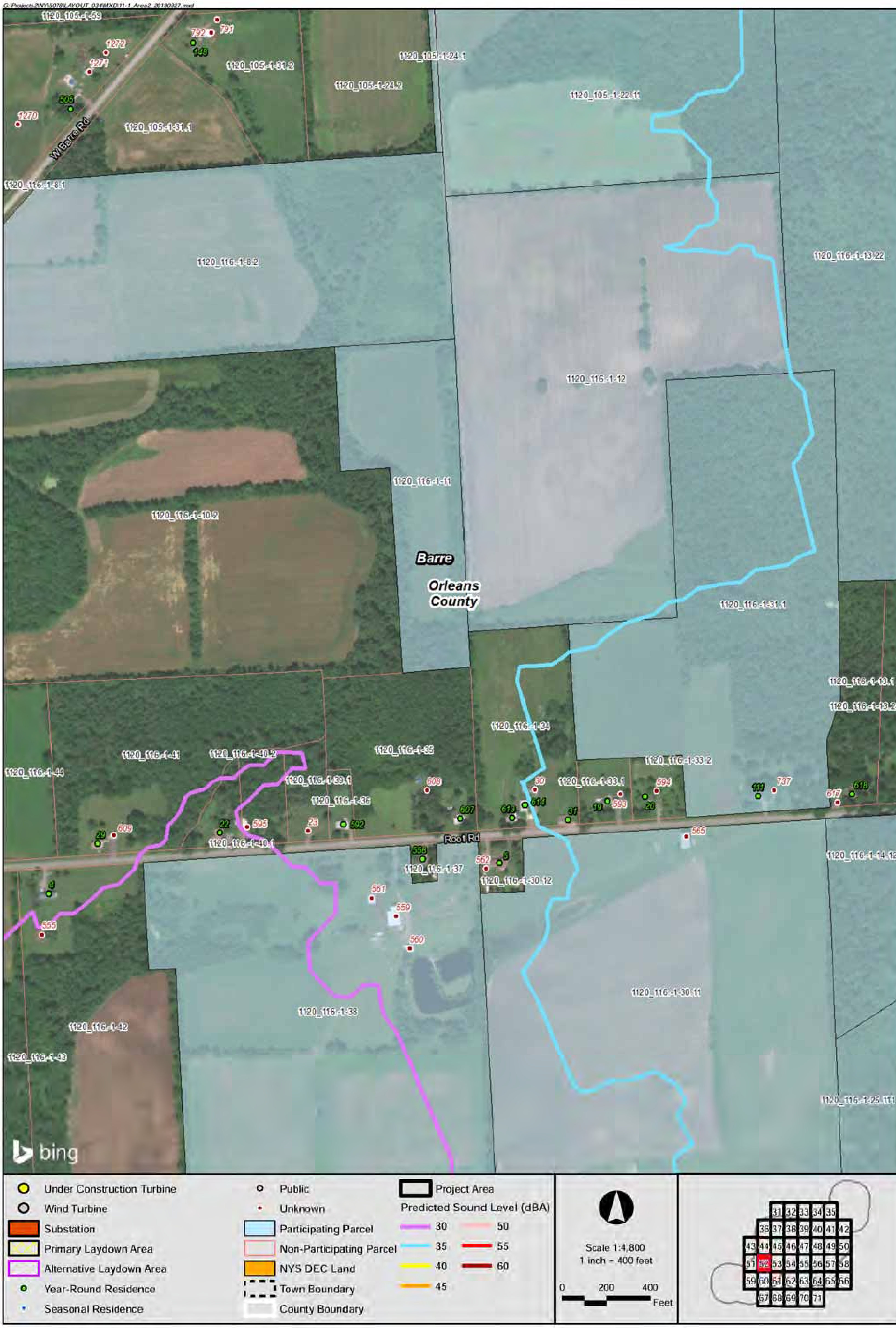

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 52 of 90

Sound Level Contours During Excavation - Area 2

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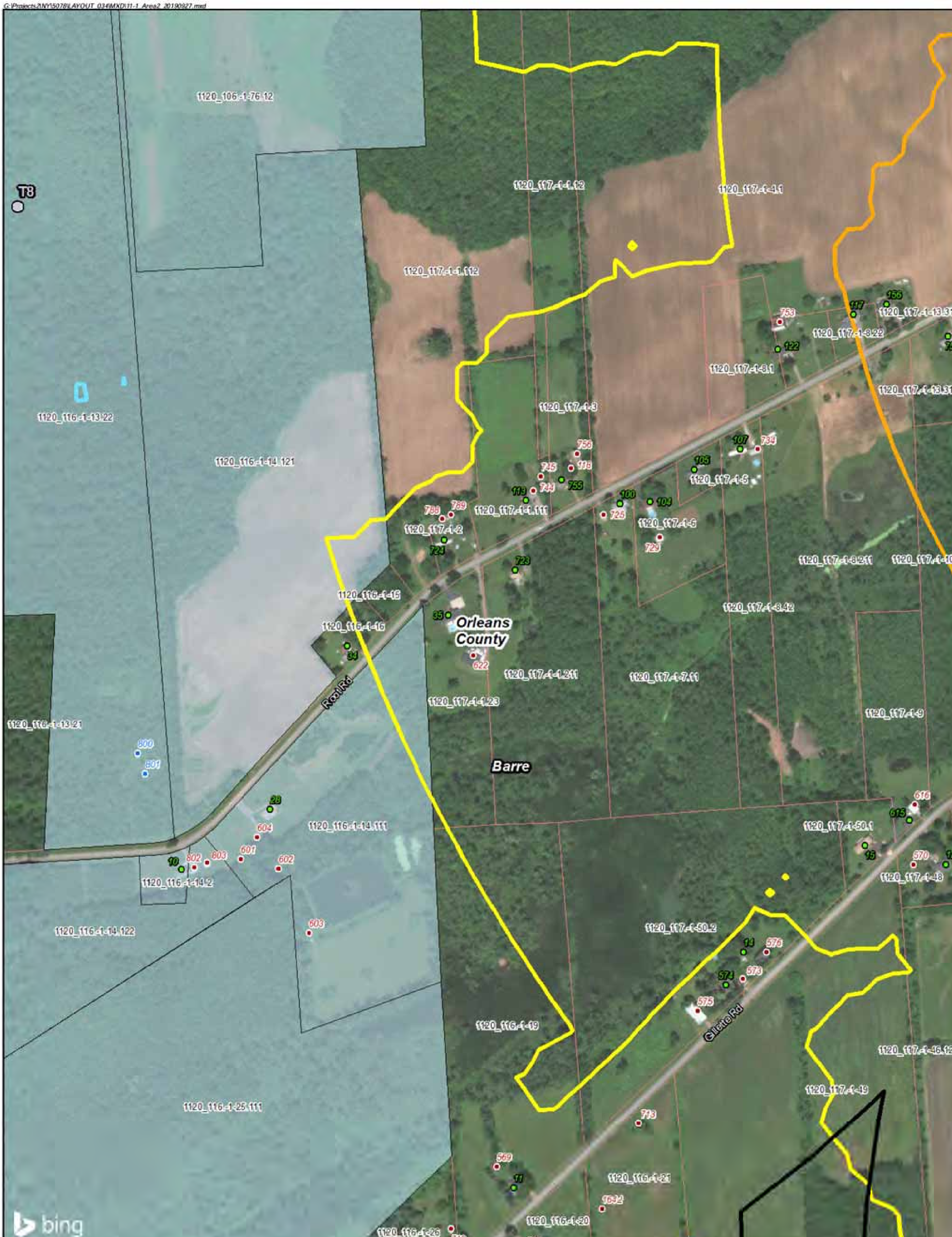


Under Construction Turbine	Public
Wind Turbine	Unknown
Substation	Participating Parcel
Primary Laydown Area	Non-Participating Parcel
Alternative Laydown Area	NYS DEC Land
Year-Round Residence	Town Boundary
Seasonal Residence	County Boundary

Project Area

Predicted Sound Level (dBA)

30	50
35	55
40	60
45	

Scale 1:4,800
1 inch = 400 feet

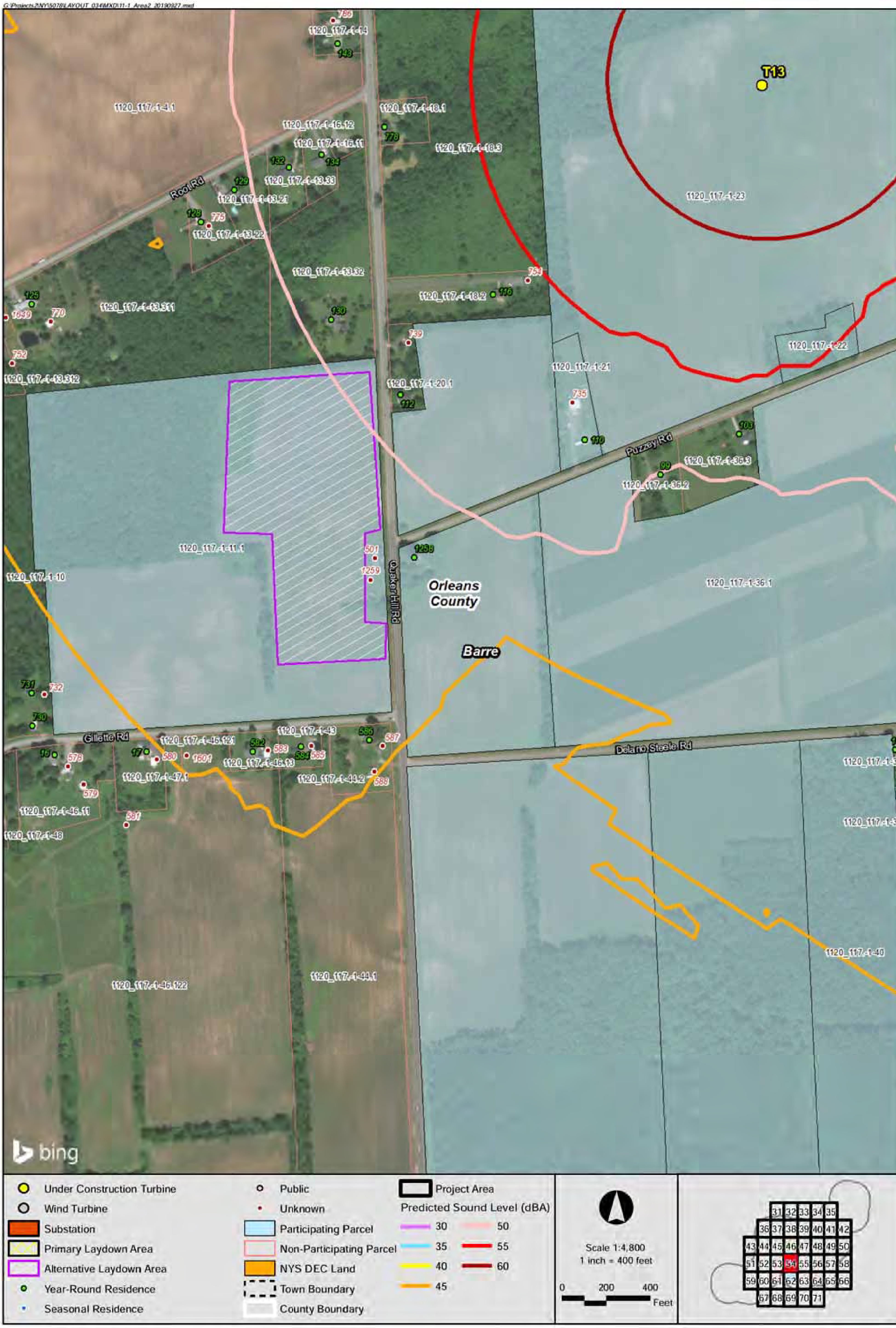
0 200 400 Feet

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 53 of 90

Sound Level Contours During Excavation - Area 2



Heritage Wind Orleans County, New York

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Figure 11-1, Map 54 of 90

Sound Level Contours During Excavation - Area 2

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 55 of 90

Sound Level Contours During Excavation - Area 2

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 56 of 90

Sound Level Contours During Excavation - Area 2

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 57 of 90

Sound Level Contours During Excavation - Area 2

Heritage Wind Orleans County, New York

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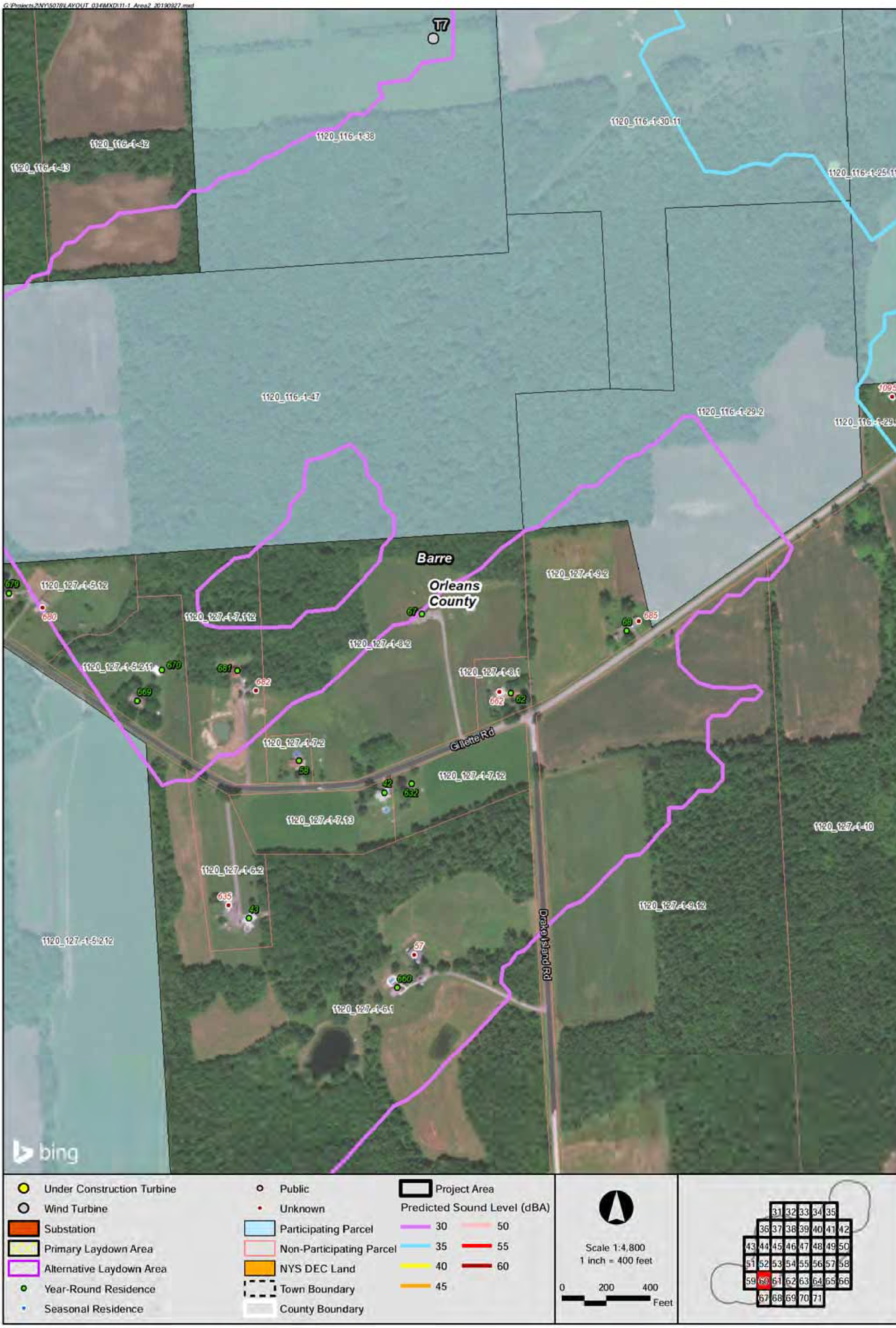
Figure 11-1, Map 58 of 90

Sound Level Contours During Excavation - Area 2

1120_116-1-74
1120_116-1-73.1
1120_116-1-73.2
1120_116-1-53.112
1120_116-1-46.25
1120_116-1-46.112
1120_116-1-43
Hill Rd
1120_116-1-47
1120_116-1-48.2
Orleans County
1120_116-1-49.1
1120_116-1-51
Gillette Rd
1120_127-1-5.12
1120_127-1-2.121
1120_127-1-3.1
1120_127-1-2.21
Barre
1120_127-1-4
1120_127-1-5.212
1120_127-1-2.112
T4
T5
T6
bing
Under Construction Turbine
Wind Turbine
Substation
Primary Laydown Area
Alternative Laydown Area
Year-Round Residence
Seasonal Residence
Public
Unknown
Participating Parcel
Non-Participating Parcel
NYS DEC Land
Town Boundary
County Boundary
Project Area
Predicted Sound Level (dBA)
30
35
40
45
50
55
60
Scale 1:4,800
1 inch = 400 feet
0
200
400
Feet



Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 60 of 90

Sound Level Contours During Excavation - Area 2

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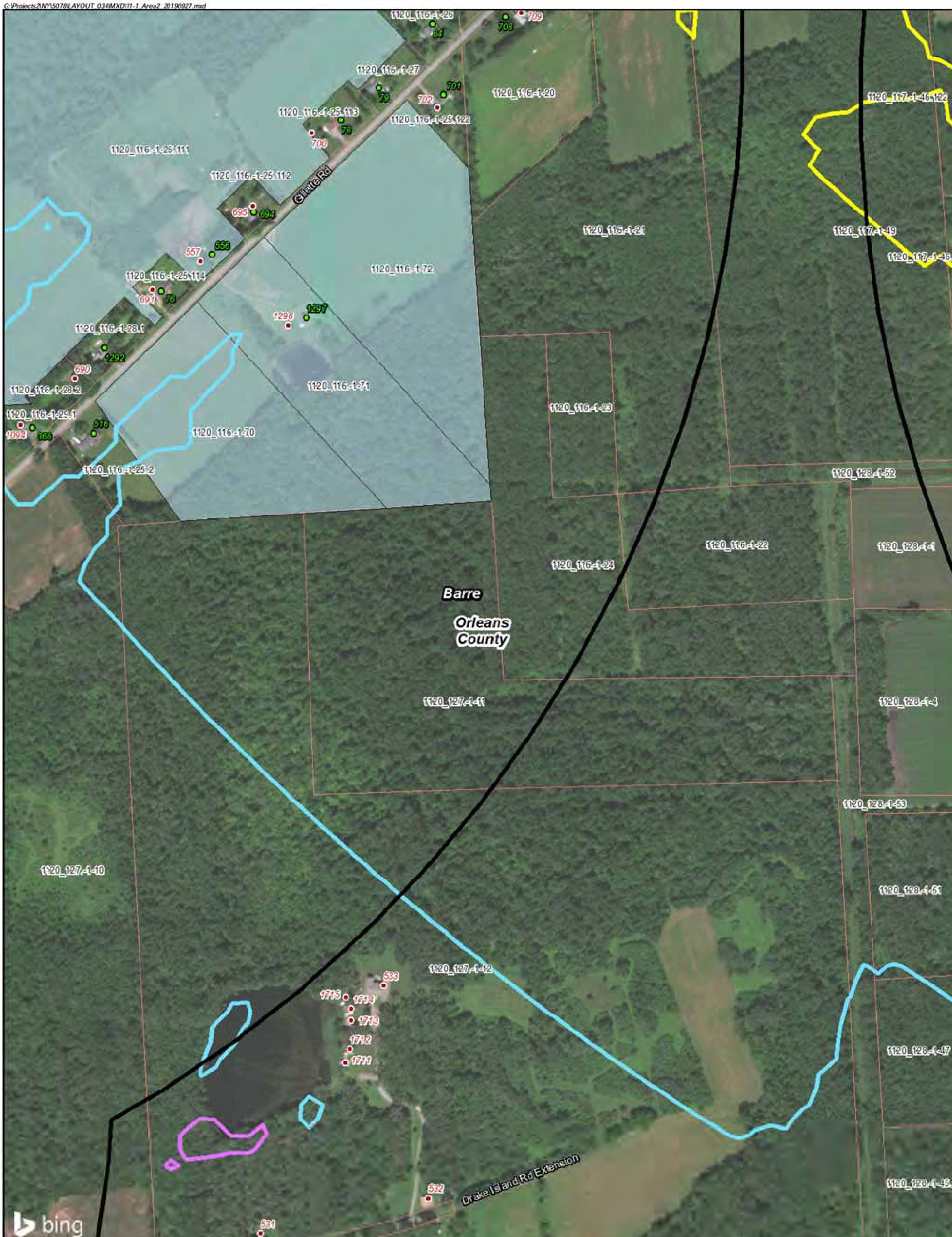

Under Construction Turbine	Public	Project Area
Wind Turbine	Unknown	Predicted Sound Level (dBA)
Substation	Participating Parcel	30 / 50
Primary Laydown Area	Non-Participating Parcel	35 / 55
Alternative Laydown Area	NYS DEC Land	40 / 60
Year-Round Residence	Town Boundary	45
Seasonal Residence	County Boundary	

Scale 1:4,800
1 inch = 400 feet
0 200 400 Feet

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 61 of 90
Sound Level Contours During Excavation - Area 2

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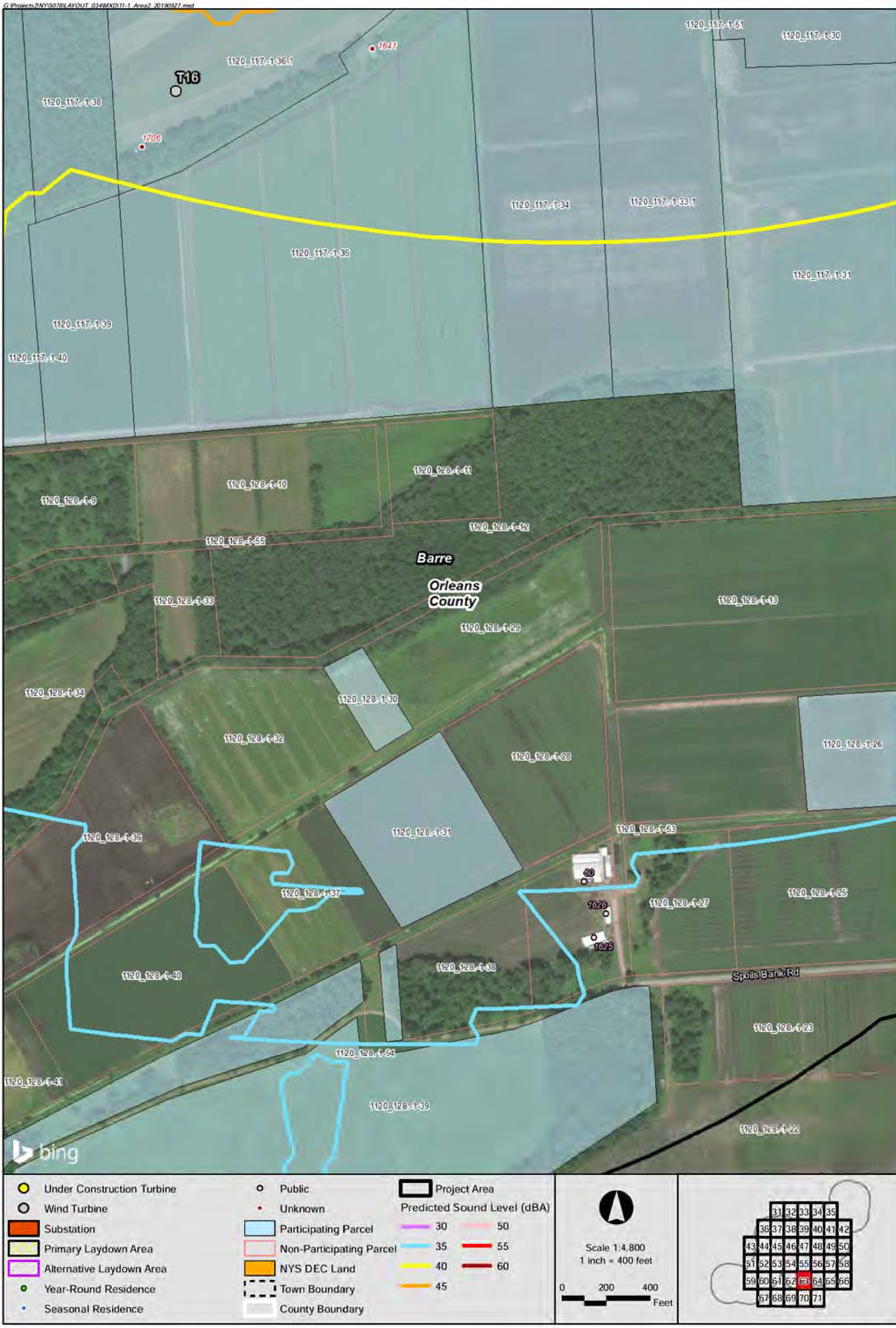

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 63 of 90

Sound Level Contours During Excavation - Area 2

Under Construction Turbine	Public	Project Area
Wind Turbine	Unknown	Predicted Sound Level (dBA)
Substation	Participating Parcel	30 / 50
Primary Laydown Area	Non-Participating Parcel	35 / 55
Alternative Laydown Area	NYS DEC Land	40 / 60
Year-Round Residence	Town Boundary	45
Seasonal Residence	County Boundary	

Scale 1:4,800
1 inch = 400 feet

0 200 400 Feet

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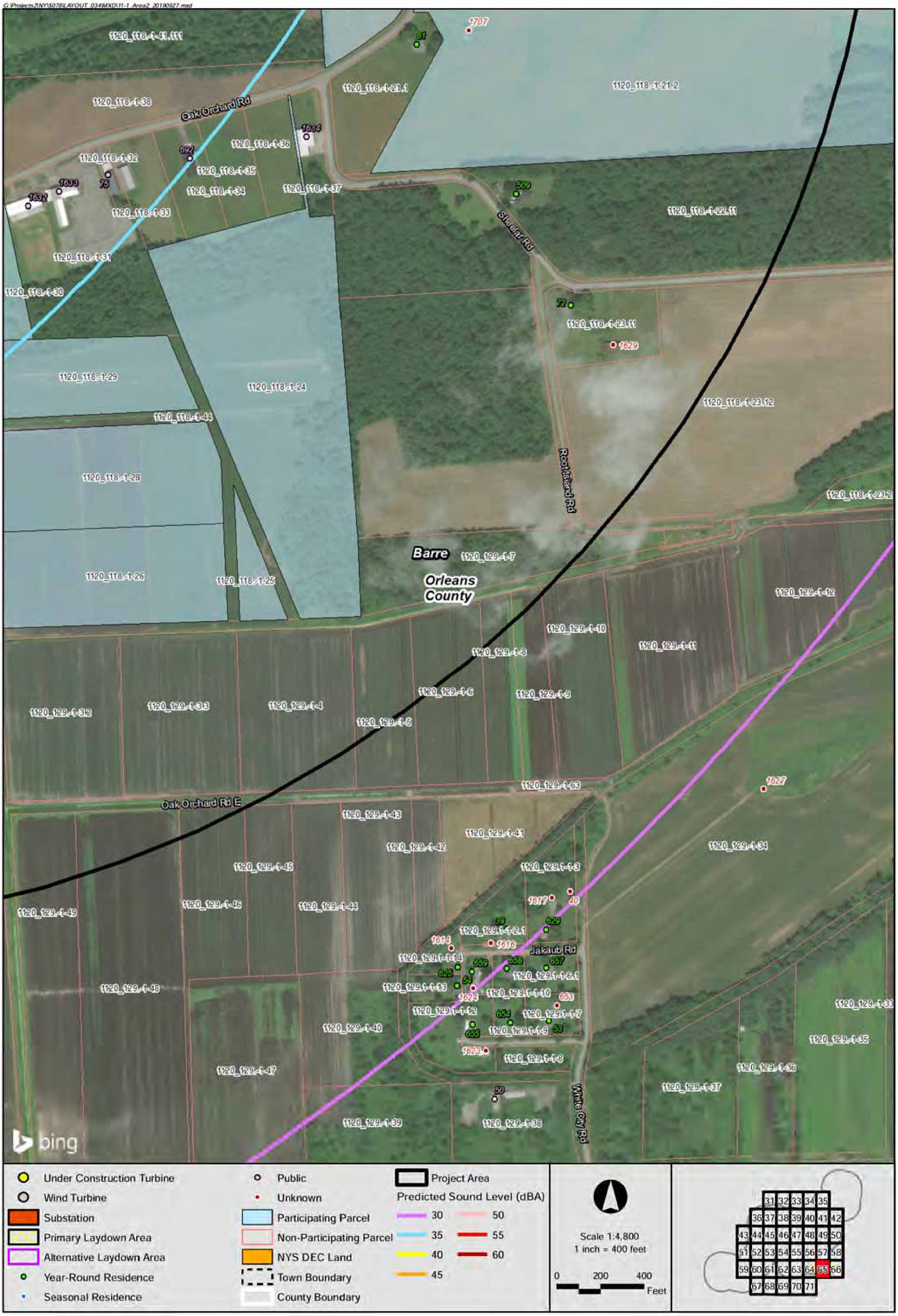

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 65 of 90

Sound Level Contours During Excavation - Area 2

Heritage Wind   Orleans County, New York

Epsilon

Figure 11-1, Map 66 of 90

Sound Level Contours During Excavation - Area 2

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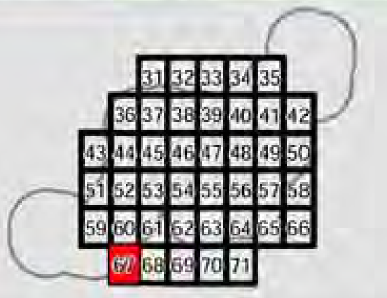
- Under Construction Turbine
- Wind Turbine
- Substation
- Primary Laydown Area
- Alternative Laydown Area
- Year-Round Residence
- Seasonal Residence
- Public
- Unknown
- Participating Parcel
- Non-Participating Parcel
- NYS DEC Land
- Town Boundary
- County Boundary
- Project Area

Predicted Sound Level (dBA)

- 30
- 35
- 40
- 45
- 50
- 55
- 60

Scale 1:4,800
1 inch = 400 feet

0 200 400 Feet



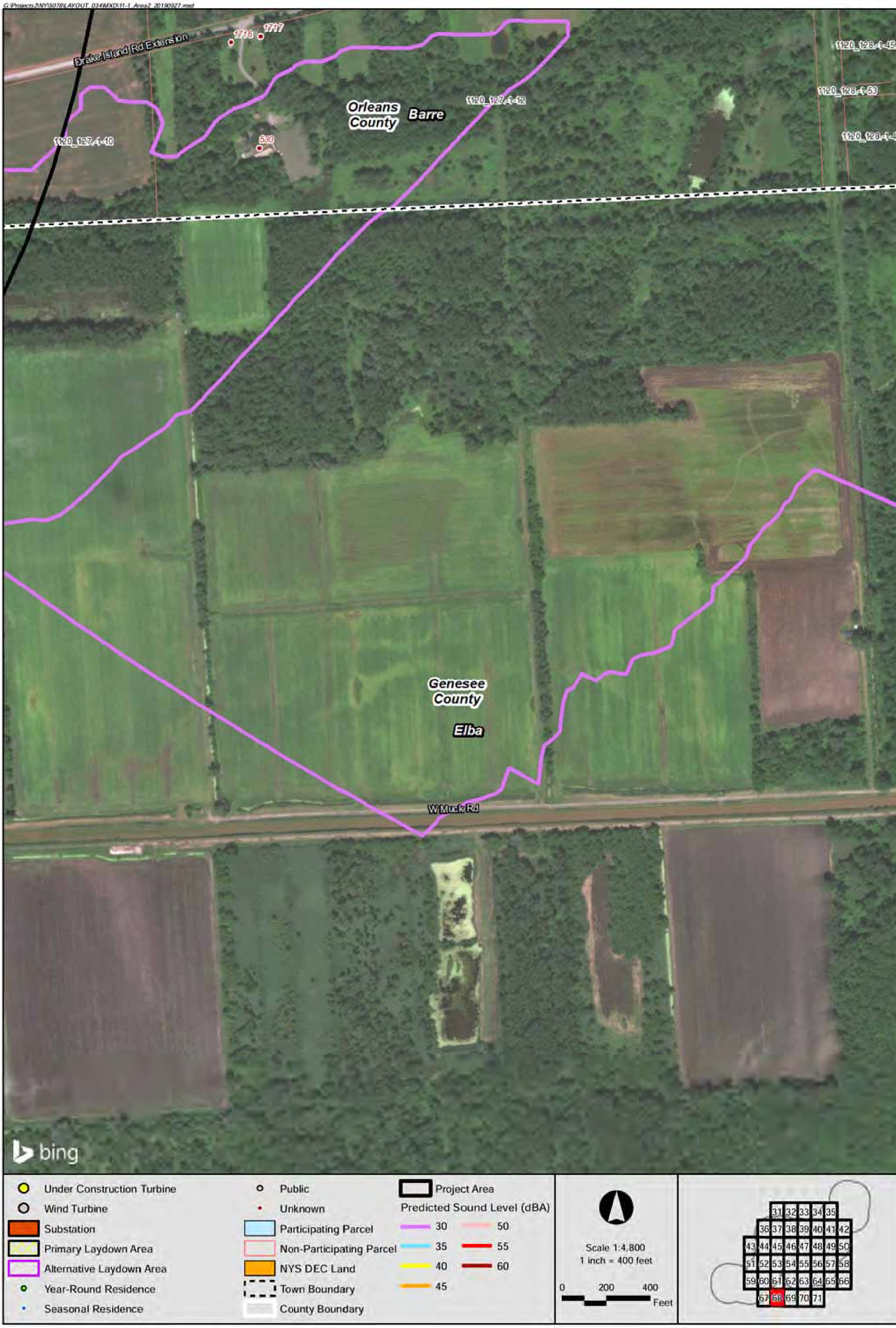


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Figure 11-1, Map 68 of 90

Sound Level Contours During Excavation - Area 2

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- Under Construction Turbine
- Wind Turbine
- Substation
- Primary Laydown Area
- Alternative Laydown Area
- Year-Round Residence
- Seasonal Residence
- Public
- Unknown
- Participating Parcel
- Non-Participating Parcel
- NYS DEC Land
- Town Boundary
- County Boundary
- Project Area

Predicted Sound Level (dBA)

30, 35, 40, 45, 50, 55, 60

Scale 1:4,800
1 inch = 400 feet

0 200 400 Feet

31 32 33 34 35
36 37 38 39 40 41 42
43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58
59 60 61 62 63 64 65 66
67 68 69 70 71

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 70 of 90

Sound Level Contours During Excavation - Area 2

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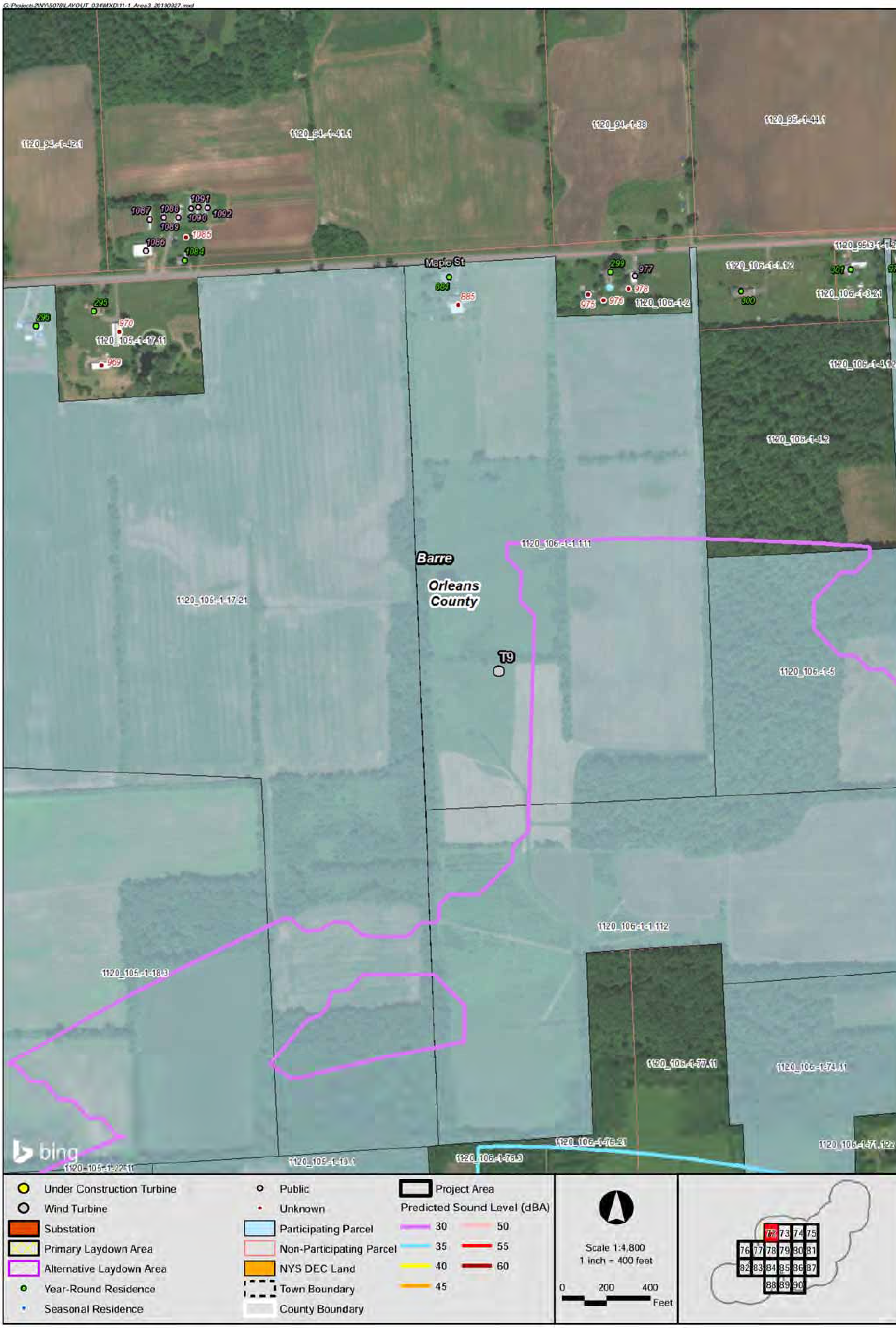
Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 71 of 90

Sound Level Contours During Excavation - Area 2



Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 72 of 90

Sound Level Contours During Foundation Work - Area 3

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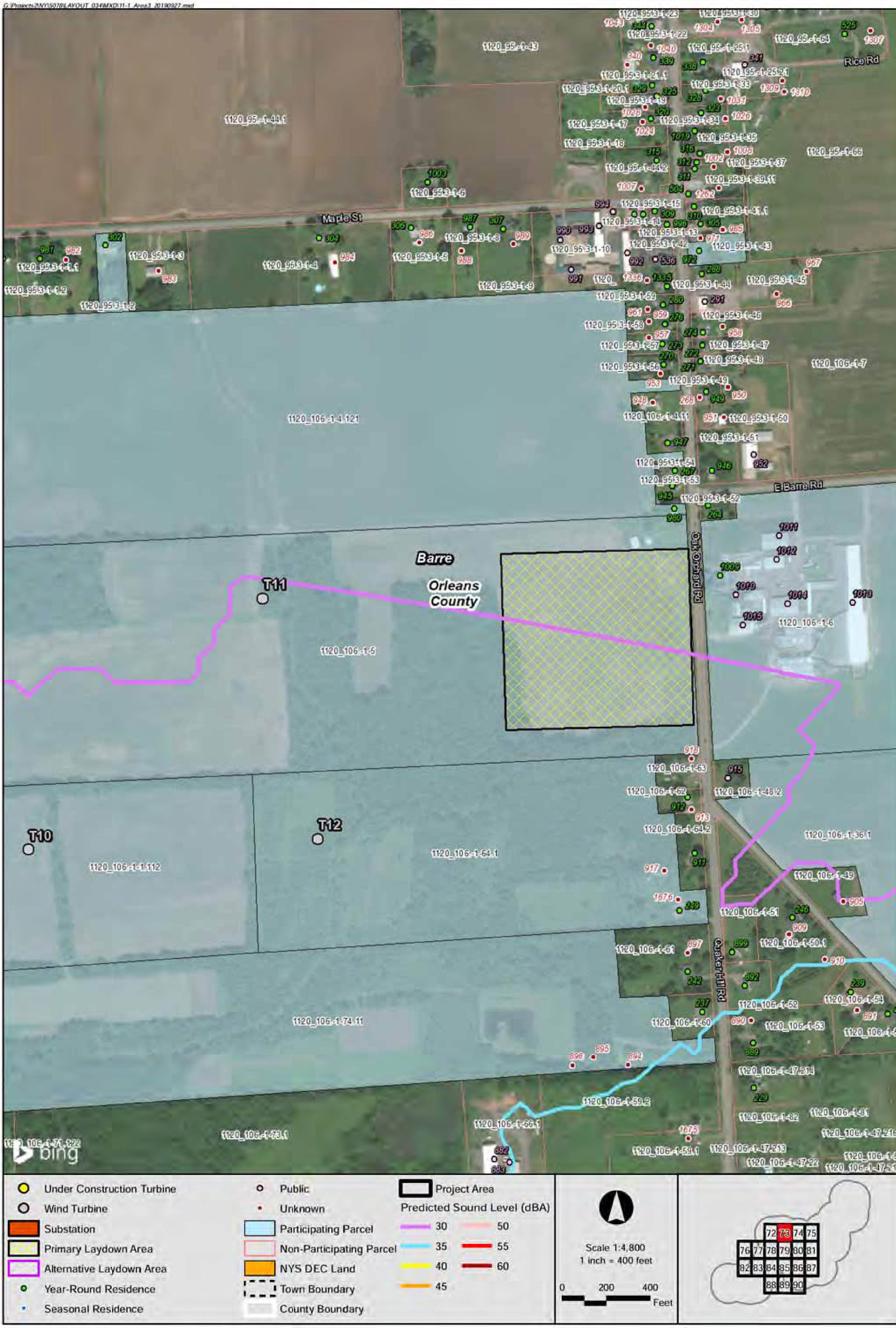

Figure 11-1, Map 73 of 90

Sound Level Contours During Foundation Work - Area 3

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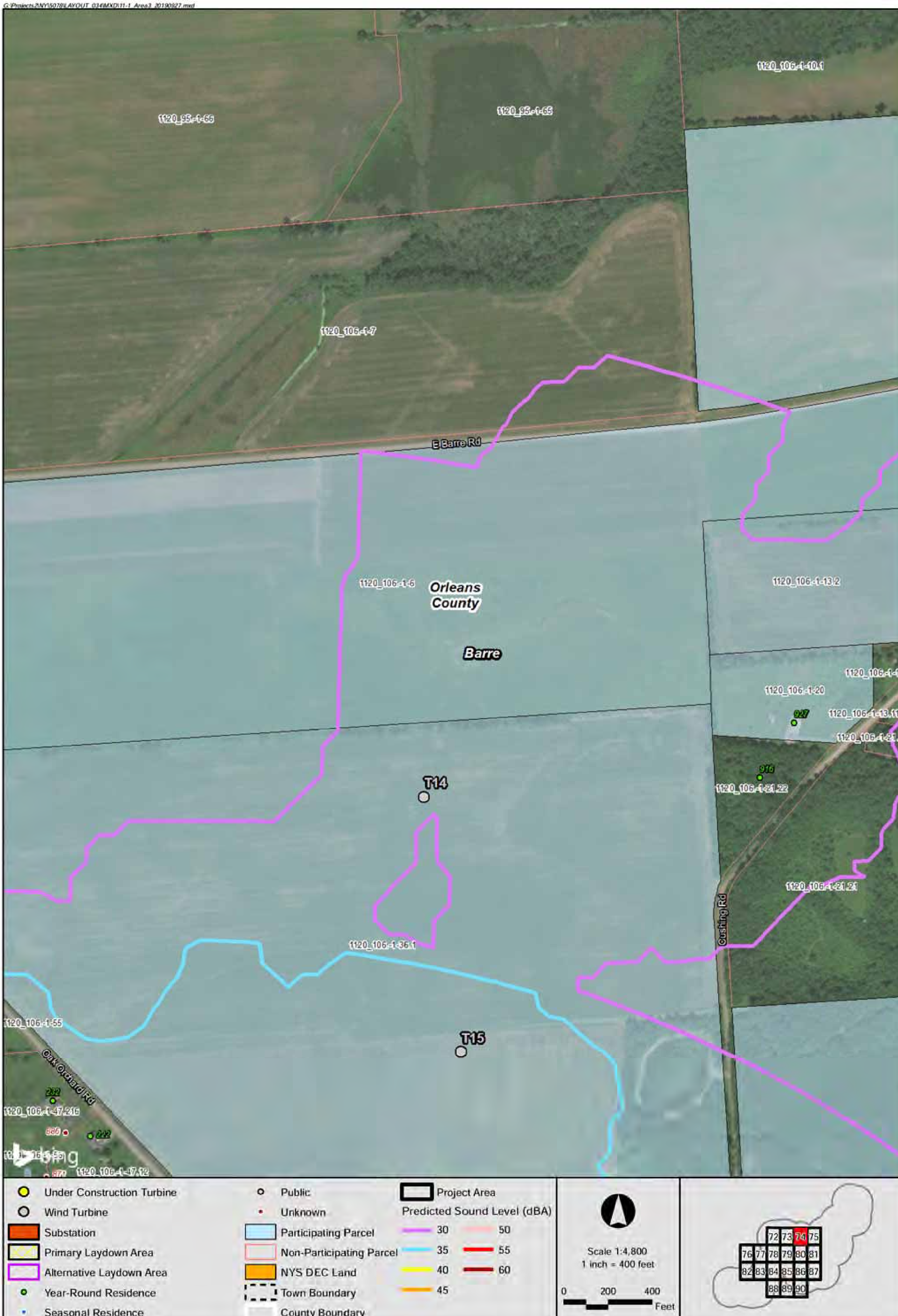


Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 74 of 90

Sound Level Contours During Foundation Work - Area 3

G:\Projects2\NY\5078\LAYOUT_034\MXD\11-1_Area3_20190927.mxd

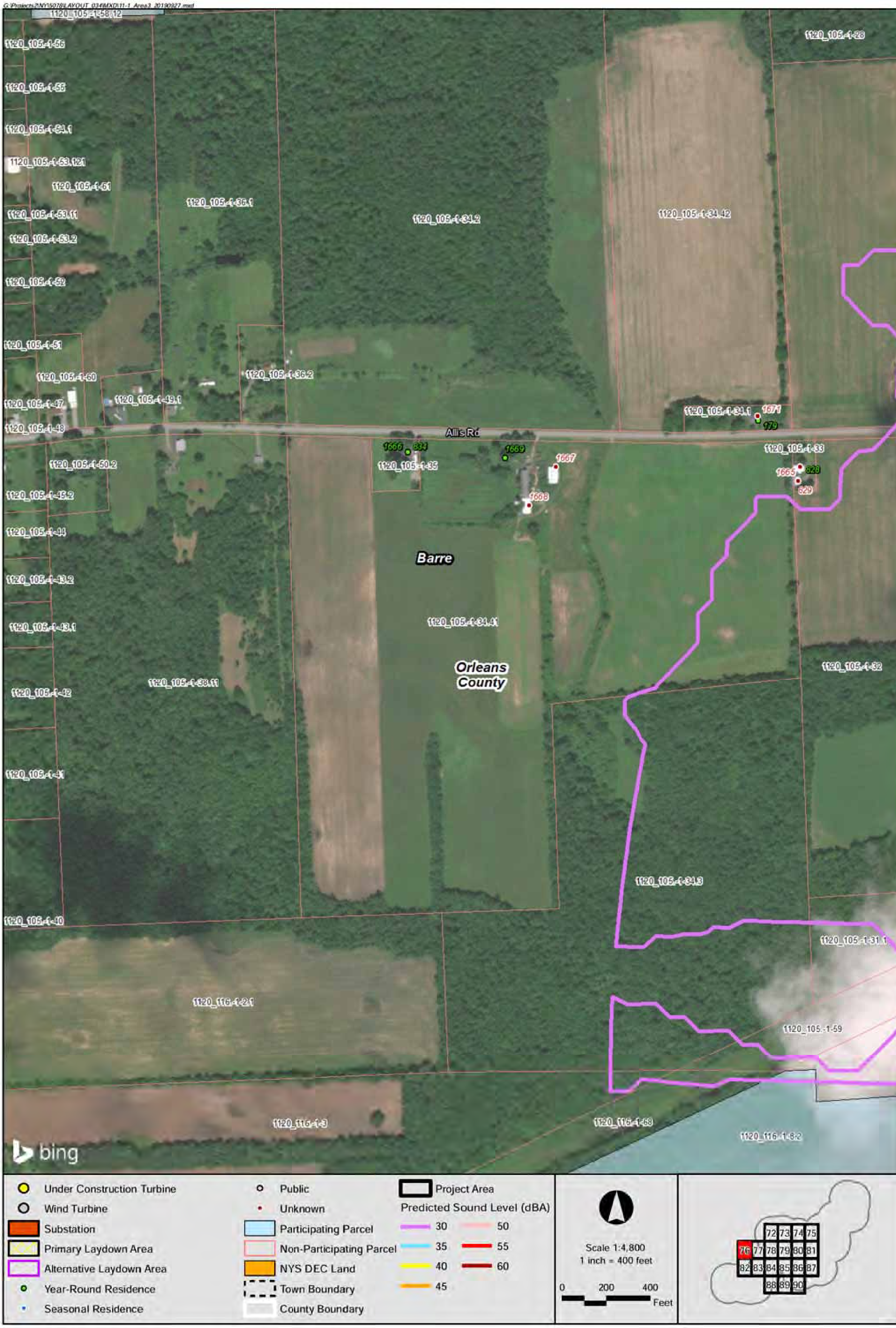
Under Construction Turbine
Wind Turbine
Substation
Primary Laydown Area
Alternative Laydown Area
Year-Round Residence
Seasonal Residence
Public
Unknown
Participating Parcel
Non-Participating Parcel
NYS DEC Land
Town Boundary
County Boundary
Project Area

Predicted Sound Level (dBA)

30, 35, 40, 45, 50, 55, 60

Scale 1:4,800
1 inch = 400 feet
0 200 400 Feet

72 73 74 75
76 77 78 79 80 81
82 83 84 85 86 87
88 89 90

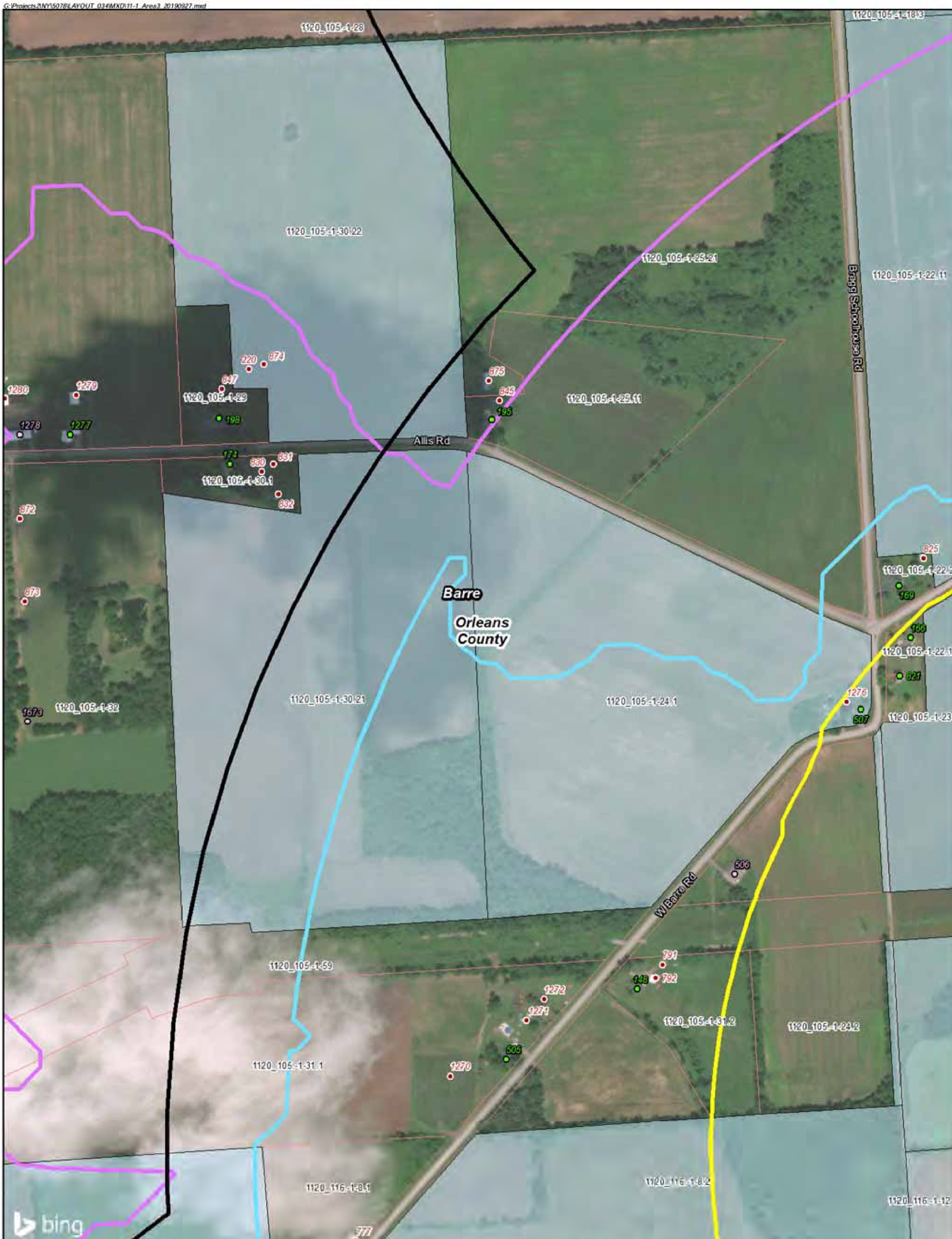


Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 76 of 90

Sound Level Contours During Foundation Work - Area 3



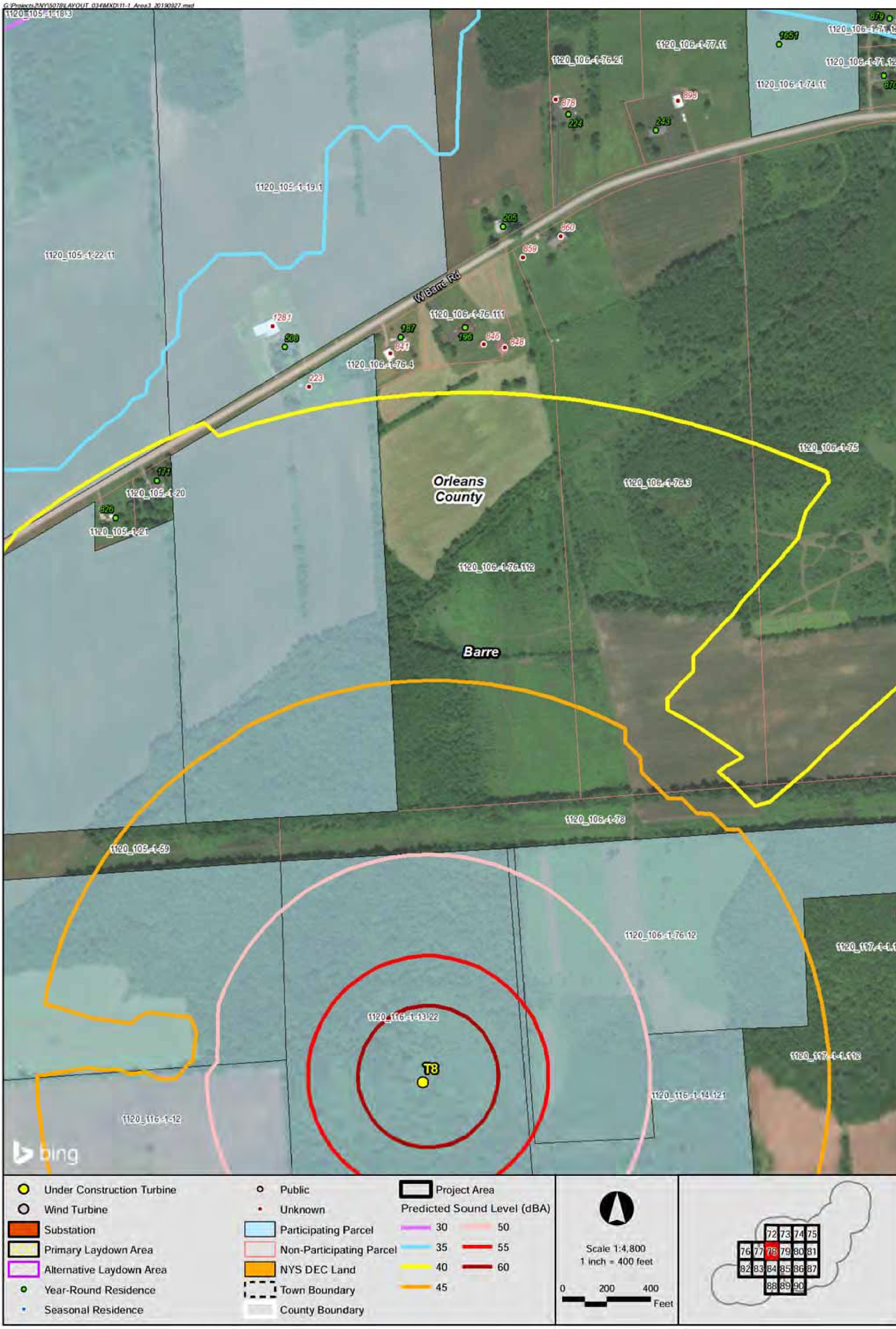
Under Construction Turbine
Wind Turbine
Substation
Primary Laydown Area
Alternative Laydown Area
Year-Round Residence
Seasonal Residence
Public
Unknown
Participating Parcel
Non-Participating Parcel
NYS DEC Land
Town Boundary
County Boundary
Project Area

Predicted Sound Level (dBA)

30, 35, 40, 45, 50, 55, 60

Scale 1:4,800
1 inch = 400 feet

0 200 400 Feet



Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 78 of 90

Sound Level Contours During Foundation Work - Area 3

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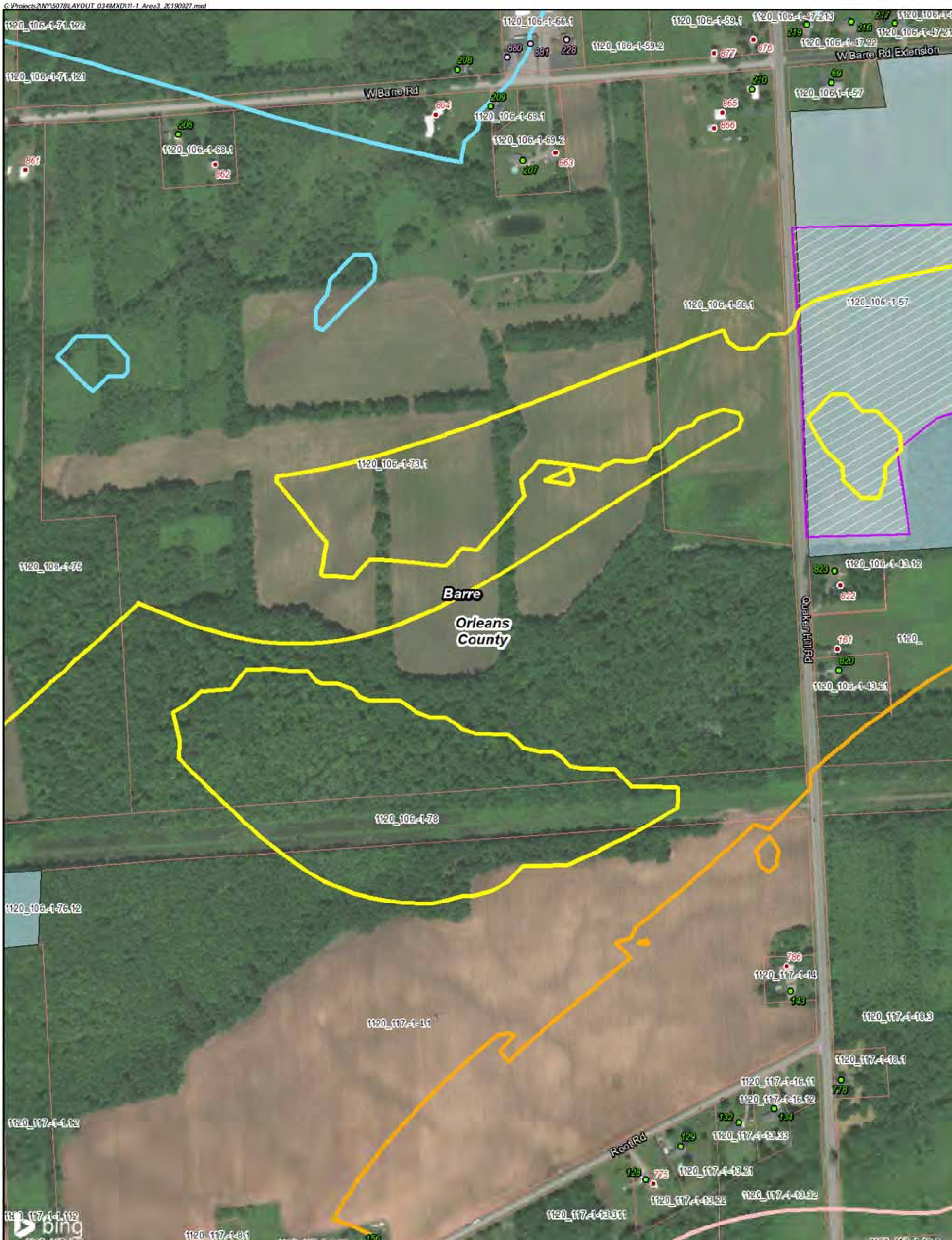


Under Construction Turbine
Wind Turbine
Substation
Primary Laydown Area
Alternative Laydown Area
Year-Round Residence
Seasonal Residence
Public
Unknown
Participating Parcel
Non-Participating Parcel
NYS DEC Land
Town Boundary
County Boundary
Project Area
Predicted Sound Level (dBA)
30
35
40
45
50
55
60

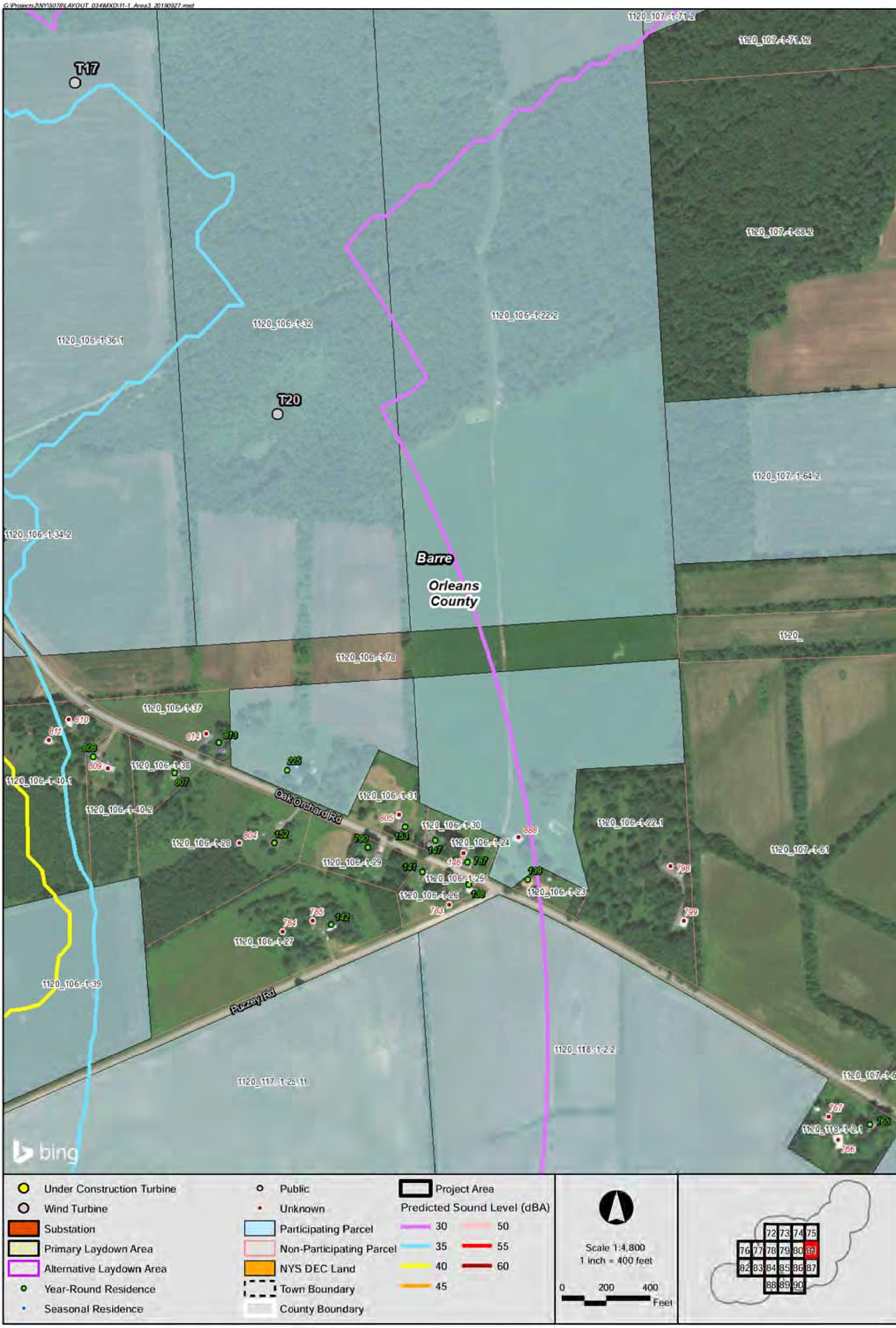
Scale 1:4,800
1 inch = 400 feet
0 200 400 Feet

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 80 of 90

Sound Level Contours During Foundation Work - Area 3



Heritage Wind Orleans County, New York

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Figure 11-1, Map 81 of 90

Sound Level Contours During Foundation Work - Area 3

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 82 of 90

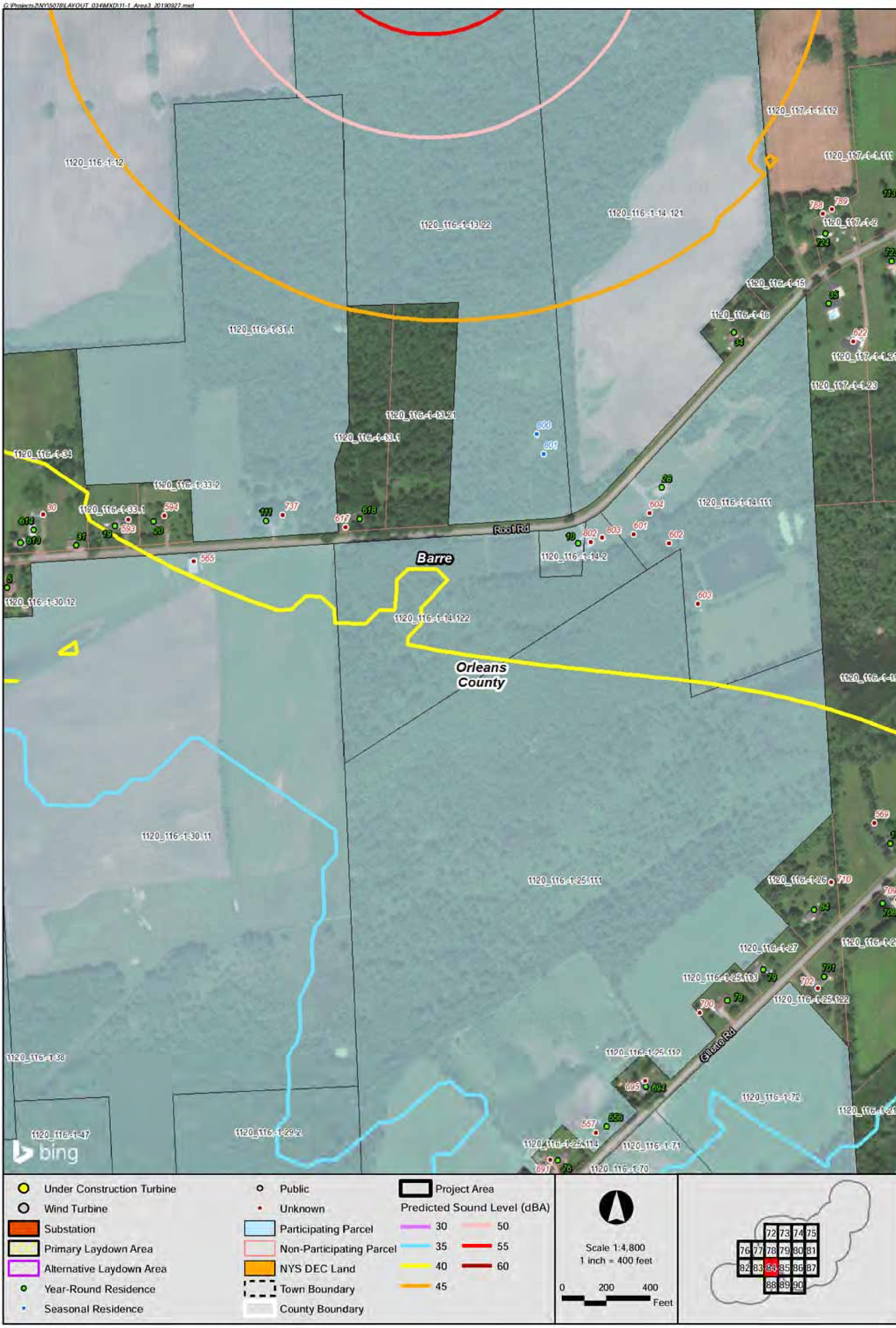
Sound Level Contours During Foundation Work - Area 3

Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 83 of 90

Sound Level Contours During Foundation Work - Area 3

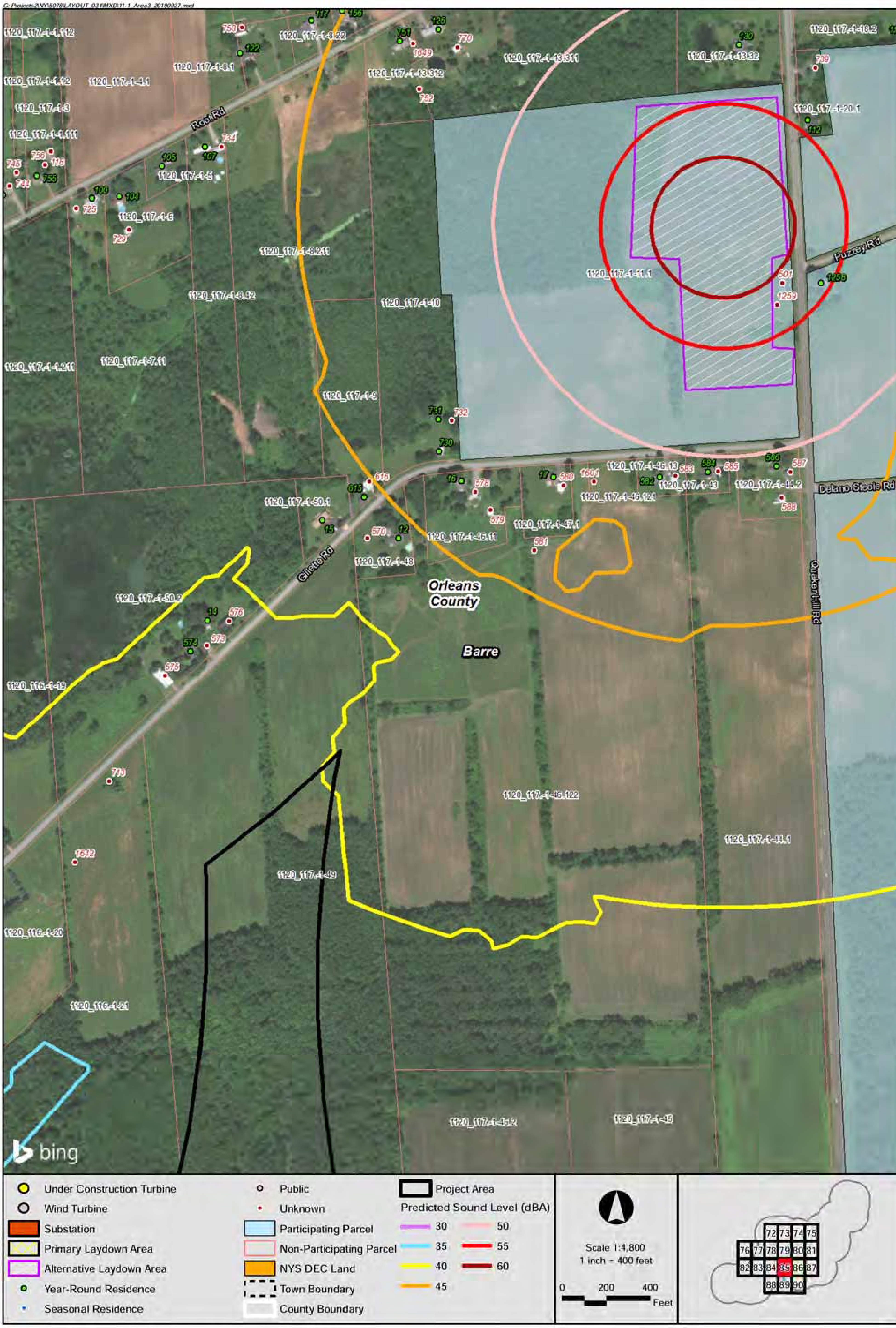


Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 84 of 90

Sound Level Contours During Foundation Work - Area 3

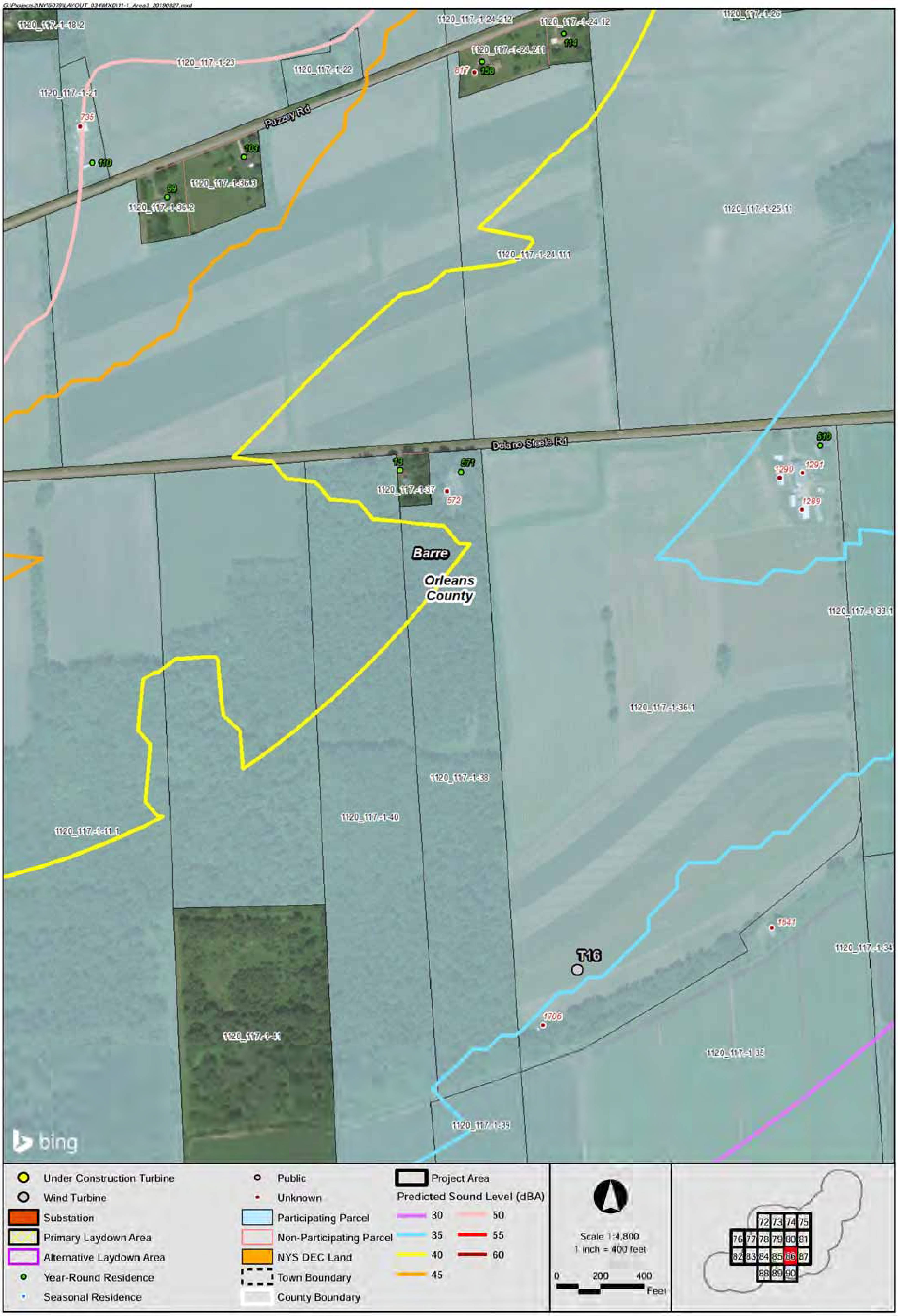


Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 85 of 90

Sound Level Contours During Foundation Work - Area 3



Heritage Wind Orleans County, New York

Epsilon

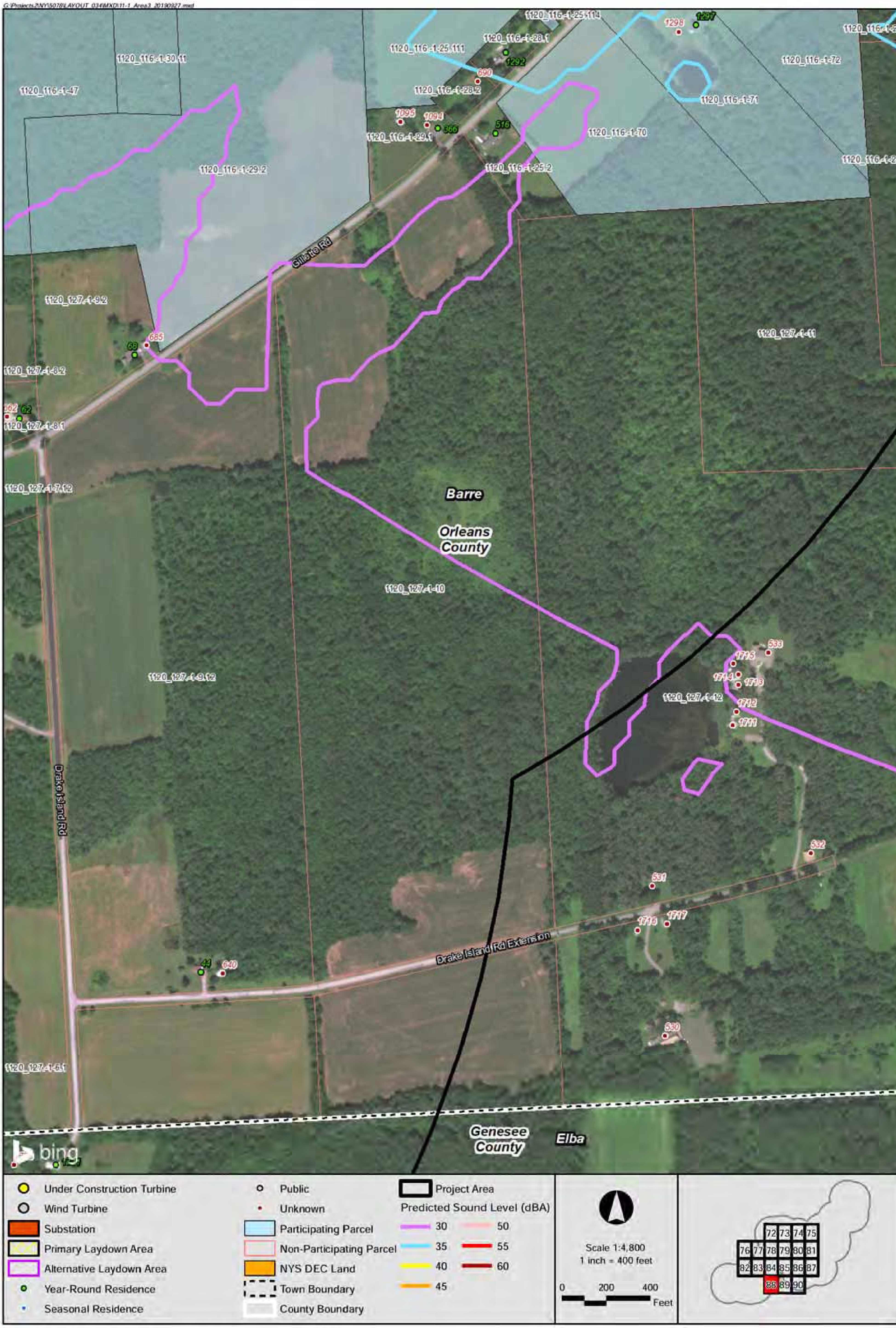
Figure 11-1, Map 86 of 90

Sound Level Contours During Foundation Work - Area 3

Epsilon

Figure 11-1, Map 87 of 90

Sound Level Contours During Foundation Work - Area 3



Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 88 of 90

Sound Level Contours During Foundation Work - Area 3

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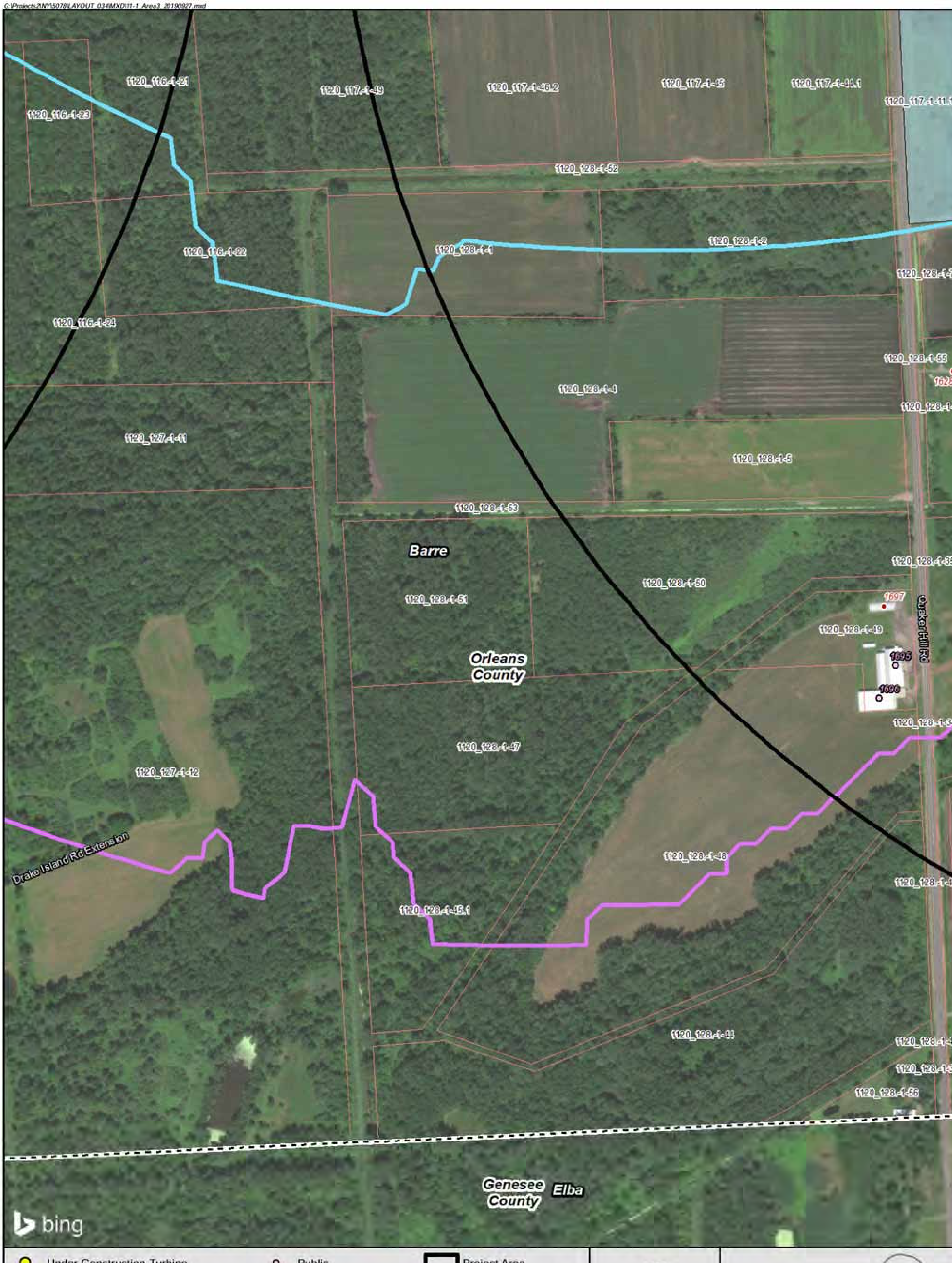


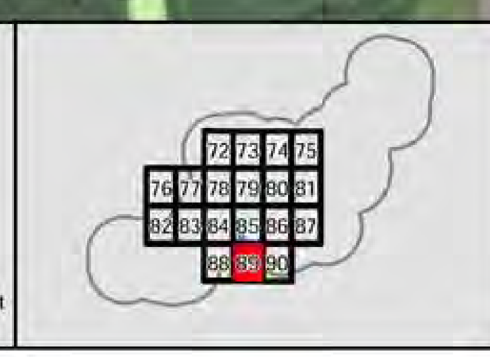
Under Construction Turbine
Wind Turbine
Substation
Primary Laydown Area
Alternative Laydown Area
Year-Round Residence
Seasonal Residence
Public
Unknown
Participating Parcel
Non-Participating Parcel
NYS DEC Land
Town Boundary
County Boundary
Project Area

Predicted Sound Level (dBA)

30 35 40 45 50 55 60

Scale 1:4,800
1 inch = 400 feet

0 200 400 Feet



Heritage Wind Orleans County, New York

Epsilon

Figure 11-1, Map 89 of 90

Sound Level Contours During Foundation Work - Area 3

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Section 12.0

Other Potential Community Noise Impacts

12.0 OTHER POTENTIAL COMMUNITY NOISE IMPACTS

12.1 Hearing Damage

The Occupational Safety and Health Administration (OSHA) protects against the effects of noise exposure in the workplace through 29CFR1910.95. Permissible noise exposure levels for an 8-hour day are 90 dBA. At sound levels above 85 dBA over an 8-hour workday, employers shall provide hearing protection to employees.

The 1974 U.S. EPA "Levels" document[57] identifies a sound level of 70 dBA over a 24-hour period as protective against hearing loss from intermittent sources of environmental noise [$L_{eq(24)}$ = 70 dBA].

The "Guideline for Community Noise" (World Health Organization, Geneva, 1999) also identifies a sound level of 70 dBA over a 24-hour period as protective against hearing loss from a lifetime exposure to environmental noise [$L_{eq(24)}$ = 70 dBA].

According to the WHO 1999 Guidelines, the threshold for hearing impairment is 110 dBA (Lmax, fast) or 120/140 dBA (peak at the ear) for children/adults. The FHWA Highway Construction Noise Handbook (FHWA-HEP-06-015; August 2006) estimates construction blasting noise levels to be approximately 82 dBA at 200 feet (Lmax). The closest existing receptor to any wind turbine foundation will be well beyond 200 feet. This would result in an Lmax sound level of less than 82 dBA at any receptor. These sound levels are well below the WHO hearing impairment threshold.

In addition, if any blasting is required, the contractor responsible for blasting will have a Health & Safety Plan approved by Heritage Wind. This Plan will include the appropriate worker hearing protection and procedures to prevent hearing loss from impulse noise.

12.2 Speech Interference

The 1974 U.S. EPA "Levels" document states that at an outdoor level of 55 dBA (L_{dn}) there is 100% sentence intelligibility indoors, and 99% sentence intelligibility at 1 meter outdoors. These are the maximum sound level below which there are no effects on public health and welfare due to interference with speech or other activity. This has a 5 dBA margin of safety – in other words the EPA believes the actual threshold is 60 dBA, but has reduced it by 5 dBA. An outdoor L_{dn} is equivalent to a 24-hour sound level of 49 dBA.

57 Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, U. S. Environmental Protection Agency, 550/9-74-004, March 1974.

The “Guideline for Community Noise” (World Health Organization, Geneva, 1999) recommends an indoor sound level of 35 dBA (L_{eq}) to protect speech intelligibility. This is equivalent to approximately 50 dBA L_{eq} outdoors based on reduction from outside to inside by approximately 15 dBA with windows open, and 25 dBA with windows closed.[58]

12.3 Outdoor Public Facilities

One method to evaluate the potential for interference in the use of outdoor public facilities is to look at ANSI S12.9-2007/Part 5 “Quantities and Procedures for Description and Measurement of Environmental Sound – Part 5: Sound Level Descriptors for Determination of Compatible Land Use” (Reaffirmed September 5, 2012). The nearest public land near the project area is the Oak Orchard Wildlife Management Area located on the southwest edge of the Project area along Albion Road (receptor ID #1735). While wildlife management areas are not found in ANSI S12.9/Part 5, neighborhood parks are listed as compatible up to 55 dBA adjusted annual average day-night sound level (DNL).

From a review of the annual sound level modeling results in Table G-2, the average annual sound levels (L_{50}) at receptor #1735 are 25 dBA using the loudest turbine under consideration. Assuming a 10 dBA penalty for all nighttime hours in a year would increase this sound level by ~6 dBA to 31 dBA which is well below the ANSI S12.9/Part 5 guideline for compatible land use of 55 dBA.

12.4 Structural Damage

Information regarding construction activities is included the Preliminary Blasting Plan and the Preliminary Geotechnical Report, and is summarized in Exhibit 12 and Exhibit 21 of the Application. Blasting of bedrock may be required for construction of turbine foundations, and portions of the electrical interconnect lines. It is not anticipated that pile driving will be needed to construct this Facility. Potential for any cracks or structural damage due to impact activities during construction will be analyzed in Exhibits 12 and 21.

12.5 Ground-Borne Vibration

The nearest operating wind turbine to a non-participating noise-sensitive receptor (#560) is approximately 1,148 feet (350 meters). The frequency of rotation for the GE5.5-158 wind turbine will range from 6.0 rpm to 10.1 rpm under all operating conditions. This translates to blade pass frequencies of 0.3 Hz to 0.51 Hz. The frequency of rotation for the Vestas V162-5.6 wind turbine will range from 4.3 rpm to 12.1 rpm under all operating conditions. This translates to blade pass frequencies of 0.22 Hz to 0.61 Hz. Based on the literature findings presented in Section 4.7 where ground-borne vibration was below perceptible thresholds at comparable distances and frequency

58 Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, U. S. Environmental Protection Agency, 550/9-74-004, March 1974.

of rotation, ground-borne vibrations from operation of this project will be below the thresholds as recommended in ANSI S2.71-1983 (R2012).

12.6 Air-borne Vibration

Table 12-1 shows the low frequency ANSI 12.2-2008 and ANSI S12.9-2005/Part 4 criteria. These data and the modeling procedures were discussed in Section 9.6. Results show that the sound levels from the project will be at the minimal annoyance levels. As per the Project's understanding of the required DPS scope of studies, the number of non-participating and participating receptors at or above the 65 dB level for each of the three low frequency octave bands is presented below in Table 12-2 through 12-3. These results do not include any reductions associated with running the wind turbines in NRO mode which may be needed to meet the A-weighted (dBA) design goals. Appendix E-3.1 to E-3.3 lists the specific receptor IDs associated with the counts in Tables 12-2 to 12-3.

Modeling results at the 31.5 Hz and 63 Hz low frequency octave bands have been calculated using the Cadna/A acoustic model. Results at the 16 Hz octave band were extrapolated from the 31.5 Hz results as discussed in Section 9.4. Complete octave band sound pressure level results at each receptor for the Project are presented in Appendix E.

Table 12-1 ANSI/ASA S12.2-2008 Section 6 and ANSI S12.9-2005/Part 4 Annex D Low Frequency Criteria Compared with Modeled Sound Levels at Worst-Case Receptors

Octave-band center frequency→	16 Hz	31.5 Hz	63 Hz
Low Frequency Guidelines			
Clearly perceptible vibration and rattles likely	75 dB	75 dB	80 dB
Moderately perceptible vibration and rattles likely	65 dB	65 dB	70 dB
Minimal annoyance levels	65 dB	65 dB	65 dB

Table 12-2 Participating and Non-Participating Receptors Modeled 65 dB or Greater for Low Frequency Criteria (GE5.5-158) – no NRO

Modeled Leq Sound Level (dB)[1]	16 Hz # of Receptors		31.5 Hz # of Receptors		63 Hz # of Receptors	
	Participating	Non-Participating	Participating	Non-Participating	Participating	Non-Participating
75	1	0	0	0	0	0
74	0	0	0	0	0	0
73	1	0	0	0	0	0
72	0	0	1	0	0	0
71	1	0	1	0	0	0
70	3	3	0	0	0	0
69	23	41	0	0	0	0
68	41	101	1	0	1	0
67	32	103	7	8	0	0
66	36	148	29	58	1	0
65	26	149	42	97	0	0

Notes: 1. Rounded to the nearest whole decibel. All receptors are either residences or unknown.

Table 12-3 Participating and Non-Participating Receptors Modeled 65 dB or Greater for Low Frequency Criteria (Vestas V162-5.6)

Modeled Leq Sound Level (dB)[1]	16 Hz # of Receptors		31.5 Hz # of Receptors		63 Hz # of Receptors	
	Participating	Non-Participating	Participating	Non-Participating	Participating	Non-Participating
75	0	0	0	0	0	0
74	0	0	0	0	0	0
73	0	0	0	0	0	0
72	0	0	0	0	0	0
71	0	0	0	0	0	0
70	0	0	0	0	0	0
69	1	0	0	0	0	0
68	0	0	0	0	0	0
67	1	0	0	0	0	0
66	0	0	0	0	0	0
65	1	0	1	0	0	0

Notes: 1. Rounded to the nearest whole decibel. All receptors are either residences or unknown.

12.7 Potential Interference with Technology

The potential of low-frequency noise including infrasound and vibration from operation of the Project to cause interference with the closest seismological and infrasound stations within 50 miles of the Project site was investigated. The Preparatory Commission for the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) website was reviewed for the nearest location of any infrasound monitoring stations. The closest locations are in Bermuda (IS51) and Lac du Bonnet, Manitoba, Canada (IS10). Bermuda (IS51) is approximately 1,050 miles from the Project, while Lac du Bonnet, Manitoba, Canada (IS10) is approximately 975 miles from the Project There are also some auxiliary seismic stations to monitor shock waves in the Earth as part of the CTBTO program. The nearest seismic monitor to Heritage Wind is located in Sadowa, Ontario, Canada (AS014) which is approximately 120 miles away. Given these large distances and the relatively low levels of infrasound emissions from this project, we conclude there will be no impact to the CTBTO's ability to monitor infrasound. There are no US Geological Survey (USGS) seismological stations within 50 miles of the site. The nearest station is located at Binghamton, New York, over 100 miles to the southeast. The two closest hospitals to the project are Medina Memorial Hospital in Medina, NY approximately 8.5 miles west northwest of the nearest wind turbine and Lakeshore Hospital in Brockport, NY approximately 8 miles to the east of the nearest wind turbine. Distances are "as the crow flies."

12.8 Amplitude Modulation

The current body of work on amplitude modulation indicates that it is not possible to predict or forecast its occurrence. Design considerations for minimization, and practical post-construction operational mitigation options are in the early phases of development.

The Massachusetts Study on Wind Turbine Acoustics measured amplitude modulation (AM) in detail and provides a description of the phenomenon.[59] With respect to wind turbines, amplitude modulation is a recurring variation in the overall level of sound over time. The modulation sound is typically broadband, and it comes from interactions of the blade with the atmosphere, wind turbulence, directionality of the broadband sound of the blades, or tower interaction with the wake of the blade. This modulation is not infrasound; rather, it is variation in audible sound that is synchronized to the passage of the turbine blades.

The fundamental frequency of the modulations is usually coincident with the rotational speed of the turbine multiplied by the number of blades:

Modulation frequency = (RPM x Number of blades)/60 seconds per minute

The rotor speed (RPM) varies according to the type of wind turbine and operating conditions. For example, if a three-bladed turbine is turning at 15 rpm, the fundamental modulation frequency would be 0.75 Hz. The time it takes for a complete modulation cycle (the period) is 1/frequency. In this case, the cycle time would be about 1.33 seconds.

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[59] *Massachusetts Study on Wind Turbine Acoustics,* Massachusetts Clean Energy Center and Massachusetts Department of Environmental Protection, RSG et al., 2016.

The greater the modulation in sound level, the greater the "modulation depth." The modulation depth is often measured from the minimum sound level to the maximum sound level, or "crest-to trough level". Half of this level is called the *amplitude* of the sine wave. For the perfect sine wave, the rms value defined above is equal to the modulation depth multiplied by the square root of two (1.414). The standard deviation is also approximately equal to the rms average level of the signal. This is important, as some of the methods used to quantify amplitude modulation of a signal use the rms of standard deviations.

Normal amplitude modulation from wind turbines is generally characterized as "swishing," which is a broadband modulated sound. Under some circumstances, it is characterized as "thumping," which has a faster rise time and is composed of sound at lower frequencies. A "churning" sound has also been described, which is made up of broadband mid-frequency sound, but with a faster rise-and-fall rate.

The primary conclusions with respect to amplitude modulation from the *Massachusetts Study on Wind Turbine Acoustics*[60] are as follows:

- Data analyzed for this study indicate that low-frequency sound and infrasound from the wind turbines are not modulated for the most part, and sounds in the frequency range from about 250 Hz to 2 kHz are amplitude-modulated.
- The technique of calculating a spectrogram from A-weighted sound levels and one-third octave band levels is very effective at revealing the signature of amplitude modulated wind turbine sound. A logging interval of 125 milliseconds or faster is required.
- The maximum observed increase in modulation depth was at 500 Hz.
- The measured sound level, wind speed, and distance to turbine have the greatest impact on modulation depth.
- Approximately 90% of all measured AM depth was 2 dB or less while over 99.9% was 4.5 dB or less.
- Wind turbulence, wind shear, and yaw error have a lesser, but statistically significant, effect on amplitude modulation depth compared to distance and sound level.
- The turbulence intensity does not show any trend with respect to the sound levels.

60 *Massachusetts Study on Wind Turbine Acoustics,* Massachusetts Clean Energy Center and Massachusetts Department of Environmental Protection, RSG et al., 2016.

Another reference reviewed for AM in this Application is the "Wind Turbine AM Review: Phase 2 Report".[61] This report reviews research into the effects of and response to the acoustic character of AM. The report notes that "the setting of a threshold for excessive AM is not straightforward. The available research does not identify a clear onset of increased annoyance from AM." Nonetheless, a proposal is put forth to possibly "control" AM by establishing a "penalty scheme" for excessive AM during periods of complaints. There would be no penalty for AM depths of 0-3 dB, a sliding scale penalty (3-5 dB) for AM depths of 3-10 dB, and a 5 dB penalty for AM depths greater than 10 dB. The report also concludes that "it is not possible to predict whether AM will or will not be present on a site." This paper does not relate specific levels of wind shear or turbulence to AM levels.

Cooper and Evans analyzed several weeks of sound data approximately 1500 meters from a wind turbine in flat terrain for evidence of AM.[62] They found zero periods with an amplitude modulation depth of 5 dBA or more which is defined as "excessive" AM in New Zealand. These findings are consistent with the *Massachusetts Study on Wind Turbine Acoustics*. Their data set did not find any significant trend in the level of AM and wind shear.

Research work being sponsored by RenewableUK has identified two possible mitigation options to reduce the AM more often associated with complaints ("thumping").[63] They found the thumping occurred under transient stall effects occurring over part of the turbine blade surfaces. Two mitigation measures were tested and found to reduce AM Depth significantly. These two mitigation techniques are a "kit" installed on the blades designed to improve or modify the flow of air on the blades to reduce stall, and a software design change which modified the turbine blade pitch control angle by several degrees under specific wind regime conditions.

Section 10.5 of the IEC standard used for reference sound level measurements of all wind turbines by the manufacturers, notes that amplitude modulation is an optional data element that may be reported during testing.[64] Annex A and B of this standard also contain a brief mention of AM and its relationship to turbulence conditions.

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61 *Wind Turbine AM Review: Phase 2 Report,* U. K. Department of Energy & Climate Change, prepared by WSP Parsons Brinckerhoff, August 2016.

62 Automated detection and analysis of amplitude modulation at a residence and wind turbine, J. Cooper & T. Evans, Proceedings of Acoustics 2013 – Victor Harbor, Australia.

63 *Measurements demonstrating mitigation of far-field AM from wind turbines,* M. Cand and A. Bullmore, 6th International Meeting on Wind Turbine Noise, Glasgow, Scotland, April 2015.

64 *Wind turbines—Part 11: Acoustic noise measurement techniques,* International Electrotechnical Commission IEC 61400-11, Edition 3.0, Geneva, Switzerland, 2012.

12.9 Tonality

Tonal audibility may be reported by the wind turbine manufacturers through the IEC 61400-11 standards process.[65] According to the standard, a tone is audible if the tonal audibility is above 0 dB. According to the technical documentation from GE for the 5.5-158 wind turbine, the tonal audibility is less than 4 dB. Similar information for the Vestas V162-5.6 was not available from the manufacturer.

ANSI S12.9 Part 3, Annex B, section B.1 (informative) presents a procedure for testing for the presence of a prominent discrete tone. According to the standard, a prominent discrete tone is identified as present if the time-average sound pressure level (L_{eq}) in the one-third octave band of interest exceeds the arithmetic average of the time-average sound pressure level (L_{eq}) for the two adjacent one-third octave bands by any of the following constant level differences (K_T): 15 dB in low-frequency one-third octave bands (from 25 up to 125 Hz); 8 dB in middle-frequency one-third octave bands (from 160 up to 400 Hz); or, 5 dB in high-frequency one-third octave bands (from 500 up to 10,000 Hz). A source of sound with a tone may be more annoying at the same A-weighted sound level than a source without a tone. Typically, the tone must be loud enough so that it is prominent, and thus annoying. Though not applicable from a regulatory perspective, the State of Illinois Pollution Control Board (IPCB) noise regulations recognize this fact by noting that their prominent discrete tone rule does not apply if the one-third octave band levels are 10 dB or more below the octave band limits in the IPCB regulations.

Sound pressure level calculations using the Cadna/A modeling software which incorporates the ISO 9613-2 standard is limited to octave band sound levels; therefore, a quantitative evaluation of one-third octave band sound levels using the modeling software was not possible. Instead, one-third octave band sound pressure levels due to the closest wind turbines were calculated at the nearest ten (10) potentially impacted and representative receptor locations using equations accounting for hemispherical radiation and atmospheric absorption. These receptors included both non-participants and participants. The calculations at these locations were conducted as discussed in Section 9.6 and similarly used the one-third octave band spectrum data for the calculations. The results presented in Table 12-4 shows that received sound pressure levels due to the closest wind turbines at each of these locations are not predicted to result in any prominent discrete tones as defined in the ANSI standards.

One-third octave band sound power levels for the substation transformer were not supplied by the vendor for the substation equipment; therefore, a quantitative evaluation of one-third octave band sound using the spreadsheet modeling approach was not possible. In general, substation

[65] *Wind turbines—Part 11: Acoustic noise measurement techniques,* International Electrotechnical Commission IEC 61400-11, Edition 3.0, Geneva, Switzerland, 2012.

transformers have the potential to create a prominent discrete tone at nearby receptors, specifically during the ONAN (fans off) condition. For this Project the substation is modeled to be less than 39 dBA at all non-participating sensitive receptors. Therefore, prominent discrete tones from the substation are not a concern with this Project.

Table 12-4 Tonal Analysis & Compliance Evaluation: Modeled Sound Pressure Levels

Rec. ID	One-Third Octave Band Center Frequency (Hz)	25	**31.5**	40	50	**63**	80	100	**125**	160	200	**250**	315	400	**500**	630	800	**1000**	1250	1600	**2000**	2500	3150	**4000**	5000	6300	**8000**	10000
	Tonal Limit	-	15	15	15	15	15	15	15	8	8	8	8	8	5	5	5	5	5	5	5	5	5	5	5	5	5	-
560	Received Sound Pressure Level (dB)	59	58	57	55	54	52	50	48	46	45	43	42	41	40	39	38	38	38	36	33	29	23	15	5	0	0	0
	Average Sound Pressure Level of Contiguous Bands	-	58	57	55	54	52	50	48	46	45	43	42	41	40	39	39	38	37	35	32	28	22	14	8	2	0	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	-3	-2	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
631	Received Sound Pressure Level (dB)	60	59	58	56	55	53	51	49	47	46	45	44	42	41	40	40	39	39	37	34	30	26	20	14	12	9	7
	Average Sound Pressure Level of Contiguous Bands	-	59	57	56	55	53	51	49	48	46	45	43	42	41	40	40	39	38	37	34	30	25	20	16	12	9	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	-1	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
754	Received Sound Pressure Level (dB)	57	56	56	54	53	51	49	47	45	43	42	41	39	38	38	37	36	36	33	31	26	20	11	0	0	0	0
	Average Sound Pressure Level of Contiguous Bands	-	56.5	55.4	54.4	52.6	51.0	48.9	46.8	45.0	43.3	42.0	40.5	39.5	38.4	37.6	36.9	36.4	34.9	33.3	29.9	25.4	18.8	10.2	5.6	0.0	0.0	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	2	1	-6	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
836	Received Sound Pressure Level (dB)	60	59	58	56	55	53	51	49	47	46	44	43	42	41	40	39	39	38	36	33	28	22	12	0	0	0	0
	Average Sound Pressure Level of Contiguous Bands	-	59	57	56	55	53	51	49	48	46	45	43	42	41	40	40	39	37	36	32	27	20	11	6	0	0	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	2	1	-6	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
1137	Received Sound Pressure Level (dB)	59	58	57	56	54	52	50	48	47	45	44	43	41	41	40	40	40	40	38	37	34	31	27	23	20	18	16
	Average Sound Pressure Level of Contiguous Bands	-	58	57	56	54	52	50	48	47	45	44	43	42	41	40	40	40	39	38	36	34	31	27	24	20	18	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	-1	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-

Table 12-4 Tonal Analysis & Compliance Evaluation: Modeled Sound Pressure Levels (Continued)

Rec. ID	One-Third Octave Band Center Frequency (Hz)	25	**31.5**	40	50	**63**	80	100	**125**	160	200	**250**	315	400	**500**	630	800	**1000**	1250	1600	**2000**	2500	3150	**4000**	5000	6300	**8000**	10000
	Tonal Limit	-	15	15	15	15	15	15	15	8	8	8	8	8	5	5	5	5	5	5	5	5	5	5	5	5	5	-
1215	Received Sound Pressure Level (dB)	59	58	58	56	55	53	51	49	48	46	45	44	42	41	41	40	40	40	38	36	34	31	26	22	19	17	15
	Average Sound Pressure Level of Contiguous Bands	-	58	57	56	55	53	51	49	48	46	45	43	43	42	41	40	40	39	38	36	34	30	26	23	19	17	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	-1	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
1238	Received Sound Pressure Level (dB)	59	58	57	56	55	53	51	49	47	45	44	43	42	41	41	40	40	40	39	37	35	32	28	23	21	18	16
	Average Sound Pressure Level of Contiguous Bands	-	58	57	56	54	53	51	49	47	46	44	43	42	41	41	40	40	40	39	37	35	31	28	24	21	19	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	-1	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
1249	Received Sound Pressure Level (dB)	59	58	57	56	54	53	51	49	47	45	44	43	42	41	41	40	40	40	39	37	35	32	28	23	21	18	16
	Average Sound Pressure Level of Contiguous Bands	-	58	57	56	54	53	51	49	47	46	44	43	42	41	41	40	40	40	39	37	35	31	28	24	21	19	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	-1	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
1640	Received Sound Pressure Level (dB)	66	65	64	63	62	60	58	56	54	53	51	50	49	48	48	47	47	48	46	44	42	39	35	30	28	26	23
	Average Sound Pressure Level of Contiguous Bands	-	65	64	63	61	60	58	56	54	53	52	50	49	48	48	48	47	47	46	44	42	39	35	31	28	26	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	-1	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
1706	Received Sound Pressure Level (dB)	69	68	68	66	65	63	61	60	58	56	55	54	53	52	51	51	51	51	50	48	46	43	39	34	32	29	27
	Average Sound Pressure Level of Contiguous Bands	-	68	67	66	65	63	62	60	58	56	55	54	53	52	51	51	51	50	50	48	45	42	38	35	32	29	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	-1	0	0	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-

Section 13.0

Evaluation

13.0 EVALUATION

13.1 Local Laws

In the Town of Barre, sound is currently limited to an L_{10} of 45 dBA at a distance of 1,000 feet from the base of a wind turbine. This sound level limit cannot be met by any economically viable wind turbine technology and would preclude wind energy in the town. Therefore, Heritage Wind will request a waiver of the existing local law with respect to this sound standard, as further described in Exhibit 31.

13.2 World Health Organization & Certificate Conditions Cases 14-F-0490, 15-F-0122, 16-F-0328, 16-F-0559 —Short-Term (Goals #1; #2; #10)

According to the WHO 1999 "Guideline for Community Noise" document, sound levels at the outside facades of living spaces should not exceed an L_{eq} of 45 dBA, so that people may sleep with bedroom windows partly open. This is an 8-hour average. This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind). Nighttime in NY State is defined as 9-hours which is minimally different than an 8-hour average. Since the 9-hour sound level cannot be any higher than the highest 1-hour modeled sound level, the sound levels shown in Appendix E are conservative surrogates for the highest nighttime L_{eq} (9-hour).

Tables 9-9 to 9-10 in this PNIA summarize the unmitigated results applicable to these goals for each wind turbine under consideration. For the GE5.5-158 there are five (5) non-participating receptors with an L_{eq} (9-hour) sound level of 48 dBA, 21 non-participating receptors at 47 dBA, and 68 non-participants at 46 dBA. However, NRO will be used to reduce worst-case sound levels to 45 dBA at all 94 receptors (Goal #1). For the Vestas V162-5.6, all non-participating receptors will be at 45 dBA or less thus meeting Goal #1 without needing NRO.

The highest sound level at a participating residence is 48 dBA. There are three "unknown" structures modeled at 55 dBA, 53 dBA, and 50 dBA respectively. Therefore, even assuming all unknown structures are residences, the Project meets the 55 dBA L_{eq} (9-hour) design goal (Goal #2). This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind). Figure 9-2, and all inset maps, show that short-term 1-hour L_{eq} sound levels for the GE5.5-158 (worst-case) at all property lines between participating land and non-participating land are less than 55 dBA. Therefore, the Project meets the 55 dBA 1-hour L_{eq} design goal for property lines (Goal #10). This design goal is consistent with Certificate conditions for Case 16-F-0062 (Eight Point Wind).

13.3 World Health Organization & Certificate Conditions Cases 14-F-0490, 15-F-0122, 16-F-0062, 16-F-0328, 16-F-0559 —Long-Term (Goals #3; #4)

The results of the annual nighttime $L_{eq,\ night,\ outside,}$ sound level modeling results are summarized in Tables 9-11 to 9-12 in the PNIA, and presented in detail in Tables F-1 (without zeros) and F-2 (with zeros) in Appendix F. Annual nighttime $L_{eq,\ night,\ outside}$ Project sound levels range from 49 dBA and lower for "Method 1" (no zeros), and 49 dBA and lower for "Method 2" (with zeros) calculations. The modeled level "without zeros" only includes nights when the winds are above cut-in speed, and thus the wind turbines are operating and generating sound. The modeled level "with zeros" includes sound levels from all 365 nights whether or not the wind turbines would be operating. Since the 2009 WHO document guideline sound level of 40 dBA includes all 365 nights of the year, the relevant set of calculations are those in Table F-2 which include model results from all 365 nights of a year. Calculating an annual sound level without including the nights when the wind turbines will not be operating is inconsistent with the 2009 WHO definition of the annual nighttime $L_{eq,\ night,\ outside}$. Therefore, the sound levels in Table F-1 (without zeros) are irrelevant, but have been provided to comply with the Project's understanding of the required DPS scope of studies.

The number of non-participating residences above 40 dBA $L_{eq,\ night,\ outside}$ for each wind turbine manufacturer are summarized below:

- GE5.5-158 — 43 dBA (4); 42 dBA (11); 41 dBA (38)
- Vestas V162-5.6 — 42 dBA (3); 41 dBA (1)

All but four non-participating receptors meet the $L_{eq,\ night,\ outside}$ design goal of 40 dBA using the Vestas V162-5.6 (Goal #3). The GE5.5-158 does not currently meet Goal #3 at 53 receptors. It is expected that use of NRO on applicable wind turbines could lower these sound levels to the design goal. At this time, the turbine manufacturer has not completed the technical NRO documents for this specific model so a detailed long-term analysis is not yet possible. These analyses will be refined upon final turbine selection, NRO data from the manufacturer, and final layout in order to meet this design goal. This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0062 (Eight Point Wind), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind).

The highest $L_{eq,\ night,\ outside}$ for a participating receptor using any wind turbine is 49 dBA. Therefore, all participating receptors meet the $L_{eq,\ night,\ outside}$ design goal of 50 dBA (Goal #4). This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0062 (Eight Point Wind), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind).

13.4 ANSI S12.9-2005/Part 4 & Certificate Conditions Cases 14-F-0490, 15-F-0122, 16-F-0062, 16-F-0328, 16-F-0559 (Goal #6)

Annex D of the American National Standard ANSI S12.9-2005/Part 4 identifies that low frequency sound annoyance is minimal when the 16, 31.5 and 63 Hz octave band sound pressure levels are each less than 65 dB. Tables 12-2 to 12-3 show the highest sound level modeled in the 16, 31.5, and 63 Hz octave bands.

For the V162-5.6 all non-participating receptors are less than 65 dB at 16 Hz, 31.5 Hz, and 63 Hz. The V162-5.6 meets Goal #6 (V162-5.6). This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0062 (Eight Point Wind), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind).

For the GE5.5-158, all non-participating residences are at or below 65 dB at the 63 Hz octave band. The GE5.5-158 has eight (8) receptors at 67 dB and 58 receptors at 66 dB at the 31.5 Hz octave band. For the 16 Hz octave band, the GE5.5-158 has three (3) receptors at 70 dB, 41 receptors at 69 dB, 101 receptors at 68 dB, 103 receptors at 67 dB, and 148 receptors at 66 dB. It is expected that use of NRO on applicable wind turbines could lower these sound levels to the design goal. At this time, the turbine manufacturer has not completed the technical NRO documents for this specific model so a detailed analysis of the 16 Hz and 31.5 Hz octave bands is not yet possible. These analyses will be refined upon final turbine selection, NRO data from the manufacturer, and final layout in order to meet this design goal. This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0062 (Eight Point Wind), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind).

The 16 Hz modeled results are conservative and likely overstate reality for the following reasons. The ISO 9613-2 modeling is inherently conservative with the assumption that every wind turbine is operating at maximum sound power simultaneously, and the receptor is downwind of every turbine regardless of orientation or wind direction. In addition, as stated in NARUC 2011 "the widespread belief that wind turbines produce elevated or even harmful levels of low frequency and infrasonic sound is utterly untrue as proven repeatedly and independently by numerous investigators."

13.5 Tonality (Goal #5) & Certificate Conditions Cases 14-F-0490, 15-F-0122, 16-F-0062, 16-F-0328, 16-F-0559

As discussed in Section 12.9, ANSI S12.9 Part 3, Annex B, section B.1 (informative) presents a procedure for testing for the presence of a prominent discrete tone. The results presented in Table 12-4 show that received sound pressure levels due to the closest wind turbines are not predicted to result in any prominent discrete tones at either participating or non-participating residents. For this Project the collector substation is modeled to be less than 39 dBA at all non-participating sensitive receptors. Therefore, prominent discrete tones from the substation are not a concern with this Project. The project thus meets the design goal of no pure tone at any non-participating resident. This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0062 (Eight Point Wind), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind).

13.6 Vibration (Goal #7)

As discussed in Section 12.5 of this PNIA, vibration from the proposed wind turbines will not create perceptible vibration thus meeting design Goal #7. This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0062 (Eight Point Wind), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind).

13.7 Collector Substation (Goal #8)

As discussed in Section 12.9, the collector substation is modeled to be less than 39 dBA at all non-participating sensitive receptors. The project thus meets the design goal of 40 dBA at the collector substation (Goal #8). This design goal is consistent with Certificate Conditions for Case 14-F-0490 (Cassadaga Wind), Case 15-F-0122 (Baron Winds), Case 16-F-0062 (Eight Point Wind), Case 16-F-0328 (Number Three Wind), and Case 16-F-0559 (Bluestone Wind).

13.8 Minimize Complaints (Goal #11)

In order to minimize complaints, the long-term mean sound levels should be limited to 40 dBA (ideal) and 45 dBA (maximum) at a residence outdoors according to NARUC 2011. As discussed in Section 4.6, the 40 dBA and 45 dBA targets listed above are long-term mean sound levels, from data collected over a period of "several weeks." In other words, these are not short-term maximum sound levels and are not directly comparable to the short term or annual average design goals established for this Facility. For example, the NARUC modeling methodology does not add the wind turbine manufacturer uncertainty, or "K" factor, which is typically 2 dBA. Therefore, a short-term worst-case sound model of 45 dBA would be the same as 47 dBA under the NARUC approach when the "K" factor is included. Since the highest short-term sound level for this project is 45 dBA (with NRO where necessary), this is equivalent to 47 dBA NARUC which is below the recommended limit of 45 dBA to minimize complaints. Long-term sound levels will be even lower than this sound level. Therefore, this project has met the NARUC goal to minimize complaints (Goal #11).

13.9 Summary of Compliance

Table 13-1 summarizes all applicable noise standards and design goals applicable to the Heritage Wind project, and the expected compliance status with said standards and goals.

Table 13-1 Summary of Compliance with Sound Standards and Design Goals - Heritage Wind

#	Design Goal. (Not to exceed)	Assessment Location	Noise descriptor	Period of Time	Participant Status	Design Goals and basis	Meet?
1	45 dBA	At residence, Outdoor	Leq	8-hour; day or night	Non-participant	Certificate Condition 72(a) Case 16-F-0328 and WHO-1999	Yes (V162-5.6); Yes w/ NRO (GE5.5-158)
2	55 dBA	At residence, Outdoor	Leq	8-hour; day or night	Participant	Certificate Condition 72(a) Case 16-F-0328	Yes
3	40 dBA	At residence, Outdoor	Lnight-outside (Leq)	Annual; nighttime. (2009-WHO)	Non-participant	Certificate Condition 68(d)(i) Case 16-F-0328 and WHO-2009	Yes w/ NRO
4	50 dBA	At residence, Outdoor	Lnight-outside (Leq)	Annual; nighttime. (2009-WHO)	Participant	Certificate Condition 68(d)(ii) Case 16-F-0328 and WHO-2009	Yes
5	No audible prominent tones or 5 dBA penalty if they occur.	At residence, Outdoor	Leq	1-hour	Non-participant	Certificate Condition 72(c) Case 16-F-0328	Yes
6	65 dB at 16, 31.5, and 63 Hz full-octave bands.	At residence, Outdoor	Leq	1-hour; daytime and nighttime	Non-Participant	Certificate Condition 72(d) Case 16-F-0328	Yes (V162-5.6); Yes w/ NRO (GE5.5-158)
7	No perceptible vibrations	At residence, Indoor	See ANSI S2.71-1983 (R August 6, 2012).	See ANSI S2.71-1983 (R August 6, 2012).	Non-participant	Vibrations. Certificate Condition 72(e) Case 16-F-0328	Yes
8	40 dBA (subject to 5-dBA prominent tones penalty, if they occur).	At residence, Outdoor	Leq	1-hour	Non-participant	Collector substation; Certificate Condition 72(f) Case 16-F-0328	Yes
10	55 dBA	At Property line; Outdoor	Leq	1-hour; daytime and nighttime	Non-participant	Boundary lines and Lands Except Wetlands; Certificate Condition 64(d)(iii) Case 16-F-0062	Yes
11	40-45 dBA. Ideal and Maximum Design Goals, respectively	At residence, Outdoor	L90 (See NARUC-2011 for details)	Long-term mean as obtained with computer modeling.	Non-participant. (Daytime and nighttime)	National Association of Regulatory Utility Commissioners. NARUC-2011	Yes

Section 14.0

Conclusions

14.0 CONCLUSIONS

Potential broadband, octave band, one-third octave band, low frequency, infrasound, and ground-borne vibration impacts from the Heritage Wind project were examined. Noise design goals for each of these elements were selected based on recent Siting Board Certificate Conditions, applicable regulations and guidelines. Based on the detailed analyses presented in this report, the future project sound levels will meet most design goals and standards. NRO is needed for one wind turbine model (GE5.5-158) to meet the short-term sound limit while the other (V162-5.6) does not need NRO. In addition, one wind turbine model (V162-5.6) meets the low frequency design goal while one wind turbine model would require NRO (GE5.5-158). For the long-term annual $L_{night, outside}$ design goal at a non-participating residence, some form of NRO will be required for either wind turbine model to meet the design goal.

These levels do not mean the project sound will be inaudible or completely insignificant, only that its noise will generally be low enough that it will probably not be considered objectionable by the vast majority of neighbors. Therefore, at this stage of permitting, assuming some level of NRO is implemented, the project will meet the design goals, and adverse impacts from noise and vibration from the construction and operation of the Heritage Wind project have been avoided or mitigated to the maximum extent practicable.