HAND OUTS

CITY COUNCIL SPECIAL MEETING

JULY 5, 2022

What can possibly change over the next 60 days

Alena Callimanis

La Quinta Residents for Responsible Development

What does the EIR say about noise

FINDINGS

The August 15, 2021, Surf Ranch noise measurements show that wave machine cable roller system improvements reduced the peak wave event noise levels from 75.7 to 73.5 dBA Leq. This represents a noise level reduction of approximately 2.2 dBA Leq. The updated noise level measurements suggest that the peak noise levels outlined in the March 17, 2021, Coral Mountain Specific Plan Noise Impact Analysis conservatively overstate the Project related wave machine by approximately 2.2 dBA Leq.

TABLE 1: NOISE LEVEL MEASUREMENT SUMMARY

Location[1]	Peak Wave Noise Event (dBA L_{eq})[2]	
	4/13/2020	8/15/2021
L1	73.8	71.6
L2	69.3	71.0
L3	62.6	62.4
L4	71.6	73.5
L5	75.7	71.4
Peak Wave Event	75.7	73.5

[1] See Exhibit 5-A for the noise level measurement locations.
[2] Energy (logarithmic) average levels. The long-term 24-hour measurement worksheets are included in Appendix 5.2.
"Daytime" = 7:00 a.m. to 10:00 p.m.; "Nighttime" = 10:00 p.m. to 7:00 a.m.

Note: L4 is the location of the start up cable roller system and will be located close to Coral Mountain and close to Lisa Castro's house

Points to Consider

- City Noise Ordinance says Daylight is 7AM to 10PM!!!
- Wave is Every three minutes, 365 days per year
- First study was only the wave, second included one jet ski and one announcement at beginning of wave
- Where are the crowds, screaming, warning horns, music, multiple jet skis since wave is bi-directional, all echoing off Coral Mountain
- As John Pena says we have echoing off our Santa Rosa Mountains
- It was a software only test, no actual noise test done on site, there were only noise receptors

Video

Property Taxes to La Quinta at bond retirement before or by 2033

- Existing residences at PGA West Greg Norman, The Palms and Plaza Serena, Andalusia, Griffin Ranch, Trilogy, Santa Rosa Trail, Lion's Gate, Santerra and Alta Verde.
- Today's total assessed value = $2,155,196,284
- Riverside County Property tax = 21,551,962.8
- 6.5 cents to a dollar to La Quinta = $1.4 M

- Does not consider all the new developments in the Thermal Redevelopment Area or new residences in these existing developments
- Assessment Increases
- Coral Mountain as Residences only, no golf course, with special assessments with the gorgeous location, dark skies, club house, community pool, pickle ball and tennis courts, quiet

Development Agreement Timeline

Table 1
Development Agreement Performance Schedule Summary

Project Component	Years
Wave Basin and some resort residential and hotel development (quantities undefined)	3-5
Completion of hotel and balance of resort residential (quantities undefined)	5-10
8,000± SF of Neighborhood Commercial	3-6
220 single family units in Planning Area 2	8-15
11,000± SF Neighborhood Commercial	9-12
250 single family units in Planning Area 2 (balance of single-family units)	15-22
41,000± SF Neighborhood Commercial	20-23

Per the Staff Report: With the revenue generated by Transient Occupancy Tax from the hotel and short-term vacation rentals on the site, the project is fiscally positive, generating a net revenue of up to $1.9 million annually at build out. As the project is to be built in phases, the actual costs and revenues are dependent on which portions of the project are constructed in any given year.

Colorado River Basin

- You have received links to every article and you tube clip on this topic
- Mr. Gamlin says if we don't get another drop of Colorado River Water the aquifer is good for several hundred years
  - Mr. Gamlin, the Sustainable Groundwater Management Act of 2014 prohibits overdraft of the aquifer. You can't take out more than you can replenish
- I have given you the relevant CVWD pages regarding State Water Project allocations of 5% that CVWD ignored in their December report, and how they assumed they were still getting their maximum allocations of Colorado River Water
- The development as proposed is 940,000 gallons per day or .5% of CVWD annual supply
- Add in the STVRs and undercalculated evaporation due to high temperatures, wind and wave action, it is over 1 million gallons a day

The City Must Show the Initiative to Reduce Water Usage

- No Golf Course is currently approved for Coral Mountain – just a developer fear tactic, which is ironic given Mr. Gamlin's association with Silver Rock

- Being in the current Zoning does not mean a golf course will be there if the Wave Basin is not approved

- You must work with the Golf Courses to implement Links-Style irrigation – only irrigate greens and fairways

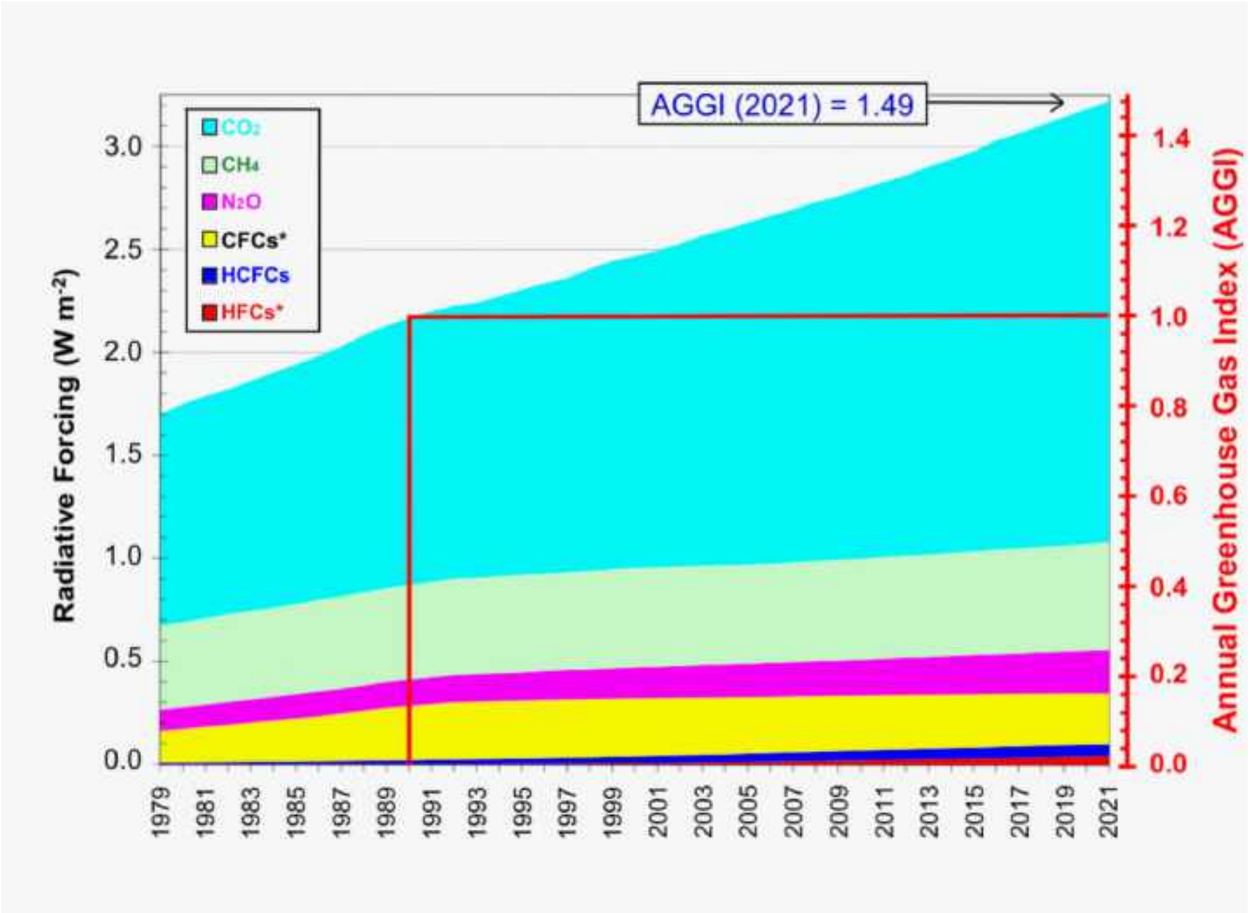
Non-Mitigatable Green House Gases

- From Council Member Radi's recommended site, National Oceanic and Atmospheric Administration: Monday, May 23, 2022
- Greenhouse gas pollution caused by human activities trapped 49% more heat in the atmosphere in 2021 than they did in 1990, according to NOAA scientists.

The biggest culprit:

- Carbon dioxide, or CO_2, is by far the most abundant human-emitted greenhouse gas. Roughly 36 billion metric tons of CO2 are emitted each year by transportation, electrical generation, cement manufacturing…

Green House Gas Emissions



What causes Coral Mountain's High GHG

- The wave basin's incredible size with over 17 acres of cement since it has to go down into a basin
- The electrical requirements of the wave mechanism
- Just look at special events or just normal weekends. With 4500 people, say 4 people per card, that is 1000 cars.
- Mr. Gamlin said the project designs will save 850 car trips a year!

Non-Mitigatable Aesthetics

- Mr. Gamlin, stop saying people always complain about a development coming into an area that has no development
- Stop comparing us to La Quinta Resort, PGA West or any other development
- None will have 17 eighty foot lights
- None will have a surfing resort, with waves running every three minutes, 365 days a year from 7AM to 10PM
- None will have 600 short term vacation rentals and a 150 key hotel in the middle of established, quiet, residential neighborhoods

All of the items discussed are irrefutable

- The only thing that might change is that the Feds will cut more water to CVWD
- By the way, water can be removed out of our aquifer and sent to the Metropolitan Water District for Distribution to LA and other counties
- Before approaching Palm Springs, the Whitewater River is fed imported water from the Colorado River Aqueduct, managed by the Metropolitan Water District of Southern California.
- Today, MWD stores water from the Colorado River Aqueduct into the Indio Subbasin by Whitewater River for use as needed for MWD

What do YOU as City Officials hope to gain by waiting another 60 days

- This is still the wrong project anywhere in desert

CHAPTER 6: WATER SUPPLY

6.1 Overview of Water Supply

The Plan Area relies on a combination of local groundwater, Colorado River water, State Water Project (SWP) exchange water, local surface water, and recycled water to meet water demands. This chapter describes the existing water supplies available to the Plan Area and discusses the key assumptions associated with each water supply source. For the purposes of discussion in this chapter, separate accounting is provided in the following subsections for local groundwater (Section 6.2), local surface water (Section 6.3), Colorado River water (Section 6.4), SWP exchange water (Section 6.5), and recycled water (Section 6.6). Plan scenarios, which assume variable supply assumptions to meet future demands, are described in Chapter 7, *Numerical Model and Plan Scenarios*.

6.2 Local Groundwater

Mountain-front runoff and Whitewater River flows replenish the Indio Subbasin.

Groundwater from the Indio Subbasin represents a source of supply for domestic, agricultural, and municipal water demands. In this arid region, natural recharge to groundwater is limited and groundwater supply historically has been insufficient to satisfy local water demands without leading to overdraft. However, groundwater remains a key part of the supply portfolio for the Plan Area. Moreover, the Indio Subbasin serves an important role in providing storage capacity that is replenished when surface water is available and then utilized when needed, such as during drought or shortage. The Indio Subbasin also serves to convey water through groundwater flow from areas of recharge to areas of discharge, including production wells. For example, the Indio Subbasin receives substantial replenishment with imported water at three Groundwater Replenishment Facilities (GRFs) and distributes this water through the aquifer to production wells.

The overall purpose of the Sustainable Groundwater Management Act (SGMA) is to establish a plan for basin management that achieves long-term groundwater sustainability. A sustainable groundwater basin is one in which the groundwater use is balanced with the replenishment from natural sources, return flows, and artificial recharge. The Indio Subbasin is described in detail in Chapter 3, *Hydrogeologic Conceptual Model* and Chapter 4, *Current and Historical Groundwater Conditions*.

6.2.1 Uses of Groundwater

Local groundwater was the principal source of not only municipal and rural domestic supply, but also of agricultural water supply, until construction of the Coachella Canal in 1949. Groundwater continues to supply municipal, agriculture, golf courses, and other demands such as fish farms and duck clubs (see Chapter 5, *Demand Projections*). Managed aquifer recharge with imported water at the GRFs ensures an adequate supply for users extracting groundwater through numerous production wells. Chapter 2, *Plan Area,* briefly describes the uses of groundwater, and Figure 2-13 illustrates the distribution of groundwater production wells across the Indio Subbasin.

6.2.2 Groundwater Supply

Groundwater has been a principal source of water supply in the Coachella Valley since the early part of the 20th century. Management of groundwater resources requires knowledge of the groundwater balance which is an estimate of the inflows (gains) and outflows (losses) from the groundwater system. Historically, the demand for groundwater annually exceeded the limited natural inflows of the arid Indio Subbasin. Sources of natural inflow to the Indio Subbasin average approximately 60,000 acre-feet per year (AFY) from watershed runoff and subsurface inflows from adjacent Subbasins. Limited natural recharge has been supplemented with imported water supplies beginning with the delivery of Colorado River water through the Coachella Canal in 1949. Imported water is now a major component of the inflows to the groundwater balance of the Indio Subbasin through return flows of applied Colorado River water and managed aquifer recharge. This section discusses the sources of inflows and outflows of the Indio Subbasin and compares the average groundwater balance for the 10-year periods of 2000 to 2009 and 2010 to 2019.

6.2.2.1 Groundwater Inflows

The groundwater inflows to the Indio Subbasin consist of a combination of sources, as listed below.

- **Watershed runoff** including subsurface inflow from mountain front areas and surface runoff from the Whitewater River, Snow and Falls Creek channels, minor tributaries along the San Jacinto, Santa Rosa, and Little San Bernardino mountain front, and several smaller streams that flow during wet years (excluding outflow to Salton Sea and surface water diversions);
- **Subsurface inflows** from the San Gorgonio Pass and Mission Creek Subbasins (note that the Desert Hot Springs Subbasin is a no-flow boundary);
- **Return flow of applied water, treated wastewater, and septic** including deep percolation of water applied to agricultural fields, golf courses, and urban landscapes; septic tanks/leachfield systems, which are distributed across rural portions of the Indio Subbasin and some urban areas; and treated wastewater from municipal wastewater treatment plants; and
- **Imported water recharge** using Colorado River and SWP Exchange supplies, as described in Sections 6.4 and 6.5 below.

Of the above, irrigation return flows and imported water recharge are now the major source of inflows to the Indio Subbasin. Table 6-1 below provides an overview of estimated groundwater inflows comparing the 10-year periods of 2000 to 2009 and 2010 to 2019. Chapter 7, *Numerical Model and Plan Scenarios,* provides estimates of future groundwater inflows for various management scenarios.

6.2.2.2 Groundwater Outflows

Groundwater outflows are part of the Subbasin's water balance, as listed below.

- **Net drain flow and subsurface outflows** including subsurface flow from the agricultural tile drain system to the Coachella Valley Stormwater Channel (CVSC) or directly to the Salton Sea and subsurface outflows to the Salton Sea at the Subbasin boundary; and

- **Groundwater production** for municipal, agricultural, golf and other users who are not served by direct delivery of other sources (non-potable, Canal, or surface water).

Of the above, drain flows are a significant source of outflow from the Indio Subbasin, as tabulated in Table 6-1. The *2010 CVWMP Update* discussed the historical correlation between higher groundwater levels in the East Valley and increased drain flows. The upward gradient resulting from increased groundwater levels serves to flush the more saline water in the shallow and semi-perched aquifers into the drain system. Conversely, groundwater level declines in the deep aquifer could result in a downward gradient that could allow more irrigation return flow to recharge the groundwater basin rather than flow to the drains. Chapter 9, *Sustainable Management,* describes this relationship between groundwater levels, drain flows, and groundwater quality. Chapter 11, *Projects and Management Actions,* includes a proposed study of the correlation between groundwater levels, vertical gradients, drain flow volume, and salinity export.

Table 6-1 provides an overview of estimated average groundwater inflows and outflows over the 10-year periods from 2000-2009 and 2010-2019. The groundwater balance for the 2010-2019 period shows average gains of 49,100 AFY compared to the 2000-2009 period when the basin was losing 110,000 AFY on average. As described in Chapter 4, *Current and Historical Groundwater Conditions,* implementation of the *2010 CVWMP Update* has reversed decades of declining groundwater levels. The groundwater balance over the last decade has been positive, contributing to increasing storage in the Subbasin. Chapter 7, *Numerical Model and Plan Scenarios,* provides estimates of future groundwater inflows and outflows across the various management scenarios.

Table 6-1. Indio Subbasin Groundwater Balance (2000-2009 and 2010-2019)

--	2000-2009 Average (AFY)[a]	2010-2019 Average (AFY)[b]
Groundwater Inflow		
Natural Infiltration[c]	29,000	28,800
Subsurface inflows[d]	11,000	11,800
Return flow of applied water, treated wastewater, and septic[e]	240,000	162,000
Imported water recharge[f]	51,000	178,400
Total Groundwater Inflow	**331,000**	**381,500**
Groundwater Outflow		
Net drain flow and subsurface outflows[g]	52,000	46,800
Groundwater production	389,000	285,600
Total Groundwater Outflow	**441,000**	**332,400**
Change in Storage (10-Year Average)	**-110,000**	**+49,100**

Note Colorado water influx

Deficit not made up

[a] 2000-2009 averages from *2010 CVWMP Update*.
[b] 2010-2019 averages are based on historical conditions as measured or simulated in the numerical model.
[c] Natural infiltration of watershed runoff excludes surface diversions and net stormwater outflow through the CVSC to the Salton Sea.
[d] Subsurface inflows are simulated using the numerical model described in Chapter 7, *Numerical Model and Plan Scenarios*.
[e] Return flows from applied water, septic system, and treated wastewater percolation minus evapotranspiration.
[f] Imported water recharge minus evaporation.
[g] Net drain flow includes subsurface outflow from the agricultural complex and excludes discharges from wastewater treatment plants and regulatory water.

6.2.3 Groundwater Storage

The geologic framework of the Indio Subbasin is described in Chapter 3, *Hydrogeologic Conceptual Model*. This framework defines the Subbasin's storage capacity, namely its lateral basin boundaries (bedrock boundaries and faults), depth of the basin bottom (insofar as data are available), and water-storing characteristics of the aquifer materials in the Subbasin. In 1964, DWR estimated that the Subbasins in the Coachella Valley Groundwater Basin contained approximately 39,200,000 acre-feet (AF) of water in the first 1,000 feet below the ground surface, of which 29,800,000 AF is in the Indio Subbasin. The capacities of the individual Subareas of the Indio Subbasin are shown in Table 6-2.

Table 6-2. Indio Subbasin Groundwater Storage Capacity

Subarea	Groundwater Storage (AF)[a]
Garnet Hill Subarea	1,000,000
Oasis Subarea	3,000,000
Palm Springs Subarea	4,600,000
Thermal Subarea	19,400,000
Thousand Palms Subarea	1,800,000
Indio Subbasin Total	**29,800,000**

[a] Storage volume in first 1,000 feet below the ground surface (DWR, 1964).

While use of this groundwater in storage has practical limitations (for example, by the depth of production wells), the significant water storage capacity in the Indio Subbasin provides flexibility for the management of groundwater resources. In brief, storage capacity in the Indio Subbasin allows for local storage of water supplies when available and use of stored water supplies when needed. Sustainable management requires that inflows and outflows to the Subbasin are balanced over the long term such that net storage remains stable.

The Indio Subbasin was at its minimum storage in 2009, with a calculated storage loss of 1,890,000 AF from 1970 to 2009 (see Chapter 4, *Current and Historical Groundwater Conditions*, and Figure 4-9). This represents use of stored groundwater until the management actions identified in the *2002 CVWMP* and *2010 CVWMP Update* resulted in cessation of overdraft, a positive Subbasin groundwater budget, and groundwater storage increases. Since 2009, groundwater pumping has decreased and replenishment activities have increased, leading to the observed recovery of groundwater in storage. The GSAs' management activities have resulted in replacement of approximately 840,000 AF of groundwater in storage, or about 45 percent of the cumulative depletion observed from 1970 to 2009.

This *Alternative Plan Update* builds on recent management activities for a long-term sustainable groundwater supply. The remainder of this Chapter 6, *Water Supply*, documents the local and imported water supplies that provide water for direct use and for replenishment to help sustain the Indio Subbasin groundwater supply. Chapter 7, *Numerical Model and Plan Scenarios*, describes the Subbasin's water budget.

California's Colorado River supply is protected by the *1968 Colorado River Basin Project Act* (USBR, 1968), which provides that in years of insufficient supply on the main stem of the Colorado River, supplies to the Central Arizona Project shall be reduced to zero before California will be reduced below 4.4 million AF in any year. This assures full supplies to the Coachella Valley, except in periods of extreme drought.

The Coachella Canal extends approximately 123 miles to terminate in Lake Cahuilla.

The Coachella Canal is a branch of the All-American Canal that brings Colorado River water into the Imperial and Coachella Valleys. Under the *1931 Seven Party Agreement* (USBR, 1931), CVWD receives 330,000 AFY of Priority 3A Colorado River water diverted from the All-American Canal at the Imperial Dam. The Coachella Canal originates at Drop 1 on the All-American Canal and extends approximately 123 miles, terminating in CVWD's Lake Cahuilla. The service area for Colorado River water delivery under CVWD's contract with the U.S. Department of the Interior Bureau of Reclamation (USBR) is defined as Improvement District No. 1 (ID-1), which encompasses 136,400 acres covering most of the East Valley and a portion of the West Valley north of Interstate 10. Under the *1931 Seven Party Agreement*, CVWD has water rights to Colorado River water as part of the first 3.85 million AFY allocated to California. CVWD is in the third priority position along with IID.

6.4.1 2003 Quantification Settlement Agreement (QSA)

In 2003, CVWD, IID, and MWD successfully negotiated the *2003 Quantification Settlement Agreement* (*2003 QSA*) (CVWD, 2003), which quantifies Colorado River allocations through 2077 and supports the transfer of water between agencies. Under the *2003 QSA*, CVWD has a base entitlement of 330,000 AFY. CVWD negotiated water transfer agreements with MWD and IID that increased CVWD supplies by an additional 123,000 AFY. CVWD's net QSA supply will increase to 424,000 AFY by 2026 and remain at that level until 2047, decreasing to 421,000 AFY until 2077, when the agreement terminates (Secretary of the Interior, 2003). CVWD's available Colorado River diversions through 2045, this *Alternative Plan Update* horizon, are shown on Table 6-3.

As of 2020, CVWD's available Colorado River water diversions at Imperial Dam under the QSA were 394,000 AFY. This includes the base entitlement of 330,000 AFY, the MWD/IID Transfer of 20,000 AFY, IID/CVWD First Transfer of 50,000 AFY, and IID/CVWD Second Transfer of 23,000 AFY. CVWD's QSA diversions also deducts the -26,000 AFY transferred to San Diego County Water Authority (SDCWA) as part of the Coachella Canal Lining Project and the -3,000 AFY transfer to Indian Present Perfected Rights.

Additionally, under the 2003 QSA, MWD transferred 35,000 AFY of its State Water Project (SWP) Table A Amount to CVWD. This SWP water is exchanged for Colorado River water and can be delivered at Imperial Dam for delivery via the Coachella Canal to the eastern portion of the Indio Subbasin or at Lake Havasu for delivery via the Colorado River Aqueduct to the western portion of the Indio Subbasin at the WWR-GRF. The 2019 Second Amendment (CVWD, 2019b) guaranteed delivery of the 35,000 AFY from 2019 to 2026, for a total of 280,000 AFY of water to the WWR-GRF during that timeframe. MWD can deliver the water through CVWD's Whitewater Service Connections (for recharge at WWR-GRF) or via the Advance Delivery account.

The Colorado River Aqueduct conveys water to the western portion of the Indio Subbasin at the WWR-GRF.

The MWD/IID Transfer originated in a 1989 agreement with MWD to receive 20,000 AF of its Colorado River supply. The *2019 Amended and Restated Agreement for Exchange and Advance Delivery of Water* (CVWD, 2019a) defined the exchange and delivery terms between MWD, CVWD, and DWA. The *2019 Second Amendment to Delivery and Exchange Agreement* (CVWD, 2019b) reduced CVWD's annual delivery of the MWD/IID Transfer to 15,000 AFY, for a total of 105,000 AF, if taken at the Whitewater Service Connections (for recharge at WWR-GRF) between 2020 and 2026. For those seven years, MWD keeps the remaining 5,000 AFY, after which CVWD's allocation increases back up to 20,000 AFY. In this *Alternative Plan Update*, both the 15,000 AFY MWD/IID Transfer and the 35,000 AF QSA MWD SWP Transfer are assumed to be delivered to WWR-GRF through 2026. CVWD's total allocations under the QSA, including MWD's transfer of 35,000 AFY and the MWD/IID Transfer, will increase from 424,000 AFY in 2020 to 459,000 AFY by 2026 and remain at that level for the remainder of the 75-year term of the QSA.

6.4.2 Colorado River Water Consumptive Use

Each year, CVWD submits its water order to USBR for its total QSA entitlement. USBR provides an annual Colorado River Accounting and Water Use Report that provides diversions, return flows, and consumptive use of water diverted from the mainstream of the Colorado River below Lee's Ferry (USBR, 2020). For the eight years between 2013 and 2020, CVWD consumed less than its QSA allotment by an average of 25,574 AFY. CVWD can transfer up to 20,000 AF of the *1989 Approval Agreement* water to MWD, to help mitigate the lower consumption. Despite minor annual variability, CVWD anticipates full consumptive use of its QSA entitlement by 2030. Payback for the over consumption that occurred in years 2001 and 2002 has been completed; no additional payback is assumed during the planning horizon.

Assumptions regarding Colorado River (Canal water) supplies available for use are based on CVWD's delivery schedule from the QSA, minus estimated Canal conveyance losses (see discussion below). Table 6-3 and Figure 6-2 provides CVWD's contracted Colorado River water entitlement through 2045. Note that due to the IID/CVWD Second Transfer, CVWD's Colorado River supplies continue to increase by 5,000 AFY per year through 2027 before reaching a total volume of 424,000 AFY. Table 6-3 lists total Colorado River entitlements under existing agreements. However, this *Alternative Plan Update* does not assume full QSA ramp up volumes will be available due to ongoing drought and forecasted climate change on the Colorado River system. Section 6.4.4 describes the Colorado River volumes assumed in baseline and climate change.

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PUBLIC HEARING ITEM NO. 1 - CORAL MOUNTAIN RESORT PROJECT

Table 6-3. Colorado River Water Entitlements (AFY)

Diversion	2020	2025	2030	2035	2040	2045
Base Entitlement	330,000	330,000	330,000	330,000	330,000	330,000
1988 MWD/IID Approval Agreement	20,000	20,000	20,000	20,000	20,000	20,000
IID/CVWD First Transfer	50,000	50,000	50,000	50,000	50,000	50,000
IID/CVWD Second Transfer	23,000	48,000	53,000	53,000	53,000	53,000
Coachella Canal Lining	-26,000	-26,000	-26,000	-26,000	-26,000	-26,000
Indian Present Perfected Rights Transfer	-3,000	-3,000	-3,000	-3,000	-3,000	-3,000
QSA Diversions	**394,000**	**419,000**	**424,000**	**424,000**	**424,000**	**424,000**
MWD SWP Transfer	35,000	35,000	35,000	35,000	35,000	35,000
Total Diversions	**429,000**	**454,000**	**459,000**	**459,000**	**459,000**	**464,000**
Assumed Conveyance Losses (5%)	-21,200	-22,700	-22,950	-22,950	-22,950	-22,950
MWD/IID Approval Agreement Transfer[1]	-5,000	-5,000	0	0	0	0
Total Available Deliveries	**402,800**	**426,300**	**436,050**	**436,050**	**436,050**	**436,050**

[1] Accounts for -5,000 AFY reduction in MWD/IID Approval Agreement deliveries from 2020–2026 per the 2019 Amendments with MWD.

Source: Colorado River Water Delivery Agreement (https://www.usbr.gov/lc/region/g4000/crwda/crwda.pdf, Exhibit B)

Assumes Colorado River uptick until 2025 where it stays.
So no assumption of water increases after 2025 but
no assumption of decrease in CO River water at all.

Figure 6-2. Colorado River Water Supply Projections

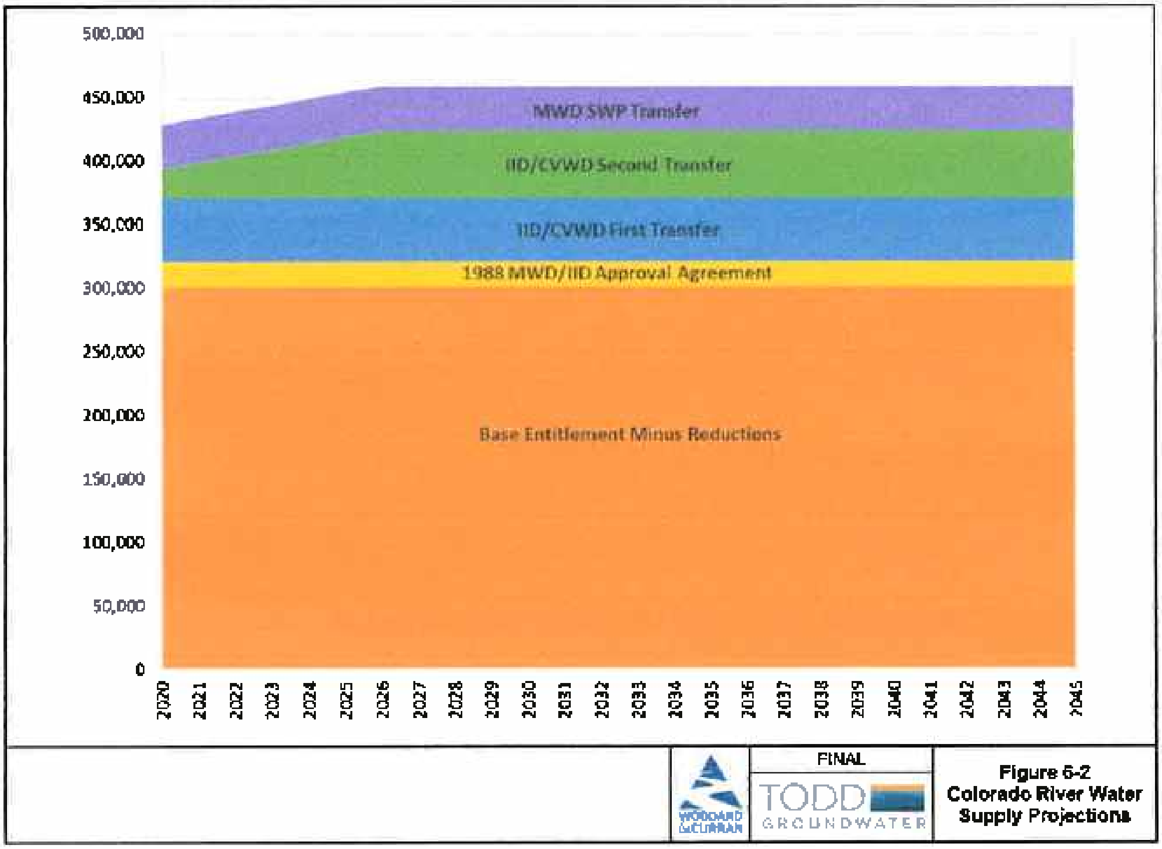


chart shows uptick, then stabilization — no decrease

Note: This graphic reflects total Colorado River water diversions and does not reflect conveyance and transfer losses.

6.4.2.1 Conveyance Losses

Conveyance losses, which are defined as the loss of water to evaporation, seepage, or other similar cause resulting from any transportation or delivery of water, are also factored into the water available for delivery. Conveyance losses in the Coachella Canal are estimated to be approximately five percent annually based on the percentage annual average conveyance losses from 2014 to 2019. Regulatory water is defined as metered releases of excess water from the Canal water delivery system needed to meet scheduled deliveries in the gravity flow irrigation water delivery system. Regulatory water is released into the open drain system and flows to the Salton Sea. Although regulatory water is metered, it is considered a loss and not accounted for in the direct deliveries.

6.4.3 Supply Reliability

Colorado River supplies face a number of challenges to long-term reliability including the extended Colorado River Basin drought and shortage sharing agreements, endangered species and habitat protection, and climate change. Due to both California's and CVWD's high-priority position regarding Colorado River allocations, CVWD's Colorado River supply is expected to be reliable.

6.4.3.1 QSA Litigation

The *2010 CVWMP Update* cautioned against the reliability of CVWD's Colorado River supplies because of ongoing QSA litigation at the time. However, the QSA has held up to scrutiny under several unsuccessful legal challenges in state and federal court. Immediately following passage of the QSA, in November 2003, IID filed a complaint in Imperial County Superior Court to confirm the validity of the QSA and 12 of the 34 QSA-related agreements. The case was coordinated for trial with other lawsuits challenging QSA environmental and regulatory approvals in the Sacramento County Superior Court. CVWD, IID, MWD, SDCWA, and the State defended these suits, which sought validation of the contracts. In February 2010, a California Superior Court judge ruled that the QSA and 11 related agreements were invalid because the QSA-JPA Agreement created an unconditional obligation for the State to pay for excess environmental mitigation costs, in violation of California's constitution. The court declined, for jurisdictional reasons, to validate the thirteenth agreement, the IID-CVWD Salton Sea Flooding Settlement Agreement.

The QSA parties appealed this decision. In March 2011, the California Court of Appeal, Third Appellate District issued a temporary stay of the trial court judgment. In December 2011, the California Court of Appeal reversed the lower court ruling and remanded the case back to trial court for decision on the environmental challenges to the QSA Program EIR. In July 2013, a Sacramento Superior Court entered a final judgment validating the QSA and rejecting all of the remaining legal challenges. In May 2015, the California Court of Appeal issued a ruling that dismissed all remaining appeals.

6.4.3.2 Colorado River Interim Guidelines

Since 2000, drought conditions in the Colorado River basin have led to significant fluctuations and decreases in water elevations at key Colorado River reservoirs. Each year, the Secretary of the Interior is required to declare the Colorado River water supply availability conditions for the Lower Basin States in terms of normal, surplus, or shortage. In 2007, USBR adopted *Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead* (*2007 Interim Guidelines*). These *2007 Interim Guidelines* will remain in effect for determinations to be made through December 2025 regarding water supply and reservoir operating decisions through 2026 and provide guidance for development of the Annual Operating Plan (AOP) for Colorado River reservoirs (USBR, 2007).

The purposes of the *2007 Interim Guidelines* are to:

- Improve USBR's management of the Colorado River by considering trade-offs between the frequency and magnitude of reductions of water deliveries and considering the effects on water storage in Lake Powell and Lake Mead. USBR will also consider the effects on water supply, power production, recreation, and other environmental resources;
- Provide mainstream U.S. users of Colorado River water, particularly those in the Lower Basin states, a greater degree of predictability with respect to the amount of annual water deliveries in future years, particularly under drought and low reservoir conditions; and
- Provide additional mechanisms for the storage and delivery of water supplies in Lake Mead to increase the flexibility of meeting water use needs from Lake Mead, particularly under drought and low reservoir conditions (USBR 2007).

In October 2020, USBR released a *Review of the Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead* (*7D Review*; USBR 2020a). The *7D Review* acknowledged the operational stability provided by the *2007 Interim Guidelines* and the cooperation of participating agencies in providing information to inform the post-2026 operations of Lake Powell and Lake Mead. Negotiations began in 2021 for the *2027 Interim Guidelines* that may affect available supplies of Colorado River water.

6.4.3.3 Lower Basin Drought Contingency Plan

In May 2019, CVWD entered into the *Lower Basin Drought Contingency Plan Agreement* (USBR, 2019) to provide an additional mechanism to prevent Lake Mead from reaching critically low elevations by establishing that certain Colorado River users in the Lower Basin make Drought Contingency Plan (DCP) contributions if Lake Mead reaches certain elevations. The *Implementation Agreement* (CVWD 2019c) explains that the *Lower Basin Drought Contingency Plan (Lower Basin DCP)* provides that USBR's annual 24-month study's projection of Lake Mead's January 1 elevation will determine the amount of California DCP contributions for the subsequent year, if any. CVWD's portion of California DCP contributions under the *Lower Basin DCP* is seven percent (which is approximately 14,000 to 24,500 AFY). CVWD will implement its portion of the *Lower Basin DCP* contributions by storing water in MWD's Lake Mead DCP Intentionally Created Surplus (ICS) account and/or by CVWD reducing its call for the 35,000 AFY MWD SWP Transfer (refer to description above). MWD will then reduce its USBR water order by an equivalent amount in that year to cover CVWD's contribution. The *Lower Basin DCP* is a short-term plan that will end when the 2027 Interim Guidelines are implemented.

6.4.4 Use of Colorado River Water

This *Alternative Plan Update* considers the QSA ramp up to ensure that all available supply is used. This requires balancing direct uses and replenishment deliveries against the available Colorado River supply (less conveyance and regulatory water losses). This *Alternative Plan Update* considers two Colorado River delivery scenarios:

1) **Historical hydrology conditions** – Full ramp up of the *2003 QSA* entitlement, along with transfers where there are agreements in place. These assumptions are used only in the baseline scenario in Chapter 7, *Numerical Model and Plan Scenarios*.
2) **Climate change conditions** – Full ramp up of the *2003 QSA* entitlement and transfers, minus CVWD's portion of California's *Lower Basin DCP* contribution increasing from 14,500 AFY to 24,500 AFY. These assumptions are used in all future project scenarios in Chapter 7, *Numerical Model and Plan Scenarios*.

To fully utilize the Colorado River water entitlement, the GSAs propose several source substitution (replacing existing groundwater pumping with Canal water deliveries) and replenishment projects that can be found in Chapter 11, *Projects and Management Actions*.

6.5 SWP Exchange Water

The SWP is managed by the California Department of Water Resources (DWR) and includes 705 miles of aqueduct and conveyance facilities extending from Lake Oroville in Northern California to Lake Perris in Southern California. The SWP has contracts to deliver 4.172 million AFY to the State Water Contractors. The State Water Contractors consist of 29 public entities with long-term contracts with DWR for all, or a portion of, their water supply needs. In 1962 and 1963, DWA and CVWD, respectively, entered contracts with the State of California for a total of 61,200 AFY of SWP water.

SWP water has been an important component of the region's water supply mix since CVWD and DWA began receiving and recharging SWP exchange water at the WWR-GRF. Starting in 1973, CVWD and DWA began exchanging their SWP water with MWD for Colorado River water delivered via MWD's Colorado River Aqueduct. Because CVWD and DWA do not have a physical connection to SWP conveyance facilities, MWD takes delivery of CVWD's and DWA's SWP water, and in exchange, delivers an equal amount of Colorado River water to the Whitewater Service Connections (for recharge at WWR-GRF and MC-GRF). The exchange agreement was most recently re-established in the 2019 *Amended and Restated Agreement for Exchange and Advance Delivery of Water* (CVWD, 2019a).

6.5.1 SWP Table A Amounts

Each SWP contract contains a "Table A" exhibit that defines the maximum annual amount of water each contractor can receive excluding certain interruptible deliveries. DWR uses Table A amounts to allocate available SWP supplies and some SWP project costs among the contractors. Each year, DWR determines the amount of water available for delivery to SWP contractors based on hydrology, reservoir storage, the requirements of water rights licenses and permits, water quality, and environmental requirements for protected species in the Sacramento-San Joaquin River Delta (Delta). The available supply is then allocated according to each SWP contractor's Table A amount.

SWP exchange water is recharged at the WWR-GRF.

CVWD's and DWA's collective increments of Table A water are listed in Table 6-4. Original Table A SWP water allocations for CVWD and DWA were 23,100 AFY and 38,100 AFY, respectively, for a combined amount of 61,200 AFY. CVWD and DWA obtained a combined 100,000 AFY transfer from MWD under the 2003 Exchange Agreement. In 2004, CVWD purchased an additional 9,900 AFY of SWP Table A water from the Tulare Lake Basin Water Storage District (Tulare Lake Basin) in Kings County (DWR, 2004). In 2007, CVWD and DWA made a second purchase of Table A SWP water from Tulare Lake Basin totaling 7,000 AFY (DWR, 2007a and 2007b). In 2007, CVWD and DWA also completed the transfer of 16,000 AFY of Table A Amounts from the Berrenda Mesa Water District in Kern County (DWR, 2007c and 2007d). These latter two transfers became effective in January 2010. With these additional transfers, the total SWP Table A Amount for CVWD and DWA is 194,100 AFY.

Previously, the 100,000 AFY MWD Transfer obtained under the *2003 Exchange Agreement* included a "Call Back" component that allowed MWD to call-back the 100,000 AFY and assume the entire cost of delivery if it needed the water. In 2019, the *Amended and Restated Agreement for Exchange and Advance Delivery of Water* (CVWD, 2019a) ended MWD's right to call back that 100,000 AFY of Table A water.

CITY COUNCIL SPECIAL MEETING - JULY 5, 2022 - HAND-OUT - ALENA CALLIMANIS
PUBLIC HEARING ITEM NO. 1 - CORAL MOUNTAIN RESORT PROJECT

2002 through 2021. The reliability of SWP deliveries has declined since 2007 when Judge Wanger overturned the Biological Opinion regarding Delta export pumping operations. This decision significantly impacted DWR's ability to convey SWP supplies across the Delta for export. Since the 2007 Wanger decision, SWP final allocations have averaged 45 percent annually. This period has also been marked by six critically dry years.

Table 6-5. Historical SWP Table A Allocations, CVWD and DWA (2002-2021)

Year	100% Table A Volume Max Contract (AFY)[a]	Water Year Type	SWP Initial Allocation (%)	SWP Final Allocation (%)
2002	61,200	Dry	20%	70%
2003	61,200	Above Normal	20%	90%
2004	71,100	Below Normal	35%	65%
2005	171,100	Above Normal	40%	90%
2006	171,100	Wet	55%	100%
2007	171,100	Dry	60%	60%
2008	171,100	Critically Dry	25%	35%
2009	171,100	Dry	15%	40%
2010	194,100	Below Normal	5%	50%
2011	194,100	Wet	25%	80%
2012	194,100	Above Normal	60%	65%
2013	194,100	Critically Dry	30%	35%
2014	194,100	Critically Dry	5%	5%
2015	194,100	Critically Dry	10%	20%
2016	194,100	Above Normal	10%	60%
2017	194,100	Above Normal	20%	85%
2018	194,100	Critically Dry	15%	35%
2019	194,100	Above Normal	10%	75%
2020	194,100	Below Normal	10%	20%
2021	194,100	Critically Dry	5%	5%
20-year Average	–	–	**24%**	**54%**
14-Year Average Since Wanger	–	–	**20%**	**45%**

[a] Source: DWR 2018, Bulletin 132-18, Appendix B Table B-4
[b] Source: DWR 2018, Bulletin 132-18, Appendix B Table B-5B

they took average SWP of 45% versus actually 2021, 2022, 2023 of 5%

87,345 acre-feet v. 9705 acre-feet.

This is already more than they decreased CR numbers

Good afternoon Mayor Evans and Council members and others, I am Carol Strop, a CPA. Tonight I would like to speak to the developer's request for postponement. Where has he been the last two plus years? Innumerable letters were sent to the planning commission and City Council and they are public record. The concerns should have been his responsibility to review from the start. Why give him more time now?

Of course, running a City is business and development has benefits. The builder paid his fees and Mayor Evans was correct that they had an obligation to let him present his project. That is not a fiduciary responsibility but it was a commitment – to listen, not to agree. Now he has had his say and you have no further duty to him. The builder understands the risk of doing business. Trilogy at the Polo Fields, which has no Golf Course and no special amenities has waiting lists.

Our opposition has been constructive. Look how much more we know than two years ago. In February 2020 the Wave sounded like a nice idea to me and no doubt to you, too. But had you known before the last meeting that a loud warning horn is sounded before every wave? That a wave is every three minutes? Really? Seems too many "small details" keep coming out. And to the proponents or Council members still in favor I ask - Do any of you live near Coral Mountain? No? Well then, no problem for you.

A postponement would energize us further. Here is an example of the power of residents coming together. A well known Burbank developer, Gangi Development, proposed to shave off a hillside of a Glendale mountain to complete a controversial subdivision. Several homeowner associations enlisted the help of attorneys, the Santa Monica Conservancy, and the Sierra Club to try to overturn the City council's affirmative vote for the project, and defeat it they did. The groups of opposition to the Wave are spreading. The developer certainly has other options. After all, he still has the property and perhaps Andalusia agreed to a compensatory price reduction amount should the rezoning fail. I would ask for that. Why else would the builder go forward?

Mr. Gamlin, you have the opportunity to make Coral Mountain truly special. Forget the Wave, forget the golf course. Did you know that 80% of Americans cannot see the Milky Way and many see no stars at all? Here is a NASA picture of night lights in our Valley. The International Dark Sky Association has more than 190 cities, towns, parks, and preserves worldwide committed to limiting night time light. Why not a section of La Quinta? Our street lights at Trilogy are soft yellow and I can see the stars all the time. Why not use the Coral Mountain's dark skies and gorgeous mountains as the selling point? Why not build beautiful homes with glass atriums, and trails with sky viewing areas? You do not need a postponement, you need to start over. So City Council, let's hear your vote. Thank you.

Presentation script for Rick Roth's July 5, 2022 presentation to the LQ City Council

Good evening ladies and gentlemen. It's my pleasure to present to you material prepared for your benefit by Rick Roth, a resident of La Quinta.

Rick is a retired executive, professor and scientist who has overseen many multimillion dollar projects, including both successes and failures, some costing tens of billions of dollars. He cautions that proposed projects always look shiniest before predictable but nasty issues must be faced. He worries that our city is about to fall prey to the same type of terrible outcome, primarily because project proponents have not faced prudent financial scrutiny.

Rick has analyzed the financial documents submitted by the developer and planning consultant. He has produced a detailed spreadsheet covering forecast revenues and costs the project would generate over the first 13 years. To do this, he adopted the developers' proposed build-out plans and then generated revenues from occupancy, rental, and retail sales taxes. The developers' plans become totally hazy beyond 13 years, and in any case those future dollars would make a negligible impact on the conclusions.

Most importantly, Rick has included the probability of the proposed business failing. A failure and bankruptcy would shrink revenues and abrogate obligations. This would leave the City holding the bag for a half-mile long, nearly 17-acre abandoned concrete basin, becoming the greatest public nuisance in City history.

The bottom line of his analysis is this: nobody would voluntarily choose to purchase or buy into the expected results of this project: a 91% likelihood of a bankruptcy within 13 years, with only a 9% chance of survival. Approving the project is financially equivalent to buying a lottery ticket offering a 9% chance of netting $6M cumulatively over 13 years but a 10X chance of a failure costing the city $600K over the same time frame. Rational humans are loss averse and would quickly reject such a gamble.

His slides summarize the analysis, and the detailed electronic spreadsheet enables anyone to investigate further. The spreadsheet also shows a residential community developed under the existing zoning would have vastly lower risk and generate $2M in profit over the same time period.

In light of this analysis, Rick believes approval of this project would be a breach of fiduciary duty. As he says, "No one can reasonably argue that economic advantages of this project justify its unmitigated environmental harms."

Proposed Wave Park is a Terrible Financial Bet for La Quinta

Rick Roth
La Quinta Resident

Retired Executive & Professor

1

How Much Would You Pay for this Lottery Ticket?

If You Win:		
	Get	**$6,000,000**
Chance of Winning:		**9%**
If You Lose:		
	Pay	**$600,000**
Chance of Losing:		**91%**

2

How Much Would You Pay for this Lottery Ticket?

If You Win:		
	Get	**$6,000,000**
Chance of Winning:		**9%**
If You Lose:		
	Pay	**$600,000**
Chance of Losing:		**91%**

This Lottery Ticket is Equivalent to the Expected Results of the Proposed Wave Park (see spreadsheet for details)

Expected Annual Profit (Loss) = -$286

3

Bottom Line:

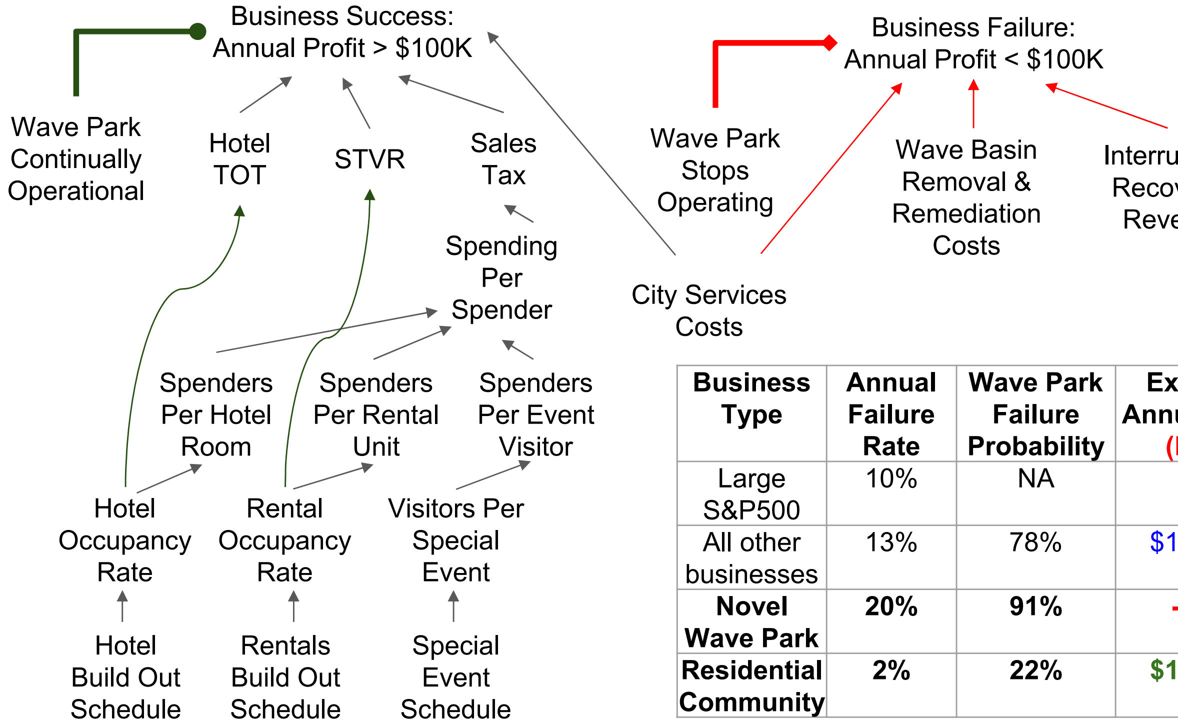
Nobody would voluntarily choose the Wave Park Project based on its financial prospects

Fiduciary advisory:

The project's dismal financial prospects do not provide a credible justification for overriding unmitigated environmental impacts

4

 7/6/2022



Business Type	Annual Failure Rate	Wave Park Failure Probability	Expected Annual Profit (Loss)
Large S&P500	10%	NA	NA
All other businesses	13%	78%	$130,805
Novel Wave Park	**20%**	**91%**	**-$286**
Residential Community	**2%**	**22%**	**$158,614**

5

The Wave Park almost certainly loses money for La Quinta,

and Nobody would willingly choose to buy a lottery ticket that offered the same payout odds

NET PROFIT (LOSS) over 13 years (discount rate on future dollars = 5%)

Residential Community Profits at 0.1% Special Assessment Levels

	Wave Park	Residential		Expected Annual Profit
Risk level cases:				
Zero risk	$6,000,212	$2,067,196		
Business Failure Rate (20% v 2%)	-$567,913	$2,042,950	*Lottery Ticket #1*	-$286
Business Failure Rate (13% v 1.3%)	$514,943	$2,050,959	*Lottery Ticket #3*	$130,805

	Win Payout	Lose Payout	Win Probability	Lose Probability	
Wave Park Lottery Ticket #1	$6,000,212	-$567,913	9%	91%	-$286
Residential Community Lottery Ticket #2	$2,067,196	$2,042,950	78%	22%	$158,614
Wave Park Lottery Ticket #3	$6,000,212	$514,943	22%	78%	$130,805

	Options		
Simplified Decision Alternative	**#1**	**#2**	**#3**
Chance of Winning	1 out of 10	10 out of 10	1 out of 30
Amount you Win	$6M	$2M	$6M
Chance of Losing	9 out of 10	none	29 out of 30
Amount you Pay on Losing	$600K	0	
Amount you Win on Losing			$500K

6

	A	B	C	D
1	**Assumptions: Wave Park Pro Forma (based on developer documents)**			
2				Wave Park
3	Number of years to build hotel & residential units			10
4	Fraction of hotel & residential units built by year 5			40%
5	Total number of hotel rooms			150
6	Total number of rental units (surf village residential units)			104
7	Rate of completion of remaining units yrs 6-10			12.0%
8	**Years after start**			1
9	Hotel & Surf village pct complete			0.0%
10	Number of hotel rooms available			0
11	Number of rental units available			0
12	Rate of building 220 single family units/yr after year 7			27.5
13	Number of single family units			
14	Short-term rental participation rate			30%
15	Participating rental units			0
16	Annual rental occupancy rate			45%
17	Hotel visitors per room			1.5
18	Rental units visitors per room			3.0
19	Hotel visitor spend/day			$100
20	Rental unit visitor spend/day			$50
21	Annual total hotel room days			0
22	Annual hotel visitor days			0
23	Annual hotel visitor spending			$0
24	La Quinta retained sales tax rate			2%
25	Annual sales tax hotel visitors			$0
26	Hotel room rental rate			$350
27	Annual hotel room revenues			$0
28	TOT rate			11%
29	Annual TOT on hotel rooms			$0
30	Residential unit rental rate			$800
31	Annual total rental unit days			0

	A	B	C	D
32	Annual rental unit visitor days			0
33	Annual rental visitor spending			$0
34	Annual rental unit revenue			$0
35	STVR rate			10%
36	Annual STVR on rental units			$0
37	Annual sales tax renters			$0
38	Event non-renting visitor-days per year			0
39	Daily spending non-renting visitor			$50
40	Annual retail spending non-visitors			$0
41	Annual sales tax non-visitors			$0
42	Total all sales tax			$0
43	TOTAL TOT+STVR+Sales Tax			$0
44				
45				
46	Annual LQ servicing costs of project at full build-out			$1,592,234
47	Fraction LQ servicing costs of incomplete project			10%
48	Annual LQ servicing costs of project			$159,223
49	Annual LQ Profit (Loss) (no future risk discount)	$9,869,827		$ (159,223)
50				
51	Discount rate for uncertain future dollars			5%
52	Discounted Annual LQ Profit (Loss)	$6,000,212		-$151,262
53				
54	Total Profit through Year 13 (future risk discounted)			$6,000,212
55				
56				
57				
58	Decrease in revenues upon project failure			50%
59	Recovery rate of revenue per year after project failure			10%
60	Land remediation costs after a project failure			$10,000,000
61	Revenue recovery rates after project failure			
62	Years after project failure			0

7

	A	B	C	D
76	Adjusted Profit before Remediation Costs	$10,256,892		-$159,223
77	Expected remediation cost	$9,141,007		$0
78	Adjusted Profit including probable remediation	$1,115,886		-$159,223
79	Discounted Adjusted Profit with Remediation Costs	-$567,913		-$151,262
80				
81				
82	Annual probability of a project failure (4 levels, see below)			FRWP
83	Discount factor for future dollars			5%
84	Year k probability of continuity without failure			(1-FRWP)^k
85	Year k probability of a failure to date			1-(1-FRWP)^k
86	Value of a profit dollar or cost dollar at end of year k			(1-.05)^k
87	Number of hotel units			150
88	Number of residential units			600
89	Average sales price			$2,303,333
90	Special assessment of taxes for LQ			NA
91				
92	**Alternative levels of project failure risk (FR)**			
93	The Wave Park is considered 10 times more likely to fail than a Residential Community			
94	If and when the Wave Park fails, the City incurs a one-time restoration cost			
95	***Zero Risk***	0%	0%	
96	***Probable risk of failure***	20%	2%	
97				
98	**Revenues and costs taken from Development Plan for Wave Park**			
99	**Revenues for Residential Community based entirely on an assumed special assessment**			
100	**Costs for Residential Community conservatively estimated at $500,000 at full build-out**			
101				
102				
103				
104				
105				
106				

8

The Wave Park almost certainly loses money for La Quinta, and Nobody would willingly choose to buy a lottery ticket that offered the same payout odds

NET PROFIT (LOSS) over 13 years (discount rate on future dollars = 5%)

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Chance of Losing	9 out of 10	none	29 out of 30
Amount you Pay on Losing	$600K	0	
Amount you Win on Losing			$500K

More Problems with the EIR

Katrina Chevalier

COVE RESIDENT

Significant Issues with IID – Ongoing meetings with Cities on how to deal with IID and electrical issues

- How will electricity be provided for Coral Mountain and projects?

- That is a significant issue with Coral Mountain Surf Resort because the wave mechanism uses significant amount of energy, the highest of any artificial wave mechanism

What does the DEIR say about IID and power

- *In a will serve letter dated **May 26, 2020**, IID indicated that it can extend electrical facilities to serve the site. Therefore, with the project's connection to the IID substation, it is anticipated that IID's existing and planned electricity capacity and electricity supplies would be sufficient to support the project's demand. **IID has indicated that additional offsite improvements will be required to meet the project's power demand.** The project will be required to install twelve, 6-inch conduits along Avenue 58 to bring additional power to the site and install a transformer bank at IID's existing substation yard located at Avenue 58 and Monroe Street.*
- *The offsite improvements for the conduit system will take place in the existing right of way, on both sides of Avenue 58, between Andalusia and PGA West, and on Madison Street, west of Andalusia. Avenue 58 is an improved road and classified as a secondary arterial. These improvements would occur along the existing right-of-way and will be installed underground during Phase I of the development. The purpose of the extension is to provide electricity to the project only.*

This referenced Will Serve Letter was expired at the time of the DEIR so the DEIR contained invalid and misleading information

- We were told by Ms. Criste that the DEIR did not need to include a Will Serve letter so it is not an issue

- But it was in the DEIR

- Reviewers were mistaken thinking that the power requirements would be met

The Final EIR references the same IID Will Serve letter which says IID was providing a commitment for Phase One only

- *The project will be required to make offsite improvements for electrical power to the site. The project will be required to install an off-site transformer bank at an existing IID substation located at 81600 Avenue 58 and extend a distribution line along Avenue 58. Conduit systems will also be installed along Avenue 58 as part of the proposed upgrades. Construction of the conduits and line extension would occur in the existing right-of-way. The extension of IID's infrastructure will provide electricity exclusivity to the proposed project. The project's connection to the existing IID infrastructure will occur during the first phase of development and will be for exclusive use of the proposed project.* ***In a letter dated May 26, 2020, IID concluded that electrical facilities can be extended to serve the project, under the conditions in the will serve letter. IID was providing a commitment for Phase One only***

The EIR Referenced Will Serve letter is again the expired May 26, 2020 letter

- Mr. Gamlin indicated that a new Will Serve letter was issued in the fall of 2021 and again, it did not need to be referenced in an EIR
- However, in the Final EIR issued in February 2022, the same expired Will Serve letter is referenced
- The same expired letter for Phase 1 only
- Why was the new Will Serve letter not referenced?

The Referenced Will Serve letter is again the expired May 26, 2020 letter

- In a public records request, the City stated it did not have a copy of the new Will Serve letter
- Mr. Gamlin in the June 7, 2022 meeting stated that IID was very impressed with what the project was doing to use and save electricity
- How does that relate to a real “new” Will Serve Document?
- Is it again Phase 1 only and in this MAJOR IID CRISIS?
- You need to actually see a new Will Serve document and what is says about the overall project
- How can we believe in the integrity of the EIR if we know there is erroneous information in it?

You Cannot Certify the EIR for Coral Mountain

- The integrity of the EIR is called into question
- We have documented for you numerous discrepancies, not just for IID
- How many more or this discrepancies are there?

Evaporation

Lisa Jeffrey
Citrus Resident

What are the assumptions for Wave Pools

- Currently, CVWD Landscape Ordinance defines a “Water Feature” as any water applied to the landscape for non-irrigation, decorative purposes, including fountains, streams, ponds and lakes. The Wave Basin is considered a water feature under CVWD Landscape Ordinance No. 1302.4.
- Water features use more water than efficiently irrigated turf grass and are assigned an evapotranspiration adjustment factor of 1.1 for a stationary body of water and 1.2 for a moving body of water for this reason.
- **The proposed Wave Basin is essentially a lake with moving water** and is why the factor of 1.2 is used to estimate evaporation at Coral Mountain Surf Resort in La Quinta.

Hydrologist defined area to calculate

- A six foot wave that will be traveling for almost a half mile has more surface area than just the base area of the pool.
- For example, if the Wave Basin water surface is 12.5 acres, the actually square footage surface area to be calculated for evaporation is significantly higher and must account for the total 6 foot wave surface.

Other evaporation considerations

- If the wave itself does wash over areas, those areas must be considered for evaporation as well.
- Our significant wind events must be used in any calculations for evaporation as water will be absorbed into the air at a much higher rate since the air is moving and won't become saturated.
- Pan evaporation numbers that were used as part of the calculations for evaporation by CVWD have not been updated since 2005. That year the Indio area had only 99 days over 100. In 2020, for example, we had over 140 days over 100 and significantly higher temperatures. This would cause significantly more evaporation.

WADI adventure Surf Park located in a desert

- WADI Adventures in the United Arab Emirates is the only other Wave Pool in a desert environment. They had to pipe desalinated water from the coast for 140 miles so they knew exactly how much water was added to the pool.
- Their pool was only 2.8 Million gallons and 3 acres. From May to November they added 40,000 gallons and from December to April they added 10,000 gallons.
- PLEASE NOTE: They cooled their pool to 84 degrees for the protection of their surfers from the potential of heat stroke and from deadly protozoa. So cooler water evaporates less than the Coral Mountain Wave Basin water which will be in the 90's in the summer

Replenishment at WADI due to evaporation

- Summer replenishment was 1.5% a day which equates to 270,000 gallons for our Coral Mountain 18 million gallon pool, if our pool was only at 84 degrees.
- That is 38 Million gallons for only 140 days, vs. the CVWD calculated 24 Million gallons for a whole year. And this is not including the wind events and higher water temperatures.
- And is only 140 days, not a full year. It also does not include the extra surface area of the wave that is exposed to evaporation.

Evaporation in Lemoore

- For your information, the Kelly Slater Wave Pool in Lemoore, California, the equivalent pool, size and technology of the Coral Mountain Wave Basin, has said that they lose 250,000 gallons of water on hot days in 2020.
- That year they only had 40 days over 100 degrees, with the hottest day 107 degrees. La Quinta had 140 days over 100 degrees with the high temperature of 124 degrees.

EPA formula Calculation vs. Actual Golf Usage

- We did calculations using an EPA formula that takes wind and high temperatures into effect. We only used monthly averages and that came to 740 acre feet or 260 million gallons of evaporation a year versus the 24 million calculated by CVWD
- A water bill for a local 18 hole golf course was 165 Million gallons of water consumption in a year. This is lot less than the surf pool.
- The golf course was down 15% year over year in the summer, and overall down year over year. Golf courses can conserve. Surf pools cannot conserve. 15% less water means a surf pool cannot operate. They must close.

Wave Pool Evaporation will be significantly higher than calculated by CVWD

- A Surfing Wave is not a moving lake
- CVWD did not bother to explore more accurate means of calculations to address the Wave Pool
- You cannot approve the Coral Mountain Surf Resort because *all the water features plus the high number of STVRs will significantly exceed your MAWA in the middle of a historic drought project*

How Pools Fare in the Summer

Brian Levy

La Quinta

We spoke to the Manager of the Olympic – sized pool at the Palm Springs Aquatic Center

1) How many gallons of water does it take to fill the pool? **600,000 gallons** (vs 18 million gallons)

2) What is the physical size of the pool? **50 meters by 25 meters, ¾ meters by 4 meters** (vs 804 meters by 122 meters by 2 meters)

3) Why do you heat the pool in the winter and to what temperature? **We have lap swimmers. We keep our pool around 78 to 82 degrees.** (No plans to heat the surfing basin)

4) Why to you cool the pool in the summer and to what temperature? **If we did not cool the pool it would be around 100 degrees and that's too hot for swimmers.** (No plans to cool the surfing basin)

5) What are the reasons you cool the pool? (Viruses, bacteria and algae?) **We have lap swimmers at this pool. They cannot safely swim in high water temperatures.**

(no cooling at Coral Mountain. Participants at Lemoore comment on the exertion of surfing a long wave. Let's add the sun beating down on you…)

6) How difficult is it to keep algae from the pool during the summer? **Not hard.** **We brush the entire pool every weekend**. (how does one brush a ½ mile by 400 foot pool. Even with chlorine, in extreme heat it is very difficult to combat algae. For every 10 degrees above 84, you need to double chlorine levels. Excessive sun and heat cuts free chlorine levels. And the hydrofoil tracks will accumulate algae, another public health risk).

7) Are you following a Public Health Code when you clean out the sand and debris from the pool after excessive wind events? **Yes** (And yes for the surf pool)

8) How long does it take to clean the pool before you can open it to the public? After a typical wind event it can take 3 man hours to clean the pool from sand and debris. Do you have to open late during the days you must clear out sand and debris? **It depends on the damage left the wind.**

9) Do you close the pool during excessive wind? **Yes, if a lifeguard cannot see the bottom of the pool. Or if there is items or debris flying around making for unsafe conditions.**

(In a typical Garrett Simon answer, when discussing announcements and warning horns from the Tower which is higher up, so sound carrying further since higher, he says they may not have a tower and people might communicate over head phones on the ground. How does one monitor a ½ mile basin from the ground for safe conditions?)

10) How long does it take for the entire pool water to recirculate? **4 hours to filter this pool.** (for Coral Mountain the circulation systems will have to run 24 hours a day especially if the basin isn't used during the day in the summer heat, adding to the ambient noise)

CORAL MOUNTAIN IS NOT LEMOORE!

Good evening Mayor Evans, Mayor Pro Tem Fitzpatrick, Council Members, Staff.

My name is Steve Jeffrey. I live in the Citrus development and I am here to talk to you about noise.

Minimizing noise is such a critical component for a healthy environment. You will see that we have provided you a significant amount of reference material to go along with this presentation. There is so much new information that is coming out on noise impacts of wave pools which were never analyzed before.

My presentation and the references will make it obvious that the Coral Mountain Surf Park cannot be located at the proposed current location.

In your own documentation about Planning for the Future, it is written that the City's current land use patterns buffer sensitive land uses from high noise levels. However, as the City and Sphere grow in the future, noise impacts will need to be carefully considered. This is particularly true of any area where Mixed Use development is considered – along Highway 111 or in the Village – where there may be less room to buffer residential uses from commercial activities. Careful consideration of each future project will be required to assure that compatibility is maintained.

The City's ongoing efforts to preserve the quality of life for all its residents, present and future, must include the protection of a quiet noise environment. This is worth repeating:

The City's ongoing efforts to preserve the quality of life for all its residents, present and future, must include the protection of a quiet noise environment.

I have friends who live with noise and sound reflection issues in the Point Happy area of La Quinta.

I have wonderful friends who live adjacent to Coral Mountain and I feel their pain with similar reflective noise issues. I sympathize with their need for quiet enjoyment as a Surf Park Resort will change what was tranquil living they have come to expect to cesspool of noise and more.

My friends living near Point Happy know that noise from Festivals can be clearly heard in the neighborhood, traveling far distances to hit the Mountain and bounce off to amplify the sound, similar to an amphitheater - enough to rattle vents, windows and nerves. The same thing happens at Coral Mountain as many of the so-called NIMBY's have been accused of reporting. I can only imagine if they put the Surf Park just down from St. Francis of Assisi church on Washington, you'd have Point Happy, Laguna de La Paz and Lake La Quinta residents being NIMBY's too.

We uncovered ‘a new kinda noise’ that typically is not studied for land-use projects but needs to be if it is known to be present!

What is it? It is low frequency noise that is often described as a rumbling, humming or a vibrating sound that can ruin the quiet enjoyment and health of some people.

Some might say, don’t worry about it, you can’t hear it, but that is wrong. Per the EPA Victoria Australia Noise Guidelines for Low Frequency Noise - Sensitivity to sound varies greatly between individuals. The person investigating low frequency noise may not hear the sound that someone has reported. However, it is audible by others. This means low frequency sounds only just above the threshold of hearing can be perceived as loud by some people.

In humans, the World Health Organization and others have shown that low frequency noise can cause…cardiovascular issues due to increased blood pressure and heart rate, irritability and stress that can increase cortisol levels, sleep disorders and more.

In wildlife it can affect foraging, mating and cause herd relocation.

So knowing this, we researched Low Frequency Noise and discovered a big association with the words - surf and waves.

Even more eye-opening…we found a paper by Shane Chambers from Western Australia that discusses wave and surf components and how they have strong low frequency noise components. He summed it all up by stating until noise from surf waves and surf parks is better understood, control of such noise will be difficult to evaluate and authorities should demonstrate caution when assessing such proposals placed in noise sensitive areas.

Shortly after that paper came out, the proposed Tompkins Bay Surf Park was killed by the Western Australia State Authority.

Our research continued and we discovered deficiencies and flaws in the Noise Study element of the Coral Mountain EIR.

- Low Frequency Noise associated with Surf Waves and parks that was not adequately studied in the EIR thus requiring that the EIR be recirculated as this is New Significant Information.
- Poorly designed and described Noise studies with data omissions and result reporting problems and errors that under-report NOISE
- Please see the ‘new kinda noise and reference packet prepared for the City Council.
- All of that make it more compelling for the City Council not to certify the Coral Mountain EIR.

A list of ‘must-haves’ In the next round of Noise Studies is provided.

We ask for a noise study to be done at night, at Coral Mountain, replicating the sounds of the surf park, the wave, the wave mechanism, the jet skis, the announcements, the crowds, the warning horns. As you know, daytime in the La Quinta noise ordinances goes from 7AM to 10PM. That is absurd, especially in the South East La Quinta area by Coral Mountain where the quiet nights are amazing. This test needs to go on for at least one week.

The Coral Mountain Surf Park EIR is flawed due to not only Noise Study errors/problems but more importantly due to not measuring and reporting any Low Frequency Noise and not adopting a dBC noise standard from another agency to use as a guideline which can be done per CEQA. This new significant information requires the City Council to recirculate the EIR per **§ 15088.5 "Recirculation of an EIR Prior to Certification."**

To all affected Coral Mountain residents, beware, a Surf Park with unstudied low frequency noise may be coming to your backyard and house real soon!

A new kinda noise

July 5, 2022

I live near Point Happy in La Quinta and hear the Coachella-fest music bouncing off of Point Happy - and just like Coral Mountain, it’s granite with some porosity but still a rough/hard surface that reflects noise

I have friends who live near Coral Mountain and the proposed Surf Park and ‘echo’ their concerns about noise from the waves, machinery, loudspeakers and music events

I am here today to share new significant information about noise from the Surf Park and resort setting

Here's what we found out!

Surf and Waves have low-frequency sound components

Shane Chambers Paper on Surf and Wave Parks…details the physical components of surf park waves and low-frequency noise

Western Australia State Authority KILLED the Tompkins Bay Surf Park due to its proximity to residents and more

Low frequency Noise (dBC) travels farther, penetrates walls and windows, and reflects off surfaces more than 'ambient' (dBA) mid-range noise often used in assessing 'everyday' noise

- So if there is a potential for low-frequency rumbling humming noise from waves, why not measure it correctly using C-weighted filtered dBC measurements?
- Low frequency dBC noise is responsible for why we hear the bass tones miles away in Point Happy and at Coral Mountain during Coachella-fest
- Echoing or reflecting noise can be heard at Coral Mountain…you have many resident reports!

Imagine a rumbling low-frequency wave noise coming into your yard or house every 4 minutes for 15 hours a day! Or being subjected to loud announcements and the rushing seadoo noise let alone 4 or more festival/music events all aimed at ruining your 'quiet enjoyment.'

It will be like Chinese water torture! Coral Mountain residents beware!

And worse, Low Frequency Noise could adversely affect the health of residents and local wildlife! Low Frequency Noise is associated with increased cardiovascular risks like increased heart rate and blood pressure, irritation/annoyance and more.

A new kinda noise

July 5, 2022

Flawed noise study design and criteria

La Quinta uses 65dBA as the peak noise reading based on ‘traffic noise studies’ which ignores unique noises from a recreational wave park

- The EIR consultants use that as their ‘guideline’ for evaluation of any noise from a proposed project

- The dBA reading represents noise as what we typically hear…but disregards any dBC or low frequency airborne noise, thus any bass-like, rumbling, vibrational noise that is reflected off large objects, TRAVELS farther and easily penetrates walls/windows is IGNORED
- By not measuring dBC low frequency noise - La Quinta’s N-1 Noise Goal of a ‘Healthful Environment’ is missed
- La Quinta made its communities ‘noisier’ by adopting the recommendation in their 2035 plan to change the Municipal-Noise-Code from 60dBA during the day to 65dBA.
    - Page 17/59 - https://www.laquintaca.gov/home/showpublisheddocument/33565/636340814687270000
- La Quinta’s newer noisier 65dBA-only standard ignores any bass-like, humming, rumbling low frequency noise that can cause health issues, especially in older citizens (see Health References)
    - La Quinta cannot say they have met their 2035 noise tenet and goals - Page 17/59 - https://www.laquintaca.gov/home/showpublisheddocument/33565/636340814687270000

The City’s ongoing efforts to preserve the quality of life for all its residents, present and future, must include the protection of a quiet noise environment.

A new kinda noise

July 5, 2022

CEQA allows the Lead Agency to use existing standards or applicable standards of other agencies meaning they are not bound to just using dBA!

Even Fort Lauderdale, Greensboro NC and others have Noise Ordinances with dBC measures in place
https://nonoise.org/lawlib/cities/ordinances/Fort%20Lauderdale,%20Florida.pdf
https://www.greensboro-nc.gov/Home/ShowDocument?id=20473

Sound level meters can be used to measure and quantify low frequency noise.

- Class 1 sound level meters (as defined in the standard IEC 61672-1) will provide more accurate measurements at low frequencies as they are required to meet stricter tolerances and have a wider frequency range. The Piccolo II is not a Class 1 meter - so it cannot be used to adequately measure potential low frequency noise. https://www.merford.com/en/news/a-guide-to-low-frequency-noise

The Sound Consultant says they 'measured everything 'low medium and high' but the EIR shows they only reported A-weighted dBA. (Audio/video of April 12 Planning Commission Meeting)

- He further stated that any low frequency noise (wasn't measured using dBC) is now gone due to wave machine re-design, but the EIR says that the primary noise source is from moving waves (Draft EIR 4-11-45).
    - So wave noise is still there! And known to have low-frequency noise components per the Chambers paper. So measure it! If you don't you are not…

> The City's ongoing efforts to preserve the quality of life for all its residents, present and future, must include the protection of a quiet noise environment.

And…more flawed noise study design and criteria

- The EIR states that they used a Point Study - noise from a single, stationary source. Why use that when the wave machine and waves move 100's of feet as multiple noise sources? A Line study would be more representative - but then the dBA noise would be 3dBA louder at receiver locations in the CadnaA Noise Prediction software simulation of Coral Mountain Surf Park and might exceed the 65dBA limit La Quinta has!

- ***The Noise Study states that Sea Waves cause ground vibration, not measured as VdB at Lemoore, and this would be daily if present…not temporary compared to construction vibration!***

- ***Poor EIR Noise report…missing Meter type and locations on a map for the Operational Noise (Lemoore surf park) study. The Existing Noise Study (24 hr Traffic Noise Study) shows locations of each meter, and all measurements are listed in Appendix K.***

- ***Only 3 out of 8 Lemoore surf park measurements were reported in the Operational Noise section and in Appendix K. Where are the other readings…was one even higher in dBA? Be transparent! The public has the right to see the sound meter data logs.***

- ***Ground attenuation (sound lessening) described and WRONG in the Study…see last reference***

The Noise Study element of the Coral Mountain EIR is flawed and add to this the NEW discovery of unstudied Low Frequency Noise associated with Surf Waves and Machinery - you have a deficient EIR and it must be recirculated!

The City's ongoing efforts to preserve the quality of life for all its residents, present and future, must include the protection of a quiet noise environment.

Here's what we ask of you!

- Implement another agency's dBC guideline as CEQA allows or create your own
- Measure the Low Frequency Noise accurately at the Wave Park in Lemoore with a Class 1 meter, include detailed design layout and data, AND measure VdB as ground vibration from Sea Waves at Lemoore.
- Replicate potential noise and measure onsite at Coral Mountain to accurately to assess wave noise, loudspeaker noise and music event noise against the mountain backdrop
- Show the CadnaA software Coral Mountain site map and detail if a Large Barrier/Mountain is used in the study - Nearmap aerial imaging is available!
- Unlike measuring existing area and traffic noise for 24 hours and getting a CNEL L50 result, per the 1999 WHO Noise Guidance, when there are 'Distinct' Noise events, like a wave every 4 minutes, measure using SEL or Lmax and if there is a low-frequency component, like waves or music, then do a C-weighted SEL or Lmax. https://apps.who.int/iris/rest/bitstreams/62698/retrieve and https://acousticalengineer.com/are-lpeak-and-lmax-different/

So that would apply to -

- Loudspeaker Announcements
- Music over a period of time
- Waves every 4 minutes
- Water rescue skidoo racing/revving

- Given what has been presented here with poor EIR noise study issues combined with the New Significant Negative Information related to unstudied Low Frequency Noise, do not certify the EIR per § 15088.5 "Recirculation of an EIR Prior to Certification"

- Remember La Quinta's driving noise goal -

The City's ongoing efforts to preserve the quality of life for all its residents, present and future, must include the protection of a quiet noise environment.

- **City Council members, you must consider what has been presented here as Significant New Information per § 15088.5 "Recirculation of an EIR Prior to Certification." Ref 2a.b.**

- **This is applicable as the Coral Mountain Resort EIR has not yet been certified.**

14 CCR § 15088.5

§ 15088.5. Recirculation of an EIR Prior to Certification.

(a) A lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the draft EIR for public review under Section 15087 but before certification. As used in this section, the term "information" can include changes in the project or environmental setting as well as additional data or other information. New information added to an EIR is not "significant" unless the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect (including a feasible project alternative) that the project's proponents have declined to implement. "Significant new information" requiring recirculation include, for example, a disclosure showing that:

(1) A new significant environmental impact would result from the project or from a new mitigation measure proposed to be implemented.

(2) A substantial increase in the severity of an environmental impact would result unless mitigation measures are adopted that reduce the impact to a level of insignificance.

(3) A feasible project alternative or mitigation measure considerably different from others previously analyzed would clearly lessen the significant environmental impacts of the project, but the project's proponents decline to adopt it.

(4) The draft EIR was so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded. (Mountain Lion Coalition v. Fish & Game Com.(1989) 214 Cal.App.3d 1043).

So…take notice!

Coral Mountain residents…unstudied, unmeasured Surf Wave Park NOISE will be coming your way that could cause you adverse health issues if this EIR is certified

References

Shane Chambers Surf Wave Noise Paper - https://acoustics.asn.au/conference_proceedings/AAS2018/papers/p142.pdf

- This observation implies that the noise would also have directional low frequency components apart from the omnidirectional broadband noise created by bubble cavitation in the spill or breaking processes. These processes result in a pink noise spectrum dominated by low frequencies with harmonic content.
- The effect of anthropogenic noise on birds is well documented where levels above 45-50 dBA have been demonstrated to have significant negative impacts resulting in a large observed reduction in numbers of affected species (Ware et al. 2015).
- Until further evidence of noise generated from such parks is available, control of such noise will be difficult to evaluate, and authorities should demonstrate caution when assessing such proposals placed in noise sensitive areas

Tompkins Surf Park Killed…one mentioned in Chambers Paper -
https://wavepoolmag.com/urbnsurf-forced-to-find-new-location-for-perth-wave-pool/

Hard Granite = Coral Mountain - Draft EIR describes the mountain as granite. (pg 8/127 Draft EIR Appendix G) Granite has some porosity which will absorb some sound but still reflect sound, *but it is clearly not 'soft' like the EIR consultant described it*. Low frequency noise reflects off large objects better. https://www.teachmeaudio.com/recording/sound-reproduction/wave-behaviour
And https://soundproofliving.com/sound-reflecting-materials/

Rough walls - Like Coral Mountain! Rough walls tend to diffuse sound, reflecting it in a variety of directions. This allows a spectator to perceive sounds from every part of the room, making it seem lively and full. For this reason, auditorium and concert hall designers prefer construction materials that are rough rather than smooth. https://www.physicsclassroom.com/class/sound/Lesson-3/Reflection,-Refraction,-and-Diffraction

65dBA La Quinta Guideline Outdoor Noise - page 27
https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0

Low Frequency Noise Reflection/Travels Farther - page 8/19
https://www.mne.psu.edu/lamancusa/me458/10_osp.pdf
Sound Propagation Close to the ground - K. Attenborough 2002 Annual Reviews Fluid Mechanics 34:51-82
Steve Morgan - Low Frequency Noise Identification and Mitigation - see article and his references

References

Noise and health issues -

Anthropogenic Noise -CA Dept Fish and Wildlife Cannabis Special Issue 108-119; 2020
Low Frequency Noise and Annoyance - Leventhall, Noise Health, April - June 2004, 6(23):59-72
Steve Morgan - Low Frequency Noise Identification and Mitigation - see article and his references
Portugal Review of Low Frequency Noise - https://www.mdpi.com/2076-3417/10/15/5205/htm

La Quinta N-1 Goal - a healthful noise environment which complements he City's residential and resort character
Page 27/53, Noise Study - healthful noise environment which complements the City's residential and resort character https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0

CEQA allows Lead Agency to adopt standards - just because you don't have a dBC guideline, then look elsewhere to get one

- Section 15064.7 – defines thresholds of significance and encourages Lead Agencies to develop and publish such thresholds; requires that thresholds of significance that are to be adopted for general use be developed through a public review process, be supported by substantial evidenced, and be formally adopted; and allows Lead Agencies to consider using thresholds of significance adopted by other public agencies or experts, provided those thresholds are supported by substantial evidence.
    - La Quinta did this for construction vibration standards…used County of Riverside Page 30/253 - https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0
    - Fort Lauderdale and Greensboro have dBC guidelines in their Noise Ordinances
    - https://nonoise.org/lawlib/cities/ordinances/Fort%20Lauderdale,%20Florida.pdf
    - https://www.greensboro-nc.gov/Home/ShowDocument?id=20473

References

Sound Consultant - April 12 meeting video -

- Stated the wave machine at Lemoore has no low frequency noise with its re-design (so the machine had it all along?)
- They measured low/med/high frequencies with the meter, BUT only dBA was reported and specified in the Draft EIR Noise Study.
- He further emphasizes on the video that dBA is the Land Planning standard…but that is not always the case. Wind Farms and Fracking sites are now being evaluated for low frequency noise emissions using C-weighted (dBC) measurements.

Coral Mountain Specific Plan - Appendix K.1 - Noise Study.pdf

Most sound meters have the ability to low, med, high noises and give statistical data, but you have to choose A- or C-weighting before the measurement begins which provides 2-different data sets. If they used the Piccolo II for this (we don't know - not listed in the Operational Noise Section), then they probably only pressed the A-weight button prior to measurement which is why the L50 dBA result is being presented. According to Piccolo tech support, you have to depress the C-weighting dBC button and take a reading which will give statistical, percentile and other information needed to better measure any low frequency noise.

La Quinta requires L50 and other percentlles for assessing dBA measurements in their traffic-based existing noise studies, so why not for any dBC measurements moving forward? See Page 38/253 - https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0

> Table 5-1 provides the (energy average) noise levels used to describe the daytime and nighttime ambient conditions. These daytime and nighttime energy average noise levels represent the average of all hourly noise levels observed during these time periods expressed as a single number. Appendix 5.2 provides summary worksheets of the noise levels for each hour as well as the minimum, maximum, L_1, L_2, L_5, L_8, L_{25}, L_{50}, L_{90}, L_{95}, and L_{99} percentile noise levels observed during the daytime and nighttime periods.

Using just dBA measurements only backfired on many Wind Farms and Fracking sites so they now use dBC measurements along with dBA to assess Low Frequency Noise as they know it is PRESENT! We need the same for the Surf Wave Park as it is a huge unknown and as shown here, surf and waves have low frequency components. Additionally, surf waves cause ground vibration as stated in the Vibration Study section…needs to be measured as well in VdB.

- MN Windfarm Guidelines use dBC now - https://apps.commerce.state.mn.us/eera/web/doc/13710
- Colorado Fracking dBC used - https://cogcc.state.co.us/documents/reg/Rules/Rules_Prior_to_20210115/800Series.pdf

References

CadnaA Noise Prediction Model - Urban Crossroads created a model for assessing noise in a dBA setting. The described highest noise level of 75.7dBA from the Lemoore Surf Park was put into the model to create a 112 Sound Power Level to blast to other receivers in the simulator to deliver computer generated dBA levels at receiver locations R1-10 and P1-10 to compare to the 65dBA La Quinta Noise Limit - none of which exceeded La Quinta's limit but a few got close!
Page 91/253 https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0

Point Study

- The Operational Noise Study for the Coral Mountain Surf Park used point/stationary noise source and hard surface for ground level attenuation (noise lessening of -6dbA) in CadnaA noise simulation software. Point study = stationary source like a 'fixed' compressor etc. Page 29/253 https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0
    - Why is it that they have a moving wave shuttle machine and a moving wave and not treat them as a set of moving objects consistent with a 'LINE Study' often used in railroad and freeway noise studies? Maybe because it lessens the ability for them to SUBTRACT more dBA like what they did with a Point study.
    - Line studies only allow -3dBA per doubling of distance. That would result in higher readings at the 'receiver sites' in the CadnaA Noise Simulator Software meaning they might exceed the 65dBA La Quinta noise standard!
        - Page 91/253 https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0.
        - And https://www.ontarioca.gov/sites/default/files/Ontario-Files/Planning/Reports/environmental-reports/section_4.6_-_noise.pdf

References - Ground Attenuation/Lessening of Sound

To make it clear -

Point Source (stationary noise source) was used in the CadnaA software program for Noise Study Design created by Urban Crossroads.
Allows for -6dBA lessening of noise for every doubling of distance

If a LINE study were used - which requires a completely different layout of sound meters to measure noise at Lemoore, then only -3dBA lessening of noise is allowed.

Next Step - what type of ground is the NOISE traveling over?

The consultant can select Hard/Reflective Surface like pavement/water (note wave pool) which by ISO 9613-2 standards (0) for NO ADDED attenuation or lessening of noise in the CadnaA prediction model

The consultant can select Soft/Porous - which is like agricultural ground, or open fields which means (1) is put into the software to get an added BONUS of -1.5 or more (see below) of noise reduction. The (1) soft porous option is what used in the Coral Mountain CadnaA prediction model DESPITE them describing the location as a ‘hard surface’ which calls for a selection of ‘0’ for no added attenuation.

- What is going on here? Bottomline, if it was meant to be a Hard Surface, the data in the Noise Study is bogus and is artificially lowered because they chose ‘1’ as ground attenuation.
- And per the information below, it could be even more ‘attenuation!’

https://www.acoustics.org.nz/sites/www.acoustics.org.nz/files/journal/pdfs/Hannah_L_NZA2007_c.pdf

> Acoustically “soft” ground will also affect the total sound attenuation. Soft ground effects can produce additional attenuation of up to approx 3dB over distances of 100m. This can increase with increasing distance up to about 9dB at approx 1,000m.

References - Ground Attenuation/Lessening of Sound

level measurements include loudspeaker announcements that were considered in the operational noise analysis section of the *Noise Impact Analysis*. As indicated in section 10.1.1 of the *Noise Impact Analysis*, Prior to each wave, the control tower announces the event over the public address system.

3. **Would noise measurements across "agricultural fields" be decreased compared to the desert floor? (this was in regard to the measurements taken at the Lemoore site.)** Both agricultural fields and desert floors are considered soft surfaces for the purposes sound propagation. Only hard surfaces such as pavement would change the sound attenuation characteristics of the Project. In addition, the wave basin/wave machine reference noise level measurements were taken during peak wave noise events at 12 feet. The reference noise level measurements themselves do not include any sound attenuation for the "agricultural fields."

12642-11 FAQ Noise Memo

Mr. Garrett Simon
CM Wave Development LLC
April 20, 2021
Page 2 of 2

1

No sound attenuation? Why is there attenuation here - factor 1.0 in CadnaA is for soft porous soil/agri and that gets you more attenuation! Shady!

And in CadnaA, G= 0 is for sound reflecting ground like a hard surface, so why did 1.0 get put into the CadnaA?

2

The operational noise level calculations provided in this noise study account for the distance attenuation provided due to geometric spreading, when sound from a localized stationary source (i.e., a point source) propagates uniformly outward in a spherical pattern. Hard site conditions are used in the operational noise analysis which result in noise levels that attenuate (or decrease) at a rate of 6 dBA for each doubling of distance from a point source. A default ground attenuation factor of 1.0 was used in the CadnaA noise analysis to account for hard site conditions. Appendix

12642-10 Noise Study

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URBAN CROSSROADS

3

CadnaA user manual -

A new calculation is now performed on the basis of the data entered with frequency-dependent ground attenuation. Compare the values before and after.

☞ Now enter in the **Calculation|Configuration|Industry** a ground attenuation of G=0 for sound-reflecting ground - the calculation results in a level higher than the first level.

Beside this global specification of the ground absorption, which refers to the entire project, individual areas may be assigned specific absorption co-efficients. Upon clicking the **Ground Absorption** icon on the toolbox, enter the borderlines of the area. The ground absorption is specified in the edit dialog (opened by double-clicking on the borderline of the area). For areas to which no such area has been assigned, the global settings as defined under **Calculation|Configuration** will apply.

4

Appendix K.

Ground Absorption(s)

Name	M.	ID	G	Coordinates x (ft)	Coordinates y (ft)
GROUND		0	1.0	6558802.37	2167864.72
				6558996.92	2167822.26
				6559662.48	2167250.25
				6559909.37	2167450.59
				6560022.45	2167364.58
				6560089.35	2167366.17
				6560082.98	2166545.88
				6559426.75	2166545.88
				6558818.29	2166794.36

5

The Noise Study states the site is a Hard Surface for no additional ground attenuation, but by putting in Ground = 1 for soft surface the consultants get an additional 1.5dBA reduction to the sound across receivers in the CadnaA noise simulator which is deceptive and wrong

References - Ground Attenuation/Lessening of Sound - cont'd

Ground Effect (reflection and absorption) using ISO9613-2:1996

Sound waves are reflected or absorbed by the ground depending upon the frequency of the sound wave and how porous the ground is (indicated by the "Ground Factor" value G).

- For "**Hard Ground**" G = 0. Hard ground reflects sound waves. Examples include roads and paved areas.
- For "**Soft Ground**" G = 1. Soft ground is porous and absorbs sound waves. Examples include grass, trees and other vegetation.
- For "**Mixed Ground**" use a value for G between 0 and 1 that represents the fraction of the ground that is soft.

P4	53.9	65	No
P5	55.1	65	No
P6	54.1	65	No
P7	51.8	65	No
P8	53.7	65	No
P9	62.4	65	No
P10	64.5	65	No

[1] See Exhibit 10-A for the off-site (R)eceiver and on-site (P)roject locations.
[2] Proposed Project daytime operational noise levels as shown on Tables 10-2.
[3] Exterior noise level standards for residential land use, as shown on Table 4-2.
[4] Do the estimated Project operational noise source activities exceed the noise level standards?

12642-10 Noise Study

78

URBAN CROSSROADS

CadnaA Ground Attenuation based on ISO

So Ground = 1 is for soft porous ground…but the Urban Crossroads Noise Study says they used 1 for Hard Surfaces which what they specified…see prior pages.

What does this mean? 0 = no additional attenuation as sound bounces off of hard surfaces…but 1, like they used, gave them an additional 1.5 dBA of sound reduction at the sound receiver locations in the CadnaA prediction model. So, if you have a reading, say at P10 of 64.5dBA…which is below the 65dBA La Quinta standard, then it will be 66dBA and over the limit because you need to take away the -1.5dBA reduction as it doesn't match the hard surface requirement of 'zero 0 attenuation' that should have been put into the CadnaA Noise Prediction Model for Coral Mountain!

Add the fact they used a Point Source noise study design and measurement scheme, they got a minus 6dBA reduction at receiver locations…but if a LINE study was used, it would have only been a minus 3dBA…

So in the P10 case…for illustration if they designed it to be a LINE study, you need to add 3dBA to 66dBA (above) making it much higher and way past the La Quinta 65dBA Standard.

Makes one QUESTION the Validity of this Noise Study.

The EIR Must be Recirculated!

More References to support the need to Recirculate the EIR

Urban Crossroads Vibration Noise Study - 2.9/12642-10.
STATES that sea waves are a source of ground vibration. Reported as RMS VdB. This was **NOT** measured at Lemoore Surf Park. Was not used in CadnaA…only construction vibration simulation was used. This needs to be studied. It is not a 'short term' construction vibration, it will last the life of the Surf Park! Page 22/253 https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0

2.9 VIBRATION

Per the Federal Transit Administration (FTA) *Transit Noise Impact and Vibration Assessment* (11), vibration is the periodic oscillation of a medium or object. The rumbling sound caused by the vibration of room surfaces is called structure-borne noise. Sources of ground-borne vibrations include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) or human-made causes (e.g., explosions, machinery, traffic, trains, construction equipment). Vibration sources may be continuous, such as factory machinery, or transient, such as explosions. As is the case with airborne sound, ground-borne vibrations may be described by amplitude and frequency.

There are several different methods that are used to quantify vibration. The peak particle

Poor EIR Noise Report -

Existing Noise Studies talk about type of meter used…page 33 and locations page 37 https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0

Operational Noise Studies - no meter type or study design mentioned - page 88
https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0

Dubious Operational Noise Report - only 3 out of 8 measurements from Lemoore Surf Park are listed, where are the other 5? They are NOT in Appendix K. Only 3 measurements are listed in the Noise Study - pages 88 and 90/253 - https://files.ceqanet.opr.ca.gov/267707-4/attachment/gLYlsap7DjkliZZXT83rK-fbkLxCENFIpE1BrSd0HEM_YLEHrOGz1uJTXjtEGSaODBEAbxc9A2_l3Qxc0

- We, the residents, need to see all the data and sound meter data logs to support measurements taken…just like what was shown in the 'existing/traffic' studies above.

References by Topic

Surf and Wave Noise
1a packet of articles

Low Frequency Noise
1a, 1d (generators), 2a, 2b. 2c, 2d, 2e, 2f, 2g, 3a

Adverse Events - Humans and Wildlife
1b, 1c, 1d, 2a, 2f, 2g, 3b

Regulations
3b, 4, 6a-c, MN Windfarm Reg

CEQA and more
5a, 5b, 6a-c

HEAR TO LISTEN
ACOUSTICS 2018

REF 1A

Surf Wave Parks – Assessing the Sound of Fun

Shane Chambers, Ralph James (1)

(1) Bioacoustics Research Laboratory, Department of Physics, University of Western Australia

SUMMARY

Surf wave parks are an emerging commercial development that are increasingly being proposed to be built around Australia. When considering noise control they present large areas of water where substantial inertial masses are displaced in order to create surfable waves of heights, currently up to 2 m, that continuously break in sections of the water body area with a high frequency and long duration. Patron, traffic, plant and machinery noise are often misperceived by the public to be the main contributing noise sources, where long durational noise from resonance of air in the tube of the wave or cavitation of the bubbles created in the spilling or breaking process are dominant. Airborne generation of noise from breaking waves has been shown to be complex, containing tonal, modulating and broadband components, which are all additive when assessing noise dose. A case study is presented of a wave park proposal in Tompkins Park, Alfred Cove, Western Australia alongside the Swan River. This proposal has been controversial due to its placement next to a protected migratory water bird sanctuary, and the large number of noise sensitive receivers in the surrounding residential neighbourhood. Characteristics of wave noise are examined indicating placement and assessment problems relative to the location.

1 OUTLINE

The observation of underwater noise generated from breaking waves has been extensively studied, but when considering airborne noise, the literature is sparse. A few studies exist indicating spectra of plunging and spilling waves and physical modelling (Bolin and Åbom 2010; Tollefsen and Byrne 2011; Dallas and Tollefsen 2016). The tonal components have been shown to be approximated by a horizontal flu like open/closed ended tube that has tonal and harmonic frequencies directly related to the width and length of the tube where the acoustic mechanism is the resonance of the entrained air in the wave's barrel. This observation implies that the noise would also have directional low frequency components apart from the omnidirectional broadband noise created by bubble cavitation in the spill or breaking processes. These processes result in a pink noise spectrum dominated by low frequencies with harmonic content. The main determinants of magnitude of noise has also been shown to be wave height and speed. Modulation has also been observed in the 50 Hz third octave band. Any assessment of the airborne noise from breaking waves needs to account for such complex noise characteristics, the operational nature of the wave park (such as frequency of wave creation, height and speed), the area of the noise source and placement of the park relative to noise sensitive receivers. This assessment must also account for the surrounding atmospheric environment when considering acoustic propagation behaviour. Usually such parks are planned or placed in remote areas where noise control tends to not be an issue, but due to commercial reasons developers would ideally like to place them in residential areas to increase patronage. The placement of this particular proposal in a southerly location adjacent to Alfred Cove with the most sensitive area of a nature reserve directly north, separated by a cove of water with an ever present south-westerly/easterly wind means that assessment must take into account the strong positive sound speed gradient and downward refracting conditions that would likely be present in the evenings, which is the control criterion. This could potentially have a severe negative impact on the migratory bird habitat. The effect of anthropogenic noise on birds is well documented where levels above 45-50 dBA have been demonstrated to have significant negative impacts resulting in a large observed reduction in numbers of affected species (Ware et al. 2015). This has mainly been attributed to increased vigilance due to noise, resulting in lower body mass, changes in demography, communication masking and general area avoidance.

Analysis of a similar wave park proposal in Sydney reveals floors in the noise assessment process due to the non-consideration of the above-mentioned characteristics of wave noise and noise generation area. Additionally, the application of tonal and modulation penalties (+10 dBA) are likely to be applied in such a proposal (Figure 1 & 2). Furthermore, application of refraction in propagation modelling indicates that Tompkins Park is not an ideal location. Noise emissions would likely exceed the prescribed regulations for Western Australia in the absence of objective evidence. Until further evidence of noise generated from such parks is available, control of such noise will be difficult to evaluate, and authorities should demonstrate caution when assessing such proposals placed in noise sensitive areas.

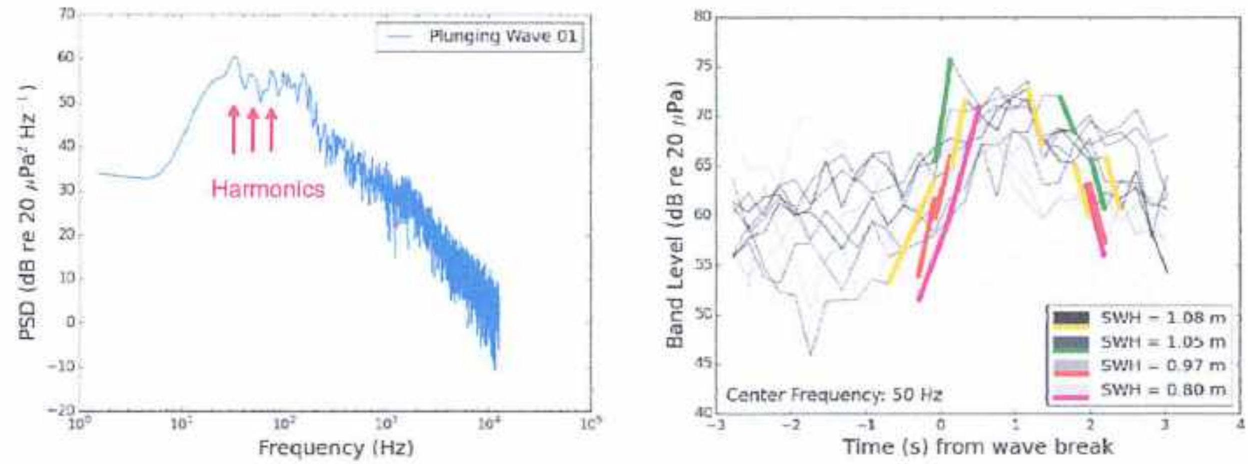

Figure 1: Analysis of Dallas and Tollefsen indicating a $L_{A\,Fast}$ 3dB modulation is present.

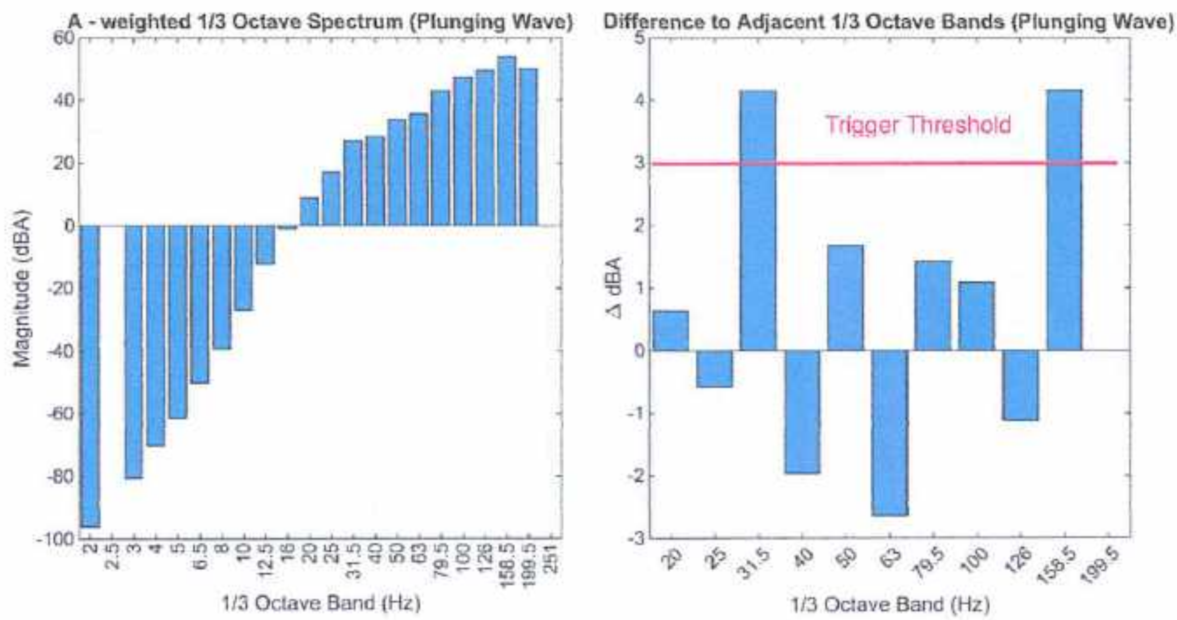

Figure 2: Transformation of the spectrum in Figure 1 to 1/3 Octave band analysis indicates tonality is present.

REFERENCES

Bolin, Karl, and Mats Åbom. 2010. "Air-Borne Sound Generated by Sea Waves." *The Journal of the Acoustical Society of America* 127 (5): 2771–79. https://doi.org/10.1121/1.3327815.

Dallas, C A, and C D S Tollefsen. 2016. "Physical Mechanisms Underlying the Acoustic Signatures of Breaking Waves." DRDC-RDDC-2016-R150.

Tollefsen, Cristina, and Brendan Byrne. 2011. "Dependence of Airborne Surf Noise on Wave Height." *Journal of the Canadian Acoustical Association* 39 (3).

Ware, Heidi E., Christopher J. W. McClure, Jay D. Carlisle, and Jesse R. Barber. 2015. "A Phantom Road Experiment Reveals Traffic Noise Is an Invisible Source of Habitat Degradation." *Proceedings of the National Academy of Sciences* 112 (39): 12105–9. https://doi.org/10.1073/pnas.1504710112.

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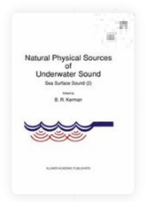

Natural Physical Sources of Underwater Sound pp 277–304

Low Frequency Noise from Breaking Waves

William M. Carey & James W. Fitzgerald

Chapter

Abstract

Recent experiments confirm the production of sound by breaking waves at lower frequencies (30 to 500 Hz). Individual breakers produce impact noise as well as a random collection of individual spectral events. Measured ocean ambient noise spectrum levels increase at less than 1 dB per octave toward a broad maximum, which has a weak wind speed dependence between 300 to 500 Hz. Noise intensities (< 500 Hz) are a function of wind speed (U) to the 2n power with 1.3 < n < 2.5 and a value of n=1.5 at 200 Hz. The production of noise in this region has a dipole characteristic. Breaking waves produce an impact, bubble plume, and bubble cloud. The dynamic evolution of these plumes and clouds provides a mechanism for sound production. Since the initial plume and cloud have appreciable void fractions, compressible resonant behavior of these structures as a whole or as multiply connected regions can be represented as compact acoustic monopoles and dipoles. The pressure release surface would result in an effective dipole characteristic. Sufficient energy exists in the initial breaking vorticity and turbulence to explain measured source levels. Since a good radiator of sound is also a scatterer of sound, these plumes and clouds will also scatter sound.

Keywords

Wind Speed **Ambient Noise** **Wave Breaking** **Source Level**

Bubble Size Distribution

These keywords were added by machine and not by the authors. This

CITY COUNCIL SPECIAL MEETING - JULY 5, 2022 - HAND-OUT - STEVE JEFFREY
PUBLIC HEARING ITEM NO. 1 - CORAL MOUNTAIN RESORT PROJECT

The Journal of the Acoustical Society of America

No Access • Submitted: 13 April 1999 • Accepted: 20 April 2001 • Published Online: 03 August 2001

Low-frequency sound generation by an individual open-ocean breaking wave

The Journal of the Acoustical Society of America **110**, 761 (2001); https://doi.org/10.1121/1.1379729

Steven L. Means *and* Richard M. Heitmeyer

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- Topics
  - Topics
    - Auditory system
    - Electrodynamics
    - Radiation patterns
    - Turbulent flows
    - Acoustic phenomena
    - Sound generation

PDF

ABSTRACT

Bubble cloud resonances have been proposed as an explanation of the low-frequency acoustic radiation produced by breaking waves. A previous model [H. N. Ogũz, J. Acoust. Soc. Am. **95**, 1895–1912 (1994)] considered excitation of the bubble cloud by a rigid piston at the base of a hemispherical bubble cloud. The present model considers excitation of the cloud by individual point sources within the cloud. A Green's function is obtained for a point source displaced from the origin of a hemispherical bubble cloud beneath a pressure release surface. The method of images and superposition allow one to obtain the field generated by a distribution of point sources within the bubble cloud. The frequency-dependent radiation pattern for two distributions of point sources within the cloud is obtained. Distributing the point sources within the forward sector of the bubble cloud generates spectral characteristics consistent with measured open-ocean breaking wave spectra.

REFERENCES

1. V. O. Knudsen, R. S. Alford, and J. W. Emling, "Underwater ambient noise," J. Mar. Res. **7**, 410–429 (1948). **Google Scholar**, **ISI**

2. G. M. Wenzand M. P. Bradley, "Acoustic ambient noise in the ocean: Spectra and sources," J. Acoust. Soc. Am. **34**, 1936–1956 (1962). **Google Scholar**, **Scitation**

PDF

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Low Frequency Noise from Breaking Waves

October 1990
DOI:10.1007/978-94-011-1626-8_22

Authors:

William M. Carey

James W. Fitzgerald

David Browning
Naval Undersea Warfare Center

Abstract

This document contains an invited paper given at the Conference on Natural Physical Sources of Underwater Sound at the University of Cambridge, July 1990. Recent experiments confirm the production of sound by breaking waves at lower frequencies (30 to 500 Hz). Individual breakers produce impact noise as well as a random collection of individual spectral events. Measured ocean ambient noise spectrum levels increase at less than 1 dB per octave toward a broad maximum, which has a weak wind speed dependence between 300-500 Hz. Noise intensities (< 500 Hz) are a function of wind speed (U) to the 2n power with 1.3 < n < 2.5 and a value of n=1.5 at 200 Hz. The production of noise in this region has a dipole characteristic. Breaking waves produce an impact, bubble plume, and bubble cloud. The dynamic evolution of these plumes and clouds provides a mechanism for sound production. Since the initial plume and cloud have appreciable void fractions, compressible resonant behavior of these structures as a whole or as multiply connected regions can be represented as compact acoustic monopoles and dipoles. (jd)

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Ambient noise in the natural surf zone: wave-breaking frequencies

Publisher: IEEE

S.J. Bass ; A.E. Hay **All Authors**

Abstract: Ambient noise in the surf zone, in the frequency range 120 Hz to 5 kHz, was recorded using a broad-band hydrophone, located approximately 1 m above bottom and 1-2 m below... **View more**

Metadata

Abstract:
Ambient noise in the surf zone, in the frequency range 120 Hz to 5 kHz, was recorded using a broad-band hydrophone, located approximately 1 m above bottom and 1-2 m below the mean sea surface. The predominant source of this noise is breaking waves. Analysis of simultaneous land-based video observations of the sea surface in the region of the hydrophone, along with wave height data, reveals quantitative correlation between wave-breaking events and the hydrophone signal. In energetic surf, locally breaking waves appear as discrete events in the ambient noise spectra. Distant breaking events do not appear to be detected, as distinct events above the ambient background noise, by the hydrophone. The noise events associated with local breakers are characterized by an asymmetry in the time envelope: low frequencies (less than 500 Hz) are observed leading the breaking crest, followed by a broader range of frequencies peaking in intensity with the passage of the wave crest above the hydrophone, and then decreasing abruptly at all frequencies. Low frequencies are generally not observed trailing the breaking wave. The detection by the hydrophone of breaking waves in the immediate vicinity implies that ambient noise in heavy surf provides a means of studying breaking-wave statistics in the surf zone in situ: in particular, the frequency of occurrence of local breaking.

Published in: IEEE Journal of Oceanic Engineering (Volume: 22 , Issue: 3, Jul 1997)

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PUBLIC HEARING ITEM NO. 1 - CORAL MOUNTAIN RESORT PROJECT

Page(s): 411 - 424

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Citations

Keywords

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CITY COUNCIL SPECIAL MEETING - JULY 5, 2022 - HAND-OUT - STEVE JEFFREY
PUBLIC HEARING ITEM NO. 1 - CORAL MOUNTAIN RESORT PROJECT

EPA VICTORIA

Noise guidelines: Assessing low frequency noise

Publication 1996 June 2021

VICTORIA State Government

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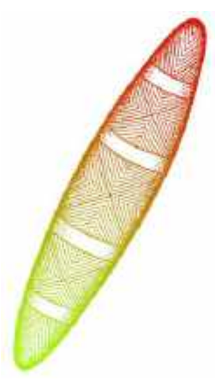

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Contents

Glossary

This glossary defines the terms for the purpose of this guideline.

Term	Definition

Commercial, industrial and trade premises	Is defined the Regulations and includes any premises except the following:
	• residential premises (other than common plant under the control of an owners' corporation)
	• a street or road, including every carriageway, footpath, reservation and traffic island on any street or road
	• a railway track used by rolling stock in connection with the provision of a freight service or passenger service:
	    o while travelling on a railway track or tramway track; or
	    o while entering or exiting a siding, yard, depot or workshop
	• a railway track used by rolling stock in connection with the provision of a passenger service, while in a siding, yard, depot or workshop and is:
	    o powering up to commence to be used in connection with the provision of a passenger service; or
	    o shutting down after being used in connection with the provision of a passenger service
	• the premises situated at Lower Esplanade, St Kilda, Luna Park, and being the whole of the land more particularly described in Certificate of Title Volume 1204 Folio 109.
	
	Note: The maintenance, cleaning or loading of rolling stock stabled in a siding, yard, depot or workshop are included within the meaning of commercial, industrial and trade premises.
	
	Examples
	
	Common plant under the control of an owners' corporation at residential premises includes:
	• common air conditioning units
	• car stackers and lift equipment in apartment buildings.
	
	These must be assessed as noise from commercial, industrial and trade premises in accordance with the Noise Protocol.

Term	Definition
C-frequency weighting	Frequency weighting, as specified in *Australian standard AS IEC 61672.1-2019*. that gives more emphasis to low frequency sounds than the A-frequency weighting.
Duty holder	The owner, occupier or person in control of the commercial, industrial or trade premises.
Engineering calculation method	Calculation algorithm relying on a combination of acoustic principles and empirical relationships. A suitable engineering calculation method must have been validated against extensive measurement. Also, the set of conditions for which it is fit for purpose must be documented in a verifiable reference, together with the uncertainty of calculation.
Excited	An element of a structure vibrating, following an impact or a contact with a moving object.
Fast (F) time weighting	Time weighting characteristic of a sound level meter as specified in *Australian Standard AS/NZS IEC 61672.1*.
Free field conditions	Noise measurement conditions where the sound pressure levels recorded by the microphone are not affected by the reflection of sound on surfaces, other than the ground.
Frequency	Property of sound that measures the rate of repetition of the sound wave, in Hertz (Hz) or cycles per second.
Frequency spectrum*	Distribution of the energy or the magnitude of a sound across each frequency component.
$L_{Ceq,T}$	Overall equivalent sound pressure level measured using C-frequency weighting. As an overall level, it combines the sound energy of all frequencies.
$L_{eq,T}$ (also known as $L_{Zeq,T}$)	The equivalent continuous sound pressure level. It is the value of the linear or Z-weighted sound pressure level of a continuous steady sound that has the same acoustic energy as a given time-varying linear or Z-weighted sound pressure level when determined over the same measurement time interval T.

Term	Definition
Low frequency noise	Noise with low frequency components containing significant acoustic energy within a frequency range defined by one-third octave bands 10 Hz to 160 Hz.
Narrow-band spectral analysis	A sound analysis approach based on a high resolution in the frequency domain such as Fourier analysis or 1/12th octave band analysis.
Octave band	A division of the frequency range that can be used to analyst eh frequency spectrum of the measured sound. Noise is measured in octave bands using frequency filters as specified in *Australian Standard AS IEC 61260.1:2019 Electroacoustics—Octave band and fractional-octave-band filters.*
One-third octave band	A division of the frequency range that can be used when octave bands don't provide sufficient resolution. Each octave band comprises three one-third octave bands. Noise is measured in one-third octave bands using frequency filters as specified in *Australian Standard AS IEC 61260.1:2019 Electroacoustics—Octave band and fractional-octave-band filters.*
Percentile level $L_{10,T}$, $L_{50,T}$, $L_{90,T}$	Sound pressure level that is exceeded respectively 10%, 50% and 90% of the time during a measurement of duration T.
Sensitive receiver	That part of the land within the boundary of a parcel of land that is outside the external walls of any: • dwelling (including a residential care facility) or residential building • dormitory, ward, bedroom or living room • classroom or any other room in which learning occurs. Or, in the case of a rural area only, that part of the land within the boundary of: • a tourist establishment • a campground • a caravan park.
Spot measurements	A survey measurement, typically of short duration, that's conducted using a handheld sound level meter to get an indication of the sound levels, as they vary within the area surveyed.

Term	Definition
Structure-borne noise	Noise caused by the vibration of the elements of a structure. The source of vibration that results in structure-borne noise is within the building where it's perceived or within a structure with common elements that transmit vibration.
Threshold of hearing	The level at which an individual can hear a sound at a given frequency.
Unreasonable noise	Section 3(1) of the Act defines unreasonable noise as noise that: • is unreasonable having regard to the following: o its volume, intensity or duration o its character o the time, place and other circumstances in which it is emitted o how often it is emitted o any prescribed factors*, or • is prescribed to be unreasonable noise.
Z-frequency weighting	Means the sound pressure level when no frequency weighting is applied, as specified in *Australian standard AS IEC 61672.1-2019.*

*Frequency spectrum is a prescribed factor in Regulation 120 of the Environment Protection Regulations 2021. It applies to noise from commercial, industrial and trade premises only.

Introduction

This guideline is for acoustic consultants and other qualified professionals who assess low frequency noise (10 to 160 Hertz (Hz)). This guideline is also for:

- duty holders at commercial, industrial and trade premises to understand and manage low frequency noise emissions
- EPA authorised officers to determine whether the emission of low frequency noise from commercial, industrial and trade premises is unreasonable under section 166 of the *Environment Protection Act 2017* (the Act).

Use this guideline to:

- understand the risk of harm from the emission of low frequency noise
- assess and address low frequency noise.

This guideline should also be used when you're designing new commercial, industrial and trade premises or installing new equipment or plant at existing premises.

When this guideline applies

The assessment methods and guidance set out in this guideline only applies to noise emitted from commercial, industrial and trade premises.

This guideline does not apply to:

- music noise from entertainment venues
- noise from residential premises
- noise from wind turbines.

The New Zealand Standard *NZS 6808:2010 Acoustics – Wind farm noise*, or its predecessor *NZS 6808:1998 Acoustics – The assessment and measurement of sound from wind turbine generators* is used to assess wind turbine noise.

The assessment of low frequency noise using this guideline is separate from an assessment for compliance with the regulatory noise limits. The regulatory noise limits for commercial, industrial and trade premises are set out in the:

- Environment Protection Regulations 2021
- *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (publication 1826)

What is low frequency noise?

Low frequency noise is often described as rumbling or droning noise. It can be generated by machinery such as pumps, compressors, diesel engines, fans, generators and boilers. Low frequency noise can also be produced by natural sources such as surf in coastal areas and wind. Electrical appliances in homes and buildings, such as refrigerators, can emit low-frequency noise.

Low frequency noise may also occur when an object or machine transmits vibration to the structure of a building, generating 'structure-borne' noise. This is when a building's structural elements, such as walls or floors vibrates and radiates noise following an impact or a contact with a moving object. The noise can be heard inside other rooms to where the object or machine is housed.

In this guideline, low frequency noise is defined as noise with significant acoustic energy in one-third octave bands ranging between 10 Hz to 160 Hz.

How low frequency noise affects people

Low frequency noise can affect people in the same way as other types of noise. This can include sleep disturbance, annoyance, impaired task performance, daytime tiredness, and disturbed daily cortisol pattern due to stress. These effects can cause some people to experience nausea and headaches.

The human range of hearing is often described as being from 20 Hz to 20,000 Hz (20 kHz). However, low frequency sound at frequencies less than 20 Hz can be audible. Its audibility depends on the sound pressure level measured in decibels (dB) and the hearing sensitivity of whoever can hear it.

Sensitivity to sound varies greatly between individuals. The person investigating low frequency noise may not hear the sound that someone has reported. However, it may be audible by others. The perceived loudness of low frequency sounds increases rapidly with increasing noise level (measured in decibels). This means low frequency sounds only just above the threshold of hearing can be perceived as loud by some people (Moorhouse, Waddington and Adams 2011).

This doesn't mean that any audible sound is unreasonable.

Characteristics of low frequency noise that can increase its effect

Characteristics that can increase the effects of low frequency noise, particularly how disturbing it is, include:

- the presence of tones (a sound with energy concentrated at one or two single frequencies, often described as a drone or hum)
- fluctuating noise level (rapid increase and decrease in noise level)
- frequency modulation (small variations in the frequency of the noise)
- rattles or vibration caused by low frequency noise.

Low frequency noise with tones can induce greater fatigue and can interfere with task performance more than low frequency noise without tones or with the tones masked by other noise (Leventhall, 2003).

How the effect of low frequency noise varies with your location

The effect of the low frequency noise also varies with the location of where it's heard. Low frequency noise is often experienced indoors. Inside a room, low frequency noise levels can vary due to interference caused by sound reflections on the room surfaces. Sound levels can then increase or reduce depending on where a person is positioned. This effect depends on the dimensions of the room and the frequency spectrum of the noise.

Common sources of low frequency noise

The presence of any of these sources at a premises does not necessarily mean that a low frequency noise issue will occur.

Table 1: Sources of low frequency noise

Type	Noise source
Commercial/industrial/trade	• aircraft • blasting • boilers • cooling towers • cooling fans • compressors • diesel engines • electrical installations • extraction fans • heavy machinery • large generators • loading and unloading activities • metal thudding • motors • power stations • pumps • shipping and ships in the harbor • steam releases • shakers • transformers • ventilation plant • vibratory screens
Residential	• air conditioners • electric appliances • fish tank pumps • heat pumps • refrigerator • spa bath pumps
Natural causes	• sea, including surf • seismic activity • thunder • wind • wind effects on structures

Legislative framework

Under section 166 of the Act, a person must not emit an unreasonable noise or permit an unreasonable noise to be emitted from any place or premises that is not residential premises.

Understanding unreasonable noise

Noise is assessed as being unreasonable having regard to the characteristics of the noise and the circumstances in which it is emitted, as defined under ***unreasonable noise*** in section 3(1) of the Act.

An assessment of unreasonable noise can also include any prescribed factors. Regulation 120 of the Environment Protection Regulations 2021 (the Regulations) makes frequency spectrum a prescribed factor when assessing noise from commercial, industrial and trade premises. The frequency spectrum from 10 Hz to 160 Hz must be used to assess whether the low frequency noise is unreasonable.

Other factors which may be considered in an assessment include:

- how often the noise occurs
- how long the noise continues
- its character such as the presence of tones, fluctuations, or pulsing.

If an authorised officer reasonably believes that unreasonable noise has been or is being emitted, the officer may issue an improvement or prohibition notice to the duty holder.

How to reduce low frequency noise levels

If a low frequency sound can be traced to a known source, this increases the potential to take action to reduce the noise.

Hierarchy of controls

The hierarchy of controls is a step-by-step approach to eliminate or reduce risk, including controls from the highest level of protection, elimination, to the lowest, administrative controls.

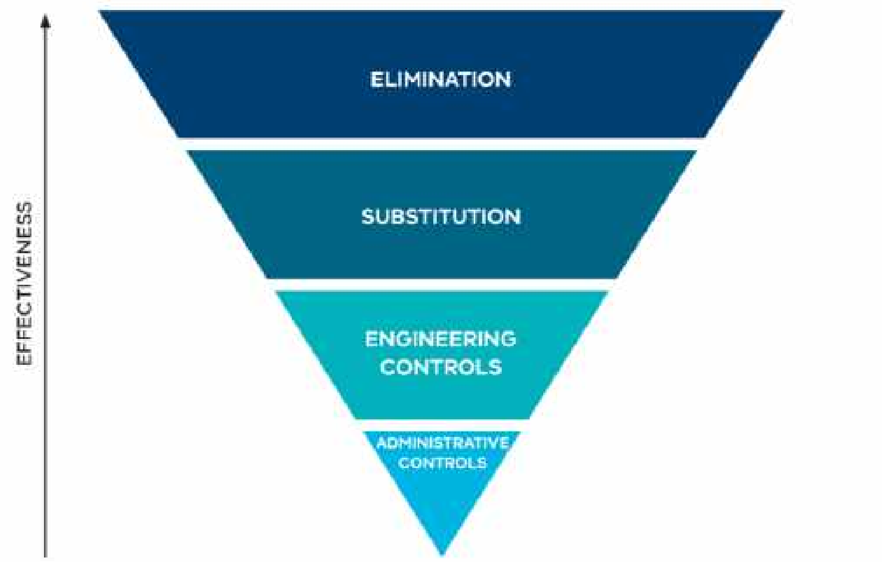

Figure 1: Hierarchy of controls

REF 1B

> Glob Chang Biol. 2015 Sep;21(9):3278-89. doi: 10.1111/gcb.12997. Epub 2015 Jul 4.

How anthropogenic noise affects foraging

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Abstract

The influence of human activity on the biosphere is increasing. While direct damage (e.g. habitat destruction) is relatively well understood, many activities affect wildlife in less apparent ways. Here, we investigate how anthropogenic noise impairs foraging, which has direct consequences for animal survival and reproductive success. Noise can disturb foraging via several mechanisms that may operate simultaneously, and thus, their effects could not be disentangled hitherto. We developed a diagnostic framework that can be applied to identify the potential mechanisms of disturbance in any species capable of detecting the noise. We tested this framework using Daubenton's bats, which find prey by echolocation. We found that traffic noise reduced foraging efficiency in most bats. Unexpectedly, this effect was present even if the playback noise did not overlap in frequency with the prey echoes. Neither overlapping noise nor nonoverlapping noise influenced the search effort required for a successful prey capture. Hence, noise did not mask prey echoes or reduce the attention of bats. Instead, noise acted as an aversive stimulus that caused avoidance response, thereby reducing foraging efficiency. We conclude that conservation policies may seriously underestimate numbers of species affected and the multilevel effects on animal fitness, if the mechanisms of disturbance are not considered.

Keywords: Myotis daubentonii; allostatic load; anthrophony; global change; highway noise; noise pollution; road impact; soundscape ecology.

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Short communication

Anthropogenic noise impairs owl hunting behavior

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Highlights

- Northern saw-whet owls hunted under noise levels corresponding with distances of 50 - 800 m from a compressor station
- For each dB increase in noise, the odds of an owl successfully capturing prey declined by 8%.
- For acoustically specialized predators, noise should be managed by dose of the pollutant.

Abstract

Emerging evidence indicates that anthropogenic noise has highly detrimental impacts on natural communities; however, the effects of noise on acoustically specialized predators has received less attention. We demonstrate experimentally that natural gas compressor station noise impairs the hunting behavior of northern saw-whet owls (*Aegolius acadius*). We presented 31 wild-caught owls with prey inside a field-placed flight tent under acoustic conditions found 50–800 m (46–73 dBA) from a compressor station. To assess how noise affected hunting, we postulated two hypotheses. First, hunting deficits might increase with increasing noise—the dose–response hypothesis. Secondly, the noise levels used in this experiment might equally impair hunting, or produce no impact—the threshold hypothesis. Using a model selection framework, we tested these hypotheses for multiple dependent variables—including overall hunting success and each step in the attack sequence (prey detection, strike, and capture). The dose–response hypothesis was supported for overall hunting success, prey detection, and strike behavior. For each decibel increase in noise, the odds of hunting success decreased by 8% (CI 4.5%–11.0%). The odds of prey detection and strike behavior also decreased with increasing noise, falling 11% (CI 7%–16%) and 5% (CI 5%–6%), respectively. These results suggest that unmitigated noise has the potential to decrease habitat suitability for acoustically specialized predators, impacts that can reverberate through ecosystems.

Previous Next

REF 1D

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Anthropogenic noise: potential influences on wildlife and applications to cannabis cultivation

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Biological sounds play an important role in activities ranging from territory defense to mate choice to predator avoidance to foraging. Anthropogenic noise can mask these sounds, potentially altering the habitat selection, activity patterns, phenology, and physiology of wildlife species. For example, cannabis (Cannabis sativa or C. indica) cultivation may increase levels of anthropogenic noise given the use of diesel generators, irrigation pumps, and landscaping equipment. To predict how noises associated with cannabis cultivation may influence wildlife in California, we review scientific literature assessing the influences of anthropogenic noise on various species of mammals, birds, herpetofauna, and invertebrates. We then outline potential noises associated with cannabis cultivation and why they may be unique on the landscape and provide recommendations on future research needs.

Key words: activity patterns, anthropogenic noise, cannabis, habitat selection, phenology, physiology, wildlife

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The acoustic environment is more than just a collection of auditory signals between individuals, it is an interconnected landscape of information networks consisting of many signalers, receivers, and sounds vital to the fitness of a species (Templeton and Greene 2007; Barber et al. 2010; Read et al. 2013). For example, sounds pertaining to territory defense, mate attraction, or family cohesion (i.e., contact calls) promote reproductive success (Halfwerk et al. 2011a, b; Allen et al. 2016). In songbirds, these sounds are used to assess numerous individuals simultaneously for mate choice, extra-pair copulations, and rival assessment (Barber et al. 2010). Alternatively, sounds announcing the approach of predators (i.e., alarm calls) promote survival of both conspecifics to whom the calls were directed and other species that capitalize on the alarms (Templeton and Greene 2007; Sloan and Hare 2008; Magrath et al. 2015).

Successful acoustic communication requires sounds to 1) move through the environment from senders to receivers and 2) be detectable through background noise (Patricelli and Blickley 2006). There is mounting evidence that noise produced by humans, whether from vehicles, construction equipment, or humming power sources (e.g., generators, power lines, wind turbines), dramatically increases the amount of background noise, in turn impeding detectability of acoustic signals and negatively impacting the ability of a species to communicate (Fernández-Juricic et al. 2005; Gillam and McCracken 2007; Barber et al. 2010; Kite and Swaddle 2011; Francis and Barber 2013). Masking of biologically relevant sounds can limit mate choice, cause species to abandon territories or potential habitat, negatively impact species' ability to locate food, or cause deleterious physiological effects like hearing loss, raised blood pressure, and increased production of stress hormones (Rabin et al. 2006; Wright et al. 2007; Schaub et al. 2008; Shannon et al. 2014; Ware et al. 2015). In a rural to suburban area where ambient noise levels are 45 – 55 decibels (dB), new sources of anthropogenic noise can begin having deleterious effects when they increase overall noise by just 5 – 10 dB (Dooling and Popper 2007). The specific noise level at which impacts begin to appear, however, depends on the amount of ambient noise and the temporal and spectral overlap between anthropogenic and biological sounds (Dooling and Popper 2007; Halfwerk et al. 2011). Species with low-frequency vocalizations like owls and grouse tend to have the largest spectral overlap with traffic noise, for example, which means these species are more likely to have their mate attraction or territorial defense songs obscured by human-produced noises (i.e., experience a decline in signaling efficiency; Slabbekoorn and Ripmeester 2007; Bunkley et al. 2015).

Cannabis cultivation has the potential to add additional sources of anthropogenic noise into a landscape through, for example, diesel generators, irrigation pumps, climate control systems, landscaping equipment, and vehicles. There is concern that this additional anthropogenic noise may reach the level of take, as defined by the Federal Endangered Species Act (ESA; i.e., an action of or attempt to hunt, harm, harass, pursue, shoot, wound, capture, kill, trap, or collect a species), for sensitive species like the northern spotted owl (*Strix occidentalis occidentalis*) and marbled murrelet (*Brachyramphus marmoratus*; USFWS 2006). For northern spotted owl and marbled murrelet it was determined that disturbance may reach the level of take if 1) project-generated sound exceeds ambient nesting conditions by 20-25 dB, 2) project-generated sound, when added to existing ambient conditions, exceeds 90 dB, or 3) human activities occur within a visual line-of-sight distance of 40 m or less from a nest (USFWS 2006). We note that California's ESA has a narrower definition of take (i.e., any action of or attempt to hunt, pursue, catch, capture, or kill). This could make it more difficult to directly attribute take to anthropogenic noise under the California ESA when compared to the Federal ESA.

Information on the levels of noise produced by cannabis cultivation specifically and the subsequent influences on wildlife species, however, is scant. To predict how anthropogenic noise associated with cannabis cultivation may influence wildlife in California, we reviewed scientific literature that assessed the influences of human-produced noise on species' habitat selection, activity patterns, phenology, and physiology. We then provide recommendations on future research needs.

Habitat selection and Activity Patterns

Mobile animals are often guided by sound, with conspecific signals attracting group members or potential mates, heterospecific signals (i.e., signals from a different species) indicating suitable habitat, and overall soundscape signals providing cues for general orientation (Slabbekoorn and Bouton 2008). Consequently, site abandonment and changes in habitat selection and activity patterns are among the most detected impacts of noise (Table 1; Francis and Barber 2013). Species ranging from deer to songbirds to frogs have been documented avoiding areas with anthropogenic noise, in turn influencing both fine-scale habitat selection and large-scale patterns of movement (Table 1; Sawyer et al. 2006; Mukhin et al. 2008; Francis et al. 2011; Ware et al. 2015; Caorsi et al. 2017). Further, avoidance or use by one species may lead to avoidance or use by others. This has been documented in nocturnally migrating bird species, where migrant birds listen for the heterospecific calls of resident birds to make decisions about which habitats to use as stopover sites (i.e., the heterospecific attraction hypothesis; Mönkkönen et al. 1990; Mukhin et al. 2008). It has

Table 1. Examples of changes in habitat selection and activity patterns resulting from anthropogenic noise.

Taxa	Species	Response	Source
Mammals	Mule deer (*Odocoileus hemionus*)	Radio-collared deer were more likely to occupy habitat away from noise-producing oil and gas developments than habitat in close proximity; changes in habitat selection happened within 1 year of development and there were no signs of acclimation.	Sawyer et al. 2006
	Sonoran pronghorn (*antilocapra Americana sonoriensis*)	Pronghorn at a military site where there was noise from overflights, ordinance deliveries, and human activity foraged less and stood and traveled more than pronghorn not exposed to military activity.	Krausman et al. 2004
	California ground squirrels (*Otospermophilus beecheyi*)	Close to wind turbines, where noise levels were higher than control sites (110.2 dB vs. 79.8 dB), squirrels exhibited increased rates of vigilance and were more likely to return to their burrows during alarm calling (i.e., increased caution).	Rabin et al. 2006
	Prairie dogs (*Cynomys ludovicianus*)	When exposed to road playback noise (77 dB at 10m), the number of prairie dogs aboveground decreased by 21%, the proportion of individuals foraging decreased by 18%, and vigilance increased by 48%. These results were consistent across a 3-month period suggesting there was no habituation.	Shannon et al. 2014
✓	Bat community	Bat species emitting low frequency (< 35 kHz) echolocation calls had a 70% reduction in activity levels at loud compressor sites (70 – 82 dB) vs. quieter well pads (53 – 70 dB). Bat species emitting high frequency calls did not show altered activity levels.	Bunkley et al. 2015
✓	Greater mouse-eared bat (*Myotis myotis*)	Successful foraging bouts decreased, and search time increased with proximity to acoustically simulated highway noise. At 7.5m from the noise source, it took the bats 5x longer to find their prey, which they locate by listening for faint rustling sounds.	Siemers and Schaub 2011
Birds	American robin (*Turdus migratorius*)	Foraging success was reduced when the auditory cues that robins rely on to locate buried worms were obscured by white noise (61 dB).	Montgomerie and Weatherhead 1997
	Nocturnally migrating birds	To test the effect of noise alone, a "phantom road" was created through an array of speakers broadcasting traffic noise. Among the bird community, 31% avoided using the phantom road as a stopover site during migration and the birds that did use the site showed a decrease in their overall body condition.	Ware et al. 2015
	Grey flycatcher (*Empidonax wrightii*)	Occupancy of flycatchers was lower at sites with 46-68 dB of noise than sites with 32-46 dB of noise.	Francis et al. 2011

Table 1. continued.

Taxa	Species	Response	Source
	White-throated sparrow (*Zonotrichia albicollis*), yellow-rumped warbler (*Dendroica coronata*), and red-eyed vireo (*Vireo olivaceus*)	Passerine density was 1.5x higher at energy sites that did not produce noise than at those that did (48 dB).	Bayne et al. 2008
	Greater sage-grouse (*Centrocercus urophasianus*)	Radio-marked female grouse were more likely to select habitat away from noise-producing oil and gas developments and were 1.3x more likely to occupy sagebrush habitats lacking wells within a 4-km² area.	Doherty et al. 2008
Herpetofauna	Bischoff's tree frog (*Boana bischoffi*) and fine-lined tree frog (*B. leptolineata*)	Both species moved away from playbacks of road noise (played at two intensities- 65 and 75 dB), suggesting the noise resulted in their spatial displacement.	Caorsi et al. 2017

also been documented in marbled newts (*Triturus marmoratus*) and smoot newts (*Lissotriton vulgaris*), which orient towards the calls of species that share similar breeding habitat (Diego-Rasilla and Luengo 2004; Pupin et al. 2007).

Sound is also important in determining how much time and energy a species expends on activities like resting, vigilance, and foraging (Quinn et al. 2006; Rabin et al. 2006; Shannon et al. 2014). Many animals use sound to detect approaching predators or to warn conspecific and heterospecific co-occurring species (e.g., through alarm calls) that a predator is approaching. Quiet environments facilitate detection of these auditory cues, so less time needs to be spent searching for predators. Conversely, noisy environments impede auditory cues resulting in species spending more time and energy on anti-predator behaviors like vigilance and caution (e.g., not traveling far from a burrow; Quinn et al. 2006; Shannon et al. 2014). A positive relationship between noise and predator avoidance has been documented in both mammal and bird species (Quinn et al. 2006; Francis and Barber 2013; Shannon et al. 2014). California ground squirrels (*Otospermophilus beecheyi*), for example, tend to exhibit increased rates of vigilance in noisy environments where their ability to hear conspecific alarm calls is hindered (Rabin et al. 2006). If noise causes ground squirrels to miss just a single conspecific alarm call, then they may underestimate potential threats and in turn, increase their exposure to predation (Sloan and Hare 2008). In chaffinches (*Fringilla coelebs*) and prairie dogs (*Cynomys ludovicianus*), alternatively, noise leads to more time expended on vigilance and less time on foraging (Quinn et al. 2006; Shannon et al. 2014). Delayed response times of ground squirrels and loss of foraging time in chaffinches and prairie dogs demonstrate how noise, through its influence on predator-prey dynamics, can have both immediate (i.e., survival) and long-term (i.e., decreased nutrition/energy) impacts on species' fitness (Frid and Dill 2002).

Lastly, anthropogenic noise may decrease foraging efficiency if the species relies on auditory cues to locate food. Bat species specialized in gleaning arthropods off vegetation or the ground, for example, find prey by passively listening for prey-produced sounds

(Schaub et al. 2008). Thus, in environments with more noise, gleaning bats have fewer successful foraging bouts and spend more time searching for prey (Table 1; Schaub et al. 2008; Siemers and Schaub 2011). Decline of 12 species of bats in California that are either endangered or species of special concern has been correlated to reduced foraging success in noisy environments (Schaub et al. 2008; Siemers and Schaub 2011). Bird species like American robins (*Turdus migratorius*), marsh hawks (*Circus cyaneius*), and barn owls (*Tyto alba*), as well as reptile species like geckos (*Hemidactylus tursicus*), also use auditory cues to detect and locate prey. Like gleaning bats, these species have reduced foraging success in noisy environments where cues are obscured (Knudsen and Konishi 1979; Rice 1982; Sakaluk and Belwood 1984; Montgomerie and Weatherhead 1997).

Phenology and Physiology

To mitigate the negative impacts that anthropogenic noise may have on acoustic communication, many species adjust the frequency structure (i.e., pitch), amplitude (i.e., loudness), or timing of their vocalizations (Table 2; Patricelli and Blickley 2006). Vocal adjustments have been documented in a range of species, including bats, birds, frogs, and insects (Table 2). Brazilian free-tailed bats (*Tadarida brasiliensis*), reed buntings (*Emberiza schoeniclus*), great tits (*Parus major*), cicadas (*Cryptotympana takasagona*), and grasshoppers (*Chorthippus biguttulus*), for example, use higher call frequencies in the presence of anthropogenic noise (Slabbekoorn and Peet 2003; Gillam and McCracken 2007; Gross et al. 2010; Lampe et al. 2012; Shieh et al. 2012). Conversely, various species of frogs often increase or decrease their call rates based on the level of background noise (Lengange 2008; Cunnington and Fahrig 2010; Vargas-Salinas and Amézquita 2013). The benefit of vocal plasticity is that it allows species to adjust to new, noisy conditions (Gross et al. 2010). The hindrance is that it may negatively impact species' fitness by reducing transmission distances (e.g., high frequency signals attenuate faster), increasing the risk of predation or parasitism by making animals more conspicuous, altering energy budgets causing vital information to be lost (e.g., for mate choice), or breaking down signaler-receiver coordination (Luther 2008; Read et al. 2013).

In addition to altering the phenology of a species, exposure to noise can also influence the physiology of a species. Ungulates, bears, whales, game birds, songbirds, and frogs have all been documented to have adverse physiological responses to anthropogenic noise (Table 2; Powell et al. 2006; Rolland et al. 2012; Troianowski et al. 2017). These responses include hearing loss, hypertension (i.e., raised blood pressure), and increased production of glucocorticoids or stress hormones (Wright et al. 2007; Dooling and Popper 2007; Shannon et al. 2016). Increased production of stress hormones can in turn, negatively impact the survival and reproduction of a species by causing decreased immune response, diabetes, or reproductive malfunctions (Kight and Swaddle 2011; Tennessen et al. 2014). Exposure to noise led to increased stress hormone levels in European tree frogs (*Hyla arborea*), for example, which led to an immunosuppressive effect (Troianowski et al. 2017). The severity of a species' physiological responses is likely dependent on season. Northern spotted owl (*Strix occidentalis caurina*) males, for example, had the strongest response to motorcycle noise in May, when feeding themselves, their mates, and their nestlings (Hayward et al. 2011). The physiological response of migratory birds, alternatively, may be most acute mid-migration when maintenance of body condition is particularly imperative (Ware et al. 2015).

Table 2. Examples of phenological and physiological changes associated with anthropogenic noise.

Taxa	Species	Response	Source
Mammals	General	If the inner ear sensory hair cells are damaged, then mammals will experience permanent hearing loss.	Dooling and Popper 2007
	Brazilian free-tailed bats (*Tadarida brasiliensis*)	Bats recorded in the presence of high-frequency sounds used higher call frequencies than bats recorded in silence, which suggests that bats adjusted their echolocation call structure to minimize acoustic interference.	Gillam and McCracken 2007
	✓ Desert mule deer (*Odocoileus hemionus crooki*) and desert bighorn sheep (*Ovis canadensis mexicana*)	Heart rates of captive animals increased relative to dB levels (from simulated jet aircraft noise) but returned to pre-disturbance levels within 60-180 seconds.	Weisenberger et al. 1996
Birds	House finches (*Carpodacus mexicanus*)	Males increased the low frequency (1.62 kHz) of their songs in areas with higher ambient noise to reduce the masking effects of the noise.	Fernández-Juricic et al. 2005
	Ash-throated flycatcher (*Myiarchus cinerascens*)	Occupancy was not influenced by noise from gas well compressors but bird vocalizations were; and individuals in areas with more noise vocalized at frequencies ~200 kHz higher. Noise levels averaged 37.4 and 56.1 dB at control and treatment sites, respectively.	Francis et al. 2011
	Song sparrows (*Melospiza melodia*)	Males shifted more energy into the higher frequencies of their vocalizations when there was more noise (total ambient background noise ranged from 54.8 – 71.3 dB).	Wood and Yezerinac 2006
	House sparrows (*Passer domesticus*)	Nests in area with large generator noise (68 dB) produced fewer young of lower body mass, and fewer recruits; females also provided young with food less often in noisy area.	Schroeder et al. 2012
	Tree swallows (*Tachycineta bicolor*)	Nestlings exposed to white noise playbacks (65 dB) had begging calls with higher minimum frequencies and narrower frequency ranges. These effects persisted in the absence of noise, suggesting that noise may influence call development. Further, when exposed to playbacks, nestlings were less likely to beg when parents arrived with food.	Leonard and Horn 2008
	Black-capped chickadee (*Poecile atricapillus*)	Noise reduced the number of individuals that could be heard, thus limiting mate choice and rival assessment.	Hansen et al. 2015
	Northern spotted owl (*Strix occidentalis occidentalis*)	Males had highest glucocorticoid response to experimentally applied motorcycle noise in May, when they are generally responsible for feeding themselves, their mates, and their nestlings.	Hayward et al. 2011
	Quail (*Coturnix coturnix*)	When quail were exposed to 116 dB of noise for 4 hours, they experienced hearing loss of up to 50 dB immediately following exposure.	Niemiec et al. 1994
	Greater sage-grouse (*Centrocercus urophasianus*)	Fecal corticosterone metabolite levels were 16.7% higher, on average, at leks where 67.6 dB of road noise was broadcast vs. control leks with no noise. Further, peak male attendance and abundance at noise-treated leks decreased by over 29% when compared to paired controls.	Blickley et al. 2012a, b

Table 2. continued.

Taxa	Species	Response	Source
Herpeto-fauna	Bischoff's tree frog (*Boana bischoffi*)	Advertisement call rates decreased during playbacks of road noise (played at two intensities- 65 and 75 dB) and dominant call frequency decreased when exposed to noise.	Caorsi et al. 2017
	Green frog (*Rana clamitans*), leopard frog (*R. pipiens*), gray treefrog (*Hyla versicolor*)	Call rates were significantly lower at low-noise sites (mean = 43.8 dB) than high-noise sites (mean = 73.2 dB). Further, when traffic noise was broadcast at low-noise sites, green and leopard frog vocalizations changed to having higher frequencies.	Cunnington and Fahrig 2010
	European tree frog (*H. arborea*)	Exposure to traffic playback noise (76 dB) led to increased stress hormone levels and in turn, an immunosuppressive effect.	Troianowski et al. 2017
	Wood frogs (*Lithobates sylvaticus*)	Traffic playback noise (87 dB) increased levels of glucocorticoid hormones in females. It also negatively influenced female travel towards male breeding choruses, highlighting the sublethal impacts of acoustic habitat loss.	Tennessen et al. 2014
	Grey treefrog (*Hyla chrysoscelis*)	Traffic playback noise (70 dB) resulted in female frogs taking longer to localize male calls; females were also less successful in correctly orienting to male signals.	Bee and Swanson 2007
Inverte-brates	Grasshoppers (*Chorthippus biguttulus*)	Compared to males from quiet habitats, males in roadside habitats produced acoustic courtship songs with higher local frequency maximum (6-9 kHz).	Lampe et al. 2012
	Cicada (*Cryptotympana takasagona*)	Cicadas shifted the energy distribution of calling songs to higher frequencies when higher anthropogenic noise.	Shieh et al. 2012

The effects that anthropogenic noises can have on species' habitat selection, activity patterns, phenology, and physiology can culminate in decreased reproductive success. This decrease may be a consequence of limited mate choice, a reduction in pairing success, decreased provisioning rates to offspring, or a decline in offspring survival (Table 2; Francis and Barber 2013). If noise impedes the transmission of bird songs, for example, it may negatively impact mate attraction (Klump 1996; Hansen et al. 2005). If noise impedes parent-offspring communication, alternatively, it may result in young receiving food less often (e.g., if nestlings fail to beg when their parents arrive; Leonard and Horn 2012; Schroeder et al. 2012). Numerous species of birds, including eastern bluebirds (*Sialia sialis*), great tits (*Parus major*), and house sparrows (*Passer domesticus*), are known to produce fewer eggs in noisier areas (Halfwerk et al. 2011b; Kight et al. 2012; Schroeder et al. 2012). Lastly, anthropogenic noise may make it harder for females to detect and locate males, as has been documented in frogs (Bee and Swanson 2007; Tennessen et al. 2014).

FUTURE DIRECTIONS

California's Department of Food and Agriculture (CDFA) identified several potential impacts of the noises associated with cannabis cultivation in their Program Environmental Impact Report (PEIR; CDFA 2017). This noise may result from the use of irrigation pumps, diesel generators, landscaping equipment, equipment and water trucks, worker vehicles, and if a greenhouse has climate control, the heating, ventilation, and air conditioning systems.

As outlined in the PEIR, increased noise and human presence may cause substantial adverse effects on special-status terrestrial wildlife species, and use of mechanical equipment for the cultivation of cannabis may cause excessive ground borne vibration or ground borne noise levels, as well as substantial increases in ambient noise levels in the vicinity of a proposed program activity (CDFA 2017). Upon review, however, CDFA found all noise-related impacts to be "less than significant", stating that in general, the noises resulting from cannabis cultivation would be consistent with other land uses in the area (CDFA 2017). We propose, however, that the noises resulting from cannabis cultivation may differ from those associated with other land uses in the area and warrants further consideration and research.

Determining whether the noises resulting from cannabis cultivation are consistent with other land uses in the area requires an understanding of the noises' duration, loudness (i.e., decibels), and spatial location. Short-term noises from chainsaws, mowers, and vehicles may be consistent with other human-generated noises in an area; however, long-term noises from irrigation pumps, diesel generators, and climate control systems may be new. These long-term noises may adversely affect local fauna not only because they are novel, but also because they are perpetual, meaning they act as a constant impediment to the ability of the species to hear. Loudness of a noise may also play a role in determining impacts, particularly when loudness is considered in relation to ambient noise levels. A generator running at night, for example, likely has greater impacts on surrounding wildlife in a rural area, where ambient noise levels are around 20 dB, than in an urban area, where ambient noise levels are around 40 dB (Dooling and Popper 2007; CDFA 2017).

To date, most mixed-light licenses have been issued in Humboldt and Mendocino counties in northwestern California, a region of the state that is relatively undeveloped and until recently, was predominantly covered in natural vegetation (Butsic et al. 2018). This suggests that cannabis cultivation may be concentrated in rural, forested areas where the negative impacts of anthropogenic noise are likely amplified. Empirical data assessing the distribution and impacts of noises resulting from cannabis cultivation, however, are scant. Consequently, in relation to permitted cannabis cultivation in California, we encourage:

- Studies that evaluate the sound output (loudness, frequency, and duration) of cannabis growing operations in rural vs. suburban areas and how sound outputs (a) vary on a daily and annual basis, (b) compare to ambient noise conditions, and (c) compare to the sound outputs of other agricultural practices.
- Studies that assess the effectiveness of varying types of sound attenuation or insulation devices, with the goal of providing recommendations on the best devices/approaches for minimizing sound output to cannabis cultivators.
- Studies that evaluate the level of sound output (specific to cannabis cultivation) necessary to cause take, harassment, or behavioral changes in a variety of threatened and endangered species and how this varies between rural, forested habitats and suburban habitats.
- Studies assessing the call output levels (loudness, frequency, duration) and call response rates of songbirds and raptors in areas with cannabis cultivation vs. (a) areas with no human development and (b) areas with other forms of human development.
- Improving our understanding of the noises associated with cannabis cultivation and how they vary spatially, temporally, and in relation to ambient noise conditions is a critical first step in understanding how these noises may be impacting terrestrial wildlife in California and how they could be better mitigated in the future.

Author Contributions
Conceived and designed the study: LNR, ADB
Collected the data: LNR, ADB
Performed the analysis of the data: LNR, ADB
Authored the manuscript: LNR, ADB, EC
Provided critical revision of the manuscript: ADB, EC

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Low frequency noise and annoyance

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REF 2A – WHO HEALTH
& C–WEIGHTED MEASUREMENTS

Abstract

Low frequency noise, the frequency range from about 10Hz to 200Hz, has been recognised as a special environmental noise problem, particularly to sensitive people in their homes. Conventional methods of assessing annoyance, typically based on A-weighted equivalent level, are inadequate for low frequency noise and lead to incorrect decisions by regulatory authorities. There have been a large number of laboratory measurements of annoyance by low frequency noise, each with different spectra and levels, making comparisons difficult, but the main conclusions are that annoyance of low frequencies increases rapidly with level. Additionally the A-weighted level underestimates the effects of low frequency noises. There is a possibility of learned aversion to low frequency noise, leading to annoyance and stress which may receive unsympathetic treatment from regulatory authorities. In particular, problems of the Hum often remain unresolved. An approximate estimate is that about 2.5% of the population may have a low frequency threshold which is at least 12dB more sensitive than the average threshold, corresponding to nearly 1,000,000 persons in the 50-59 year old age group in the EU-15 countries. This is the group which generates many complaints. Low frequency noise specific criteria have been introduced in some countries, but do not deal adequately with fluctuations. Validation of the criteria has been for a limited range of noises and subjects.

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Full Text

Introduction

Low frequency noise, considered as the frequency range from about 10Hz to 200Hz, causes extreme distress to a number of people who are sensitive to its effects. The sensitivity may be a result of heightened sensory response, within the whole or part of the auditory range, or may be acquired. Onset of low frequency noise annoyance tends to occur in middle age. The noise levels are often low, in the region of a subject's hearing threshold, where there are large differences between individuals. The problem arises both in homes and in offices, or similar, premises. Whilst noise sources causing annoyance in the home may be unknown, in offices they are often fans or pumps in the building services. Similar plant, in those apartment blocks which have central services, may be the source of the noise in these premises, but a core of low frequency noise problems remain, of unknown origin, which continue to cause considerable annoyance. Low frequency noise problems also occur in industry, but generally at levels well above threshold, presenting a different noise problem to those in homes and offices.

Attempts to assess low frequency noise by conventional wide-band noise methods often fail, so illustrating the inadequacy of these methods for low frequencies. In particular, the regulatory dominance of A-weighted levels, leads to dismissal of valid problems of low frequency noise, so compounding the difficulties of some complainants

The World Health Organization recognizes the special place of low frequency noise as an environmental problem. Its publication on Community Noise (Berglund et al., 2000) makes a number of references to low frequency noise, some of which are as follows

"It should be noted that low frequency noise, for example, from ventilation systems can disturb rest and sleep even at low sound levels"

"For noise with a large proportion of low frequency sounds a still lower guideline (than 30dBA) is recommended"

"When prominent low frequency components are present, noise measures based on A-weighting are inappropriate"

"Since A-weighting underestimates the sound pressure level of noise with low frequency components, a better assessment of health effects would be to use C-weighting"

"It should be noted that a large proportion of low frequency components in a noise may increase considerably the adverse effects on health"

"The evidence on low frequency noise is sufficiently strong to warrant immediate concern"

Annoyance-The meaning of annoyance

Annoyance has roots in a complex of responses, which are moderated by personal and social characteristics of the complainant. (Belojevic and Jokovljevic, 2001; Benton and Leventhall, 1982; Fields, 1993; Grime, 2000; Guski, 1999; Guski et al., 1999; Kalveram, 2000; Kalveram et al., 1999; Stallen, 1999).

REF 2B – dBC measured higher day & night noise

Residential noise from nearby oil and gas well construction and drilling

Authors: Benjamin D. Blair, Stephen Brindley, Eero Dinkeloo, Lisa M. McKenzie and John L. Adgate
Date: Nov. 2018
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Length: 6,628 words
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Abstract :

Public concern about oil and gas (O&G) operations in residential areas is substantial. Noise from construction and drilling related to O&G operations may be greater than other phases of O&G operations; yet the impacts of audible and low-frequency noise during these operations are not extensively explored nor the effects on health well understood. This study documents the noise levels at a multi-well O&G well pad during construction and drilling in a residential area in Colorado. A-weighted (dBA) and C-weighted (dBC) noise measurements were collected at four locations during development over a 3-month period. The maximum 1-min equivalent continuous sound levels over a 1-month period were 60.2 dBA and 80.0 dBC. Overall, 41.1% of daytime and 23.6% of nighttime dBA 1-min equivalent continuous noise measurements were found to exceed 50 dBA, and 97.5% of daytime and 98.3% of nighttime measurements were found to exceed 60 dBC. Noise levels exceeding 50 dBA or 60 dBC may cause annoyance and be detrimental to health; thus, these noise levels have the potential to impact health and noise levels and associated health effects warrant further investigation.

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REF 2C – CadnaA can it measure
wind refraction due to Coral Mtn?

The Deceit of Turbine Noise Models (collateral damage from government energy forcing)

MR masterresource.org/noise-wind-turbines/turbine-noise-deceit

October 19, 2011

> *"When will the environmentalist community writ large wake up to the unintended micro consequences of their increasingly futile macro policy of forced energy transformation?"*

Herkimer County, New York, is the latest location to register wind turbine noise complaints. The source? Iberdrola's Hardscrabble wind facility (37 turbines) that went online earlier this year.

Studies are underway to determine if the project is operating outside legal sound limits, but the larger question is "Why?" Why, with over 1,300 MW of wind installed in New York today and an extensive body of evidence showing turbine noise is causing deleterious impacts on people living near the towers, was Herkimer County fooled into thinking it would be spared?

The answer is simple: *Herkimer County residents were lied to.*

Yes, we could use softer words to explain the situation. But given what sound experts already know about turbine noise, the time for niceties has passed.

Predicted Turbine Noise at Hardscrabble

Prior to erecting a wind facility, project owners usually engage acoustic engineers to prepare models that predict sound level increases a community can expect from an operating project at certain reference points. These engineers rely on the CADNA/A [1]software tool for their models. CADNA/A is based on ISO 9613-2, the international standard developed for sound prediction.

The CADNA/A tool generates predicted sound levels at various distances from the turbines. Developers present the sound levels as contour lines overlaid around the turbine sites. Each contour shows a sound level in decibels with the lines closest to the turbines having higher decibel levels.

The sound predictions developed for Hardscrabble showed that during periods of low wind conditions, non-participating residents closest to the turbines could expect to experience noise increases of less than 6 dBA over the presumed existing level of 35 dBA. During high wind conditions, modeled data showed property owners would experience slightly higher levels but most increases would still be under 6 dBA [2].

Prior to construction, Iberdrola insisted the facility would meet the New York state noise guidelines for most situations and would be in full compliance with local regulations that limited noise to 50 dBA.

CADNA/A and the ISO 9613-2 Standard

Acousticians hired by the wind industry insist the ISO standard is an appropriate method for modeling wind turbine sound provided the correct input parameters are used. But what they do not admit is that the ISO 9613-2 standard, on which CADNA/A is based, *was never* validated for wind turbine noise. In fact, the standard is mainly applicable to situations concerning road or rail traffic, industrial noise sources, construction activities, and many ground-based noise sources. It does not apply to sound from aircraft in flight, to blast waves from mining, military, or other similar operations. And it was not designed to predict turbine noise.

The ISO Standard limits use of its methods to noise sources that are close to the ground (approximately 30 meter difference between the source and receiver height) and within 1 kilometer of the receiving location. A wind turbine with a hub height of 80+ meters exceeds the ISO height limit by 50 meters. Meteorological conditions are also limited to wind speeds of approximately 1 meter/second and 5 meters/second when measured at a height of 3 meters to 11 meters above the ground.

Only when all of these constraints are met by the situation being modeled can the predicted noise levels be assumed to be accurate within a +/- 3 dB range.

The constraints placed on the ISO standard having to do with wind speed, direction and weather conditions indicate just how limited the models are for anything other than simple weather conditions — NOT the types of conditions that wind turbines need to operate.

The way sound spreads outdoors can be affected by temperature differences in different layers of the wind that cause sound waves to bend up or down at the boundaries just like water bends light. If a noise source is above a boundary then sound that would have gone down to the ground surface might bend up and dissipate. If the noise source is below a boundary layer then sound that might have dissipated upwards is bent down and added to the sounds that would normally be directed downwards. The current science of meteorology does not have precise ways to know what is happening right near any particular turbine.

Heinrich A. Metzen of DataKustik GmbH [3], maker of CADNA/A confirmed this fact in an e-mail where he stated:

> "long range propagation including atmospheric refraction is not part of the standards used for (normal, "standard") noise calculations. It is known that atmospheric refraction may cause sound to be refracted downwards again and contributing strongly to the level at long distances. The atmosphere in the standards existing is just homogeneous above height."

Since there are no accepted algorithms to predict these refractions, sound propagation models cannot evaluate conditions that have vertical or horizontal turbulence even though we know they can add significant sound at the receiving location when present. As a result, predicted sound levels are understated.

Countries in the European Union are developing their own models for predicting turbine noise propagation because of their concerns with limitations of the ISO standard. Unlike the ISO 9613-2 standard, these newer models have been validated for turbine noise by peer-reviewed independent studies.

Iberdrola Knows Better

The first post-construction sound study in Herkimer revealed noise levels reaching 60 to 65 decibels, *nearly 20 decibels above* what was predicted for homes in the area. Iberdrola's Paul Copleman told the press that the excessive noise levels were largely due to the wind rustling leaves and cannot be "attributable to the wind farm."

Seriously? Any guesses on the number of complaints filed over noisy leaves before the turbines were sited?

Use of a model that understates real-world operational sound levels is very likely the root cause of the problem at the Hardscrabble facility.

Acoustic experts who work for the wind industry, including Iberdrola, are well aware of the limitations of the ISO modeling. They are well aware that the standard is intended for ground-based sound sources and has never been validated for predicting wind turbine noise. They also know that literature on turbine noise dating back nearly a decade has shown that these models underestimate wind turbine noise levels. But here in the U.S., wind industry acousticians still use the CADNA/A tool without qualification.

Conclusion

Herkimer County residents are now suffering the consequences of an environmentally intrusive, government-enabled industrial project. Moreover, they were lied to.

When will the environmentalist community writ large wake up to the unintended micro consequences of their increasingly futile macro policy of forced energy transformation?

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[1] The CADNA/A software tool is written and sold by DataKustik GmbH of Munich, Germany.

[2] The 6 dBA figure comes from New York's published guidance which states "In non-industrial settings the [Sound Pressure Level] should probably not exceed ambient noise by more than 6 dB(A) at the receptor. An increase of 6 dB(A) may cause complaints."

[3] Email from H. Metzen, DataKustik GmbH, manufacturer of CADNA/A software, Nov. 16, 2006.

Lisa Linowes is Executive Director and spokesperson for the Industrial Wind Action (IWA) Group, a national advocacy focused on the impact/benefits analysis and policy issues associated with industrial wind energy development. As publisher and editor of the IWA website, www.windaction.org, she tracks news and research pertaining to industrial wind, and facilitates information sharing on the issue.

REF 2D – low frequency noise

posted: October 10, 2012 • Impacts, New York, Ordinances

Wind Energy Facilities Local Law, Town of Litchfield, New York

Author: Town of Litchfield (N.Y.)

The Town Board of the Town of Litchfield adopts this Wind Energy Facilities Local Law to promote the effective and efficient use of the town's wind energy resource through wind energy conversion systems (WECS), without harming public health and safety, and to avoid jeopardizing the welfare of the residents.

The Town Board of the Town of Litchfield finds and declares that:

1. While wind energy is a renewable energy resource, there are significant impacts including noise, shadow flicker, aesthetic and physical hazards such that the potential benefits must be balanced against potential impacts.

2. The generation of electricity from properly sited small wind turbines can be a mechanism for reducing on-site electric costs, with a minimum of environmental impacts.

3. Regulation of the siting and installation of wind energy facilities is necessary for protecting the health, safety, and welfare of neighboring property owners and the general public.

4. Utility-scale wind energy facilities represent significant potential aesthetic impacts and because of their large size, noise, lighting, and shadow flicker effects.

5. One of the key aspects of the Town of Litchfield, and one that sets it apart from many communities in the state, are the unique viewsheds created by the Town of Litchfield's location along the highlands between the Mohawk and Sauquoit valleys. In the Town of Litchfield the viewshed is a significant part of the residential property value of many communities within the Town. There are numerous areas in the Town of Litchfield which would be significantly impaired if the viewshed included utility-scale wind energy facilities.

6. The Town of Litchfield has a long history including many homes and structures eligible for listing on the State or National Historic Register located within the town or in the immediate vicinity, several of which predate the founding of the Town of Litchfield in 1796. The town highly values its history and has published a 376 page book entitled Litchfield Through the Years which has undergone four printings and two revisions since 1976. Full appreciation of these resources requires that the setting remain the rural landscape in which they were built. Construction of utility-scale wind energy facilities in the town would have a significant adverse impact on such settings.

7. The State Historic Preservation Office (SHPO) has found that every wind farm in the State it has reviewed has a negative impact on the historical resources of the host community.

8. SHPO has particularly noted the impact on historic cemeteries, of which there are several in the area. These resources would be negatively impacted by the noise, shadow flicker, and visual imposition of utility-scale wind energy facilities in the town.

9. Wind energy facilities installed and operating in the Towns of Fairfield and Norway are visible from several areas of the Town of Litchfield during the day and display flashing red lights at night. The view of these utility-scale wind energy facilities

impairs the enjoyment of the north facing viewsheds in those areas even though the turbines are over 15 miles away. Further impairment of the viewshed of the town may limit residential growth within the town. Should multiple utility scale wind energy facilities be
installed in the Town of Litchfield, they would likely impair viewsheds well beyond the borders of the town.

10. The high elevation of the Town of Litchfield and the lack of street lights results in clear, dark night skies as compared to the lower elevation metropolitan areas. The relatively dark skies offer opportunities for astronomy, astrophotography and casual stargazing. The presence of flashing lights, strobe lights or rotating blades from utility-scale wind energy facilities will impair the enjoyment of this resource. ...

16. Numerous residents of the Town of Fairfield have complained about high sound levels from operation of large industrial wind energy facilities installed near homes. These complaints have occurred despite the fact that pre-construction analytical predictions concluded that sound levels would be within acceptable limits. This may be due to factors such as atmospheric conditions, temperature inversions, wind layers, geography and low frequency noise which travels further with greater intensity than higher frequency noise. In addition, at night when air stabilizes near ground level, elevated wind turbine noise can travel further than expected and can be 5-15 dB(A) louder than predicted with conventional models. (See Kamperman and James 2008; Acoustic Ecology Institute Special Report: Wind Farm Noise, Science and Policy 2011). This leads to the conclusion that pre-construction analytical predictions of sound must comply with appropriate standards and be independently verified. Minimum setbacks from residences are necessary to mitigate noise impacts due to the uncertainty of these models.

17. While mechanical sounds of wind turbines have been reduced by modern designs, aerodynamic sounds by air turbulence around the turbine blades have increased with increasing turbine size.

18. The closer people live to wind energy facilities the more likely they will experience noise annoyance or develop adverse health effects from noise. However, it is common for those located very close to a wind energy facility or facilities to hear less noise than those farther away, due to the formation of a "shadow zone" upwind of the turbine. This has been demonstrated by the on-going problems reported by residents in the Town of Fairfield in which industrial wind energy facilities have become operational recently. This has also been demonstrated by continuing reports of problems related to noise at other recent wind energy projects throughout the United States. Further, the degree of difficulties resulting from the sound of wind energy facilities seems clearly related to the distance from the turbines, though the literature has studied a variety of turbine sizes in a variety of locations. A setback of 2,460 feet from residences would eliminate most noise complaints. Research conducted by Bajdek (2007) showed that at approximately 0.8 km (1/2 mile) from wind turbines, 44% of the population would be highly annoyed by wind turbine noise. At a distance of approximately 1.62 km (1 mile) from wind turbines, the percent of highly annoyed people is expected to drop to 4%. Kamperman and James reviewed several studies to determine the impact of wind turbine noise on nearby residents. Their review showed that some residents living as far as two miles from wind turbines complained of sleep disturbance from turbine noise and many residents living 1,000 feet from wind turbines experienced major sleep disruption and other health problems from nighttime turbine noise. Van den Berg (2006) studied a wind farm in northwestern Germany and discovered that residents living 500 meters (1,640 feet) from the wind turbines reacted strongly to wind turbine noise and residents up to 1,900 meters (1.18 miles) from the wind turbines expressed annoyance. A survey conducted by Pedersen and Waye (2008) found that less than 10% of the respondents experienced sleep disturbance at distances of 1,984 feet to 3,325 feet and found that the sound from wind turbines was of greater concern in rural environments because of the lower ambient noise. The Town of Litchfield notes with approval that wind project developer NorthWind and Power LLC (November 23, 2009) has stated in its marketing literature that the "Minimum Distance from residences owned by non-participating landowners: 2,500 ft".

19. Several studies recommend wind turbines be located between 1/2 mile to over 1 mile from residences. To avoid adverse noise impacts, the Western Australia Planning Commission Bulletin recommends that wind energy systems include sufficient buffers or setbacks to residences of 1 km (0.62 mile). The National Wind Collaborating Committee states that an appropriate setback distance may be up to 1/2 mile. The National Research Council states that noise produced by wind turbines generally is not a major concern for humans beyond one mile or so. The Wisconsin Towns of Woodville, Clay Banks, Magnolia, Wilton and Ridgeville recently adopted large wind turbine ordinances with setbacks of 1/2 mile from residences. The French National Academy of Medicine and the UK Noise Association suggest a 1.5 km (approximately 1 mile) distance between large wind turbines and residences. See Gueniot (2006), Dr. Amanda Harry (2007), Dr. Nina Pierpont (2006), and Frey and Hadden (2007) recommend a setback greater than 1 mile.
20. It is noted that the Wind Turbine Handbook (Burton, 2001, January 2008 Printing) notes that a ten rotor diameter setback is likely necessary to protect from the impact of noise, shadow flicker and visual domination. The Department of the Environment, Northern Ireland (2009), establishes a best practice guideline of a separation distance between a WECS and occupied property of 10 times the rotor diameter.

21. It is noted that The New York State Department of Environmental Conservation document Assessing and Mitigating Noise Impacts (2001) teaches that sound levels that are 0-5dB above ambient are "unnoticed to tolerable" whereas noise increases over 5dB are considered "intrusive". This document further states: "Appropriate receptor locations may be either at the property line of the parcel on which the facility is located or at the location of use or inhabitance on adjacent property". And "The most conservative approach uses the property line".

22. Background sound levels in rural residential areas in New York are commonly in the range of 20 dBA to 30 dBA at night. See Kamperman and James (2008), pg. 2

23. A C-weighted sound determination dB(C) is needed to minimize adverse health effects from low frequency noise. A dB(C) requirement will likely result in setbacks between large wind turbines and nearby residences of 1 km, (0.62 miles) or greater for 1.5 to 3 MW wind turbines if wind turbines are located in rural areas where L90A background levels are close to 30 dB(A). (See Kamperman & James; WHO 1999; Bajdek Noise-Con 2007; Pedersen and Waye 2008). ...

37. Low frequency vibrations or infrasound may cause health impacts even if inaudible. Recent field testing in Falmouth, MA indicated that in a home located 1,300 feet from one turbine and 1,700 feet from another, excessive infrasound was present inside the home while not measurable outside the home (See Ambrose and Rand (2011)). Previous studies of infrasound from wind turbines have shown levels to be low in outdoor testing, while others have effectively measured infrasound outdoors near turbines when the atmosphere is stable, for example at night (See van den Berg (2006)). In the Ambrose and Rand study, testing indicated that infrasound was magnified (10dB gain) by a whole-house cavity response and was likened to "living in a drum". The investigators were surprised to experience the same adverse health symptoms described by residents of the house and those near other large industrial wind turbine sites. The onset of adverse health effects was swift, within twenty minutes, and persisted for some time after leaving the study area. Ambrose and Rand correlated their symptoms to turbine operation and infrasound measurements and found that infrasound pulsations at levels sufficient to stimulate the ear's outer hair cells (OHC) and thus cause vestibular dysfunction (see Dr. Salt, 2011) were present when the turbines were operating. Dysfunctions in the vestibular system can cause disequilibrium, nausea, vertigo, anxiety, and panic attacks, which have been reported near a number of industrial wind turbine facilities. Similar adverse health symptoms have been associated with noise complaints such as "sick building syndrome", correlated by field study to low-frequency pulsations emanating from ventilation systems. (See Burt, (1996); Shwartz (2008)) That is, adverse health effects from low frequency noise exposure in buildings have been studied and confirmed by the acoustics
profession. Ambrose and Rand conclude that their study underscores the need for more effective and precautionary setback distances for industrial wind turbines. ...

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DEFINITIONS

LARGE WIND ENERGY CONVERSION SYSTEM or Large WECS – A Wind Energy Conversion System larger than 50kW. A Wind Energy Facility consisting of a wind turbine, a Tower, and associated control or conversion electronics, which has a Name Plate Rating of more than 50 kW (Fifty Thousand Watts).

PERMITS REQUIRED

A. No Large WECS shall be constructed, reconstructed, modified, or operated anywhere in the Town of Litchfield.

B. No Small WECS or Wind Energy Facility comprising a Small WECS shall be constructed, reconstructed, modified, or operated in the Town of Litchfield except pursuant to and in compliance with a Wind Energy Permit issued pursuant to this Local Law.

C. No Wind Measurement Tower shall be constructed, reconstructed, modified, or operated in the Town of Litchfield except in connection with an application for a Small WECS, and pursuant to and in compliance with a Wind Measurement Tower Permit issued pursuant to this Local Law. …

SOUND and SETBACKS

A Small WECS shall comply with the following standards:

1. Setback requirements. A Small WECS shall not be located closer to a Property Line than one and a half times the Turbine Height of the WECS or ten times the Rotor Diameter, whichever is greater.

2. Noise. Except during short-term events including utility outages and severe wind storms, a Small WECS shall be designed, installed, and operated so that the Sound Pressure Level (Leq) generated by a Small WECS shall not exceed 45 dBA in daytime hours nor 35 dBA at night as measured at the nearest off-Site Residence existing at the time of approval (including structure under construction at said time), nor more than 6 dBA greater than either the nighttime or daytime pre-application Background Sound level measured in leaf-off conditions for a period of no less than 24 hours. Measurement of Background Sound may also be performed with the turbine turned off and with its blades trimmed to minimize Noise from aerodynamic effects.

ARTICLE IV. LARGE WECS

INTENT & PURPOSE

It is the intent of the Town of Litchfield to prohibit the construction, reconstruction, modification or operation of Large WECS as defined in this Wind Energy Facilities Local Law. The purpose of this Article is to provide substantive standards for Large WECS in the event an application is made to the Public Service Commission under Article X of the Public Service Law for the construction and operation of Large WECS in the Town of Litchfield.

STANDARDS FOR WIND ENERGY FACILITIES

The following substantive standards shall apply to all Large WECS in the Town of Litchfield in the event an application to construct and operate Large WECS in the Town of Litchfield is made to the New York Public Service Commission pursuant to Article 10 of the Public Service Law. …

SOUND LEVELS

A. The equivalent level (LEQ) generated by a WECS shall not exceed the limits listed in Table 1 when measured at the nearest off-Site Residence or Buildable Lot. If the

A-weighted Background Sound pressure level, without the WECS, is within 5 dB of some or all of the limits in Table 1 or exceeds some or all of the limits in Table 1, then the A-weighted criterion to be applied to the WECS application for those affected limits shall be the A-weighted background level + 5 dB. The remaining limits that are more than 5 dB above the A-weighted background shall remain as given in Table 1.

Note: For example, during daytime, if the background is less than or equal to 40 dB, then the limit is 45 dB. However, if the background is greater than 40 dB, say 44 dB, then the applicable WECS limit is the background level plus 5 dB which calculates to 49 dB for this example.

B. In all cases, the corresponding C-weighted limit shall be the operable A-weighted limit (from Table I or based on the A-weighted background, as appropriate) plus 18 dB. The application shall include certification by an independent acoustical engineer as to the predicted A- and c-weighted WECS sound levels at potentially impacted residential Sites. The engineer, or the firm with which the engineer is associated shall be a member of the National Council of Acoustical Consultants (NCAC) with a specialty in environmental Noise, and shall be a Member, Board Certified of the Institute of Noise Control Engineering of the USA. The background shall be measured and predicted in accordance with clause C below.

Table I. WECS Noise limits at residential receivers

	Daytime 7 AM to 7 PM	Evening 7 PM to 10 PM	Nighttime 10 PM to 7 AM
A-weighted level (dB)	45	40	35
C-weighted level (dB)	63	58	53

C. A-weighted background sound levels shall be based on measured hourly L90 levels gathered over a sufficient time to characterize each of the following three time periods, respectively. The day shall be divided into three time periods: (1) daytime, the hours from 7 AM to 7 PM, (2) evening, the hours from 7 PM to 10 PM, and (3) nighttime, the hours from 10 PM to 7 AM. If insect Noise possibly can dominate some of the hourly L90 measurements, then Ai weighted (see Schomer, Paul D. et al., "Proposed 'Ai' – Weighting: a weighting to remove insect Noise from A-weighted field measurements," InterNoise 2010, Lisbon Portugal, 13-16 June 2010) shall be used in lieu of the Standard A-weighting, or measurements shall not be made when insect Noise possibly can dominate some of the hourly L90 measurements. The background shall be reported by time period, and computed as follows. The minimum hourly L90 shall be tabulated by time period and by day, and the arithmetic average of these measurements by time period over all the days of measurement shall be computed. These three averages of daily minima shall be reported as that Site's daytime, evening, and night time A-weighted background levels, respectively.

> Note: In relatively quiet areas insect Noise, especially during summer months, can easily dominate the A-weighted Ambient Sound level. This occurs partly because the primary frequencies or tones of many, if not most, insect Noises are in the range of frequencies where the A-weighting is a maximum, whereas, most mechanical and WECS Noises primarily occur at the lower frequencies where the A-weighting significantly attenuates the sound. Also, insect noises and bird songs do not mask WECS Noise at all because of the large differences in frequencies or tones between them. ...

SETBACKS

Each WECS shall be located with the following minimum setbacks, as measured from the center of the WECS:

i. Ten (10) Rotor Diameters from the property line of off-Site Residences or Buildable Lots.

ii. Four (4) Turbine Heights from the nearest on-Site Residence.

iii. 100 feet or the rotor radius, whichever is more from state-identified wetlands, except where permits for other setbacks have been received from the New York State Department of Environmental Conservation, or federal wetland permits issued by the US Army Corps of Engineers.

iv. 1.5 times the sum of the hub height plus Rotor Diameter from a public highway.

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- Local law governing wind energy facilities in the town of Hamlin, N.Y.
- Commercial Wind Power Facilities Law of 2010 of the Town of Rensselaerville
- Critique of wind law recently enacted by Town of Holland, Erie County, N.Y.
- Background sound measurements and analysis in the vicinity of Cape Vincent, New York

REF 2E pg55 low frequency enhanced over porous ground

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Sound Propagation Close to the Ground

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Key Words acoustics, ground effect, refraction, diffraction, scattering

■ **Abstract** Some applications of the study of outdoor acoustics and sets of data for sound-level spectra obtained close to the ground are described. Measurements and models of ground effects arising from the interaction between sound traveling directly from source to receiver and sound reflected from the ground are emphasized. Details are given concerning the influences of porosity, layering, small-scale surface roughness, and tall vegetation. Areas of related current and future research are outlined.

1. INTRODUCTION

1.1. Applications of Outdoor Acoustics

Sound in the atmosphere is a pressure wave. A single-frequency sound wave in air consists of a series of compressions and rarefactions that alternate in time and space around mean atmospheric pressure. Sound at low frequencies (<100 Hz) can travel for considerable distances outdoors. Among the first experiments conducted on outdoor sound were those concerned with the speed of sound (Hunt 1992). The Franciscan friar Marin Mersenne (1588–1648) suggested timing the interval between seeing the flash and hearing the report of guns fired at a known distance. William Derham (1657–1735), the Rector of a small church near London, observed and recorded the influence of wind and temperature on sound speed. Derham also noted the difference in the sound, measured at the same distance, of church bells over newly fallen snow versus over a frozen surface. Before enough was known of outdoor acoustics for the military to exploit its use, there were many unwitting influences of propagation conditions on the course of battle (Ross 2000). In June 1666, Samuel Pepys noted that the sounds of a naval engagement between the British and Dutch fleets were heard clearly at some spots but not at others a similar distance away or closer (Naramoto 2000). The effects of the atmosphere on battle sounds were not studied in a scientific way until after World War I. During that war, acoustic shadow zones, similar to those observed by Pepys, were observed during the battle of Antwerp. Observers also noted that battle sounds from France reached England only during the summer months, whereas during the winter they were best heard in Germany. After the war, there was great interest in these observations among the scientific community. Large amounts of ammunition were detonated throughout England, and the public was asked to listen for sounds of explosions.

Although considerable interest in atmospheric acoustics existed after World War I, the advent of the submarine encouraged the greatest efforts in underwater acoustics research during and after World War II. Outdoor acoustics continues to have extensive military applications in source acquisition, ranging, and identification (Becker & Gudesen 2000). Acoustic disturbances in the atmosphere give rise to solid-particle motion in porous ground, induced by local pressure variation as well as air particle motion in the pores. There is a distinction between the seismic disturbances associated by direct seismic excitation of the ground and solid-particle motion in the ground induced by airborne sounds. This has enabled the design of systems that distinguish between airborne and ground-borne sources and the application of acoustical techniques to the detection of buried landmines (Xiang & Sabatier 2000).

The many other applications of studies of outdoor sound propagation include the prediction and control of noise from land and air transport and from industrial sources (Int. Stand. Org. 1996), aspects of animal bioacoustics (Michelson 1978), and acoustic remote sounding of the atmosphere (Ostashev 1999). Atmospheric sound propagation close to the ground is sensitive to the acoustical properties of the ground surface as well as to meteorological conditions. Most natural ground surfaces are porous. The surface porosity allows sound to penetrate, and hence, it may be both absorbed and delayed through friction and thermal exchanges. There is interference between sound traveling directly between source and receiver and sound reflected from the ground. This interference is known as ground effect (Piercy et al. 1977, Attenborough 1988). Although it is a similar interference effect, it is not directly analogous to the Lloyd's mirror effect in optics. Usually, the propagation of light may be described by rays. At the lower end of the audible frequency range (20–20,000 Hz), the consequences of curvature of the sound waves, for example of the spherically expanding waves from an omnidirectional source, are significant. Consequently, ray-based modeling is not appropriate, and it is necessary to use full-wave techniques. Moreover, few outdoor surfaces are mirror-like to incident sound waves and cause changes in phase as well as amplitude during reflection. Apart from the relevance to outdoor noise prediction, the sensitivity of sound propagation to ground-surface properties has suggested some relatively noninvasive acoustical techniques for determining soil physical properties such as porosity and air permeability (Moore & Attenborough 1992, Harrop 2000).

1.2. Factors That Influence Outdoor Sound

Full consideration of outdoor sound involves different source properties, meteorological effects, and the many possible configurations of the paths between sources and receivers. This review concentrates on mechanisms of sound attenuation from sources close to flat ground. The attenuation is the sum of the reductions due to geometric spreading, air absorption, ground effect, vegetation, and atmospheric refraction.

Distance alone will result in wave-front spreading. From a point sound source (most sources appear to be point sources at sufficient distance), this means a reduction of 6 dB per distance doubling in all directions. From a line source, such as a busy highway, wave-front spreading means a reduction of 3 dB per distance doubling. In most meteorological conditions, the speed of sound changes with height above the ground. Usually, temperature decreases with height (the adiabatic lapse condition). In the absence of wind, this causes sound waves to bend, or refract, upward. Wind speed adds or subtracts from sound speed. When the source is downwind of the receiver, the sound has to propagate upwind. As height increases, the wind speed increases and the amount that is subtracted from the speed of sound also increases, leading to a negative sound-speed gradient. A negative sound-speed gradient means upward refraction and the creation of a sound shadow at a distance from the source that depends on the gradient. The presence of a shadow zone means that the sound level decreases faster than would be expected from distance alone. However, the shadow zone is penetrated by sound scattered by turbulence, and this sets a limit to the reduction of sound levels within the sound shadow (Embleton 1996, Sutherland & Daigle 1998).

A combination of slightly negative temperature gradient, strong upwind propagation, and air absorption has been observed, in carefully monitored experiments, to reduce sound levels, 640 m from a source 6 m high over relatively hard ground, by up to 20 dB more than expected from spherical spreading (Zouboff et al. 1994). Downwind, sound refracts downwards. Wind effects tend to dominate over temperature effects when both are present. Temperature inversions, in which air temperature increases up to the inversion height, cause sound waves to refract downwards below that height.

Under inversion conditions, or downwind, sound levels decrease less rapidly than would be expected from wave-front spreading alone. In general, the relationship between sound-speed profile $c(z)$, temperature profile $T(z)$, and wind-speed profile $u(z)$ in the direction of sound propagation is given by

$$c(z) = c(0)\sqrt{\frac{T(z) + 273.15}{273.15}} + u(z). \qquad (1)$$

The atmosphere is constantly in motion because of wind shear and the uneven heating of the earth's surface. Any turbulent flow of a fluid across a rough solid surface generates a boundary layer. Most interest, from the point of view of outdoor noise prediction, focuses on the lower part of the meteorological boundary layer called the surface layer. In the surface layer, turbulent fluxes vary by less than 10% of their magnitude, but the wind-speed and temperature gradients are largest. In typical daytime conditions, the surface layer extends over 50–100 m. Usually, it is thinner at night.

During most common daytime conditions, the net radiative energy at the surface is converted into sensible heat. This warms up the atmosphere thereby producing negative temperature gradients. If the radiation is strong (high sun, little cloud cover), the ground is dry, and the surface-wind speed is low, then the temperature gradient is large. The atmosphere exhibits strong thermal stratification. If the ground is wet, most of the radiative energy is converted into latent heat of evaporation, and the temperature gradients are correspondingly lower. In unstable daytime conditions, the wind speed is affected by the temperature gradient and exhibits slightly less variation with height than in the isothermal case. On the other hand, "stable" conditions prevail at night. The radiative losses from the surface cause positive temperature gradients. Wind-speed and temperature gradients are not independent. For example, very large temperature and wind-speed gradients cannot coexist. Strong turbulence associated with high wind speeds does not allow for the development of marked thermal stratification. Table 1 shows a rough estimate of the probability of occurrence of various combinations of wind and temperature gradients (Zouboff et al. 1994).

Prediction of outdoor sound propagation requires information about turbulence. Specifically, it requires values of the mean square refractive index, the outer length scale of the turbulence, and a parameter representing the transverse separation between adjacent rays (Clifford & Lataitis 1983). The mean squared refractive index may be calculated from the measured instantaneous variation of wind speed and temperature with time at the receiver. Typical values of mean squared refractive index are between 10^{-6} for calm conditions and 10^{-4} for strong turbulence.

Atmospheric absorption acts as a low-pass filter at long range. It results from heat conduction losses, shear viscosity losses, and molecular relaxation losses (Bass et al. 1995). Atmospheric absorption varies significantly with humidity, temperature, and season. When sound encounters outdoor obstacles, it is diffracted to an extent that depends on the sound wavelength. However, this review concentrates on ground effects rather than meteorological or barrier effects.

Ground effects (for elevated source and receiver) are the result of interference between sound traveling directly from source to receiver and sound reflected from the ground. Because the effect of the ground on sound propagation involves interference, there can be enhancement as well as attenuation. Above ground surfaces such as nonporous concrete or asphalt, the sound pressure is doubled more or less

TABLE 1 Estimated probability of occurrence of various combinations of wind and temperature gradient

Combination	Zero wind	Strong wind	Very strong wind
Very large negative temperature gradient	Frequent	Occasional	Rare or never
Large negative temperature gradient	Frequent	Occasional	Occasional
Zero temperature gradient	Occasional	Frequent	Frequent
Large positive temperature gradient	Frequent	Occasional	Occasional
Very large positive temperature gradient	Frequent	Occasional	Rare or never

over a wide range of audible frequencies. Such ground surfaces are described as acoustically hard. Over porous surfaces, enhancement tends to occur at low frequencies because the larger the sound wavelength is, the less able it is to penetrate the pores. The presence of vegetation tends to make the surface layer of ground, including the root zone, more porous. The layer of partly decayed matter on the floor of a forest is highly porous. In addition, sound propagating through trees reverberates between tree trunks and is scattered by branches and foliage.

1.3. Example Measurements

Zouboff et al. (1994) have carried out a series of measurements using a loudspeaker source broadcasting broadband noise with maximum energy in the 500- and 1000-Hz octave bands over a flat homogeneous area, in the South of France, covered with pebbles and sparse vegetation. Acoustical data were collected at a series of microphones positioned between 20 m and 640 m from the source. Meteorological parameters (mean air temperature and wind speed at three heights, together with wind direction, solar radiation, and hygrometry) were monitored on a tower 22 m high located approximately at the center of the measurement line. One hundred and ninety-five samples 10 min long were collected over a range of meteorological conditions and were expressed in terms of L_{Aeq} (energy equivalent continuous sound level). Because the ground condition changed very little during the measurement period, most of the variation may be attributed to meteorological effects. Figure 1 shows the maximum, minimum, and mean differences in levels (total attenuation) from 80 m to 640 m, deduced from measurements at 1.5 m high microphones normalized to a level of 100 dB at 20 m.

These data offer evidence for the asymmetry of meteorological effects on the distribution of sound levels about the mean level. The difference between the minimum and mean attenuation is considerably less than the difference between the maximum and mean attenuation. Smaller differences were obtained with longer averaging times. For example, a range of 38 dB in a 10-min L_{Aeq} at 640 m was reduced to a range of only 19 dB when comparing values of an 8-h L_{Aeq} during days differing in wind direction and cloud cover. Long-term values of L_{Aeq} are dominated by the highest levels, even though they are relatively infrequent. Moreover, levels observed under downward-refraction conditions exhibit less variability than those measured under upward-refraction conditions. For these reasons, an International Standard Scheme (Int. Stand. Org. 1996) predicts noise levels under "moderate" downwind conditions and distinguishes long-term (say, seasonal or monthly) L_{Aeq} from short-term (say, daily) L_{Aeq}.

Figure 2 shows the spectra of the difference in levels recorded by vertically separated microphones at heights of 0.5 m and 2 m above flat grassland and 100 m from a helicopter that rose vertically into the air. The conditions were calm and windless. Such vertical level differences are surrogates for the excess attenuation due to ground effect alone, as they are independent of the source spectrum and automatically allow for the reduction in levels due to distance and atmospheric

CITY COUNCIL SPECIAL MEETING - JULY 5, 2022 - HAND-OUT - STEVE JEFFREY
PUBLIC HEARING ITEM NO. 1 - CORAL MOUNTAIN RESORT PROJECT

REF 2F Effects

Noise and Health - Effects of Low Frequency Noise and Vibrations: Environmental and Occupational Perspectives

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Abstract and Figures

This article provides a current knowledge base of adverse effects due to community and occupational low frequency noise (20–200 Hz). Low frequency noise has a large annoyance potential, and the prevalence of annoyance increases with higher sound pressure levels (SPLs) of low frequencies. Low frequency noise annoyance is related to headaches, unusual tiredness, lack of concentration, irritation, and pressure on the eardrum. Data suggest that sleep may be negatively affected. In occupational environments, low frequency noise may negatively affect performance at moderate noise levels, whereas the health consequences of higher SPLs are less well known. Factors inherent in most low frequency noise such as the throbbing characteristics, the intrusion of low frequencies felt when other frequencies in the sound are attenuated, and the vibration sensations sometimes felt contribute to the response. Measurements need to properly assess the individual exposure and include spectral, temporal, and if present also vibration characteristics. The risks for adverse effects are of particular concern because of its general presence due to numerous sources, an efficient propagation of the noise from the source, and poor attenuation efficiency of building structures. Compared to other noise sources, data on low frequency noise are limited, and further studies are clearly needed.

+1

Results from recent... | Hearing and vibrotactile... | Average response time... | Curves showing the expected... | 'Unacceptable' and 'acceptabl...

Figures - uploaded by Kerstin Persson Waye Author content

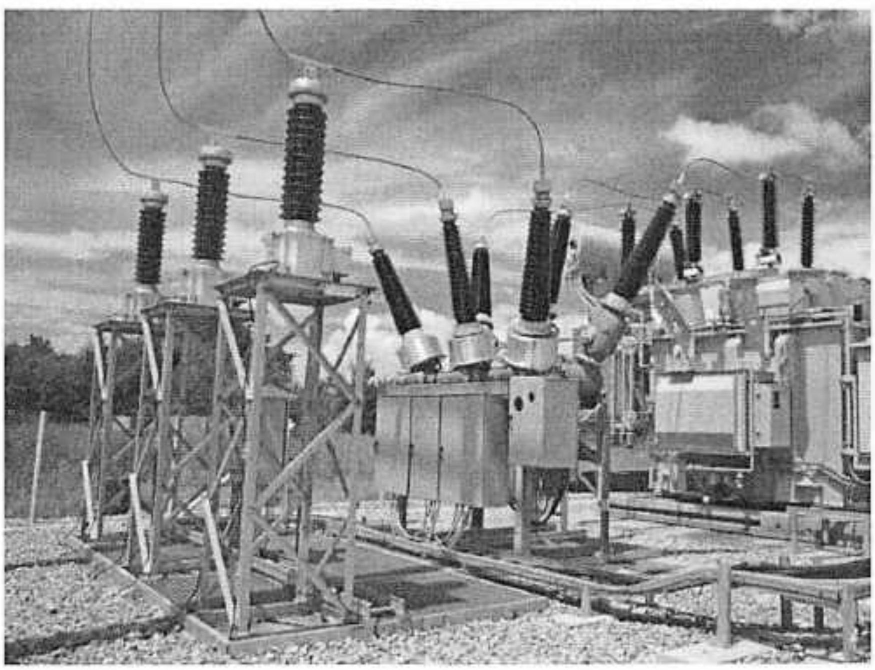
REF 2G

A Guide to Low Frequency Noise

05 June 2020

Low frequency noise (500 Hertz and lower) from various sources is an increasingly common form of environmental noise pollution in urban environments and it can also be quite a challenging problem to treat effectively.

This blog article aims to help set out some information on the; common sources of low frequency noise, ways to identify and measure it, the health issues associated with it, as well as the specialist low frequency noise control solutions Sonobex can offer to mitigate it.



Causes & sources

There are many possible sources of low frequency noise, but it is most often associated with some form of machinery. It could be industrial noise from nearby heavy industry, factories and plants.

frequency noise, including transformers in substations, generators and wind farms.

A major complicating factor with low frequency noise is that it can travel long distances with relatively little attenuation compared to higher frequency components noise. Typically, noise levels fall over distance due to geometric spreading and absorption by the ground or air.

Also, constructions like walls or barriers and buildings will help to block transmission from the noise source to sensitive receivers. All of these attenuation and noise control mechanisms are frequency dependent and are generally less effective at lower frequencies.

This means that as sound travels, its relative frequency content alters making the low frequencies more prominent at greater distances, creating low frequency noise problems. As a result of this it is not uncommon for complaints to be received from residences located far away from a problem source and over quite a wide area.

Transformers in electrical substations are a particularly common source of low frequency noise complaints as they are found in the vicinity of residential areas and workplaces. They produce quite a distinctive low frequency hum, which consists of tones at multiples of 100 Hz. The tonal nature of the noise they produce often increases the perceived annoyance.

In terms of household low frequency noise sources, heat pumps are a growing issue, particularly with their increased usage across Europe.

The fans and compressors in many models of heat pump produce a significant amount of low frequency noise; some of the issues and solutions we can offer for heat pump noise are covered in a previous blog article. https://www.sonobex.com/blog/heat-pump-noise-enclosures-noisetrap-blox-application

How to identify

Low frequency noise is typically perceived as a low throbbing, beating, rumbling, or even as a pressure on the ears. A person's response to low frequency noise can also be quite individual due to differences in the frequency sensitivity of their hearing, which can vary considerably from person to person and with age.

When these perception factors are combined with the fact that low frequency noise can travel relatively easily with little attenuation, it means that the identification and location of low frequency noise sources can sometimes be challenging without specialist measurement equipment.

Sound level meters can be used to measure and quantify low frequency noise. Class 1 sound level meters (as defined in the standard IEC 61672-1) will provide more accurate measurements at low frequencies as they are required to meet stricter tolerances and have a wider frequency range.

Typically, sound pressure level measurements and levels in environmental noise regulations are expressed in dB(A) or A-weighted decibels. The 'A' frequency weighting applies a filter which reflects the frequency response of the human ear. Large weightings are applied to low frequency components, reducing their contribution to the total sound pressure level. This means measurements in dB(A) may not capture or highlight the presence of low frequency noise very well.

Alternatively, measurements made using either 'C' weighting (dB(C)) or 'Z' weighting (dB(Z) or simply dB) can be useful to help identify the presence of low frequency noise. The 'C' weighting filter is also designed to account for the response of the human ear, but with smaller weightings at low frequencies when compared to the 'A' weighting filter. The 'Z' or zero weighting is simply a filter with a flat frequency response, so it effectively counts all frequencies equally.

Most sound level meters are capable of displaying results in dB(A), dB(C) or dB(Z). A useful rule of thumb to help confirm the presence of a low frequency noise problem is when the total sound pressure level measured in dB(C) is considerably larger than in dB(A), i.e. a difference of 15 dB or more.

Some environmental noise regulations include criteria based on noise levels in dB(C) to specifically account for low frequency noise. They may also include specific penalties for low frequency noise sources, where an additional penalty factor, e.g. 5 dB, is added to the measured noise level in dB(A) during the assessment to account for the more problematic nature and higher perceived annoyance of low frequency noise.

It is also worth noting that some noise regulations also include penalty factors for multiple other complicating noise issues, such as tonality and impulsiveness. This means particularly problematic noise sources may be eligible for multiple penalties, for example a power transformer in a substation may have penalties applied for producing noise that is both low frequency and tonal.

In the UK, the Department for Environment, Food and Rural Affairs have recognised the prevalence of low frequency noise issues and some of the technical complexities with it's assessment. As a response to this they commissioned the development of a special "Procedure for the assessment of low frequency noise complaints" by the Acoustics Research Centre at the University of Salford which can be found here http://usir.salford.ac.uk/493/ and provides useful practical guidance.

We have access to a number of sophisticated class 1 sound level meters as well other advanced acoustic measurement equipment to aid in this process, including sound intensity probes and an acoustic camera.

More information on the noise survey and measurement services we offer can be found here https://www.sonobex.com/noise-surveys-and-mapping and will hopefully also be discussed in a future blog post.

Helath effects & problems

life years lost in Europe" from 2011 provides a good overview of the situation and can be found freely available at https://apps.who.int/iris/handle/10665/326424.

The health effects caused by noise can broadly be broken into two main categories; auditory and nonauditory effects. Auditory effects, such as tinnitus and hearing loss, are caused by injury to a person's hearing system through direct exposure to high levels of noise. The nonauditory effects can be more subtle and are often associated to more long-term exposure to levels of noise which may not be as high in absolute terms.

Nonauditory effects highlighted by the WHO include; high blood pressure and cardiovascular diseases, cognitive impairment of children, sleep disturbance, and annoyance (when considering a broader definition of health accounting for physical, mental and social well-being).

The WHO estimate that the total impact of all these adverse health effects leads to the loss of at least 1 million health life years per calendar year in Western Europe. They point out that road traffic related noise is one of the most common sources related to these health effects, but note that a large proportion of low frequency components in a noise may increase considerably the adverse effects on health.

Noise Sources and Their Effects

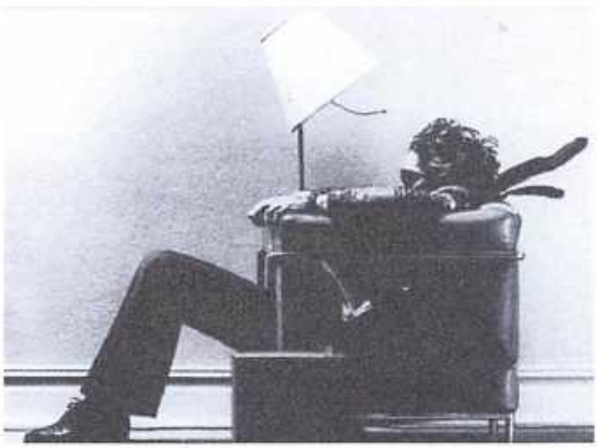
Noise Source	Decibel Level	comment
Jet take-off (at 25 meters)	150	Eardrum rupture
Aircraft carrier deck	140	
Military jet aircraft take-off from aircraft carrier with afterburner at 50 ft (130 dB).	130	
Thunderclap, chain saw. Oxygen torch (121 dB).	120	Painful. 32 times as loud as 70 dB.
Steel mill, auto horn at 1 meter. Turbo-fan aircraft at takeoff power at 200 ft (118 dB). Riveting machine (110 dB); live rock music (108 - 114 dB).	110	Average human pain threshold. 16 times as loud as 70 dB.
Jet take-off (at 305 meters), use of outboard motor, power lawn mower, motorcycle, farm tractor, jackhammer, garbage truck. Boeing 707 or DC-8 aircraft at one nautical mile (6080 ft) before landing (106 dB); jet flyover at 1000 feet (103 dB); Bell J-2A helicopter at 100 ft (100 dB).	100	8 times as loud as 70 dB. Serious damage possible in 8 hr exposure
Boeing 737 or DC-9 aircraft at one nautical mile (6080 ft) before landing (97 dB); power mower (96 dB); motorcycle at 25 ft (90 dB). Newspaper press (97 dB).	90	4 times as loud as 70 dB. Likely damage 8 hr exp
Garbage disposal, dishwasher, average factory, freight train (at 15 meters). Car wash at 20 ft (89 dB); propeller plane flyover at 1000 ft (88 dB); diesel truck 40 mph at 50 ft (84 dB); diesel train at 45 mph at 100 ft (83 dB). Food blender (88 dB); milling machine (85 dB); garbage disposal (80 dB).	80	2 times as loud as 70 dB. Possible damage in 8 h exposure.
Passenger car at 65 mph at 25 ft (77 dB); freeway at 50 ft from pavement edge 10 a.m. (76 dB). Living room music (76 dB); radio or TV-audio, vacuum cleaner (70 dB).	70	Arbitrary base of comparison. Upper 70s are annoyingly loud to some people.
Conversation in restaurant, office, background music, Air conditioning unit at 100 ft	60	Half as loud as 70 dB. Fairly quiet
Quiet suburb, conversation at home. Large electrical transformers at 100 ft	50	One-fourth as loud as 70 dB.
Library, bird calls (44 dB); lowest limit of urban ambient sound	40	One-eighth as loud as 70 dB.
Quiet rural area	30	One-sixteenth as loud as 70 dB. Very Quiet
Whisper, rustling leaves	20	
Breathing	10	Barely audible

(modified from http://www.wenet.net/~hpb/dblevels.html] on 2/2000. SOURCES: Temple University Department of Civil/Environmental Engineering (www.temple.edu/departments/CETP/environ10.html), and *Federal Agency Review of Selected Airport Noise Analysis Issues*, Federal Interagency Committee on Noise (August 1992). Source of the information is attributed to *Outdoor Noise and the Metropolitan Environment*, M.C. Branch et al., Department of City Planning, City of Los Angeles, 1970.

Thought Leadership

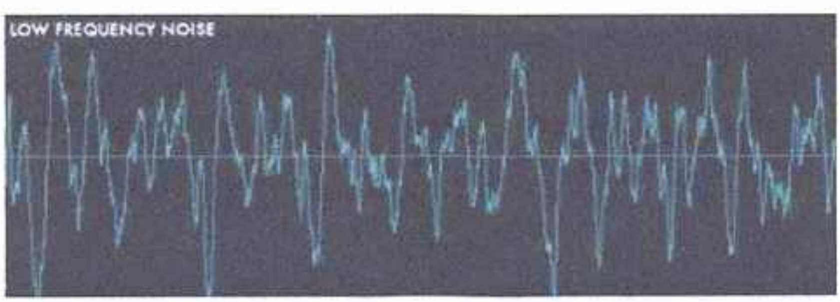
Noise Solutions

Steve Morgan on: Low Frequency Noise Identification and Mitigation



Low frequency noise (LFN) is generally defined on the Common Octave Bands as 250 hertz (Hz) or less. You might know it better as that chest-rattling thump of the bass from a car driving past with its music cranked. You can't really make out the song, but you can feel the beat in your chest. Or even as the pulse of the speakers at a concert that make you worry you're having heart palpitations. In short, LFN is *felt* more than it is heard.

LFN is to the noise world what the marathon runner is to athletics; it has long wavelengths (31.5 Hz, for example, is almost 35 feet long), high endurance, and will travel long distances. Compared to the high-frequency sprinter, a sound wave at 8000 Hz is only 1.65 inches long. The higher the energy, the quicker it dissipates.



In many ways, this makes LFN even more important to address. The vibration of LFN can get into nearby houses as the sound wave itself develops through the enclosure, having an adverse effect on the residents. For a community in close proximity to industry, LFN can pose a detrimental health risk while also increasing the likelihood of community complaints.

Though noise-induced hearing loss is a common concern relating to higher frequencies of noise, LFN is known to produce a number of negative physiological reactions (e.g.,

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changes to blood pressure and heart rate, headaches, vertigo, sleep disturbance, difficulty breathing, anxiety) and subjective complaints (e.g., feelings of vibration, pressure, and annoyance), as well as mental and physical performance impairment (e.g., fatigue, irritability, lack of concentration).[1][2][3][4] LFN has even been found to physiologically affect both hearing and deaf participants in studies comparing the two, demonstrating that it is the cochlear stimulation of LFN that adversely affects those exposed to it in a manner unique from high frequency noise (HFN).[1]

Even if a site is equipped with noise control or meets regulations at its property line, the operator's risk of complaints may remain high due to the presence of LFN.

Unfortunately, LFN is often overlooked in newer noise regulations, for a number of intriguing reasons. Chief of these is the simple fact that, at the noise source itself, the LFN tends to be discounted in favor of the more obvious HFN. In auditory terms, the high-pitched 4000 Hz tone may be perceived as a squeak, while the lower-pitched 200 Hz tone would be perceived by the listener as closer to a hum. [1] LFN may not have the same high-pitched shriek of a fan that demands attention upfront, but it can be felt from far away and it is equally, if not more, annoying to those exposed to it, particularly over long periods of time. [2]

If standing in a compressor station, trying to identify by ear the loudest noise sources, more than likely it is the HFN that will garner the most attention, such as the pitch of a fan. Even though HFN stands out on site, these noise sources tend to have minimal effect on residents farther away, as it is the LFN—the marathon runner—that travels farthest and retains the most energy at a distance. When a complaint comes in from a resident that should have been marginally or not at all affected by a facility, more times than not this is symptomatic of a LFN issue.

As the noise regulations of jurisdictions mature, and industrial facilities come into compliance based on those regulations, LFN often becomes a greater concern. In those cases where there seems to be a continuous flow of residential complaints prompting regulators to dig deeper into the source of those complaints, LFN is frequently the common factor. Through continuous assessment of noise complaints, LFN is eventually addressed by environmental policies, as seen with such regulations as the Colorado Oil and Gas Conservation Commission's (COGCC) Aesthetic and Noise Control Regulations of the US[5] (i.e., requires a low frequency Noise Impact Assessment when readings exceed 65 dBC) and the Alberta Energy Regulator's (AER) Directive 038 in Canada[6] (i.e., there is a potential 5 dBA penalty added onto the facility noise level when there is a LFN component). Both regulatory bodies identify LFN as an important consideration.

Noise Impact Assessments

Assessment of noise is the first step to attenuating it. This is one of many reasons why Noise Impact Assessments (NIAs) are integral to the implementation of effective noise control measures, especially in cases where LFN is a potential concern. NIAs assess dBA levels (standard A-weighting sound measurement) concurrently with dBC levels (LFN-specific C-weighted sound measurement) and help to identify all noises and their sources, including LFN. In this manner, the rumble of that generator that didn't seem like a big problem while standing next to it can be identified as a significant noise source at a nearby residence where the sound is spurring complaints. NIAs are extremely valuable in ranking noise sources, not just in regard to sound power levels, but also in identifying contributing frequencies at certain distances or receiver points.

The nature and behavior of low frequency wavelengths also make it more difficult to attenuate than its high-frequency counterparts. Low frequency sound waves take longer to develop and so can travel greater distances than HFN. In order to effectively attenuate LFN, the sound needs to be allowed to develop as fully as possible while enclosed. Because of size of the wavelength, it needs space to develop before it can be attenuated. Therefore, LFN requires large mufflers and cooler silencers to grant those wavelengths the space necessary to develop and then be attenuated—it is volume that is most imperative when attenuating LFN.

In conclusion, low frequency noise poses health risks for communities as well as complaint risks for industry. This is increasingly being addressed by noise regulations, and should be factored in when considering noise control measures on new or existing facilities. Identifying low frequency noise through a Noise Impact Assessment is the first step to successful mitigation. Noise control measures must also take into account the need for space and volume of machinery in order to most effectively attenuate low frequency noise—because when it comes to low frequency noise, size matters.

Thought Leadership

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About Steve Morgan

Steve Morgan is Executive Vice President at Noise Solutions, after serving as the company's Vice President Business Development since 2004. Steve has been part of the speaker rotation at Olds College in Alberta since 2012, specializing in business development and social media. He has written and facilitated a variety of leadership-training courses, and has been a keynote speaker at events for the Canadian Institute of Management and the Lone Star College's Continuing Education of Engineers Program. Steve lives in Alberta, Canada with his wife of 17 years.

Resources and Citations

[1] Passchier-Vermeer, W., Passchier, W.F. (March 2000). Noise Exposure and Public Health. *Environmental Health Perspectives, Vol. 108,* Supplement 1, 123-131. The Netherlands.

[2] Ising, H., Kruppa, B. (2004). Health Effects Caused by Noise: Evidence in Literature From the Past 25 Years. *Noise and Health: A Bimonthly Inter-Disciplinary International Journal, Vol. 6,* Issue 22, 5-13. Federal Environmental Agency, Berlin, Germany.

[3] Schust, M. (2004). Effects of Low Frequency Noise up to 100 Hz. *Noise and Health: A Bimonthly Inter-Disciplinary International Journal, Vol. 6,* Issue 23, 73-85. Federal Institute for Occupational Safety and Health, Berlin, Germany.

[4] Stansfeld, S., Matheson, M. (2003). Noise Pollution: Non-Auditory Effects on Health. *British Medical Bulletin, Vol. 68,* 243-257. The British Council, London, UK. doi: 10.1093/bmb/ldg033

[5] Colorado Oil and Gas Conservation Commission (COGCC) Aesthetic and Noise Control Regulations, 802.d (August 1, 2013). http://cogcc.state.co.us/RR_Docs_new/rules/800series.pdf

[6] Alberta Energy Regulator (AER) Directive 038: Noise Control, 3.5.2 and 4.1.1 (February 16, 2007). http://www.aer.ca/documents/directives/Directive038.pdf

Article written by Taija Morgan

REF 4 - Draft EIR
meters only A–weighted measurements

Table 4.11-8 Significance Criteria Summary

Analysis	Receiving Land Use	Condition(s)	Significance Criteria	
			Daytime	Nighttime
Off-Site Traffic Noise[1]	Noise-Sensitive	If ambient is < 60 dBA CNEL	≥ 5 dBA CNEL Project increase	
		If ambient is 60 - 65 dBA CNEL	≥ 3 dBA CNEL Project increase	
		If ambient is > 65 dBA CNEL	≥ 1.5 dBA CNEL Project increase	
On-Site Traffic Noise		Exterior Noise Level Criteria	65 dBA CNEL	
		Interior Noise Level Standard	45 dBA CNEL	
Operational Noise[3]		Exterior Noise Level Standards	See Table 3-1.	
		if ambient is < 60 dBA L_{eq}	≥ 5 dBA L_{eq} Project increase	
		if ambient is 60 - 65 dBA L_{eq}	≥ 3 dBA L_{eq} Project increase	
		if ambient is > 65 dBA L_{eq}	≥ 1.5 dBA L_{eq} Project increase	
Construction[4]		Noise Level Threshold	85 dBA L_{eq}	n/a
		Vibration Level Threshold	0.01 in/sec RMS	n/a

[1] Source: FICON, 1992.
[2] Sources: City of La Quinta General Plan Noise Element & California Building Code.
[3] Sources: City of La Quinta Municipal Code, Section 6.08.050 (Appendix 3.1) and FICON guidance.
[4] Sources: NIOSH, Criteria for Recommended Standard: Occupational Noise Exposure and County of Riverside General Plan Noise Element, Policy 16.3.
"Daytime" = 7:00 a.m. to 10:00 p.m.; "Nighttime" = 10:00 p.m. to 7:00 a.m.; "n/a" = No nighttime construction activity is permitted, so no nighttime construction noise level limits are identified; "RMS" = root-mean-square

Existing Noise Level Measurements

To assess the existing noise level environment, ten 24-hour noise level measurements were taken at sensitive receiver locations near the project. The receiver locations were selected to describe and document the existing noise environment within the project study area **(Exhibit 4.11-1, *Noise Measurement Locations*)**. To fully describe the existing noise conditions, noise level measurements were collected by Urban Crossroads, Inc. on Wednesday, October 16th, 2019.

Measurement Procedure and Criteria

In order to describe the existing noise environment, Urban Crossroads measured hourly noise levels during typical weekday conditions over a 24-hour period. By collecting individual hourly noise level measurements, it is possible to describe the daytime and nighttime hourly noise levels and calculate the 24-hour CNEL. The long-term noise readings were recorded using Piccolo Type 2 integrating sound level meter and dataloggers. The Piccolo sound level meters were calibrated using a Larson-Davis calibrator, Model CAL 150. All noise meters were programmed in "slow" mode to record noise levels in "A" weighted form. The sound level meters and microphones were equipped with a windscreen during all measurements. All noise level measurement equipment satisfies the American National Standards Institute (ANSI) standard specifications for sound level meters ANSI S1.4-2014/IEC 61672-1:2013.

REF 4

THE GOVERNOR'S OFFICE OF PLANNING AND RESEARCH

CEQA 101

REF 5A

What is CEQA?

The California Environmental Quality Act (CEQA) requires government agencies to consider the environmental consequences of their actions before approving plans and policies or committing to a course of action on a project.

What is the purpose of CEQA?

This process is intended to: (1) inform government decision-makers and the public about the potential environmental effects of proposed activities; (2) identify the ways that environmental damage can be avoided or significantly reduced; (3) prevent significant, avoidable environmental damage by requiring changes in projects, either by the adoption of alternatives or imposition of mitigation measures; and (4) disclose to the public why a project was approved if that project has significant environmental impacts that cannot be mitigated to a less than significant level.

What is a "Project"?

A "project" is defined as a "whole action" subject to a public agency's discretionary funding or approval that has the potential to either (1) cause a direct physical change in the environment or (2) cause a reasonably foreseeable indirect physical change in the environment. "Projects" include discretionary activity by a public agency, a private activity that receives any public funding, or activities that involve the public agency's issuance of a discretionary approval and is not statutorily or categorically exempt from CEQA. (Pub. Res. Code § 21065.)

The CEQA Process

If an agency determines that a proposed activity is a project under CEQA, it will usually take the following three steps:

(1) determine whether the project falls under a statutory or categorical exemption from CEQA;
(2) if the project is not exempt, prepare an initial study to determine whether the project might result in significant environmental effects; and
(3) prepare a negative declaration, mitigated negative declaration, or EIR, depending on the initial study.

AEP CEQA Portal

REF 5B

CEQA Portal Topic Paper

What is CEQA?

History

The impetus for the California Environmental Quality Act (CEQA) can be traced to the passage of the first federal environmental protection statute in 1969, the National Environmental Policy Act (NEPA). In response to this federal law, the California State Assembly created the Assembly Select Committee on Environmental Quality to study the possibility of supplementing NEPA through state law. This legislative committee, in 1970, issued a report entitled The Environmental Bill of Rights, which called for a California counterpart to NEPA.

Later that same year, acting on the recommendations of the select committee, the legislature passed, and Governor Reagan signed, the CEQA statute. California was the first state to adopt its own "mini-NEPA" to identify and reduce the environmental impacts of new state projects, attempting to expand the factors balanced in decision-making, to add environmental goals to economic and social goals. While CEQA originally only pertained to projects sponsored or approved by state agencies, CEQA was expanded during the 1970s to include all California development proposals– public or private – that are subject to the discretionary approval of a public agency.

Purpose

CEQA's purpose is to disclose the potential impacts of a project, suggest methods to minimize those impacts, and discuss project alternatives, so that decision-makers will have full information upon which to base their decisions. The State *CEQA Guidelines* (see below for more details) state the following as CEQA's purpose:

> "Identify the ways that environmental damage can be avoided or significantly reduced, prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible, and to disclose to the public the reasons why a governmental agency approved the project in the manner the agency chose if significant environmental effects are involved." (Section 15002(a))

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Chapter 3. Guidelines for Implementation of the California Environmental Quality Act
Article 7. EIR Process

14 CCR § 15088.5

§ 15088.5. Recirculation of an EIR Prior to Certification.

(a) A lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the draft EIR for public review under Section 15087 but before certification. As used in this section, the term "information" can include changes in the project or environmental setting as well as additional data or other information. New information added to an EIR is not "significant" unless the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect (including a feasible project alternative) that the project's proponents have declined to implement. "Significant new information" requiring recirculation include, for example, a disclosure showing that:

(1) A new significant environmental impact would result from the project or from a new mitigation measure proposed to be implemented.

(2) A substantial increase in the severity of an environmental impact would result unless mitigation measures are adopted that reduce the impact to a level of insignificance.

(3) A feasible project alternative or mitigation measure considerably different from others previously analyzed would clearly lessen the significant environmental impacts of the project, but the project's proponents decline to adopt it.

(4) The draft EIR was so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded. (Mountain Lion Coalition v. Fish & Game Com.(1989) 214 Cal.App.3d 1043).

(b) Recirculation is not required where the new information added to the EIR merely clarifies or amplifies or makes insignificant modifications in an adequate EIR.

(c) If the revision is limited to a few chapters or portions of the EIR, the lead agency need only recirculate the chapters or portions that have been modified.

(d) Recirculation of an EIR requires notice pursuant to Section 15087, and consultation pursuant to Section 15086.

(e) A decision not to recirculate an EIR must be supported by substantial evidence in the administrative record.

(f) The lead agency shall evaluate and respond to comments as provided in Section 15088. Recirculating an EIR can result in the lead agency receiving more than one set of comments from reviewers. The following are two ways in which the lead agency may identify the set of comments to which it will respond. This dual approach avoids confusion over whether the lead agency must respond to comments which are duplicates or which are no longer pertinent due to revisions to the EIR. In no case shall the lead agency fail to respond to pertinent comments on significant environmental issues.

(1) When an EIR is substantially revised and the entire document is recirculated, the lead agency may require reviewers to submit new comments and, in such cases, need not respond to those comments received during the earlier circulation period. The lead agency shall advise reviewers, either in the text of the revised EIR or by an attachment to the revised EIR, that although part of the administrative record, the previous comments do not require a written response in the final EIR, and that new comments must be submitted for the revised EIR. The lead agency need only respond to those comments submitted in response to the recirculated revised EIR.

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Note: Authority cited: Section 21083, Public Resources Code. Reference: Section 21092.1, Public Resources Code; Laurel Heights Improvement Association v. Regents of the University of California (1993) 6 Cal. 4th 1112.

HISTORY

1. New section filed 8-19-94; operative 9-19-94 (Register 94, No. 33).

2. New subsections (f)-(g) filed 10-26-98; operative 10-26-98 pursuant to Public Resources Code section 21087 (Register 98, No. 44).

3. Amendment of subsections (f)-(f)(2) and new subsection (f)(3) filed 9-7-2004; operative 9-7-2004 pursuant to Public Resources Code section 21083(e) (Register 2004, No. 37).

4. Change without regulatory effect amendingNote filed 10-6-2005 pursuant to section 100, title 1, California Code of Regulations (Register 2005, No. 40).

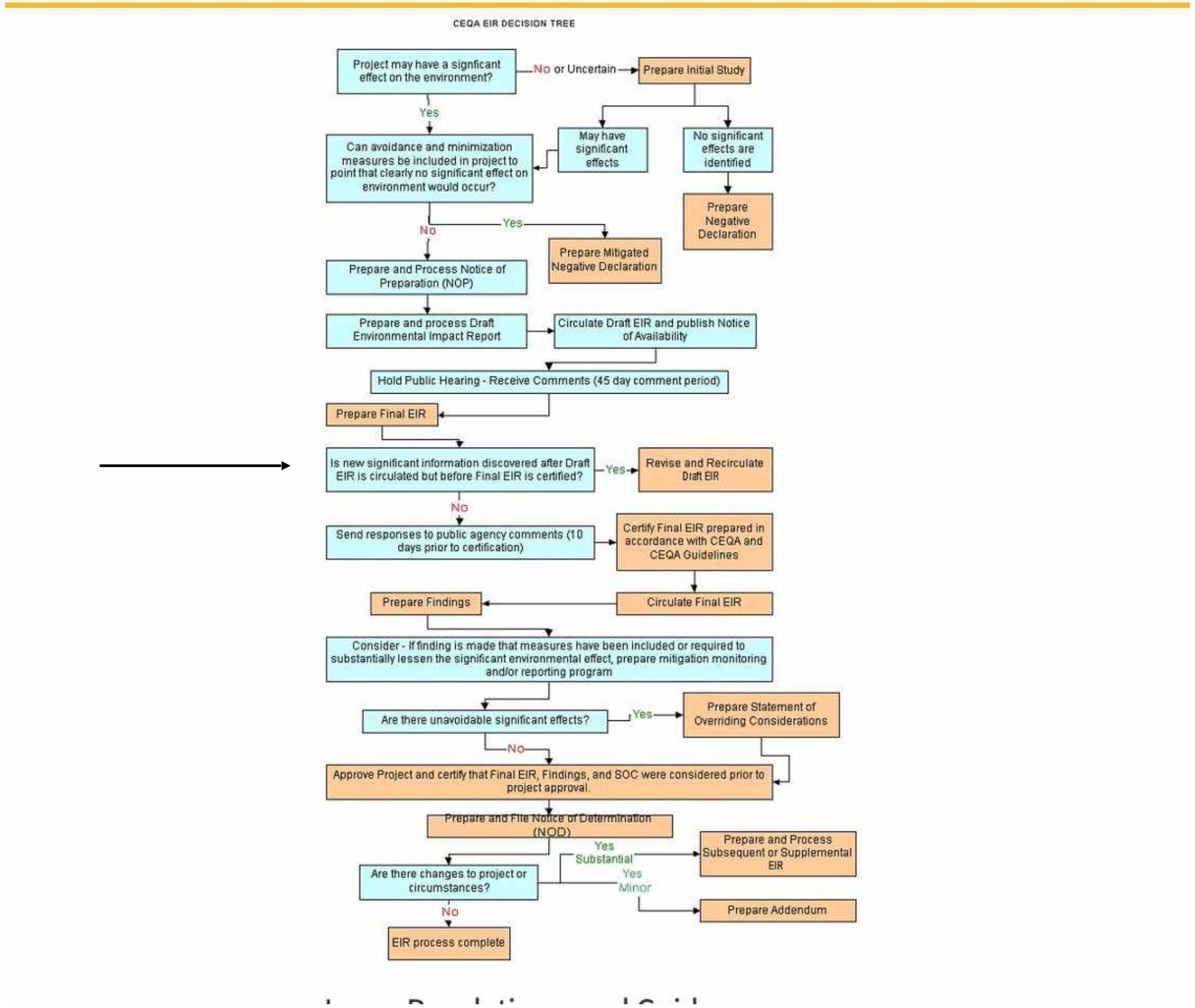
This database is current through 3/11/22 Register 2022, No. 10

14 CCR § 15088.5, 14 CA ADC § 15088.5

END OF DOCUMENT

Reference 6b

Recirculation of EIR prior to Certification Process



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This database is current through 3/25/22 Register 2022, No. 12

14 CCR § 15088.5, 14 CA ADC § 15088.5

END OF DOCUMENT

Guidance for Large Wind Energy Conversion System Noise Study Protocol and Report

Guidance for Developing and e-Filing the LWECS Noise Study Protocol and Report Submittals to the Minnesota Public Utilities Commission

COMMERCE DEPARTMENT
DIVISION OF ENERGY RESOURCES

Energy Environmental Review and Analysis

Acknowledgments

The Department of Commerce Energy Environmental Review and Analysis staff developed this guidance in coordination with the Minnesota Pollution Control Agency (MPCA). We thank Frank Kohlasch and Fawkes Steinwand of the MPCA staff for their efforts.

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Guidance for Developing and e-Filing an LWECS Noise Study Protocol and Report

Purpose

The purpose of this guidance document is to help wind developers prepare and use a project-specific noise study protocol to guide post-construction noise monitoring, data analysis and reporting according to standard methodologies. Pre-construction modeling recommendations are available in the Department of Commerce's "Application Guidance for Site Permitting of Large Wind Energy Conversion Systems in Minnesota".

The purpose of the protocol and the resulting noise study report are to quantify total post-construction sound and assess Large Wind Energy Conversion System (LWECS) contribution at receptors in the project area. The monitoring, analysis, and report will provide information to:

- determine total noise levels and LWECS contribution at different frequen-cies and at various distances from the turbines at various wind directions and speeds;
- assess probable compliance with Minnesota noise standards;
- confirm the validity of the noise modeling conducted prior to permit issuance or prior to construction; and
- assess the modeling as a predictor of probable compliance with Minnesota noise standards.

This document describes the general parameters for monitoring and reporting post construction noise. It also provides general guidance for developing the noise study protocol document and the report. The actual monitoring, protocol and report for a specific project will likely include more detail and shall address project-specific consider-ations.

Noise study protocols and reports are reviewed by Department of Commerce, Energy Environmental Review and analysis (EERA) staff, and staff comments and recommen-dations are provided to the Minnesota Public Utilities Commission (Commission). EERA staff may recommend and the Commission may require changes to a noise study protocol. However, consultation with the EERA staff state permit manager for the project during preparation of the noise study protocol and report is recommend-ed to minimize the need for changes after filing.

Monitoring and Reporting Guidelines

Scope

Noise standards under Minnesota Rule 7030 are total noise standards. Therefore, noise monitoring must address total post-project sound levels in the project area as well as turbine contribution to total sound. This can be accomplished in a couple of ways. First, through an "on/off" monitoring campaign that collects total sound data in the project area with all turbines operating as well as total sound data in the project area without turbines operating, and uses information from these two datasets to deduce turbine contribution. Second, this can be accomplished through a monitoring campaign that collects total sound data in the project area with all turbines operating and also collects total sound data offsite in an area that is similar to the project area, but unaffected by turbine sound, comparing the two datasets and evaluating sound data characteristics to assess turbine contribution. Permittees should consult with the EERA staff state permit manager as they determine which approach to use and both the protocol and final report should document the rationale for the method chosen.

Specifically, the scope of the monitoring must address:

1. **Total Sound:** Monitor total noise levels at receptors in the project area during operation, with all project turbines operating.

AND

2. **LWECS Turbine Contribution to Total Sound:** Monitor total noise levels in the absence of LWECS operational noise. Use these noise monitoring results, along with the measure of total noise during tur-bine operation collected in **1** to assess turbine contribution to total sound. Choose one of the following methods:

2a. Monitoring Within the Project, Same Locations, Turbines Off. In conjunction with the monitoring in **1**. and using the same methods and the same monitoring locations within the project site, monitor sound with all of this project's turbines in place but not operating. OR

2b. Monitoring Off-Site, Same Timeframe. Concurrently with the monitoring in **1.**, conduct off-site monitoring to contribute additional data that supports evaluation of sound that exists in analogous environments in the absence of wind turbines. For comparability, noise monitoring methodology for off-site monitor-ing must be the same as for the monitoring in **1**.

Monitoring Methodology

Monitoring Locations

- The protocol must include a clear rationale of the selection of the locations where sound will be monitored. The rationale should identify the features that each location was selected to represent and address its distance to receptors and to nearby turbines or other sources of sound.
- Monitoring should be conducted at a minimum of three representative lo-cations within the project area that are in proximity to a receptor, such as a residence. Discuss the monitoring locations with the EERA staff state permit manager as early in the planning process as possible.
- One monitoring location must be in proximity to the worst- case receptor pre-dicted by the model.
- Do not choose monitoring locations that are in areas that reflect or absorb sound or where there are obstructions to sound.
- For off-site monitoring that is done under 2b., the rationale for the selection of off-site monitoring locations should address factors that were considered in determin-ing that the environment at the location(s) is(are) analogous to the locations within the project site.

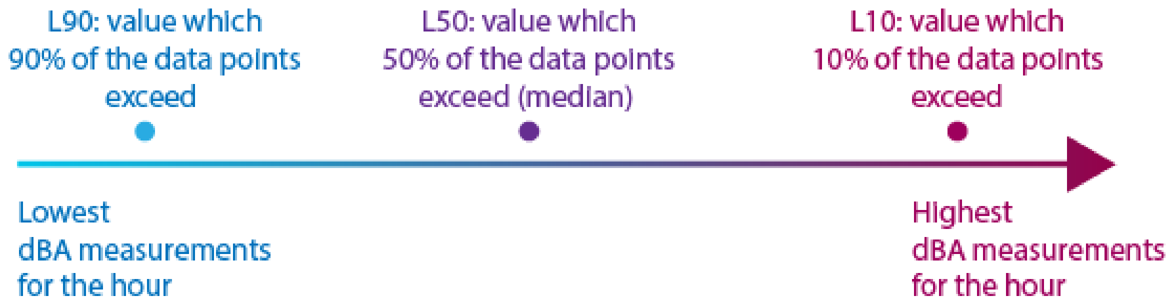
Monitoring Timing and Duration

- The choice of season and factors that were considered in determining the timing of monitoring should be explained in the protocol.
- At each location, monitoring must adequately capture sound levels for hub-height wind speeds above the identified cut-in wind speed for the turbine model. If adequate data is not captured during the initial planned duration for monitoring, the monitoring duration should be extended.
- At each location, monitoring must adequately capture sound levels for microphone-height wind speeds below the identified level at which distortion may compromise the data (11 miles per hour) If adequate data is not captured during the initial planned duration for monitoring, the monitoring duration should be extended.
- Include in the protocol an explanation of the criteria that will be used to deter-mine if the monitoring timeframe will be extended; for example, if insufficient data of a certain type is not obtained.
- For monitoring described in 1. and 2b., collect sound measurements continuously over a minimum of a 7 to 14 day period. Data will be evaluated in 1 hour increments (see below).
- For monitoring described in 2a., collect sound measurements over a sufficient period of time to ensure that valid comparisons can be made between “off” and “on” measurements. This will likely require 3 or more targeted nights of monitoring to adequately characterize sound levels over the relevant range of hub height windspeeds.

Monitored Data

- Sound pressure level, audio recordings, and meteorological data should be collected at each monitoring location.
- Sound level data must be collected to provide a quantitative indication of noise at the microphone and allow comparison to numerical standards. Sound level data should include time-synchronized one-third octave band levels at 1- second intervals to allow characterization of different sound sources as well as identification of short-term activities for potential filtering from the dataset (e.g. mowing, heavy equipment).
- Audio recordings should be automatically collected when noise levels were unusually high. Collecting audio during such times makes it possible to go back and listen to anomalous noise events and determine the potential cause(s) of elevated sound levels.
- Determine unweighted sound; A-weighted dBA as L10, L50, L90 and Leq on an hourly basis; and C-weighted L10, L50, L90 and Leq on an hourly basis. Each one hour period must begin at the start of the hour in the recorded time of day. In the protocol and final report these terms should be defined as indicated in Figure 1 to avoid confusion.

Figure 1. Statistical calculations to quantify noise over one-hour periods



Minnesota's noise pollution rules are based on statistical calculations that quantify noise levels over a one-hour monitoring period. The L10 calculation is the noise level that is exceeded for 10 percent, or six minutes, of the hour, and the L50 calculation is the noise level exceeded for 50 percent, or 30 minutes, of the hour.

- Determine unweighted, A-weighted and C-weighted one-third octave- band analysis for at least as low as 16 (preferably lower), 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1K, 1.25K, 1.6 K, 2K, 2.5K, 3.15 K, 4K, 5 K, 6.3 K, and 8K HZ or higher for a representative wind speed for the location that is in proximity to the worst-case receptor predicted by the model and for the off-site location (if applicable).
- Meteorological data should be collected at sound level meter height and should include wind speed, and precipitation. This data should be used to identify periods during which weather conditions (precipitation, high winds on the microphone) distort and invalidate sound level measurements.
- Hub-height meteorological data from one or more met towers within the project area must be obtained for the same time periods and time intervals as the monitoring and should include wind speed and direction. This data should be used to confirm that adequate sound level monitoring data is captured across the relevant range of hub height wind speeds.

Monitoring Equipment

- Use a sound level meter and a microphone conforming to type 0, 1, 2 or S specifications under ANSI S1.4-1983, a calibrator of known frequency and level, and an oversized microphone wind screen.
- Calibration must be done before and after the monitoring period. Sound measurements must be taken at least 3 feet above the ground.
- An anemometer or similar instrumentation to determine wind speed at microphone height must be used.

Monitoring Analysis and Reporting

Data processing

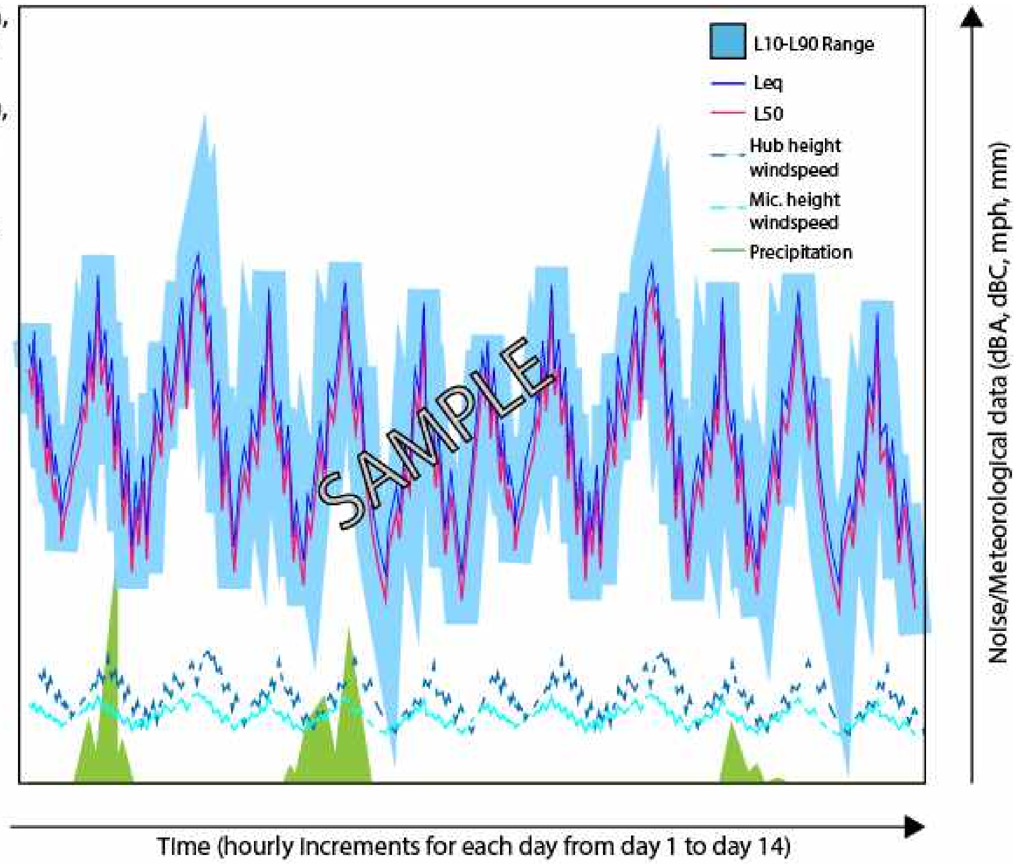
- "Spikes" of sporadic noise, such as a motorized vehicle going by, a clap of thunder, or a dog barking, may be eliminated from the data, as long as an explanation is included in the report for the types of sound and percentage of measurements for each that were eliminated, for each location and for each monitoring event. Similarly, data collected during documented periods of precipitation may also be eliminated from the data, as long as an explanation is provided in the report and the percentage of mea-surements that were eliminated, for each location and for each monitoring event, is reported.
- For each hour, for all the sound mea-surements obtained during that hour, determine the L10, L50, L90, and Leq as dBA and the L10, L50, L90 and Leq as dBC. Do not include the sound measure-ments that are being eliminated with explanation as allowed above.

Data Reporting

- **Map Location of Monitoring Points.** Provide a map showing an aerial photo-graphic layer with the location of turbines, monitoring locations, residences and location of significant local noise sources such as concentrations of agricul-tural activity (for example, a feedlot) or human activity (for example, traffic). The scale of the map should show the distance between monitoring points and the distance of the monitoring point to the nearest turbine.
- **Results at Varying Wind Speeds.** Report continuous sound measurements at all wind speeds that occur during the monitoring. Present a time series of the total Leq, L90, L50 and L10 for dBA and Leq, L90, L50 and L10 for dBC sound levels for each hour (Figure 2). Chart a similar time series (combine them onto one chart with the sound levels) for corresponding hub-height and microphone height wind speed in miles per hour and precipitation in mm. If the number of parameters presented on the chart is crowded, separate charts may be done for the sound level parameters if preferred but wind speed and precipitation should always be shown along with a measure of sound level.

Figure 2. Presentation of Results for all data for monitoring

For each montitoring location, create a time series chart for each monitoring event. Chart data points for Leq, L90, L50 and L10 for each hour in dBA and also in dBC. On the same chart create a time series for wind speed at hub height and microphone height and for precipitation.



- **Results at Varying Frequencies.** Present one-third octave-band analysis (at least as low as 16 and preferably lower, 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1K, 1.25K, 1.6 K, 2K, 2.5K, 3.15 K, 4K, 5 K, 6.3 K, and 8K HZ or higher) for each monitoring location. Do not include the sound measurements that were excluded as part of the data processing step described above.
- **Results for Turbine Contribution.**
  1. Use monitoring results from 2a to assess turbine on, turbine off, and turbine only sound levels for each monitoring location. Present these results in charts and tables as appropriate.
  2. Use monitoring results from 2b to assess sound measurements over the range of frequencies with turbines operating to the sound measurements at the offsite monitor and present estimated turbine only L10 and L50 levels for each monitoring location. Present these results in charts and tables as appro-priate.
- **Comparison to Minnesota Noise Standards**. Compare total and turbine only sound levels to the daytime and nighttime Minnesota noise standards. Include in the report a summary of the L10 and L50 hourly determi-nations for total sound that are above the Minnesota noise standards for each monitoring location and discuss turbine to these total noise levels exceedanc-es.

- **Results of Noise Modeling.**
  1. Present a map of the modeling that was done previously for the project. Modeling contours must be represented on the map as lines, or transparent shading, at 5 db increments. Show the contours for modeling provided with the permit application, adjusted for the final turbine layout prior to construction. Explain what the contours represent precisely.

2. For modeled sound predicted during the permitting process or prior to construction, include in the report an explanation of the methodology, the assumptions in the chosen model and a narrative description of the choices made for criteria in using the model.
3. Include a narrative conclusion regarding how well the monitored results compare to the predicted sound levels for the project and how well the modeling performed as a predictor of probable compliance with the Minnesota noise standards. If the results do not compare favorably, explain.

Protocol and Report Development Guidelines

Noise Study Protocol Document

Protocol Contents

The noise study protocol for the monitoring should address following elements, consistent with the monitoring and reporting guidelines in this document:

- the purpose of the monitoring;
- the monitoring scope;
- the monitoring locations and their rationale;
- the monitoring timing and duration;
- the monitored data
- the monitoring the equipment;
- data processing;
- data reporting;

Preparation/Efiling

After the Noise Study Protocol has been prepared according to this guidance, complete a compliance filing on the Minnesota Public Utilities Commission (Commission) and Department of Commerce E-Dockets system, by the date specified in the Commission LWECS site permit for the project, at this web address: https://www.edockets.state.mn.us/EFiling/.

Address the cover letter to the Executive Secretary of the Minnesota Public Utilities Commission for the submittal and for any subsequent revisions.

Daniel Wolf, Executive Secretary

Minnesota Public Utilities Commission 350 Metro Square Building

121 Seventh Place East Saint Paul, MN 55101

Noise Study Report Document

Report Contents

In the noise study report, describe the actual conditions, measurement locations, instrumentation, procedures, methodology, data obtained and results, including charts, and conclusions consistent with the monitoring and reporting guidelines in this document and the noise study protocol approved by the Commission. Document any changes from the approved protocol with an explanation as to the necessity, and any impact the changes may have on interpretation of results.

Prepara ion/Efiling

E-file the noise study report for the completed monitoring and a cover letter summarizing the results and conclusions. Attach the previously e-filed protocol for the monitoring to the noise study report. Indicate in the report any approvals of the protocol by the Minnesota Public Utilities Commission and how and when the approvals were obtained.

Address the cover letter to the Executive Secretary of the Minnesota Public Utilities Commission for the submittal and for any subsequent revisions.

Daniel P. Wolf, Executive Secretary

Minnesota Public Utilities Commission 350 Metro Square Building

121 Seventh Place East Saint Paul, MN 55101

References

1. American Wind Energy Association and Canadian Wind Energy Association, Wind Turbine Sound and Health Effects, An Expert Panel Review, December 2009.
2. Minnesota Department of Health, Environmental Health Division, Public Health Impacts of Wind Turbines, May 22, 2009.
3. Minnesota Pollution Control Agency, A Guide to Noise Control in Minnesota, 2008.
4. National Association of Regulatory Utility Commissioners, Wind Energy & Wind Park Siting and Zoning Best Practices and Guidance for States, January 2012.
5. National Association of Regulatory Utility Commissioners, Assessing Sound Emissions from Proposed Wind Farms and Measuring the Performance of Completed Projects, October 2011.
6. Wisconsin Public Service Commission, Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Wind Electric Generation, adopted May 26, 2010.