CENTRE FOR OPEN & RESPONSIBLE DIGITAL INFRASTRUCTURE DEVELOPMENT

Evaluating Data Centres: A Toolkit for Communities

Noise Impacts

About this toolkit

How to use this toolkit: This toolkit is a general educational resource to help communities better understand data centres and take part in informed, constructive conversations about them.

It’s not an assessment of any specific project, site, or company, and it isn't intended to advocate for or against development.

Noise impacts vary widely by facility design, location, and local rules. The sound levels and examples presented are general, not specific to any one facility.

This Toolkit is not a substitute for technical assessments or for local regulations, which vary across jurisdictions. This module reflects information available as of October 2026.

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Noise impacts at a glance

Key ideas communities need to know:

Data centre noise is often less about how loud it is, and more about a constant, low-pitched hum and sometimes a single, steady tone that can be disruptive.

The impact of noise on a community is relative: it depends largely on what kind of community the facility is built near.

Existing local noise regulations are the starting point. They will tell you the level, type, and timing of noise allowed by law, and whether data centres are specifically or uniquely regulated at all. These regulations can vary dramatically across different jurisdictions.

Managing data centre noise is the cheapest and easiest in the planning and design project stages.

Independent verification of noise levels after a facility opens is one of the biggest gaps.

Some steps communities can take:

01 Ask what the facility will sound like at the nearest home in the middle of the night at full operation, rather than what the average noise reading will be.

02 Push for monitoring after the facility opens to be written into the approval conditions, which are a municipality's strongest tool for regulating noise.

03 Push for approval conditions to include background noise measurement before approval, assessment of low frequencies and tones, independent measurement after the facility opens, and a deadline to fix any exceedance.

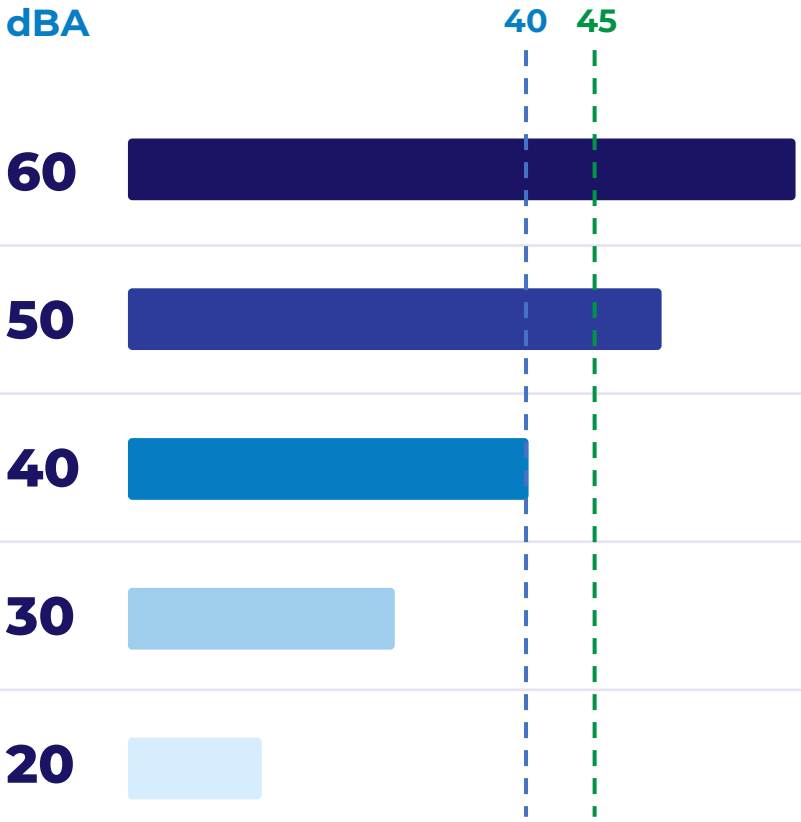
Key noise concepts

There are some key concepts that are important to understand to assess a data centre's potential noise impacts.

Concept	What it means	Why it matters
Hertz (Hz)	Hz measures frequency, which may be perceived as a high- or low-pitched sound (e.g., a low hum vs a high whine).[1]	Community concerns about data centres often focus on low-pitch hums rather than high-pitched sounds or loudness.
Decibels (dB)	dB is the standard unit of measurement for sound. It is often used to understand how loud a sound is.[1]	Sound levels presented in noise assessments or compliance limits are typically reported in dB.
A-weighted decibel (dBA)	The most common measurement used in noise regulations, weighted to reflect human hearing.	dBA measurements reduce the influence of low-frequency sounds on the overall measured sound level, which is one reason a facility can be compliant but still generate complaints.[2]
Tonal noise	A distinct, steady frequency (like a single music note) that stands out from a broader rumble or hum.	People can notice a tone even when the overall sound level is relatively low. Some noise standards account for this by applying a tonal penalty, an adjustment of a few dB to the measured level when a tone is present.[3]
Background ambient sound level	The existing sounds in an area without the new facility/data centre.	The same data centre may have very different impacts depending on what sounds are already in the surrounding area.

How much noise is a lot of noise?

Noise limits are written in decibels (dBA), which can be hard to picture. This scale compares common nighttime limits in Canada with everyday sounds.



dBA	Sounds like [4,5]
60	A normal conversation
50	Rainfall or a refrigerator running
40	A quiet office or library, or a quiet residential street
30	A soft whisper or a quiet suburban night
20	Someone whispering 5 ft away or a quiet rural night

40dBA is Ontario's night limit in rural areas and Quebec's limit at homes.[6,7]

45 dBA is Ontario's night limit in urban areas, measured at the bedroom window, and Toronto's by-law limit for outdoors at night.[6,8]

These comparisons use dBA, which discounts low-pitched sounds.[2] Low-pitched hums, like that from transformers and cooling equipment, can seem louder and more noticeable than its dBA number suggests.

Sound level, pitch, and background conditions affect perceived loudness. These examples provide approximate comparisons.

Understanding data centre noise



How does a data centre create noise?

As introduced in the *Understanding Data Centres* module, data centres (DCs) require large electrical, cooling, and backup power equipment. These systems, rather than the computing equipment itself, are the main sources of noise a surrounding community may experience.

1

Cooling equipment

Continuous or variable

Fans, chillers, and cooling towers remove the heat produced by computing equipment. They may operate continuously and are often a major source of the site's everyday hum.[9]

2

Transformers and substations

Continuous

Transformers and substations manage the large amounts of electricity required by a data centre. They operate continuously and can produce a steady, tonal hum.[10]

3

Backup generators

Intermittent

Backup generators provide electricity during a grid outage. Although outages may be rare, generators must be tested regularly, and testing many units at once can create frequent or extended periods of noise.[9]

4

Other onsite power generation

Potentially continuous

Some projects may use onsite power generation, such as natural gas turbines, as a regular source of electricity rather than only for emergencies. This introduces another potentially continuous source of noise that is a newer consideration.[11]

What does it actually sound like?

Data centre noise complaints are rarely about loud noise. It's about a **low, continuous hum.** Residents living near operating facilities describe a constant sound similar to a distant engine or a large appliance, rather than intermittent bangs or roars.

- **It's low-pitched**. Most of the sound sits at the lower end of human hearing – the kind of sound that travels further, passes through walls and windows more easily, and is harder to block.[12] The lowest end of this sound (20 Hz or lower) is called infrasound.

- **The constancy** of the sound, rather than the volume, is part of what most residents find disruptive.[11]

- **Some of it is a single distinct note**, or pitch, rather than a general rumble. This is called tonal noise. Transformers particularly produce a single fixed tone rather than broad background noise.[10] The human ear picks up a steady note far more easily, which is why a facility can be objectively quiet and still be noticeable and disruptive. Many noise standards recognize this by adding a penalty of 3-6 dB for tonal noise.[3,13]

Common community concerns

Community concerns are rarely just about volume. They are also about how the sound is experienced, how it is measured, and who is accountable if problems arise.

What will it sound like?

- Is it a hum?
- Is it continuous?
- Will I hear it at night?

How could it affect my daily life?

- Will it interfere with my sleep?
- Will it interfere with my use of outside spaces?
- Will it affect my health?

Will existing regulations capture it?

- Will the assessment go beyond volume and capture low hums and tonal noise?
- Will it cover nighttime conditions?

Who will monitor and respond?

- Who will check actual noise once the facility opens?
- What if the facility changes?
- Can residents request an assessment?

How these concerns show up as real impact

Most DCs have not had noise complaints logged against them, but for those that have, the content of the reports is largely consistent.

Adverse health effects are reported, but more research is needed.

Residents report headaches, disrupted sleep, and several other symptoms. However, existing scientific research is inconclusive on whether these symptoms can be linked directly to noise from data centres.[11] More research is urgently needed.

Communities feel stuck when a noise complaint involves a DC that is compliant with noise regulations.

Meeting a noise limit doesn't mean a facility can't be heard. When a facility is compliant, but residents still find the noise disruptive, the complaint may fall outside what local rules are designed to address (see pg. 15). This might leave regulators with limited authority to resolve the issue.

Communities and DC operators sometimes disagree about an issue being resolved.

In most documented cases of noise interventions, operators report noise issues being resolved while residents disagree.[14] Often, no independent party verifies the outcomes. Plus, facilities are often built in phases. Noise can increase after approval with additional equipment.[15]

What rules apply to data centre noise?



How noise is regulated

Noise is often regulated by sound ordinances designed for any industrial or construction noise sources. These ordinances are rarely designed for DCs specifically, meaning they lack adequate coverage of DC-specific noise considerations (pg. 15 describes this in more depth).

In Canada, sound in general is relatively well regulated. Still, DC noise may be insufficiently captured. No single level of government is responsible for DC noise, so regulating it falls across government jurisdictions on a case-by-case basis. It is important to understand your specific local and provincial regulatory coverage and stringency.

Level	What it covers for DCs	When it applies
Municipal	Zoning, site plan approval, and noise by-laws, plus temporary development pauses	• Decides whether and where a DC can be built ***This is residents' best chance to ask for noise studies and conditions before project approval.** By-laws are the main protection where a province has no rule, but a provincial approval can override them in some cities[8]
Provincial	Noise from industrial equipment like cooling systems, generators, transformers, and any onsite power plant or substation; rules vary widely by province[6,7,16]	• Applies through environmental approvals (ON, QC) or from energy regulators (AB) • Sets the noise limit an approved facility must meet and handles complaints once it's running • Some provinces have no rule at all, while this is the most prominent source of regulation in ON and QC
Federal	Federal impact assessment for very large projects, plus Health Canada's noise guidance (advice only, not enforced)[17]	• Applies only if the site includes a new fossil fuel power plant of 200+ MW[18] • For most DCs, the federal government plays no role in noise

Provincial rules that apply to data centres

While municipal governments determine whether a DC can or cannot be built and what conditions a proposed DC needs to meet to get built, provincial governments can set actual noise limits. None of these rules were written for DCs, but these provinces have the most developed noise rules that can apply to them:

ONTARIO [6]

- dBA night limits based on rural (40) or urban (45) settings
- Covers DC equipment through provincial approval
- No separate test for low-pitched hums

Note: Ontario's Compliance Protocol for Wind Turbine Noise already includes resident-initiated measurement, a 5 dB tonal penalty, and public audit reports, but it does not apply to DCs.[19]

QUEBEC [7]

- 40 dBA at night at homes, or background level if higher
- Set by building use, not zoning
- 5 dB penalty for tonal noise or strong low-pitched noise
- Operators must fix any exceedance
- Applies to new sites and noise-increasing changes (since Jan 2026)

ALBERTA [16]

- Alberta Utilities Commission Rule 012 covers onsite power plants and substations, but not the DC itself
- Night limits starting at 40 dBA
- 5 dB penalty when strong low-pitched noise comes with a clear tone (20-250 Hz)
- Complaints can trigger a noise survey, and operators must submit a plan to address the exceedance

Regulations measure how much sound is produced

Noise is typically regulated based on an **A-weighted decibel (dBA)** measurement. dBA measures the type of noise most within range to be perceived by the human ear at moderate levels. As a result, it **discounts very low frequencies** which sit at the edges of that range, such as the low frequencies produced by DCs.[2,20]

A dBA measurement produces a single number for the level of sound present. It combines a broad rumble and any single tones without telling them apart. This means a tone, which is more annoying and disruptive to the human ear, can get lost in a dBA reading.[3]

Some stronger regulations do attempt to account for low frequency and tonal noise and may involve limits for noise during the day versus at night.[16,21]

Why facilities compliant with noise regulations may still get complaints

Noise limits and how sound is experienced do not always line up, which is why a facility can meet its limit and still be heard, and why checking results after opening matters

1. The dBA measurement may not adequately characterize the noise.

Most noise rules use dBA, which can reduce low-frequency readings by up to 16-19 dB.[2] This means that a real, audible hum at facilities emitting high levels of low-frequency noise can appear as only a small number on a compliance report. Assessments that report “frequency bands” instead make tonal content visible, while an overall decibel level does not.

As well, an overall decibel level hides a single tonal noise. Even where low frequencies are measured, averaging everything into one level may mask a distinct tone. For example, a transformer hum disappears into the background of the reading while remaining obvious to the ear. Distinct tones are heard differently, so it is important that they’re recognized.[3]

2. The limit may be set above how quiet the area actually is.

Most limits are fixed numbers that don’t account for how quiet an area normally is at night. In Ontario, the rural night limit is 40 dBA.[6] If a specific community’s rural night is, for example, 10 dBA quieter than that limit, a facility could comply and still be clearly audible. Some places address this directly with relative limits: Ireland requires facilities in quiet areas stay 10 dB below existing background levels[21], and Oregon caps how much a new source can raise background noise.[22]

3. There may be a lack of independent monitoring afterwards.

Across the documented cases CORD reviewed, operators often report the matter resolved while residents disagree, with no independent party determining the outcome.[14]

What would great regulations look like?

Data centre noise is still a relatively new regulatory issue. Establishing exemplar noise regulations will take time.

However, they will likely involve a few key elements:

01

Regulate both the data centre itself and its power equipment that runs nearly 24/7 (many regulations only cover the latter)

02

Adequately capture low frequency noise *and* tonal noise

03

Require noise levels measurement and verification after the facility is operating, not only in the planning and modelling phase

What determines the impact of noise on a community?



Impact depends on the place and project

The impacts experienced by a community depend on the interaction between local conditions and project characteristics.

Local conditions, or site context, can inform project design and development decisions aimed at reducing noise impacts.

1 Place

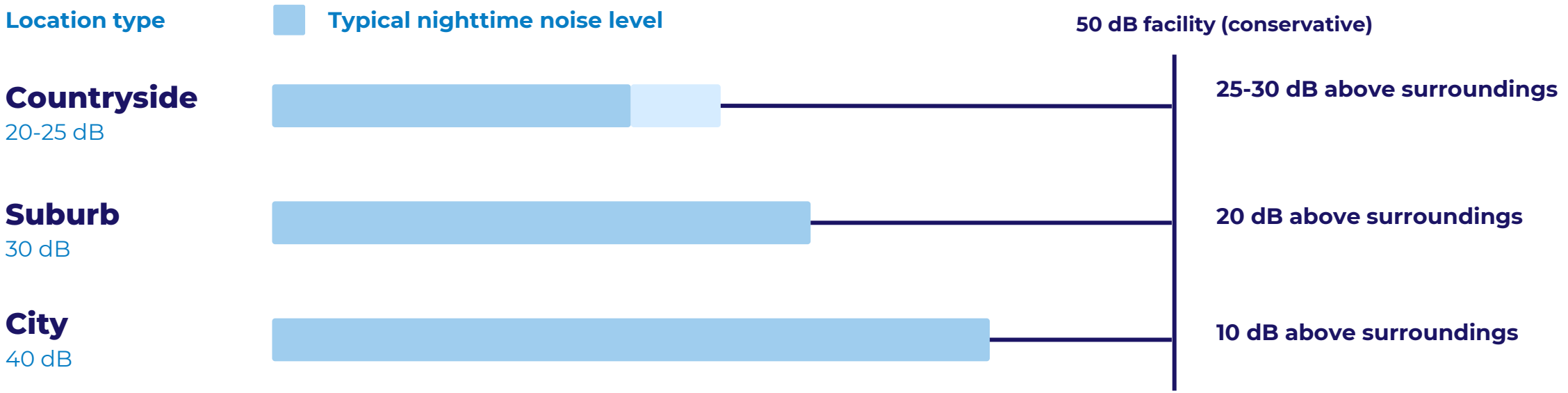
Characteristic	Why it matters
Ambient sound level	A sound is often more noticeable in a quiet area than in a noisy one.
Distance to homes and sensitive receptors	Distance influences how much sound reaches surrounding communities.
Nighttime conditions	Noise often becomes more noticeable when surrounding activity decreases.
Existing land uses	Expectations and sensitivity to noise can vary across residential, commercial, and industrial areas.

2 Project

Characteristic	Why it matters
DC scale (MW)	Larger facilities generally require more equipment, which can increase sound levels and affect noise management.
Cooling design and equipment selection	Directly influence the type and amount of sound produced.
Layout and setbacks	Influence how much sound reaches surrounding communities.
Mitigation measures	Influence how much sound is reduced before it reaches residents.

Measurements are only meaningful relative to place

Rather than an absolute measure of how much sound a facility produces, what actually matters is how much sound it adds to what's already there (the background ambient sound level). Operating facilities generally produce 45-65 dB from the property line.[23] Here's how a conservatively quiet facility at 50 dB compares to typical nighttime noise levels:



This is important for how we set noise limits. A single fixed limit applied everywhere under-protects quiet areas, which is frequently where facilities are built.[1,24]

How is the impact managed?

Due to differences in site characteristics, mitigation should be identified on a site-by-site basis. Developers have used traditional methods for noise reduction over the years, including:

1 Place

Strategic siting, orientation, and scale: Noise impacts can be reduced when the building and equipment are oriented away or farther from surrounding residents, or when the main building is placed between residents and noisy equipment.
In some cases, distance or "setbacks" can play a role in noise reduction, but there are limits to their effectiveness.[12,26]

2 Project

1. **Equipment selection:** Quieter fans, chillers, and transformers exist. These are often design decisions made years before construction or operations.
2. **Silencers and enclosures:** Effective, but they restrict airflow and so must be designed into the cooling system rather than added afterward.[9]
3. **Sound barriers:** Useful against higher-pitched noise, but less so against a low pitch because low-frequency waves bend over walls.[25]

Overall, treating specific equipment is better than physically boxing it in.[27,28] Planting vegetation around the building usually doesn't resolve noise issues on its own, but it can still help[29]. How bothersome a sound feels depends on more than how loud it is. This is the field of psychoacoustics, which studies how people perceive sound. A greener, softer-looking site can make the same sound feel less intrusive to residents.

Emerging best practices

In addition to traditional methods, these emerging practices may support better impact mitigation:

1. **Updated regulations**

   A. **Conduct multiple measurements:** Require measurement before and after construction using frequency (pitch)-band data and a tonal assessment. C-weighted decibels (dBC) apply far less discount to low frequencies and may help capture the sounds that dBA misses.[2]

   B. **Regulate sound level with time specificity:** For example, different noise limits for daytime versus nighttime.[21]

   C. **Regulate sound character:** Ensuring tonal noise is accounted for and even limited based on time of day (e.g., tonal noise may be more disruptive at night).[16,21]

2. **Equipment sound certification:** Certifying quieter equipment helps ensure the quiet equipment choices are being made and helps the industry move toward better solutions. The Cooling Technology Institute launched a certification program in 2026 verifying manufacturers' published sound figures against independent testing. It followed documented cases of published figures being up to 10 dB off on uncertified equipment.[30]

3. **Complaint-triggered and independent verification:** Some jurisdictions give residents a defined route when noise persists after approval. Combined with independent verification and a required timeline for remediation, this can help ensure noise issues are resolved.[16,19]

Emerging best practice examples

Oregon: Limiting increases above background sound levels

Noise Control Regulations for Industry and Commerce (Administrative Rule 340-035-0035) [22]

Oregon caps how much a new industrial or commercial noise source on a previously unused site can raise existing background sound: no more than 10 dBA in any hour. Regulators can also require an extra test that breaks the sound into narrow frequency bands to capture low frequencies (a one-third-octave test). Operators can be required to allow the Oregon Department to monitor and report noise from the facility.

Ireland: Nighttime limits and tonal noise provisions

EPA Ireland, Guidance Note for Noise (NG4) [21]

Ireland's environmental regulator sets typical limits of 55 dB by day, 50 dB in the evening, *and* 45 dB at night at the nearest home. At night, no tonal or impulsive noise (such as a steady tone or sudden bangs) should be "clearly audible or measurable." In quiet areas, a facility must stay at least 10 dB below the existing background level, and that background must be measured for at least two weeks before approval.

Virginia: dBC measurement and compliance monitoring

Prince William County, Virginia, Noise Ordinance (adopted October 2025) [31,32,33]

After a resident-and-industry advisory group studied data centre noise, the county adopted a new ordinance that measures noise in dBC, which gives more weight to low frequencies than dBA. It also funded county engineers to monitor compliance. The limits that passed were however looser than its consultants recommended, so the ordinance shows progress alongside the pressures involved.

Alberta: Low-frequency and tonal assessment, with complaint-triggered checks

Alberta Utilities Commission, Rule 012 Noise Control [16]

Alberta adds a 5 dB penalty when an energy facility's noise has a strong low-frequency component (dBC minus dBA is 20 dB or more) together with a clear tone below 250 Hz. A complaint can trigger a measurement survey, and an operator found out of compliance must submit a plan and timeline to fix it. The rules applies to power plants and substations, so it would cover on-site generation but not the data centre building itself.

Verification and accountability



What to measure and when

Measurements at different project stages can help assess and manage noise impacts.

Stage	What should be measured	Why it matters
Before approval	Existing nighttime background sound at the nearest homes, plus predicted levels in both dBA and dBC, with frequency-band data (20-250 Hz) and a tonal assessment.[3,26]	Background sound is the baseline everything else should be compared against to protect relative local conditions. These steps will help capture DC-specific sounds.
As conditions of approval are being written	Requirements for who measures after opening, when, and what happens if the facility doesn't comply, including resident-triggered measurement.[19]	Making these steps clear helps ensure timely measurement and verification of results.
Once the DC begins operating	The same measurements at the same homes, at night, at full operation within a set period, and repeated, if equipment is added.	Checks whether measured levels match predictions and whether levels change as the facility expands.

How can my community ensure a lower impact?



Questions to ask

These are examples of questions that can support a constructive conversation. Which ones are relevant will depend on the project and local context.

Before data centre development application approval

What will this sound like at the nearest home at 3 am at full operation, not just the annual average sound level?

What background ambient sound level was the facility's predicted noise compared against, and when was that background measured?

What noise-related pre-approval conditions can we put in place to ensure noise levels are managed?

As conditions of project approval are written

Who measures compliance after the data centre opens, how often, and who pays?

What happens if the project fails to comply with noise limits (e.g., a fix deadline for remediation, a penalty, or nothing)?

Is there a tonal-noise penalty in the limit, or only an overall dB or dBA cap?

Can residents request a measurement, and do the results go to them?

Once the data centre begins operating

Have sound levels been measured in both dBA and dBC, with frequency-band data from 20-250 Hz and a check for tones?

Where is the complaints log and who else can see it?

Has anything changed on site since approval (e.g., more servers, new chillers, generator testing hours)?

Additional resources



Measurement and assessment standards

ISO 9613-2	How outdoor sound propagation is calculated
ISO 1996-1	Sound description and assessment, including tonal penalties
BS 4142 (UK)	Assessing industrial sound against local background levels

Regulatory examples

- EPA Ireland, Guidance Note for Noise (NG4)
- Ontario compliance protocol for wind turbine noise – includes resident-initiated measurement
- Alberta Utilities Commission Rule 012
- Quebec environmental noise guidelines (2026)
- Prince William County and Loudoun County, Virginia – ordinance development and enforcement record

Equipment and technical

- Cooling Technology Institute sound certification program
- Manufacturer published sound power data

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