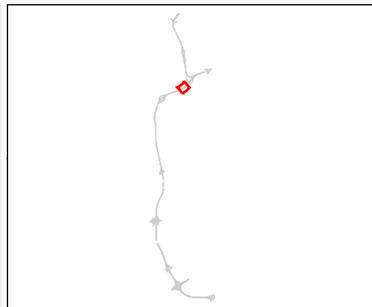


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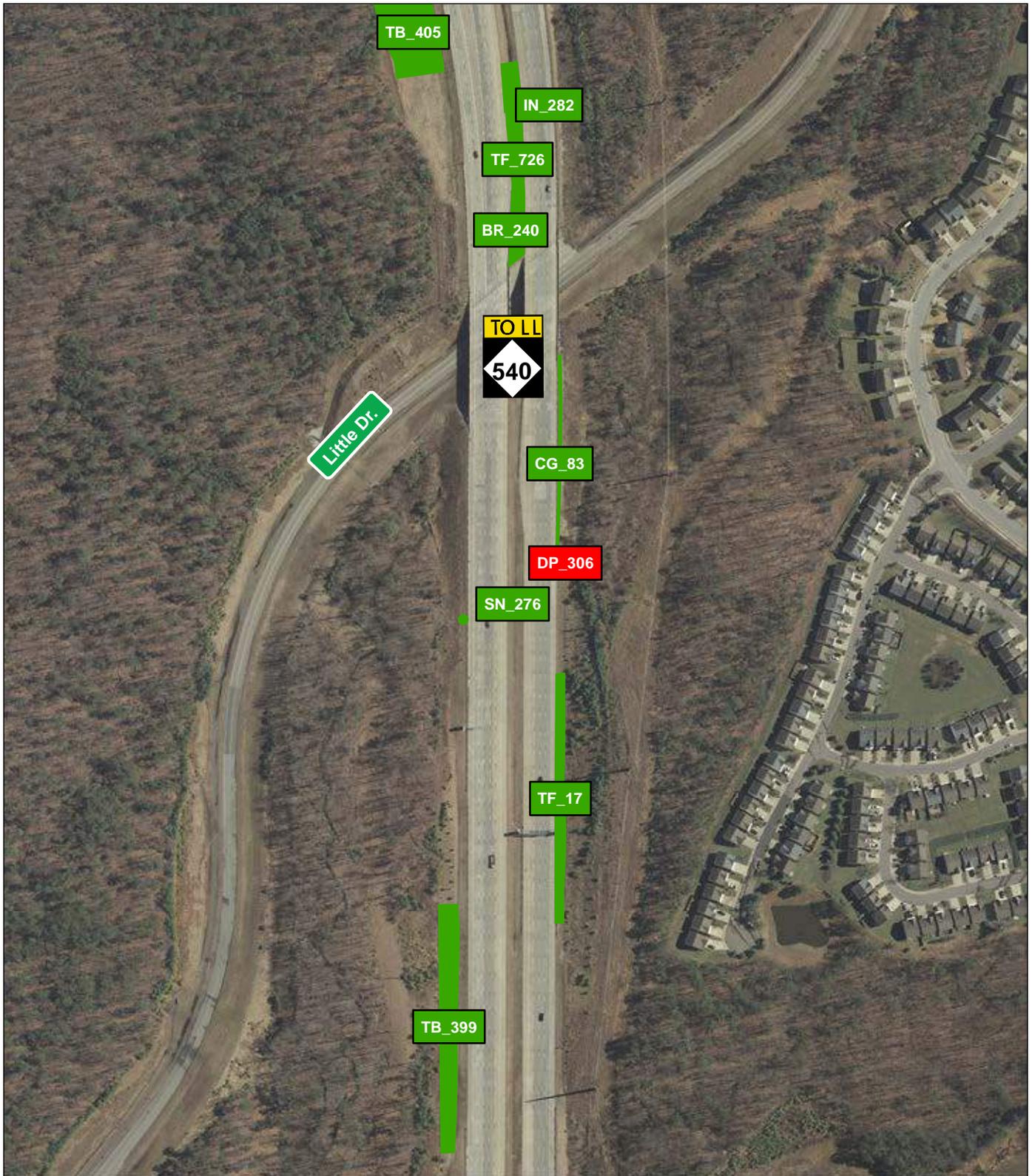


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset

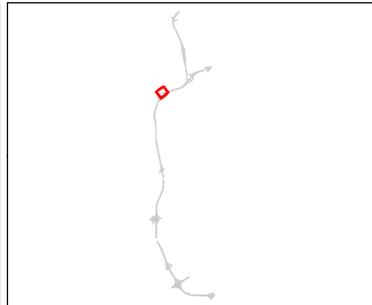


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

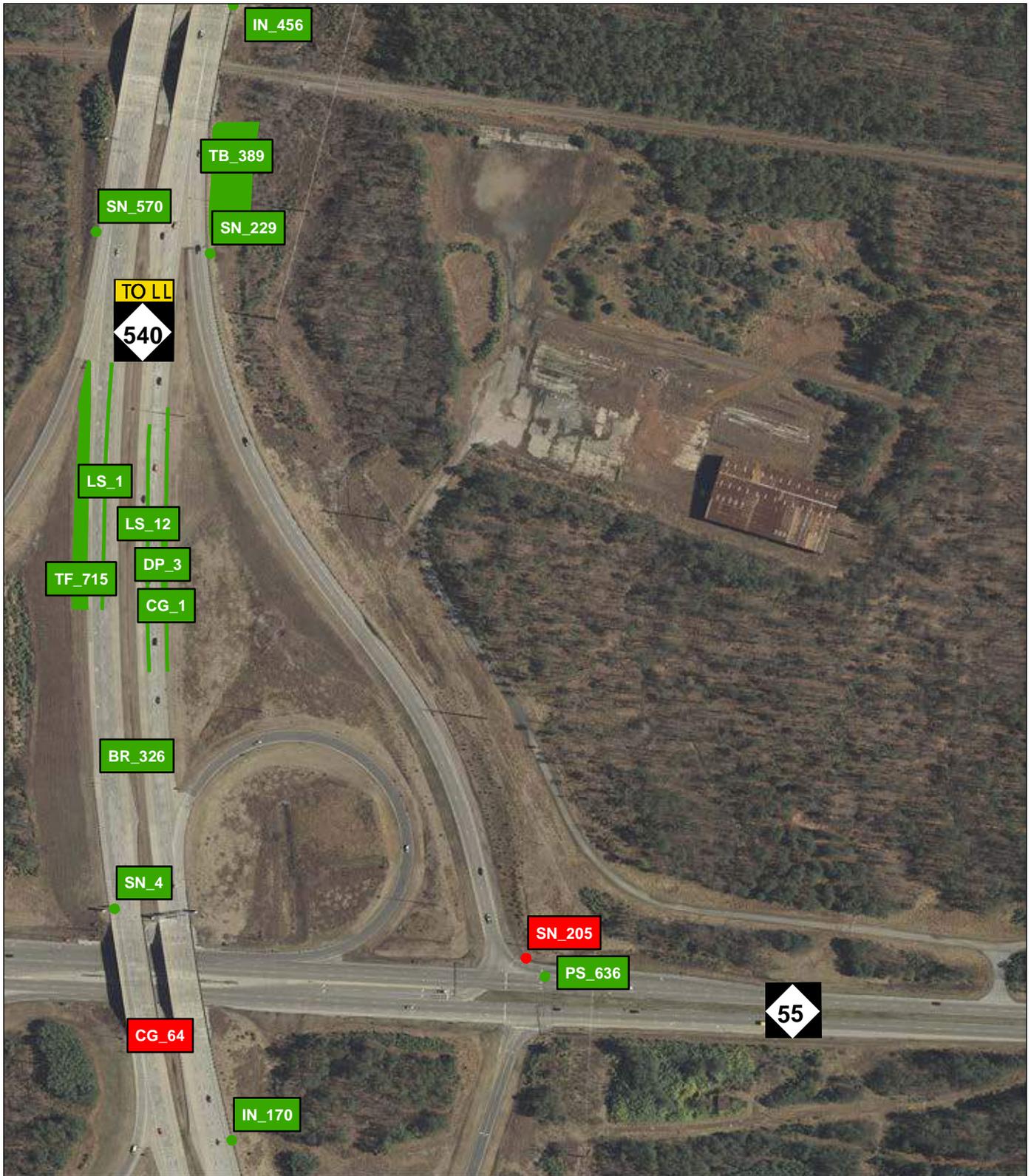


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

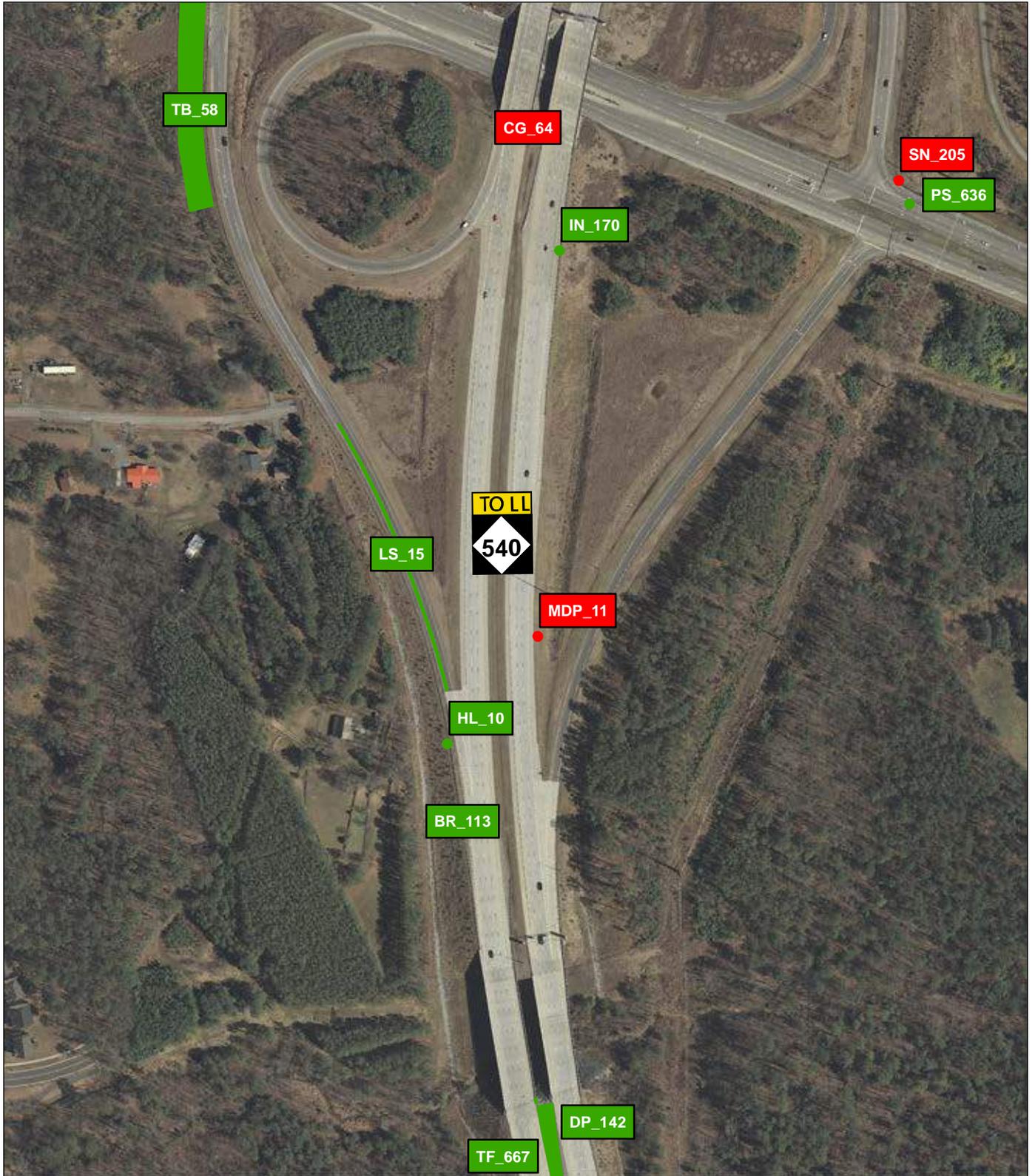


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

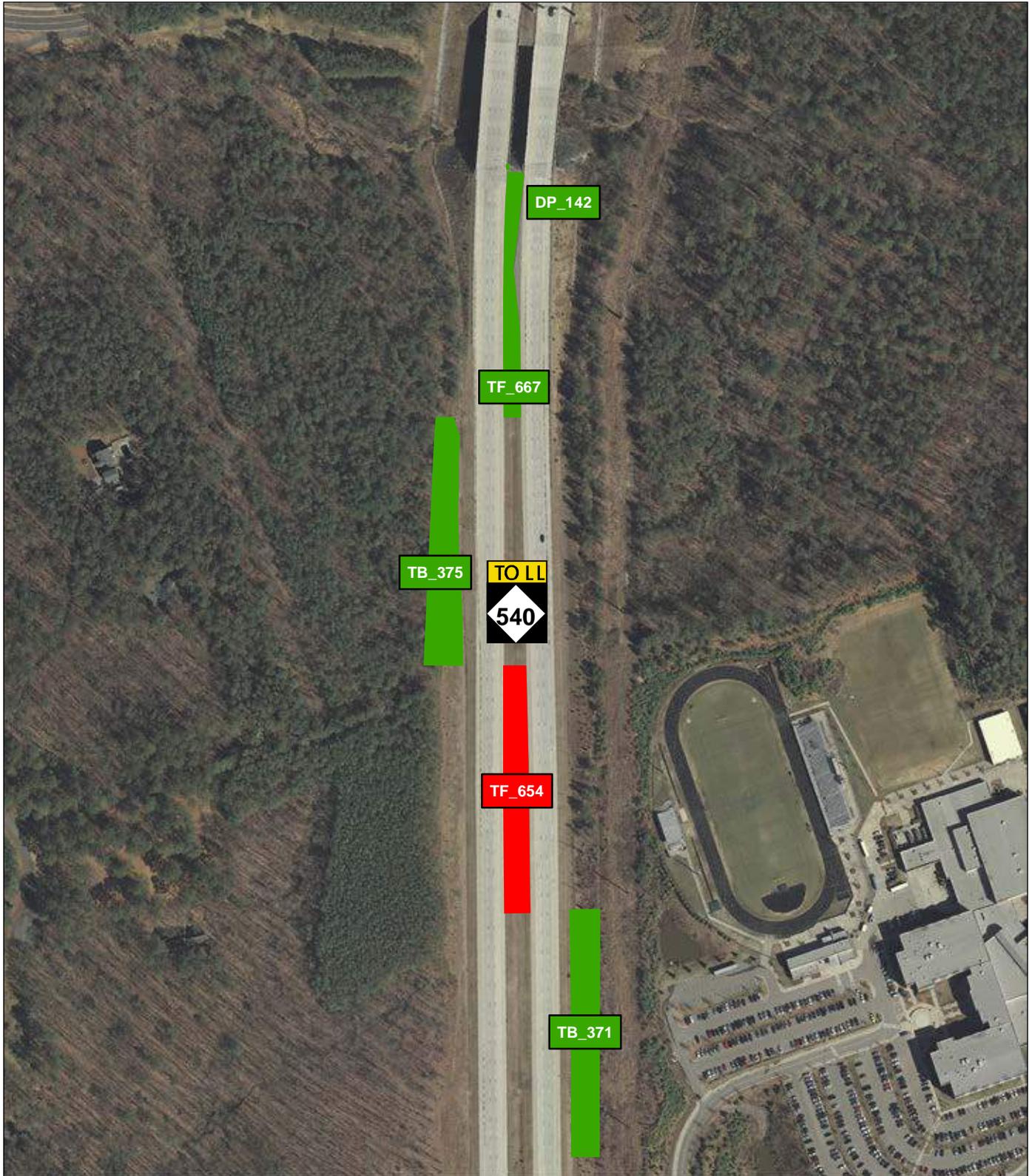


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

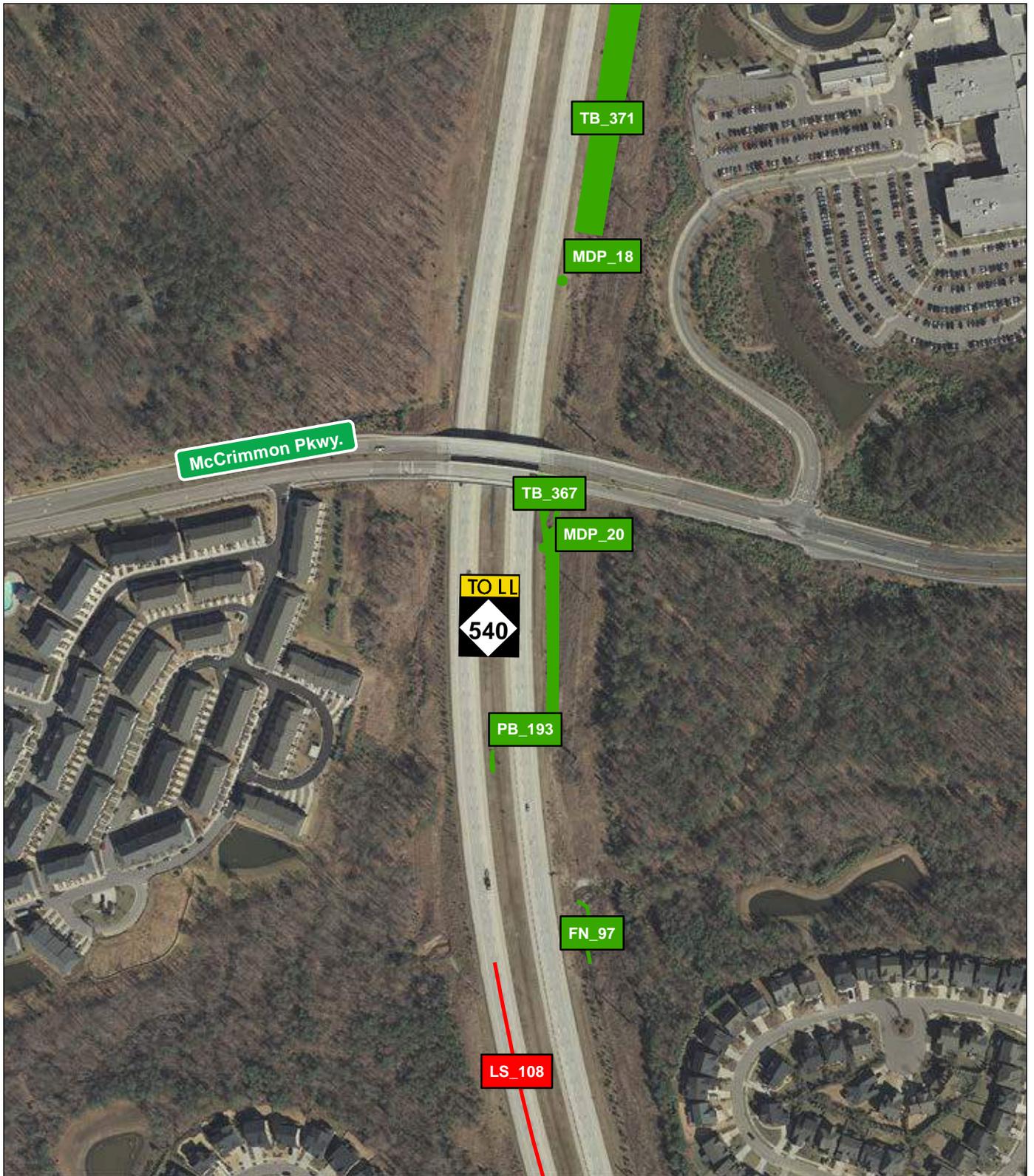


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

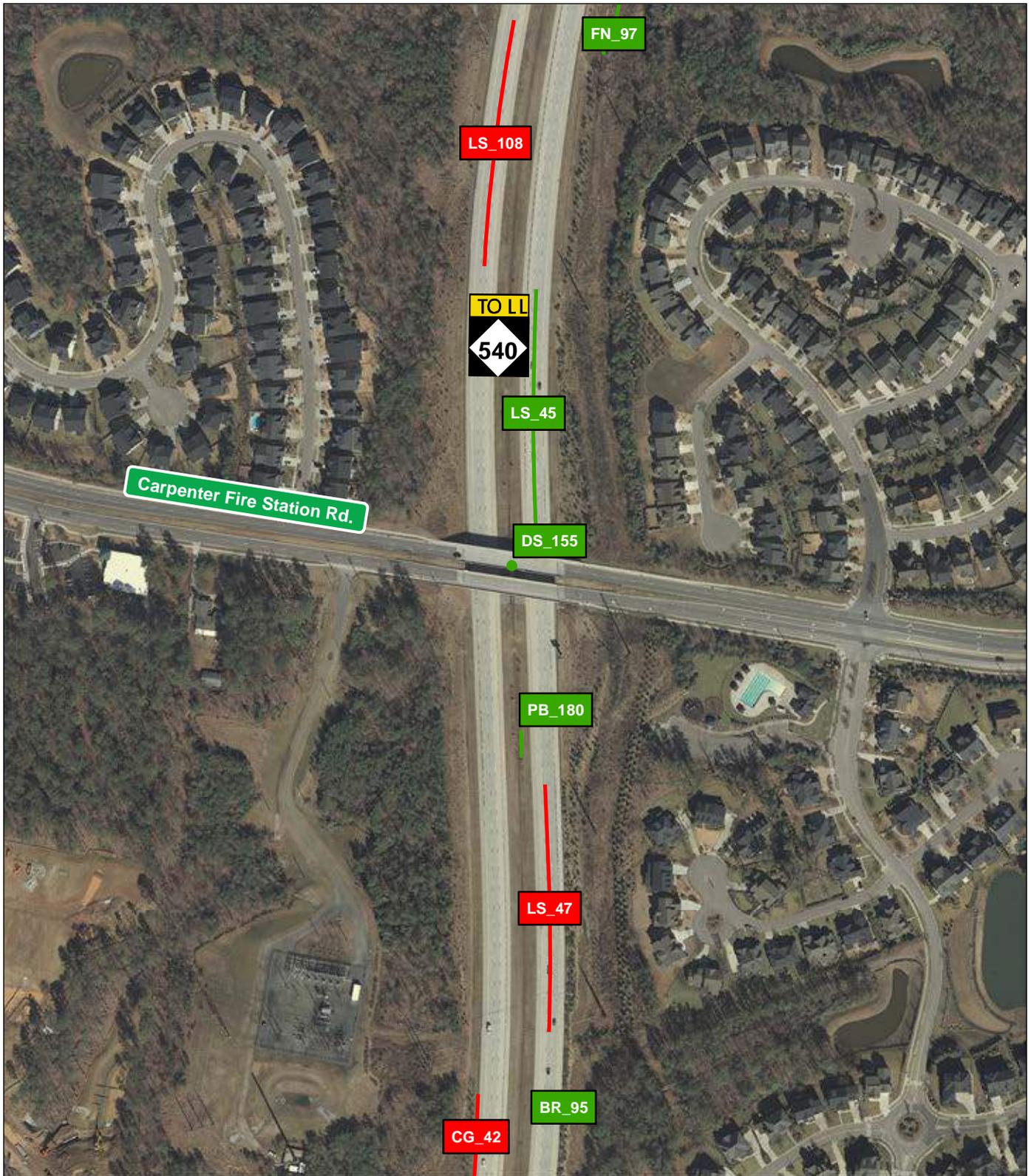


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

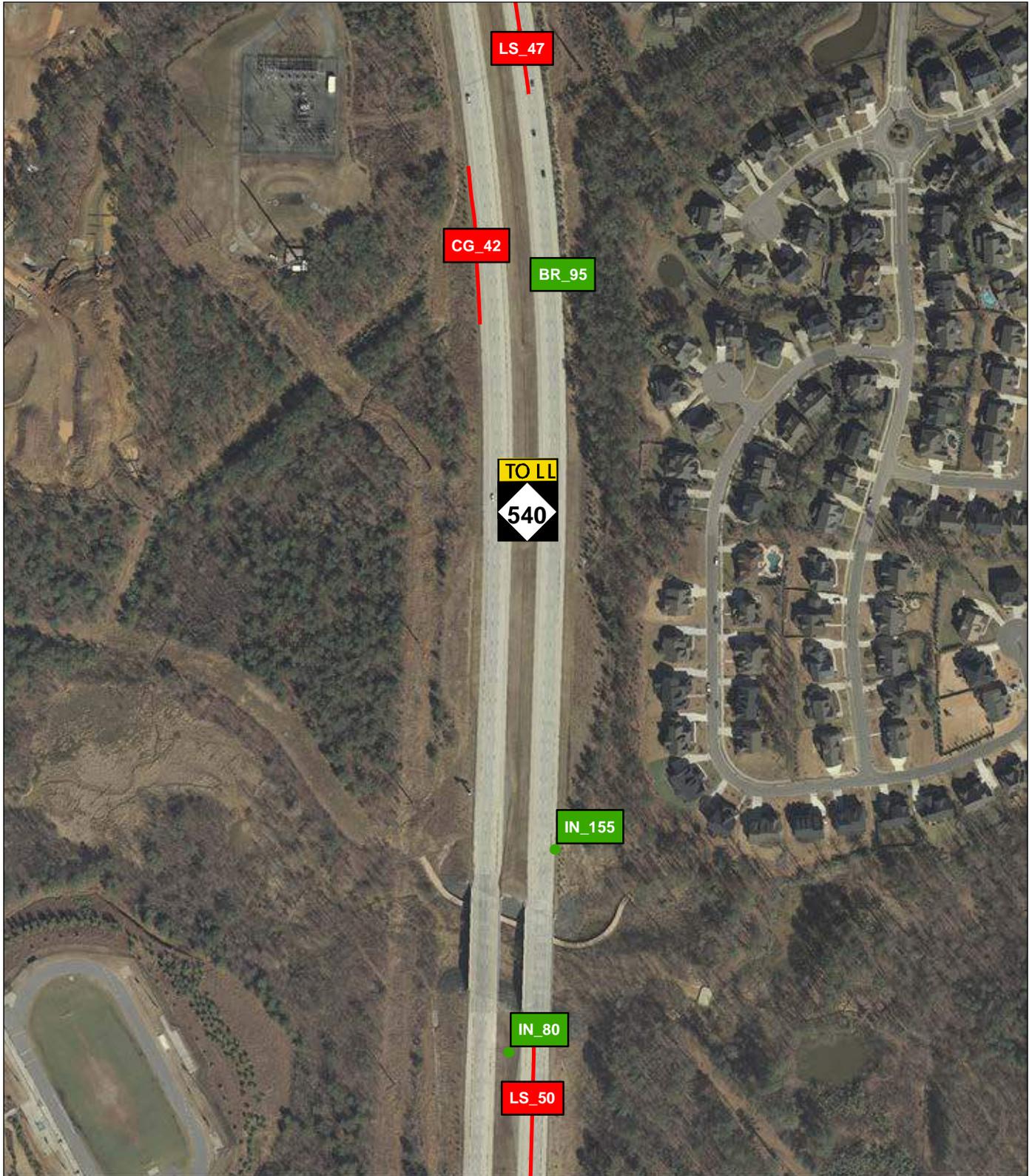


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

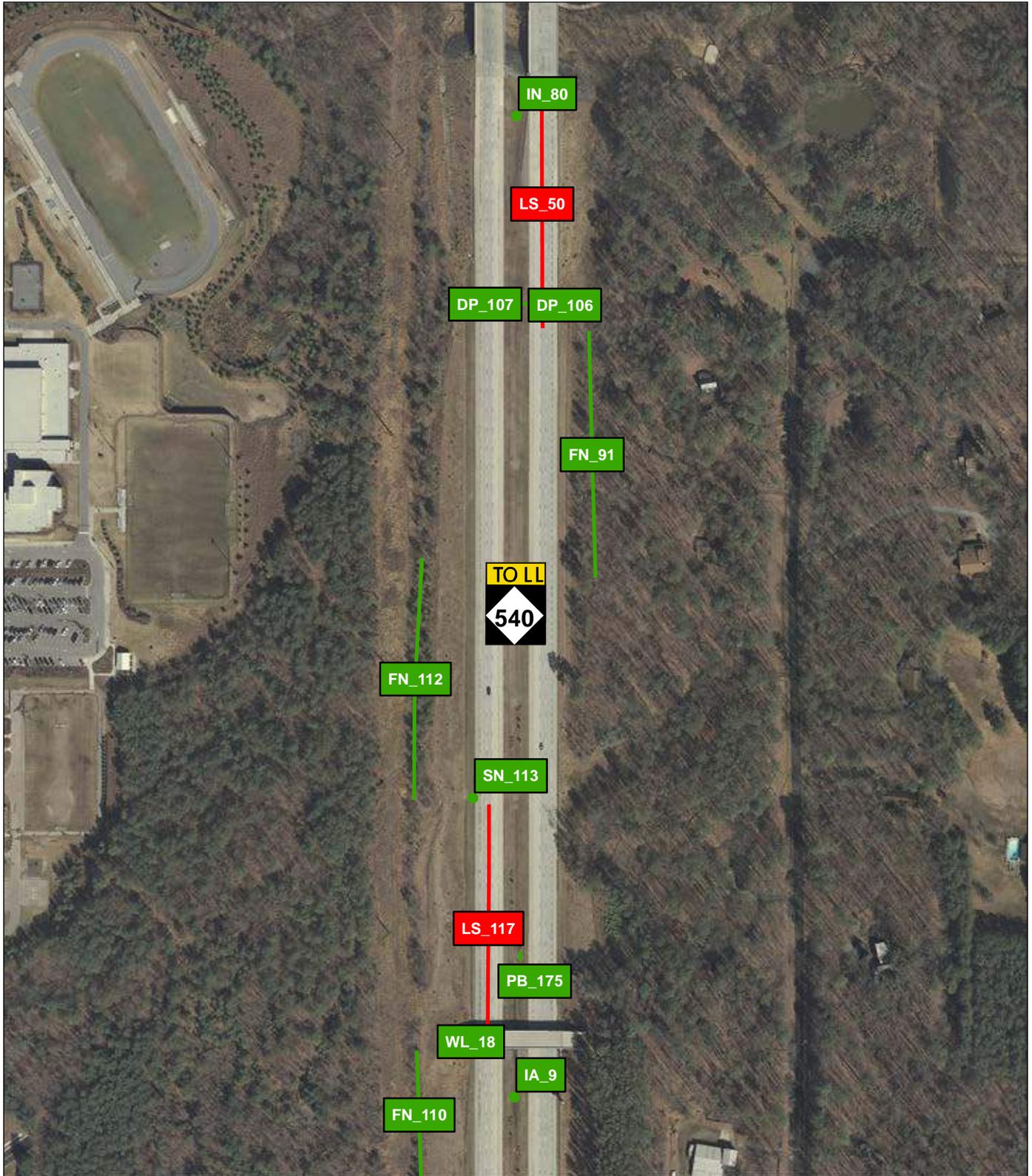


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

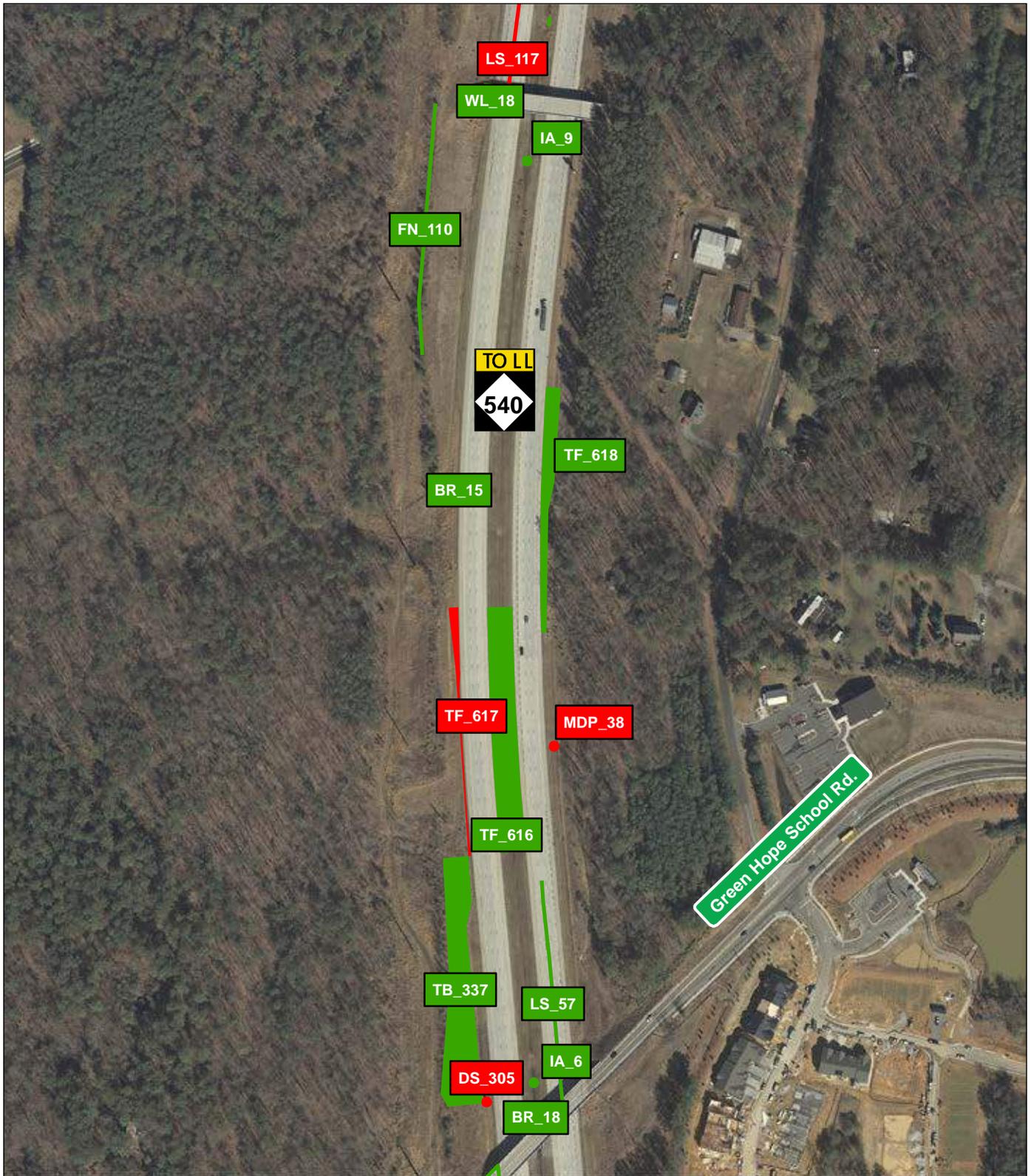


Legend

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-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

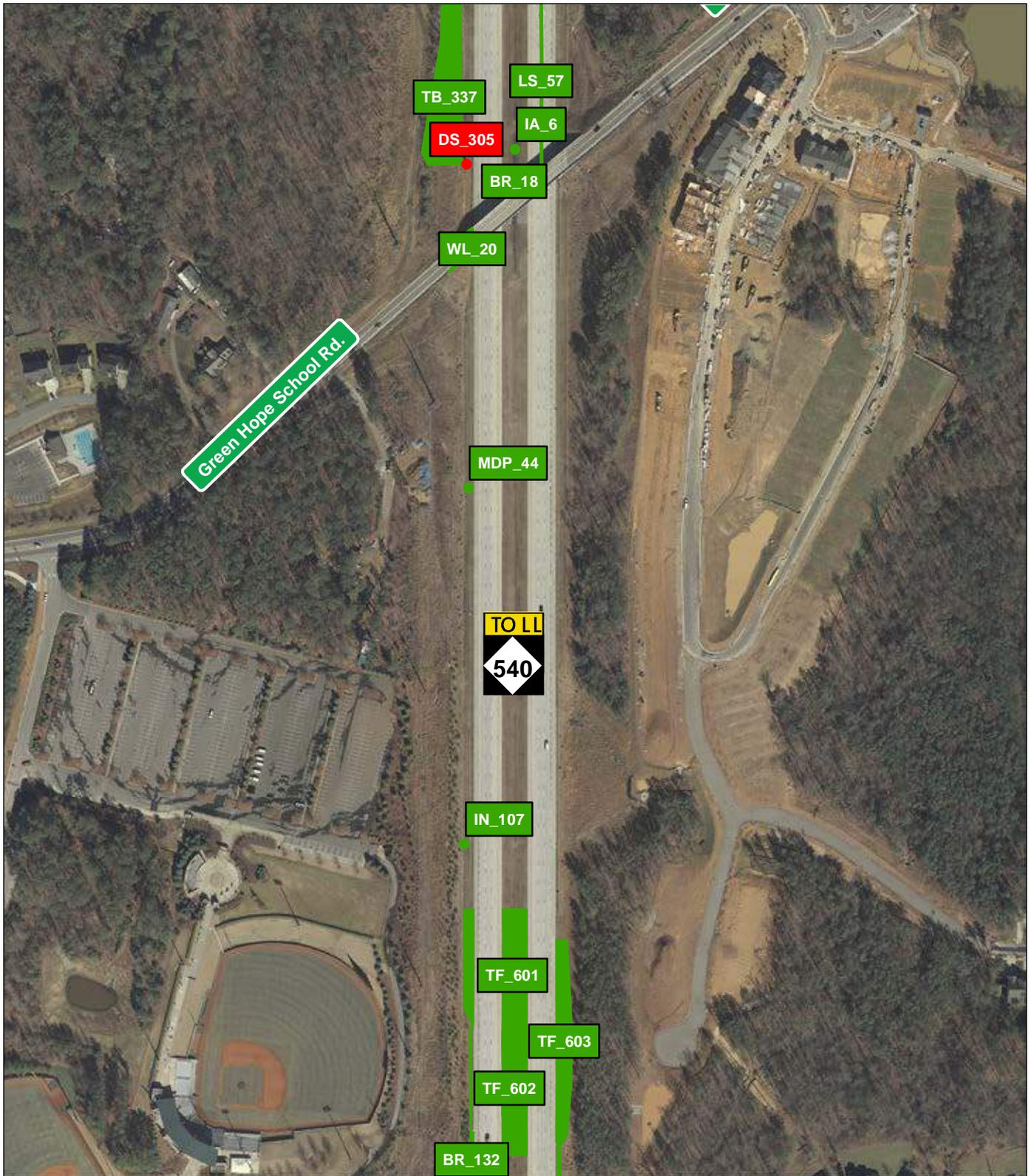


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

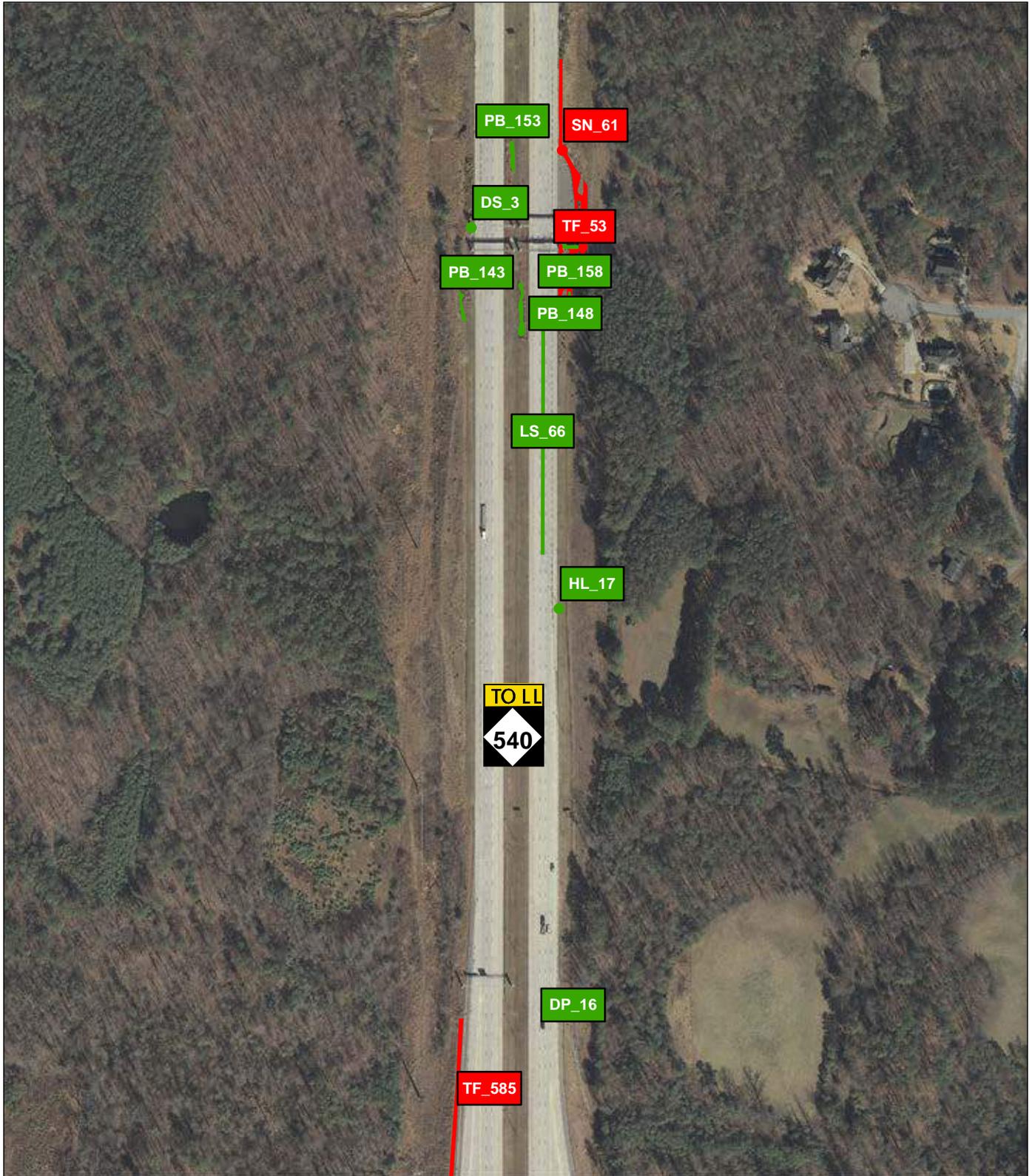


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-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



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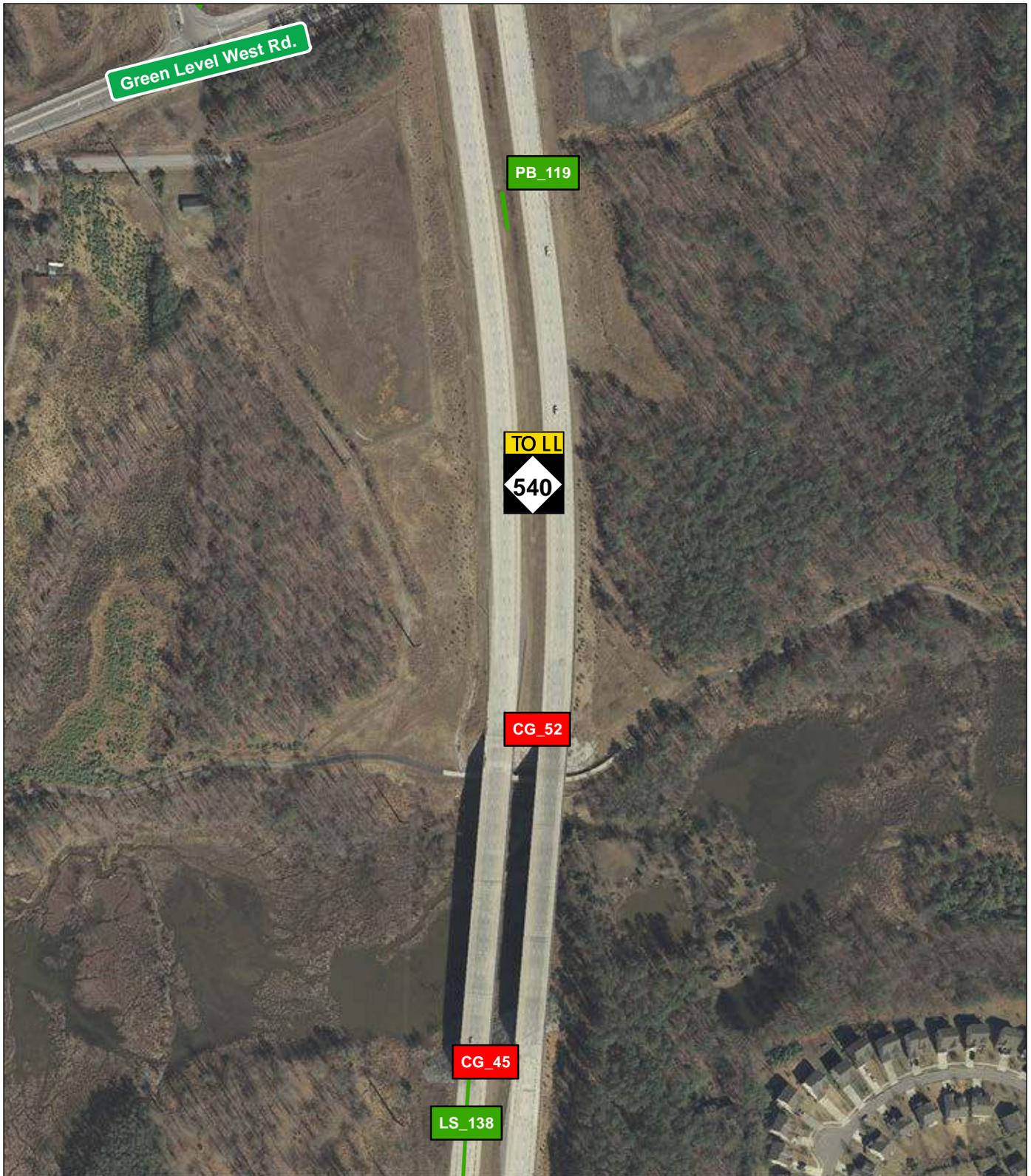


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

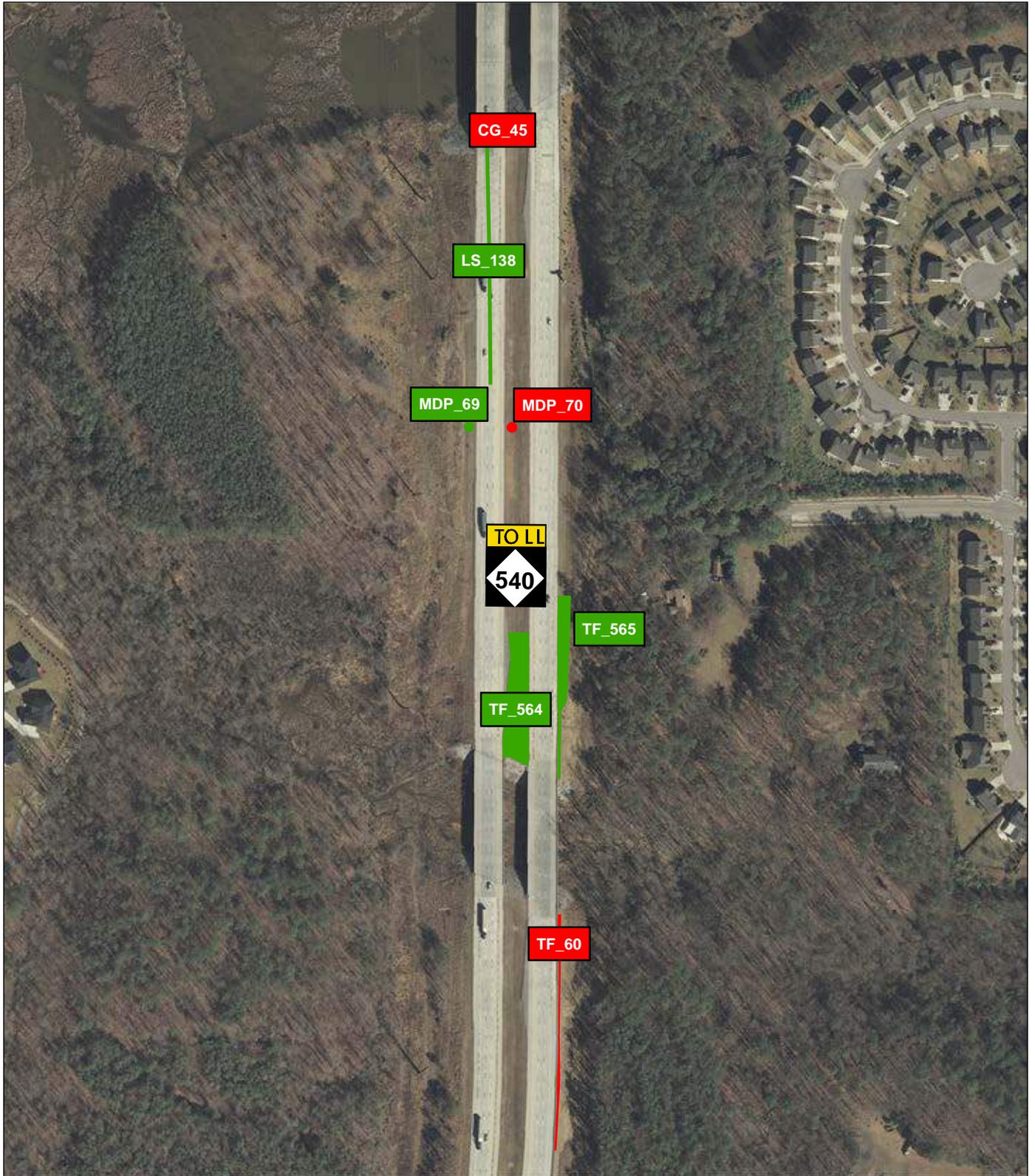


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

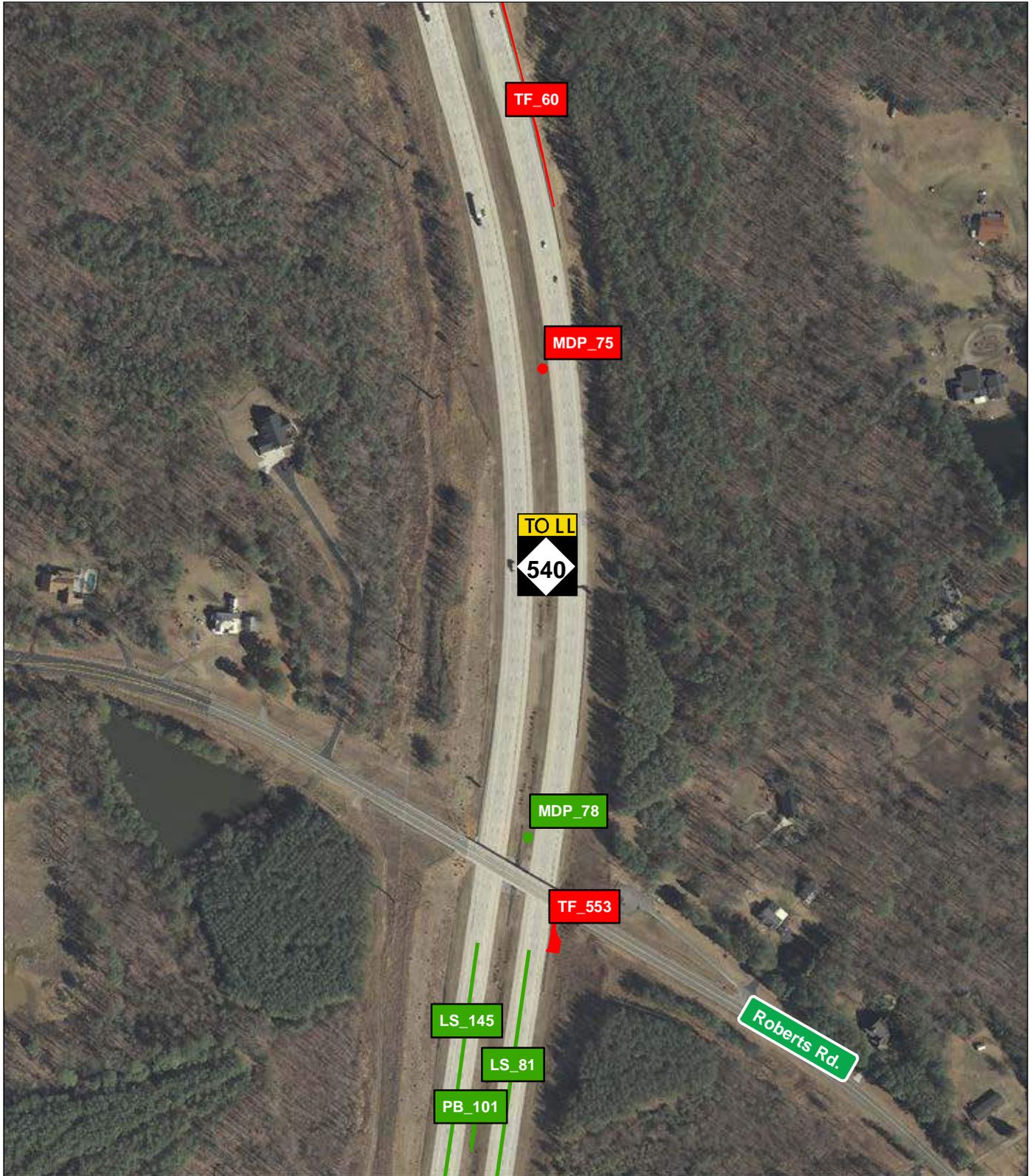


Legend

-  Passing Asset
-  Failing Asset

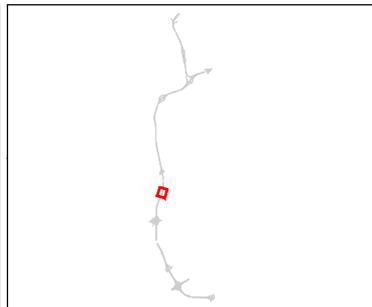


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

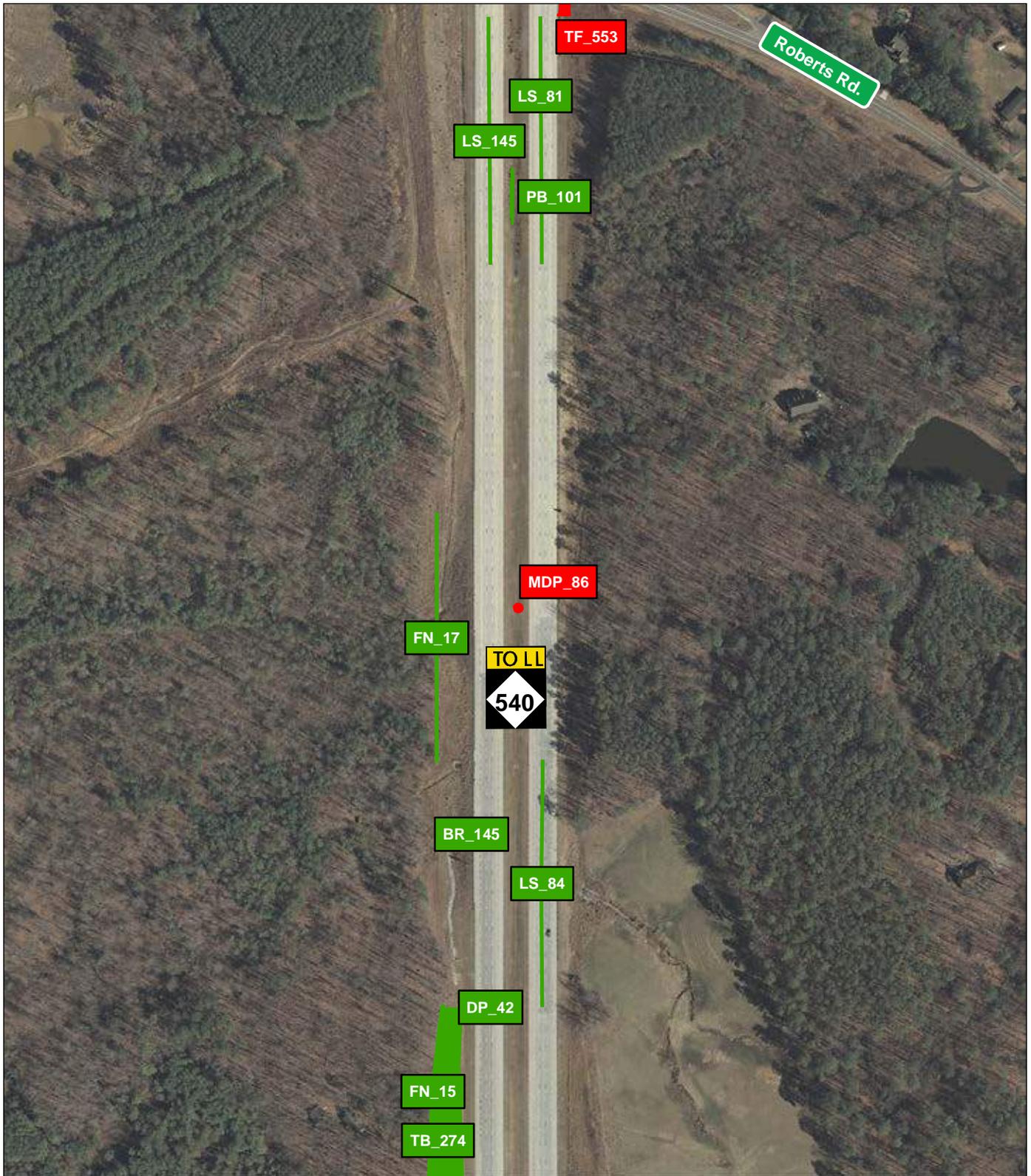


Legend

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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

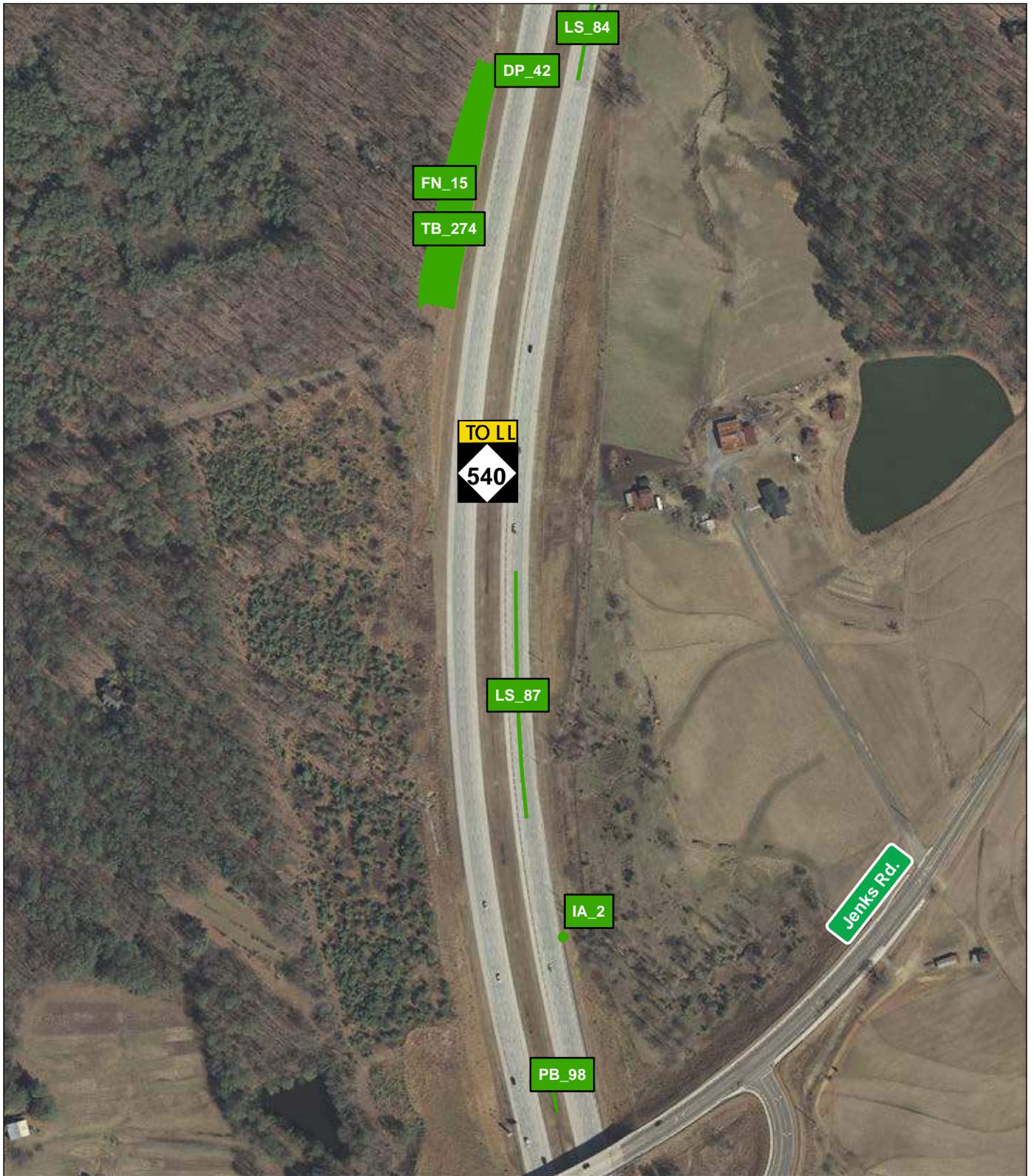


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

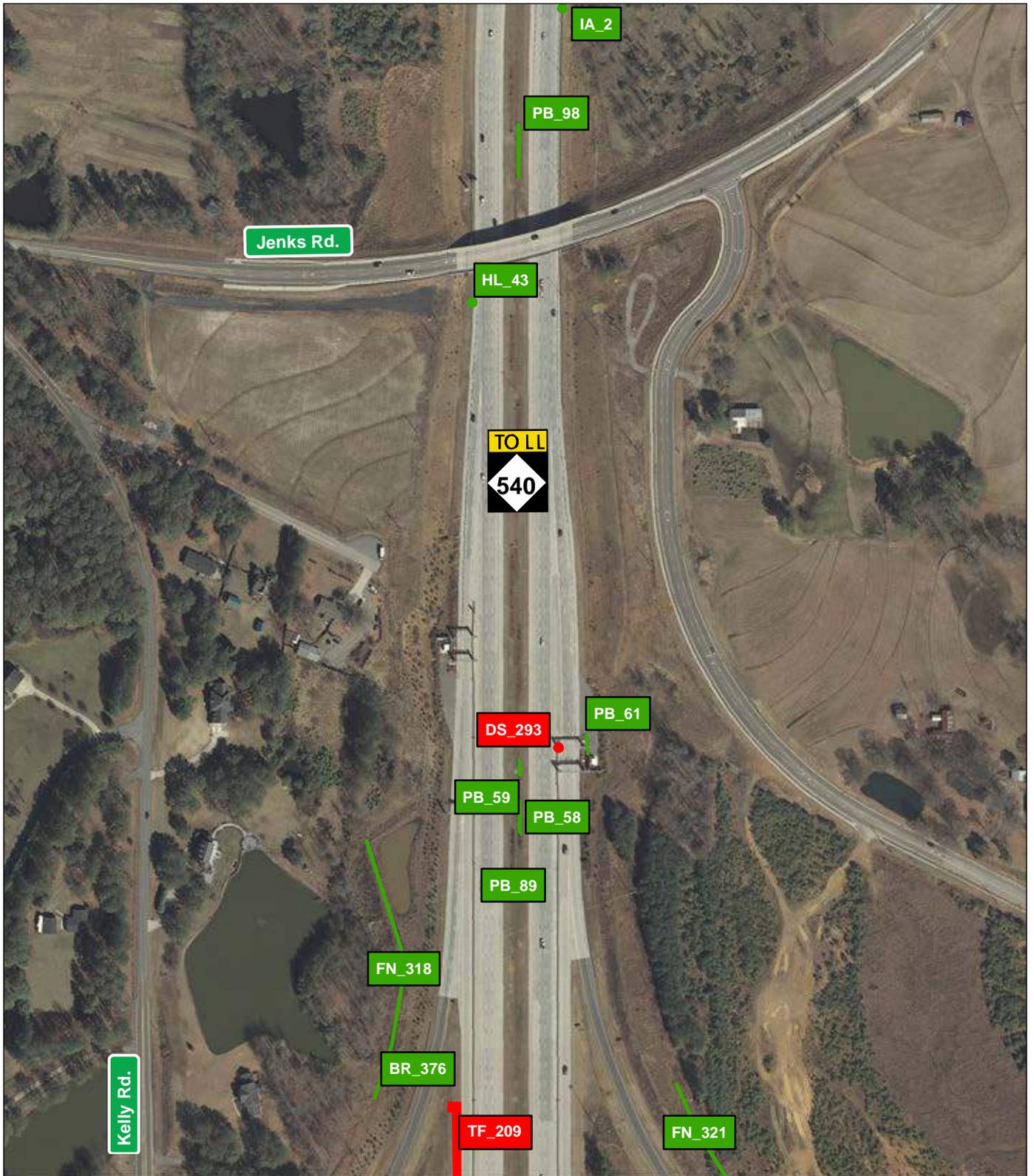


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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset

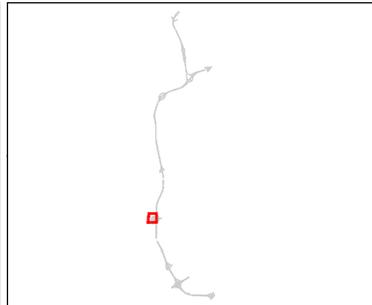


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

- Passing Asset
- Failing Asset



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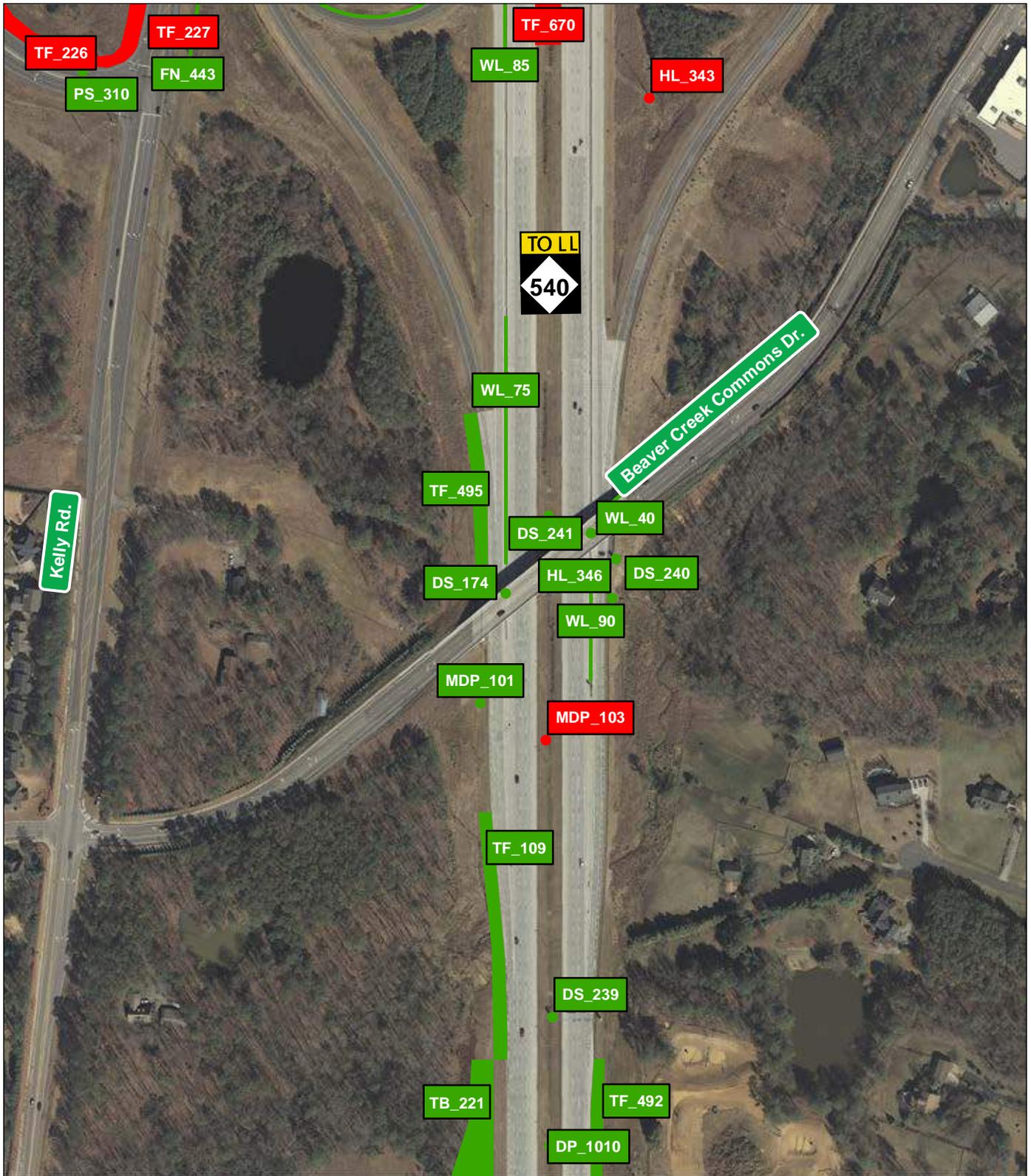


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-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

- Passing Asset
- Failing Asset



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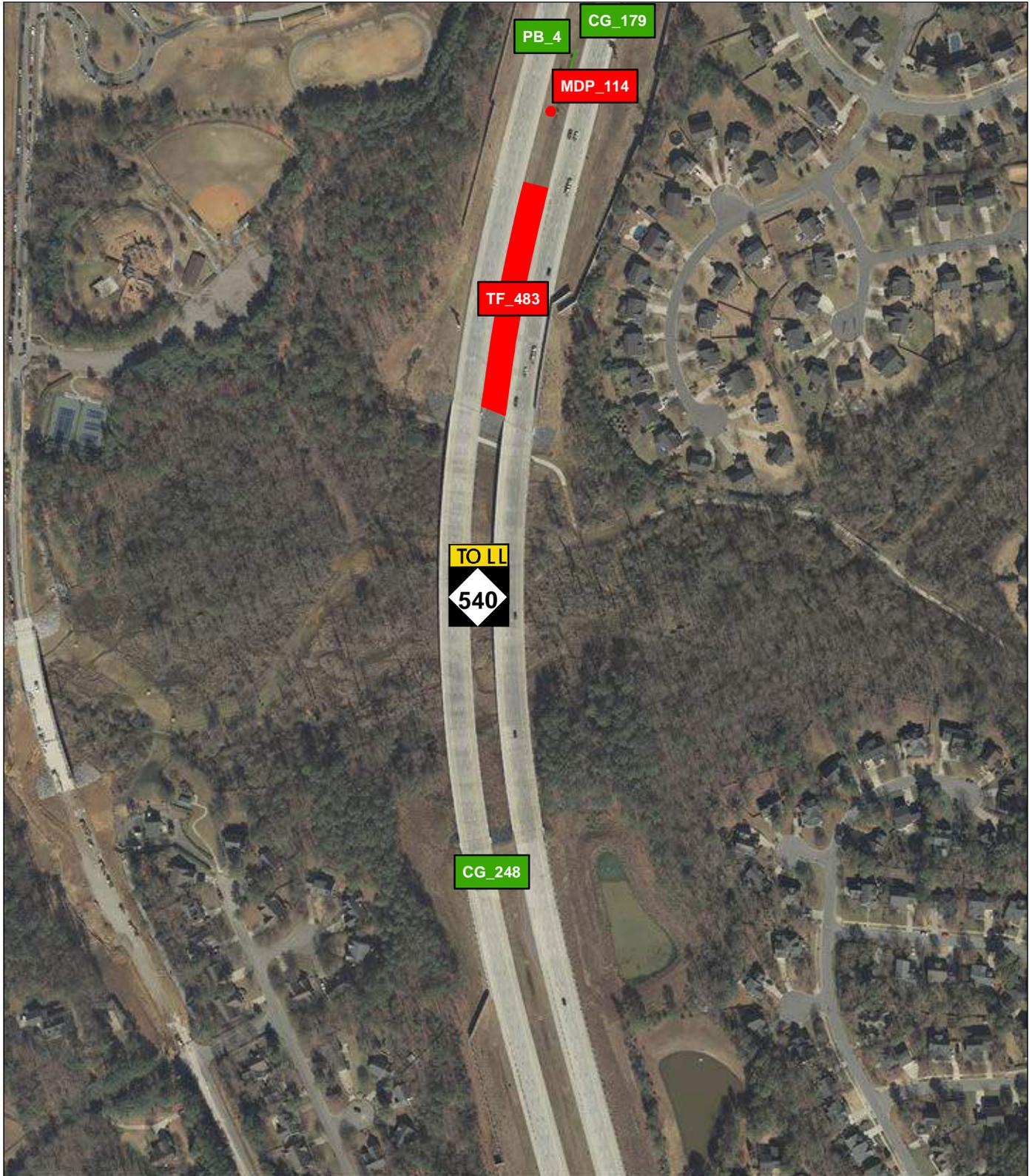


Legend

- Passing Asset
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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

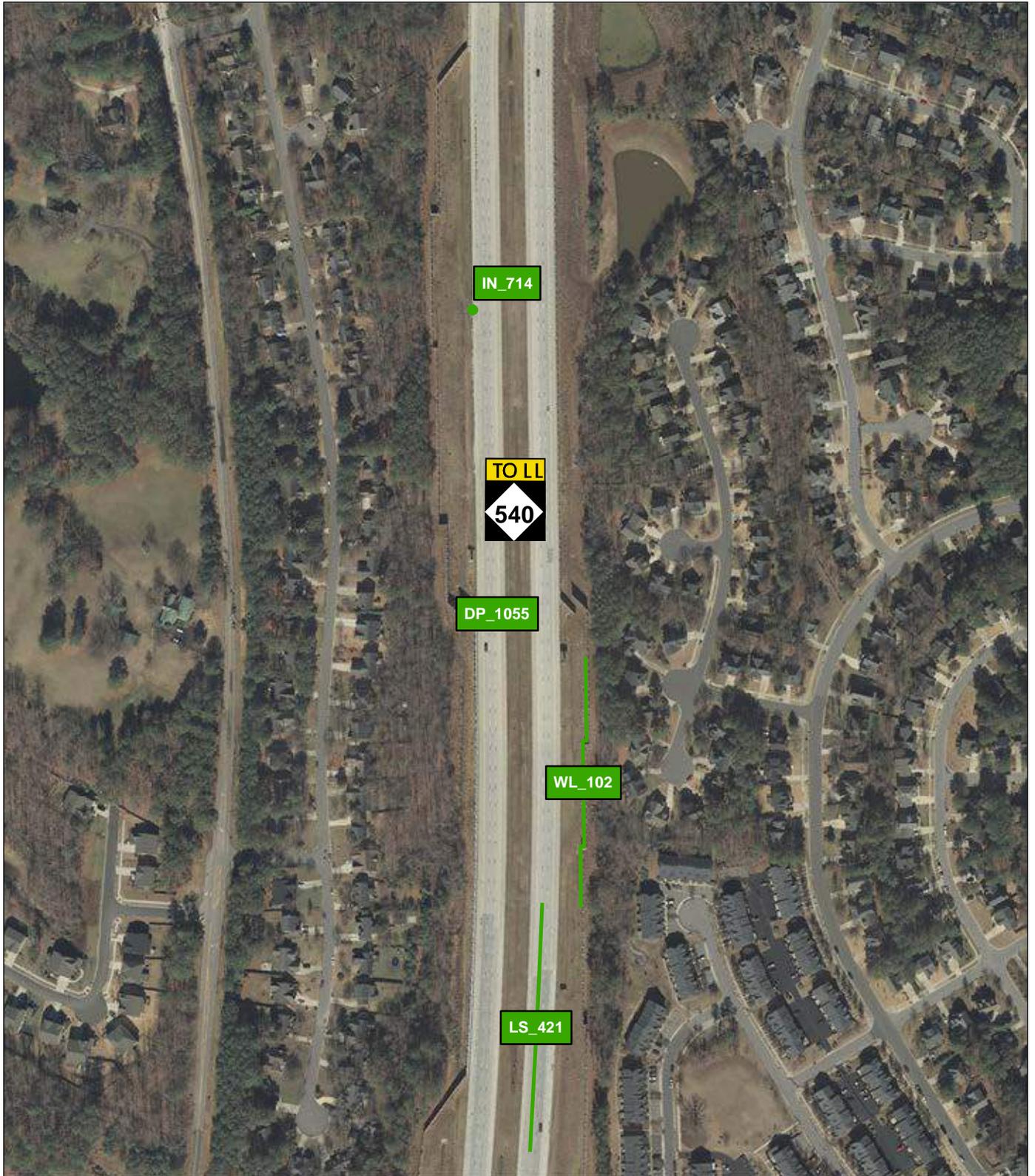


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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

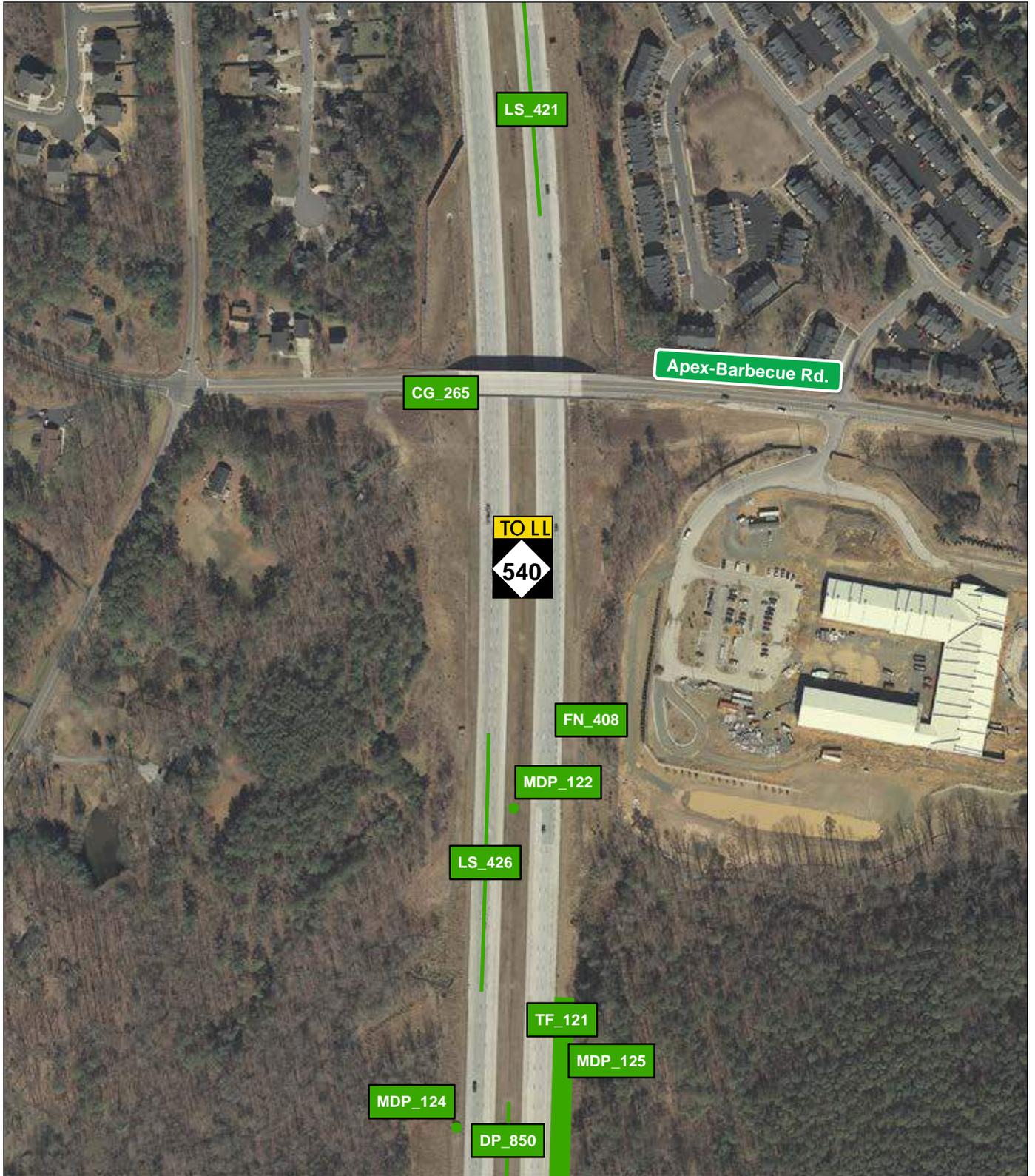


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

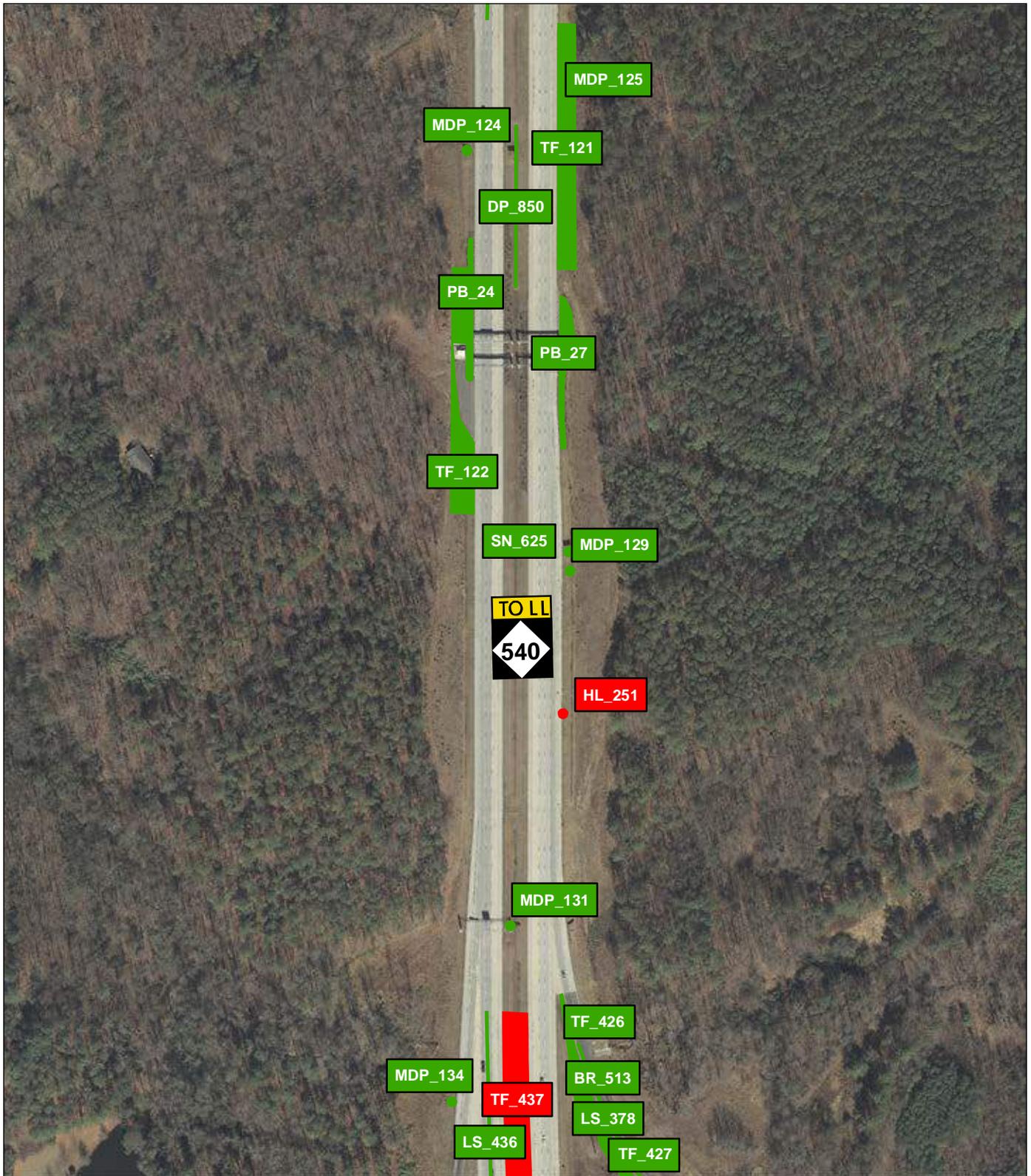


Legend

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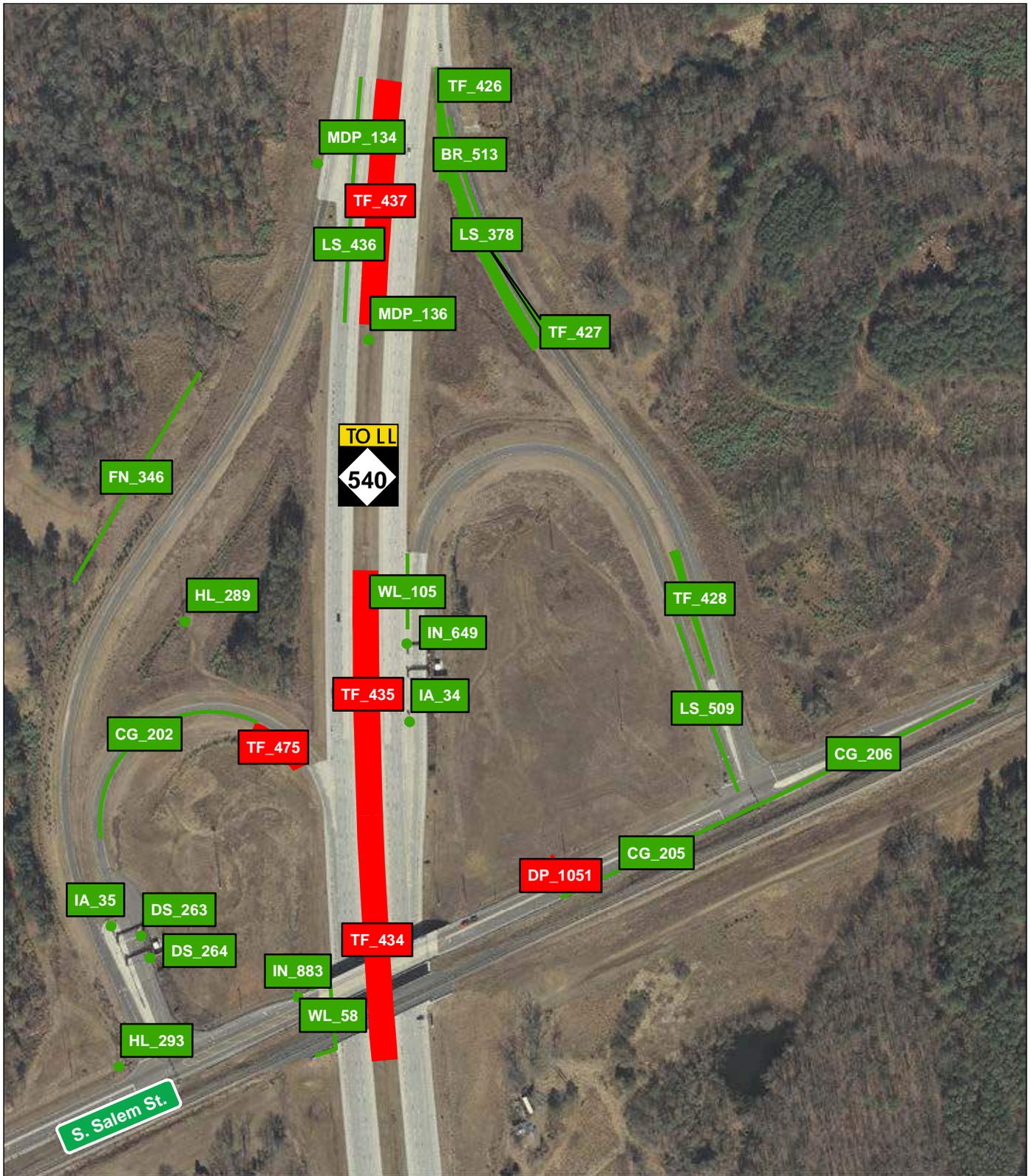


Legend

- Passing Asset
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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

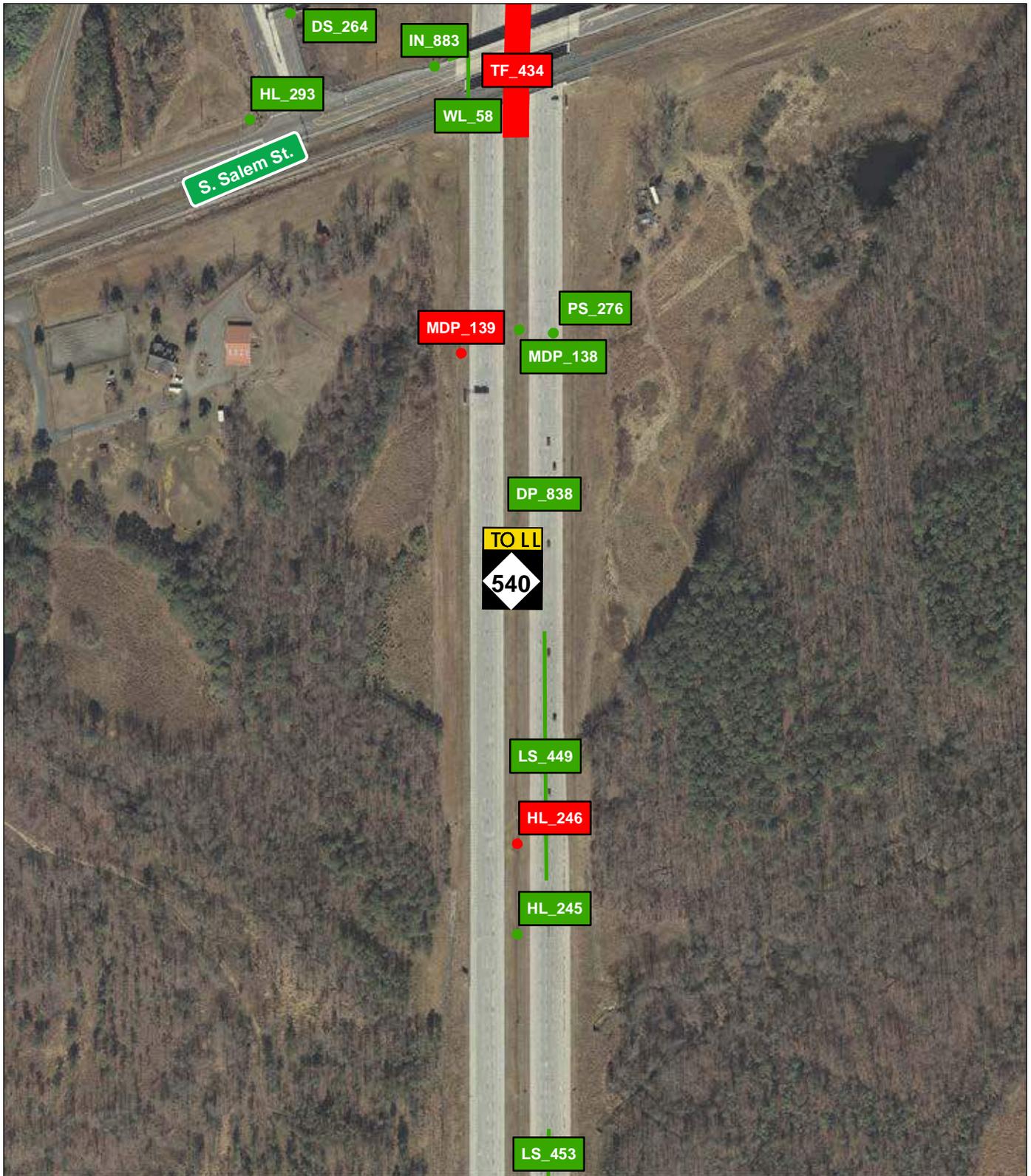


Legend

- Passing Asset
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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

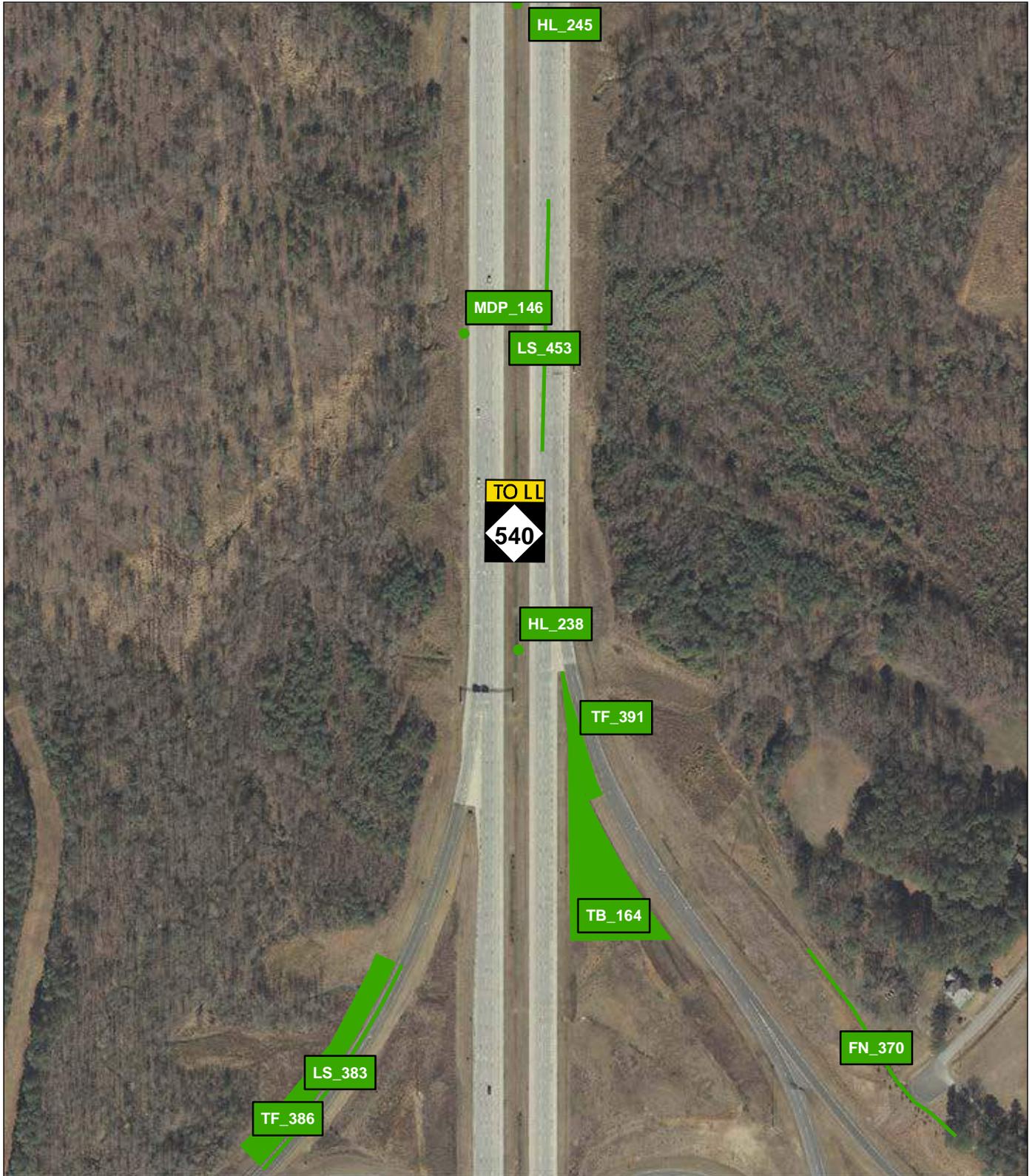


Legend

-  Passing Asset
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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

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-  Failing Asset



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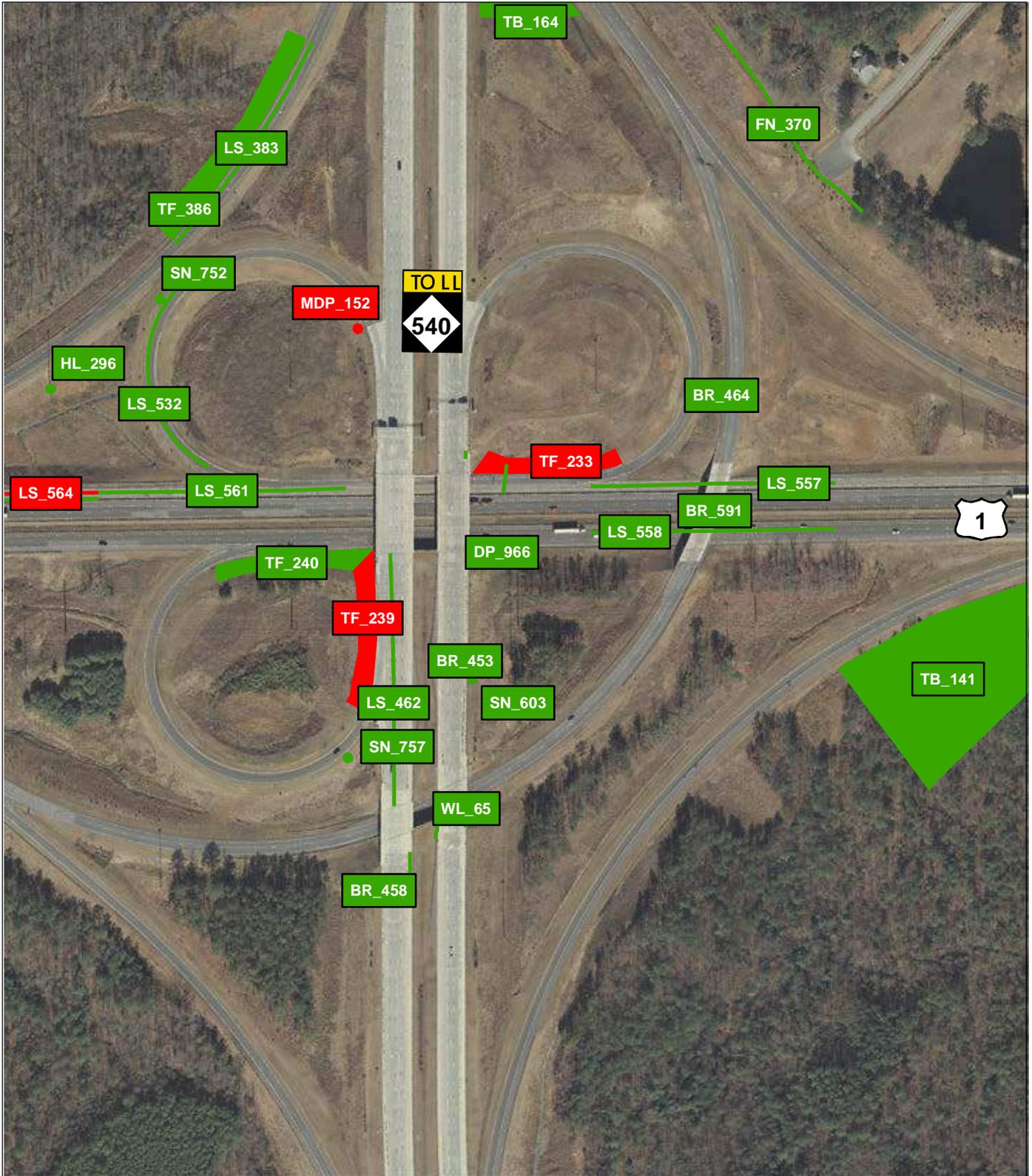


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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

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- Failing Asset

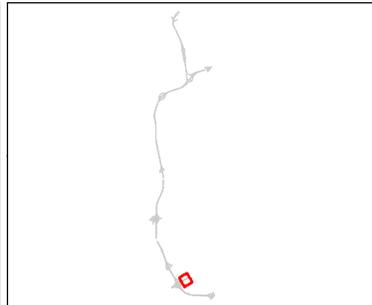


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

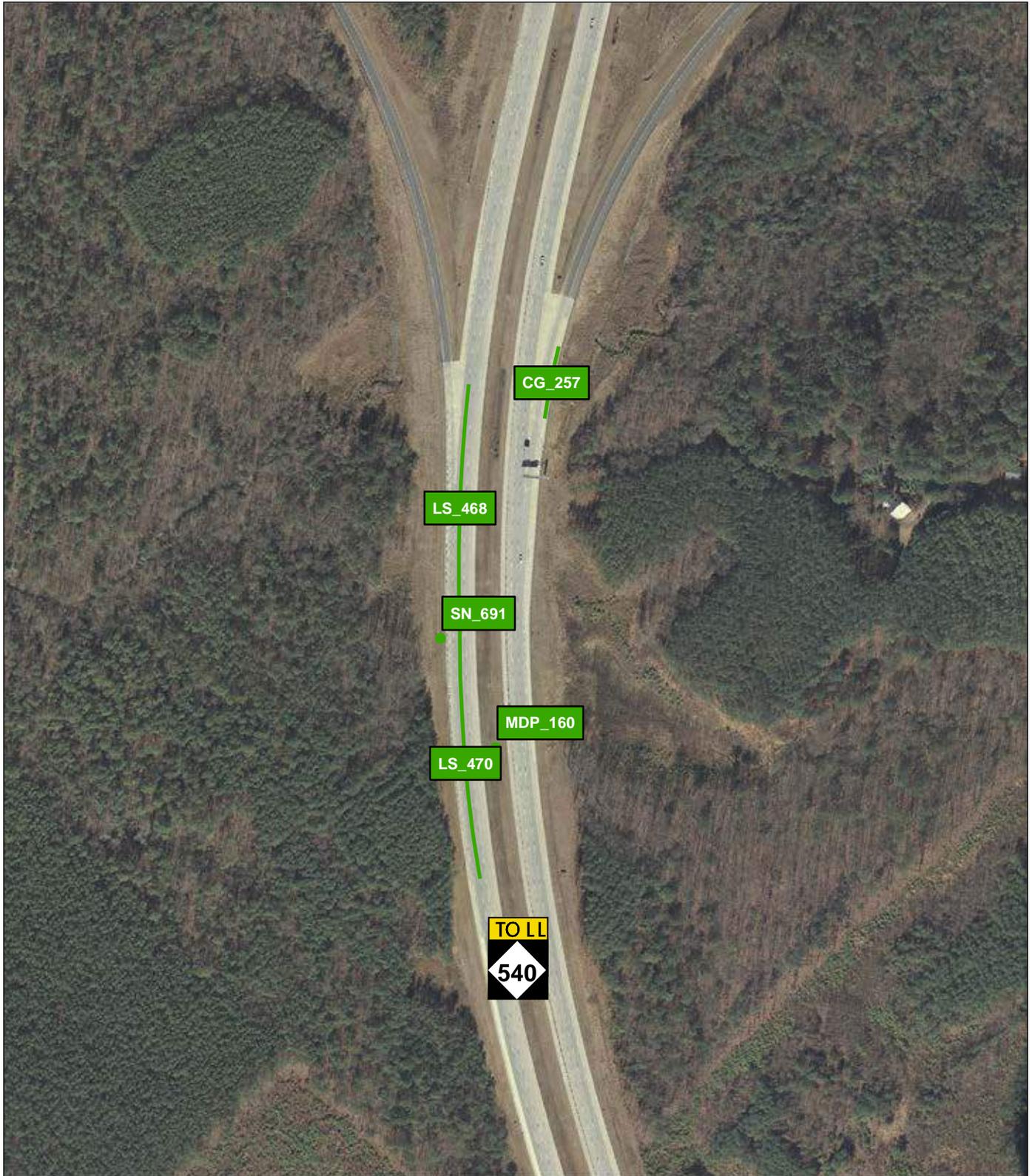


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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

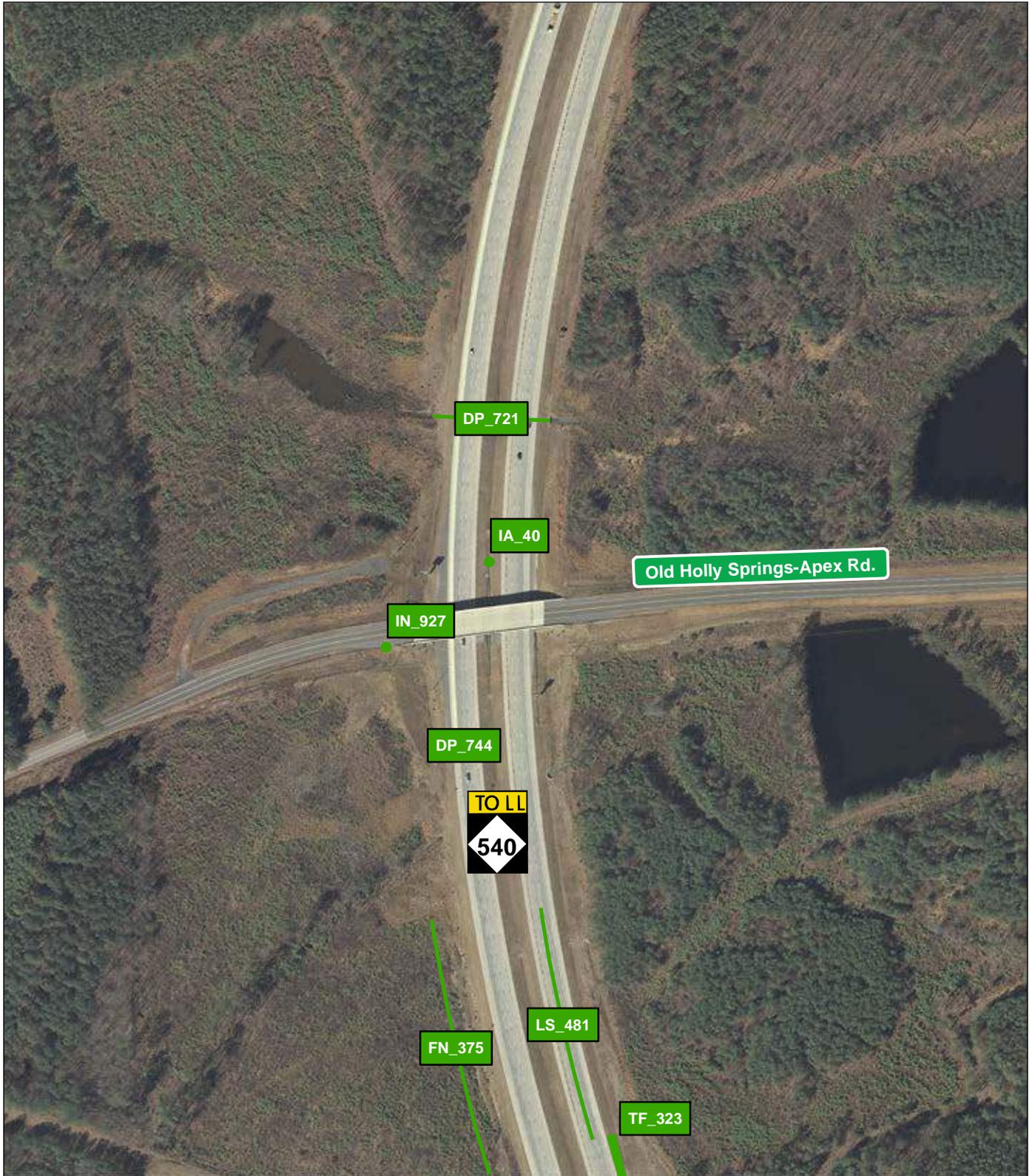


Legend

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-  Failing Asset

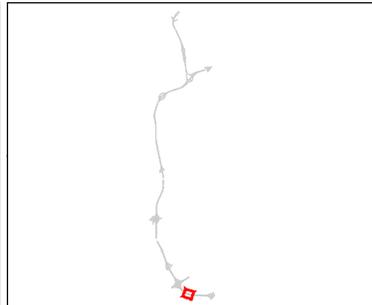


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

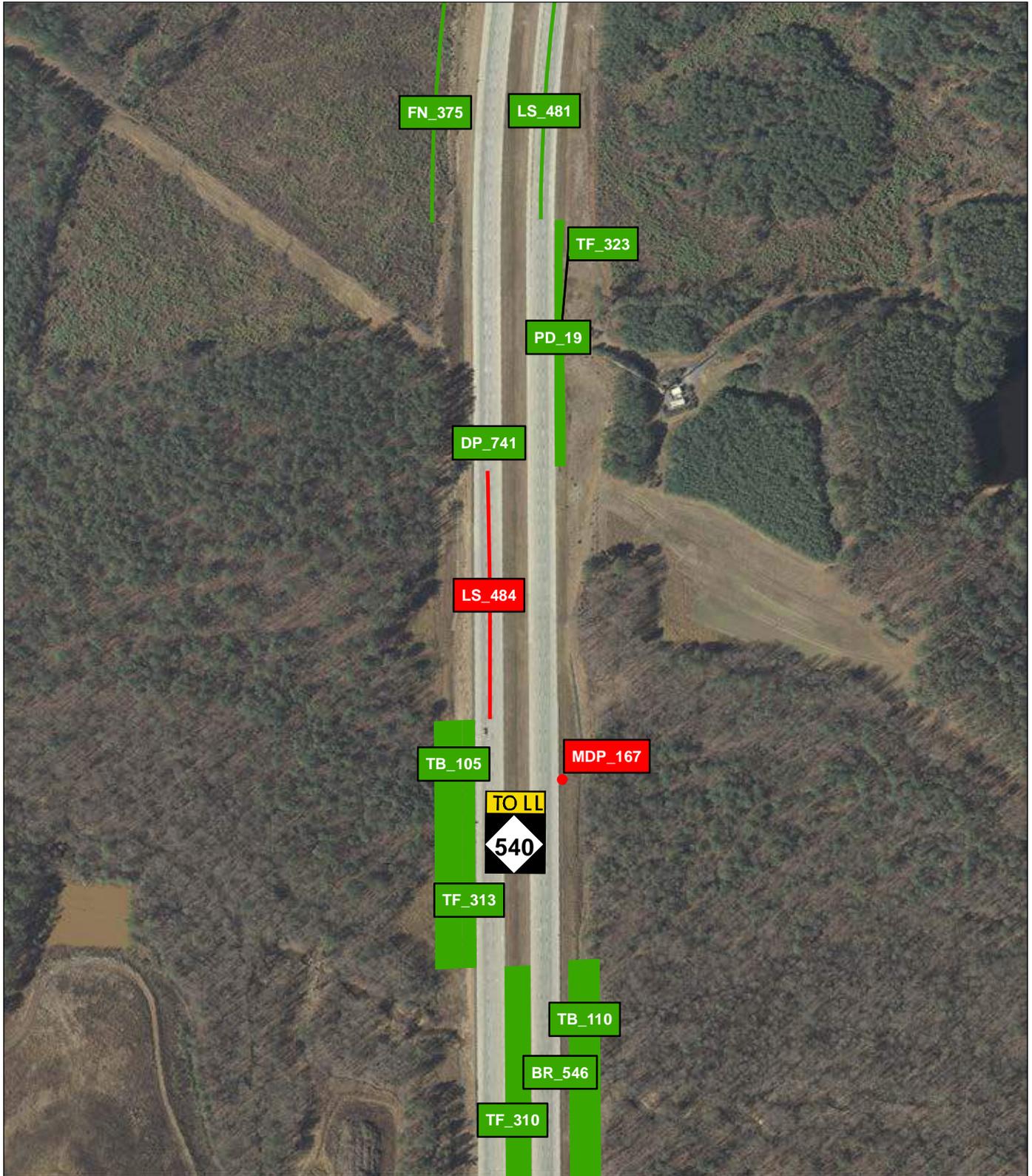


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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

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-  Failing Asset



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Legend

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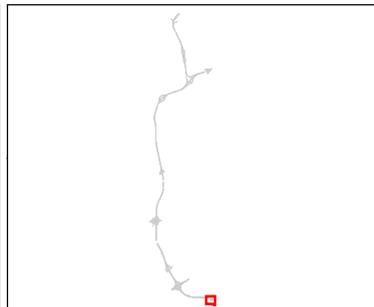


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset

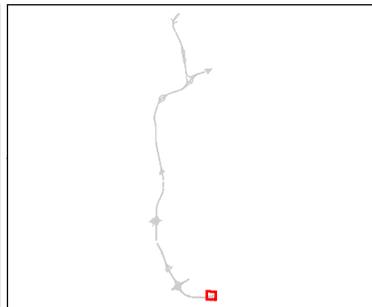


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

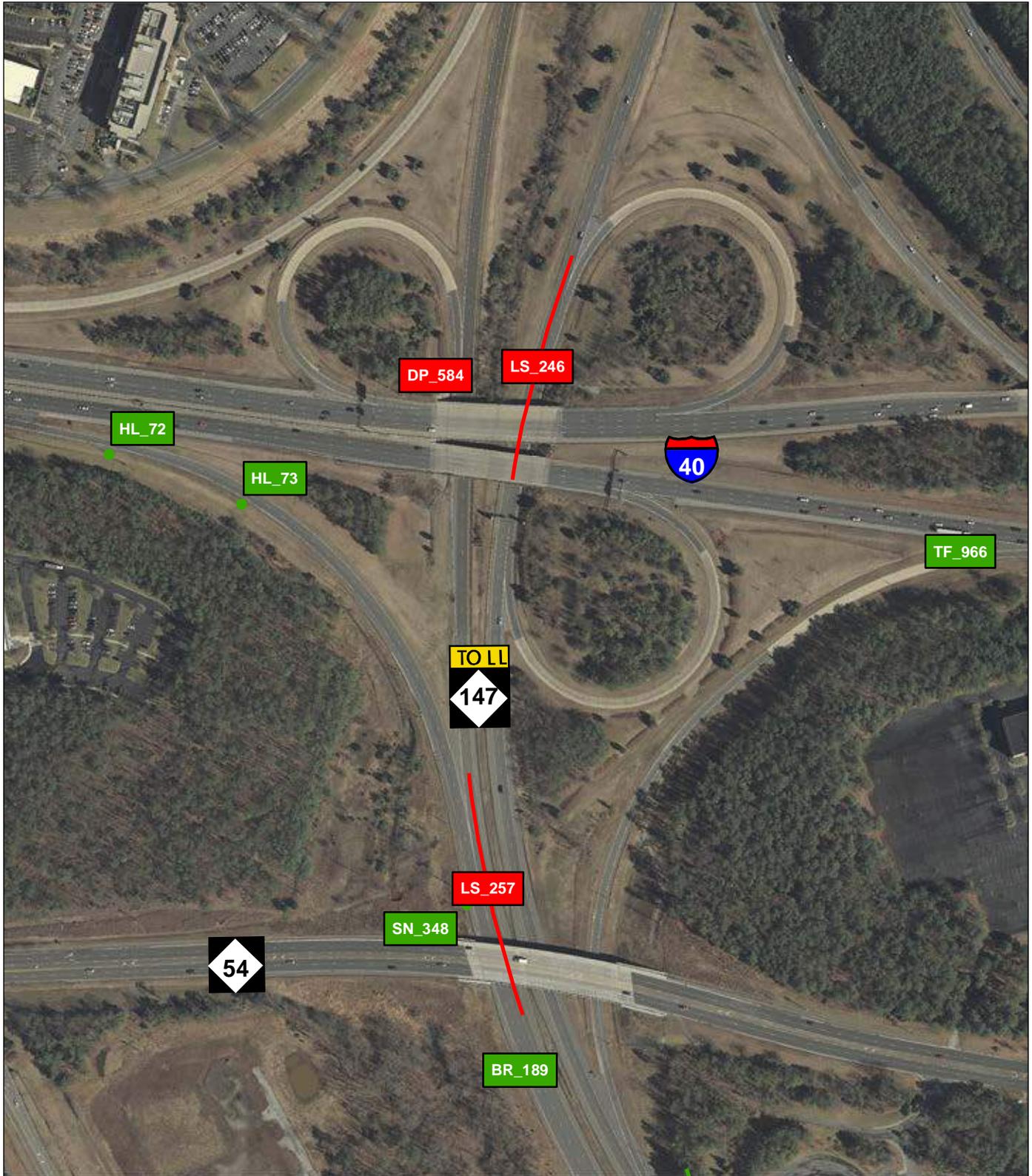


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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

-  Passing Asset
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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



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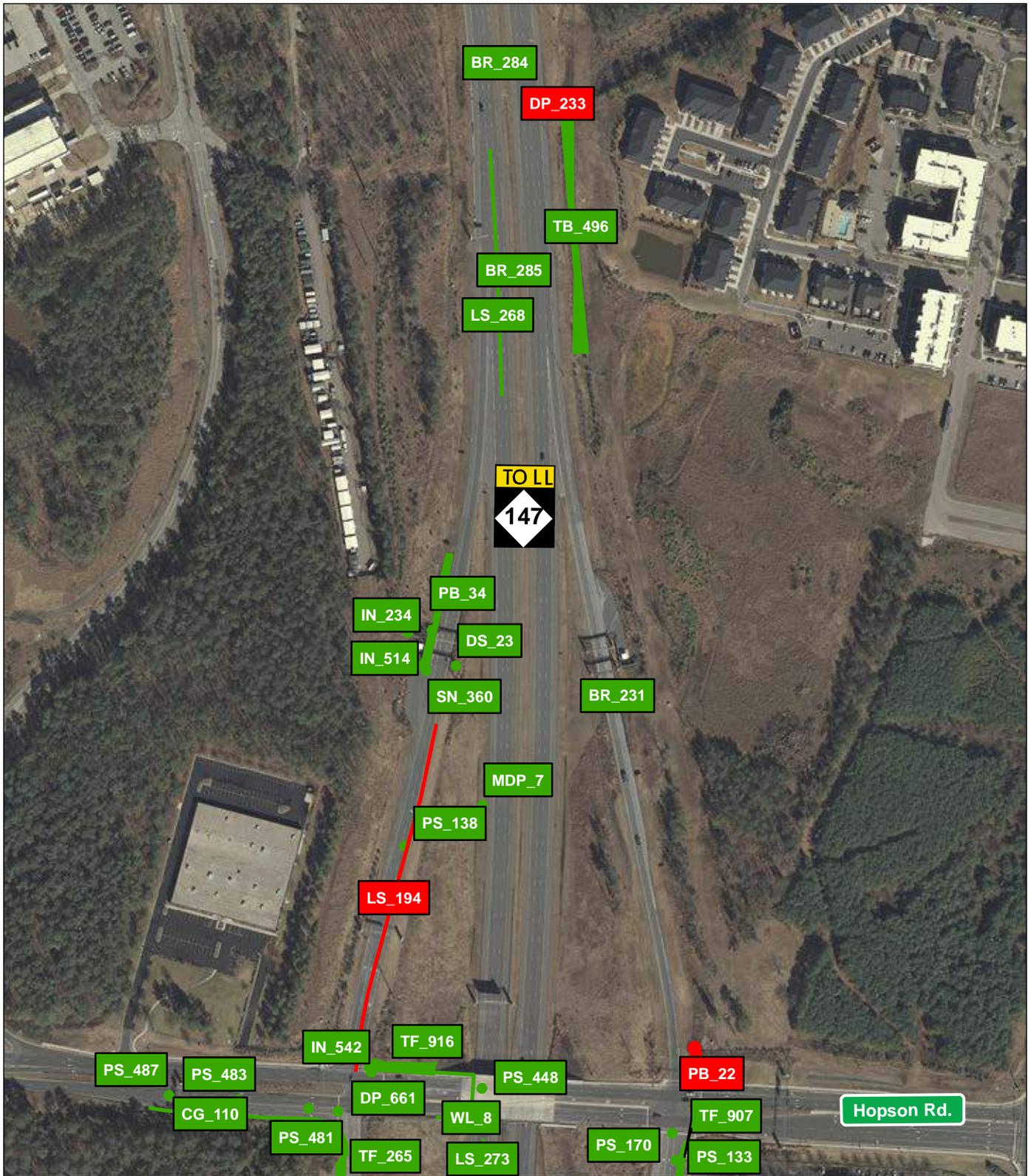


Legend

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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

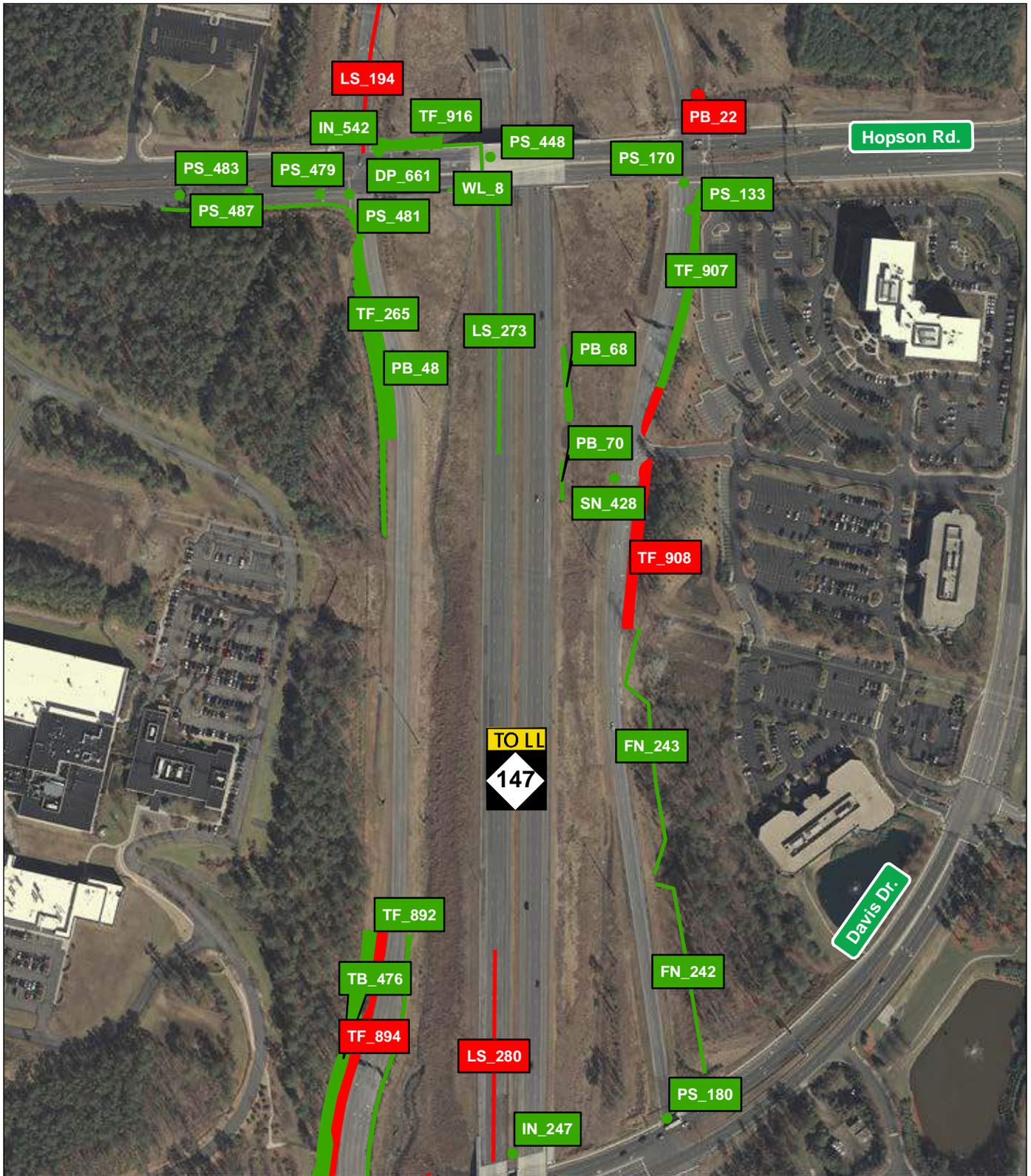


Legend

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- Failing Asset

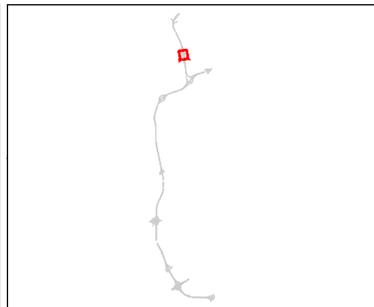


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

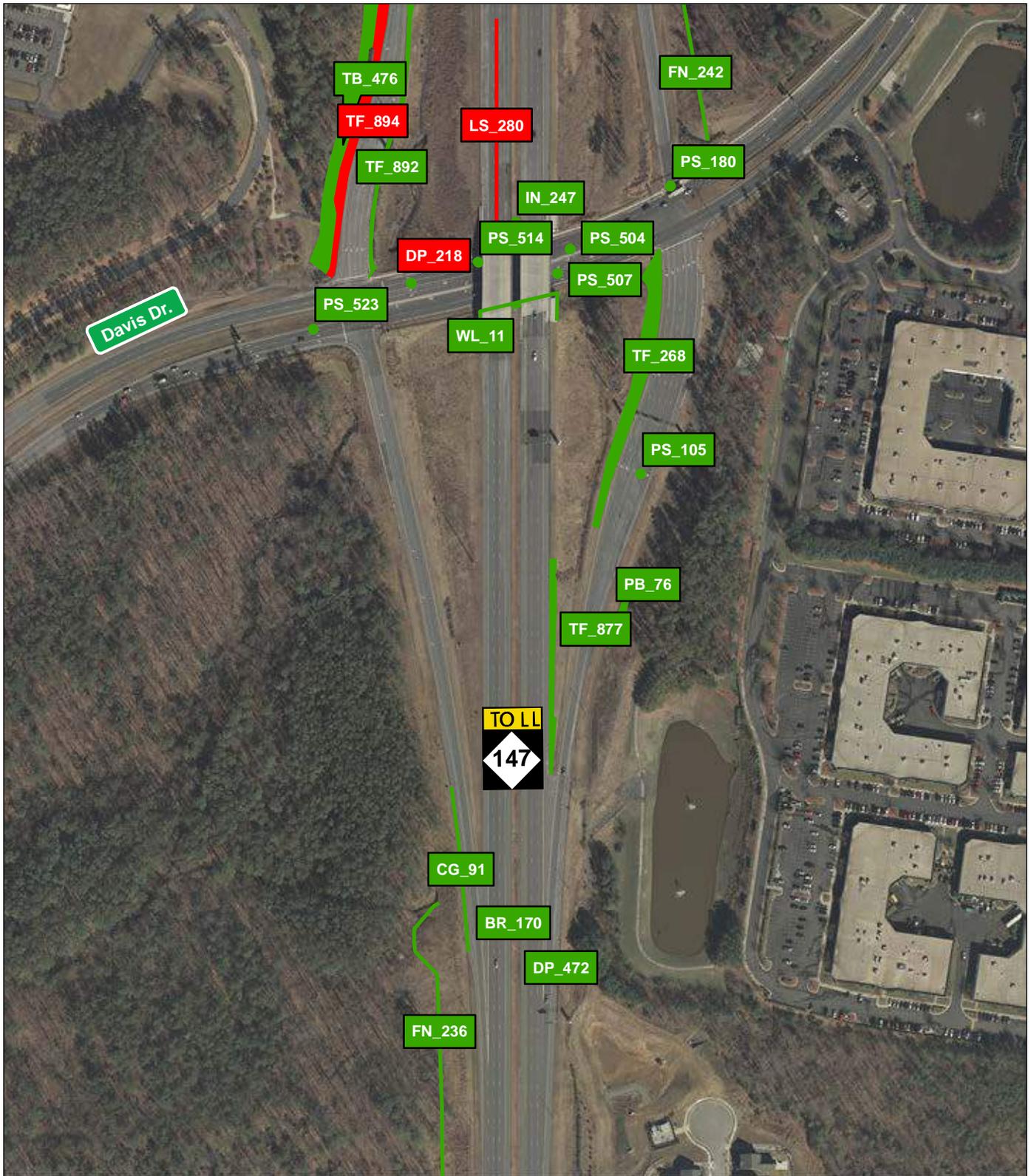


Legend

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- Failing Asset

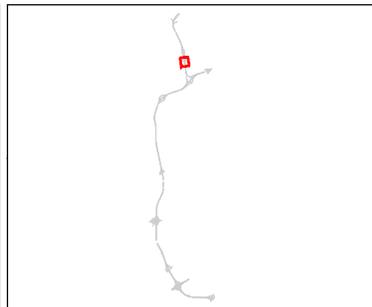


Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

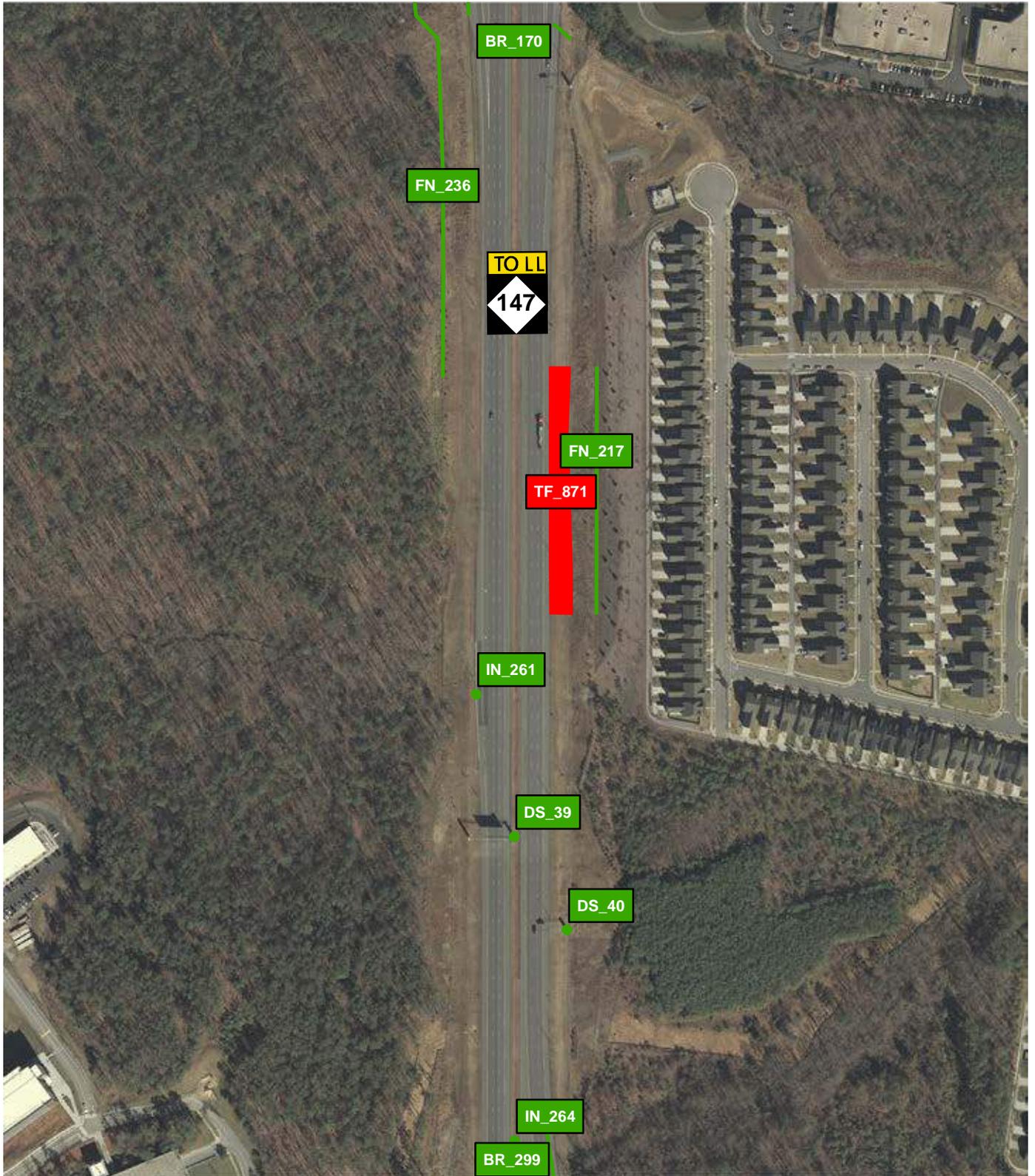


Legend

- Passing Asset
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Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations

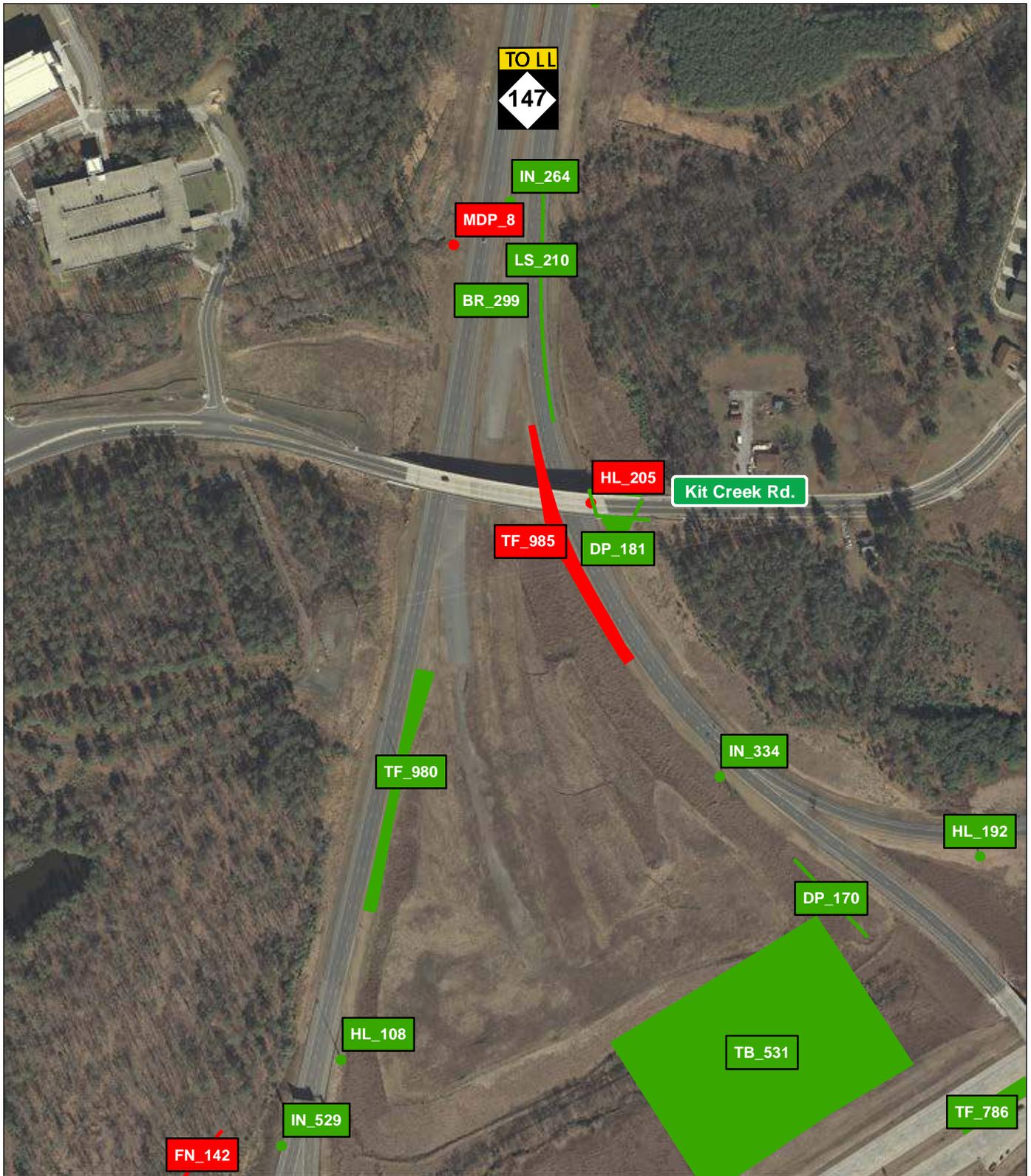


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Fourth Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix B

Triangle Expressway 2015 Fourth Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2015 Fourth 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 Structures (MDP)..... 8
Fence and Control of Access (FN) 11
Graffiti (GR) 12
Highway Lighting (HL) 13
Impact Attenuators (IA) 14
Inlets (IN)..... 15
Landscaping (PB) 16
Paved Lanes – Asphalt (LS)..... 17
Paved Lanes – Concrete (LS) 18
Paved Shoulders (LS)..... 19
Unpaved Shoulders (LS) 20
Front/Back Slopes (LS) 21
Unpaved Lateral and Outfall Ditches (LS) 22
Litter (LS) 23
Roadway Sweeping (LS) 24
Pavement Striping (LS)..... 25
Pavement Markers (LS)..... 26
Delineators (LS) 27
Paved Ditches (PD)..... 29
Pavement Words and Symbols (PS)..... 30
Signs (SN) 31
Tree and Brush (TB)..... 32
Turf Condition (TF) 33
MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL)..... 40

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 are provided when applicable.

Guardrail, Concrete Barrier and End Anchors (BR)

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

Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Valley	CG_42	Misalignment, Obstruction and Material Accumulation		A15, A16
2	Valley	CG_45	Material Accumulation		A23, A24
3	Valley	CG_52	Material Accumulation		A23
4	Valley	CG_64	Material Accumulation		A10, A11, A12

Decorative Supports (DS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Overhead Sign Support	DS_266	Paint Scaling		A47
2	Gantry Support	DS_293	Paint Scaling		A28
3	Overhead Sign Support	DS_305	Paint Scaling		A18, A19

Drainage Pipes (DP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Drain	DP_218	End Treatment Damaged		A55
2	Lateral Pipe	DP_233	End Treatment Damaged		A52, A53
3	Drain	DP_306	Obstruction		A8
4	Drain	DP_584	Erosion		A49

Drainage Pipes (DP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Cross Pipe	DP_1051	End Treatment Damaged		A37

Misc. Drainage Structures (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Drain	MDP_8	Erosion		A57
2	Shoulder Drain	MDP_11	Obstruction		A12
3	Shoulder Drain	MDP_38	Obstruction		A18
4	Shoulder Drain	MDP_63	Obstruction		A22

Misc. Drainage Structures (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Shoulder Drain	MDP_70	Obstruction		A24
6	Shoulder Drain	MDP_75	Obstruction		A25
7	Shoulder Drain	MDP_86	Obstruction		A26
8	Shoulder Drain	MDP_103	Obstruction		A31
9	Shoulder Drain	MDP_114	Obstruction		A32, A33

Misc. Drainage Structures (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
10	Shoulder Drain	MDP_139	Obstruction		A38
11	Shoulder Drain	MDP_152	Obstruction		A41
12	Shoulder Drain	MDP_167	Obstruction		A45

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_142	Fence Height		A6, A57
2	Chain Link	FN_247	Opened Gate		A51, A52
3	Woven	FN_251	Hole Height		A2, A3

Graffiti (GR)

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

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Single Roadway	HL_145	Functional Damage	Not Available for Nighttime Failure	A4
2	Underpass Lighting	HL_205	Functional Damage	Not Available for Nighttime Failure	A57
3	Single Roadway	HL_228	Functional Damage and Part Damage		A46
4	Single Roadway	HL_246	Functional Damage	Not Available for Nighttime Failure	A38
5	Single Roadway	HL_251	Functional Damage and Part Damage		A36
6	High Mast	HL_343	Missing Part		A30, A31

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	Inlet	IN_562	Obstruction		A30
2	Inlet	IN_956	Erosion		A29

Landscaping (PB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Plant Bed	PB_22	Unhealthy		A53, A54

Paved Lanes – Asphalt (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_280	Pavement Crack		A54, A55

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	Concrete	LS_50	Paved Shoulder Joint		A16, A17
2	Asphalt	LS_280	Paved Shoulder Crack		A54, A55
3	Concrete	LS_484	Paved Shoulder Joint		A45
4	Concrete	LS_492	Paved Shoulder Joint		A46

Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_117	Shoulder Build Up		A17, A18
2	Asphalt	LS_246	Shoulder Drop Off and Elevation Deviation		A49
3	Asphalt	LS_564	Shoulder Drop Off		A40, A41

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
This asset did not produce any failures.					

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_297	Missing Markers		A2
2	Concrete	LS_492	Missing Markers and Continuous Markers		A46
3	Asphalt	LS_547	Marker Reflectivity, Missing Markers and Continuous Markers		A42
4	Asphalt	LS_550	Marker Reflectivity	Not Available for Nighttime Failure	A42
5	Asphalt	LS_554	Marker Reflectivity	Not Available for Nighttime Failure	A42
6	Asphalt	LS_567	Marker Reflectivity	Not Available for Nighttime Failure	A40

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_47	Nighttime Reflectivity and Missing Parts		A15, A16
2	Concrete	LS_108	Missing Parts		A14, A15
3	Asphalt	LS_194	Nighttime Reflectivity	Not Available for Nighttime Failure	A53, A54
4	Asphalt	LS_257	Nighttime Reflectivity	Not Available for Nighttime Failure	A49, A50
5	Concrete	LS_484	Missing Parts		A45

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
6	Asphalt	LS_547	Missing Parts		A42

Paved Ditches (PD)

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

Pavement Words and Symbols (PS)

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

Signs (SN)

#	Sign Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Authorized Vehicles	SN_61	Height Requirement		A20, A21
2	Yield	SN_205	Height Requirement		A11, A12
3	Do Not Enter	SN_477	Leaning		A3
4	Keep Right	SN_494	Height Requirement		A2

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_53	Bareground		A20, A21
2	Turf	TF_60	Height		A24, A25
3	Turf	TF_96	Bareground		A47, A48
4	Turf	TF_111	Bareground		A32

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_180	Bareground		A22
6	Turf	TF_209	Bareground		A28, A29, A30
7	Turf	TF_226	Bareground		A29, A31
8	Turf	TF_227	Bareground		A29, A31

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Turf	TF_233	Bareground		A41
10	Turf	TF_239	Bareground		A41
11	Turf	TF_434	Bareground		A37, A38
12	Turf	TF_435	Bareground		A37

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
13	Turf	TF_437	Bareground		A36, A37
14	Turf	TF_475	Bareground		A37
15	Turf	TF_483	Bareground		A32, A33
16	Turf	TF_509	Height		A30

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
17	Turf	TF_553	Bareground		A25, A26
18	Turf	TF_585	Height		A21, A22
19	Turf	TF_617	Bareground		A18
20	Turf	TF_654	Bareground		A13

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
21	Turf	TF_670	Bareground		A30, A31
22	Turf	TF_871	Bareground		A56
23	Turf	TF_894	Bareground		A54, A55
24	Turf	TF_908	Bareground		A54

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
25	Turf	TF_985	Bareground		A57

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

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Sound Wall	WL_7	Joint Separation		A51, A52