



NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program Triangle Expressway



2014 Second Quarter Ratings

CONSULTANT CERTIFICATION OF COMPLETION

September 2, 2014

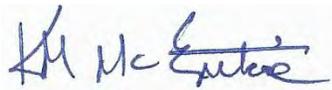
Mr. Andy Lelewski, PE
NCTA Director of Toll Road Operations
1 South Wilmington Street
Raleigh, NC 27601

NCTA Triangle Expressway Roadway and Facility Maintenance Performance Rating Program

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, Version 4 September 2013*.

Sincerely,

A handwritten signature in blue ink, appearing to read "Ken M. McEntire".

Ken M. McEntire, PE

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Maintenance Rating Program for the Triangle Expressway

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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 2014 Second Quarter Assessment of the Triangle Expressway.

The overall 2014 second quarter maintenance rating of the Triangle Expressway is 89.5. As shown in Table 1, four of the five elements assessed achieved a rating greater than the target rating.

TABLE 1: MRP ELEMENT RESULTS FOR THE 2014 SECOND QUARTER ASSESSMENT		
ELEMENT	Q2 2014 MRP Rating	Target Rating
Road Surface	95.6	85
Unpaved Shoulders	87.6	85
Drainage	93.3	85
Roadside	84.7	85
Traffic Control Devices	86.1	85
Overall MRP Performance Rating	89.5	90

As part of the NCTA MRP, this report provides a cumulative rolling annual rating of the latest four quarterly inspections of the Triangle Expressway. The current cumulative rolling annual maintenance rating of the Triangle Expressway is 92.1.

This report also provides findings for the high-level maintenance inspections conducted at the roadside toll facilities and Green Level Historical District signs. Currently all high-level maintenance inspections are meeting contract expectations with the exception of electrical components and standby generators services. Also, all Green Level Historic District signs inspected were found to be in good condition. However, overgrown vegetation is starting to partially block some of these signs.

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 asset features. Over time, these ratings will then be charted to identify work needs and subsequent necessary actions. The evaluations are based on the establishment of threshold conditions that quantify the maximum defect allowed to exist for a characteristic before it is considered unacceptable.

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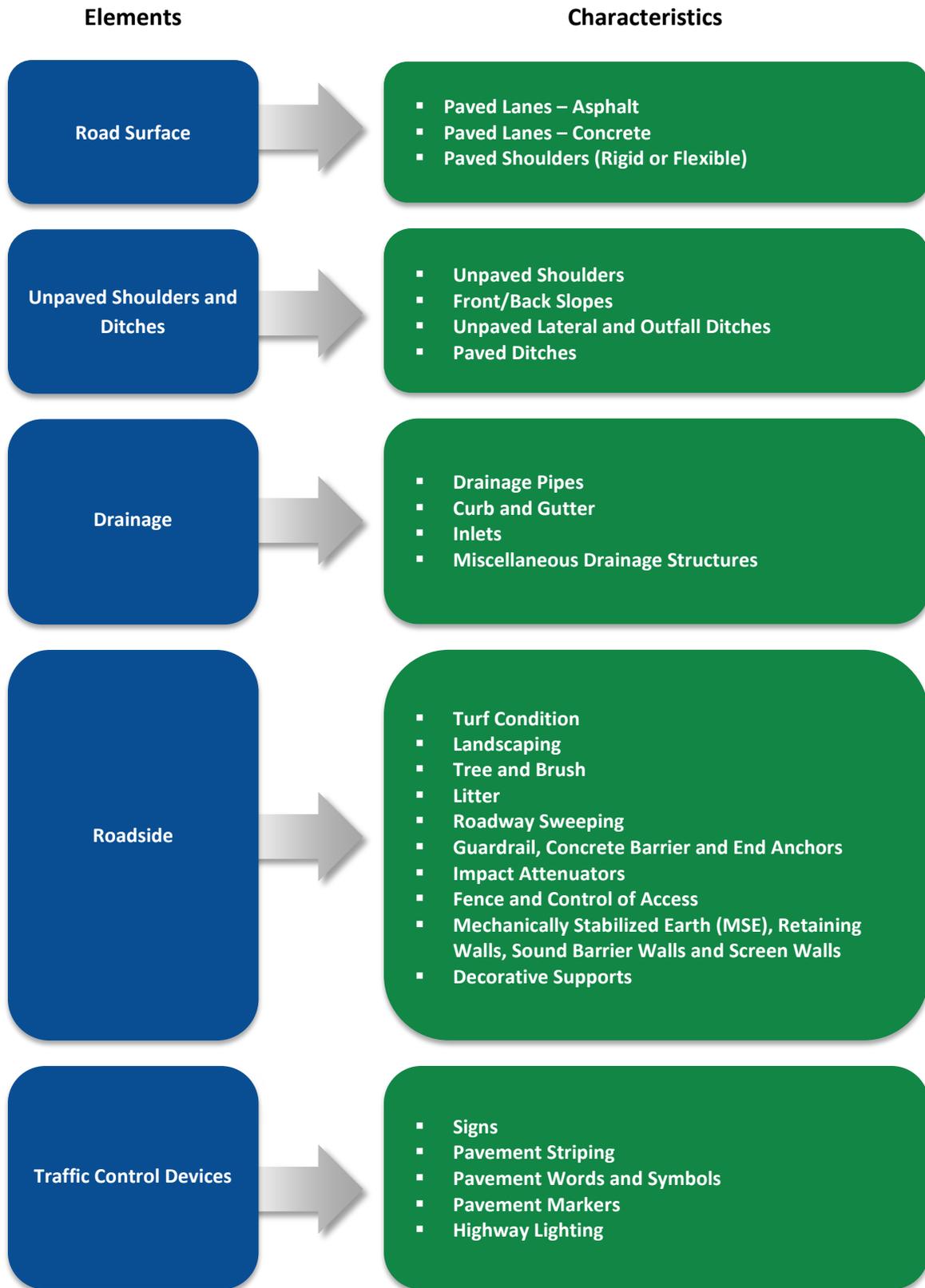
The NCTA performance standards, threshold criteria and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff, and consultants.

Using this 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 will be used to schedule and prioritize routine maintenance activities and provide uniform maintenance conditions that meet established objectives.

3.0 MRP SURVEY PROCEDURE

Per the NCTA Roadway and Facility Maintenance Performance Standards, roadway assets on NCTA facilities have been grouped into characteristics which then roll up into 5 elements. These elements and their characteristics can be seen on the following page in *Figure 1*:

Figure 1: Maintenance Elements and Characteristics



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Due to some roadway characteristics being of greater importance than others, a weighting system is applied to enable rational calculation of an overall level of service rating. Although one set of weighting factors for all characteristics could serve this purpose, a more useful system consists of two sets of weighting factors: one set that accounts for the importance of individual characteristics within a given maintenance element (1-9) and another set that accounts for the importance of the maintenance elements to the total rating (by % of score). This two-set system reveals deficiencies among characteristics and it shows which maintenance elements are deficient.

The program analysis is accomplished through the use of statistically valid, random sampling procedures that capture the level of service for individual assets with a 95% confidence level in sampling. Inspections are performed during the months of February, May, August, and November to account for dynamic changes in assets during the various seasons. Each maintenance characteristic that was selected for sampling was evaluated according to the criteria developed by the NCTA performance standards. This evaluation was completed with the assistance of NCDOT's State Roadway Maintenance Unit using their electronic data collection tablets.

The evaluations are based on established threshold conditions that quantify the maximum defect allowed to exist for a characteristic before it is considered unacceptable. The ratings are done by comparing existing field conditions to the threshold value. If the characteristic meets or exceeds the threshold, then it is coded as PASSING to meeting the criteria. If it does not meet the criteria then it is coded as NOT PASSING. When the survey is complete, the number of PASSING's and NOT PASSING's are totaled, and a composite number (using from 1 to 100 scale) is produced which represents the level of maintenance currently being provided.

For any given asset, the number assigned as the target level of service represents the percentage of random samples in which the maintenance condition standard corresponding to the activity is to be met or exceeded. For instance, an activity with a level of service rating of 83 means that 83 percent of the sites met the condition standards.

The cumulative rolling annual rating is calculated from a summation of the latest four quarterly inspections rather than taking the straight average of each quarter's rating. This is done to compensate for the event of uneven sample sizes for various assets to produce a more accurate result.

The NCTA's overall target rating score is 90, with each target element level scoring at or above 85 and every target characteristic at or above 80.

4.0 TRIANGLE EXPRESSWAY DESCRIPTION

The Triangle Expressway extends for approximately 18.8 miles from the interchange of I-40 and NC-147 on the north end to the NC-55 Bypass near Holly Springs, North Carolina on the south end (**Figure 2**). It includes an approximately 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.

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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 and modified on the roadway. To ensure the validity of the MRP, there is necessary proactive actions to take that maintain an accurate asset inventory of the Triangle Expressway. These actions include coordination with NCDOT Division maintenance managers and routine field visits.

In preparation for the 2014 Second Quarter assessment, trailblazer signs directing the public to the Customer Service Center in Morrisville were added to the list of Triangle Expressway assets. These signs were installed as part of the Triangle Expressway construction projects and are located along Chapel Hill

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Rd/NC-54, Airport Boulevard and Sorrell Grove Church Road. The signs will now be assessed according to MRP standards and examples of these signs can be seen below in **Figure 3**.

Figure 3: Triangle Expressway Trailblazer Signs



6.0 MRP ASSESSMENT

6.1 Quarterly Results

The overall 2014 second quarter maintenance rating of the Triangle Expressway is 89.5. This score represents the first quarter where our score is not above our overall Expressway target rating score of 90, and the first time that we have one element rating score (Roadside) below the desired rating of 85. All characteristics scored above the minimum rating of 80, except for Paved Ditches, Turf Condition and Pavement Markers which had a rating of 0, 49 and 71, respectively. The second quarter results can be viewed in **Tables 2 and 3** of this report. It is important to note that these results are only representative of the second quarter sample, one of the four surveys done throughout the year to provide an intermediate snapshot of seasonal conditions. Therefore, they are not a statistically valid representation of the assets conditions; only the latest four inspection summations will provide a 95% confidence level in statistical sampling.

Appendix A shows maps of each of the assets that were assessed during the second quarter. **Appendix B** shows each of the individual assets that failed the MRP.

The MRP rating value designated to each element and feature refers to the percentage of elements or features that pass the asset's particular threshold criteria respectively. After developing an inventory and totaling each particular feature, they are assessed based on the established threshold criteria. The sample passed and sample totals are then multiplied by weighted values, which were assigned to each element based on importance. This determines the actual and available rating points. Lastly, an MRP Performance Rating is calculated for each asset and element group based on the ratio of the actual points over the available points. The MRP Performance characteristic rating results for the 2014 second quarter assessments are found in **Table 2**:

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TABLE 2: MRP CHARACTERISTIC RESULTS FOR Q2 2014						
ROAD SURFACE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q2 2014 MRP RATING
Paved Lanes Asphalt	12	13	9	108	117	92
Paved Lanes Concrete	18	18	9	162	162	100
Paved Shoulder	29	31	5	145	155	94
Element Total				415	434	95.6
UNPAVED SHOULDERS AND DITCHES	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q2 2014 MRP RATING
Unpaved Shoulder	25	31	9	225	279	81
Front/Back Slopes	29	31	6	174	186	94
Lateral and Outfall Ditches, Unpaved	30	31	6	180	186	97
Ditches, Paved	0	2	5	0	10	0
Element Total				579	661	87.6
DRAINAGE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q2 2014 MRP RATING
Drainage Pipes	33	34	7	231	238	97
Curb and Gutter	23	25	6	138	150	92
Inlets	32	34	7	224	238	94
Misc. Drainage Structure	21	25	4	84	100	84
Element Total				677	726	93.3
ROADSIDE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q2 2014 MRP RATING
Turf Condition	30	61	7	210	427	49
Landscaping	23	26	4	92	104	88
Trees and Brush	31	31	4	124	124	100
Litter	31	31	4	124	124	100
Roadway Sweeping	31	31	5	155	155	100
Guardrail, Concrete Barrier and End Anchors	29	31	9	261	279	94
Impact Attenuators	9	9	9	81	81	100
Fence, Control Access	27	29	7	189	203	93
Retaining Walls and Sound Barrier Walls	14	17	5	70	85	82
Decorative Supports	24	25	5	120	125	96
Graffiti and Stain Removal	31	31	4	124	124	100
Element Total				1550	1831	84.7
TRAFFIC CONTROL DEVICES	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q2 2014 MRP RATING
Signs	57	64	7	399	448	89
Pavement Striping	28	31	8	224	248	90
Words and Symbols	28	30	7	196	210	93
Pavement Markers	22	31	9	198	279	71
Highway Lighting	28	32	6	168	192	88
Element Total				1185	1377	86.1

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The overall score is determined by summing the elements multiplied by weighted factors as follows: Road Surface (25%), Unpaved Shoulders (13%), Drainage (15%), Roadside (17%), and Traffic Control Devices (30%).

The overall MRP Performance element rating results for the second quarters are found in **Table 3**:

TABLE 3: MRP ELEMENT RESULTS FOR Q2 2014	
ELEMENT	Q2 2014 MRP Rating
Road Surface	95.6
Unpaved Shoulders	87.6
Drainage	93.3
Roadside	84.7
Traffic Control Devices	86.1
Overall MRP Performance Rating	89.5

6.2 Analysis and Recommendations

Elements

One element (Roadside) falls below the NCTA minimum threshold criteria of 85, due to turf condition.

Characteristics

Most characteristics satisfied the NCTA minimum threshold criteria of 80 with the exception of Paved Ditches, Turf Condition, and Pavement Markers. This section will focus on these characteristics that need specific attention and future emphasis in the work plan in order to maintain the desired performance. Example pictures of these failures are included in **Appendix B** of this report.

Paved Ditches

Paved Ditches scored an overall MRP rating of 0 in our May survey. There are only two paved ditches on the Expressway and each are inspected during every quarter. During this inspection, both of them failed for material accumulation, and one for erosion. These can be seen in **Figure 5** below. There has been very heavy rain this spring and it is recommended that the maintenance provider complete a thorough sweep of the paved ditches on the project regularly to remove any debris that may have been washed down.

Figure 5: Paved Ditch Failures



Turf Condition

Turf Condition did not score well in this survey (49), and there was a noticeable degradation in this second quarter assessment. Almost half of the areas surveyed failed due to bare ground, and several others failed due to undesirable vegetation. Some of these can be seen in **Figure 6** below. Many of the bare ground areas previously had active Bermuda and Centipede runners growing that are now dead. It is suspected this was caused by low cutting heights last summer during extreme heat months. With such a noticeable drop in the turf condition it is recommended that the maintenance provider schedule overseeding of these areas with warm season grasses and possibly add soil enrichment to increase the chances of survival. It is further suggested that mowing heights be closely monitored especially during the months of extreme heat conditions.

Figure 6: Turf Failures



Pavement Markers

Pavement markers scored a 71 in this survey and all were due to missing markers primarily on the bridge decks. The Triangle Expressway saw several rounds of frozen precipitation this past winter where plows

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removed the non-snowplowable markers from bridge decks. It is recommended that the maintenance provider consider replacing markers as soon as practical at the end of each winter season.

With minor attention toward specific deficiencies the overall MRP score can easily be maintained above the 90 percentile threshold. For instance, had pavement markers passed the overall MRP Second Quarter score would have been 91.3 instead of 89.5.

7.0 ROLLING ANNUAL MRP

The current cumulative rolling annual maintenance rating of the Triangle Expressway is 92.1. The cumulative rolling annual results can be viewed in *Tables 4 and 5* of this report. These results are a collective of the four latest quarterly inspections conducted throughout the year. This score is above our target rating score of 90 for the overall Expressway. All element ratings were above the desired rating of 85. Paved Ditches and Turf Condition are the only two characteristics that scored below the minimum rating of 80 with ratings of 67 and 64, respectively.

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TABLE 4: CUMULATIVE ROLLING ANNUAL MRP CHARACTERISTIC RESULTS					
ROAD SURFACE	Q3 2013 RATING	Q4 2013 RATING	Q1 2014 RATING	Q2 2014 RATING	CUMULATIVE ANNUAL RATING
Paved Lanes Asphalt	100	94	91	92	94
Paved Lanes Concrete	100	100	100	100	100
Paved Shoulder	95	80	71	97	86
Element Total	98.1	91.5	87.6	96.8	93.6
UNPAVED SHOULDERS AND DITCHES	Q3 2013 RATING	Q4 2013 RATING	Q1 2014 RATING	Q2 2014 RATING	CUMULATIVE ANNUAL RATING
Unpaved Shoulder	100	98	90	81	93
Front/Back Slopes	100	98	94	94	96
Lateral and Outfall Ditches, Unpaved	95	93	94	97	94
Ditches, Paved	75	100	50	0	67
Element Total	97.9	96.3	91.5	87.6	93.8
DRAINAGE	Q3 2013 RATING	Q4 2013 RATING	Q1 2014 RATING	Q2 2014 RATING	CUMULATIVE ANNUAL RATING
Drainage Pipes	92	95	91	97	94
Curb and Gutter	96	92	84	92	91
Inlets	90	93	97	94	93
Misc. Drainage Structure	88	81	88	84	85
Element Total	91.0	90.7	91.2	93.3	92.0
ROADSIDE	Q3 2013 RATING	Q4 2013 RATING	Q1 2014 RATING	Q2 2014 RATING	CUMULATIVE ANNUAL RATING
Turf Condition	37	81	87	49	64
Landscaping	75	89	92	88	86
Trees and Brush	100	100	100	100	100
Litter	100	100	100	100	100
Roadway Sweeping	100	100	100	100	100
Guardrail, Concrete Barrier and End Anchors	90	97	100	94	95
Impact Attenuators	90	100	100	100	97
Fence, Control Access	94	82	90	93	89
Retaining Walls and Sound Barrier Walls	100	94	88	82	91
Decorative Supports	100	100	100	96	99
Graffiti and Stain Removal	100	100	97	100	99
Element Total	83.9	92.8	94.6	84.7	89.0
TRAFFIC CONTROL DEVICES	Q3 2013 RATING	Q4 2013 RATING	Q1 2014 RATING	Q2 2014 RATING	CUMULATIVE ANNUAL RATING
Signs	91	71	86	89	85
Pavement Striping	100	100	97	90	97
Words and Symbols	100	100	100	93	98
Pavement Markers	97	100	100	71	93
Highway Lighting	79	86	97	88	87
Element Total	94.7	92.9	94.4	86.1	91.8

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A summary of the rolling annual MRP element results is found in **Table 5**:

TABLE 5: ROLLING ANNUAL MRP ELEMENT RESULTS					
ELEMENT	Q3 2013 RATING	Q4 2013 RATING	Q1 2014 RATING	Q2 2014 RATING	CUMULATIVE ANNUAL RATING
Road Surface	98.1	91.5	87.6	96.8	93.6
Unpaved Shoulders	97.9	96.3	91.5	87.6	93.8
Drainage	91.0	90.7	91.2	93.3	92.0
Roadside	83.9	92.8	94.6	84.7	89.0
Traffic Control Devices	94.7	92.9	94.4	86.1	91.8
Overall MRP Performance Rating	93.6	92.6	91.9	89.8	92.1

8.0 Triangle Expressway Toll Facility Maintenance

As part of the Roadside Toll Collection System contract, XEROX is to provide toll facility maintenance for all Toll Zones along the Triangle Expressway. Facility maintenance will include all labor, equipment, materials and incidentals for the maintenance items under contract.

The equipment and services covered by the facilities maintenance agreement include:

- Air Conditioning Equipment
- Electrical Components
- Fire and Carbon Monoxide Alarms and Fire Extinguishers
- Standby Generators
- Security Components
- Toll Facility Vaults
- Pressure Cleaning
- Pest Control
- Grounding and Ground System Testing

Upon completion of any and all services performed on the equipment identified above, XEROX will update the Maintenance Log File with the following detailed information:

- Date of Service Request
- Date of Service Completion
- Date of Regularly Scheduled Maintenance Activities
- Detail of Tasks Performed
- List of Any Issues Found
- List of Any Replacement Parts Required
- Notification to NCTA for Replacement Part Approval

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All maintenance logs will be stored in the CMMS (Computerized Maintenance Management System) database and submitted to the NCTA for review. As part of each quarterly inspection, HNTB will review the facility maintenance logs submitted to ensure XEROX is meeting maintenance contract expectations. Equipment services will meet maintenance contract expectations only if the maintenance logs provided prove that the service has been completed.

8.1 Quarterly Results

Air Conditioning Unit Service Requirements	Status
Monthly Service (Scheduled for April, May and June 2014)	
<ul style="list-style-type: none"> • Replace filters (pleated high efficiency filters shall be used) 	Completed
Semi-Annual Service (Scheduled for May 2014)	
<ul style="list-style-type: none"> • Perform inspection and maintenance checks/cleaning (preventative maintenance) on all air conditioning equipment units. All items in the preventive maintenance inspection shall be checked along with any other item necessary to ensure that each unit is operating properly. <ul style="list-style-type: none"> ○ Clean condenser and evaporator coils on air conditioning units, with industry approved chemicals and methods and per recommendations by the manufacturer. ○ Clean oil air handling units of the air conditioning equipment (per manufacture recommendations) ○ Clean drain pans and condensate lines of the air conditioning equipment. ○ Lubricate all motors required for the air conditioning equipment. ○ Clean inlet and outlet registers for the air conditioning equipment. ○ Check controls and thermostats for proper operation for the air conditioning equipment. ○ Check for leaks and adjust amounts of refrigerant as needed for the air conditioning equipment. ○ Record refrigerant pressures for the air conditioning equipment. ○ Check electrical connections for the air conditioning equipment. ○ Check for vibrations and noises stemming from the air conditioning equipment. ○ Check all belts and belt pulleys and replace worn belts for the air conditioning equipment. 	Completed

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Electrical Components Service Requirements	Status
Monthly Service (Scheduled for April, May and June 2014)	
<ul style="list-style-type: none"> • Electrical Distribution Equipment <ul style="list-style-type: none"> ○ Inspect electrical distribution equipment for warning signs, wear, or malfunction. ○ Inspect enclosures in electrical distribution equipment for damage, unauthorized openings, and corrosion of metallic objects. Repair and paint to match as required. Inspect air passages and remove any blockage. ○ Inspect, investigate, and solve conditions in which the electrical distribution equipment produces unusual odors. ○ As electrical distribution equipment is operated and tested, listen, investigate, and mitigate conditions for unusual noises. ○ Inspect electrical distribution equipment grounding components such as conductors and connections. Inspect insulators for damage. ○ Inspect liquid immersed electrical distribution equipment for leaks and damage. ○ Inspect indicating lights on electrical distribution equipment for correct illumination. ○ Remove debris, dirt, insect nests, and other foreign objects from all components, housings, cabinets, panels, etc. of the electrical distribution equipment. ○ Verify operation of space heaters and control thermostat of electrical distribution equipment. Check thermostat set point for proper setting. 	Not Completed
Annual Service (Scheduled for November 2014)	
<ul style="list-style-type: none"> • Electrical Distribution System <ul style="list-style-type: none"> ○ Inspect electrical connections in the electrical distribution system for degradation. ○ Torque all electrical connections in the electrical distribution system to design value. ○ Verify the grounding of the equipment and associated neutral where applicable for the electrical distribution system. ○ Conduct infrared test on all main current carrying equipment in the electrical distribution system for hot spots that may indicate overheat conditions or loose connections. ○ Using calibrated test instruments, calibrate ammeters, voltmeters, etc. Verify continuity of metering selector switch contacts with ohmmeter. ○ Change filters on Main Distribution Panel in the electrical distribution system at site 6-1 and 7-2. ○ Inspect electronic power meter on Main Distribution Panels in the electrical distribution system for proper operation. • Low Voltage Panel Boards <ul style="list-style-type: none"> ○ Inspect electrical insulation of low voltage panel boards for discoloration and degradation. ○ Service low voltage panel board circuit breakers per manufacturers' recommendations. ○ Inspect low voltage panel board breakers' current carrying components for discoloration that may indicate overheating. ○ Perform insulation resistance test on each phase-to-phase and phase-to-ground for the low voltage panel boards using a megohmmeter. ○ Prove low voltage panel board circuit breaker operation by actuation of each associated protective device. ○ Verify low voltage panel board Surge Protection Device (SPD) is functioning (lights). ○ Measure and record neutral currents for low voltage panel boards. • Automatic Transfer Switches <ul style="list-style-type: none"> ○ Inspect, operate, adjust, and lubricate mechanical linkages for the automatic transfer switches. ○ Verify operation of mechanical interlocks of automatic transfer switches. ○ Inspect and dress current carrying contacts in accordance with manufacturer's recommendations for the automatic transfer switches. ○ Test automatic transfer switches. Perform insulation resistance test on each phase-to-phase and phase-to-ground using a megohmmeter. ○ Perform contact resistance test for automatic transfer switches. ○ Prove correct operation of the transfer switches by manually initiating transfers in 	N/A

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Electrical Components Service Requirements	Status
<ul style="list-style-type: none">○ both directions.○ Simulate the automatic conditions requiring automatic transfer switches to transfer in both directions.○ Verify generator start on transfer for automatic transfer switches.○ Verify correct indicating light operation for automatic transfer switches.○ Verify equipment alarms – critical monitoring system for automatic transfer switches.● Safety Switches (Disconnects)<ul style="list-style-type: none">○ Inspect, operate, adjust, and lubricate mechanical linkages for safety switches.○ Verify operation of mechanical interlocks for safety switches.○ Inspect and dress current carrying contacts for safety switches in accordance with manufacturer’s recommendations.○ Test safety switches. Perform insulation resistance test on each phase-to-phase and phase-to-ground using a megohmmeter on each critical load switch.○ Perform contact resistance test on each critical load switch.	

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Fire and Carbon Monoxide Alarms and Fire Extinguishers Service Requirements	Status
Monthly Service (Scheduled for April, May and June 2014)	
<ul style="list-style-type: none"> • Test smoke detector per manufacture’s specification. • Test carbon monoxide detector per manufacture’s specification. • Visual inspection of all for fire and carbon monoxide alarms and fire extinguishers. • Clean smoke detectors using a vacuum cleaner attachment to remove dust and cobwebs. If possible, carefully vacuum inside the unit as well. • Clean carbon monoxide detectors using a vacuum cleaner attachment to remove dust and cobwebs. If possible, carefully vacuum inside the unit as well. Retest test/silence button after each cleaning. 	Completed
Annual Service (Scheduled for November 2014)	
<ul style="list-style-type: none"> • Fire and carbon monoxide alarm detector maintenance check. • Check charge on fire extinguisher. • Replace batteries for fire and carbon monoxide alarms. 	N/A
Every Two (2) Year Service (Phases I & II Scheduled for September 2014, Phase III Scheduled for January 2015)	
<ul style="list-style-type: none"> • Replace carbon monoxide detectors. 	N/A
Every Five (5) Year Service (Phases I & II Scheduled for August 2017, Phase III Scheduled for January 2018)	
<ul style="list-style-type: none"> • Re-fill and conduct a hydrostatic test on fire extinguishers. 	N/A

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Standby Generators Service Requirements	Status
Weekly Service	
<ul style="list-style-type: none"> • Exercise cycle run for standby generators for twenty (20) minutes. • Visual inspection of standby generators for obvious issues. • Verify the exercise cycle for standby generators has run. 	Completed
Monthly Service (Scheduled for April, May and June 2014)	
<ul style="list-style-type: none"> • Visual inspection of all devices for standby generators. • Perform standby generator inspections. • Check all standby generator systems for leaks. • Engine <ul style="list-style-type: none"> ○ Test low oil pressure (LOP) safety – record seconds to shut down. ○ Test high engine temperature (HET) safety – record seconds to shut down. ○ Test over speed (O/S) safety – record seconds to shut down. ○ Check pre-alarms if applicable. ○ Check over crank (O/C) item – record seconds to shut down. ○ Check cycle cranker time. ○ Check noises or leaks. • Oil System <ul style="list-style-type: none"> ○ Check oil filter and gaskets. • Cooling system <ul style="list-style-type: none"> ○ Check general condition. ○ Sample and test anti-freeze and add if needed. ○ Check coolant level. ○ Pressure test system. ○ Check and replace belts and hoses if needed. • Exhaust System <ul style="list-style-type: none"> ○ Visually check for leaks, corrosion and check condensation trap and muffler condition. ○ Drain condensation if possible. • Fuel System <ul style="list-style-type: none"> ○ Check for leaks; check all visible connections and flexible hoses. Replace flexible hoses if needed. ○ Adjust carburetor as needed. ○ Service air filters as needed. ○ Clear debris from around engine from grass or other foreign sources. ○ Check tanks to ensure they meet EPA requirements for standby generators. ○ Keep monthly log of fuel tank inspect reports. • Generators <ul style="list-style-type: none"> ○ Visually inspect generator condition, check slip rings and commutator for wear, check lubrication of rear generator bearing. ○ Check diode heat sinks. • Battery <ul style="list-style-type: none"> ○ Check specific gravity and load test. ○ Check water level. ○ Clean terminals and posts and coat with inhibitor. ○ Check battery charge. ○ Replace all batteries at the end of the contract. • Ignition System <ul style="list-style-type: none"> ○ Check all wires. ○ Inspect plugs and electronic ignition. ○ Lubricate upper and lower bearing. ○ Set timing as needed. • Accessories <ul style="list-style-type: none"> ○ Lubricate all hinges, door locks and cover snaps. Test locks and replace or repair as 	Not Completed

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Standby Generators Service Requirements	Status
<ul style="list-style-type: none"> needed. ○ Inspect annunciator. ○ Inspect battery charger. ○ Adjust battery charger – AMP-MA ○ Adjust annunciator battery lights. ○ Inspect tanks for rust and corrosion; prepare and paint all areas showing signs of rust or corrosion. ○ Prepare and paint any areas on the generator enclosure showing signs of rust or corrosion. 	
Quarterly Service (Scheduled for May 2014)	
<ul style="list-style-type: none"> ● Testing <ul style="list-style-type: none"> ○ Check unit under actual or full load as approved by the NCTA. This check should be performed after hours or during weekends. ○ Adjust voltage and frequency under actual load. ○ Adjust clock exerciser, day, time, load, no load. ○ Test delay start, pick up, transfer, cool down, transition and preheat. ○ Calibrate Under Voltage (UV) sensors, generator sensor, and Over Voltage (OV) sensors. ○ Record load per leg, voltage, hertz, oil pressure, and water temperature. ○ Check battery charging system. ○ Test transfer switch relays for proper operation including loss of single phase power. ○ Provide certification of proper operation. ○ Load test the Generator as recommended by the equipment manufacturer. ○ Annual 2 hour Load Bank test per manufacturer recommendation. ○ Provide load test reports. ○ Visually check for leaks. 	Completed
Semi-Annual Service (Scheduled for August 2014)	
<ul style="list-style-type: none"> ● Oil System <ul style="list-style-type: none"> ○ Change engine oil. ○ Change oil filter and gaskets. ○ Visually check for leaks. 	N/A
Annual Service (Scheduled for November 2014)	
<ul style="list-style-type: none"> ● Annual 2 hour Load Bank test per manufacturer recommendation. <ul style="list-style-type: none"> ○ Provide load test reports. ○ Visually check for leaks. ● Replace batteries. ● Replace filters annually. 	N/A

Maintenance Rating Program for the Triangle Expressway

2014 Second Quarter Ratings

Security Components Service Requirements	Status
Quarterly Service (Scheduled for June 2014)	
<ul style="list-style-type: none">• Check all locks on security components are in working order.• Lubricate all security component locks per manufacturer's recommendations.• Verify keys for all security component locks can be located.• Note and report any lock tampering.	Completed

Maintenance Rating Program for the Triangle Expressway

2014 Second Quarter Ratings

Toll Facility Vaults Service Requirements	Status
Weekly Service	
<ul style="list-style-type: none"> • Clear and remove all debris, litter, etc. inside toll facility vaults and out. • Remove cobwebs and insect nests from walls, corners and ceilings of all toll facility vaults. • Clean exterior door jambs, frames and transoms in all entrances. 	Completed
Quarterly Service (Scheduled for April 2014)	
<ul style="list-style-type: none"> • Inspect the toll facility vaults for cracks in panels at sharp angles near doors and openings and at panel connection joints. • Inspect coatings for peeling on doors where concrete was cracking. • Inspect the floor coatings for chipping and wear. • Inspect for rust stains found around cracks, or exposed reinforcing steel, or other causes for concern. • Look at door and vault seals, caulking, exposed backer bar, or door jamb seals missing or damaged. 	Completed
Annual Service (Scheduled for October 2014)	
<ul style="list-style-type: none"> • Inspection by and report on condition from a qualified structural engineer. 	N/A

Maintenance Rating Program for the Triangle Expressway

2014 Second Quarter Ratings

Pressure Cleaning Service Requirements	Status
Semi-Annual Service (Scheduled for June 2014)	
<ul style="list-style-type: none">• Provide all labor, materials, tools, equipment and incidentals (including water if not available at the facility) necessary to perform the work as specified. Use cleaners, degreasing agents and other approved means to remove all dirt, oil, tar, exhaust residue, spider webs and egg sacs, mud dauber nests, wasp and bee nests and any other deposit or film which may be present on the exterior of the vaults. Streaking of surfaces will not be allowed and manual scrubbing may be required in order to attain the desired results.• Materials Safety Data Sheets (MSDS) for all chemicals used shall be submitted by ACS. All chemical agents and additives must be approved by NCTA prior to beginning any work.• Protect all NCTA equipment during the time that cleaning is in progress. ACS shall be responsible for any and all damages caused by their Contractor's operations to either NCTA property or to the public moving through the facilities. No equipment, vehicles or materials may be stored at any NCTA facility.• Upon completion of each day's work, ACS shall ensure that the toll zone or facility being cleaned is free from debris caused by the work and remove and dispose of such debris off NCTA right-of-way.• The cleaning equipment shall be independently powered and capable of attaining adequate pressure and temperature to perform a job that meets the desired cleaning results. The equipment must also be designed to apply approved cleaning agents to surfaces to be cleaned in a volume sufficient to attain the desired cleaning results. Chemical cleaners that are used on surfaces in areas of plants and grass shall not be harmful to vegetation. Care shall also be taken to avoid any damage to existing grass, plants, shrubs and trees by equipment or personnel. Any plants or foliage damaged shall be replaced with equal or better plantings at no cost to the NCTA.	Completed

Maintenance Rating Program for the Triangle Expressway

2014 Second Quarter Ratings

Pest Control Service Requirements	Status
Quarterly Service (Scheduled for May 2014)	
<ul style="list-style-type: none">• Insect control includes those measures which are necessary to suppress general household insects within and around the facilities by using properly registered and labeled pesticide products and approved devices.• Rodent control includes those measures necessary to suppress populations of rats and mice that become a nuisance within or around the NCTA premises and equipment. There shall be no signs of infestations.• The program for the control of general pests shall be continually in effect. There shall be no signs of infestations.• Treat all areas of the facility to eliminate those pests mentioned above. These areas include, but are not limited to, vaults (interior and exterior perimeter which extends for a distance of fifteen feet (15') around the vaults), toll cabinets, emergency generators, and storage facilities.• Protect NCTA equipment during the time the work is underway. All materials for pest control shall conform to federal, state and local ordinances and precautions shall be used to avoid accident or injury to the employees and prevent damage to the facilities.	Completed

Maintenance Rating Program for the Triangle Expressway

2014 Second Quarter Ratings

Grounding and Ground System Testing Service Requirements	Status
Semi-Annual Service (Scheduled for August 2014)	
<ul style="list-style-type: none"> • Testing <ul style="list-style-type: none"> ○ Perform testing of ground rods at each toll zone and facility as directed by the NCTA to determine the resistance of each ground rod. Document, certify, correct and provide a report of Ground Resistance Test for the results of all tests performed. ○ For all ground rods exceeding 25 ohms (unless otherwise specified), furnish and install 5/8" x 10' copper clad ground rods or ground rod segments as necessary to achieve the grounding requirements until ground resistance of 25 ohms (unless otherwise specified) or less is achieved. ○ Furnish and install exothermic weld connections, Cadweld by ERICO approved equal as necessary to achieve the testing requirements. ○ Perform testing and provide and certify a report of Ground Resistance Test at each toll zone grounding system upon completion of installation of new ground rod(s). 	N/A

8.2 Analysis and Recommendations

As part of the second quarter inspection, HNTB reviewed the April, May and June maintenance logs provided by XEROX. According to these logs, air conditioning unit, fire and carbon monoxide alarms and fire extinguishers, security components, toll facility vaults, pressure cleaning, pest control, and grounding and ground system testing services were completed and are therefore meeting all maintenance contract expectations. This quarter the maintenance logs provided did not show proof that the electrical components and standby generators' monthly services were completed. Due to the lack of documentation proving that service has been provided, electrical components and standby generators services are failing to meet maintenance contract expectations.

9.0 Green Level Historic District Signs

The four (4) Green Level Historic District signs and surrounding landscaped areas were installed as part of the Triangle Expressway construction projects. A maintenance agreement is being developed between NCDOT and the Town of Cary proposing that NCDOT will maintain the signs and the Town of Cary will maintain the landscaped areas.

9.1 Analysis and Recommendations

As part of each quarterly inspection, assessors also visit the four Green Level Historic District signs to conduct a visual inspection of the sign to ensure they are in good standing.

These signs were visually inspected as part of this quarterly inspection and were found to all be in good condition. However, as shown in the picture below, the landscaped areas surrounding the signs now contain numerous weeds and have started to look unsightly and overgrown. In several instances, part of the signs has become blocked from the vegetation, which can be seen in **Figure 4**.

Maintenance Rating Program for the Triangle Expressway
2014 Second Quarter Ratings

Figure 4: Green Level West Historical District Signs



10.0 CONCLUSION

This report represents the 2014 second quarter and the current cumulative rolling annual assessment of the Triangle Expressway. **The NCTA's target rating for an overall score is 90, the element level should not be below an 85, and no feature/characteristic should be below an 80.**

The second quarter 2014 score is **89.5** and the cumulative rolling annual score is **92.1**. While the rolling annual score is within the established parameters, this assessment marks the first time that the overall score has dropped below a 90. All elements were above the minimum rating of 85 except for the second quarter Roadside which scored an 84.7, and several characteristics fell below the minimum threshold of 80. Paved Ditches, Turf Condition and Pavement Markers scored 0, 49 and 71 respectively for the 2014 Second Quarter, and Paved Ditches and Turf Condition scored 67 and 64 respectively for the cumulative rolling annual assessment.

The maintenance provider should plan to remove any debris that may have been washed down onto the paved ditches due to the subsequent heavy rains on a consistent basis, and pavement markers should be checked and reapplied after the inclement weather season. The maintenance provider has demonstrated responsiveness to previous assessments and is expected to provide adequate corrective measures for both of these items. It should be noted that if both ditches did not contain debris and all of the markers had been reapplied after the winters inclement weather that the total second quarter score would be 91.4.

Turf Condition is failing for both the second quarter and for the cumulative rolling score, and needs the most attention. It is recommended that over seeding of these areas occur with warm season turf seed such as Bermuda grass, and that the cycles of mowing and trimming are maintained with special attention toward preventing scalping the turf from low cutting heights.

Maintenance Rating Program for the Triangle Expressway

2014 Second Quarter Ratings

Additionally, it should be noted that while Pavement Striping has scored a 90 for the 2014 Second Quarter and a 97 for the annual rolling rating the lifespan of epoxy paint pavement markings are 3 to 5 years and some of the Triangle Expressway is approaching this time period. This can also be seen in the slight lowering of scores since last quarter (97 first quarter and 99 rolling). Preparations should be made in the budget and work schedule for the maintenance contractors to plan for this work.

It has also been noticed that many of the overhead signs have had a degradation of nighttime reflectivity. It is assumed that this is caused by condensation on the signs, but, it is recommended that the maintenance provider provide a more thorough analysis.

All toll facility maintenance services are meeting contract expectations with the exception of electrical components and standby generators services. It is recommended that XEROX submits to NCTA monthly copies of the maintenance logs for each of the facility maintenance components. These logs should demonstrate that all required services have been provided when applicable.

Also, all Green Level Historic District signs inspected were found to be in good condition. However, overgrown vegetation is starting to partially block some of these signs. In order to avoid vegetation from covering these signs, it is recommended for the Town of Cary to increase the maintenance frequency of the landscaped areas surrounding the signs.

Overall, the Triangle Expressway is being maintained well and in a manner consistent with other toll facilities in the United States.

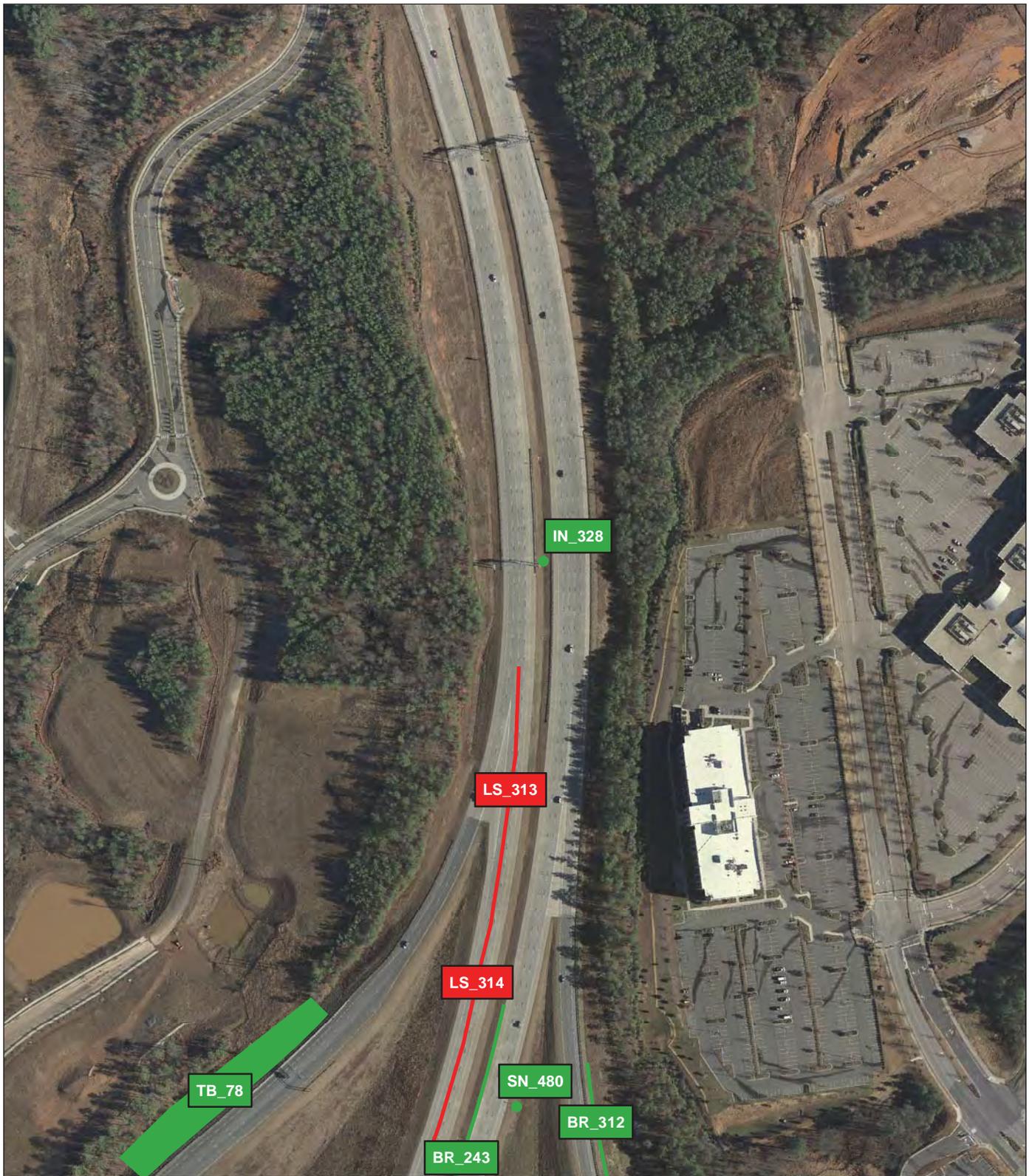
Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations

Appendix A: Triangle Expressway 2014 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
 - Pavement Markers
- 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 2014 Second Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



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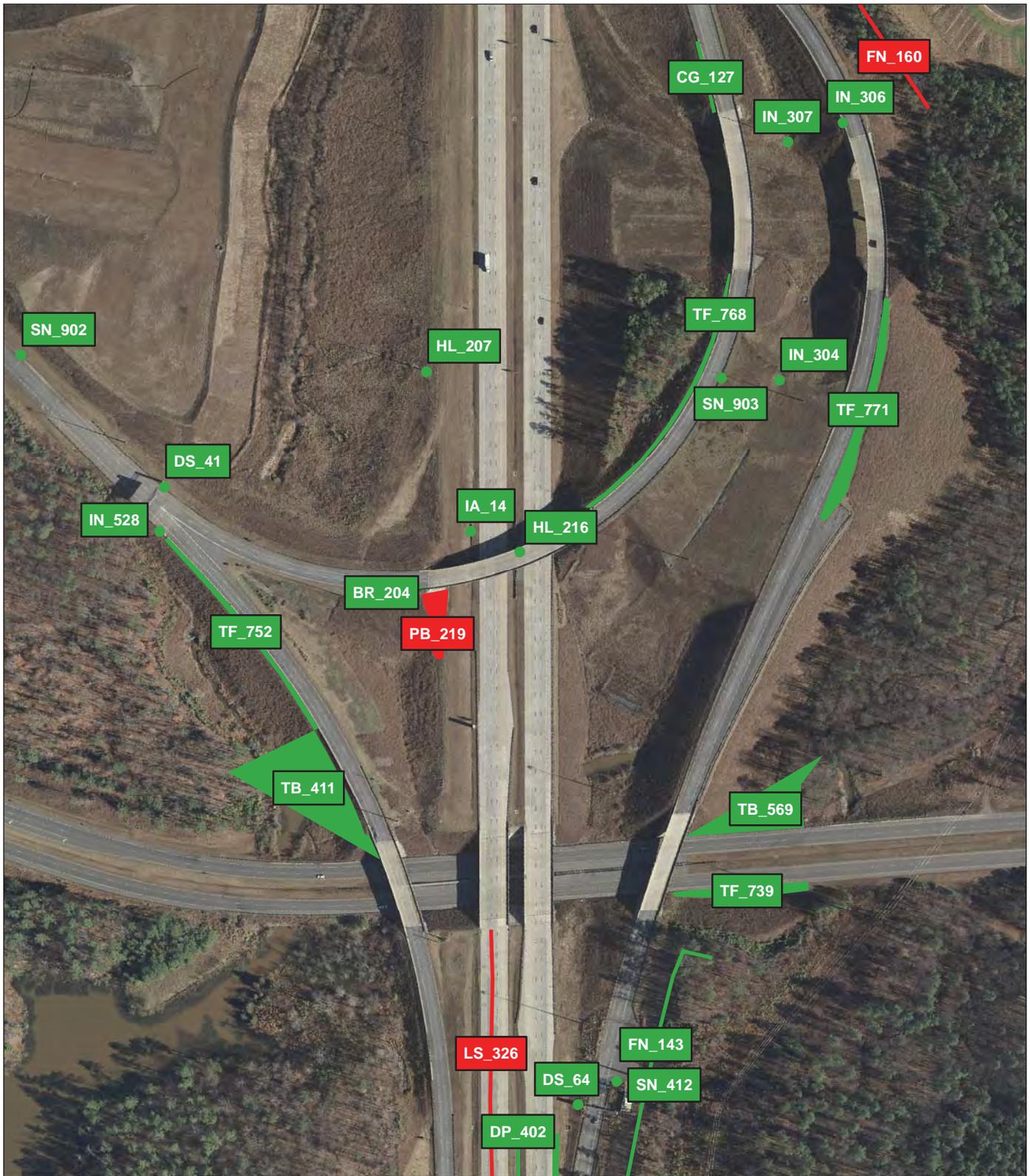


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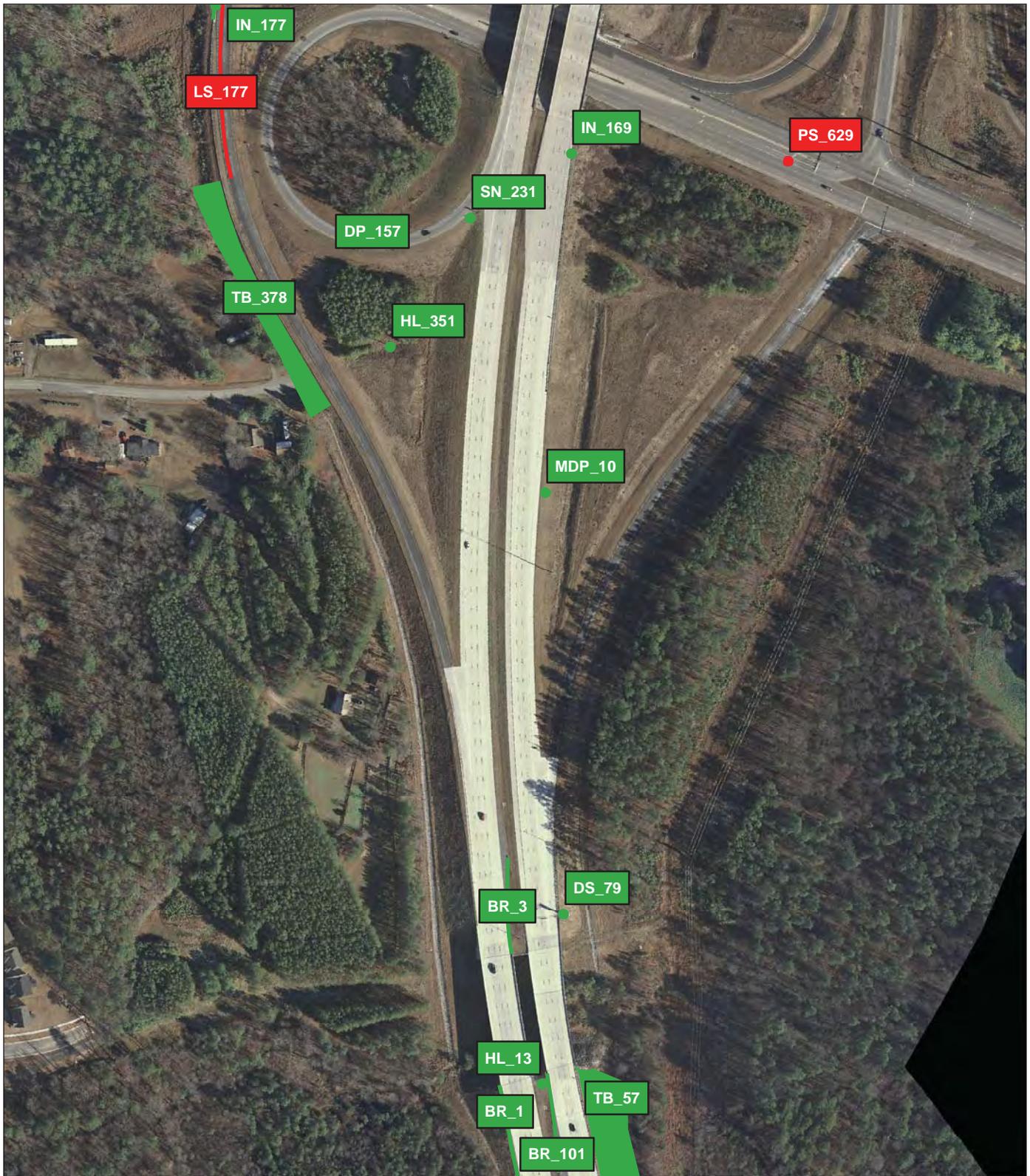


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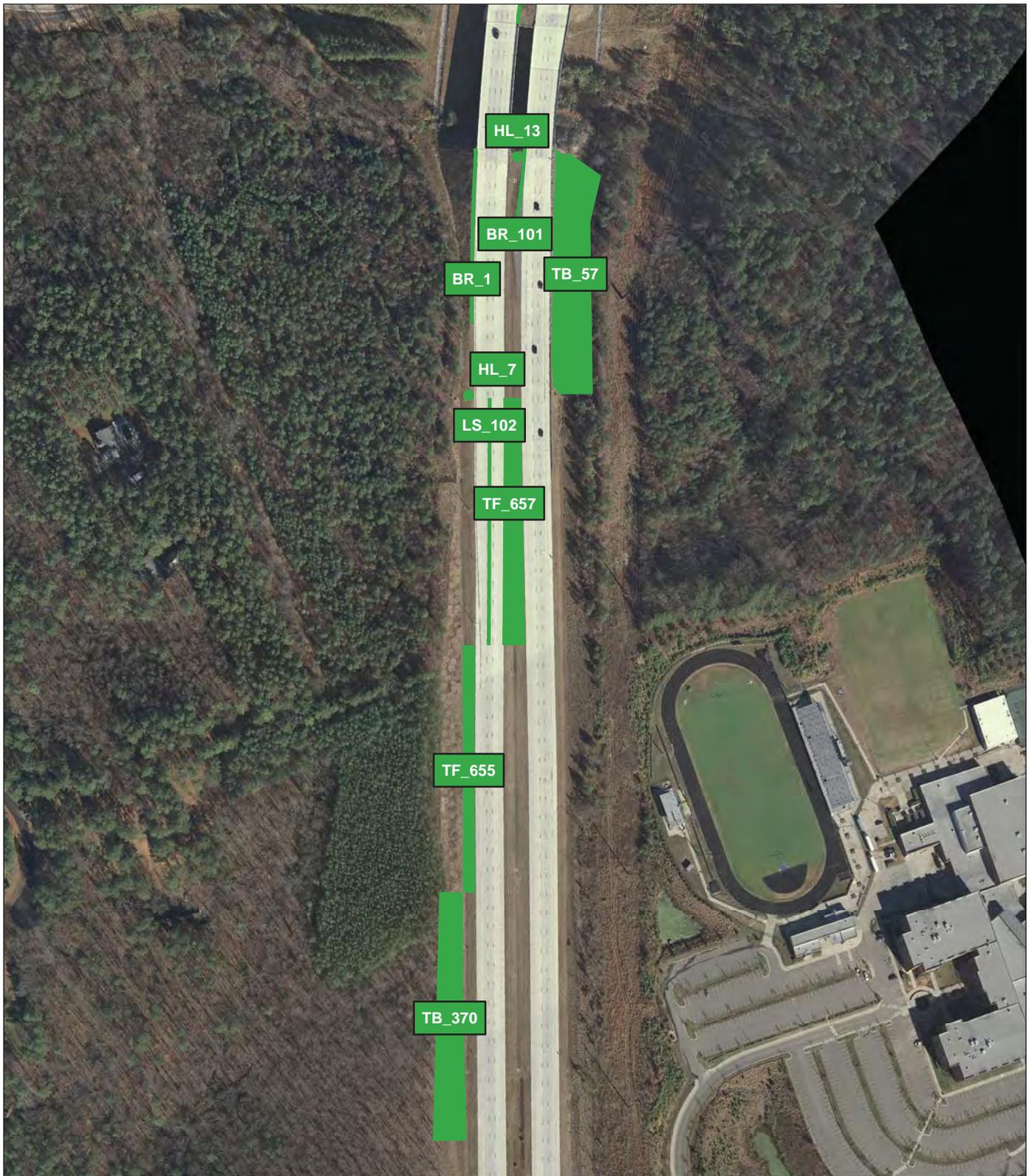


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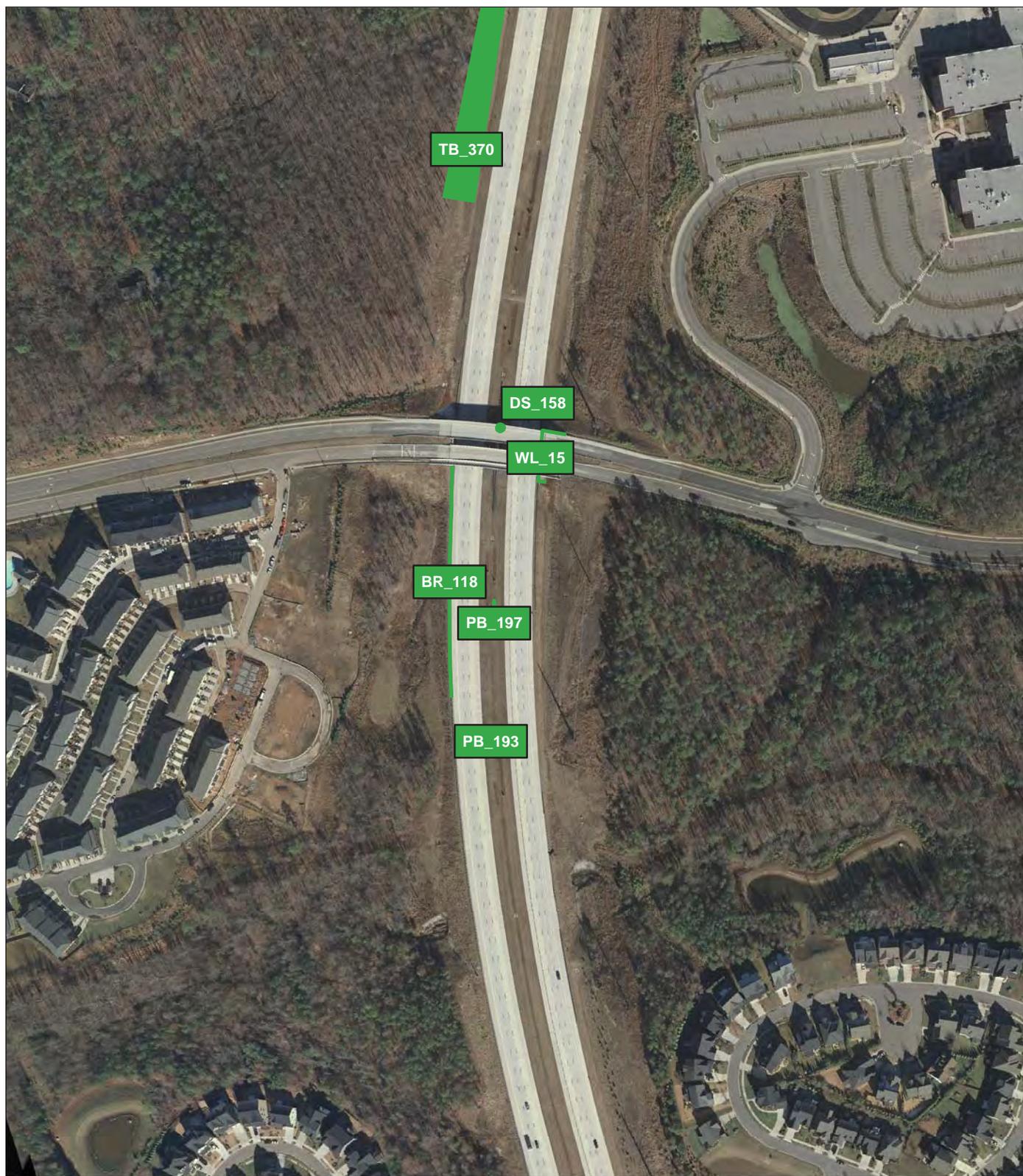


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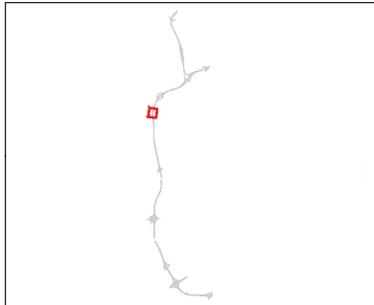


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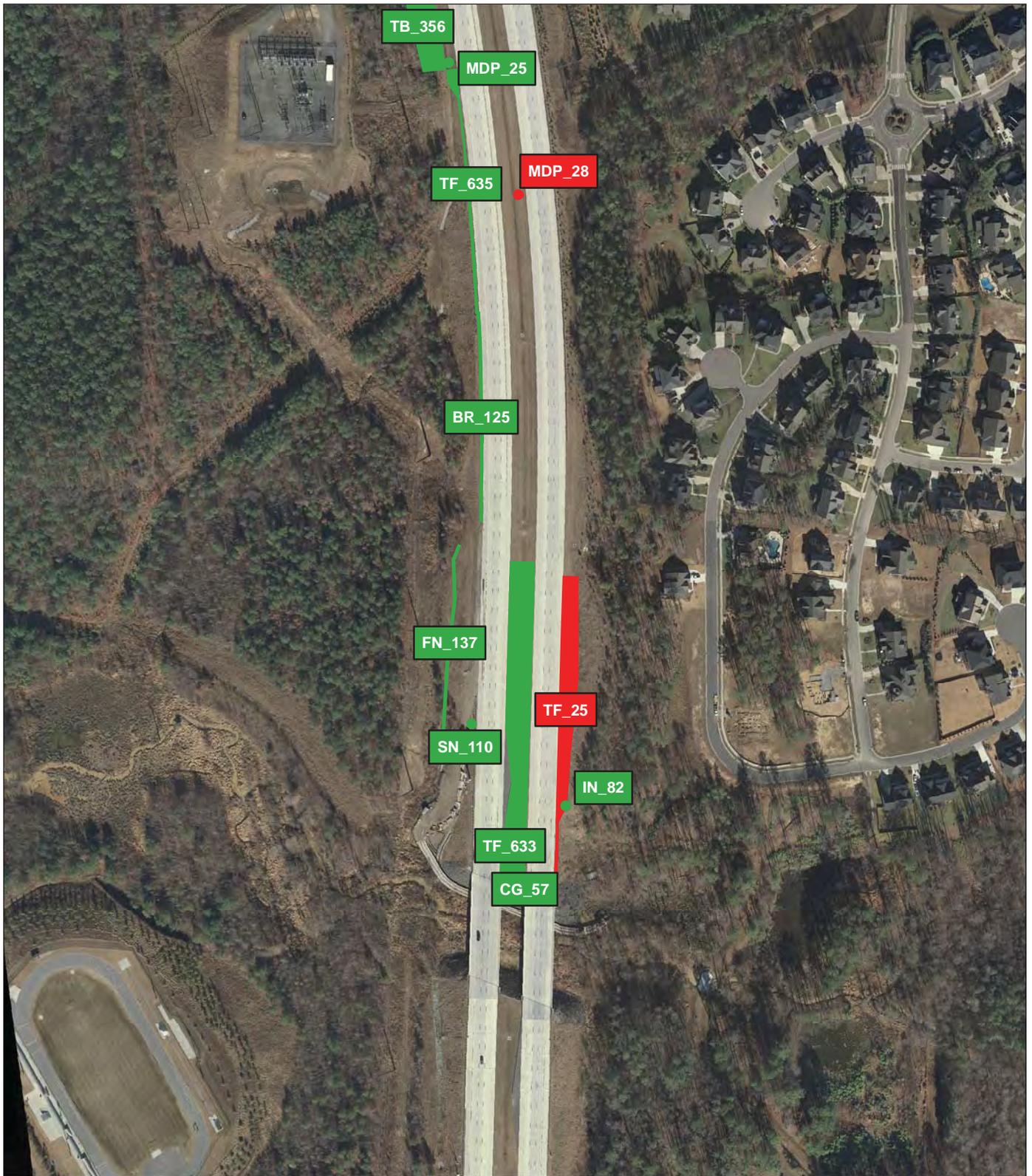


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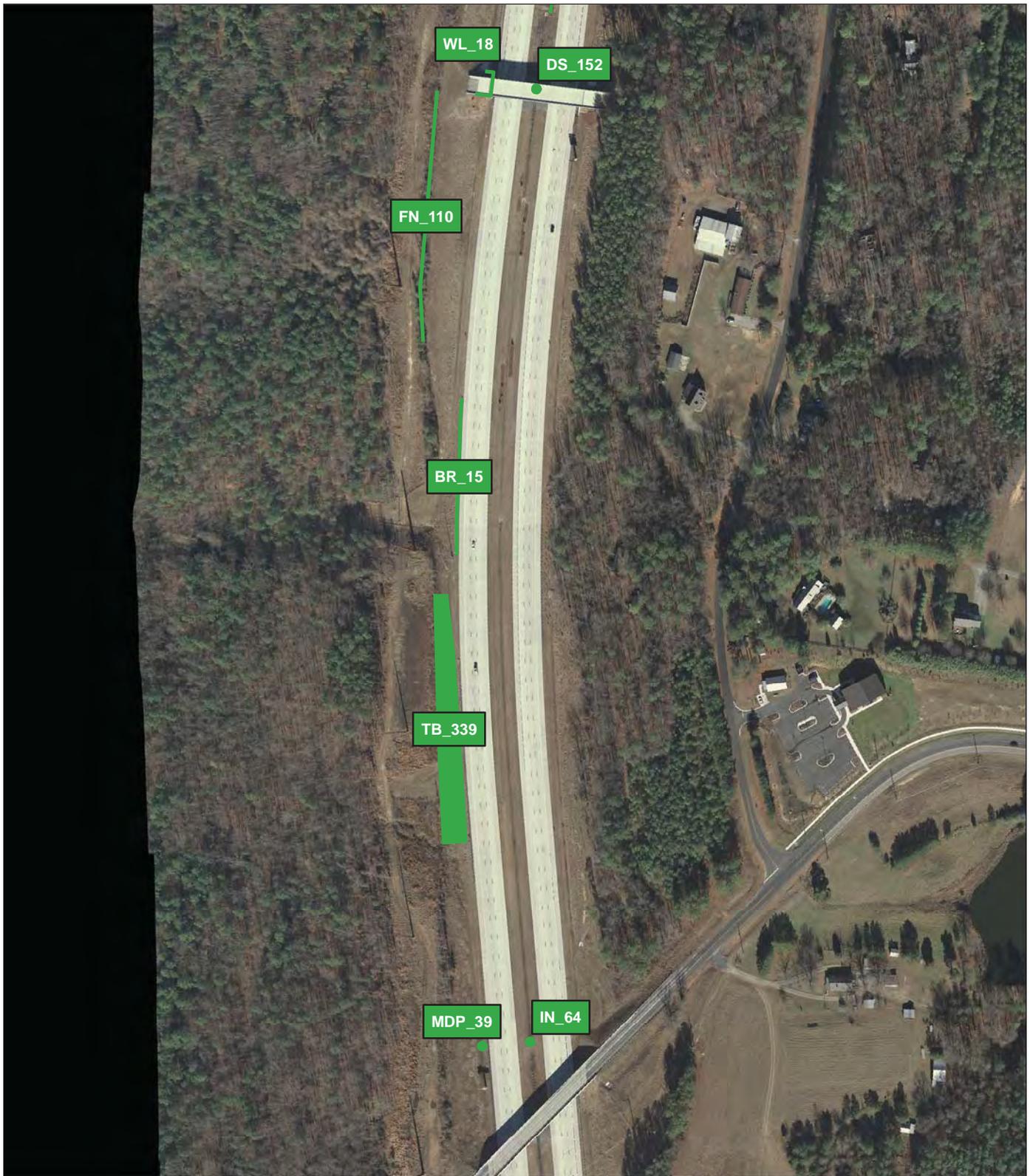


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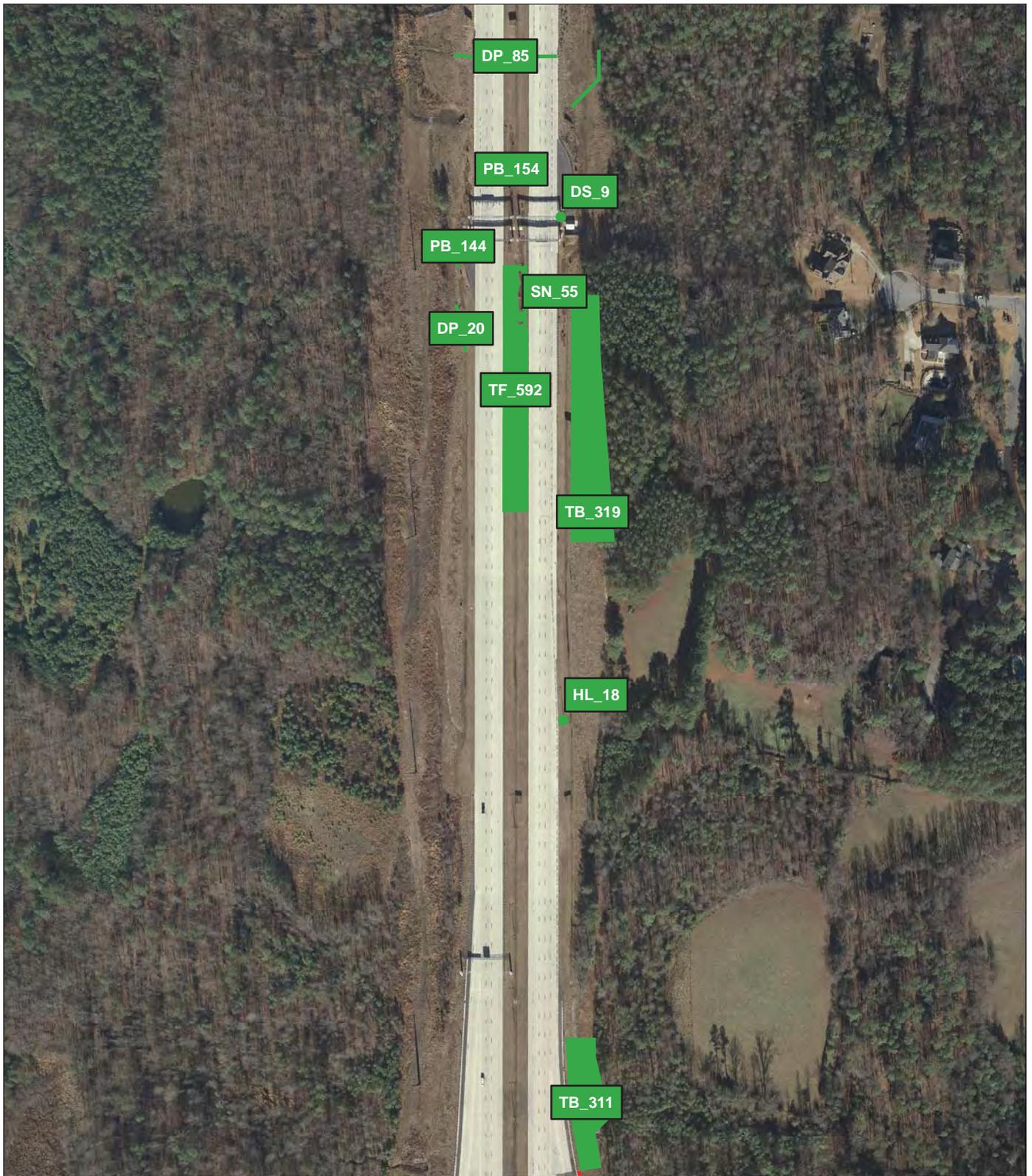


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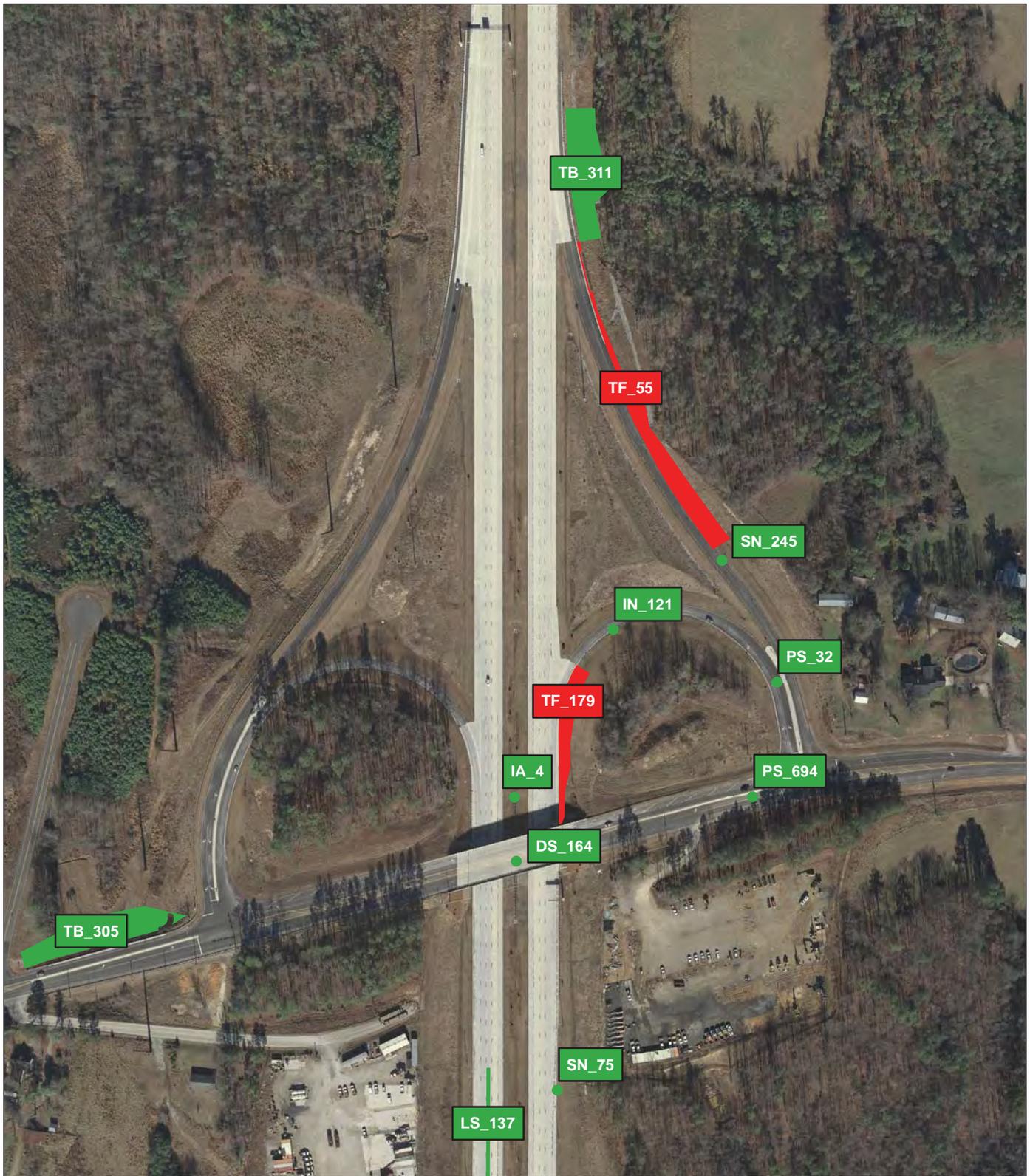


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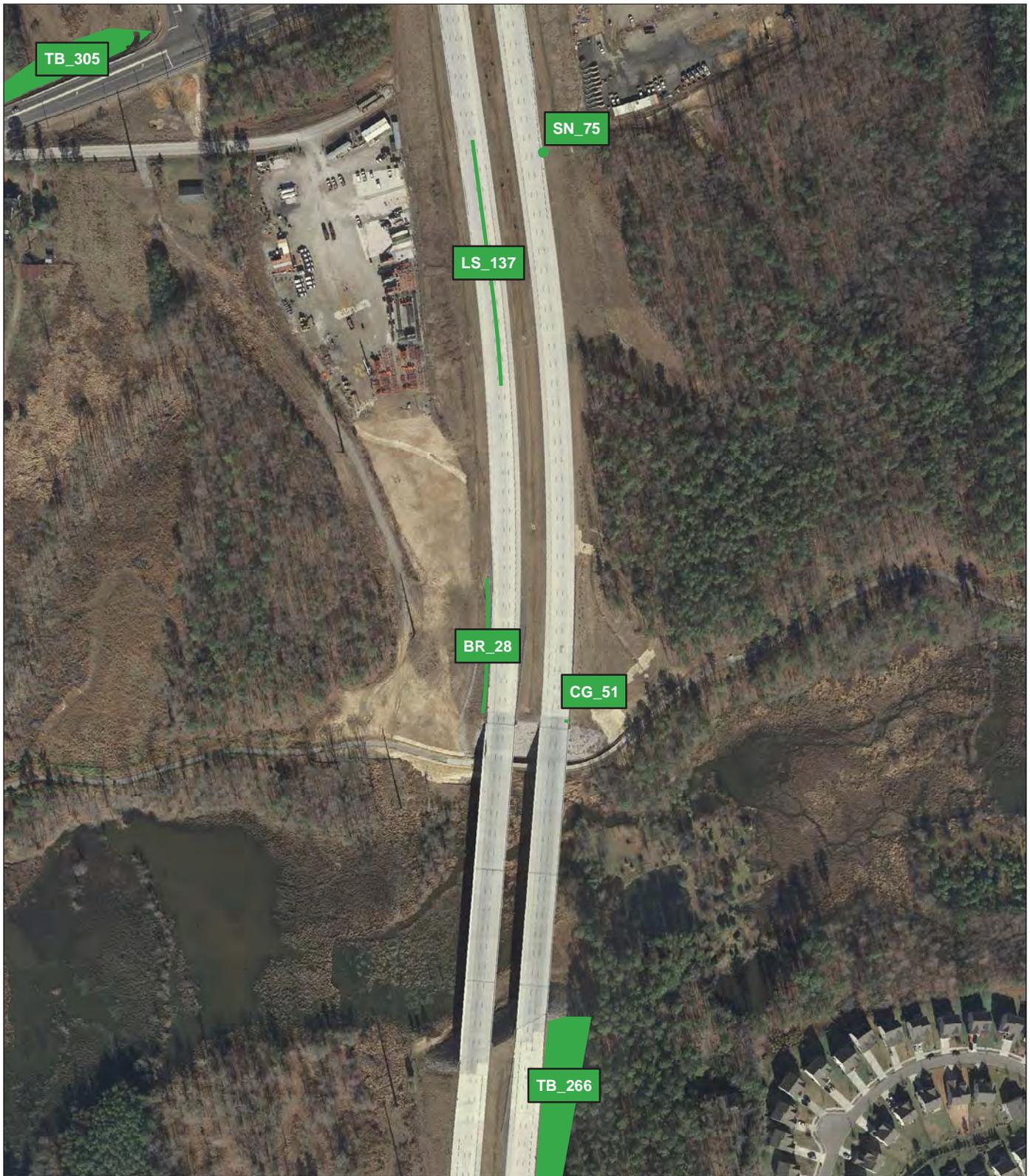


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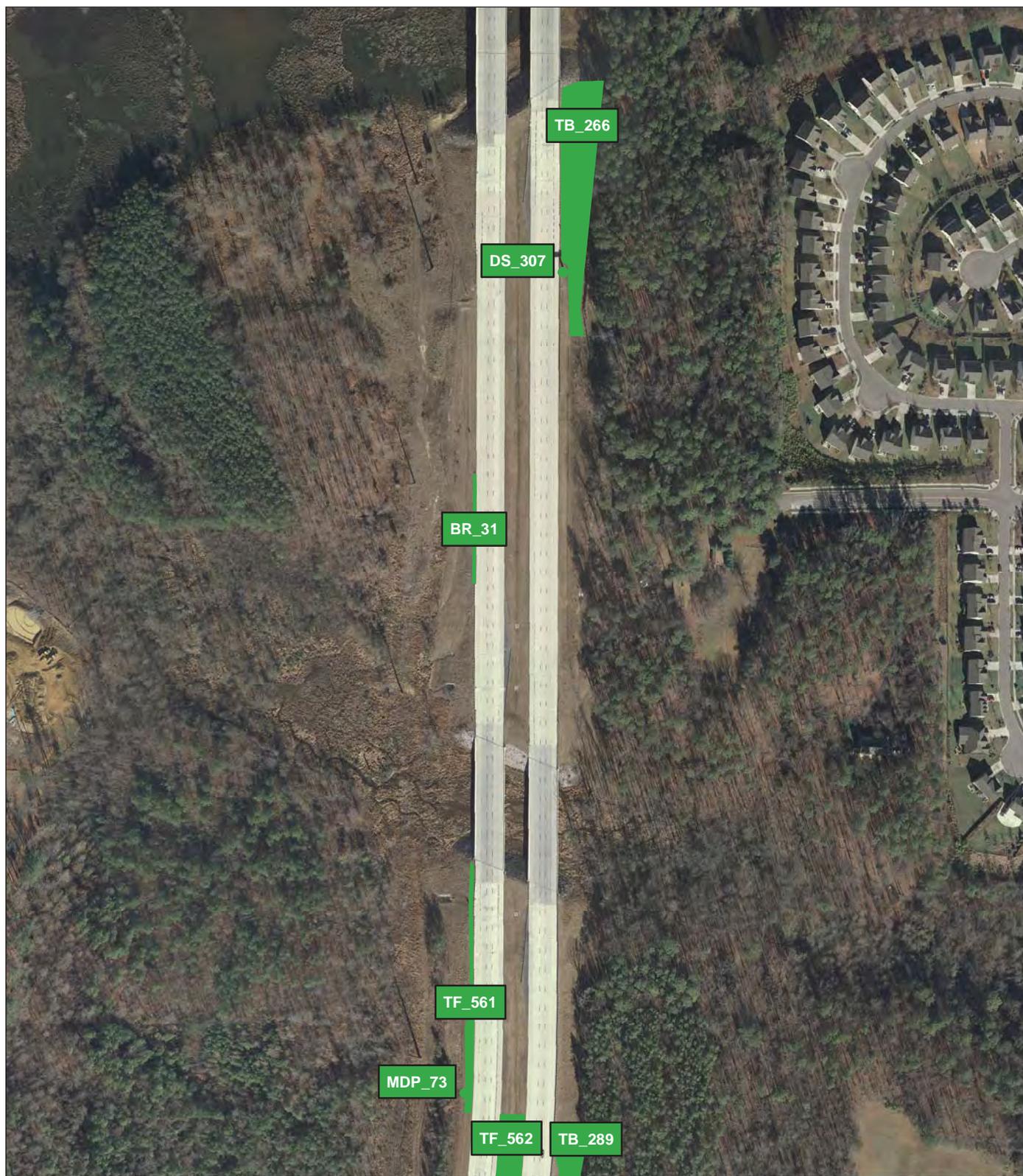


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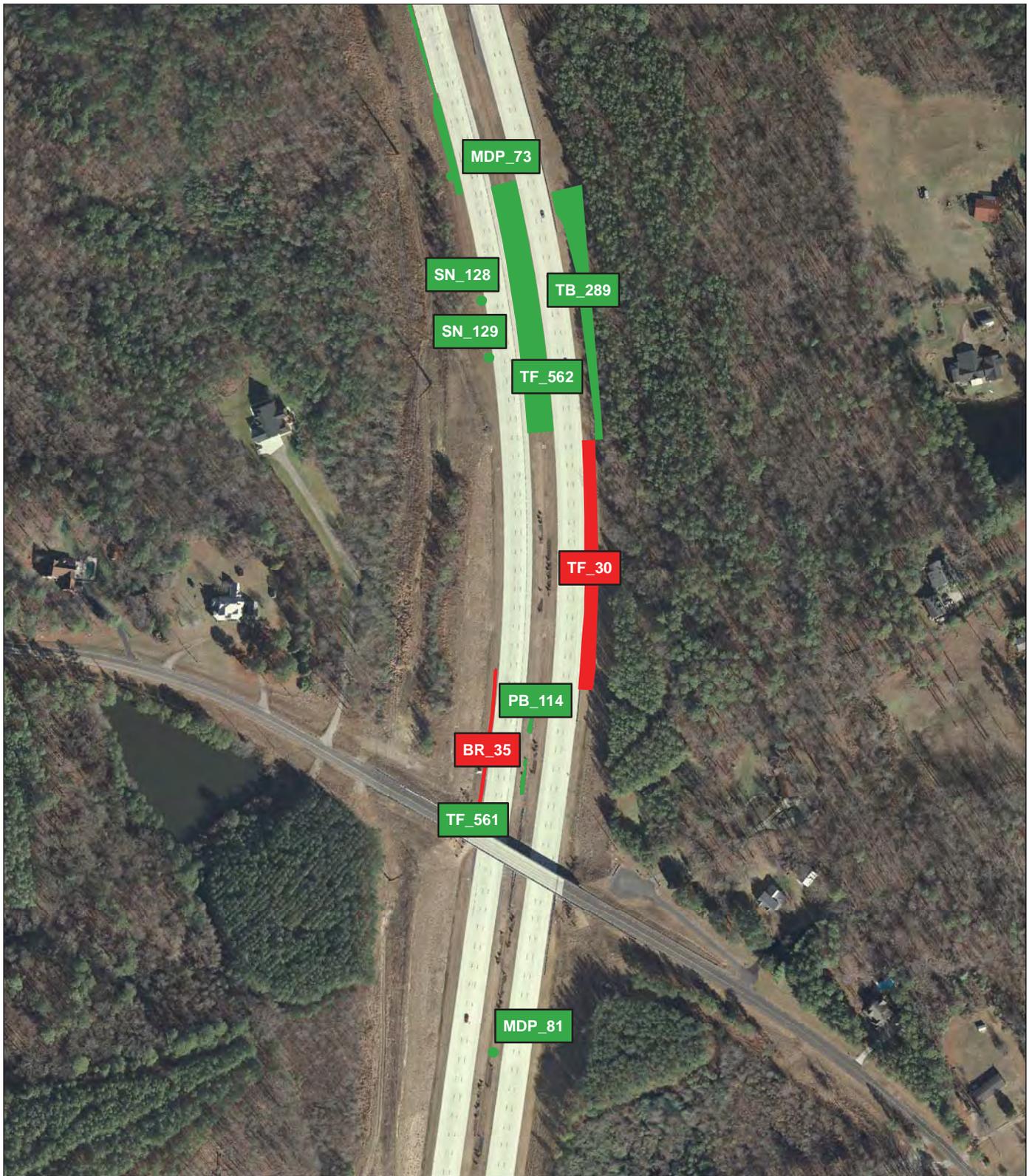


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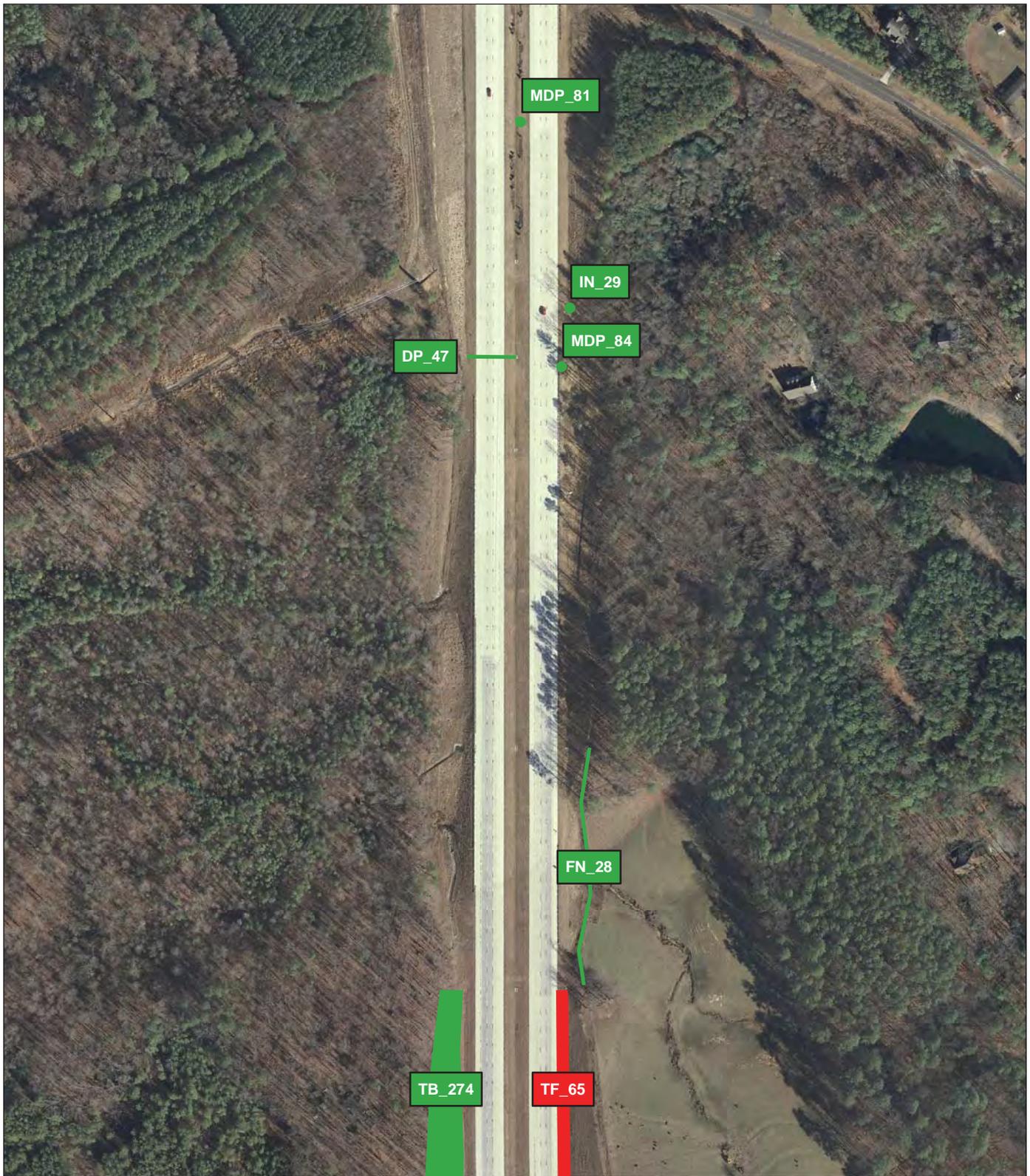


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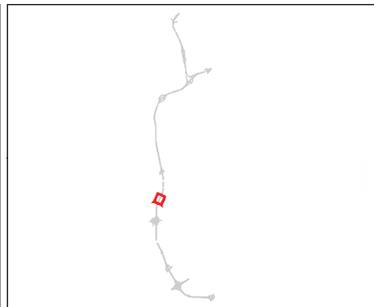


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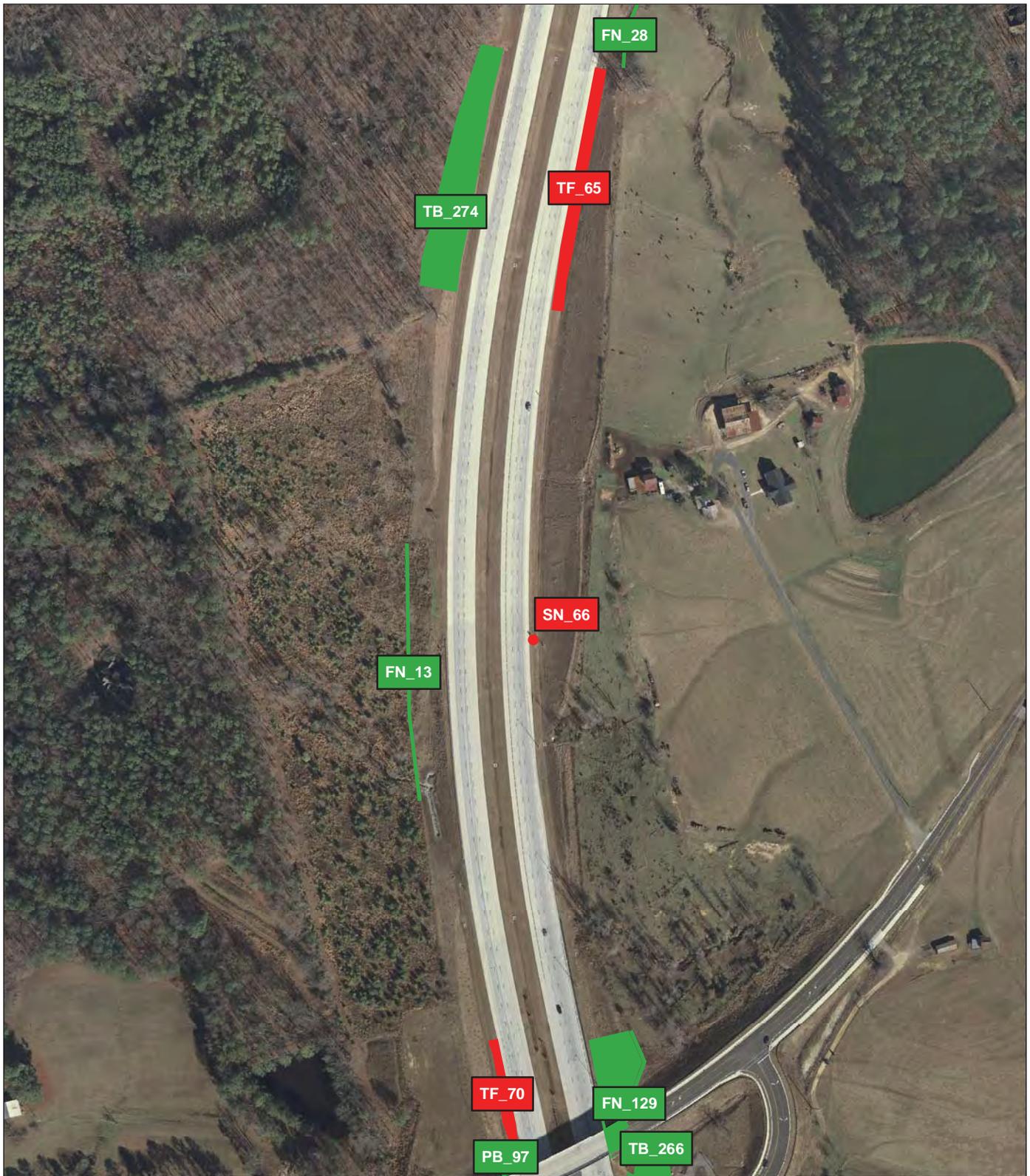


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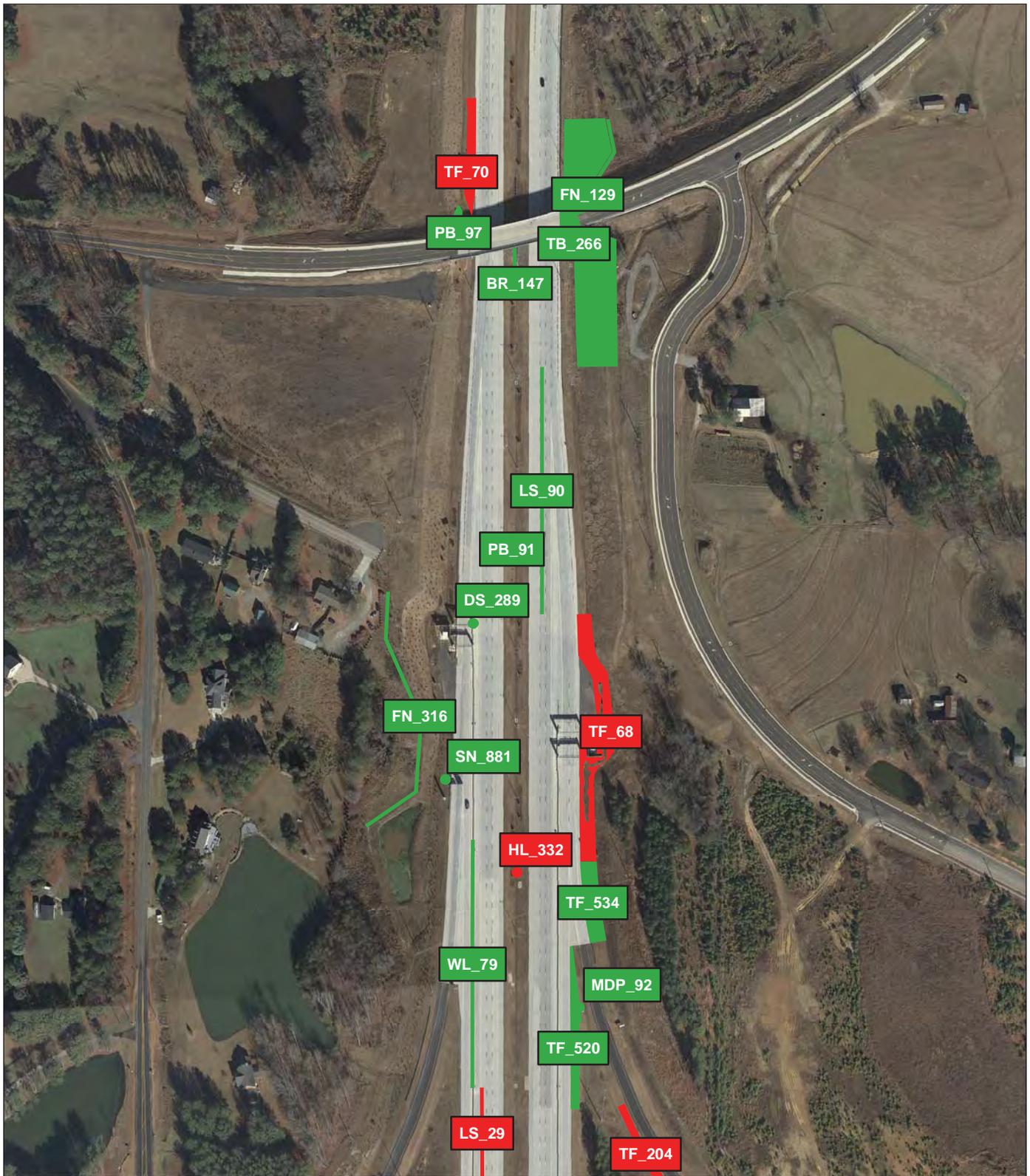


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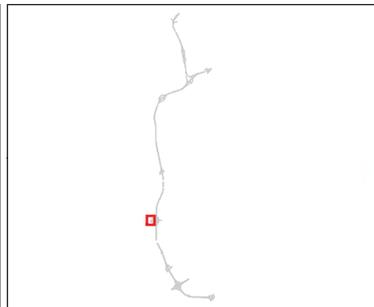


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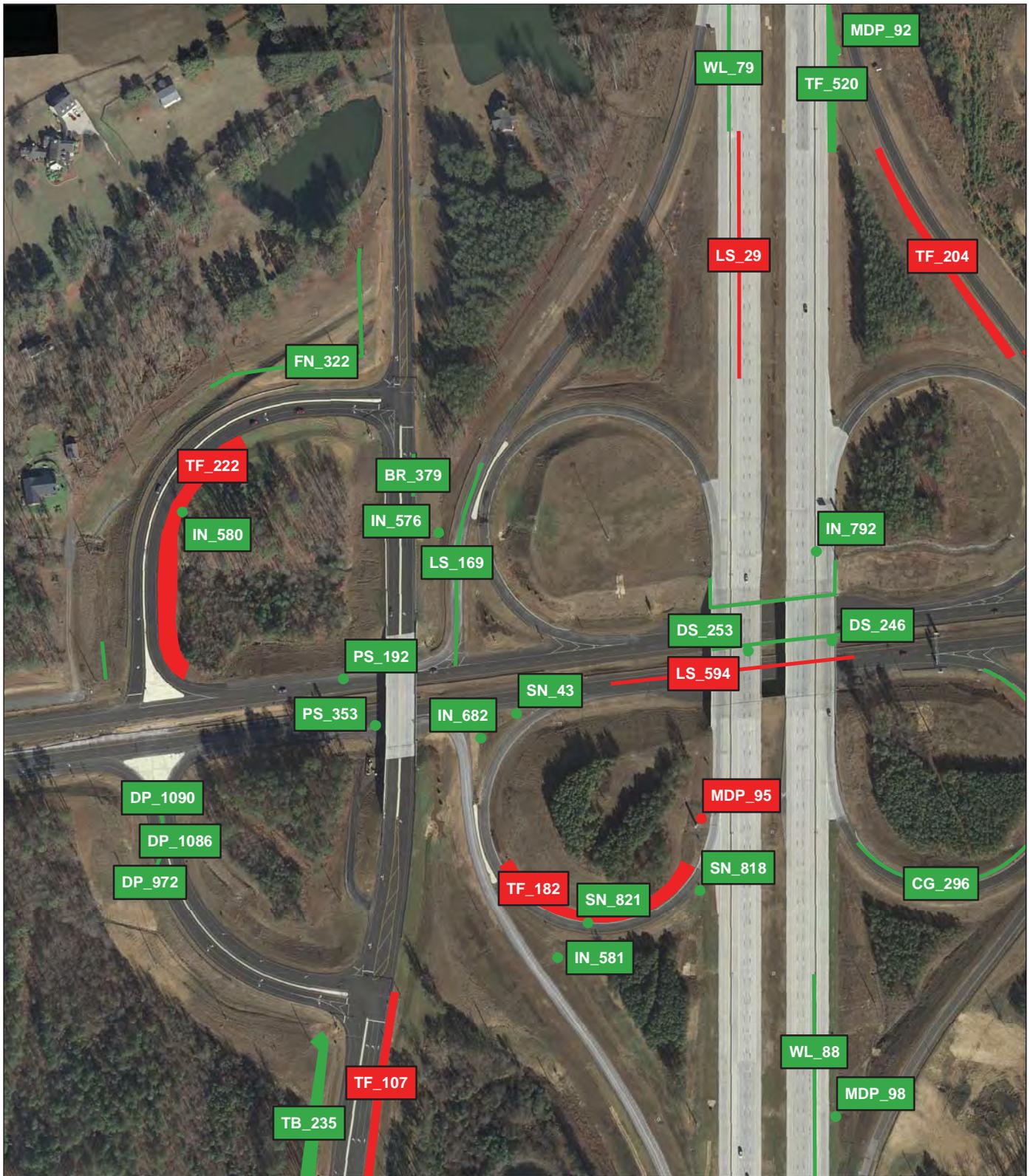


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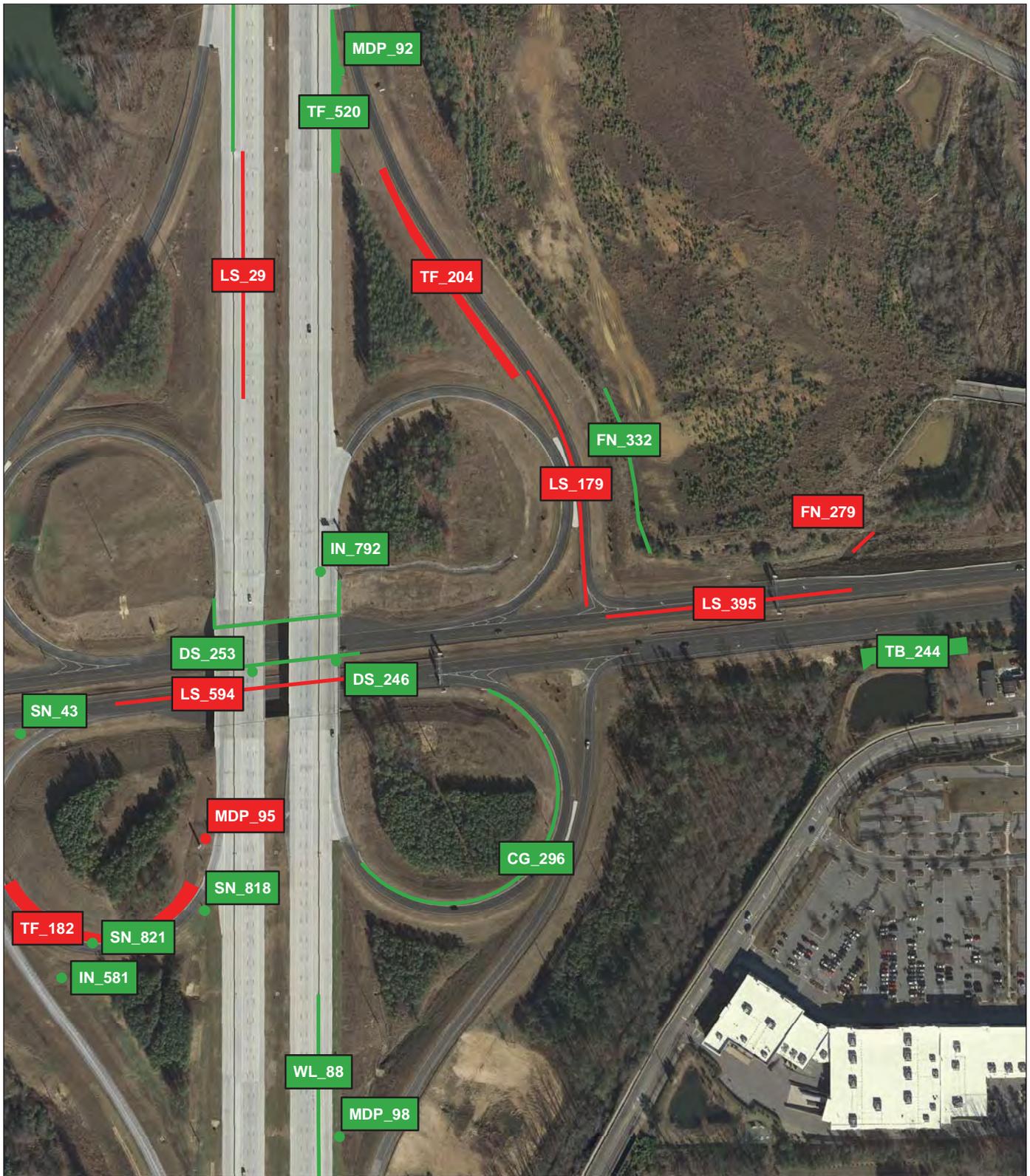


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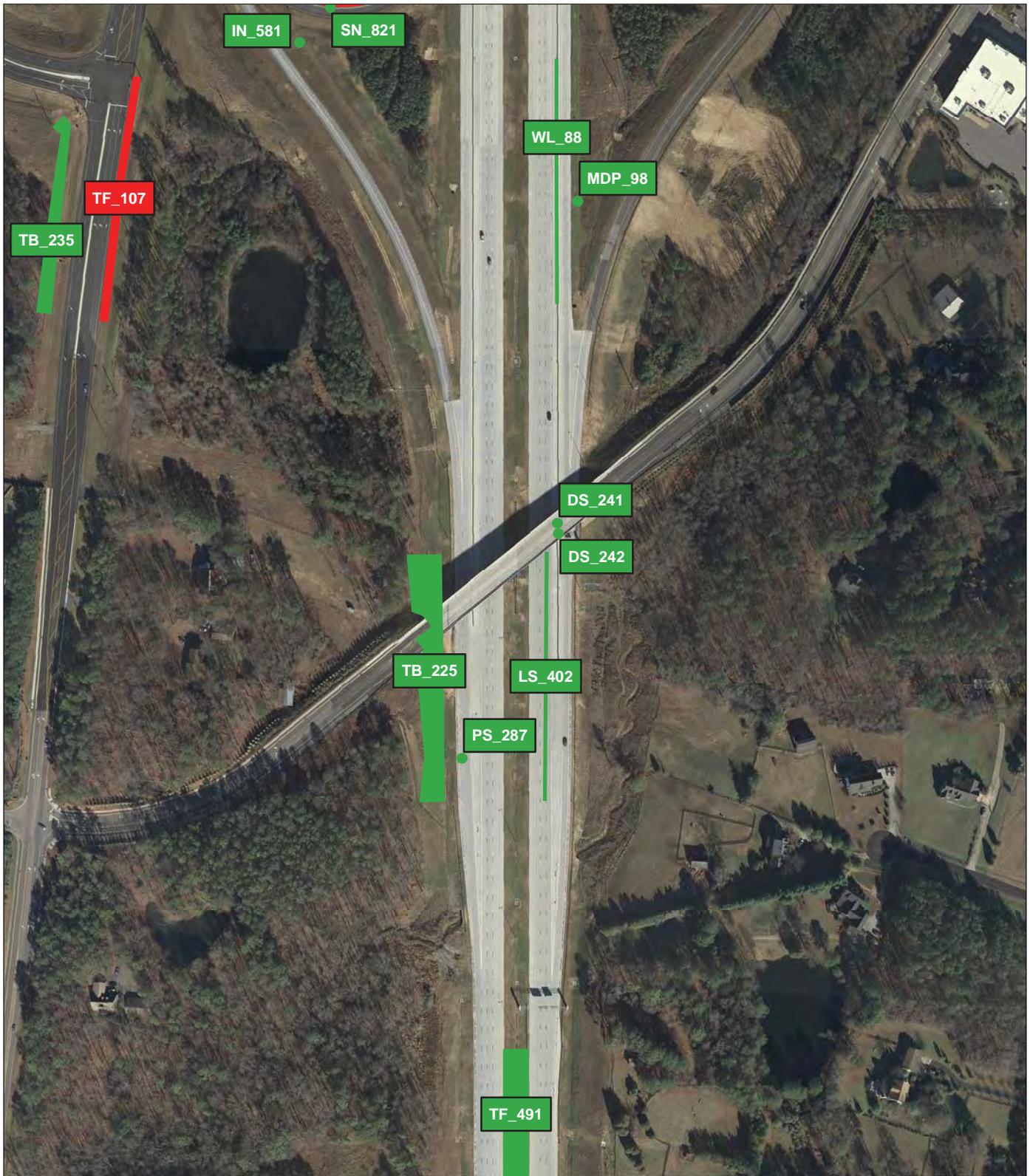


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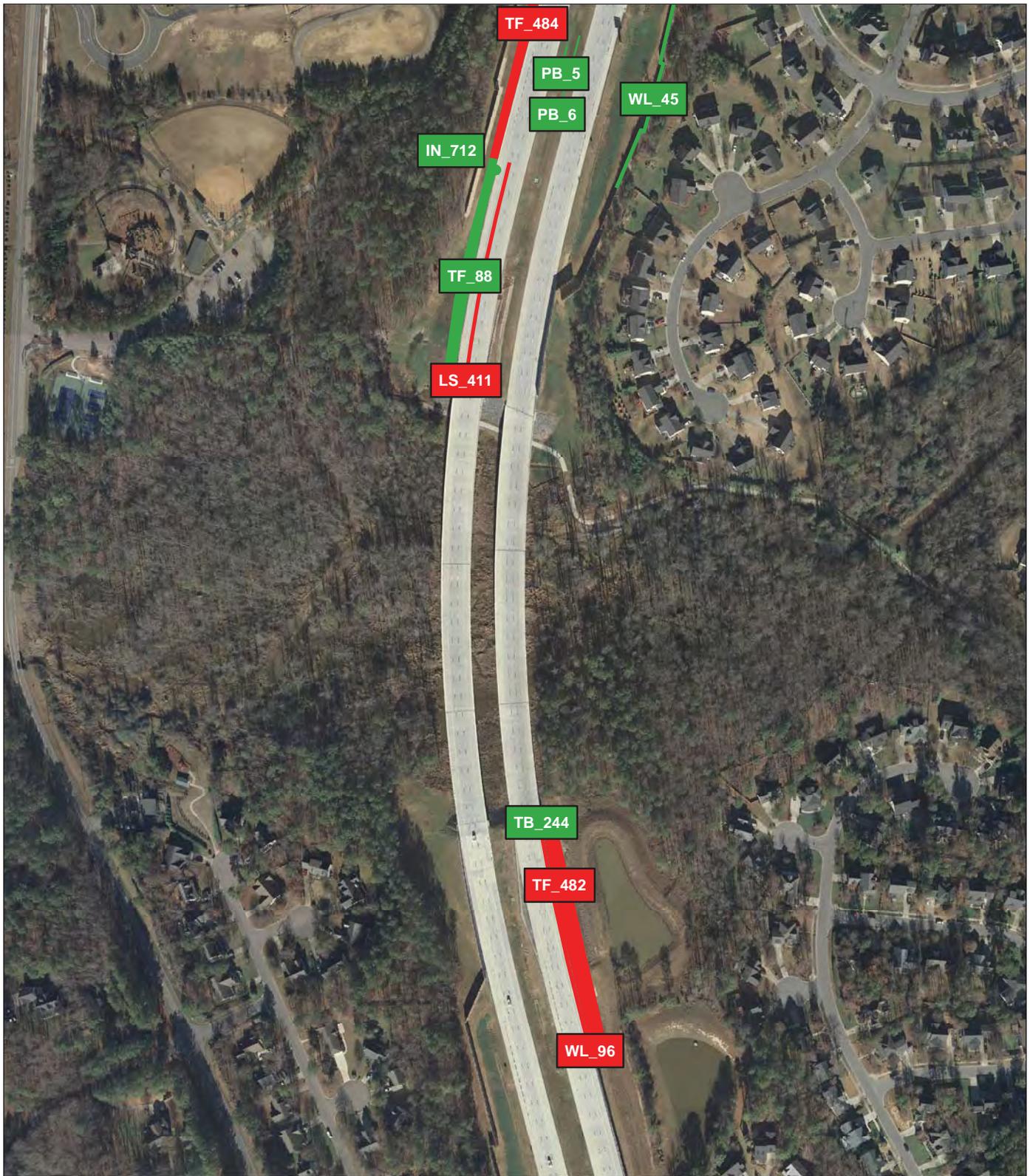


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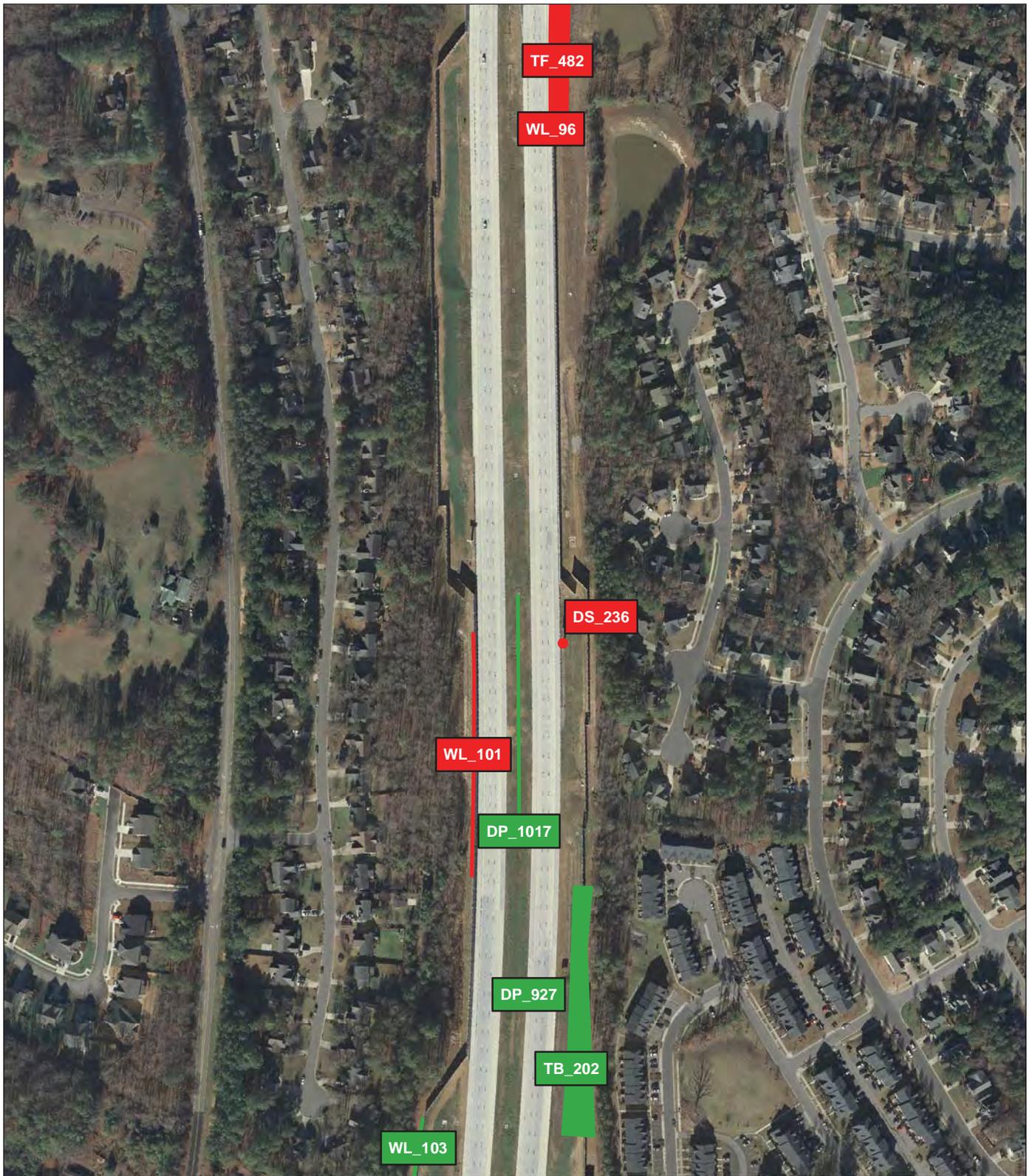


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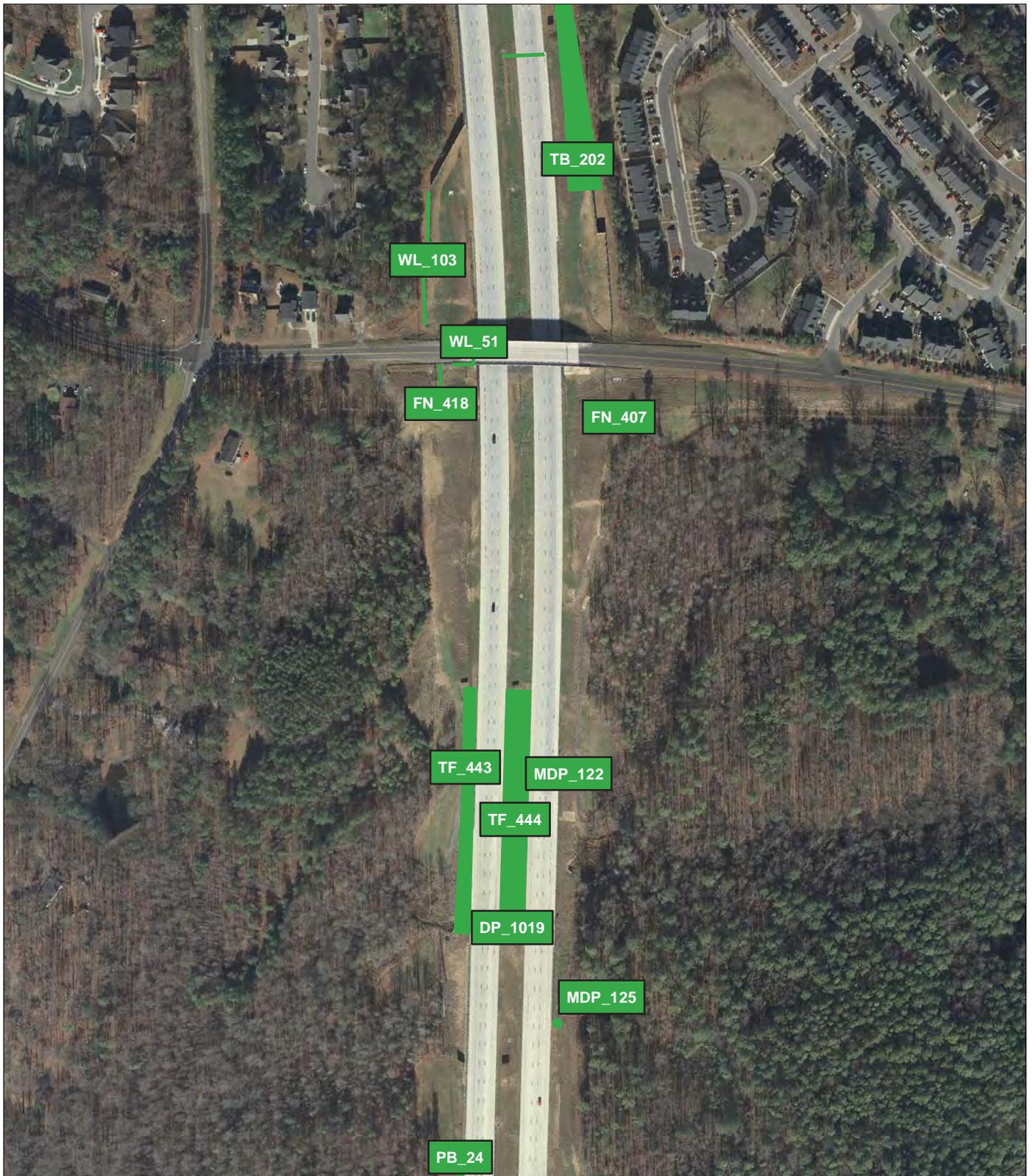


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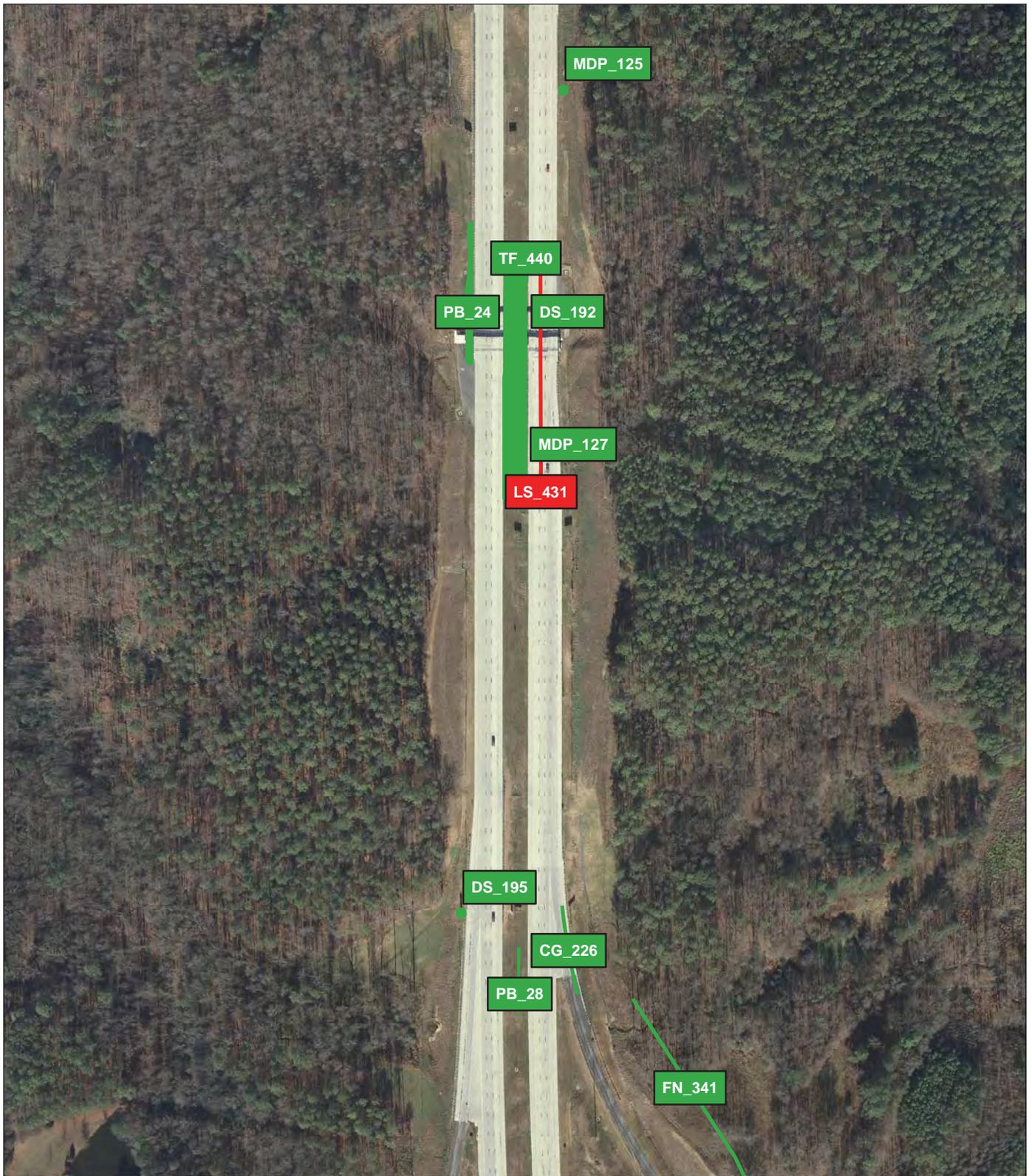


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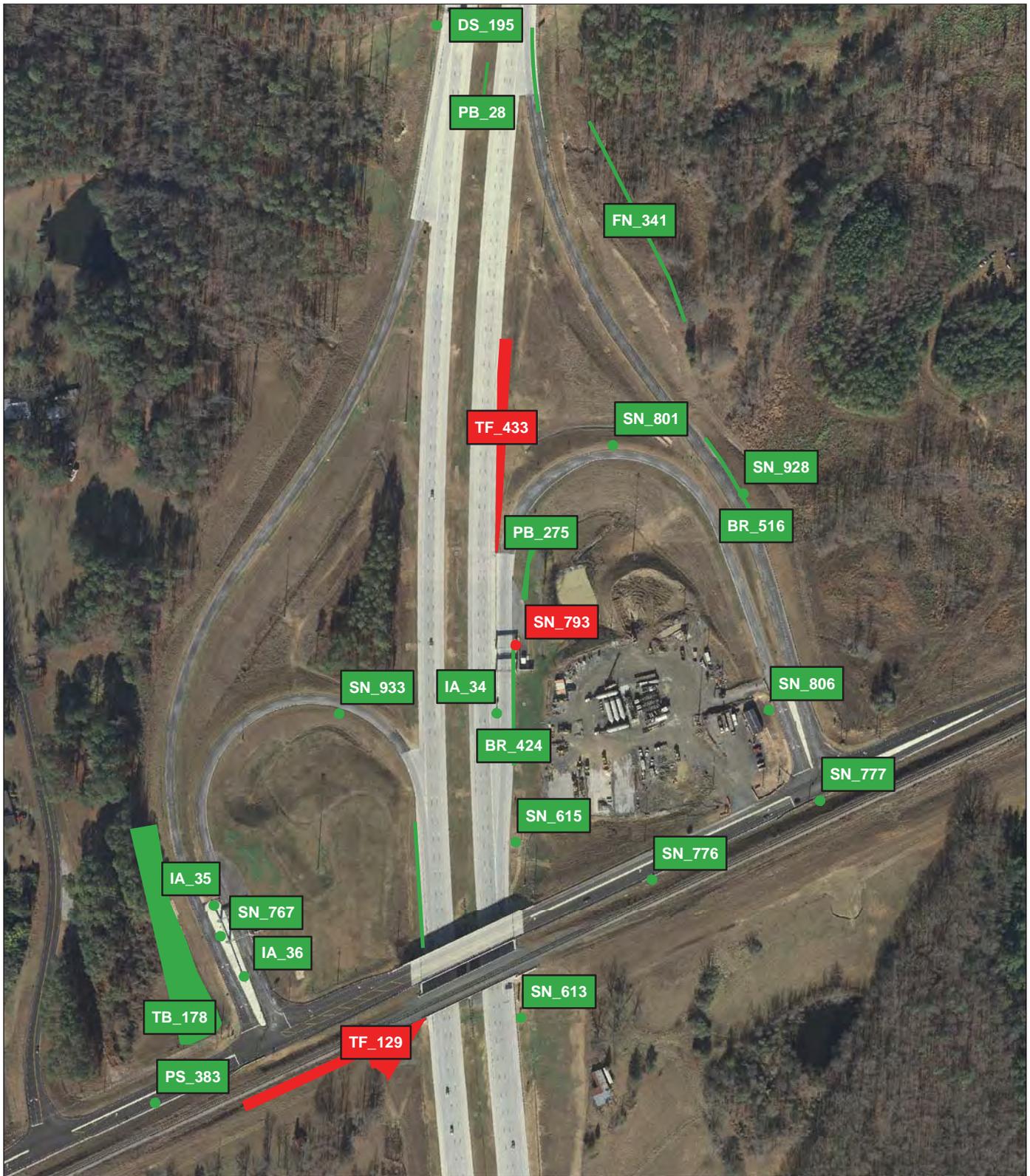


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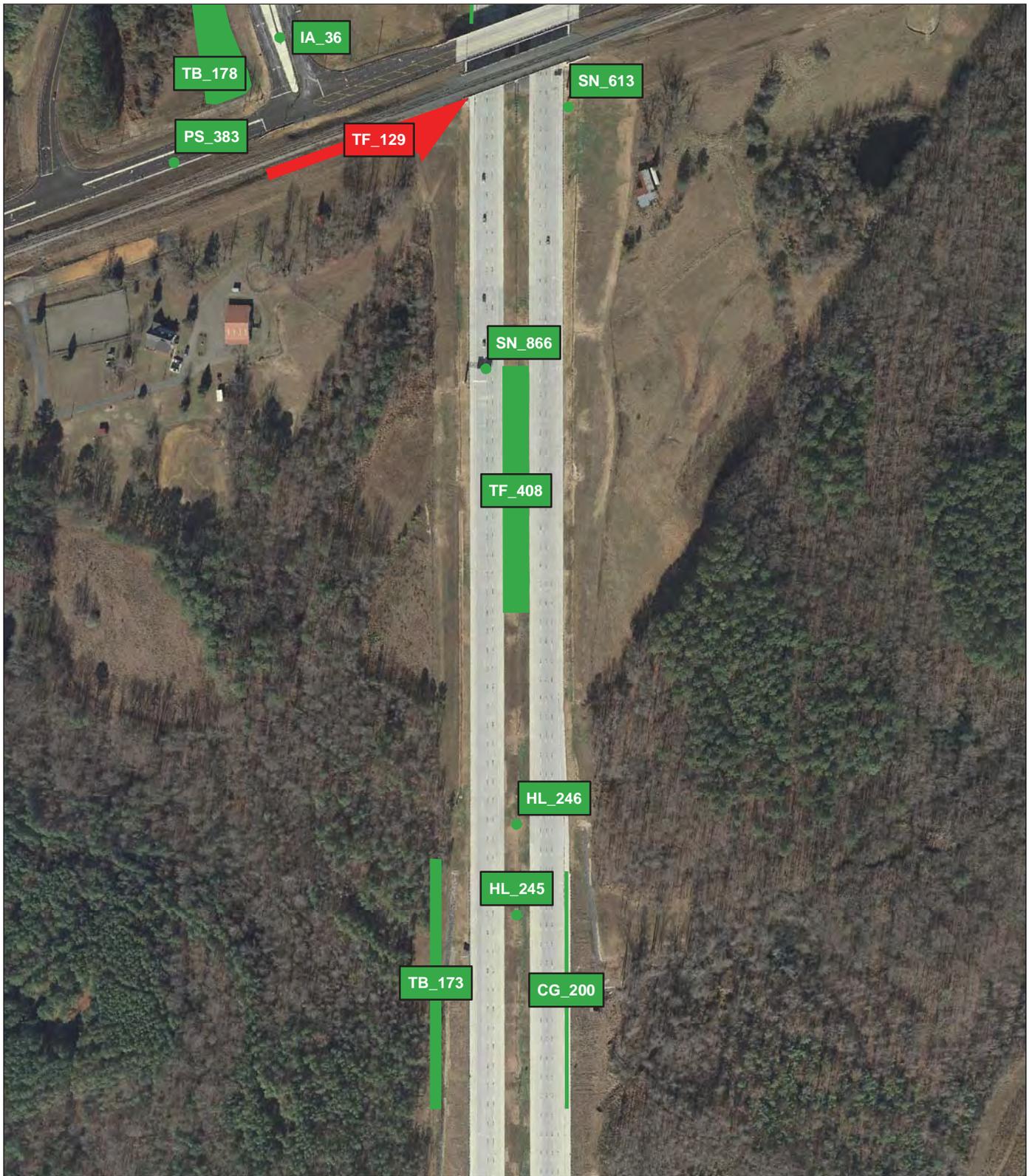


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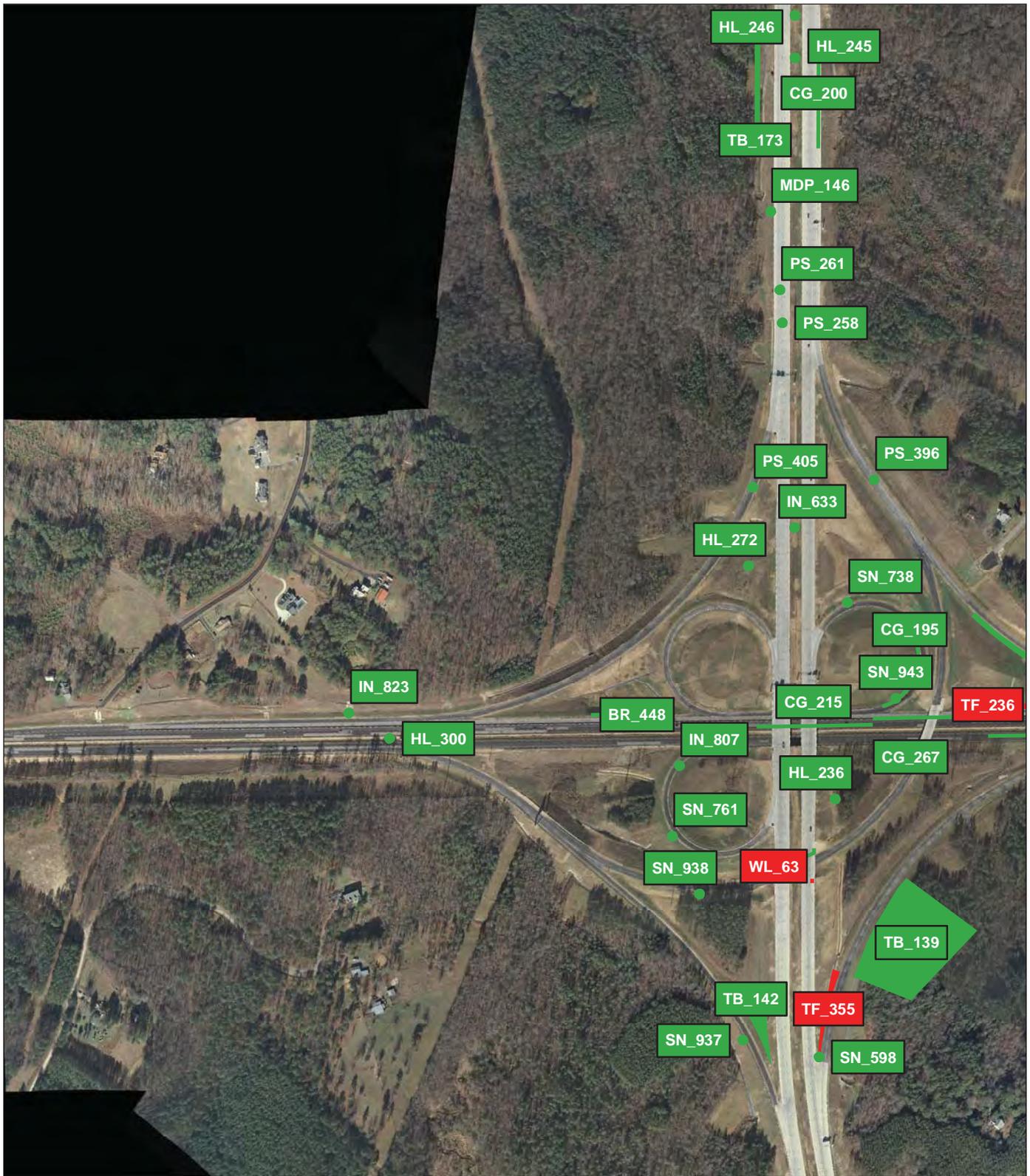


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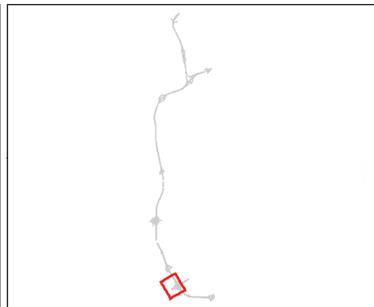


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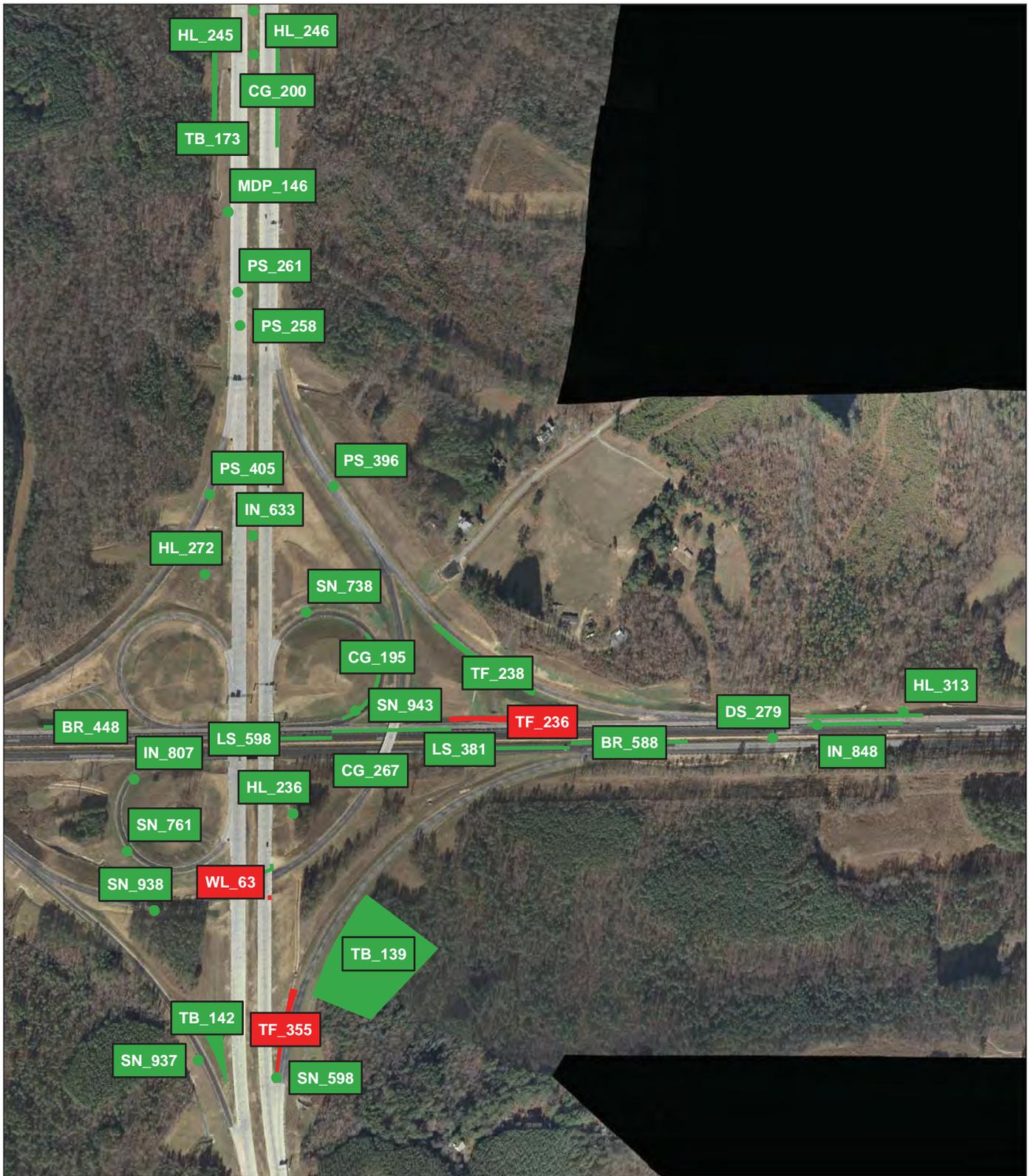


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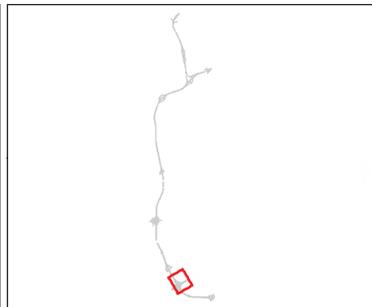


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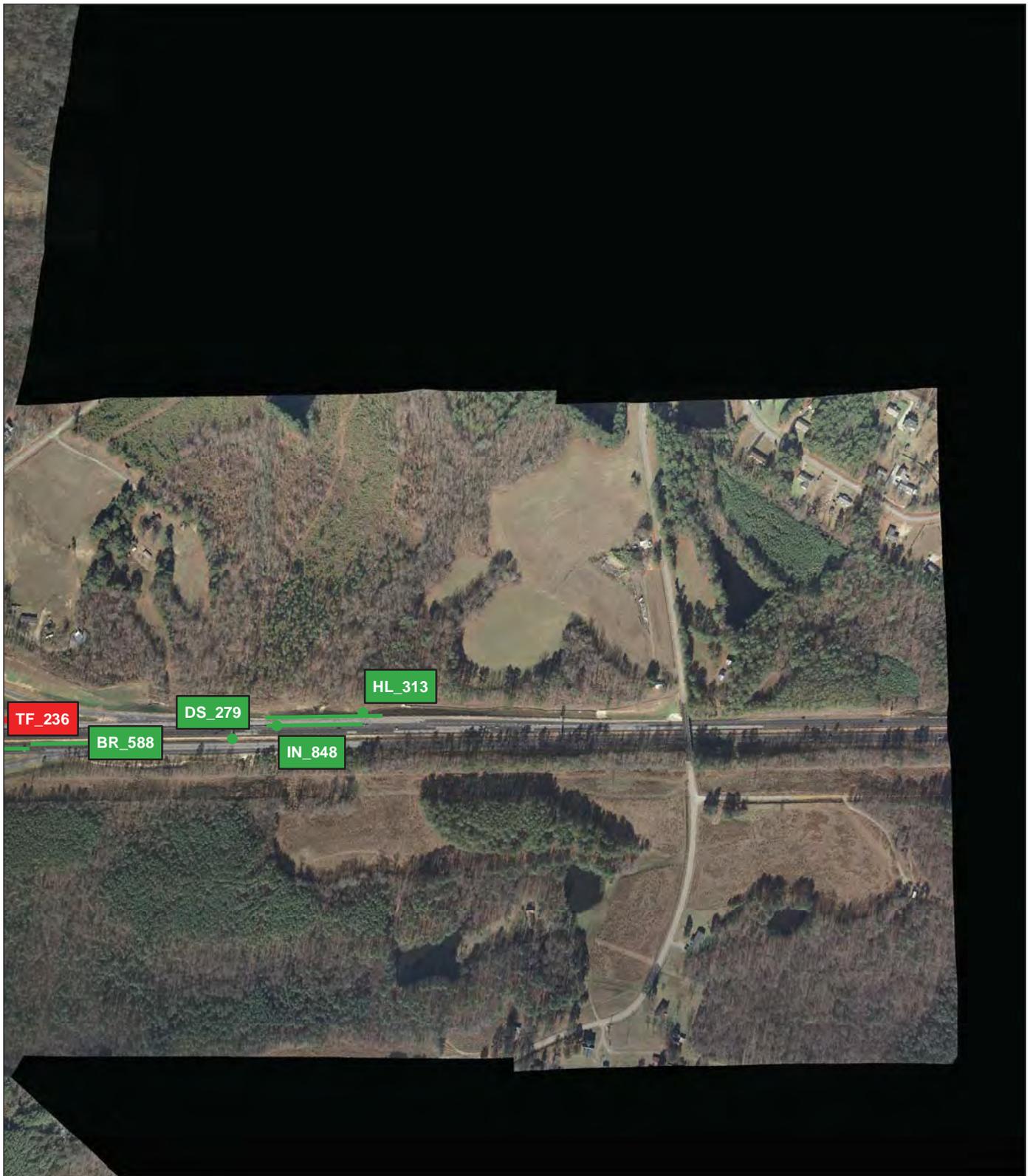


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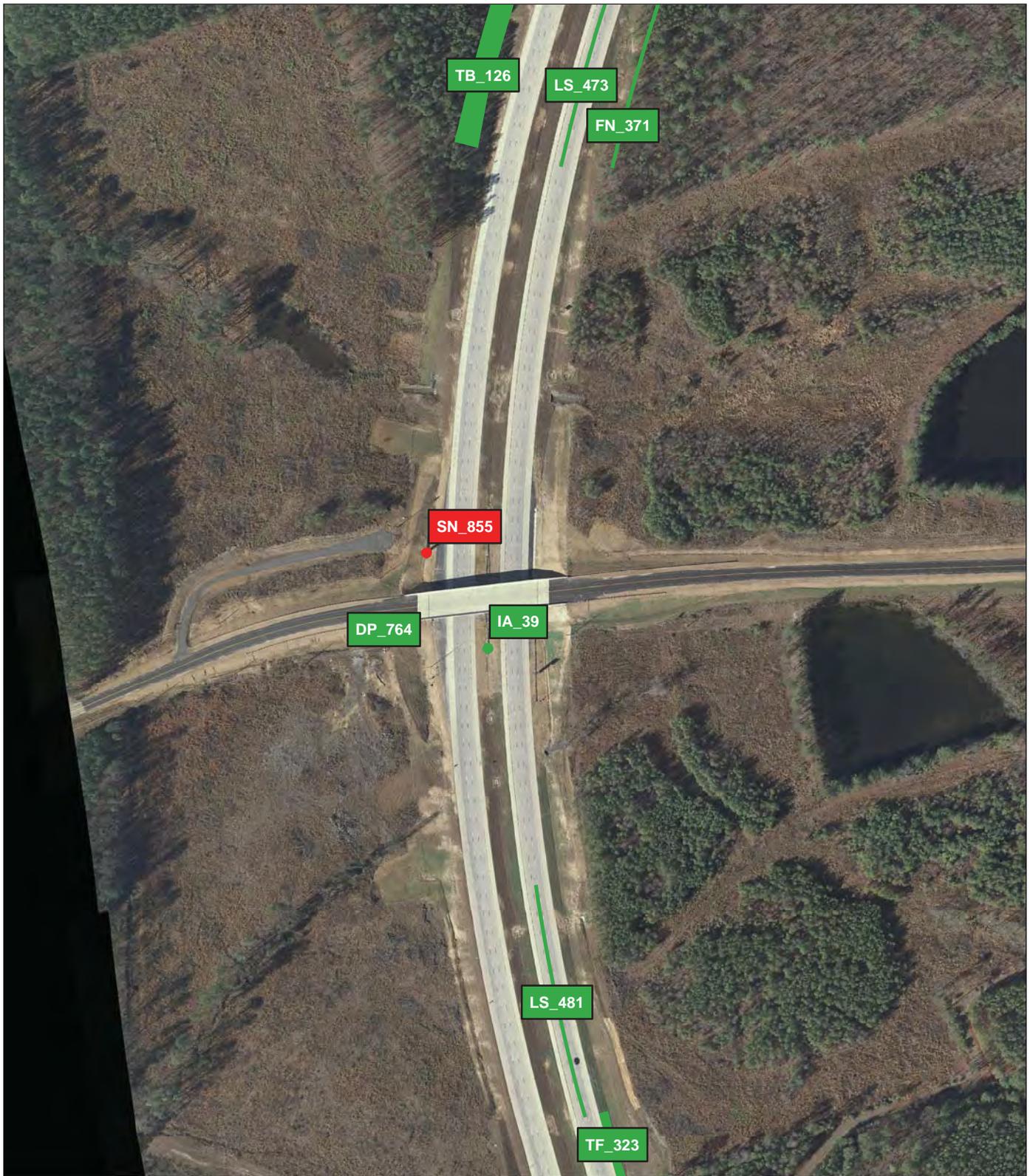


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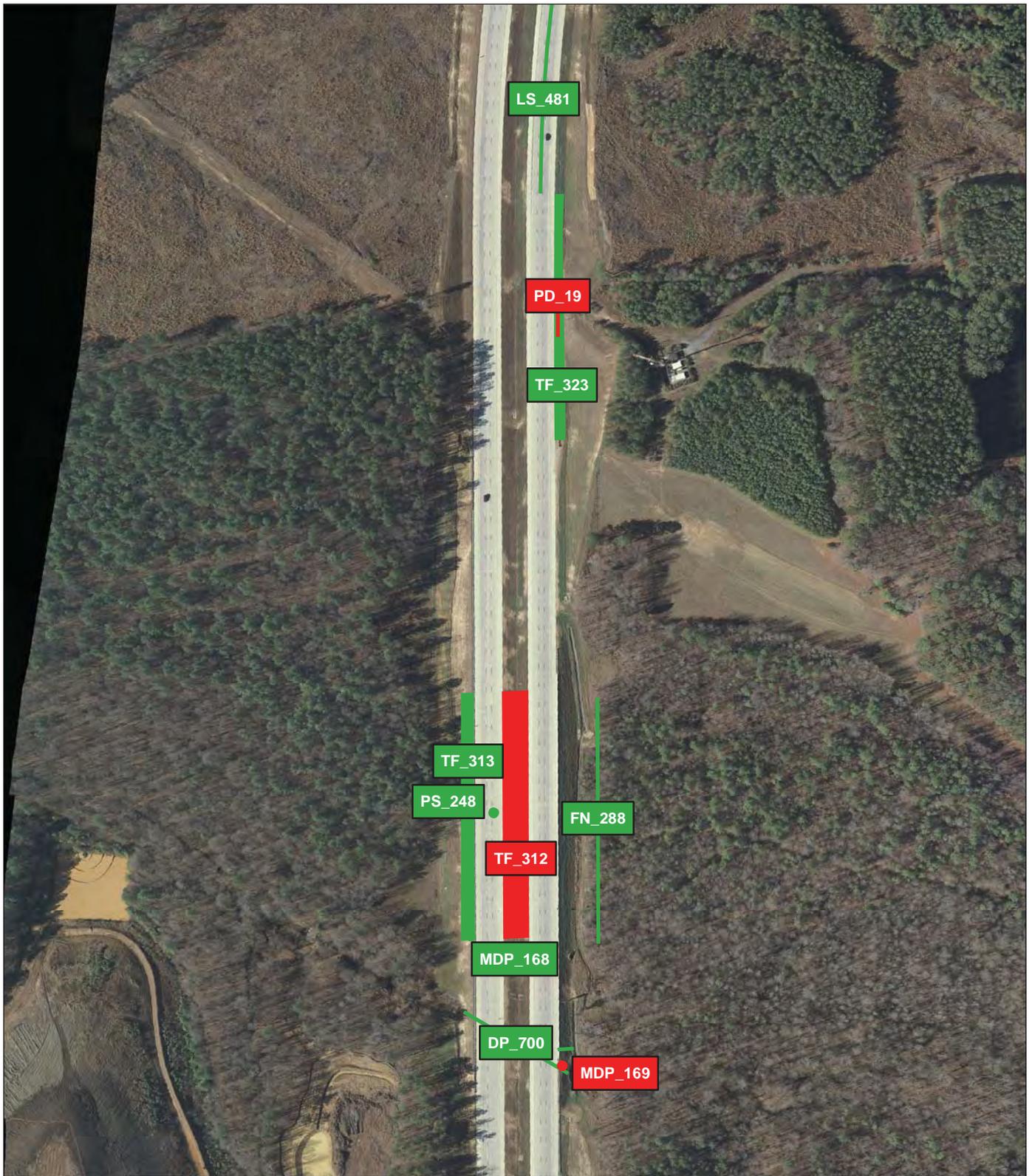


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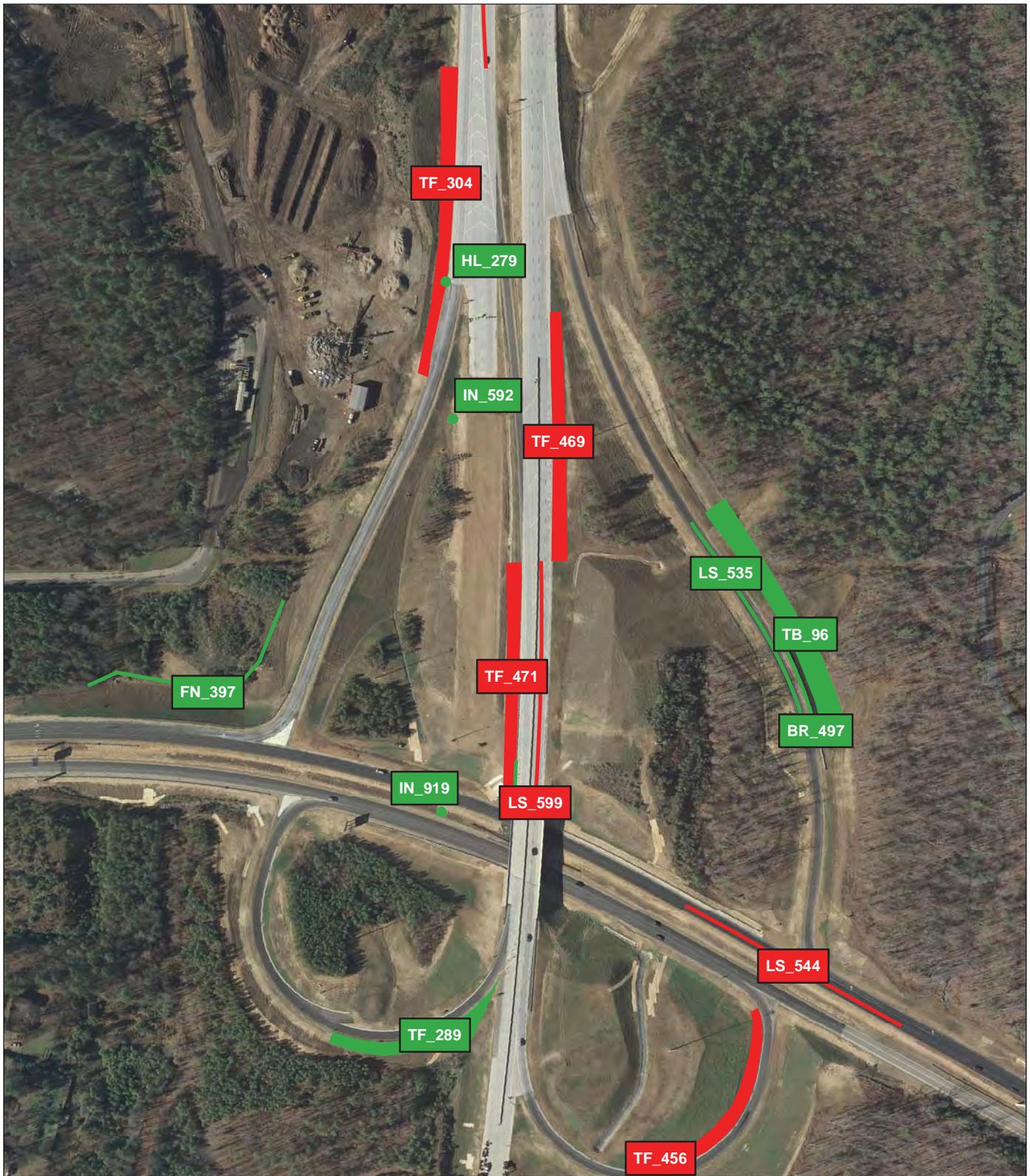


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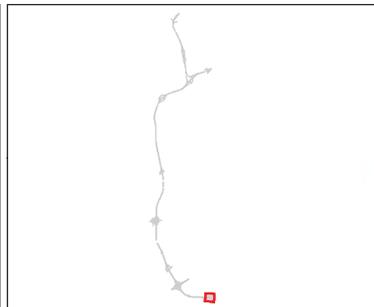


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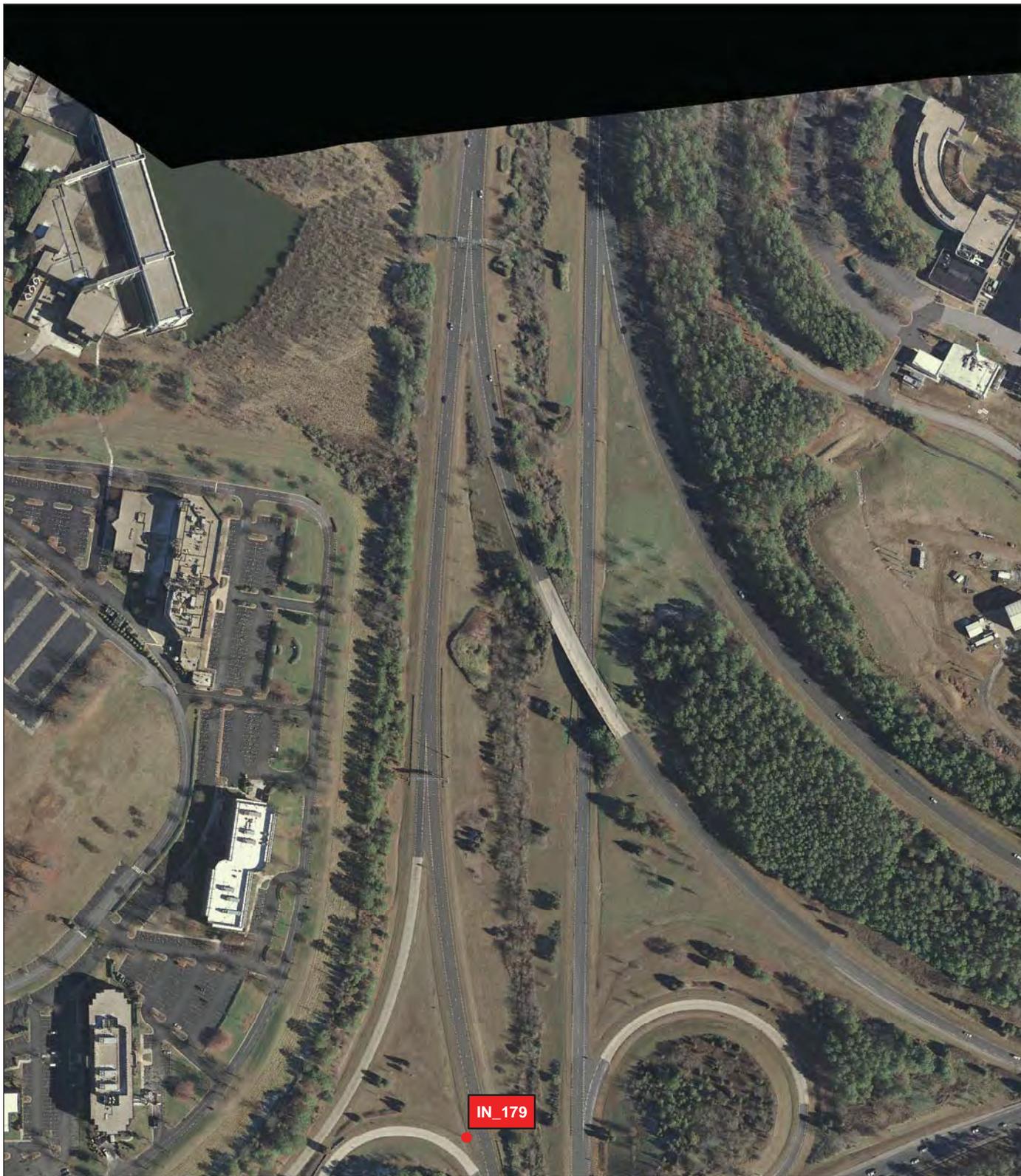


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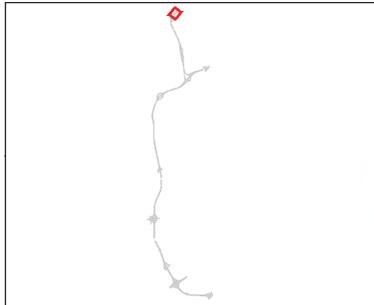


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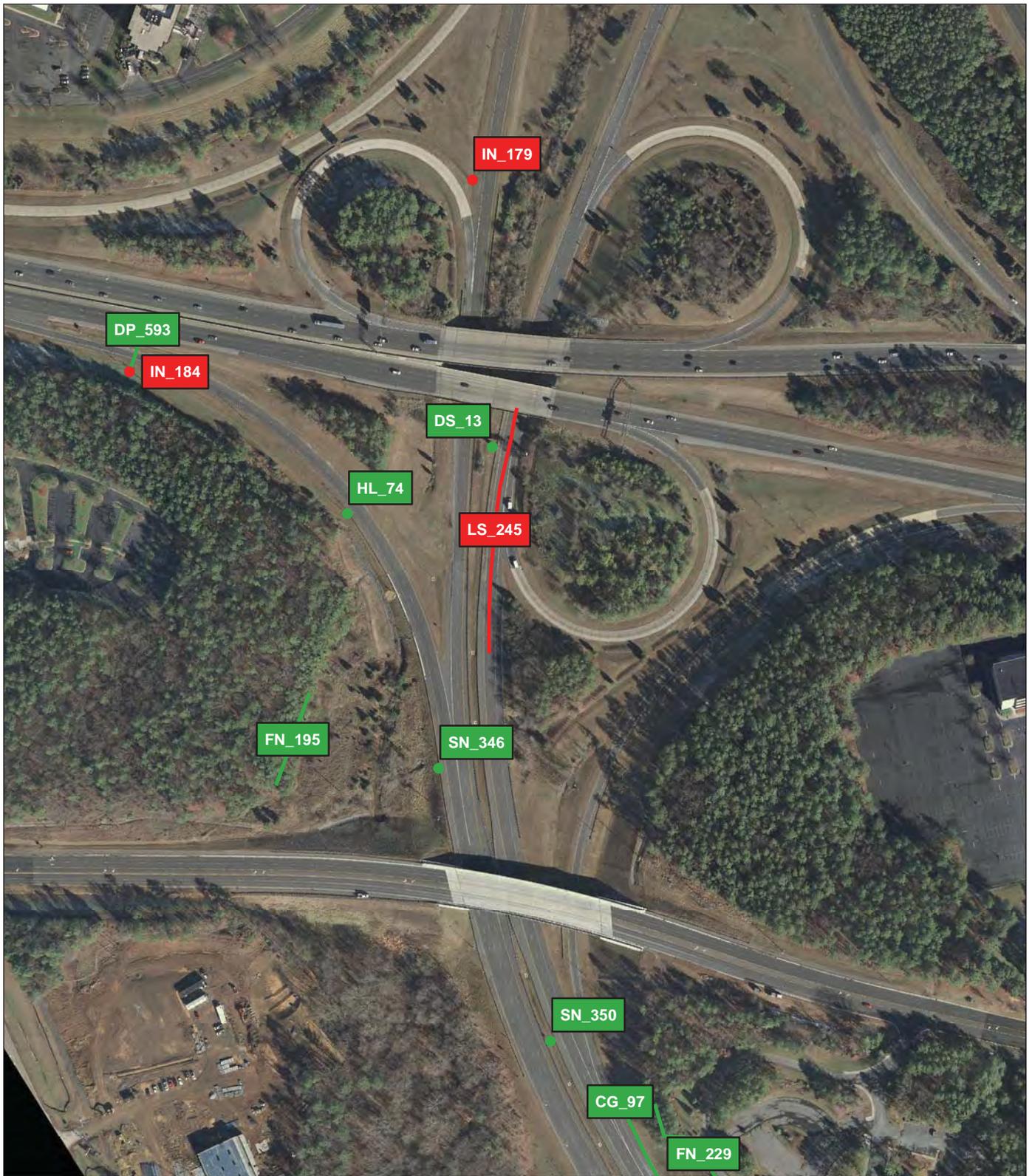


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-  Passing Asset
-  Failing Asset

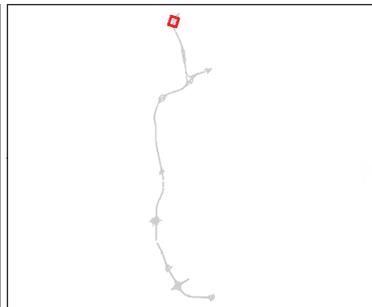


Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations

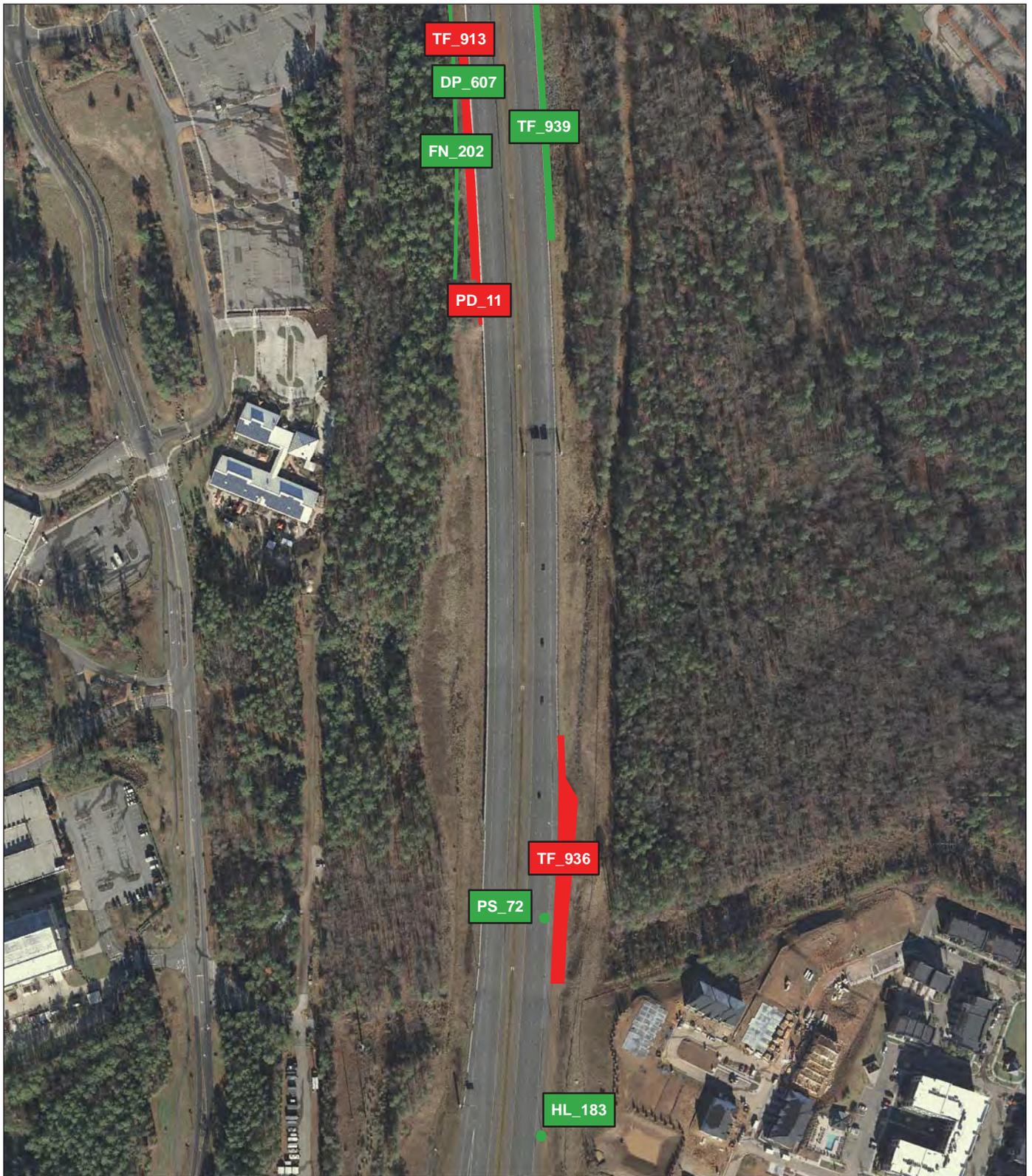


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations

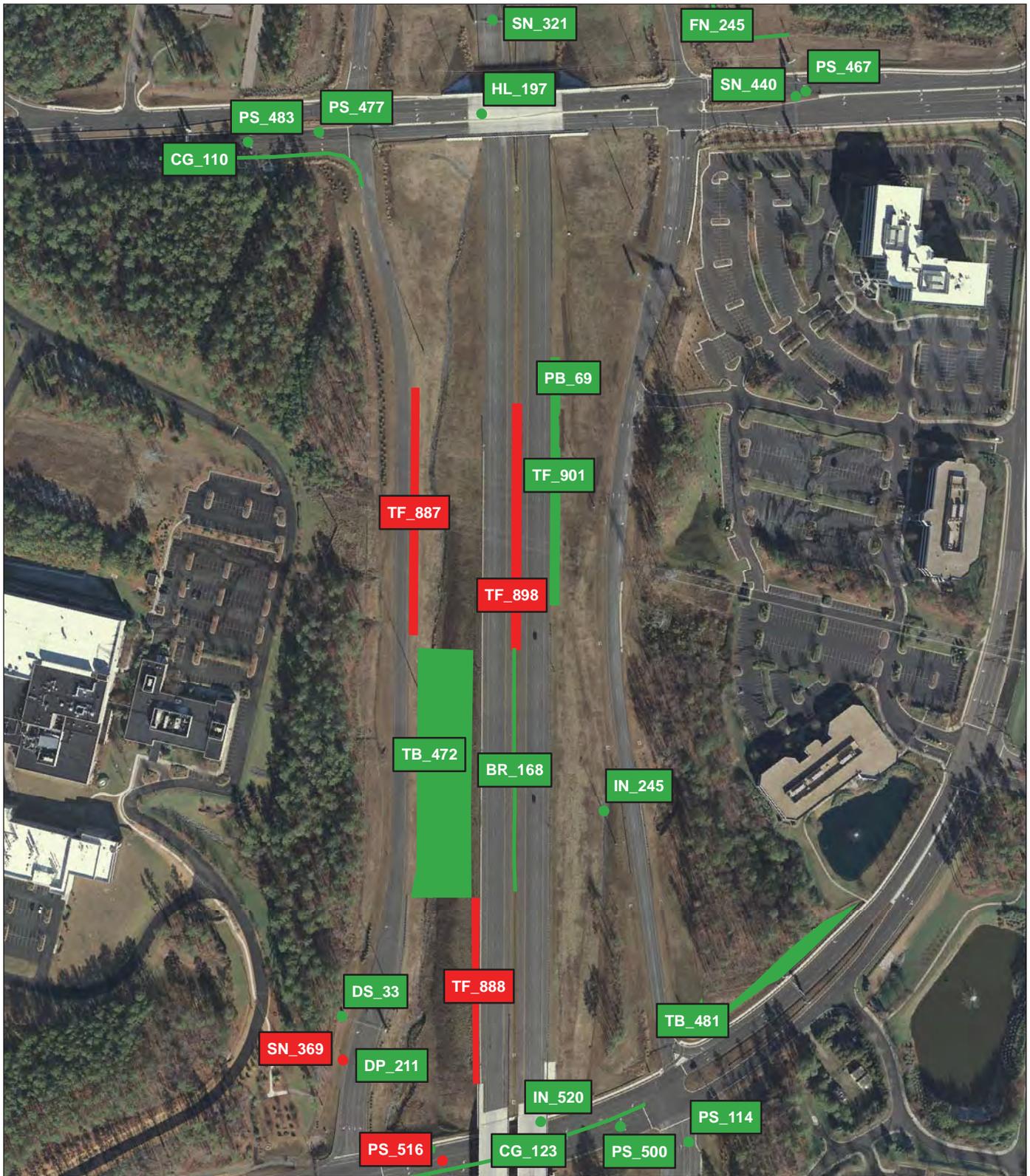


Legend

- Passing Asset
- Failing Asset

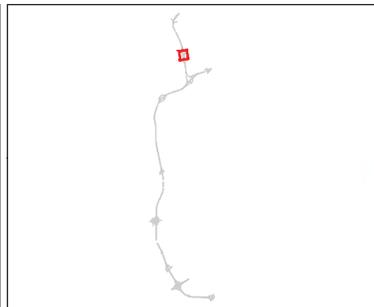


Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations

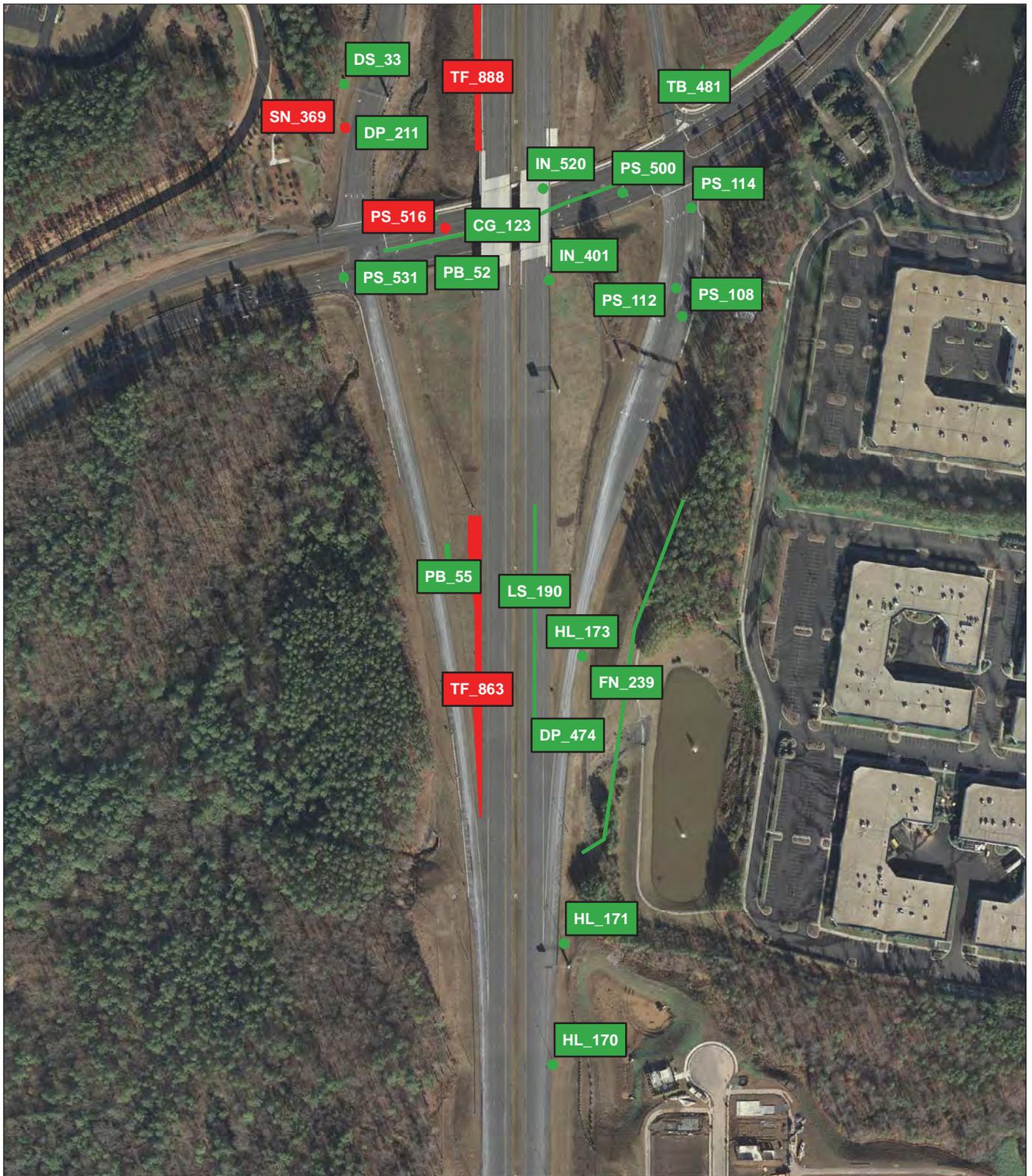


Legend

- Passing Asset
- Failing Asset

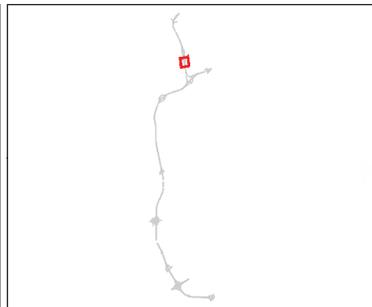


Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations

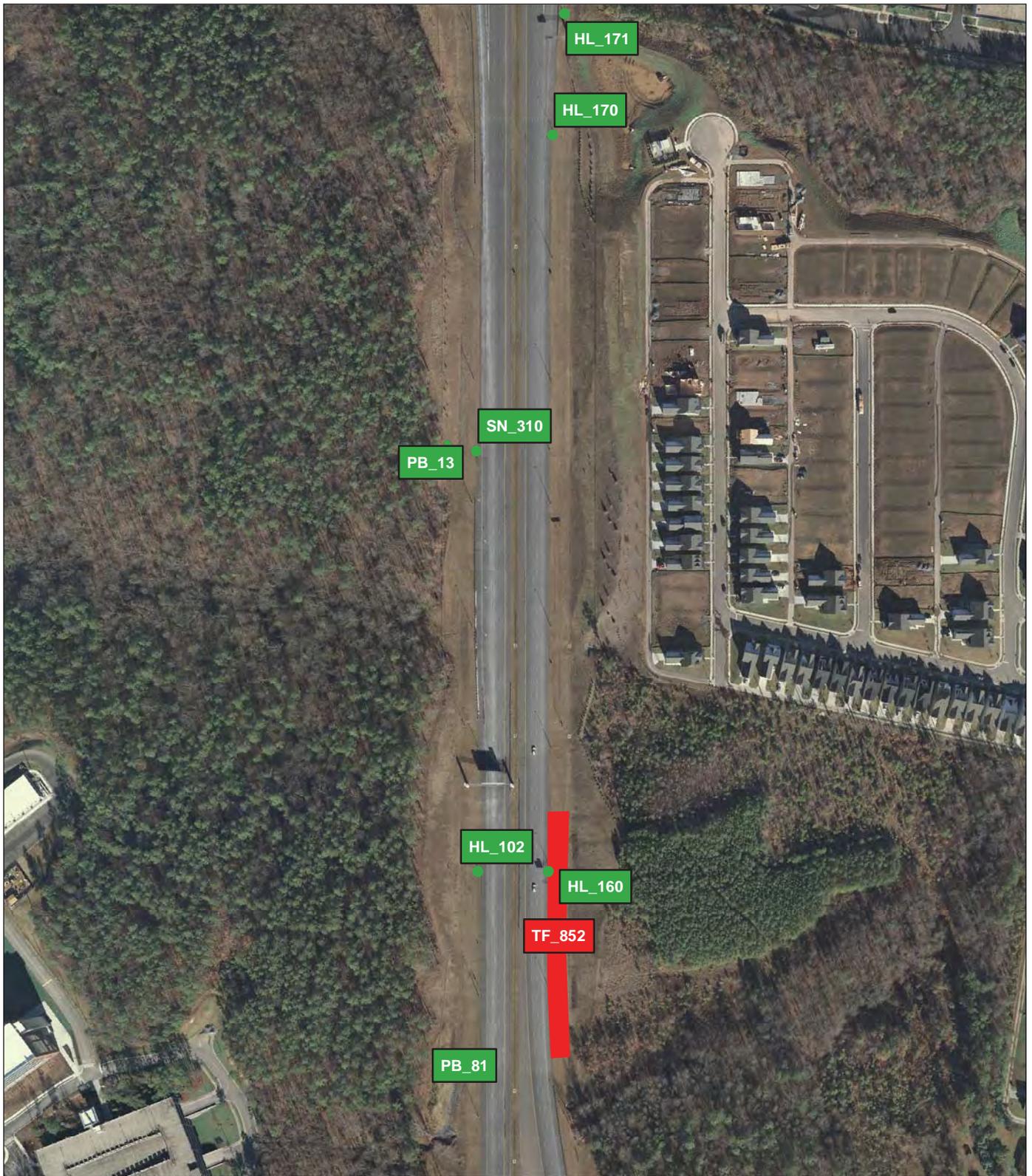


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2014 Second Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix B: Triangle Expressway 2014 Second Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2014 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).....	B3
Curb and Gutter (CG)	B4
Decorative Supports (DS).....	B5
Drainage Pipes (DP).....	B6
Miscellaneous Drainage Structures (MDP)	B7
Fence and Control of Access (FN)	B8
Graffiti (GR).....	B9
Highway Lighting (HL)	B10
Impact Attenuators (IA)	B11
Inlets (IN).....	B12
Landscaping (LD)	B13
Paved Lanes – Asphalt (LS).....	B14
Paved Lanes – Concrete (LS)	B15
Paved Shoulders (LS).....	B16
Unpaved Shoulders (LS)	B17
Front/Back Slopes (LS)	B19
Unpaved Lateral and Outfall Ditches (LS)	B20
Litter (LS)	B21
Roadway Sweeping (LS)	B22
Pavement Striping (LS).....	B23
Pavement Markers (LS).....	B24
Paved Ditches (PD).....	B27
Pavement Words and Symbols (PS).....	B28
Signs (SN)	B29
Tree and Brush (TB).....	B31
Turf Condition (TF).....	B32
MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL).....	B40

The Inventory ID and GIS Reference Page number correspond to the provided map packets and allow for quick location of particular asset failures. Photos of failures were provided when applicable.

Guardrail, Concrete Barrier and End Anchors (BR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Guardrail	BR_35	Missing Parts		A23
2	Guardrail	BR_245	Functional Damage		A3

Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Valley	CG_163	Misalignment		A2, A3
2	Valley	CG_222	Structural Damage		A39, A40

Decorative Supports (DS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Overhead Sign Support	DS_236	Scaling		A34

Drainage Pipes (DP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Cross Pipe	DP_425	Obstruction		A3

Miscellaneous Drainage Structures (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Drain	MDP_28	Obstruction	 A photograph showing a concrete shoulder drain partially blocked by a large, light-colored plastic bag or debris. The drain is surrounded by dry grass and some green weeds.	A13, A14
2	Shoulder Drain	MDP_44	Obstruction	 A photograph showing a concrete shoulder drain heavily obstructed by a large, light-colored plastic bag. The surrounding area is overgrown with tall grass and weeds.	A17
3	Shoulder Drain	MDP_95	Obstruction	 A photograph showing a concrete shoulder drain with a significant obstruction of dry grass and debris. A shadow is cast across the drain, indicating the sun is high.	A28, A29
4	Shoulder Drain	MDP_169	Obstruction	 A photograph showing a concrete shoulder drain almost completely covered by a dense layer of dry, brown grass and debris. Some green grass is visible on the left side.	A44, A45

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_160	Tree on Fence		A4, A5
2	Woven	FN_279	Hole in Fence		A29, A30

Graffiti (GR)

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

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	High Mast	HL_118	Part Damage		A9
2	Underpass Lighting	HL_277	Part Damage		A45
3	Double Roadway	HL_332	Nighttime Failure	Not Available for Nighttime Failure.	A26
4	Single Roadway	HL_333	Nighttime Failure	Not Available for Nighttime Failure.	A32

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_179	Surface Damage		A48, A49
2	Inlet	IN_184	Surface Damage		A49

Landscaping (LD)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Plant Bed	PB_34	Unhealthy		A53
2	Plant Bed	PB_38	Unhealthy		A53
3	Plant Bed	PB_219	Unhealthy		A5

Paved Lanes – Asphalt (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_8	Cracking		A9

Paved Lanes – Concrete (LS)

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

Paved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_245	Paved Shoulder Joint		A49

Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Unpaved Shoulder	LS_8	Buildup		A9
2	Unpaved Shoulder	LS_29	Elevation Deviation		A26, A28, A29
3	Unpaved Shoulder	LS_245	Elevation Deviation		A49
4	Unpaved Shoulder	LS_313	Buildup		A1

Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Unpaved Shoulder	LS_314	Elevation Deviation		A1, A2
6	Unpaved Shoulder	LS_599	Shoulder Drop-off		A46

Front/Back Slopes (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Slope	LS_29	Slope Failure		A26, A28, A29
2	Slope	LS_179	Slope Failure		A29, A30

Unpaved Lateral and Outfall Ditches (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Outfall Ditch	LS_431	Erosion		A36

Litter (LS)

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

Roadway Sweeping (LS)

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

Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_8	Line Width		A9
2	Concrete	LS_411	Line Width		A32, A33
3	Concrete	LS_599	Line Missing		A46

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_8	Missing Markers		A9
2	Asphalt	LS_177	Missing Markers		A9, A10
3	Concrete	LS_326	Missing Markers		A5, A6
4	Concrete	LS_335	Missing Markers		A8, A9

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Asphalt	LS_395	Missing Markers		A29, A30
6	Concrete	LS_411	Missing Markers		A32, A33
7	Concrete	LS_494	Missing Markers		A45, A46
8	Asphalt	LS_544	Missing Markers		A46, A47

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Asphalt	LS_594	Missing Markers	 A photograph showing a road surface under a bridge. The road is dark asphalt, and there are several white dashed lines. The bridge structure is visible above, with concrete pillars and a brick wall. The scene is outdoors with some greenery in the background.	A28, A29

Paved Ditches (PD)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Paved Ditch	PD_11	Material Accumulation		A51, A52
2	Paved Ditch	PD_19	Material Accumulation and Erosion		A44

Pavement Words and Symbols (PS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Only	PS_516	Nighttime Failure	Not Available for Nighttime Failure.	A54, A55
2	Left Turn	PS_629	Nighttime Failure	Not Available for Nighttime Failure.	A9, A10

Signs (SN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	NC Route	SN_66	Nighttime Failure, Rotation and Sign Support		A25
2	Toll Payments	SN_163	Nighttime Failure	Not Available for Nighttime Failure.	A18
3	Wrong Way	SN_369	Leaning		A54, A55
4	NC Route	SN_498	Leaning and Sign Support		A2

Signs (SN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
4 (Cont.)	NC Route	SN_498	Leaning and Sign Support		A2
5	Toll Rates	SN_578	Nighttime failure	Not Available for Nighttime Failure.	A45
6	Authorized Vehicles	SN_793	Leaning		A37
7	Highway	SN_855	Nighttime failure	Not Available for Nighttime Failure.	A43

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_25	Bareground		A14
2	Turf	TF_30	Bareground		A23
3	Turf	TF_55	Bareground		A20
4	Turf	TF_65	Bareground		A24, A25

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_68	Bareground		A26
6	Turf	TF_70	Bareground		A25, A26
7	Turf	TF_107	Bareground		A27, A28, A31
8	Turf	TF_129	Undesirable vegetation		A37, A38

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Turf	TF_179	Bareground		A20
10	Turf	TF_182	Bareground		A27, A28, A29
11	Turf	TF_204	Bareground		A26, A28, A29
12	Turf	TF_222	Bareground		A27, A28

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
13	Turf	TF_236	Bareground		A39, A40, A41
14	Turf	TF_304	Bareground		A45, A46
15	Turf	TF_309	Bareground		A45
16	Turf	TF_312	Bareground		A44

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
17	Turf	TF_355	Bareground		A39, A40, A42
18	Turf	TF_433	Bareground		A37
19	Turf	TF_456	Bareground		A46, A47
20	Turf	TF_469	Bareground		A46

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
21	Turf	TF_471	Bareground		A46
22	Turf	TF_482	Undesirable vegetation		A33, A34
23	Turf	TF_484	Bareground		A32, A33
24	Turf	TF_816	Bareground		A2, A3

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
25	Turf	TF_852	Bareground		A56, A57
26	Turf	TF_863	Bareground		A55
27	Turf	TF_887	Noxious Weeds		A54
28	Turf	TF_888	Bareground		A54, A55

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
29	Turf	TF_898	Noxious Weeds		A54
30	Turf	TF_913	Bareground		A51, A52
31	Turf	TF_936	Bareground		A52, A53

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

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Bridge Wall	WL_63	Cracked joint		A39, A40
2	Sound Wall	WL_96	Cracked joint		A33, A34
3	Sound Wall	WL_101	Cracked joint		A34