*Other noise sensitive receivers*

The future (2023) noise levels are predicted to exceed the trigger levels for non-residential sensitive receivers at one location (Quakers Hill Pre-school). A summary of the predicted noise levels at this location is provided in Table 8-27.

**Table 8-27 Summary of IGANRIP trigger level exceedances – other noise sensitive receivers during Year 2023 (track chainage 40.200 km – 43.250 km)**

| Noise level descriptor | Predicted noise level (dBA) (Year 2007)[1] | Overall noise trigger level (dBA) | Predicted noise level increase (dBA) | Noise level increase trigger (dBA) | Number of IGANRIP exceedances within zone |
|---|---|---|---|---|---|
| $L_{Aeq(1\ hour\ internal)}$ | 46 (42) | 45 | 4 | 2 or more | 1 |
| $L_{Aeq(15\ hour)}$ | 55 (51) | 65 | 4 | 2 or more | 0 |

Noise levels received at the Quakers Hill Preschool, located on the corner of Pearce and Lalor roads, are predicted to increase by approximately 4 dBA, exceeding the overall $L_{Aeq(1hour\text{-}internal)}$ 45 dBA trigger level by 1 dBA. The noise levels predicted at the active recreational area attached to the preschool are expected to comply with trigger level of $L_{Aeq(15hour)}$ 65 dBA. This facility is open between 7 am and 6 pm, with the morning peak hour occurring between 7 am and 8 am. The trigger level exceedance is based on the overall $L_{Aeq(1hour\text{-}internal)}$ trigger being exceeded with a corresponding increase of more than 2 dBA of the hourly $L_{Aeq}$. Therefore, further assessment is warranted for the consideration of reasonable and feasible noise mitigation at this location.

## Summary of predicted noise levels

A summary of the predicted overall IGANRIP noise trigger level exceedances at each of the receivers discussed above is provided for Years 2013 (after opening situation) and 2023 (long-term situation) in Tables 8-28 and 8-29, respectively.

Table 8-28 indicates that further assessment of noise mitigation measures is required for receivers located on Bridge Street and Tain Place for the Year 2013 (after opening situation), while Table 8-29 indicates that further assessment is needed for noise mitigation for receivers located on Manorhouse Boulevard, Bridge Street, Tain Place and the Quakers Hill Pre-school for the Year 2023 (long-term situation).

**Table 8-28 Predicted IGANRIP noise trigger level exceedances – after opening situation (Year 2013)**

| Location | Number of receivers | $L_{Aeq(15\ hour)}$[1] | | $L_{Aeq(9\ hour)}$ | | $L_{Amax}$ | | Further assessment required? |
|---|---|---|---|---|---|---|---|---|
| | | > 65 dBA | Increase ≥ 2 dBA | > 60 dBA | Increase ≥ 2 dBA | > 85 dBA | Increase ≥ 3 dBA | |
| Manorhouse Boulevard (Quakers Hill) | 8 | No | Yes | No | Yes | Yes | No | No |
| Reycroft Avenue (Quakers Hill) | 4 | No | No | No | No | Yes | No | No |

| Location | Number of receivers | $L_{Aeq(15\ hour)}$[1] | | $L_{Aeq(9\ hour)}$ | | $L_{Amax}$ | | Further assessment required? |
|---|---|---|---|---|---|---|---|---|
| | | > 65 dBA | Increase ≥ 2 dBA | > 60 dBA | Increase ≥ 2 dBA | > 85 dBA | Increase ≥ 3 dBA | |
| Bridge Street, Tain Place, (Schofields) | 6 | No | Yes | No | Yes | Yes | Yes | Yes |
| Quakers Hill Preschool | 1 | No[2] | Yes | n/a | n/a | n/a | n/a | No |

Notes: 1: The largest increase in noise levels is predicted during the daytime period.

2: The Quakers Hill Preschool is subject to the 45 dBA $L_{Aeq(1hour\text{-}internal)}$ trigger level.

**Table 8-29 Predicted IGANRIP noise trigger level exceedances – long-term situation (year 2023)**

| Location | Number of receivers | $L_{Aeq(15\ hour)}$[1] | | $L_{Aeq(9\ hour)}$ | | $L_{Amax}$ | | Further assessment required |
|---|---|---|---|---|---|---|---|---|
| | | > 65 dBA | Increase ≥ 2 dBA | > 60 dBA | Increase ≥ 2 dBA | > 85 dBA | Increase ≥ 3 dBA | |
| Manorhouse Boulevard (Quakers Hill) | 8 | Yes | Yes | No | No | Yes | No | Yes |
| Reycroft Avenue (Quakers Hill) | 4 | No | Yes | No | Yes | Yes | No | No |
| Bridge Street, Tain Place, (Schofields) | 6 | No | Yes | No | Yes | Yes | Yes | Yes |
| Quakers Hill Preschool | 1 | Yes[2] | Yes | n/a | n/a | n/a | n/a | Yes |

Notes: 1: The largest increase in noise levels is predicted during the daytime period.

2: The Quakers Hill Preschool is subject to the 45 dBA $L_{Aeq(1hour\text{-}internal)}$ trigger level.

### Draft 2009 CityRail Timetable

RailCorp are planning to introduce a new timetable in 2009 in order to integrate the new Epping to Chatswood Rail Link and other recently completed projects.

The proposed timetable will see additional peak hour services, 6-car trains increased to 8-car trains on more services across Sydney in order to provide extra capacity, as well as additional off-peak services added to the late morning period on the Western, Northern, North Shore and Southern lines.

Proposed improvements for services on the Richmond Branch line include:

- A new morning peak service will operate from Quakers Hill to the North Shore via the central business district (CBD).
- Two services from Quakers Hill to the City, which currently terminate at Central in the morning peak, will now extend to the North Shore via the CBD.
- The hourly City to Riverstone service will now extend to Richmond, providing two services an hour during the weekday off-peak.

- A new semi-fast afternoon peak service will operate to Quakers Hill via the CBD.
- Some additional movements may be required (empty trains) between Quakers Hill and Vineyard in order to position trains for the peak periods.

It should be noted that the changes proposed in the 2009 timetable are in Draft format and are subject to confirmation. The proposed timetable changes, if adopted for the Existing Scenario, would not affect the outcome of the operational noise assessment for the following reasons:

- The $L_{Amax}$ noise levels expected with the Year 2009 Draft timetable would be no different from the $L_{Amax}$ noise levels with the current Year 2007 timetable. This is because the type of trains and the train speeds would not change. Therefore, the IGANRIP assessment of the increase in $L_{Amax}$ between the existing situation (Year 2007) and Year 2023 would not change if the Year 2009 Draft timetable was introduced.
- The existing $L_{Aeq}$ noise levels expected with the Year 2009 Draft timetable would be less than 1 dBA higher than the $L_{Aeq}$ noise levels with the existing Year 2007 timetable (used for the 'existing situation'). The IGANRIP assessment using the current Year 2007 timetable for the 'existing situation' (Year 2007) indicates a 3 dBA increase in $L_{Aeq(15\ hour)}$ between Year 2007 and Year 2023. If the Year 2009 Draft timetable was adopted for the 'existing situation', a 2 dBA to 3 dBA increase would be expected. A 2 dBA increase in $L_{Aeq(15\ hour)}$ is one of the IGANRIP trigger levels. Therefore, the IGANRIP assessment of the increase in $L_{Aeq(15\ hour)}$ between the existing situation and Year 2023 would not change if the Year 2009 Draft timetable was introduced.

### Options for operational noise mitigation

Three options for noise mitigation are proposed for further consideration for the Project — source control measures (i.e. rail dampers), acoustic shielding (i.e. barriers, set back zones and land use treatments) and receiver controls (i.e. architectural treatment of buildings). These measures are summarised in Table 8-30 and the feasible options are discussed in the following sections. Based on consideration of these options, the proposed operational rail noise mitigation strategy for the Project is outlined in Section 8.4.8.

The hierarchy of noise control that would be applied to the Project would be to give preference to source control measures (i.e. rail dampers), then to physical mitigation measures (i.e. barriers and set back zones) between the source and receivers. The final, least preferred, noise mitigation option that would be considered would be at-receiver controls (i.e. architectural treatment of buildings).

It should be noted that the improvement of existing rolling stock and the implementation of new quieter rolling stock is continually being reviewed by RailCorp. These measures may provide future benefits to receivers located adjacent to the Project; however, such benefits have not been included in the consideration of Project specific noise mitigation measures.

The implementation of appropriate planning controls within the Project area may also provide future benefits to receivers located adjacent to the Project. As discussed in Section 3.1.3, the Project is located in the centre of the proposed NWGC and directly borders six planned precincts that will be redeveloped over the next 25–30 years. Each of these precincts will be subject to a precinct planning process that includes numerous investigations, including appropriate land use options as well as environmental and socio-economic considerations.

Discussions with the GCC regarding the planning and location of sensitive noise receivers are ongoing. Locations that are currently undeveloped but which fall within the GCC master plans adjacent to the Project area have not been assessed in detail at this stage. A review of the future (2023) $L_{Aeq(15hour)}$ noise contours adjacent to these areas indicates the 65 dBA contour is typically located up to 10 metres from the rail corridor boundary. Further discussions between TIDC and the GCC are required in to order determine the appropriate protocol in dealing with future rail noise levels at these locations.

**Table 8-30 Operational noise mitigation options**

| Measure | Description |
|---|---|
| Source control measures | Rail dampers are the only identified source control measure that are considered capable of reliably delivering a substantive noise reduction on the Project. These consist of tuned masses fixed to the rails via resilient material and fasteners. Noise radiated by rails fitted with these devices is reduced by the damping effect they have on the rails.<br><br>Rail dampers have a long service life and are essentially maintenance-free, requiring only periodic visual inspections to ensure they remain attached to the rails. Rail dampers are designed to not interfere with normal track maintenance but can be removed and reused if rail welding is required. The small physical size of rail dampers means that they have no visual impact. |
| Acoustic shielding | Acoustic shielding includes the construction of earth mounds and/or noise barriers (which shield some of the direct airborne noise that propagates between the source and receiver locations).<br><br>The locations where earth mounds can be used on the Project are limited because of the space required for an earth mound, which is usually constructed with a batter of 2:1 on both sides of the mound.<br><br>Noise barriers can provide significant noise reductions in locations where source control measures are not able to mitigate noise levels adequately. Noise levels on the ground floor (including back yards and living areas) can usually be significantly reduced through the use of noise barriers. However, noise barriers (of typical heights) are generally not as effective for upper floor receivers and are usually ineffective above the second level.<br><br>In terms of noise reduction, noise barriers and earth mounds can be regarded as providing similar acoustic performance if the top of the barrier and mound are at the same height and distance from the track. In practice, earth mounds may be preferred because they can be visually less intrusive and are less likely to be vandalised. The disadvantage, however, is that they require a larger land area (due to the batter) and this may result in the top of an earth mound being located further from the track than an equivalent noise barrier. Earth mounds are generally not suitable for use where track is on embankment, as the resultant widening of the embankment can require substantial amounts land-take or fill material.<br><br>The use of planned setbacks can reduce or eliminate the need for noise barriers (which can have detrimental visual, cost and social impacts). This Project has the potential to employ the benefits of careful land use planning along the rail corridor. |
| Receiver controls | Receiver controls generally involve the inclusion of specific acoustical measures as part of the design of individual dwellings in order to reduce noise levels inside buildings.<br><br>Treatments to buildings usually involve higher performance windows, doors and seals to minimise the transmission of noise into the structure. Building treatments effectively require occupants to keep their windows and doors closed, and hence, alternative ventilation is usually required to maintain adequate air flow. An obvious disadvantage is that building treatments would not have any effect on the noise levels outside the dwelling (i.e. in front or back yards). Building treatments are normally more costly than source control and source/receiver control measures. For these reasons, building treatments are generally not favoured until after all other options have been explored. |

The parameters that establish the threshold trigger levels and consideration of potential mitigation measures at existing noise sensitive locations are the $L_{Aeq(15hour)}$ or $L_{Amax}$ values for residential properties (65 dBA and 85 dBA respectively), depending on whether the $L_{Aeq(15hour)}$ or $L_{Amax}$ are triggered at a given location. (No exceedances of the $L_{Aeq(9\ hour)}$ parameter were predicted.) The 65 dBA $L_{Aeq(15hour)}$ and 85 dBA $L_{Amax}$ noise levels have been adopted as the Project target levels to be achieved (at the relevant noise sensitive receivers) through the adoption of feasible and reasonable noise mitigation measures (if available) within the rail corridor. Project-specific noise levels would be determined following the final selection of reasonable and feasible noise mitigation, and would include consultation with the affected community.

The following sections describe the indicative extent of the potential reasonable and feasible noise mitigation measures that may be required in order to achieve the Project target noise levels at the IGANRIP trigger level exceedances locations.

### *Rail dampers*

$L_{Aeq(15\ hour)}$ and $L_{Amax}$ noise contours for Manorhouse Boulevard, Quakers Hill Preschool, Tain Place and Bridge Street, incorporating a 3 dBA reduction in source noise levels due to rail dampers, are provided in Appendix J of Technical Paper 2. Noise modelling with a 3 dBA noise attenuation due to rail dampers at each of the exceedance locations predicts that:

- the 65 dBA $L_{Aeq(15\ hour)}$ target noise level would be achieved at all locations where exceedances were predicted without mitigation (refer Section 8.4.5)
- $L_{Amax}$ noise levels would be reduced at Manorhouse Boulevard and the Quakers Hill Preschool, and would comply with the $L_{Amax}$ noise target of 85 dBA at all but one location on Bridge Street (refer Appendix J of Technical Paper 2).

The use of rail dampers to confine the 65 dBA $L_{Aeq(15\ hour)}$ noise contour to the rail corridor at all affected locations is considered reasonable, feasible and cost-effective. Rail dampers have a long service life, low maintenance and no visual impact. Dampers would need to be installed on both rails of both tracks at any given location.

It is noted that the use of rail dampers is currently trialled to confirm their acoustic performance on the Sydney suburban rail network. Accordingly, the potential adoption of rail dampers as a noise mitigation measure is subject to the successful trial of the technology and RailCorp approval.

### *Noise barriers*

$L_{Aeq(15\ hour)}$ and $L_{Amax}$ noise contours for Manorhouse Boulevard, Quakers Hill Preschool, Tain Place and Bridge Street incorporating noise barriers located on the rail corridor boundary are provided in Appendix K of Technical Paper 2.

Noise modelling predicts that noise barriers (1.5 metres above rail level) could be used to provide noise reductions similar to those given by rail dampers. It should be noted, however, that a noise barrier with an above rail height of 1.5 metres would appear at least 2 metres high (in its built form) due to the configuration of the track formation. At Bridge St and Tain Place, the resultant noise barrier height would be in the order of 3 metres (when measured from the bottom of the existing embankment).

Noise modelling with a noise barrier height of approximately 1.5 metres above rail at each exceedance location predicts that:

- the 65 dBA $L_{Aeq(15\ hour)}$ target noise level would be achieved at all locations where exceedances were predicted without mitigation (refer Section 8.4.5)
- the $L_{Amax}$ noise levels would be reduced at Manorhouse Boulevard and the Quakers Hill Preschool, and would comply with the $L_{Amax}$ noise target of 85 dBA at all locations on Bridge Street and Tain Place.

While offering similar noise mitigation to that given by rail dampers, barriers would have a visual impact and ongoing maintenance issues related to graffiti.

Architectural treatment to buildings minimise the transmission of noise into the structure and reduces visual impact; however, these treatments would not have any effect on the noise levels outside the dwelling and are normally more costly than source control and source/receiver control measures. For these reasons, building treatments are generally not favoured until after all other options have been explored.

### 8.4.6 Operational road traffic noise impacts

The predicted existing and future noise levels in the vicinity of the proposed bus, kiss-and-ride and taxi interchanges are provided in Table 8-31, and described below.

A bus interchange facility is not currently in operation at the proposed interchange locations at the new Schofields and Vineyard stations. Hence, the predicted increase in noise levels (particularly from bus operations) would be noticeable. It is noted, however, that heavy vehicle road traffic is not new to this area. Other heavy vehicles (such as large trucks) regularly use nearby roads. On this basis, it is unlikely that the $L_{Amax}$ noise levels for the future situation (Year 2023) would be greatly affected by the commissioning of the proposed bus interchange.

**Table 8-31 Predicted noise levels due to road traffic movements**

| Distance from interchane (m) | Daytime $L_{Aeq(1\ hour)}$ (dBA) | | | Night-time $L_{Aeq(1\ hour)}$ (dBA) | | |
|---|---|---|---|---|---|---|
| | Existing (2007) | Future (2021)[1] | Criterion (collector/local road) | Existing (2007) | Future (2021) | Criterion (collector/local road) |
| **New Schofields Station** | | | | | | |
| 20 | 56 | 62 | 60/55 | 54 | 57 | 55/50 |
| 30 | 54 | 60 | 60/55 | 52 | 55 | 55/50 |
| 40 | 53 | 58 | 60/55 | 50 | 53 | 55/50 |
| 50 | 51 | 57 | 60/55 | 49 | 52 | 55/50 |
| 60 | 50 | 55 | 60/55 | 48 | 51 | 55/50 |
| 70 | 49 | 54 | 60/55 | 47 | 50 | 55/50 |
| **Vineyard Station** | | | | | | |
| 20 | 0 | 62 | 60/55 | 0 | 57 | 55/50 |
| 30 | 0 | 60 | 60/55 | 0 | 55 | 55/50 |
| 40 | 0 | 58 | 60/55 | 0 | 53 | 55/50 |
| 50 | 0 | 57 | 60/55 | 0 | 52 | 55/50 |
| 60 | 0 | 55 | 60/55 | 0 | 51 | 55/50 |
| 70 | 0 | 55 | 60/55 | 0 | 50 | 55/50 |

Note 1: 2021 is referenced in the traffic and transport report (refer Technical Paper 1 in Volume 2)

### $L_{Aeq}$ noise levels — general operational noise

*Schofields Station*

At Schofields Station, the future $L_{Aeq(1hour)}$ noise levels during the daytime and night-time periods are predicted to comply with the criterion for land use developments associated with collector roads at a distance of 30 metres or more from the operational zone of the upgraded facilities. At a distance of 20 metres, the future $L_{Aeq(1hour)}$ noise levels would exceed both the daytime and night-time noise criteria, and as such, consideration of noise mitigation may be required.

At a distance of 70 metres from the operational zone of the upgraded facilities, the future $L_{Aeq(1hour)}$ noise levels at Schofields Station are predicted to comply with the criteria associated with local roads. However, at distances less than 70 metres, the ECRTN criterion would be exceeded, and as such, noise mitigation may be required for existing receivers within this zone.

It is noted that the construction of a car park on the western side of the new Schofields Station would result in new light vehicle traffic on Bridge Street. Assuming that 40% of the car park capacity was located on the western side of the station, $L_{Aeq(1\ hour)}$ noise levels in the order of 55 dBA, with a corresponding increase of up to 5 dBA, would be expected. On this basis, further assessment is recommended at the detailed design stage (when car park designs and orientations have been finalised) in order to minimise the potential impacts and determine reasonable and feasible noise mitigation measures, if necessary.

*Vineyard Station*

At Vineyard Station, the future $L_{Aeq(1hour)}$ noise levels during the daytime and night-time periods are predicted to comply with the criterion for land use developments associated with collector roads at a distance of 30 metres or more from the operational zone of the upgraded facilities. At a distance of 20 metres, the ECRTN criterion would be exceeded and, as such, noise mitigation may be required for existing receivers within this zone.

At a distance of 70 metres from the operational zone of the upgraded facilities, the future $L_{Aeq(1hour)}$ noise levels at Vineyard Station are predicted to comply with the criteria associated with local roads. However, at distances less than 70 metres, the ECRTN criterion would be exceeded and as such noise mitigation may be required for existing receivers within this zone.

### $L_{Amax}$ noise levels at residential receivers — potential for sleep disturbance

For residential receivers, $L_{Amax}$ bus noise levels have also been calculated. Exact locations of potential receivers are currently unknown (as the new Schofields and Vineyard stations are planned to form the centre of the Schofields and Vineyard growth centre precincts). Therefore, external $L_{Amax}$ noise levels were calculated for a variety of offset distances.

The calculations were based on a bus $L_{Amax}$ sound pressure level of 87 dBA within 7 metres of the noise source. Assuming that an offset distance of 30 metres (typical nearest residential receiver location) would provide a calculated external $L_{Amax}$ noise level of 70 dBA, the internal noise level would be between 60 dBA (with windows open) and less than 50 dBA (with windows closed). While this level exceeds the 55 dBA criterion, this represents no change to the ‘existing’ exposure levels of these receivers, given their locations are subject to other heavy vehicle usage such as large trucks.

### 8.4.7 Ground-borne noise from rail operations

For surface rail projects, the effect of ground-borne noise tends to be less of an issue than that for underground rail projects, due to the airborne noise emissions generally being much higher than the ground-borne noise levels. In some situations, however, the ground-borne noise emissions may be audible. (For example, at locations where airborne noise emissions are attenuated by a noise barrier, the track is located within a deep cutting, or where there are no windows facing the railway corridor.)

In accordance with IGANRIP, the ground borne-noise levels must be higher than the airborne noise levels in order to trigger further assessment. The airborne noise mitigation strategy will only be finalised during the detailed design stage of the Project (i.e. after the Environmental Assessment has been publically exhibited and after feedback from the community and other relevant stakeholders has been received). This would include the determination of the location and extent of noise mitigation measures (particularly if noise barriers are proposed) for the Project. As such, a detailed ground-borne noise assessment would be undertaken at the detailed design stage, once the mitigated airborne noise levels are known at the relevant locations.

Whilst the application of mitigation measures is not mandatory, it is necessary to investigate the potential requirement for mitigation at potentially affected locations. It is likely that exceedances of the ground-borne noise trigger levels would be noticeable in residential receiver locations. The degree of potential impact is dependent on the extent of the increase in overall ground-borne noise level, as well as the absolute level (loudness) of the ground-borne noise.

#### Options for ground-borne noise and vibration mitigation

A number of measures are currently available for the mitigation of ground-borne noise and vibration levels, including resilient ballast mat and resilient under sleeper pads. A brief description of these mitigation measures is provided in Table 8-32.

**Table 8-32 Options for ground borne noise and vibration mitigation**

| Mitigation measure | Description |
|---|---|
| Resilient ballast mat | Ballast mats comprise a soft resilient layer, usually made from rubber or other synthetic compounds, which are placed beneath the track ballast to reduce the vibration transmitted into the surrounding ground.<br><br>It is anticipated that ballast mats would mitigate vibration levels by up to 5 dB, and would provide a corresponding reduction in ground-borne noise levels of 5 dBA to 10 dBA. In order to provide the required attenuation, the ballast mat treatment area is typically extended approximately 15 metres to 20 metres either side of the receiver location. |
| Resilient under sleeper pads | Under sleeper pads comprise a resilient material that can be retrofitted to existing sleepers, or be included in the manufacturing process of new sleepers. Current literature suggests that under sleeper pads would provide a reduction in vibration transmission of 6 dBA to 10 dBA in the 40 Hz to 250 Hz frequency range, with a similar reduction in overall ground-borne noise levels. The under sleeper pads are typically applied to the section of track up to 15 metres to 20 metres either side of the receiver location to provide the required attenuation.<br><br>Under sleeper pads do not have RailCorp approval for use in NSW, but are used in many locations across Europe for the purpose of reducing ground-borne noise and vibration levels from railway operations. |

### 8.4.8 Operational vibration impacts

The results of the vibration modelling are presented in the form of vibration velocity (dB re $10^{-9}$ m/s) and are provided in Appendix F of Technical Paper 2. The monitoring results predict that the vibration level during train pass-by events ($V_{rms}$) would comply with the 0.45 mm/s rms vibration trigger level (corresponding to a VDV of 0.2 $m/s^{1.75}$ during the daytime and 0.13 $m/s^{1.75}$ during the night-time) at all residential locations. At offices, schools, educational institutions and places of worship, the vibration level during train pass-by events are predicted to comply with the 0.9 mm/s rms (119 dB) vibration trigger level (corresponding to a VDV of 0.4 $m/s^{1.75}$) at all locations.

It is anticipated that for some train pass-bys, vibration levels would be perceptible at buildings located within approximately 23 metres of the nearest track (at train speeds of 80 kilometres per hour) or at buildings located within approximately 33 metres of the nearest track (at train speeds of 115 kilometres per hour).

Because of the intermittent nature of the vibration generated by train pass-bys, the vibration trigger levels in the vibration guideline are set to be above the threshold of perception levels. The guideline notes, however, that for intermittent vibration, there is a low probability of adverse comment or disturbance to building occupants at vibration levels below the trigger levels that have been adopted for this assessment.

A number of measures are currently available for the mitigation of ground-borne noise and vibration levels, including resilient ballast mat and resilient under sleeper pads. A brief description of these mitigation measures is provided in Table 8-32.

### 8.4.9 Management measures

#### Construction

Construction noise and vibration management measures would be developed for the Project as part of the overall CEMP. These would be prepared in accordance with TIDC's (2007) *Construction Noise Strategy (Rail Projects)*, and would address Section 49 of the Occupational Health and Safety Regulation 2001. Construction noise and vibration mitigation measures detailed in the CEMP would include the following:

- Noise intensive construction works would be carried out during normal construction hours wherever practicable. Where works involving the operating line need to be carried out during track possessions, noise-intensive activities would be scheduled to occur during the daytime, where possible.
- The quietest available plant suitable for the relevant tasks would be used.
- The duration of noise-intensive activities would be minimised as far as possible.
- Where feasible and reasonable, site hoardings or temporary noise barriers would be used to provide acoustic shielding of noise intensive activities.
- Rock breakers (if required) would be of the 'vibro-silenced' or 'City' type, where feasible and reasonable.
- Activities resulting in highly impulsive or tonal noise emission (e.g. rock breaking) would be limited to 8 am to 12 pm Monday to Saturday and 2 pm to 5 pm Monday to Friday (except where essential during track possessions and other necessary out of hours works) or when otherwise approved.

- Noise awareness training would be included in inductions for site staff and contractors.
- Noise-generating plant would be oriented away from sensitive receivers, where possible.
- Notification would be provided to residents via newspaper advertising and letterbox drops, advising of the nature and timing of works, contact number and complaint procedures.
- Noise monitoring would be carried out to confirm that noise levels do not significantly exceed the predictions and that noise levels of individual plant items do not significantly exceed the levels shown in Table 25 of Technical Paper 2.
- Deliveries would be carried out within standard construction hours, except as directed by the Police or the RTA.
- Non-tonal reversing beepers or equivalent would be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
- Trucking routes would be via major roads, where possible.
- Trucks would not be permitted to queue near residential dwellings with engines running.
- For works required to be undertaken outside of normal construction hours, a detailed construction noise impact assessment would be undertaken when detailed information on the type of work, site locations and construction scheduling is known.
- Council and other stakeholders would be appropriately notified of all out of hours work.
- The noisiest out of hours works would be undertaken before 10 pm wherever feasible, with preparation work being undertaken during daytime hours wherever practicable.
- Where possible, noise intensive construction works during the weekend possessions would be undertaken during the daytime periods, with noise emissions during the night-time period being kept to a minimum, except where activities are critical to meeting the construction program and restoring rail services.
- At locations close to sensitive receivers, light rock breakers (approximately 300 kilograms) would be used where possible to minimise ground-borne vibration impacts.
- The safe working distances provided in tables 31 and 32 of Technical Paper 2 would be observed to avoid structural damage and adverse human responses. If work within these zones is necessary, vibration monitoring would be undertaken to confirm these safe working distances.
- Vibration monitoring would undertaken to determine safe working distances before commencement of vibration intensive activities adjacent to the Riverstone Station and Yard Group, to avoid structural damage to these State heritage-listed items.
- Less vibration intensive equipment would be selected to undertake works close to sensitive receivers (for example, using a smaller vibratory roller) to reduce the vibration impacts on such receivers as far as practicable, without compromising the ability to complete the required works.
- Vibration monitoring would be undertaken prior to the commencement of any vibration intensive works (such as vibratory rolling, pile driving or jackhammer) to determine the acceptable locations and durations of activities.

## Operation

### *Rail noise*

At this stage in the assessment process and subject to the current trials being successful, the preferred mitigation option is the use of rail dampers on the both tracks adjacent to the affected receivers, with the consideration of architectural treatments (including boundary fence installation or upgrade) at residual receiver locations. A residual exceedance is predicted at one receiver located on Bridge Street, Schofields. It is estimated that approximately 3 kilometres of rail dampers would be required (i.e. 750 metres per rail for each of the tracks).

The use of building treatments would, however, be subject to feedback from the community consultation process, detailed design and confirmation of noise levels following post-operation noise monitoring to validate predictions.

It is recognised that property boundary fences located adjacent to the rail corridor, while not acoustically designed, may provide an additional level of noise attenuation at some receiver locations. It is likely that the incorporation of new fences, or the upgrading of existing boundary fences, would provide sufficient additional noise benefit (additional to rail damper noise reduction) such that compliance is achieved at all exceedance locations. However, this option would not always be a feasible or reasonable noise mitigation option due to site-specific conditions and constraints.

A summary of the potential extent of rail dampers and noise barriers required for the Quakers Hill to Vineyard Duplication Project is provided in Tables 8-33 and 8-34, respectively.

**Table 8-33 Potential extent of rail dampers required for the Project**

| Location | Chainage (km) | Length (m) per rail | Length (m) both rail, both tracks |
|---|---|---|---|
| Manorhouse Boulevard | 40.900 – 41.350 | 450 | 1,800 |
| Bridge Street and Tain Place | 43.530 – 43.730 | 200 | 800 |
| Quakers Hill Pre-school | 40.180 – 40.280 | 100 | 400 |
| **Total Requirement** | **–** | **750** | **3,000** |

**Table 8-34 Potential extent of noise barriers required for the Project**

| Location | Chainage (km) | Length (m) | Height above rail (m) |
|---|---|---|---|
| Manorhouse Boulevard | 40.930 – 41.320 | 390 | 1.5 |
| Bridge Street and Tain Place | 43.530 – 43.720 | 190 | 1.5 |
| Quakers Hill Pre-school | 40.190 – 40.260 | 70 | 1.5 |
| **Total Requirement** | **–** | **650** | **–** |

### *Road traffic noise*

TIDC would undertake consultation with the GCC and other relevant stakeholders in order to reduce the potential noise related impacts associated with the bus interchange facilities at the new Schofields and Vineyard stations through careful land use planning and operational

measures. Land use planning measures could include options such as ensuring that commercial and industrial occupancies face onto the main operational zone of each precinct. Operational measures could include careful selection of bus routes and the implementation of 'quiet' buses into the area. It is also recommended that further noise assessment of the interchanges is undertaken once the design development and GCC planning processes have further progressed.

*Ground-borne noise*

A ground-borne noise assessment would be undertaken during the detailed design stage of the Project, once the location and extent of airborne mitigation measures have been determined.

**Future environment**

As discussed in Section 8.4.4, the impacts of the Project on the future environment are difficult to ascertain as planning for the NWGC is still in preliminary stages. Noise dampers and/or noise barriers have been considered as part of this Project only where impacts to existing sensitive receivers have been identified. Future residential development should be guided by the Department of Planning's (2008) *Development near rail corridors and busy roads – interim guideline*, and Clause 87(3) of the *State Environmental Planning Policy (Infrastructure) 2007*, which states that for development for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following $L_{Aeq}$ levels are not exceeded:

(a) in any bedroom in the building — 35 dB(A) at any time between 10 pm and 7 am

(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway) — 40 dB(A) at any time.

Potential noise and vibration impacts on the future environment could be reduced by appropriate land use zoning of surrounding areas. For example, commercial development, such as that of a town centre, would have a lower sensitivity to rail noise than residential development.

## 8.5 Non-Indigenous heritage

This section summarises the non-Indigenous heritage impacts associated with the Project based on the key findings of Technical Paper 3 — Non-Indigenous Heritage, contained in Volume 2. Measures proposed to manage identified non-Indigenous heritage impacts are also outlined. Existing non-Indigenous heritage values in the vicinity of the Project are described in Section 3.5.

### 8.5.1 Assessment approach

The key objective of the non-Indigenous heritage assessment was to identify historic/European (non-Indigenous) archaeological and cultural heritage values in the vicinity of the Project that are likely to be impacted during the construction and operation of the Project. The likely impacts associated with the proposed construction works and final project form were assessed for identified items of heritage significance (refer Section 3.5.2), based on the principles and guidelines of the *Burra Charter* (Australia ICOMOS 1999), the *NSW*