Project

Mondelez Bournville
Noise Impact Assessment

Prepared for

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P1	06/12/2021	-	Chris Wright BA(Hons), MIOA
P2	14/01/2022	Noise contours at heights of 10m and 15m included	Chris Wright BA(Hons), MIOA
P3	15/02/2022	Included data for additional items of equipment following site visit	Chris Wright BA(Hons), MIOA
P4	08/07/2022	Updated following comments from PESL Consulting	Chris Wright BA(Hons), MIOA
P5	27/07/2022	Updated following comments from PESL Consulting	Chris Wright BA(Hons), MIOA

Summary

SRL has been appointed by Mondelez UK to assess the impact of operational noise from their Bournville site in order to support their environmental permit variation application.

SRL has assessed the impact using background noise levels and source noise levels measured by us off and on site. We have used data collected from our surveys to construct a detailed 3D noise propagation model of the site to predict the cumulative levels of operational noise at the nearest noise sensitive receptors in accordance with the method of calculation set out in ISO 9613-2:1996. The noise model includes all new noise sources (such as chiller plant) covered by the scope of the permit variation application, as well as pre-existing noise sources associated with the site.

The predicted operational noise levels have been used to assess the noise impact using BS 4142:2014+A1:2019 and BS 8233:2014 as guidance where appropriate.

The assessment shows that noise from the site during the day is expected to be low impact.

The assessment shows that noise from the site has the potential to cause adverse impact at night, and therefore I have recommended mitigation methods using the best available techniques (BAT), notably:

- Reducing noise from the ammonia chillers. (I understand plans have already been put in place for this)
- Upgrading or adding in-duct attenuators / acoustic louvres or noise barriers to the AHUs located below the ammonia chillers. (I understand plans have already been put in place for this)
- Attenuating the sugar extract fans. (I understand mitigation works have already been completed to one fan since our visit to site, with plans for noise mitigation to the remaining fans to be provided in due course)
- Reschedule sugar deliveries to after 07:00 if possible (and no later than 23:00) or explore alternative methods of reducing noise. Methods to be developed based on practicability and effectiveness.

Contents

1.0 Introduction

The Bournville site (the site) is a large historic factory owned by Mondelez UK and is renowned for producing chocolate in the model village of Bournville outside Birmingham (B30 2LU). The approximate extent of the site covered by permit application is outlined red in Figure 1.

Figure 1 - Cadbury Bournville site boundary covered by permit application

The vast majority of dwellings in the village of Bournville have existed since the late 19th century since founded by the Cadbury family for factory employees. The site is surrounded on all sides by these dwellings, and as such the site is not only visually dominant in the village it also contributes to the long-standing noise climate around the immediate area.

The site operates 24 hours a day, 7 days per week and 365 days per year. Typically the noise climate in the surrounding areas is dominated by noise from plant associated with the operations relating to chocolate production.

SRL has been appointed by Mondelez to complete a noise impact assessment of the operations, taking account of the most significant sources of noise associated with the operation of the site. This impact assessment is prepared in order to support the application to vary the Bournville environmental permit, and includes all new noise sources (i.e. chiller plant) covered by the scope of this variation application.

There has been a history of complaints from nearby residents regarding noise from the site. SRL has recently worked with Mondelez to address some of these complaints from resident(s) to the west of the site on Linden Road.

Please note that Note 2 of BS 4142 states: "*Adverse impacts may include but not be limited to annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.*"

2.0 Assessment Guidance

Environmental permits have conditions that require operators to control noise pollution. The Environment Agency has produced guidance on how to apply for, vary and comply with these permits.

This new guidance supersedes the Environment Agency's Horizontal Guidance for Noise (H3) parts 1 and 2, and SEPA's Guidance on the control of noise at PPC installations.

2.1 The four steps

The Environment Agency advises that noise is assessed in four steps:

- **Step 1 - Desktop risk assessment**. The risk assessment determines whether a noise impact assessment is required. As noise from this site is audible at the receptors, a noise impact assessment is being completed.
- **Step 2 - Off-site noise monitoring**. When assessing the noise impact of the site overall, the background noise survey should exclude existing noise from the site. As the factory (and plant) operates 24/7, we have achieved this using surrogate positions that best represent the background noise at the receptors without noise contribution from the site.
- **Step 3 - Source assessment**. The Environment Agency require noise impact from the site to be assessed using the methodology in BS 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound*' (BS 4142). The Environment Agency state how the level of noise is to be assessed.
  - 'Unacceptable level of audible or detectable noise'. This level of noise means that significant pollution is being, or is likely to be, caused at a receptor (regardless of whether you are taking appropriate measures).
    You must take further action or you may have to reduce or stop operations. The environment agencies will not issue a permit if you are likely to be operating at this level.
    The closest corresponding BS 4142 descriptor is "significant adverse impact" (following consideration of the context).
  - 'Audible or detectable noise'. This level of noise means that noise pollution is being (or is likely to be) caused at a receptor.
    Your duty is to use appropriate measures to prevent or, where that is not practicable, minimise noise. You are not in breach if you are using appropriate measures. But you will need to rigorously demonstrate that you are using appropriate measures.
    The closest corresponding BS 4142 descriptor is "adverse impact" (following consideration of the context).
  - 'No noise, or barely audible or detectable noise'. This level of noise means that no action is needed beyond basic appropriate measures or BAT.
    The closest corresponding BS 4142 descriptor is "low impact or no impact"' (following consideration of context).

  Step 4 – BAT or appropriate measures justification. The findings in steps 1 to 3 must be justified and controlled using best available techniques to minimise noise pollution.

2.2 BS 4142: 2014+A1:2019 Methods for rating and assessing industrial and commercial sound

BS 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound*' provides a method to assess whether *"sound of an industrial and/or commercial nature"* is likely to have an adverse impact at noise sensitive receptors.

BS 4142's assessment methodology considers how loud the noise is and its character (e.g. whether it contains hisses, bangs or clicks). The assessment is then based on how loud (and how annoying) the source noise is compared with the existing background noise at the receptor.

The following corrections can potentially be applied for the acoustic character:

Tonality – a correction of up to +6 dB can be applied depending on how tonal the specific noise is:

- +2 dB for a tone which is just perceptible at the receptor
- +4 dB for a tone which is clearly perceptible at the receptor, and
- +6 dB for a tone which is highly perceptible at the receptor

Impulsivity – a correction of up to +9 dB can be applied if the noise is impulsive:

- +3 dB for impulsivity which is just perceptible at the receptor
- +6 dB for impulsivity which is clearly perceptible at the receptor, and
- +9 dB for impulsivity which is highly perceptible at the receptor

If the source is both tonal and impulsive it is usual to only apply the correction for the characteristic which is most dominant.

Intermittency – when the noise source has identifiable on/off conditions (e.g. an item of plant which switches on and off), and these on/off conditions are readily distinguishable against the residual acoustic environment, a correction of up to +3 dB can be applied.

Other sound characteristics – where the noise source is not tonal or impulsive but has another characteristic that is readily distinguishable against the residual acoustic environment, a correction of up to +3 dB can be applied.

The rating level is determined by applying these corrections to the specific level. The rating level can then be compared with the measured background level. The difference between the rating level and the typical background level can then be interpreted using the following guidance from BS 4142, depending on the context:

- If the Rating Level is +10 dB or more above the background level, this indicates a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

2.3 BS 8233:2014 Guidance on sound insulation and noise reduction for buildings

BS 4142 specifically states that it is not intended to be applied to the assessment of indoor sound levels. Situations where this would be applicable include assessing noise at night where primary concern is the potential for disturbance of residents who could be sleeping with open windows.

For situations like this BS 4142 states that "*other guidance, such as BS 8233, might also be applicable in this instance*".

BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* gives for suitable guidance on indoor ambient noise levels for bedrooms and living rooms. I have summarised these guidelines in Table 1.

Table 1 - Guideline indoor noise levels for dwellings from BS 8233:2014

Location	Daytime 07:00 to 23:00 hours	Night-time 23:00 to 07:00 hours
Living Rooms	35 dB $L_{Aeq,\ 16\ hour}$	-
Bedrooms	35 dB $L_{Aeq,\ 16\ hour}$	30 dB $L_{Aeq,\ 8\ hour}$

3.0 Survey

3.1 Background noise survey

SRL completed a background noise survey in November 2021 to establish the typical background L_{A90} noise levels at the nearby noise sensitive receptors. As the site does not 'shut down', and operates 24 hours a day, the survey was completed using surrogate positions which are deemed to be representative of the nearest noise sensitive 'receptors' (i.e., the surrounding dwellings) taking advantage of distance attenuation and shielding provided by residential buildings. The entire survey was completed using attended measurements to achieve noise levels with minimum contribution from the factory and to provide subjective context to the recorded data.

Figure 2 shows the nearest noise sensitive receptors surrounding the site, marked A to H. The surrogate measurement positions are marked 1 to 7. A description of the locations is shown in Table 2.

The ground type between the site and the receptors is a mixture of hard and soft ground. The area to the south-west is a large recreation green, the area to the south-east of the site is industrial.

Figure 2 - Receptor and measurement locations

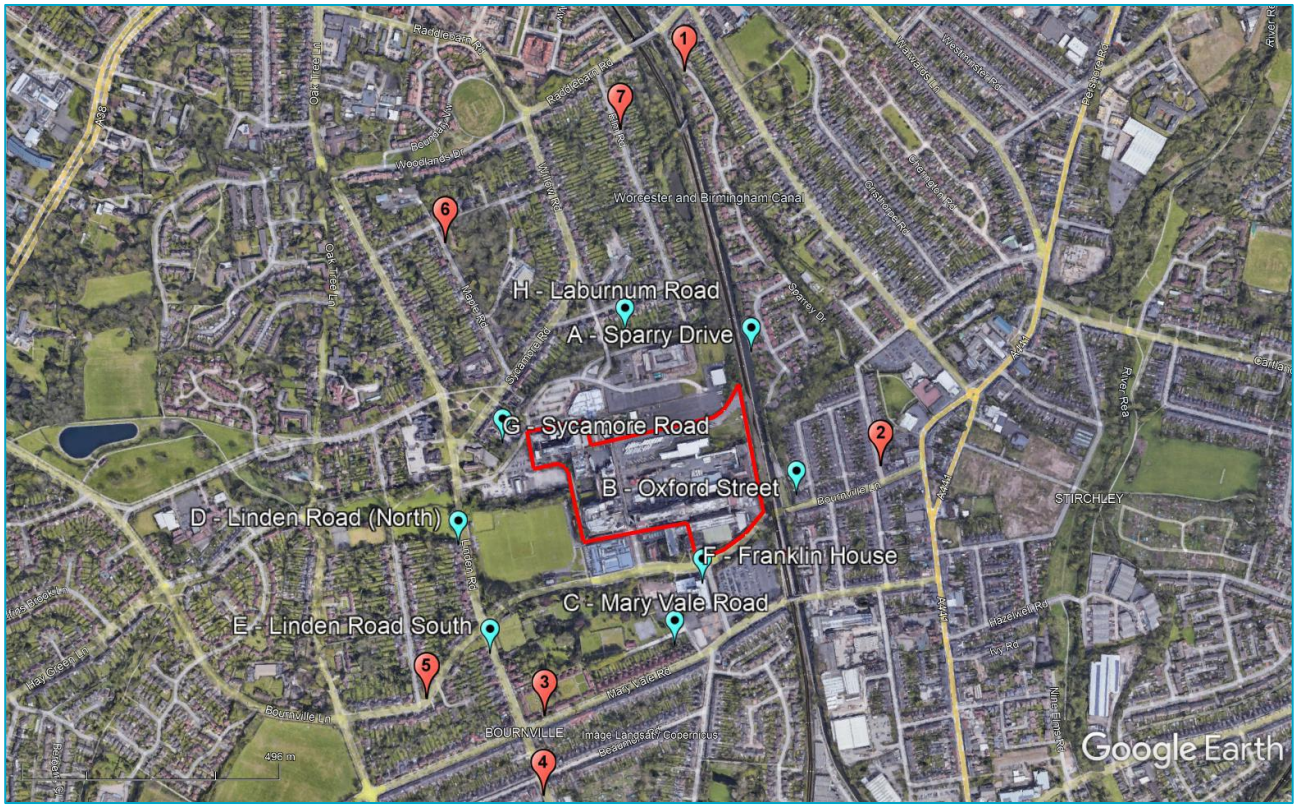


Table 2 - Position and measurement justification

Receptor	Representative Measurement Position	Explanation of Measurement Position
Sparry Drive	Pos. 1	Laterally equidistant from the site and train line
Oxford Street	Pos. 2	Equidistant from Bournville Lane to the south
Mary Vale Road	Pos. 3	Shielding provided by buildings, on Mary Vale Road
Linden Road (north)	Pos. 4	Equidistant from the next dominant source of noise (Linden Road)
Linden Road (South)		
Franklin House	Pos. 5	Equidistant from the next dominant source of noise (Bournville Lane)
Sycamore Road	Pos. 6	North of the site. Factory noise minimised through distance attenuation and localised screening
Laburnum Road	Pos. 7	

Generally, the noise around the site at each of the measurement locations is consistent, therefore measurements with a 5-minute duration were considered representative, and as previously mentioned they were fully attended to minimise any uncertainty. All measurements were at least 1.5m from floor level, and in free field conditions.

To capture the lowest noise levels the daytime measurements were completed between 10:00am to 13:15pm to avoid rush hour traffic noise, and night-time measurements were completed in the first half of the night between 00:00am and 02:45am to avoid noise from fauna (the morning chorus) and the increasing levels of road traffic in the second half of the night. This resulted in forty-two separate measurements covering the day and night periods.

I have summarised the measured noise levels in Table 3. To reduce uncertainty, I have reported the lowest L_{A90} background level at each receptor. For reference and comparison, I have included the logarithmically averaged ambient $L_{Aeq,15min}$ noise level for each receptor.

The receiver locations for all receptors with the exception of Franklin House have been assessed at a height of 4.5m from floor level which is representative of bedroom windows The receptor for Franklin House has been assessed at a height of 22 m from floor level representing the worse affected windows of the flats overlooking the site.

Table 3 - Summary of noise levels

Position In Figure 2	Receptor Name	Minimum Background Noise Level dB $L_{A90,5min}$		Average Ambient Noise Level dB $L_{Aeq,15min}$	
		Day	Night	Day	Night
Pos. 1	Sparry Drive	44	35	57	52
Pos. 2	Oxford Street	42	34	59	50
Pos. 3	Mary Vale Road	52	33	63	59
Pos. 4	Linden Road (north)	62	31	75	67
Pos. 4	Linden Road (South)	62	31	75	67
Pos. 5	Franklin House	45	31	64	52
Pos. 6	Sycamore Road	42	31	53	39
Pos. 7	Laburnum Road	41	31	49	44

It should be noted that the measurements are considered to be representative of the background noise at the receptors without any contribution from the factory. Due to the long-standing nature of the factory these it's unlikely that the receptors have experienced background noise measurements as low as the levels reported above for several decades and therefore these levels provide an absolute worst-case scenario for our assessment.

3.2 Source noise survey

Mondelez UK has provided a list of the dominant noise sources at the site. These sources include a mixture of fixed mechanical services such as chillers and air handling units, and goods deliveries such as sugar and palm oil.

SRL returned to site on the 24th November 2021 and 3rd February 2022 to measure these dominant sources of noise at their origin and take additional measurements of other noise sources observed during the visit. We used data for the southern Chocolate Block chiller measured by us during a visit to site on 9th July 2021.

All new chiller plant covered by the scope of the permit variation application were included (suitable surrogate data was used where applicable for the O Block chillers and the Sugar Delivery at the Eastern area of the site – see Section C2 in Appendix C). A full list of our measurements is found in Appendix B.

4.0 Assessment

4.1 Modelling

I have built a 3D noise propagation model of the site using proprietary 3D noise modelling software, CadnaA by Datakustik. CadnaA uses the calculation methodology set out in ISO 9613: "*Acoustics – attenuation of sound during propagation outdoors*" to calculate noise propagation. The model has been built and calibrated using the data and information collected from our survey. The model includes topographical data to account for differences in ground level, uses octave band data for all noise sources, and considers reflections caused by existing dwellings and surfaces.

A list of the sources and sound power levels used in the model is included in Appendix C.

The vast majority of noise at the site is from fixed mechanical services plant that continually operate through the day and night, therefore no on-time corrections have been applied. In regard to deliveries the model assumes a worst-case scenario of all deliveries (sugar, palm oil, and crumb) occurring at the same time.

A screenshot from the noise model is seen in Figure 3, and the predicted noise levels produced by the site can be seen as contours at a height of 4.5m in Figure 4, a height of 10m in Figure 5, and a height of 15m in Figure 6.

Figure 3 - Noise model

Figure 4 - CadnaA noise model, specific noise levels, dB $L_{Aeq,T}$, contours at 4.5m above floor level

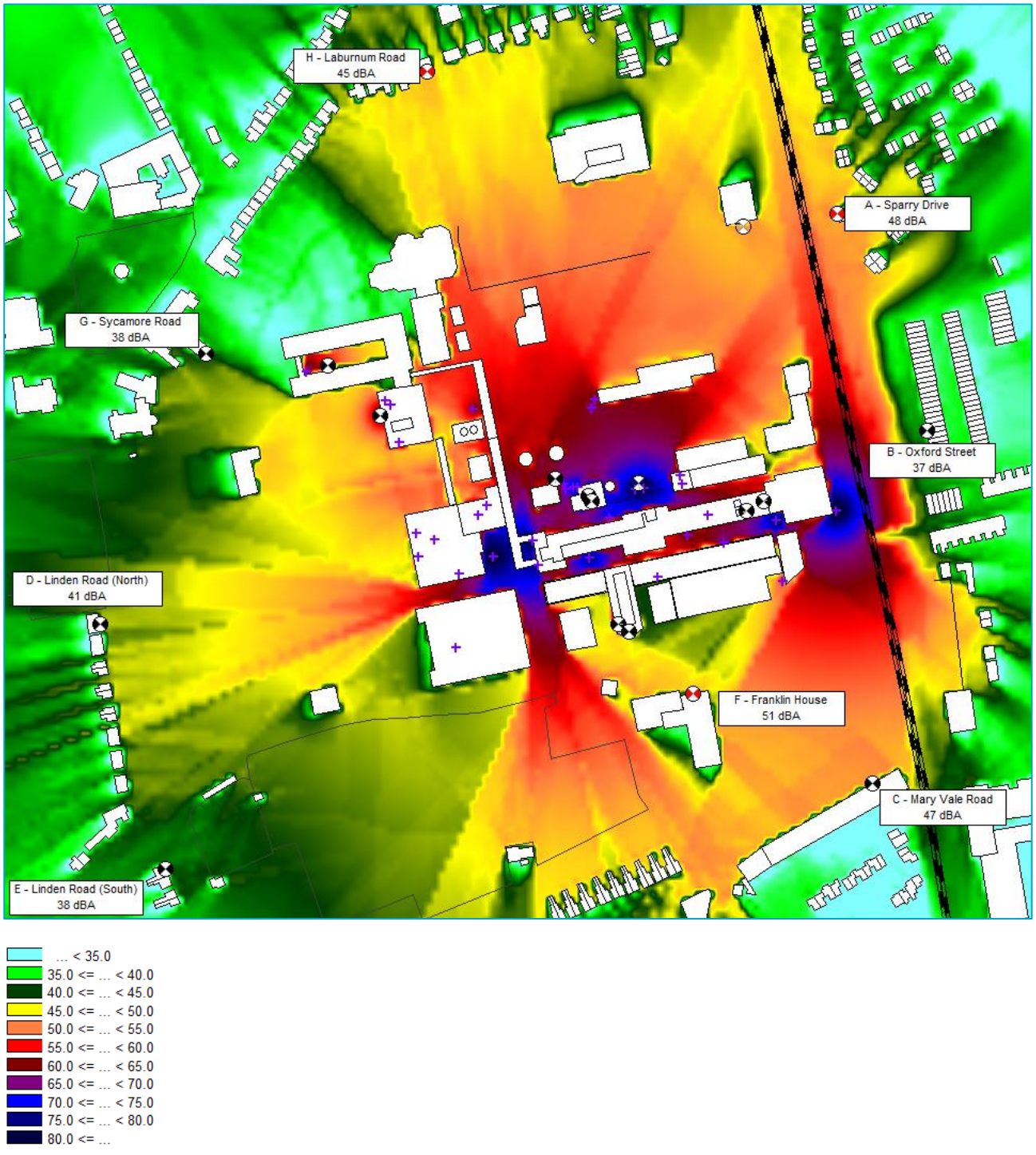


Figure 5 - CadnaA noise model, specific noise levels, dB $L_{Aeq,T}$, contours at 10m above floor level

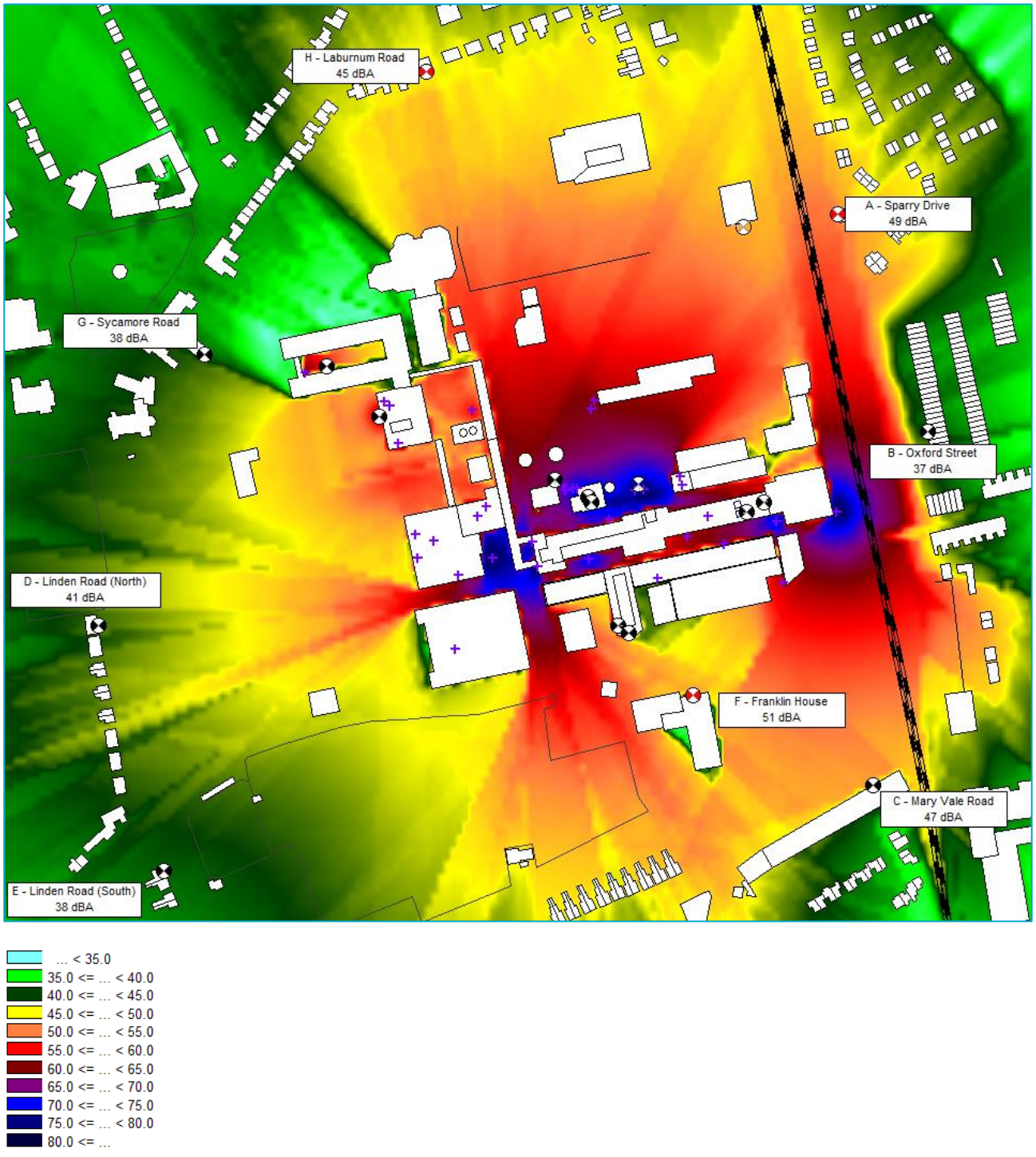
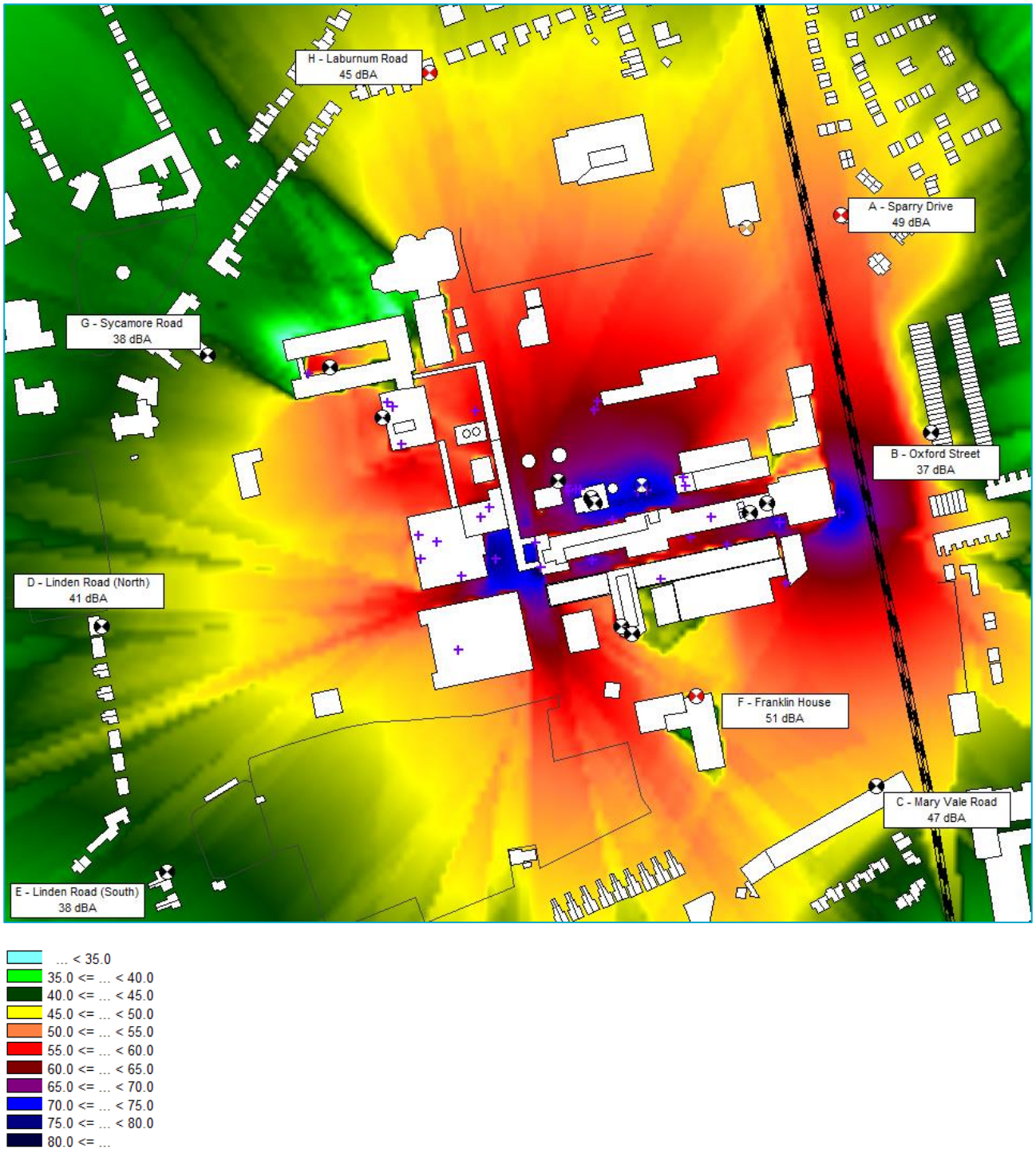


Figure 6 - CadnaA noise model, specific noise levels, dB $L_{Aeq,T}$, contours at 15m above floor level



5.0 Noise Impact Assessment

The noise model calculates the specific noise levels at each of the receptors. This is the noise level not including any additional BS 4142 character corrections.

For the purpose of the assessment, I have included an additional +3 dBA correction for 'other sound characteristics' in line with BS 4142 for all noise sources in the model. The reason for this is because intermittency or tonal elements are not perceivable at the receptors due to the large quantity of simultaneously operating plant as the site. As the dominant sources of noise are continuously running plant (e.g. chillers and air handling units), impulsivity is not generally expected. The +3 dBA character correction represents a worst-case scenario as much of the equipment within the site is at least 10 dBA below the background level, and is therefore inaudible at the receptors (and therefore does not require a character correction).

This data below includes noise from all items of equipment operating at once, with simultaneous sugar and crumb deliveries.

5.1 Daytime Assessment (07:00 to 23:00)

Table 4 shows the BS 4142 assessment for each receptor during the daytime based on the results of the noise model.

Table 4 - BS 4142 assessment (daytime)

Receptor	A - Sparry Drive	B - Oxford Street	C - Mary Vale Road	D - Linden Road (North)	E - Linden Road (South)	F - Franklin House	G - Sycamore Road	H - Laburnum Road
Specific Noise levels dB $L_{Aeq,T}$	48	37	47	42	38	51	38	45
BS 4142 character correction	+3 dB for 'other sound characteristics'							
Noise rating level dB $L_{Ar,Tr}$	51	40	50	45	41	54	41	48
Background level dB L_{A90}	44	42	52	62	62	45	42	41
Difference (dBA)	+7	-2	-2	-17	-21	+9	-1	+7

The assessment shows that the rating level is not expected to exceed the background noise levels at the majority of receptors. The exception is Sparry Drive, Franklin House, and Laburnum Road where it exceeds the background noise levels, but not more than 10 dBA. Noise from the site is expected to be audible, but the receptors are unlikely to experience a significant adverse impact, during the daytime.

5.2 Night-time Assessment (23:00 to 07:00)

Table 5 shows the BS 4142 assessment for each receptor during the night-time based on the results of the noise model.

As with the daytime assessment this includes noise from all items of plant measured. I understand the sugar and crumb deliveries can occur at 05:30hrs, therefore I have included these noise levels in the assessment

Table 5 - BS 4142 assessment (night-time) - during sugar delivery

Receptor	A - Sparry Drive	B - Oxford Street	C - Mary Vale Road	D - Linden Road (North)	E - Linden Road (South)	F - Franklin House	G - Sycamore Road	H - Laburnum Road
Specific Noise levels dB $L_{Aeq,T}$	48	37	47	42	38	51	38	45
BS 4142 character correction	+3 dB for 'other characteristics'							
Noise rating level dB $L_{Ar,Tr}$	51	40	50	45	41	54	41	48
Background level dB L_{A90}	35	34	33	31	31	31	31	31
Difference (dBA)	+16	+6	+17	+14	+10	+23	+10	+17

The assessment shows that the rating level is expected to exceed the background noise levels at all of the receptors.

Noise rating levels at Oxford Street and Sycamore Road exceed the background noise by no more than 10 dBA. Noise from the site at these receptors is expected to cause an adverse impact depending on context. Noise levels at Sparry Drive, Mary Vale Road, Linden Road, Franklin House, and Laburnum Road all exceed the background noise by 10 dBA, indicating a possibility of a significant adverse impact depending on context.

Close inspection of the calculated noise levels within the model show that the higher exceedances at Mary Vale Road, Linden Road and Franklin House are dominated by the sugar deliveries. I understand that these deliveries start ~05:30hrs. If sugar deliveries do not take place within the night time period (23:00 to 07:00) these noise levels reduce to those shown in Table 6.

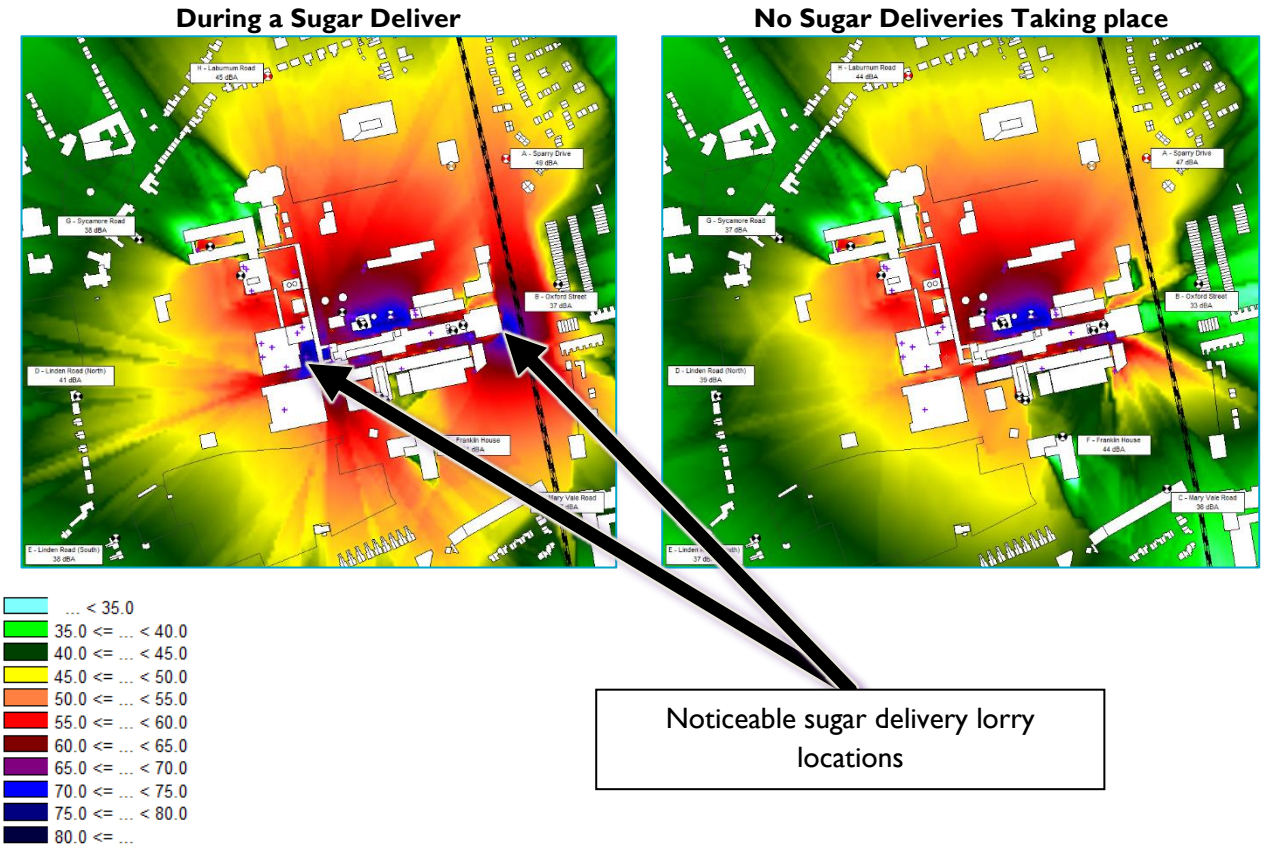
Table 6 - BS 4142 assessment (night-time) - without sugar delivery

Receptor	A - Sparry Drive	B - Oxford Street	C - Mary Vale Road	D - Linden Road (North)	E - Linden Road (South)	F - Franklin House	G - Sycamore Road	H - Laburnum Road
Specific Noise levels dB $L_{Aeq,T}$	47	33	36	39	37	44	38	44
BS 4142 character correction	+3 dB for 'other characteristics'							
Noise rating level dB $L_{Ar,Tr}$	50	36	39	42	40	47	41	47
Background level dB L_{A90}	35	34	33	31	31	31	31	31
Difference (dBA)	+15	+2	+6	+11	+9	+16	+10	+16

Without sugar deliveries at night noise levels at Linden Road reduce to less than 10 dBA above background at Mary Vale Road and Linden Road, and reduce by 7 dBA at Franklin House. This shows that the sugar deliveries impact Mary Vale Road and Franklin House more so than any other receptor, this can be seen in Figure 7 where I have compared the noise contours at high level during a sugar delivery with that of a period with no sugar delivery.

Whilst the ideal solution would be to reschedule sugar deliveries, this is likely impracticable. Alternative methods of reducing the impact using best available techniques may be appropriate (e.g. use of land based blowers located internally or with acoustic shrouds to the compressors.

Figure 7 - CadnaA noise model, specific noise levels, dB $L_{Aeq,T}$, contours at 15m above floor level.



5.3 Assessed Noise Levels – Impact vs Context

The assessed night-time noise rating levels at the Sparry Drive, Franklin House, and Laburnum Road receptors are up to 23 dBA greater than the background noise levels measured without contribution from the factory. This would normally indicate an "unacceptable level of audible or detectable noise" as defined by the Environment Agency (the closest corresponding BS 4142 descriptor is 'significant adverse impact').

However, the Environment Agency criteria are based on qualitative assessment levels which have referenced the guidance from BS 4142. BS 4142 suggests quantitative noise levels for these qualitative levels based on the context of the noise. In this case the context would include the sensitivity of the receptor, the characteristics of the noise, and the long-standing nature of the factory. Therefore based on the qualitative approach used by the Environment Agency guidance, the following contextual elements must be considered in this situation:

- The Bournville site is a long-standing industry, having been built before all the surrounding dwellings.

- The dominant source of noise is the "bland sound" of fixed mechanical services such as air handling units and chillers, noise is not impulsive, and any intermittency is 'lost' in the quantity of plant items.
- The background measurements were taken without contribution from the factory, however as the factory has produced the background noise in the area for several decades, the levels we measured are untypically low and not expected to have been experienced the receptors.
- During the night (23:00hrhs - 07:00hrs) noise from the site should be assessed internally as outdoor amenity areas (residential gardens) are not expected to be in use at these times. BS 4142 specifically states that it is not intended to be used to assess internal nose levels and suggests using BS 8233 instead.
- The area is an urban environment and therefore is less sensitive to noise compared to rural areas.

A note on internal noise levels - Franklin House

The worse affected receptor is Franklin House during sugar deliveries. Franklin House was previously an office block that was converted into residential flats. As part of the planning application for the redevelopment of Franklin House (ref 2014/08451/PA) a noise survey and acoustic design review was completed by Cundall Johnson and Partners LLP. In the subsequent report (1010449-SPC-AS-0001) minimum sound insulation requirements for the glazing and trickle ventilators were given, including areas of enhanced sound insulation on the facades facing the Site. Birmingham City Council approved the application with a Planning Condition attached (condition 3) that states:

> 3. *Requires the implementation of glazing specification and prior submission noise specification for trickle Vents.*
> *Prior to the occupation of the building details of the weighted element normalised level difference (Dne,w + Ctr) for trickle vents shall be submitted to and agreed in writing by the Local Planning Authority. The scheme shall be implemented in accordance with the approved details to all replacement fenestration proposed.*

What this means in practice is that Franklin House is designed to be ventilated using trickle ventilators, and not by open windows. Nor does it have any outdoor amenity areas such as balconies to consider.

Based on the highest external levels of 51 dB $L_{Aeq,T}$, during two concurrent sugar deliveries, and 25 dBA of attenuation for standard thermal double glazing and non-acoustic trickle ventilators, internal levels of 26 dB $L_{Aeq,T}$ are expected within the worst affected Franklin House flats, this is 4 dBA lower than the BS 8233 guideline noise level of 30 dB $L_{Aeq,8hrs}$ for bedrooms. This is expected to reduce to 19 dB $L_{Aeq,T}$ when no sugar deliveries are occurring.

For the reasons listed above I consider the impact of noise at the Sparry Drive, Franklin House, and Laburnum Road receptors to be an "audible or detectable noise" as defined by the Environment Agency (the closest corresponding BS 4142 descriptor is 'adverse impact'). On this basis Mondelez has a duty to *"use appropriate measures to prevent or, where that is not practicable, minimise noise"* and *"rigorously demonstrate that you are using appropriate measures"*.

5.4 Best Available Techniques (BAT)

5.4.1 Mary Vale Road

Typically, noise levels from the site at Mary Vale Road are relatively low for the vast majority of the time. However during sugar deliveries noise levels are expected to significantly increase due to noise from the lorry compressors associated with the western lorry deliveries. The ideal solution would be to limit deliveries to only occur during the 'day' (07:00 to 23:00), however this is expected to be impracticable for operational reasons. If possible, alternative methods of noise mitigation should be explored. Examples of this could include:

- Making sure that the lorry's compressor is operating for as little time as needed.
- Using land based blowers.
- Constructing an acoustic screen to block line of site between the compressor and the bedroom windows of properties on Mary Vale Road.
- Construct a portable acoustic shroud or hood to place over or as close to the lorry's compressor as possible to block line of site between the compressor and the receptor. This can consist of 2 sheets of dense plasterboard (such as British Gypsums 'SoundBloc') on a timber frame that can be 'wheeled out' when needed.

Please note that these mitigation actions should be taken just as example principles of noise reduction, not an exhaustive list. Noise mitigation methods should be developed based on a balance of practicability and effectiveness.

5.4.2 Sparry Drive

The dominant source of noise at Sparry Drive is the ammonia air handling units (AHUs) situated in the centre of the site as seen in Figure 8.

These items of plant are already positioned in the most ideal location within the Bournville site, i.e. they are positioned in the centre of the site utilising as much screening by other buildings as possible as seen by the noise contours in Figure 9.

It is unknown if the AHUs are already attenuated. If they are not attenuated, then additional attenuators could be sourced to reduce the noise levels by at least 5 dBA. Since our initial noise survey Mondelez already has plans in place to add noise abatement to the AHUs in the coming months.

The noise level increases by 1 dBA when a sugar delivery is taking place at the south east corner of the site, this is an exceptionally small increase which isn't expected to be noticeable. This is the same sugar delivery that impacts Mary Vale Road, and therefore any of the example mitigation measures recommended in Section 5.4.1 would also reduce noise levels at this receptor.

5.4.3 Franklin House

Franklin House is a block of flats that does not have outdoor amenity areas such as balconies, therefore any noise from the factory will only be experienced internally during both the daytime and night-time. As I mentioned in Section 5.3, as the noise can only be assessed internally BS 4142 is not an applicable for assessing noise at this receptor.

The dominant noise contributors at the upper floors of Franklin House are from sugar deliveries (both the south west and south east deliveries, and the sugar extract fans). I understand sugar deliveries can happen any time from 05:30hrs onwards, until typically 22:00. Rescheduling sugar deliveries to the daytime only (07:00 - 23:00), will reduce night time noise levels by 7 dBA. This reduction would be noticeable to the occupants of the flats.

As mentioned in Section 5.4.1, rescheduling deliveries is expected to be impracticable. The example alternative best available techniques mentioned for Mary Vale Road could also reduce noise levels at this receptor. Nosie abatement should be developed and balanced by practicability and effectiveness.

In addition to the noise from the lorry compressors, noise from vents/fans in the factory's façade emit noise during sugar deliveries. If these vents/fans are not attenuated, then I recommend seeking alternative means of reducing noise.

Since our initial survey Mondelez has added noise abatement to one of the sugar fans (U4 east). They also have plans to implement similar noise abatement techniques to two other fans (U6 and U1w) by the end of the year when operational down-time allows.

Noise levels during lulls of deliveries are expected to be dominated by hum from the high level enclosed AHU on the roof of the Linden Building, This is a long standing item of equipment that has not resulted in complaints. Further noise reduction should not be necessary.

5.4.4 Linden Road

Noise levels are approximately 3 dBA higher during sugar deliveries from the south west delivery location and the vents/fans in the factory's façade.

As mentioned above, one of the fans has already had acoustic treatment applied, with plans to treat the remaining fans in the coming months.

The noise reduction technique which is developed for the south east and south west would also reduce noise levels at this receptor.

5.4.5 Laburnum Road

The dominant sources of noise at Laburnum Road are the cumulative noise level from the new plant associated with cooling ammonia including air handling units and chillers as seen in Figure 8.

Before these were installed the dominant noise at the receptor was from the two long standing chillers on the roof of Substation No.1. I understand that these have not caused complaints. No further mitigation methods are necessary.

The new items of plant are already positioned in the most ideal location within the Bournville site, i.e. they are positioned in the centre of the site utilising as much screening by other buildings as possible as seen by the noise contours in Figure 9. By placing the equipment in this location, Mondelez has already taken steps to controlling the noise using best available techniques.

As discussed above for Sparry Drive, Mondelez have plans in place to further reduce noise from the AHUs using an acoustic barrier.

The next highest contributor of noise at the Laburnum Road receptor is from the new ammonia chillers themselves. Mondelez has already installed a barrier at high level in front of the ammonia chillers as seen Figure 10. I consider this barrier to provide limited acoustic attenuation and therefore I have considered it to be acoustically transparent in my calculations. Improvements to this barrier would be to change it for an acoustic barrier with a minimum mass of 10 kg/m^2, this can be achieved with a close boarded solid timber fence extending to 1 m above the height of the chillers.

Since our noise survey and this subsequent assessment, I understand that Mondelez has taken several steps in reducing noise from these chillers including:

- Adding sound absorption material in front of the chillers, this will help control noise reflections.
- Adding metal plates to base of the gantry to reduce vertical noise leakage

Figure 8 - Ground floor ammonia AHUs and chillers

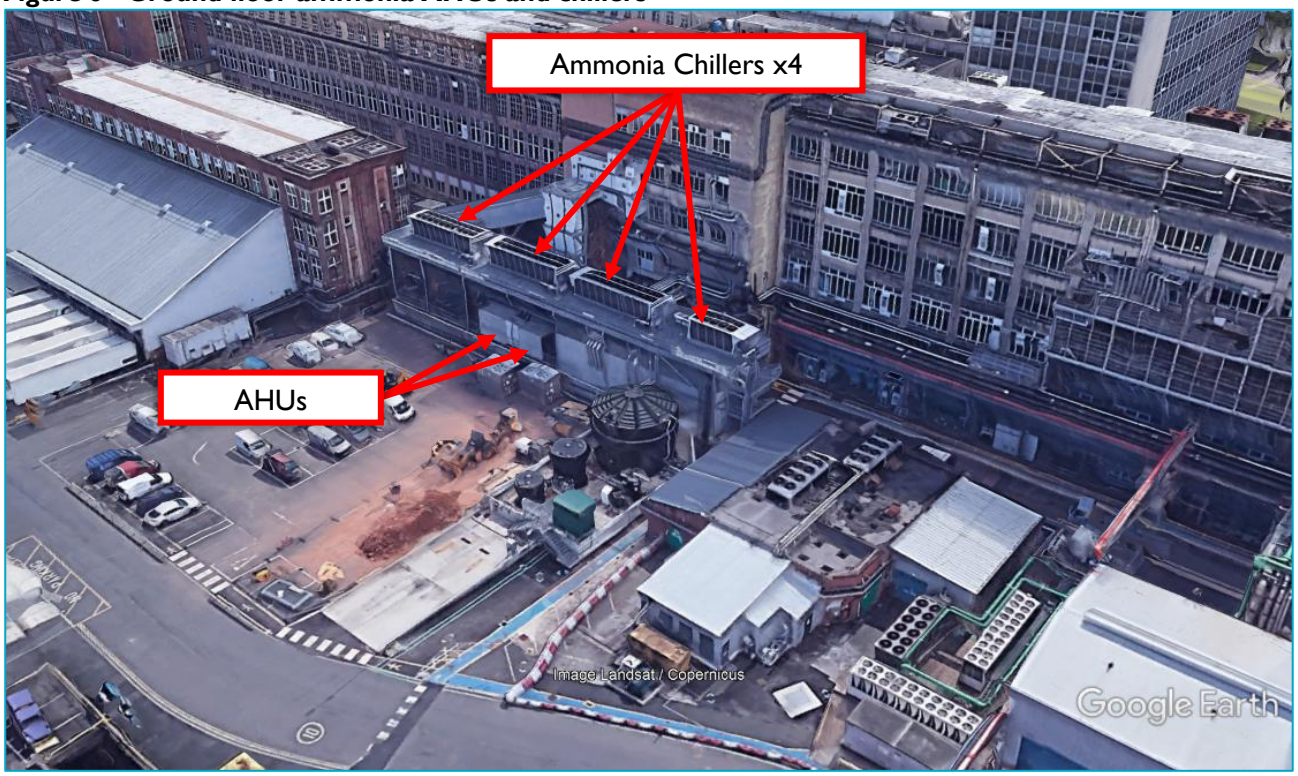


Figure 9 - Ammonia chillers and AHU locations

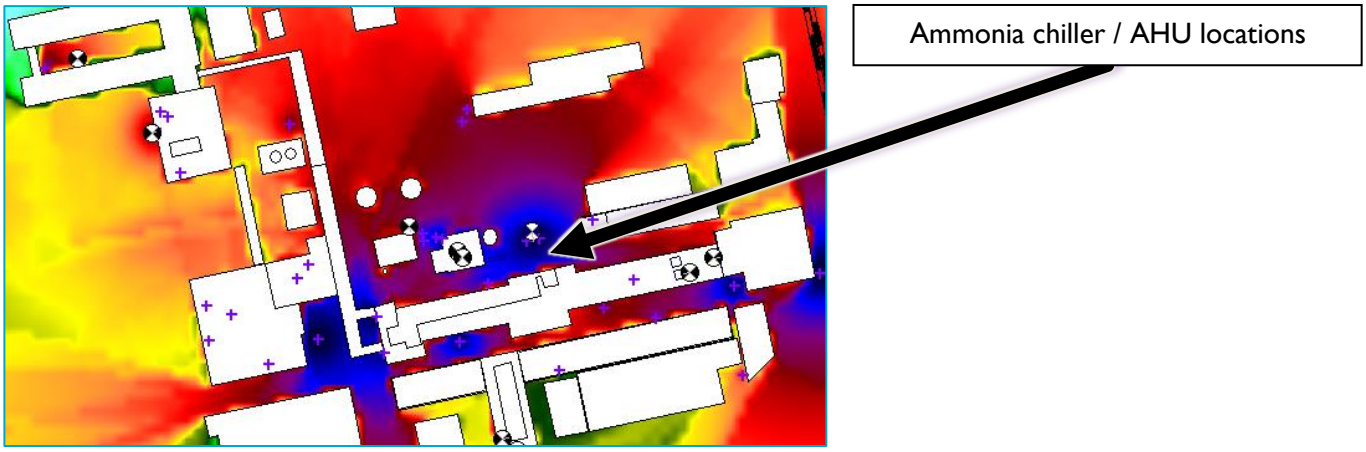


Figure 10 - Ammonia chiller barrier

5.5 Uncertainty

As with all assessments there is a degree of uncertainty. Uncertainties have been controlled to a minimum where possible as shown in Table 7.

Table 7 - Uncertainty

Uncertainty	Mitigation and justification
Plant measured at source may not be operating typically at the time of the survey	It is assumed that as the factory runs 24/7 and all plant was operating under normal duty. A lot of plant was included in the assessment, if one or two items were running at low load, the change at the receptor would be small. However, by using measured in-situ data we have increased the robustness of the assessment that cannot be achieved using manufactures noise data. The southern chocolate block chiller has been measured at multiple positions in a separate visit to site. I have used the highest noise level we measured from the chiller for a worst case scenario.
Only dominant sources assessed	It's impossible to measure all sources at the factory as there is a vast number of plant which cannot be switched off. It's impossible to measure non-dominant sources of noise without contribution from other sources.
Background noise is measured with short duration.	Long term monitoring of background noise levels without contribution from the site is not possible as the site does not shut down. Attended noise levels were used to minimise uncertainty in the background noise, and the minimum measured level was used in the assessment.
Surrogate positions used for all receptors.	The factory is long standing and does not shut shown. Impossible to measure background at all receptors without surrogate positions being used. Measurement positions were chosen based on the expected secondary sources of noise at the closest receptors (i.e. road traffic network)
Unavailable equipment in the source noise survey	Some items of equipment were not operating at the time of the survey, in lieu of these surrogate sources were used, i.e., the O Block chillers was substituted with data for a chocolate block chiller, and the south east lorry compressor was substituted with data from the south west lorry compressor.
Inaccessible sources	During sugar deliveries there are several fans that operate on the façade of U Block. I understand that there is a high-level unit (approx. 14 m) that operates at the same duty. Our model includes this high level unit and is supplemented with data collected at a ground floor unit of the same type.

Appendix A – Completed and Planned Noise Control

Since our last visit to site Mondelez has completed, and has plans to complete, several methods of reducing noise on-site, as seen is the tables below

Table 8 - Noise control completed

Source Description / Location	Details	Dates Completed
Chocolate Block Chiller	Software Update – Night Noise Set-back installed Cladding with 75mm insulation installed around chiller Pipework fitted with TechWrap2 as recommended by Advance Noise Solutions (ANS) and metal lagging.	TechWrap2 installation: done. Cladding: Done Metal Lagging: 14/04/2022
Sugar Fan	U4 east	Sound abatement fitted. Baffle fitted in to sugar fan housing
Ammonia (Azane) Chillers	Noise abatement barrier in front of the chiller units	Sounded absorption material in place in front of the chillers – completed 05/07/2022
Ammonia (Azane) Chillers	Metal plates fitted over the metal grilles to stop noise from descending from the gantry	Metal plates in place, also extending to remove gaps from sound absorption matting – completed 12/07/2022

Table 9 - Planned noise control methods

Equipment	Action	Date of completion
Ammonia (Azane) Air Handling Unit (AHU)	Noise abatement barrier to be fitted to the front of the air handling unit	01/10/2022
Sugar Fan (U6)	Noise abatement to be fitted as per U4 to be modified during plant down time on the general shut down	31/12/2022
Sugar Fan (U1w)	Noise abatement to be fitted as per U4 to be modified during plant down time on the general shut down	31/12/2022

Appendix B - Survey Details

B1. Location of Survey

- Survey 1: Background survey
  - Around Cadbury Bournville
- Survey 2: Source noise survey
  - On Cadbury Bournville site
- Survey 3
  - On Cadbury Bournville site
- Survey 4
  - On Cadbury Bournville site (Chocolate block south chiller)

B2. Date & Time of Survey

- Survey 1: Background survey
  - 16th November 2022 10:00am to 17th November 2021 03:00am
- Survey 2: Source noise survey
  - 24th November 2022 10:45 to 15:00
- Survey 3: Source noise survey
  - 3rd February 2022 13:30 to 15:15
- Survey 4: Source noise survey
  - 9th July 2021 12:30 to 13:30

B3. Personnel Present During Survey

- Survey 1: Background survey
  - Lewis Bullivant (SRL Technical Services Ltd)
- Survey 2: Source noise survey
  - Lewis Bullivant (SRL Technical Services Ltd)
- Survey 3: Source noise survey
  - Lewis Bullivant (SRL Technical Services Ltd)
- Survey 4: Source noise survey
  - Lewis Bullivant (SRL Technical Services Ltd)

B4. Weather Conditions during Survey

- Survey 1: Background survey
  - Approximately 8˚C, wind speed <5 ms^{-1}, no precipitation or surface water
- Survey 2: Source noise survey
  - Approximately 6˚C, wind speed <5 ms^{-1}, no precipitation or surface water
- Survey 3: Source noise survey
  - Approximately 6˚C, wind speed <5 ms^{-1}, no precipitation or surface water
- Survey 4: Source noise survey
  - Approximately 22˚C, wind speed <5 ms^{-1}, no precipitation or surface water

B5. Instrumentation

- Survey 1 and Survey 2

Description	SRL No.	Make	Type	S/N
Sound Level Meter (HE2)	615	Brüel & Kjær	2250	2579806
Pre-amp	616	Brüel & Kjær	ZC0032	22126
Microphone	617	Brüel & Kjær	4189	2584598
Calibrator	618	Brüel & Kjær	4231	2583398

- Survey 3

Description	SRL No.	Make	Type	S/N
Sound Level Meter (HE3)	519	Brüel & Kjaer	2250	2559287
Pre-amp	869	Brüel & Kjaer	ZC0032	8088
Microphone	868	Brüel & Kjaer	4189	2471146
Calibrator	520	Brüel & Kjaer	4231	2564290

- Survey 4

Description	SRL No.	Make	Type	S/N
Sound Level Meter (HT2)	859	Brüel & Kjaer	2250	3007927
Pre-amp	458	Brüel & Kjaer	ZC0032	20880
Microphone	457	Brüel & Kjaer	4189	2771929
Calibrator	693	Brüel & Kjaer	4231	2412357

B6. Calibration Procedure

Before and after each survey period the measurement apparatus were check calibrated to an accuracy of ±0.3 dB using the type 4231 Sound Level Calibrators. The Calibrators produces a sound pressure level of 93.8 dB re 2 x 10^{-5} Pa at a frequency of 1 kHz.

Appendix C - Measurement Results

C1. Background Survey Data (Survey 1)

Position	Date	Time	Elapsed Time	L_{Aeq} (dB)	L_{A90} (dB)
1	16/11/2021	09:59	00:05:00	54	44
1	16/11/2021	11:19	00:05:00	60	46
1	16/11/2021	12:16	00:05:00	55	45
1	17/11/2021	00:01	00:05:00	51	36
1	17/11/2021	00:58	00:05:00	52	39
1	17/11/2021	01:51	00:05:00	53	35
2	16/11/2021	10:10	00:05:00	57	42
2	16/11/2021	11:28	00:05:00	61	48
2	16/11/2021	12:26	00:05:00	58	44
2	17/11/2021	00:09	00:05:00	54	35
2	17/11/2021	01:06	00:05:00	47	35
2	17/11/2021	01:59	00:05:00	40	34
3	16/11/2021	10:33	00:05:00	59	52
3	16/11/2021	11:37	00:05:00	64	59
3	16/11/2021	12:36	00:05:00	64	59
3	17/11/2021	00:17	00:05:00	59	34
3	17/11/2021	01:14	00:05:00	58	35
3	17/11/2021	02:07	00:05:00	60	33
4	16/11/2021	10:41	00:05:00	73	62
4	16/11/2021	11:44	00:05:00	76	63
4	16/11/2021	12:43	00:05:00	75	62
4	17/11/2021	00:24	00:05:00	68	38
4	17/11/2021	01:21	00:05:00	66	32
4	17/11/2021	02:14	00:05:00	65	31
5	16/11/2021	10:50	00:05:00	65	51
5	16/11/2021	11:51	00:05:00	63	45
5	16/11/2021	12:51	00:05:00	65	49

Position	Date	Time	Elapsed Time	L_{Aeq} (dB)	L_{A90} (dB)
5	17/11/2021	00:33	00:05:00	53	33
5	17/11/2021	01:28	00:05:00	53	31
5	17/11/2021	02:20	00:05:00	49	31
6	16/11/2021	11:02	00:05:00	52	42
6	16/11/2021	12:00	00:05:00	55	47
6	16/11/2021	13:00	00:05:00	48	42
6	17/11/2021	00:41	00:05:00	39	36
6	17/11/2021	01:36	00:05:00	38	34
6	17/11/2021	02:28	00:05:00	38	31
7	16/11/2021	11:12	00:05:00	48	41
7	16/11/2021	12:08	00:05:00	48	42
7	16/11/2021	13:08	00:05:00	50	41
7	17/11/2021	00:51	00:05:00	43	34
7	17/11/2021	01:44	00:05:00	45	32
7	17/11/2021	02:37	00:05:00	42	31

C2. Source Noise Data (Survey 2)

Notes	L_{Aeq}	Octave Band Centre Frequency (dB, Hz)							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Ammonia chiller at 1m	84	74	77	81	84	81	69	63	57
AHU (dominant) at 1m	77	72	76	71	72	76	65	59	51
York chiller at 1m	76	79	77	73	73	71	68	64	61
Compressor house at 3m	76	75	74	73	71	72	67	65	66
Boiler house at 3m (boiler house inaudible), dominated by other sources	64	75	66	63	60	59	57	51	45
Crumb delivery at 2m (other sources are dominant)	67	66	63	65	63	64	57	53	47
WIP tent AHU at 2m	64	66	66	68	60	58	55	53	45
WIP tent compressor at 2m	68	79	73	69	65	62	58	56	53
Choc block façade openings at 2m. (4x louvres)	63	71	72	65	61	57	52	48	41
AHU at 2m. Dominant source is nearby duct breakout, see below	58	65	64	60	55	52	47	43	36
Ductwork breakout at 2m	71	64	69	77	65	65	61	57	52
Bournville place AHU at 3m	56	66	61	59	53	51	46	39	34
Chiller at 1m	64	62	58	69	62	54	50	44	40
U block AHU at 2m	84	78	78	81	82	80	76	73	66
V Block OPM chiller at 1m	72	73	72	73	70	67	62	57	48
Ground floor V Block AHU at 1m	76	74	80	77	73	71	68	64	55
Palm Oil Delivery at 1m (compressor)	90	75	74	76	89	81	81	80	81
V Block roof AHU at 1m	70	64	62	66	64	62	64	63	61
U6 plant louvres at 3m (dominated by U Block cooling towers)	70	71	75	69	69	62	59	57	55
U Block cooling towers at 3m	74	77	79	75	73	67	63	59	59
M2 rooftop chiller at 1m	72	67	64	69	66	65	64	66	59
Creme egg AHUs at 2m	66	73	69	66	66	60	53	52	51
M2 sub roof chiller at 1m	78	73	77	78	77	72	70	66	67
Choc Block chiller (1) at 1m	71	73	69	68	67	66	65	56	49
Choc Block chiller (2) at 1m	70	72	69	67	63	64	65	64	54

C3. Source Noise Data (Survey 3)

Notes	L_{Aeq}	Octave Band Centre Frequency (dB, Hz)							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Clarendon chiller at 3m	67	68	67	66	64	56	51	63	68
Clarendon chiller at 3m	68	67	64	62	58	53	49	67	67
Clarendon chiller at 3m	66	69	67	66	62	56	53	60	69
M2 Chiller at 3m	73	70	75	73	72	66	62	64	70
M2 Chiller at 3m	68	68	76	69	65	61	55	57	68
M2 Chiller at 3m	70	70	74	74	68	62	56	56	70
Sugar delivery compressor at 2m	92	86	72	76	83	87	84	84	86
No1 Sub Roof Chiller (north) at 2m	84	92	91	86	83	78	71	66	92
No1 Sub Roof Chiller (south) at 2m	81	87	86	84	80	74	67	62	87
Stadco dry air cooler (dominant) at 2m	75	76	77	75	69	66	71	66	76
Linden rooftop enclosed plantroom louvre (dominant) at 3m	83	81	86	85	83	78	69	60	81
Sugar Extraction Fan at 6.3m	77	75	69	67	74	74	69	61	75

C4. Source Noise Data (Survey 4)

Notes	L_{Aeq}	Octave Band Centre Frequency (dB, Hz)							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Choc Block chiller (south) at 1m	87	72	73	86	81	84	71	61	72

Appendix D - Noise model sources

D1. New noise sources covered by scope of permit application

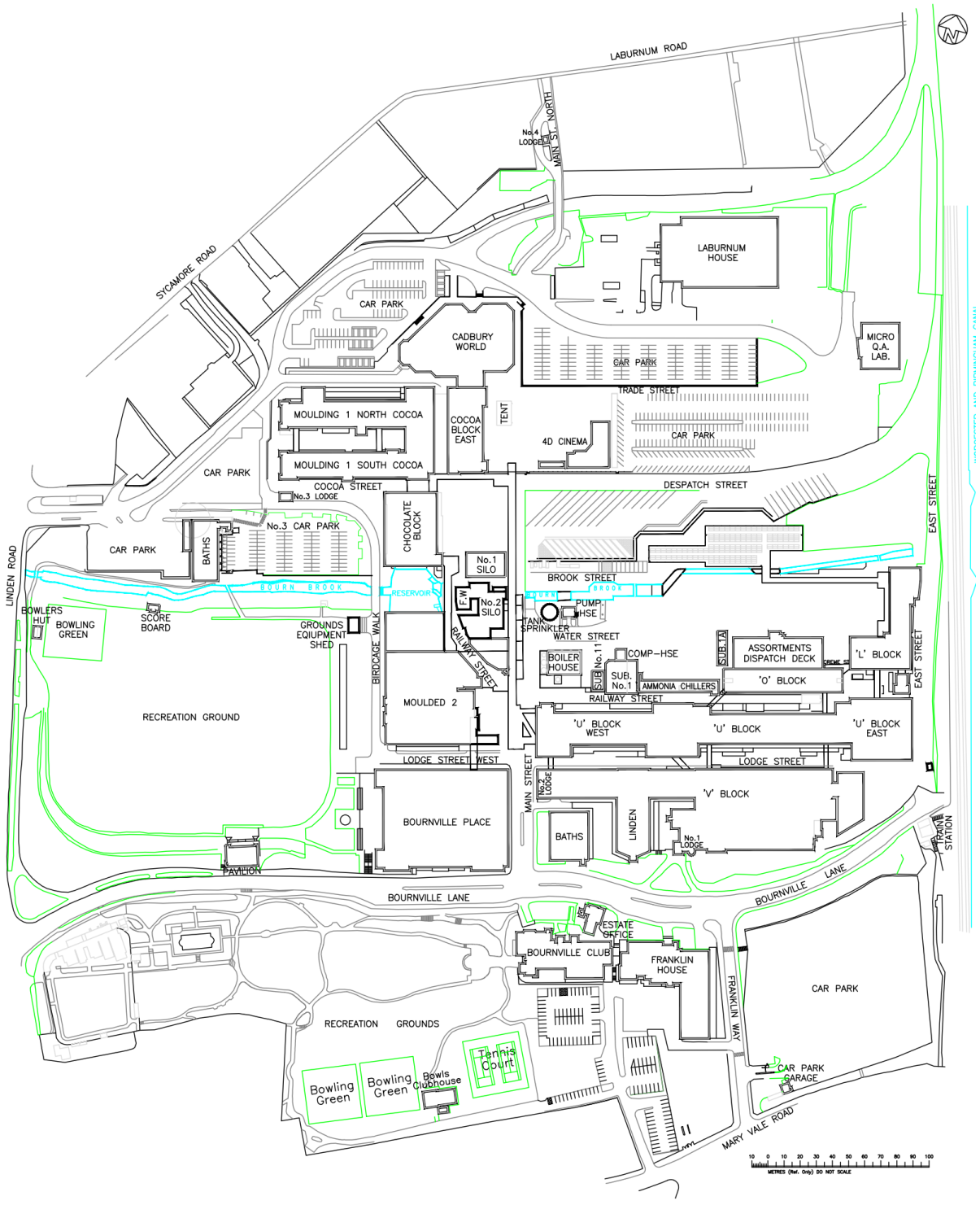
Sources in noise model	Sound Power dB L_w
Ammonia chillers x 4	92.4
Choc Block chiller (south)	93.8
Clarendon Chiller (U Block Roof)	85.8
M2 Chiller	90.6

D2. Existing dominant noise sources at the site

Sources in noise model	Sound Power dB L_w
Ammonia AHUs x2	98.7
Bournville Place AHU	73.9
Choc Block Roof Chiller (1)	78.9
Choc Block Roof Chiller (2)	84.8
Chocolate Block West Ventilation Louvres x4	77.5
Compressor House Louvre	93.4
Creme Egg AHU x3	80.3
Creme Egg Pack System chiller x2	86.5
Crumb Delivery	80.9
Linden Rooftop Enclosed AHU Louvre (dominant)	98.1
Moulded 1 R&D AHU	67.4
Moulded 1 R&D Ductwork	85.5
No1 Substation Chiller (North)	98.4
No1 Substation Chiller (South)	94.9
O Block Roof Chiller x2 – Surrogate data from chock block chiller (1)	78.9
Palm Oil Delivery	97.5
Stadco Dry Air Cooler	89.4
Station Entrance Chiller	71.6
Sugar Delivery (south west)	105.2
Sugar Delivery (south east) – Surrogate data from south west sugar delivery	105.2

Sources in noise model	Sound Power dB L_w
Sugar Delivery Fan During Delivery (ground level)	100.9
Sugar Delivery Fan During Delivery (high level)	100.9
U6 plant room louvre x4	80.4
U Block Ground Floor AHU (East)	98.4
U Block Ground Floor Plant	80.0
V Block AHU	78.1
U Block Cooling tower x2	88.5
V Block Ground Floor Plant	84.3
WIP Tent AHU	78.4
WIP Tent Condenser	82.0
York Chillers x3	83.9

Appendix E - Site Plan



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