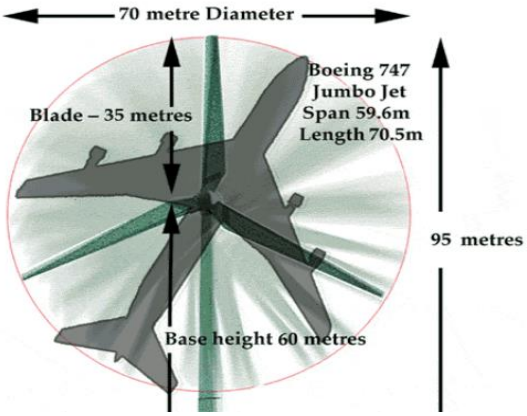
Wind Farm Living EDUCATING THE LAWYERS Series

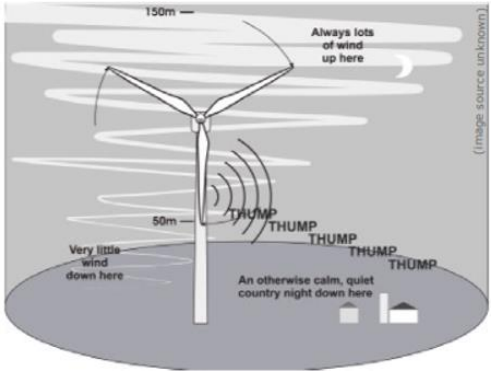
Lesson 14: The Tonality of Turbines

The New Zealand Standards (NZS6808:2010) state that wind farm noise can be audible against the background noise of the land and has restricted the outdoor level (using questionable corrections) to 40dB LA90(10min) to protect people from sleep disturbance indoors that is generally considered acceptable for road traffic noise at 30 dB LAeq, as advised in the WHO Guidelines for Community Noise.
(https://www.who.int/publications/i/item/a68672)

Tonal noise is a specific noise characteristic such as a hum or whistle that can be clearly heard.
It is generally accepted that any hum or whistle which is 5dB higher than the same noise level without the tones or whistles would be considered tonal.
Tonal noise is more disturbing than non-tonal noise and when observed is considered a Special Audible Characteristic (SAC).
Penalties of up to 6dB can apply to SACs where tones are observed.

A turbine is a big hollow steel tube with mechanical moving parts perched on top.





Amplification of the vibrations

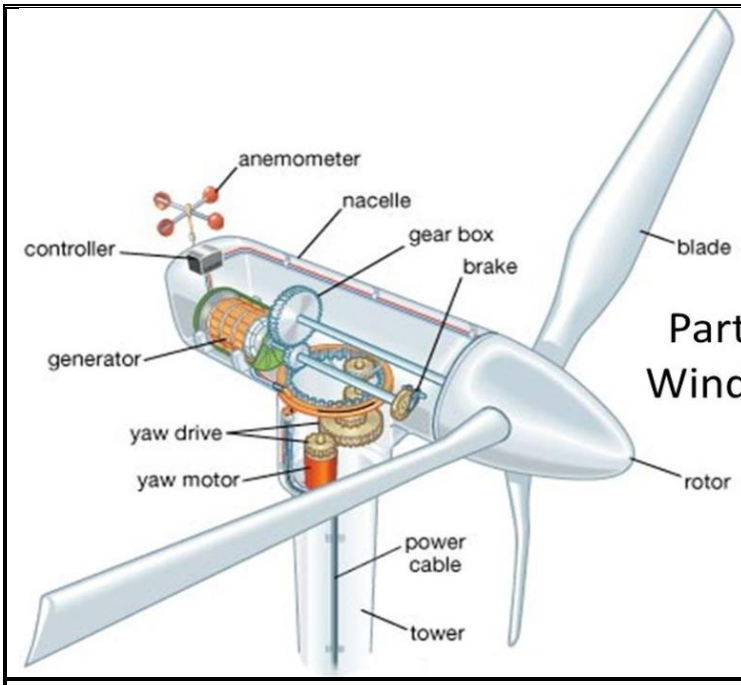
The towers can amplify and radiate tonal noise.
They are large steel structures with very large surface areas and extremely efficient vessels for radiating tonal noise.
Towers are designed to absorb or "dampen" the noise of attached moving mechanical parts, but sometimes they get it wrong.
If the frequency of a turbine's mechanical components' vibrations is closely aligned to the steel tower structural frequency, then that model of turbine could be inherently noisy.

Aerodynamically, turbine blades are the same as aeroplane wings.

Just as aeroplanes roar as they come into land – so too do the blades of the turbines roar.
People say they are like a jet plane coming into land – but never landing. Modern turbines are now 3 x the size and growing.

Like whooshing a big stick

Turbine blades are just like long, thin, flimsy sticks.
If you swish a long thin stick through the air it makes a swish-swish-swish sound. (Try it).
Turbine blades work in the same way, but on a bigger scale.
And the noise is more like a whoosh-whoosh-whoosh, or a thump-thump-thump.

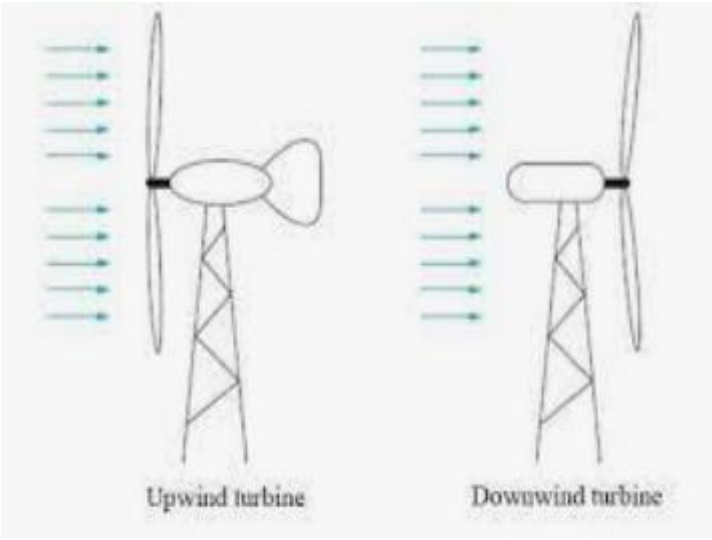


Parts of the Wind Turbine

The Nacelle of the turbine houses the mechanical parts.

The crunching, grinding, squealing, whirring, and humming are the noises made by these mechanical parts.

And these noise tones are distinctively loud against the quiet rural ambient background, particularly at night.



The Brakes /Yaw Brakes are on ALL THE TIME

Modern Turbines are built with the blades in front of the nacelle (upwind turbines). This results in the wind continually trying to swing the blades around behind the nacelle.
To keep the blades in this front position the yaw/brakes system needs to stay on continuously.

But then,

When the wind changes, the yaw/brakes need to be released to allow the blades to turn to face the new wind direction.

Turbine brakes can squeal and screech or impact mechanical parts as they release to allow the blades to turn to face the new wind direction and re-set.

This squeal can be loud and wake people up at night.

These significantly annoying squeals and screeches are not picked up in the LA90 statistical calculation.

The Brakes get Sticky.

If you are stationary in a car on a hill - you need to keep the brake or handbrake on hard to stay still.

As you release the brakes you hear a squeal or a clunk. This is the sticky brakes letting go.

Turbine nacelles work the same way when they turn to follow different wind directions.

Gear Boxes and Generators Rev Up and Down

Like a revving engine – the gearbox revs up and down with the blade speed.
Rotating equipment can become out of balance.

The gearbox drives the generator in the nacelle.

Just like when an out-of-balance wheel on a car can hit a resonance in the steering – the gearbox will rev up as the blade's speed is increased and resonances can occur in the turbine structure.

Resonances generally cause higher noise levels.

This revving-up period can be short-lived, and not picked up in the LA90 statistical calculation.

Also, the gearbox and generator will vibrate as they rev up by the faster spinning blades.

Continuous Noises

Cooling fans and hydraulic pumps operate all the time. The fans and pumps will keep whirring and humming away even when the blades are still.

Temperature Inversion plays a part.

In the still of the early morning, the meteorological condition of *temperature inversion* directs any prominent noise low across the paddocks into people's homes.