Environmental management of two industrial sites in NSW using Pollution Reduction Programs

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ABSTRACT

Regulation of noise emissions from major industrial facilities in NSW comes under the control of the EPA. Pollution Reduction Programs (PRPs) are one method that has been used to manage noise emissions from sites developed many decades before any pollution control acts came into being. Since 2003, two of the authors have been providing the consulting services for two major industrial sites subject to PRPs – Port Kembla steelworks and Berrima Cement works. This paper describes the components of the PRPs, the methods used to respond to them and progress in their implementation. Monitoring methods required for the studies included identifying background sound levels for sites that operate 24-hours per day 365 days per year. Noise source data-bases and identifying control options for major plant items were also a part of the studies.

INTRODUCTION

The NSW Industrial Noise Policy (INP) was introduced in 2000. It provides a regulatory guidance framework for industrial noise sources. It has application to setting objectives for new developments, as well as for assessment of existing industry and it is existing industry to which this paper is directed. The INP document notes that its overall aim is to allow the need for industrial activity to be balanced with the desire for quiet in the community. Many people will be familiar with its requirements.

For the many industrial sites in operation at the time of the introduction of the policy, the Policy's recommended acceptable amenity sound levels in residential receiver areas provides an indication of what noise levels they are required to achieve. Depending on the age of the industrial plants and their relative location to residential receiver areas, the objectives could be well below existing sound levels. For many sites, if they had Environment Protection Licences (EPLs), they most likely did not include conditions for noise in residential receiver areas. This left the INPs amenity objectives as defacto noise limits in the eyes of the community they affected. While this situation can present problems for a plant not designed to achieve such objectives, most large industries regularly upgrade and modernise over the long term to remain competitive. These periods of upgrade can be used to progress towards lower noise emissions.

This paper describes how this policy has been used with two major and relatively large industrial sites which influence the sound levels in communities close to their boundaries. These are the BlueScope Steel Port Kembla Steelworks and the Boral Berrima Cement Plant. Both sites have been in operation since the 1920's and the communities which serve them were established close to their boundaries to provide convenient housing for their workforce.

Both sites were requested and agreed to a Pollution Reduction Program (PRP) on their EPL. The intention was to identify noise levels for residential receivers near their sites which could be used as the basis for site limit conditions on the site EPL. Hatch has been involved with both sites during the PRP process and provided the noise monitoring and analysis aspects for the operators.

Amongst other parts of the PRP was the requirement to establish background sound levels for the residential receiver areas and use these as the basis for the objectives. "Background sound levels" implies sound levels occurring without noise emission from the subject site. This had the potential to cause some difficulty in the assessment for both sites, as they were 24 hour continuous operations, and for the steelworks especially, the very large and multifaceted nature of the site meant that annual shutdowns did not occur.

This paper describes how the PRPs were progressed and the outcomes to date.

BLUESCOPE STEEL PORT KEMBLA STEELWORKS

The Port Kembla steelworks is the largest integrated steelmaking site in Australia and produces steel by an integrated process using blast furnaces, a sinter plant, coke ovens, basic oxygen steelmaking vessels and continuous casting to produce steel slabs. It then can process those slabs in a hot strip mill to produce hot rolled coil. The coil is processed in other BlueScope steel sites to produce coated steel sheeting for various markets. Production currently involves one blast furnace and approximately 2.5 mtpa of steel slabs are produced. Previously up to two blast furnaces and 5mtpa of finished steel slabs have been produced at the site.

The site was established in the 1920's to utilise the coal available from the nearby Southern Coalfields of NSW and the port facilities. Figure 1 shows a schematic layout of the plant and Figure 2 shows an aerial photograph. The site extends over an area approximately 4 km north to south and 3.8km west to east. It borders and sits on either side of major roads and a railway, as well as some fairly large and extensive residential areas surrounding the site on most of three sides. Some of these residential areas are close enough for the workers to walk short distances to work. There are other major industries and noise emitting activities in the area, including the port (coal export, vehicle imports, and general cargo), manufacturing and fabrication, and transport (road and rail).

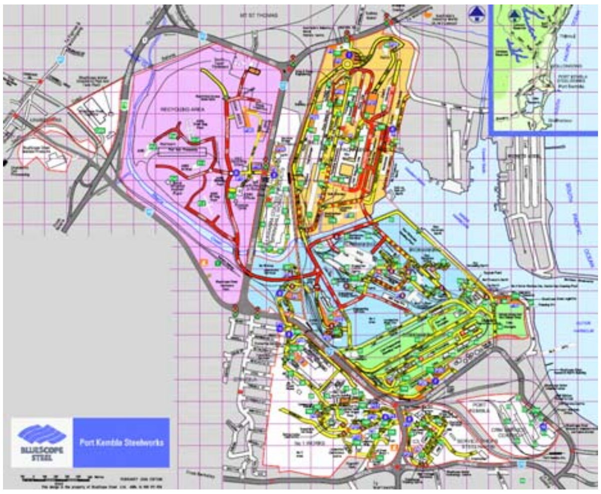

Figure 1. Schematic map of Port Kembla steelworks

Figure 2. Aerial view of Port Kembla steelworks area

Raw materials for the site include iron ore received by ship from the Pilbara, coal received by rail and road truck from the Illawarra coalfields, and limestone received by ship and rail. Raw, process and product material is moved around the site by special rail or road vehicles. Finished slabs are moved off-site by rail or ship.

Major sources of noise on the site include several very large fans of up to 7 MW (mechanical power), as well as many smaller fans, materials handling noise from conveyors, chutes and bins, impact noise sources from scrap handling and plate mill operations, gas discharges at various times from blast furnaces and coke ovens, and trucks and locomotives transporting material around the site. The PRP for the BlueScope steel site was requested in 2003.

BORAL BERRIMA CEMENT PLANT

The Berrima Cement plant was established in the 1920s in the Southern Highlands of NSW. The nearest major towns are Mossvale and the historic town of Berrima is nearby. A residential village known as New Berrima was established for the workers at the plant, on the northern side of the plant boundary. Other boundaries of the site are rural. Figure 3 shows an aerial view of the site and Figure 4 shows a schematic layout.

Figure 3. Aerial view of New Berrima and Boral Cement

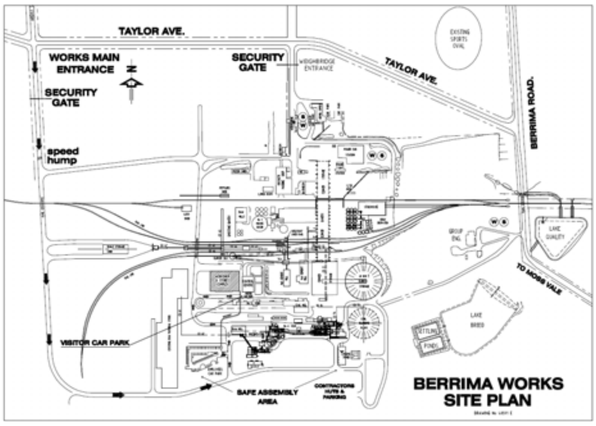

Figure 4. Schematic layout plan of Boral Cement Berrima

The Berrima Cement plant produces 1.3 mtpa of clinker and 1 mtpa of cement. Operations on site include raw limestone, shale and coal receival and storage, limestone and coal (grinding) mills, a shale crushing plant, raw-meal preheater tower, a rotating cement kiln, clinker storage, cement grinding mills and product storage and despatch. Raw materials are received by road and rail. Product is despatched by road and rail. A shale quarry is also a part of the site for raw material supply. Coal is supplied by truck from the nearby Berrima Colliery.

The main road separating the plant from New Berrima is also the main route between Mossvale and the Hume Highway for trucks delivering livestock to saleyards and other materials. So for this site there are sources other than those of the subject site causing noise immission to the residential receiver area. The site is approximately 1.3km east to west and 900m north to south.

Major sources of noise on site include grinding and crushing mills, large fans, materials handling plant (belt conveyors, chutes, bucket elevators, screw conveyors, pneumatic conveying), large compressors and locomotives and trucks moving material around the site.

Environmental noise monitoring (attended and unattended) has regularly occurred at two residential locations in New Berrima that are close to the boundary, one rural location and one boundary location. Other residential receiver locations have been monitored at other times also. In 2003, monitoring also occurred at two "background" locations as part of identifying objectives for an upgrade of the kiln. These were approximately 1.3km to the north-west and 2km to the south-east of the site – however they were not as exposed to traffic noise as are the boundary and other residences in New Berrima which are exposed to through traffic to the freeway.

The PRP for the Boral Berrima site was requested in 2011.

INDUSTRIAL NOISE POLICY AND PRP COMPONENTS

INP and existing premises

As noted in the INP, many existing industrial sources were designed for higher noise emission levels than the criteria outlined in this policy. In other cases industries may have been in existence before neighbouring noise sensitive developments and even before noise control legislation was introduced. The range of mitigation measures available for these sites may be either extremely limited or costly.

Section 10 of the INP deals with managing noise from existing premises. The approach is designed to allow established industries to adapt to changes in the noise expectations of the community while remaining economically viable.

The need to establish achievable noise limits and implement a noise reduction program may be triggered by actions such as:

• the site becomes the subject of serious and persistent noise complaints;

• a proposal to upgrade or expand the site;

• the site has no formal consent or licence conditions and management wish to clarify their position;

• management chooses to initiate a noise reduction program.

The intention of this approach in the INP is to provide a formal structured program to reduce high existing noise levels to acceptable levels over time by applying feasible and reasonable control measures. Its intent is to establish certainty through an agreed process to achieve noise reduction, while providing flexibility in the choice of noise reduction measures.

Environmental noise objectives

The approach taken in the INP to setting noise objectives has a two part approach. The first is recommended ***Amenity*** sound levels for different types of receiver areas at different times of the day. These are given in Table 2.1 of the INP. The second part of the setting of noise objectives is the Intrusive objective, based on the median 10% L_{A90} (existing background sound level) + 5 dB. The lowest of these is selected as the noise objective for a new development. There are also modifying factors for noise from existing industry and traffic noise to be included. The identified objective sound level becomes the Project Specific Noise Level (PSNL).

Environmental noise background monitoring

For existing major industrial sites, the difficult part is identifying the background sound level, and then having an objective which assumes the site was being built new.

The PRP for the both sites required the measurement of the existing background sound level, as if the industry was not present; then calculating the objectives as if this was a new development.

Port Kembla steelworks monitoring

For the Port Kembla steelworks, obtaining a background sound level was difficult. Monitoring of boundary sound levels had been occurring since the early 1990's. Studies had shown that the ambient sound levels in residential receiver locations were dependent on the wind direction. If the wind was from the west around to the south, sound levels were 10 dB higher in the receiver areas north of the site than if they were from the north around to the east. As might be expected, the opposite occurred for the receivers on the southern side of the plant. Being such an extensive site with large 24-hour continuous operation meant that finding periods when major parts of the plant were shut-down was impossible. Also, as the site was a major employer in the area, associated road traffic was a major aspect of receiver noise. If there was a period when operations were at a low level because of holidays or similar, all other businesses would also be at low levels for the same reasons and road traffic noise would be low.

The INP allows a representative background to be measured at similar representative sites exposed to similar sources but not the subject industry, if 24-hour operations occur. Finding such sites within the areas close to the steelworks was not possible. Road rail traffic were significant sources in the area – major roads through and around the site and between the site and residential areas carrying 10,000 to 36,000 vehicles per day, a highway with 23,000 vehicles per day along one side and a freeway with 55,000 vehicles per day along one side. The railway feeding the Port Kembla Coal Terminal on the northern boundary of the site delivered about 8 mtpa. All contributed to general noise received by residents.

Six residential receiver monitoring locations were identified in near boundary areas on the southern, south-western, western and northern sides of the plant. These had been used in similar studies in 1991 and were kept to provide a comparison with those previous results. EPA noise branch officers viewed the sites and agreed with their locations. As well as these sites, two "background" sites were selected which were approximately 8 km to the north and 9 km to the south of the site and exposed to some noise from major roads, but none from the steelworks. Traffic flows near these background locations were less than around the steelworks and there were rail sources near the northern site only. Monitoring was undertaken as attended and unattended measurements at all 9 sites over two week periods in winter and summer in 2005.

Outcomes of the monitoring identified that background sound levels could be considered as periods when the winds were in the direction from the receivers to the source site. While not true background, as the site was still operating, the directional effects of the wind on receiver sound levels provided sufficient data to allow this assessment to be made, and this was agreed by the regulator. Figure 5 shows a 'typical' monitoring result graph for a boundary residence. Figure 6 shows a result graph for the northern background residence for the same period. Both graphs show $L_{Aeq.15\text{-}min}$, $L_{Aeq.period}$, $L_{A90.15\text{-}min}$, 10% $L_{A90.period}$ and wind speed. All data is typical only and modified from real values.

Typical boundary $L_{Aeq.period}$ are 55 to 60 dBA daytime and 45 at night, with $L_{A90.15\text{-}min}$ varying from 35 to over 50 dBA, depending on time of day and wind direction. This location is an area immediately outside a boundary fence to a relatively low operational area of the plant at 250m, but exposed to the main steelmaking and other noise source areas at a distance of approximately 1.2 km.

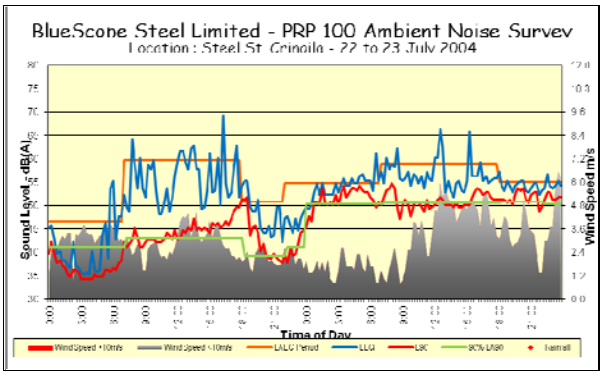

Figure 5. Result graph of Port Kembla boundary area

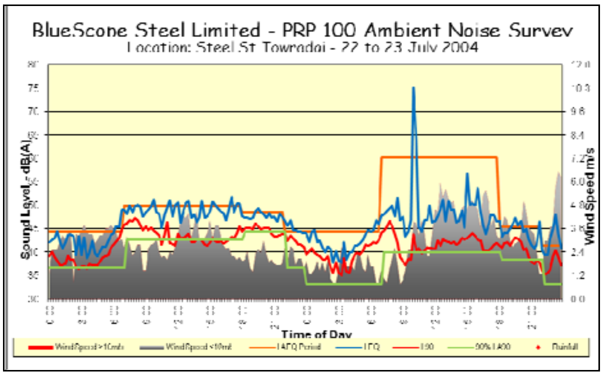

Figure 6. Result graph of Port Kembla background area

The background site results in Figure 6 show $L_{Aeq.period}$ are around 50 dBA in daytime and 40 dBA at night. $L_{A90.15\text{-}min}$ varies from 35 dBA at night to 45 dBA in daytime.

Berrima Cement monitoring

For the Berrima site, monitoring had been occurring at regular intervals since 2003, associated with development projects. These had identified similar wind direction effects to those at Port Kembla – southerly winds caused increased sound levels at residences to the north of the site, if the wind was northerly the plant was barely discernible from those locations. Plant operation is continuous but there are periods when the kiln shuts down for major maintenance at roughly annual intervals, and these can occur for one to two weeks. At those times, raw materials and processing sources are also idle, but clinker cement stockpiles can still be processed in the cement grinding mills.

Road traffic noise is a major source for the closest residents to the Cement plant in new Berrima, with the main road between the plant and the residences carrying 3000 vehicles per day. The Hume Highway is 2km from the village and carries 25,000 vehicles per day so there is an influence from it during periods with westerly winds.

Monitoring (attended and unattended) has regularly occurred at two residential locations in New Berrima that are close to the boundary, one rural location and one boundary location. During a two week shutdown of the kiln in mid-2011, another similar monitoring exercise was undertaken (for a four week period) at three New Berrima residences, one rural residence and several boundary locations. During this period, there were times when the whole plant was idle. This allowed measurement of background sound levels from the site. Figures 7 and 8 compare monitoring results at a boundary residence for periods with no plant operations and with full plant operations. Figure 9 shows a result graph for a site boundary fence during full operations.

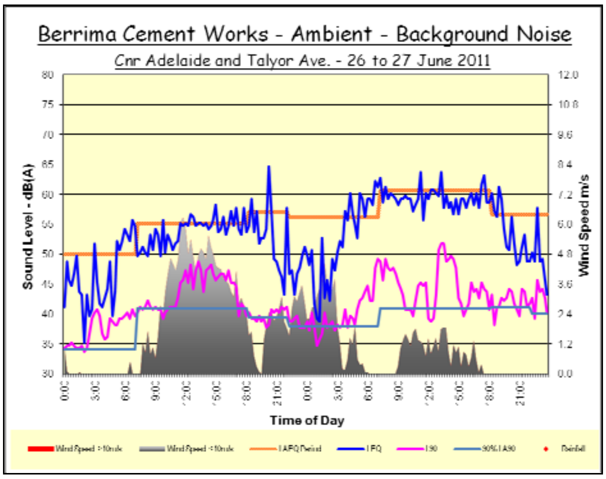

Figure 7. Result graph of Berrima Cement boundary residence during total plant shutdown

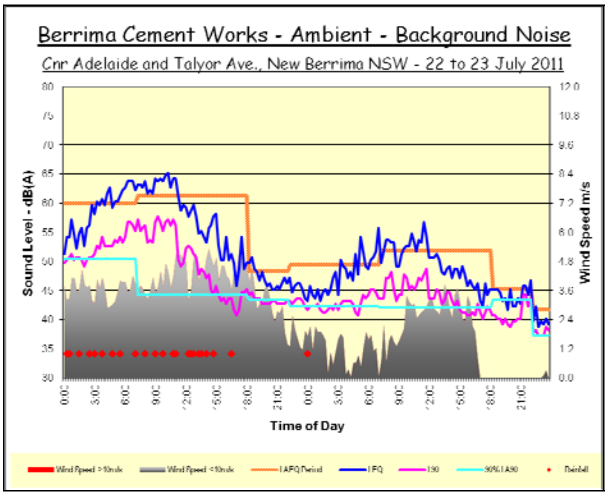

Figure 8. Result graph of Berrima Cement boundary residence during total plant operating

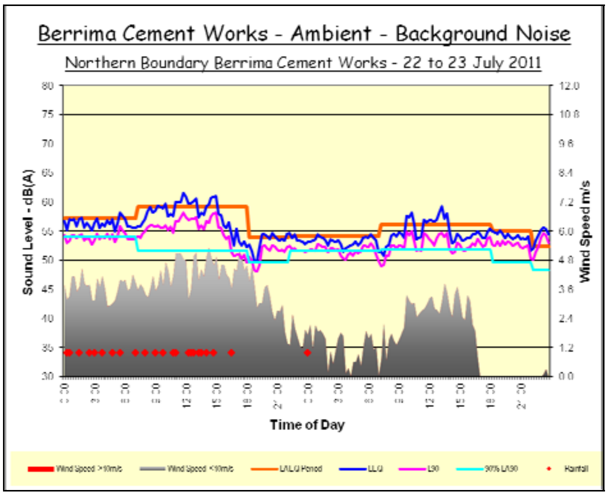

Figure 9. Result graph of Berrima Cement boundary fence during total plant operating

Comparing the results shows the influence of road traffic noise on receiver sound levels – $L_{Aeq.15\text{-}min}$ can be 55 to 60 dBA in daytime and 45 to 50 dBA at night, whether the plant is operating or not. Site boundary sound levels shown in Figure 9 are also influenced to some extent by passing traffic noise in daytime

From these monitoring exercises at both industrial sites, identification of background sound levels were made on a reasonably statistical basis, and from these the noise objectives could be determined according to the requirements of the INP.

Noise source identification and database

A second part of the PRP process is to identify noise sources at the site. This might take the form of a noise source database with information on the characteristics of each source and management of it so that when sources are changed, the data can be included.

Due to complexity of the data and the number of noise sources, the Microsoft MSACESS platform was used for this task. The main objective was the ability to display a one third octave spectrum and narrow band sprectra to a specific noise source on the steelworks site. Figure 10 indicates how a user would locate a specific noise source using the database form. (In this case the example noise source has since been upgraded)

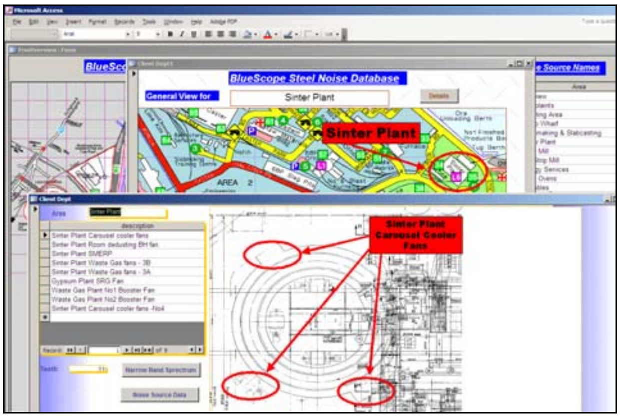

Figure 10. An image of the database form for a user to locate a specific noise source in the plant

The user would then view the the specific spectrum as indicated in Figure 11 below.

The functionality of the database to store narrow band spectrum is also available. The use of narrow band analysis is also helpful to identify noise sources at receiver locations. It is like storing a "finger print" of that noise source on file. An example is shown in Figure 13.

Figure 11. A display of the one-third sprectrum for a source with relavent notes of the measurement.

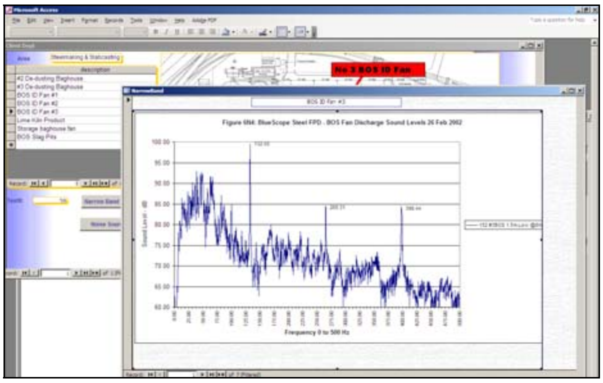

Figure 13. Image of the Narrow Band form in the database of a replaced piece of equipment

Identification of improvements

A final part of the PRP can include identification of improvements or methods for reductions in noise emissions for sources which are causing sound levels at receivers to exceed the noise objectives identified in the monitoring activity. This can be relatively straightforward for small sites, but for larger sites such as the subjects of this paper, it is not so easy. With dozens of sources spread across large areas of industrial plant, significant reductions in received sound levels could require significant reductions to most of them – such an approach could have very high costs.

The approach taken by BlueScope Steel has been to include noise emission reductions as part of improvements occurring as major plant is upgraded or modified, and to apply a noise specification to all new plant such that the contribution is less than 35 dBA at any boundary location. This has been a self-imposed objective by the BlueScope Steel site and is well below the contribution objectives identified as part of the PRP. This means that improvements may take some time to achieve, as it occurs within the typical life-cycle of plant items.

When major plant items often have life expectancies of several decades, ensuring improvements include noise control engineering is an essential part of the process. Upgrading or installing new plant and equipment that may require acoustical engineering is achieved through consultation with regulatory authorities such as the Environment Protection Authority (EPA) and Department of Planning (DoP). This consultation and approval process results in an agreed set of plant/equipment site specific contribution noise levels (PSNLs) that are to be achieved in residential receiver areas.

PSNLs are then incorporated as operational noise and monitoring requirements in the project development consent and or EPL licence conditions.

Boral Cement has taken a similar approach. As new cement mills or kiln upgrades have occurred, their component noise objectives have been to ensure their receiver contribution levels are below those identified during the PRP. Treatment of existing high-ranking noise sources to reduce their noise emission is also tied to upgrades where possible. For smaller plant items, such as dust collectors and fans, improvements might be included as part of annual maintenance budgets.

IMPLICATIONS OF PSNLS IN LICENCES

For both sites, the long-term intention of the EPA is to include the PSNLs identified through the PRP process to be noise limits at residential locations for emissions from the whole plant. A perceived problem is that the neighbouring residents will expect these limits to be those for total sound levels measured at their place, rather than the contribution from the plant only. As the former employees of the sites move out and those from or seeking non-industrial area exposure arrive to take their place, they will likely be expecting lower sound levels. In the case of each plant described, PSNLs developed from the monitoring data were typically 10 dB lower than existing ambient sound levels, mainly caused by traffic noise.

As monitoring results and licence conditions become publicly available on the internet, communities will potentially be seeking advice from authorities about why measured sound levels exceed licence conditions, when the contribution levels may or may not be being achieved.

The second aspect of setting a licence condition is when it will begin to apply. Large manufacturing and processing entities such as both of these discussed have plant which lasts for periods of 30 or more years, with various levels of upgrades occurring to either parts or whole of major components perhaps every 10 years. As noted earlier, such upgrades provide the best opportunities for improvements to reduce noise emissions while maintaining process and production improvements. Providing noise controls to significant plant items without associated process upgrades could cost several million dollars and not achieve process improvements to offset them. For such large plants, treatment of most of the sources will be required to achieve any reduction in emissions.

Where the residences are also affected by noise from transport sources, there may not be any reduction in the long-term statistical period sound levels observed after improvements are made to the plant. As seen in the monitoring results for Berrima Cement, daytime L_{Aeq} levels were no different with the plant on or off.

The situation is different when it comes to specific sources which have tonal, impulsive or varying level characteristics. If these are identified as significant sources at receiver locations, then even though source reduction may not change the total sound levels, it may significantly improve the amenity of the received sound characteristics. In such cases, feasible and reasonable options for control of emissions can be sought as part of a planned process. Programs for treatment of specific sources can then be given a high priority for action in shorter plant planning horizons of say 5 years or less, depending on the significance of the source and its history of occurrence. Such cases have occurred at both subject sites with tonal emissions from large fans, where improved silencers have been installed. This type of approach to control of significant noise emissions has been the case for most of the past thirty years and is considered to remain relevant and the most effective one for both communities and plants.

CONCLUSIONS

The NSW INP provides a method for its application to existing industrial sources of noise. The approach is virtually the same as that for new developments – a background sound level without contributions from the plant is required to be assessed to develop noise objectives. However, for large sites with continuous process operations, this is difficult to schedule and identification of suitable alternative sites has been found to be problematical. This is especially the case with larger sites adjacent to major transport routes, as identified in this paper.

Long-term monitoring of receiver immissions has provided opportunities to identify differences in receiver levels with different wind directions and seasons, and these have provided data that can be used to represent ‘background’ periods. When plants are small enough to have total shut-downs while other surrounding activities and transport continue, opportunities should be taken to measure the receiver sound levels. Such measurements can help identify plant contributions during operational periods.

The use of PSNLs identified from background levels in the types of cases described has problems of perception in receiver communities – they expect PSNLs to represent total sound levels, whereas the plant operators, as emitters, and authorities see them as contribution levels.

Timing of introduction of licence conditions for existing plant based on PSNLs needs to consider the plant life-cycle process, which occurs over decades for major process and production plants. Simply applying a PSNL as a licence condition for a plant and activity and surrounding community that has been in place for almost a century will likely lead to non-compliance if an adequate time for implementation of emission controls within the project plant lifecycle is not considered.

The most effective method of regulation and control of noise emissions from existing plant is not unusual and has been in place for many years. Significant sources causing annoying noise in receiving communities need to be identified, feasible and reasonable control options identified and programs for implementation developed for those annoying characteristics. Reductions in long-term statistical sound levels may not occur because of influences from other sources, but the character of received noise can be improved such that communities have improved noise amenity. This is recommended to be the preferred approach to management of noise from existing major industrial sites.

REFERENCES

Environment Protection Authority NSW “Industrial Noise Policy” 2000.

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