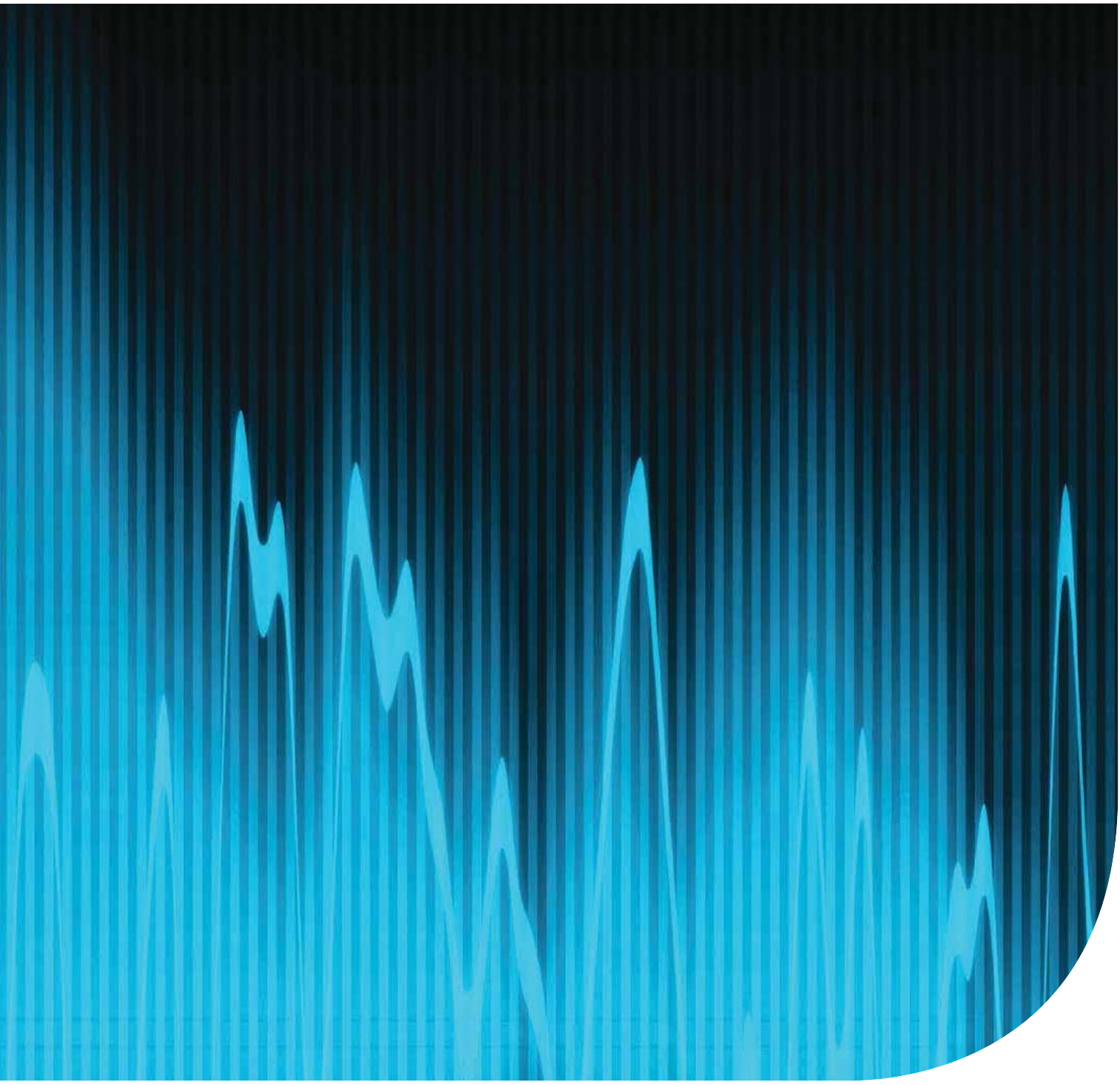
# Georges Cove Marina Residential Planning Proposal

## Acoustic study

Prepared for Mirvac Homes (NSW) Pty Ltd | 24 April 2018



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# Georges Cove Marina Residential Planning Proposal

Final

Report J17357RP1 | Prepared for Mirvac Homes (NSW) Pty Ltd | 24 April 2018

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|---|---|---|---|
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| Signature |  | Signature |  |
| Date | 24 April 2018 | Date | 24 April 2018 |



**Document Control**

| Version | Date | Prepared by | Reviewed by |
|---|---|---|---|
| v1 | 19/1/18 | Teanuanua Villierme | Najah Ishac |
| v2 | 31/1/18 | Teanuanua Villierme | Najah Ishac |
| v3 | 24/4/18 | Teanuanua Villierme | Najah Ishac |

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# 1 Introduction

EMM consulting Pty Ltd (EMM) has been engaged by Mirvac Homes (NSW) Pty Ltd (Mirvac) to prepare an acoustic assessment for the planning proposal relating to residential uses at the future Georges Cove Marina development (the project) at Lot 7 DP 1065574 in the Liverpool City Council Local Government Area (LGA). The subject site is on a 22 ha lot adjoining the Georges River and has previously been used for sand extraction, dredging and recycling operations. It is noted that the subject planning proposal is for the inclusion of an enabling clause allowing residential development within the RE2 zoning, and partial rezoning from RE2 to R3. Hence this study focuses on the proposed residential development within the subject site.

The acoustic study has been prepared with reference to the following relevant guidelines, policies and standards:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI) 2017;
- NSW Government, State Environmental Planning Policy (Infrastructure) 2007;
- Australian Standard AS/NZS 2107:2016 'Acoustics – Recommended design sound levels and reverberation times for building interiors'; and
- Building Code of Australia / National Construction Code (BCA/NCC) 2016, Volume One, Part F5.

This acoustic study references concept architectural drawings provided by Mirvac for the purposes of the planning proposal, which are provided in Appendix A.

Several technical terms are required for the discussion of noise. These are explained in Appendix B.

# 2 Project description

## 2.1 Overview

The planning proposal is seeking to amend Liverpool Council's Local Environmental Plan (LEP) to enable residential development within the development site. The proposed Georges Cove residential development includes the following main elements:

- 353 apartments (above ground floor retail facilities) and 21 terraces;
- 532 basement and 62 external carparking spaces to cater for both residential and other uses; and
- support infrastructure including power, water and sewerage services.

Refer to Appendix A for the proposed residential development concept layout.

## 2.2 Access and parking

Vehicular access from Brickmakers Drive to the proposed residential buildings will be provided via a road (and bridge) proposed to be constructed as part of the Moorebank Cove residential estate immediately north of the project, also proposed by Mirvac. The development will incorporate 594 car spaces, which will be provided by external parking areas and in basement carparks.

## 2.3 Marina

For the purposes of this assessment, the layout of the future marina development has been adopted as per the plans included in Appendix A and further detailed within the *Georges Cove Marina – Noise impact Assessment* report prepared by EMM dated 17 June 2015 (. The main elements of the marina include wet and dry berth facilities (eg dry dock building) for small craft, ground floor retail facilities and public recreational facilities on the foreshore including bike paths and walkways.

The marina berthing and associated activities (including the use of the dry dock forklift) would operate between 7 am and 10 pm seven days a week (including on public holidays). The retail facilities would generally operate between 7 am and 12 am (midnight) seven days a week (including on public holidays).

Deliveries and on-site maintenance of watercraft (dry dock workshop) would be limited to normal daytime business hours between 7 am and 6 pm Monday to Saturday, and 8 am to 6 pm on Sunday and public holidays.

## 2.4 Key noise matters

The key matters addressed as part of this study include potential industrial noise impact on the proposed residential development from the (approved, but yet to be constructed) Moorebank Recycling Facility to be located immediately to the south of the subject site. The Georges Cove Marina site layout (refer to concept plans in Appendix A) includes a dry dock building (approximately 20 m high) south of the proposed residential buildings. This provides significant acoustic shielding and therefore the expected remaining issue is potential truck movement noise from the future Moorebank Recycling Facility proposed access road and its impact on the development (apartments and terraces).

Further, the potential operational noise impact from the future marina activities (boat movements, refuelling, workshop and storage) and retail are also of consideration.

# 3 Existing environment

## 3.1 Existing acoustic environment

A key element in assessing environmental noise impact is to quantify the existing ambient and background noise levels at representative assessment locations.

Existing ambient noise levels for the project area have previously been reported in the following reports:

- *Georges Cove Marina – Noise impact Assessment* prepared by EMM dated 17 June 2015;
- *Liverpool City Council v Moorebank Recyclers Pty Ltd & Ors and Benedict Industries Pty Ltd & Ors v Minister for Planning & Ors – L&EC Proceedings No 2016/159652 and 2016/157848 - Expert Evidence of Renzo Tonin – Acoustics* prepared by Renzo Tonin & Associates (Renzo Tonin) for the NSW Land and Environment Court dated 17 August 2016; and
- *Statement of Evidence: Najah Ishac – Benedict industries Pty Limited and Tanlane Pty Ltd v Minister for Planning and Moorebank Recyclers Pty Ltd – Land & Environment Court Proceedings No. 16/*157848 (formerly 2015/10951) prepared by EMM for the NSW Land and Environment Court dated 21 July 2016.

A review of the noise monitoring data presented in these reports and as agreed in the consent conditions for the Moorebank Recycling Facility (Application No: 05_0157) showed that the area surrounding the subject site is generally dominated by distant and local traffic, typical suburban or urban noise, occasional aircraft noise and natural noise sources (eg birds and wind in foliage). Background noise levels were typically controlled by traffic on Newbridge Road in areas north of the site and/or by traffic on Brickmakers Drive.

## 3.2 Future industrial noise

The subject site is located immediately north of land having an approval for the Moorebank Recycling Facility. The Moorebank Recycling Facility is yet to be built. Potential noise impacts from the Moorebank Recycling Facility on the proposed residential development have been assessed based on concept plans for the purpose of the planning proposal. These will be finalised during the development application stage of the proposal.

## 3.3 Noise-enhancing meteorological conditions

Noise propagation over distance can be significantly affected by the meteorological conditions. Of most interest are source-to-receiver winds, the presence of temperature inversions or the combination of both, as these conditions can enhance received noise levels. To account for these phenomena, the NPI specifies the following two options:

1. adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur (conservative approach); and
2. determine the significance of noise-enhancing conditions.

### 3.3.1 Wind

Source-to-receiver wind (as being the directional component of wind) can enhance noise levels from a development at receivers.

The NPI states that where wind is identified to be a significant feature of the area then assessment of noise impacts should consider the highest wind speed up to 3 m/s, which is considered to prevail for at least 30% of the time. The NPI defines "significant" as the presence of source-to-receiver wind speed (measured at 10 m above ground level) of 3 m/s or less, occurring for 30% of the time or more in any assessment period and season.

### 3.3.2 Temperature inversion

The NPI states that the assessment of the impact of temperature inversion be confined to the night-time noise assessment period where temperature inversions generally occur. Sigma-theta data is required to determine the prevalence of temperature inversions, that is if they occur for 30% of the time or more during the night period.

### 3.3.3 Adopted meteorological conditions

The use of both 'standard' and/or 'noise-enhancing' meteorological conditions (NPI option 2) was conservatively adopted for this study. Standard and noise-enhancing conditions as presented in Table D1 of the NPI (EPA 2017) are reproduced in Table 3.1.

**Table 3.1 Standard and noise-enhancing meteorological conditions**

| Meteorological conditions | Meteorological parameters |
|---|---|
| Standard | Day/evening/night: stability categories A-D with wind speed up to 0.5 m/s at 10 m AGL |
| Noise-enhancing | Day/evening: stability categories A-D with light winds (up to 3 m/s at 10 m AGL) |
| | Night: stability categories A-D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL |

*Notes: 1. m/s - metres per second; m = metres; AGL = above ground level; stability categories are based on the Pasquill-Gifford stability classification scheme.*

*2. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night is the remaining periods.*

Industrial noise levels from the yet to be constructed Moorebank Recycling Facility have been modelled based on the meteorological parameters shown in Table 3.2.

**Table 3.2 Meteorological conditions adopted for noise modelling**

| Assessment period | Meteorological condition | Meteorological parameter | Air temperature | Relative humidity | Wind speed | Wind direction | Stability category |
|---|---|---|---|---|---|---|---|
| Day | Standard | Calm | 20°C | 70% | 0.5 m/s | All | D class |
| | Noise-enhancing | Wind | 20°C | 70% | 3.0 m/s | All | D class |

# 4 Project target noise levels

## 4.1 Industrial noise

Noise from industrial sites or processes (eg onsite traffic movements, mechanical plant, refuelling pumps etc) in NSW are regulated by the local council, the Department of Planning and Environment (DP&E) and/or the Environment Protection Authority (EPA), and usually have a licence and/or approval conditions stipulating noise limits. They are based on NPI guidelines (EPA 2017) or noise levels that can be achieved at a specific site following the application of all reasonable and feasible noise mitigation.

The objectives of assessment noise trigger levels for industry are to protect the community from excessive intrusive noise and preserve amenity for specific land uses. To ensure these objectives are met, the EPA provides two separate noise trigger levels: intrusiveness noise level and amenity noise level. The assessment of intrusiveness and amenity noise levels from the yet to be constructed Moorebank Recycling Facility were considered for the proposed residential development.

A review of the Renzo Tonin report (2016) and preliminary noise modelling indicated that the proposed dry dock building (approximately 20 m high) immediately south of the proposed apartment buildings and the noise mitigation measures (ie earth bunds) to be constructed for the Moorebank Recycling Facility (required by their approval conditions), are expected to provide a significant degree of acoustic shielding from the approved Moorebank Recycling Facility's on-site noise emissions. It is therefore anticipated that noise from the approved Moorebank Recycling Facility's road truck movements on their private access road, immediately west of the subject site boundary, will be the only material industrial noise source affecting the proposed residential buildings.

In regards to industrial noise from private access roads, the NPI (EPA 2017) states:

> Where a private haul road is proposed to convey materials from one premises to another and is proposed for the express purpose of removing traffic from a public road, the private haul road should be assessed against the project amenity noise levels only.

Given the above, the noise impact from the Moorebank Recycling Facility haul road was assessed only against the amenity noise levels, relevant to the proposed residential development.

The assessment of amenity is based on trigger noise levels specific to the land use. The trigger noise levels relate only to industrial noise and exclude road or rail noise. The noise amenity category that represents the proposed residences in the fully developed subject site (including the future Marina), and should the Moorebank Recycling Facility be constructed and operated, is urban as described in Table 2.3 of the NPI (EPA 2017). The daytime ambient noise environment for the fully developed project would likely be dominated by the marina activities, industrial noise from the Moorebank Recycling Facility (from access road truck movements) and general mixed use noise sources (from retail and recreational uses). The NPI's amenity category relies on a number of factors including the typical planning zoning, and by extension the permitted land uses. Whilst the subject site is currently zoned RE1 or RE2, it is clear that, if approved, the future permitted land use would be mixed use comprising the marina, retail and medium to high density residential. On this 'future' basis, the NPI's urban category has been adopted for potential future residences of the Georges Cove development as this category applies to mixed use and high density residential developments as per Table 2.3 of the NPI reproduced in Table 4.1.

**Table 4.1 Urban residential category**

| Receiver category | Typical planning zoning - standard instrument[1] | Typical existing background noise levels | Description |
|---|---|---|---|
| Urban residential | R1 – general residential<br>R4 – high density residential<br>B1 – neighbourhood centre (boarding houses and shop-top housing)<br>B2 – local centre (boarding houses)<br>B4 – mixed use | Daytime RBL>45 dB(A)<br>Evening RBL>40 dB(A)<br>Night RBL>35 dB(A) | An area with an acoustical environment that:<br>- is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources<br>- has through-traffic with characteristically heavy and continuous traffic flows during peak periods<br>- is near commercial districts or industrial districts<br>- has a combination of the above |

*Notes: 1. As cited in Standard Instrument - Principal Local Environment Plan, New South Wales Government, Version 15 August 2014.*

The amenity noise levels adopted for the future residential elements of the project are given in Table 4.2.

**Table 4.2 Amenity noise levels for the project**

| Receiver type | Indicative area | Assessment period | Recommended amenity $L_{Aeq}$ noise level[1], dB | Project amenity $L_{Aeq}$ noise level[2], dB |
|---|---|---|---|---|
| Residence | Urban | Day | 60 | 60 |
| | | Evening | 50 | 50 |
| | | Night | 45 | 45 |

*Notes: 1. In accordance with Table 2.2 of the NPI (EPA 2017).*

*2. In accordance with Section 2.4 of the NPI (EPA 2017), project amenity noise levels are the recommended amenity noise levels as no other industries are present or likely to be introduced into the area.*

## 4.2 Residential internal acoustic amenity

The NSW Government Infrastructure State Environmental Planning Policy (SEPP) (2007) and Australian Standard AS/NZS 2107-2016 provide guidance on design criteria for the acoustic environment within occupied building spaces. Table 4.3 provides a summary of desirable internal $L_{Aeq}$ noise levels for residential developments relevant to the proposed development (apartments and terraces) in accordance with the SEPP (2007). These are intended for assessment of road and rail traffic noise, and provide a benchmark for internal noise expectations.

**Table 4.3 Recommended internal noise levels for residential buildings**

| Type of occupancy | $L_{Aeq}$ noise level, dB | Applicable time period |
|---|---|---|
| Sleeping areas (bedrooms) | 35 | 10 pm to 7 am |
| Living areas (excluding garages, kitchens, bathrooms & hallways) | 40 | Any time |

*Source: NSW Infrastructure SEPP (2007).*

These recommended internal $L_{Aeq}$ noise levels were adopted to assess to potential impact of access road traffic noise from the Moorebank Recycling Facility on the proposed residential development.

# 5 Noise modelling and assessment

## 5.1 Modelling software

This section presents the methods and assumptions used to model access road traffic noise levels at the proposed apartments and terraces.

The noise levels were modelled using Brüel & Kjær Predictor noise modelling software. 'Predictor' calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. The model considers factors such as:

- the lateral and vertical location of noise sources;
- source-to-receiver distances;
- ground effects;
- atmospheric absorption;
- topography of the subject site and surrounding area; and
- applicable meteorological conditions.

## 5.2 Industrial noise impact on the proposed development

### 5.2.1 Moorebank Recycling Facility

As discussed earlier, the land to the south of the subject development has been approved for development (for the Moorebank Recycling Facility) but remains vacant land at this time. Hence, the following section is provided to future proof the proposed residential development occupants should industrial use occur. Furthermore, any outcomes such as identified mitigation measures as a consequence of this potential future industrial noise should only be imposed once the Moorebank Recycling Facility is constructed.

The Moorebank Recycling Facility has the potential to impact on the proposed residential development, specifically from the Moorebank Recycling Facility's access road traffic movements. The traffic noise from the Moorebank Recycling Facility was modelled and assessed based on information provided in the Moorebank Recycling Facility project approval and the Renzo Tonin report prepared for the NSW Land and Environment Court dated 17 August 2016.

Noise levels from the Moorebank Recycling Facility access road traffic were predicted at the most affected building facades (western facades) for all floor levels of the proposed apartments and terraces. No future industrial noise sources are present or likely to be introduced into the area other than the Moorebank Recycling facility and therefore noise levels from the Moorebank Recycling Facility were assessed against the relevant amenity noise levels in Table 2.2 of the NPI (EPA 2017).

The results are provided in Table 5.1. Noise levels have been predicted based on the daytime meteorological conditions provided in Table 3.2.

**Table 5.1 Proposed Moorebank Recycling Facility daytime noise levels at the proposed apartments and terraces**

| Residential building | Receiver type | Predicted $L_{Aeq,15\ min}$[1], dB | Amenity $L_{Aeq,15\ min}$ noise level[2], dB | Exceedance, dB |
|---|---|---|---|---|
| Western apartment buildings[3] | Residence[5] | 59-61 | 63 | Nil |
| Western terraces[3] | Residence[5] | 59-61 | 63 | Nil |
| Eastern apartment buildings[4] | Residence[5] | 39-49 | 63 | Nil |
| Eastern terraces[4] | Residence[5] | 46-52 | 63 | Nil |

*Notes:* *1. Range of predicted noise levels are for all floors at the most affected building facade.*

*2. $L_{Aeq,15\ min}$ is equal to $L_{Aeq,period}$ + 3 dB as per the NPI (EPA 2017). In accordance with Section 2.4 of the NPI (EPA 2017), cumulative industrial noise is not a necessary consideration as no other industries are present or likely to be introduced into the area.*

*3. Residential buildings closer to the Moorebank Recycling Facility's private road further to the west.*

*4. Residential buildings closer to the marina berths further to the east.*

*5. Urban residential amenity area.*

Noise levels from the Moorebank Recycling Facility are predicted to satisfy the daytime amenity noise levels on all floor levels of the apartment buildings and residential terraces during worst case meteorological conditions. The proposed residential development is therefore not expected to be impacted by industrial noise in accordance with the NPI.

### 5.2.2 Marina noise

The marina development as shown in Appendix A has been designed with the provision of a buffer for potential residential premises within the subject site. Notwithstanding, the proposed residential buildings design would need to consider the mitigation of potential noise from marina berthing activities (eg noise from vessels), in particular for the eastern apartments and terraces. Acoustic screening (eg louvres) on the eastern balconies of the apartments and terraces facing the marina berths would likely provide acoustic attenuation. However, it is anticipated that noise mitigation and management specific to each unit will be assessed in further detail at the development application stage.

### 5.2.3 Retail noise

The project design would need to consider the mitigation of potential noise from ground level retail and general foot traffic. An awning above the retail facilities and a concrete floor slab separating retail and residential spaces (eastern apartment buildings only) above would likely provide sufficient acoustic isolation.

In addition, individual retail tenancies will be required to manage their operation so as to prevent adverse noise impacts on the apartments above. It is anticipated that noise mitigation and management specific to individual tenancies will be developed at the development application stage (if required) of those tenancies when proposed uses are known.

## 5.3 Residential internal acoustic amenity

Noise levels from the approved Moorebank Recycling Facility's private access road truck movements were predicted for all floor levels of the proposed apartment buildings and terraces to assess internal noise levels as discussed in Section 4.2. Internal noise levels were not assessed for the night-time period (eg in bedrooms) as the Moorebank Recycling Facility is not approved to operate during the night-time period.

Internal noise levels from the approved Moorebank Recycling Facility's access road predicted at all residential facades are provided in Table 5.2. Noise levels are worst case and have been predicted based on the daytime meteorological conditions provided in Table 3.2. A typical (industry accepted standard) 10 dB reduction has been assumed for external-to-internal noise levels with windows partially open to allow for natural ventilation.

**Table 5.2 Proposed Moorebank Recycling Facility daytime internal noise levels at the proposed apartments and terraces**

| Residential building | Predicted internal $L_{Aeq}$ noise level[1,2], dB | Internal $L_{Aeq}$ noise criteria for living spaces | Exceedance, dB |
|---|---|---|---|
| Western apartment buildings[3] | 46-48 | 40 | **6-8** |
| Western terraces[3] | 46-48 | 40 | **6-8** |
| Eastern apartment buildings[4] | 26-36 | 40 | Nil |
| Eastern terraces[4] | 33-39 | 40 | Nil |

*Notes: 1. Range of predicted noise levels are for all floors for rooms adjacent to west facing building facade.*

*2. A 10 dB reduction has been assumed for external-to-internal noise levels with windows partially open.*

*3. Residential buildings closer to the Moorebank Recycling Facility's private road further to the west.*

*4. Residential buildings closer to the marina berths further to the east.*

The modelling results demonstrate that daytime internal noise levels for living spaces facing the approved Moorebank Recycling Facility's private access road to the west are predicted to satisfy the relevant criteria on all floor levels for the eastern apartment buildings and terraces.

For the western apartment buildings and terraces, daytime internal noise levels for living spaces facing the Moorebank Recycling Facility's private road to the west are predicted to be above the relevant criteria by up to 8 dB with partially open windows. Noise mitigation measures are therefore recommended for the proposed western apartment buildings and terraces to comply with the criteria provided within the SEPP (2007).

Industrial noise mitigation measures are discussed in Section 6.

# 6 Industrial noise mitigation measures

The assessment demonstrated that industrial noise levels from the approved Moorebank Recycling Facility's access road truck movements have the potential to impact on the proposed residential building design for western apartment buildings and terraces. Feasible and reasonable noise mitigation measures are discussed in the following sections. As noted earlier, given that the Moorebank Recycling Facility is yet to be constructed, any measures herein to mitigate that industrial noise should only be imposed once the facility is constructed. Otherwise the imposition of, a noise barrier for example, would be unreasonable to the development.

## 6.1 Noise barrier

A 3 m high noise barrier or earth bund (or combination of both) was modelled along the entire western site boundary and extending eastward along the northern boundary for approximately 16 m. It is noted that the relevant western and northern site boundaries are at higher elevation than the Moorebank Recycling Facility's proposed private road alignment.

The noise barrier would provide a significant reduction in industrial noise levels for most apartments and terraces, with the most significant acoustic benefits observed at the lower floor levels. Further, this would provide sufficient attenuation for industrial noise levels to satisfy the internal noise criteria for most of the apartments and terraces in accordance with the SEPP (2007). The exception would be at the higher floor levels of the western apartment buildings (including level 6, level 7 and level 8) where industrial noise levels are predicted to remain marginally (by up to 2 dB) above the relevant internal criteria.

## 6.2 Residential building design

Future residents of the proposed development will move in with the knowledge of the marina's activities and therefore would have an expectation consistent with such an acoustic environment. Hence the focus should be on building design treatment of units with the most potential to be affected by industrial noise from the Moorebank Recycling Facility.

Noise mitigation measures associated with the design of the residential buildings can achieve significant noise reduction. Taking into account the attenuation afforded by the construction of the noise barrier as provided in the previous section, the implementation of contemporary building design techniques for all units on floor level 6, level 7 and level 8 of the western apartment buildings would provide additional and sufficient acoustic attenuation to satisfy the internal noise criteria in accordance with the SEPP (2007). Contemporary building design techniques could include:

- partial acoustic screening (eg wintergarden with louvres) if balconies are constructed on the west facing side of the building;
- location of sleeping areas (bedrooms) on the eastern side of the buildings; and
- provision of mechanical ventilation in accordance with BCA requirements to allow occupants to keep windows/doors closed.

# 7 Conclusion

EMM has completed an acoustic assessment for the Georges Cove Marina residential development planning proposal at Moorebank, NSW.

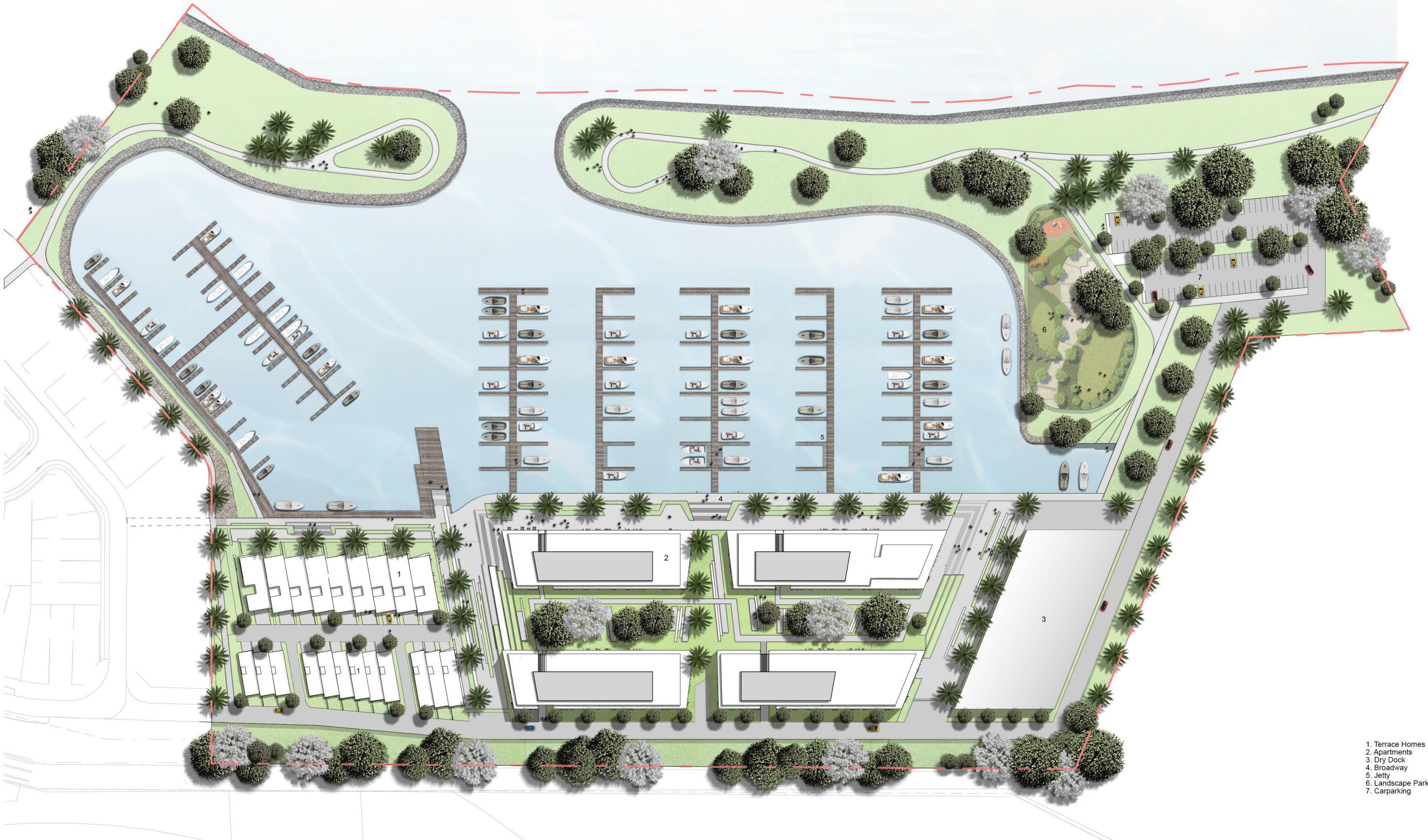
Although the future (approved) Moorebank Recycling Facility is yet to be constructed, the potential noise impact of the facility on the proposed residential development was assessed. It was found that industrial noise levels from the Moorebank Recycling Facility, specifically from traffic movements on their proposed access road, will satisfy NPI amenity noise trigger levels.

Further, the potential impact of daytime industrial noise from the Moorebank Recycling Facility on the proposed apartments and terraces internal noise levels was assessed. The study demonstrated that daytime internal noise levels are predicted to satisfy the relevant criteria on all floor levels for the eastern apartment buildings and terraces. For the western apartment buildings and terraces, daytime internal noise levels for living spaces facing the Moorebank Recycling Facility's private road to the west require contemporary noise mitigation measures to achieve acceptable internal noise levels. This can include noise control and building design techniques provided herein for the proposed western apartment buildings and terraces.

# Appendix A

## Concept architectural drawings

MIRVAC
DESIGN




1. Terrace Homes
2. Apartments
3. Dry Dock
4. Broadway
5. Jetty
6. Landscape Park
7. Carparking

# Georges Cove Marina

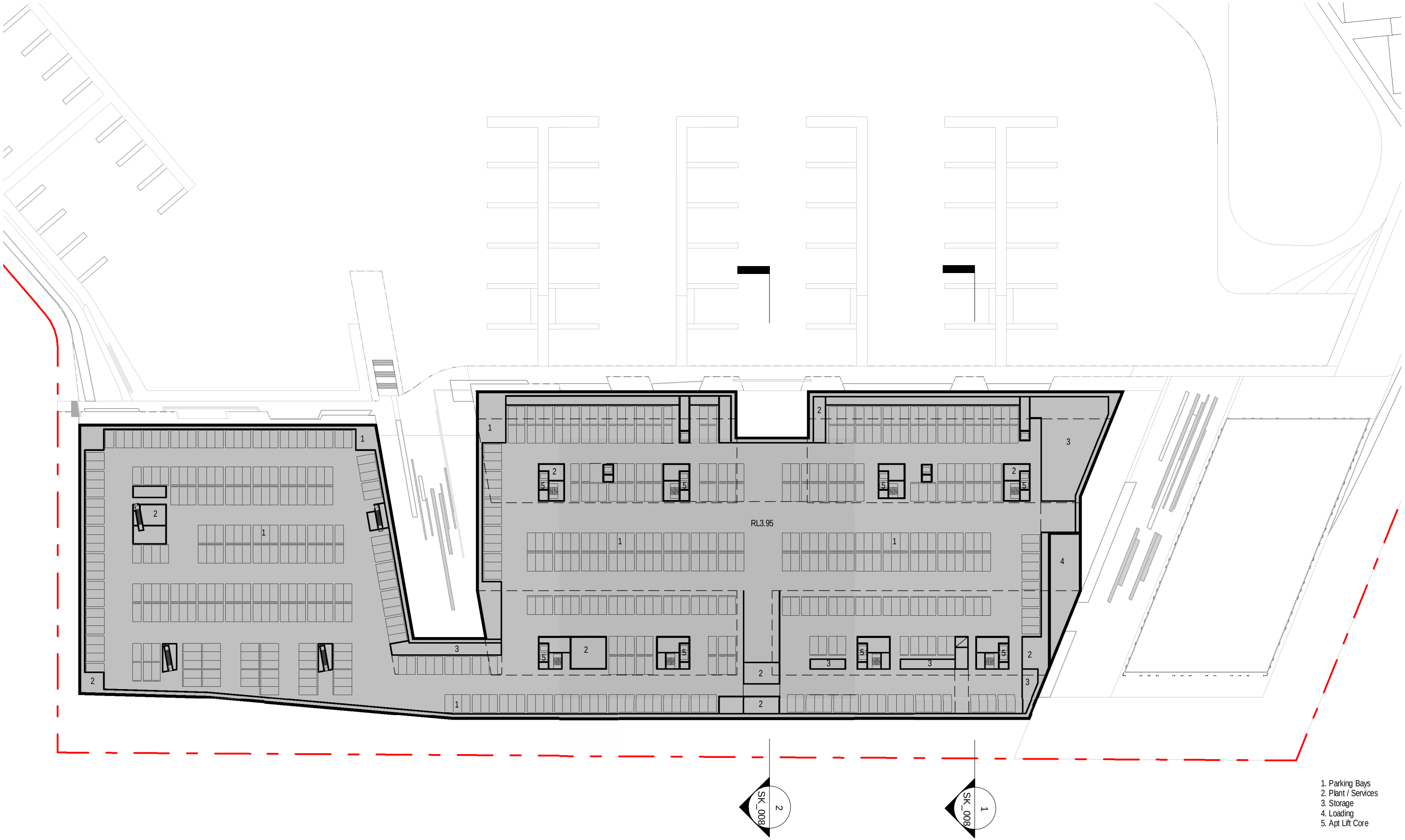
0 18.75 37.5 75

Scale 1 : 1500

## SITE PLAN

SK_001

MIRVAC
DESIGN




1. Parking Bays
2. Plant / Services
3. Storage
4. Loading
5. Apt Lift Core

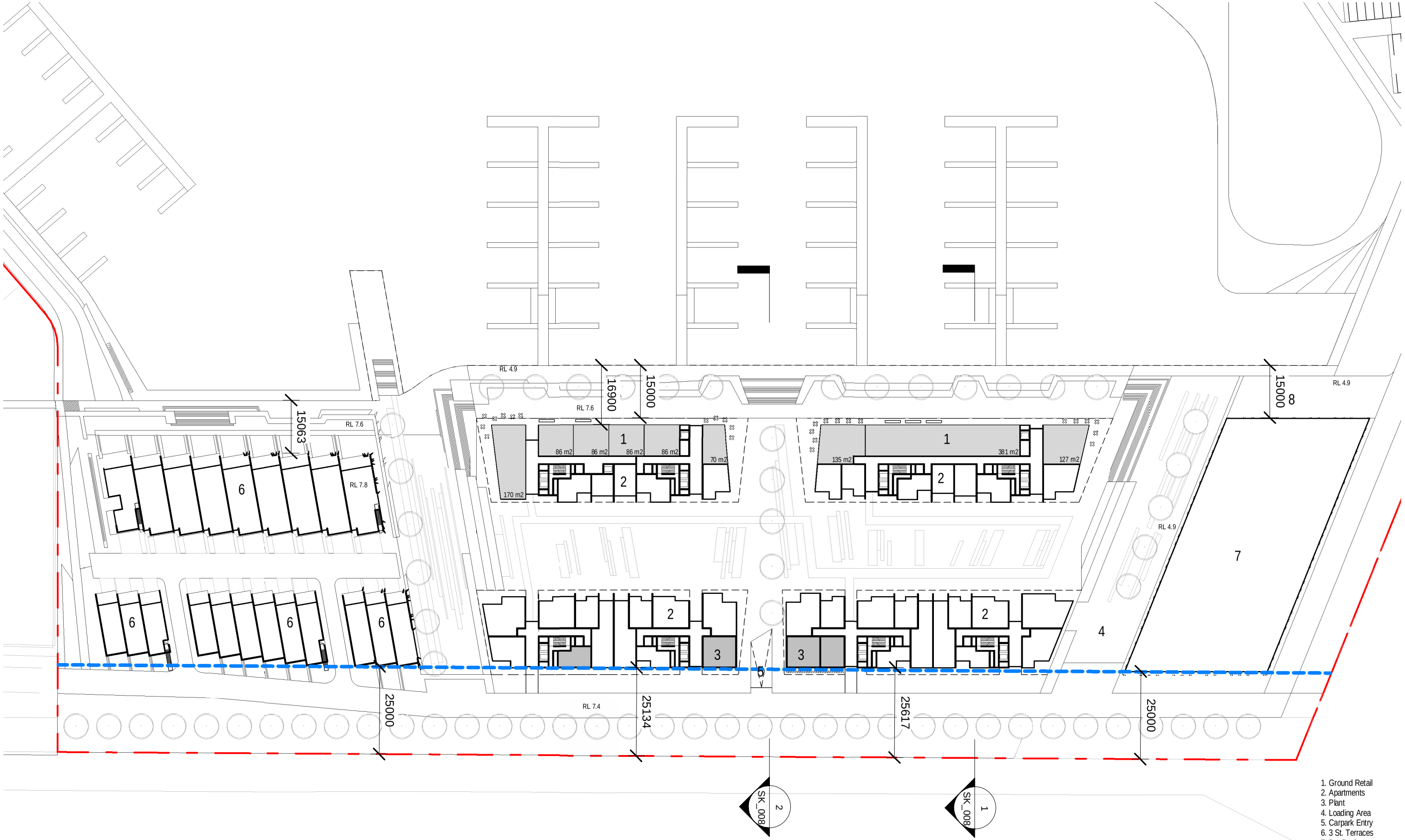
**Georges Cove Marina**

0 12.5 25 50
Scale 1 : 1000

**BASEMENT**

SK_002 E

MIRVAC
DESIGN




1. Ground Retail
2. Apartments
3. Plant
4. Loading Area
5. Carpark Entry
6. 3 St. Terraces
7. Dry Dock
8. Dry Dock Loading

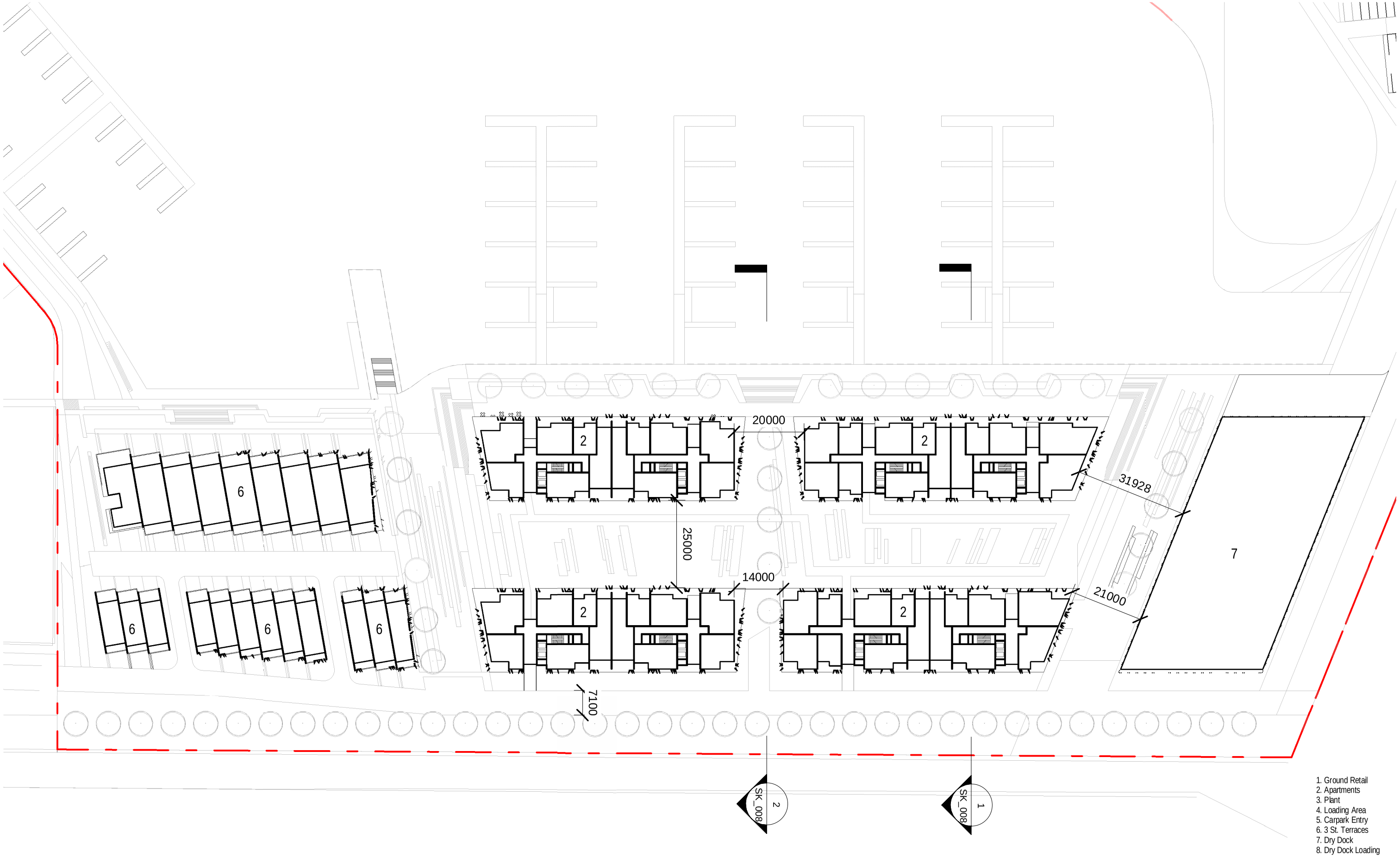
**Georges Cove Marina**

0 6.25 12.5 25
Scale 1 : 500

**LEVEL 1**

SK_003 E

MIRVAC
DESIGN




1. Ground Retail
2. Apartments
3. Plant
4. Loading Area
5. Carpark Entry
6. 3 St. Terraces
7. Dry Dock
8. Dry Dock Loading

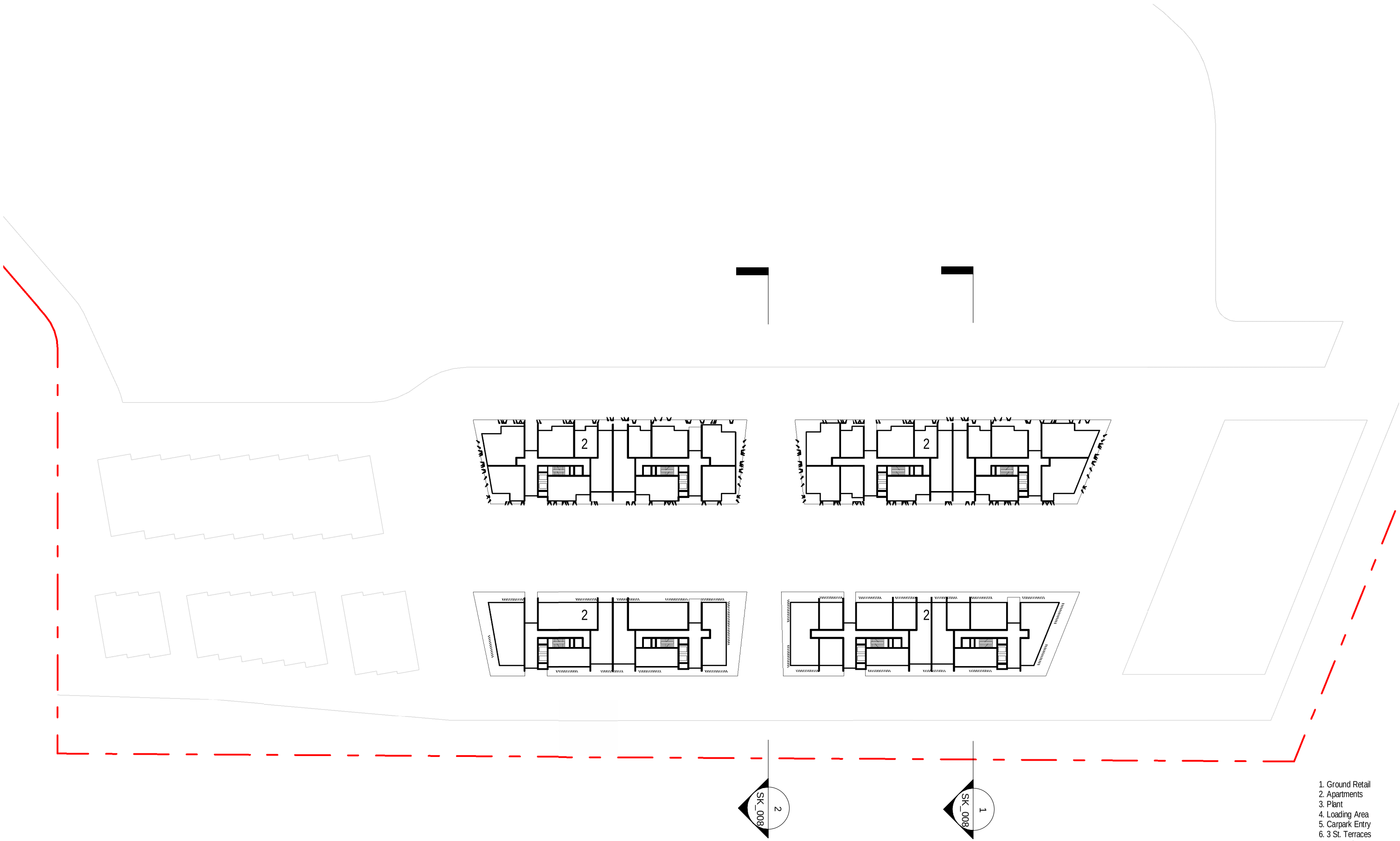
**Georges Cove Marina**

0 6.25 12.5 25
Scale 1 : 500

**LEVEL 2-6** (excl. Terraces)

SK_004 E

MIRVAC
DESIGN




1. Ground Retail
2. Apartments
3. Plant
4. Loading Area
5. Carpark Entry
6. 3 St. Terraces
7. Dry Dock
8. Dry Dock Loading

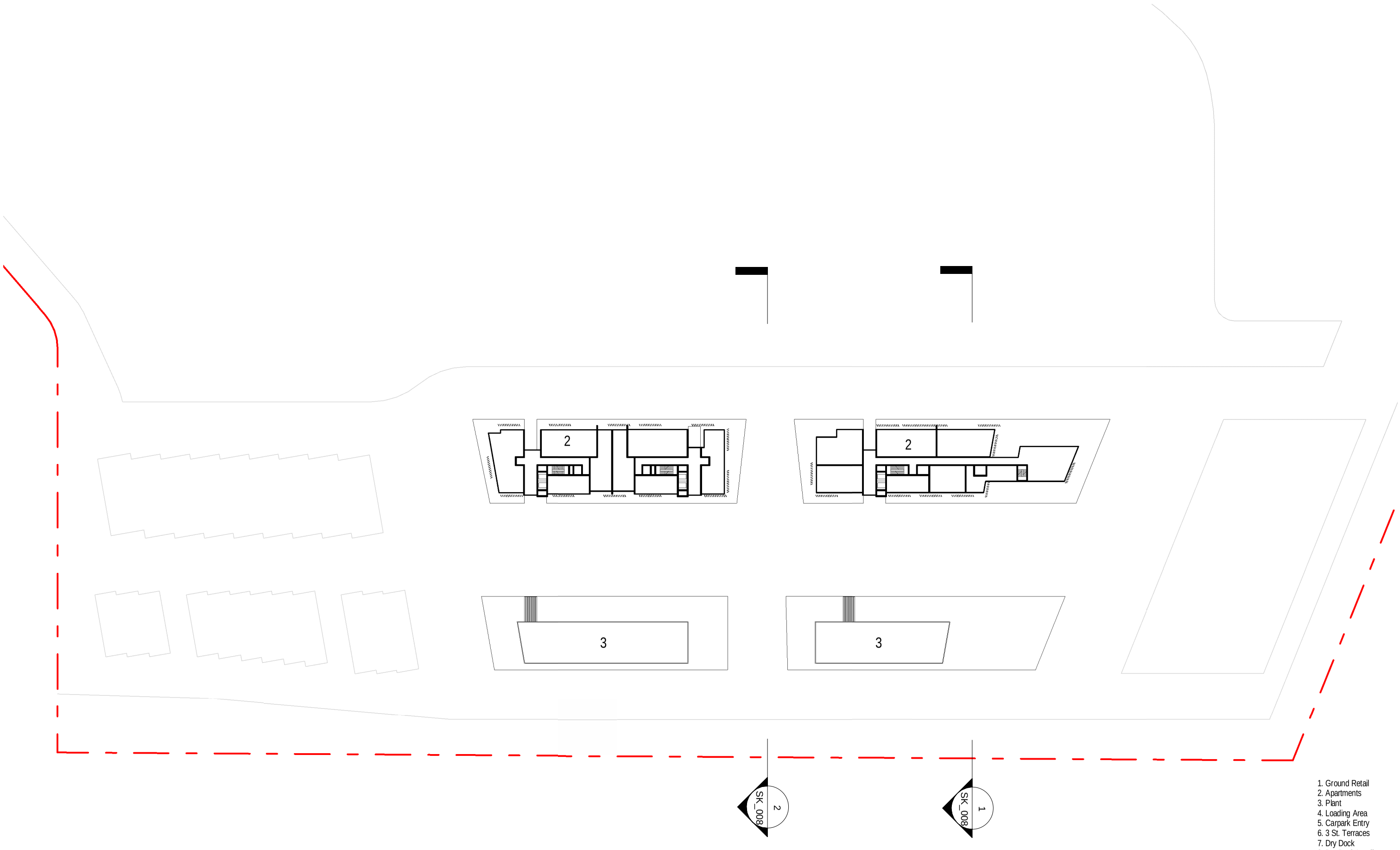
**Georges Cove Marina**

0 6.25 12.5 25
Scale 1 : 500

**LEVEL 7**

SK_005 E

MIRVAC
DESIGN




1. Ground Retail
2. Apartments
3. Plant
4. Loading Area
5. Carpark Entry
6. 3 St. Terraces
7. Dry Dock
8. Dry Dock Loading

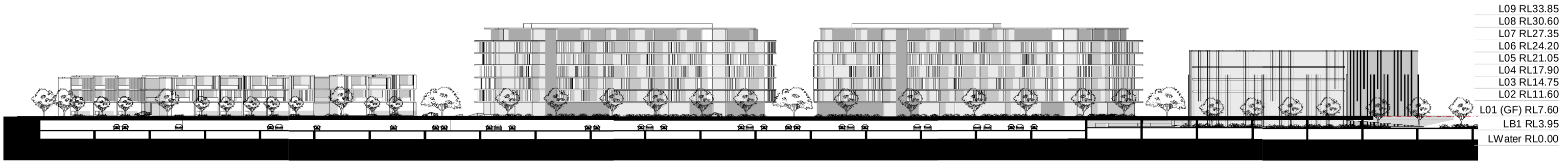
**Georges Cove Marina**

0 6.25 12.5 25
Scale 1 : 500

**LEVEL 8**

SK_006 E

MIRVAC
DESIGN


**Georges Cove Marina**

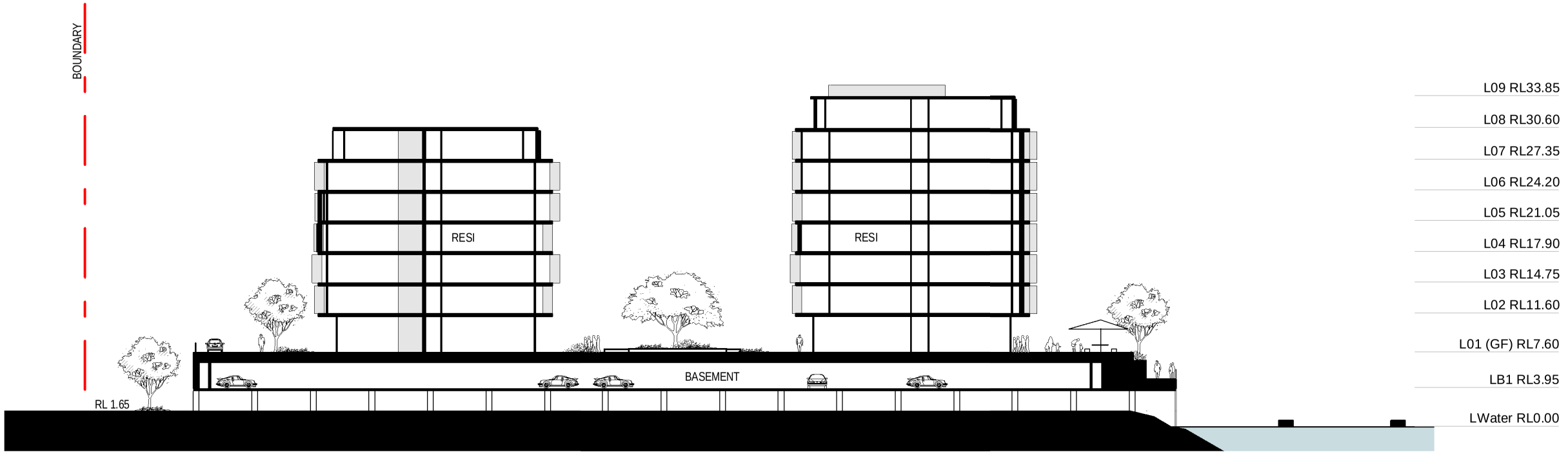
0 12.5 25 50

Scale 1 : 1000

**ELEVATIONS**

SK_007 E

MIRVAC
DESIGN





**Georges Cove Marina**

0 6.25 12.5 25

Scale 1 : 500

**SECTIONS**

SK_008 E

# Appendix B

## Acoustic terms

A glossary of acoustic and other terms referenced in this report are provided in Table B.1.

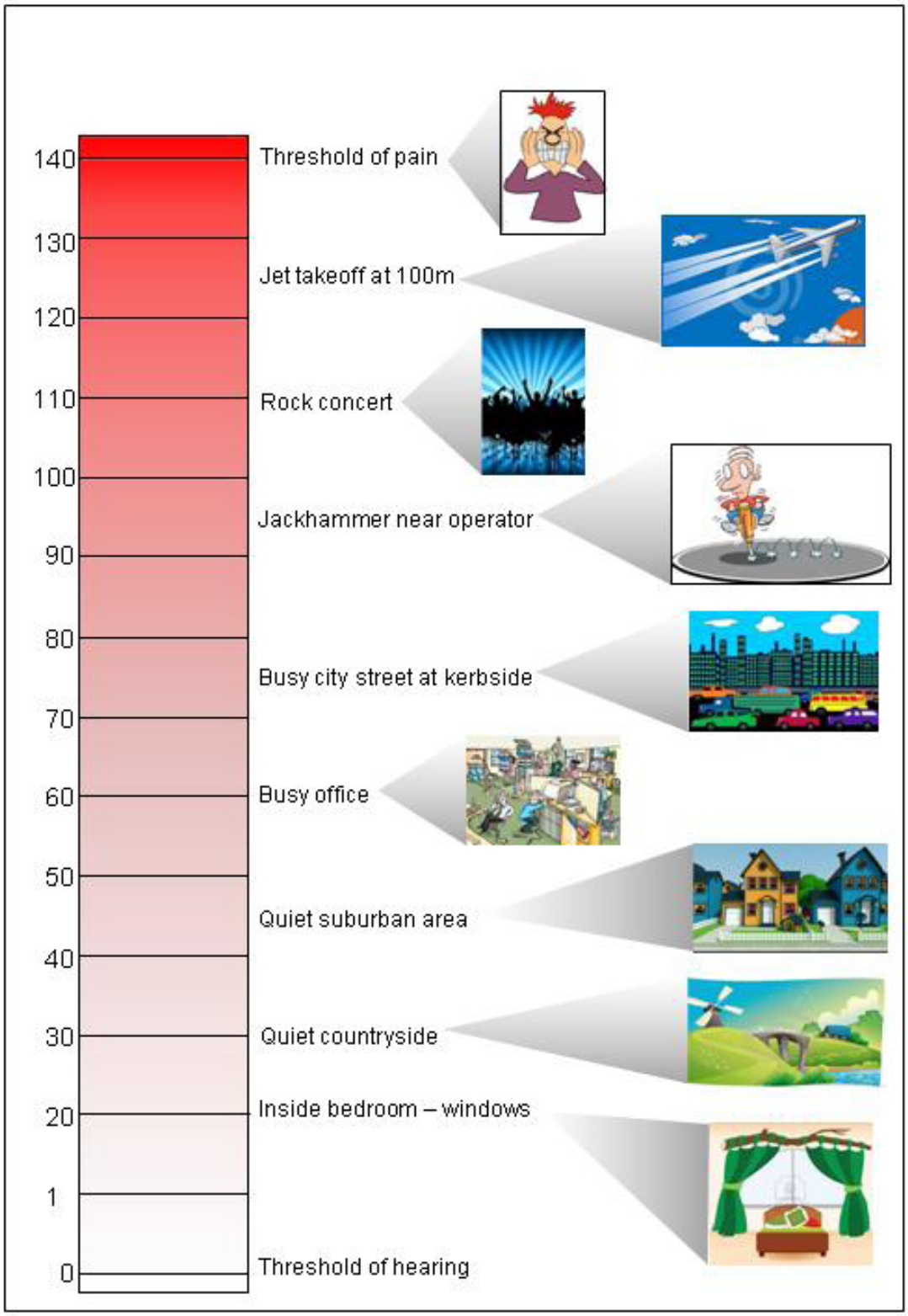
### Table B.1 Glossary of terms

| Abbreviation or term | Definition |
|---|---|
| ABL | The assessment background level (ABL) is defined in the NPI as a single-figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured $L_{A90,15\ min}$ statistical noise levels. |
| Amenity noise level | The amenity noise level relate to existing industrial noise. Where industrial noise approaches base amenity noise level, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise. See Section 3.1.2 for more detail. |
| Day period | Monday–Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm. |
| dB | Noise is measured in a unit called decibel (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale which attempts to closely approximate the frequency response of the human ear. |
| EPA | The NSW Environment Protection Authority (formerly the Environment Protection Authority and the Department of Environment, Climate Change and Water). |
| Evening period | All days: 6 pm to 10 pm (including public holidays). |
| NPI | Noise Policy for Industry (NSW). |
| Intrusiveness noise level | The intrusiveness noise level refer to noise that intrudes above the background level by more than 5 dB. The intrusiveness noise level is described in detail in Section 2.3. |
| $L_{A90}$ | The A-weighted sound pressure level measured that is exceeded 90% of the time. This is a measure of the background noise level. |
| $L_{Aeq}$ | The energy average noise from a source. This is the equivalent continuous A-weighted sound pressure level over a given period. The $L_{Aeq,15\ min}$ descriptor refers to an $L_{Aeq}$ noise level measured over a 15-minute period. |
| $L_{Amax}$ | The maximum A-weighted sound pressure level measured during a measuring interval. |
| Night period | Monday–Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am. |
| PNTL | The project noise trigger level (PNTL) is a target noise level for a particular noise-generating facility. The PNTL is the lower of either the intrusiveness noise level or amenity noise level. |
| RBL | The rating background level (RBL) is an overall single value background level representing each assessment period (day/evening/night) over the monitoring period. The RBL is used to determine the intrusiveness level for noise assessment purposes and is the median of the assessment background levels. |
| RNP | Road Noise Policy (NSW). |
| Sound power level | A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment. |

Table B.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure B.1.

### Table B.2 Perceived change in noise

| Change in sound pressure level (dB) | Perceived change in noise |
|---|---|
| 3 | just perceptible |
| 5 | noticeable difference |
| 10 | twice (or half) as loud |
| 15 | large change |
| 20 | four times (or quarter) as loud |




*Source: Noise Measurement Manual (Queensland Department of Environment and Heritage Protection 2013).*

**Figure B.1 Common noise levels**

SYDNEY
Ground floor, Suite 01, 20 Chandos Street
St Leonards, New South Wales, 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 1, Suite 6, 146 Hunter Street
Newcastle, New South Wales, 2300
T 02 4907 4800 F 02 4907 4899

BRISBANE
Level 4, Suite 01, 87 Wickham Terrace
Spring Hill, Queensland, 4000
T 07 3839 1800 F 07 3839 1866