Ft Lauderdale Soundscape Study

Meeting 10/17/23

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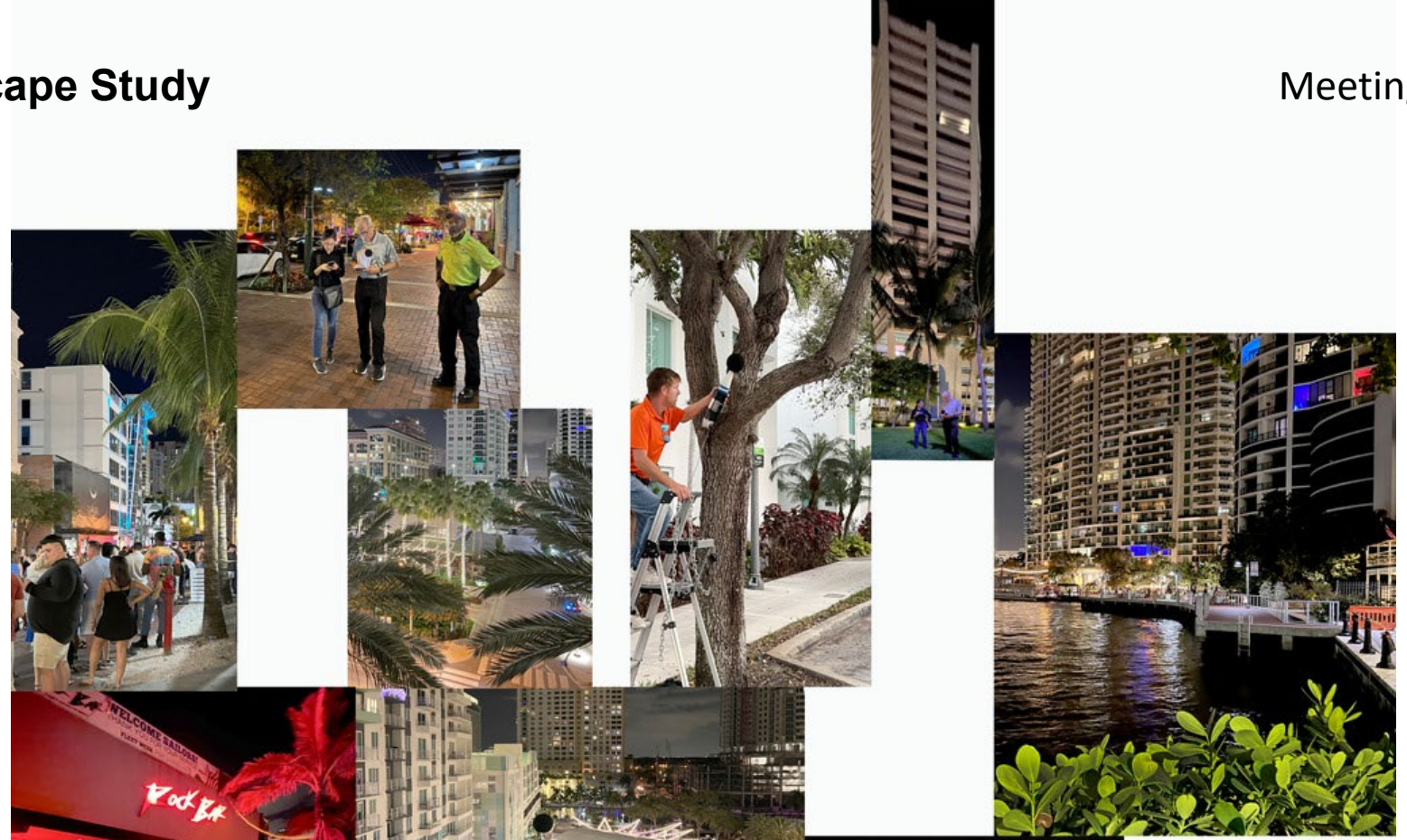

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POTENTIAL ACTION ITEMS

City Of Fort Lauderdale Noise Ordinance Potential Action Items

Analysis of the measurement data included in the report, discussions with the Noise Control Advisory Committee and others related to the project have resulted in a list of potential action items for the City to consider implementing to fine tune the Noise Ordinance. Adjustments to measurement procedures and metrics are recommended to improve enforcement procedures and to help control amplified music sounds propagating to residential and mixed-use properties.

KEEP ENTERTAINMENT DISTRICT OVERLAY SOUND LEVEL LIMITS in Section 17-7-c.

1. Maintain the current sound level limits in the Ordinance. The overall sound level limits in the current Noise Ordinance are generally reasonable and are supported by statistical analysis of the measurement data collected in this study.

ADD C-WEIGHTED RESIDENTIAL SOUND LEVEL LIMIT TO TABLE 1 SECTION 17-6

2. Consider using a C-weighted, LCFmax, metric in addition to the A-weighted metric in all zoning categories. The dBC sound level would be 10 dB higher than the current dBA sound level.
    a. Consideration could be given to reducing the dBC to dBA difference to 5 dB after 11:00 p.m. or 12:00 a.m. after a 6 month or 12 month trial period of including the C-weighted metric for all measurements.
    b. Consider raising the night time sound level limit to 55 dBA and 60 dBC in areas of the City where the "Quiet ambient" and "General ambient" sound levels measured in this study are > 55 dBA/55 dBC. This includes buildings that are immediately adjacent to The Wharf, Riverwalk, and built up areas of the City.
    c. Consider raising the night time sound level limit to 55 dBA and 60 dBC in areas immediately adjacent to A1A and Seabreeze in the Beaches.
    d. The current 50 dBA sound level limit should remain in place in other areas of the City with lower densities and less vehicular traffic.

POTENTIAL ACTION ITEMS

SOUND LEVELS IN AMPLIFIED MUSIC VENUES in Section 17.7.c and 17.7.d

3. Develop methods to enforce the current sound level limits in Entertainment Districts.
    a. Consider voluntary interior sound level monitoring of sound levels in entertainment venues to demonstrate compliance with the appropriate sound level limits.
    b. This could include self-monitoring of sounds inside clubs using a system like 10EaZy; making approximate corrections for the ambient sound level contributions of multiple clubs by subtracting 10 dB from the measured sound levels as a potential interim solution before a more technically sophisticated solution can be implemented, using ANSI or ASTM procedures for correcting for the influence of background sounds and multiple contributors to the measured sounds, using an acoustic camera, multiple capsule microphone, or other sound measuring devices capable of determining the direction and level of individual sound sources or other technically feasible method.
4. Consider adding maximum interior sound levels inside clubs and entertainment venues to protect human and hearing health of occupants and staff. This may start at XX dBA and XX dBC and be gradually reduced over time.

POTENTIAL ACTION ITEMS

COMPLIANCE TO SOURCE, RECEIVER AND PLAINLY AUDIBLE REQUIREMENTS in Section 17-7-c.

5. Add required compliance for sounds propagating from Entertainment Districts at residential receiving properties using the current dBA and new proposed dBC residential sound level limits in the Noise Ordinance. This would require special measurement procedures to implement.

ENFORCEMENT OF SOUND LEVEL LIMITS WITHOUT NEED FOR COMPLAINANT in Section 17-3.

6. Consider monitoring of sounds propagating from entertainment venues by Code Enforcement staff on a proactive basis without the need to receive a complaint from a resident.

POTENTIAL NEED FOR SOUND LEVEL LIMIT AT SOURCE FOR VENUES NOT IN SPECIAL ENTERTAINMENT DISTRICT in Section 17.7-d.

7. A sound level limit may need to be set for clubs, bars and restaurants that are not in the Entertainment Districts to determine compliance. Alternately, compliance measurements could be taken at or near the locations of potentially noise exposed residences on City rights-of-way.

TECHNICAL REQUIREMENTS FOR METERS IN SECTION 17.4

8. Employ ANSI and ASTM standards for equipment used to verify compliance, measurement methods, metrics, etc.
9. Consider use of Type 1 sound level meters for greater measurement certainty.

TRAINING OF NOISE CONTROL OFFICERS IN SECTION 17.3

10. Require training in ordinance requirements, measurement procedures, accounting for multiple sound sources and other technical acoustical knowledge for enforcement staff on a periodic basis.

POTENTIAL ACTION ITEMS

SUGGESTION TO EXPAND SECTION 17-9 TO INCLUDE NOISE STUDIES FOR NEW ENTERAINMENT VENUES AND NEW RESIDENTIAL DEVELPOMENTS OR INCLUDE IN PERMITTING PROCESS

11. Consider adjusting current zoning regulations to require a noise study for site plan approval for new and renovated projects with entertainment venues, amplified music, residential, office and mixed use projects so that the general planning of the projects and the Outside to Inside Noise Level Reduction (NLR) of the buildings would result in meeting Noise Ordinance requirements once they are built.
12. Consider adjusting current zoning regulations to include vertical zoning of mixed-use buildings with requirements for sound and vibration isolation of mixed uses analyzed in a noise study for the project.

AUTOMATIC LOUD VEHICLE DETECTION in Section 17-7-9.

13. Consider a pilot installation of vehicle noise detection systems to help address vehicle noise to determine if the technology is feasible to achieve the City's goals.

TRIAL PERIOD

14. Any modifications to the Noise Ordinance should be enacted for a trial period of 6 months without penalty and an additional 6 months where warnings are given to help establishments move into compliance where needed.

PRIORITIZED LIST OF ACTION ITEMS

IMMEDIATE PRIORITIES

Item	Recommendation	Priority			Notes
		Immediate	Near-Term	Long-Term	
1	Trial Periods and Phasing	X			Establish an interim trial period protocol for perhaps 4, 6, and 12 month study periods depending on the exected impact of abatement strategy.
2	Metrics - adopt LAFmax and LCFmax as sound level metrics	X			This metric is not explicit in the code yet meets the general definition of LMAX given there. Revise the code to specify LAFmax and LCF max during next revision.
3	Sound Level Meters	X			Use ANSI standard Type 1 sound level meters with accuracy of +/- 1.5 dB to enforce the published sound level limits. Or, revise the code to specify Type 2 meters (+/- 2.3 dB) are acceptable to enforce the published sound levels.
4	Entertainment Overlay Districts - measure using the C-weighted Ordinance limits	X			This should be viable with the City's new sound level meters.
5	Himmershee District - enforce existing entertainment district overlay sound level limits	X			Measurements of 111 dBC were measured on multiple occaisons at 5 feet from a number of venues. Meeting the current noise level limits would reduce the perceived sound by 3 to 6 times -- 3 - 6 times quieter.
6	Himmarshee District - measure at 5-feet from venue opening or center of venue on the street using C-weighting and subtract 10 dB from the measurement. If still over the set limit, issue warning or citation.	X			Subtracting 10dB mathematically eliminates the contribution of adjacent sources at similar sound levels. This could be introduced with warnings perhaps for a period of 2-4 months and tested for efficacy. If the need for enforcement persists, consider purchasing acoustic cameras or other sophisticated measurement systems to isolate individual contributors to the sound levels at given locations as a longer term solution.
7	Himmarshee District - enforce closing of doors and windows after 12:00 am	X			This could be applied for venues open to the street or open at the rear of the venues to significantly reduce off site noise.
8	Noise enforcement training program for officers	X			Training on new sound level meters, measurement techniques, documentation, and interpreting the data could improve enforcement and follow-up litigation.
9	Entertainment Overlay District - Self-Limiting with in-venue monitoring	X			Venues could adopt these systems voluntarily. Self monitoring would provide a basis for venues to show they are in compliance if adjacent venues are not.

NEAR TERM PRIORITIES

10	Entertainment Overlay Districts - limit levels set relative to ambient for area.		X		Consider reducing allowable sound levels emanating into the public domain from venues during the early morning hours to no more than 5 dB above the ambient at the current 5-foot measurement designation. This could be studied for a test period immediately and then designated for code implementation if proving effective.
11	Nonresidential to Residential Areas - noise level detection devices.		X		Consider noise level detection devices for any nonresidential establishment from which amplified musical entertainment, whether live or recorded, emanates to residential areas to alert the owners of the commercial establishment that the sound is exceeding the set limits.
12	Vehicular Noise Monitoring		X		Deploy automatic detection systems such as Sorama Loud Vehicle Detection System. This would require testing and enforcement protocols to be added to the muicipal code of ordinances.
13	Planning and Zoning		X		Consider implementing acoustical and noise-related requirements in planning and zoning applications for new construction and renovations of buildings in and near entertainment venues and other sources of sound.
14	Receiver Oriented Standards		X		Establish requirements to limit sounds produced inside or outside venues to the confines of those venues.
15	Mechanical Equipment Noise Control		X		Building mechanical equipment or central plant equipment; loading activities at commercial buildings, indoor and outdoor dining; entertainment; animal facilities and any other potentially noisy building types and related activities could all be considered/studied for the establishment of noise control protocol.
16	Entertainment Overlay Districts - Measuremenet Protocols		X		Consider adjusting the measurement protocols for these districts to include measurement options at receiver locations and that meet the allowable limits for those locations. Also, consider flexibility for officers to choose among two or more measurement protocols to employ the one most effective for the situation.
17	Compliance Improvement - graduate fine increases		X		Consider a graduated scale for increasing fines as multiple offences accumulate.
18	Revise sound level limits in Regional Activity Centers to correspond to nominal ambient levels.		X		This would generally be an increase of the level limits as ambient sounds in many areas are nominally above the 50dBA sound level limit for adjacent residential areas. This would only apply to areas of the City with ambient sound levels > 50 dBA.
19	Noise study requirements for new entertainment venues		X		Require an environmental noise study or noise mitigation plan that includes sound management strategies as part of the application and approval process for permitting the use.
20	Entertainment Overlay Districts - consider reducing allowable low frequency sound levels using the same measurement procedures currently in place.		X		This could be applied to A-weighted and/or C-weighted. For example, lowering the C-weighted levels to 5 dB above dBA rather than the current 10 dB above the dBA levels would significantly reduce low frequency sound propagation from venues.
21	Indoor Sound Level Limits		X		Clarify the definition of the term 'Premises' in the code to mean inside the residence.
22	Vehicular Noise Monitoring		X		Consider language in the noise section of the code that requires factory installed exhaust and mufflers on all vehicles.
23	Urban Residential Areas - raise sound level limit		X		Consider raising sound level limits in residential areas to 55 dBA where the current ambient sounds (breezes, cars, etc.) are regularly above the current limits. Limits should not be below the ambient of normal sounds in the neighborhood.

LONG TERM PRIORITIES

24	Develop Noise Level Reduction (NLR) criteria for new and renovated construction.			X	This would be applied through building plans review and permitting to ensure the building assembly met a designated acoustic standard - similar to the way hurricane and fire rating standards are required. Guide lines to be developed and provided to developers as they initiate planning for new projects.
25	Vertical Zoning criteria for new construction			X	Establish vertical buffer spaces. For example, residential units in mixed use must be 100' - 150' feet from the street level.
26	Noise Study for Differing Zoned Uses			X	Planning efforts for new developments, especially those projects near Special Entertainment Districts, Regional Activity Centers, railroads, roadways, airports or in downtown areas could include a sound managemnt plan based on a site specific sound study requirement to protect the soundscape of the existing city fabric and the new development.
27	Noise Study for Residential Developments			X	Consider requiring any residential development that is within 1,000 feet of a major roadway or 3,000 feet from a rail line to provide adequate noise mitigation to the site, exterior areas, and interior spaces to meet HUD, FTA, FAA and FHWA requirements at a minimum with options for Grade A, B, and C housing to have stricter requirements.
28	Noise Study for Indoor or Outdoor Amplified Music			X	New establishments proposing amplified music with outdoor or partially open to the outdoors should be required to demonstrate that they can meet the requirements of the Code of Ordinances for amplified sounds before a permit is issued. This would require a sound management study.
29	Building Façade Requirements			X	Establish approval requirements that include Sound Transmission Class (STC) or Outdoor-Indoor Transmission Class (OITC) ratings for the building facades of hotels and residences to limit the propagation of sounds from Special Entertainment Districts, Regional Activity Centers or planned indoor and outdoor entertainment activities into sleeping and living areas.
30	Sound Isolation for Mixed-Use			X	In mixed-use buildings consideration could be given to establish minimum requirements for sound separations between mixed-use activities within a single building as well as within a complex of adjoined buildings.
31	Self-Contained Activated Mixed-Use Areas			X	Consider zoning for future outdoor amplified music venues to use site planning strategies that wrap the activity spaces to diffuse, absorb, and act as acoustic barriers to sound transmission.
32	Planning and Developmnet Noise Study Requirements			X	Include sound management study requirements for venues with amplified music to determine the likely impact and/or mitigation needed to maintain ambient sound conditions in the surrounding area.
33	Planning and Developmnet Noise Study Requirements			X	Require a sound management and noise mitigation plan showing measures to be taken that will comply with the noise ordinance.
34	Planning and Developmnet Noise Study Requirements			X	Consider requiring new residential development located within 1,000 feet of an Entertainment District or amplified music venue or transportation noise source to require a sound management study that shows it will comply with HUD interior noise levels, at a minimum, to protect its future occupants.

EXISTING NOISE ORDINANCE WITH MARKUP OF ACTION ITEMS

DEFINITIONS

Impulsive sound means a sound that has a duration of less than one (1) second and under investigation.

LMAX means the maximum sound level measured during the sound measurement p

Mechanical device means any device that transmits or modifies energy.

Moped means any vehicle with pedals to permit propulsion by human power, having the rider and designed to travel on not more than three (3) wheels; with a motor rated r horsepower and not capable of propelling the vehicle at a speed greater than thirty (30) as defined in F.S. § 316.03, as may be amended from time to time.

Motor vehicle means any self-propelled vehicle not operated upon rails or guideway, but not including any bicycle, motorized scooter, electric personal assistive mobility device, or moped; as defined in F.S. § 316.03, as may be amended from time to time.

ordinary sensibilities, or any sound which affects the health, safety, or welfare of other persons, or exceeds the noise levels as defined in section 17-6.

Plainly audible means any sound that can be detected by a person using his or her unaided hearing faculties.

Public right-of-way and *public space* means land conveyed or dedicated by plat, deed, easement or other conveyance which is devoted to, required for or intended for the use by the public as a means of public traverse and other public purposes.

Vessel means every watercraft, barge, and airboat, used or capable of being used as a means of transportation on water, as defined in F.S. § 327.02, as may be amended from time to time.

(Ord. No. C-08-37, § 2, 7-15-08)

Replace LMax with:
LAFmax - the maximum A-weighted sound level taken during the measurement period with a Fast response (125ms)

LCFmax - the maximum C-weighted sound level taken during the measurement period with a Fast response (125ms)

Premises means structures that make up a parcel of property

Voluntary self monitoring system means the use of an audio monitoring system that monitor and log the sound levels produced by the system to demonstrate compliance with the noise ordinance.

MAXIMUM PERMISSIBLE dB SOUND LEVELS

It shall be unlawful for any person to make or continue or cause to be made or continued any noise disturbance within the limits of the city.

(Ord. No. C-08-37, § 2, 7-15-08)

Sec. 17-6. - Maximum permissible dBA sound levels.

50 dBA/55dBC in areas of lower density in other areas of the City

55 dBA/60 dBC in areas surrounding the Wharf, Riverwalk, A1A, Seabreeze and built up areas in the city

…other provision in this chapter, it shall be unlawful, except as expressly permitted herein, to …e making of any sound which exceeds the limits set forth in this section.

70dBC

TABLE I

MAXIMUM PERMISSIBLE SOUND LEVEL LIMITS dBA

USE	TIMES	OUTDOOR	INDOOR
Residential	7:00 a.m. to 10:00 p.m.	60 dBA*	45 dBA
	10:00 p.m. to 7:00 a.m.	50 dBA	35 dBA
Commercial	24 hours	65 dBA	55 dBA
Industrial	24 hours	75 dBA	65 dBA

75 dBC

60 dBC from 12:00pm to 10pm

85 dBC

55dBC from 10pm to 12pm

If a complainant is located in elevated dwelling units, measurements shall be taken in the area where the disturbance is heard.

and 75 dBC

*If the residential use is within a commercial, industrial, or mixed use, or within two hundred (200) feet of such use, the outdoor sound level limit is sixty-five (65) dBA between 7:00 a.m. to 10:00 p.m.

SOUNDSCAPE ANALYSIS BACKGROUND

Method

Acoustic Concepts

3D Acoustic Modeling Studies

Source-Path-Receiver Building Interventions

Noise Ordinance Limits

Data Analysis

Quiet Times

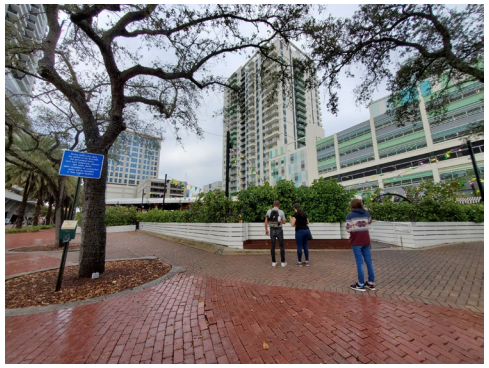
Source Analysis

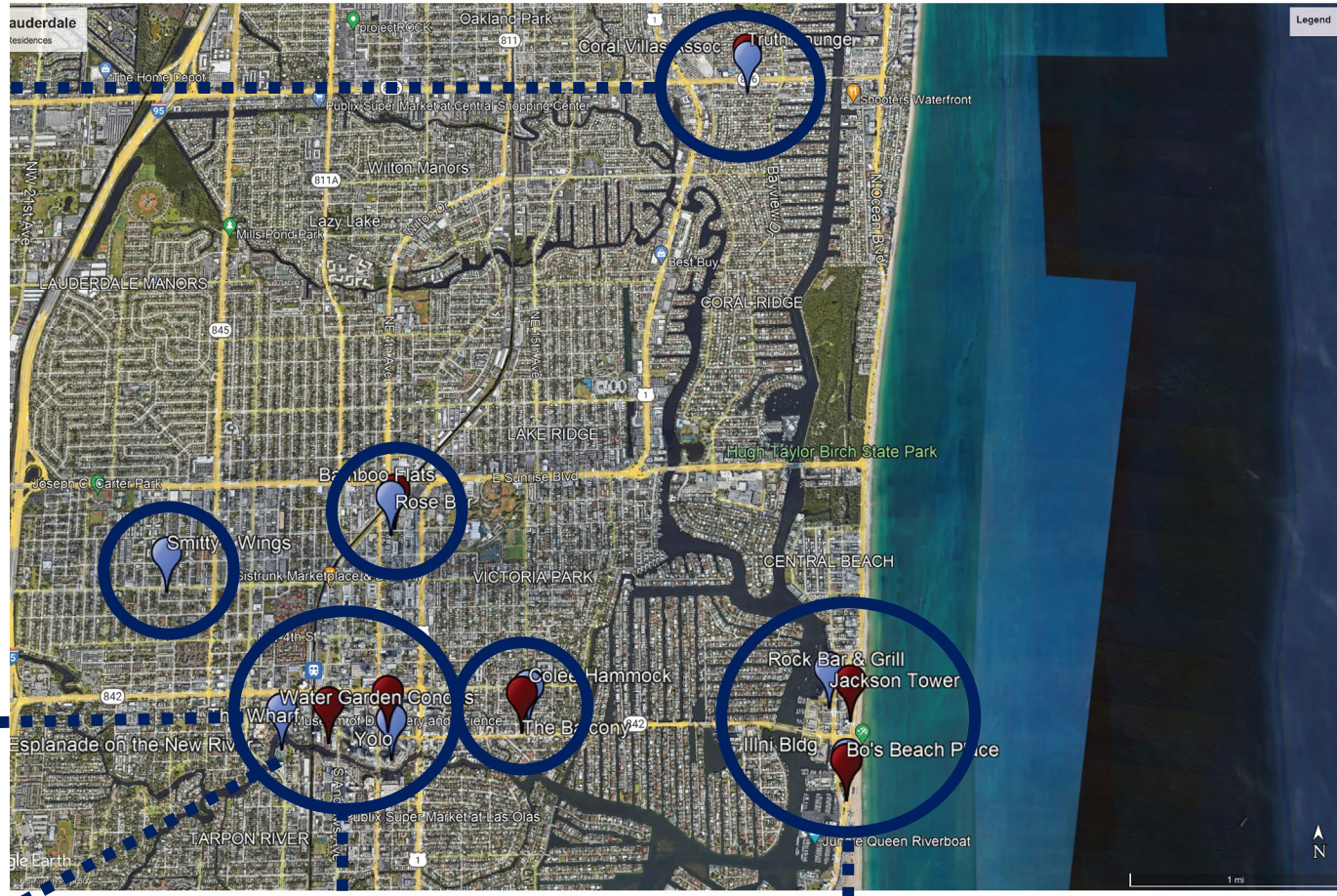
Student Work

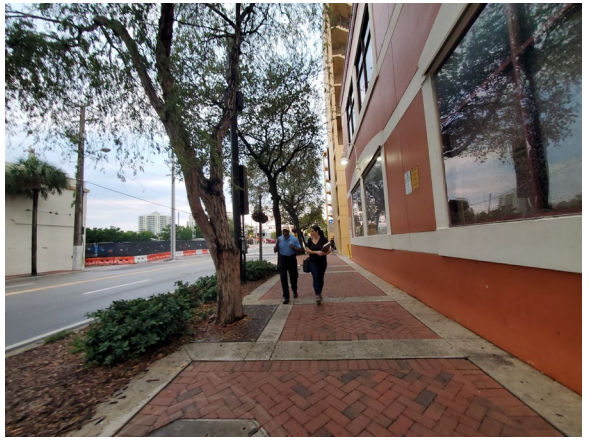
Hearing Health

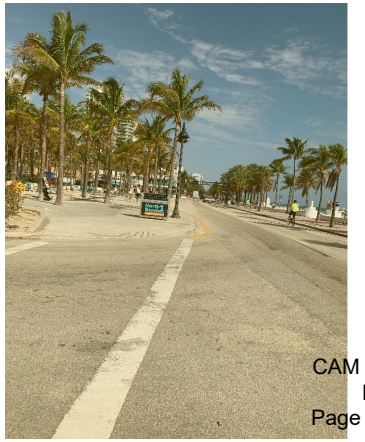
NLR Analysis for Planning Purposes

Soundwalks with Noise Advisory Board to identify priorities









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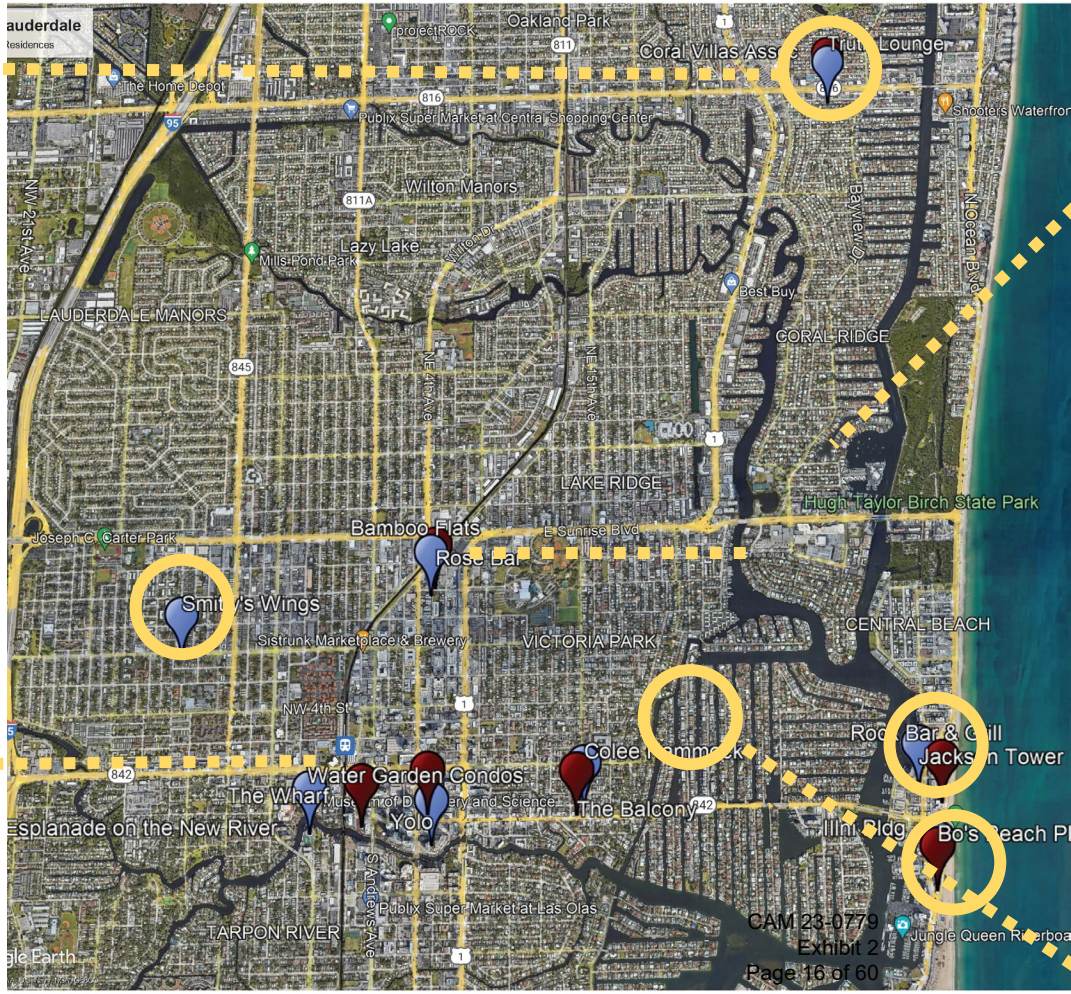
Long term measurements

Near Source locations: Trip 1

Near Receiver Locations: Trip 2



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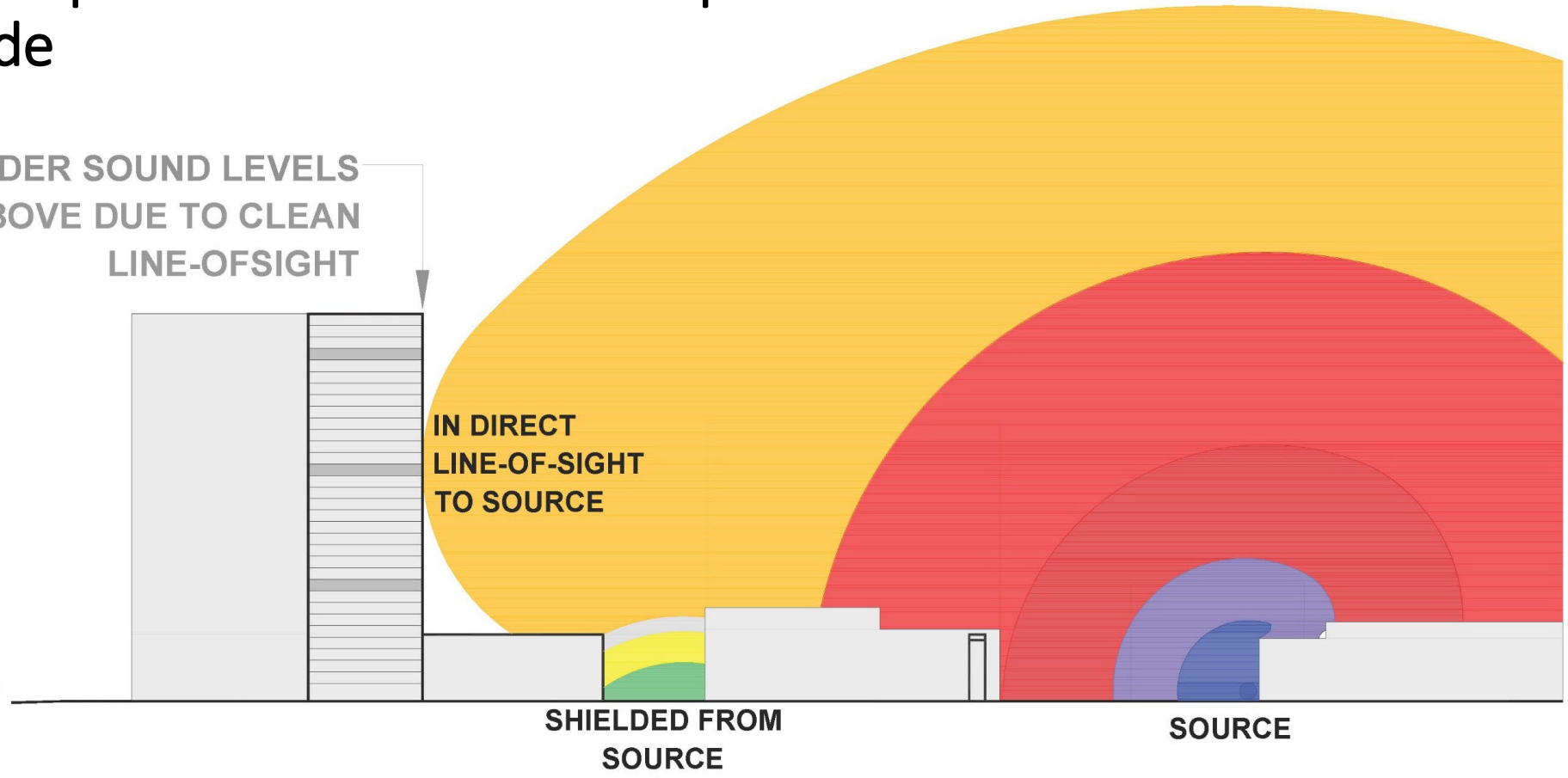
Concept: Sound levels from amplified music can be louder above than on grade



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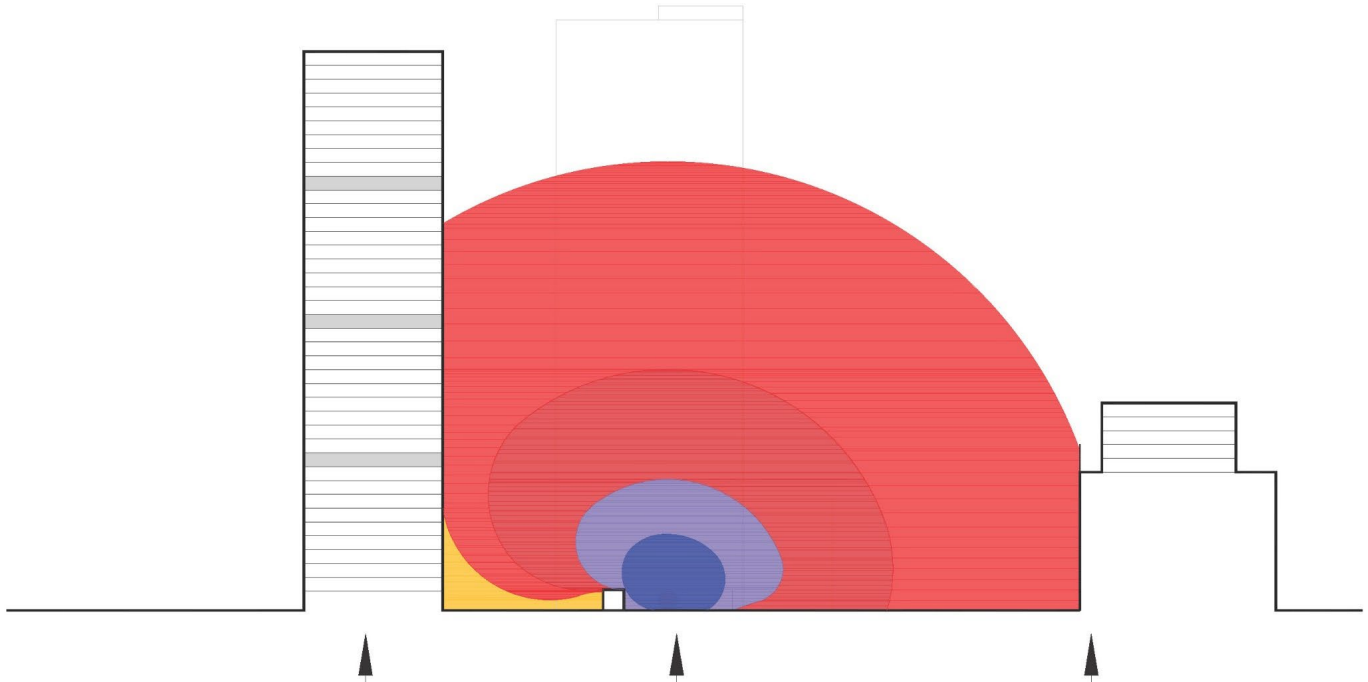
Concept: Sound levels from amplified music can be louder above than on grade



'ED BEHIND
FIED MUSIC,
OVE GRADE
ED SOUNDS

OUTDOOR VENUE PLAYING AMPLIFIED MUSIC

RECEIVER EXPOSED TO LOWER SOUND LEVELS FROM AMPLIFIED MUSIC DUE TO INCREASED DISTANCE FROM OUTDOOR VENUE AND SETBACK OF NOISE SENSITIVE FLOOR LEVELS

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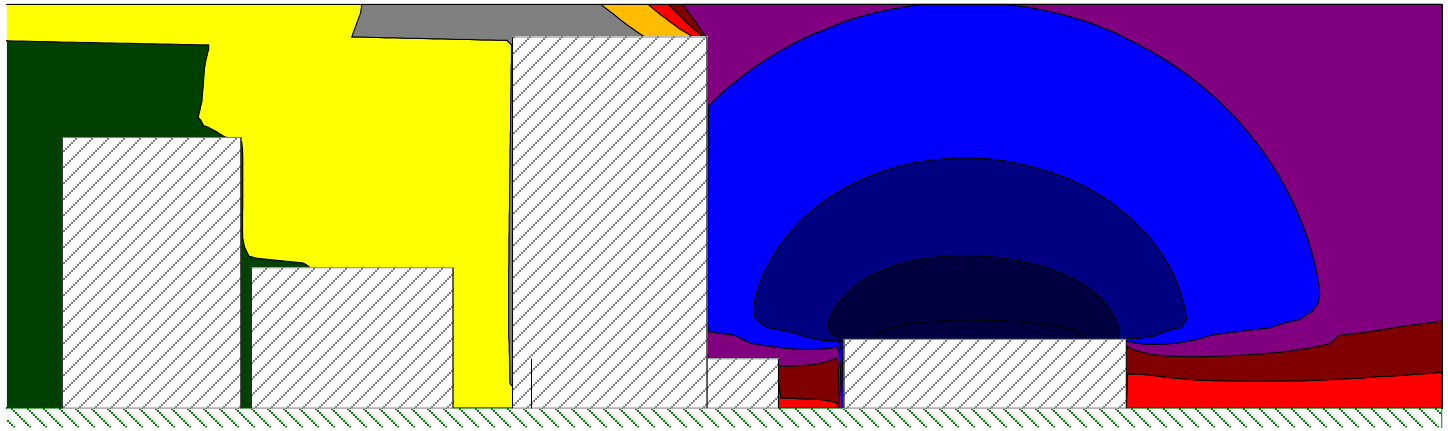
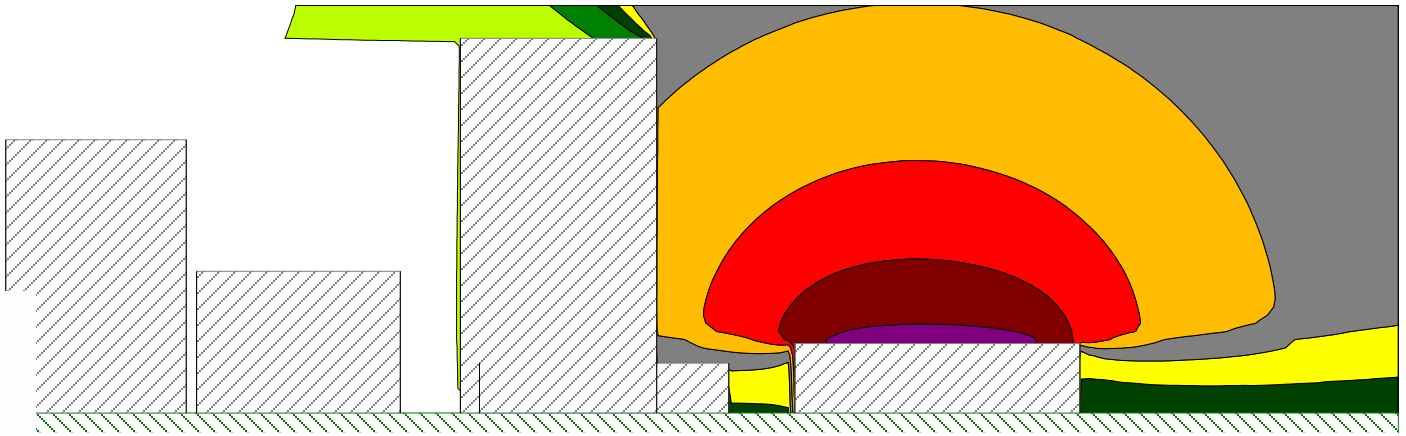
Concept :
Source Building- Open vs Closed



OPEN



CLOSED

Sound Pressure Level: dBA

- > 35.0 dB
- > 40.0 dB
- > 45.0 dB
- > 50.0 dB
- > 55.0 dB
- > 60.0 dB
- > 65.0 dB
- > 70.0 dB
- > 75.0 dB
- > 80.0 dB
- > 85.0 dB

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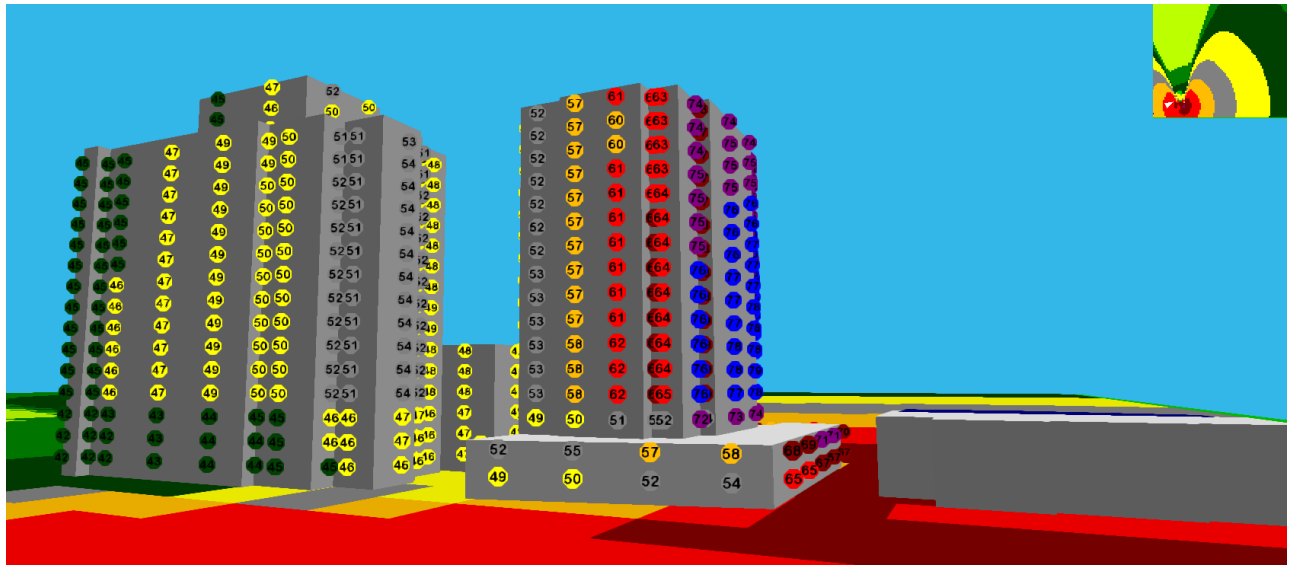
Concept: Source Building- Open vs Closed



OPEN

CLOSED

Sound Pressure Level: dBA

- > 35.0 dB
- > 40.0 dB
- > 45.0 dB
- > 50.0 dB
- > 55.0 dB
- > 60.0 dB
- > 65.0 dB
- > 70.0 dB
- > 75.0 dB
- > 80.0 dB
- > 85.0 dB

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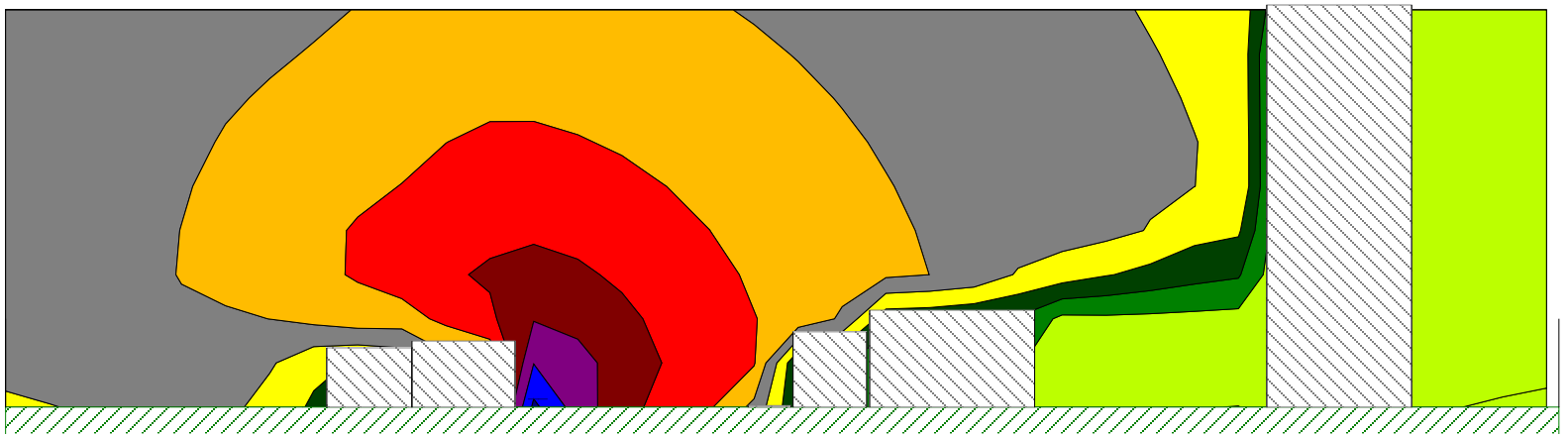
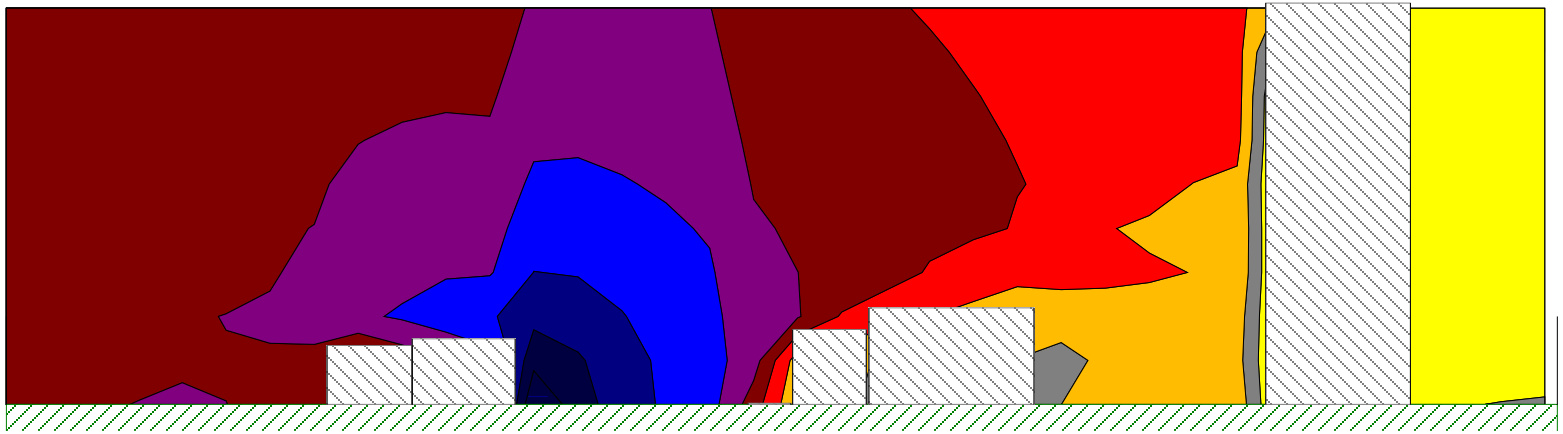
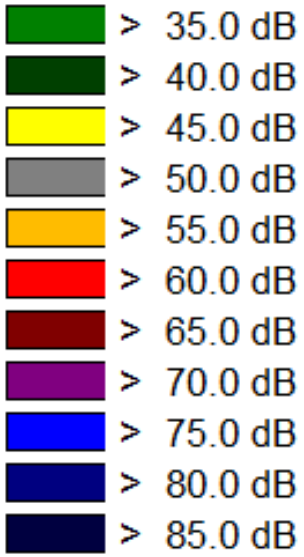
Concept: Bass sounds travel farther and remain stronger



Overall Sound Level (dBA)



63 Hz Frequency Sound Level



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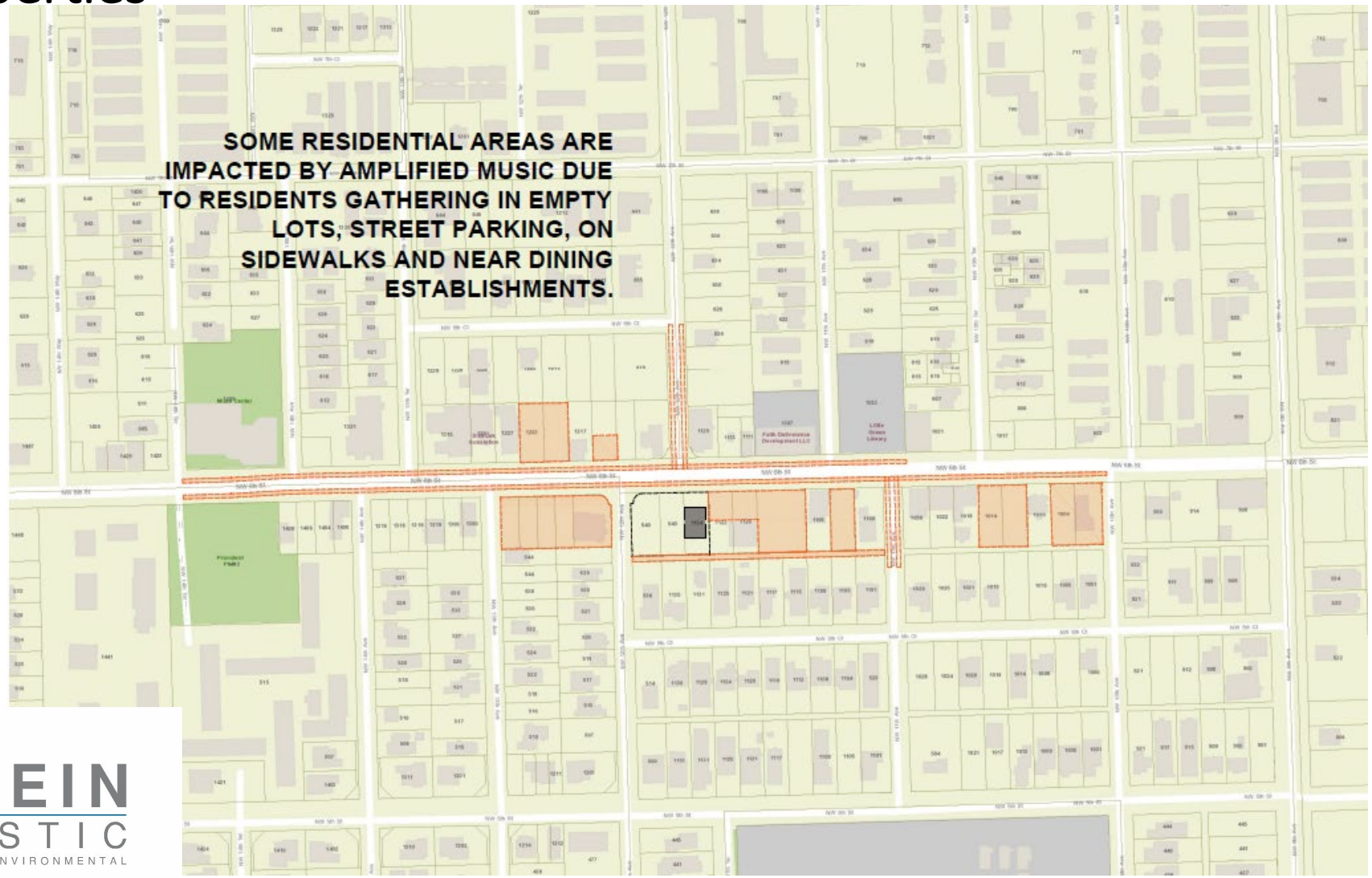
Concept: Noise concerns from public realm not associated with properties



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Concept: Noise concerns from public realm not associated with propert

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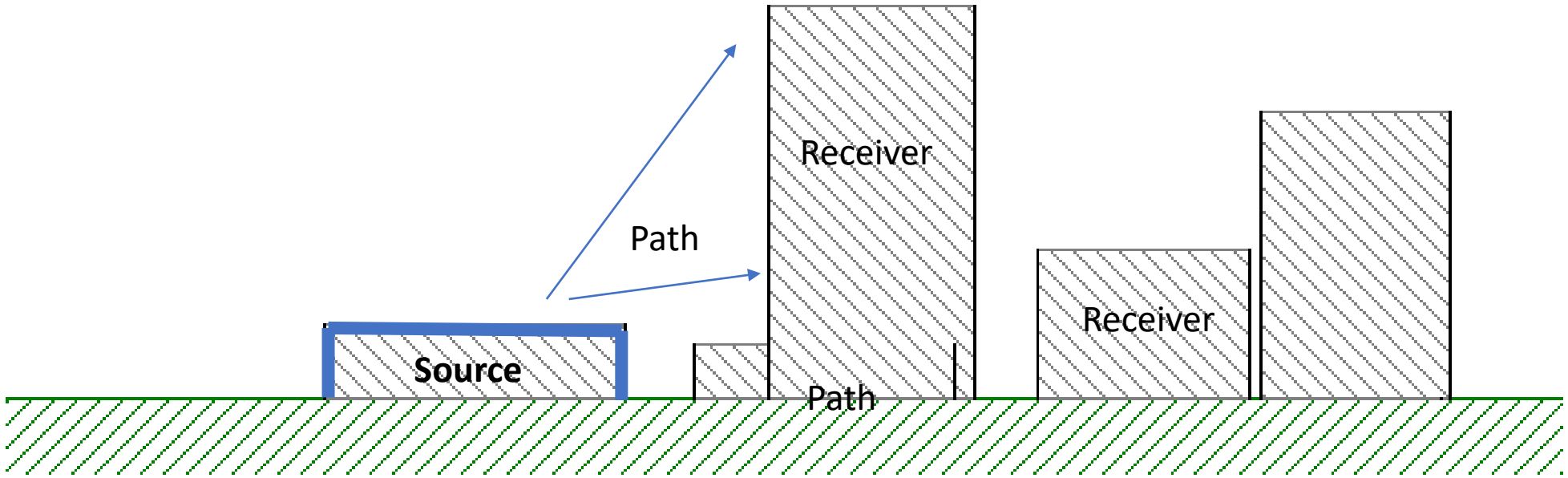
WHERE MITIGATION CAN OCCUR

Source



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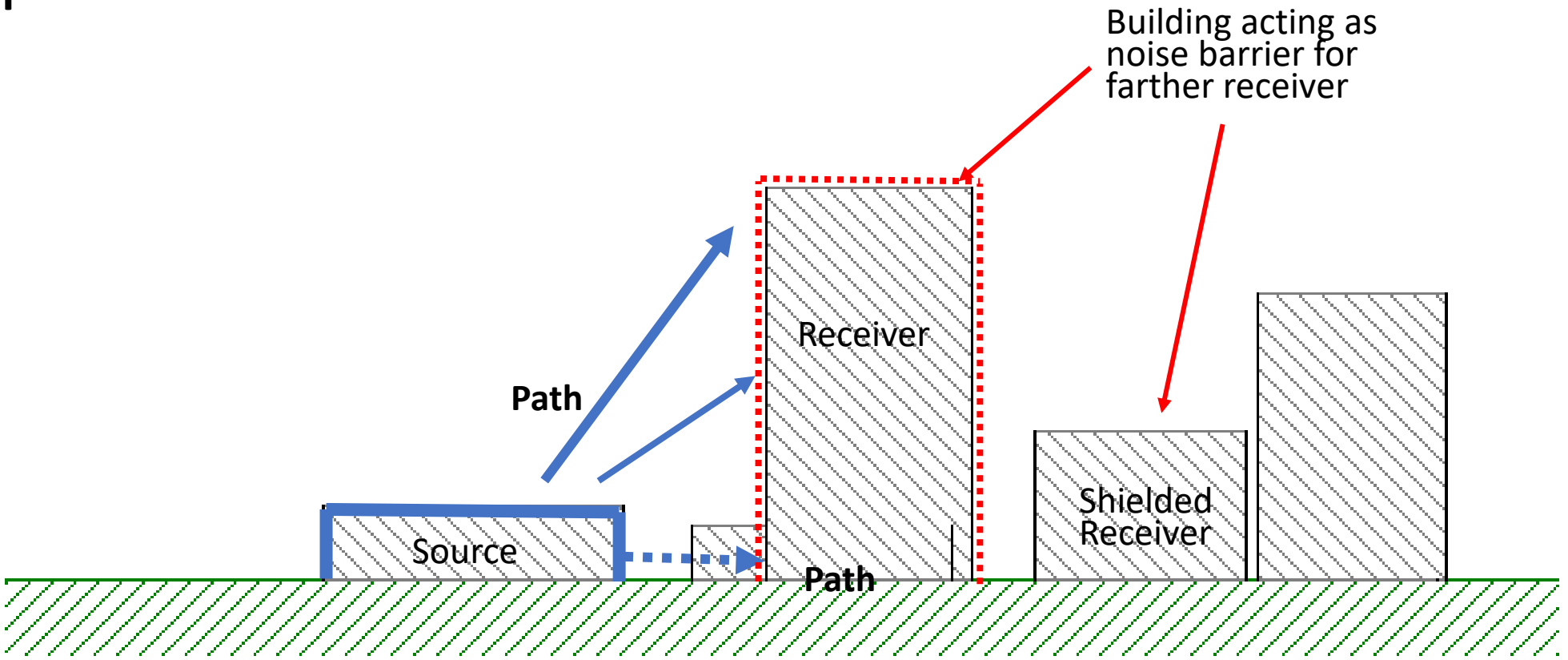
WHERE MITIGATION CAN OCCUR

Path



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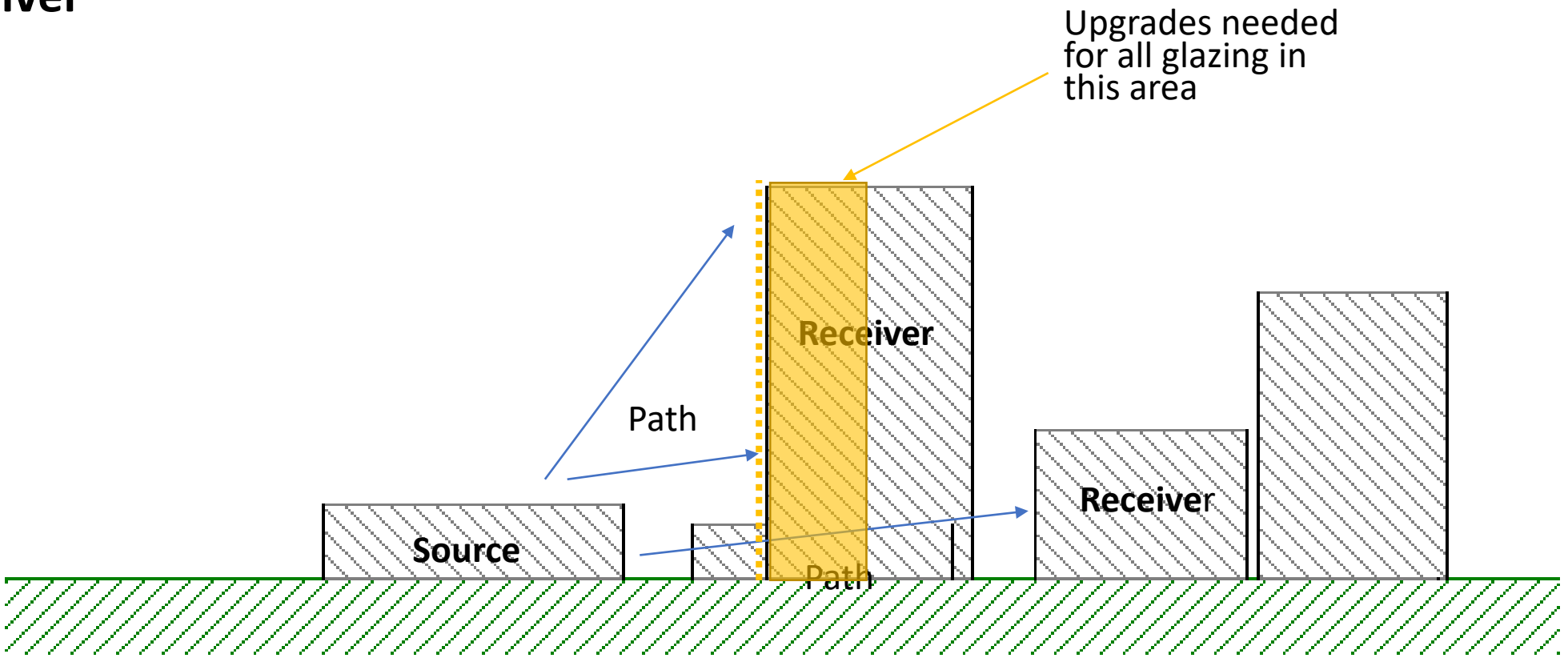
WHERE MITIGATION CAN OCCUR

Receiver



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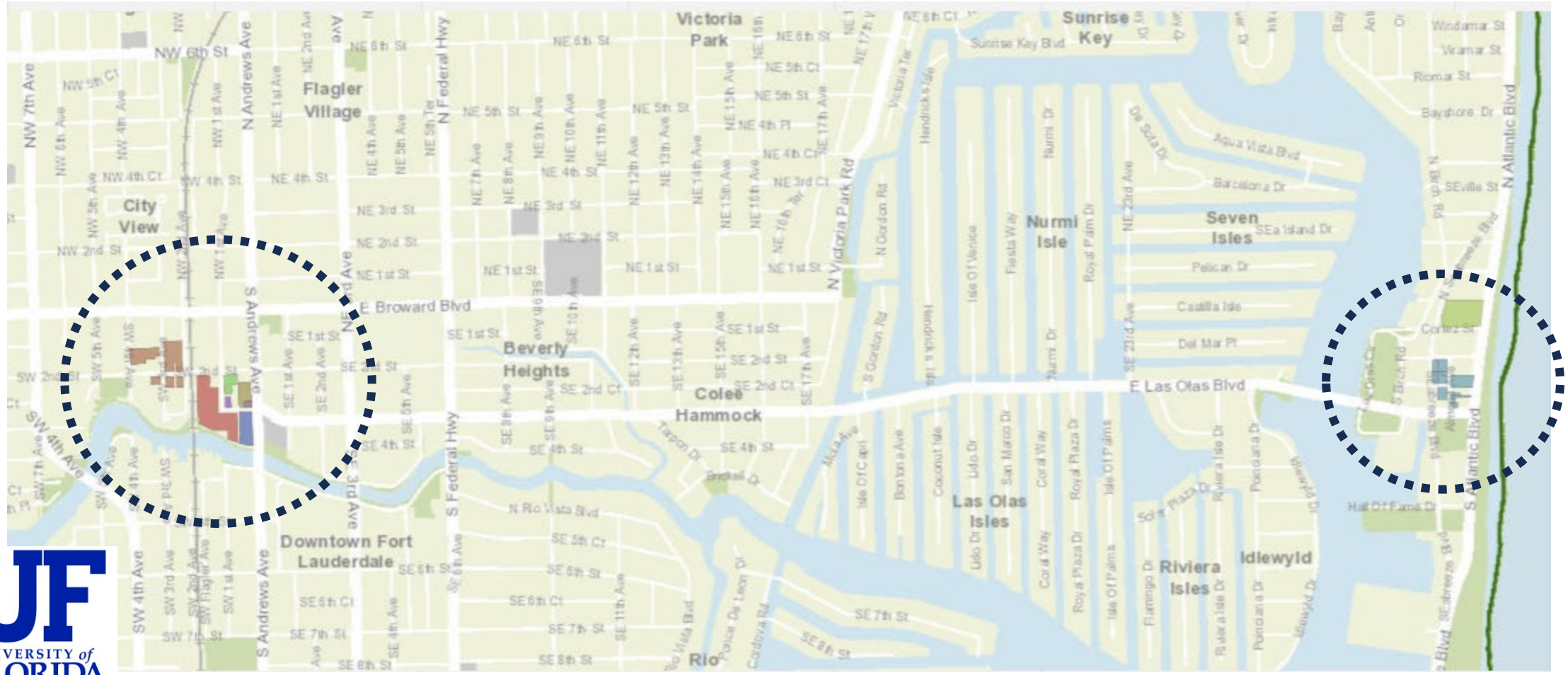
Entertainment Overlay Districts



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Ft Lauderdale Sound Level Limits

MAXIMUM PERMISSIBLE SOUND LEVEL LIMITS			
	Times	Outdoor	Indoor
Residential	7 am – 10 pm	**60 dBA** ***65 dBA** if residential is within Commercial, Industrial or Mixed or within 200 ft of such **80 dBA** (Impulsive sounds that occur less than 4 times in 1 hour)	45 dBA
	10 pm – 7am	**50 dBA** **70 dBA** (Impulsive sounds that occur less than 4 times in 1 hour)	35 dBA
Commercial	24 hours	65 dBA	55 dBA
Industrial	24 hours	75 dBA	65 dBA
SPECIAL ENTERTAINMENT DISTRICT			
Measured 5 ft from building, structure or establishment	Mon-Thur 12pm to 12am	85 dBA, 95 dBC	
	Mon – Thur 12am-2am	70 dBA, 80 dBC	
	Mon-Thur 2am-12pm	65 dBA, 75 dBA	
	Fri-Sun 12pm to 1am and Legal holidays	85 dBA, 95 dBC	
	Fri-Sun 1am-3am and Legal holidays	70 dBA, 80 dBC	
	Fri-Sun 3am-12pm and Legal holidays	65 dBA, 75 dBC	

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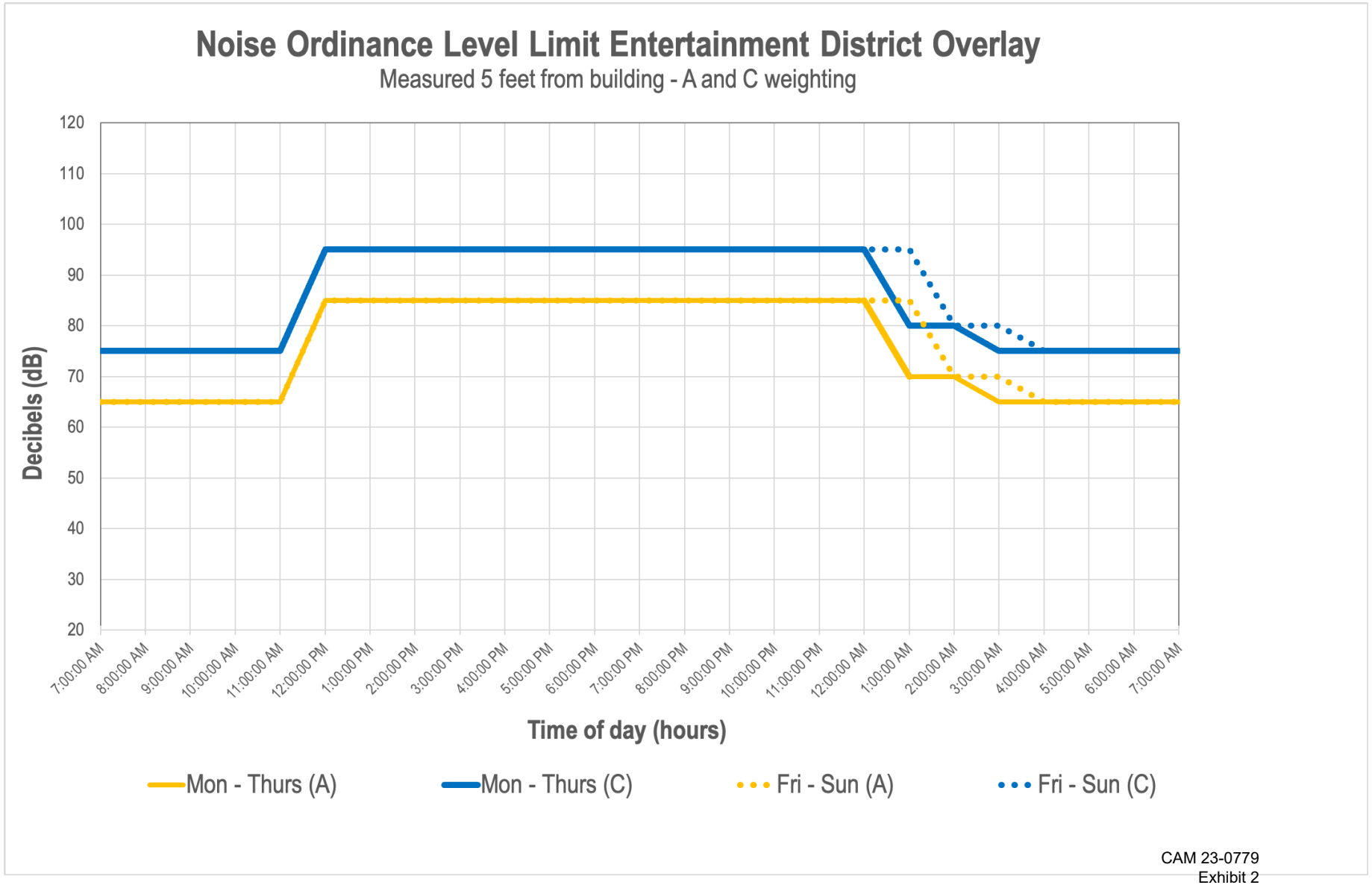
Entertainment Overlay Districts



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Entertainment District at Riverwalk

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SIEBEIN ACOUSTIC
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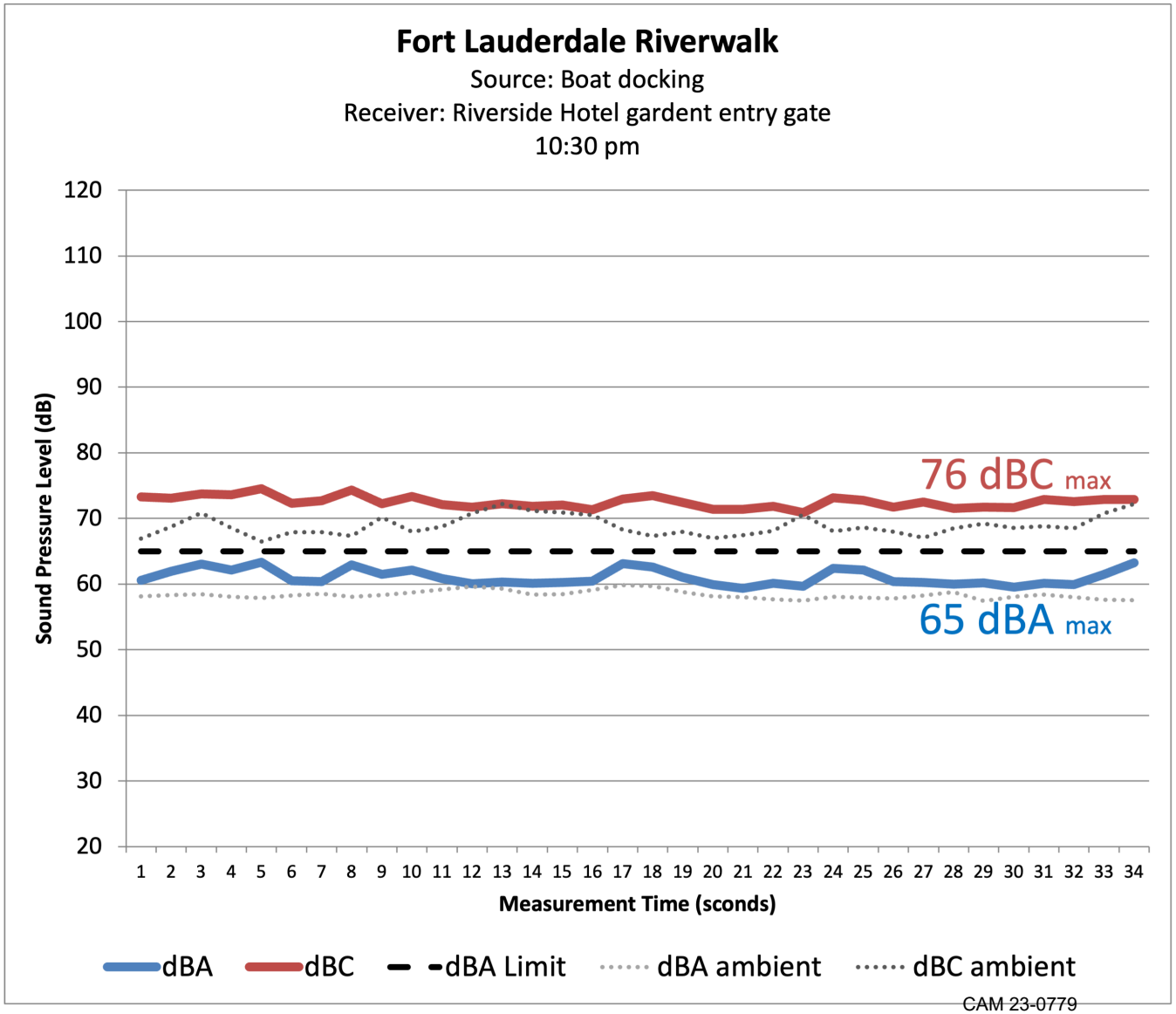

Entertainment District at Riverwalk

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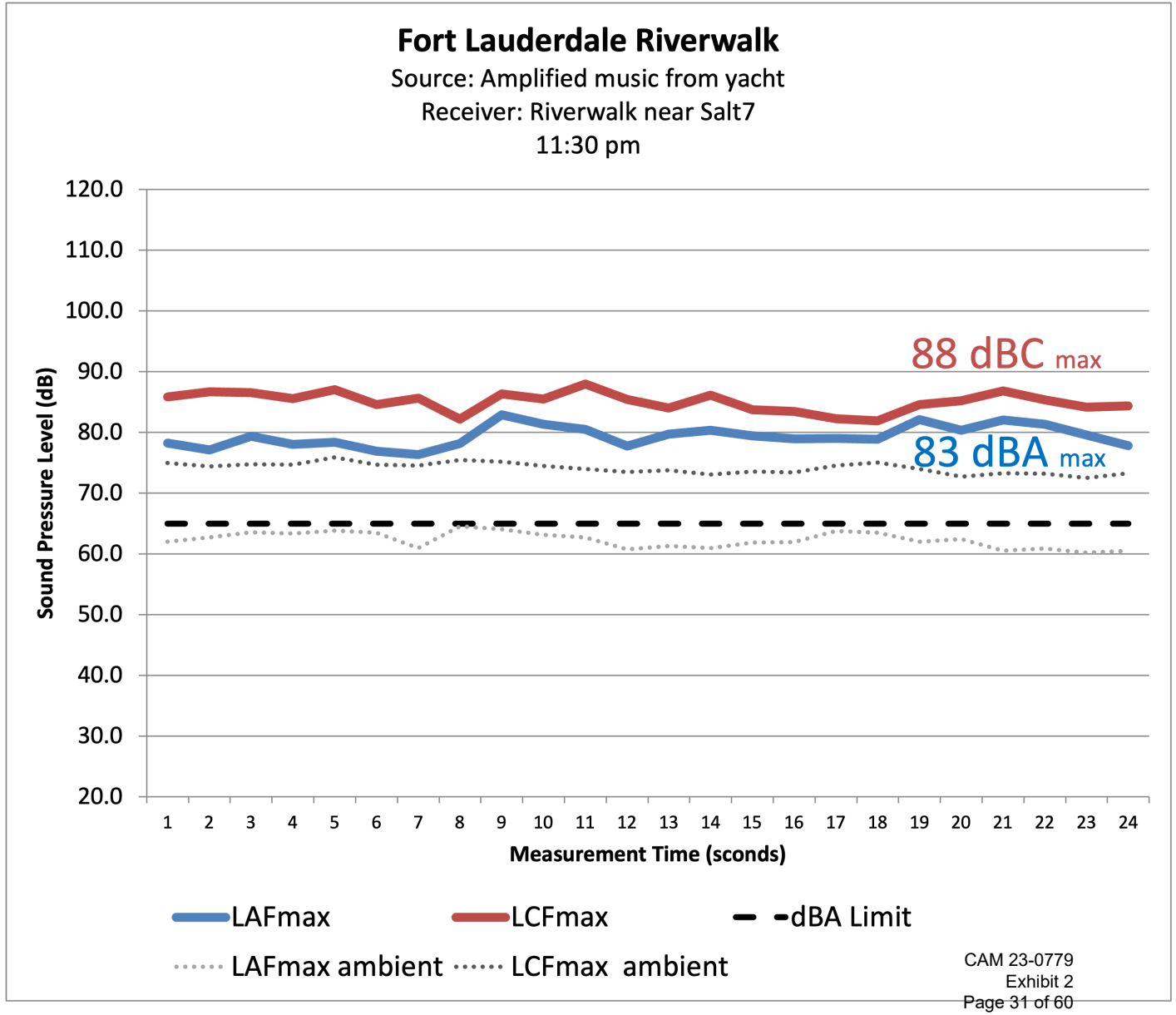

Entertainment District at Riverwalk

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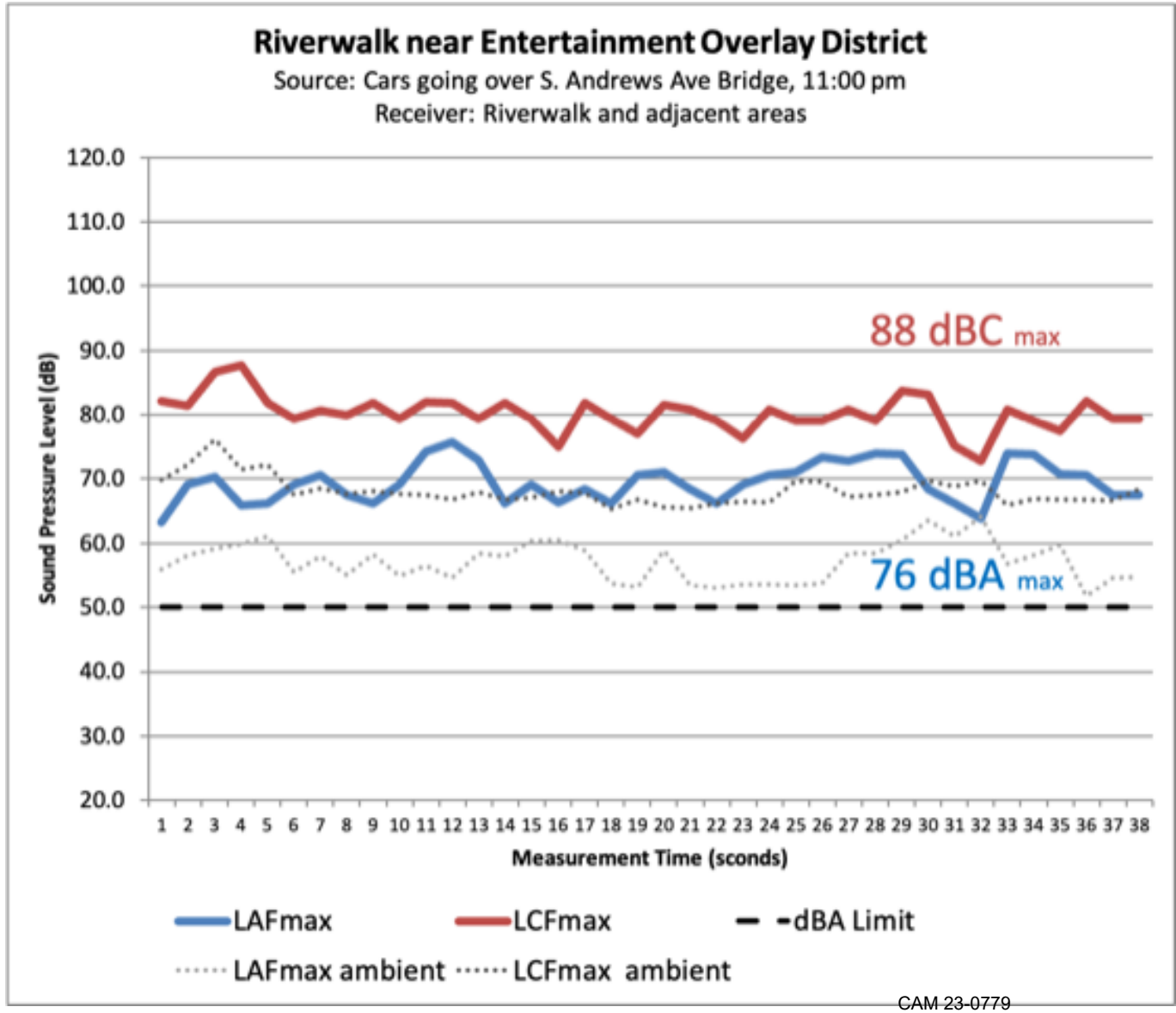
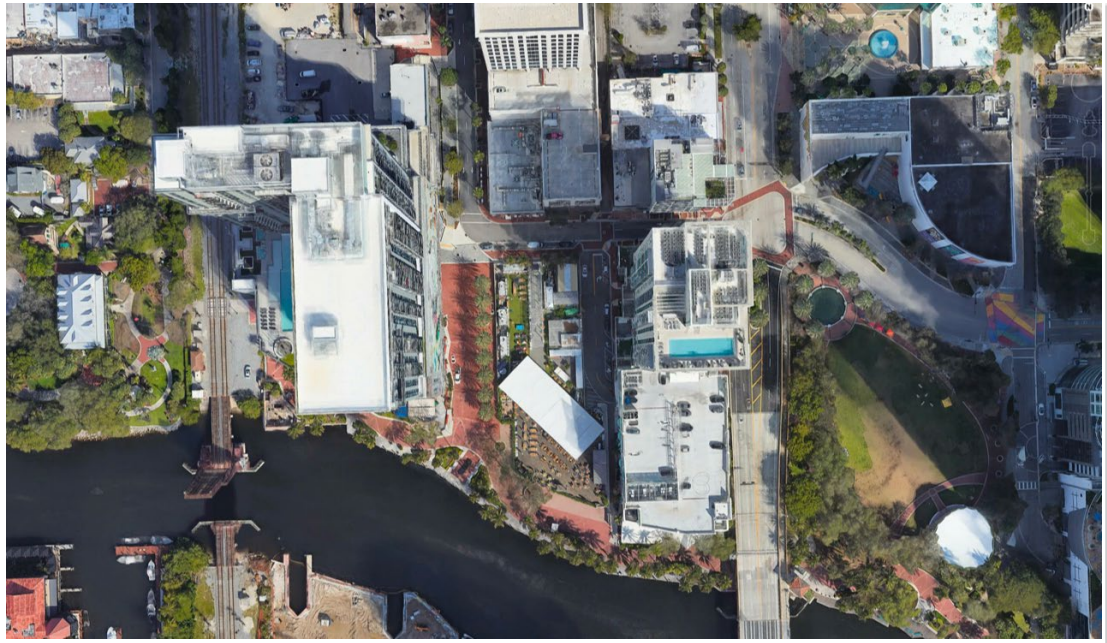
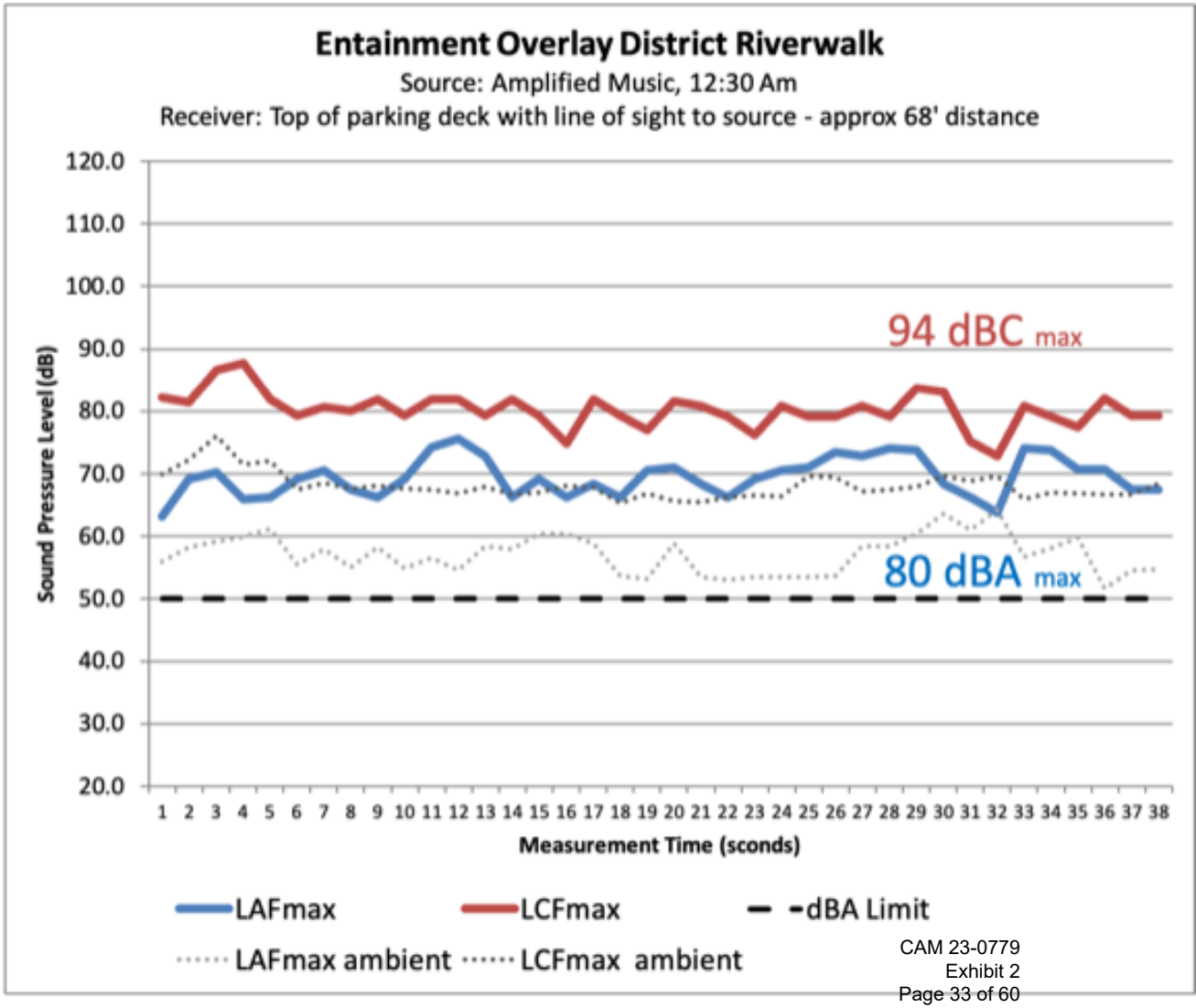


Entertainment District at Riverwalk





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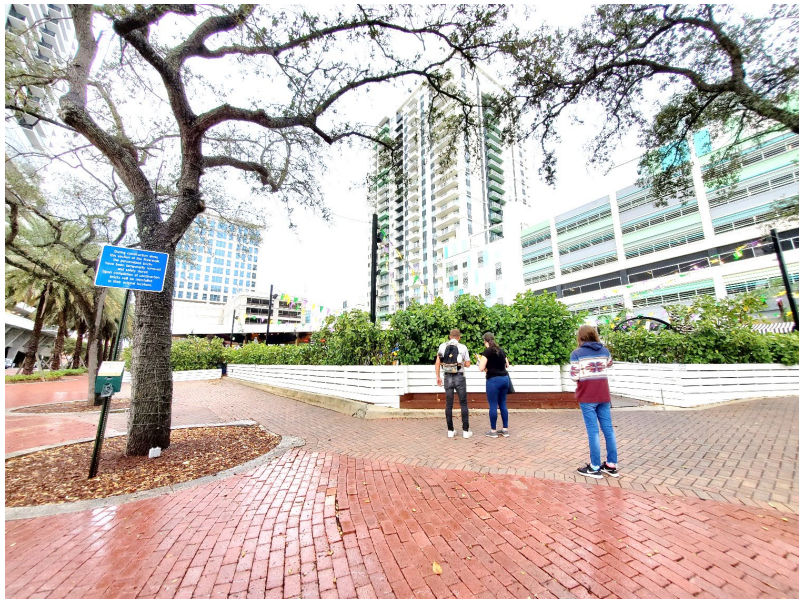
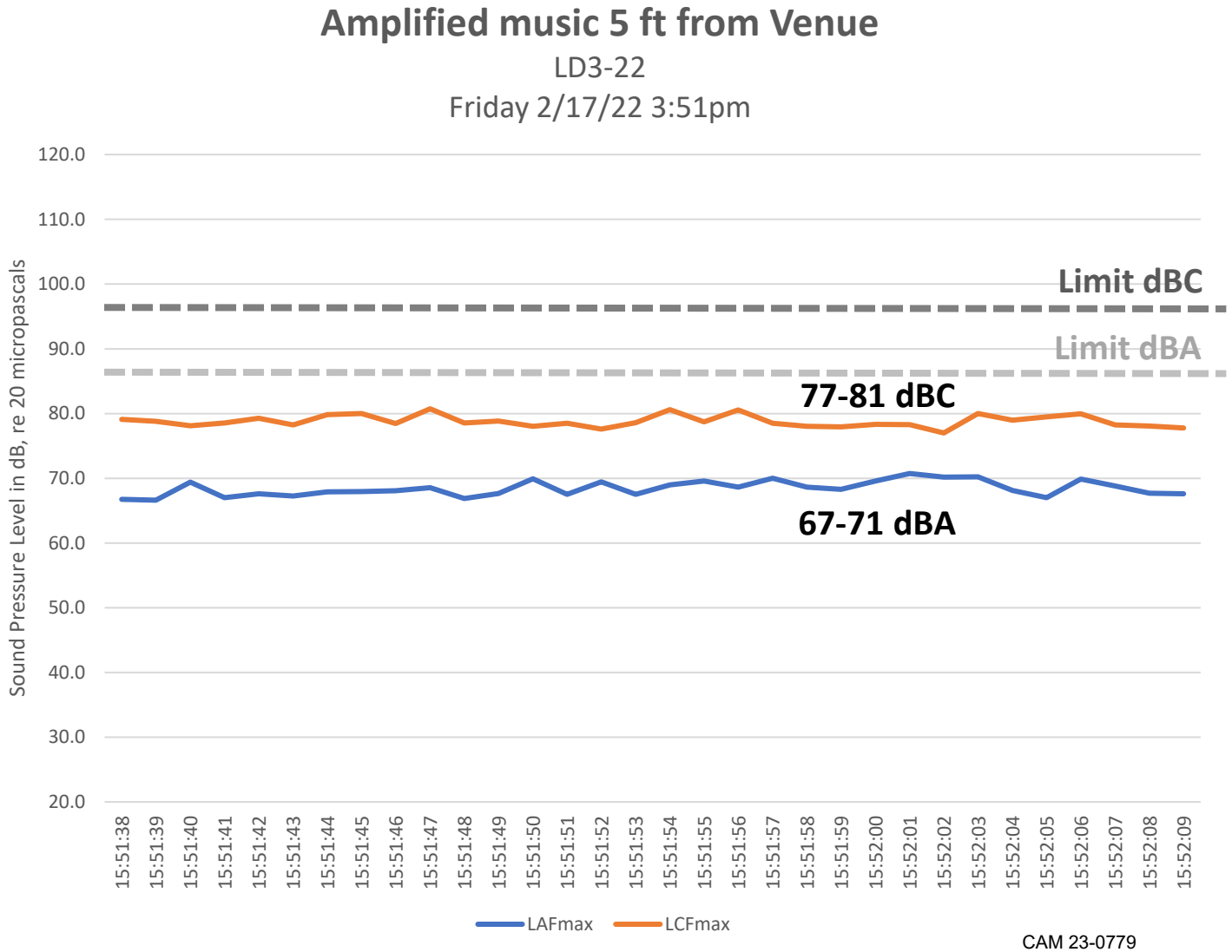
Entertainment District at Riverwalk





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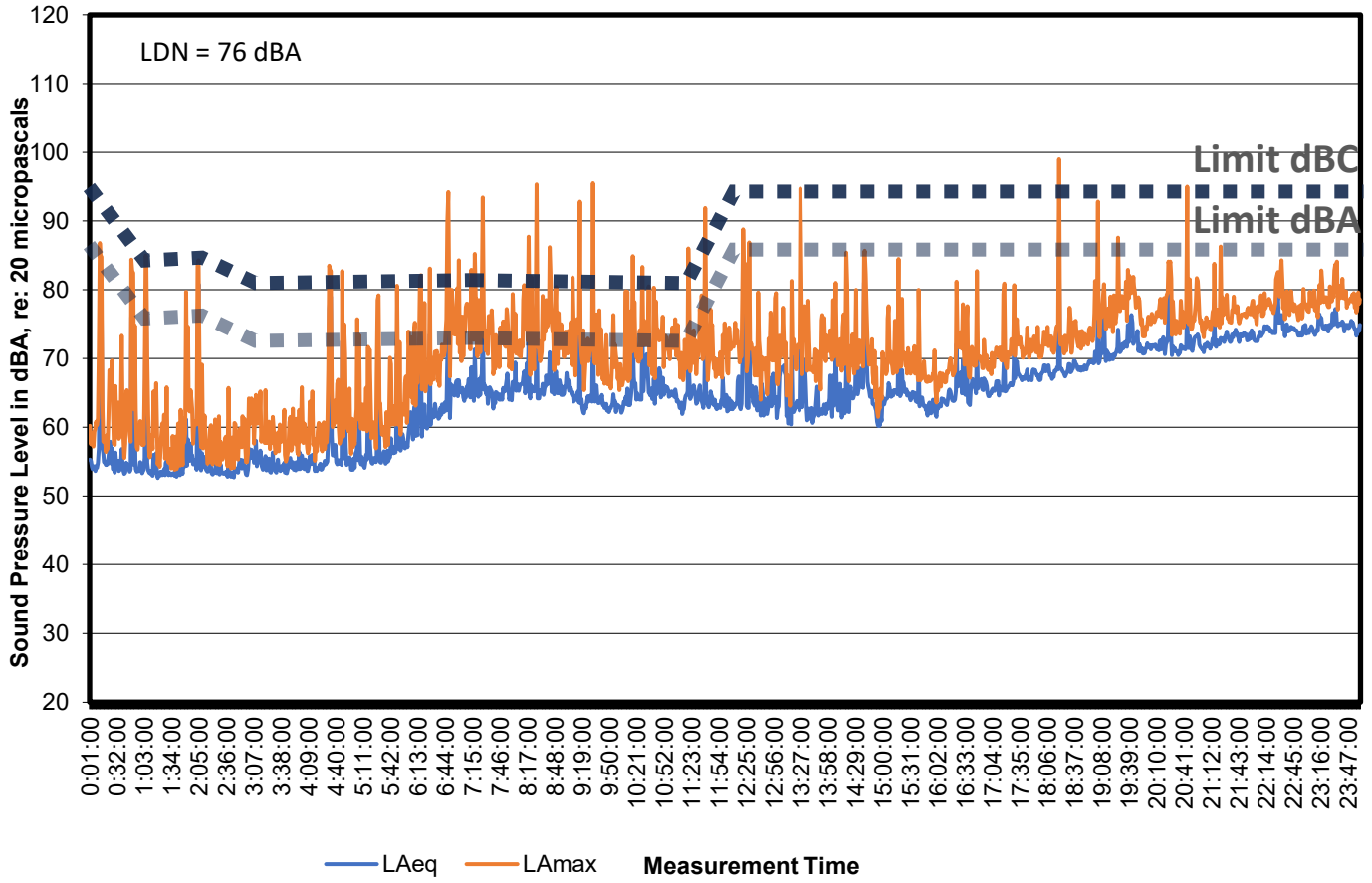
Entertainment District at Riverwalk

City of Fort Lauderdale Soundscape Study
Location : Riverwalk near the Wharf
Friday February 17, 2023



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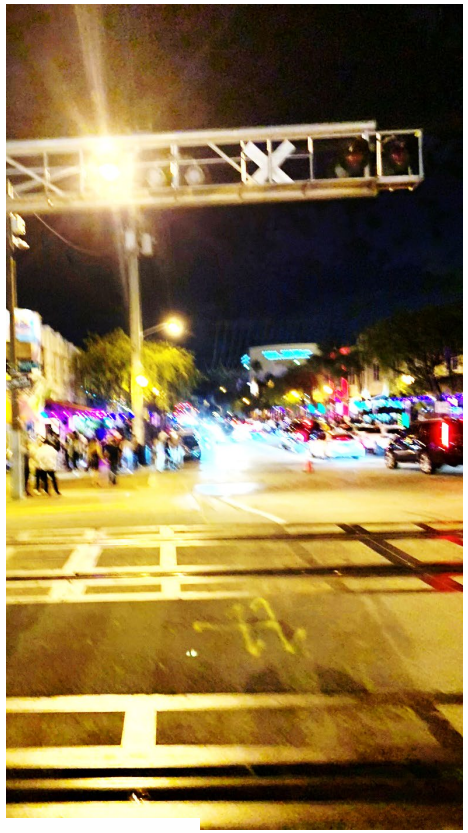
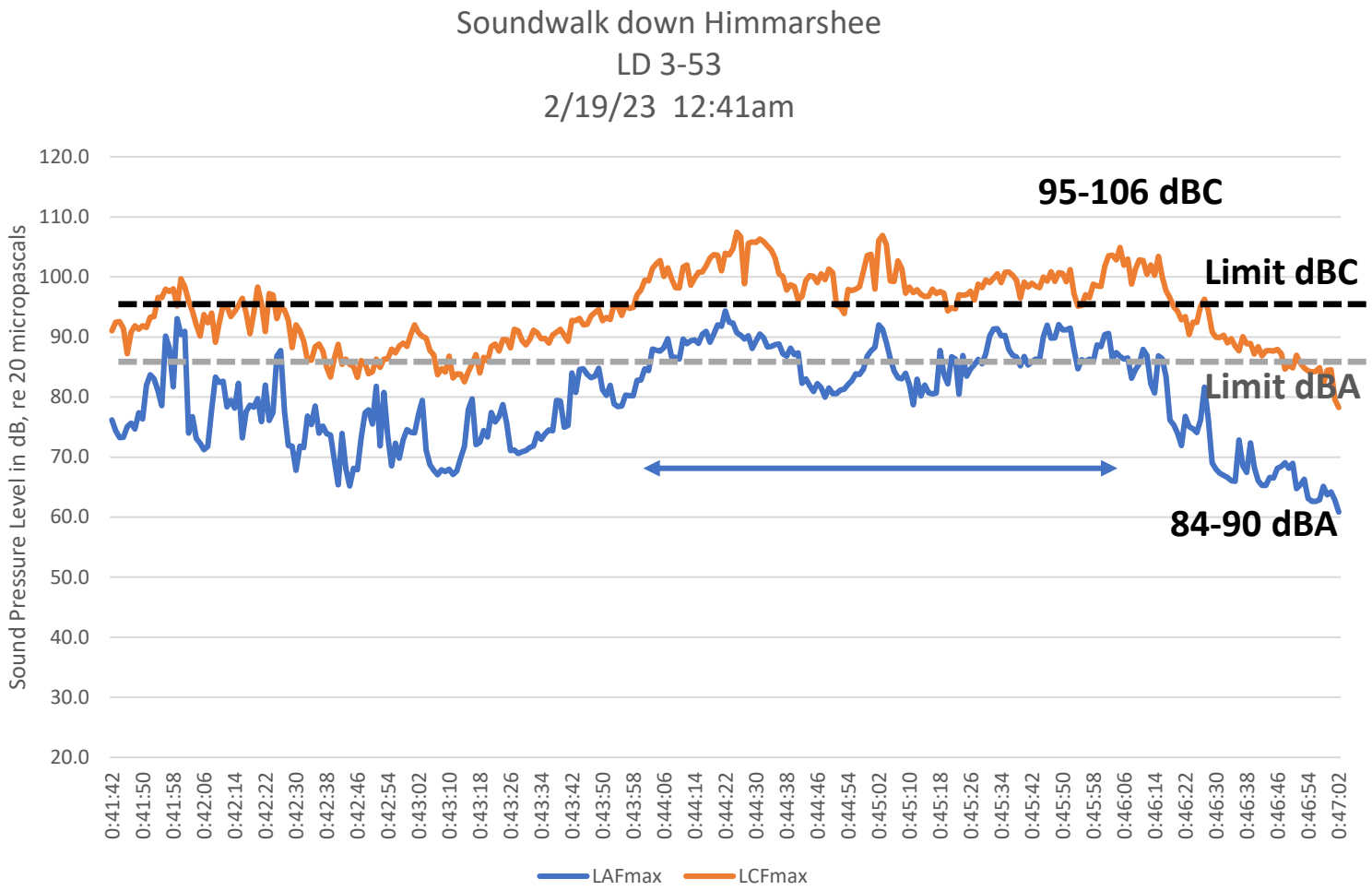
Himmarshee Soundwalk

Hearing Health





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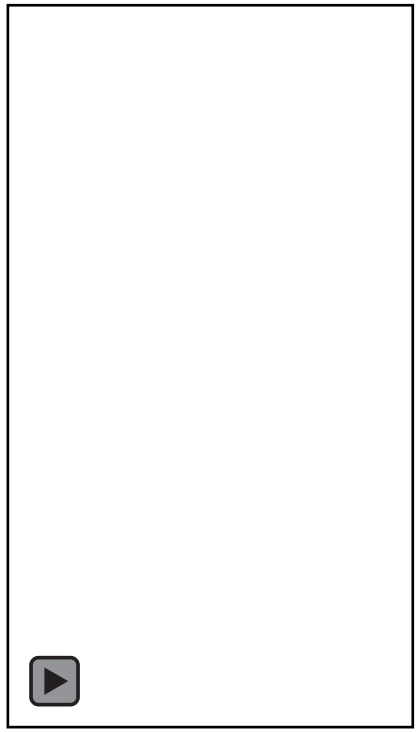
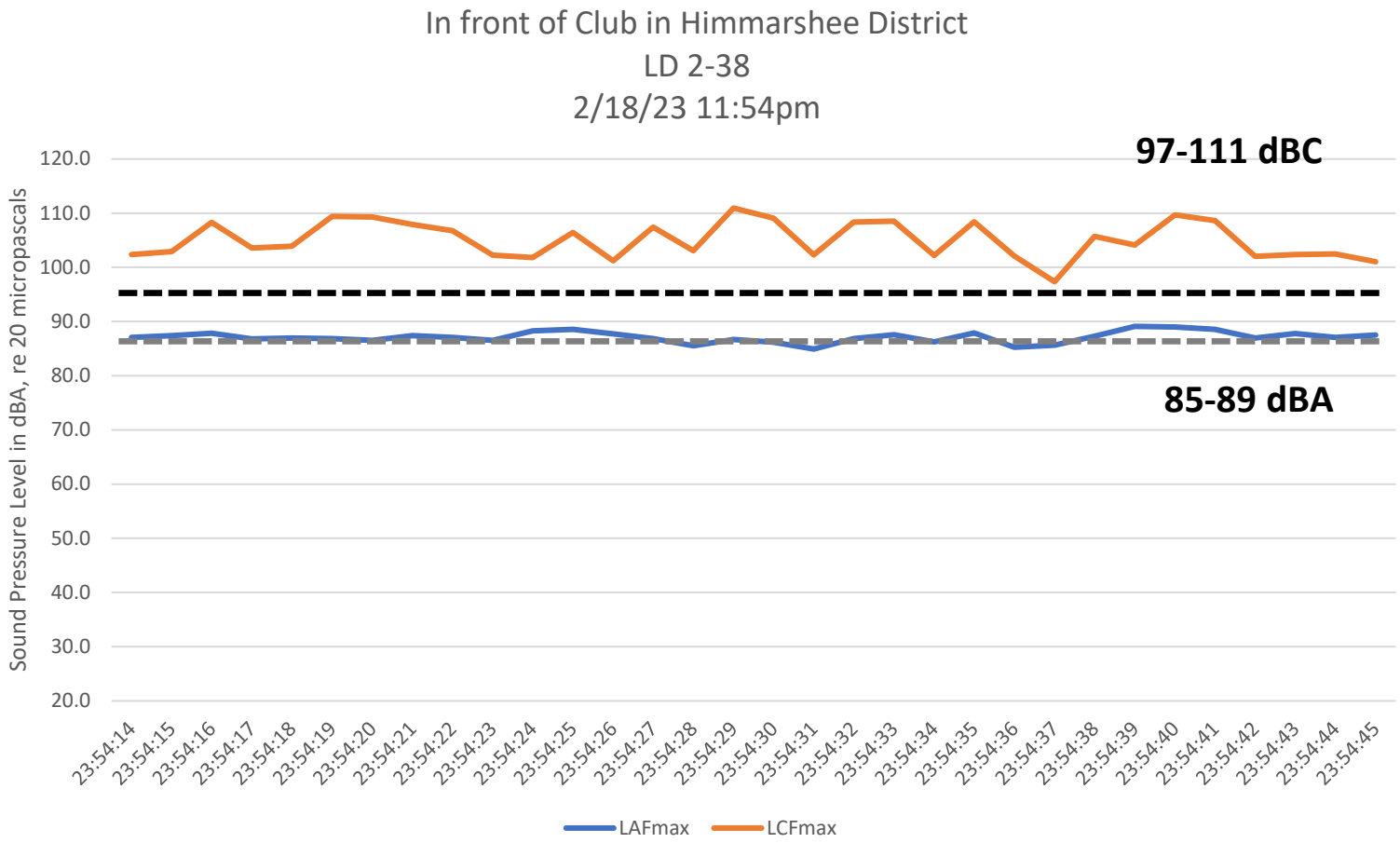
Himmarshee Soundwalk
Hearing Health





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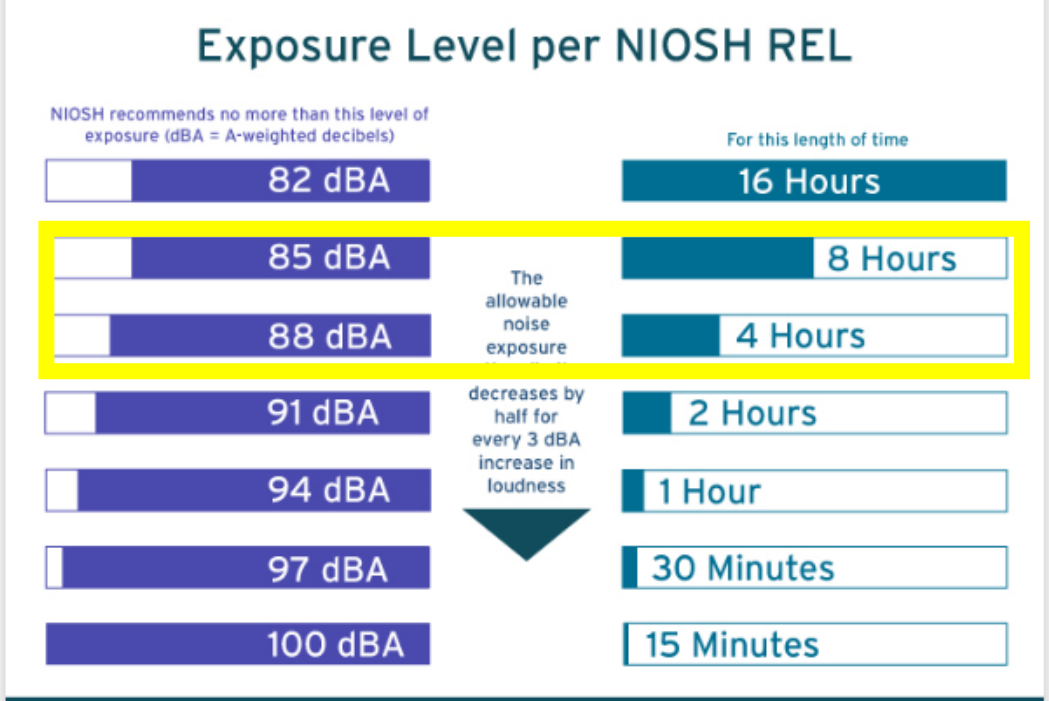
Himmarshee Soundwalk Hearing Health

Duration per days hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

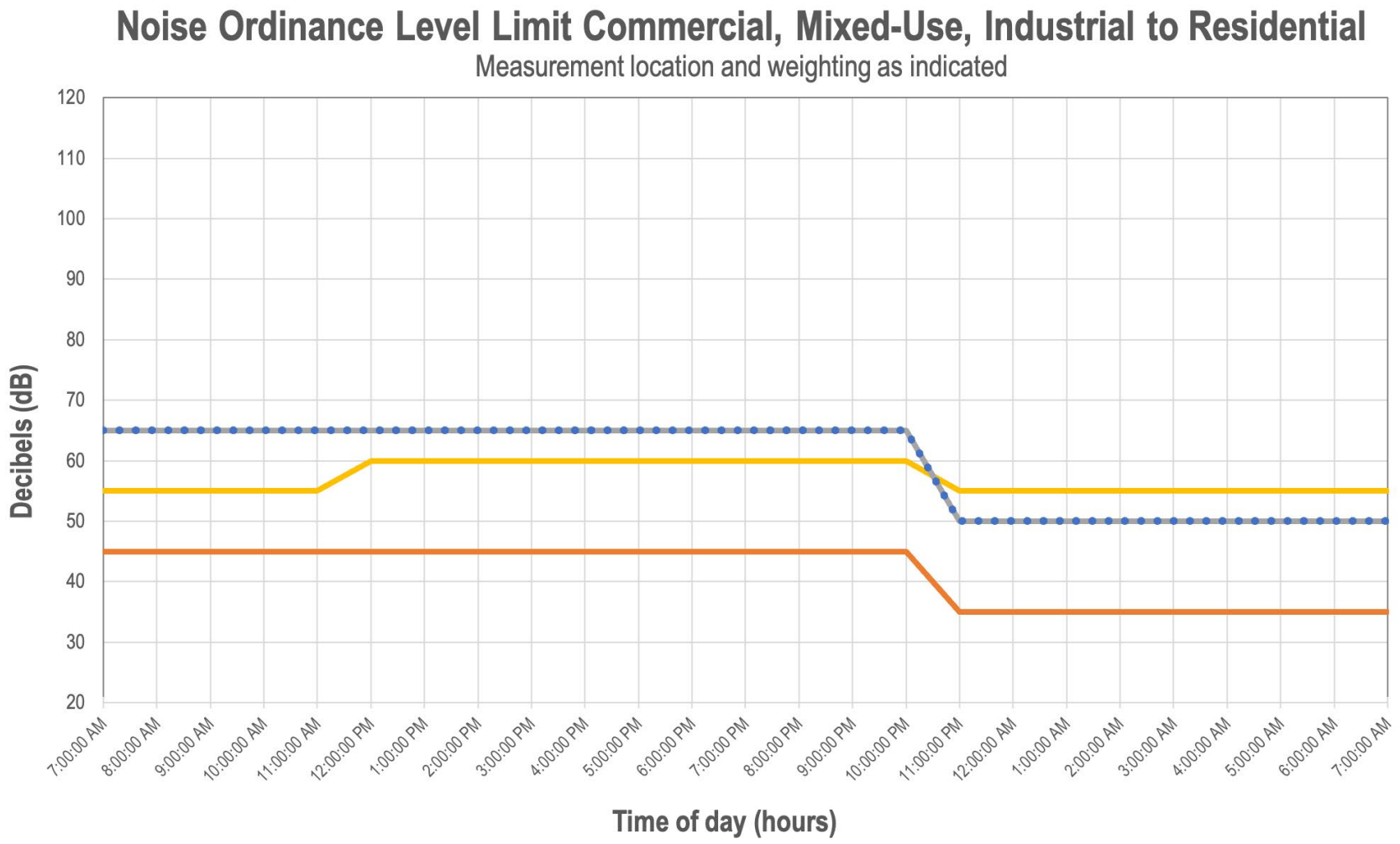
https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.95



This figure shows the relationship between exposure level and exposure duration under the NIOSH REL. As sounds become louder than 85 dBA, the length of a daily exposure must be reduced. For each 3 dBA increase in noise level, NIOSH recommends reducing the exposure duration by half. This is called the exchange rate. Similarly, if the daily exposure is longer than 8 hours, the allowable noise level is lower. To learn more, see Table 1-1 of the Criteria for a Recommended Standard Occupational Noise Exposure.

https://www.cdc.gov/niosh/topics/noise/noise.html#:~:text=NIOSH%20recommends%20wearing%20hearing%20protection,chosen%20correctly%20and%20used%20consistently.

Commercial and Residential Districts



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Commercial and Residential Districts

COMMERCIAL, MIXED USE OR INDUSTRIAL			
Measured within the premises of a complainant	12pm-10 pm	Use limits in Table 1	60 dBC
Sound level limits from Table 1 apply when measurements are taken outdoors or within the property line of the complainant	10pm – 12 pm	Use limits in Table 1	55 dBC

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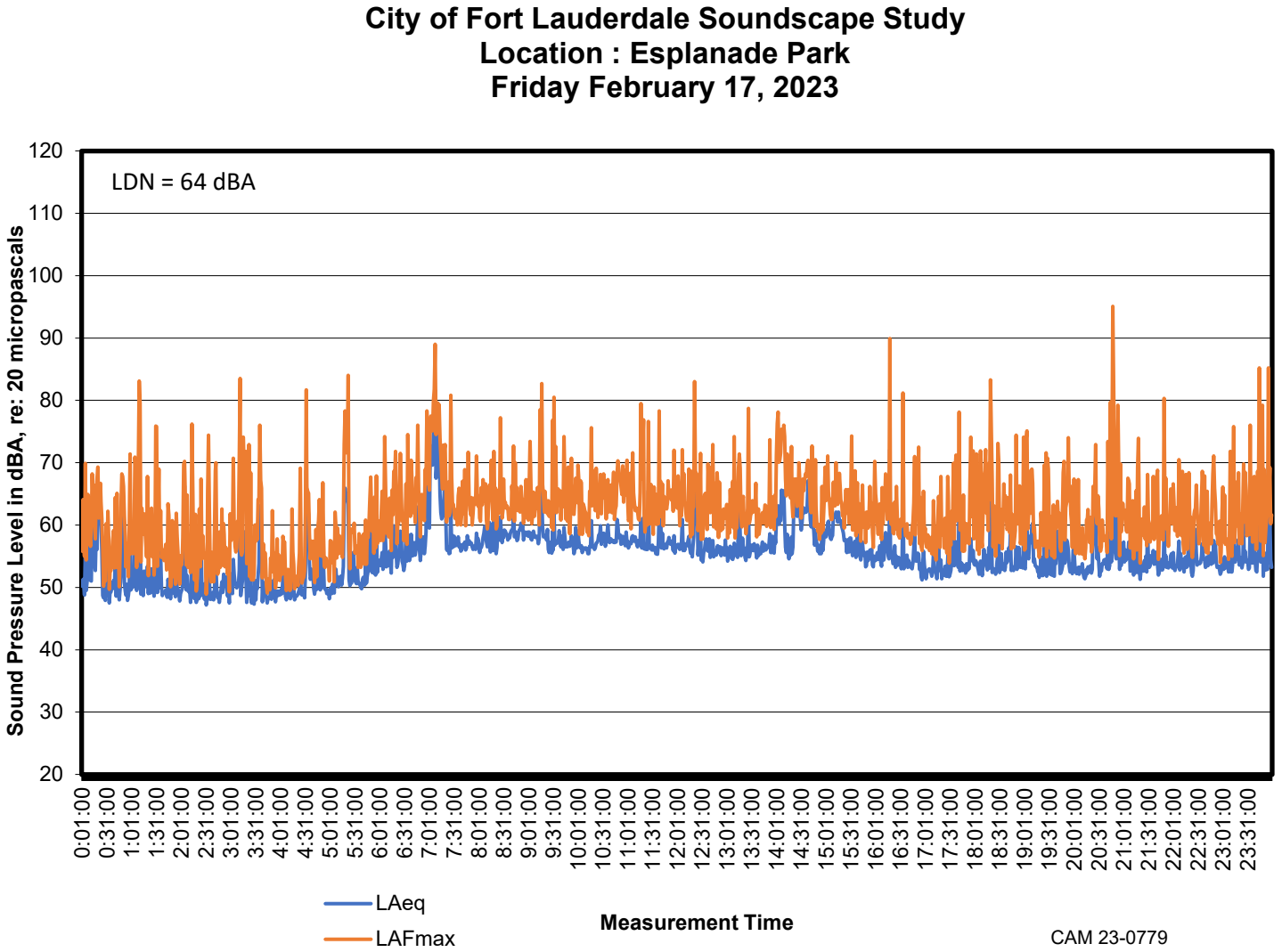
Esplanade Park



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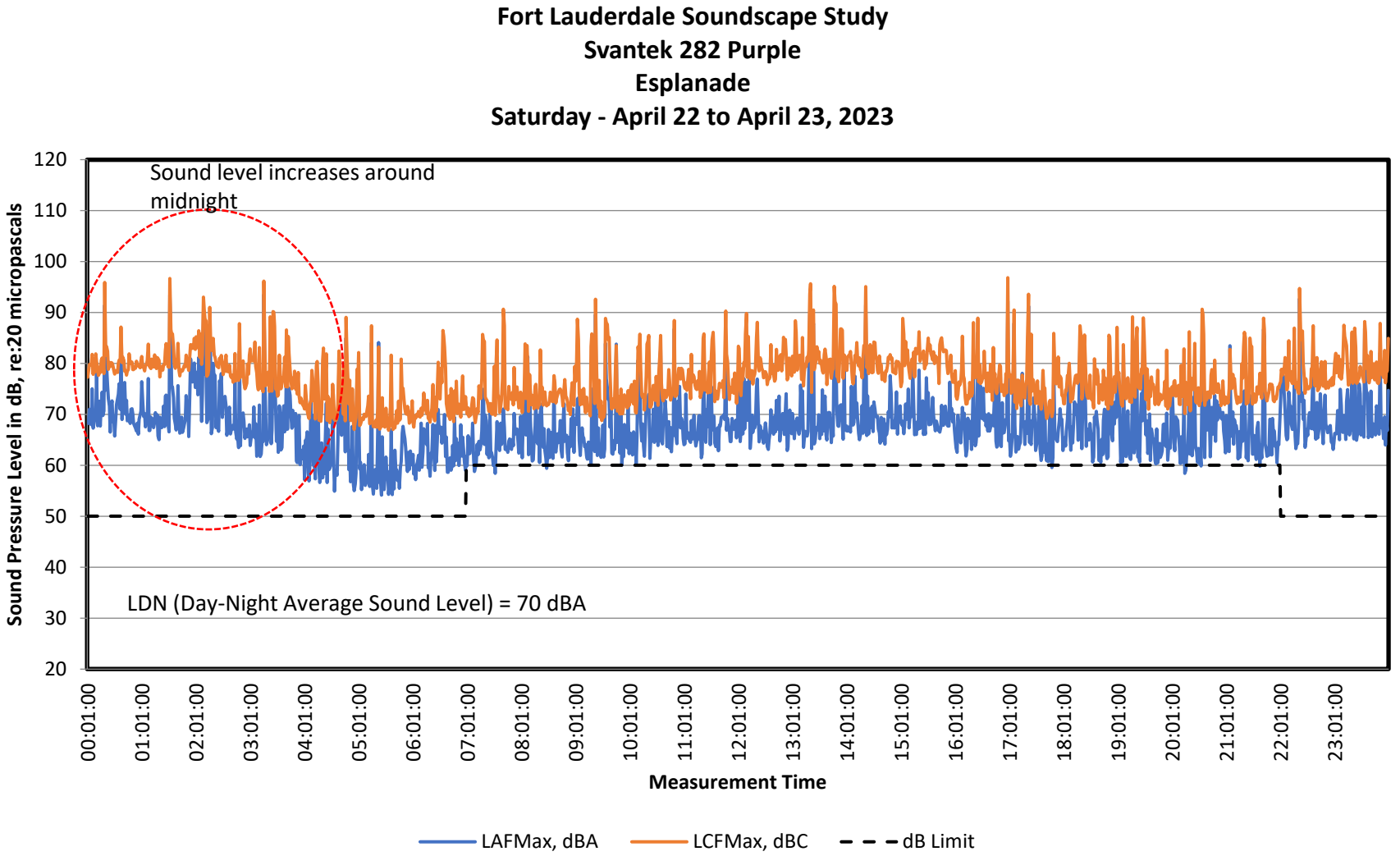
Across from Esplanade



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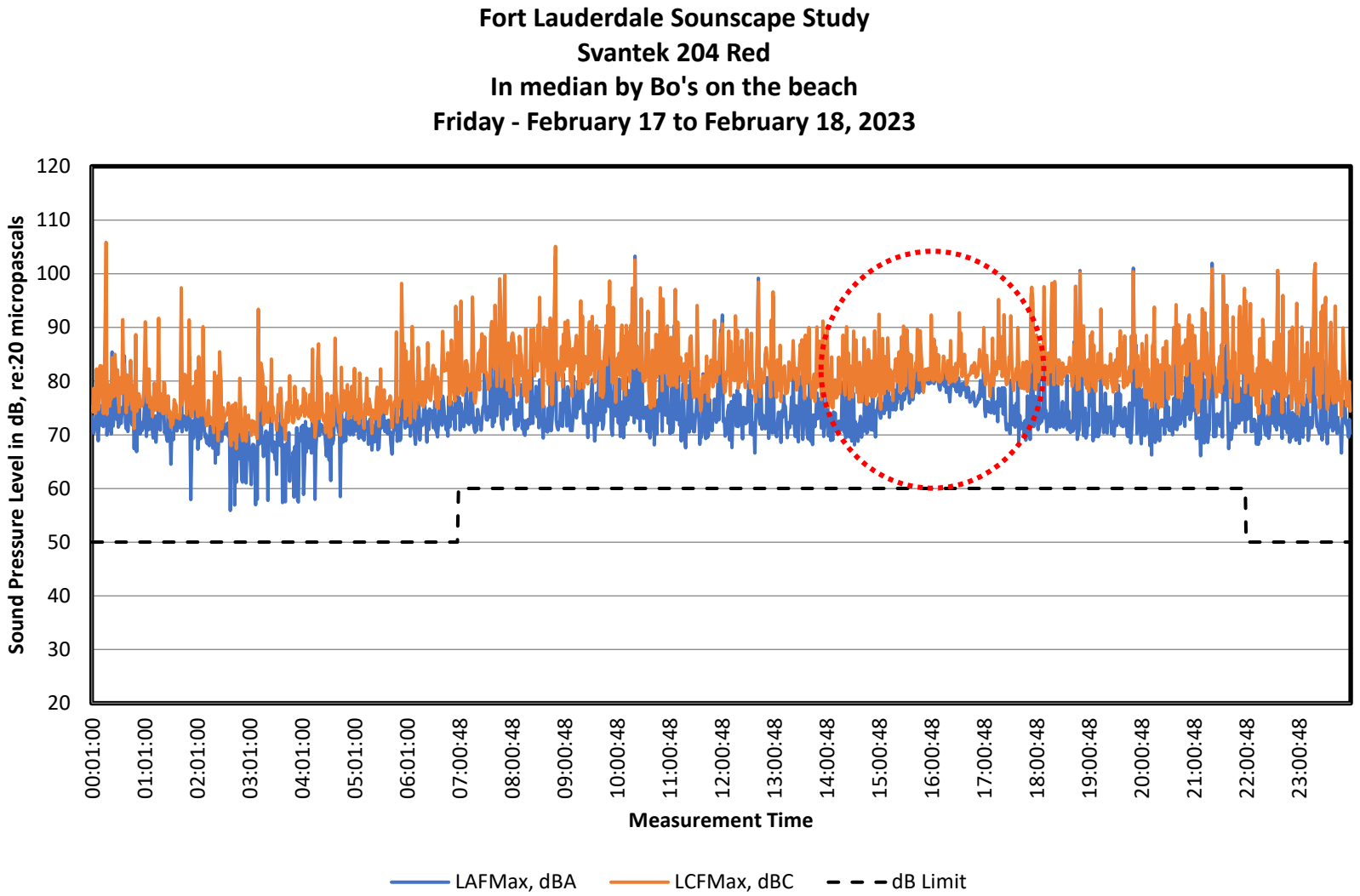
Bo’s on the Beach



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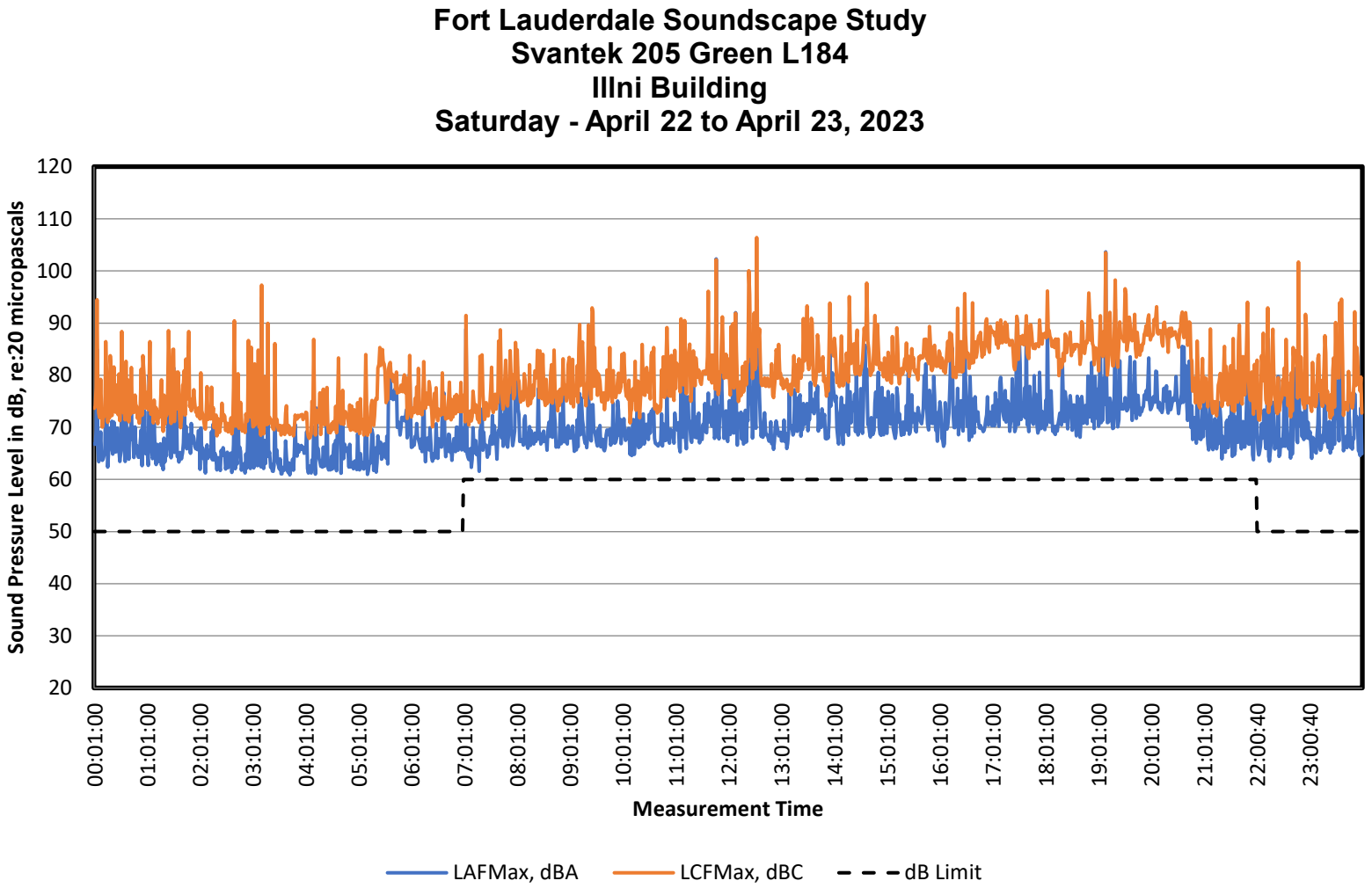
Illni Building Balcony



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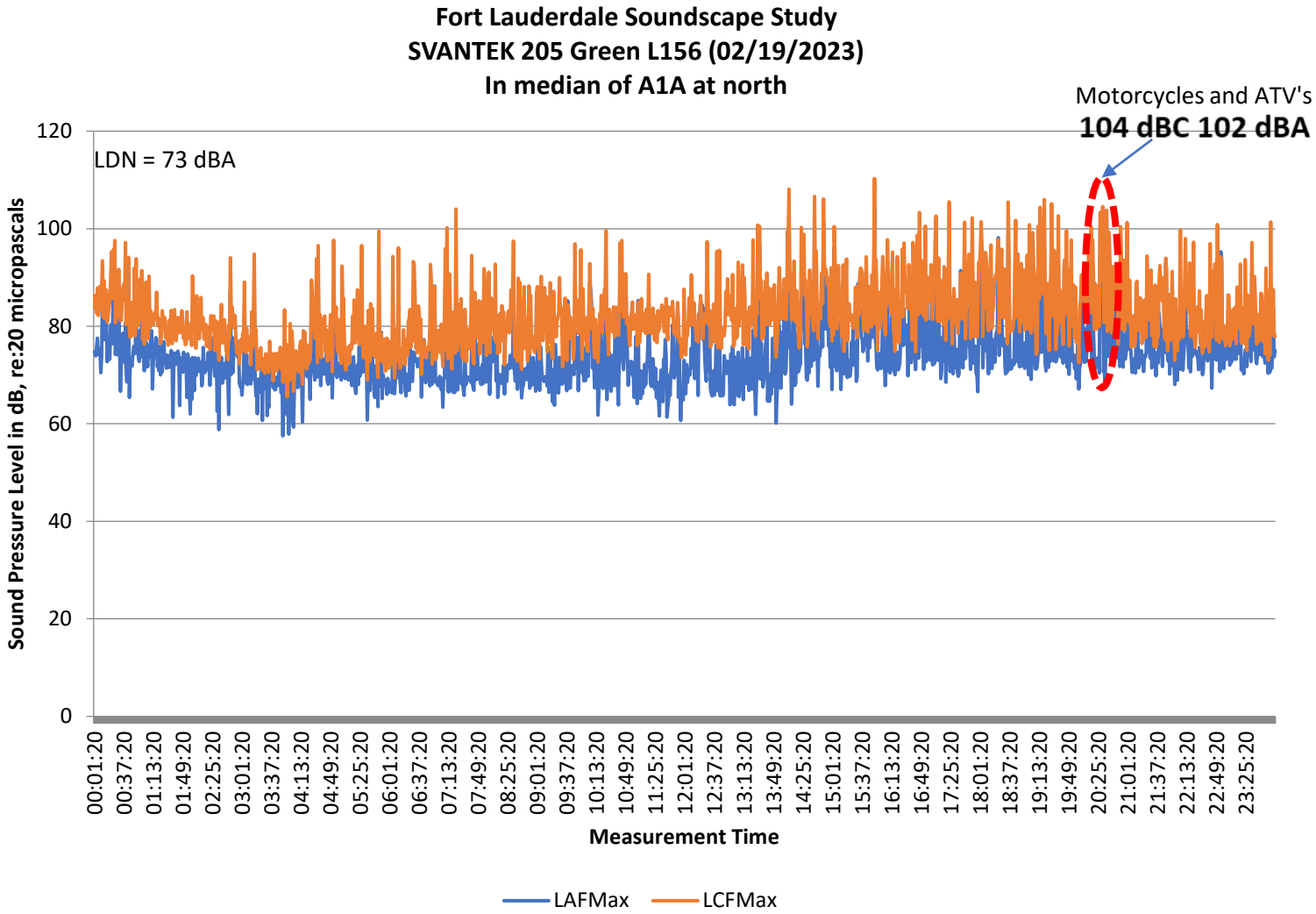
The Beach A1A



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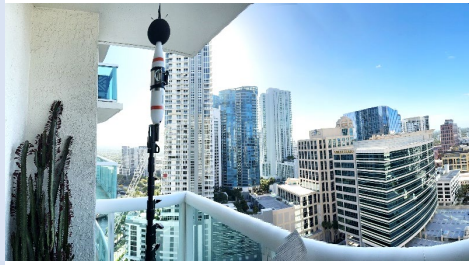
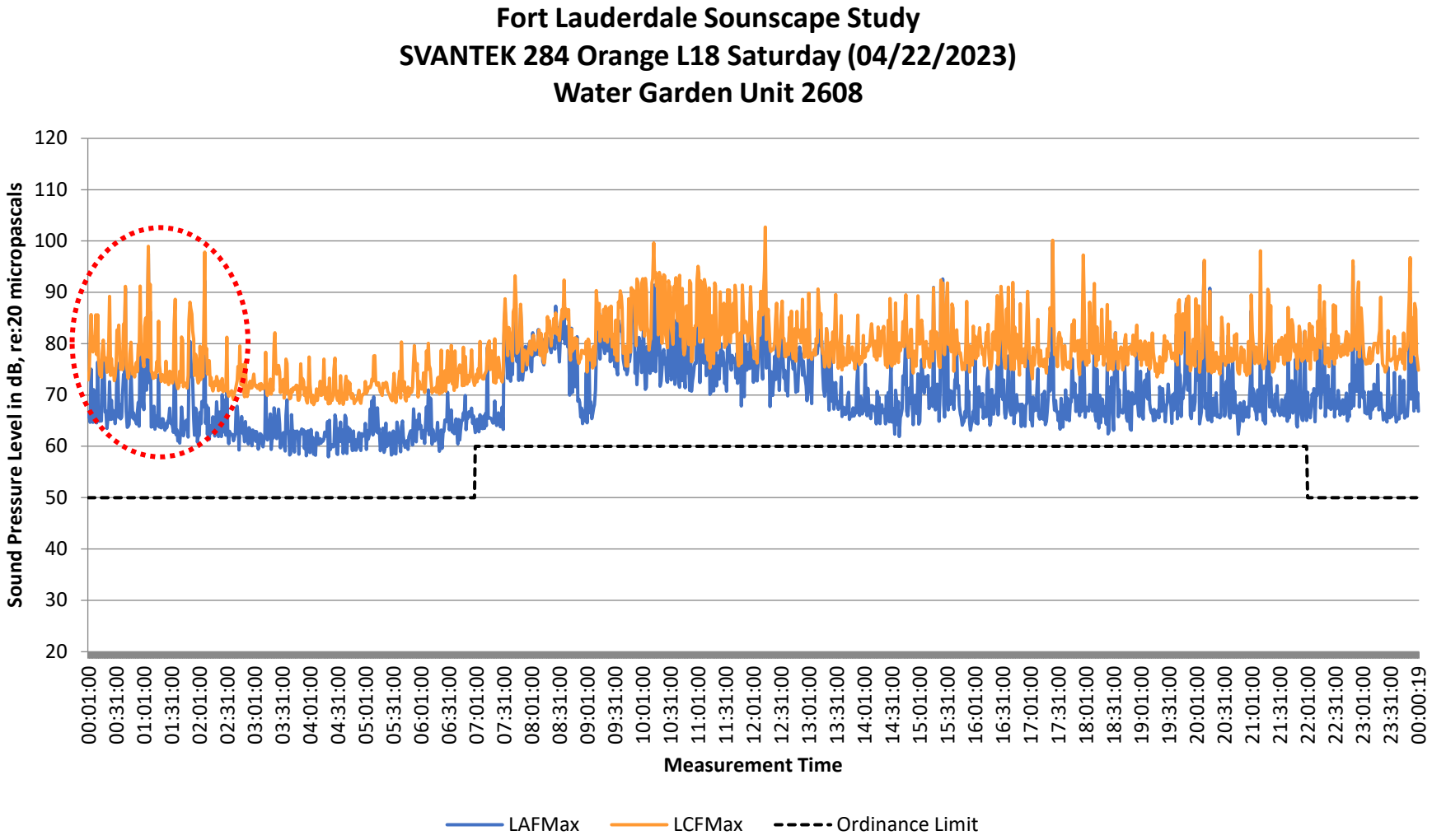
Water Garden 26th Floor





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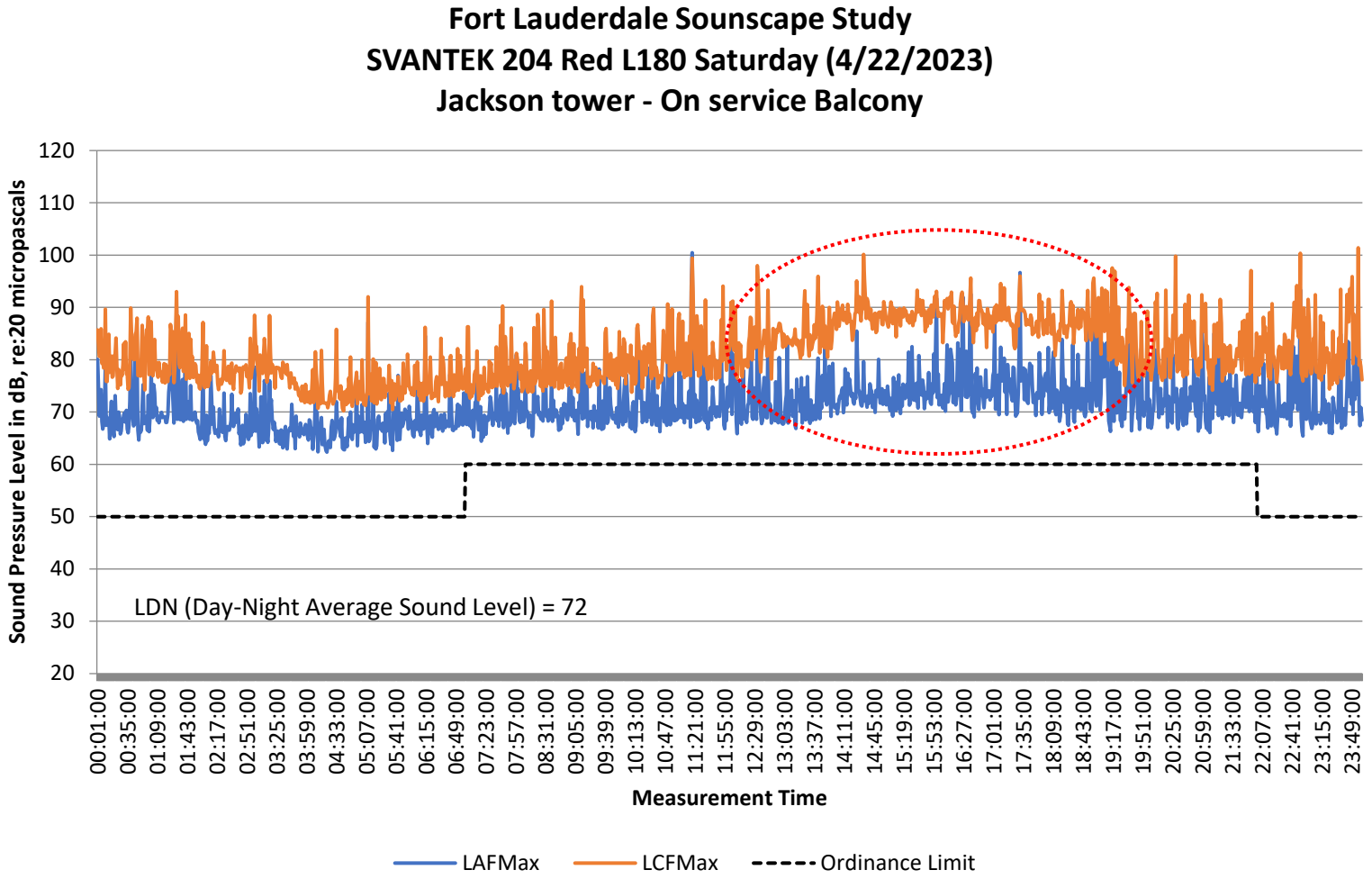
Jackson Tower Balcony



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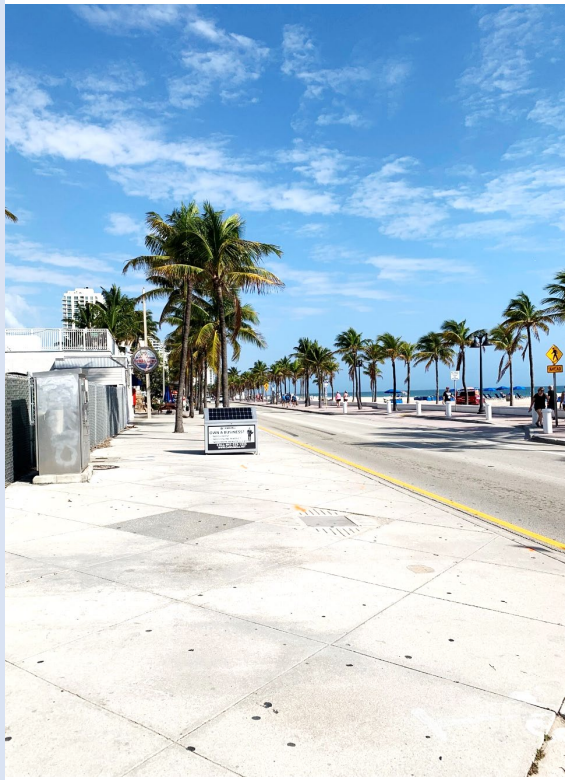
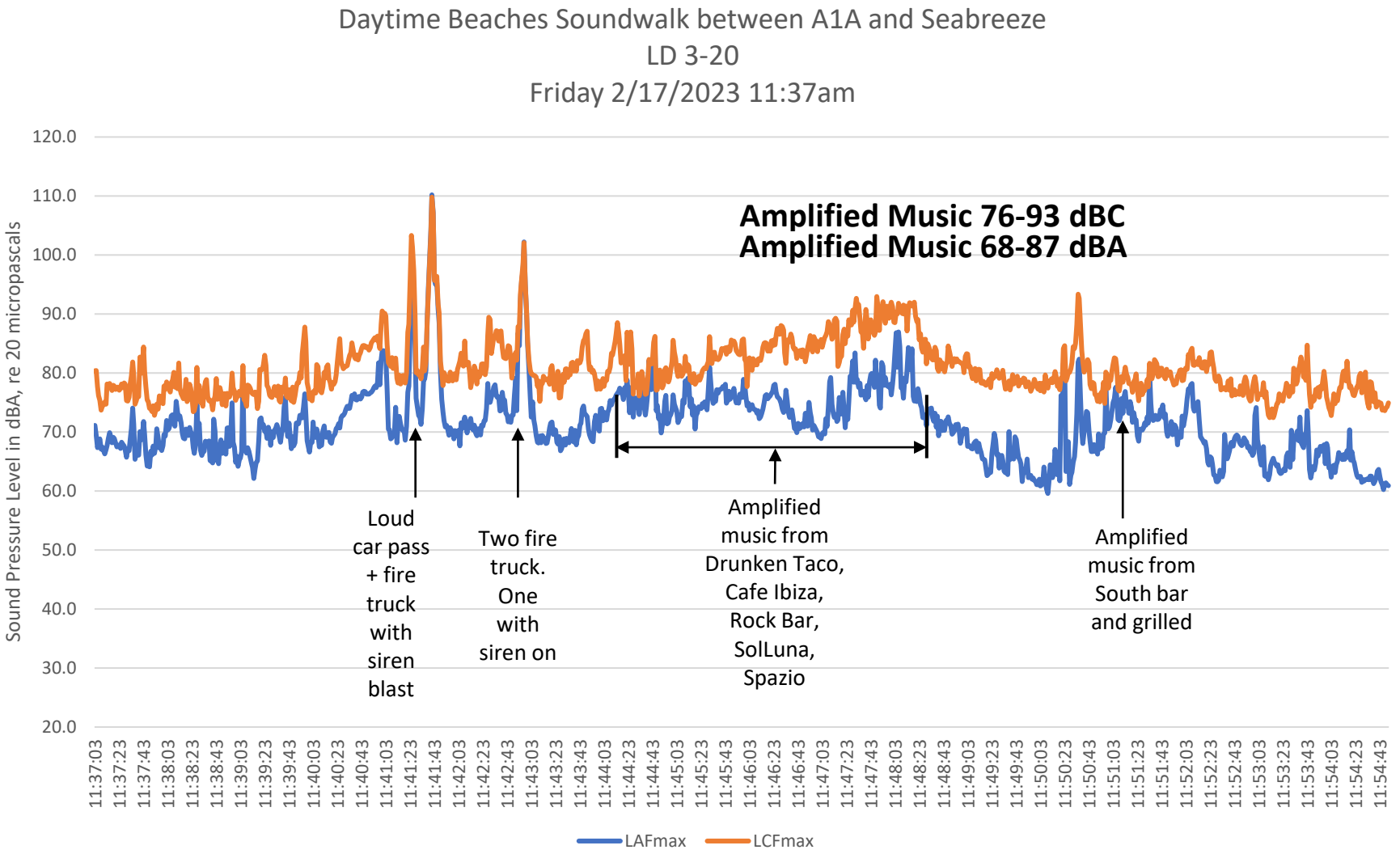
Beaches Soundwalk





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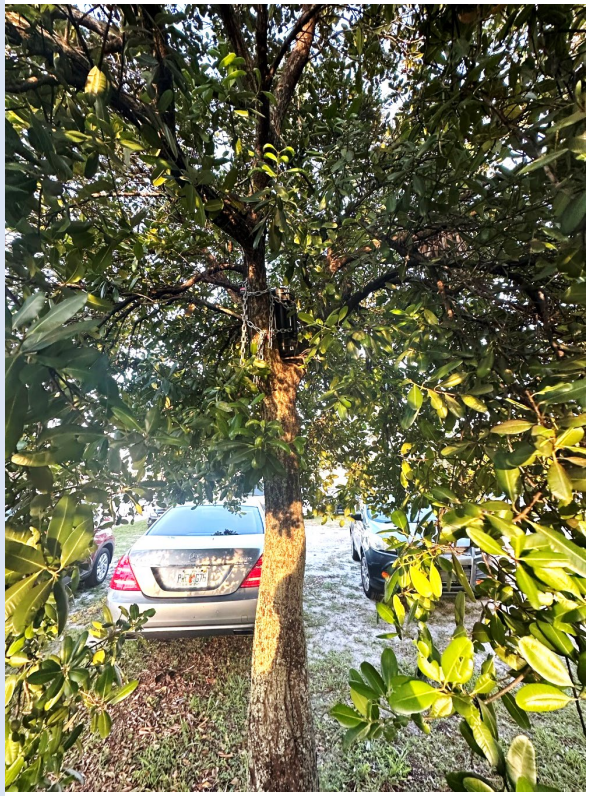
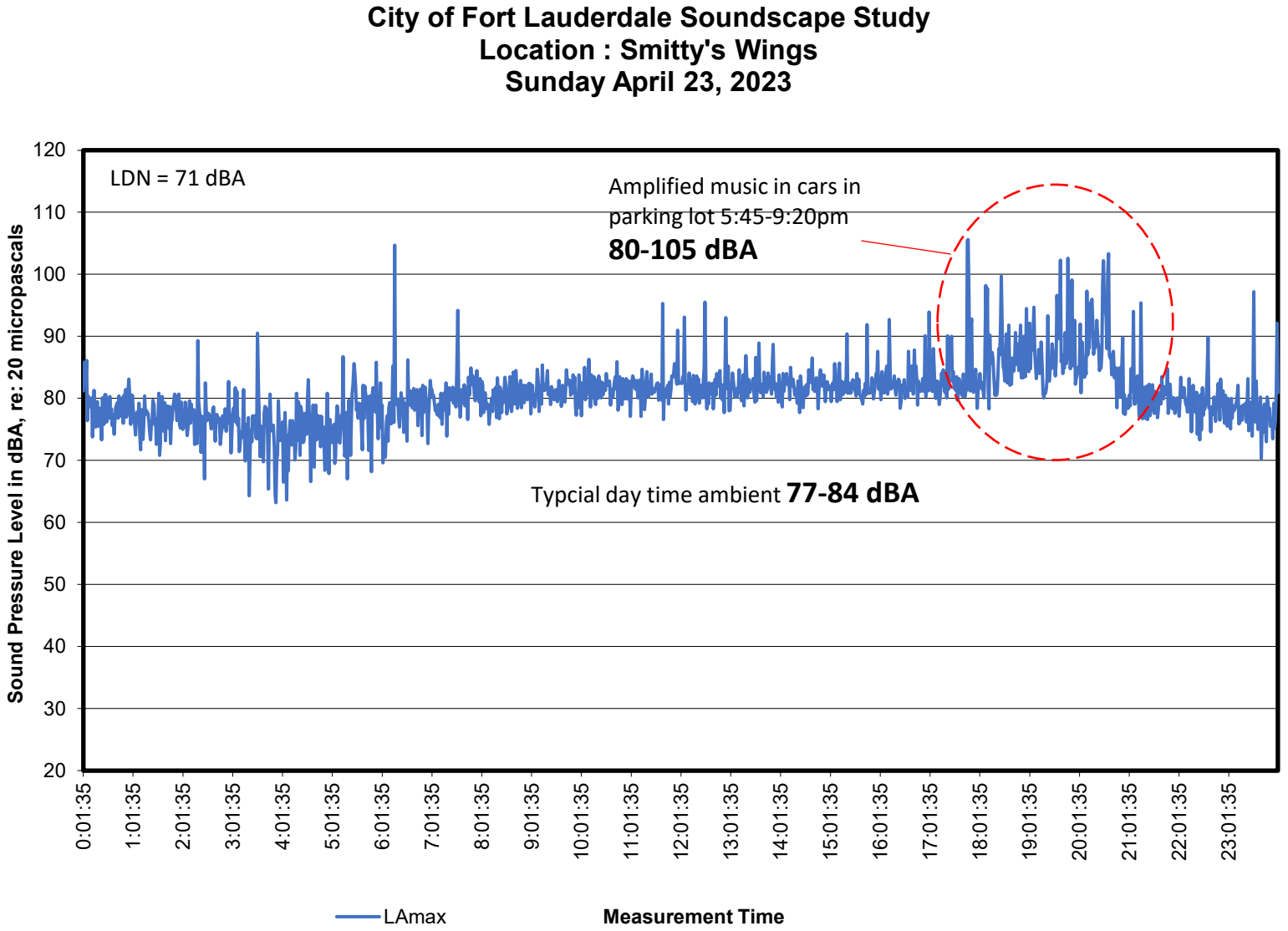
Smitty's





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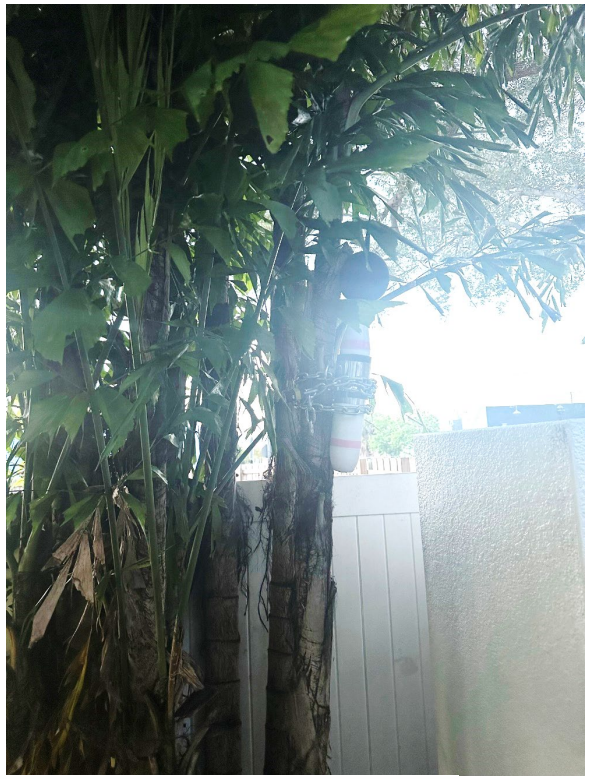
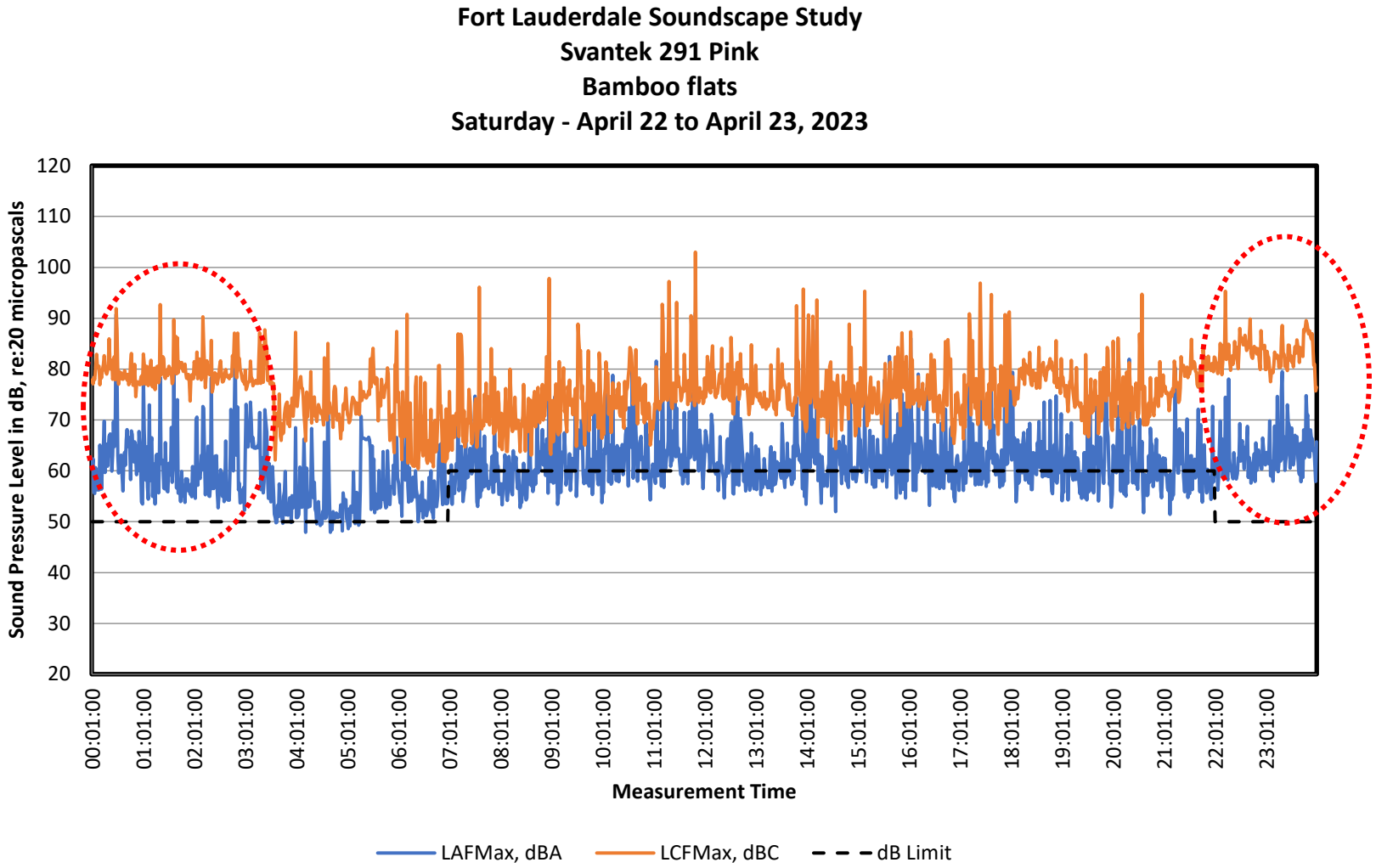
Bamboo Flats





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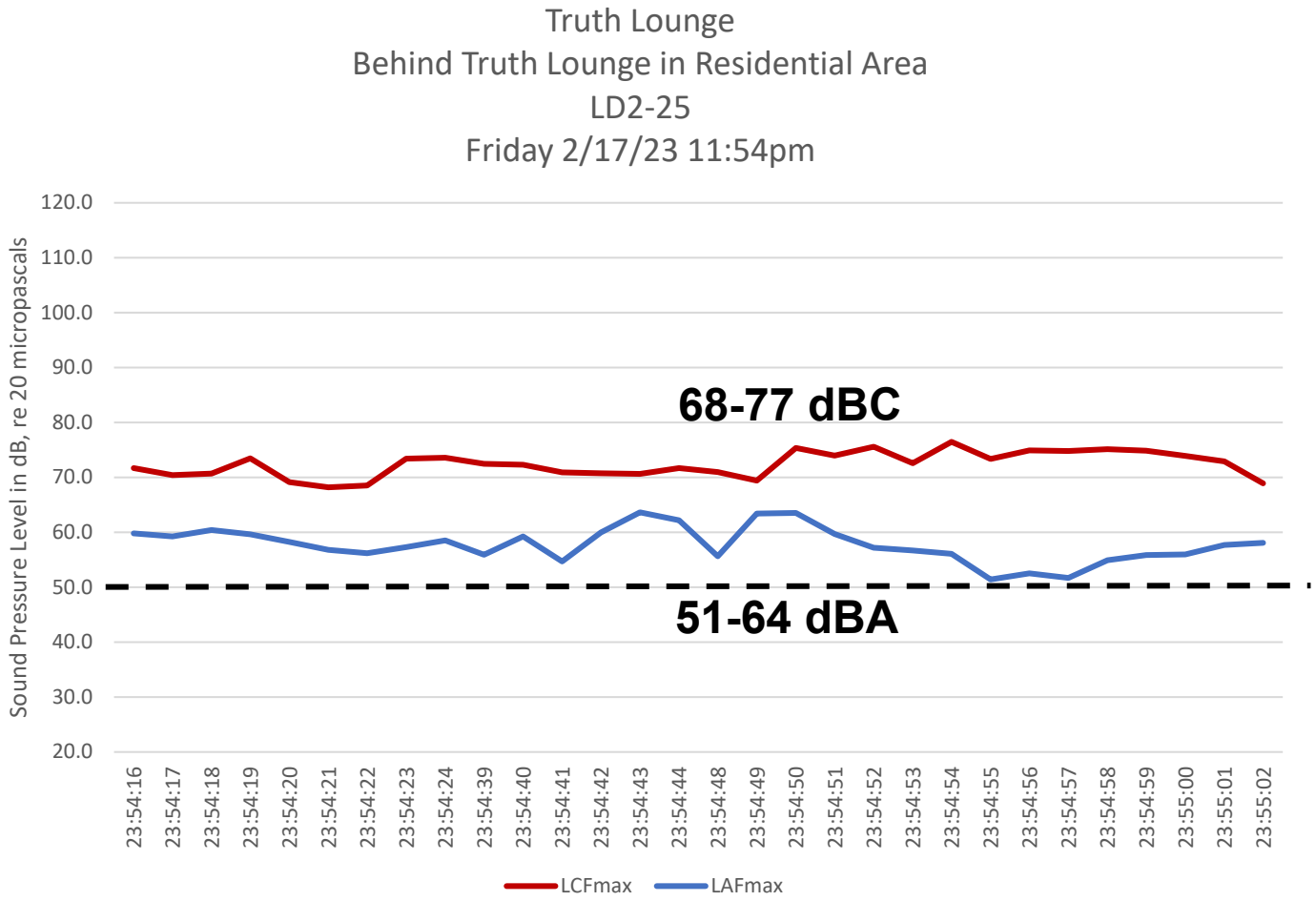
Truth Lounge

Behind in residential area



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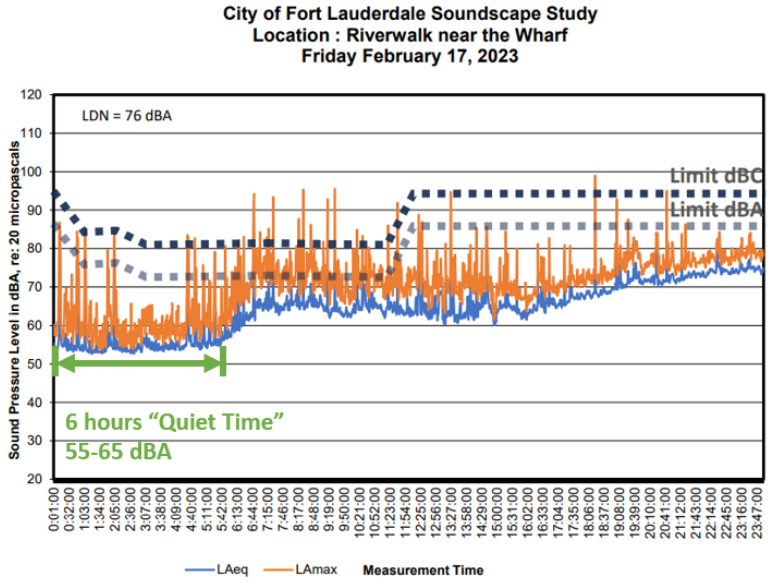
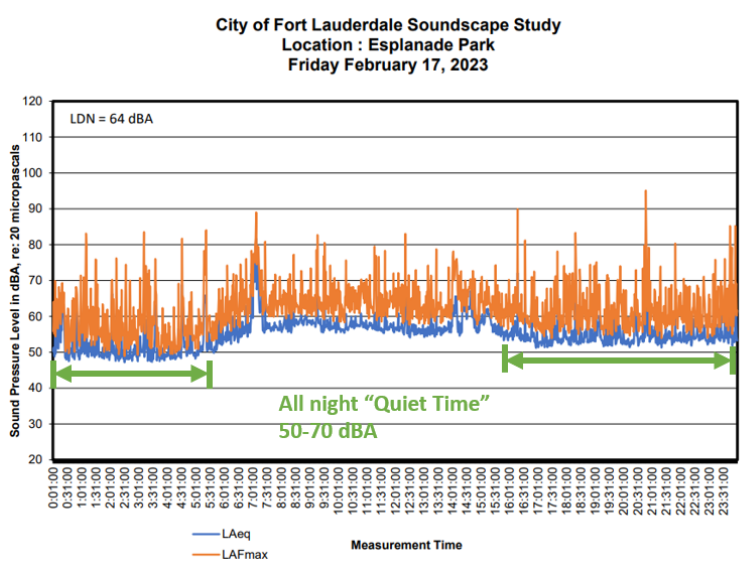
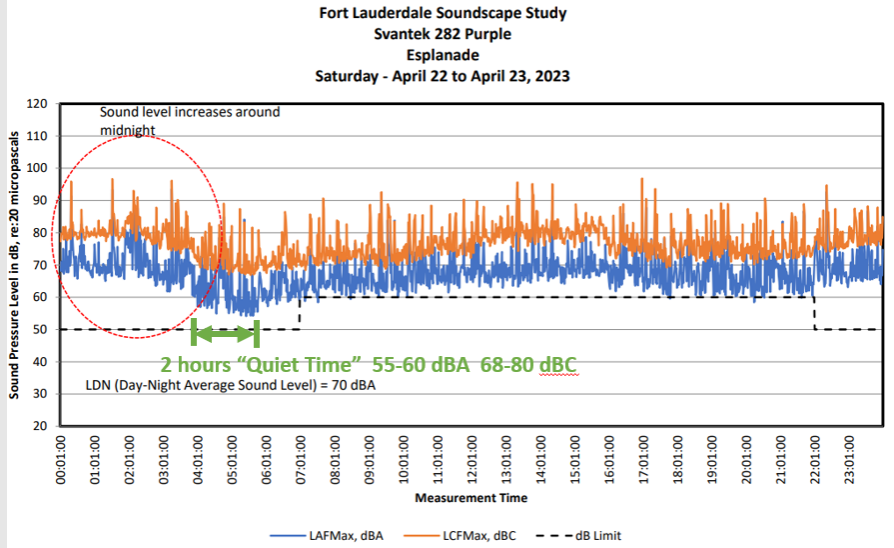
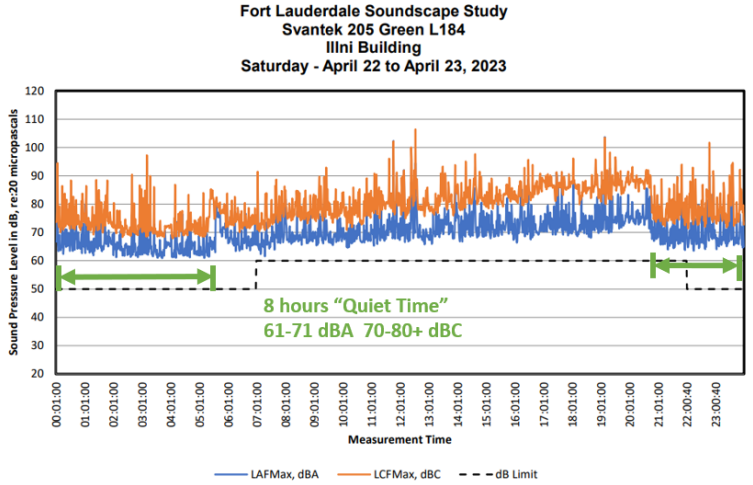
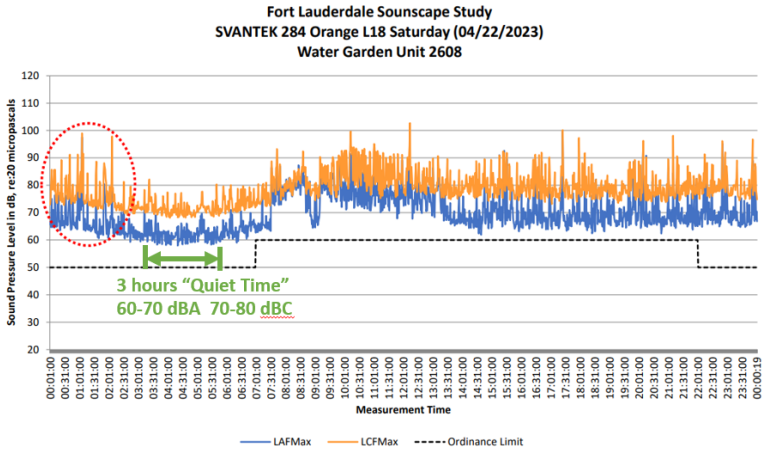
Quiet Times


City of Fort Lauderdale Soundscape Study
Location : Riverwalk near the Wharf
Friday February 17, 2023
LDN = 76 dBA
Limit dBC
Limit dBA
6 hours "Quiet Time"
55-65 dBA
Sound Pressure Level in dBA, re: 20 micropascals
LAeq
LAmax
Measurement Time

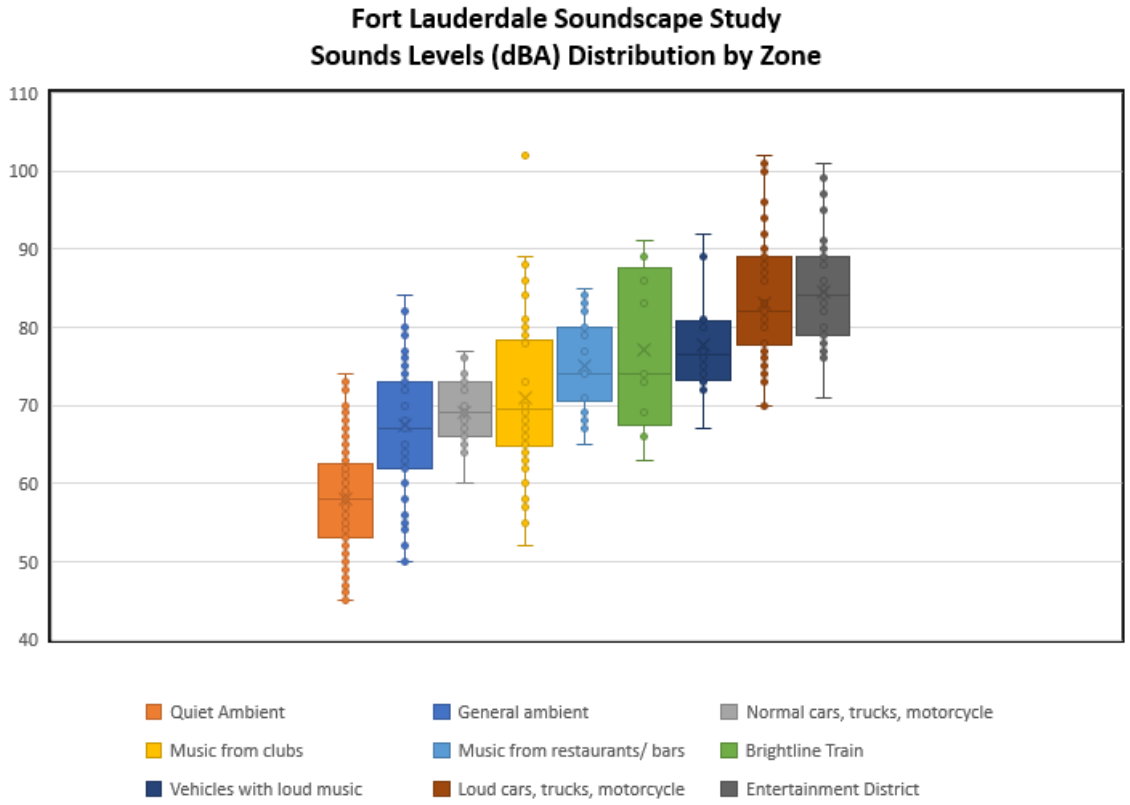

City of Fort Lauderdale Soundscape Study
Location : Esplanade Park
Friday February 17, 2023
LDN = 64 dBA
All night "Quiet Time"
50-70 dBA
Sound Pressure Level in dBA, re: 20 micropascals
LAeq
LAFmax
Measurement Time

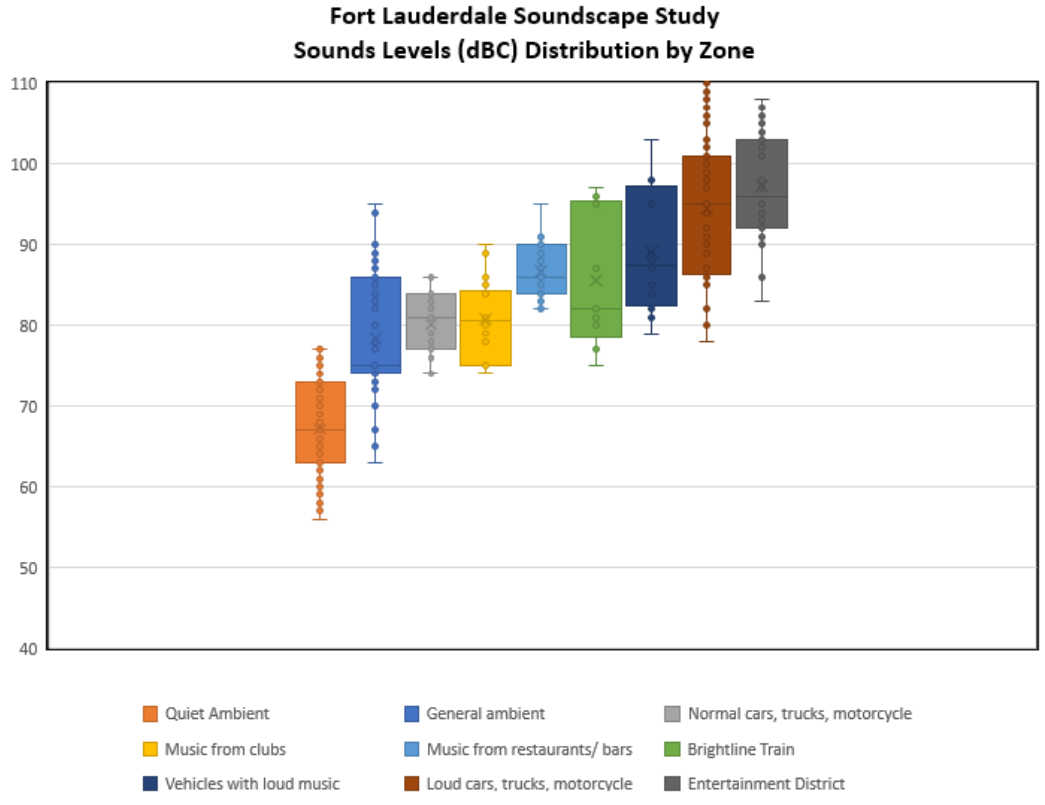

Fort Lauderdale Soundscape Study
Svantek 282 Purple
Esplanade
Saturday - April 22 to April 23, 2023
Sound level increases around midnight
2 hours "Quiet Time" 55-60 dBA 68-80 dBC
LDN (Day-Night Average Sound Level) = 70 dBA
Sound Pressure Level in dB, re:20 micropascals
Measurement Time
LAFMax, dBA
LCFMax, dBC
dB Limit


Fort Lauderdale Soundscape Study
Svantek 205 Green L184
Illni Building
Saturday - April 22 to April 23, 2023
8 hours "Quiet Time"
61-71 dBA 70-80+ dBC
Sound Pressure Level in dB, re:20 micropascals
Measurement Time
LAFMax, dBA
LCFMax, dBC
dB Limit


Fort Lauderdale Sounscape Study
SVANTEK 284 Orange L18 Saturday (04/22/2023)
Water Garden Unit 2608
3 hours "Quiet Time"
60-70 dBA 70-80 dBC
Sound Pressure Level in dB, re:20 micropascals
Measurement Time
LAFMax
LCFMax
Ordinance Limit

BOX AND WHISKER PLOT



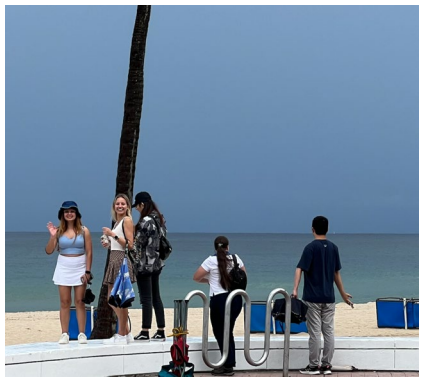


Soundscape Intervention:

academic studies and schematic proposals for locations in Fort Lauderdale, FL

Students from the University of Florida School of architecture participated in developing architectural and planning strategies that respond to the soundscape at locations of interest that were identified as part of the larger soundscape study with Siebien Acoustic and the UF School of Architecture.

2 Graduate Courses
11 students
5 sites



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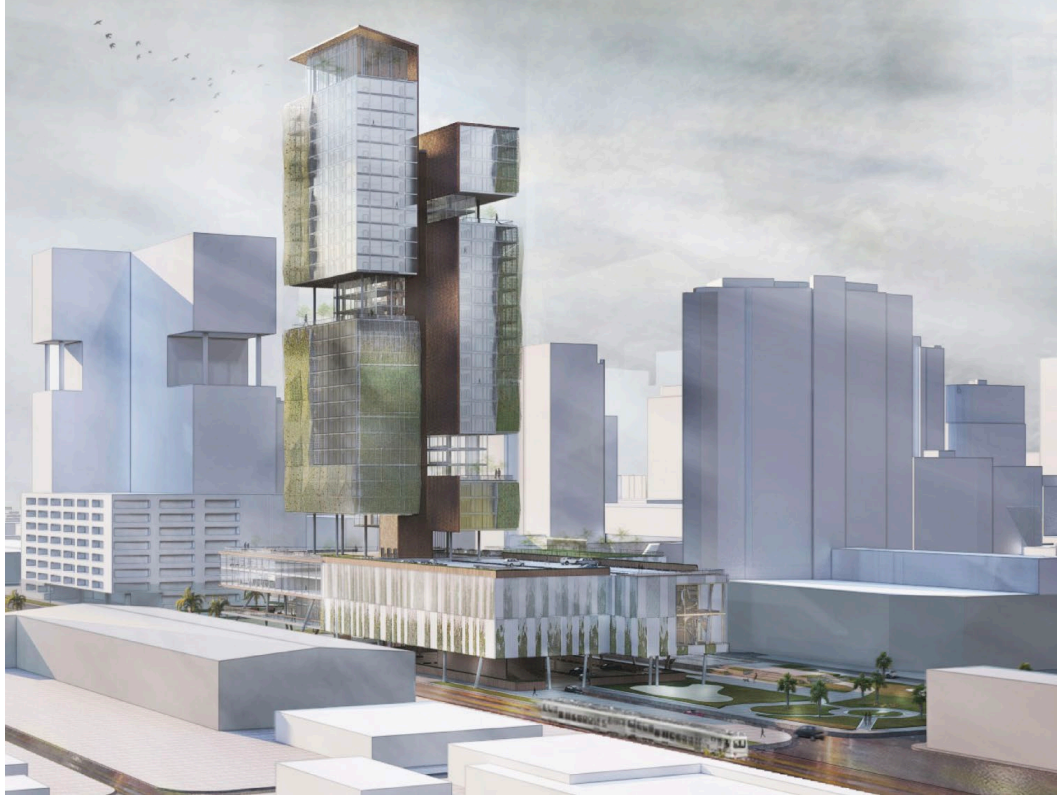
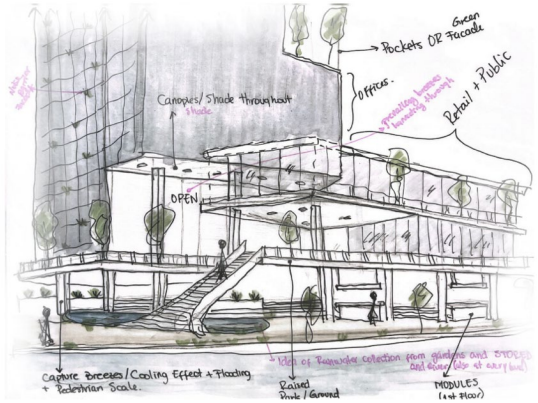
Summary of Findings

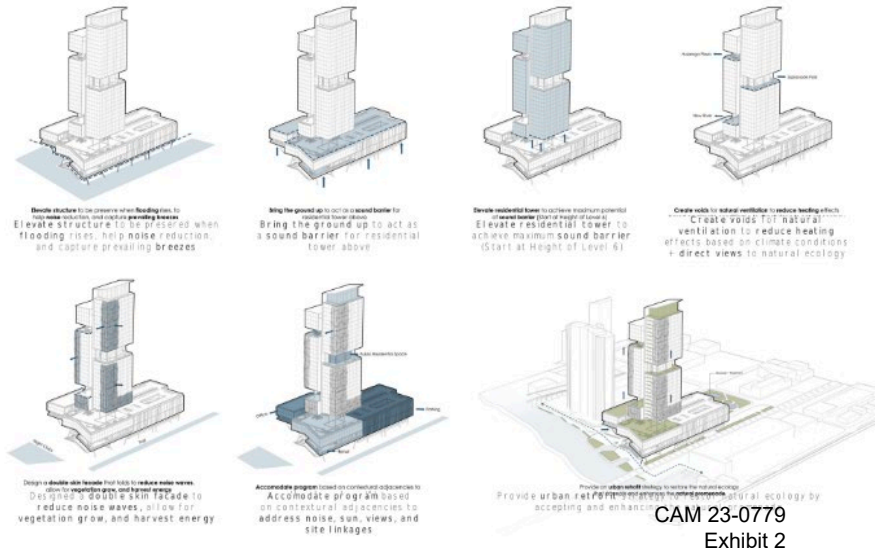
- **Vertical distance** can be an effective sound abatement strategy.
- **Sound level limits at the windows or balconies** established as a nuanced implementation of property line standards.



Pedestrian and Environmental Edge



Massing Diagrams



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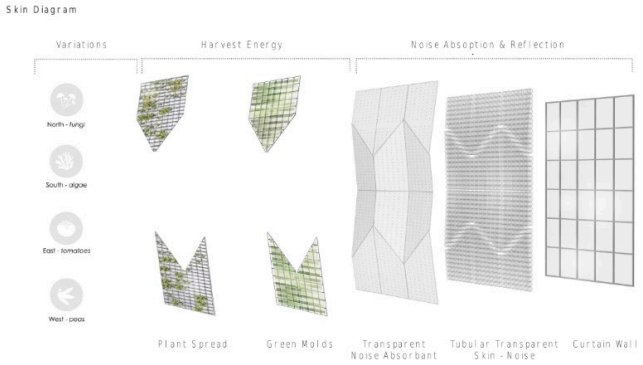
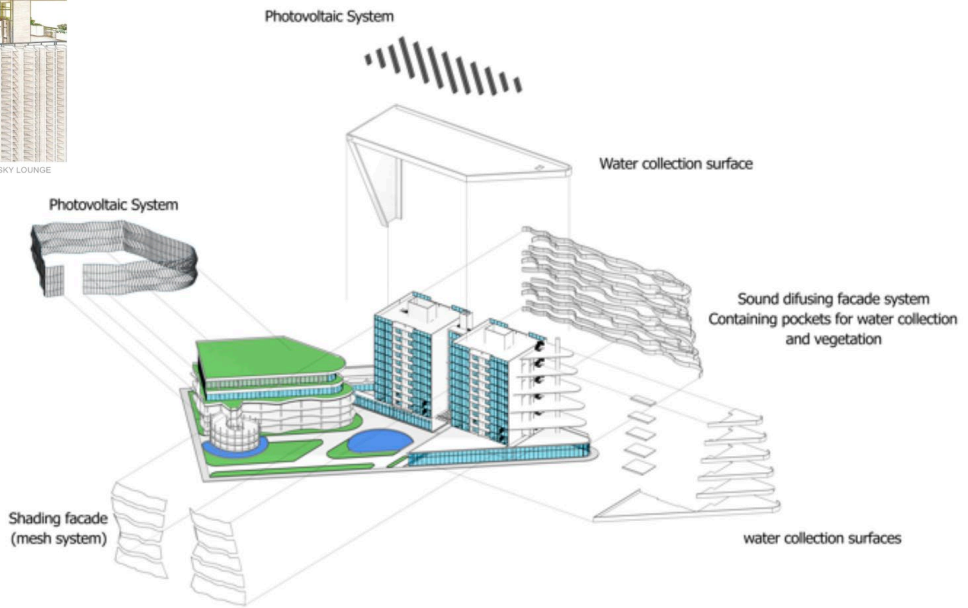
Summary of Findings

- **Building envelope systems** (walls, doors, windows) could be required that, as a system would limit the amount of sound that is transmitted through them - OITC.

- Buildings themselves could **absorb and diffuse** the sounds striking them rather than reflecting and subsequently amplifying the sounds.




RESIDENTIAL SKY LOUNGE



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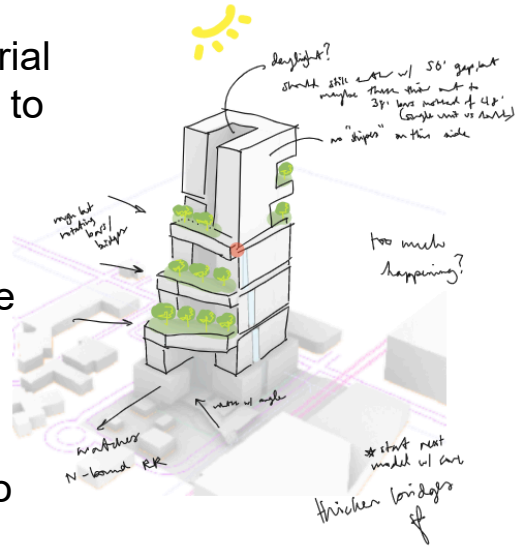
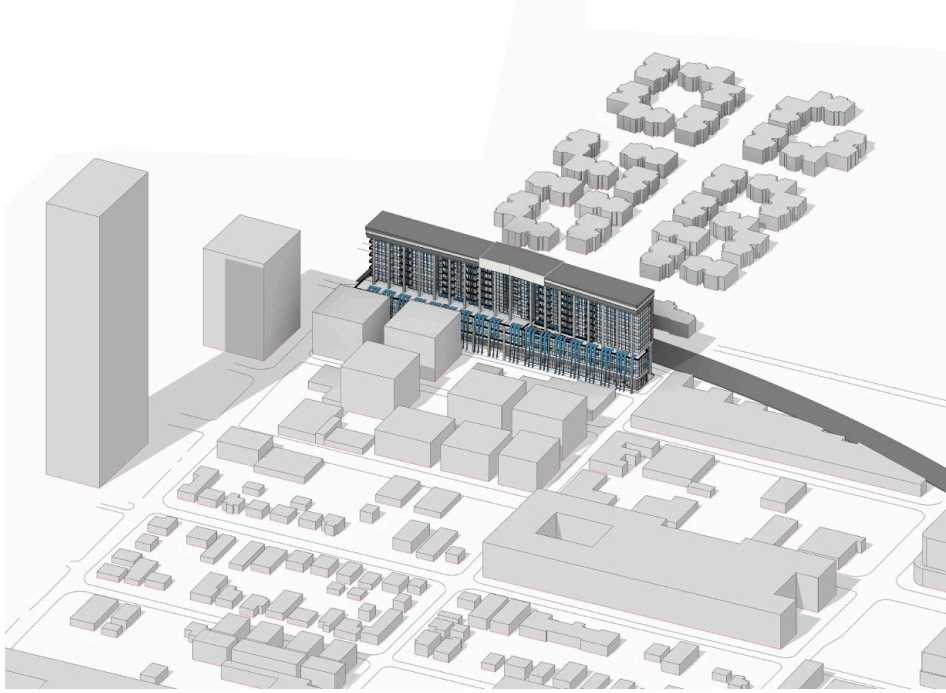
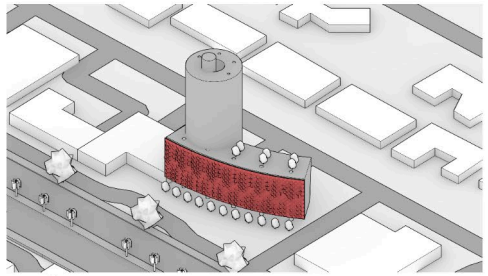
Summary of Findings

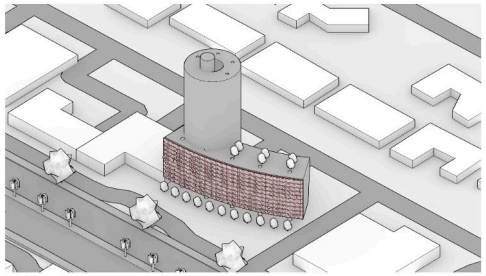
- **Strategic zoning** could incentivize designs, along arterial corridors that fill the sites and provide acoustic barriers to the residential neighborhoods behind them.
- **Sound locks or buffer spaces** between noisy interior programs such as loud clubs or manufacturing could be implemented to control intermittent loud sounds from emanating from a building.
- **Rooftop and elevated terraces**, can allow residents to find peaceful spaces within their larger buildings.

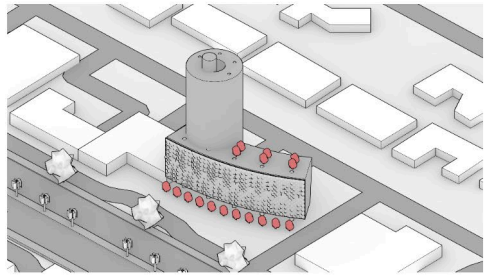




Facade Elements


Panels


Substructure


Trees

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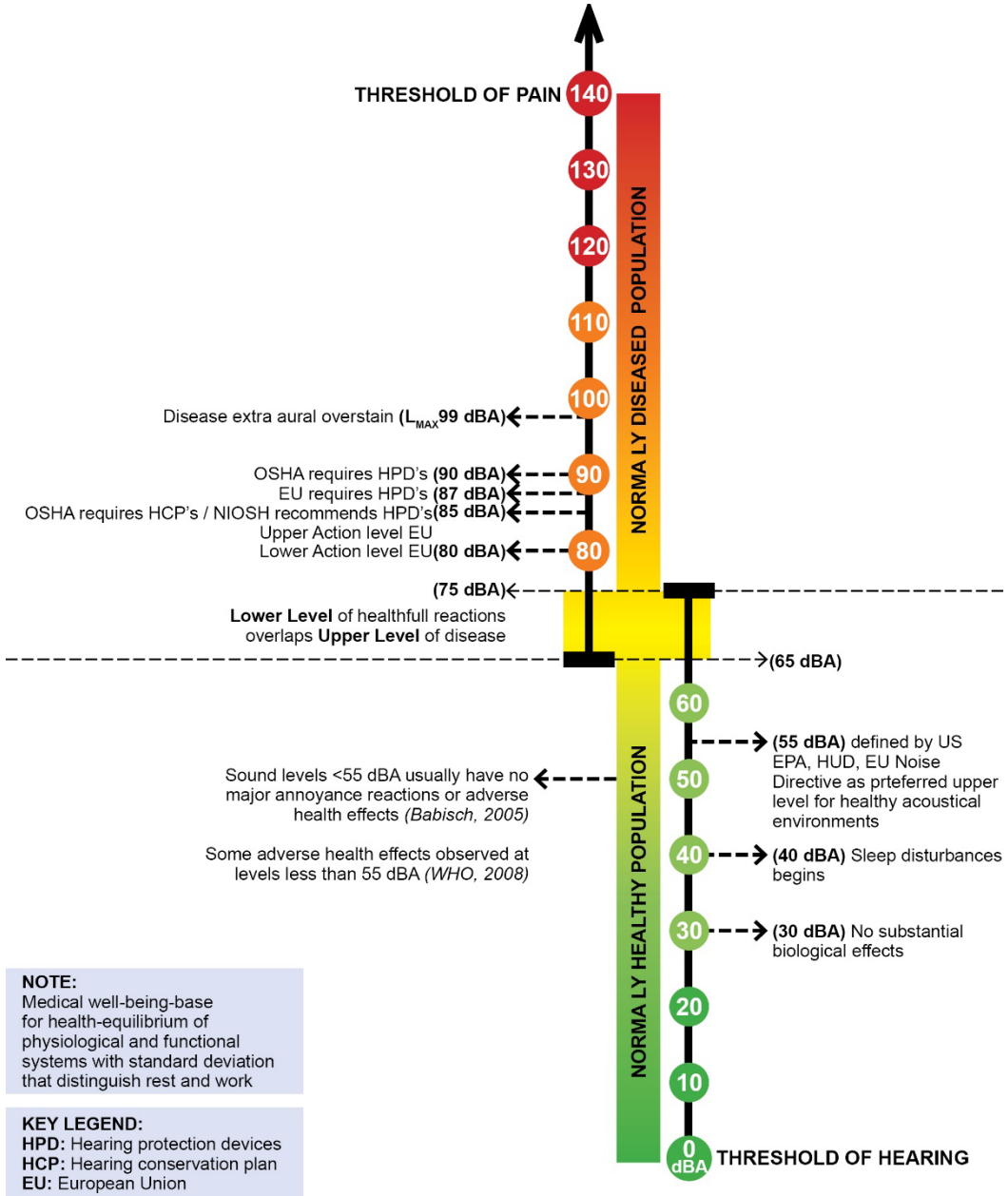
HEALTH EFFECTS OF NOISE



NOTE:
Medical well-being-base for health-equilibrium of physiological and functional systems with standard deviation that distinguish rest and work

KEY LEGEND:
HPD: Hearing protection devices
HCP: Hearing conservation plan
EU: European Union

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NOISE REDUCTION LEVELS (NLR) REQUIRED TO MEET DIFFERENT INTERIOR SOUND LEVELS IN DBA FOR GIVEN EXTERIOR SOUND LEVELS IN DBA

	Interior Sound Level (dBA)					
	HUD	HUD+	ASHRAE	ISO C	ISO B +Typ. Luxury	ISO A
	45	40	35	30	25	20
Exterior Sound Level (dBA)	Noise Level Reduction (NLR) in dB to Reach Interior Sound Level					
90	48	53	58	63	68	73
85	43	48	53	58	63	68
80	38	43	48	53	58	63
75	33	38	43	48	53	58
70	28	33	38	43	48	53
65	23	28	33	38	43	48
60	18	23	28	33	38	43
55	13	18	23	28	33	38
50	8	13	18	23	28	33

Notes:

Readily achievable NLR with typical “hurricane glass”

NLR attained with upgraded glass

Special acoustical construction; difficult to achieve

NLR numbers (dB), based on HUD’s online STrCAT Tool analysis, could be 0 to -3 dB if other criteria are applied: such as FGI, UFC and other standards.

In addition to the NLR of the exterior assembly, the assembly’s sound reduction in the lower frequencies is important to consider where the sources of sound are large trucks on a highway, railroads with diesel engines, amplified music or other sound sources with low frequency content. This is an especially important criterion in buildings with large areas of windows, sliding glass doors or other glazed openings because glass has relatively low sound reductions in the low frequencies even with laminated glass with multiple panes.

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THANK YOU FOR YOUR TIME!

Gary W. Siebein
Keely M. Siebein
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