The Network Rail (Cambridge South Infrastructure Enhancements) Order

Rebuttal Evidence

NRE-REB-02-01

Appendices - Rebuttal Evidence to OBJ-08 (University of Cambridge)

The Transport and Works (Inquiries Procedure) Rules 2004

January 2022

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Appendix A

Hutchings, Tracey

From:	Deborah Griffith <[redacted]>
Sent:	16 February 2021 09:50
To:	Lynden Spencer-Allen; Keith Savill
Cc:	'Niamh.Leonard[redacted]'; Paul Humphrey; 'Mark.Arnold[redacted]'; Samuel Koroma
Subject:	RE: Anne McLaren building - Cambridge South Railway Station Vibration Impact

Hi Lynden,

Thank you for the below and I can confirm that nothing has changed in terms of the vibration sensitivity requirements within the building and are happy for you to use the existing data.

As for noise – we are happy for this testing to take place but request ample warning so we're able to inform the various groups who will need to know that this is taking place.

Kind regards

Debs

Deborah Griffith
Project Leader
Estates Division
University of Cambridge
[redacted]

Tel: [redacted] Mob: 44 [redacted] Email: [redacted]

From: Lynden Spencer-Allen <[redacted]>
Sent: 15 February 2021 16:33
To: Deborah Griffith <[redacted]>; Keith Savill <[redacted]>
Cc: 'Niamh.Leonard[redacted] <Niamh.Leonard[redacted]; Paul Humphrey <Paul.Humphrey[redacted] 'Mark.Arnold[redacted]' <Mark.Arnold[redacted]; Samuel Koroma <samuel.koroma[redacted]>
Subject: RE: Anne McLaren building - Cambridge South Railway Station Vibration Impact

Hi Debs,

Thanks for your help with this and confirming the position on surveys. We have reviewed the data we collected previously during commissioning and we are happy it captures all the information we would need. If the University are happy for us to re-use it for this purpose we can avoid carrying out the additional surveys. We will base the assessment on the same vibration sensitivity requirements the building was designed for (VC-A generally and VC-C for imaging room) assuming nothing has changed since then.

With regards to noise there is a request from the consultants for this aspect, Arcadis, to carry out measurements within the external area of the AMB to feed into their assessment. The attached document sets out their proposals and Mark Arnold cc'd is leading from their side who will coordinate this further.

Kind regards
Lynden Spencer-Allen

MA MEng CEng MICE

Director, Science Sector Lead, Buildings

M +[redacted]
[redacted]

From: Deborah Griffith <Deborah.Griffith[redacted]>
Sent: 09 February 2021 15:43
To: Lynden Spencer-Allen <Lynden.Spencer-Allen[redacted]>
Subject: RE: Anne McLaren building - Cambridge South Railway Station Vibration Impact

Hi Lynden,

Apologies I did have a response from the AMB team.

It would be preferable if the comprehensive data gathered when the building was commissioned was used. If that is not appropriate then they could accommodate access to the building but we would need to know where the sensors would need to go so that we're able to gauge their impact and whether they would need access to the barriers/test centre.

We have also received this request from Paul Humphrey and hopefully this will respond to his correspondence too.

Kind regards

Debs

Deborah Griffith
Project Leader
Estates Division
University of Cambridge
[redacted]

Tel: [redacted] Mob: [redacted] Email: [redacted]

From: Lynden Spencer-Allen <Lynden.Spencer-Allen[redacted]>
Sent: 09 February 2021 15:37
To: Deborah Griffith <Deborah.Griffith[redacted]>
Subject: RE: Anne McLaren building - Cambridge South Railway Station Vibration Impact

Hi Debs,

I was wondering if you have had any feedback from the building management team on this? There is an option where we just agree to use the data we already have if access isn't going to be practical.

Kind regards
Lynden Spencer-Allen

MA MEng CEng MICE
Director, Science Sector Lead, Buildings

M [redacted]
[redacted]

From: Deborah Griffith <Deborah.Griffith[redacted]>
Sent: 29 January 2021 12:40
To: Lynden Spencer-Allen <Lynden.Spencer-A[redacted]>
Subject: RE: Anne McLaren building - Cambridge South Railway Station Vibration Impact

Hi Lynden,

Sorry I missed your call just now.

I have forwarded your request to the building management team to understand their views. As you quite rightly say the building is being used for CV-19 but we are also restricting the number of people in the building. Once I have their thoughts back I will return to you.

Kind regards

Debs

Deborah Griffith
Project Leader
Estates Division
University of Cambridge
[redacted]

Tel: [redacted] Mob: [redacted] Email: [redacted]

From: Lynden Spencer-Allen <Lynden.Spencer-Allen[redacted]>
Sent: 20 January 2021 17:31
To: Deborah Griffith <Deborah.Griffith[redacted]>
Subject: Anne McLaren building - Cambridge South Railway Station Vibration Impact

Hi Deborah,

We are supporting Network Rail in the Environmental Impact Assessment for the new station at CBC specifically relating to vibration impact on the surrounding buildings.

During the design stage we worked with Alan Mansey on various vibration surveys prior to construction and to validate performance at the end of construction. We understand the sensitivity and the potential impact of an increase in vibration and the building is a key focus of our assessment.

We already know a lot about the requirements but ideally would like to:

- Carry out some baseline vibration measurements in the building for comparison with future potential impacts
- Agree the vibration sensitivity formally (based on what we already know).

I was hoping you may be able to advise who the best contact would be for arranging this? I understand the building is currently heavily used for Covid operations so access may be difficult. If that is really not possible it may be possible for us to use previous data we have collected in the building with the University's agreement.

Thanks for your help with this - I would be very happy to have a chat through in more detail if easiest.

Kind regards
Lynden Spencer-Allen

MA MEng CEng MICE
Director, Science Sector Lead, Buildings

M [redacted]

Appendix B

Strategy for Controlling Noise and Vibration During Renovation of an Animal Facility

Article *in* Lab Animal · August 2003

DOI: 10.1038/laban0803-34 · Source: PubMed

Joseph Hanig
U.S. Food and Drug Administration

Strategy for Controlling Noise and Vibration During Renovation of an Animal Facility

Thomas J. Sobotka, PhD, Susan Harper, DVM, MS, DACLAM, DACVPM, Joseph Hanig, PhD, and Martin Robl, DVM, PhD

The noise level in an animal facility is an important environmental variable that can adversely affect animal welfare, as well as experimental data. The authors describe the strategy they used to record, evaluate, and control excess noise and vibration during a period of renovation, while maintaining the operation of a research facility.

Sobotka, Harper, and Robl are affiliated with the Food and Drug Administration, Center for Food Safety and Applied Nutrition, Office of Applied Research and Safety Assessment, Laurel, MD 20708; Hanig is affiliated with the Food and Drug Administration, Center for Drug Evaluation and Research, Office of Pharmaceutical Science OPS, Laurel, MD 20708. Please send reprint requests to Sobotka at FDA/CFSAN/OARSA, 8301 Muirkirk Rd., Laurel, MD 20708, or email: tsobotka@cfsan.fda.gov.

One essential mandate and legal obligation in the conduct of any experimental study using animals is that appropriate measures be taken to ensure the health and well-being of the experimental subjects[1–3]. This includes not only the use of humane laboratory procedures, but also the maintenance of an adequate laboratory environment. The environments in which animals are housed and experiments conducted represent critical variables that may affect the validity and usefulness of experimental data and thus must be adequately controlled. Among the more common environmental conditions that one should control are temperature, humidity, light cycle, and extraneous noise[2,4]. The need to control the level of noise assumes added importance in certain unusual circumstances, such as during physical renovation to an animal laboratory facility[5,6]. Furthermore, because certain construction activities associated with building renovations typically involve the use of heavy machinery or impact procedures such as hammering and the dropping of walls, there may also be a need to consider additional environmental conditions, such as changes to the background levels of vibration[6]. At one of the Food and Drug Administration (FDA) laboratories we recently experienced an authentic situation that involved dealing with the noise and vibration associated with major building renovation to an animal research facility. This narrative describes the strategy used to record, evaluate, and control the levels of excess noise and vibration during the period of renovation, while maintaining the operation of the research facility.

Background Information

The FDA is a science-based regulatory organization that maintains active research programs within each of its Centers in support of its regulatory mission. One of the FDA sites for animal studies is located in Laurel, MD. One part of the laboratory complex at this site is the Mod-I facility, which houses research groups of the Center for Food Safety and Applied Nutrition (CFSAN), as well as the Center for Drug Evaluation and Research (CDER). The research activities of both Centers involve a diversity of *in vitro* and *in vivo* experimental animal studies. Both the CFSAN and the CDER components at the Mod-I animal facility are fully accredited by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC), reflecting the FDA's commitment to compliance with all principles and provisions of animal welfare.

The Mod-I research facility is a four-level building with animal housing occupying one side of the building on the first, second, and third floors, and with the animal receiving and support areas located below these rooms on the ground-floor level. This facility houses various species of animals including rats, mice, rabbits, guinea pigs, and ferrets. The remainder of the building consists of laboratory and office space. To accommodate management decisions to refocus certain research activities, plans were developed to convert the entire animal housing area on the third floor into analytical laboratories. All renovation work was to take place on the third-floor portion of the building, aligned vertically above the animal housing rooms on the lower floors. The renovation contract specified that the work would take approximately nine months, with virtually all demolition activities being scheduled for the first three months and reconstruction activities scheduled for the remainder of the contract period. Research management

TABLE 1. Specific engineering measures taken to mitigate generation of excessive noise and vibration during facility renovation

- Pre-manufacture ducting in dimensions as large as possible off the jobsite.
- Pre-fabricate piping for sprinkler lines at yard and then bring to project area.
- Pre-manufacture heating and condensate piping in the first-floor mechanical room and raise to the third floor with a chain fall through the mechanical chases.
- Thread piping for gas lines outside of the building (reduces the noise of the machines and prevents cutting oil from soiling the concrete floor).
- Leave materials at the shop until needed on project.
- Bring building materials into the work area on rubber-tired carts.
- Place heavy material and equipment on softeners or pallets to reduce the noise.
- Use electric scissor lifts with rubber tires.
- Use metal-clad electrical cabling, with the wiring pre-installed. In this manner, there is far less regular conduit used, which is noisier to work with.
- Use "bolt-up" connections for ducting rather than slip-and-drive connections.
- Use hanger brackets that do not require drilled-in anchors to be secured but can be clipped to the bottom side of the pan deck.
- Use beam clamps to hang material.
- Use rubber mats during demolition.
- Remove duct with beam clamp, block and tackle.
- Remove cinderblock walls with power tools instead of a sledgehammer.
- Remove vinyl tiles with power machine instead of scrappers and chisel bits.
- Use shift work and Saturdays in some manner to reduce noise.
- Use two people to stack materials rather than just one person.

decided that a complete halt to animal experimentation during this period of renovation was to be avoided, if at all possible, because the continuation of certain ongoing and previously scheduled experiments with animals was considered essential.

Formulation of Strategy

In view of the necessity to continue active animal experimentation and the relative certainty that the renovation activities (demolition as well as construction) would involve the generation of increased levels of noise and vibration, it rapidly became obvious that adequate planning must include a strategy for maintaining a high-quality environment throughout this period of renovation. Such a plan would minimize, to the extent possible, not only the generation of renovation-related noise and vibration, but also the impact of any unavoidable noise and vibration on the experimental animals housed in the building.

An ad hoc group consisting of facility Principal Investigators, veterinarians, agency contract representatives, line management, FDA facility management, administrative staff, and construction contract engineers was convened to develop a coordinated strategy that would address the concerns about renovation-related noise and vibration. The efforts of this group to formulate an effective strategy proved a rather unique venture, because a thorough search of the literature provided little guidance for the development of a cohesive plan to harmonize building renovation activities with ongoing animal research.

The Strategy

The three major elements of the strategy included mitigating the generation of and exposure to noise and vibration, cageside noise and vibration monitoring, and monitoring of effects on animals.

Mitigation

We focused our primary effort on minimizing the exposure of animals to excess noise and vibration through mitigating their generation throughout the period of building renovation. To signal the importance of this issue, we included the control of excessive noise and vibration generation as one of the required selection criteria in the award of the building contract. The company that eventually received the contract for the Mod-I animal facility renovations had practical experience with working in medical and laboratory environments where control of extraneous noise was a critical concern. The contractor worked together with FDA personnel to plan and compile a series of engineering and building procedures designed to mitigate the production of excessive or unnecessary noise and vibration during each phase of renovation, including both demolition and construction (**Table 1**). The contractor also established an ongoing procedure to monitor the work being done by all of the subcontractors and to enforce implementation of the mitigating procedures. Weekly meetings held conjointly with contract and program personnel allowed for the review of work progress and discussion of any potential problems regarding noise and vibration that may have arisen during the routine operations.

In addition to the engineering and building procedures that helped to mitigate the generation of excessive noise and vibration, other procedures also helped to decrease the exposure of animals to these conditions. Several routine practices, including the use of rubber-wheeled cage racks and filtered isolation bonnets over the rat-mouse plastic housing cages, buffered the exposure of animals to vibration and noise at the cage level. Furthermore, we aimed at further minimizing animal exposure to excess noise and vibration by instituting a selective scheduling practice. This arrangement involved careful scheduling of animal housing assignments such that animals were located in rooms that were physically as far removed as possible from the areas of renovation activities. Consequently, throughout the period of the third-floor renovation, we housed the animals primarily on the first floor of the building and, to a much lesser extent, on the second floor.

Noise and Vibration Monitoring

We considered it essential to monitor the levels of noise and vibration associated with the building renovation, so as to gauge the effectiveness of the mitigating measures. For this purpose, we negotiated a separate contract specifically to monitor the levels of noise and vibration in designated animal rooms on the first and second floors of the Mod-I facility during most of the renovation project[7]. As described later, we identified threshold levels for noise and vibration, below which

TABLE 2. Calculated averages of noise and vibration L_{eq}, L_{max}, and L_{min} during Phase 1 (demolition) and Phase 2 (construction)[a]

	Noise: Phase 1 (demolition)			Noise: Phase 2 (construction)		
	L_{eq}	L_{max}	L_{min}	L_{eq}	L_{max}	L_{min}
Average	40±3	44±6	40±2	40±2	44±6	39±1
Max. value[b]	80	107	63	69	99	64
No. of intervals	19,225	19,225	19,225	23,792	23,792	23,792
	Vibration: Phase 1 (demolition)			**Vibration: Phase 2 (construction)**		
	L_{eq}	L_{max}	L_{min}	L_{eq}	L_{max}	L_{min}
Average	67±6	75±7	59±4	62±2	70±5	57±2
Max. value[b]	133	159	93	94	125	64
No. of intervals	12,350	12,349	12,350	7,823	7,823	7,823

[a]L_{eq}, Equivalent continuous sound or vibration level per recording interval; L_{max}, maximum sound or vibration level per recording interval; L_{min}, minimum sound or vibration level per recording interval.
[b]Maximum value for each index measurement across all intervals.

minimal, if any, adverse effects on animals would be expected. We designed the monitoring system to provide a continuous record of noise and vibration levels and to activate an out-of-range signal for any instances in which the preset thresholds for noise or vibration were exceeded. The monitoring period was divided into two phases to reflect the two major phases of the third-floor renovation: demolition (Phase 1) and construction (Phase 2). Four noise and three vibration sensor systems were available under the monitoring contract. A fourth vibration system malfunctioned during the project and did not provide useable data. During Phase 1, when we expected demolition activities to generate the higher levels of noise and vibration, the monitoring of these not only focused on representative rooms on the first floor of the animal facility (Rooms 1802, 1806, and 1812), but also included limited monitoring of the second floor (Room 2807). During Phase 2, when we expected that construction would generate relatively lower levels of noise and vibration, monitoring focused on the second floor of the facility (Rooms 2801, 2807, and 2813) but also included continued monitoring in one of the first-floor rooms (Room 1806). We should note that, because of equipment malfunction, vibration levels in Room 2807 were not measured during either Phase 1 or 2.

Noise and vibration thresholds. We set the threshold level for noise at 85 R-weighted decibels (dBR; noise levels were measured in dBR to account for the hearing sensitivity of rodents to high-frequency noise[8]), based on standard guidelines for use and care of laboratory animals[2] and a survey of available literature on the adverse effects of noise[4,9–11]. In contrast to the relatively straightforward identification of a threshold for monitoring noise levels, our efforts to approximate a level of vibration that would minimize the possibility of producing detrimental effects in animals proved to be more difficult. Before the initiation of renovation activities in the animal facility, a contractor determined background and construction equipment-generated levels of noise and vibration[6]. The highest ambient (or background) level of vibration recorded in the animal facility was 2,700 microinches per second (μin/s; acceleration units). The contractor reported that various pieces of construction equipment (*e.g.*, hammer drill, sledgehammer, jackhammer, pneumatic drill, and nail gun) produce high levels of vibration ranging from 14,300 to 7,600 μin/s, when measured on the floor below the location at which the equipment is used.

For humans, vibrations at 4,000–5,000 μin/s are generally considered to be within acceptable levels[10]. However, we found very little useful information in the published literature regarding vibration levels that may be detrimental to animals[12]. Most of the data published for human threshold vibration levels are typically based on vibrations transmitted and measured in direct contact with the body of the person[13,14]. However, the renovation activity in our facility did not expose animals to direct contact vibration but instead to ambient vibration generated, and measured, at varying distances from the animals. In addition, a further buffer of animal exposure to ambient vibration was their routine housing in cages (*e.g.*, microisolators) with bedding material positioned on racks with rubber tires. Based on this rationale and the limited available information, we deemed a vibration level measured at 4,500 μin/s (equivalent to 81 dB units) to represent a reasonable estimate of an average level of vibration below which adverse biological effects might not be expected in either humans or animals[13,14]. We used this same level of 4,500 μin/s as the threshold for activating an out-of-range alarm system.

Noise and vibration monitoring equipment setup. In each room to be monitored, we set up a separate noise and vibration sensor and analyzer system[7] (**Fig. 1**). To monitor noise we used a Casella CEL 302 0.25-in microphone (Casella CEL USA, Amherst, NH) and a Casella preamplifier attached to a tripod ~5 feet high and within ~2 feet of a wall. There was no windscreen, because this would affect high-frequency noise levels. A Brüel & Kjær Nexus Conditioning Amplifier (Brüel & Kjær, Norcross, GA) transmitted the output through a custom-designed R-weighting filter and into a Casella CEL 593 sound level analyzer. Calibration of this measurement chain involved the use of a Brüel and Kjær Model 4231 calibrator, which produces a 1-kHz signal. Noise was measured in dBR, which accounted for the hearing sensitivity of rodents[8]. We calibrated the analyzers to the nearest tenth of a decibel on a biweekly basis, and we collected and recorded noise measurements at 5- to 12-min intervals. For each interval, noise data included the equivalent continuous sound level (L_{eq}), the maximum sound level (L_{max}), and the minimum sound level (L_{min}).

The vibration sensor in each monitored room was screwed into a base that was glued to the floor ~2 feet from the wall. The vibration sensor was a Model

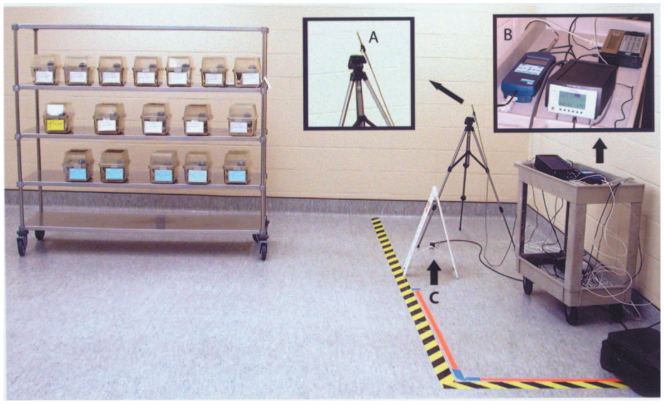

FIGURE 1. Photograph of noise and vibration monitoring equipment located in one of the animal housing rooms. Insert A is an enlarged photograph of the sound microphone sensor positioned on top of a tripod stand. Insert B is an enlarged photograph of the control and recording equipment positioned on top of the cart. Arrow C indicates the position of the vibration sensor glued to the floor of the room.

VO625A01 Industrial ICP Velocity Sensor (IMI Sensors, Depew, NY). The sensor had a sensitivity (±10%) of 100 mV/in/s, a measurement range of ±50 in/s, and a mass of 215 g. The Brüel and Kjær Nexus Conditioning Amplifier powered the sensor and transmitted the output into a Model 870 Integrating Signal Analyzer (Larson Davis Laboratories, Provo, UT). The calibration of the measurement chain involved the use of an IMI Sensors, Model 699A02 Hand Held Shaker, which produces an acceleration of 1 *g* at 159.2 Hz. We calibrated the analyzers to the nearest tenth of a decibel on a biweekly basis. We measured vibration in acceleration units of μin/s. Results appear in **Tables 2** and **3**, and in **Fig. 2** as the dB equivalent. We collected and recorded vibration measurements at 5- to 12-min intervals. Vibration data for each interval included the equivalent continuous overall vibratory-velocity level (L_{eq}), the maximum vibratory-velocity level (L_{max}), and the minimum vibratory-velocity level (L_{min}).

In each room we installed a cart to hold the noise and vibration analyzer and recording equipment (**Fig. 1**). The monitoring system activated a light signal in a central control room whenever the noise or vibration thresholds were exceeded. We installed the threshold detection alarm system with small-diameter wire cables leading from each room to a central control room. Whenever the noise or vibration levels surpassed the defined threshold limits and activated the light signal during normal working hours, a technician assigned to monitor the alarm system would notify the contract manager, who would then evaluate and take appropriate action, as warranted.

Noise and vibration monitoring results. Fig. 2 is a representative graph depicting patterns of noise and vibration for one of the monitored rooms (Room 1806). The plotted data include the noise and vibration L_{eq}, L_{max}, and L_{min} levels for all recorded intervals during both the renovation Phase 1 (demolition) and Phase 2 (construction) monitoring periods. The noise levels are plotted as dBR values and the vibration levels as dB sound-pressure level equivalents over time. A level of 0 dB (shown in the figure as a downward spike to the bottom of the graph) indicates the occasions when the meters were stopped for data downloading. Clearly, L_{max} spikes of noise and vibration followed a weekly periodicity with the relatively higher levels of noise and vibration occurring during the workweek and, conversely, lower noise and vibration levels during weekends and holidays. Though not discernable in this figure, the noise and vibration followed a daily cycle, with the highest levels of L_{max} typically occurring during the morning time period between 7:00 and 11:00 a.m. Most of the intervals that exceeded the threshold were nonconsecutive. There were often several in the same day, but they were separated by relatively quiet periods.

The calculated averaged levels of L_{eq}, L_{max}, and L_{min} for noise and vibration across all monitored rooms during Phase 1 (demolition) and Phase 2 (construction) of the renovation period are presented in **Table 2.** Overall, noise levels seemed to be very well controlled during both phases of the period of renovation. None of the averaged measures of noise exceeded the threshold of 85 dBR throughout either phase of the monitoring period. Even when we examined the noise levels for each recorded interval for each room separately (**Table 3**), there were no intervals (0%) in any monitored room for which the mean noise level (L_{eq}) exceeded threshold and there was <0.2% of the monitored intervals in the various rooms for which the maximum noise level (L_{max}) had exceeded threshold.

Vibration levels seemed to be somewhat less well controlled than were those of noise. As shown in **Table 2**, compared with noise, the overall averaged levels of vibration (expressed as L_{eq}, L_{max}, or L_{min}) for all rooms during the monitoring period did not exceed the threshold level of 81

TABLE 3. Number and percentage of noise and vibration intervals with L_{eq}, and L_{max}, above threshold[a]

Noise Room[b]	L_{eq} No. above	% of intervals	L_{max} No. above	% of intervals	Vibration Room[b]	L_{eq} No. above	% of intervals	L_{max} No. above	% of intervals
1802	0	0.00	4	0.02	**1802**	906	7.0	4759	37.0
1806	0	0.00	43	0.08	**1806**	9	0.1	1120	9.3
1812	0	0.00	23	0.14	**1812**	21	0.2	862	8.1
2801	0	0.00	2	0.01	**2801**	15	0.2	310	3.1
2807	0	0.00	41	0.12	**2807**	Not measured			
2813	0	0.00	2	0.01	**2813**	0	0.0	295	3.4

[a]L_{eq}, Equivalent continuous sound or vibration level per recording interval; L_{max}, maximum sound or vibration level per recording interval.
[b]Rooms monitored during Renovation Phase 1 (demolition): 1802, 1806, 1812, and 2807; rooms monitored during Renovation Phase II (construction): 2801, 2807, 2813, and 1806.

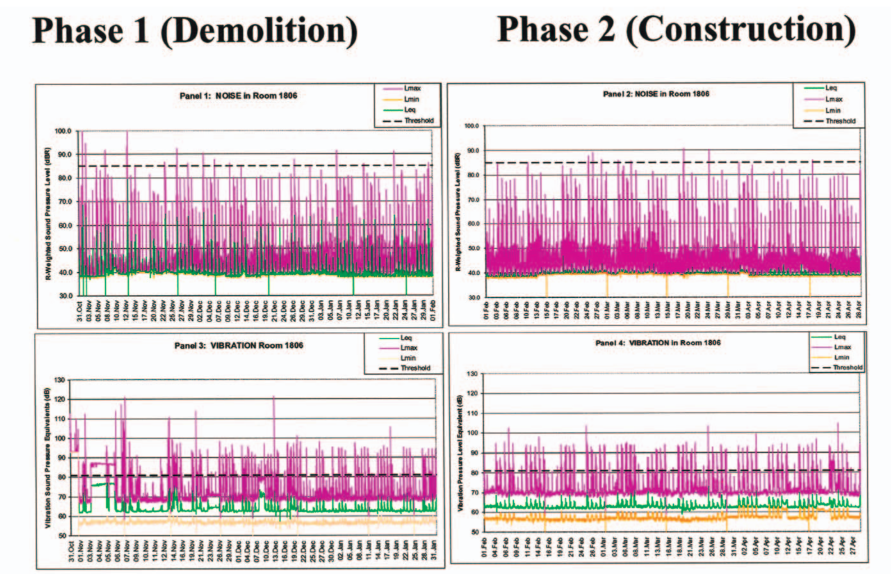

FIGURE 2. Representative graphs of noise and vibration levels in one animal room (Room 1806) during both phases of renovation: demolition (Phase 1) and construction (Phase 2). Noise levels (Panels 1 and 2) are plotted as dBR values and vibration levels (Panels 3 and 4) as dB sound pressure level equivalents. As indicated in the graph legends, the three plotted lines in each graph depict the average equivalent continuous overall vibratory-velocity levels (L_{eq}), the maximum vibratory-velocity levels (L_{max}), and the minimum vibratory-velocity levels (L_{min}) per recording interval for either noise or vibration. The dashed line in each graph represents the set threshold level for noise (85 dBR) or for vibration (81 dB).

dB (sound-pressure equivalent to a vibration of 4,500 μin/s). However, when we examined the vibration level for each recorded interval for each room separately (**Table 3**), it became apparent that the vibration measures had exceeded the threshold considerably more frequently than did noise in the various rooms monitored. There was generally a relatively small percentage of intervals in which the mean vibration level (L_{eq}) exceeded threshold, the incidence ranging from 0% to 7% in the various rooms. For the maximum vibration measurement (L_{max}), there was a greater percentage of intervals above the threshold value, with an incidence ranging from 3% to 37%. In comparison with the other rooms being monitored, we did not view the markedly higher incidence of vibration levels exceeding threshold in Room 1802 (**Table 3**) as indicative of construction activities. The pattern and frequency of these vibration surges suggested that the cause might have been some mechanical equipment in close proximity to the vibration sensor, possibly attached to the floor slab below this room.

Serendipitously, we found that recordings of L_{eq} or L_{max} noise levels could even provide a distinctive pattern corresponding with varying activity in a particular room. This is most clearly demonstrated in the graphic display of noise in Room 2807 (**Fig. 3**), where mice were present for most of the time from the beginning of the monitoring period (15 February 2002) until 18 March 2002, after which no animals were present in the room until 2 April 2002, at which time rabbits were placed in the room. The different density patterns of the L_{eq} or L_{max} tracings associated with mice or rabbits present show rabbits to be noticeably noisier than the mice. Comparative vibration levels in this room were not available because of equipment malfunction.

Animal Effects Monitoring

The principal objective of the noise and vibration control efforts described here was to minimize any adverse biological impact of excess noise and vibration on the animals housed in the facility. Consequently, there was a need to determine, to the extent possible, whether the controlled levels of noise and vibration were having any adverse biological impact on the facility animals.

Animal assessment measures. Although the use of specifically designated sentinel animals placed strategically throughout the building would have been of optimal value, we determined that the use of such groups of animals was not practical during the renovation itself. Rather, we assessed the overall health status of the animals in our facility by examining information obtained from daily clinical observations and periodic measurements of body weight and food and water consumption.

As a routine practice in the animal facility, trained, qualified, animal husbandry personnel would routinely make cage-side observations of all animals on site several times each day—at least two times a day during normal working hours. These observations included indices of physical appearance, such as texture of hair coat, loss of hair, discharge from nose or mouth, diarrhea, fecal or urinary soiling or staining, cuts, lacerations or bite marks, abnormal bumps, lesions, and any signs of abnormal behavior, such as lethargy, excessive running, stereotypic behavior, bizarre movements, ataxia, convulsions, and tremors.

Whenever staff observed abnormal physical or behavioral traits, they recorded them and notified the Attending Veterinarian (AV). The AV would then give a full physical examination to the animal involved and, when appropriate, take samples of urine, feces, blood, or saliva, and send these out for clinical and microbiological analysis. In the event of an animal death, the veterinarian would perform a necropsy and take appropriate samples for pathological evaluation.

In addition to the twice-daily clinical observations that the animal husbandry personnel made, it was a part of the routine practice in the animal facility for the AV to make rounds one to two times each

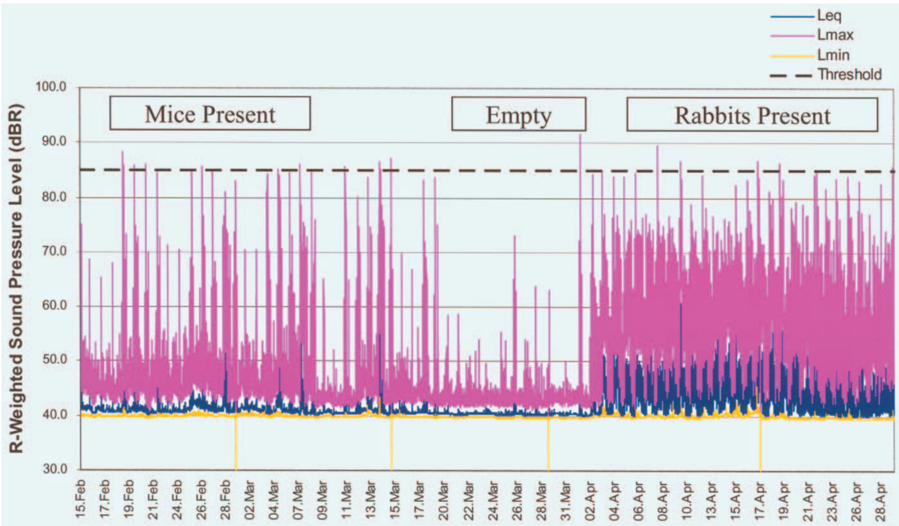

FIGURE 3. Graph of noise level patterns in one animal room (Room 2807) during the construction period (Phase 2) with only mice present, no animals present, and only rabbits present. Noise levels are plotted as dBR values. As indicated in the graph legend, the three plotted lines represent the average equivalent continuous overall vibratory-velocity levels (L_{eq}), the maximum vibratory-velocity levels (*L*max), and the minimum vibratory-velocity levels (L_{min}) per recording interval for noise. The dashed line represents the set threshold level for noise (85 dBR). The relative differences in patterns of noise are most apparent for the L_{max} and L_{eq} values.

week. During the veterinary rounds, the AV visually inspected the animals on site using the cage-side observation paradigm (described earlier) and chose a certain number of animals at random, removed them from their cages, and gave them a more comprehensive clinical examination. Animals deemed by the AV to be abnormal during his/her cage-side inspection also received an in-depth clinical examination. The appropriate Research Coordinator and Principal Investigator of the study involved received reports of abnormalities by the AV and the animal husbandry staff. In our assessment of animal health and welfare we also used periodic measurements of body weights and of food and water consumption, as scheduled within various ongoing experimental protocols.

In addition, on several occasions during the period of renovation (most notably during the demolition phase), when loud noises occurred, the AV checked a number of animal rooms and noted whether the animals were exhibiting any abnormal physical or behavioral patterns at that time.

Animal effects monitoring results. Evaluation of all the available clinical observations, including body weights and food and water consumption, revealed no evidence of noise- or vibration-related adverse biological effects on the facility animals throughout the renovation phases of demolition and construction. As one additional remark, there was one breeding colony of rats in residence during the period of renovation, but that colony was established just before initiation of the demolition phase of the renovation. Therefore, there was insufficient historical information on which to base a valid comparison regarding relative changes in breeding efficiency during the renovation. Nonetheless, the colony produced and weaned viable litters during this time with no apparent problems.

Summary

With major physical renovations planned for an active FDA animal research and testing facility, there was anticipation of the need to maintain the ongoing research activities within the facility during this period of renovation. All parties concerned expended a considerable amount of time and effort in formulating and implementing a successful strategy to deal with the construction-related noise and vibration. FDA facility management, scientific and engineering personnel, together with the renovation contractors, jointly developed a strategy to minimize the exposure of experimental animals to construction-related noise and vibration that could produce adverse health effects. The strategy consisted of various efforts to mitigate the generation of and animal exposure to excess levels of noise and vibration, to monitor these levels, and to assess facility animals for signs of adverse health effects. The monitoring data showed that the engineering and procedural measures taken to mitigate the generation of excessive noise and vibration seemed to be very effective. Overall, averages of noise and vibration levels did not exceed the preset threshold levels of noise (85 dBR) or vibration (4,500 µin/s, equivalent to a sound pressure of 81 dB) throughout the monitored periods of active renovation. Although episodic noise spikes above the threshold occurred in a limited number of recorded intervals, spikes in vibration levels above threshold occurred more frequently and seemed more difficult to control. There was additional confirmation of the effectiveness of the control strategy with the absence of any signs of adverse health effects in the facility animals, indicating that the animals were not exposed to sustained levels of noise or vibration producing adverse biological effects.

Acknowledgments

The authors thank the FDA's Division of Facility Planning, Engineering and Safety, and the many contract office, line management, FDA facility management, and administrative personnel associated with the CDER and CFSAN research animal programs who contributed their time, effort and resources in the formulation and implementation of a coordinated strategy to address the concerns about construction-related noise and vibration. We also thank Chugach Support Services, Kling Lindquist, Acentech, DynCorp, and Wyle Laboratories for their cooperation.

Received 12/16/02; accepted 2/10/03.

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Appendix C

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Property Consultants

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E chris.renshaw@brutonknowles.co.uk
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Date: 28th September 2021
Our ref: CR/BS/530260

The Chancellor Masters and Scholars of
The University of Cambridge
The Old Schools
Trinity Lane
Cambridge
CB2 1TN

Dear Sir or Madam,

Re: Anne Mclaren Laboratory of Regenerative Medicine, 90 Francis Crick Avenue, Cambridge CB2 0BA
The Chancellor Masters and Scholars of The University of Cambridge and Network Rail Infrastructure Limited (NRIL)
Cambridge South Infrastructure Enhancement Order

As you are aware Network Rail are proposing a Transport and Works Act Order to assemble the necessary parcels of land to enable the construction of the proposed Cambridge South Station and associated track works, both on a temporary and permanent basis.

Notwithstanding your Objections to the Order already received, we would like to discuss with you the potential to acquire land identified in your ownership in advance of the Order.

I would be pleased if you could confirm this is something you are prepared to consider and perhaps, we could discuss the matter further with a view to agreeing Heads of Terms.

I look forward to hearing from you.

Yours sincerely,

Chris Renshaw MRICS
Senior Associate

Appendix 1

Archived: 20 January 2022 10:51:54
From: Chris Renshaw
Mail received time: Wed, 12 Jan 2022 16:47:59
Sent: Wed, 12 Jan 2022 16:47:56
To: Bill Simms
Subject: UoC - Colin Smith [BK-BK.FID272782]
Importance: High
Sensitivity: None

Bill

further to our discussion earlier some further notes for you.

At our on site meeting on 25th November CS advised that they had let part of the building to AZ.
Furthermore see this link;
https://www.cam.ac.uk/research/news/how-science-and-innovation-are-helping-tackle-covid-19-testing

UoC repurposed the building to undertake CV-19 testing in association with others.

Whilst it may have been a bespoke building seems to me that firstly there is a market for space from other life science users and given the significant numbers of those involved there would be interest n the building also evidenced by AZ taking a lease on part of the space.

At that meeting of 25th November we predominantly discussed scheme and its impacts on the building and Paul ran through mitigations/commitments and got the HoTs out within the week.

The discussion with CS was a token gesture at the end of this session for less than 10 mins as he had to rush to get a train.

We discussed a SoCG but it was not agreed that we would agree this and was left we would ask client how they wished to proceed.

CS also advised that it was not really about the land take anyway only the impact on the building and ability to continue operating.

As we know in discussions with NRIL the SoCG was something they were not minded to do and per the Property Teams call we had I was instructed to advise CS that we would not be undertaking a SoCG and that it would be what it would be(let the chips fall where they fall). At the time on the call I also advised that we were producing offers and this would be with them shortly.

As we know some issues over PCE/ BoR etc but these HoTs for property only will be issued with NRIL approval tomorrow am plus seasonal holidays.

We have only had 1 teams call with UoC and that on site meeting and they are well behind others in interface meetings/ discussions.

Should also be note Paul has also had discussions with CS and maintained the view we would not be involved in wholesale moving of AMB.

MRC closer to the railway and the new S&C equipment and they are far happier with commitments etc and close to agreeing

If you need anything else please let me know

Chris Renshaw MRICS
Senior Associate

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Archived: 20 January 2022 10:52:04
From: Chris Renshaw
Mail received time: Mon, 1 Nov 2021 13:27:59
Sent: Mon, 1 Nov 2021 13:27:54
To: Smith, Colin @ London HH
Subject: RE: NR - CSIEO - University of Cambridge [BK-BK.FID269607]
Importance: Normal
Sensitivity: None

Colin,

Many thanks for your note.

I will revert to you shortly.

Regards

Chris Renshaw MRICS
Senior Associate

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From: Smith, Colin @ London HH <colin.smith@cbre.com>
Sent: 28 October 2021 14:52
To: Chris Renshaw <Chris.Renshaw@brutonknowles.co.uk>
Cc: Paul Humphrey <Paul.Humphrey@networkrail.co.uk>; Jane Baker <jane.baker@admin.cam.ac.uk>; Melanie Grimshaw <Melanie.Grimshaw@mills-reeve.com>
Subject: RE: NR - CSIEO - University of Cambridge

Hi Chris

I understand from Paul that you are dealing with land acquisition and compensation discussions ahead of the Inquiry and refer to my email below, sent ten days ago, to which a response is awaited please.

My view on the route to and basis of compensation, should it ever get that far (PPs and L&WA not having been secured), is as follows.

- On the land being subject to GVD or NTT/NTE, UoC would in all probability be in a position to serve and sustain a Material Detriment Notice requiring acquisition of the whole of its premises. This action would be justified if and when the operations carried on were compromised such that continuation became untenable.
- As the premises are 'devoted to a purpose for which there is no general market or demand' LCA 1961 s5 R5 would apply
- Equivalent Reinstatement would ensue to a yet to be identified alternative site.
- LCA 1961 s5 R6 compensation would be payable for the costs and losses sustained as a result of long duration research projects being compromised, lost or abandoned.

Whilst this may seem extreme and disproportionate I am entirely confident it is a sound basis on which to approach consideration of risk and budgeting.

Please let me know if you disagree, with reasoning.

Regards

Colin

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From: Smith, Colin @ London HH
Sent: 18 October 2021 11:45
To: Chris Renshaw <Chris.Renshaw@brutonknowles.co.uk>
Cc: Paul Humphrey <Paul.Humphrey@networkrail.co.uk>; Jane Baker <jane.baker@admin.cam.ac.uk>; Melanie Grimshaw <Melanie.Grimshaw@mills-reeve.com>
Subject: NR - CSIEO - University of Cambridge

Good Morning

I refer to what appears to be a 'generic standard template' letter dated 28th September addressed to the 'Masters and Scholars' at the University, rather than the specific contacts which are established.

It is not apparent how what is sought sits with what is now being progressed, vigorously, between us. However, to make clear, there is a commitment to seek to deal with land transfer within the proposed Land and Works Agreement, negating the need for resort to compulsory purchase.

My sense is that the precise terms for such transfer will be dependent on the extent of the Protective Provisions and the L&WA and it is therefore premature to engage on discussion regarding such terms at this time.

Please let me know if you do not agree, setting out what is proposed.

regards

Colin

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