

TRAFFIC NOISE REPORT ADDENDUM

Complete 540 Triangle Expressway Southeast Extension Wake and Johnston Counties

STIP Project Nos. R-2721, R-2828, and R-2829
State Project Nos. 6.401078, 6.401079, and 6.401080
Federal Aid Project Nos. STP-0540(19), STP-0540(20), and STP-0540(21)
WBS Nos. 37673.1.TA2, 35516.1.TA2, and 35517.1.TA1

Prepared for:

North Carolina Department of Transportation
North Carolina Turnpike Authority

Prepared By:

H.W. Lochner, Inc.

LOCHNER



Rebecca Thompson

Rebecca Thompson, PE
Modeler/Analyst

David Shannon

David Shannon, PE
Reviewer/Quality Control

W.D.S. 12/20/17

Accepted By:

Maryalice Parr

NCDOT Traffic Noise and Air Quality Group

12/20/2017

Date

Executive Summary

The North Carolina Department of Transportation (NCDOT) is proposing the completion of the 540 Outer Loop by way of the Southeast Extension of the Triangle Expressway in Wake and Johnston Counties. The project is included in the TIP as No. R-2721, R-2828 and R-2829. Seventeen Detailed Study Alternatives (DSAs) were investigated in the 2015 Draft Environmental Impact Statement (DEIS) and DSA2 was selected as the Preferred Alternative. For the Final Environmental Impact Statement (FEIS), the design year has been changed from 2035 to 2040 and additional traffic data for the 2016 existing condition and the 2040 Build condition have been developed. Minor revisions to the preliminary design of DSA2 have occurred and NCDOT has updated its noise policy.

This traffic noise analysis was completed using the NCDOT Traffic Noise Policy (October 6, 2016) (Appendix 5) and the NCDOT Traffic Noise Manual (October 6, 2016).

Long-term noise measurements were taken at three locations and short-term measurements were collected at twenty locations in September of 2013. An additional seven short term measurements were collected in May of 2014. The noise measurements were used to identify loudest-hour ambient noise levels and validate use of the FHWA Traffic Noise Model.

Traffic noise levels for the base year (2016) and design year (2040) were predicted using the FHWA Traffic Noise Model®, Version 2.5.

Along the Preferred Alternative (DSA 2), 2,639 residential receptors, 4 schools, 8 recreational facilities, 8 places of worship and 1 commercial receptors were identified. Overall 132 receptors are predicted to experience only Noise Abatement Criteria impacts, 473 receptors are predicted to experience only a substantial increase impact, and 213 receptors will experience both types of impact.

Noise abatement in the form of traffic management, alteration of alignments, buffer zones and building insulation was found not to be feasible. Noise barriers were studied in 42 locations. Of these, 22 barriers were preliminarily found to be both feasible and reasonable and are likely to be constructed. The other 20 barriers were preliminarily found to be either not feasible or not reasonable and are not likely to be constructed. A final determination of noise barrier feasibility and reasonableness will be made upon completion of project design and public involvement process.

Since the project area is predominately residential and commercial, construction is not expected to be disruptive for typical daytime, mid-week activities. Construction should be coordinated with the places of worship and schools along the project to avoid interrupting activity at any locations.

The final design traffic noise analysis, documented in a Design Noise Report, will re-evaluate feasible and reasonable noise abatement for the entire project corridor and not just in areas where noise abatement has been identified in this Traffic Noise Report as being preliminarily feasible and reasonable (i.e. likely).

TABLE OF CONTENTS

Complete 540 - Triangle Expressway Southeast Extension
Traffic Noise Report Addendum
NCDOT STIP Project Nos. R-2721, R-2828, R-2829
Wake and Johnston Counties

Volume I

	EXECUTIVE SUMMARY	i
1	INTRODUCTION.....	1
2	CHARACTERISTICS OF NOISE.....	1
3	GUIDELINES	2
4	AMBIENT NOISE LEVELS	4
5	PROCEDURE FOR PREDICTING FUTURE NOISE LEVELS	5
6	IMPACT ASSESSMENT.....	7
7	POTENTIAL NOISE ABATEMENT MEASURES	9
8	CONSTRUCTION NOISE.....	36
9	COORDINATION WITH LOCAL OFFICIALS	37
10	CONCLUSION.....	38
11	REFERENCES	40

LIST OF TABLES

Table 1	COMMON INDOOR AND OUTDOOR NOISE LEVELS	2
Table 2	FHWA NOISE ABATEMENT CRITERIA.....	4
Table 3	TRAFFIC NOISE MODEL (TNM) VEHICLE CLASSIFICATION TYPES	6
Table 4	SUMMARY OF HISTORIC PROPERTIES	7
Table 5	IMPACT SUMMARY PER LAND USE	8
Table 6	ALLOWABLE NOISE BARRIER BASE QUANTITIES.....	10
Table 7	CORRELATION BETWEEN 2015 DEIS AND 2017 FEIS NAMING	11
Table 8	LOCAL JURISDICTIONS WITHIN PROJECT AREA	38
Table 9	TYPICAL DISTANCES TO 66 AND 71 dB(A) NOISE CONTOURS	38
Table 10	NOISE BARRIERS LIKELY TO BE INCLUDED IN FINAL DESIGN	39
Table 11	NOISE BARRIERS UNLIKELY TO BE INCLUDED IN FINAL DESIGN	40

Exhibit 1 PROJECT LOCATION MAP

Exhibit 2 NOISE ANALYSIS LOCATIONS

VOLUME II

Appendix 1 NOISE MEASUREMENTS AND MODEL VALIDATION RESULTS

Appendix 2 IMPACT ANALYSIS TABLE

Appendix 3 NOISE BARRIER RESULTS

Appendix 4 TRAFFIC USED IN THIS ANALYSIS

Appendix 5 NCDOT TRAFFIC NOISE ABATEMENT POLICY

1 Introduction

The North Carolina Department of Transportation (NCDOT) State Transportation Improvement Program (STIP) includes a project that addresses the proposed completion of the 540 Outer Loop by means of constructing the Southeast Extension of the Triangle Expressway in Wake and Johnston Counties. The project is included in the TIP as No. R-2721, R-2828 and R-2829. Seventeen Detailed Study Alternatives (DSAs) were developed and investigated in a Draft Environmental Impact Statement (DEIS) that was completed in 2015. See Exhibit 1 for a project location map which shows the Preferred Alternative (DSA 2). The Preferred Alternative will be a 6 lane fully-controlled access expressway, with a design speed of 70mph. DSA 2 was selected as the Preferred Alternative.

This traffic noise analysis is part of the Final Environmental Impact Statement (FEIS) and is a revision of the traffic noise analysis completed for the DEIS. Since the DEIS was completed, the existing year was changed from 2012 to 2016, the design year was changed from 2035 to 2040, the NCDOT Traffic Noise Policy and the NCDOT Traffic Noise Manual were both revised, there has been additional development in the project area and various geometric changes to the project design have been made. These changes are all reflected in this traffic noise analysis.

Current land use along the project alternates is predominantly residential and undeveloped with a few commercial and agricultural areas. Federal and state guidelines establish certain noise level criteria for these different land uses, and this study will determine whether these criteria will be approached or exceeded due to the improvement, or whether there will be a substantial increase in noise due to the project.

Ambient noise measurements were collected in September 2013 and May 2014. Weather conditions during both periods of field work were clear with dry pavement and low wind speeds.

This study reveals that for the design year (2040) traffic volumes, 818 receptors will be impacted by traffic noise by the Preferred Alternative.

2 Characteristics of Noise

Noise is defined as unwanted or irritating sound. It is emitted from numerous sources, including airplanes, factories, railroads, animals, construction activity, trucks and automobiles. On-road vehicle noise is primarily comprised of noises from engine exhaust, drive train, and the tire/roadway interaction.

The magnitude of noise is usually described by its sound pressure. Because the range of sound pressure varies greatly from object to object, a logarithmic scale is used to relate sound pressures to a common

reference pressure, yielding the sound pressure level. Sound pressures levels are expressed in units of decibels (dB) and are often modified by frequency-weighted scales (e.g., A- or C-weighted scales). The A-weighted scale is used almost exclusively when measuring vehicle noise because it places a stronger emphasis on the frequency range to which the human ear is most sensitive (approximately 1,000 to 6,000 hertz). Sound levels filtered with the A-weighted scale are expressed as dB(A). Throughout this report, all noise levels will be expressed in dB(A). Examples of common indoor and outdoor noise levels are listed in Table 1.

Table 1: Common Indoor and Outdoor Noise Levels

Common Outdoor Noise Levels	Noise Level dB(A)	Common Indoor Noise Levels
	110	Rock Band
Jet Flyover at 1000 feet	100	Inside Subway Train (NY)
Gas Lawn Mower at 3 feet		
Diesel truck at 50 feet	90	Food Blender at 3 feet
Noisy Urban Daytime	80	Garbage Disposal at 3 feet
Gas Lawn Mower at 100 feet	70	Vacuum Cleaner at 10 feet
Commercial area		Normal Speech at 3 feet
	60	
		Large Business Office
Quiet Urban Daytime	50	Dishwasher in the Next Room
Quiet Urban Nighttime	40	Small Theater Large Conference Room (Background)
Quiet Suburban Nighttime		Library
	30	
Quiet Rural Nighttime		Bedroom at Night Concert Hall (Background)
	20	
		Broadcast and Recording Studio
	10	
	0	Threshold of Hearing

Adapted from Guide on Evaluation and Attenuation of Traffic Noise, American Association of State Highway and Transportation Officials (AASHTO). 1974 (revised 1993).

Since most environmental noise fluctuates from moment to moment, it is common practice to condense all of this information into a single number called the equivalent sound level (Leq). The Leq is the value of a steady sound level that would represent the same sound energy as the actual time-varying sound levels evaluated over the same period. For highway traffic noise assessment, Leq is typically evaluated over a one-hour period, and is denoted as Leq(h). Throughout this report, all noise levels are expressed in a one hour equivalency.

3 Guidelines

The noise impacts for the proposed improvements have been assessed in accordance with Federal Highway Administration (FHWA) regulations published in 23 Code of Federal Regulations, Part 772, and the NCDOT Traffic Noise Policy, October 6, 2016 (Appendix 5).

There are two types of traffic noise impacts: Noise Abatement Criteria and substantial increase.

The Noise Abatement Criteria (NAC) established by Part 772 and listed in Table 2 represent the noise level at which noise abatement must be considered. The NAC primarily apply to exterior areas of frequent human use. They do not apply to the entire tract of land on which the activity is based, but only to that portion where the activity takes place. The NAC are given in terms of the A-weighted, hourly equivalent sound level in decibels or dB(A).

The noise impact assessment is made using the criteria listed in Table 2. If, for a given activity, the design year noise levels “approach or exceed the NAC”, then the activity is impacted and abatement measures must be considered. The North Carolina Department of Transportation has defined approach as one decibel less than the NAC.

The Federal guidelines provide a second criterion for assessing impact. For some locations, a project may impose a large increase in noise levels over existing levels, although the levels may not reach the NAC. The NCDOT Traffic Noise Policy defines a “substantial increase” that justifies consideration of noise abatement measures as a 10 dB(A) increase over the existing noise level.

When traffic noise impacts are identified, noise abatement measures shall be considered for feasibility and reasonableness and may include traffic management measures, alteration of horizontal and vertical alignments, establishment of buffer zones, noise insulation for Activity Category D land uses and the construction of noise barriers. The final decision to construct noise abatement measures will be made upon completion of the project design and the public involvement process.

Table 2: FHWA Noise Abatement Criteria

Activity Category	Leq (h)¹ dB(A)²	Description of Activity
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B ³	67 (Exterior)	Residential
C ³	67 (Exterior)	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails and trail crossings.
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E ³	72 (Exterior)	Hotels, motels, offices, restaurants/bars and other developed lands, properties or activities not included in A-D or F.
F	----	Agricultural, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	----	Undeveloped lands that are not permitted

Source: *NCDOT Traffic Noise Policy*, October 6, 2016

¹The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same period of time, with Leq(h) being the hourly value of Leq.

²The Leq(h) activity criteria values are for impact determination only, and are not design standards for noise abatement measures.

³Includes undeveloped lands permitted for this activity category.

4 Ambient Noise Levels

Ambient noise is the combination of all noise sources that occur in an area and can include noise generated from human-influenced sources such as vehicle traffic, air conditioners, aircraft, construction, and recreation. Ambient noise can also include natural sources such as wildlife, insects, wind through leaves and running water. In the project area there are areas of development separated by natural and agricultural areas. Each area has its own ambient noise composition.

Noise monitoring was performed in September 2013 and May 2014 along the project corridors. The short term data collected was used in the validation of the noise model and to establish loudest-hour ambient noise levels where traffic is not the major noise source. Long term measurements were taken in order to establish a diurnal curve and find the loudest hour of the day for rural and suburban locations. The short term ambient measurements were normalized to reflect the loudest hourly Leq for each location. See

Appendix 1 for detailed information for each measurement including start and stop times of the measurements, durations, weather conditions, traffic data collected during the measurements, photographs of the meter set-ups and documentation of any other contributing noise sources or events. Ambient noise levels ranged from 44 dB(A) to 57 dB(A).

The short-term measurements that were completed in 2013 were performed with Larson-Davis Model 824 Type I Sound Level Meters and the long-term measurements were performed with a Larson-Davis Model 870 Type I Sound Level Meter equipped with an external battery. The short-term measurements that were completed in 2014 were performed with Larson-Davis Model 820 Type I Sound Level Meters. Calibration certificates are included in Appendix 1.

The noise measurements validated use of the FHWA Traffic Noise Model, Version 2.5 (TNM) as appropriate for use in determining the traffic generated noise levels. The model accounts for such factors as ground absorption, roadway geometry, receptor distance, existing buildings, topography, vehicle volumes and speeds, and volumes of medium trucks (vehicles with 2 axles/6 tires) and heavy trucks (3 axles or more). At measurement locations further from the roadway where TNM did not validate, the ambient noise was dominated by non-traffic sources such as insects and air conditioners. These locations where ambient noise was dominant were used as the ambient levels throughout the project and were normalized using the diurnal curve. The ambient levels were normalized by adding the difference between the hour of the short term measurement and the loudest hour of long term measurements to the ambient levels. See Appendix 1 for the results of the field measurements, TNM validation results, and adjusted ambient measurements.

5 Procedure for Predicting Future Noise Levels

Traffic noise emissions are composed of several variables, including the number, types, and travel speeds of the vehicles, as well as the geometry of the roadways on which the vehicles travel. Additionally, variables such as weather and intervening topography affect the transmission of traffic noise from the vehicles to noise sensitive receptors.

In accordance with industry standards and accepted best-practices, detailed computer models were created using the FHWA TNM 2.5. The computer models were validated to within acceptable tolerances of field-monitored traffic noise data, and were used to predict traffic noise levels for receptor locations in the vicinity of the proposed project. Traffic noise consists of three primary parts: tire/pavement noise, engine noise, and exhaust noise. Of these sources, tire/pavement noise is typically the most offensive at highway travel speeds. Sporadic traffic noises such as horns, squealing brakes, screeching tires, etc. are considered aberrant and are not included within the predictive model algorithm. Traffic noise is not constant; it varies in time depending upon the number, speed, type, and frequency of vehicles that pass by a given receptor.

Furthermore, since traffic noise emissions are different for various types of vehicles, the TNM algorithm distinguishes between the source emissions from the following vehicle types: automobiles, medium trucks, heavy trucks, buses, and motorcycles, as shown in Table 3. The computer traffic noise prediction model uses the number and type of vehicles on the planned roadway, vehicle speeds, the physical characteristics of the road (curves, hills, depressions, elevations, etc.), receptor location and height, and, if applicable, barrier type, barrier ground elevation, and barrier segment top elevations.

Table 3: Traffic Noise Model (TNM) Vehicle Classification Types

TNM Vehicle Type	Description
Autos	All vehicles with two axles and four tires, including passenger cars and light trucks, weighing 9,900 pounds or less
Medium Trucks	All vehicles having two axles and six tires, weighing between 9,900 and 26,400 pounds
Heavy Trucks	All vehicles having three or more axles, weighing more than 26,400 pounds
Buses	All vehicles designed to carry more than nine passengers
Motorcycles	All vehicles with two or three tires and an open-air driver / passenger compartment

Sources: FHWA Measurement of Highway-Related Noise, § 5.1.3 Vehicle Types.
FHWA Traffic Monitoring Guide, § 4.1 Classification Schemes

Noise levels have been predicted for that hour of the day when the vehicle volume, operating speed and number of heavy trucks combine to produce the worst traffic noise conditions. This condition usually occurs at Level of Service (LOS) C. An analysis showed that the existing year (2016) and design year (2040) DHV will generally operate at LOS C or better in the PM peak period.

Highway Capacity Software (HCS) was used to calculate LOS C volumes for the intersection of Holly Springs Road with Kildaire Farm Road for the existing year (2016) and at the intersections of Holly Springs Road with Kildaire Farm Road and NC 50 with Cleveland School Road for the design year (2040) build condition. Those intersections are predicted to operate at a condition worse than LOS C with the DHV.

A design speed of 70 mph was used in the modeling for the Preferred Alternative and posted speed limits were used for all side roads. See Appendix 5 for the traffic data used in this study.

Noise levels in this study have been determined for base year (2016) conditions and the design year (2040) build conditions.

6 Impact Assessment

The initial task in determining noise impacts is to identify activity areas along the project corridor that are sensitive to noise. Impact assessments have been performed for 2,660 receptors within the project corridor which represent 2,639 residential receptors, 1 commercial receptor, 4 schools, 8 recreational facilities and 8 places of worship. These areas are shown in Exhibit 2. Any properties that were not represented were determined to be Activity Category F, which are areas that are not sensitive to noise and therefore do not have NAC impact criteria.

Along the Preferred Alternative there are three Historic Properties that were included in the study. These properties consist of an historic house, a school and one country club. These properties were determined to be activity categories B, C and D. They were included because of their outside land use or their historic status. Two of the properties are listed on the National Register of Historic Places and the other is eligible for listing on the National Register of Historic Places. The three Historic Properties in the study area can be found in the Table 4.

Table 4: Summary of Historic Properties

Property Name	Survey Site Number	Eligibility Criteria	Listed ?	Receptor Number	Land Use	Existing Noise Level	Build Noise Level	Noise Level Increase	Substantial Increase	Barrier Proposed	Barrier Likely?
John Strain House	22	C	No	R1749	B	55	63	8	NO		
Meadowbrook Country Club	188	A	Yes	R2315	C	50	65	15	YES	NW68	YES
Panther Branch School	56	A	Yes	R0543	D	40	43	3	NO	NW52	NO

Note: Red highlights denote noise levels and noise level increases that are considered impacted.

Traffic noise abatement must be considered when traffic noise impacts are created by either of the following two conditions:

- The predicted traffic noise levels for the design year approach (reach one decibel less than) or exceed the Noise Abatement Criteria (NAC) contained in 23 CFR 772 and in Table 2 of this report.
- The predicted traffic noise levels for the design year substantially exceed base year (2016) noise levels by 10 dB(A) or more.

For each analysis receptor, a representative field measurement site was chosen based on proximity and area characteristics for comparison purposes. An explanation of the ambient measurements can be found in Section 4 of this report. The adjusted ambient measurement noise level for the representative site was

compared to the level that was predicted by TNM and the higher of the two was used in the analysis. This comparison was performed for both the base year (2016) and design year (2040).

The results of the noise analysis are summarized in Table 5 which include the number of noise impacts for different land uses and the range of noise levels associated with the Preferred Alternative. The noise prediction results are detailed for each noise sensitive area in Appendix 2. Included for each study area are the applicable NAC category and the worst hourly equivalent sound level for the base year and build conditions.

Table 5: Impact Summary per Land Use

Land Use Type	Impact Type	Preferred Alternative
Residence	NAC	132
	Increase	471
	Both	211
School	NAC	0
	Increase	0
	Both	0
Place of Worship	NAC	0
	Increase	0
	Both	0
Recreational	NAC	0
	Increase	2
	Both	2
Commercial	NAC	0
	Increase	0
	Both	0
Overall	NAC	132
	Increase	473
	Both	213
Totals		818

NAC – Only impacts caused by levels that approach or exceed the Noise Abatement Criteria

Increase – Only impacts caused by increases which equal or exceed the substantial noise level increase criteria of 10 dB(A)

Both – Impacts caused by both NAC and substantial increase

A comparison of the design year (2040) build noise levels (Appendix 2) with the applicable NAC, as shown in Table 2, reveals that 132 receptors will receive traffic noise levels which approach or exceed the NAC.

A comparison of the design year build noise level increases with the substantial increase criteria reveals that 473 receptors will experience design year build noise levels that will be substantially higher than base year levels. In addition, 213 receptors will experience both NAC impacts as well as a substantial noise

increase. See Exhibit 2 for a map of specific receptor locations. See Appendix 2 for an Impact Analysis Table, which shows the specific receptors based on the different segments.

7 Potential Noise Abatement Measures

Section 23 Code of Federal Regulations, Part 772 identifies certain noise abatement measures that may be considered in the project design to reduce traffic noise impacts. These abatement measures include: traffic management, alteration of alignments, buffer zones, building insulation and the construction of noise barriers.

Traffic Management

Traffic management is not a feasible option because reduced speed limits will not likely be observed. Limiting truck access is contrary to the purpose of the project and a function of the roadway. The purpose of the project is to increase mobility for people and the movement of goods. Restricting truck traffic would limit the mobility of goods and would not increase mobility.

Alignment Shifts

Shifting horizontal alignments is not feasible because moving the roadway away from an impacted receptor typically creates an impact on the opposite side of the road. Shifting vertical alignments can have a positive effect on noise levels but due to the terrain in the project area would result in excessive grading costs.

Buffer Zones

Buffer zones are not possible since the impacted receptors are located adjacent to the preliminary right of way and there is an inadequate amount of land available for use as a buffer.

Building Insulation

There are no interior impacts due to this project, so therefore building insulation did not need to be considered.

Noise Barriers

The only remaining abatement measure is the construction of noise barriers. To be considered for construction, a noise barrier must be both feasible and reasonable according to NCDOT policy.

The feasibility of a noise barrier is based on its effectiveness in reducing traffic noise levels as well as any adverse impacts to property access, drainage, topography, utilities, safety and maintenance requirements. A

reduction in noise levels by five dB(A) for at least two impacted receptors is required for a barrier to be considered feasible.

A noise abatement measure is considered reasonable by NCDOT policy if the area of the abatement measure does not exceed a set allowance. For each benefited receptor, 1,500 square feet of barrier is allowed plus an additional allowance based on the average dB(A) increase over the base year noise level for all impacted receptors. See Table 6 for the allowable noise barrier base quantities. The area of noise barrier per benefited receptor calculation considers all benefitted receptors without regard to whether they are predicted to be impacted or not.

The barrier must also provide a 7 dB(A) reduction in noise to at least one benefited receptor. A barrier should also break the line-of-sight between the impacted receptors and the exhaust stacks of passing trucks. A barrier was investigated at each cluster of impacted receptors (i.e., two or more impacted receptors in close proximity).

Table 6: Allowable Noise Barrier Base Quantities

Maximum Allowable Base Quantity	Noise Level Consideration	Noise Wall	Earthen Berm
		1,500 ft ²	4,200 yd ³
Average dB(A) Increase Between Existing and Future Build for All Impacted Receptors	< 5 dB(A)	+ 0 ft ²	+ 0 yd ³
	5-10 dB(A)	+ 500 ft ²	+ 1,400 yd ³
	> 10 dB(A)	+ 1,000 ft ²	+ 2,800 yd ³
Average Exposure to Absolute Noise Levels for All Impacted Receptors	< 5 dB(A) Over NAC Activity Category	+ 0 ft ²	+ 0 yd ³
	5-10 dB(A) Over NAC Activity Category	+ 500 ft ²	+ 1,400 yd ³
	> 10 dB(A) Over NAC Activity Category	+ 1,000 ft ²	+ 2,800 yd ³

Noise barriers were investigated at 42 locations along the Preferred Alternative. For each barrier investigated, multiple heights, lengths and locations were studied. Appendix 3 contains the results of the investigations including three variations of each barrier. In general, the optimal version of each barrier is presented in this report, but during the design phase of this project it likely will be possible to refine the end points, variations in height and the locations of the barriers relative to the proposed roadways in order to maximize their efficiency and enhance their aesthetics. During the design phase of the project there may also be modifications to the horizontal and vertical alignments which could change the effectiveness of the barriers. The investigations completed for this phase of the analysis were intended to identify the likelihood

of a barrier being both feasible and reasonable and not to identify its final configuration. Exhibit 2 shows the locations of the 42 barrier locations that were investigated. Many investigated barriers correspond to potential barriers studied in the 2015 DEIS analysis; Table 7 identifies correlation between 2015 barrier naming conventions and current barriers studied.

Table 7: Correlation Between 2015 DEIS and 2017 FEIS Barrier Naming

R-2721		R-2828		R-2829	
2017 FEIS Name	2015 DEIS Name	2017 FEIS Name	2015 DEIS Name	2017 FEIS Name	2015 DEIS Name
NW1	Barrier 1	NW41	Barrier 19	NW83	Barrier 63
NW2	Barrier 2	NW43	Barrier 20	NW90	Barrier 64
NW3	Barrier 2	NW49-1	n/a	NW92	Barrier 65
NW5	Barrier 3	NW49-2	Barrier 22	NW97	Barrier 66
NW6	n/a	NW50	Barrier 21	NW98	Barrier 107
NW7	Barrier 108	NW52	Barrier 23		
NW8	n/a	NW53	Barrier 24		
NW11	Barrier 4	NW54	Barriers 26 & 28		
NW13	Barrier 109	NW55-1	Barriers 25		
NW16	Barriers 5 & 110	NW55-2	Barriers 27		
NW18	Barrier 6	NW58	Barrier 29		
NW19-1	Barrier 7	NW60	Barrier 30		
NW19-2	Barrier 111	NW67	Barrier 32		
NW20	Barrier 113	NW68	Barrier 33		
NW21-1	Barrier 8				
NW21-2	Barrier 9				
NW22	Barrier 10				
NW24	Barrier 12				
NW25	Barrier 11				
NW27	Barrier 13				
NW28	Barrier 14				
NW32	Barrier 16				
NW35	Barrier 17				

Noise Study Area 1 - Barrier NW1

A noise barrier was investigated to abate the predicted traffic noise impacts at 117 impacted residential receptors (R0054A-H, R0054J, R0054L, R0055B-C, R0055E-F, R0055H-L, R0055N-O, R0055Q-X, R1605, R1705C-F, 1705I-L, R1705P-R, R1705V-X, R1706A-F, R1706H-I, R1706K-L, R1706O, R1706X, R1707A-L, R1707O, R1707R, R1707U, R1707W-X, R1708B-C, R1708E-I, R1708K-L, R1708N-O, R1708Q-R, R1708T-U, R1708X, R1709A-F, R1710A-H, R5004, R5063B-D, R5064D-E, R5065A-D, R5059, R5060, R5061, and R5062) along DSA2 in Noise Study Area (NSA) 1, located north of the proposed route, east of the interchange with NC55 Bypass.

In addition, Receptor R1705 is an impacted recreational area (community pool area) behind barrier NW1. The pool area is shared by the nearby residential units during daylight hours every day of the week for five months of the year. A property manager indicated the typical number of pool users is 20. This equates to 1

residential equivalent for receptor R1705. The receptor will be treated as 1 residential equivalent in the barrier analysis. A calculation of the residential equivalents is included in Appendix 3.

Barrier NW1 is 4,004 feet long with a height of 14 feet and would provide a 5 dB(A) to 12 dB(A) reduction at 110 impacted receptors, with 144 total receptors benefitted including 114 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 389 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration.

See Exhibit 2.1 and 2.3 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Areas 2 and 3 - Barrier NW2 and NW3

Noise barriers NW2 and NW3A abate noise in NSAs 2 and 3. These noise barriers were investigated to abate the predicted traffic noise impacts at 92 impacted residential receptors (R0001B, R0006A-B, R0007A-B, R5005, R1626, R0014B, R0015A-B, R0016A-B, R0017A-B, R0018A-B, R0019A-B, R0020A, R0020C, R0021A-B, R0022A-B, R0023A-B, R0024A-B, R0025A-B, R0026, R0027A, R0028A-B, R0030A-B, R0031A-B, R0032A-B, R0033A-B, R0034A, R0039A-B, R0040A-B, R0041A-C, R0042A-B, R0043A-B, R0044A-B, R0045A-B, R0046A-B, R0047A-B, R0048A-B, R0049A-B, R0050A, R0056A-C, R0057A-B, R0058A-C, R1627A-B, R1711A-B, R1714A-B, R1715A-B, R1918B, R1922A, R5072, R5073, and R5074) along DSA2, located south of DSA2 in Noise Study Areas (NSA) 2 and 3, east of the interchange with NC55 Bypass.

Barriers NW2 and NW3 combined are 5,828 feet long with a height of 16 feet and would provide a 5 to 12 dB(A) reduction in noise at 86 of the impacted receptors, with 66 receptors receiving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 972 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.2 and 2.3 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

The average height of NW1, NW2 and NW3 is 15 feet and they are approximately 190 feet apart. This distance is greater than a 10:1 ratio and a degradation in noise reduction is unlikely.

Noise Study Area 4 – No Barrier

Within Noise Study Area 4, located south of DSA 2 and west of Sunset Lake Road, 13 residential receptors and one commercial receptor were studied. One residential receptor (R5077E) is predicted to be

impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.4 for a location map of this Noise Study Area.

Noise Study Area 5 - Barrier NW5

A noise barrier was investigated to abate the predicted traffic noise impacts at 12 impacted residential receptors (R0061A-C, R0062A-B, R0065A-B, R0066A-B, R0069A-B, and R0070A) along DSA2 in Noise Study Area (NSA) 5, located north of the proposed route, north and east of the western Sunset Lake Road overpass. Barrier NW5 is 2,604 feet long, with a height of 22 feet and would provide a 5 to 7 dB(A) reduction in noise at 2 of the impacted receptors, with 7 total receptors benefitted including 2 receptors receiving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 8,182 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.4 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 6 - Barrier NW6

A noise barrier was investigated to abate the predicted traffic noise impacts at eleven residential receptors (R5083, R5084, R5085, R5086, R5100, R5101, R5102, R5103, R5104, R5105, and R5106), located north of DSA 2 in Noise Study Area (NSA) 6, east of the western Sunset Lake Road overpass. Barrier NW6 is 1,760 feet long with a height of 12 feet and would provide a 6 to 10 dB(A) reduction in noise at 9 of the impacted receptors, representing all receptors benefitted including 8 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 3,000 square feet and the wall would be 2,347 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.4 and 2.5 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 7 - Barrier NW7

A noise barrier was investigated to abate the predicted traffic noise impacts at 38 impacted residential receptors (R0085A-B, R2287A-B, R2342B, R2347A-D, R2348A-F, R2349A-E, R2350A-F, R2351A-D, R5124, R5125, R5126, R5127, R5128, R5129, R5130, and R5131) along DSA2, located north of DSA 2 in Noise Study Area (NSA) 7 on the east side of Holly Springs Road.

Receptor 75 is a recreational area (community pool, fields and playground area) behind Barrier NW7. Repeated attempts were made to contact the manager of the recreational area and no response was received. The area is used by the adjacent residential development during daylight hours every day of the week for

five months of the year. The pool area is 4,500 square feet which translates to a maximum bather load of approximately 300 users. Assuming half the pool area users are in the pool at any given moment, the total number of pool area users can be estimated at 600. The play area, tennis courts and basketball court can be estimated to be used by 125 people at any given time. This comes to 50 residential equivalents for R0075, represented by 10 receptors in a nodal array. Each receptor in the array will be treated as 5 residential equivalents in the barrier analysis. A calculation of the residential equivalents is included in Appendix 3.

Barrier NW7 is 4,434 feet long, with a height of 14 feet and would provide a 5 dB(A) to 11 dB(A) reduction in noise at 34 of the 38 impacted receptors, with 94 total receptors benefitted including 30 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 660 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibits 2.4, 2.5 and 2.6 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

The average height of NW6 and NW7 is 13 feet and they are approximately 275 feet apart. This distance is greater than a 10:1 ratio and a degradation in noise reduction is unlikely.

Noise Study Area 8 - Barrier NW8

A noise barrier was investigated to abate the predicted traffic noise impacts at five impacted residential receptors (R0083, R5168, R5169, R5170, and R5173) along DSA2 in Noise Study Area (NSA) 8, located north of the proposed route, east of the eastern Sunset Lake Road overpass. Barrier NW8 is 1,000 feet long, with a height of 20 feet and would provide a 5 dB(A) to 7 dB(A) reduction in noise at 3 of the impacted receptors, with 5 total receptors benefitted and including one receptor achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 3,997 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.6 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 9 – No Barrier

Within Noise Study Area 9, located south of DSA 2 and east of Sunset Lake Road, 12 residential receptors and one place of worship were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.6 for a location map of this Noise Study Area.

Noise Study Area 10 – No Barrier

Within Noise Study Area 10, located south of DSA 2 and west of Holly Springs Road, 15 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.8 for a location map of this Noise Study Area.

Noise Study Area 11 - Barrier NW11

A noise barrier was investigated to abate the predicted traffic noise level impacts at twelve impacted residential receptors (R0118, R0119A-B, R1628C, R1718A-B, R1719A-B, R5610, R5611, R5612 and R5614) along DSA2 in Noise Study Area (NSA) 11, located south of the proposed route, in the southeast quadrant of the Holly Springs Road interchange. Barrier NW11 is 2,805 feet long, with a height of 14 feet and would provide a 5 dB(A) to 7 dB(A) reduction in noise at all of the impacted receptors, with 15 total receptors benefitted including 5 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,128 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibits 2.8 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 12 – No Barrier

Within Noise Study Area 12, located north of DSA 2 and west of Holly Springs Road, four residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.7 for a location map of this Noise Study Area.

Noise Study Area 13 - Barrier NW13

A noise barrier was investigated to abate the predicted traffic noise impacts at 9 impacted residential receptors (R0131A-F,) located north of DSA2 in Noise Study Area (NSA) 13, along the west side of Kildaire Farm Road. Barrier NW13 is 549 feet long, with a height of 12 feet and would provide a 5 dB(A) to 10 dB(A) reduction in noise at all 9 of the impacted receptors, with 12 total receptors benefitted including 10 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,000 square feet and the wall would be 549 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.7 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 14 – No Barrier

Within Noise Study Area 14, located north of relocated Kildaire Farm Road and west of Holly Springs Road, 23 residential receptors were studied. One receptor (R0132A) is predicted to be impacted. Since

only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.7 for a location map of this Noise Study Area.

Noise Study Area 15 – No Barrier

Within Noise Study Area 15, located north of Sancroft Drive and east of Holly Springs Road, nine residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.7 for a location map of this Noise Study Area.

Noise Study Area 16 - Barrier NW16

A noise barrier was investigated to abate the predicted traffic noise level impacts at five impacted residential receptors (R0138A-C, R0139A, and R1043B) along DSA2 in Noise Study Area (NSA) 16, located north of the proposed route, east of the Holly Springs Road interchange. Barrier NW16 is 1,000 feet long with an average height of 16 feet and would provide an 5 d(B)A to 9 dB(A) reduction in noise at 3 of the impacted receptors, with 4 total receptors benefitted including 2 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 4,000 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibits 2.7 and 2.8 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 17 – No Barrier

Within Noise Study Area 17, located south of DSA 2 and west of Pierce Olive Road, one residential receptor was studied. It is not predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.9 for a location map of this Noise Study Area.

Noise Study Area 18 - Barrier NW18

A noise barrier was investigated to abate the predicted traffic noise impacts at 20 impacted residential receptors (R0161A, R0164A-B, R0167A-B, R0168A-C, R0169A-B, R0170A-B, R171A-B, R172A-B, R0173, R5191, R5192, and R5193) along DSA2 in Noise Study Area (NSA) 18, located north of the proposed route between the Holly Springs Road interchange and the West Lake Road overpass. Barrier NW18 is 2,039 feet long, with a height of 20 feet and would provide a 5 to 9 dB(A) reduction in noise at 15 of the impacted receptors, with 15 total receptors benefitted including 7 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,720 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further

consideration. See Exhibit 2.10 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 19 - Barrier NW19-1

A noise barrier was investigated to abate the predicted traffic noise impacts at 35 impacted residential receptors (R0174A-B, R0176A-B, R0179A-B, R0180A-B, R0182A-C, R0184, R0186A-B, R0187A-B, R0188A-B, R1722B, R1723A-B, R1724A, R1923, R1924A, R1925C, R5210, R5213, R5214, R5215, R5216, R5217, R5218, and R5219) along DSA2 in Noise Study Area (NSA) 19, south of the proposed route between the Holly Springs Road interchange and the West Lake Road overpass. Barrier NW19-1 is 3,896 feet long, with a height of 16 feet and would provide a 5 to 11 dB(A) reduction in noise at 26 of the impacted receptors, with 32 total receptors benefitted including 15 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 1,946 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.10 and 2.11 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 19 - Barrier NW19-2

A noise barrier was investigated to abate the predicted traffic noise impacts at seven impacted residential receptors (R0192A-B, R5217, R5639, R5640, R5641, and R5642) along DSA2 in Noise Study Area (NSA) 19, south of the proposed route and west of the West Lake Road overpass. Barrier NW19-2 is 1,363 feet long, with a height of 22 feet and would not provide at least a 5 dB(A) reduction in noise at any of the impacted receptors. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet. This barrier is preliminarily considered neither feasible nor reasonable and is not recommended for further consideration. See Exhibit 2.11 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 20 - Barrier NW20

A noise barrier was investigated to abate the predicted traffic noise level impacts to five impacted residential receptors (R0189A-C, R0191A, and R5226) along DSA2 in Noise Study Area (NSA) 20, north of the proposed route and west of the West Lake Road overpass. Barrier NW20 is 2,126 feet long, with a height of 20 feet and would provide a 6 dB(A) reduction in noise at 3 of the impacted receptors, representing all receptors benefitted but with no receptor achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 14,175 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.11 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 21 - Barrier NW21-1

A noise barrier was investigated to abate the predicted traffic noise impacts at twelve impacted residential receptors (R0196, R0197B, R1726, R1727, R1728, R1729, R1730, R1731, R1927, R5228, and R5237) along DSA2 in Noise Study Area (NSA) 21, south of the proposed route and east of the West Lake Road overpass. Barrier NW21-1 is 1,846 feet long with a height of 20 feet and would provide a 6 to 13 dB(A) reduction in noise at 7 of the impacted receptors, with 7 total receptors benefitted including five receptors achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 5,278 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibits 2.11 and 2.13 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 21 - Barrier NW21-2

A noise barrier was investigated to abate the predicted traffic noise impacts at eleven impacted residential receptors (R0198A-C, R0203, R0204, R0205, R1731, and R5255) along DSA2 in Noise Study Area (NSA) 21, south of the proposed route in the southwest quadrant of the Bells Lake Road interchange. Barrier NW21-2 is 1,578 feet long with a height of 22 feet and would provide a 5 to 6 dB(A) reduction in noise at four of the impacted receptors, representing all receptors benefitted but with no receptors achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 8,681 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.13 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 22 - Barrier NW22

A noise barrier was investigated to abate the predicted traffic noise impacts at four impacted residential receptors (R0214A-B and R0215A-B) along DSA2 in Noise Study Area (NSA) 22, north of the proposed route in the northwest quadrant of the Bells Lake Road interchange. Barrier NW22 is 1,725 feet long, with a height of 24 feet and would not provide at least a 5 dB(A) reduction in noise at any of the impacted receptors. Six total receptors would be benefitted, including 5 achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 6,909 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered neither feasible nor reasonable and is not recommended for further consideration. See Exhibit 2.12 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 23 – No Barrier

Within Noise Study Area 23, located north of DSA 2 and east of Bells Lake Road, 11 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.12 for a location map of this Noise Study Area.

Noise Study Area 24 - Barrier NW24

A noise barrier was investigated to abate the predicted traffic noise impacts at 21 impacted residential receptors (R0243, R0244A-B, R0245A-B, R0246A-B, R0247A-C, R0248, R1733, R1737A-B, R2323A-D, R5262, R5266, R5310, and R5316) along DSA2 in Noise Study Area (NSA) 24, south of the proposed route and west of the Deer Meadows Drive overpass. Barrier NW24 is 2,308 feet long with a height of 20 feet and would provide a 5 to 12 dB(A) reduction in noise at 16 of the impacted receptors, with 21 total receptors benefitted including 8 receptors achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,199 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.14 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 25 - Barrier NW25

A noise barrier was investigated to abate the predicted traffic noise impacts at 33 impacted residential receptors (R0233, R0234A-C, R0235A-B, R0236A-B, R0236F-G, R0237A-C, R0238A-C, R0239A-B, R0241A-B, R0242A-B, R0255, R0256A-B, R5281, R5282, R5284, R5288, and R5289) along DSA2 in Noise Study Area (NSA) 25, north of the proposed route between the Bells Lake Road interchange and Deer Meadows Drive. Barrier NW25 is 1,344 feet long, with a height of 22 feet and would provide a 6 to 13 dB(A) reduction in noise at 14 of the impacted receptors, with 14 total receptors benefitted including 10 receptors achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,113 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.14 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Because Rhodes Road is being bisected by DSA 2, the removal of through traffic on Rhodes results in noise levels at Receptors R5285 and R5286 being lower under the Build condition than the existing condition.

The average height of NW24 and NW25 is 21 feet and they are approximately 270 feet apart. This distance is greater than a 10:1 ratio and a degradation in noise reduction is unlikely.

Noise Study Area 26 – No Barrier

Within Noise Study Area 26, located south of Ten-Ten Road and east of Deer Meadows Road, 19 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.14 and 2.15 for a location map of this Noise Study Area.

Noise Study Area 27 - Barrier NW27

A noise barrier was investigated to abate the predicted traffic noise impacts at 21 impacted residential receptors (R0260B, R0261A-C, R0267A-B, R0268A-C, R0269, R0270, R0271A-B, R0272, R0273A-B, R0280, R1746A-B, R1747 and R1748) along DSA2 in Noise Study Area (NSA) 27, north of the proposed route between the Deer Meadows Drive and Johnson Pond Road overpasses. Barrier NW27 is 2,033 feet long, with a height of 22 feet and would provide a 5 to 14 dB(A) reduction in noise at 15 of the impacted receptors, with 15 total receptors benefitted including 9 receptors achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,986 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.15 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 28 - Barrier NW28

A noise barrier was investigated to abate the predicted traffic noise impacts at 15 impacted residential receptors (R0249, R0250A-C, R0253A-B, R0274A-C, R0277, R1744A, R1745A, R1745C, R1745F, and R1745I) along DSA2 in Noise Study Area (NSA) 28, south of the proposed route between the Deer Meadows Drive and Johnson Pond Road overpasses. Barrier NW28 is 2,036 feet long, with a height of 18 feet and would provide a 5 to 12 dB(A) reduction in noise at 13 of the impacted receptors, with 16 total receptors benefitted including 6 receptors achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,291 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.15 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 29 – No Barrier

Within Noise Study Area 29, located north of DSA 2 and east of Johnson Pond Road, four residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.15 for a location map of this Noise Study Area.

Noise Study Area 30 – No Barrier

Within Noise Study Area 30, located north of DSA 2 and west of Lake Wheeler Road, two residential receptors were studied. One receptor (R0289) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.16 for a location map of this Noise Study Area.

Noise Study Area 31 – No Barrier

Within Noise Study Area 31, located north of DSA 2 and east of Lake Wheeler Road, one residential receptor (R0290) was studied, which is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.16 for a location map of this Noise Study Area.

Noise Study Area 32 - Barrier NW32

A noise barrier was investigated to abate the predicted traffic noise impacts at 27 impacted residential receptors (R0283B, R0284A-B, R0285A-B, R0286A-B, R0287A-B, R0288, R1753A-B, R1754, R5332, R5333, R5334, R5336, R5337, R5339, R5340, R5341, R5342, R5343, and R5344) along DSA2 in Noise Study Area (NSA) 32, south of the proposed route at the bridge over Lake Wheeler Road. Barrier NW32 is 3,036 feet long with a height of 18 feet and together would provide a 5 to 10 dB(A) reduction in noise at 18 of the impacted receptors, with 20 total receptors benefitted, including 8 receptors achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,733 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.16 and 2.17 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 33 – No Barrier

Within Noise Study Area 33, located north of DSA 2 and west of Fayetteville Road, 32 residential receptors were studied. One receptor (R5353) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.17 and 2.19 for a location map of this Noise Study Area.

Noise Study Area 34 – No Barrier

Within Noise Study Area 34, along relocated Donny Brook Road west of Fayetteville Road, 29 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA,

abatement does not need to be considered. See Exhibit 2.17 and 2.18 for a location map of this Noise Study Area.

Noise Study Area 35 - Barrier NW35

A noise barrier was investigated to abate the predicted traffic noise impacts at 21 impacted residential receptors (R0341F, R0341H-I, R0341K-L, R0346B-C, R0346K-L, R0347B-C, R0347K-L, R0349F, R0350A-C, R0350E-F, and R0350H-I) located along US401 in Noise Study Area (NSA) 35, south of the proposed DSA2 route at the entrance to a residential complex off Education Road. Barrier NW35 is 694 feet long, divided between two segments. Each has a height of 18 feet and together would provide a 5 to 15 dB(A) reduction in noise at 16 of the impacted receptors, with 34 total receptors benefitted including 19 receptors achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,000 square feet and the wall would be 367 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.18 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 36 – No Barrier

Within Noise Study Area 36, located north of DSA 2 and east of Fayetteville Road, 12 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.19 for a location map of this Noise Study Area.

Noise Study Area 37 – No Barrier

Within Noise Study Area 37, located north of DSA 2 and west of Old McCullers Road, four residential receptors were studied. One receptor (R5361) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefitted by abatement to meet feasibility requirements. See Exhibit 2.19 for a location map of this Noise Study Area.

Noise Study Area 38 – No Barrier

Within Noise Study Area 38, located south of DSA 2 and east of Fayetteville Road, three institutional receptors (school buildings) and one residential receptor were studied. One receptor (R5362) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefitted by abatement to meet feasibility requirements. See Exhibit 2.18 for a location map of this Noise Study Area.

Noise Study Area 39 – No Barrier

Within Noise Study Area 39, located north of DSA 2 and west of Fanny Brown Road, three residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.20 for a location map of this Noise Study Area.

Noise Study Area 40 – No Barrier

Within Noise Study Area 40, located south of DSA 2 and west of Fanny Brown Road, one residential receptor (R0359) was studied, which is not predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.20 for a location map of this Noise Study Area.

Noise Study Area 41 - Barrier NW41

A noise barrier was investigated to abate the predicted traffic noise impacts at two impacted residential receptors (R0363B-C) along DSA2 in Noise Study Area (NSA) 41, located south of the proposed route and east of the Fanny Brown Road overpass. Barrier NW41 is 887 feet long, with a height of 13 feet and would provide a 5 dB(A) to 7 dB(A) reduction in noise at both of the impacted receptors, with 4 total receptors benefitted but including 2 achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 3,000 square feet and the wall would be 2,889 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.20 and 2.21 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 42 – No Barrier

Within Noise Study Area 42, located south of DSA 2 and west of Old Stage Road, 35 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.21 and 2.22 for a location map of this Noise Study Area.

Noise Study Area 43 - Barrier NW43

A noise barrier was investigated to abate the predicted traffic noise impacts at three impacted residential receptors (R0387A-B, and R0388B) along DSA2 in Noise Study Area (NSA) 43, located north of the proposed route in the northwest quadrant of the Old Stage Road interchange. Barrier NW43 is 1,141 feet long with a height of 16 feet and would provide a 5 dB(A) reduction in noise at two impacted receptors, with 2 total receptors benefitted but no receptors achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 9,135 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibits 2.21 and 2.23 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 44 – No Barrier

Within Noise Study Area 44, located north of DSA 2 and east of Old Stage Road, 11 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.23 for a location map of this Noise Study Area.

Noise Study Area 45 – No Barrier

Within Noise Study Area 45, located south of DSA 2 and east of Old Stage Road, three residential receptors and one place of worship were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.22 for a location map of this Noise Study Area.

Noise Study Area 46 – No Barrier

Within Noise Study Area 46, located north of DSA 2 and west of Holland Church Road, two residential receptors were studied. One receptor (R5374) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.24 for a location map of this Noise Study Area.

Noise Study Area 47 – No Barrier

Within Noise Study Area 47, located north of DSA 2 and east of Holland Church Road, three residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.24 for a location map of this Noise Study Area.

Noise Study Area 48 – No Barrier

Within Noise Study Area 48, located south of DSA 2 and west of Old Stage Road, one residential receptor was studied, which is not predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.25 for a location map of this Noise Study Area.

Noise Study Area 49 - Barrier NW49-1

A noise barrier was investigated to abate the predicted traffic noise impacts to nine impacted residential receptors (R0483A-B, R5379, R5380, R5381, R5382, R5383, R5384, R5385, and R5628) along DSA2 in Noise Study Area (NSA) 49, located south of the proposed route, west of the Sauls Road overpass. Barrier NW49-1 is 1,841 feet long, with a height of 22 feet and would provide a 5 to 6 dB(A) reduction in noise at 8 of the impacted receptors, with 8 total receptors benefitted but no receptors achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 5,065 square feet per benefitted receptor which is greater than the allowance. This barrier is

preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.25 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 49 - Barrier NW49-2

A noise barrier was investigated to abate the predicted traffic noise impacts at 17 impacted residential receptors (R0517, R0518A-C, R0519A-B, R0520A-B, R0521A-B, and R1653A-C) along DSA2 in Noise Study Area (NSA) 49, south of the proposed route and west of the Sauls Road overpass. Barrier NW49-2 is 2,130 feet long, with a height of 16 feet and would provide a 5 to 7 dB(A) reduction in noise at 6 of the impacted receptors, representing all receptors benefitted including one receptor achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 5,678 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibits 2.25 and 2.26 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 50 - Barrier NW50

A noise barrier was investigated to abate the predicted traffic noise impacts at 25 impacted residential receptors (R0497A-C, R0498A-C, R0499A-C, R0500A-B, R0501A-B, R0502A-B, R0503A-B, R504A, R0505A-B, R0506A-B, R1764A-B, and R1765) along DSA2 in Noise Study Area (NSA) 50, located north of the proposed route, east of the Sauls Road overpass. Barrier NW50 is 2,708 feet long, with a height of 14 feet and would provide a 5 to 9 dB(A) reduction in noise at 14 of the impacted receptors, representing all receptors benefitted and including six receptors achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,474 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.25 and 2.26 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 51 – No Barrier

Within Noise Study Area 51, located north of DSA 2 and east of Sauls Road, 18 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.26 for a location map of this Noise Study Area.

Noise Study Area 52 - Barrier NW52

A noise barrier was investigated to abate the predicted traffic noise impacts at seven impacted residential receptors (R0544A-B, R0545, R0546, R5414, R5415, and R5430) along DSA2 in Noise Study Area (NSA) 52, located south of the proposed route and east of the Sauls Road overpass. Barrier NW52 is 1,748 feet long, with a height of 22 feet and would provide a 5 to 12 dB(A) reduction in noise at 6 of the

impacted receptors, representing all receptors benefitted and including four receptors achieving at least a 7dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 6,414 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.26 and 2.27 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 53 - Barrier NW53

A noise barrier was investigated to abate the predicted traffic noise impacts at 23 impacted residential receptors (R0547, R0551A-B, R0552, R0553, R0554A-B, R0555A, R0556A-C, R0557A-B, R0558A-B, R0559A-C, R0562, and R0563A-B) along DSA2 in Noise Study Area (NSA) 53, north of the proposed route and east of the Sauls Road overpass. Barrier NW53 is 3,844 feet long, with a height of 21 feet and would provide a 5 to 13 dB(A) reduction in noise at 22 of the impacted receptors, with 32 total receptors benefitted including 16 receptors achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,500 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibits 2.26 and 2.27 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 54 - Barrier NW54

A noise barrier was investigated to abate the predicted traffic noise impacts at nine impacted residential and recreational receptors (R0644, R0645A-B, R0646, R0647, R0652A-B, R1632, and R2281) along DSA2 in Noise Study Area (NSA) 54, located south of the proposed route in the vicinity of the Jordan Road overpass. Barrier NW54 is 2,335 feet long, with a height of 16 feet and would provide a 5 to 9 dB(A) reduction in noise at 8 of the impacted receptors, with 8 total receptors benefitted including 3 receptors receiving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 4,667 square feet per benefitted receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.29 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 55 - Barrier NW55-1

A noise barrier was investigated to abate the predicted traffic noise impacts at 14 impacted residential receptors (R0637, R0638, R0641A-C, R0642A-B, R0643, R2282A-B, R5438, R5439, R5443, and R5444) along DSA2 in Noise Study Area (NSA) 55, located north of the proposed route at the Jordan Road overpass. Barrier NW55-1 is 1,971 feet long, with a height of 14 feet and would provide a 5 to 8 dB(A) reduction in noise at 6 of the impacted receptors, with 7 total receptors benefitted including 2

receptors receiving at least a 7 dB(A) reduction. The maximum wall allowance per benefited receptor for this barrier is 2,500 square feet and the wall would be 3,944 square feet per benefited receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.28 and 2.29 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 55 - Barrier NW55-2

A noise barrier was investigated to abate the predicted traffic noise impacts at 8 impacted residential receptors (R0745A-B, R0746A-C and R0747A-C) along DSA2 in Noise Study Area (NSA) 55, located north of the proposed route and west of the NC50 Benson Road interchange. Barrier NW55-2 is 1,948 feet long with a height of 14 feet and would provide a 5 to 8 dB(A) reduction in noise at 7 of the impacted receptors, with 7 total receptors benefitted including 4 receptors receiving at least a 7 dB(A) reduction. The maximum wall allowance per benefited receptor for this barrier is 2,500 square feet and the wall would be 3,895 square feet per benefited receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.29 and 2.30 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 56 – No Barrier

Within Noise Study Area 56, located north of DSA 2 and west of Benson Road, 12 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.30 for a location map of this Noise Study Area.

Noise Study Area 57 – No Barrier

Within Noise Study Area 57, located north of DSA 2 and east of Benson Road, four residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.30 for a location map of this Noise Study Area.

Noise Study Area 58 - Barrier NW58

A noise barrier was investigated to abate the predicted traffic noise impacts at three impacted residential receptors (R5457, R5458, and R5459) along DSA2 in Noise Study Area (NSA) 58, south of the proposed route in the southwest quadrant of the NC50 Benson Road interchange. Barrier NW58 is 1,551 feet long, with a height of 18 feet and would provide a 5 dB(A) reduction in noise at one of the impacted receptors, with 4 total receptors benefitted but no receptors receiving at least a 7 dB(A) reduction. The maximum wall allowance per benefited receptor for this barrier is 2,500 square feet and the wall would be 6,976 square feet per benefited receptor which is greater than the allowance. This barrier is preliminarily considered neither feasible nor reasonable and is not recommended for further consideration. See Exhibit 2.31 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 59 – No Barrier

Within Noise Study Area 59, located south of DSA 2 and east of Benson Road, 3 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.31 for a location map of this Noise Study Area.

Noise Study Area 60 - Barrier NW60

A noise barrier was investigated to abate the predicted traffic noise impacts at 22 impacted residential receptors (R0723A-B, R0724A-B, R5472, R5473, R5474, R5477, R5478, R5479, R5480, R5481, R5482, R5683, R5484, R5485, R5486, R5487, R5488, R5489, R5490, R5491, R5492, R5494, R5496, and R5608) along DSA2 in Noise Study Area (NSA) 60, located north of the proposed route and east of the interchange with NC50 Benson Road. Barrier NW60 is 3,430 feet long, with a height of 20 feet and would provide a 5 to 10 dB(A) reduction in noise at 20 of the impacted receptors, with 29 total receptors benefitted, including 19 receptors receiving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,365 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibits 2.30 and 2.32 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 61 – No Barrier

Within Noise Study Area 61, located south of DSA 2 near Reca Road, 3 residential receptors were studied. Two receptors (R5497 and R5499) are predicted to be impacted, but are separated by over 1,200 feet. Since these two impacts are effectively isolated impacts and the likelihood of a noise wall being both feasible and reasonable is extremely low, a barrier was not studied at this location. See Exhibit 2.32 for a location map of this Noise Study Area.

Noise Study Area 62 – No Barrier

Within Noise Study Area 62, south of US 70 and east of New Bethel Road, eight residential receptors were studied. One receptor (R5506) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefitted by abatement to meet feasibility requirements. See Exhibit 2.40 and 2.41 for a location map of this Noise Study Area.

Noise Study Area 63 – No Barrier

Within Noise Study Area 63, located north of I-40 along Willis Road, one residential receptor (R5507) was studied, which is not predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.41 for a location map of this Noise Study Area.

Noise Study Area 64 – No Barrier

Within Noise Study Area 64, located west of DSA 2 along New Bethel Church Road, four residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.37 for a location map of this Noise Study Area.

Noise Study Area 65 – No Barrier

Within Noise Study Area 65, located east of DSA 2 along New Bethel Church Road, 24 residential receptors were studied. One receptor (R0806) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.37 and 2.42 for a location map of this Noise Study Area.

Noise Study Area 66 – No Barrier

Within Noise Study Area 66, located west of I-40 along Win Road, three residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.38 for a location map of this Noise Study Area.

Noise Study Area 67 - Barrier NW67

A noise barrier was investigated to abate the predicted traffic noise impacts at 16 impacted residential receptors (R0856, R0857, R0858A, R0859, R0860A-B, R1843A, R5523, R5524, R5525, R5527, R5528, and R5529) along the east side of I-40 north of DSA2 in Noise Study Area (NSA) 67, approaching the northern project improvement limits. Barrier NW67 is 3,990 feet long, with a height of 16 feet and would provide a 5 to 13 dB(A) reduction in noise at 16 of the impacted receptors, with 16 total receptors benefitted including 11 receiving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 1,941 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibits 2.38 and 2.39 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 68 - Barrier NW68

A noise barrier was investigated to abate the predicted traffic noise impacts at 18 impacted residential receptors (R0916A-C, R0918A-C, R0922A-B, R0923A-B, and R0931A-B) along the west side of I-40 north of DSA2 in Noise Study Area (NSA) 68, approaching the northern project improvement limits.

Further, Receptor R2315 is an impacted recreational area (Meadow Brook Country Club golf course) near Barrier NW68. There are 6 locations (3 greens and 3 tee boxes) in the vicinity of the barrier. It can be

assumed that one group of four golfers is located at each of these 6 places at any given time, during daylight hours for ten months of the year. This comes to 3 residential equivalents for receptor 2315, represented by 6 receptors in a nodal array. Each receptor in the array will be treated as 1 residential equivalent in the barrier analysis. A calculation of the residential equivalents is included in Appendix 3.

Barrier NW68 is 2,811 feet long, with a height of 10 feet and would provide a 7 to 10 dB(A) reduction in noise at 12 of the impacted receptors, with 12 total receptors benefitted, including 9 achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,345 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.39 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

The average height of NW67 and NW68 is 13 feet and they are approximately 175 feet apart. This distance is greater than a 10:1 ratio and a degradation in noise reduction is unlikely.

Noise Study Area 69 – No Barrier

Within Noise Study Area 69, located east of DSA 2 along Redpath Road and Hillington Road, five residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.43 for a location map of this Noise Study Area.

Noise Study Area 70 – No Barrier

Within Noise Study Area 70, located east of DSA 2 and north of White Oak Road, five residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.44 for a location map of this Noise Study Area.

Noise Study Area 71 – No Barrier

Within Noise Study Area 71, located east of DSA 2 and south of White Oak Road, one residential receptor was studied, which is not predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.44 for a location map of this Noise Study Area.

Noise Study Area 72 – No Barrier

Within Noise Study Area 72, located west of DSA 2 and south of White Oak Road, 12 residential receptors were studied. One receptor (R1636) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefitted by abatement to meet feasibility requirements. See Exhibit 2.45 for a location map of this Noise Study Area.

Noise Study Area 73 – No Barrier

Within Noise Study Area 73, located west of DSA 2 near Mustard Seed Lane, 20 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.45 for a location map of this Noise Study Area.

Noise Study Area 74 – No Barrier

Within Noise Study Area 74, located east of DSA 2 near Escondido Farm Road, five residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.44 for a location map of this Noise Study Area.

Noise Study Area 75 – No Barrier

Within Noise Study Area 75, located west of DSA 2 and north of White Oak Road, 13 residential receptors and one place of worship were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.45 for a location map of this Noise Study Area.

Because Raynor Road will not have a connection to White Oak Road, the removal of through traffic on Raynor Road results in noise levels at Receptors R0905 being lower under the Build condition than the existing condition.

Noise Study Area 76 – No Barrier

Within Noise Study Area 76, located east of DSA 2 near Cabin View Lane, one residential receptor was studied, which is not predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.46 for a location map of this Noise Study Area.

Noise Study Area 77 – No Barrier

Within Noise Study Area 77, located west of DSA 2 along Lane of Sir Kay, 12 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.47 for a location map of this Noise Study Area.

Noise Study Area 78 – No Barrier

Within Noise Study Area 78, located west of DSA 2 and south of US 70, three residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.48 for a location map of this Noise Study Area.

Noise Study Area 79 – No Barrier

Within Noise Study Area 79, located west of DSA 2 and north of US 70, 24 residential receptors were studied. One receptor (R1414B) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.48 for a location map of this Noise Study Area.

Noise Study Area 80 – No Barrier

Within Noise Study Area 80, located east of DSA 2 and north of US 70, seven residential receptors were studied. One receptor (R1620) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.49 for a location map of this Noise Study Area.

Noise Study Area 81 – No Barrier

Within Noise Study Area 81, located west of DSA 2 along East Garner Road, four residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.49 for a location map of this Noise Study Area.

Noise Study Area 82 – No Barrier

Within Noise Study Area 82, located west of DSA 2 and north of Rock Quarry Road, three residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.51 for a location map of this Noise Study Area.

Noise Study Area 83 - Barrier NW83

A noise barrier was investigated to abate the predicted traffic noise impacts at three impacted residential receptors (R1469, R1470, and R5552) along DSA2 in Noise Study Area (NSA) 83, east of the proposed alignment between Rock Quarry Road interchange and Battle Bridge Road. Barrier NW83 is 1,999 feet long, with a height of 24 feet and would provide an 8 to 12 dB(A) reduction in noise at 2 of the impacted receptors, with 3 total receptors benefited, including 2 achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefited receptor for this barrier is 2,500 square feet and the wall would be 15,978 square feet per benefited receptor which is greater than the allowance. This barrier is preliminarily considered feasible but not reasonable and is not recommended for further consideration. See Exhibit 2.53 or a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 84 – No Barrier

Within Noise Study Area 84, located east of DSA 2 and south of Battle Bridge Road, 30 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.53 and 2.54 for a location map of this Noise Study Area.

Noise Study Area 85 – No Barrier

Within Noise Study Area 85, the Neuse River Trail (R5607) was studied. 1,700 feet of the trail is predicted to be impacted. During field review the trail was observed and users were canvassed to establish a typical usage level. The trail was used by 25 people during the field visit over the course of an hour and most trail users confirmed the number of people using the trail was typical. The corresponding number of residential equivalents is 1 and it is highly unlikely that the 2,500 square feet allowance would provide the minimum reduction in noise levels to be considered reasonable since a barrier would be required on each side of DSA 2. Also, since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. The calculation of the residential equivalents is included in Appendix 3. See Exhibit 2.55 for a location map of this Noise Study Area.

Noise Study Area 86 – No Barrier

Within Noise Study Area 86, located west of DSA 2 and south of Auburn Knightdale Road, 3 residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.55 for a location map of this Noise Study Area.

Noise Study Area 87 – No Barrier

Within Noise Study Area 87, located west of DSA 2 and north of Auburn Knightdale Road, three residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.55 for a location map of this Noise Study Area.

Noise Study Area 88 – No Barrier

Within Noise Study Area 88, located east of DSA 2 and north of Auburn Knightdale Road, one residential receptor was studied, which is not predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.56 for a location map of this Noise Study Area.

Noise Study Area 89 – No Barrier

Within Noise Study Area 89, located west of DSA 2 near Sidecreek Drive, one residential receptor was studied, which is not predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.56 for a location map of this Noise Study Area.

Noise Study Area 90 - Barrier NW90

A noise barrier was investigated to abate the predicted traffic noise impacts at nine impacted residential receptors (R1491, R1493A, R1495A-B, R1496B, R1497A-B, and R1499C-D) along DSA2 in Noise Study Area (NSA) 90, west of the proposed route and south of the Poole Road interchange. Barrier NW90 is 2,400 feet long, with a height of 16 feet and would provide a 7 to 12 dB(A) reduction in noise at all 9 of the impacted receptors, with 21 total receptors benefitted, including 16 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 3,000 square feet and the wall would be 1,827 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibits 2.57 and 2.58 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 91 – No Barrier

Within Noise Study Area 91, located east of DSA2 and south of Poole Road, 35 residential receptors and one recreational receptor were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.59 for a location map of this Noise Study Area.

Noise Study Area 92 - Barrier NW92

A noise barrier was investigated to abate the predicted traffic noise impacts at 25 impacted residential receptors (R1515A-B, R1516A-B, R1526, R1527, R1528A-B, R1529A-C, R1530A, R1533A-C, R1534C, R1539A-C, R1540B, R1543A-B, R1547A-B, R1548, and R5577) along DSA2 in Noise Study Area (NSA) 92, west of the proposed route between the Poole Road and I-495 interchanges. Barrier NW92 is 4,733 feet long, with a height of 18 feet and would provide a 5 to 13 dB(A) reduction in noise at 22 of the impacted receptors, with 52 total receptors benefitted, including 35 receptors achieving at least 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 3,000 square feet and the wall would be 1,638 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibits 2.58, 2.59 and 2.60 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 93 – No Barrier

Within Noise Study Area 93, located east of DSA2 and north of Poole Road, 22 residential receptors and one recreational receptor were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.59 for a location map of this Noise Study Area.

Noise Study Area 94 – No Barrier

Within Noise Study Area 94, located east of DSA 2 and south of I-64, two residential receptors were studied. One receptor (R1551) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.62 for a location map of this Noise Study Area.

Noise Study Area 95 – No Barrier

Within Noise Study Area 95, located east of DSA 2 and north of I-64, six residential receptors were studied. None is predicted to be impacted. Since no impacts are predicted in this NSA, abatement does not need to be considered. See Exhibit 2.62 for a location map of this Noise Study Area.

Noise Study Area 96 – No Barrier

Within Noise Study Area 96, located north of I-64 and west of DSA 2, five residential receptors were studied. One receptor (R1557C) is predicted to be impacted. Since only one traffic noise impact is predicted, noise abatement would not be feasible because the NCDOT policy requires at least two impacted receptors be benefited by abatement to meet feasibility requirements. See Exhibit 2.63 for a location map of this Noise Study Area.

Noise Study Area 97 - Barrier NW97

A noise barrier was investigated to abate the predicted traffic noise impacts at eight impacted residential receptors (R1559B, R1561A-B, and R1562A-C) along DSA2 in Noise Study Area (NSA) 97, west of the proposed route approaching the northern project improvement limits. Barrier NW97 is 1,362 feet long, with a height of 16 feet and would provide a 5 to 10 dB(A) reduction in noise at all of the impacted receptors, with 9 total receptors benefitted, including 3 receptors achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,500 square feet and the wall would be 2,423 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.63 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

Noise Study Area 98 - Barrier NW98

A noise barrier was investigated to abate the predicted traffic noise impacts at 42 impacted residential receptors (R2303C, R2304A-C, R2305A-C, R2306A-C, R2307A-C, R2308A-B, R2309A-B, R2310A-C, R2334A-C and R8001-R8019) along DSA2 in Noise Study Area (NSA) 98, east of the proposed route approaching the northern project improvement limits. Barrier NW98 is 2,389 feet long, with a height of 18 feet and would provide a 5 to 9 dB(A) reduction in noise at 34 of the impacted receptors, with 35 total benefitted receptors, including 22 receptors achieving at least a 7 dB(A) reduction. The maximum wall allowance per benefitted receptor for this barrier is 2,000 square feet and the wall would be 1,229 square feet per benefitted receptor which is less than the allowance. This barrier is preliminarily considered feasible and reasonable and is recommended for further consideration. See Exhibit 2.63 and 2.64 for a location map of this barrier and Appendix 3 for the noise barrier analysis details.

The average height of NW97 and NW98 is 17 feet and they are approximately 300 feet apart. This distance is greater than a 10:1 ratio and a degradation in noise reduction is unlikely.

8 Construction Noise

The predominant construction activities associated with this project are expected to be earth removal, hauling, grading, and paving. Temporary and localized construction noise impacts will likely occur as a result of these activities. During daytime hours, the predicted effects of these impacts will be temporary speech interference for passers-by and those individuals living or working near the project. During evening and nighttime hours, steady-state construction noise emissions such as from paving operations will be audible, and may cause impacts to activities such as sleep. Sporadic evening and nighttime construction equipment noise emissions such as from backup alarms, lift gate closures (“slamming” of dump truck gates), etc., will be perceived as distinctly louder than the steady-state acoustic environment, and will likely cause impacts to the general peace and usage of noise-sensitive receptors – particularly residences, hospitals, and hotels. Extremely loud construction noise activities such as usage of pile-drivers and impact-hammers (jack hammer, hoe-ram) will cause temporary, sporadic, and acute construction noise impacts in isolated areas.

Generally, low-cost and easy-to-implement construction noise control measures should be incorporated into the project plans and specifications (e.g. work-hour limits, equipment exhaust muffler requirements, haul-road locations, elimination of “tail gate banging”, ambient-sensitive backup alarms, construction noise complaint mechanisms, and consistent and transparent community communication and rapport).

While discrete construction noise level prediction is difficult for a particular receptor or group of receptors, it can be assessed in a general capacity with respect to distance from known or likely project activities. For

this project, earth removal, grading, hauling, and paving is anticipated to occur in the near vicinity of many residential neighborhoods, four schools, and nine places of worship. Although construction noise impact abatement should not place an undue burden upon the financial cost of the project or the project construction schedule, pursuant to the requirements of 23 CFR 772.19, it is the recommendation of this traffic noise report that:

1. Earth removal, grading, hauling, and paving activities in the vicinity of the residential neighborhoods and eight places of worship (New Breed Baptist Church, Church of God in Christ Jesus, Word of Truth Church of God, Church of St. Peter's Consecrated Way, Triangle Baptist Church of Raleigh, Juniper Level Baptist Church, Mt. Herman Christian Church, Calvary Deliverance Church of Apostolic Faith) should be limited to weekday daytime hours.
2. Earth removal, grading, hauling, and paving activities in the vicinity of the Wake Technical Community College and the Panther Branch School should be performed during evening and nighttime hours, or any hours during weekends and/or holidays.
3. If meeting the project schedule requires that earth removal, grading, hauling and/or paving must occur during nighttime hours in the vicinity of one or more of the nearby residential neighborhoods, the Contractor shall notify NCDOT as soon as possible. In such instance(s), all reasonable attempts shall be made to notify and to make appropriate arrangements for the abatement of the predicted construction noise impacts upon the affected property owners and residents.
4. If construction noise activities must occur during context-sensitive hours in the vicinity of noise-sensitive areas, discrete construction noise abatement measures including, but not limited to portable noise barriers and other equipment-quieting devices shall be considered.

9 Coordination with Local Officials

The 23 CFR Part 772 states that in order to minimize future traffic noise impacts on currently undeveloped lands in the vicinity of Type I projects, a highway agency shall inform local officials within whose jurisdiction the highway project is located the distance to the exterior noise abatement criteria in Table 2. The Preferred Alternative is located in multiple local jurisdictions which are listed in Table 8.

Table 8: Local Jurisdictions within Project Area

Local Jurisdiction
Town of Apex
Town of Fuquay-Varina
Town of Cary
Town of Garner
Town of Holly Springs
Johnston County
Town of Knightdale
Wake County

To assist local authorities in exercising land use control over the undeveloped lands adjacent to the roadways proposed for this project, land use compatibility noise data was developed. Table 9 provides the typical distance at which the 66 dB(A) and 71 dB(A) noise levels occur. If no distance is provided, the contour is predicted to fall within the preliminary proposed right of way.

Although the information contained in Table 9 is based on the results of the noise modeling, it is not site-specific for any area along the proposed Preferred Alternative. Variations in terrain and the roadway profile can result in changes to the distances to these noise contours. This information is intended to provide a general guide for future planning, but should not be used in the final design or layout of future development.

Table 9: Typical Distances to 66 and 71 dB(A) Noise Contours

Segment	Distance ¹ to 66 dB(A) Contour (feet)	Distance ¹ to 71 dB(A) Contour (feet)
NC 55 Bypass to Holly Springs Road	300	175
Holly Springs Road to Bells Lake Road	350	250
Bells Lake Road to Fayetteville Highway	325	175
Fayetteville Highway to Old Stage Road	350	Inside Proposed ROW
Old Stage Road to Benson Highway	175	Inside Proposed ROW
Benson Highway to I 40	300	Inside Proposed ROW
White Oak Road to US 70	175	Inside Proposed ROW
US 70 to Old Baucom Road	250	175
Old Baucom Road to Auburn Knightdale Road	175	Inside Proposed ROW
Auburn Knightdale Road to Poole Road	250	175
Poole Road to US 64	300	175

¹Distances measured from centerline of roadway

10 Conclusion

This traffic noise analysis for the Complete 540 project (STIP R-2721, R-2828 and R-2829) was conducted according to the requirements of 23 CFR 772, the NCDOT Traffic Noise Policy (October 6, 2016) and the NCDOT Traffic Noise Manual (October 6, 2016). Noise levels for noise-sensitive land uses

along the proposed improvements were calculated using the FHWA’s Traffic Noise Model, Version 2.5. Noise impacts were predicted to occur at 818 receptors under the Preferred Alternative.

Noise abatement was considered at each impact. The findings of the abatement study are:

- Traffic management, alignment alterations, buffer zones and building insulation are not feasible abatement measures.
- Three barriers of 42 investigated were found not to be feasible.
- In total, 17 barriers were found to be feasible but were above the maximum allowable wall area per benefited receptor and are therefore not considered reasonable.
- In total, 22 barriers were preliminarily found to be both feasible and reasonable and are likely to be included in the final design.
- A Design Noise Report containing a detailed analysis and design of the reasonable and feasible barriers will be completed as part of the final design of the project.

Table 10 summarizes the noise barriers that were found to be likely to be constructed and Table 11 summarizes the noise barriers that were found to be unlikely to be constructed.

Table 10: Noise Barriers Likely to be Constructed

Barrier	Location	Feasible	Reasonable	Likely
NW1	North and East of NC 55 Bypass	Yes	Yes	Yes
NW2 and NW3	South and East of NC 55 Bypass	Yes	Yes	Yes
NW6	North and East of Sunset Lake Road	Yes	Yes	Yes
NW7	North and East of Holly Springs Road	Yes	Yes	Yes
NW11	South and East of Holly Springs Road	Yes	Yes	Yes
NW13	North and West of Kildaire Farm Road	Yes	Yes	Yes
NW19-1	Near Grandbridge Drive	Yes	Yes	Yes
NW24	South and West of Deer Meadows Drive	Yes	Yes	Yes
NW25	North and West of Deer Meadows Drive	Yes	Yes	Yes
NW28	South and East of Deer Meadows Drive	Yes	Yes	Yes
NW35	Along Fayetteville Road	Yes	Yes	Yes
NW41	South and East of Fanny Brown Road	Yes	Yes	Yes
NW50	North and West of Sauls Road	Yes	Yes	Yes
NW53	North and West of Sauls Road	Yes	Yes	Yes
NW60	North and East of Benson Road	Yes	Yes	Yes
NW67	Near Hicks Road	Yes	Yes	Yes
NW68	Near Battlefield Drive	Yes	Yes	Yes
NW90	South and West of Poole Road	Yes	Yes	Yes
NW92	North and West of Poole Road	Yes	Yes	Yes
NW97	North and West of Old Faison Road	Yes	Yes	Yes
NW98	North and East of Old Faison Road	Yes	Yes	Yes

Table 11: Noise Barriers Unlikely to be Constructed

Barrier	Location	Feasible	Reasonable	Likely
NW5	North and East of Sunset Lake Road	Yes	No	No
NW8	North and East of Sunset Lake Road	Yes	No	No
NW16	North and East of Holly Springs Road	Yes	No	No
NW18	Near Sky Meadow Drive	Yes	No	No
NW19-2	South and West of West Lake Road	No	No	No
NW20	North and West of West Lake Road	Yes	No	No
NW21-1	South and East of West Lake Road	Yes	No	No
NW21-2	South and West of Bells Lake Road	Yes	No	No
NW22	North and West of Bells Lake Road	No	No	No
NW27	North and East of Deer Meadows Drive	Yes	No	No
NW32	At Lake Wheeler Road	Yes	No	No
NW43	North and West of Old Stage Road	Yes	No	No
NW49-1	South and East of Holland Church Road	Yes	No	No
NW49-2	South and West of Sauls Road	Yes	No	No
NW52	South and West of Sauls Road	Yes	No	No
NW54	At Jordan Road - South	Yes	No	No
NW55-1	At Jordan Road - North	Yes	No	No
NW55-2	North and West of Benson Road	Yes	No	No
NW58	South and West of Benson Road	No	No	No
NW83	Near Ferndale Road	Yes	No	No

A final decision of noise barrier feasibility and reasonableness will be made upon completion of the project design and the public involvement process, concurrence with the NCDOT Policy and FHWA acceptance (as applicable). Barriers identified as “Likely” are barriers which have been preliminarily shown to be both feasible and reasonable. However, a finding of “Likely” is not a commitment to build a barrier.

The final design traffic noise analysis, documented in a Design Noise Report, will re-evaluate feasible and reasonable noise abatement for the entire project corridor and not just in areas where noise abatement has been identified in this Traffic Noise Report as being preliminarily feasible and reasonable (i.e. likely).

11 References

Federal Highway Administration. March 13, 1984. *“Analysis of Highway Construction Noise,”* Technical Advisory T6160.2, 4 pages.

Federal Highway Administration. December 2011. *“Highway Traffic Noise: Analysis and Abatement Guidance.”*

Federal Highway Administration. May 1996. *Measurement of Highway-Related Noise*, Report Number FHWA-PD-96-046, Cynthia S.Y. Lee and Gregg Fleming, 206 pages. Available from National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

Federal Highway Administration. February 2000. *FHWA Highway Noise Barrier Design Handbook*, Gregg G. Fleming, Harvey S. Knauer, Cynthia S.Y. Lee, and Soren Pedersen. Available at https://www.fhwa.dot.gov/environment/noise/noise_barriers/design_construction/design/index.cfm

Federal Highway Administration. July 2010. *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, 23 Code of Federal Regulations Part 772.

Federal Highway Administration. February 2003. *Traffic Noise Model (TNM) Version 2.5 and User Guide*.

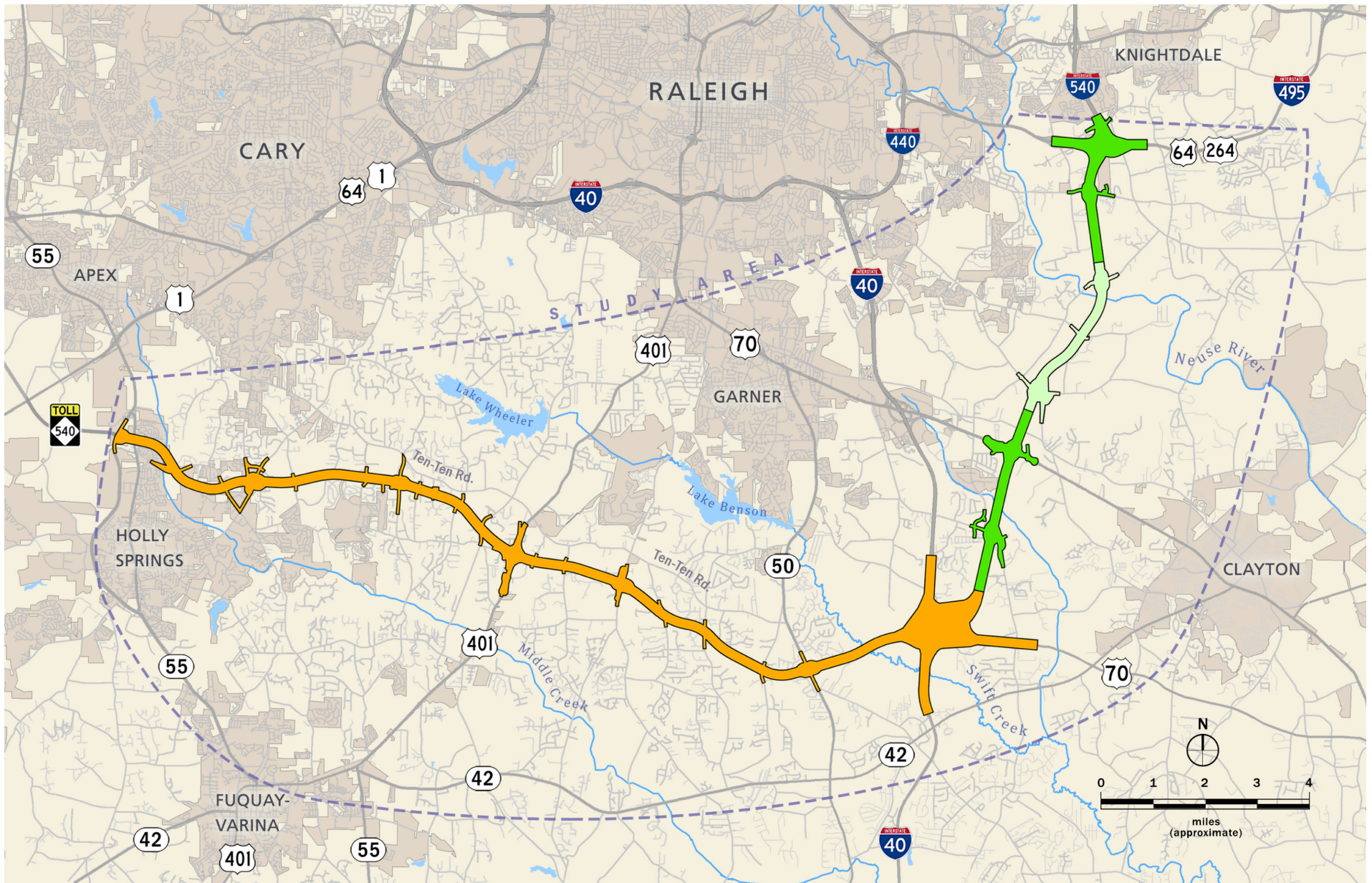
North Carolina Department of Transportation. October 2016. *Traffic Noise Policy*.

North Carolina Department of Transportation. October 2016. *Traffic Noise Manual*.

EXHIBITS

EXHIBIT 1

PROJECT LOCATION MAP



PREFERRED ALTERNATIVE

Detailed Study Alternative 2
Exhibit 1

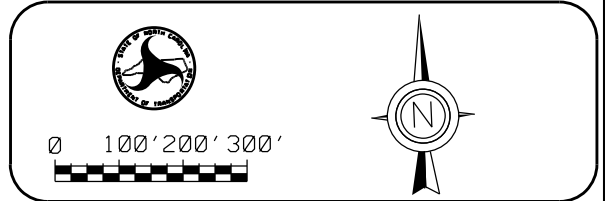
Of the seventeen Detailed Study Alternatives, Alternative 2 was selected by the Federal Highway Administration and the North Carolina Department of Transportation as the preferred alternative. This alternative consists of the Orange Segment from NC 55 Bypass to east of I-40, and the Green Segment from east of I-40 to US 64/264 Bypass. The Green Segment shifts to the Mint Green segment for a portion of its length, as shown here.

EXHIBIT 2

NOISE ANALYSIS LOCATIONS



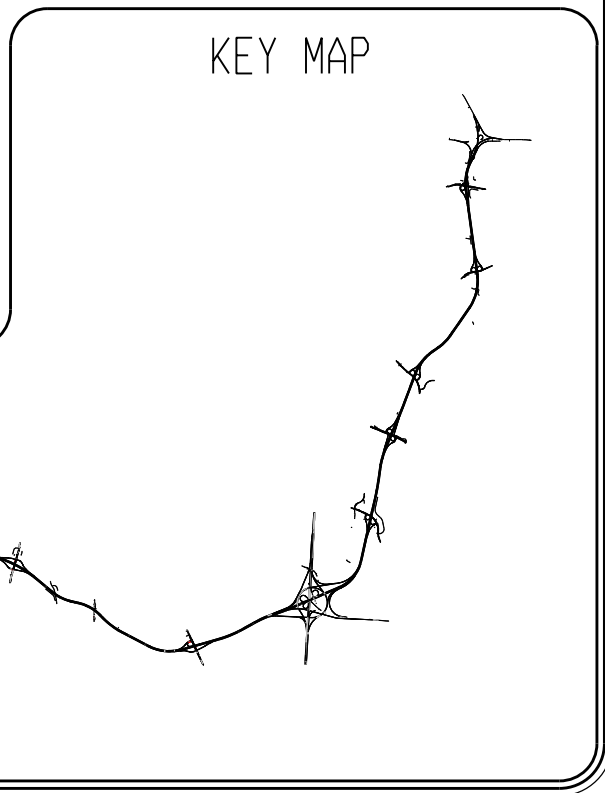
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



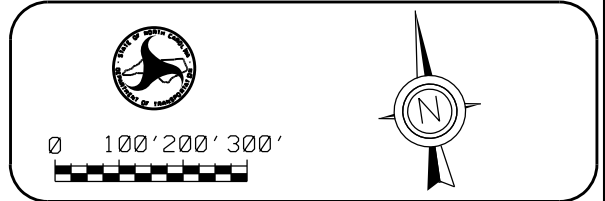
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - (thick yellow) = LIKELY NOISE WALL
 - (thin yellow) = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.1

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

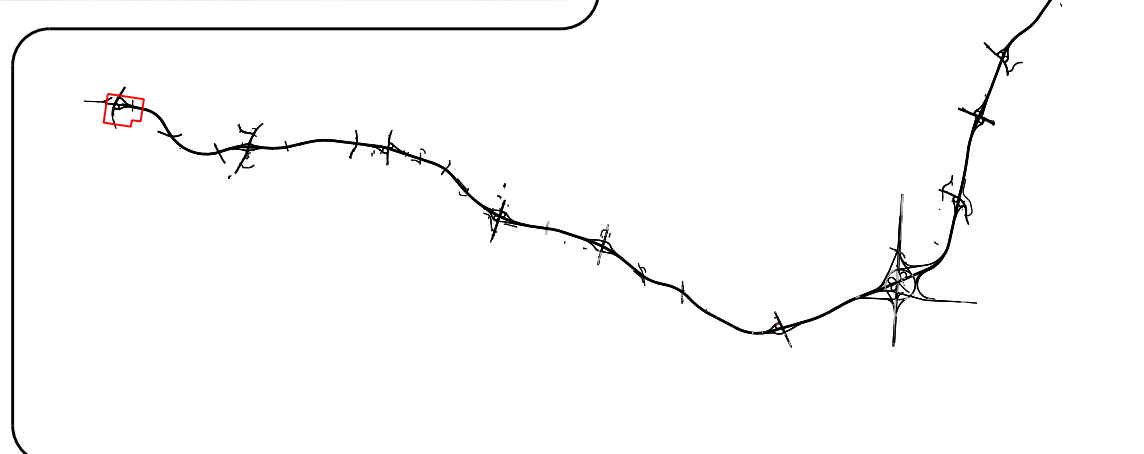
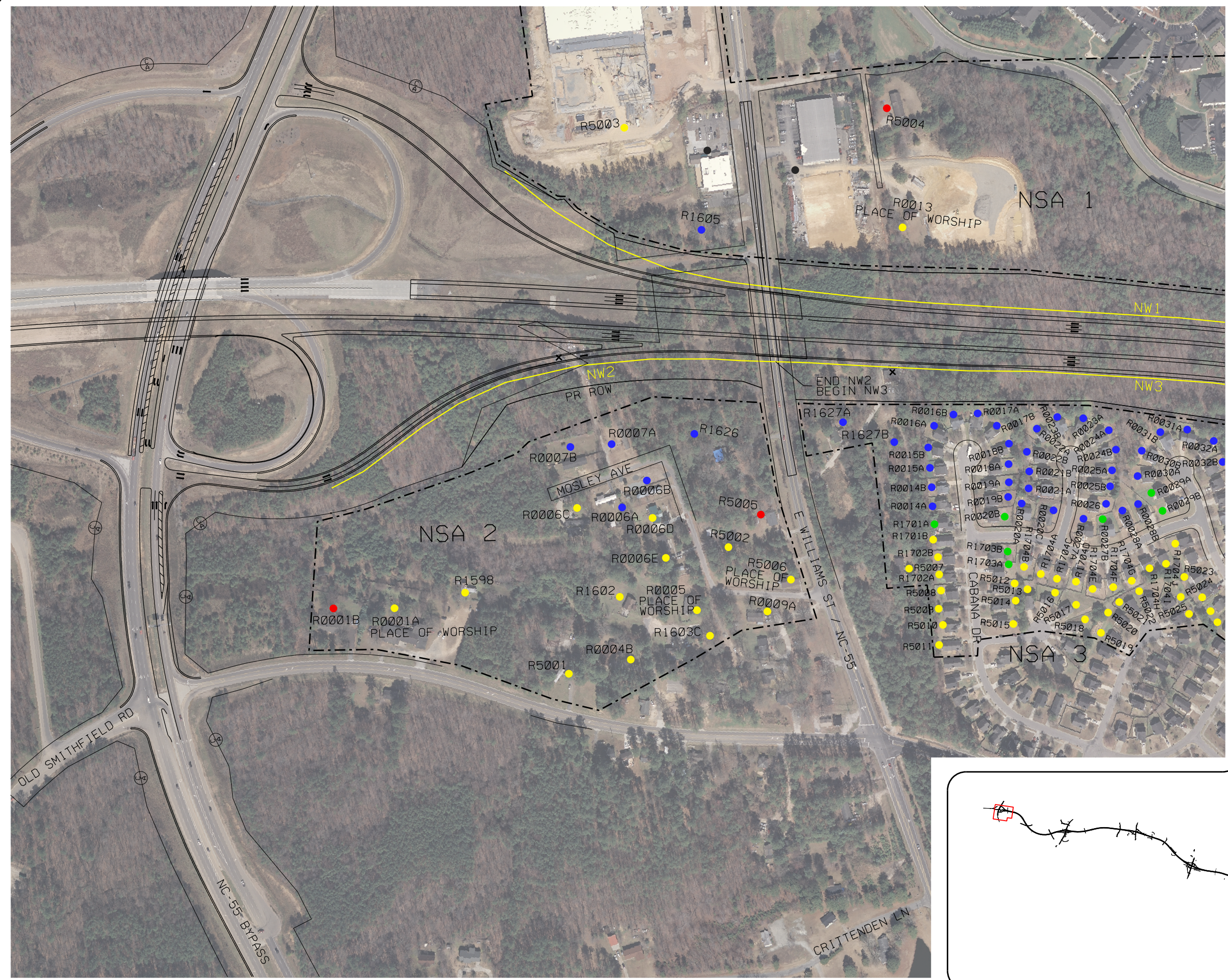


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - = UNLIKELY NOISE WALL

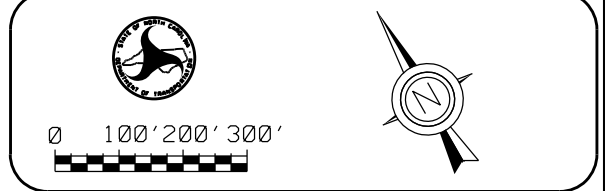
NOISE STUDY AREAS
 EXHIBIT 2.2

DECEMBER 2017

KEY MAP



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

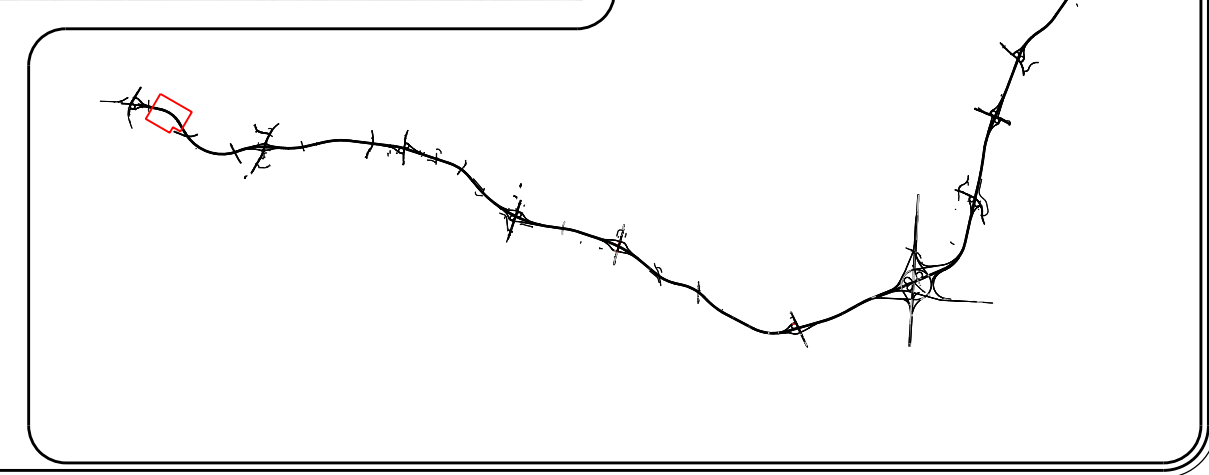
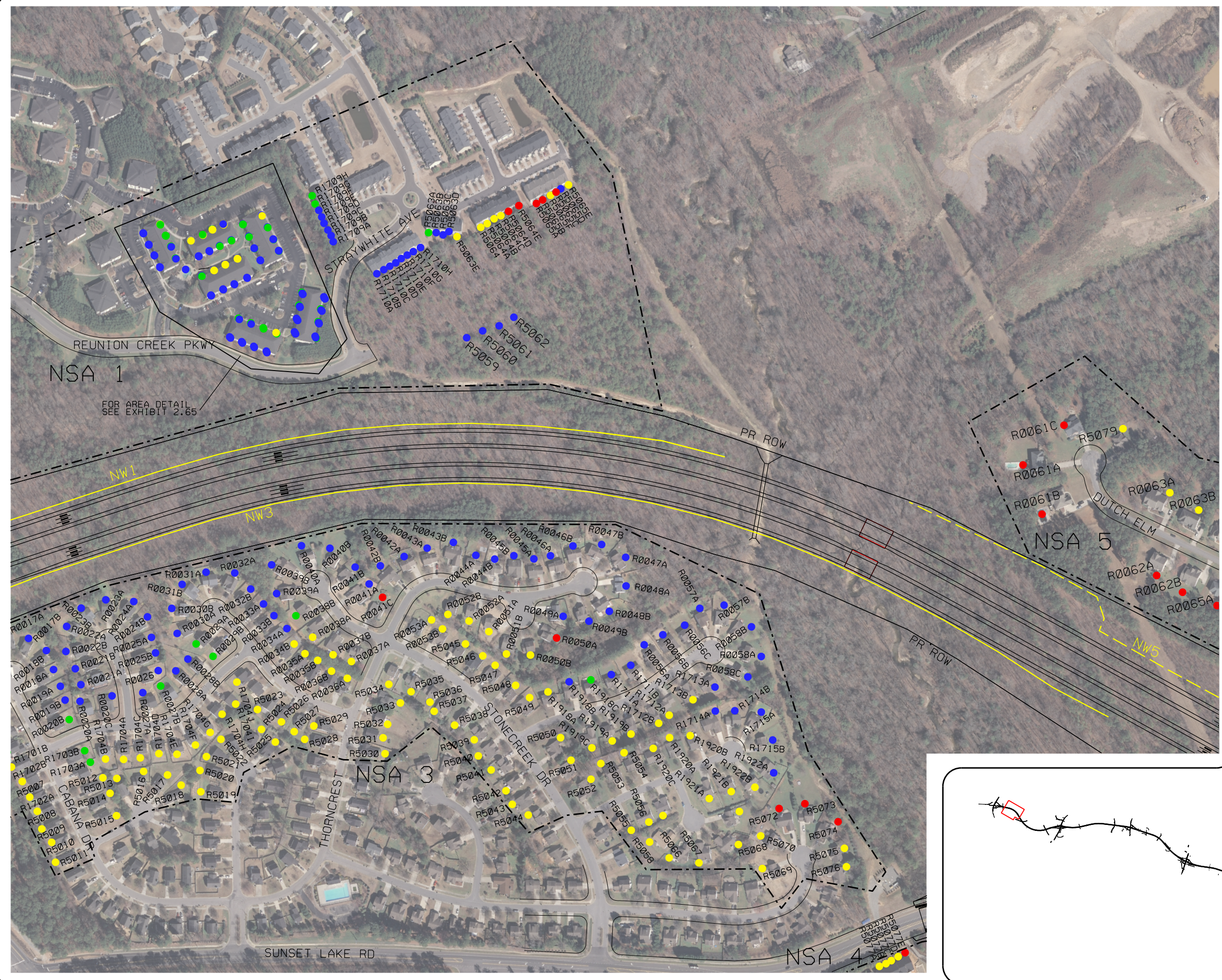


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

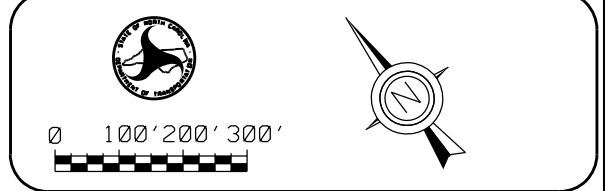
NOISE STUDY AREAS
 EXHIBIT 2.3

DECEMBER 2017

KEY MAP



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

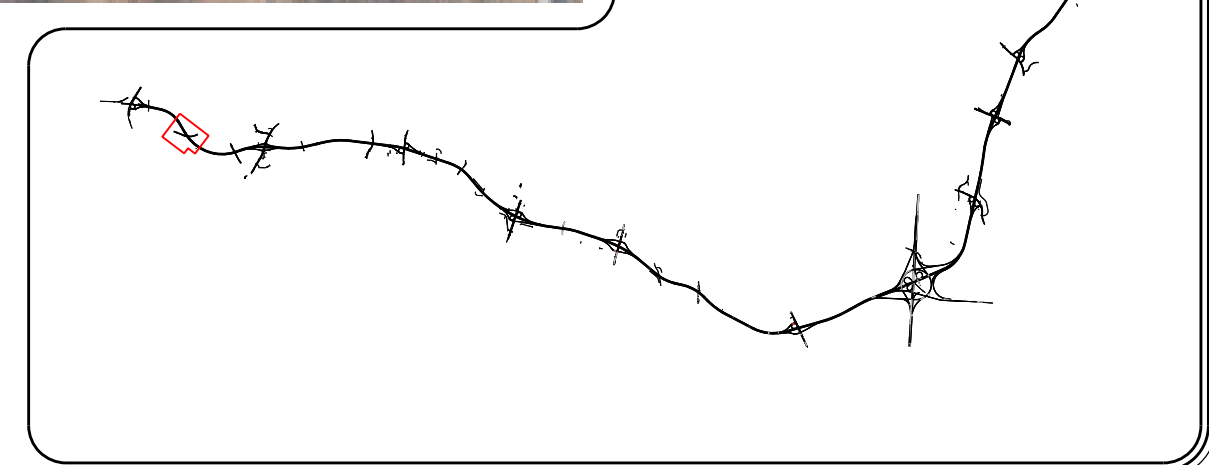
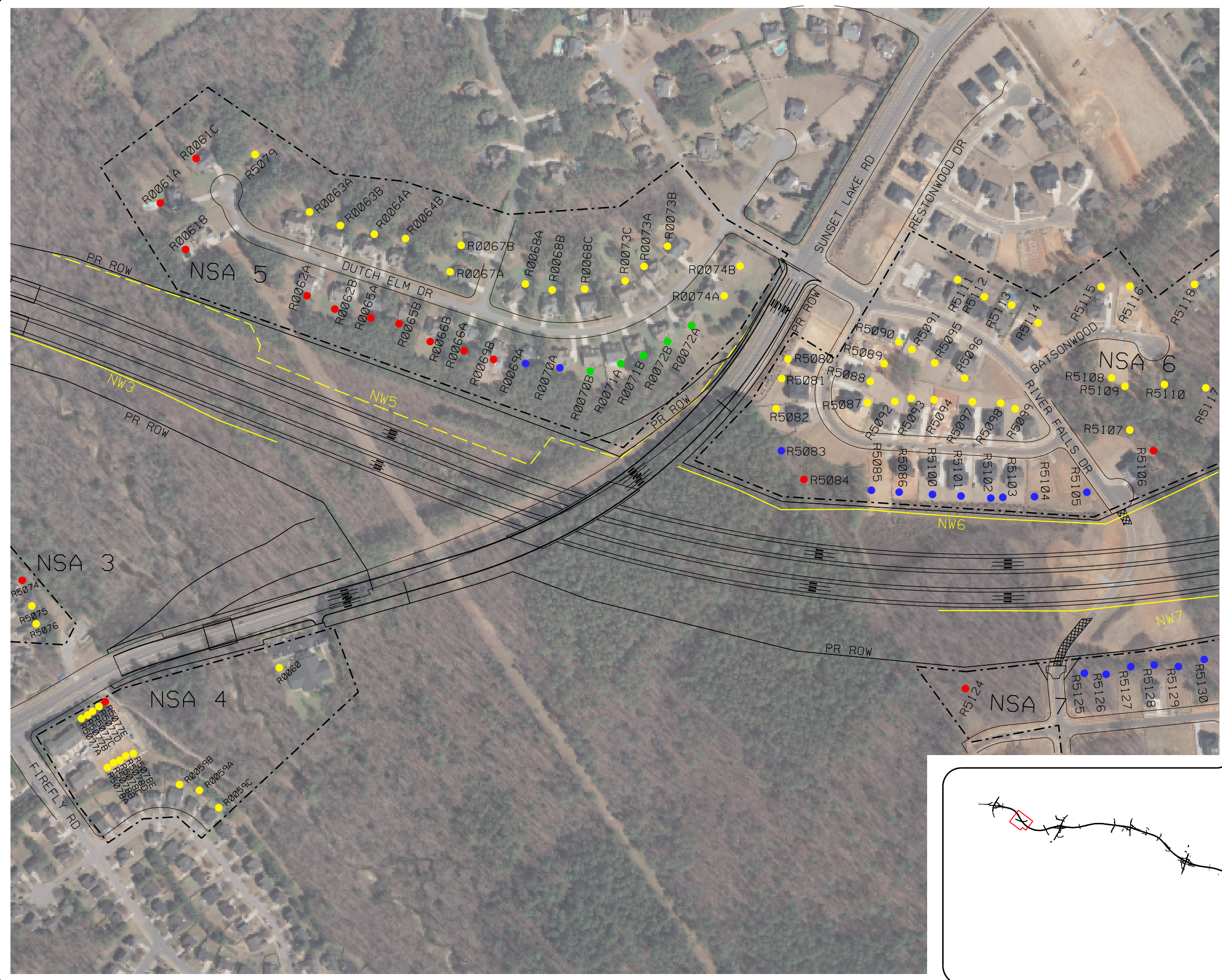


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

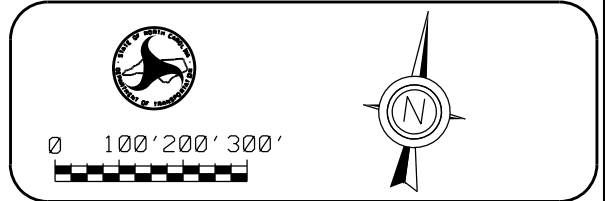
NOISE STUDY AREAS
 EXHIBIT 2.4

DECEMBER 2017

KEY MAP



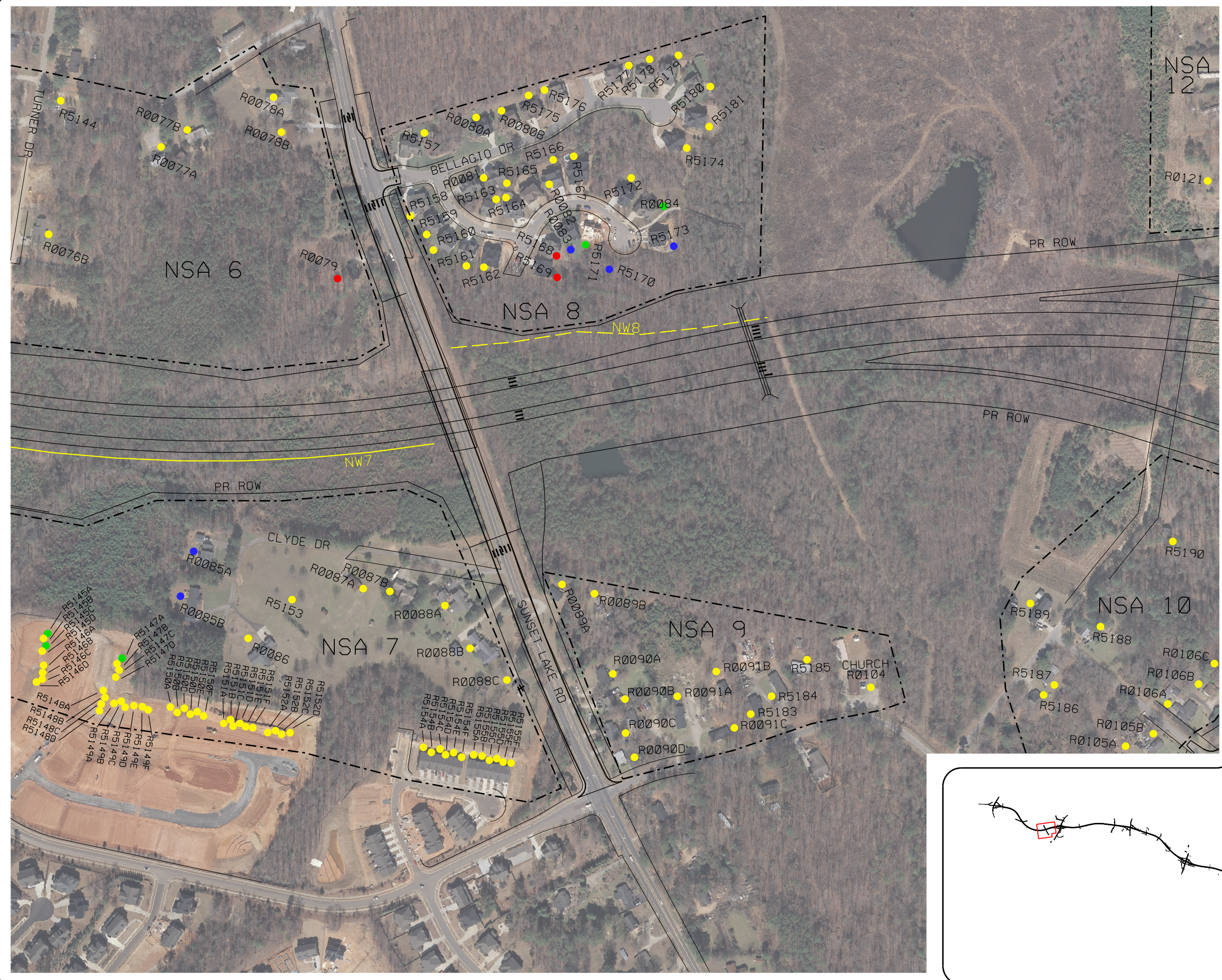
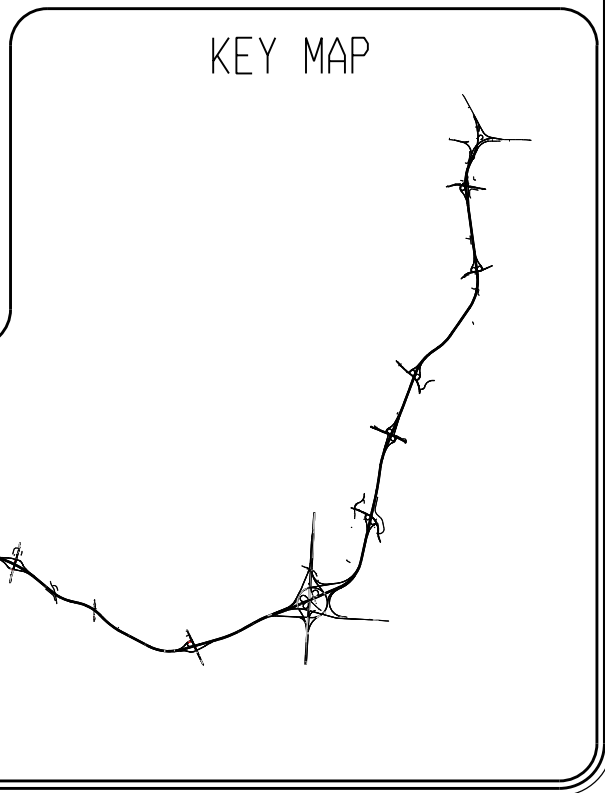
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



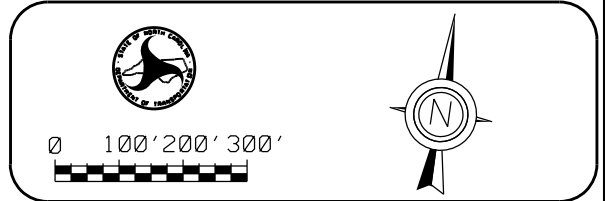
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.6

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

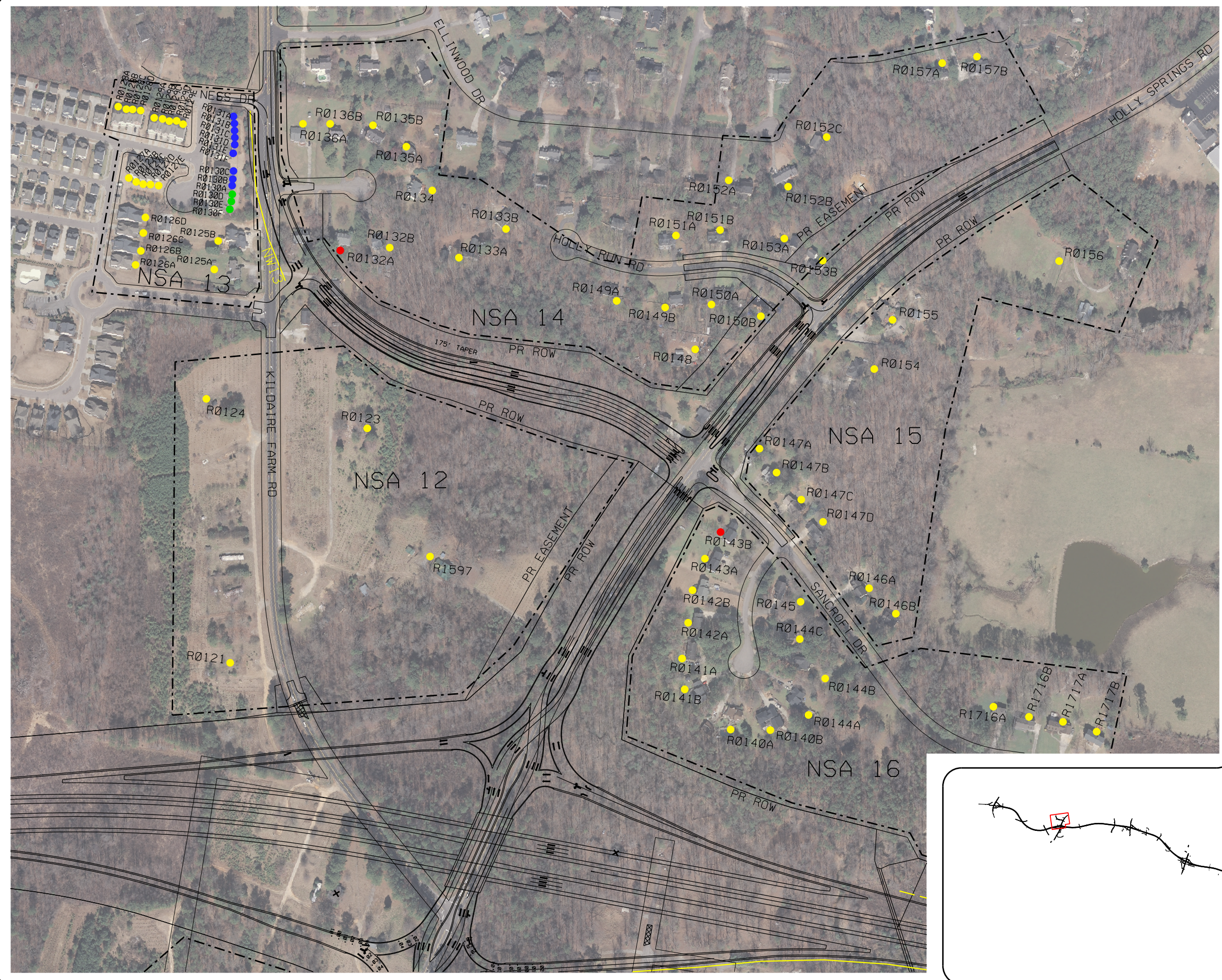
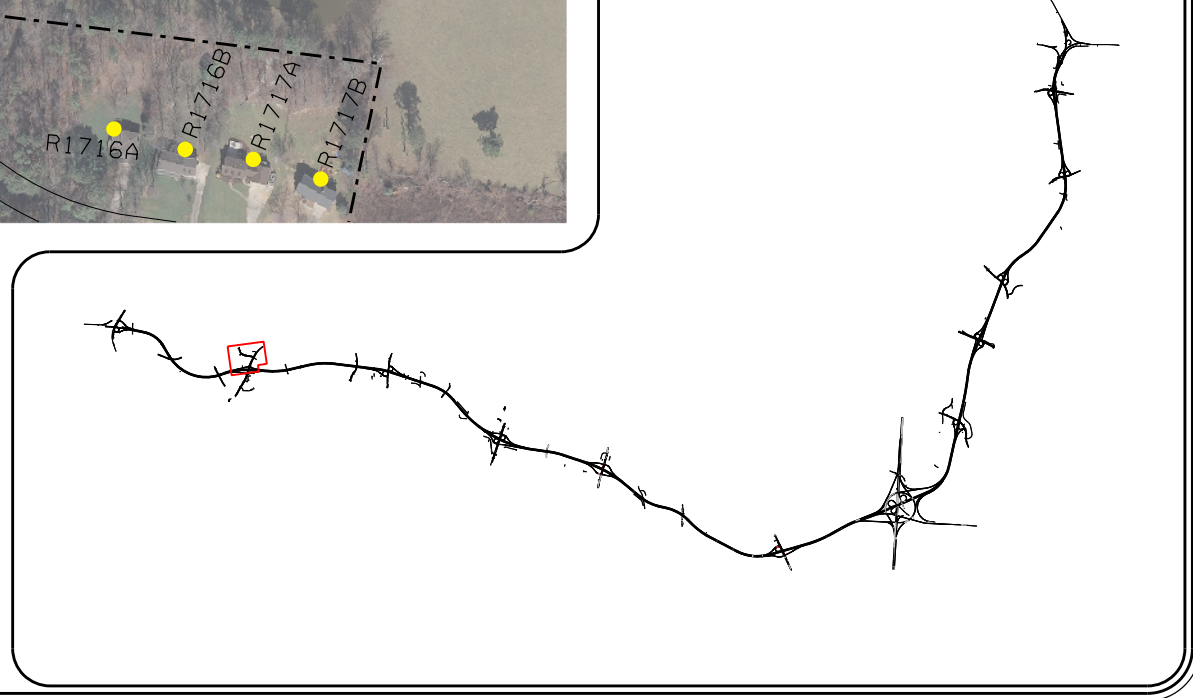


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

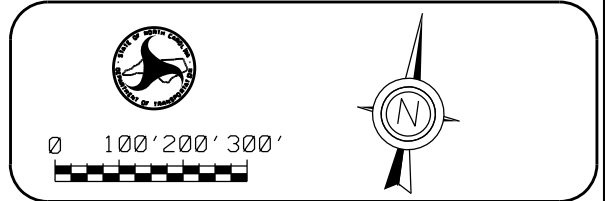
NOISE STUDY AREAS
 EXHIBIT 2.7

DECEMBER 2017

KEY MAP



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

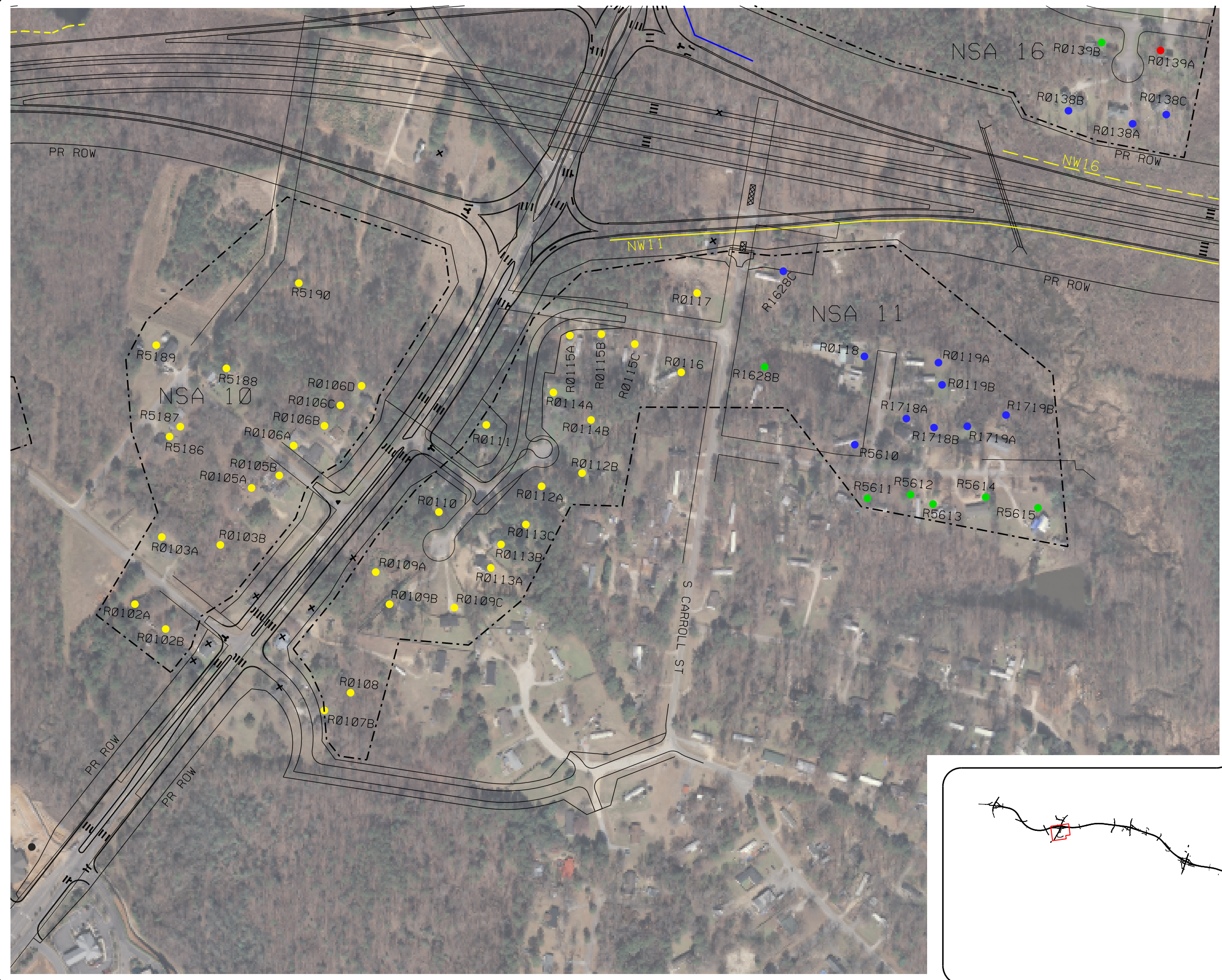
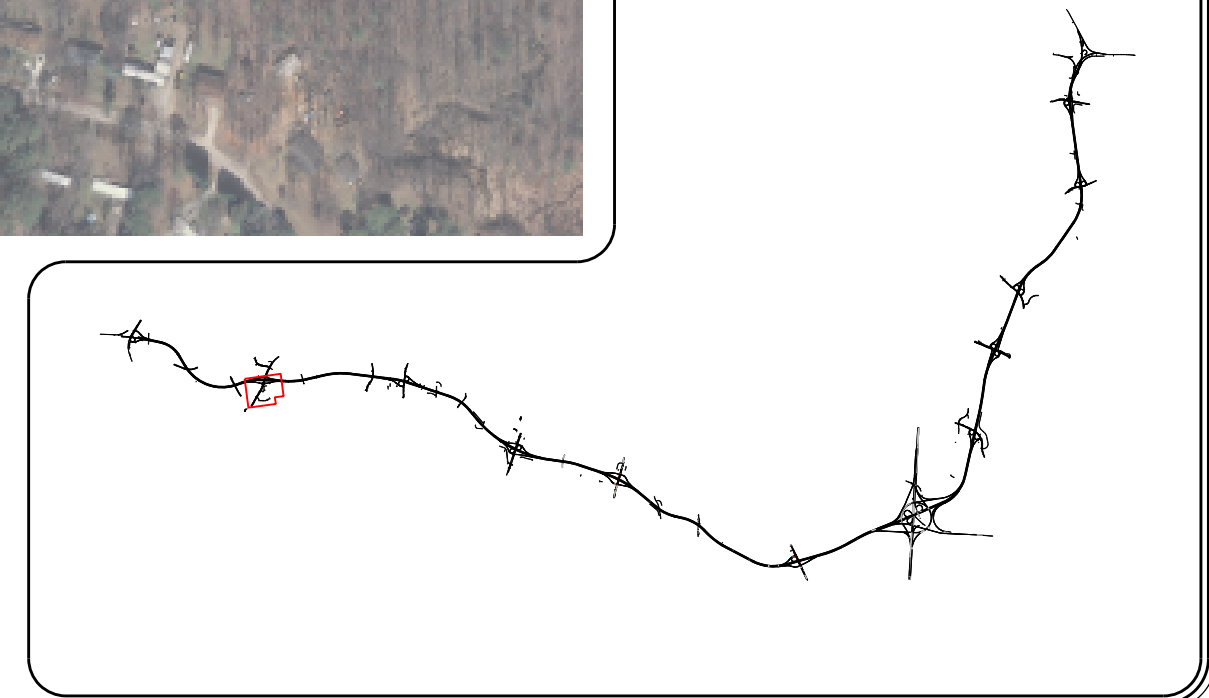


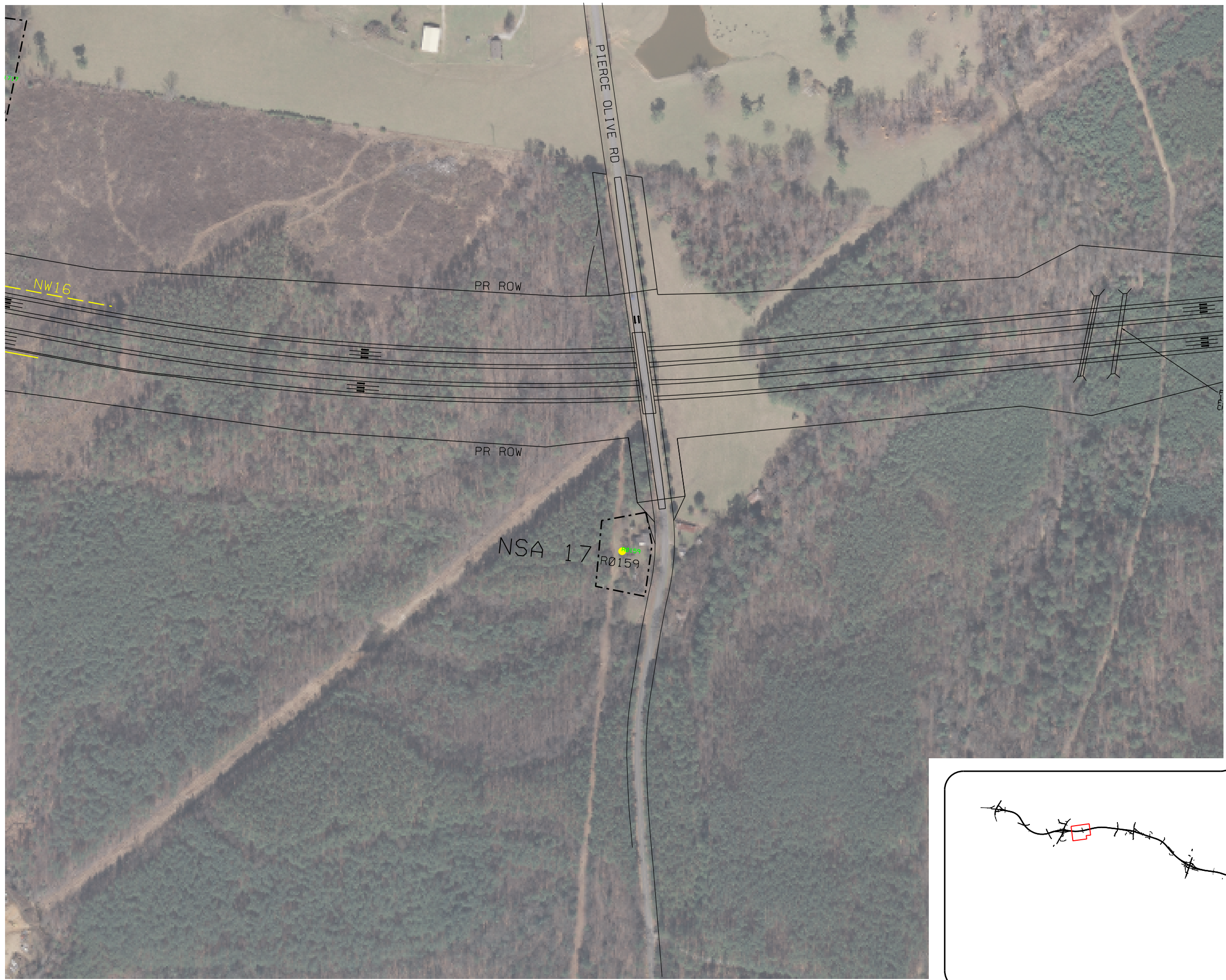
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.8

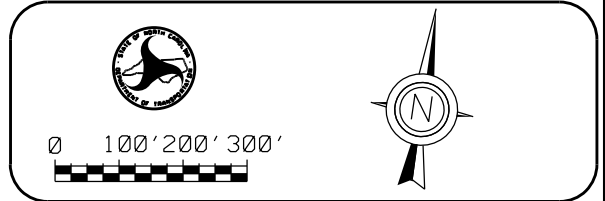
DECEMBER 2017

KEY MAP





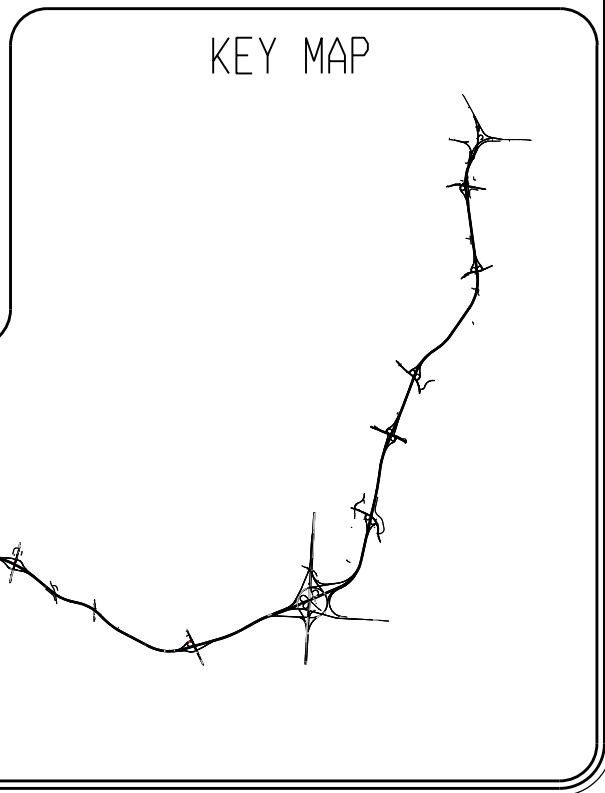
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



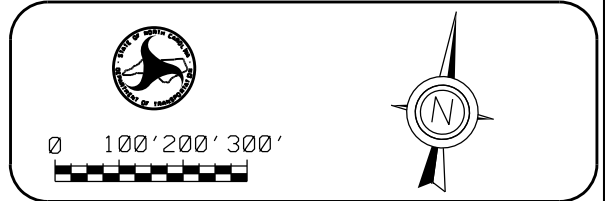
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.9

DECEMBER 2017



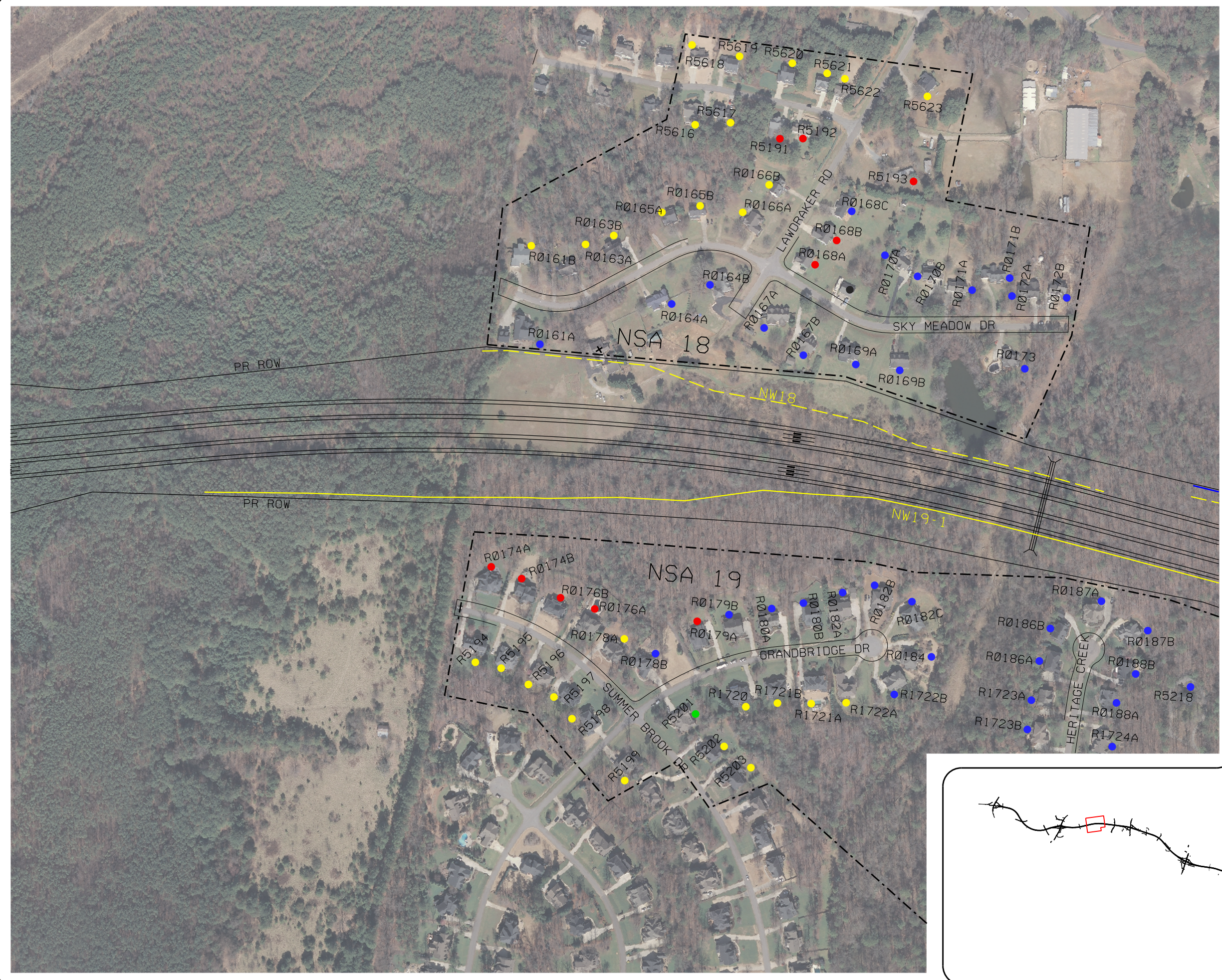
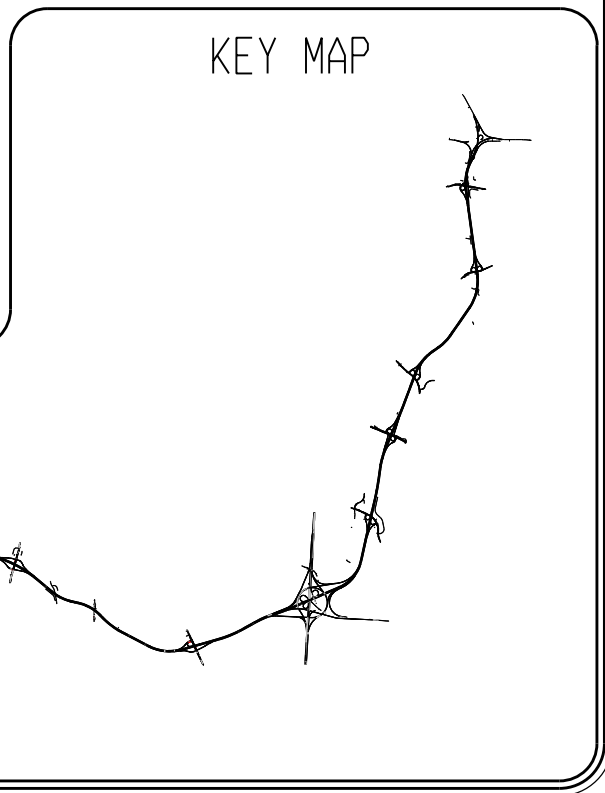
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



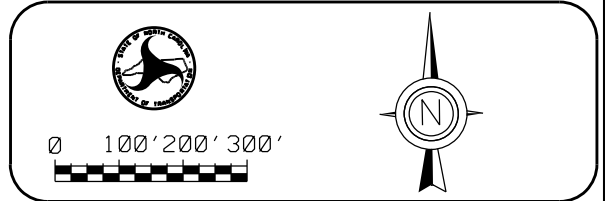
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.10

DECEMBER 2017



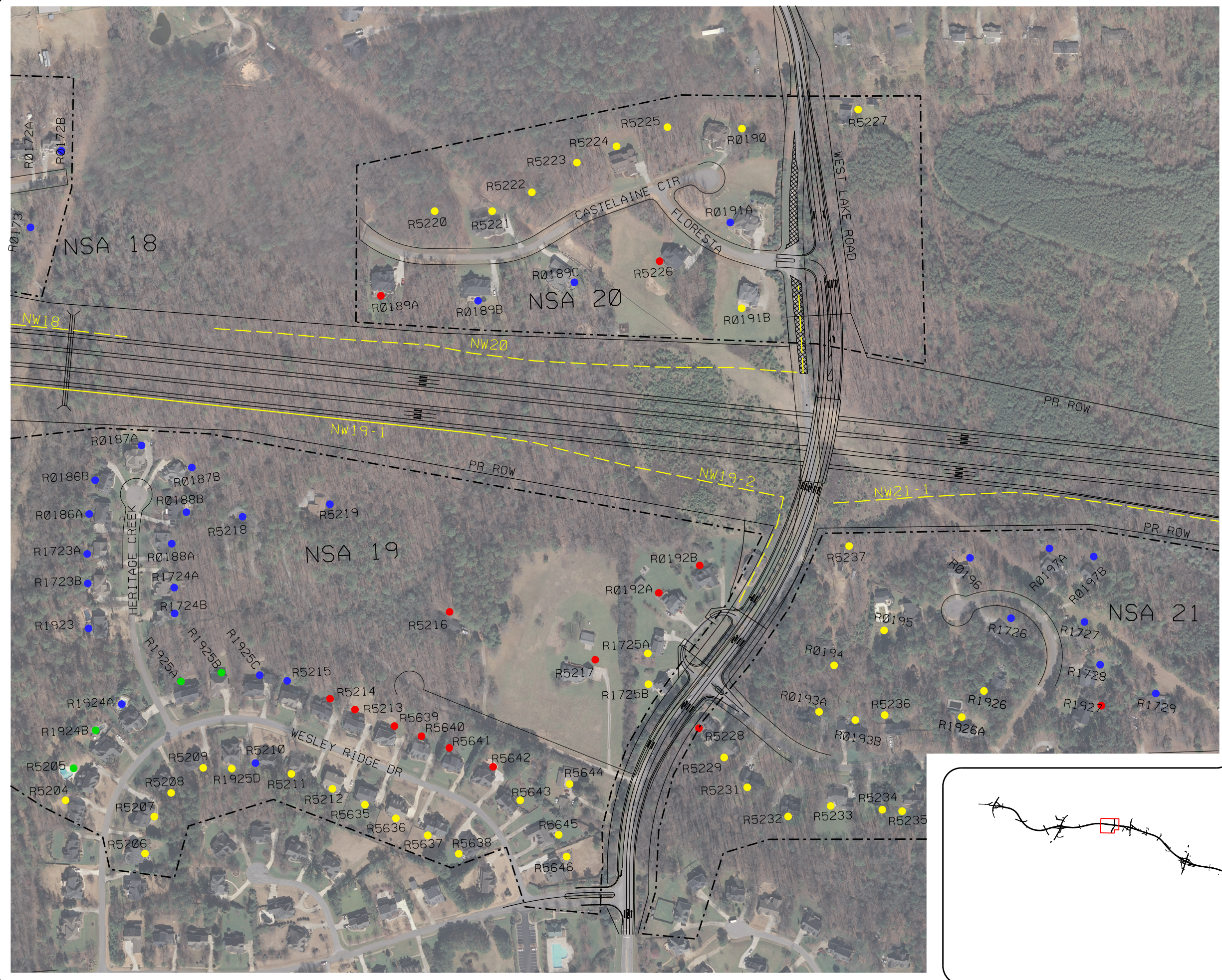
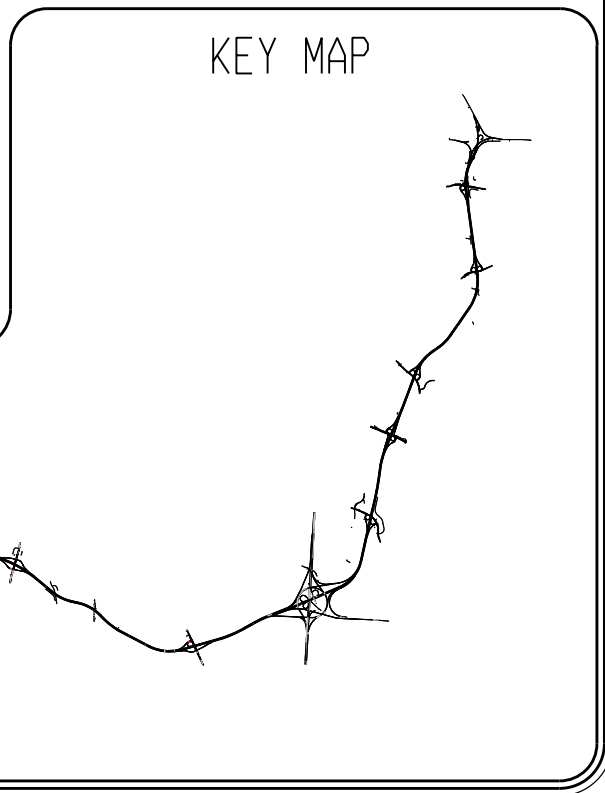
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



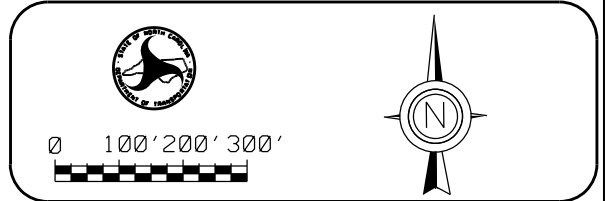
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.11

DECEMBER 2017



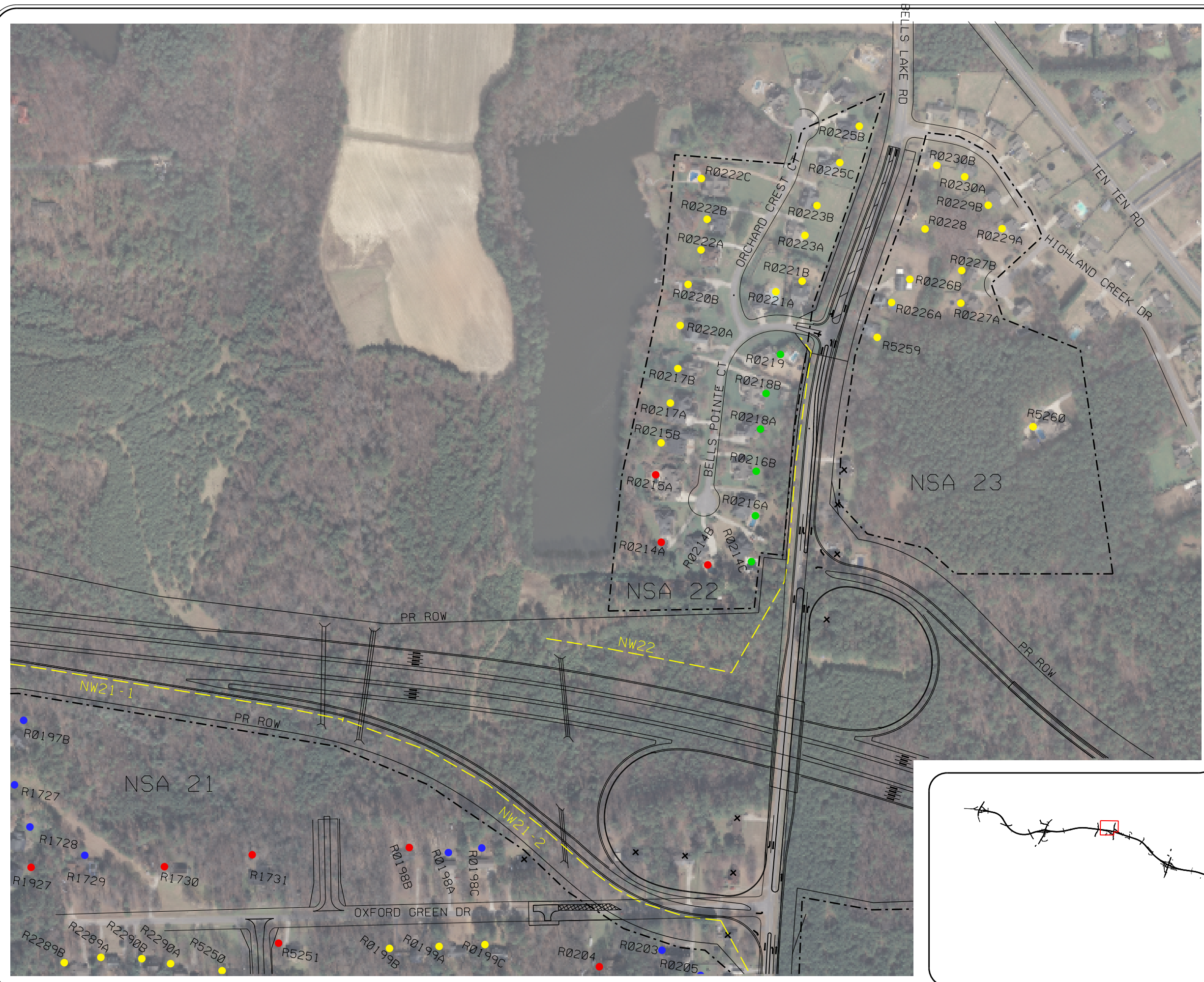
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



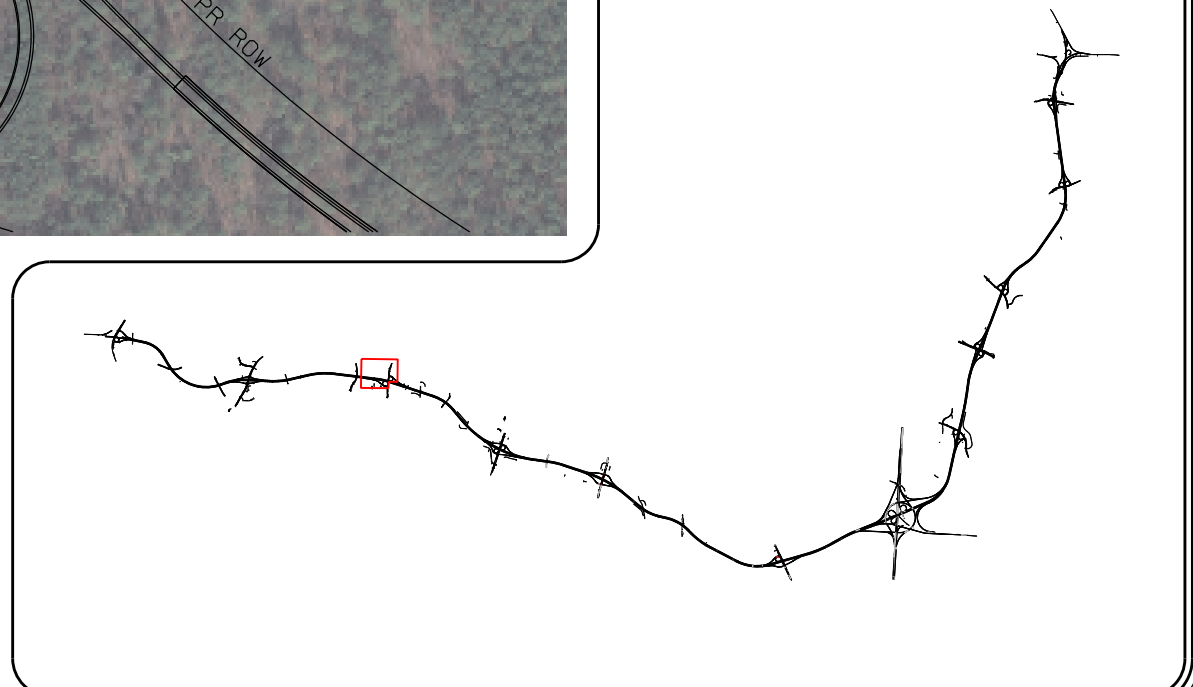
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.12

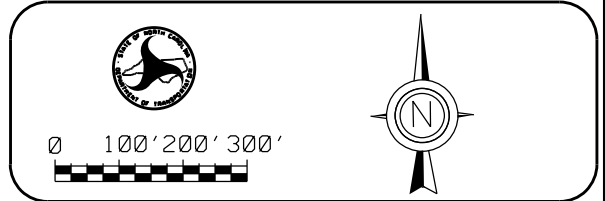
DECEMBER 2017



KEY MAP



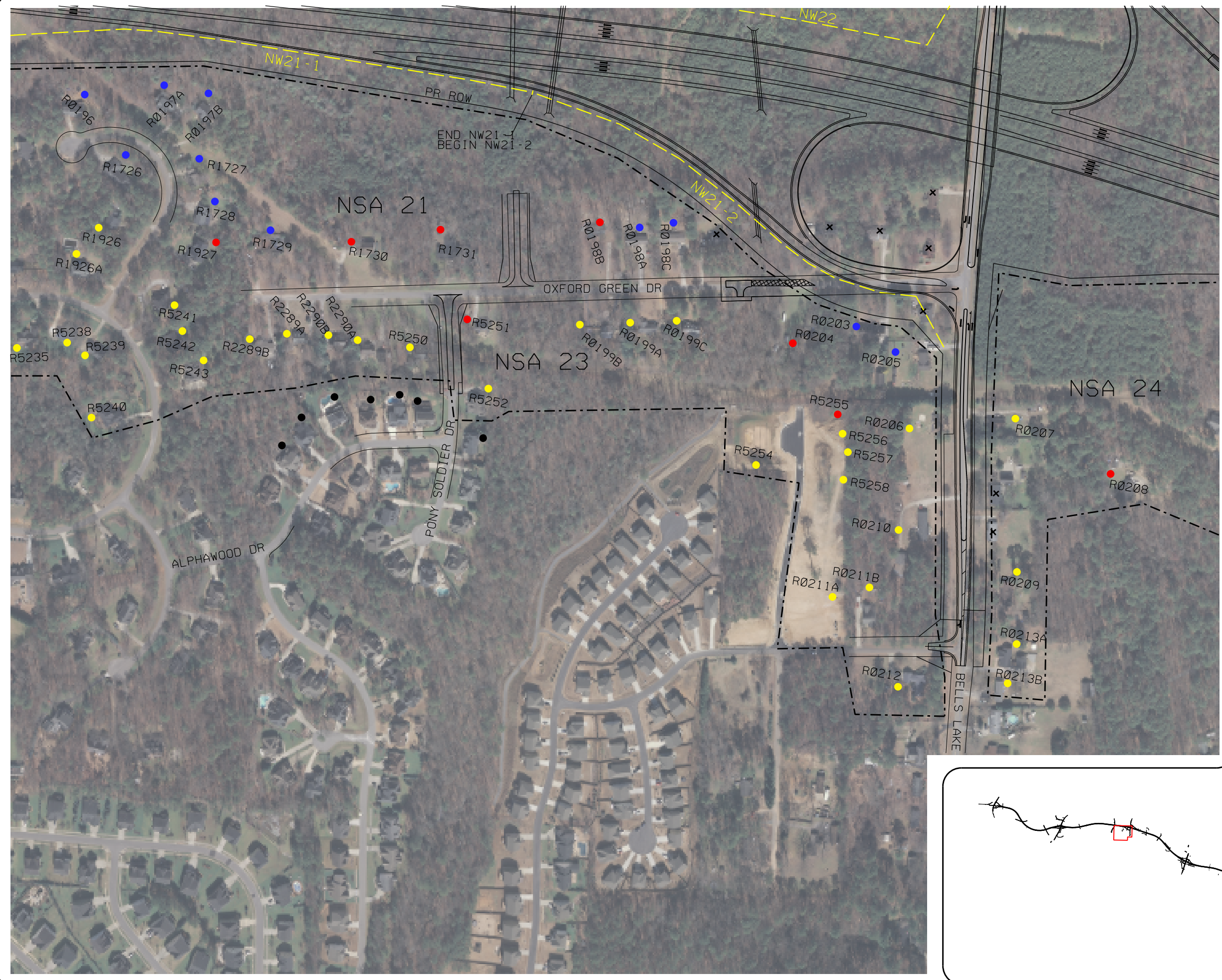
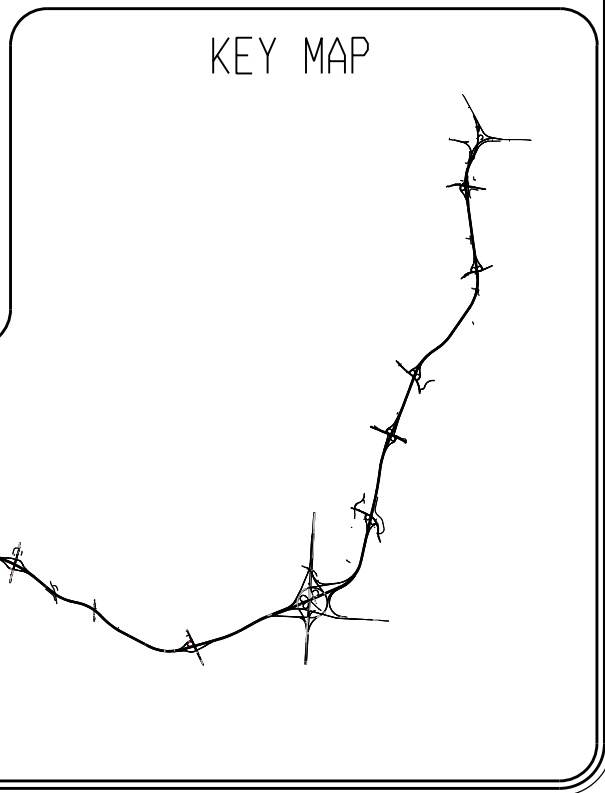
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



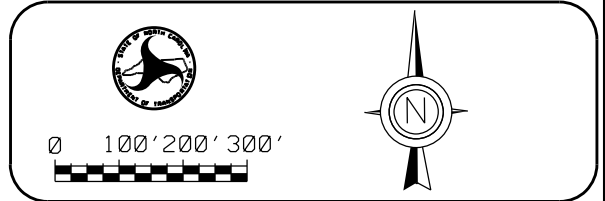
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.13

DECEMBER 2017



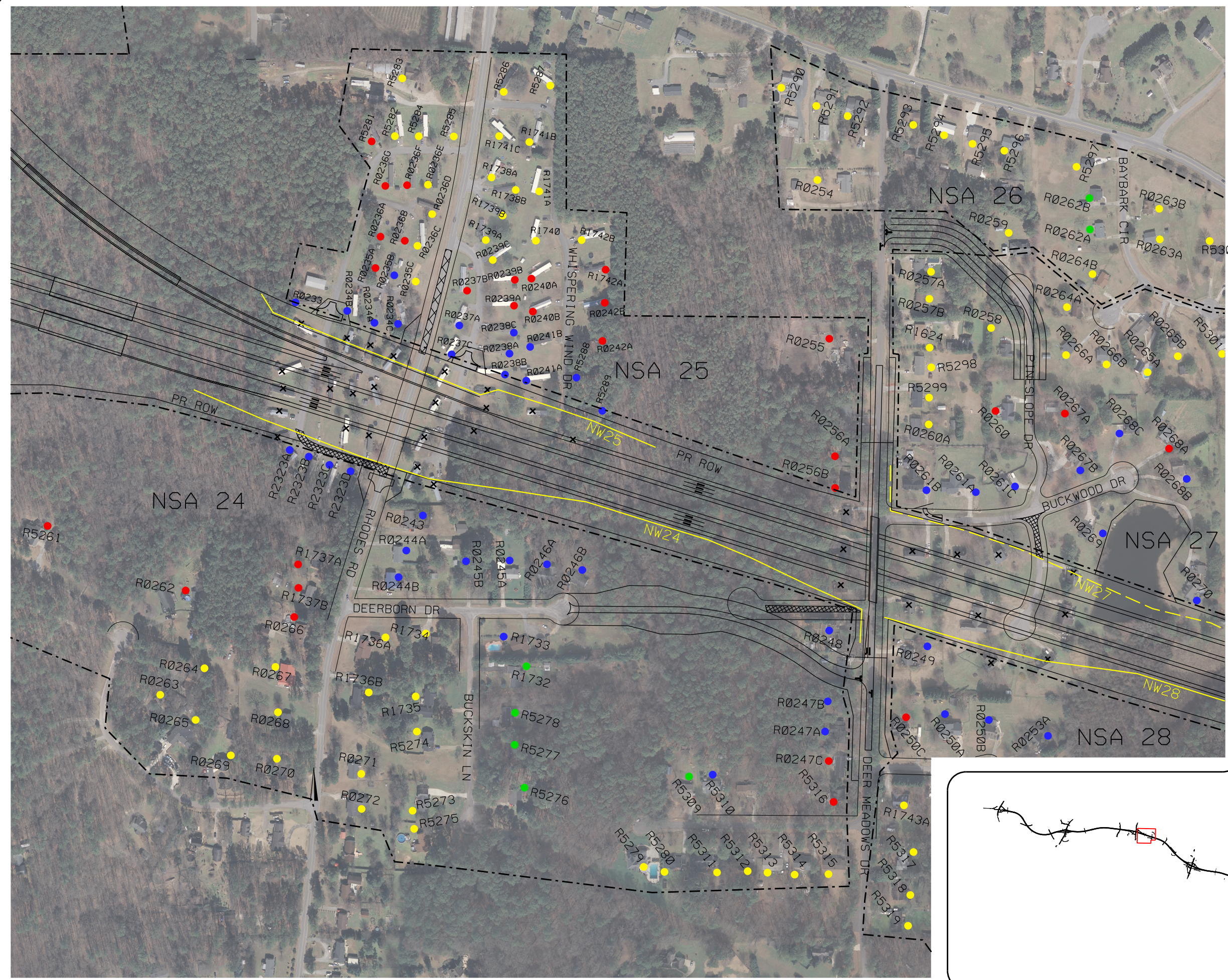
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



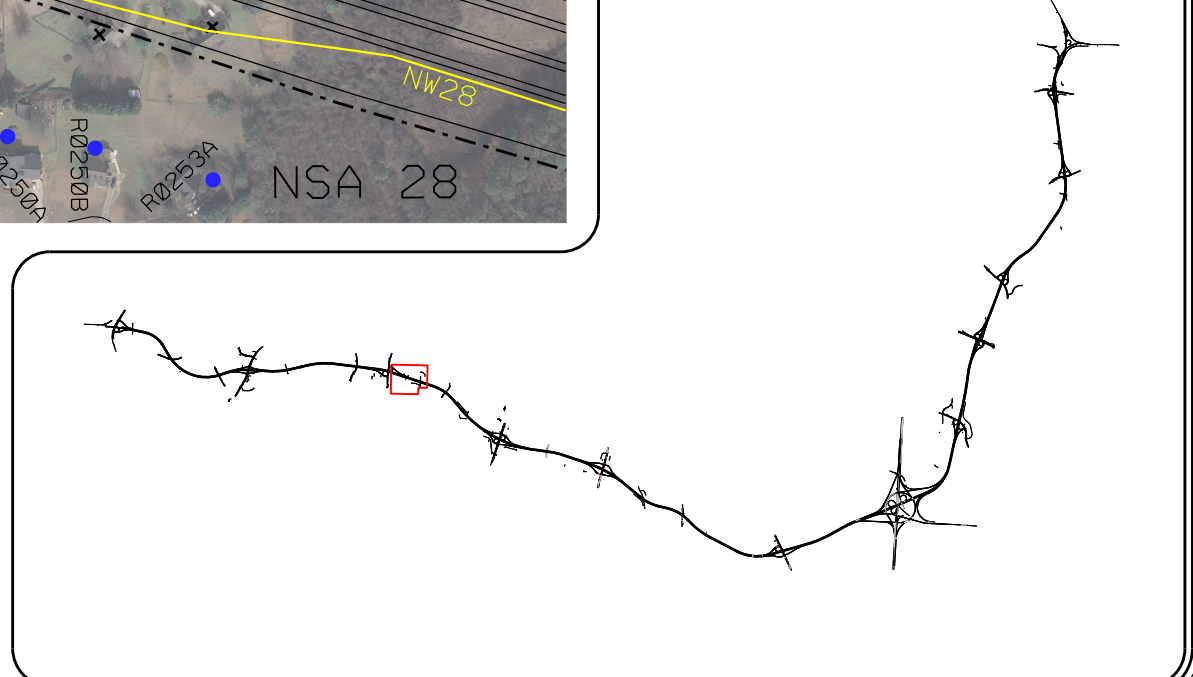
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - × = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.14

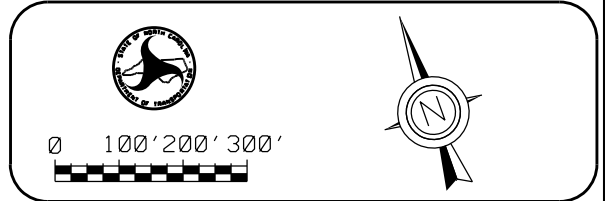
DECEMBER 2017



KEY MAP



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

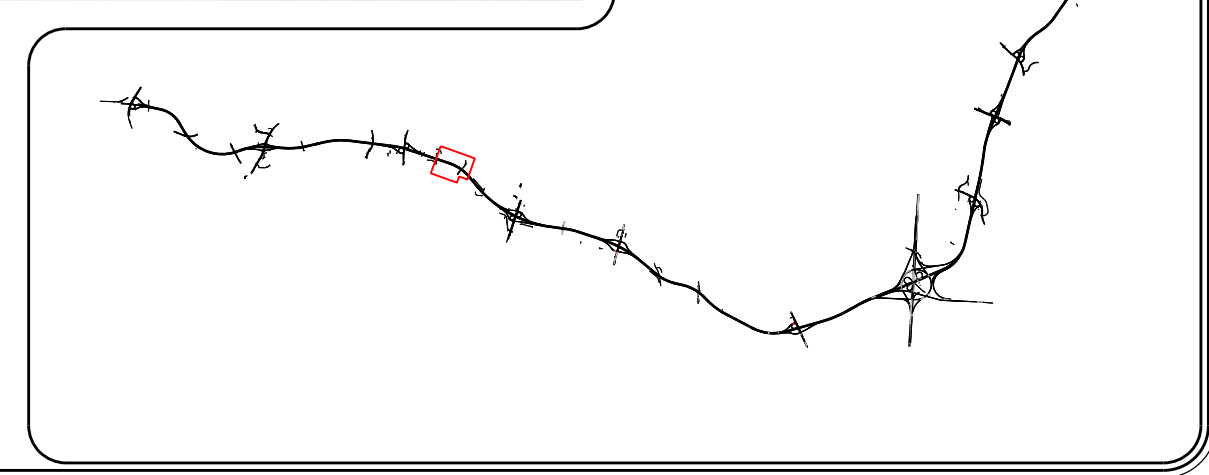
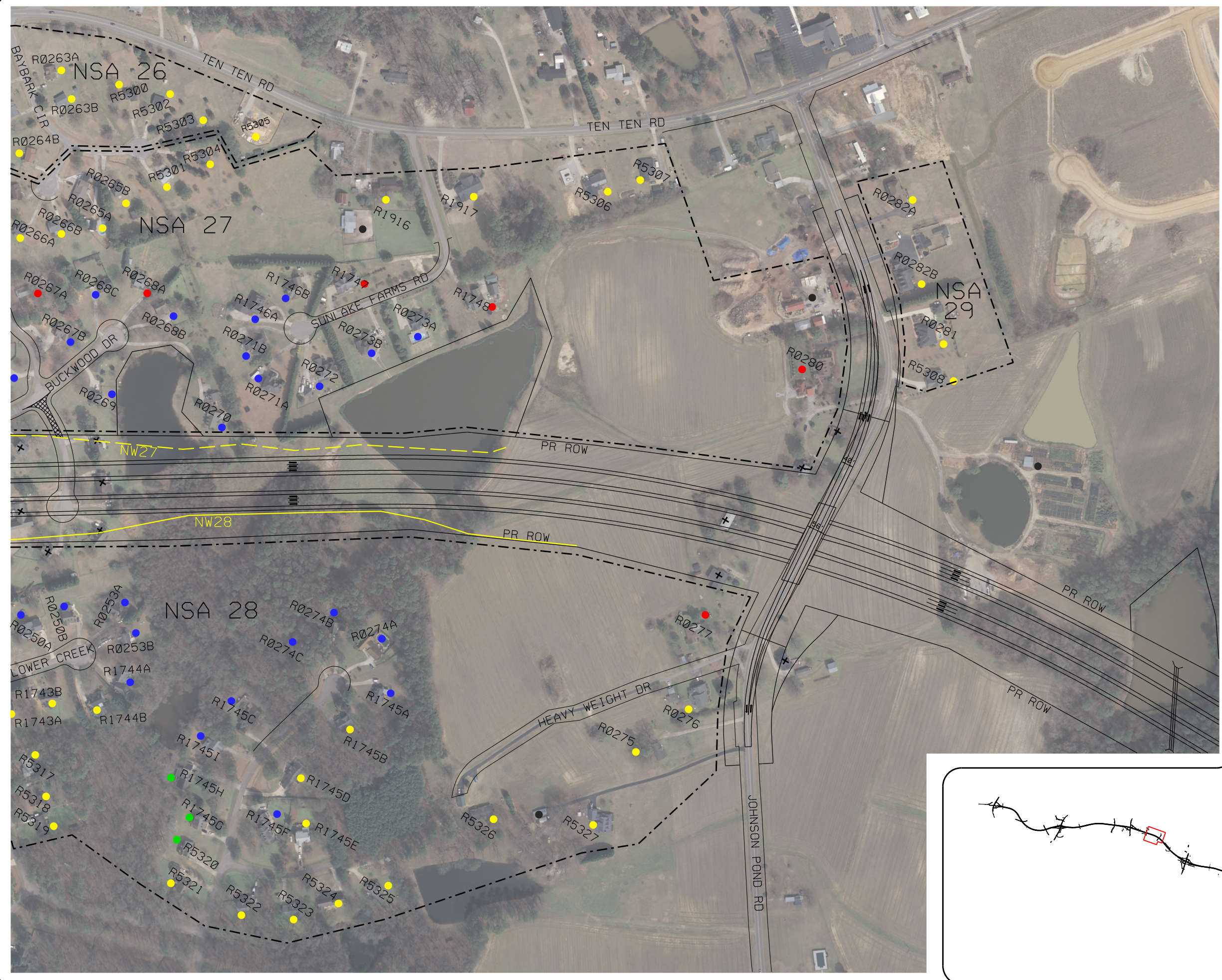


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.15

DECEMBER 2017

KEY MAP



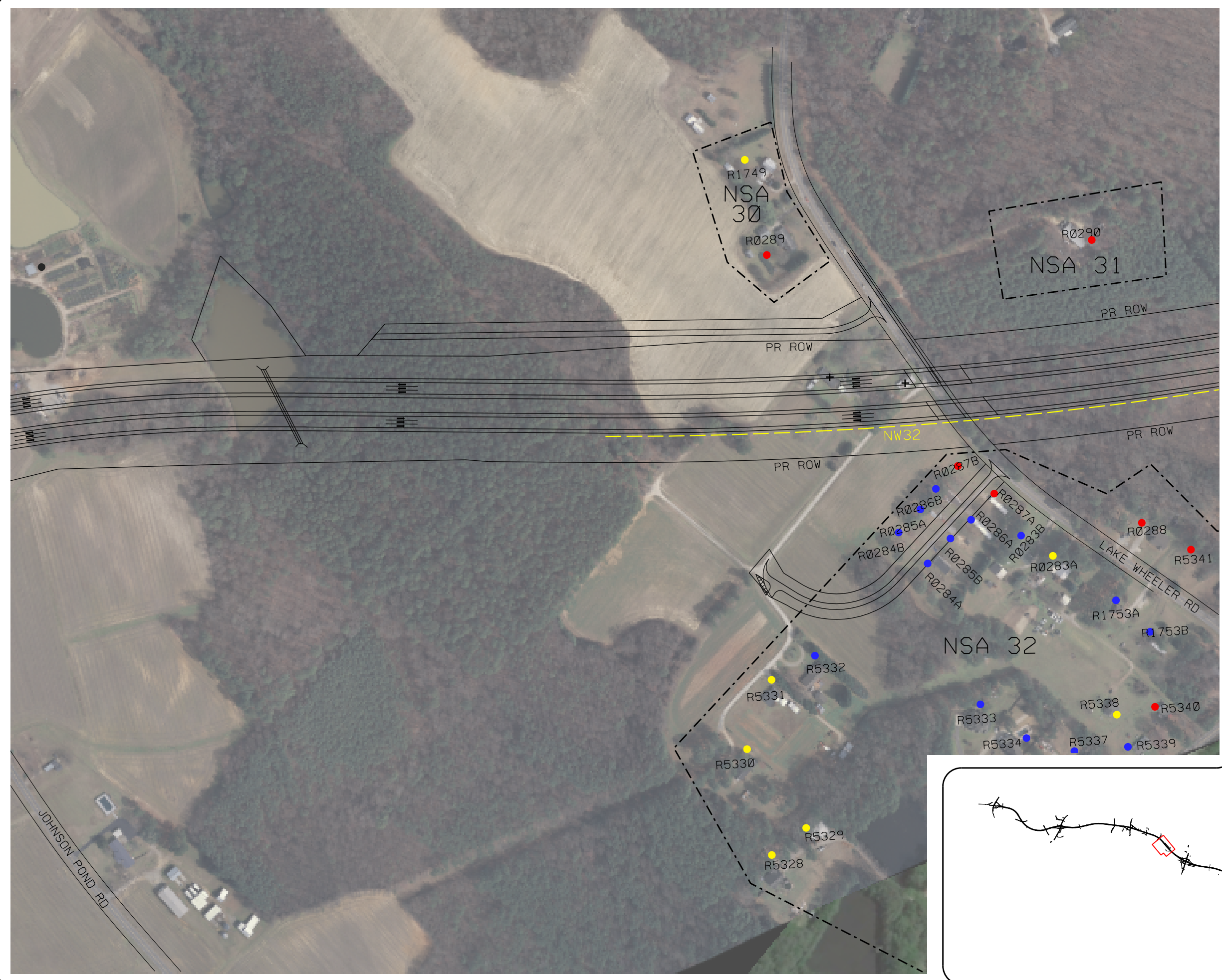
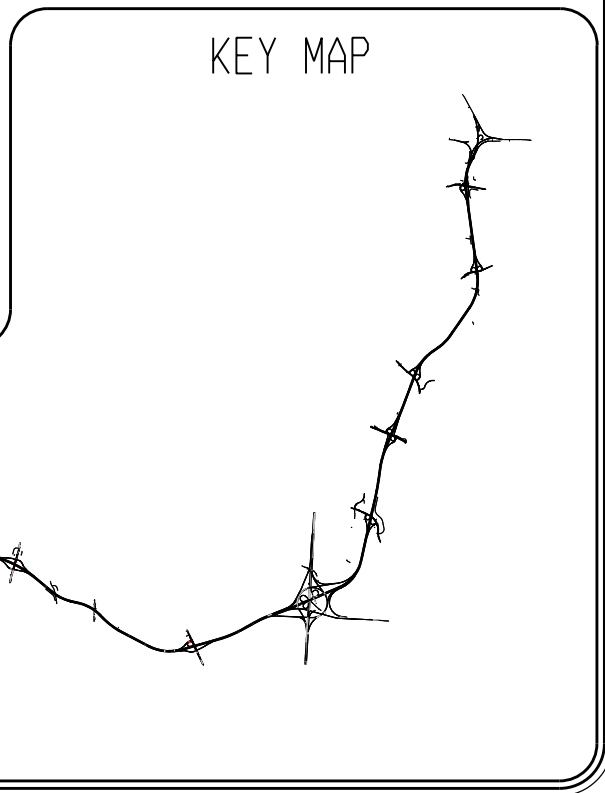
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

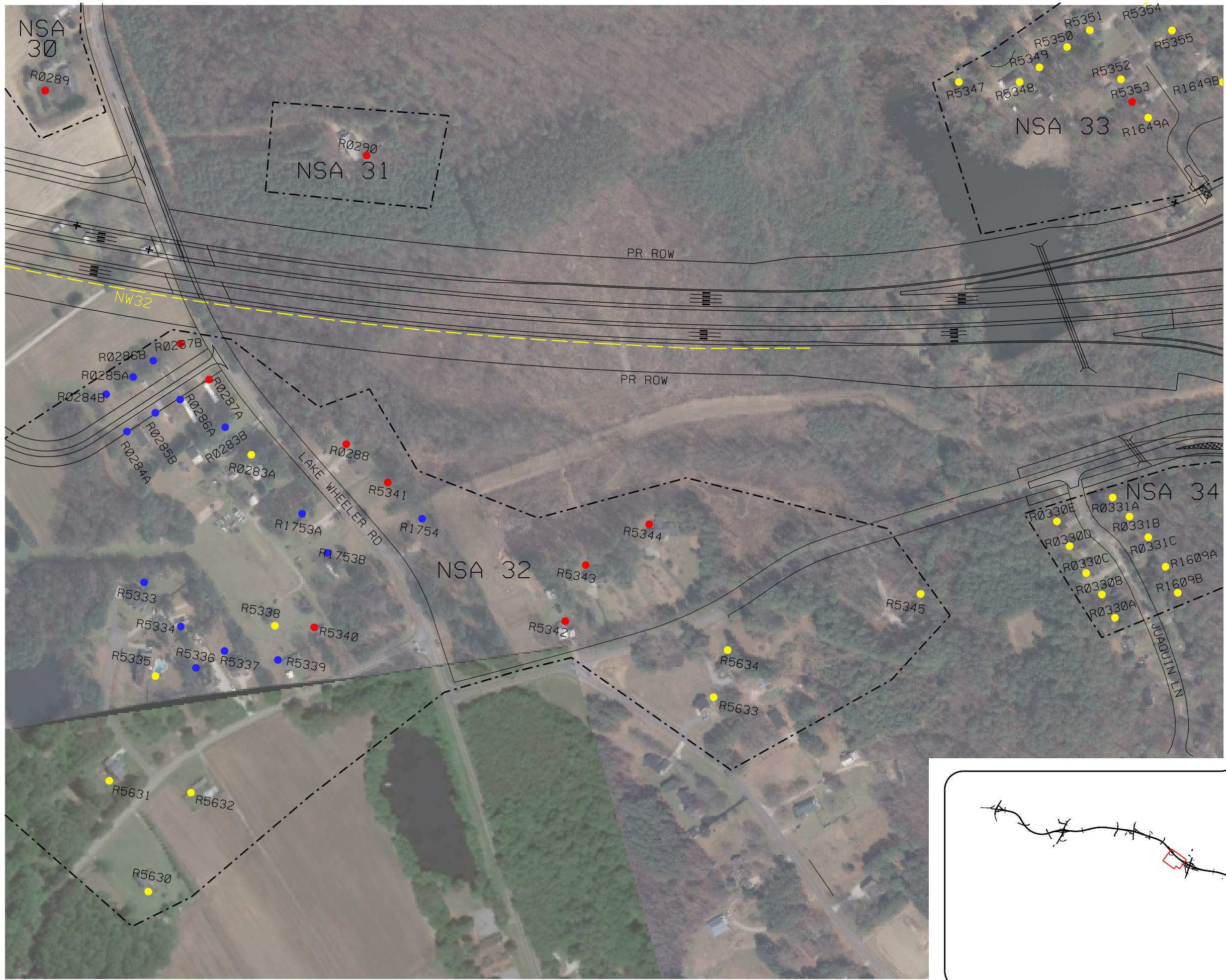


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

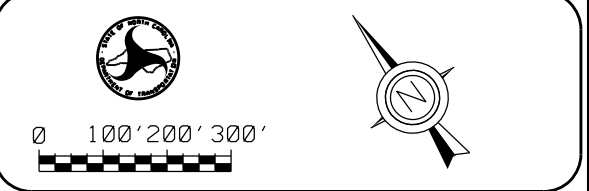
NOISE STUDY AREAS
 EXHIBIT 2.16

DECEMBER 2017





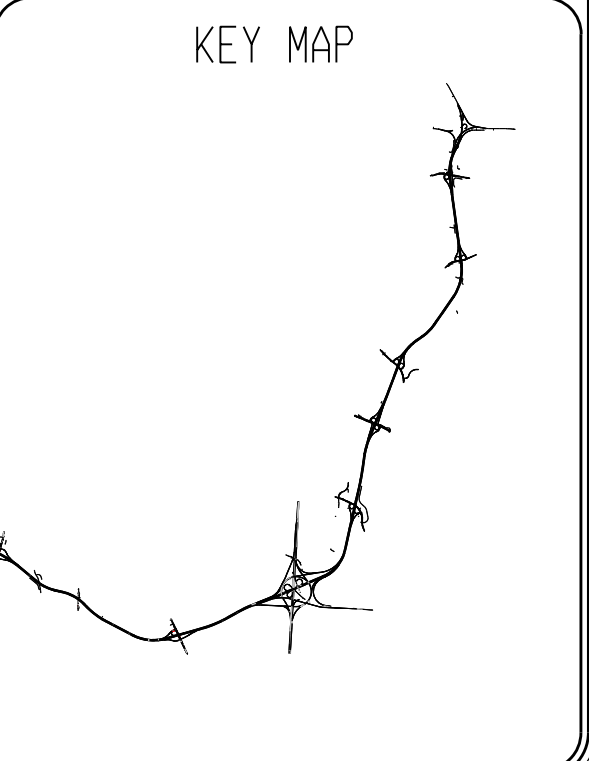
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



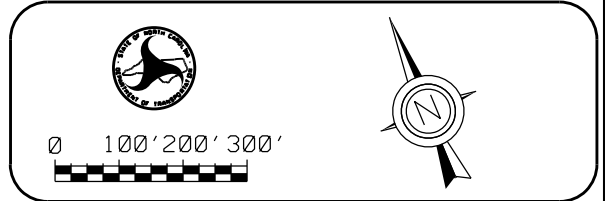
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.17

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

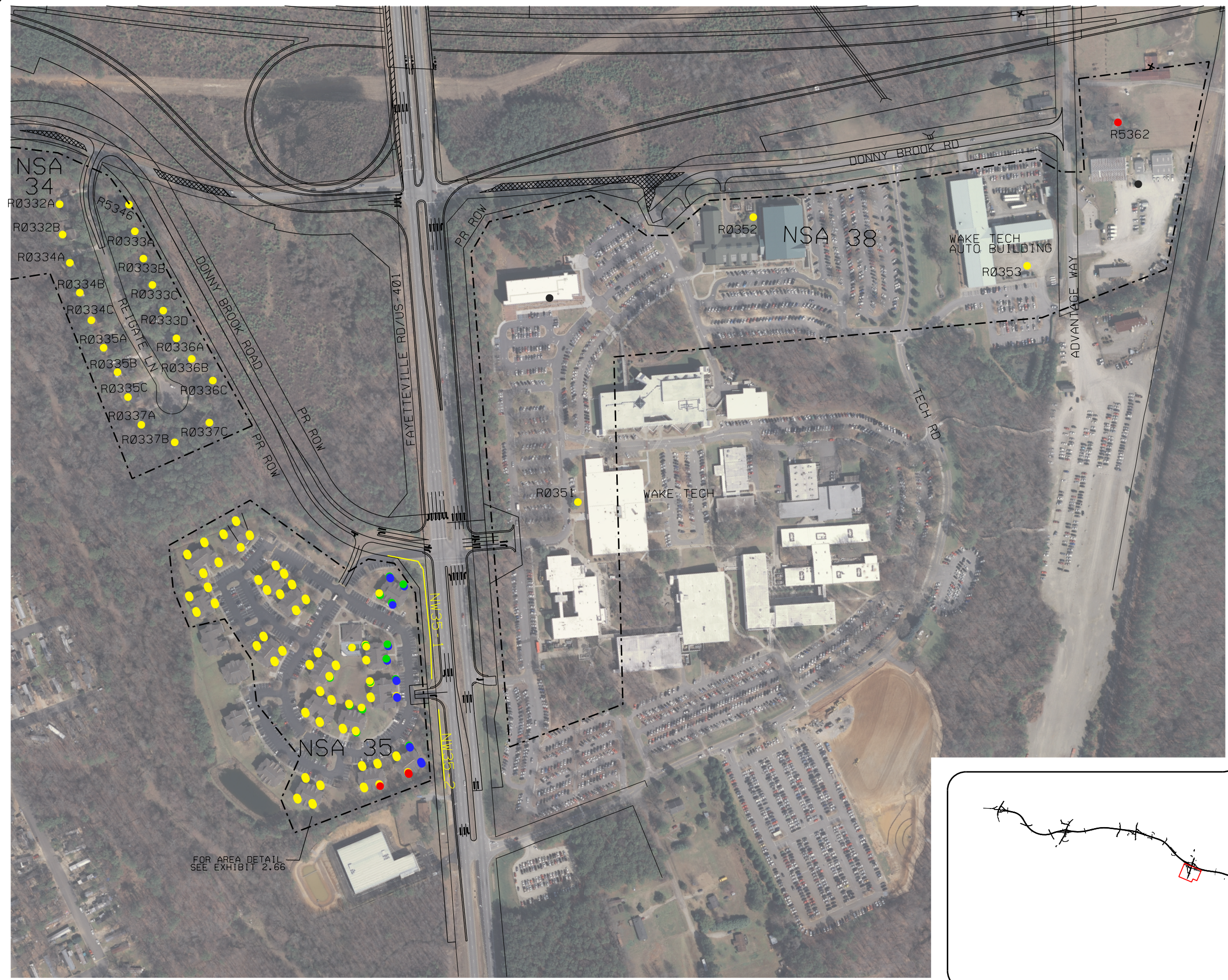
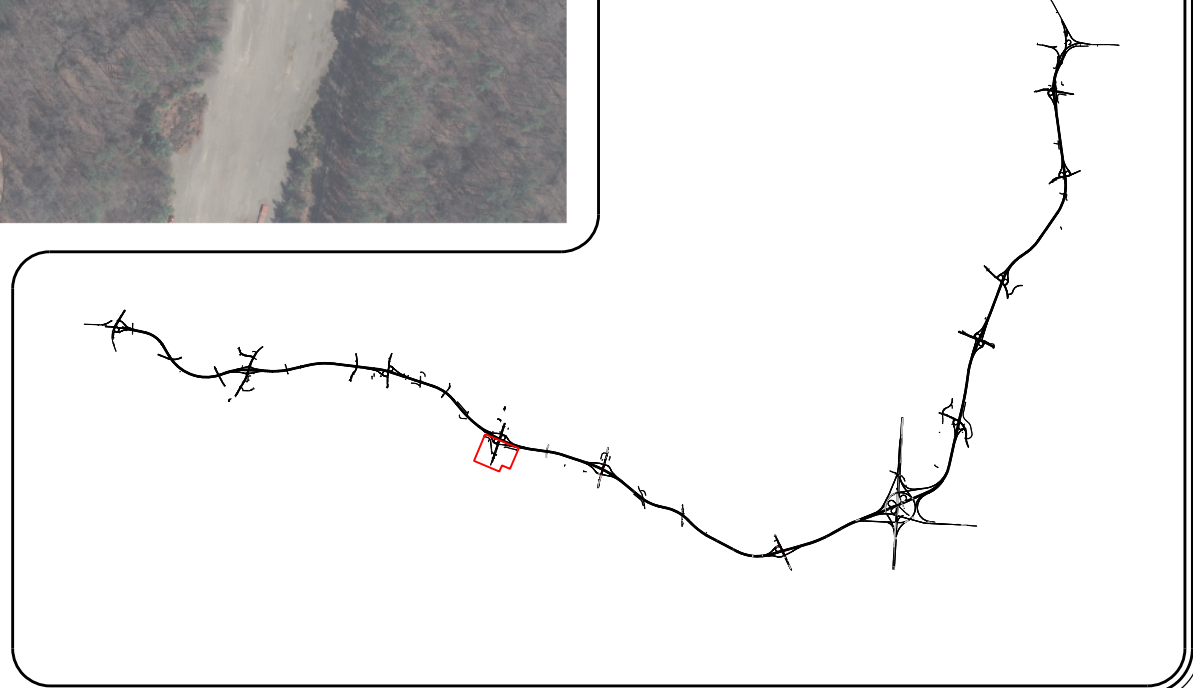


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

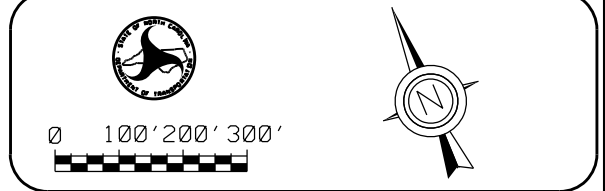
NOISE STUDY AREAS
 EXHIBIT 2.18

DECEMBER 2017

KEY MAP



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

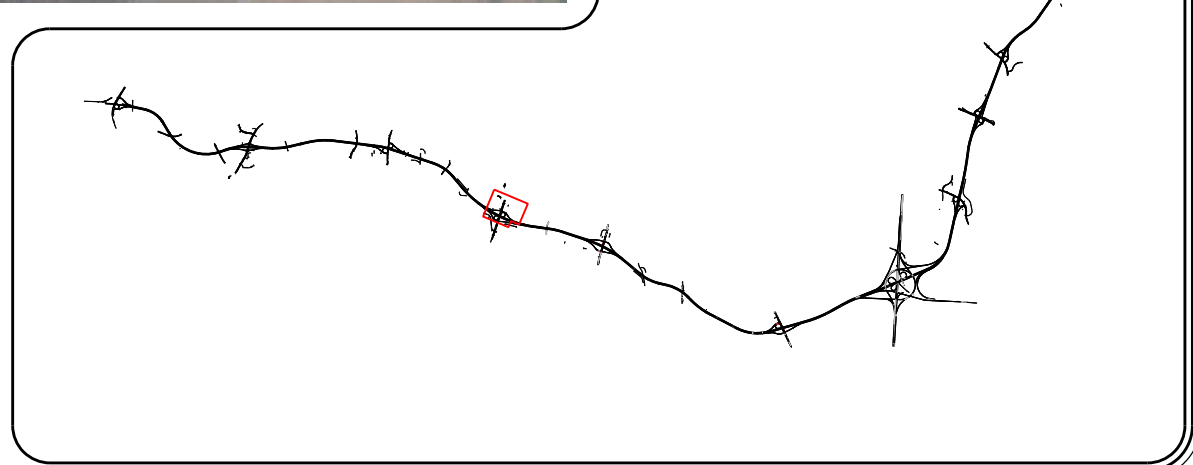
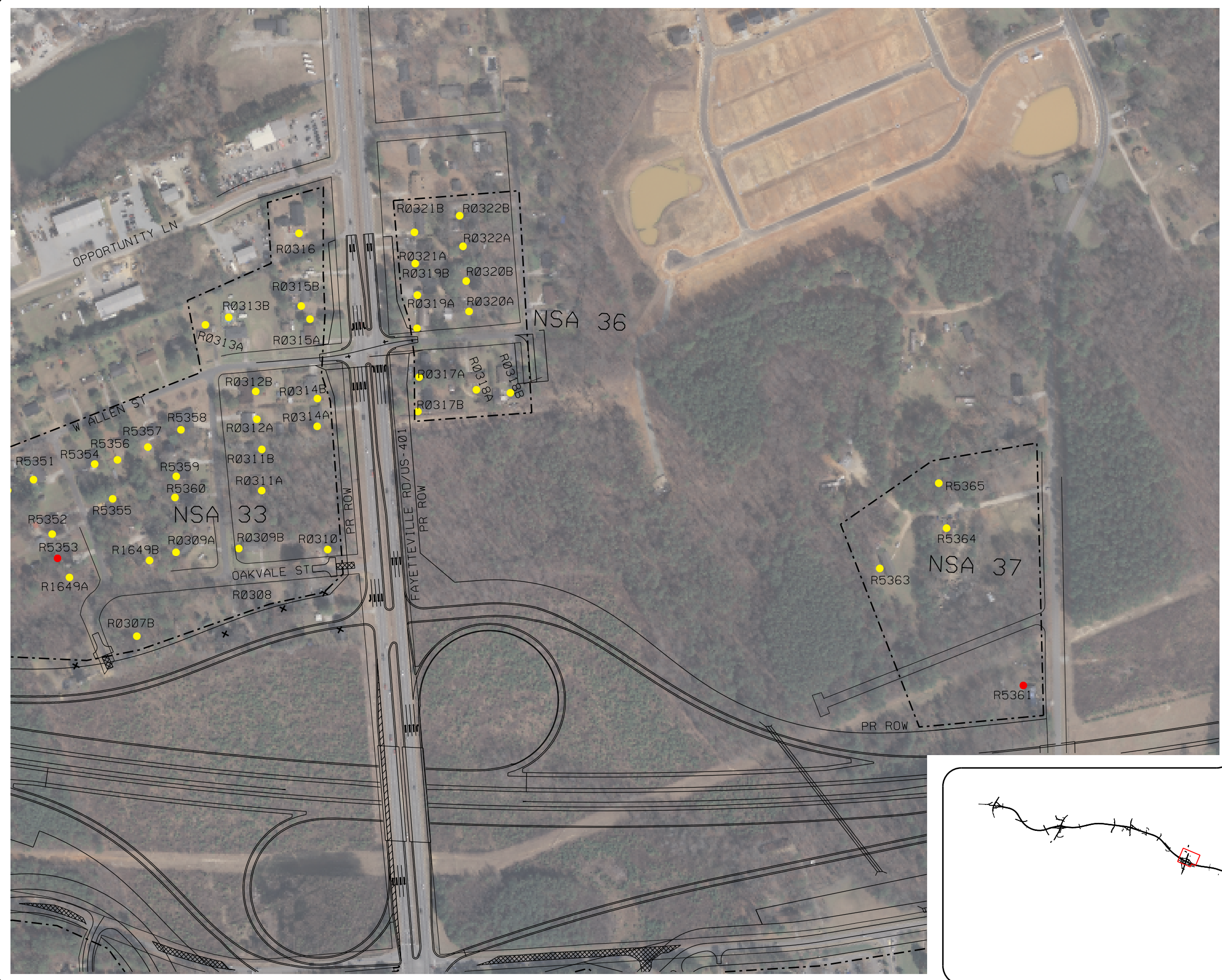


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

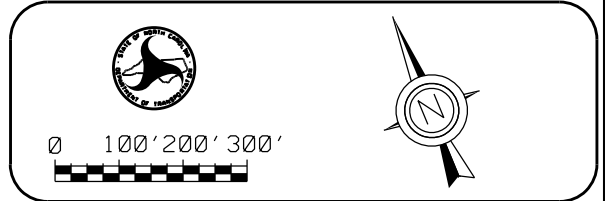
NOISE STUDY AREAS
 EXHIBIT 2.19

DECEMBER 2017

KEY MAP



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

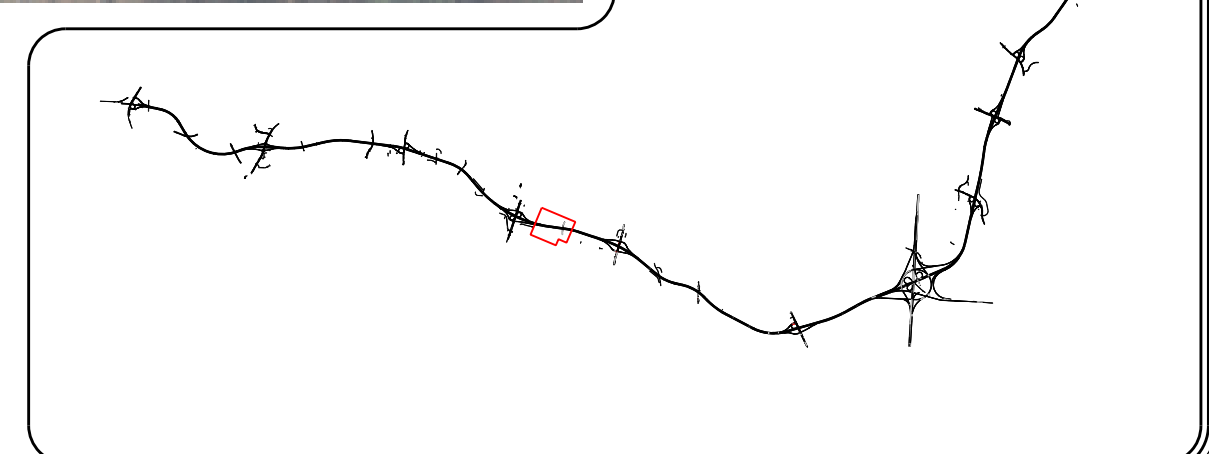
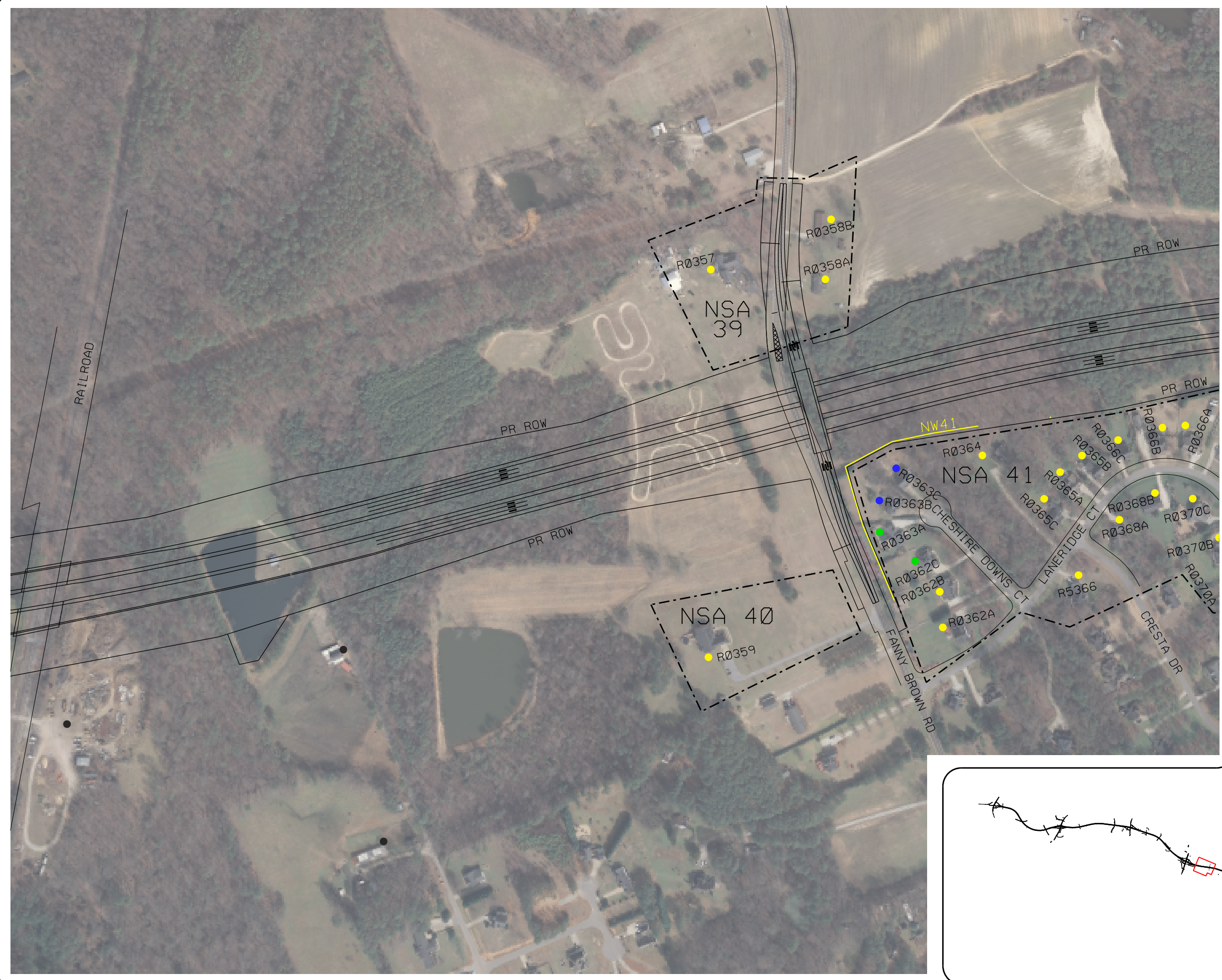


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

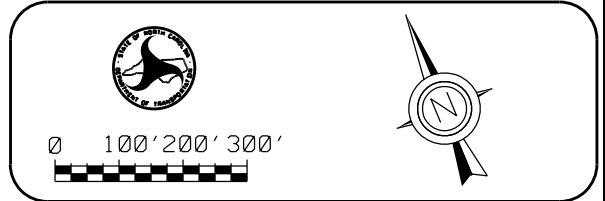
NOISE STUDY AREAS
 EXHIBIT 2.20

DECEMBER 2017

KEY MAP



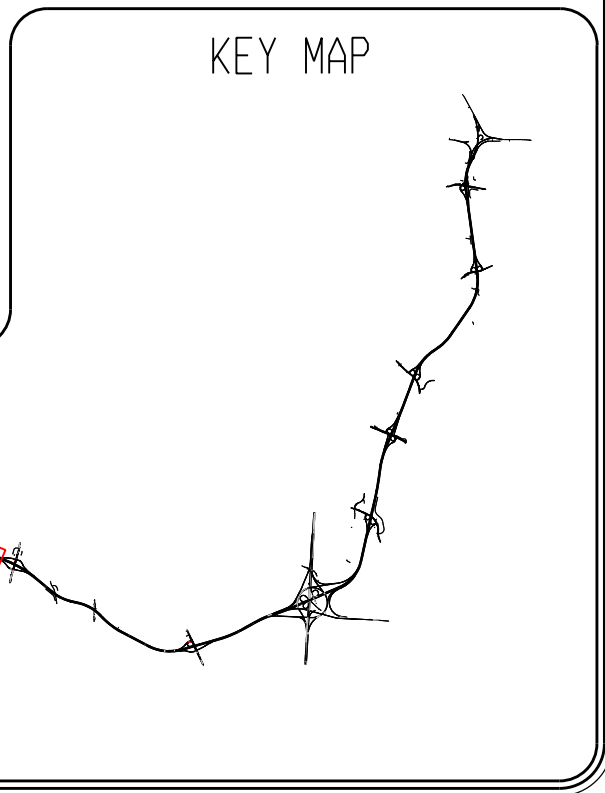
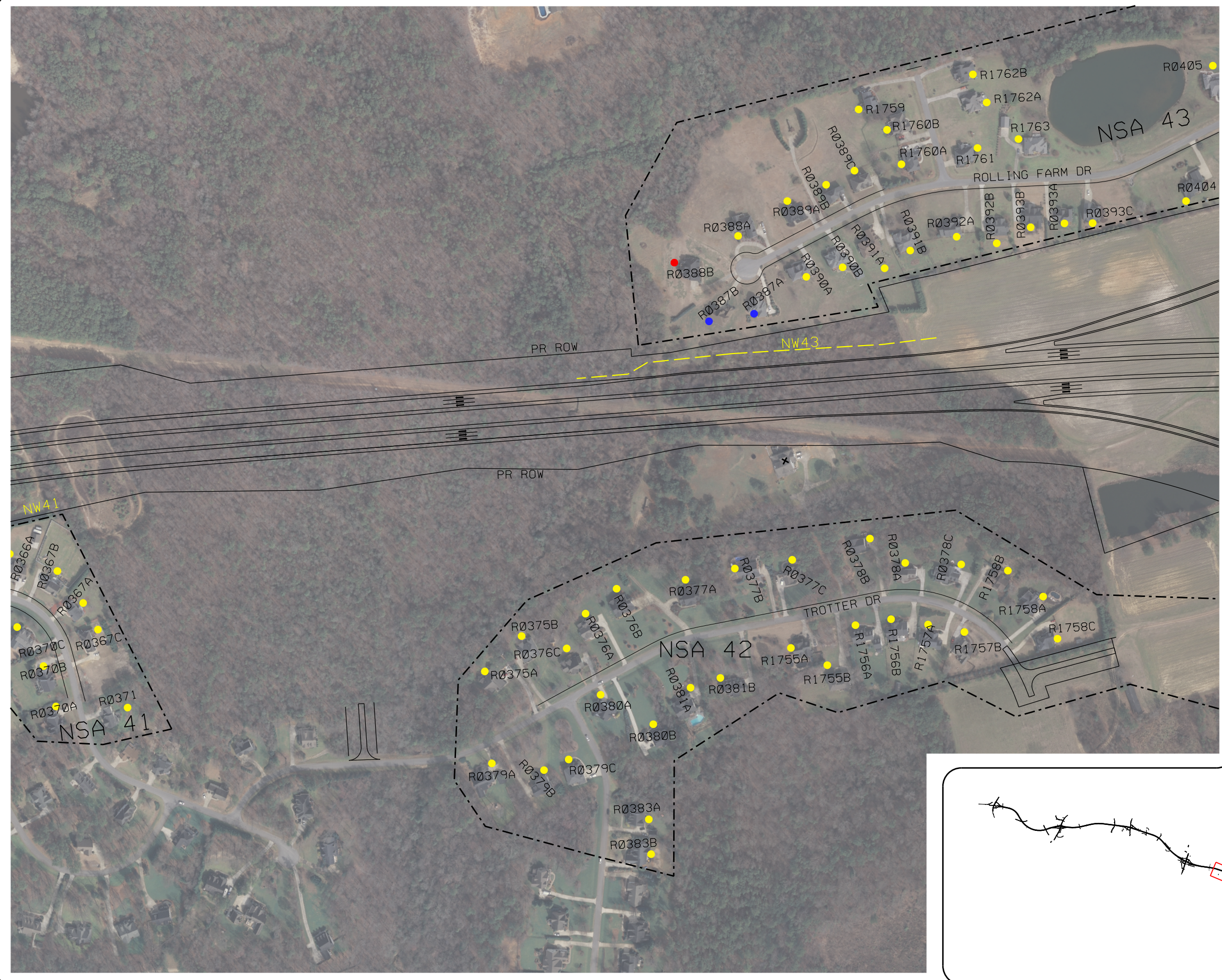
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



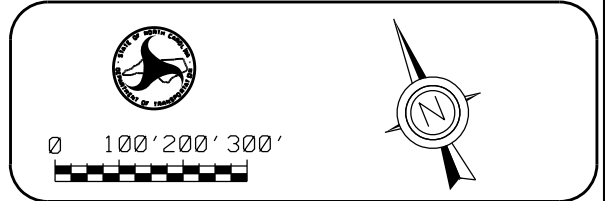
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.21

DECEMBER 2017



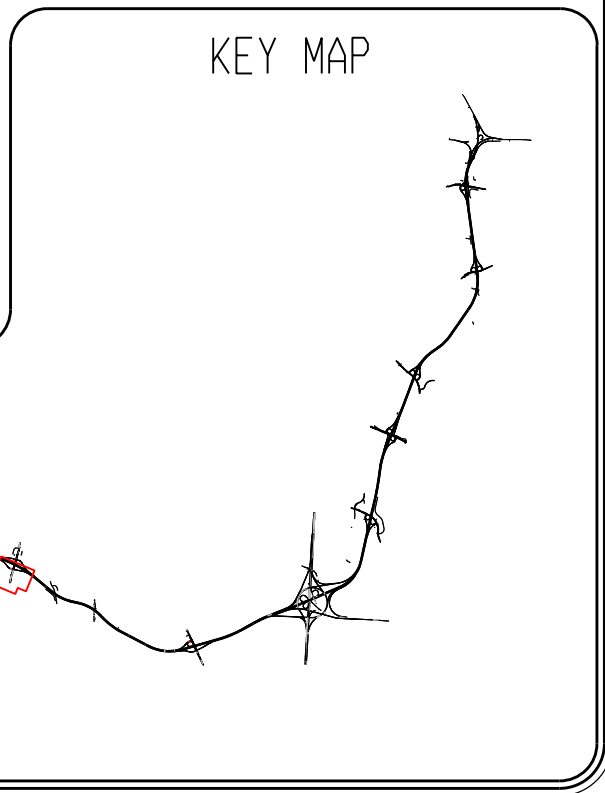
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

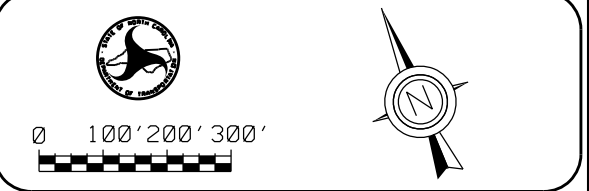
NOISE STUDY AREAS
 EXHIBIT 2.22

DECEMBER 2017





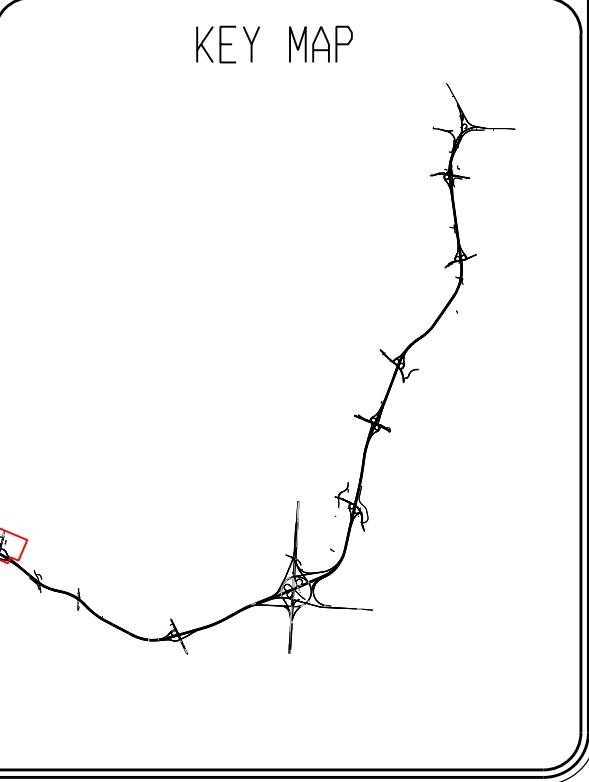
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



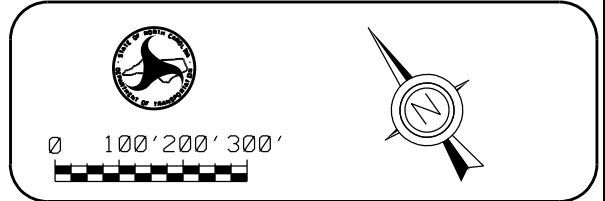
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.23

DECEMBER 2017



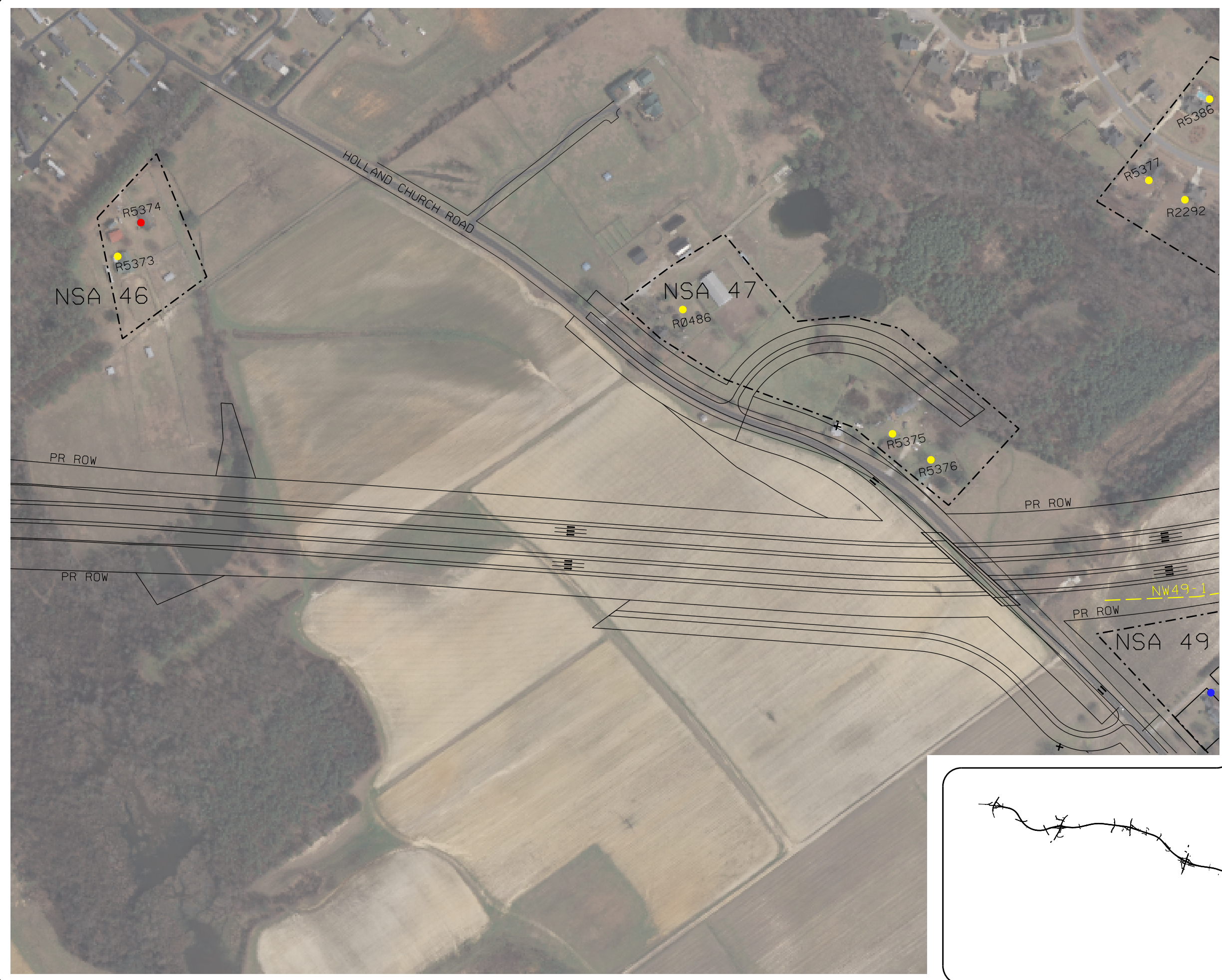
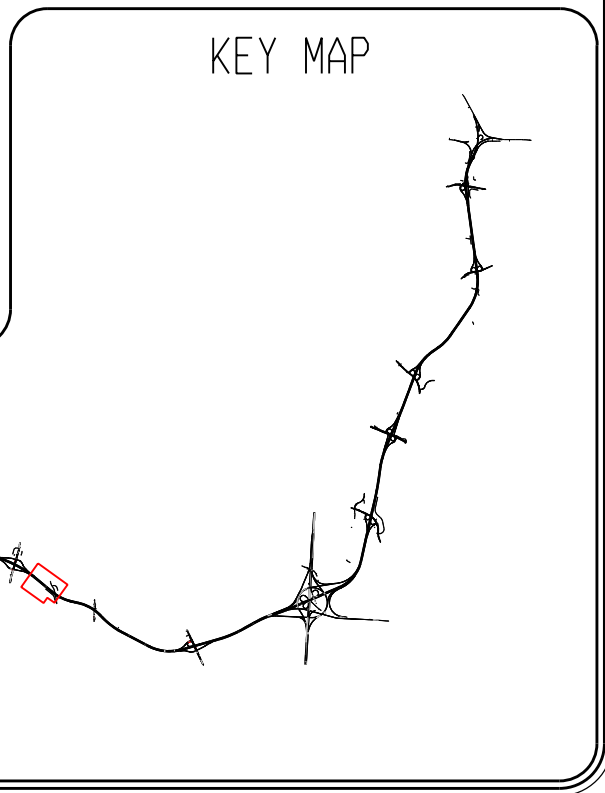
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



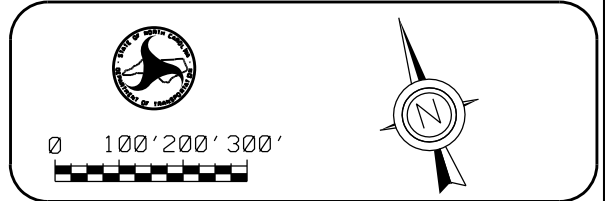
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.24

DECEMBER 2017



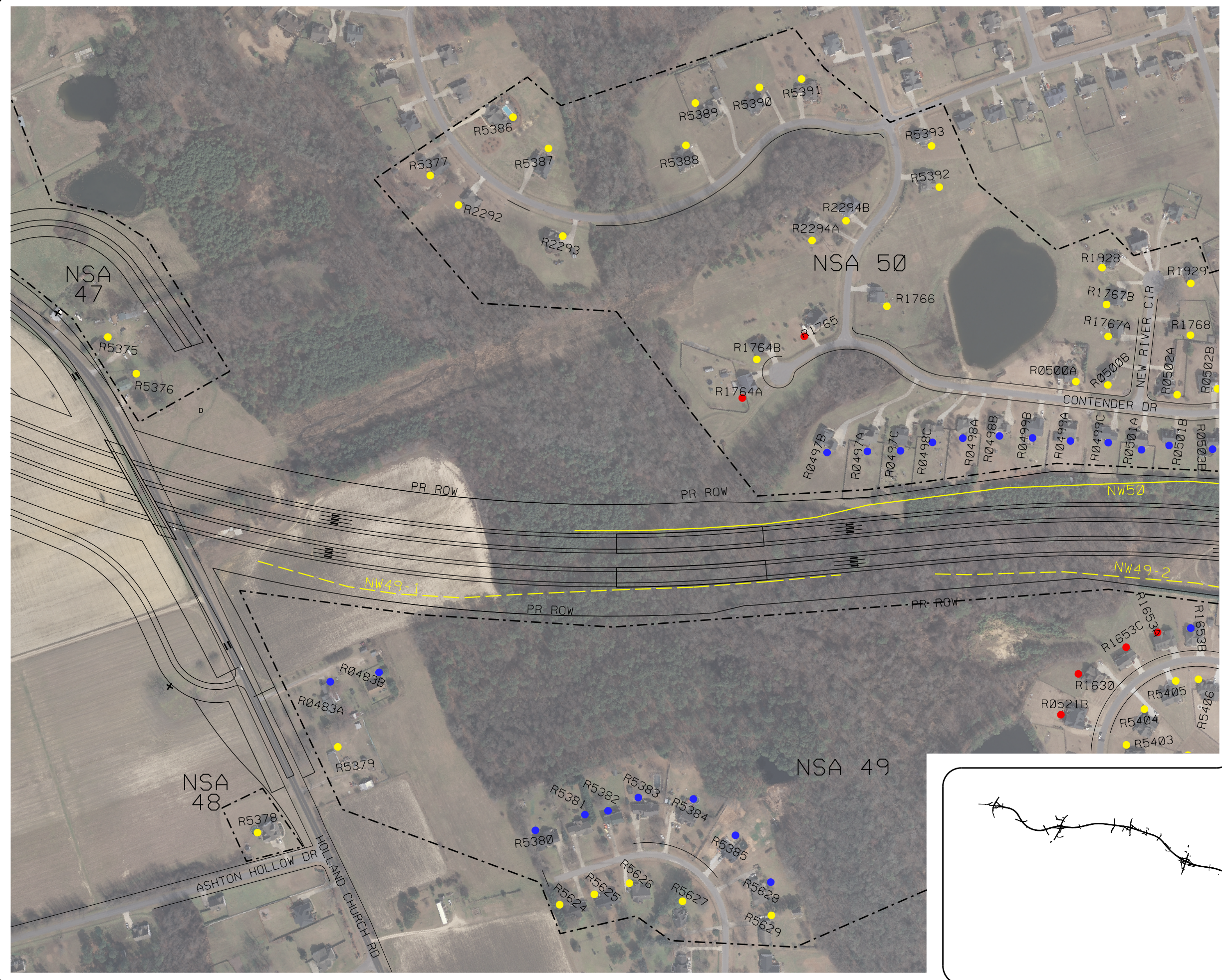
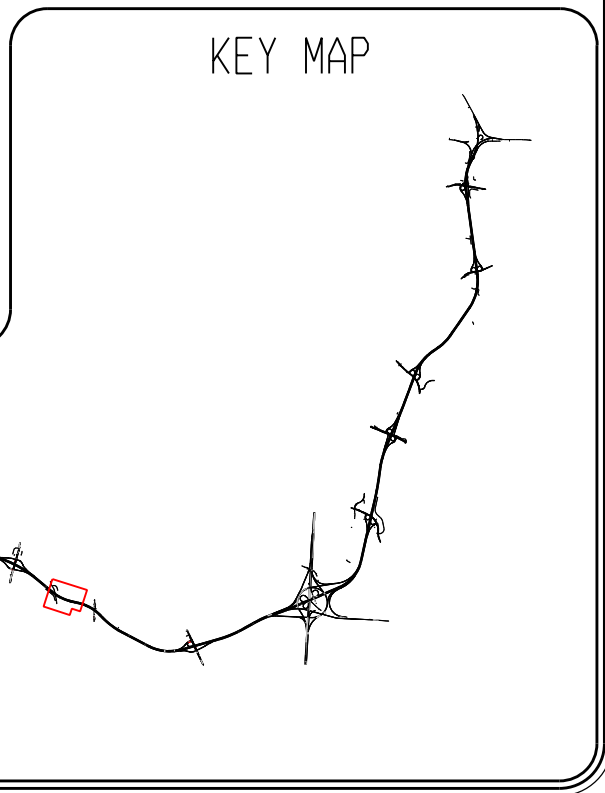
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



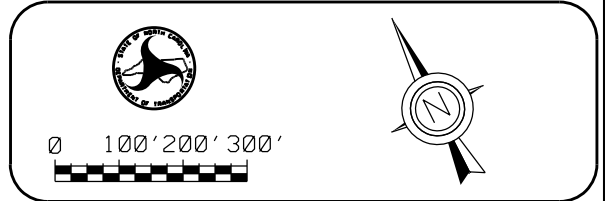
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.25

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

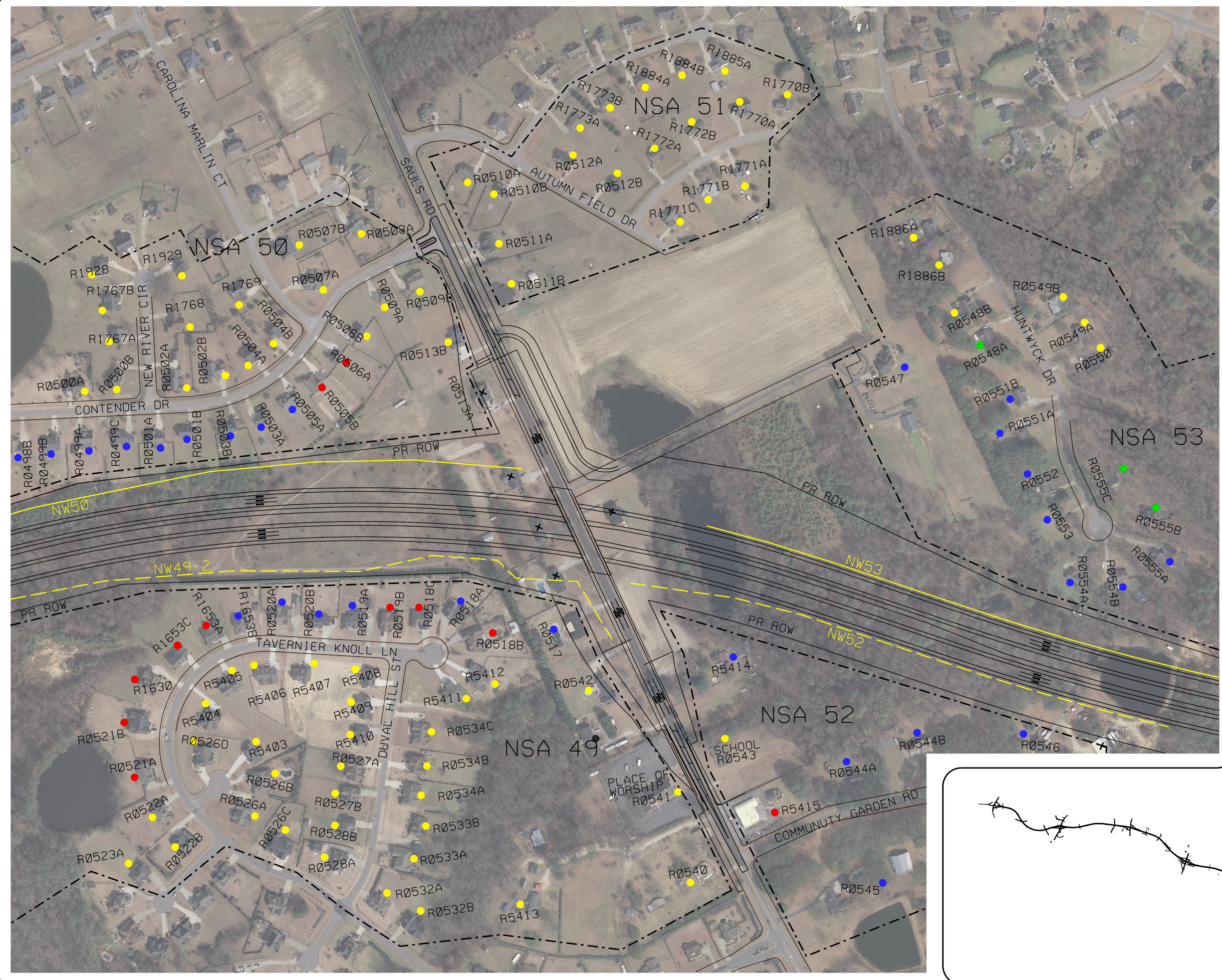
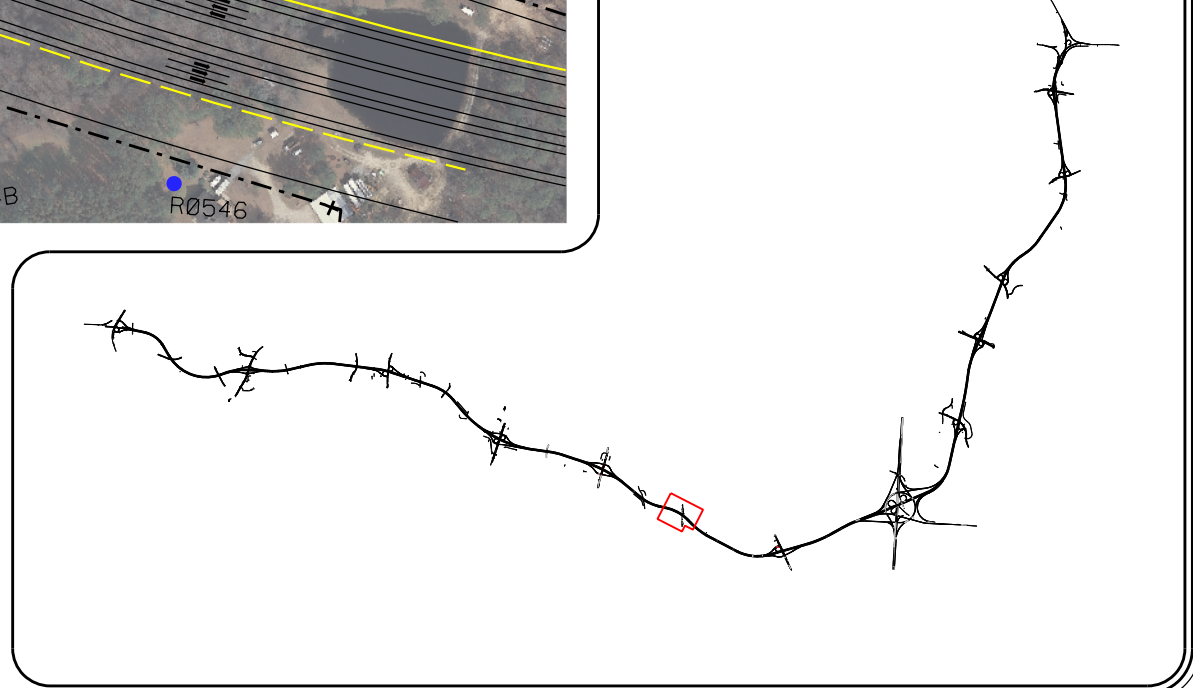


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

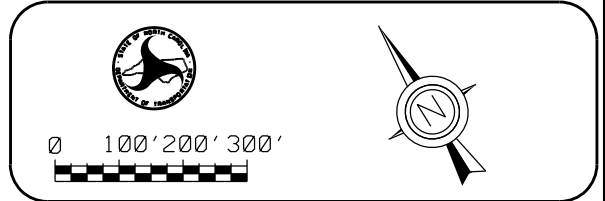
NOISE STUDY AREAS
 EXHIBIT 2.26

DECEMBER 2017

KEY MAP



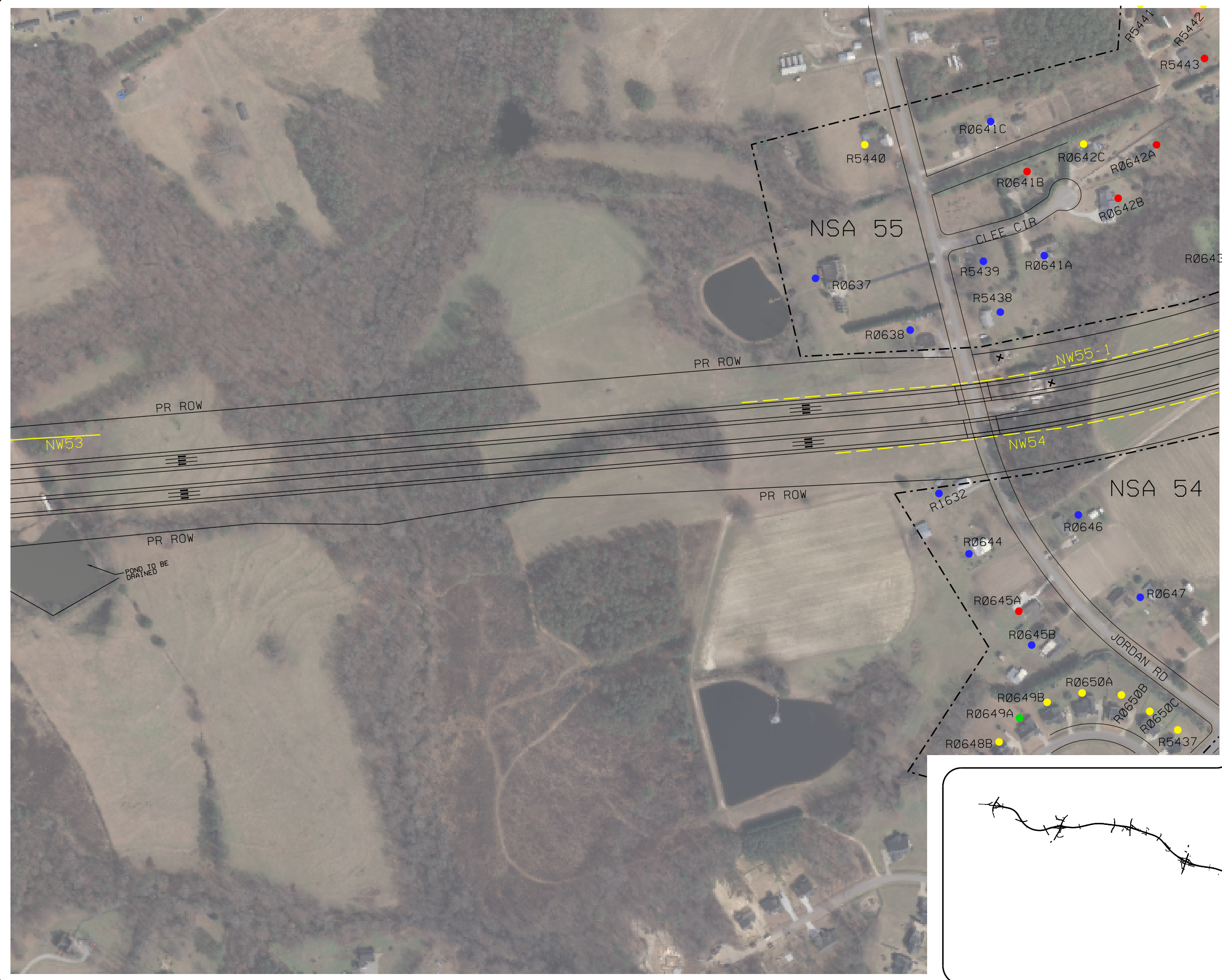
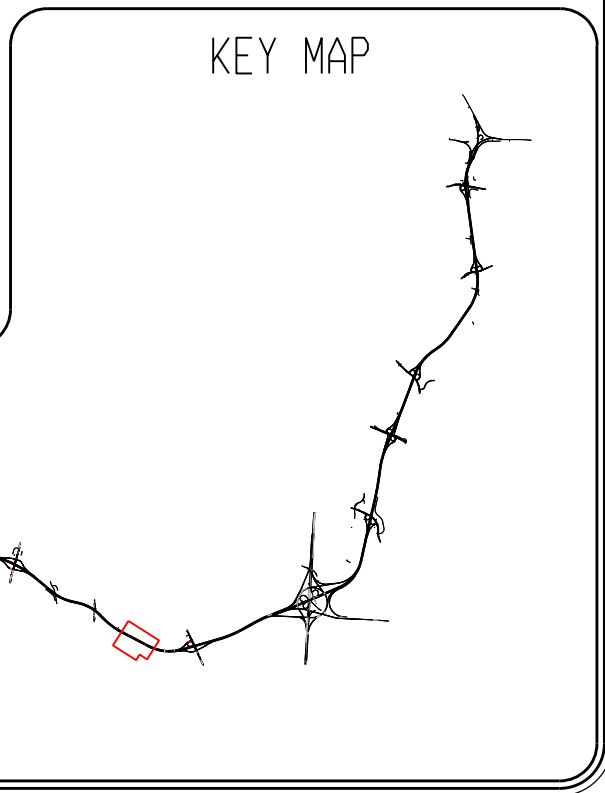
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



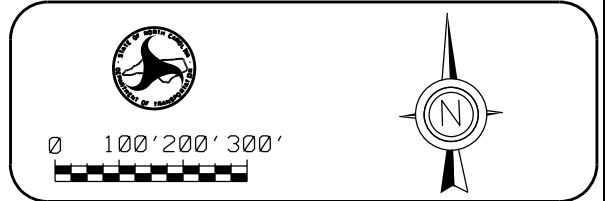
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.28

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

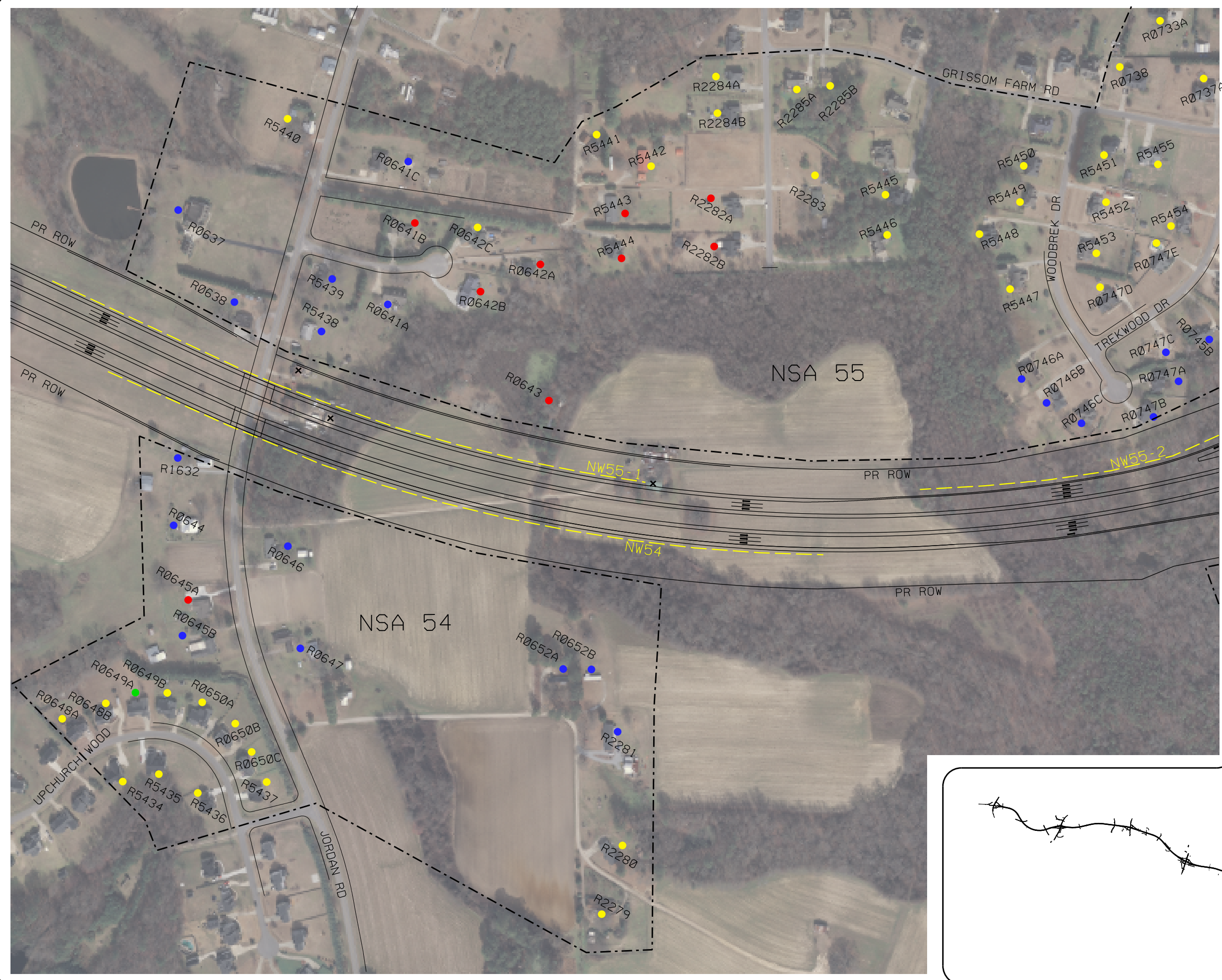
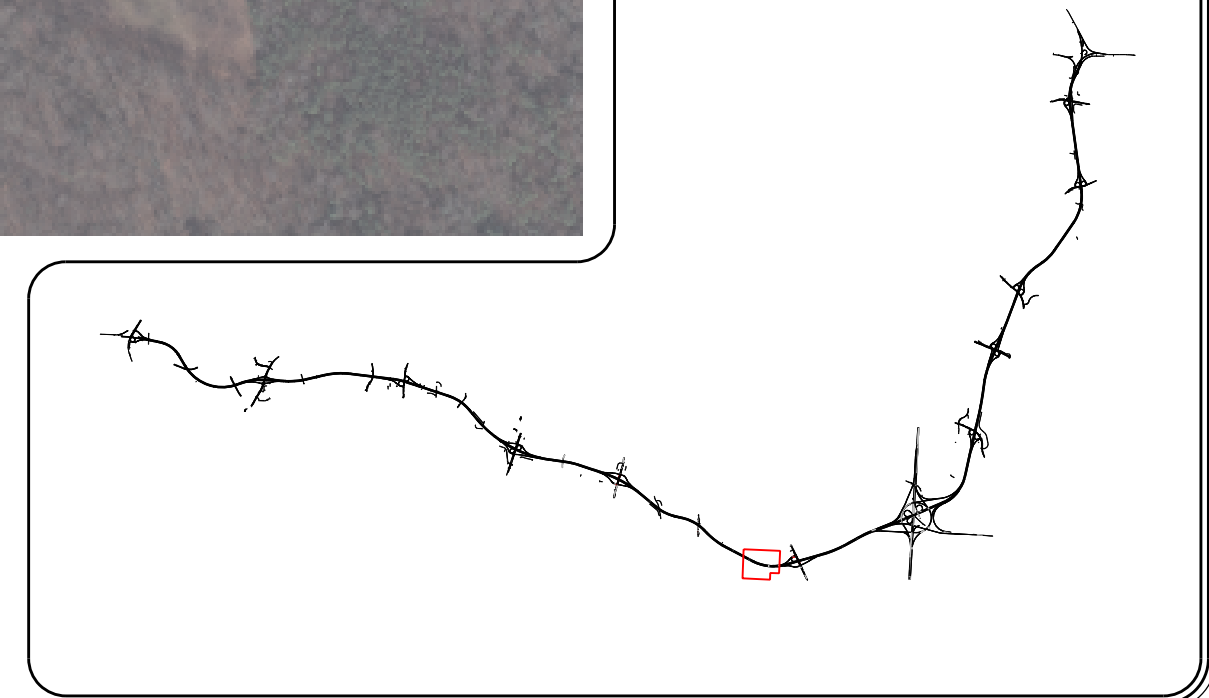


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

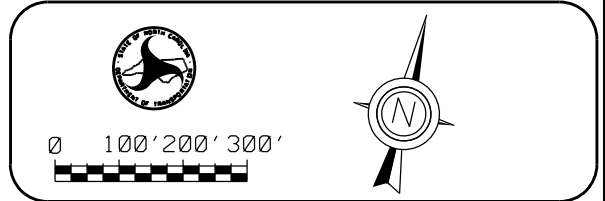
NOISE STUDY AREAS
 EXHIBIT 2.29

DECEMBER 2017

KEY MAP



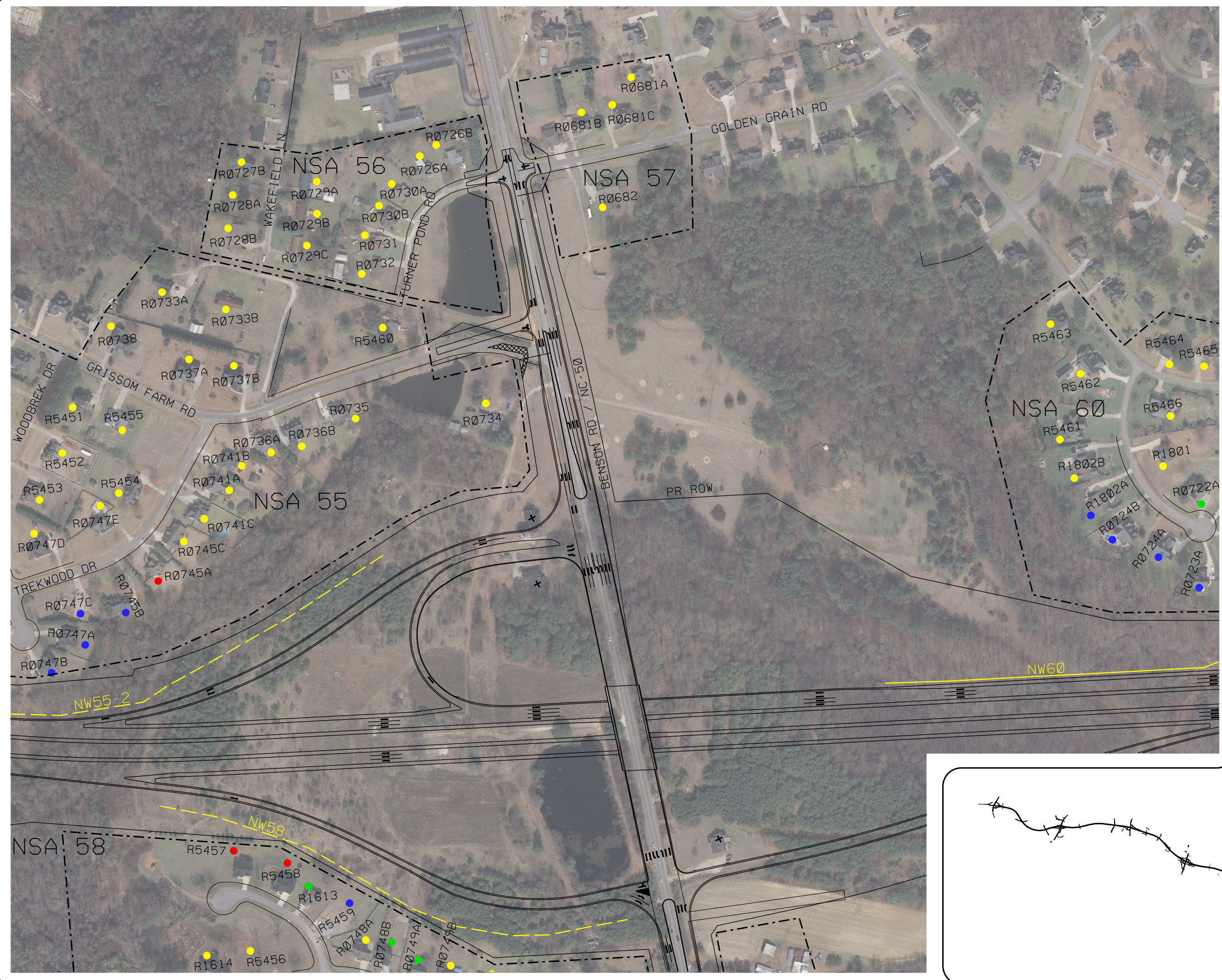
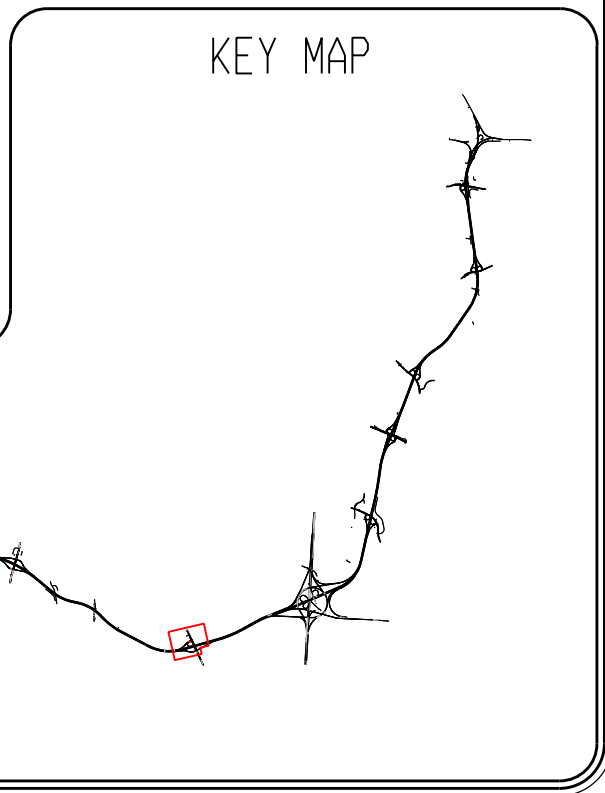
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

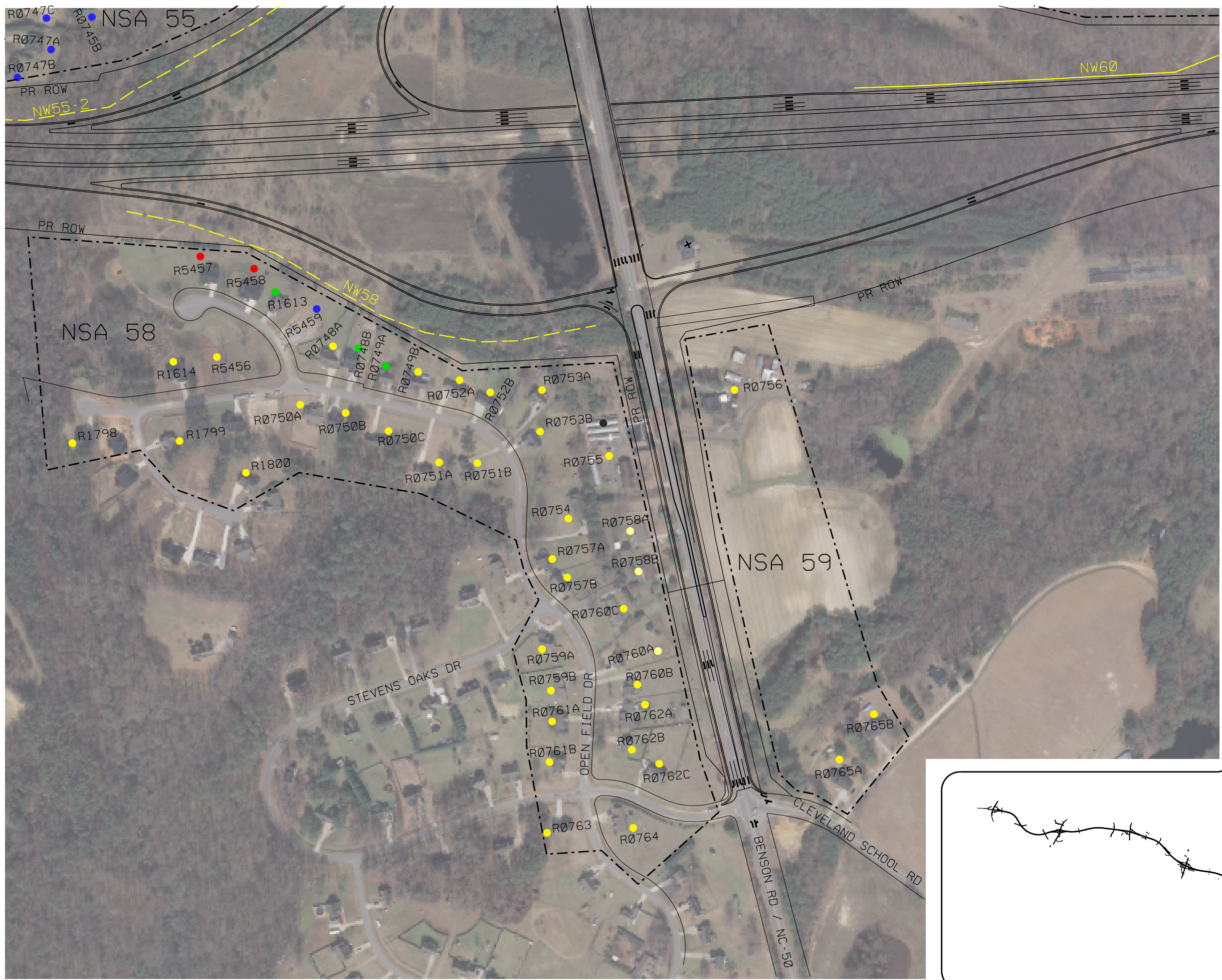


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

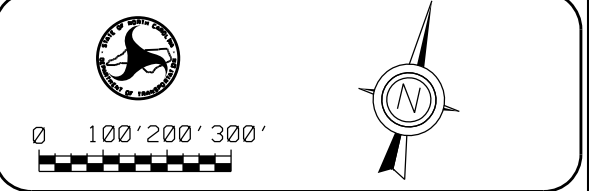
NOISE STUDY AREAS
 EXHIBIT 2.30

DECEMBER 2017





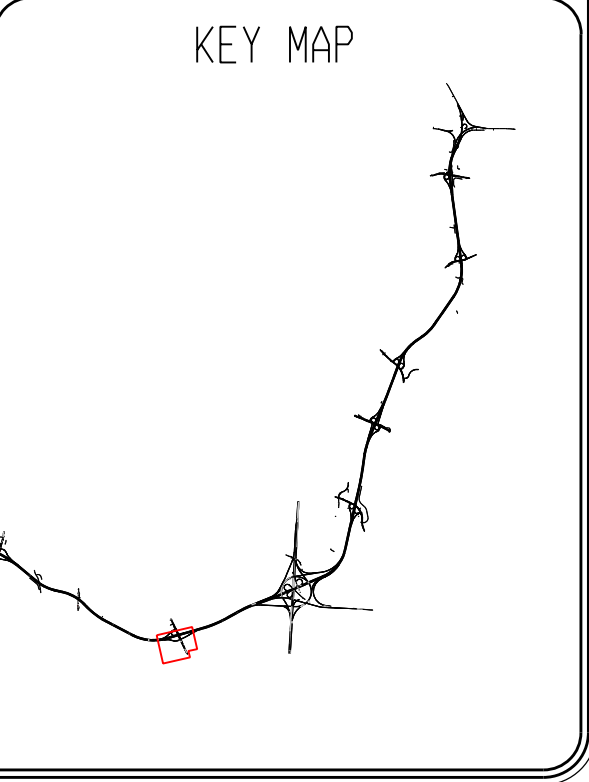
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



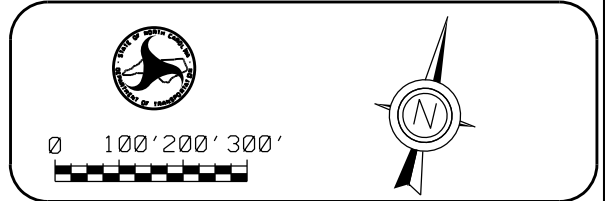
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.31

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

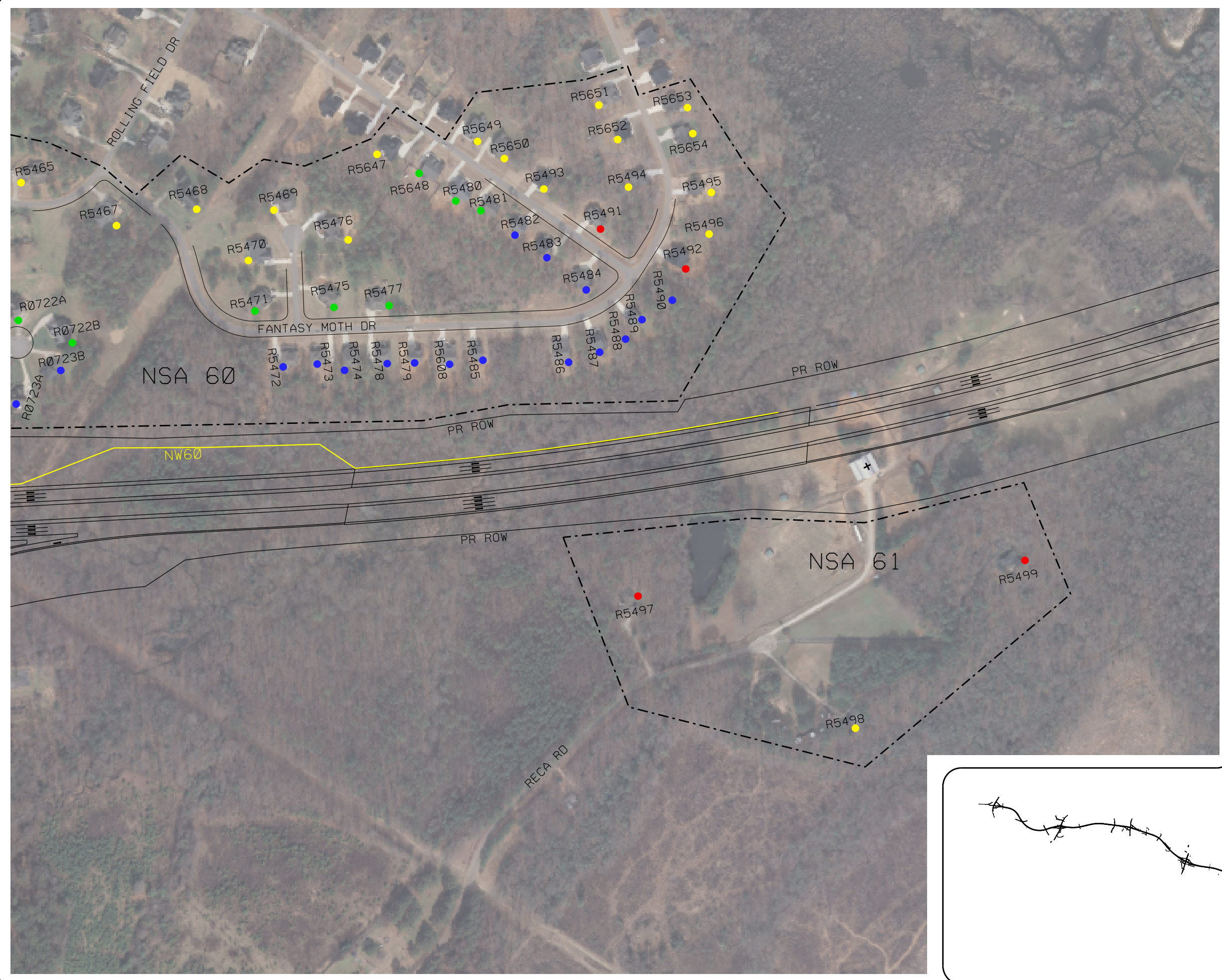
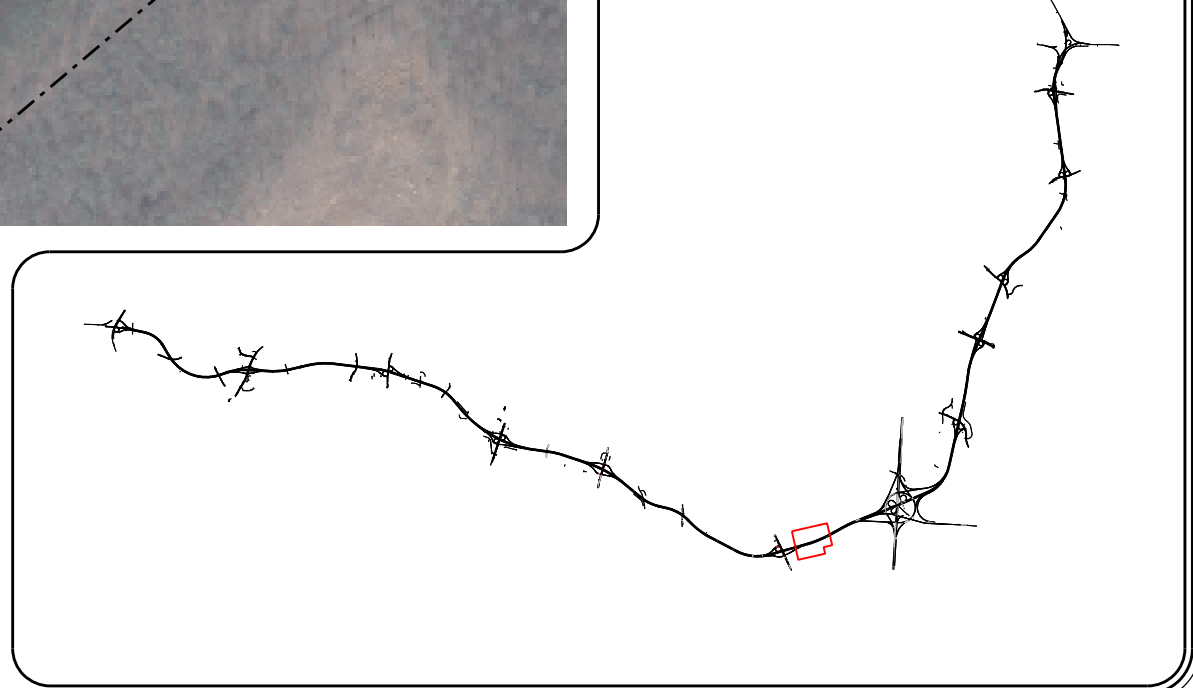


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.32

DECEMBER 2017

KEY MAP



COMPLETE 540
TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
WAKE AND JOHNSTON COUNTIES
STIP R-2721, R-2828 AND R-2829



0 100' 200' 300'



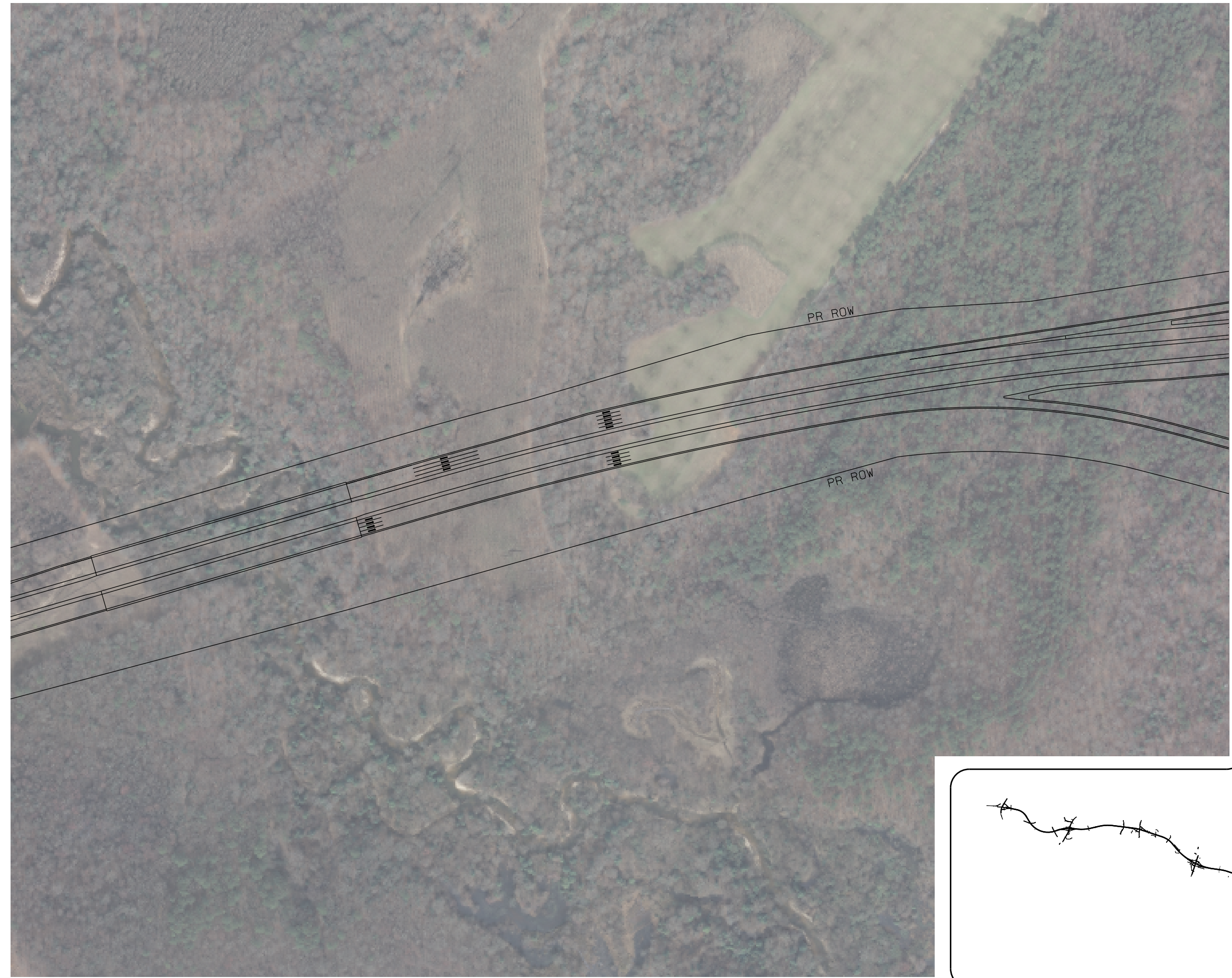
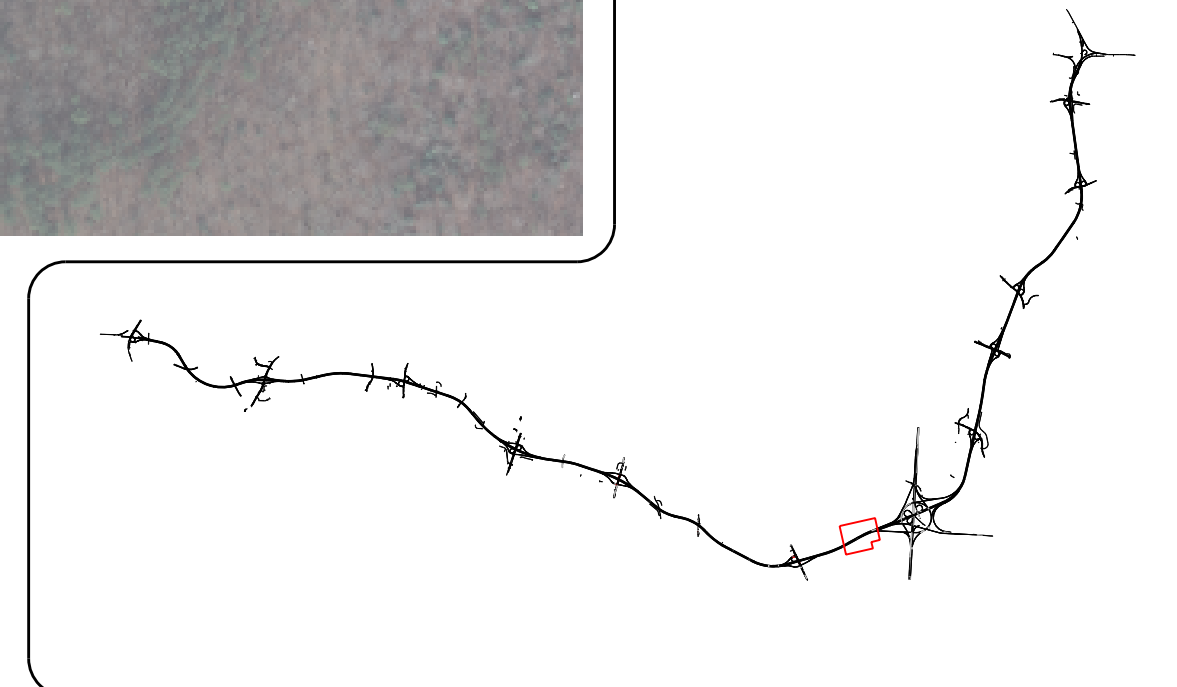
LEGEND

- R21 = NOISE RECEPTOR
- = NOT IMPACTED / NOT BENEFITED
- = NOT IMPACTED / BENEFITED
- = IMPACTED / BENEFITED
- = IMPACTED / NOT BENEFITED
- = NOT NOISE SENSITIVE
- x = ACQUIRED
- - - = NOISE STUDY AREA
- ▬ = LIKELY NOISE WALL
- ▬ = UNLIKELY NOISE WALL

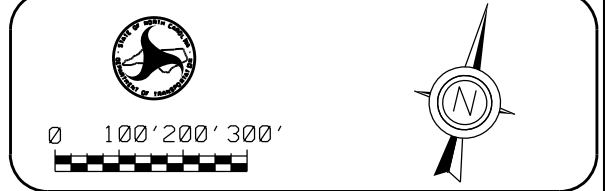
NOISE STUDY AREAS
EXHIBIT 2.33

DECEMBER 2017

KEY MAP



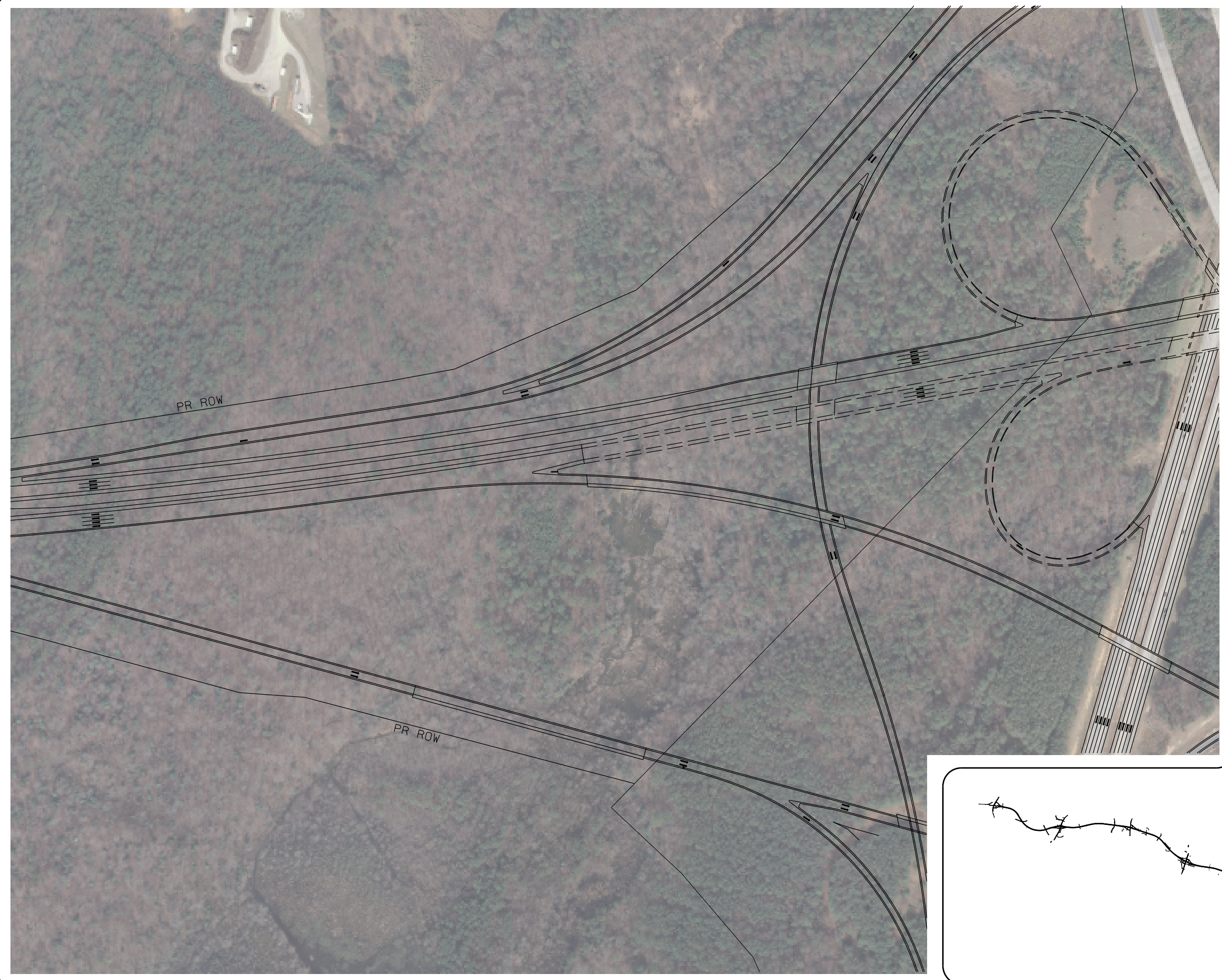
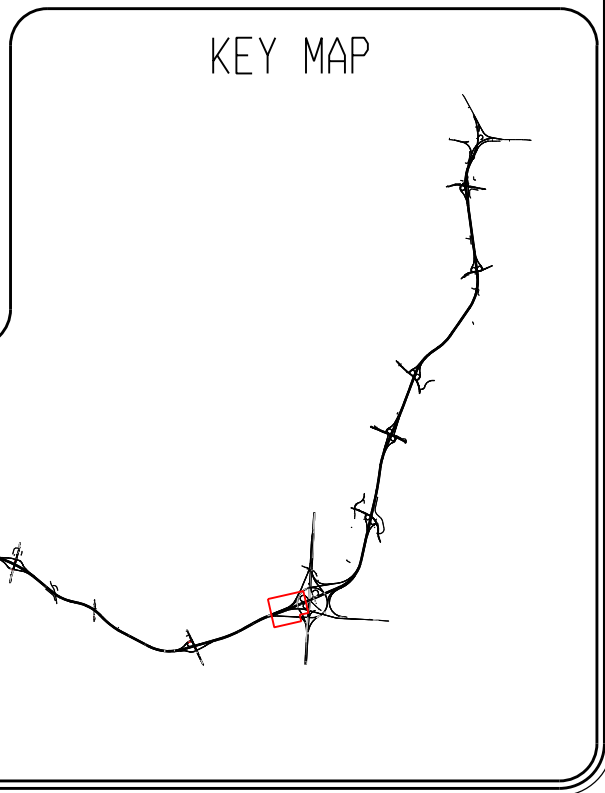
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



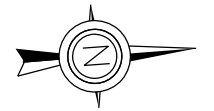
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.34

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



0 100' 200' 300'

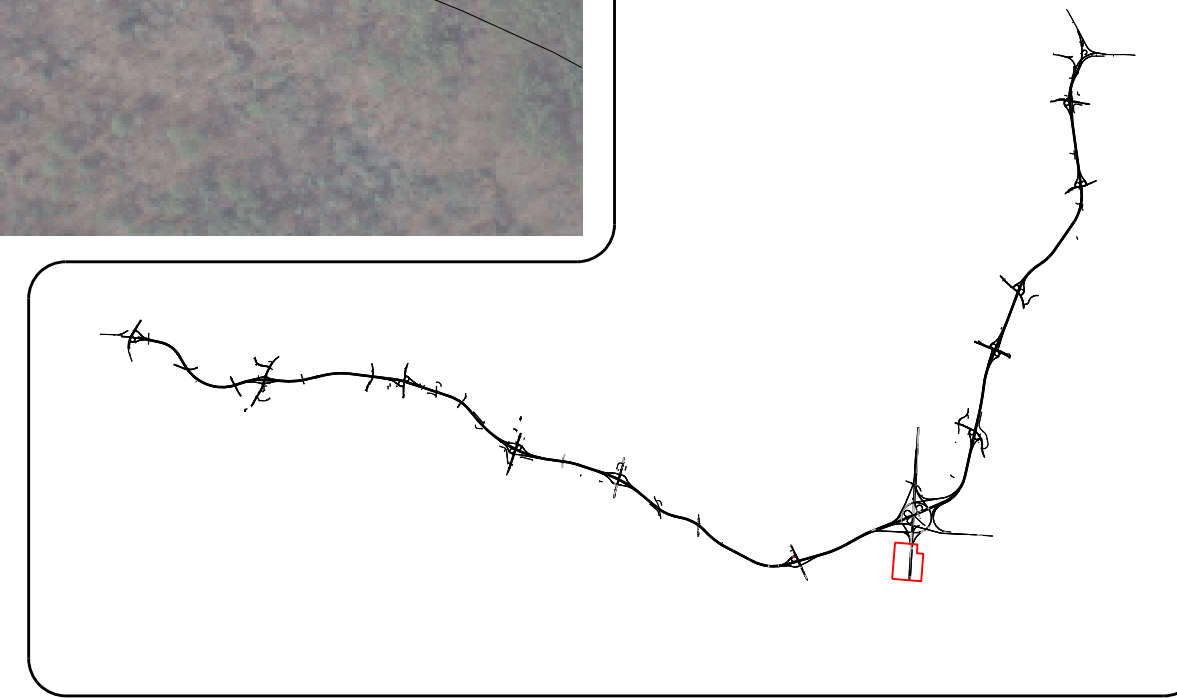
LEGEND

- R21 = NOISE RECEPTOR
- = NOT IMPACTED / NOT BENEFITED
- = NOT IMPACTED / BENEFITED
- = IMPACTED / BENEFITED
- = IMPACTED / NOT BENEFITED
- = NOT NOISE SENSITIVE
- x = ACQUIRED
- - - = NOISE STUDY AREA
- ▬ = LIKELY NOISE WALL
- ▬ = UNLIKELY NOISE WALL

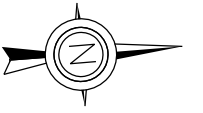
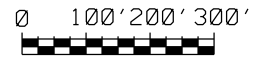
NOISE STUDY AREAS
 EXHIBIT 2.35

DECEMBER 2017

KEY MAP



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



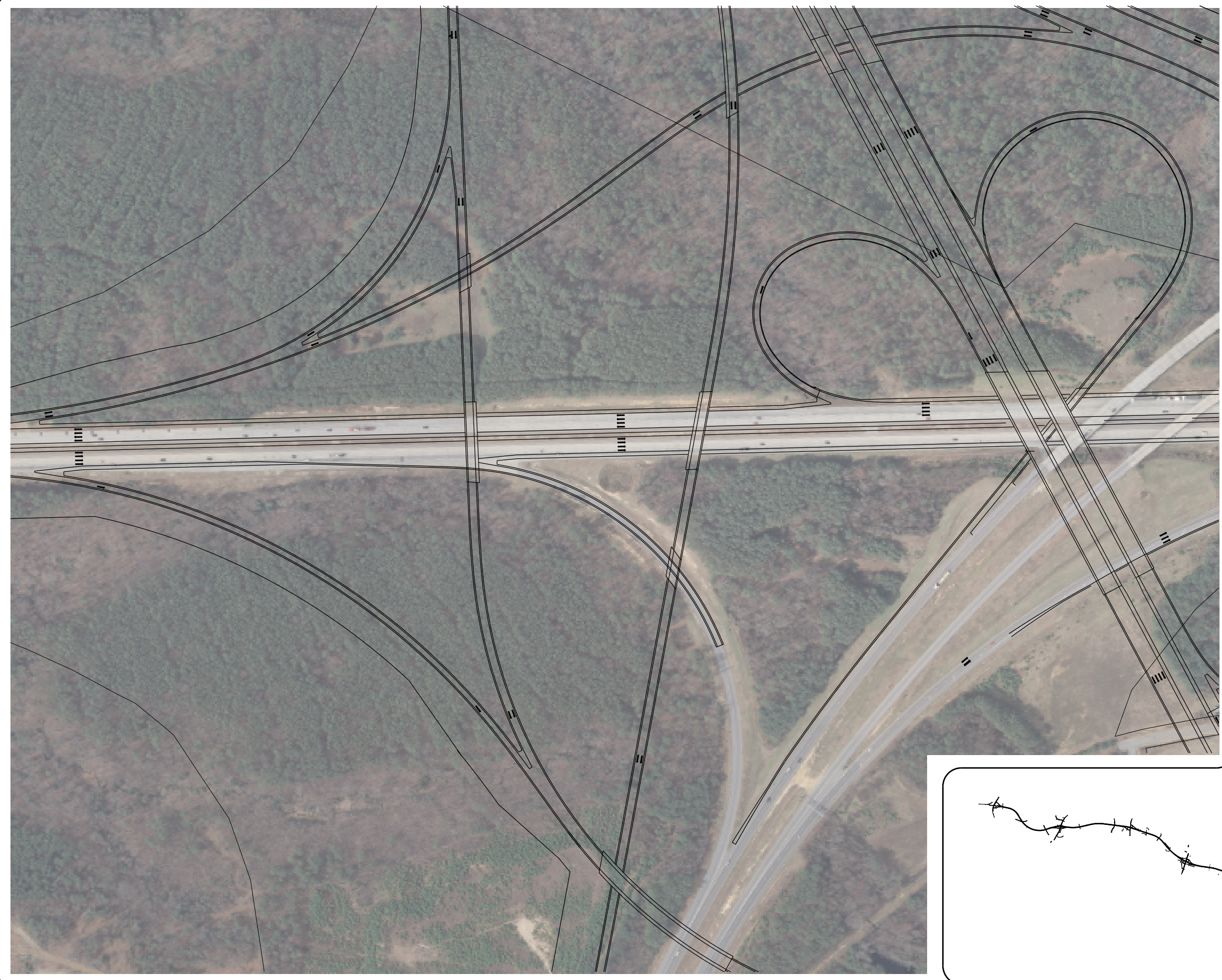
LEGEND

- R21 = NOISE RECEPTOR
- = NOT IMPACTED / NOT BENEFITED
- = NOT IMPACTED / BENEFITED
- = IMPACTED / BENEFITED
- = IMPACTED / NOT BENEFITED
- = NOT NOISE SENSITIVE
- x = ACQUIRED
- - - = NOISE STUDY AREA
- ▬ = LIKELY NOISE WALL
- ▬ = UNLIKELY NOISE WALL

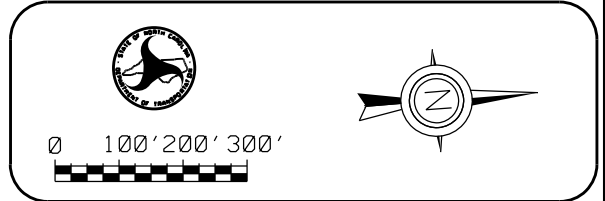
NOISE STUDY AREAS
 EXHIBIT 2.36

DECEMBER 2017

KEY MAP



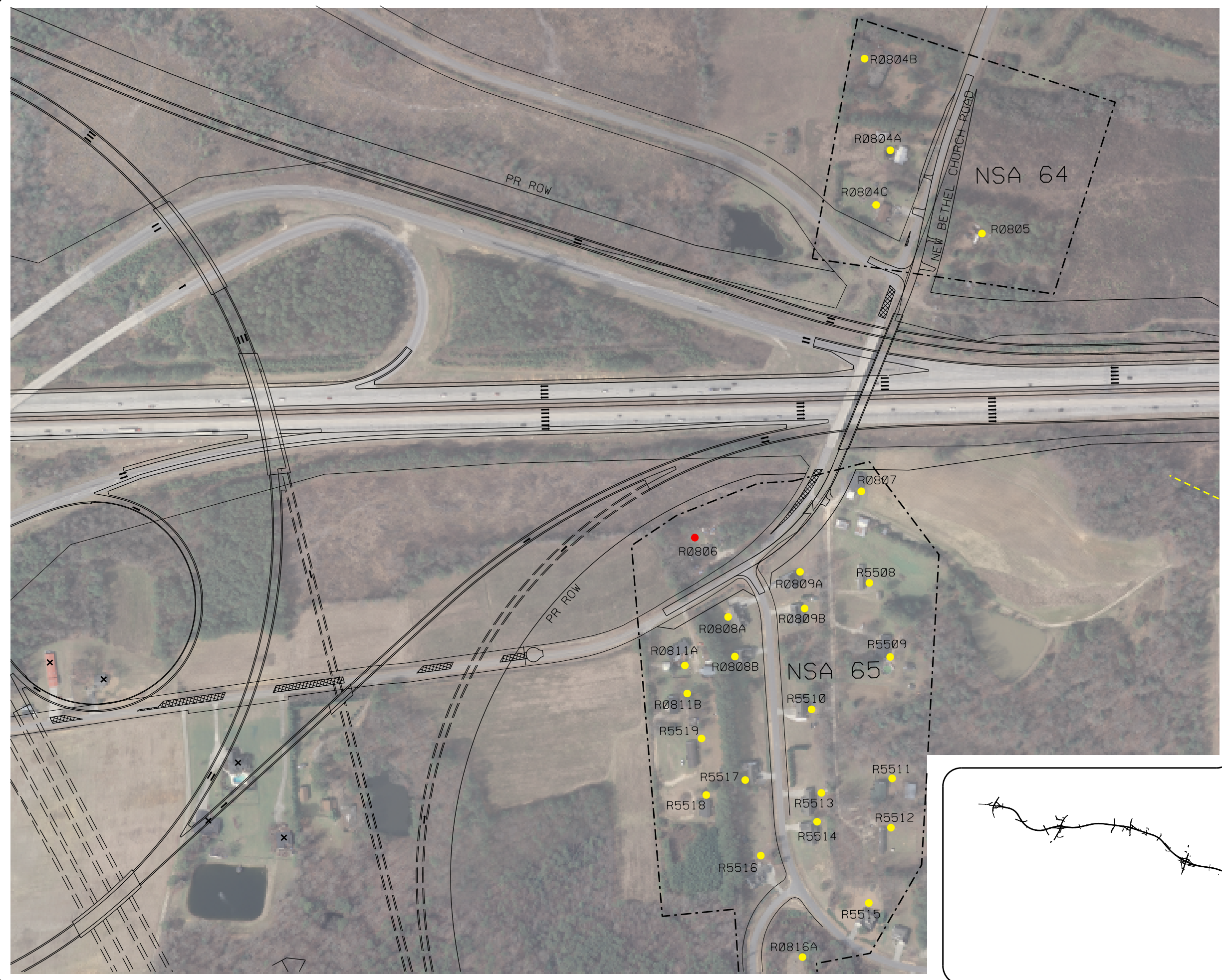
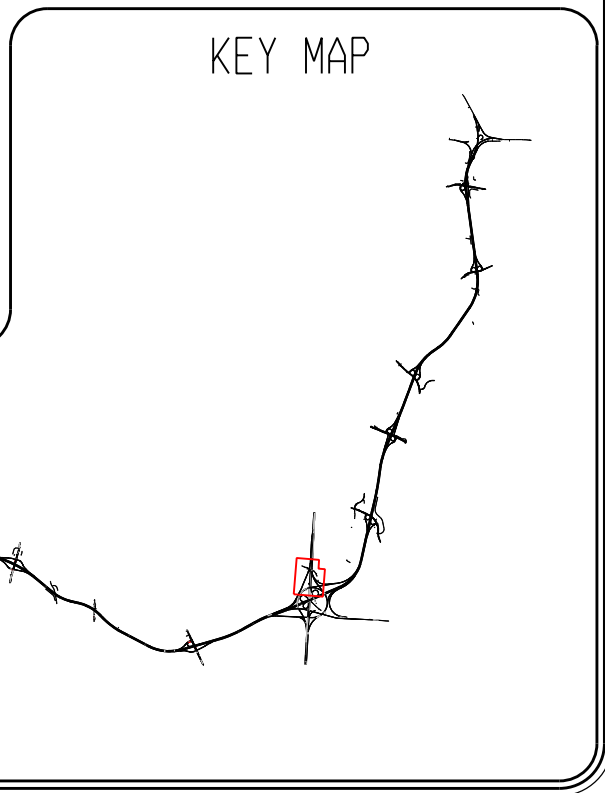
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



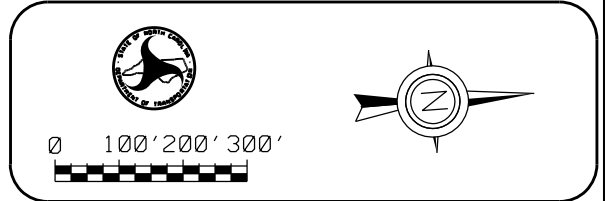
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▨ = LIKELY NOISE WALL
 - ▨ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.37

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

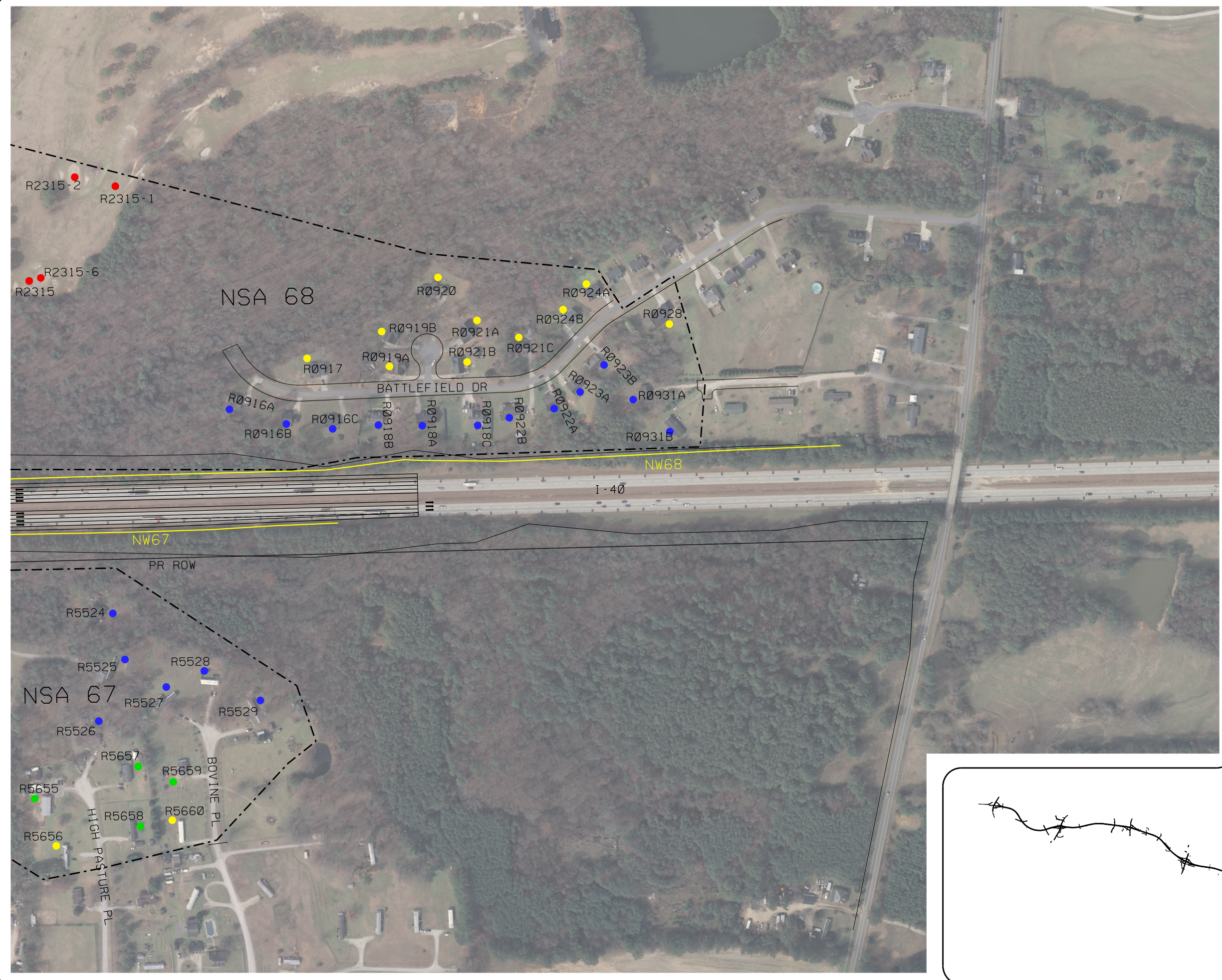
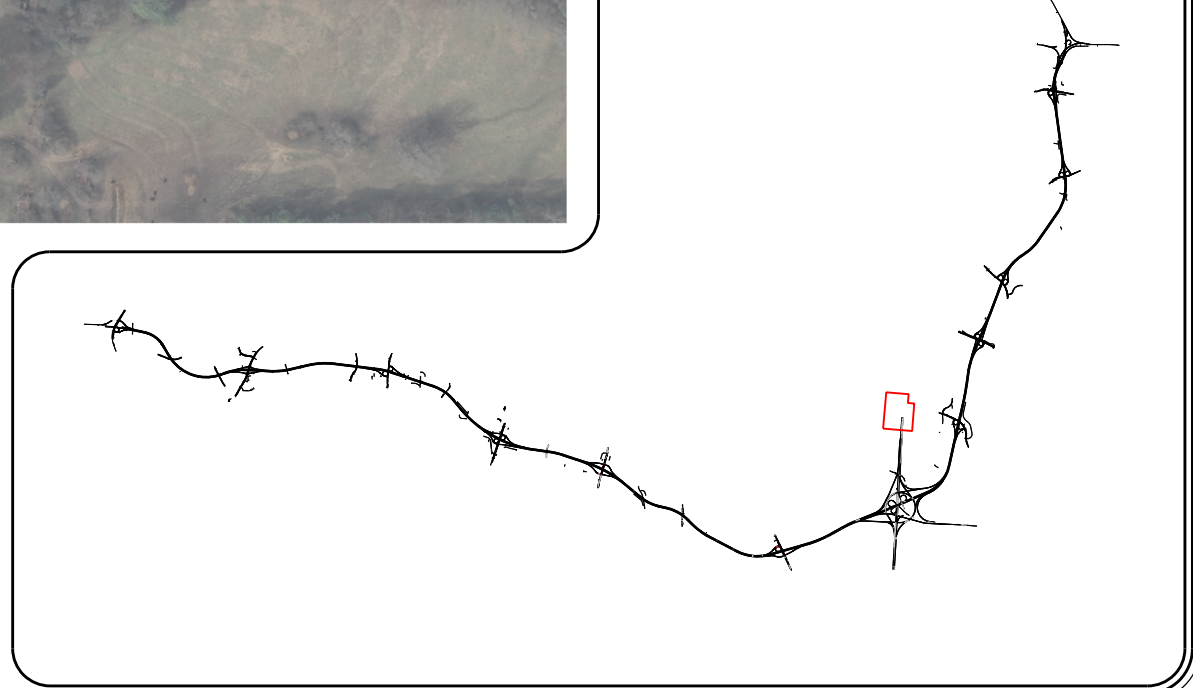


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

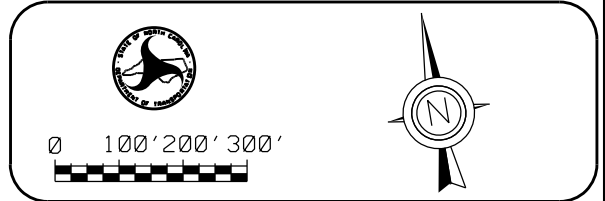
NOISE STUDY AREAS
 EXHIBIT 2.39

DECEMBER 2017

KEY MAP



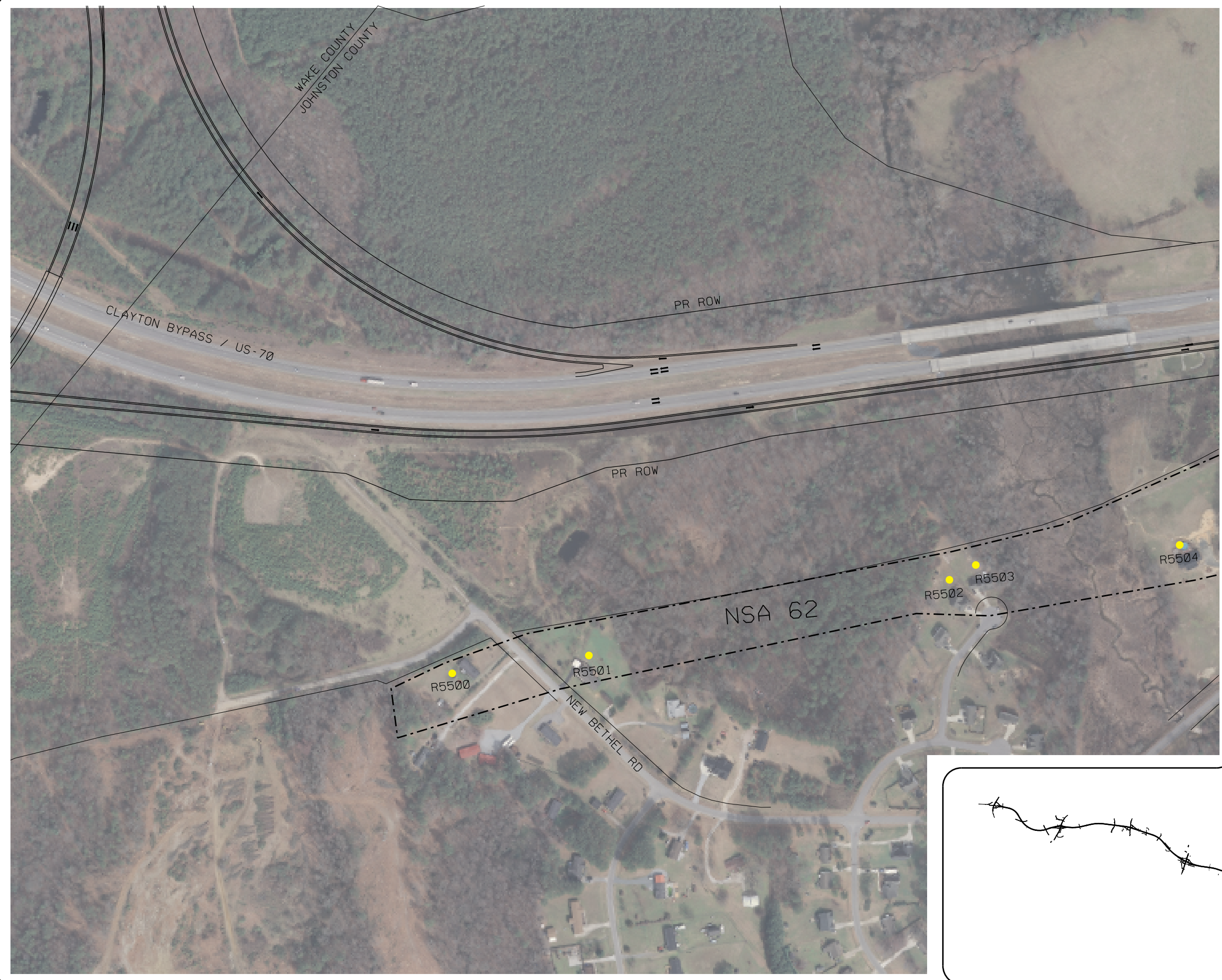
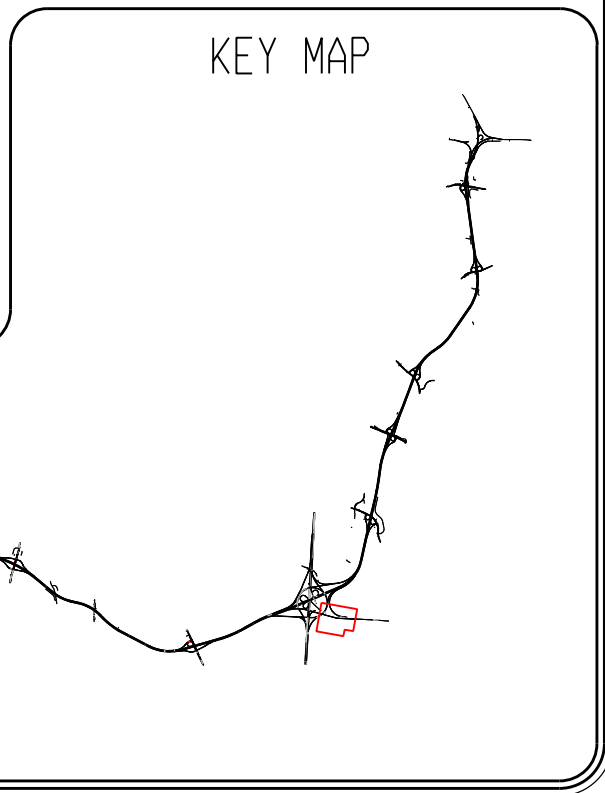
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



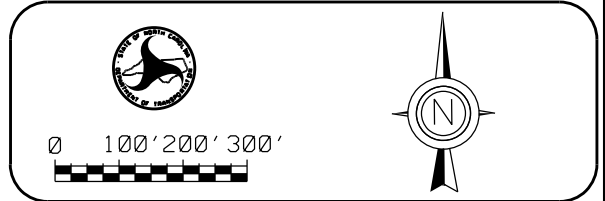
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.40

DECEMBER 2017



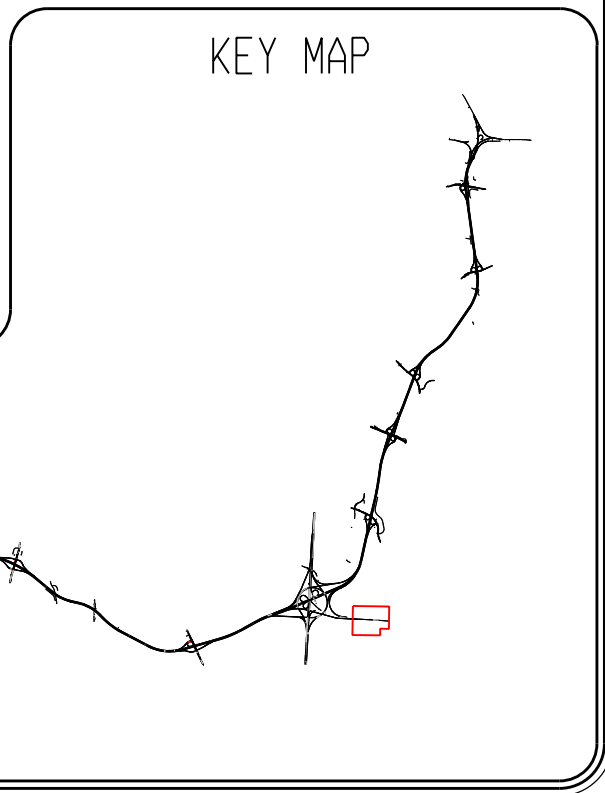
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

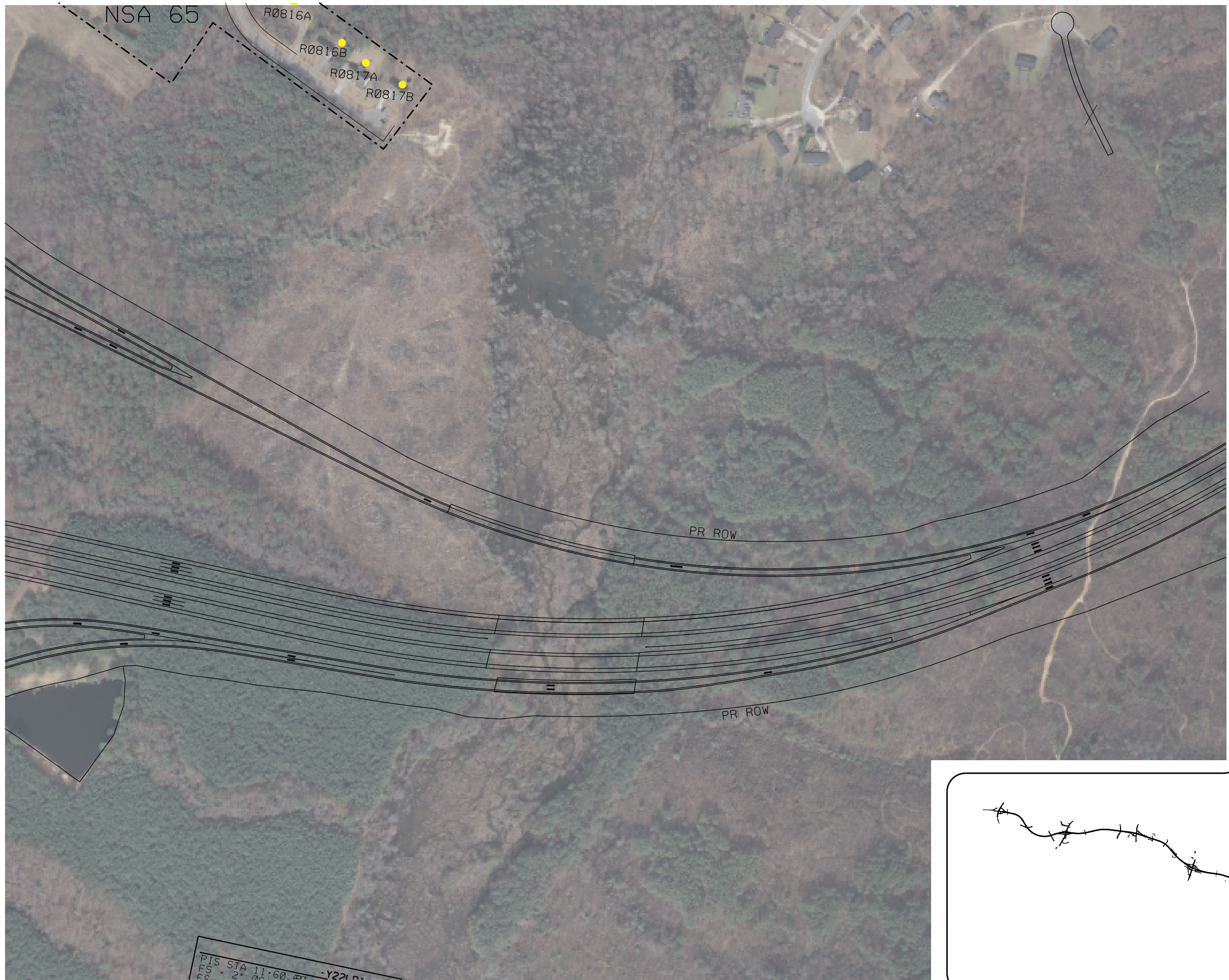


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.41

DECEMBER 2017





NSA 65

R0816A

R0816B

R0817A

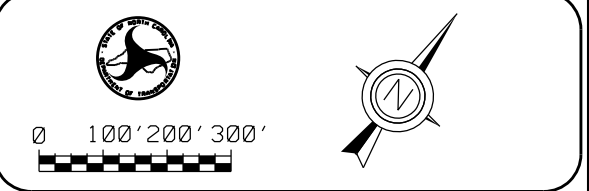
R0817B

PR ROW

PR ROW

PIS STA 11+60.47
 FS = 2.00
 Y2210

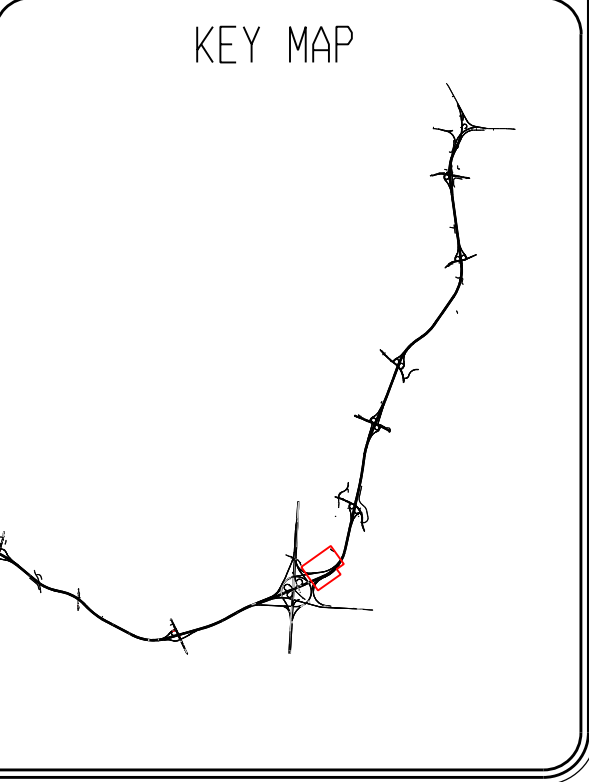
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



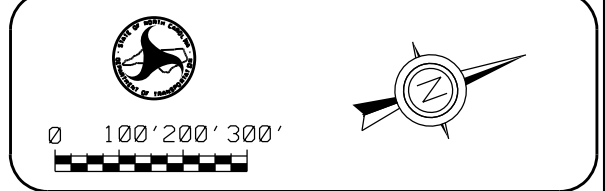
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.42

DECEMBER 2017



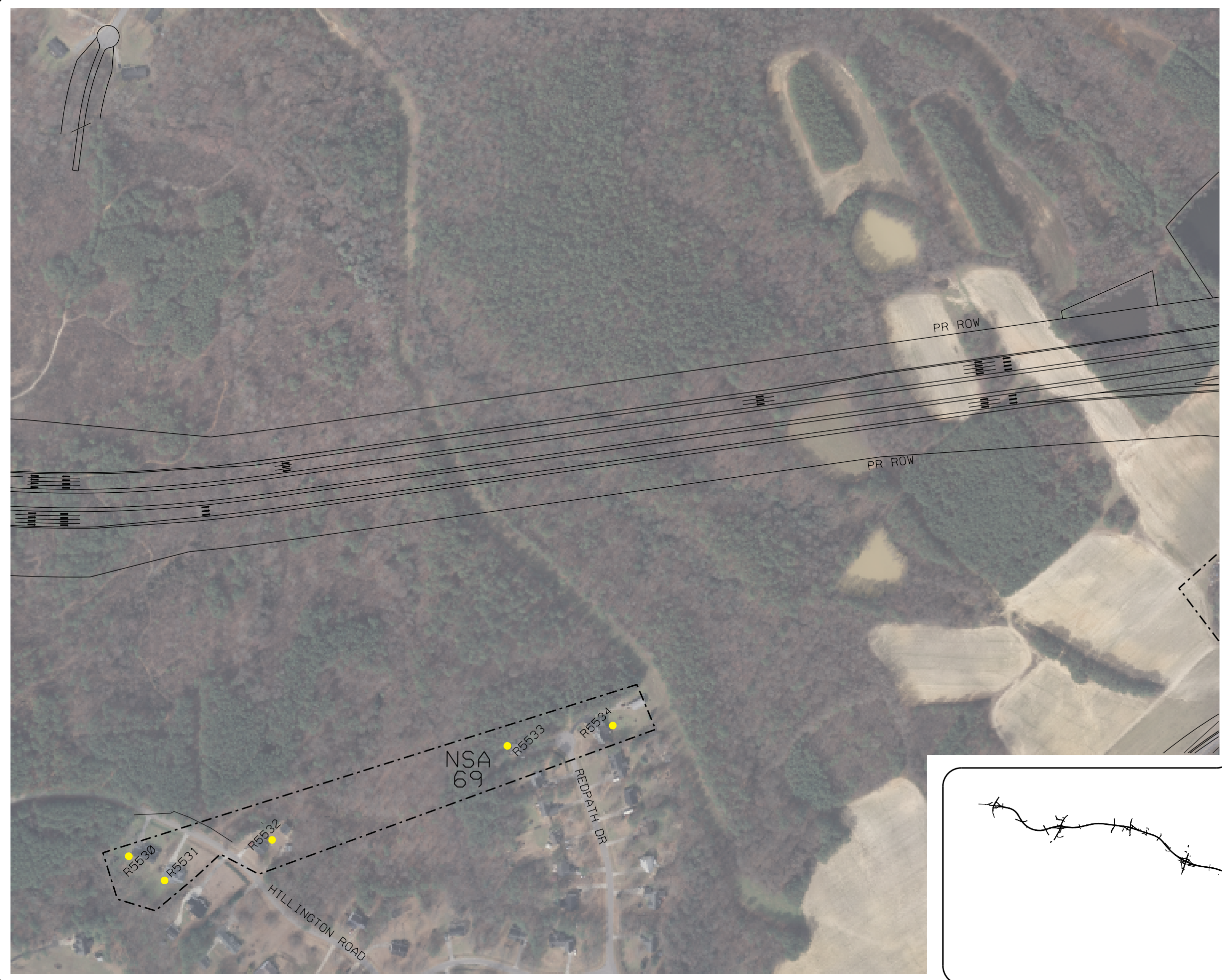
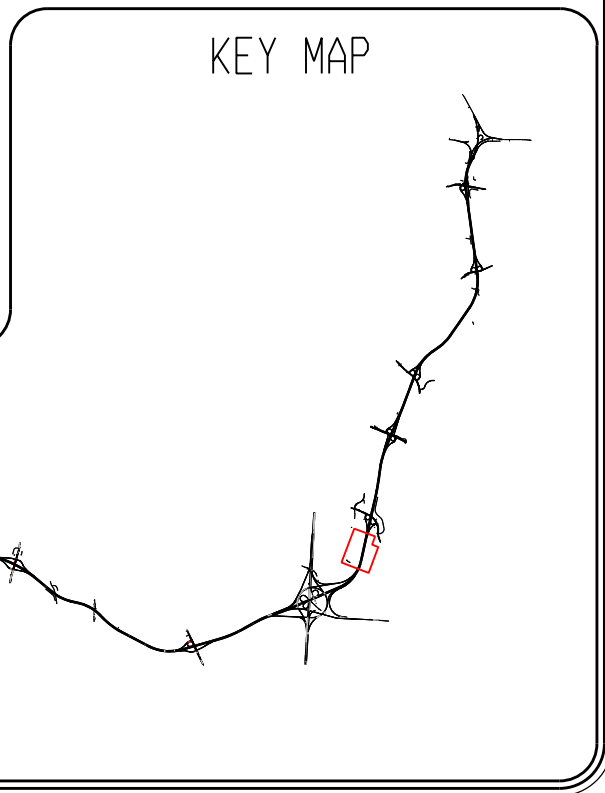
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



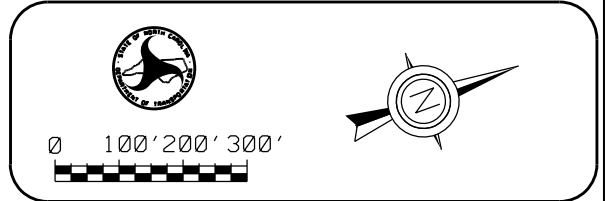
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.43

DECEMBER 2017



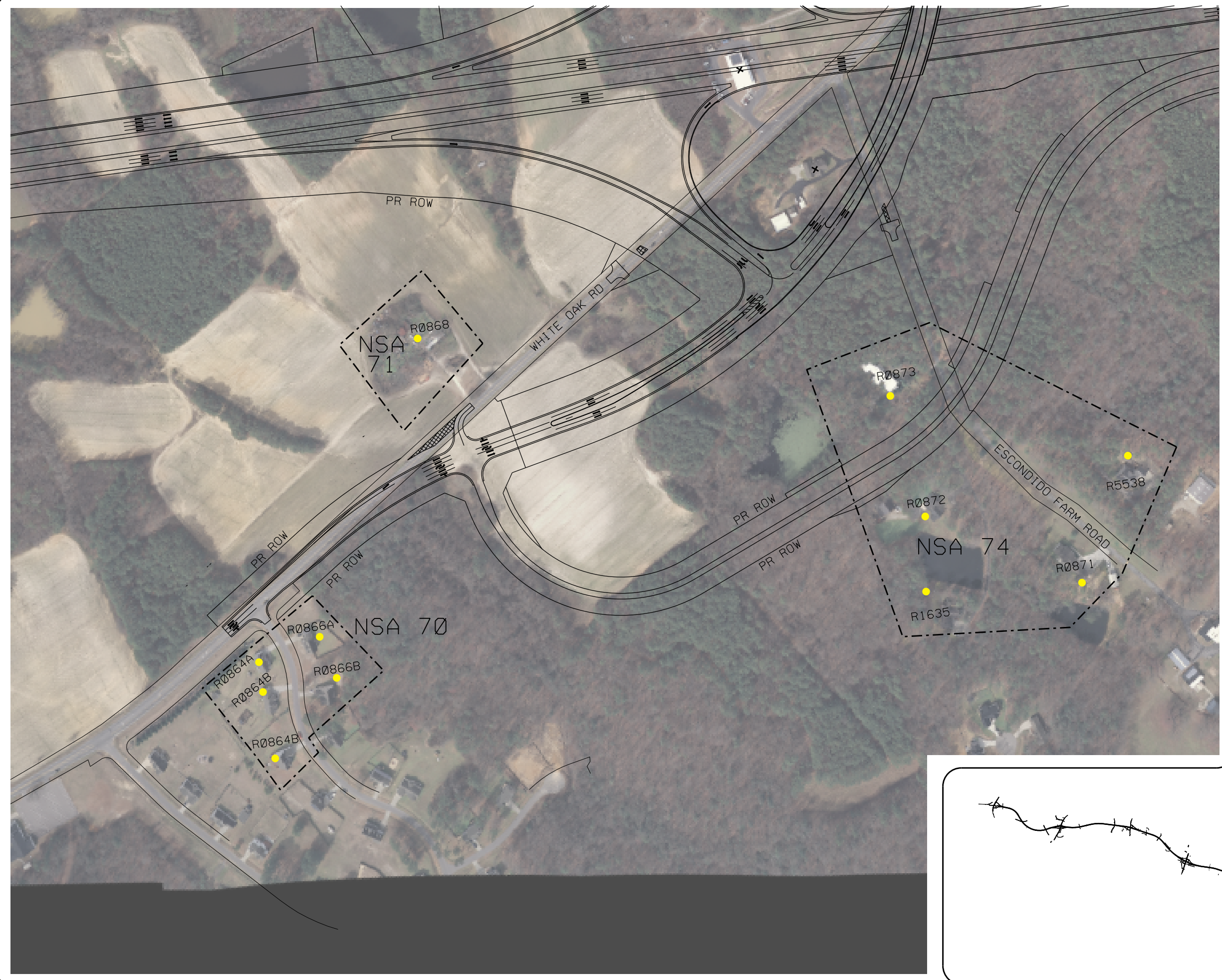
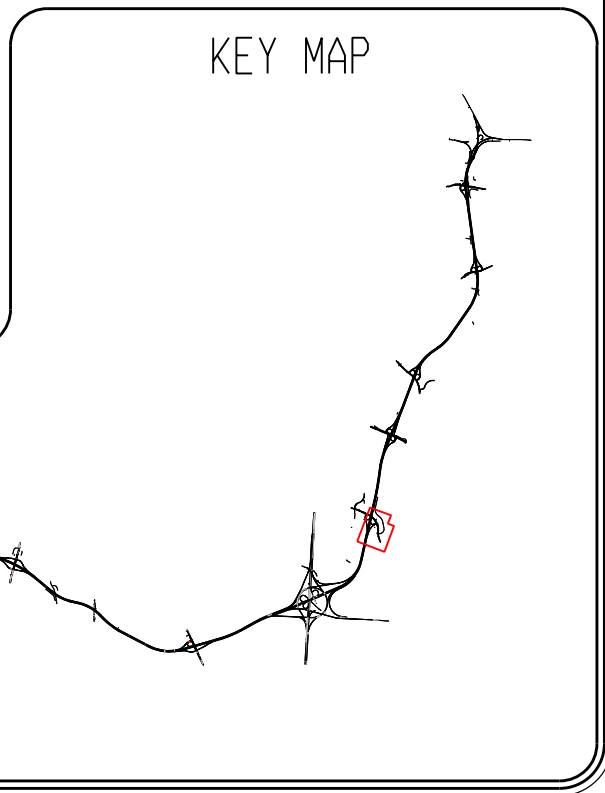
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



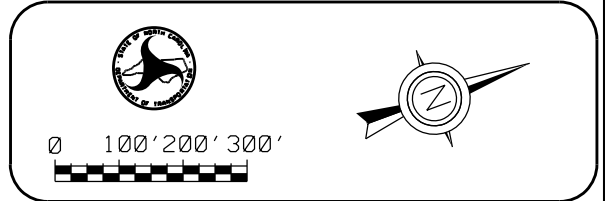
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.44

DECEMBER 2017



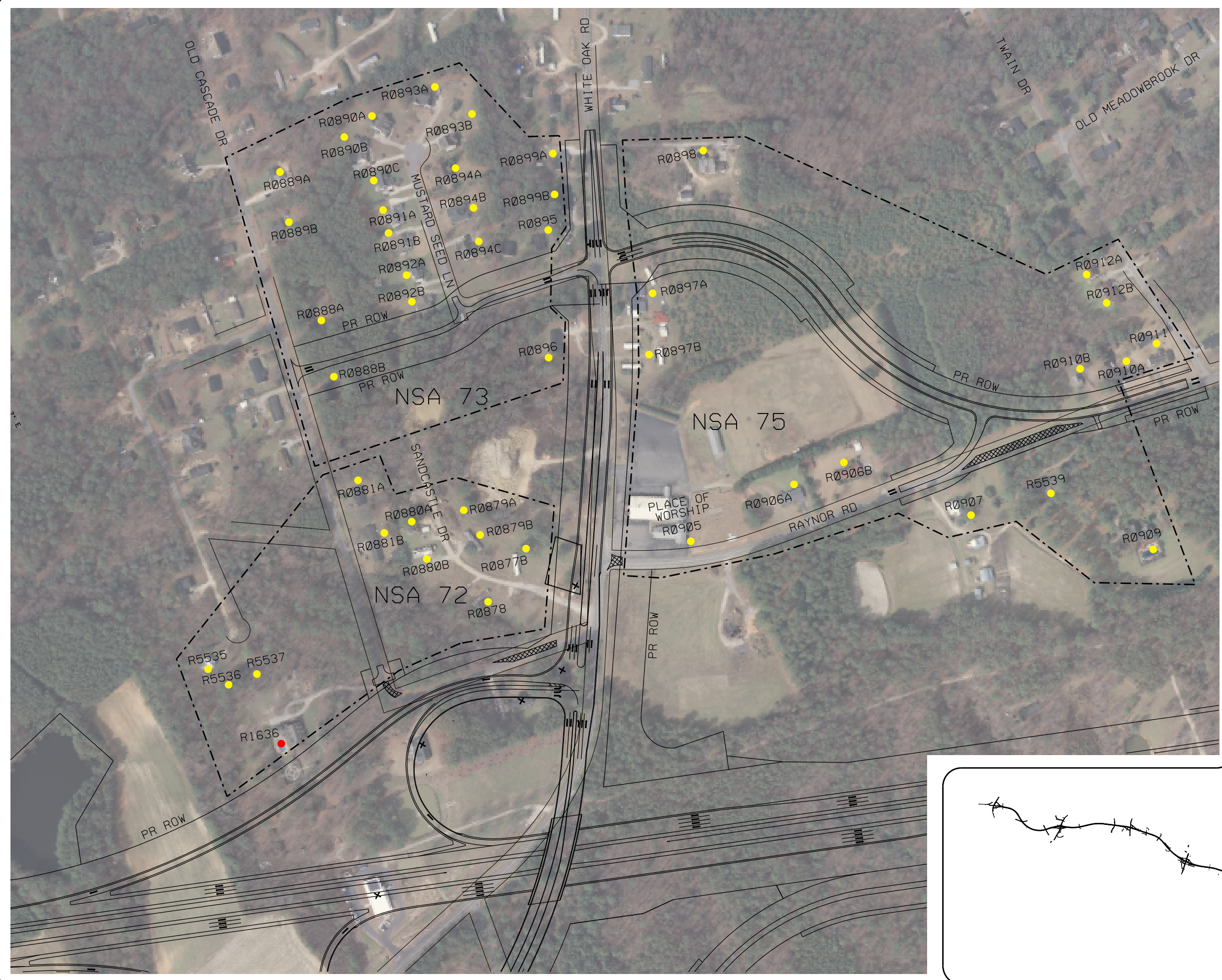
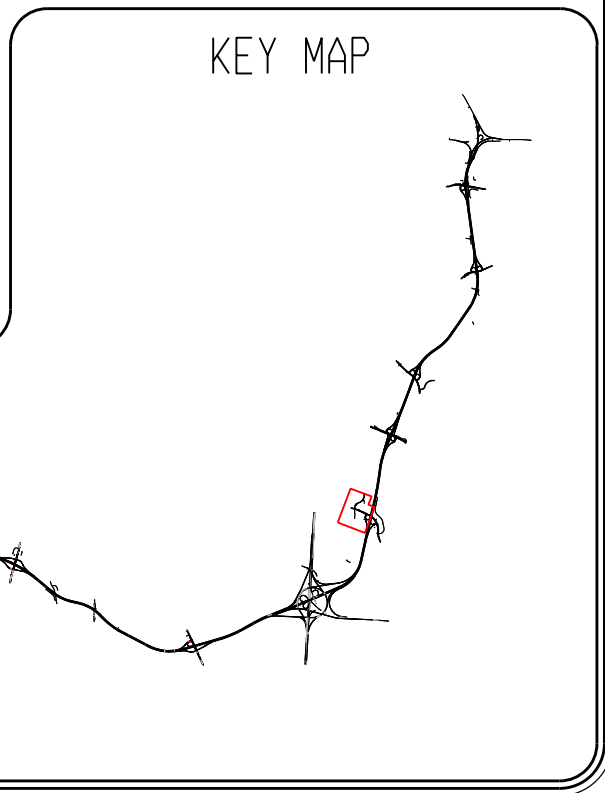
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

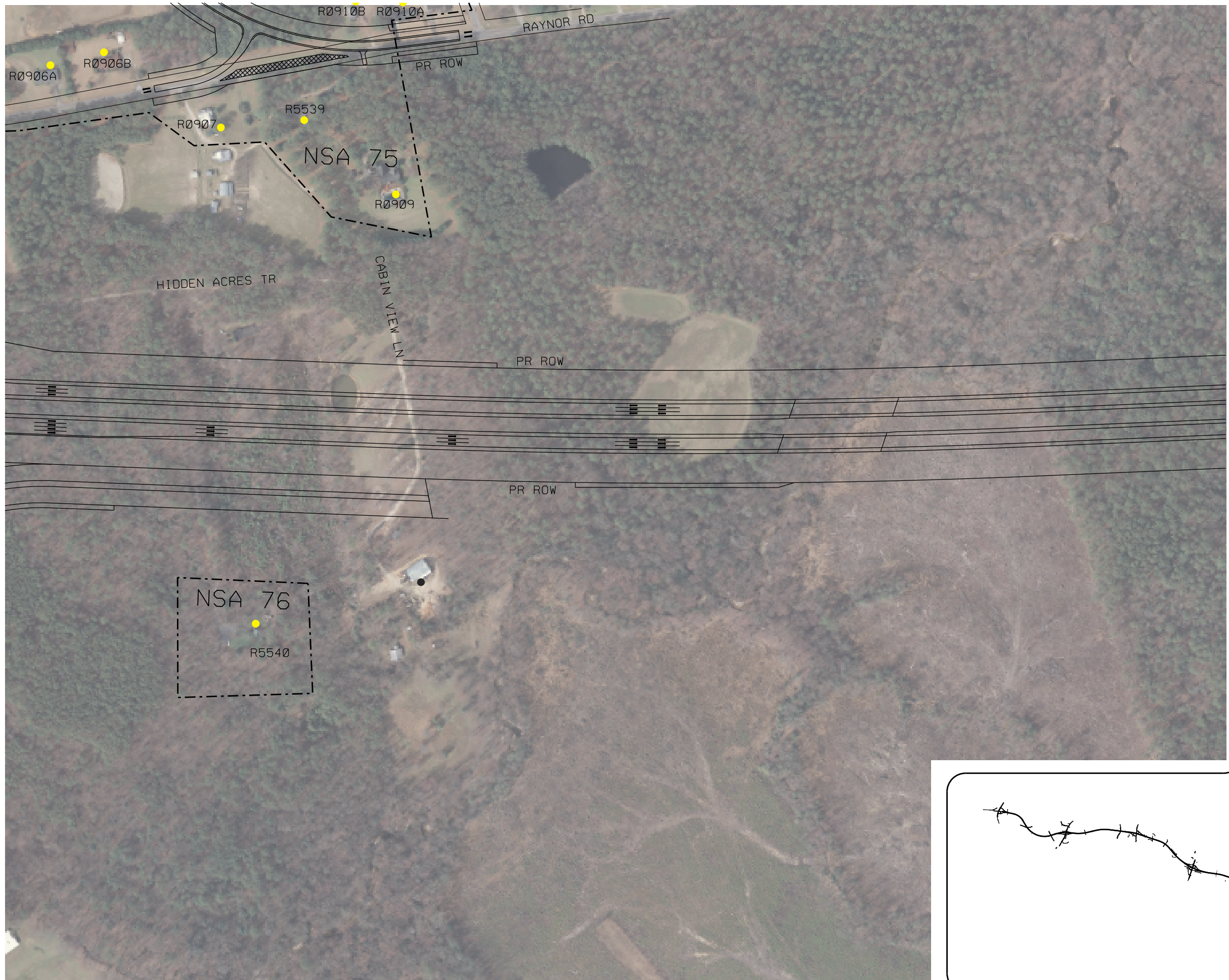


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▨ = LIKELY NOISE WALL
 - ▨ = UNLIKELY NOISE WALL

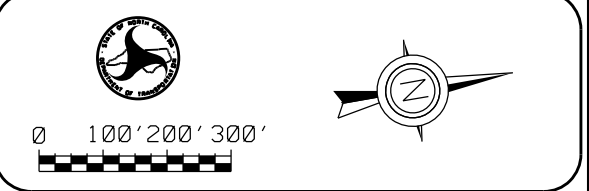
NOISE STUDY AREAS
 EXHIBIT 2.45

DECEMBER 2017





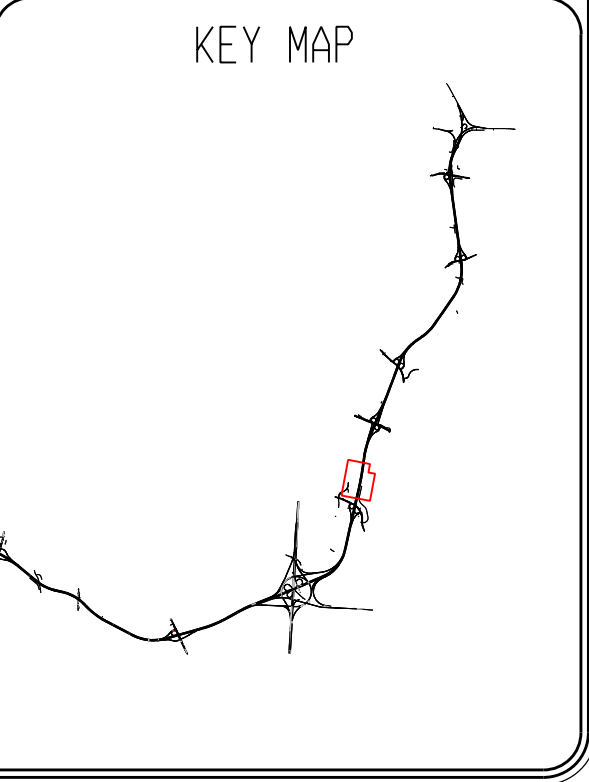
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

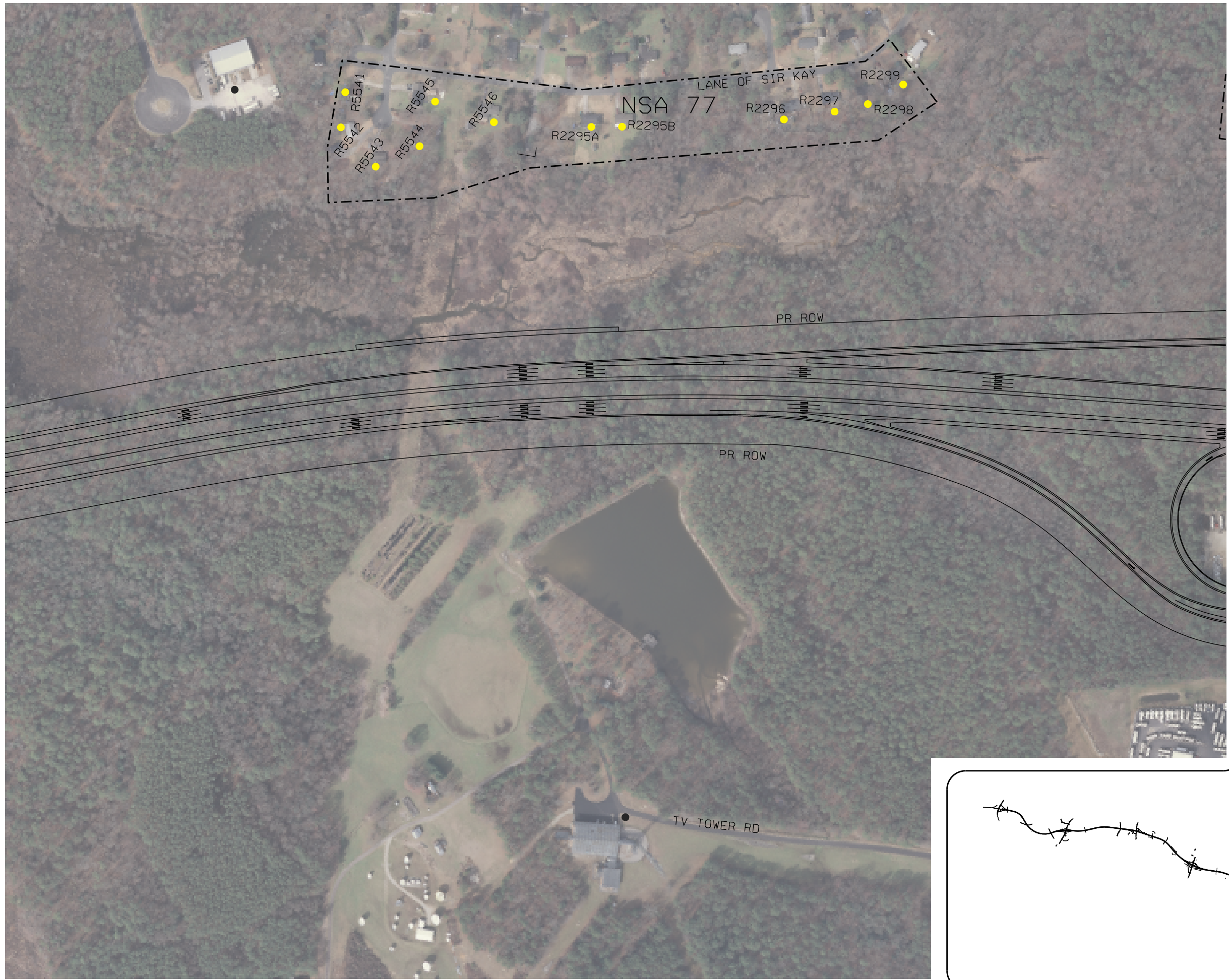


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

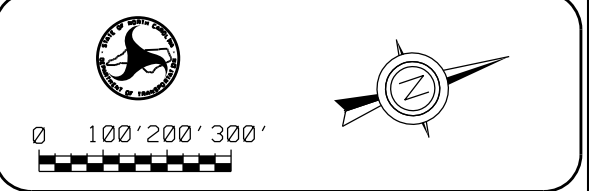
NOISE STUDY AREAS
 EXHIBIT 2.46

DECEMBER 2017





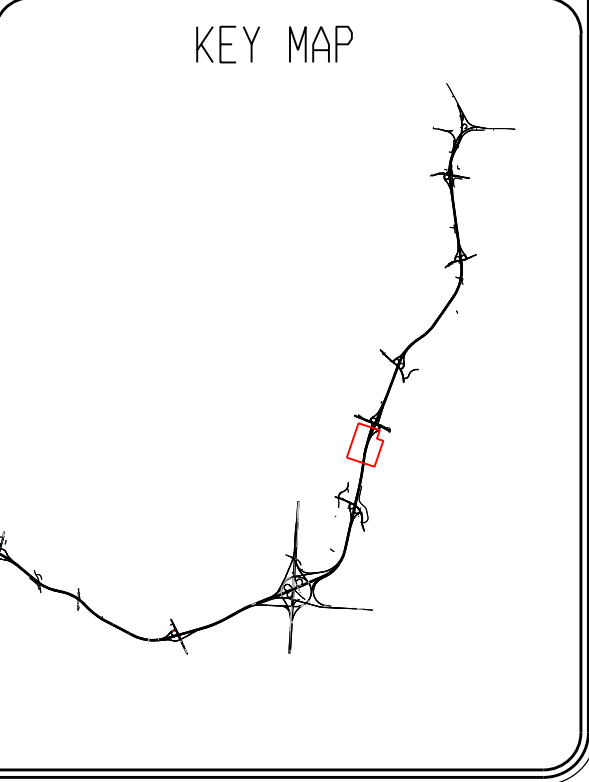
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



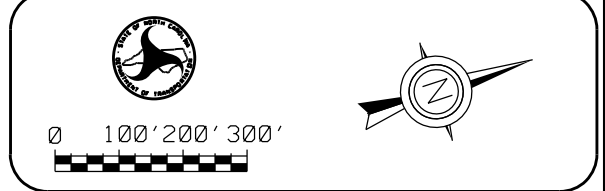
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.47

DECEMBER 2017



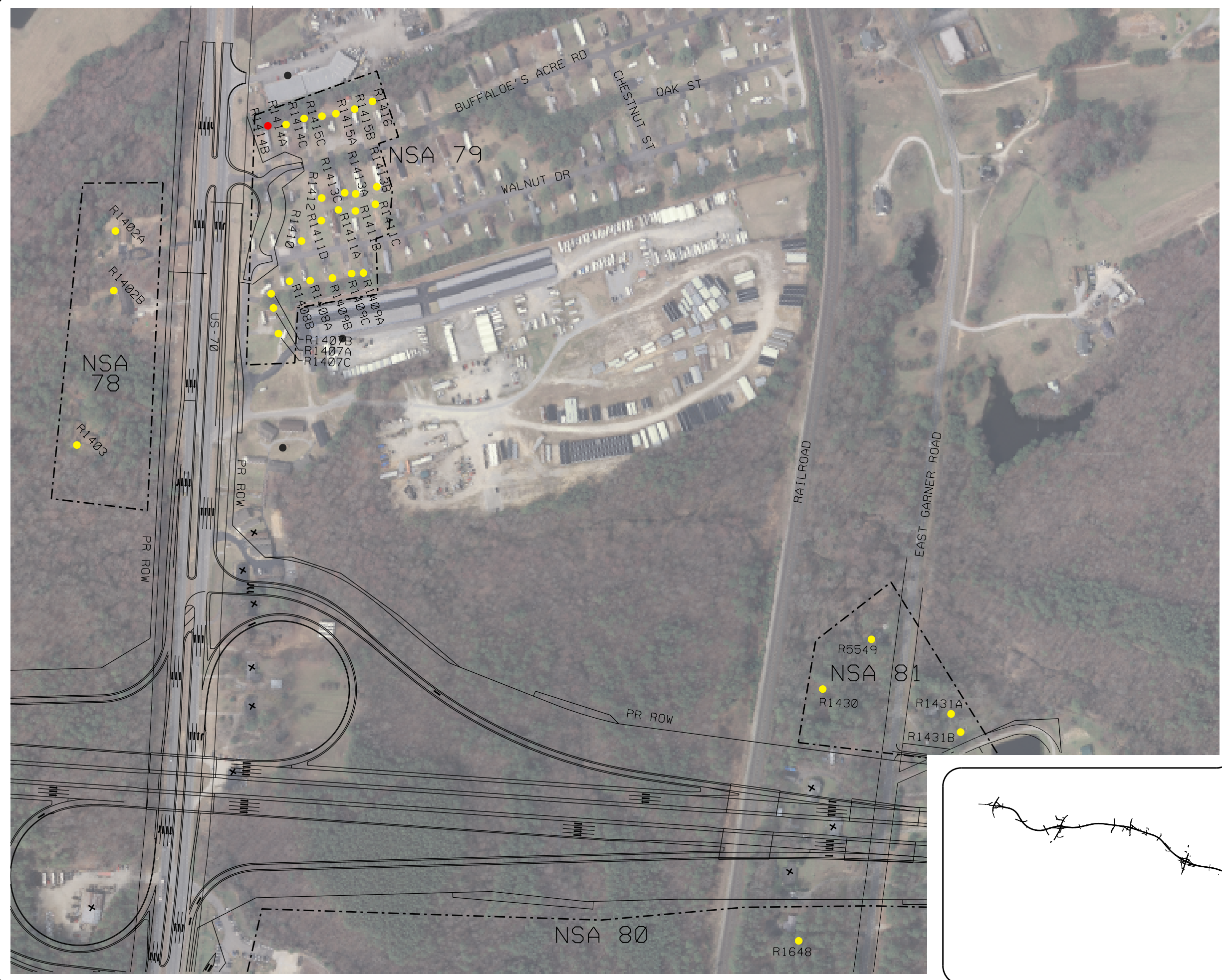
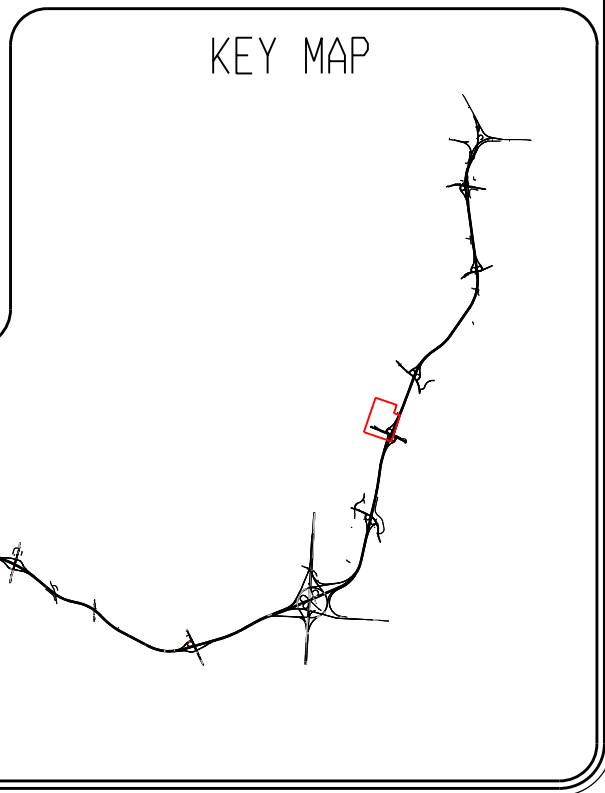
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



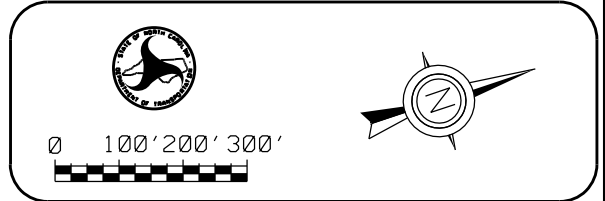
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.48

DECEMBER 2017



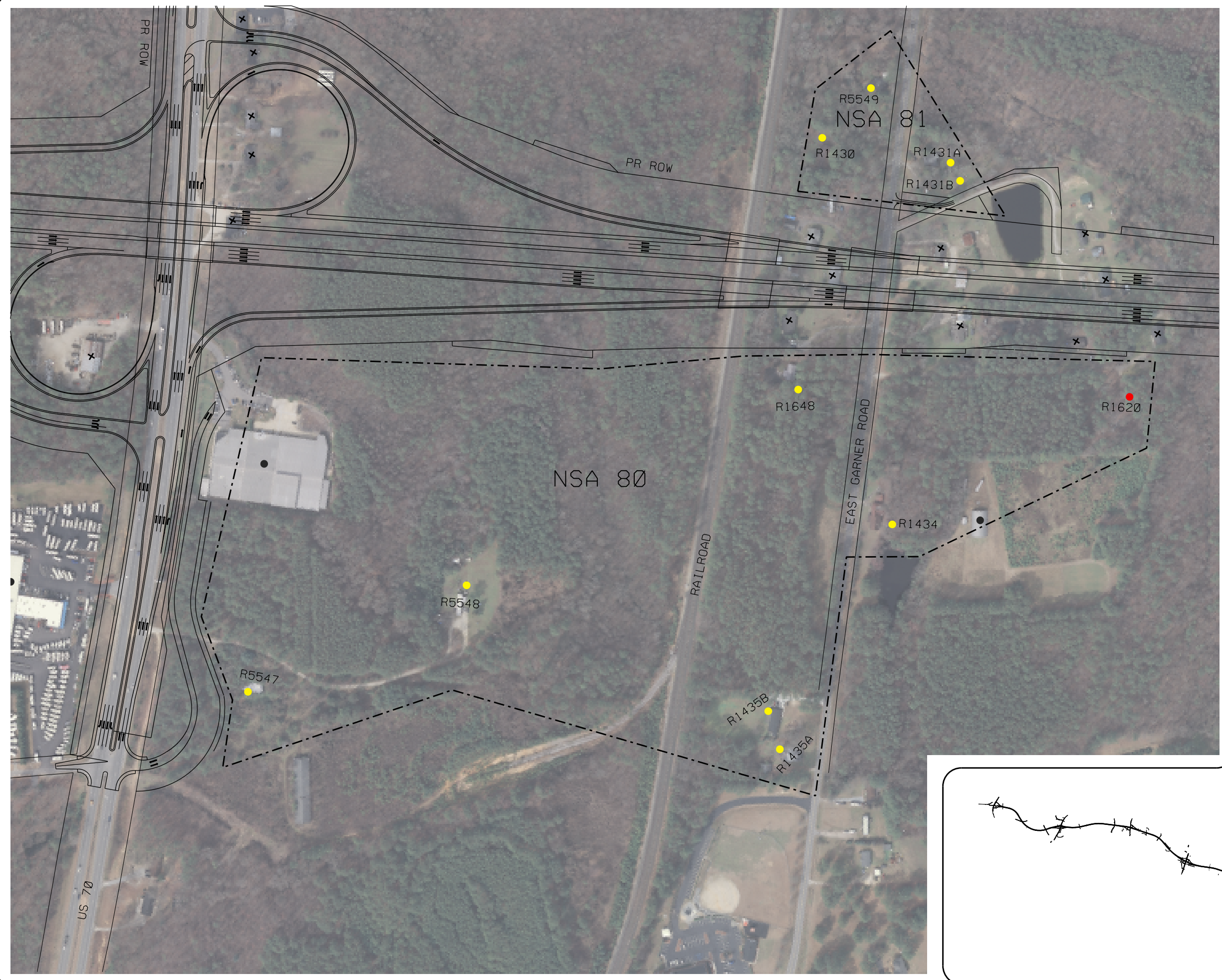
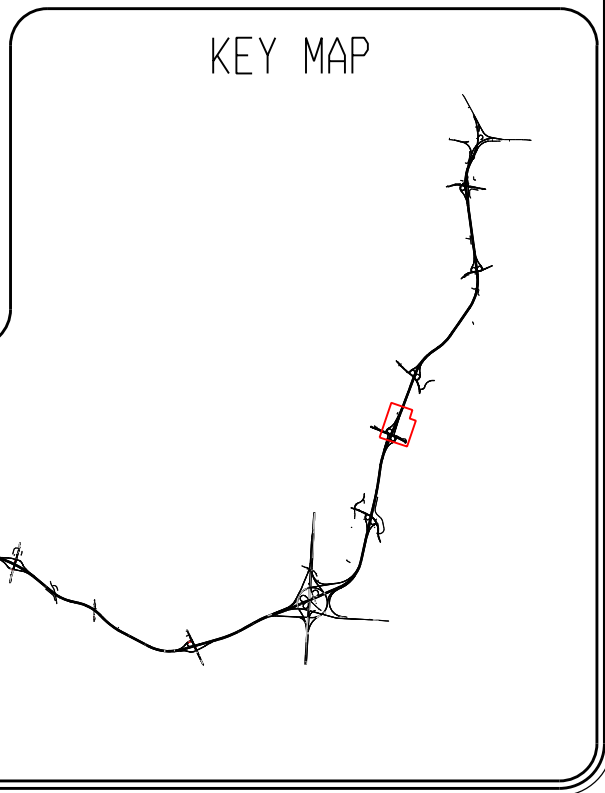
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



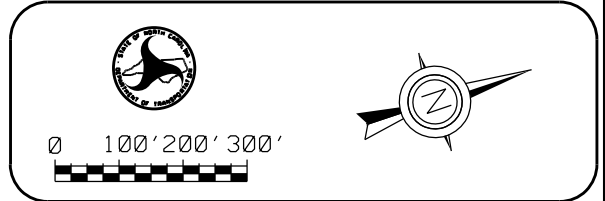
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.49

DECEMBER 2017



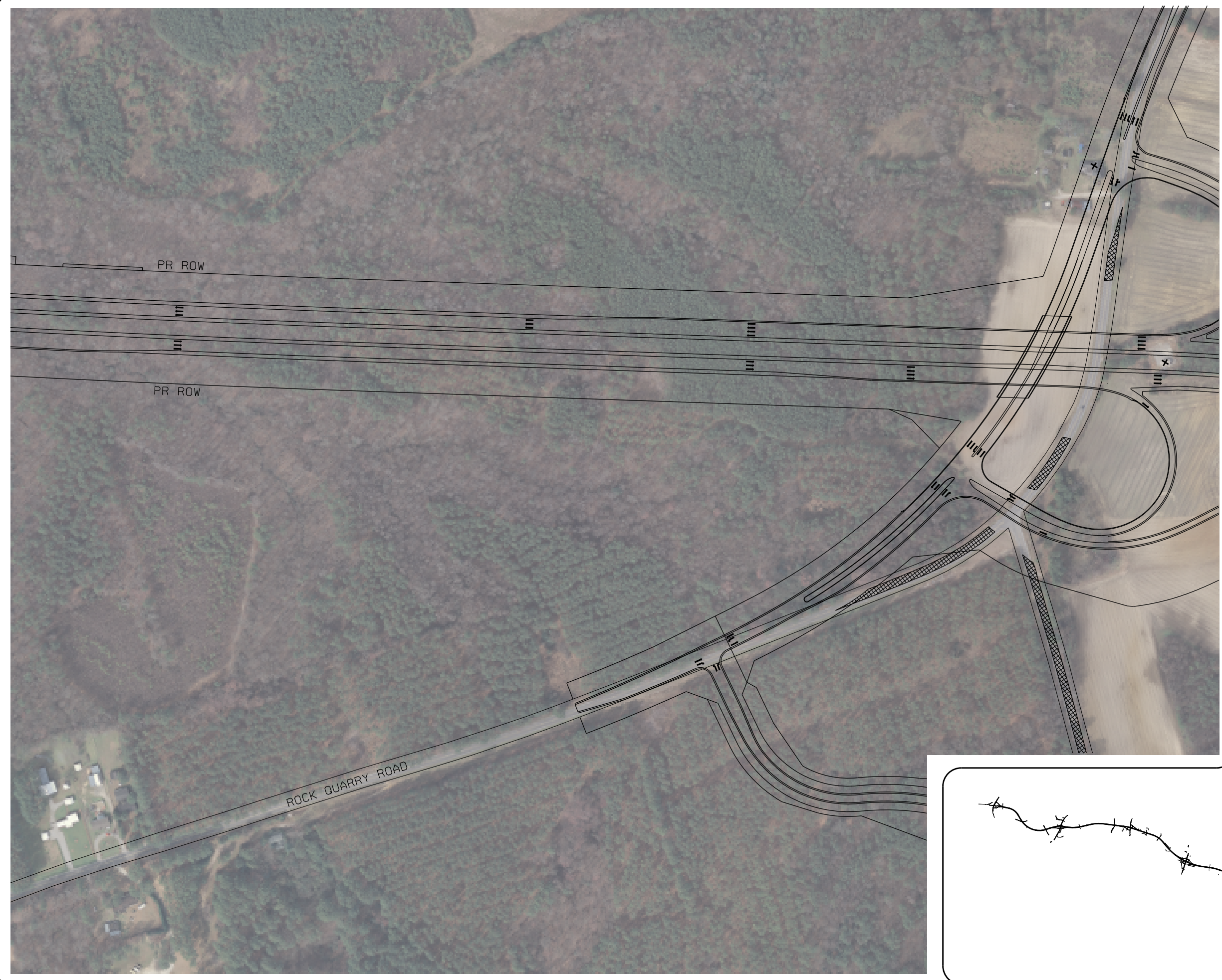
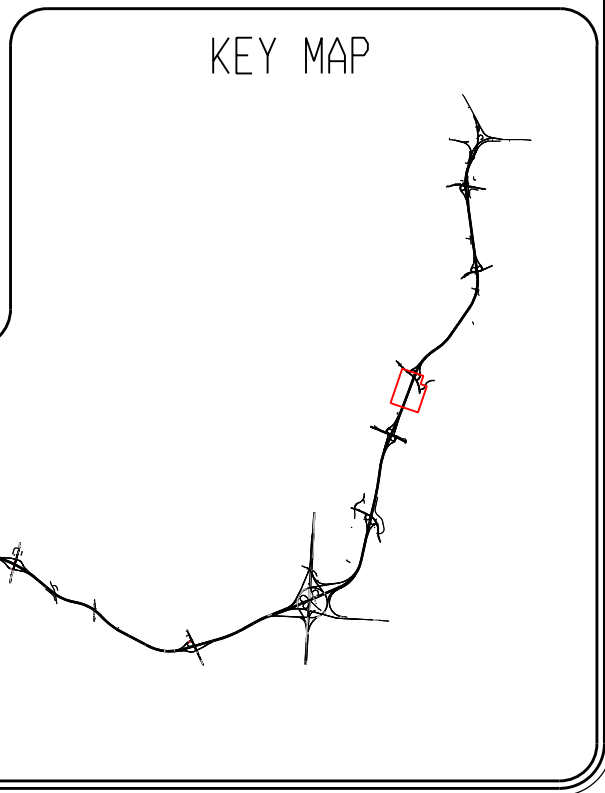
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

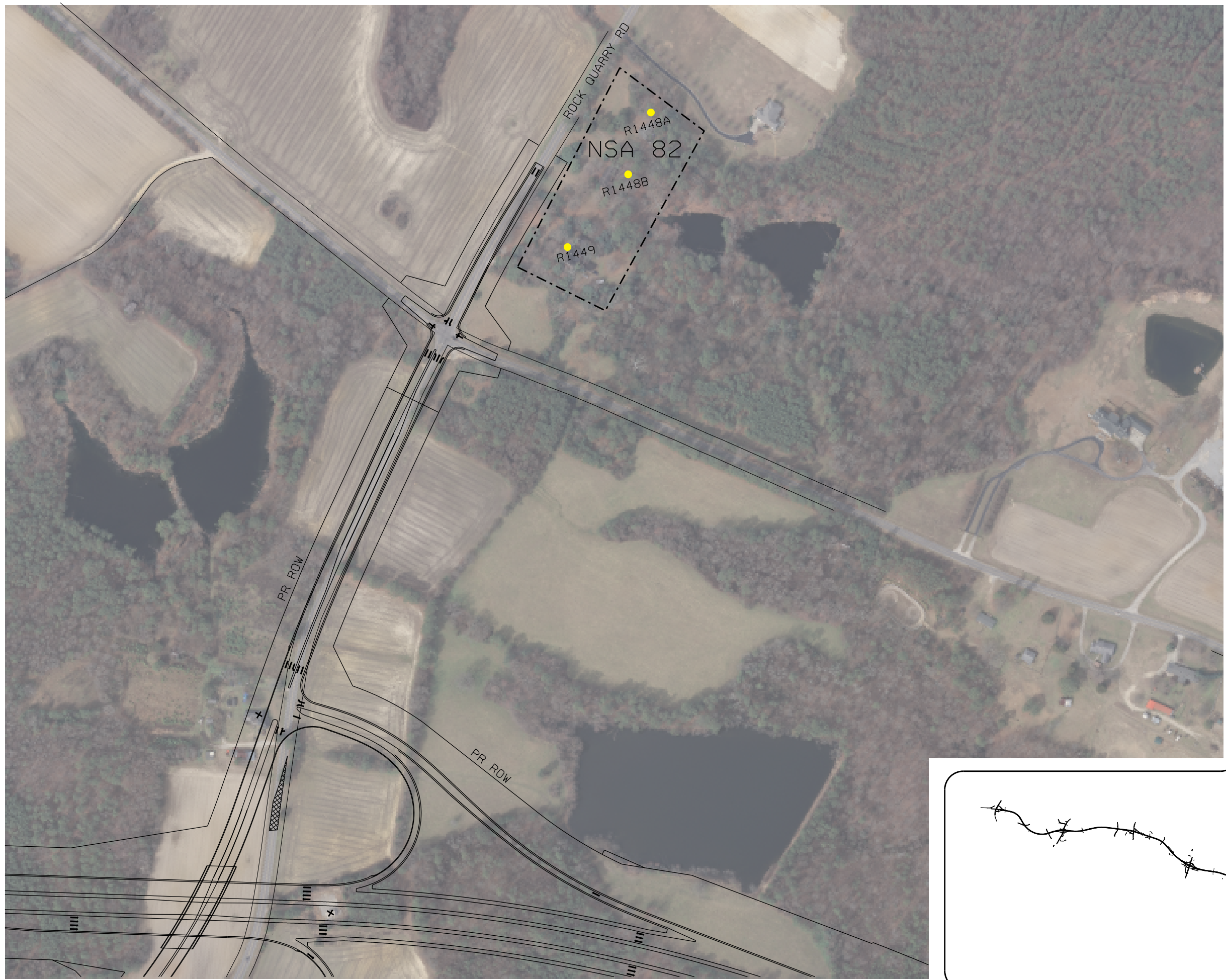


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

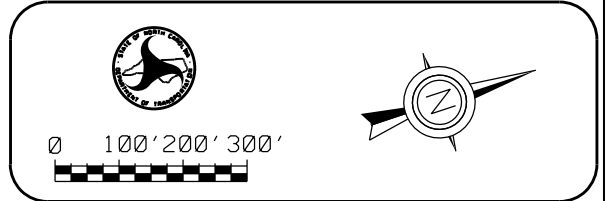
NOISE STUDY AREAS
 EXHIBIT 2.50

DECEMBER 2017





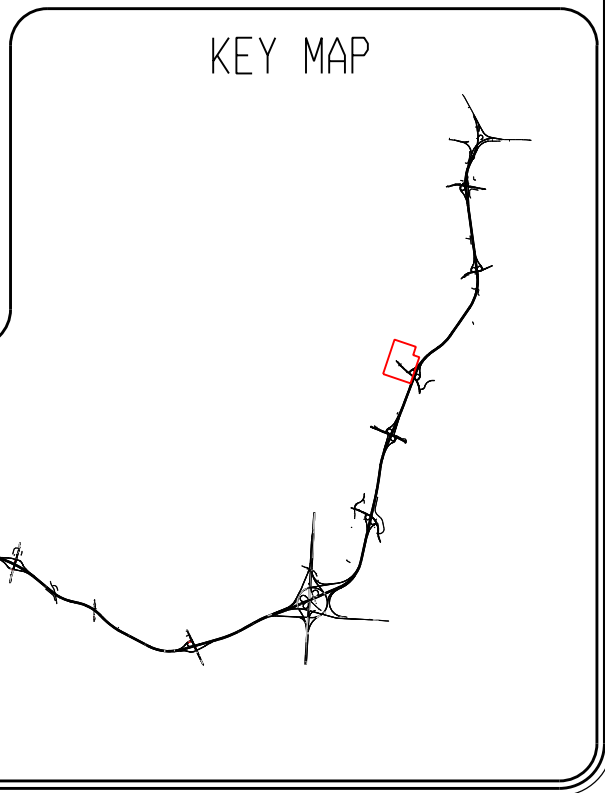
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

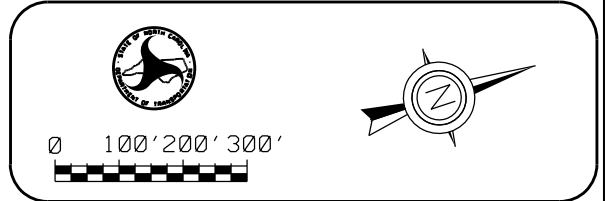
NOISE STUDY AREAS
 EXHIBIT 2.51

DECEMBER 2017





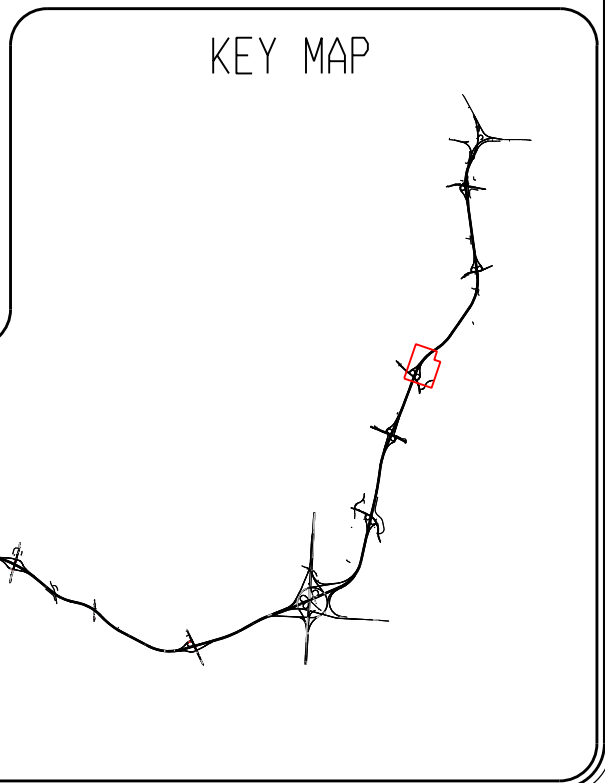
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



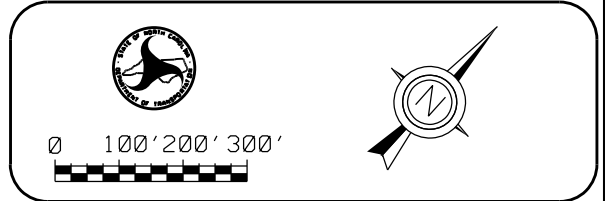
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▨ = LIKELY NOISE WALL
 - ▩ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.52

DECEMBER 2017



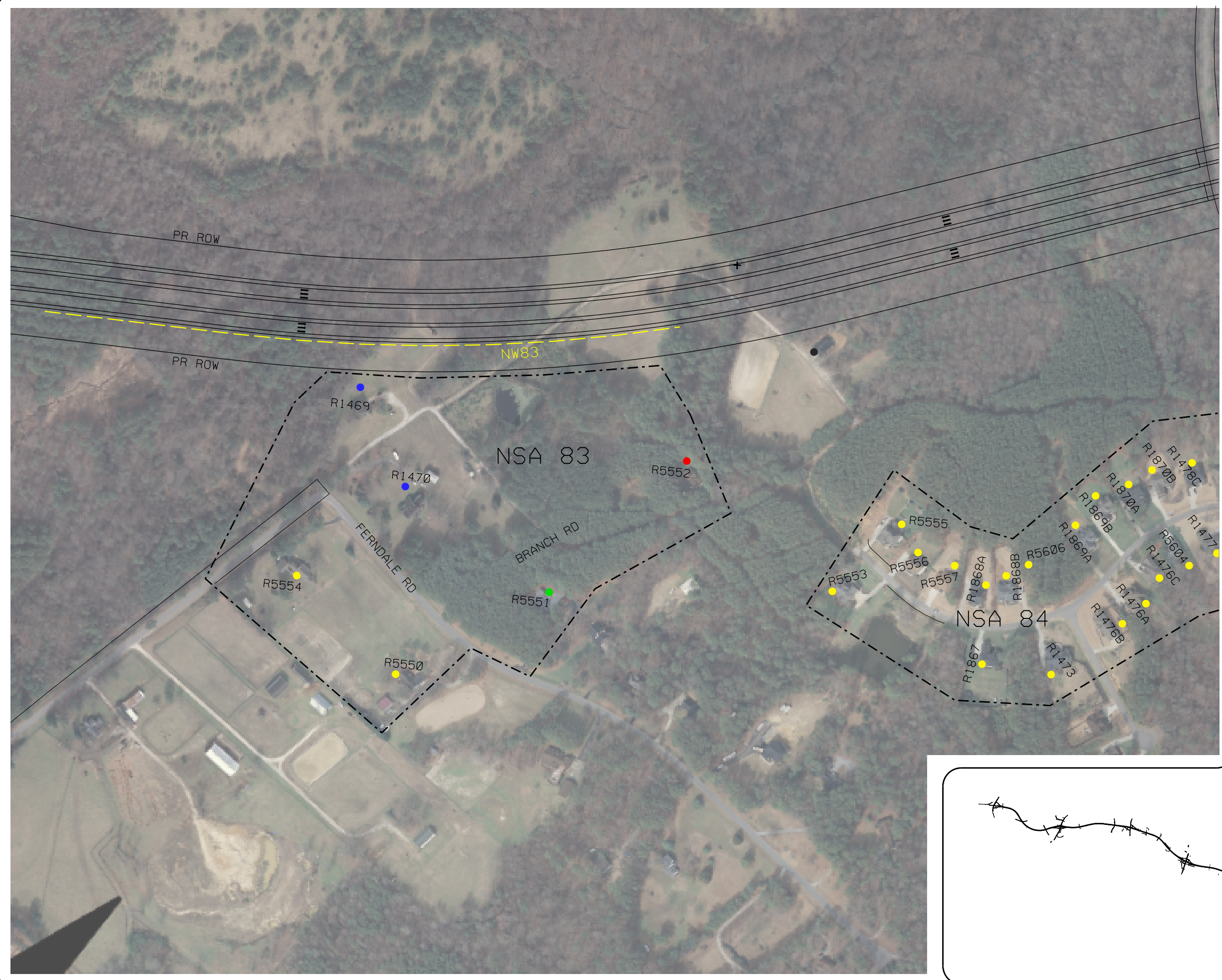
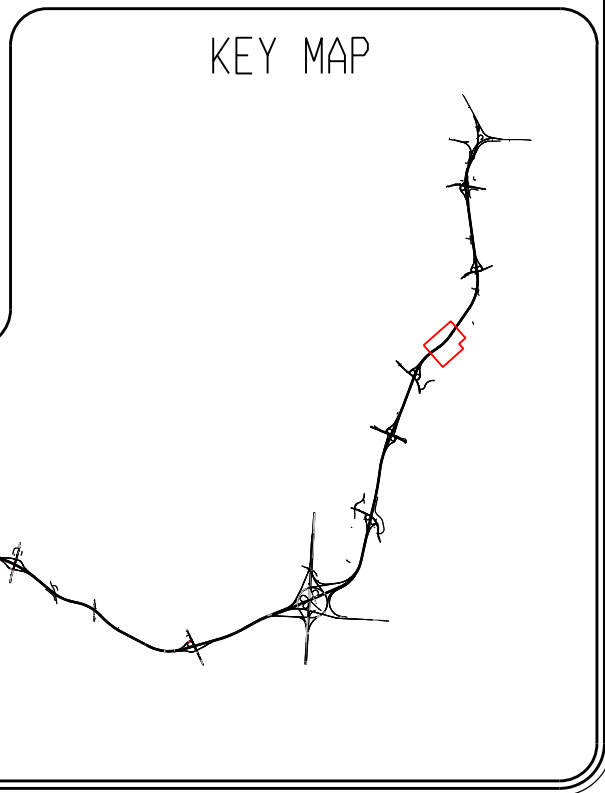
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



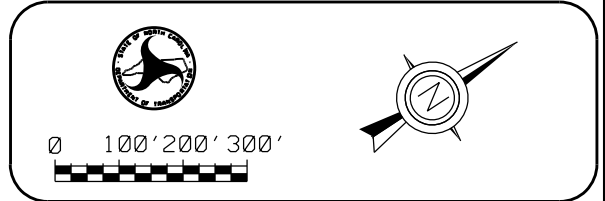
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.53

DECEMBER 2017



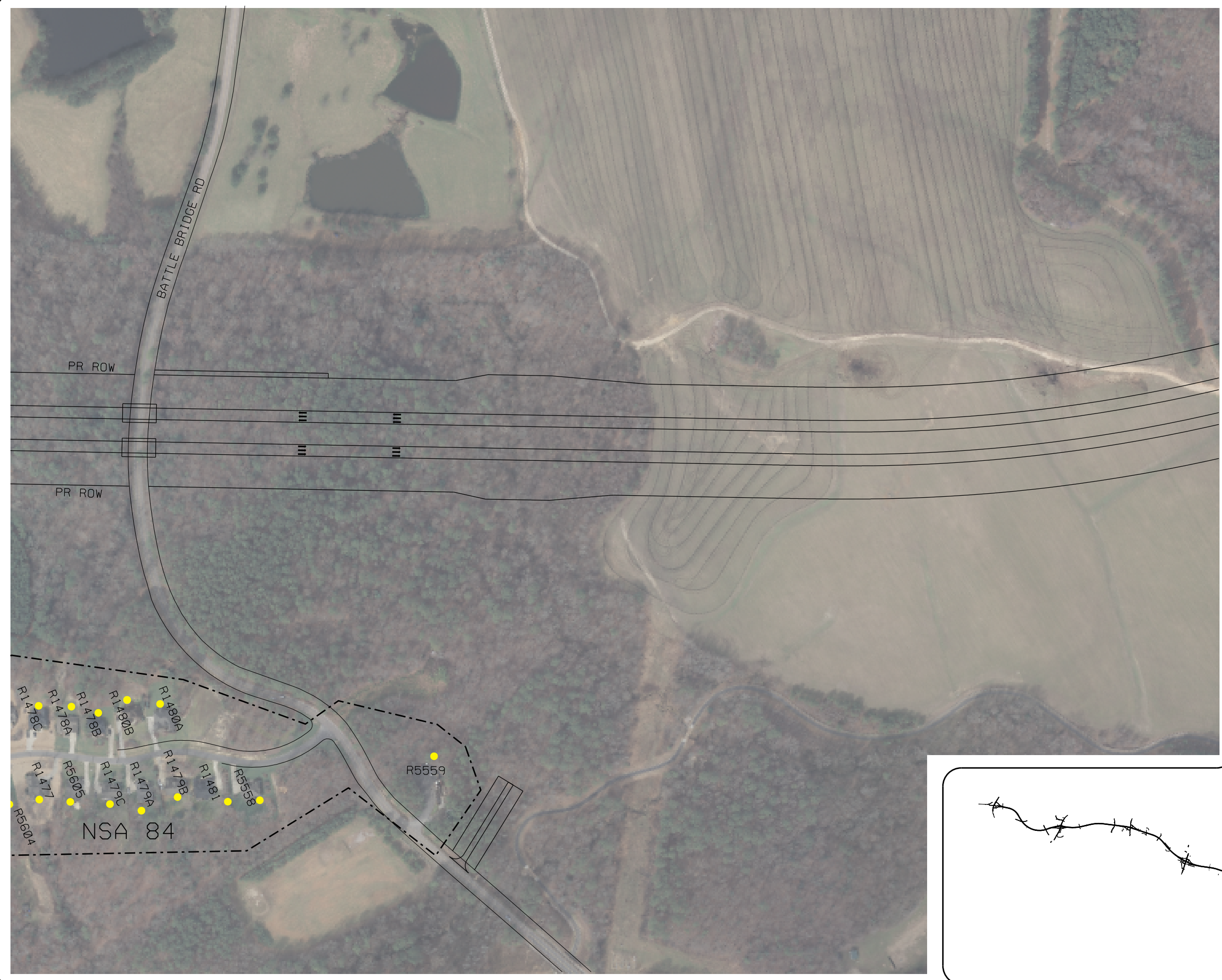
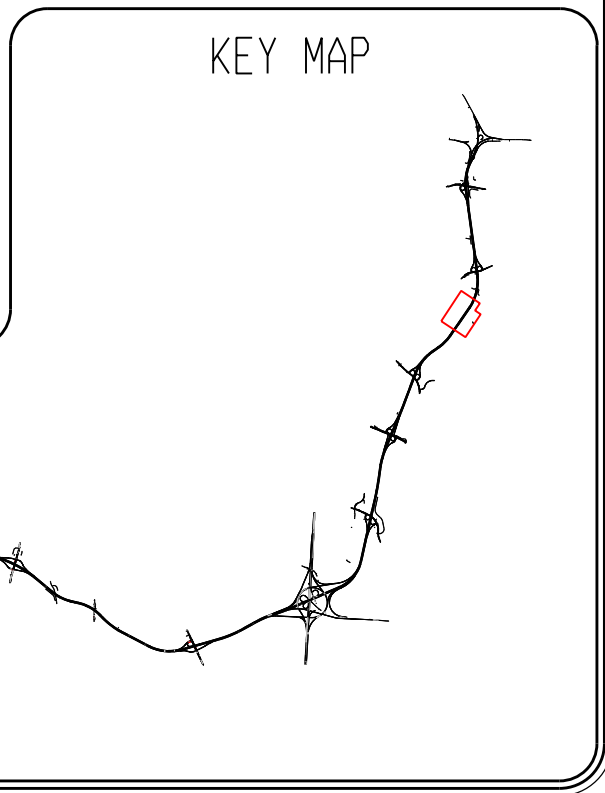
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



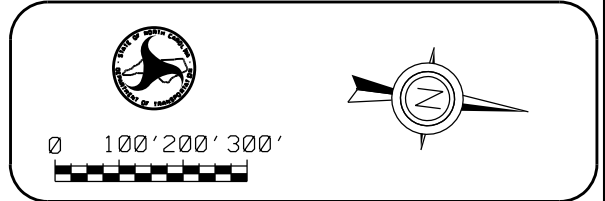
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.54

DECEMBER 2017



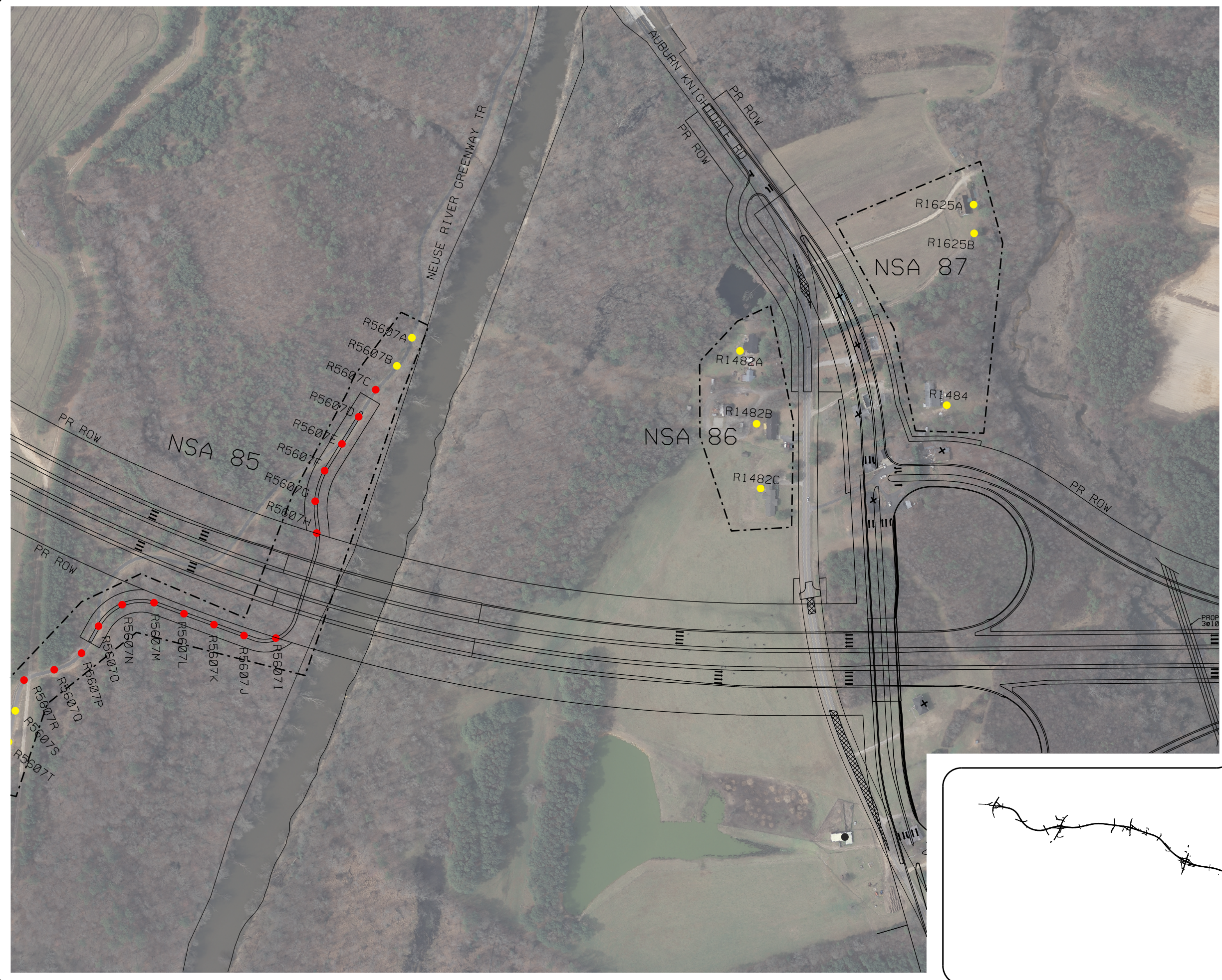
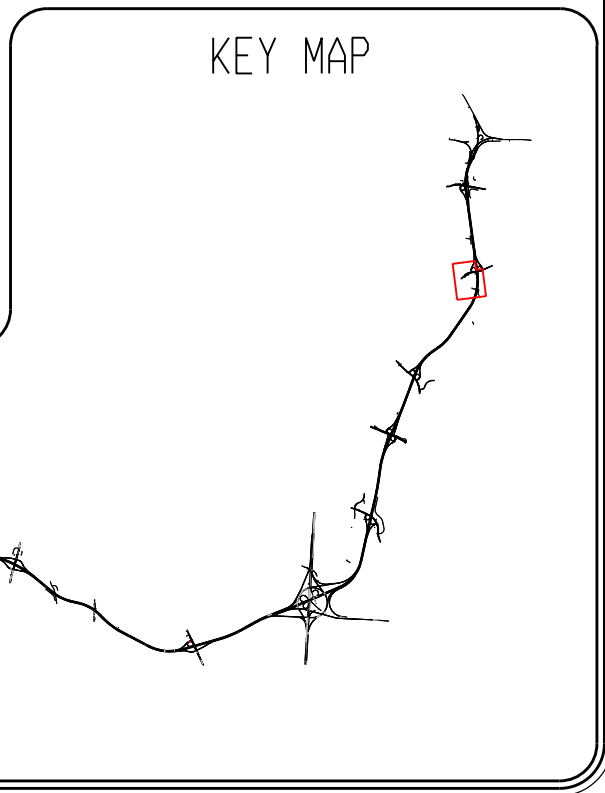
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



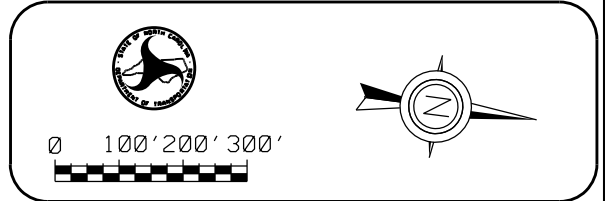
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.55

DECEMBER 2017



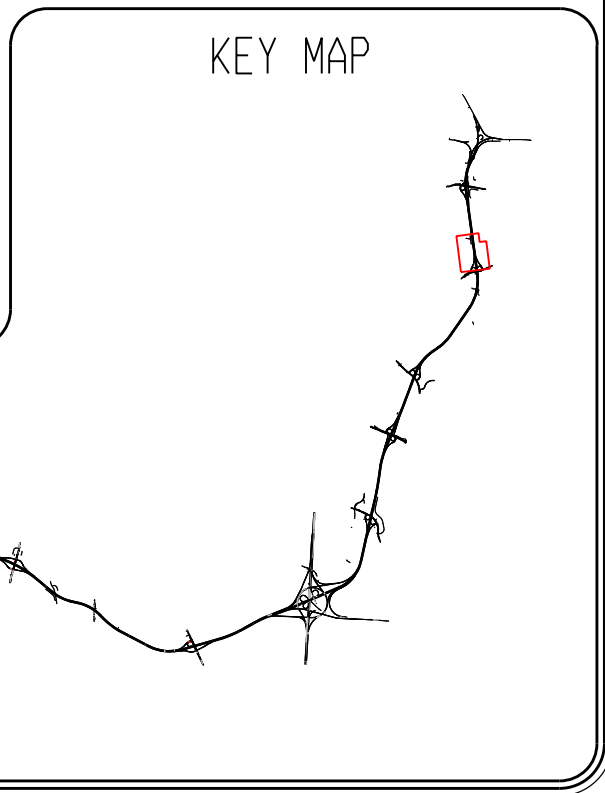
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



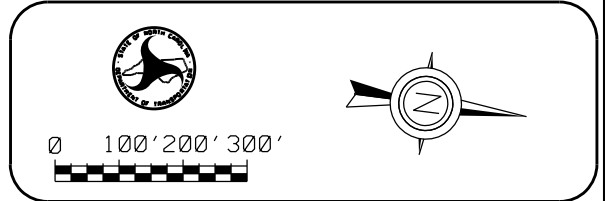
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.56

DECEMBER 2017



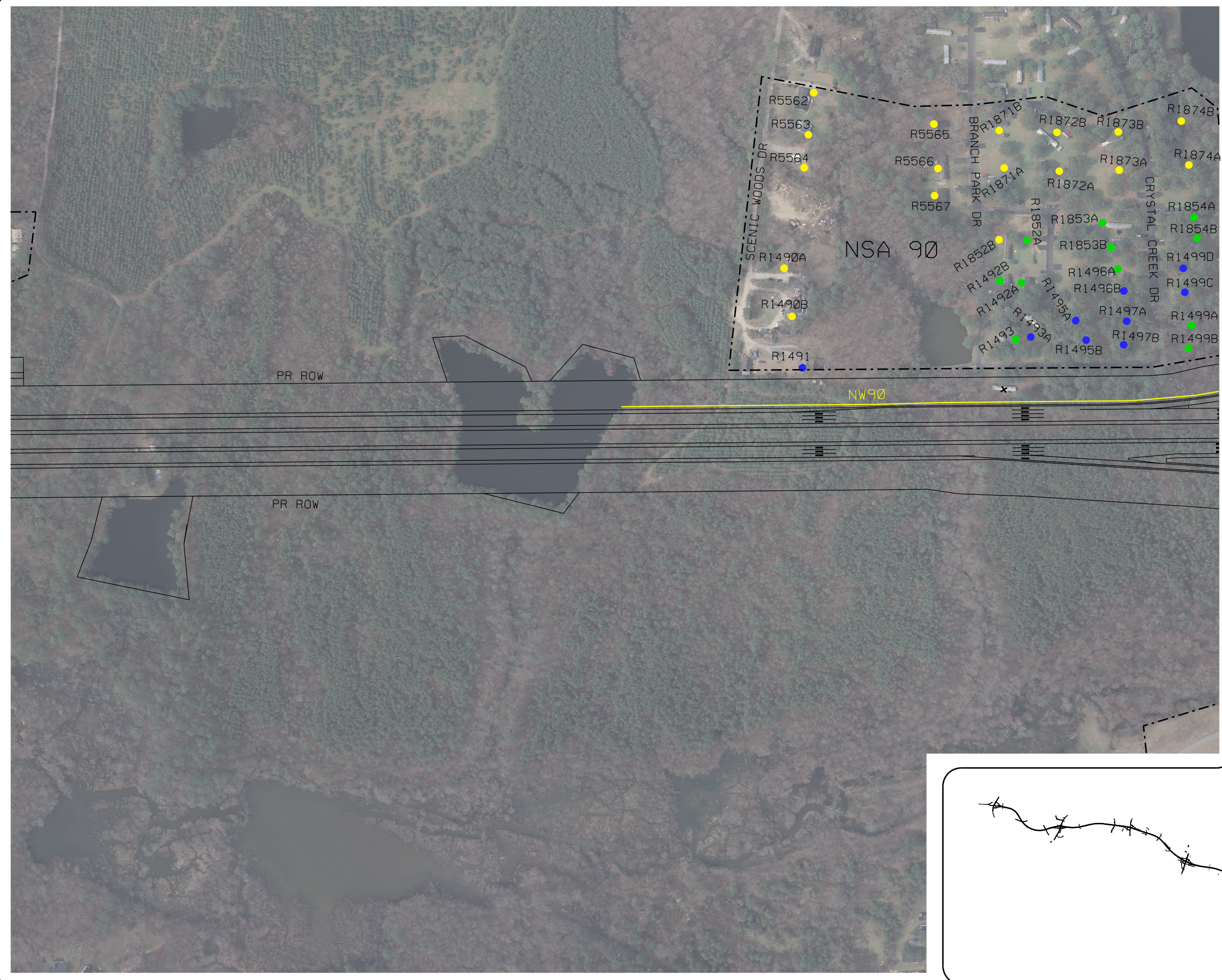
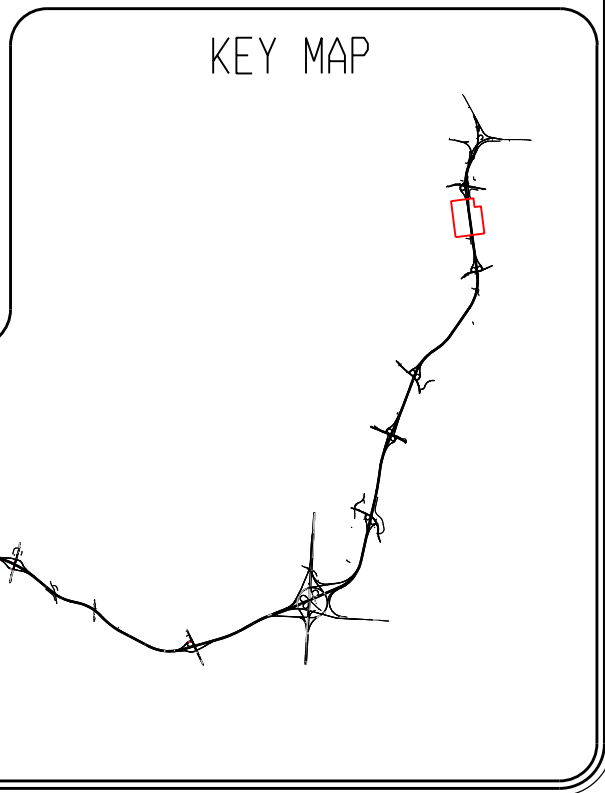
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



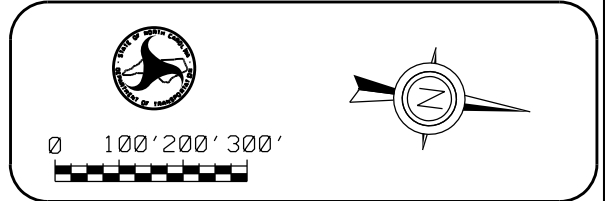
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.57

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

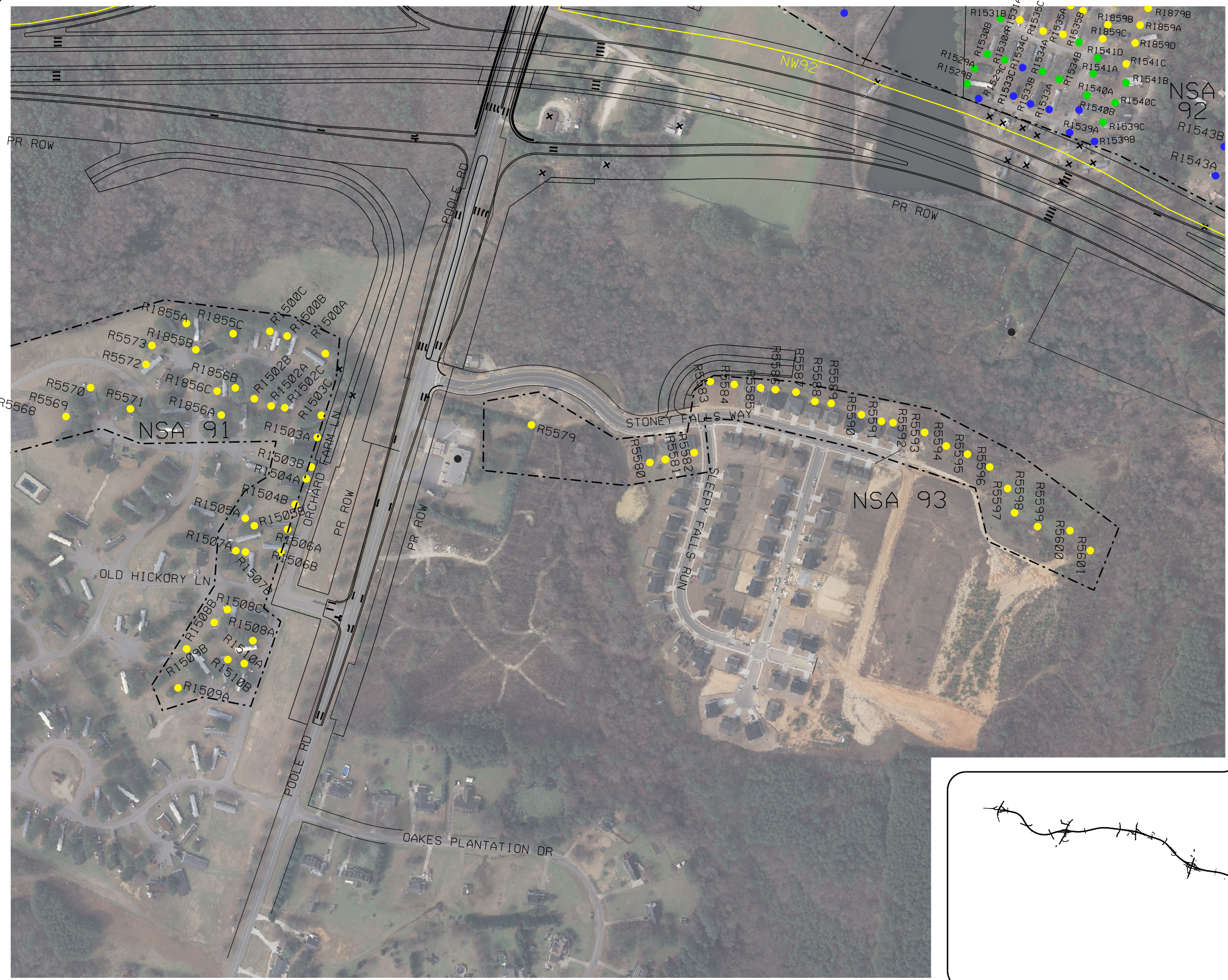


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

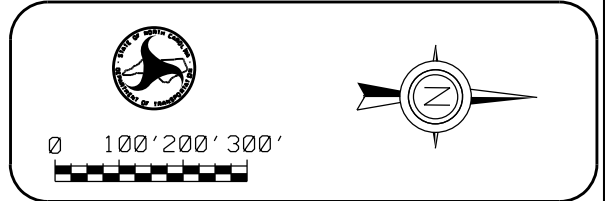
NOISE STUDY AREAS
 EXHIBIT 2.59

DECEMBER 2017

KEY MAP



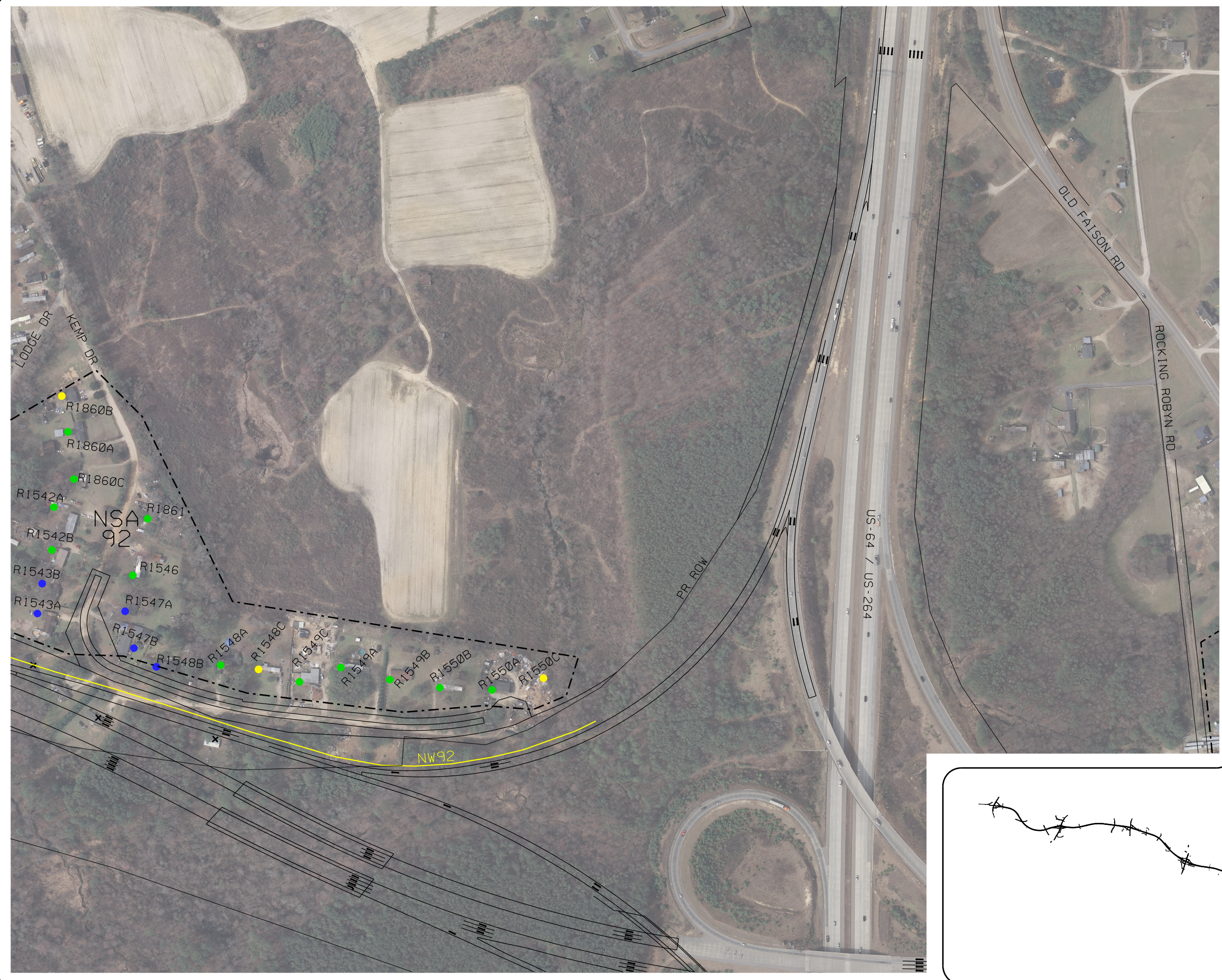
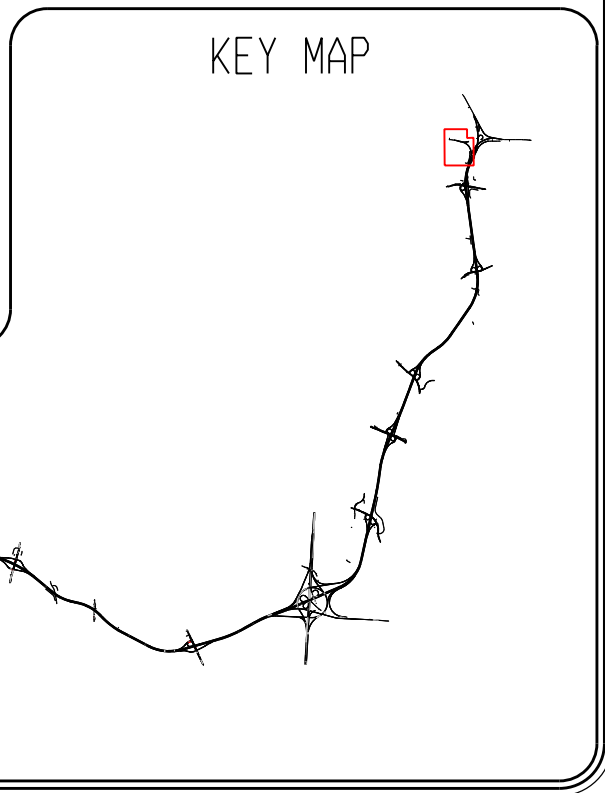
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

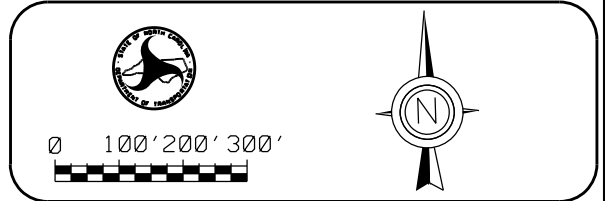
NOISE STUDY AREAS
 EXHIBIT 2.60

DECEMBER 2017





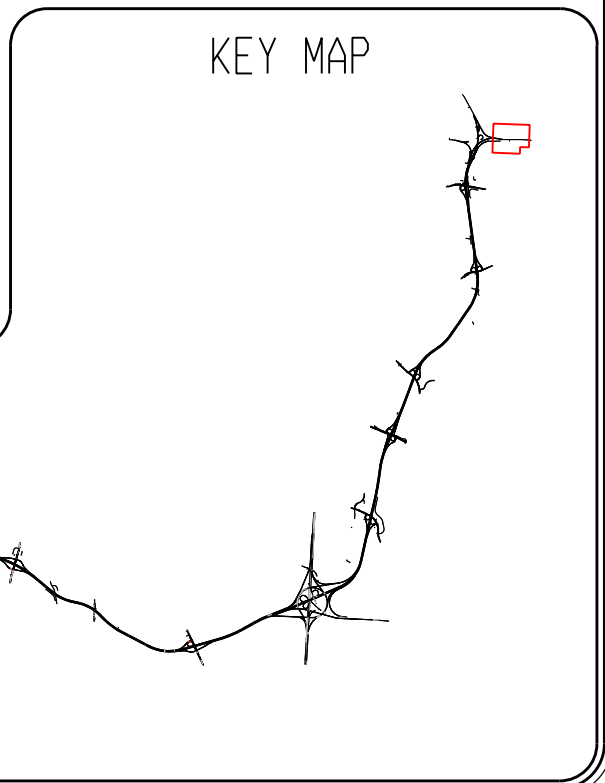
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829

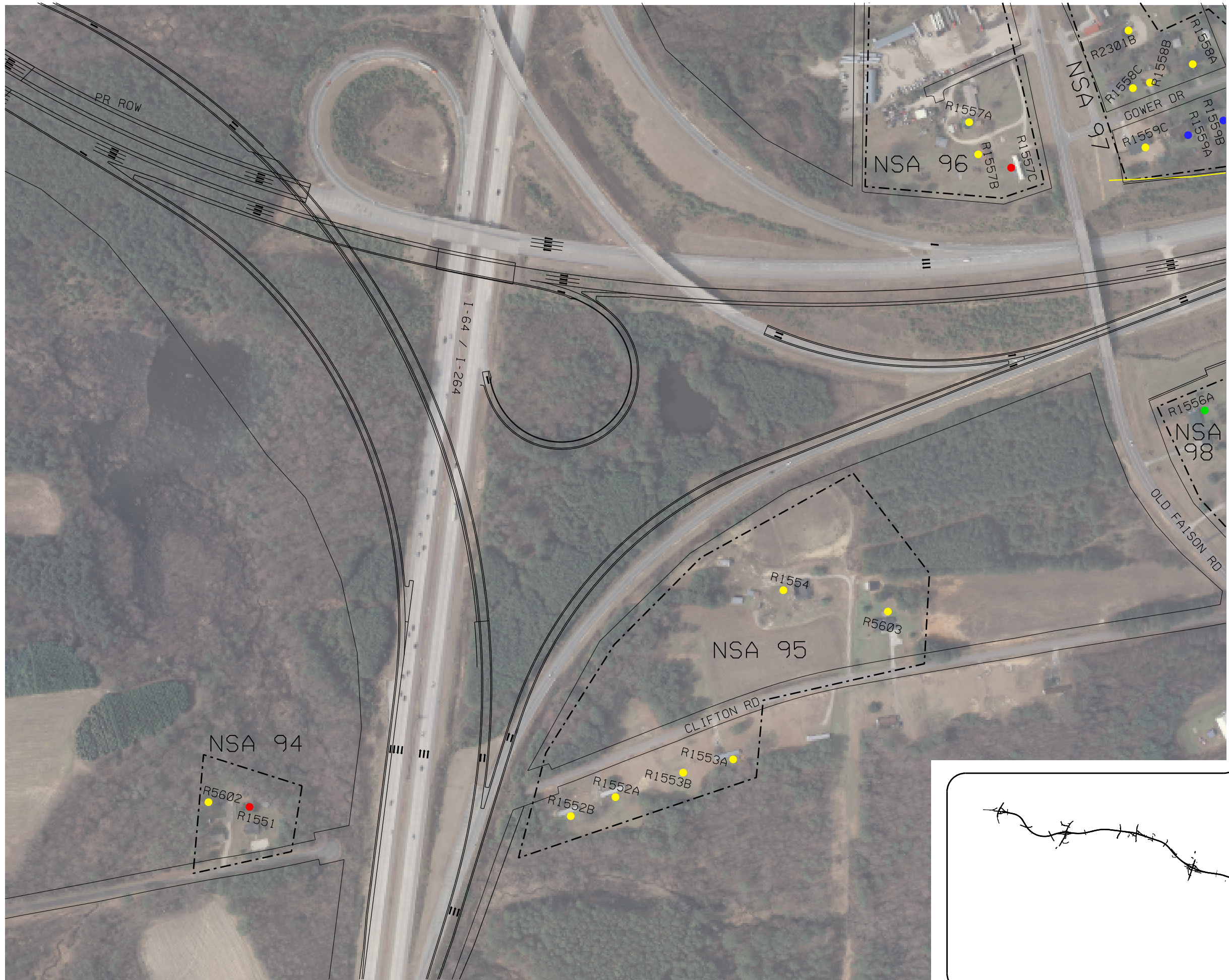


- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

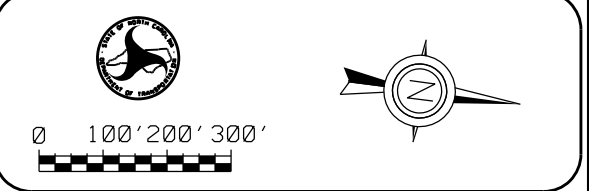
NOISE STUDY AREAS
 EXHIBIT 2.61

DECEMBER 2017





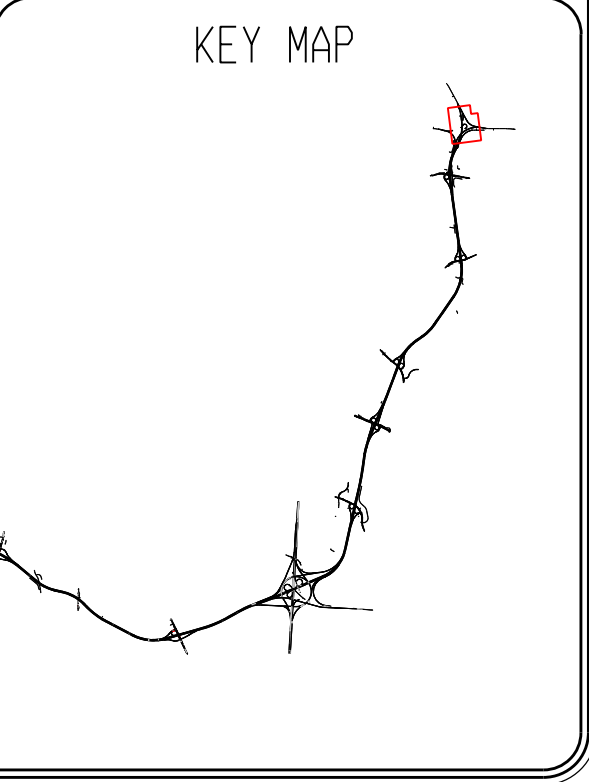
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



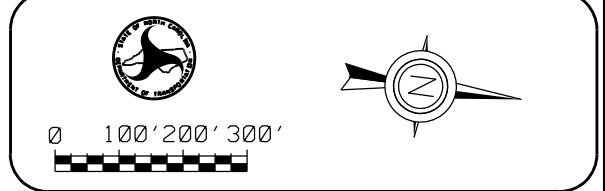
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - ▬ = LIKELY NOISE WALL
 - ▬ = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.62

DECEMBER 2017



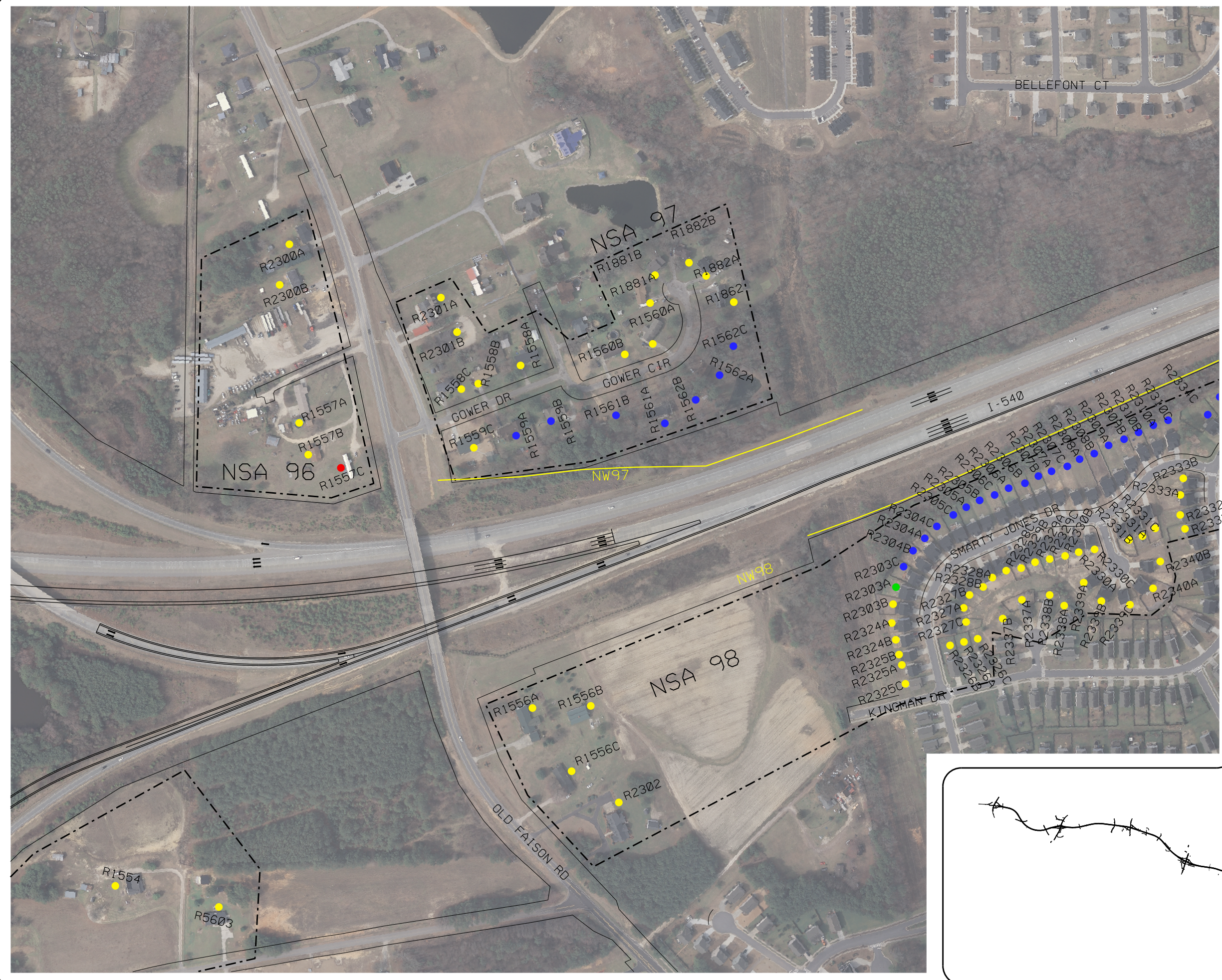
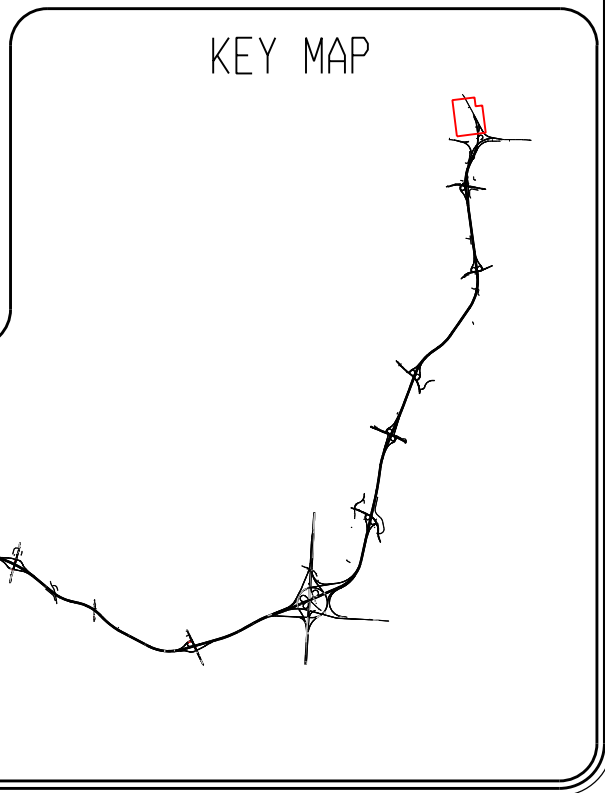
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



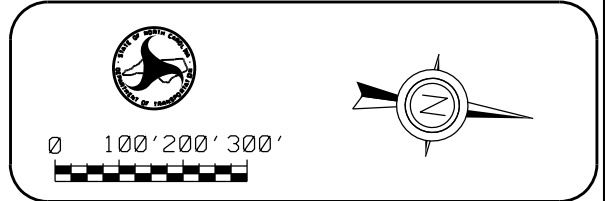
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.63

DECEMBER 2017



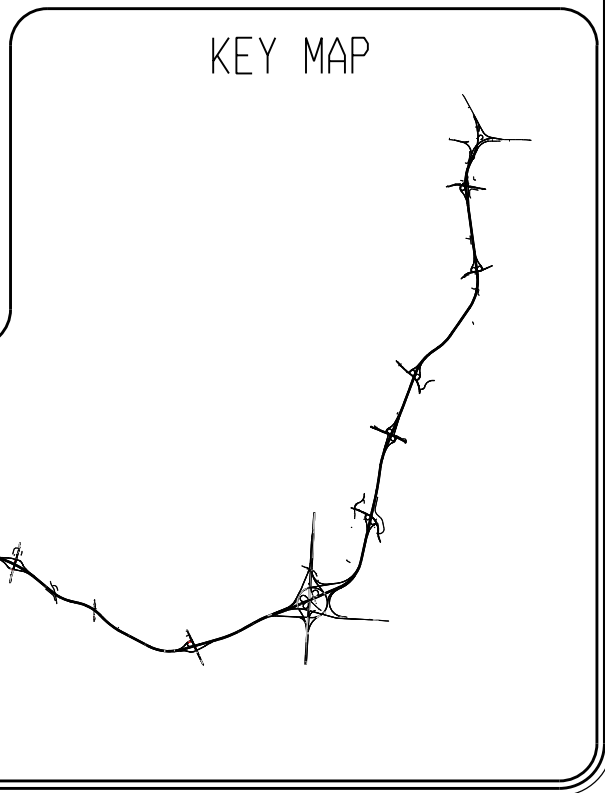
COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



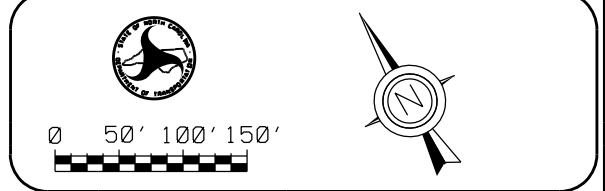
- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - - - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.64

DECEMBER 2017



COMPLETE 540
 TRIANGLE EXPRESSWAY SOUTHEAST EXTENSION
 WAKE AND JOHNSTON COUNTIES
 STIP R-2721, R-2828 AND R-2829



- LEGEND**
- R21 = NOISE RECEPTOR
 - = NOT IMPACTED / NOT BENEFITED
 - = NOT IMPACTED / BENEFITED
 - = IMPACTED / BENEFITED
 - = IMPACTED / NOT BENEFITED
 - = NOT NOISE SENSITIVE
 - x = ACQUIRED
 - - - = NOISE STUDY AREA
 - = LIKELY NOISE WALL
 - = UNLIKELY NOISE WALL

NOISE STUDY AREAS
 EXHIBIT 2.65

DECEMBER 2017

