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Great Oaks Sound Monitoring

Preliminary Report, Update v1.1

David A. Nelson

Fellow, Institute of Noise Control Engineering

Principal Consultant

Nelson Acoustics

www.nelsonacoustical.com

Summary

- Not possible to discriminate Data Center noise from the traffic noise background with a single spot measurement (Ordinance format)
- Measured sound levels and spectra strongly resemble traffic noise
 - High levels day, low levels night
 - General on the edge of compliance (daytime) and out of compliance (nighttime)
 - “Double haystack” spectrum
 - Low-frequencies from engines
 - High-frequencies from tires
- Differences
 - Very high (non-compliant) levels at 90 Hz from about 3 AM to 7 AM
 - I’ve been told this originates from the VRE train yard
 - 55 Hz tone appears at all times at all locations
 - But not a major contributor to its octave band
 - Other tones are apparent
 - Are noticeable at times for a few hours at most

Map



Dates and Locations

	4/24/25 AM – 4/26/25 AM	4/27/25 PM – 4/30/25 AM
Meter 1	10200 Winged Elm Circle	10240 Winged Elm Circle
Meter 2	10889 Loblolly Trail	10224 Winged Elm Circle

- 10-minute L_{eq} , L_{10} , L_{50} , L_{90}
- 30-seconds of audio reviewed
- Remove from analysis
 - Direct interference (e.g., operator setting up gear)
 - Weather (e.g., wind and rain)
 - Yard work (e.g., mowing, leafblowing etc)
 - Long trains

Characteristics of relevant noises

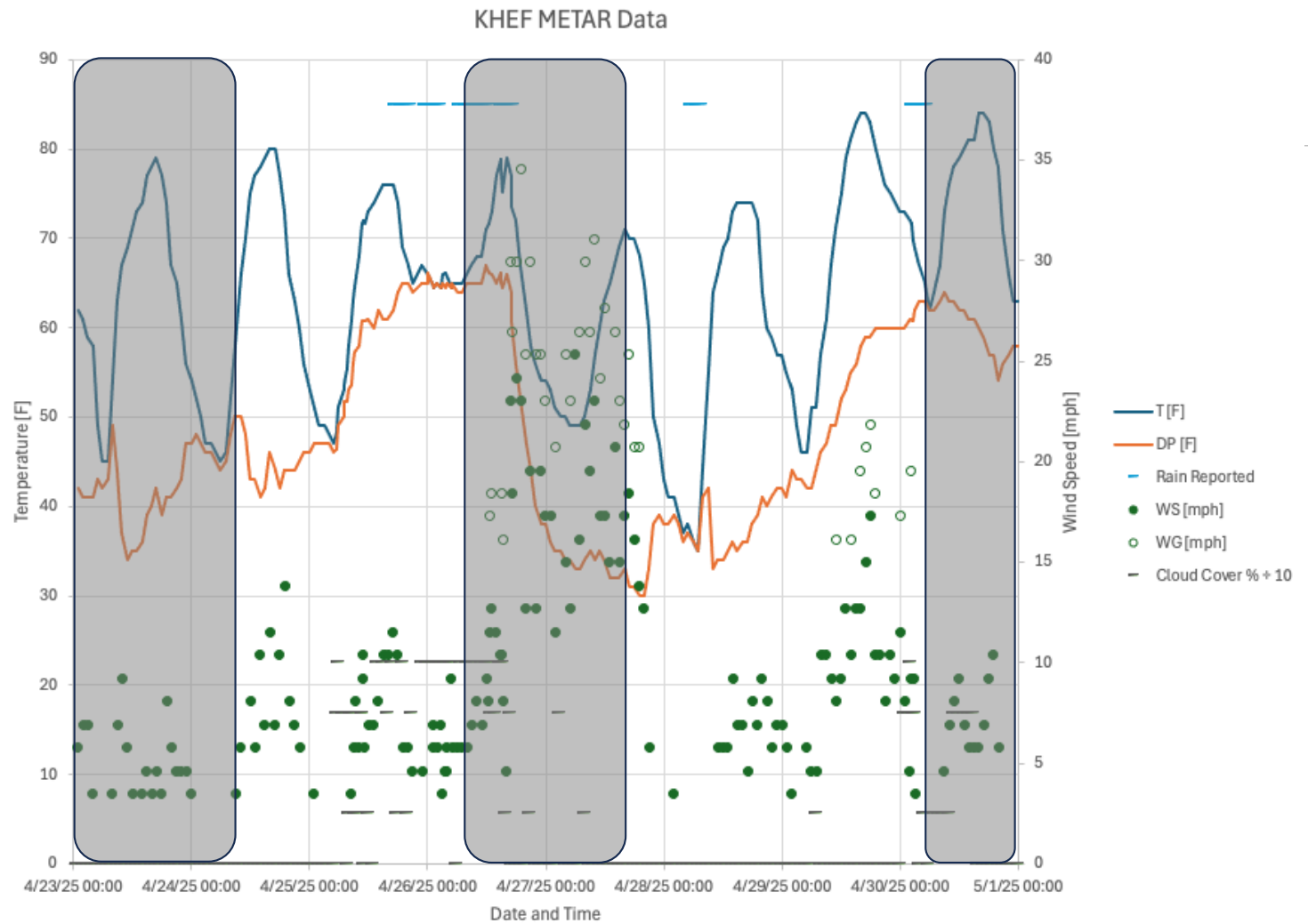
- Industrial noise

- Nearly constant sound level
 - Often louder at night due to meteorological conditions
 - For a data center, may depend on weather (i.e., cooling) conditions. Could correlate with temperature/humidity.
- Mechanical equipment tones with fixed frequency
- Broadband fan noise

- Traffic Noise

- Variable sound level (10 dB swing)
 - Tracks traffic volume, so higher in day, decreasing throughout the night, and ramping up starting at 5:00 AM
- Engine tones varying in frequency (i.e., acceleration, deceleration)
- Low-frequency engine noise, centered around 63 Hz
- High-frequency tire noise, centered around 1000 Hz

Weather



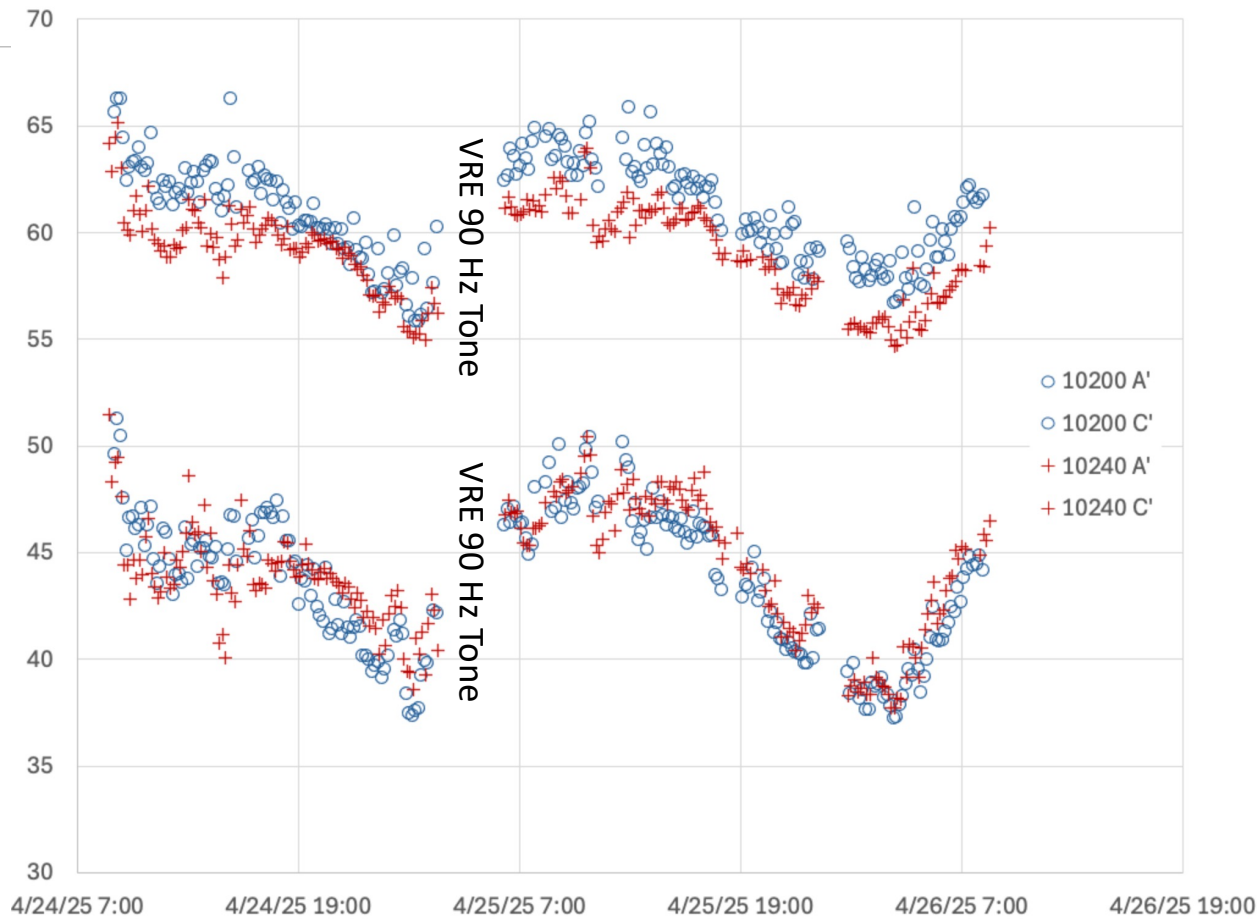
Thursday AM 4/24 to Saturday AM 4/26

LpC higher at 10200

LpC follows traffic flow

LpA same

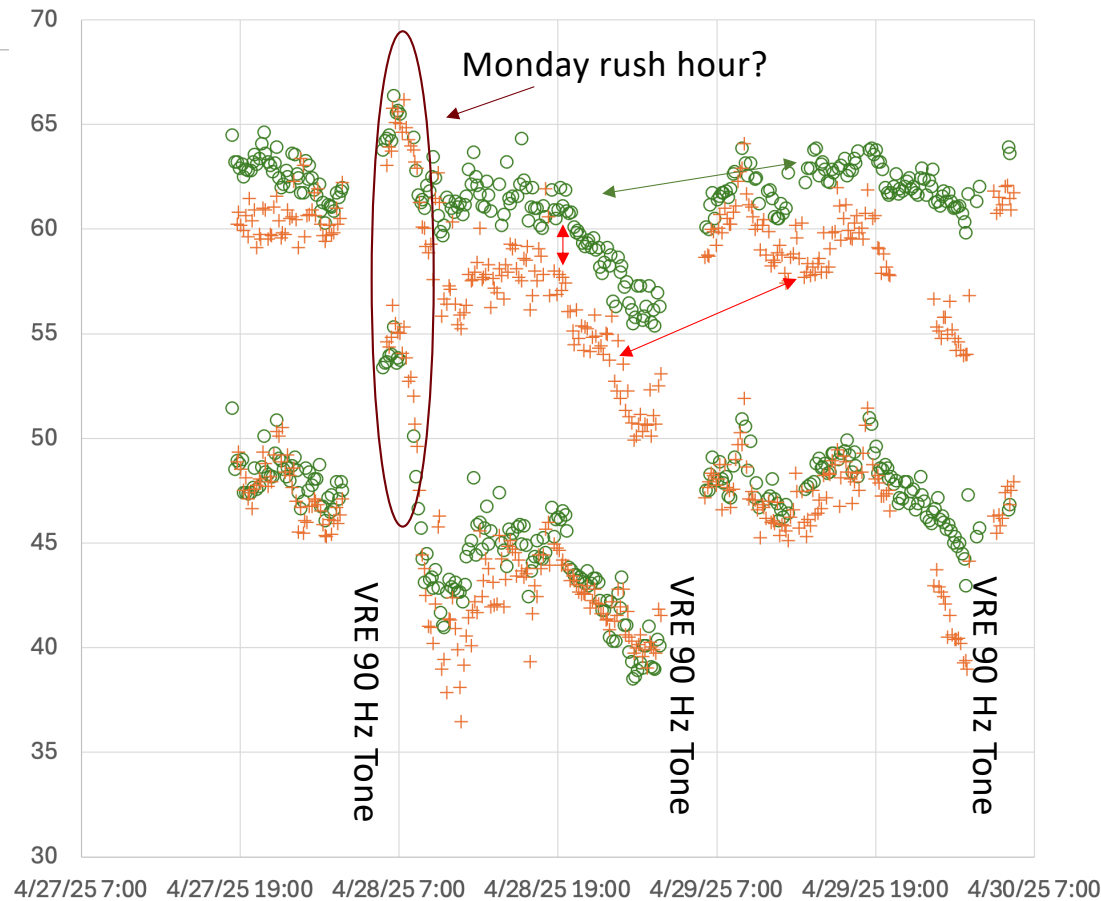
LpA follows traffic flow



Sunday PM 4/26 to Wednesday AM 4/30

LpC higher at 10224

LpA “same”
both locations



LpC sometimes
follows traffic flow,
sometimes not

LpA follows traffic
flow most of the
time

Observations and logical inferences

- At a given time, A-weighted levels are almost identical at the two locations
 - Track the typical daily pattern for traffic noise
 - “A-weighted is traffic noise”
- C-weighted levels
 - are higher at 10200 re 10240 Winged Elm
 - are higher at 10224 Winged Elm re 10889 Loblolly
 - Don’t always track the daily pattern
 - **An indication that the Data Center emits low-frequency noise**
 - “C-weighted noise is partially Data Center”

Compare to Criteria

DAYTIME

Some Exceedances?

Lp,50 OBSPL

LpAeq	LpC,eq	LpA,50	LpC,50	31.5	63	125	250	500	1000	2000	4000	8000
51		46	62	58	60	51	46	44	42	37	31	24
51		47	62	60	60	53	48	46	43	35	29	21
50		46	60	59	58	50	47	45	42	36	29	22
52		47	60	55	56	52	46	44	45	38	30	22
52	65	48	65	65	60	55	50	45	41	38	36	35

NIGHTTIME


Some Exceedances

LpAeq	LpC,eq	LpA,50	LpC,50	31.5	Lp,50 OBSPL								4000	8000
					63	125	250	500	1000	2000				
51		41	59	55	56	48	43	39	37	30	24	19		
51		46	61	57	59	53	48	45	41	32	26	17		
46		42	57	55	54	47	43	41	38	33	29	19		
50		45	59	53	55	52	44	43	42	36	31	17		
47	60	43	60	60	55	50	45	40	36	33	31	30		

Unusual Conditions

- Strong 90 Hz tone
 - Begins early weekday mornings starting 02:45 or so
 - Way out of compliance
 - $L_p \approx 60\text{s} - 70\text{s dB}$ at times
- “Rush Hour”
 - Monday morning 4/28
 - High traffic volume
 - Possible temperature inversion, which can increase sound levels
 - L_{pA} and L_{pC} levels are same at both locations
 - Indicates traffic noise
 - Way out of compliance

Possible Data Center Contribution in Low Bands



		Lp,50 OBSPL										
		16	31.5	63	125	250	500	1000	2000	4000	8000	
Daytime	Winged Elm	56	59	59	52	47	45	42	36	30	22	58 dBC L _{LF} = 60
	Loblolly	53	55	56	52	46	45	45	38	30	22	
	DC Contribution?	52	57	56	---	---	---	---	---	---	---	
	DC Noise?				Traffic Noise							
Nighttime	Winged Elm	54	56	57	49	45	41	38	32	26	18	53 dBC L _{LF} = 57
	Loblolly	50	53	55	52	44	43	42	36	31	17	
	DC Contribution?	52	53	50	---	---	---	---	---	---	---	
	DC Noise?				Traffic Noise							

Logic:

- In bands where Loblolly ≈ Winged Elm, it's traffic noise
- In bands where Winged Elm (average) > Loblolly, like source is Data Center
- Subtract Loblolly (traffic) from Winged Elm (traffic + Data Center)
- DC noise causes apparent 2-4 dB increase over traffic background

L_{PC} and L_{LF} levels ≤ 60
are not associated
with feelable vibration

Low-frequency 55 Hz tone

- Continuous tone
- The 55 Hz tone level averages about 51 dB
- Sound reduction of a typical residence at this frequency is ~12 dB
- Inside ~ 39 dB at 55 Hz (equivalent to 14 dBA)
- Likely audible indoors,
 - partially masked by broadband noise
 - potentially annoying
- May be detectable indoors
 - Not prominent enough to measure separately

Estimate Interior Levels

- < 30 dBA is recommended for sleep – “OK”
- Low-frequency noise is likely to be
 - Borderline at night
 - Tolerable during day
 - Continuous broadband LFN is not a good candidate for masking

Daytime		16	31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB(C)
Exterior: Winged Elm (avg)		56	59	59	52	47	45	42	36	30	22	47	61
Sound Isolation of Typical Frame Residence		8	11	15	19	21	23	25	25	25	25		
Interior: Est'd Winged Elm (avg)		48	48	44	33	26	22	17	11	5		25	48
Nighttime		16	31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB(C)
Exterior: Winged Elm (avg)		54	56	57	49	45	41	38	32	26	18	44	59
Sound Isolation of Typical Frame Residence		8	11	15	19	21	23	25	25	25	25		
Interior: Est'd Winged Elm (avg)		46	45	42	30	24	18	13	7	1		22	45

Compare to Previous, Daytime

			Some Exceedances												
			DAYTIME		Lp,50 OBSPL										
Multi-day averages			LpAeq	LpC,eq	LpA,50	LpC,50	31.5	63	125	250	500	1000	2000	4000	8000
4/24/25	4/26/25	10200 Winged Elm	51		46	62	58	60	51	46	44	42	37	31	24
4/27/25	4/30/25	10224 Winged Elm	51		47	62	60	60	53	48	46	43	35	29	21
4/24/25	4/26/25	10240 Winged Elm	50		46	60	59	58	50	47	45	42	36	29	22
4/27/25	4/30/25	10889 Loblolly	52		47	60	55	56	52	46	44	45	38	30	22
			52	65	48	65	65	60	55	50	45	41	38	36	35
Spot measurements															
10/9/24	10/9/24	Tanner Way Easement	54	66	53	65	64	61	56	51	51	51	42	31	24
							DC Noise?	Traffic Noise							
11/5/24	11/5/24	Rollingwood	47	62	44	60	55	57	55	47	37	36	32	31	26
1/30/25	1/30/25	Amberleigh Station	36	59	35	58	59	54	46	34	30	27	23	21	17
10/9/24	10/9/24	Kingsbrooke	52	65	44	57	54	54	50	44	41	38	33	27	19
11/5/24	11/5/24	Cloverdale	39	54	41	53	51	50	47	40	32	35	35	32	31
1/30/25	1/30/25	Heritage Hunt Club	40	55	38	53	54	50	43	39	36	33	27	22	21
11/27/24	11/27/24	Nokesville	37	53	35	52	52	50	40	35	33	31	21	14	13
11/5/24	11/5/24	Montclair Subdivision	44	57	41	52	49	49	45	39	33	36	34	32	28

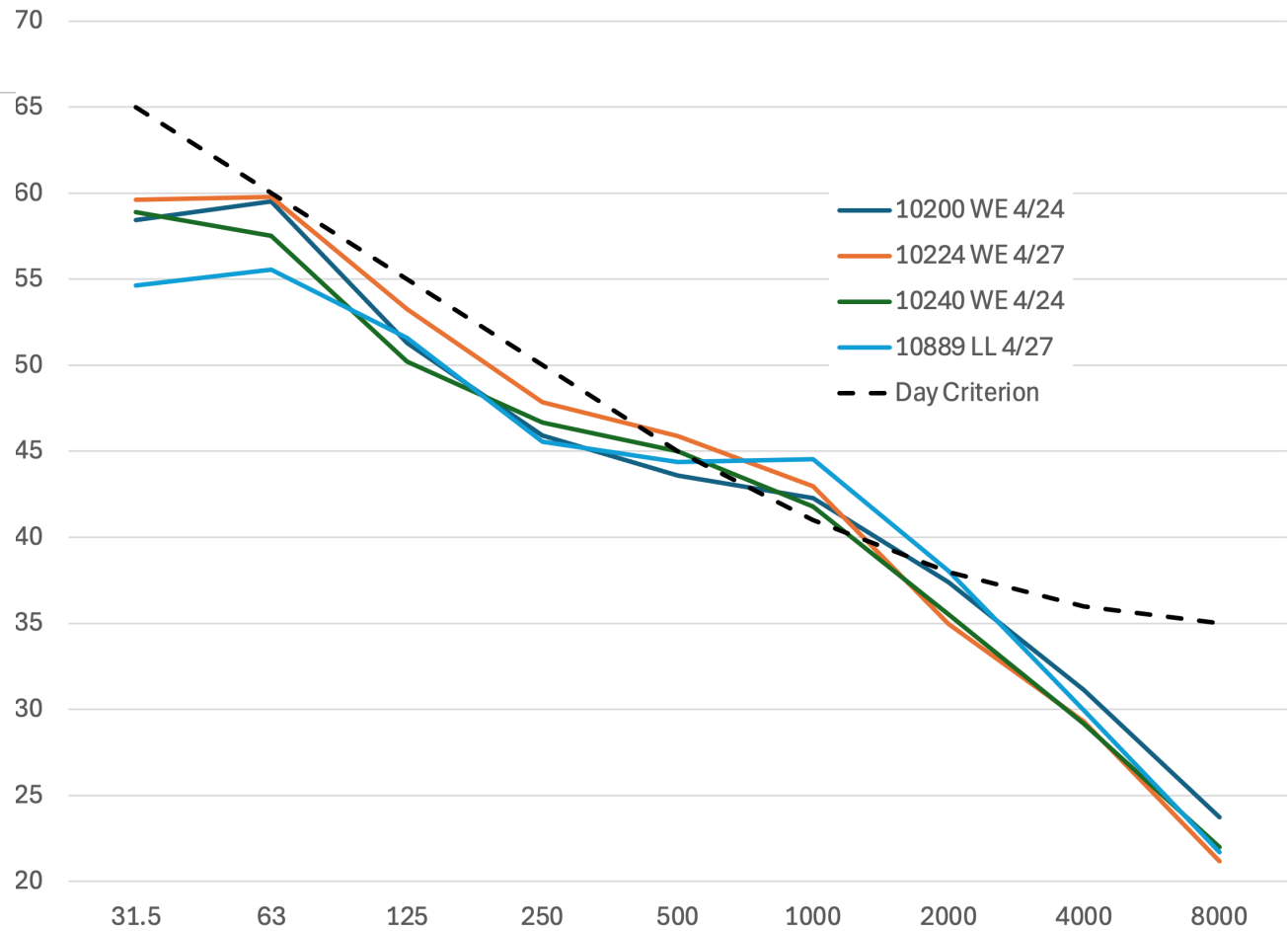
Compare to Previous, Nighttime

			NIGHTTIME												
Multi-day averages			LpAeq	LpC,eq	LpA,50	LpC,50	31.5	63	125	250	500	1000	2000	4000	8000
4/24/25	4/26/25	10200 Winged Elm	51		41	59	55	56	48	43	39	37	30	24	19
4/27/25	4/30/25	10224 Winged Elm	51		46	61	57	59	53	48	45	41	32	26	17
4/24/25	4/26/25	10240 Winged Elm	46		42	57	55	54	47	43	41	38	33	29	19
4/27/25	4/30/25	10889 Loblolly	50		45	59	53	55	52	44	43	42	36	31	17
Spot measurements			47	60	43	60	60	55	50	45	40	36	33	31	30
1/30/25	1/30/25	Tanner Way Easement*	52	65	52	63	61	60	56	50	50	48	37	22	17
1/30/25	1/30/25	10200 Winged Elm*	48	61	47	60	57	58	51	47	45	43	32	23	20
1/30/25	1/30/25	10224 Winged Elm*	52	63	48	62	59	58	56	48	46	44	33	20	17
1/30/25	1/30/25	10087 Post Oak Terrace*	49	60	48	58	54	56	50	46	45	45	35	20	17
10/23/24	10/23/24	Tanner Way Easement	47	61	47	60	58	57	54	49	45	40	37	41	19
* Includes 90 Hz VRE tone							DC Noise?		Traffic Noise						
10/23/24	10/23/24	Kingsbrooke	35	49	36	49	47	46	41	36	34	29	28	25	23
11/12/24	11/12/24	Kingsbrooke	45	58	37	48	45	43	41	39	35	30	25	20	15
11/29/24	11/29/24	Nokesville	32	48	31	47	45	44	40	33	27	26	15	12	12

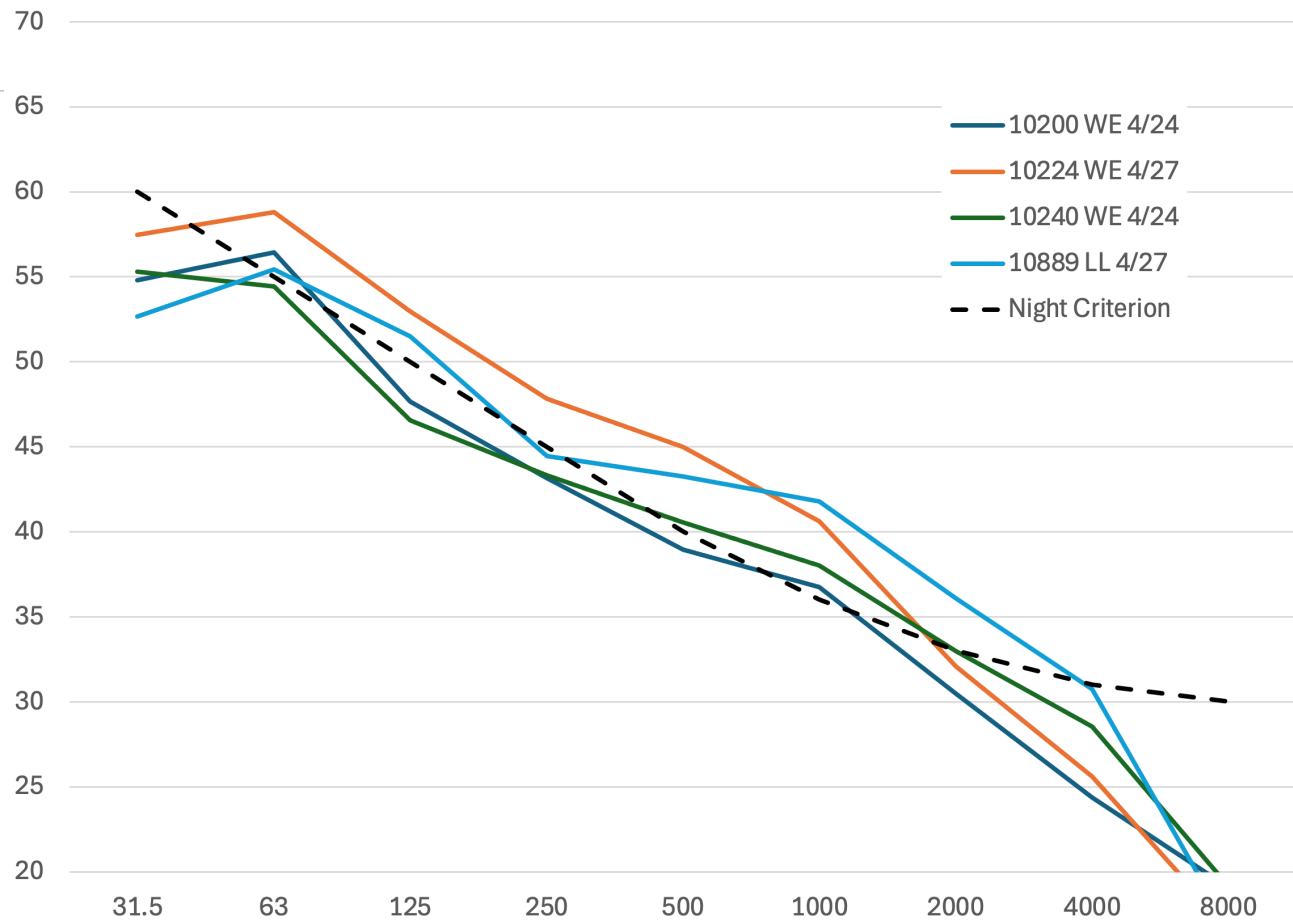
Summary

- Data Center noise is embedded in traffic noise
 - Broadband low-frequency noise
 - Not sufficiently distinguishable to isolate its contribution
 - Whether by listening or by a single measurement
- Apparent LFN contributions do not exceed criteria
 - Mid- and high-frequency noise appears to be traffic noise, exceeds criterion at night
- Interior sound levels should be tolerable
 - History of higher noise exposure may be amplifying annoyance
 - Neighbors are better able to focus attention on the DC sound (however unwillingly)
- Lowering Criterion in 31.5 and 63 Hz bands?
 - Not clear how much reduction would be satisfactory
 - Lower criterion levels can create
 - “False positives” elsewhere in the County
 - Greater difficulty in measurement due to
 - More competition from other noise sources

Daytime Comparison

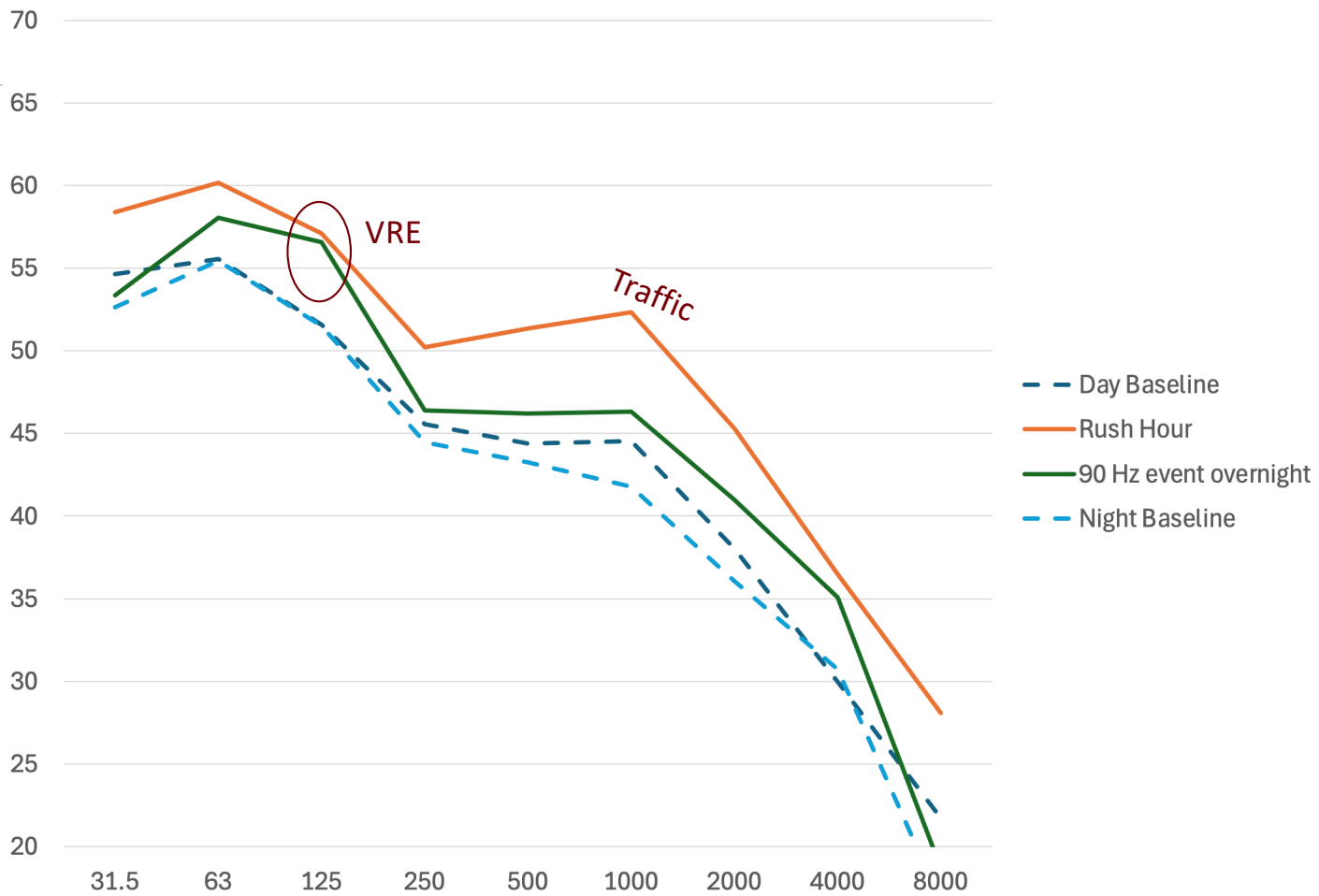


Nighttime Comparison



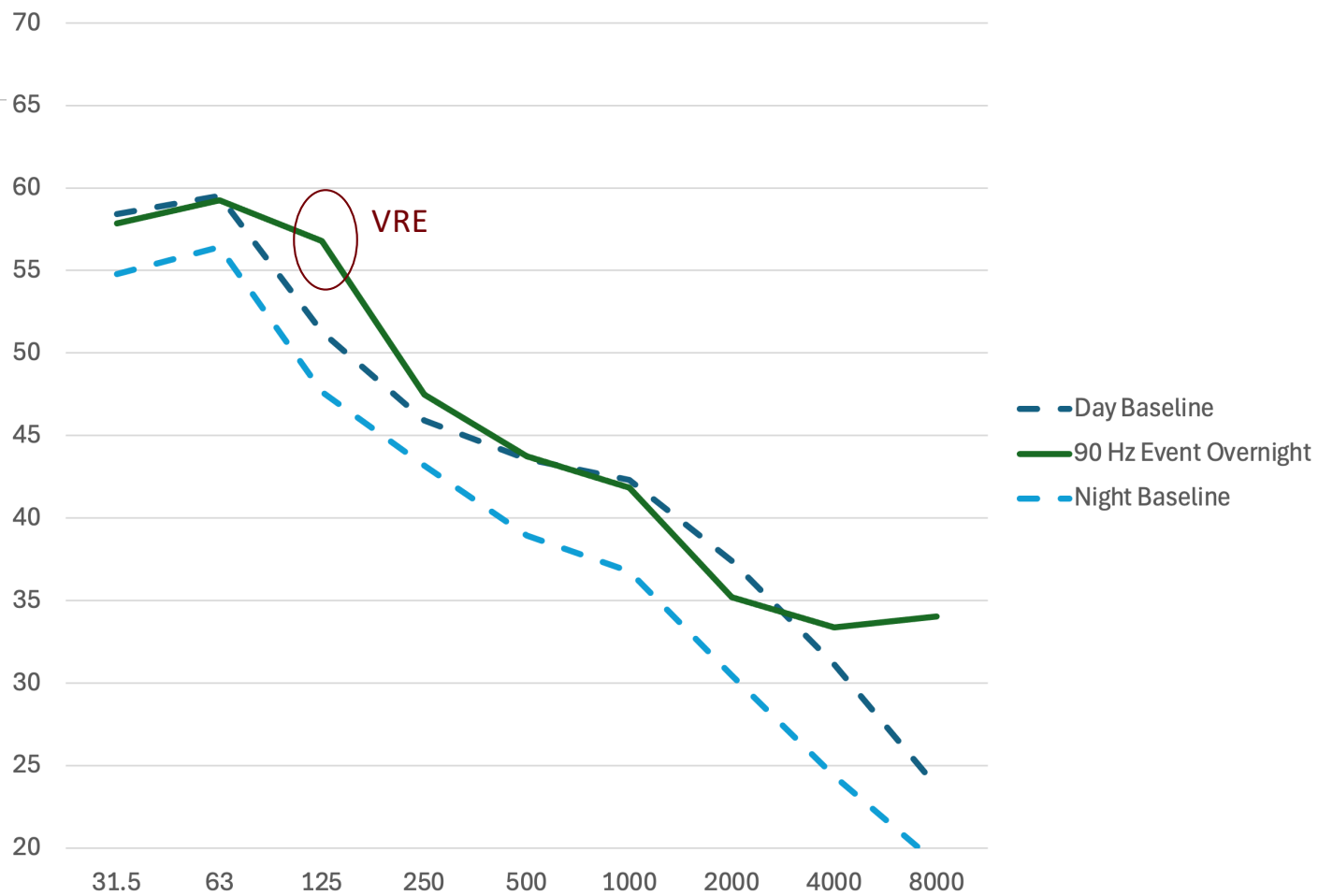
4/27-30

10889 Loblolly

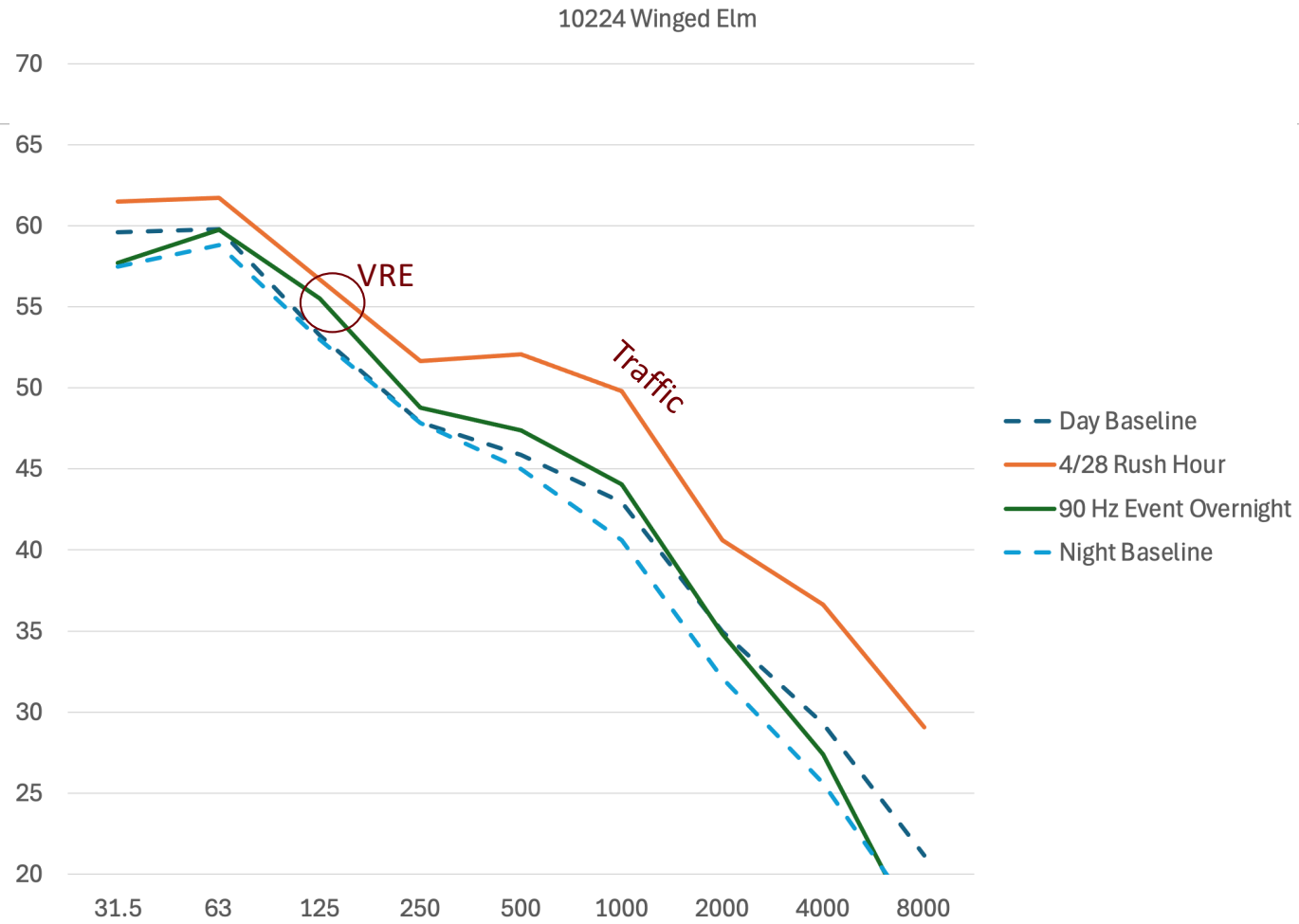


4/24-26

10200 Winged Elm

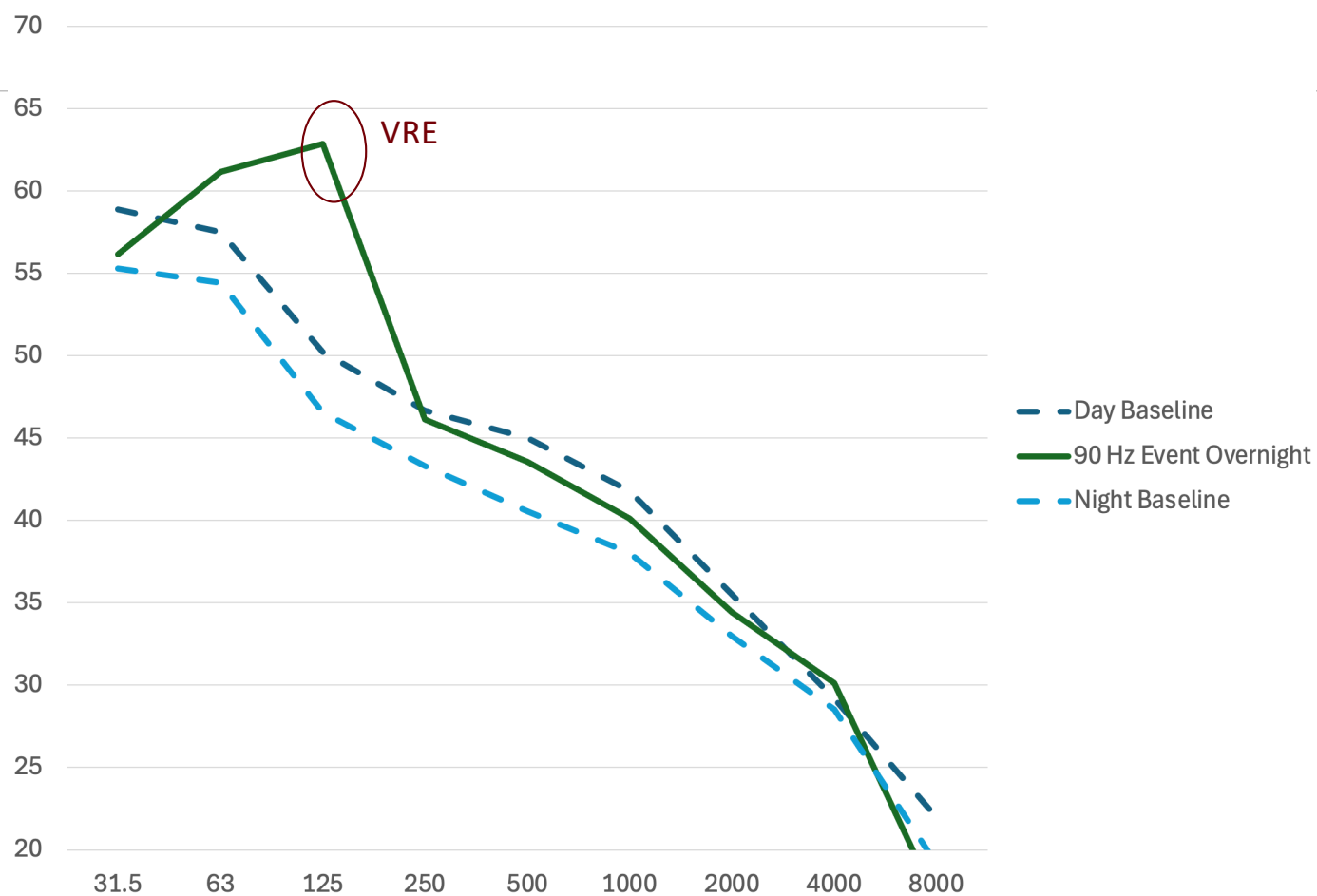


4/27-30



4/24-26

10240 Winged Elm



LFN check: 10224 Winged Elm, night

