

# A BARRIER FOR COMMUNITY POWER GENERATION CLOSE TO HOMES

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## 1 Introduction

Urban intensification can result in a loss of buffer zones, placing sources of noise and sensitive points of reception in closer proximity to each other and increasing potential for conflict. Complete removal of separation distance that is used for sound reduction can require replacement with substantial mitigation measures.

This case study looks at challenges encountered in achieving acoustic separation between a community power generation facility and neighbouring residential development lands. Characteristics of the sites and local topography combined to require use of a tall sound barrier. Installation of the barrier allowed residential land use on property immediately adjacent to a community power generation facility.

## 2 Background

Sloping topography characterizes the community power generation facility site and residential development site. Figure 1 provides a plan view of the area. The development land slopes upwards quite uniformly towards the road, with a grade difference of about 10 m. The facility is on a flat area a few metres above the lower elevation of the development land and is bordered by steep upward slopes on the development and road sides. A swale or ditch runs at the base of the steep slopes. A row of tall, mature conifers is situated along the property line between the sites. Layout of the site is shown in Figure 2.



Figure 1: Residential development and facility

The residential development is a combination of single detached, semi-detached and row housing, except for a multi-storey building at the corner of the road and demising property line. The multi-storey building is thus placed at the highest part of the development.

For this area the acoustic separation requirements between industrial and residential uses requires cumulative sound from all sources on the facility site to be no higher

than 45 dBA at the residential uses during nighttime hours.

Since the facility produces electricity, it operates at any time of the day or night. The three internal combustion engines that it uses are powered by biofuel. Unused biofuel is burned in an enclosed flare. The flare is constructed with the combustion occurring inside the base of the stack. The primary sources are therefore the internal combustion engines, aerial coolers, a compressor and a flare. The internal combustion engines had existing silencers.

Facility operation was predicted to result in sound levels of up to 60 dBA at the nearest residential parts of the adjacent subdivision, requiring an overall reduction of 15 dB to achieve the required 45 dBA limit. Approximately 40% of the development lands had facility sound levels above 45 dBA.

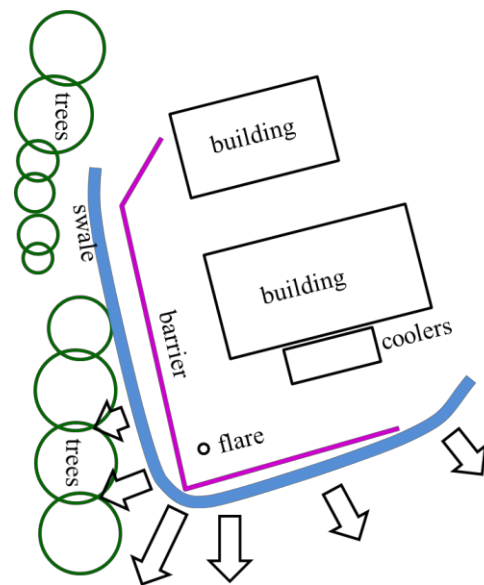


Figure 2: Community power generation facility site

## 3 Mitigation

Preventing residential development on a large portion of the land was not considered a suitable means of ensuring acoustic separation. Mitigation at the sources with or without use of a noise barrier was considered. The sources would have required upgraded combustion exhaust silencers and some large new silencers. However application of a silencer to the enclosed flare was needed and would have required special safety approval, would have incurred substantial cost and had the potential to degrade the flare performance. The idea of a silencer on the flare was set aside in consideration of the long time required for the

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approval process and lack of certainty that approval would be granted. Focus therefore shifted to use of a barrier.

To limit the height of the barrier, some restrictions were placed on the development. In particular, the multi-storey building would need to be constructed so that noise-sensitive parts of the building were not exposed to sound from the power generation facility at levels above 45 dBA. This could be achieved by some combination of setbacks of the building, height limitation or orientation of the sensitive faces away from the power generation facility. Specific details of the building were not worked out as the building concept was not sufficiently developed.

#### 4 Challenges to use of a barrier

Finding a location for the sound barrier posed a number of challenges. Locating the barrier along the property line had the disadvantage that the adjacent residences would be overshadowed by a large wall. The row of tall conifers along the property line was desirable to create a visual screen between residences and the facility. Neither was it suitable to place the barrier on the slopes between the facility and property line. A barrier location directly adjacent to the facility could be achieved as long as access separations were maintained and drainage was not impeded. However, the large grade difference between the level of the facility and parts of the residential land required substantial additional barrier height. A location as shown in Figure 2 was finalized. The required height of the barrier was more than 13.5 m. This location would retain the trees as a visual screen to the barrier.

The concept and location then proceeded to detailed design. Extra civil and structural engineering were required because geotechnical information about the location of the barrier was unknown, and a barrier height of 13.5 m was higher than previous Durisol installations. The proposed location of the barrier was over soil that had been previously disturbed and had unknown properties. Neither the materials comprising the subsurface nor the level of compaction were known. This information was needed to determine the capability of the soil to support a tall barrier and the corresponding sub-surface depth of the posts and footing for the barrier. Geotechnical testing was therefore conducted. Properties of the subsurface materials at this location required footings of almost 5.5 m depth.

Together with the analysis for sub-surface support of the barrier, the work for structures above the surface needed to consider wind loading. Loading required additional strength of the structural members. Final design provided larger and additional beams on the lower portion of the barrier, as shown in Figure 3. The addition structure required was hidden from view of the residences by locating it only on the facility side of the barrier.



Figure 3: Facility side of noise barrier

#### 5 Verification

Effectiveness of the barrier was evaluated by measurements after construction. Direct comparison with the 45 dBA limit was not possible during the measurement period because the facility was unable to operate at full capacity. The sound level from the facility was therefore compared with modelling.

Sound level measurements were conducted at the location with highest modelled sound level based on actual operating conditions of the facility with the barrier in place. Measurements were conducted during nighttime hours when background sound from other human activity was minimized. Sound at the measurement location included some human activity and the sounds of nature. This non-facility sound was therefore measured at an acoustically equivalent location away from the facility. The two measurements were conducted immediately after each other so that the background sound would be as similar as possible. The net facility sound level of 35 dBA at the measurement location was below the modelled level of 41 dBA and indicates that the barrier performs acoustically at least as well as expected.

#### 6 Conclusion

In this case the buffer zone between a community power generation facility and adjacent residential land use was successfully replaced with a sound barrier that is taller than previously constructed by Durisol. Some of the associated challenges associated were overcome by geotechnical testing and maintaining a visual screen provided by an existing stand of mature trees. The barrier performed at least as well as expected.

Implementation of the barrier allowed the developer to achieve full utilization of the site, fulfilled the electricity generator's vision of being in the community rather than isolated from it, and allowed the municipality to maximize residential development.