# 18.0 European Heritage

**Relevant DGRs**: The EIS must address **Heritage** – including a non-Aboriginal cultural heritage assessment (including both cultural and archaeological significance) which must:

- Include a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items including the Shell Oil Refinery Wharf and the surrounding wetland areas on the banks of the Parramatta and Duck Rivers and their tributaries; and
- Outline any proposed management and mitigation measures.

## 18.1 Existing Conditions

This Section summarises the findings of the historical heritage assessment that was prepared by AECOM for inclusion in this EIS regarding issues of European heritage. The historic heritage assessment is provided in **Appendix E** of **Volume 2** of this EIS.

The Project Area was found to have four key historical phases as follows:

- Aboriginal occupation pre 1804 colonial occupation of the area;
- Early land grants and Elizabeth Farm between 1816 and 1918;
- John Fells & Co between 1918 and 1927; and
- British Imperial Oil/Shell since 1928 until the present day.

A detailed outline of the historical operations of the Clyde Refinery, before refining operations ceased and it became the Clyde Terminal, is provided in **Section 4** of **Appendix E**.

### 18.1.1 Methodology

The heritage assessment assessed the significance of the Project Area according to the NSW Heritage Office guidelines *Assessing Heritage Significance* (NSW Heritage Office, 2001). There were two main components to this heritage assessment:

- Desktop historical research to gain an appreciation of the history of the Project Area; and
- A site inspection.

### 18.1.2 Desktop Investigations

A desktop analysis was undertaken to determine the location of items of historical significance on or in the vicinity of the Project Area. This included an examination of records held by the following institutions:

- National Archives of Australia;
- NSW State Records;
- Trove - newspaper accounts of the Project Area;
- State Library of NSW (particularly records held within the Mitchell Library);
- Lane Cove Public Library;
- Parramatta Heritage Centre; and
- Collections of maps and images held by Shell Australia.

Of the institutional records listed above, the records held by Trove and in Mitchell Library, Lane Cove Public Library and also by Shell were of the greatest assistance, and were used to inform an overview of the four key historical phases referred to in **Section 18.1**. The findings of that desktop historical research are outlined in **Table 18-1**.

**Table 18-1 Listed Heritage Items within and adjacent to the Project Area**

| Heritage List | Sites within the Project Area | Level of Significance | Sites Adjacent to the Project Area[1] | Level of Significance |
|---|---|---|---|---|
| World Heritage List | None | NA | None | NA |
| Commonwealth Heritage List | None | NA | None | NA |
| National Heritage List | None | NA | None | NA |
| Register of the National Estate (RNE) (Non-statutory archive) | None | NA | Lower Duck River Wetlands (RNE No. 19254, Registered Place) | Registered |
| | None | NA | Parramatta and Lane Cove Rivers Landscapes (RNE No. 14309, Indicative Place) | Indicative Place |
| State Heritage Register | None | NA | None | NA |
| *Parramatta LEP 2011* | [2]Wetlands (Item No. I1) | Local | [2]Wetlands (Item No. I1) | Local |
| | | | Pumping Station (Item No. I5) | Local |
| | | | Tram alignment (Item No. I6) | Local |
| | | | Silverwater Bridge (Item No. I73) | Local |
| | | | Capral Aluminium (Item No. I575) | Local |
| | | | RTA Depot (Item No. I576) | Local |
| | | | Sewage Pumping Station 67 (Item No. I01643) | Local |
| Sydney Regional Environmental Plan No. 28 – Parramatta 2005 | None | NA | Shell Oil Refinery Wharf (Item No. 35) | Local |
| Parramatta Plan 28 | None | NA | Tram alignment | Local |
| | None | NA | Sewage Pumping Station 67 | Local |
| State Heritage Inventory for Section 170 and REP listed items | None | NA | None | NA |
| Parramatta Archaeological Zoning Plan | Parramatta Archaeological Management Unit 2966 | No archaeological potential | None | NA |

Note: 1 Adjacent has been defined as having a common boundary or being within a line of sight. Refer to **Section 6.14** of **Appendix E**.
2 Wetlands (Item No. I1) occurs both within the Project Area and directly adjacent to it, as this Item No. I1 refers to an extensive riparian vegetation zone.

The Project Area is adjacent to the non-statutory RNE listings of the Parramatta and Lane Cove Rivers Landscape (RNE No. 14309), and the Lower Duck River Wetlands (RNE No. 19254). The listing for the Parramatta and Lane Cove Rivers Landscape is indicative, meaning information regarding the site had been entered into the Register, but a formal nomination was not been made by the time the RNE was suspended. Since this time no new entries have been accepted into the Register. The listing is undeveloped and contains no information regarding the significance of the area. However, the Project is not anticipated to impact on this heritage item, and as such no further consideration was given to it. The Lower Duck River Wetlands was found to be a registered place, meaning it was entered into the Register prior to its closure in 2007. The Wetlands are listed for their ecological values and, as such, are beyond the scope of the heritage report. Consideration of the Wetlands and the areas comprising the Lane Cove Rivers Landscape is provided in **Section 16.3**. From this analysis, it can be concluded that the Project would not impact on the ecological and therefore historical values of these wetlands (refer to **Section 16.3**).

There is one heritage item listed under LEP 2011 within the Project Area – Wetlands (I1). This heritage item also includes the riparian vegetation that runs along the southern and eastern boundary of the Project Area (refer to **Figure 1-5**). There are a further six LEP listed items located adjacent to the Project Area. All six items are sites of local significance. These items comprise the wetlands (I1), pumping station (I5), tram alignment (I6), Silverwater Bridge (I73), Capral Aluminium (I575), RTA Depot (Item No. I576) and Sewage Pumping Station 67 (Item No. I01643). It should be noted that while these items are adjacent to the Project Area, they are not in the immediate vicinity of proposed works and would not experience direct impact from the Project. The Project Area does not fall within, or adjacent to, any heritage conservation areas. One item was also identified adjacent to the Project Area on the Sydney Harbour Catchment Regional Environmental Plan 2005, this being the Shell Oil Refinery Wharf (35).

### 18.1.3 Previous Heritage Assessments

Prior to the current report, Shell had not commissioned a heritage assessment of the Clyde Terminal site. The Project Area was, however, encompassed within the *Parramatta Historical Archaeological Landscape Management Study* (Godden Mackay Logan, 2001) (PHALMS), prepared for the NSW Heritage Office and the Parramatta City Council. A detailed outline of this Study is provided in **Section 5.3** of **Appendix E**.

According to the Statement of Significance on the PHALMS inventory sheet (refer to **Section 5.3.2** of **Appendix E**), the Archaeological Management Unit 2966 within which the Project Area falls is of no archaeological significance, and has no archaeological research potential. This is despite it being assessed as providing evidence of a range of historical processes and activities relating to the history of Parramatta under the NSW State Heritage Register Criterion A – historical significance. For a detailed description of Criterion A and the remaining NSW State Heritage Register criteria, refer to **Section 3.4** of **Appendix E**. The PHALMS based its determination that the Project Area did not have any archaeological research potential on the following points:

- The major infrastructure associated with the Clyde Terminal would have significantly disturbed subsurface deposits throughout the area;
- Much of the Project Area had been reclaimed prior to development in the early twentieth century and had been subject to major disturbance resulting from the infrastructure associated with the former Clyde Refinery works; and
- The Project Area had minimal potential to contain features which could provide data pertaining to major historic themes or which could be used to address research questions.

It was furthermore noted that, in the event that subsurface archaeological resources have survived in the lesser disturbed portions of the Project Area, they are likely to be of low archaeological significance.

### 18.1.4 Heritage Significance Assessment

An assessment of significance is generally undertaken to explain why a particular item is important and to enable appropriate management measures to be implemented if an activity will impact on that heritage item. The process of linking this assessment with an item's historical context has been developed through the NSW Heritage Management System and is outlined in the guideline *Assessing Heritage Significance* (NSW Heritage Office, 2001). The *Assessing Heritage Significance* guidelines establish seven evaluation criteria under which a place can be evaluated in the context of State or local historical themes. For a detailed explanation of these criteria, refer to **Section 3.4** of **Appendix E**. Similarly, a heritage item can be significant at a local level, at a State level, or be significant to the country as a whole and be of national or Commonwealth significance. An item will be considered to be of State or local heritage significance if it meets one or more of the seven evaluation criteria outlined in the *Assessing Heritage Significance* guideline.

The Clyde Terminal is of State historical, associative, rarity and representative significance. Historically, it demonstrates NSW's increasing use of and reliance on fossil fuels and the expansion of business within the State from import to production. It is associated with Shell, one of the leading producers and retailers of fuel in NSW. The Project Area is representative of an oil refinery and is rare. Most recently it was one of only two remaining oil refineries within NSW.

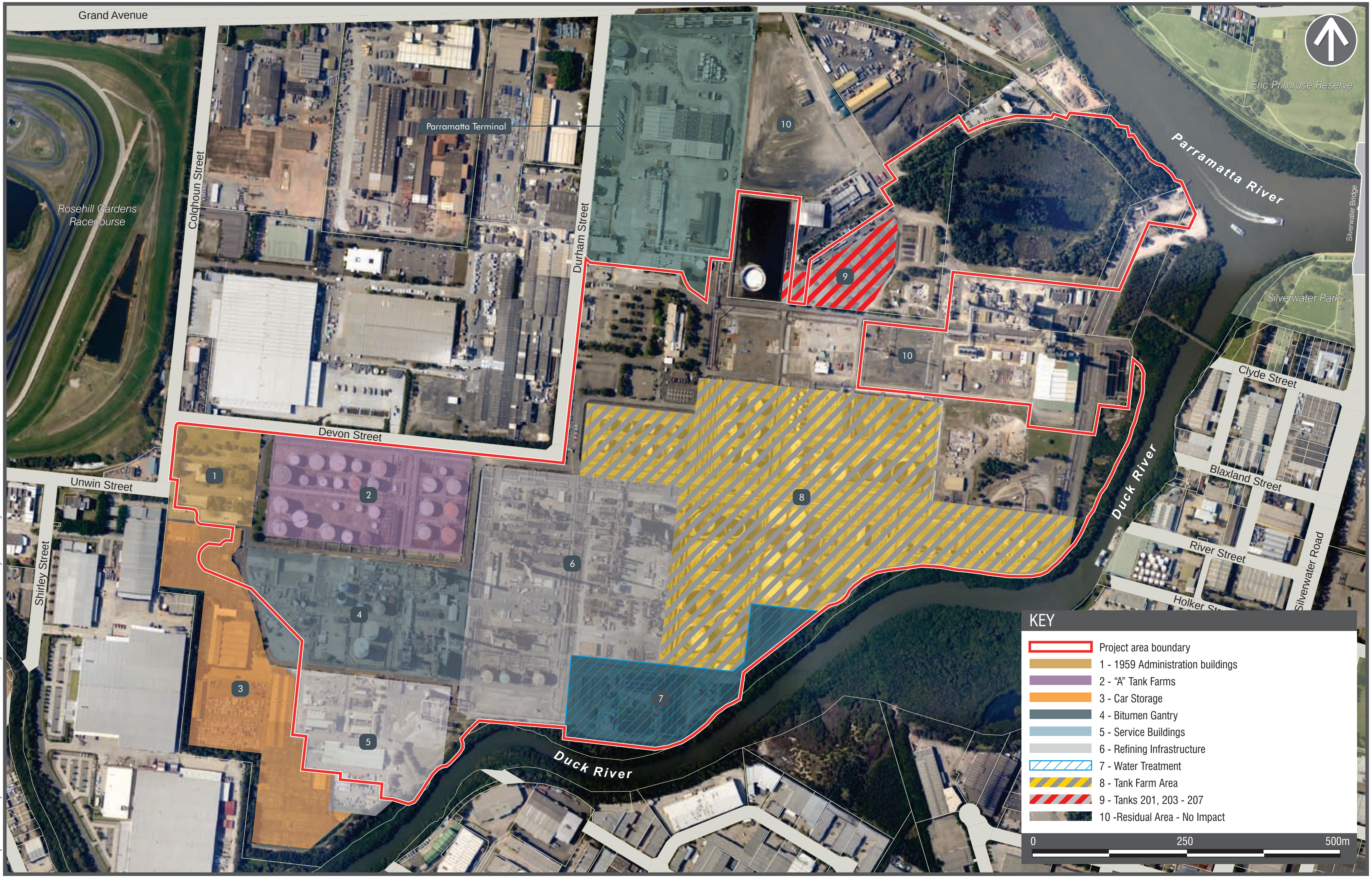
The Clyde Terminal is of local social, research and technical significance. It is also likely to be of social significance to the local community as it has been an employer of locals for over 80 years and has been an active participant and supporter of community events during that time. The Clyde Terminal can also demonstrate technical developments in the process of refining Crude Oil. The plant dates from the 1960s onwards, whilst the central control room was considered to be world class on its completion in 1988.

The Project Area contains two areas of archaeological significance. These two items have the potential, at a local level, to provide information, through archaeological investigation that is not available from other sources. One of these sites comprises the location of three houses formerly situated on the corner of Devon and Colquhoun Streets. Anecdotal evidence suggests these were used for accommodating Clyde Terminal site managers. The second item comprises an area that may contain information relating to the layout and functions of the initial refinery established by John Fell & Co (refer to **Section 3.1** for more detail on the John Fell & Co company).

#### 18.1.5 Site Inspection

A site inspection of the Project Area was undertaken by an AECOM archaeologist on 12 September 2012, who was accompanied by Erica Salazar, Shell Environment Team Lead – Clyde Project. Areas set for demolition as part of the Project were walked on foot and photographs taken of affected infrastructure. A photograph log was recorded on a plan of the Project Area with the orientation of each image and the image number being recorded where the image was taken from. Once the Project Area inspection was completed, the AECOM archaeologist undertook a vehicular survey of the surrounding area in order to gain an appreciation of the visual significance of the Project Area and to identify vantage points.

The site inspection involved analysis of the various components of the Project Area. The Project Area was divided into precincts based on the predominant function of the area to provide a clearer description. These precincts are shown in **Figure 18-1** and are described as follows.

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AECOM

# CLYDE TERMINAL PRECINCTS

Clyde Terminal Conversion Project
Environmental Impact Statement

FIGURE 18-1

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***Administration Buildings***

There are three components to this precinct: the archaeological site associated with the former manager's residences; the 1959 administration buildings; and the Shell Credit Union and contractors amenities building.

The archaeological site comprises three former residences, with the first constructed before 1930 and the subsequent two prior to 1951. The site inspection identified a feature potentially associated with the eastern most of the three houses. It is a 500 mm long by 14 mm wide section of concrete with a high number of pebble inclusions. It may be a foundation for the former residence or part of a garden bed or similar. No other artefacts were identified on the surface.

The administration building, opened in 1959, is a two storey, flat roof structure comprising two off-set components linked by a central entranceway. There appears to have been minimal intervention to the interiors following the construction of the building.

The Shell Credit Union and contractors amenities buildings mirror the administration building in footprint, although the elements are slightly wider due to the addition of a veranda on the northern side. An interior inspection was not undertaken of the building due to safety considerations as it is currently fenced, unused and in a dilapidated state.

The Administration Buildings are situated within the area proposed to be demolished (refer to **Figure 18-1**).

***Tankfarms A1, A2 and A3***

This precinct is comprised of Tankfarms A1 in the east, A2 in the south and A3 in the north. Tankfarm A1 contains seven tanks, six of which are arranged in two rows aligned in a north to south orientation. The seventh tank is placed at the northern end, central to the alignment. The tank numbers include Tanks 17, 18, 28, 29, 30, 31 and 62. Tankfarm A2 contains ten tanks (1, 9, 11, 26, 64, 65, 66, 67, 68 and 85) of various capacities with no pattern to their placement, which has probably been influenced by the replacement of tanks during operation of the former Clyde Refinery. Tankfarm A3 contains 11 tanks (3, 4 15, 19, 20, 21, 22, 23, 27, 63 and 80), with a general trend to two rows on an east to west alignment, although this is somewhat visually disrupted by the various diameters of the tanks.

This area also contains the pump house, which is a single storey cream brick building approximately 62 m long and 8.5 m wide. To the north of the pump house and adjacent to Tankfarm A3 is substation No. 5, the interior of which was not inspected due to safety considerations.

Tankfarms A1, A2 and A3 are situated within the area proposed to be demolished (refer to **Figure 18-1**).

***Bitumen Gantry***

This precinct contains the bitumen gantry and associated infrastructure at the western end, while to the east are four substations (18, 23, 26 and 29), a control room, water treatment plant associated with the boilers, utilities generator house, two boilers (7 and 9), field office and transformers (1,2,3, T3, T4 and T5). Interspersed between these are 12 tanks of various diameters and capacities, being numbers 70, 71, 72, 73, 74, 75, 76, 77, 88, 89, 96 and 97.

The bitumen gantry is a green corrugated iron, pitched roof structure elevated to allow trucks to pass underneath. To the north, three rail lines, one with a buffer still in place, are extant as evidence of the former mode of bitumen transport.

Near the bitumen gantry in the western area a memorial plaque has been mounted to the wall. The plaque is a memorial to three men, being John Simpsom Fell, Horace Liddon Spencer and Albert Edward Ward. The three men were killed in an explosion at the refinery on 19 August 1927. The memorial plaque dedicated to them is a granite block with embossed gold lettering currently inset into a section of red brick wall. The bitumen gantry is situated within the area proposed to be demolished (refer to **Figure 18-1**).

***Services Buildings***

Located adjacent to Duck River, in the far south-western corner of the Project Area are the service buildings, including the sample store, substation No. 9, Transfield Services, fire station, store, warehouse, workshop, amenities and laboratory. The sample store is a corrugated iron shed of 19 x 7 m. It appears to be sparsely used. Cranes and large moving plant are currently parked to the north of the store.

The fire station and Transfield Services workshop are conjoined buildings of different elevations. Due to operational reasons the interior of the fire station was not inspected, but from an external examination it appears the second floor may contain office spaces and amenities, while the third appears to be fitted with stairs and scaffolding for training. The Transfield Services building is a two door garage, opening to the west. The roof is unusual, being a flattened V. The interior is one open space to allow for the maintenance of vehicles. Within the road to the west of the entrance there is a short length of narrow gauge tram tracks leading into the workshop. These have been covered by concrete and bitumen within the workshop and the majority of the remaining length. The warehouse and workshops are conjoined structures to a height of approximately 1 m with green corrugated iron walls. The monitor shaped roof has windows along the vertical wall separating the shed from the gable roof, to allow natural light into the building.

The store is a warehouse store building located between the fire station and the laboratory. It was used to store general items and did not house any hazardous goods during its period of use.

The laboratory is a U-shaped structure with a portico on the front (eastern) elevation. It is constructed of red brick, with metal framed windows in the central third of the façade. For operational reasons the interior could not be inspected. To the east of the laboratory is an open area containing the stage 1, 2 and 3 high level flare stacks, as well as a radio mast and substation No. 6.

These structures and services buildings are situated within the area proposed to be demolished (refer to **Figure 18-1**).

***Refining Infrastructure***

This precinct contains the core of the former refining operations, detailed descriptions of which are beyond the scope of the historical heritage assessment. Within this precinct are the:

- Distillate splitter;
- Crude distillation unit 2;
- High vacuum unit;
- Catalytic cracking unit and gas separation unit;
- Dry gas treater;
- Poly plant;
- Alkylation plant;
- Caustic soda treater and caustic soda regeneration;
- Biotreater;
- Sulfur recovery units 1 and 2; and
- Hydro blasting area.

These pieces of plant were operated from the central control room. Also within this precinct are substations 3, 16 and 24 and Tankfarm H, which contains Tanks 501 to 505.

The refining infrastructure is situated within the area proposed to be demolished (refer to **Figure 18-1**).

***Water Treatment***

The water treatment facilities are concentrated adjacent to Duck River (refer to **Figure 13-1**), to the south of the refining infrastructure. The facilities are powered by substation No. 22 and include the cooling towers, basin, activated sludge basin, basin No. 1, feed No. 2, main interceptor and slops Tanks 103 to 106.

A portion of the water treatment area is situated within the area proposed to be demolished (refer to **Figure 18-1**).

***Tankfarm Area***

This precinct encompasses Tankfarms B, B1, B2, C, E1, E2, the mounded LPG tank area and the hydrocarbon, chemicals and solvents tanks.

Tankfarms B and B1 each contain three tanks (50, 51 and 53 and 34, 35 and 42 respectively). Tankfarm B2 contains eight tanks arranged in two rows aligned north to south and being tank numbers 32, 33, and 43 to 48. This tankfarm is proposed for demolition. To the east of Tankfarm B2 is a tetra ethyl plant, manifold pit, No. 2 Pump House, analyser house, retention basin and 21 tanks associated with LPG storage. The LPG tanks include spherical and vertical bullet style tanks. These items are also proposed for demolition. Also contained within this precinct are substations 2 and 15.

Tankfarm C, containing Tanks 54 to 61, is also proposed for demolition. The tanks are arranged in two rows aligned east-west. Tankfarm E1 contains six tanks (36 to 41) aligned in two rows north to south. Within Tankfarm E1, Tanks 40 and 41 are proposed for demolition. Tankfarm E2 contains seven tanks – 69, 82, 83, 84, 86, 87 and 1704. Tanks 69, 82 and 83 are proposed for demolition.

The mounded LPG tank area is a series of five LPG horizontal bullet style tanks encased within a concrete and earthen mound. Located directly to the west, are the redundant hydrocarbon, chemicals and solvents tanks comprising 14 tall, narrow tanks. Shell proposes to retain the mounded LPG tanks, but demolish the hydrocarbon, chemicals and solvents tanks.

***Tanks 201 and 203 to 207***

Located in the central northern portion of the Project Area are Tanks 201 and 203 to 207. The tanks are constructed on a different alignment to all the other Tankfarms, being oriented north-east to south-west. This mirrors the former railway alignment that ran to the north-west of the tanks. The tanks are sitting within an earthen bund wall with a chain-link fence. The bund has created a pond effect and the northern most tanks are partly submerged. All the tanks are rusted and in poor condition. They are currently not in use and are proposed to be demolished and removed.

***Old Shell Wharf***

The north-eastern boundary of the Project Area adjacent to the remnant wetlands contains the old Shell Wharf. This was used originally to receive barges loaded with either finished petroleum products or Crude Oil from the Gore Bay Terminal for transfer into storage tanks either for distribution or refining. This area is now used for mounting river spill control equipment if required and would continue to be maintained for this purpose.

***Residual Areas***

There are no proposed modifications to the remainder of the Project Area, and as such these areas were not inspected.

### 18.1.6 Archaeological Potential and Items of Heritage Significance

The PHALMS identified the Refinery site has having no archaeological potential. This has largely been substantiated by AECOM's heritage assessment undertaken as part of this EIS, with the exception of two sites.

The first is the area along Devon Street from the intersection with Colquhoun Street. Aerial photographs identified that three residences were constructed in this area, the first prior to 1930 and the second two prior to 1951 and then demolished between 1970 and 1978. There appears to have been limited disturbance to this area in the intervening years. It is therefore anticipated that there is high archaeological potential for features and deposits associated with the houses to remain intact.

The second area relates to the first installation constructed by John Fell & Co. The 1930 aerial indicates that the original tankfarms were located in the area where Tankfarms A2 and A3 currently stand, with the refinery infrastructure being located to the south, in what is now the bitumen loading gantry area and the water treatment plant. The date of construction for the original tank could not be verified, but it is mentioned in records as early as 1943 and featured in drawings dating to 1954. While there has been some subsequent disturbance to this area with the construction and demolition of a variety of sheds and other services prior to the bitumen loading gantry and water treatment plant, there remains potential for evidence of the previous structures to be retained beneath the current asphalt and concrete surfaces. The archaeological potential, however, is considered to be low.

## 18.2 Predicted Impacts

### 18.2.1 Overview of Predicted Impacts

The heritage impact of the Project (refer to **Appendix E**) is outlined as follows:

- Demolition would have a negative impact on the heritage significance of the Project Area. There is potential for the identified research significance of the Project Area to be impacted by the proposed demolition in the bitumen gantry area. This area has the potential to contain archaeological evidence of the original John Fell & Co. refinery;

- The proposed demolition would also require the removal and later remounting of a memorial to John Simpsom Fell, Horace Liddon Spencer and Albert Edward Ward, who were killed in 1927 when a still exploded. The memorial plaque is identified as having historical significance;
- Physical construction activities are of a relatively minor nature and would not negatively impact on the European heritage of the Project Area; and
- Operation of the converted Clyde Terminal would not have any heritage impact on the significance of the Project Area as any existing heritage fabric would have already been removed during the demolition works. It is recommended that, should there be any remaining archaeological potential in the two areas identified in **Section 18.1.6**, a brief management document or section within the OEMP would be prepared to guide the management of these areas.

### 18.2.2 Statement of Heritage Impact Assessment

The objective of a Statement of Heritage Impact is to evaluate and explain how the proposed development, rehabilitation or land use change will affect the heritage value of a site or place. It should address how the heritage value of the site or place can be conserved or maintained, or preferably enhanced by the proposed works. The heritage assessment undertaken by AECOM was prepared in accordance with the *NSW Heritage Manual* (NSW Heritage Office and Department of Urban Affairs and Planning, 1996) and *Statements of Heritage Impact* (NSW Heritage Office, 2002). Relevant questions surrounding the heritage impact of the Project are explored below.

***Have all options for retention and adaptive re-use been explored?***

As outlined in **Sections 4.0** and **5.0**, a combination of factors has led to the need for Shell to rationalise its Clyde Terminal operations and the Gore Bay Terminal (subject to a separate development application). These alterations are largely driven by an increasingly globalised petroleum market. In this context the former Clyde Refinery was not able to continue to operate profitably. As the Project Area was specialised for the refining of Crude Oil, adaptive reuse of this infrastructure is not possible for use within the converted Clyde Terminal.

***Is demolition essential at this time or can it be postponed in case future circumstances make its retention and conservation more feasible?***

The market considerations provided above, combined with the expenditure necessary to meet current environmental and operational requirements, make it exceedingly unlikely that future circumstances will make the retention and conservation of the Clyde Terminal more feasible. Conservation is not considered to be warranted given the nature of the Project Area and the complexity of the ongoing management issues that this would involve. The heritage benefit of conserving the Project Area is overshadowed by the financial and practical problems associated with conversion.

***What measures have been put in place to mitigate the impact to the heritage significance of the Terminal?***

The mitigation measures are outlined in **Section 18.3**. The majority of the impacts can be mitigated through a detailed photographic archival recording of the specified site elements prior to alteration.

***Has the advice of a heritage consultant been sought? Have the consultant’s recommendations been implemented? If not, why not?***

The heritage assessment provides the advice and recommendations of AECOM’s heritage consultant/ archaeologist. Shell would implement the recommendations within this report once the approval for the Project is obtained under the EP&A Act.

From the detailed assessment against the *Statements of Heritage Impact* guidelines (NSW Heritage Office, 2002) a number of potential impacts have been assessed. These are graded to determine their impact against the significance of the Project Area. The predicted heritage impacts of the Project are summarised in **Table 18-2**.

**Table 18-2 Summary of the Nature of Direct Impacts**

| Impact Type | Impact |
|---|---|
| Negative impacts (substantially affects fabric or values of state significance). | The demolition of infrastructure would have a negative impact on the historical, rarity and representative significance of the Project Area. |
| Moderate negative impacts (irreversible loss of fabric or values of local significance; minor impacts on State significance). | The demolition of infrastructure would have a moderately negative impact on the assessed local aesthetic, social, technical and research significance of the Project Area. |
| Minor negative impacts (reversible loss of local significance fabric or where mitigation retrieves some value of significance; loss of fabric not of significance but which supports or buffers local significance values). | None |
| Negligible or no impacts (does not affect heritage values either negatively or positively). | None |
| Minor positive impacts (enhances access to, understanding or conservation of fabric or values of local significance). | Relocation of the memorial plaque to John Simpsom Fell, Horace Liddon Spencer and Albert Edward Ward provides an opportunity to enhance access to it by mounting it within a publicly accessible area (e.g. to the fence-line along the Project Area boundary or to the visitor car park as feasible). Shell would investigate the feasibility of undertaking a memorial relocation ceremony involving family and descendants of the three men and use of the plaque as a teaching aid for the importance of workplace safety. |
| Positive impacts (enhances access to, understanding or conservation of fabric or values of state significance). | None |

### 18.2.3 Statement of Significance

A detailed significance assessment of the Project Area is provided in **Section 7** of **Appendix E**, according to the Australian Heritage Commission's *Australian Historic Themes* (2001), the *NSW Heritage Manual* (NSW Heritage Office & Department of Urban Affairs and Planning, 1996), the Assessing Heritage Significance guidelines (NSW Heritage Office, 2001), and through comparative analysis with other refinery complexes within Australia.

As part of the heritage assessment, the following summary of the Project Area's significance, a Statement of Significance, was developed as follows:

*The Clyde Terminal is of State historical, associative, rarity and representative significance. Historically, it demonstrates NSW's increasing use of and reliance on fossil fuels and the expansion of business in the State from import to production. It is associated with the Shell Company, one of the leading producers and retailers of fuel in NSW. The Refinery is representative of an oil refinery and is rare, being one of only two in NSW.*

*The Clyde Terminal is of local social, research and technical significance. It is likely to be of social significance to the local community – it has been an employer of locals for over 80 years and has been an active participant and supporter of community events throughout that time. The Refinery can also demonstrate technical developments in the process of refining crude oil. The plant dates from the 1960s onwards, while the Central Control Room was considered as world class on its completion in 1988. The site contains two areas of archaeological significance, which have the potential, at a local level, to provide information, through archaeological investigation, not available from other sources. One relates to three houses formerly located on the corner of Devon and Colquhoun Streets and anecdotally used as accommodation for the site managers. The second area may contain information relating to the layout and functions of the initial refinery established by John Fell & Co.*

## 18.3 Mitigation Measures

It is anticipated that the impacts to the historical and technical significance of the Refinery identified in **Section 18.2** can be managed through a full photographic and documentary archival recording of the facility. Specifically, the following mitigation measures are proposed for the Project to minimise impacts on heritage significance:

- Parramatta Council requires consideration be given to provision of an Arts Plan. As such, oral histories are to be recorded from past and present staff regarding the operations of the former Clyde Refinery, and a full photographic and documentary archival recording of the Project Area would be used to manage the impact to the historical and technical significance of the former Clyde Refinery;
- Photographic recording would be undertaken in accordance with the NSW Heritage Branch guidelines *How to prepare archival records of heritage items* (NSW Heritage Office, 1998) and *Photographic recording of heritage items using film or digital capture* (NSW Heritage Office, 2006);
- Archival recordings would be undertaken prior to demolition works taking place, and for infrastructure that to be demolished;
- Documentary recording would contain a detailed timeline of each piece of equipment and tankfarm, together with copies of plans and schematics;
- A photographic archival recording would be undertaken prior to the demolition of the stacks. The recording would include broad views of the larger Clyde Refinery area;
- Subsurface impacts to the area of archaeological potential identified around the bitumen gantry through the removal of foundations or other invasive works, are to be managed through the preparation and implementation of an Archaeological Research Design and Methodology;
- The memorial to John Simpsom Fell, Horace Liddon Spencer and Albert Edward Ward, located near the bitumen gantry, is to be relocated to a publicly accessible area (e.g. visitor car park or Project Area boundary). Shell would investigate the feasibility of undertaking a memorial relocation ceremony involving family and descendants of the three men and use of the plaque as a teaching aid for the importance of workplace safety; and
- A brief management section is to be prepared within the site's OEMP to guide the management of archaeological potential at the historical residential area along Devon Street and at the second bitumen gantry.

## 18.4 Residual Impacts

The four key historical phases of the Project Area are relatively well documented, and the current historical assessment has extensively considered the available information regarding these historical phases. As such, it is considered unlikely for the Project to result in residual impacts to European heritage that were not captured by this heritage assessment.

In the unlikely event that the Project is, or is suspected to result in the discovery, exposure, movement damage or destruction of a further heritage relic not captured in this heritage assessment, the work site would be secured and the NSW Heritage Branch and DP&I would be contacted.

Furthermore, should archaeological values remain at the completion of the demolition and construction works, a management document or section would be inserted in the OEMP to guide the management of these areas.

# 19.0 Hazard and Risk

**Relevant DGRs**: The EIS must address **Hazards and Risks** – including a summary of the results of a Preliminary Hazard Analysis (PHA) undertaken for the proposed development. The PHA should be prepared in accordance with *Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis*, and in particular:

- Identify the hazards associated with the existing site and the proposed development, as well as any external hazards (i.e. natural hazards) to determine the potential for offsite impacts;
- Include failure rates approximate to the plant and equipment to be used;
- Address all relevant recommendations arising from the Buncefield incident; and
- Demonstrate that the proposed development complies with the criteria set out in Hazardous Industry Planning Advisory Paper No. 4 –Risk Criteria for Land Use Safety Planning; and
- Estimate the cumulative impacts from the overall site and the surrounding potentially hazardous developments in the area (existing and proposed) and demonstrate that the proposed development does not increase the cumulative risk of the area to unacceptable levels.

## 19.1 Existing Environment

### 19.1.1 Existing Clyde Terminal

The existing Clyde Terminal, situated within the Camellia Industrial estate, operates 24 hours a day seven days a week receiving, storing and distributing bulk fuel products, including Gasoline, Diesel and Jet Fuel. The hazardous properties of these materials stored and handled at the Clyde Terminal are provided in **Table 19-1**. Smaller quantities of chemicals would also be stored as packaged goods, including cleaning products, lubricants and acetylene for site maintenance activities.

**Table 19-1 Hazardous Properties of Materials Stored and Handled at the Clyde Terminal**

| Material | Dangerous Goods Classification | UN Number* | Hazchem Code | Flash Point (°C) | Auto-ignition Temperature (°C) |
|---|---|---|---|---|---|
| Butane/Isobutane | 2.1 | 1011 1969 (iC4) | 2YE | < -70 | 370 |
| Gasoline | 3 PGII | 1203 | 3YE | < -35 | 280 |
| Jet fuel | 3 PGIII | 1863 | 3Y | > 23 | 210 |
| Diesel | C1 | 3082 | - | > 60 | 210 |
| Natural Gas | 2.1 | 1971 | 2SE | -188 | 537 |

***- Dangerous goods are assigned to UN numbers according to their hazard classification and their composition, as described in the Australian Dangerous Goods Code.**

The current workforce of the Clyde Terminal is approximately 83 personnel. Once the conversion works are complete, it is estimated that around 35 staff and 23 contractor positions would be required for operation of the Clyde Terminal. Following its conversion, the Clyde Terminal would continue to operate 24 hours per day seven days a week.

The fundamental operations of the Clyde Terminal are not expected to change significantly from the current operations. Finished petroleum products would continue to be imported to the Clyde Terminal, with Gasoline, Jet fuel and Diesel being pumped directly from tanker ships at the Gore Bay Terminal to the Project Area via the existing underground, 19 km bidirectional pipeline. To increase the efficiencies of Shell's Gore Bay Terminal and to hasten ship discharges – limiting impacts that ships have on the local Gore Bay community - some intermediate storage of Jet fuel and Diesel would be required at the Gore Bay Terminal prior to its transfer to the Clyde Terminal,. The storage tanks in the western section of the Clyde Terminal Project Area would be demolished with those in the central section of the Project Area converted for the more efficient storage of finished petroleum.

#### 19.1.2 Surrounding Land Uses

The land use context of the areas surrounding the Clyde Terminal is discussed in **Section 2.0**, and is comprised of industrial and transport related facilities, parks and recreational areas, Rosehill Gardens Racecourse and Sydney Speedway. The Clyde Terminal is bordered by Durham Street, Devon Street and Grand Avenue. The Parramatta Terminal is immediately north of the Clyde Terminal and is bounded by Durham Street to the west and Grand Avenue to the north. Gate four on Durham Street provides the main point of access to the Project Area (refer to **Figure 1-3**). The Clyde Terminal lies at the confluence of the Duck and Parramatta Rivers, and is bordered to the south and north-east by these two rivers respectively.

## 19.2 Methodology

Sherpa Consulting Pty Ltd (Sherpa) prepared the PHA for the proposed operations at the converted Clyde Terminal to determine if the facility would meet the definition of ‘hazardous’ and/or ‘offensive’ in the context of SEPP 33, which was developed to provide a policy for the management of potentially hazardous and offensive developments.

The PHA was prepared in accordance with the requirements of SEPP 33 and the approach developed by the DP&I, which recommends the use of the following methodologies and guidelines:

- Hazardous Industry Planning Advisory Papers (HIPAPs), including:
  - *Hazardous Industry Planning Advisory Papers No. 4 – Risk Criteria for Land Use Safety Planning* (Department of Planning, 2011d); and
  - *Hazardous Industry Planning Advisory Papers No. 6 – Guidelines for Hazard Analysis* (Department of Planning, 2011b).
- *The Multi-Level Risk Assessment approach* (Department of Planning, 2011c); and
- *Applying SEPP33, Hazardous and Offensive Development Application Guidelines* (Department of Planning NSW, 2011a).

The methodology was developed in consultation with the DP&I and WorkCover NSW to identify areas that may require particular attention during the study (refer to **Section 9.3.3**).

The PHA methodology is summarised in the following sections and detailed in **Appendix F** of **Volume 3** of this EIS. Two draft revisions of the PHA prepared by Sherpa were provided to DP&I for comment during the preparation of this EIS. All DP&I comments were addressed in the final version (Revision 1) of the PHA Report (refer to **Appendix F** of **Volume 3** of this EIS). Given the fact that the Clyde Terminal also operates alongside Shell’s adjacent Parramatta Terminal, the PHA Report undertook a cumulative assessment of the hazards and risks of these two Terminals operating together.

#### 19.2.1 Multi-Level Risk Assessment

The DGR’s require a PHA to be prepared in order to determine whether the Project should be considered hazardous and/or offensive and thus identify the need for further risk reduction. Screening against the guidance thresholds of SEPP 33 was therefore not required.

The DP&I’s *Multi-Level Risk Assessment Guidelines* (formerly Department of Planning, 2011c) were used to determine the most appropriate level of risk assessment. The three levels of assessment provided in the Multi-Level Risk Assessment approach are:

- A level 1 qualitative analysis, primarily based on the hazard identification techniques and qualitative risk assessment of consequences, frequency and risk;
- A level 2 partially quantitative analysis, which uses hazard identification and the focused quantification of key potential offsite risks; and
- A level 3 Quantitative Risk Analysis (QRA), based on the full detailed quantification of risks, consistent with the NSW Department of Planning’s *Guidelines for Hazard Analysis, Hazardous Industry Planning and Advisory Paper No 6* (Department of Planning, 2011b).

It was determined that a Level 3 QRA was the most suitable to use for the PHA for this Project. This provides for results that are sufficiently quantified to allow an assessment of the offsite risk levels against acceptance criteria (Department of Planning NSW, 2011b). Chronic health effects are not covered in the PHA. **Section 17.2.5** of this EIS included an assessment of the potential for the Project to result in human health and ecological risks based on historical contamination present at the Project Area. Human health and ecological risks from historical contamination are considered unlikely, and the mitigation measures in **Section 17.3** would further prevent residual impacts. The potential for chronic health impacts and occupational exposure to result from operational hazards at the Project Area such as plant and equipment failure would continue to be managed through Shell's OH&S system.

A Level 3 QRA approach uses the methodology outlined in **Figure 19-1**. A detailed breakdown of consequence, frequency and risk analysis methodologies used for each hazard, is provided in **Appendix F** of **Volume 3** of this EIS.

## 19.3 Potential Impacts

The PHA provides a detailed hazard identification, consequence, frequency and risk analysis for the assessment of potential hazards relating to the Project. The key elements of the Clyde Terminal that were assessed included:

- Atmospheric product (Gasoline, Jet fuel and Diesel) storage tanks and bunds;
- Non-LPG product pumps (Pump House 2 Area) and pigging facilities;
- Gate 1 Warehouse dangerous goods (flammable/combustible);
- Aboveground LPG storage spheres and pumps; and
- LPG road tanker unloading gantry.

The following pieces of infrastructure located within the Parramatta Terminal, adjacent to the Clyde Terminal, were also assessed as part of the PHA:

- Atmospheric underground ethanol storage tank;
- Non-LPG road tanker product loading gantry; and
- Vapour recovery unit.

As outlined in **Section 19.2,** the PHA was prepared in consultation with DP&I. **Figure 6-1** illustrates the proposed layout of the Clyde Terminal, including the location and configuration of storage tanks.

### 19.3.1 Hazard Identification

A hazard identification word diagram was prepared for incidents at the Clyde Terminal, and is included in **Appendix A** of the PHA Report (refer to **Appendix F**). **Appendix A** of the PHA contains information for major accident events (resulting in leaks, fires or vapour cloud flash fires/explosions) that could occur at the Project Area, and includes the following information for those identified hazards:

- Cause of loss of controls/containment of hazards;
- Prevention measures;
- Consequences;
- Detection measures; and
- Protection measures.

All of the hazards identified in **Appendix A** of the PHA (refer to **Appendix F** of **Volume 3** of this EIS) were carried forward for further analysis, with the following exceptions:

- Combustible liquids (non-dangerous goods). Diesel has a high flash-point and is handled at ambient temperatures, however the chance of ignition and involvement in a fire is remote unless it is due to escalation of an existing fire (the potential for which was assessed in the PHA); and
- Rim seal fires. These occur at elevation and the tank shell and wind girder provide shielding to anyone at grade. The PHA conservatively assumed that all rim seal fires would escalate to full surface tank roof fires.

It is relevant to note that all petroleum products stored at the Clyde Terminal have been refined with no water content and, as such, boilover is not considered to be a credible scenario for tank fires. Furthermore, all hazardous scenarios identified (refer to **Table 19-2**) were considered to have the potential to impact offsite and so were carried forward for further analysis.

**Table 19-2 Scenarios Carried Forward for Analysis**

| Source | Scenario | Comments |
| --- | --- | --- |
| Atmospheric Storage Tanks and Bunds | Tank roof fire | Ignition of seals (EFR) or vents/ vapour space (IFR tanks) by lightning. |
| | Full bund fire | Due to tank overfill, strake/structural catastrophic failure, pipe/flange leak, valve leak, drain leak, floor leak, and corrosion. |
| | Vapour cloud explosion/flash fire | A potential outcome of gasoline tank overfills. |
| Butane Spheres, Gantry and Pumps | Pool fire | Pool fire size based on a distribution of leak rates. |
| | BLEVE | - |
| | Vapour cloud explosion/ flash fire | Unignited pool evaporation. |
| Pump House No. 2 and Pump Pits | Bund fire | Fire covering full bunded area of pump house. |
| Pipe Tracks | Pool fire | Fire covering pipe track routes. |
| Gate 1 Warehouse Package Store | Pool fire | Pool fire size based on bunded area. |
| Ethanol Tanker Unloading Bay | Bund fire | Pool fire size based on bunded area. |
| Road Tanker Loading Gantry | Bund fire | Pool fire size based on bunded area. |
| Road Tanker Loading Gantry | Bund fire | Pool fire size based on bunded area. |
| Vapour Recovery Unit | Pool fire | Pool fire size based on bunded area. |

### 19.3.2 Consequence Assessment

The purpose of the consequence assessment was to determine if the identified hazardous incidents have potential offsite impacts exceeding the impairment criteria described in *Guideline for Hazard Analysis, Hazardous Industry Planning and Advisory Paper No 6* (Department of Planning, 2011b). All of the hazardous scenarios (refer to **Table 19-2**) were carried forward for consequence analysis to determine whether they have the potential to result in such offsite effects. The consequence assessment involved the analysis and quantification of the potential for a hazardous scenario to cause injury, fatality, damage or loss in accordance with the following impairment criteria (refer to **Table 19-3**).

**Table 19-3 Impairment Criteria**

| Impediment | Effect Criteria |
|---|---|
| Thermal radiation | • ≤ 4.7 kW/$m^2$ (injury)<br>• 4.7 – 14 kW/$m^2$ (50% chance of fatality)<br>• ≥ 14 kW/$m^2$ (100% chance of fatality) |
| Flash fire | 100% chance of fatality within flammable vapour cloud defined by Lower Flammability Limit concentration. |
| Vapour cloud explosion | • 7 kPa (injury)<br>• Fatal explosion overpressure was taken to be within the dimensions of the flash fire (consistent with Buncefield Incident).<br>• The study assumes that people within buildings will be fatally injured by a flash fire (conservative), but this is to account for building damage due to explosion overpressure*. |

**Note: * For the purpose of calculating the total (location specific) risk contours in Shepherd (the risk model), the effects on people (in terms of fatalities) from vapour cloud explosion overpressure are accounted for by the fireball consequence size (i.e. personnel within the flash fire are assumed to be fatalities).**

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## Hazard Identification

Hazards identified to have a potential impact offsite are carried forward for a consequence analysis.

## Consequence Assessment

Determines the impact distance from a postulated incident such as an explosion or fire. Incidents with the potential to impact beyond the boundary of the Clyde Terminal were then carried forward for frequency and risk analysis.

## Frequency Assessment

A review of each potential incident was undertaken and an initiating frequency was developed. Failure probabilities for equipment and safety systems were referenced from the previous Preliminary Hazard Analysis undertaken for the Clyde Terminal.

These were combined with the initiating incident frequency to determine the postulated incident frequency. The incident frequency was then carried forward for risk assessment.

## Risk Assessment

Determined the probability of fatality and injury at the boundary of the Clyde Terminal. Fatality and injury contours were then developed to indicate risks beyond the boundary of the terminal.

## Risk Review and Reduction

Results of the study were then compared to the DP&I's acceptable risk criteria published in Hazardous Industry Planning Advisory Paper No.4 - "Risk Criteria for Land Use Safety Planning"

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The following sections summarise the findings of the consequence analysis undertaken in the PHA (refer to **Appendix F** of **Volume 3** of this EIS for each hazardous scenario). Study assumptions and detailed consequence effect distances are provided in **Section 7.0** of **Appendix F**.

***Incorporating the Findings of the Buncefield Incident Investigation***

Flammable vapour cloud formation as a result of a tank overfill event and subsequent cascade was considered for tanks storing the flammable products described in Appendix 1, Part 2 (Table 6) of the UK Health and Safety Executive - Process Safety Leadership Group's *Final Report on the Buncefield Investigation (Safety and Environmental Standards for Fuel Storage Sites)* (2009) as having the potential to form flammable vapour clouds.

Advice on modelling the overfill cascade and the resulting source term for dispersion modelling is provided in Appendix 1, Part 1 of the *Final Report on the Buncefield Investigation (Safety and Environmental Standards for Fuel Storage Sites)*. Shell Global Solutions, a co-author of some of these reports, and a party to both the Phase One Joint Industry Group and the Phase Two Technical Group, undertook these specialist analyses on behalf of Shell and provided the gas dispersion results for various wind speed and atmospheric stabilities, which were used in the QRA risk analysis model.

The risk model for the Clyde Terminal used the dispersion results to simulate gas spread through the plant and evaluate the potential for ignition in both open, uncongested areas (generating flash fires) and within areas where assets may cause congestion and collection of vapours (generating explosion overpressure). Also consistent with the Buncefield incident investigations, the QRA model includes fatal effects within the extent of the flammable vapour cloud.

***Effects on People***

The impairment criteria for people have been provided in **Table 19-3**. These values relate to acute affects, and impairment is considered to occur if the levels are equal to or higher than those given in that **Table 19-3**.

***Effects on Equipment and Structures***

Equipment and structures subject to direct flame impingement from fires can weaken with time, from a combination of thermal radiation and convective heating. Eventually failure occurs, resulting in possible escalation of the incident, escape route impairment, and significant plant damage.

It is difficult to assign a specific value for structural failures, since failure is determined by structural characteristics (e.g. material type, pipe thickness asset dimensions and degrees of fire proofing), handling conditions (e.g. whether the equipment is subject to internal pressure) and flame characteristics (e.g. surface emissive power, flame dimensions). The PHA adopted the findings of heat-up simulations and explosion overpressure thresholds to set criteria for damage to equipment and structures. Details of this are provided in **Appendix D** of the PHA Report (refer to **Appendix F** of **Volume 3** of this EIS).

***Combustion Products***

Toxic products of combustion, e.g. carbon oxides and soot, have the potential to affect (by respiratory irritation) those attending a fire emergency and possibly people offsite.

The products of combustion rising from a fire typically have a temperature between 800ºC and 1200ºC, and a density a quarter that of air (Lees, 2005). Therefore, impact from toxic products of combustion would be significant only local to the fire, since the plume of combustion products would be buoyant and the combustion products would tend to rise and disperse with the prevailing weather (unless a temperature inversion exists).

***Conclusions from Consequence Assessment***

The PHA found negligible potential for offsite escalation at adjacent industrial facilities (including the boundary of the Project Area with the LyondellBasell Plant).

The following scenarios were carried forward for likelihood and risk assessment based on their potential for offsite impact:

- Tank roof fire at Tank 90;
- Tank overfill cascade leading to flash fire/vapour cloud explosion for all Gasoline tanks;
- Tank bund fires at Tankfarms B, B1 and K;
- Pipe track pool fires;

- Pipe track leaks (medium/large leaks) leading to flash fire/vapour cloud expansion;
- LPG fires at the storage spheres and at the tanker unloading gantry;
- LPG leaks (large only) at the storage spheres and at the tanker loading gantry leading to flash fire/vapour cloud explosion; and
- LPG Boiling Liquid Expanding Vapour Explosion (BLEVE) at the storage spheres and at the tanker loading gantry.

### 19.3.3 Likelihood Assessment

The likelihood assessment is used in conjunction with the consequence assessment to determine the expected risk of an event occurring.

Hazardous incidents may occur in the event of an equipment failure, such as a leak from a flange, or following a process control failure, such as a tank overfill incident. The frequency of tank overfill was modelled using the residual risk values evaluated in the Model Bowtie Layer of Protection Analysis (Shell Global Solutions International BV, 2010), which was updated to reflect the proposed operating conditions of the converted Clyde Terminal.

The likelihood assessment is provided in full in **Section 8** and **Appendix C** of the PHA Report **Appendix F**.

***Equipment Failure and Leak Frequency Data***

The Shepherd software package used by Sherpa to carry out the PHA differentiates between LPG and non-LPG equipment, with LPG equipment being that which handles butane and/or propane mixtures liquefied by pressure.

***Equipment Parts Count***

The equipment parts count for the converted Clyde Terminal is provided in **Table 19-4**.

**Table 19-4 Equipment Parts Count for the Converted Clyde Terminal**

| Equipment Type | Average Leak Source Count per Equipment Item | | |
|---|---|---|---|
| | Connections (>25 mm) | Flange/Valve Equivalents | Fittings (<25 mm) |
| Pumps | 1 | 18 | 9 |
| Pipe | 3 | 20 | 3 |
| LPG Bullet/Sphere | NA | 50 | 10 |

***Summary of Frequencies Used***

A summary of the equipment failure and leak frequency data used in this assessment is provided in **Table 19-5**.

**Table 19-5 Summary of Failure and Event Frequencies used in QRA**

| Equipment Item | Equivalent Leak Size Diameter (mm) | Frequency (per item per year) |
|---|---|---|
| **LPG Equipment Leaks** | | |
| Flanges and equivalent valves | 2.5 | $5.6 \times 10^{-6}$ |
| Instrument fittings and connections | 1.4 | $5.6 \times 10^{-6}$ |
| Pipe (including pipelines) x (L/D) | 100 | $4.9 \times 10^{-7}$ |
| Hose/hard-arm (hose failure) | 10 | $6.65 \times 10^{-6}$ per operation |
| Hose / hard-arm (coupling failure) (Excess flow valve limited) | 1.4 | $5.2 \times 10^{-6}$ per operation |
| Catastrophic vessel failure | NA | $2.4 \times 10^{-8}$ |

| Equipment Item | Equivalent Leak Size Diameter (mm) | Frequency (per item per year) |
|---|---|---|
| Overfill of Aboveground LPG Storage Vessels | NA | $7.6 \times 10^{-5}$ |
| **Non-LPG Equipment Leaks** | | |
| Flanges and equivalent valves | 2.5 | $2.2 \times 10^{-4}$ |
| Instrument fitting (< 1 inch diameter) | 20 | $1 \times 10^{-4}$ |
| Connection (>1 inch diameter) | 50 | $1 \times 10^{-5}$ |
| Pipe rupture | ≥300 | $7 \times 10^{-8}$ per m |
| | <300 | $2 \times 10^{-7}$ per m |
| Pump seal | 10 | $3 \times 10^{-3}$ (single seal) |
| Pump casing failure | Full bore | $3 \times 10^{-5}$ |
| **Atmospheric Storage Tanks** | | |
| Full surface tank roof fire | NA | $1.2 \times 10^{-4}$ per tank |
| Tankfarm E1 tank overfill (summed across all tanks in bund) | NA | $8.5 \times 10^{-5}$ |
| Tankfarm E2 tank overfill (summed across all tanks in bund) | NA | $8.9 \times 10^{-5}$ |
| Tankfarm K tank overfill (summed across all tanks in bund) | NA | $2.6 \times 10^{-5}$ |
| Tankfarm B tank overfill (summed across all tanks in bund) | NA | $4.2 \times 10^{-5}$ |
| Tankfarm B1 tank overfill (summed across all tanks in bund) | NA | $6.6 \times 10^{-5}$ |

### 19.3.4 Risk Assessment

The risk analysis brings together the physical consequence model, effects models, leak frequency and parts count. The modelling also includes site specific issues such as equipment layout and prevailing weather conditions.

***Fatality and Injury Risk Criteria***

In land use planning assessments, risk is usually quoted as the chance of fatality or injury per million per year (pmpy). This assessment uses risk criteria established by the HIPAP No.4 - *Risk Criteria for Land Use Safety Planning* (formerly the Department of Planning, 2011d). Industrial facilities that are *potentially* hazardous should be evaluated against these criteria to determine whether the risk mitigations that are in place are sufficient or whether further work must be done. **Table 19-6** and **Table 19-7** provide a summary of the individual fatality and individual injury risk criteria for various adjacent land uses as published in HIPAP No.4, and expressed as chances of individual fatality pmpy as the limit of acceptable risk for new developments. For instance, the acceptable level of risk for a residence is one fatality in a million or five in a million for a commercial development. This takes into account the fact that a residence is more likely to be occupied for a greater percentage of time and be less well prepared and organised in the event of an emergency to evacuate personnel to a safe location. These are presented graphically as a series of contours per land use type in **Figure 19-2** and **Figure 19-3**.

When compared to other risks that exist within the population, the level of acceptable risk from potentially hazardous industrial facilities is very small. For instance, the chance of an individual fatality within the entire population of the United Kingdom from collective hazards is 10,309 pmpy; from smoking 20 cigarettes per day the chance of an individual fatality is 5,000 million pmpy and from travelling in a motor vehicle, the chance of an individual fatality is 145 ppmy.

**Table 19-6 NSW Individual Fatality Risk Criteria (HIPAP No.4, 2011)**

| Land Use | Risk Criteria (pmpy) |
|---|---|
| Hospitals, schools, child care facilities and aged care housing | 0.5 |
| Residential developments and places of continuous occupancy such as hotels, motels and resorts | 1 |
| Commercial developments including retail centres, offices warehouses with show rooms, restaurants and entertainment centres | 5 |
| Sporting complexes and active open space | 10 |
| Industrial (must not be exceeded at any boundary adjacent to another industrial facility) | 50 |

**Note: pmpy = The chance of an individual fatality expressed as a number pmpy should the person be continually exposed to the risk at the same location on the land's surface.**

**Table 19-7 NSW Individual Injury Risk Criteria (HIPAP No.4, 2011)**

| Land Use | Risk Criteria (pmpy) |
|---|---|
| Residential areas (4.7 $kW/m^2$ heat flux radiation) | 50 |
| Residential areas – 7 kPa explosion overpressure | 50 |
| Residential areas – injurious toxic concentrations<br>*Note: risk contour not evaluated – no toxics handled at Clyde Terminal* | 10 |
| Residential areas – toxic concentrations causing irritation<br>*Note: risk contour not evaluated – no toxics handled at Clyde Terminal* | 50 |

***Criteria for Risk to the Biophysical Environment***

The risk tolerability criteria suggested by the DP&I for sensitive environmental areas relate to the potential effects of an accidental emission on the long-term viability of the ecosystem or any species within it. The criteria are expressed as follows:

- Industrial developments should not be situated in proximity to sensitive natural environmental areas where the effects of the more likely accident emissions may threaten the long-term viability of the ecosystem or any species within it; and
- Industrial developments should not be situated in proximity to sensitive natural environmental areas where the likelihood of impacts that may threaten the long-term viability of the ecosystem, or any species within it, is not substantially lower than the background level of threat to the ecosystem.

The potential for long-term effects due to an accidental emission of hydrocarbons from the Project Area on the viability of ecosystems in the vicinity of the Project Area is provided in **Section 16.0**. This assessment found that:

- The effects of the more likely accident emissions do not threaten the long-term viability of the ecosystems in the vicinity of the Project Area; and
- The likelihood of the impacts that potentially threaten the long-term viability of those ecosystems, or any species within them, is lower than the background level of threat to the ecosystem.

***Societal Risk***

The DP&I suggest that judgements on societal risk be made on the basis of a qualitative approach rather than on specifically set numerical criteria. Societal risk estimation is warranted only where significant and potentially vulnerable populations exist beyond the boundary of the proposed development. This is not the case for this Project, since the worst-case consequence generated by the Clyde Terminal hazards does not reach residential development. Societal risk was not evaluated for this proposal but would be part of consideration for subsequent redevelopment options for surplus land as a consequence for this Project, where relevant.

***Results of Risk Assessment***

Individual fatality risk contours for the Clyde Terminal are shown in **Figure 19-2** and a summary of the risk assessment findings against the relevant risk criteria is provided in **Table 19-8**.

Individual fatality risk contours for operations at the former Clyde Refinery when Crude Oil was still being processed (i.e. prior to later 2012) are shown in **Figure 19-3** (Shell, 2012c), which indicate the following individual fatality risk contours extended offsite:

- The industrial risk contour encroached onto the LyondellBasell facility, the Parramatta Terminal, the land leased by Shell to Autonexus, and also onto the Iplex Pipelines Factory;
- The sporting complexes and active open spaces risk contour encroached onto parts of recreational public space along Duck River, and foreshore areas across Duck River from the Project Area;
- The commercial risk contour encroached onto the area leased by Shell to Patrick and to SITA, several commercial facilities along the foreshore area of Silverwater across Duck River from the Project Area and onto the Iplex Pipelines Factory; and
- The residential risk contour encroached into a residential part of Silverwater to the south of the Project Area.

The risk contours for hospitals, child care facilities and old age housing developments did not encroach onto any of these existing land uses under the former operations of the former Clyde Refinery (refer to **Figure 19-3**). These risk contours were considered to be typical of an operating refinery storing substances that, upon release, have large consequence distances e.g. hydrofluoric acid.

The individual fatality risk contours for the current operations and for the ongoing future operation of the converted Clyde Terminal are shown in **Figure 19-2**. In comparison, this Figure demonstrates that the individual fatality risk is substantially reduced with the current and the future proposed operations at the Project Area when compared to the previous refinery operations. The contour relevant to fatality risks associated with industrial developments is contained within the site boundaries. As shown in **Figure 19-2**, for the current and future operations, the fatality risk contours for hospitals, child-care facilities and old age housing developments, for commercial developments and for sporting complexes still extend beyond the boundary of the Clyde Terminal. However there continues to be no hospitals, child care facilities and old age housing developments within the risk contours.

The following areas, however, continue to lie within their respective risk contour zones (refer to **Figure 19-2**):

- A commercial wharf area across Duck River from the Clyde Terminal; and
- Over part of Duck River and foreshore areas across Duck River from the Project Area although these areas are not accessible to the public. There is signage on the river that no private vessels are permitted to travel beyond the Silverwater Bridge and the foreshore areas across Duck River are not accessible by land.

Land uses such as commercial and open space do not involve continuous human occupancy by the same people, as individual occupancy of these areas is likely to be on an intermittent basis and the people present are already mobile. Therefore, a higher level of risk (compared to permanent housing or exposure to those who are less mobile) may be tolerated.

The Project would not introduce any new significant land use risks, or aggravate any existing land use risks. The current and future use of the converted Clyde Terminal would also result in significantly reduced risk contours than those modelled for the previous refinery operations. These risks to commercial and open space users have therefore already been reduced, and it is not feasible to further amend operations of the Clyde Terminal to reduce these risks further. There is also societal benefit in continuing the operation of the converted Clyde Terminal, as it continues to supply a secure source of fuel for the NSW fuel market (refer to **Section 4.0**).

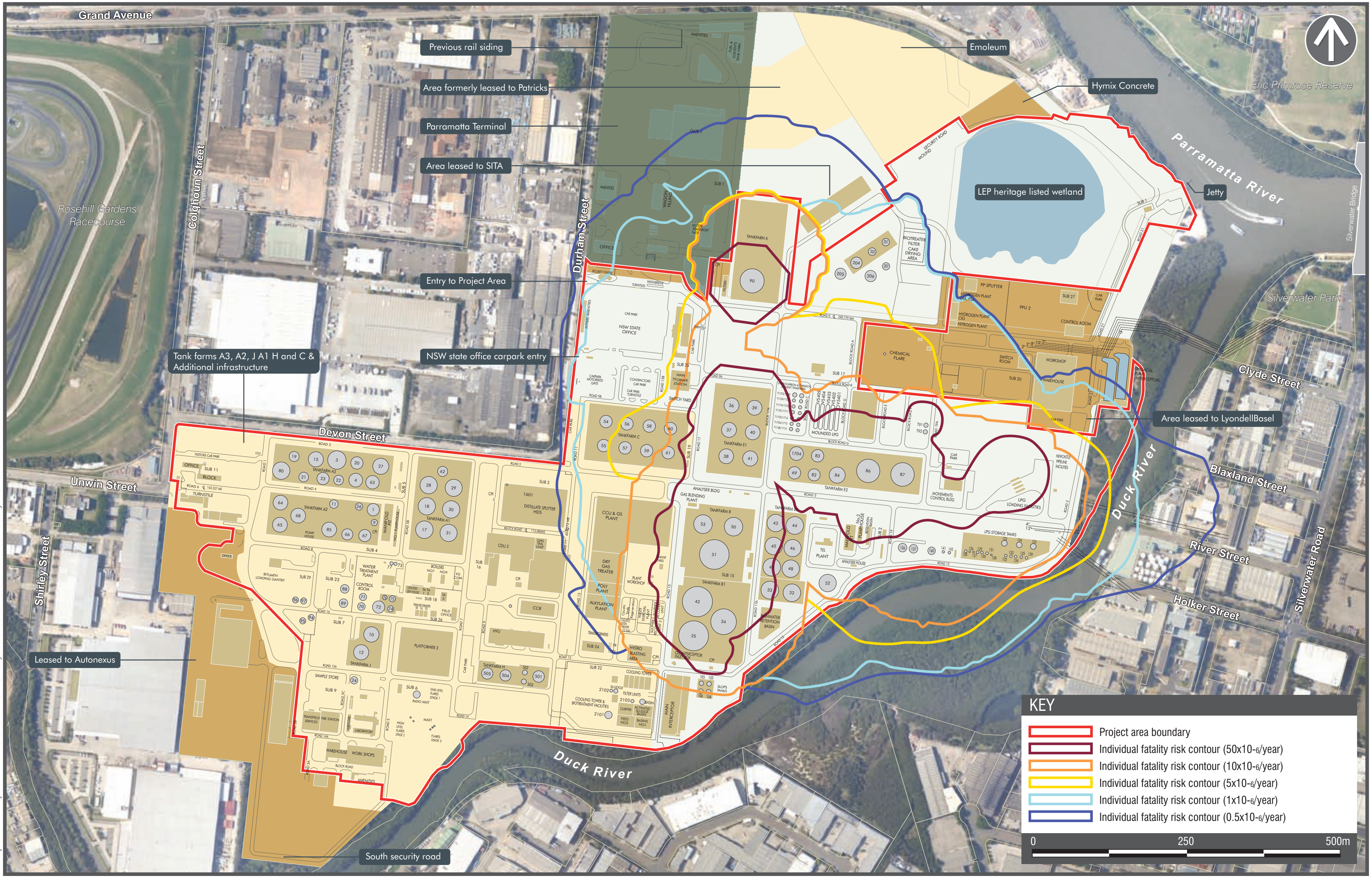
**Table 19-8 Individual Fatality Risk Assessment**

| Land Use | Outcome |
|---|---|
| Hospitals, child-care facilities and old age housing developments | The risk at the nearest existing hospital, child-care facility and old age housing development is less than $0.5x10^{-6}$ /year (as shown in lilac in **Figure 19-2**). |
| Residential developments and places of continuous occupancy such as hotels and tourist resorts | The risk at the nearest existing residential area is less than $1 \times 10^{-6}$ /year (as shown in light blue in **Figure 19-2**). |
| Commercial developments | The risk at the nearest existing commercial development is less than $5 \times 10^{-6}$ /year (as shown in yellow in **Figure 19-2**). |
| Sporting complexes and active open space areas | The risk at the nearest existing sporting complex is less than $10x10^{-6}$ /year (as shown in orange in **Figure 19-2**). |
| Industrial – must not be exceeded any Refinery boundary adjacent to another industrial facility | The risk at the Clyde Terminal boundary with adjacent industrial land use is less than $50 \times 10^{-6}$ /year (as shown in maroon in **Figure 19-2**). |

Heat radiation injury risk points are shown in **Figure 19-4**. A summary of the findings against the *Risk Criteria for Land Use Safety Planning, Hazardous Industry Planning and Advisory Paper No. 4* (Department of Planning, 2011d) is provided in **Table 19-9**.

**Table 19-9 Individual Injury Risk Assessment**

| Land Use | Outcome |
|---|---|
| Residential areas – 4.7 kW/$m^2$ heat flux radiation | Heat flux radiation levels of 4.7 kW/$m^2$ do not impact residential development at frequencies of more than 50 chances in a million per year (shown as maroon in **Figure 19-4**). |
| Residential areas – 7 kPa explosion overpressure | Explosion overpressure levels of 7 kPa or greater would not be expected to occur at frequencies of more than 50 chances in a million per year (note: no contour plot is shown, risk points only are shown in in **Figure 19-4**). |

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# INDIVIDUAL FATALITY RISK CONTOURS

Clyde Terminal Conversion Project
Environmental Impact Statement

Injury risk contour data derived from Sherpa Consulting (J20648-001, January 2013)

FIGURE 19-2

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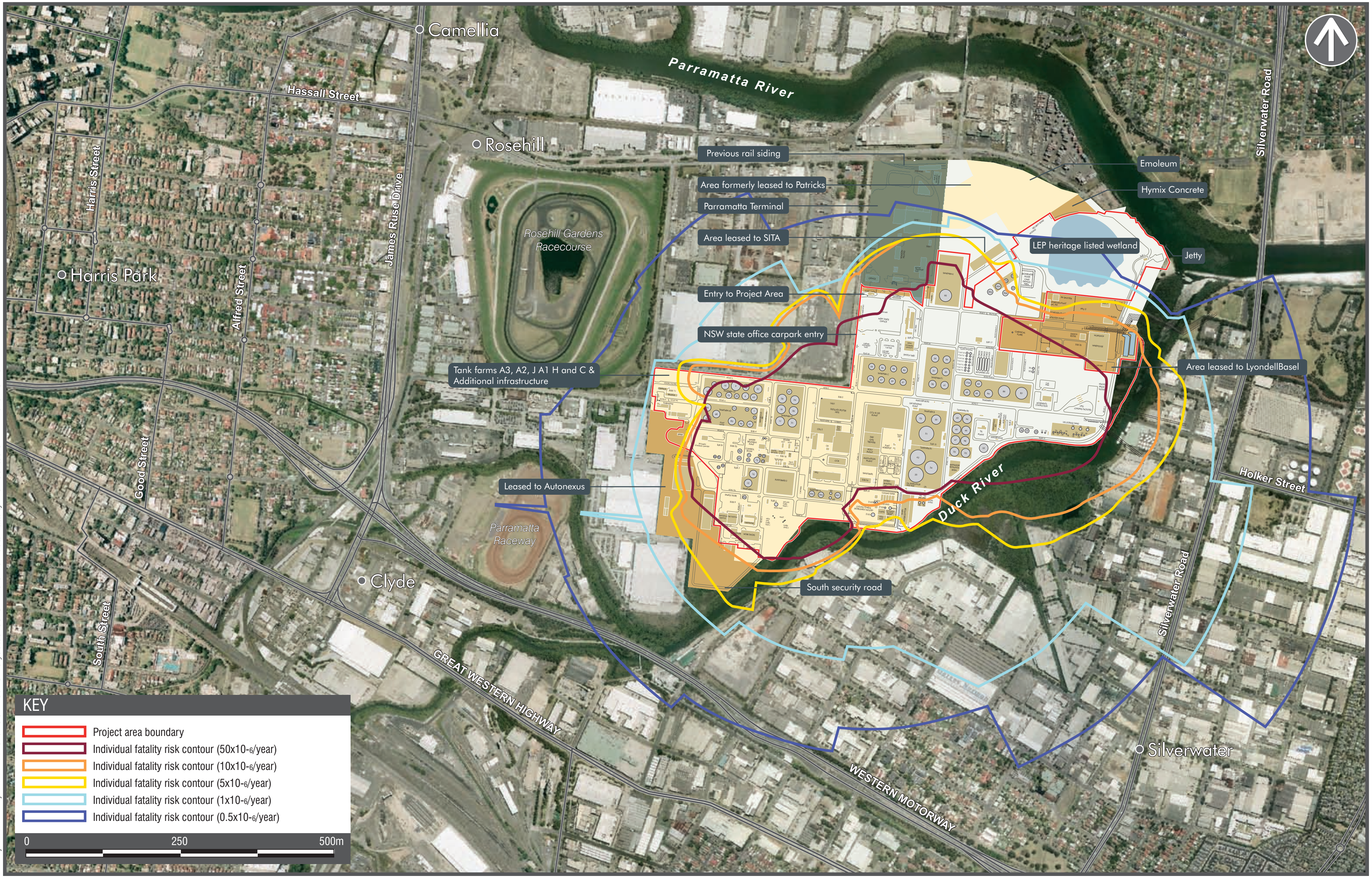


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# INDIVIDUAL FATALITY RISK CONTOURS - INCLUDING CRUDE OIL AND TOXIC COMPONENTS OF PREVIOUS REFINING OPERATIONS

Clyde Terminal Conversion Project
Environmental Impact Statement

Injury risk contour data derived from Sherpa Consulting (J20648-001, January 2013)

FIGURE 19-3

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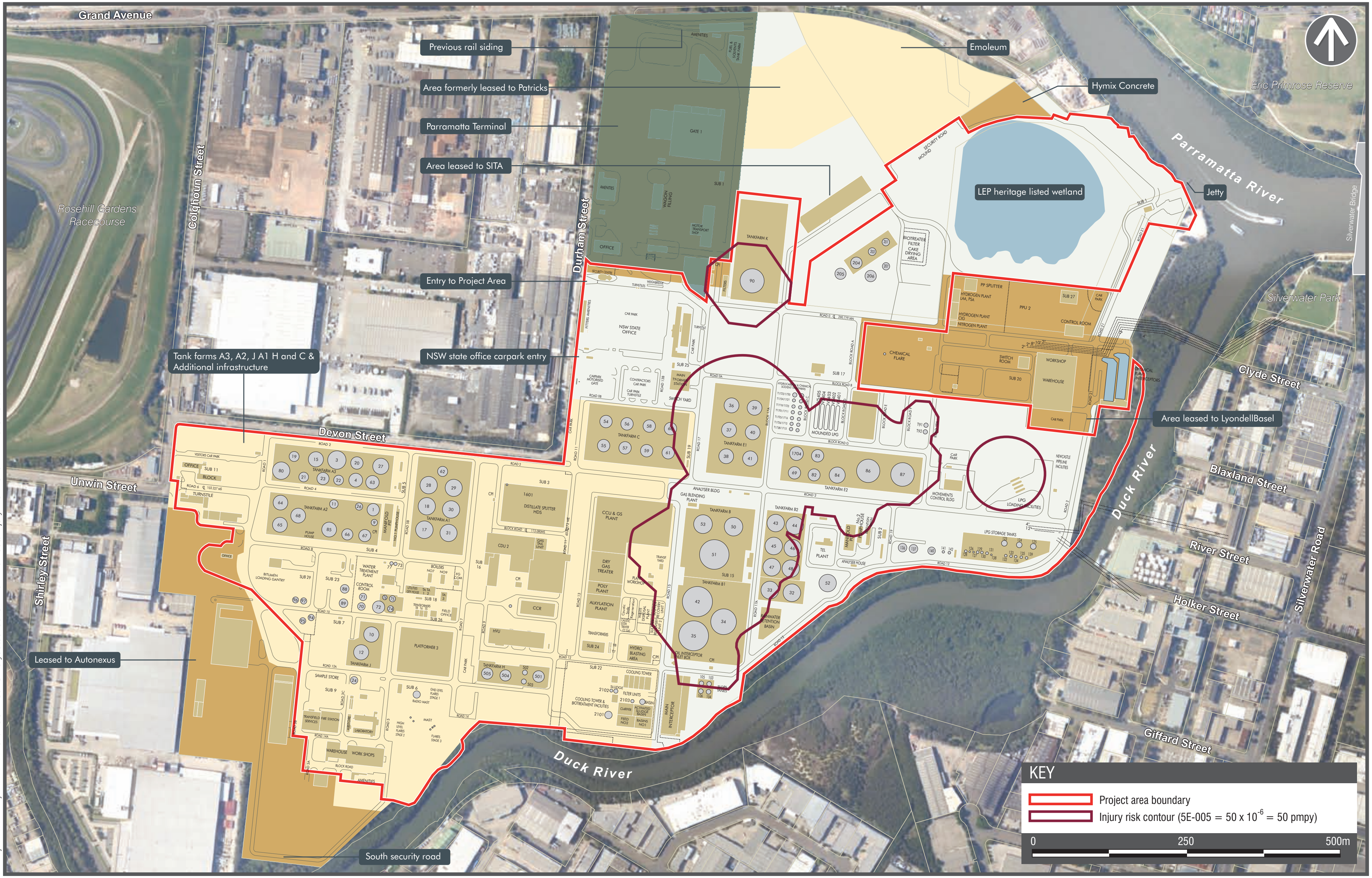




AECOM

# INDIVIDUAL HEAT RADIATION INJURY RISK CONTOURS

Clyde Terminal Conversion Project
Environmental Impact Statement

Injury risk contour data derived from Sherpa Consulting (J20648-001, January 2013)

FIGURE 19-4

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Heat radiation accident propagation (escalation) risk points are shown in **Figure 19-5**. A summary of the findings against the *Risk Criteria for Land Use Safety Planning, Hazardous Industry Planning and Advisory Paper No. 4* (Department of Planning, 2011d) is provided in **Table 19-10**.

**Table 19-10 Accident Propagation (Escalation) Risk Assessment**

| Land Use | Outcome |
|---|---|
| Potentially hazardous installations – 23 kW/m$^2$ heat flux radiation (flame impingement) | Flame or incident heat flux radiation levels of 23 kW/m$^2$ do not exceed a risk of 50 pmpy at neighbouring potentially hazardous installations (shown as maroon in **Figure 19-5**). |
| Potentially hazardous installations – 14 kPa explosion overpressure | Incident overpressure of 14 kPa or greater would not be expected to occur at frequencies of more than 50 chances in a million per year (note: no contour plot shown, risk points only are shown in **Figure 19-5**). |

### 19.3.5 Conclusions of the Preliminary Hazard Assessment

The main contributors to offsite fatality risk were found to be BLEVE of the LPG spheres and flash fire (vapour cloud explosion) following overfill of gasoline storage tanks. The risk assessment indicates that the Project Area complies with all relevant HIPAP criteria. The PHA can therefore be considered ‘potentially hazardous’ rather than ‘hazardous,’ and ‘potentially offensive’ rather than ‘offensive,’ in the context of SEPP33.

***Cumulative Risk***

As outlined in **Section 19.2**, the PHA has considered the cumulative hazard and risk impacts of Shell’s Clyde Terminal continuing to operate alongside its existing Parramatta Terminal, as the two Terminals are adjacent to one another. This methodology was considered appropriate by DP&I. While estimates of the cumulative risk from other potentially hazardous developments in the area surrounding the Clyde and Parramatta Terminals could not be made due to insufficient information, it can be confirmed that the proposed conversion works at the Clyde Terminal would not increase the cumulative risk to the surrounding area. Indeed, the Project would not introduce any new significant land use risks, or aggravate any existing land use risks. The current and future use of the converted Clyde Terminal would also result in significantly reduced risk contours (refer to **Figure 19-2**) than those modelled for the previous refinery operations (refer to **Figure 19-3**).

### 19.3.6 Implementation of Recommendations from the Buncefield Incident Investigation

The explosion and fire at the Buncefield oil storage depot in the UK in 2005 was a significant event. As part of the work of the Major Incident Investigation Board, the Health and Safety Executive and the Environment Agency, as the Competent Authority in England and Wales for the regulation of major accident hazards, carried out a joint investigation into the cause of the incident.

On the night of Saturday 10 December 2005, Tank 912 at the Hertfordshire Oil Storage Limited (“Buncefield”) was filling with Gasoline. The tank had two forms of level control (primary control): a gauge that enabled the employees to monitor the filling operation; and an independent high-level switch which was designed to close down operations automatically if the tank was overfilled. Due to the practice of working to alarms in the control room, the control room supervisor was not alerted to the fact that the tank was at risk of overfilling. The level of Gasoline in the tank continued to rise unchecked (as the first gauge stuck and the independent high-level switch was inoperable). Large quantities of Gasoline overflowed from the top of the tank creating a vapour cloud that ignited, causing a massive explosion and a fire.

The investigation revealed that the gauge had stuck intermittently after the tank had been serviced in August 2005. Both the site management and the maintenance contractor, who knew of the issue, responded effectively to this unreliability. The independent high-level switch also needed a padlock to retain its check lever in a working (rather than test) position; however, the switch supplier did not communicate this critical point to the installer, maintenance contractor and site operator such that the padlock was not fitted (and the independent high-level switch remained in test mode).

Following the explosion and subsequent fire, there was reliance on bund retaining walls around the tanks (secondary containment) and a system of drains and catchment areas (tertiary containment) to ensure that resultant liquids could not be released to the environment. Both forms of containment failed due to the intensity of the fire. Pollutants from fuel and fire fighting liquids leaked from the bund, flowed offsite and entered the groundwater. These containment systems were inadequately designed and maintained for such events.

Systematic failures of design and maintenance (rather than random equipment failures) of both the overfill protection systems and liquid containment systems were the technical causes of the initial overfill enabling the explosion and the seepage of pollutants to the environment in its aftermath. However, underlying these immediate failings lay root causes based in broader management failings, these included:

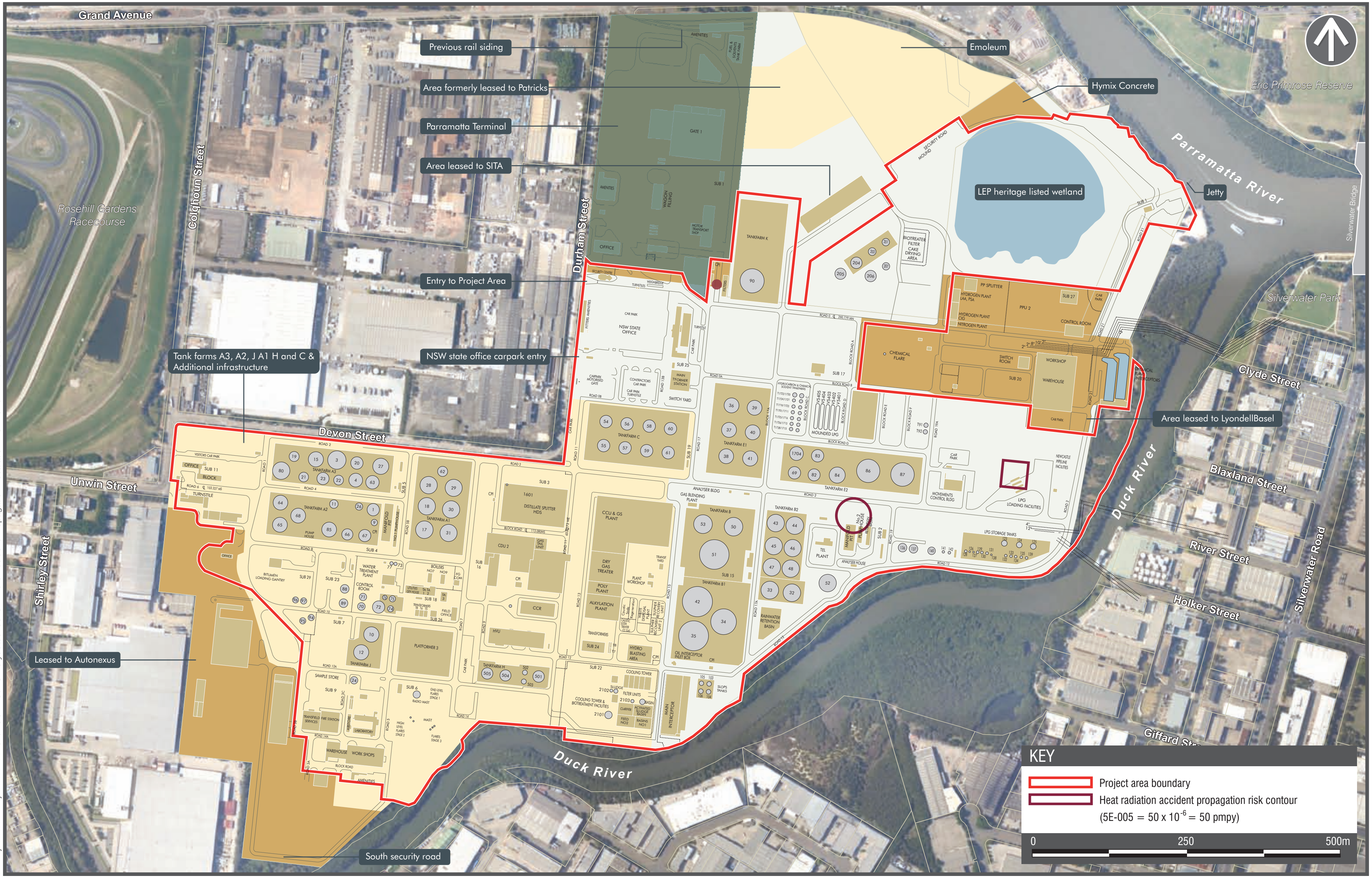
- Management systems in place at Buncefield relating to tank filling were both deficient and not properly followed, despite the fact that the systems were independently audited;
- Pressures on staff had been increasing before the incident. The site was fed by three pipelines, two of which control room staff had little control over in terms of flow rates and timing of receipt. This meant that staff did not have sufficient information easily available to them to manage precisely the storage of incoming fuel; and
- Throughput had increased at the site. This put more pressure on site management and staff and further degraded their ability to monitor the receipt and storage of fuel. The pressure on staff was made worse by a lack of engineering support from Head Office.

Cumulatively, these pressures created a culture where keeping the terminal operating was the primary focus and process safety did not get the attention, resources or priority that it required.

The Buncefield Report reinforced some important process safety management principles that have been known for some time:

- There should be a clear understanding of major accident risks and the safety critical equipment and systems designed to control them;
- There should be systems and a culture in place to detect signals of failure in safety critical equipment and to respond to them quickly and effectively;
- Time and resources for process safety should be made available;
- There should be effective auditing systems in place which test the quality of management systems and ensure that these systems are actually being used on the ground and are effective; and
- At the core of managing a major hazard business should be clear and positive process safety leadership with board-level involvement and competence to ensure that major hazard risks are being properly managed.

Four volumes of recommendations resulted from the investigation, each targeted to different parts of the broader community responsible for the oversight of the Buncefield operations. Many of these recommendations have now been included in various legislation requirements, such as Chapter 9 of the WH&S Regulation.




G:\Projects\602 Projects\60236231\FIGURES\EIS - Clyde\60236231 F19-5 Accident Propagation Escalation Risk Point 14 11 2013 TO Rev D

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# ACCIDENT PROPAGATION (ESCALATION) RISK CONTOURS

Clyde Terminal Conversion Project
Environmental Impact Statement

Injury risk contour data derived from Sherpa Consulting (J20648-001, January 2013)

FIGURE 19-5

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**Shell's Response to the Buncefield Incident Investigation Recommendations**

Shell has taken the learnings from the Buncefield Incident and other serious process safety related incidents very seriously in all of its petroleum and chemical terminal and refining operations worldwide. This has resulted in many standardised work practices, operating procedures and asset design and management practices to prevent such events from occurring. The focus of such programs has been to reduce the risk of these events to as low as reasonably practical.

Shell's general approach to the changes necessary at the Clyde Terminal is to ensure compliance with these latest standards across all facets where it is reasonably practical to do so. In many cases there are no options but to comply, and this has resulted in part to the levels of investment necessary to further assure the long term safe operations at the Clyde Terminal. Practically many of these are already in place and incorporated within the site management system.

Potential major accidents are identified in Shell's risk assessment work and in the MHF submission to WorkCover. The Emergency Response Plan includes all potential major accidents and Shell has a system of exercising these both with staff and combat agencies. Additionally, planned emergency response exercises are scheduled and performed at the Clyde Terminal including tank overfill and potential subsequent fires. The design of equipment and assets must be in line with Shell's prescriptive Design and Engineering Procedures which include mandatory process safety requirements which have been updated following the Buncefield Incident to include the relevant findings and recommendations of the incident investigation.

The scheduling of testing for safety critical equipment is established according to the importance of the equipment to safe operation and prevention of major accidents. Shell has a system of controls for those potential major accidents requiring multiple barriers that are independent of one another rather than relying on a single preventative barrier, or multiple barriers sharing any single component which would not allow them to be viewed as truly independent.

Reporting of incidents, potential incidents and near misses is a requirement for all Shell staff. These are reported into a global incident database which generates immediate alert notifications to the local process safety team and relevant site managers for action. The incident reports are also reviewed weekly with further investigation or action decided at this review. Additionally, for significant reports, an investigation is undertaken with learnings and actions communicated and allocated to specified personnel. These actions are tracked and verified before the report can be closed.

Global learnings are approached in the same way as the reporting of incidents so that the Gore Bay and Clyde Terminals also receive learnings and actions such as those that originated from the Buncefield investigation with changes to the process safety requirements and a timeframe in which to have these actions completed.

Shell trains all staff that it is completely acceptable to shut down operations if they are concerned about the safety of individuals or the operation. This starts with the induction and continues through all aspects of training and applies to process safety aspects of operations. A number of process safety field observations and audits take place each year. These focus on various aspects of operation and are facilitated by onsite staff and accompanied by site staff. The findings are reported to the site manager with actions reported within the global incident database for review by the management team and tracking of items to closure.

Shell has developed the staffing numbers for the Gore Bay and Clyde Terminals based on a detailed review of activities and responsibilities. This was done by external consultants to ensure that the correct numbers of staff would be available on all shifts to fulfil the requirements of the roles.

There is a system of audit for the Gore Bay and Clyde Terminals which has a layered approach. There is an annual audit system performed by Safety staff of the process safety requirements, inspection records and tests with verification of completeness and accuracy. This is supplemented by an internal auditor and a further level of global Shell auditors every three to five years. Additionally, the process safety requirements relating to the prevention of potential major accidents is audited by WorkCover as part of the MHF audit process. The WorkCover audit was last performed in 2012 and no significant findings were made for Shell's Gore Bay Terminal and Clyde Terminal.

The Shell system of controls includes line-up controls and verifications, inconsistent movement alarms and interlocks to prevent a tank gauge indicating a static condition while filling or emptying.

Independent high level alarms and separate alarms for various operational set points exist so that there are at least two 'pre alarm' set points before reaching the final set point which is also set below the overfill point. These two systems are completely independent of one another sharing no components.

Under no circumstances does Shell rely on alarms to control filling of tanks. Tank filling is a monitored activity with calculated durations and checks instituted during the expected duration with the Project Area manned continuously during the filling operation.

Shell already has system security controls preventing non-authorised site operations staff from altering tank parameters. The process for alteration of these parameters must go through a change management process to ensure the relevant personnel and experts are involved in the design, calculations and review process before these are amended in the system and, again, verified as correct. In addition to these, Shell undertakes a process of testing the tank parameters with real "wet" tests conducted under controlled conditions to verify operation of the probes and their settings.

Both the Gore Bay Terminal and Clyde Terminal safeguarding systems and controls identified in the system of controls for potential major accidents requires both preventative and recovery barriers. Preventative barriers are designed to prevent the loss of control/containment of hazards and include items such as tank gauging and overfill protection systems. Recovery barriers are designed to prevent escalation of a loss of control/containment event and include items such as tank bunds, emergency shutdown systems, fire systems, foam suppression and spill containment. There are a number of both preventative and recovery safeguarding upgrades proposed as part of the current Project.

Shell regularly reviews the integrity of the site bunds and maintains bunds as a critical piece of infrastructure that is required to hold more than the entire contents of largest product volume stored within the compound. This includes an allowance for initial fire water volumes where necessary. Bund wall penetrations are minimised, but where they exist, these along with bund wall joints are appropriately sealed and where necessary protected from possible fire damage.

Shell has taken the Buncefield report and reviewed operations at the Gore Bay and Clyde Terminals against the findings and recommendations. The vast majority of findings had already been considered and effective means were already in place. A system of further upgrades was planned for some items of which WorkCover is aware; and these have been included in the modifications proposed as part of the proposed Project.

## 19.4 Mitigation Measures

In order to demonstrate that risks are being controlled, the *Multi-Level Risk Assessment Guidelines* (formerly Department of Planning, 2011c) require a discussion of the technical controls, risk reduction measures and management measures in place.

***Risk Management in Design***

All tanks converted as part of the Project would be constructed to recognised Australian and International Standards, in line with the existing tanks at the Clyde Terminal.

The design would be subject to the Shell risk management process. Risk management activities that directly relate to the NSW Seven Stage Planning Process are outlined below:

- Preliminary Hazard Analysis;
- Shell's Hazard and Effects Management Process;
- Hazard and Operability Study;
- Fire Safety Study;
- Final Hazard Analysis;
- Emergency Response Plan Review annually or prior to each critical modification;
- Construction Safety Study;
- Commissioning review; and
- Safety Management System Update.

***Terminal Safety Systems***

Safety Systems proposed for the Project are as follows:

- Process Control: The process control system (i.e. tank level gauging) is integrated with the existing Clyde Terminal process Distributed Control System;
- Process Shutdown Systems: Existing pump interlocks would be retained and new tank high level trips would be provided as required to demonstrate as low as reasonably practicable risk;
- Bund Walls and Drains: The existing bunds and drains would be retained;
- Articulated and remotely operated foam application system would be installed;
- Fire Water: The existing firewater main, monitors and hydrants would be modified for the converted Clyde Terminal operations;
- Tank Rim Seam Foam Pourers: Rim seal foam pourers would be modified or installed to meet the revised tank configuration; and
- Hazardous Area Classification: Ignition sources would be controlled by the application of suitable hazardous area classification standards.

***Safety in Operation***

The existing Clyde Terminal and Gore Bay Terminal Management System would be updated to align with operation of the modified Gore Bay Terminal and converted Clyde Terminal. The Management System includes the following:

- Training of operators on new plant;
- Operating procedures; and
- Spares and maintenance of new equipment.

The ERP 2012 (refer to **Section 8.2.3**) would also be updated again as required before operation of the converted Clyde Terminal commences, and in particular the Final Hazard Analysis would be prepared at this time. The implementation of the Emergency Response Plans would include the activation of external emergency services if required.

***Proposed Automation and Safeguarding Operation***

The following safeguards and automation upgrades are proposed:

- Yokogawa Prosafe SGS would be installed to replace the functionality of the existing relay logic;
- Permissives (interlocks) would be improved to prevent the incorrect valves being opened;
- Motorised valves would be installed inside tank bunds to allow quicker acting valves and remote operation;
- The reliability of telemetry between Clyde/Gore Bay would be improved;
- The Independent High Level Alarm and tank gauging systems would be improved;
- Pump trip systems would be improved;
- The site fire system and dump valve logic would be improved; and
- Non-safeguarding controls would also be upgraded.

***General Mitigation Measures***

General mitigation measures are identified in **Appendix A** of the PHA Report (refer to **Appendix F** of **Volume 3** of this EIS), and would be employed during the Project to significantly reduce the potential for hazard and risks to cause significant impacts.

## 19.5 Residual Impacts

With the proposed mitigation measures in place, it is unlikely that the Project would increase the magnitude of hazards and risks associated with the Project Area. Rather, the Project is considered to reduce the overall hazard profile of the Project Area. In the event that an emergency scenario did eventuate as a result of the Project, the incident response measures provided in the ERP would be implemented in order to minimise impacts to life, property or the environment. This would include the activation of external emergency services if required.

With the mitigation measures outlined in **Section 19.4** and the implementation of the updated ERP for the Project, the risk of hazards inherent to the proposed Project impacting surrounding industrial and residential areas is considered to be low. The risks remaining from the converted facility will be further assessed and this assessment will be used in determining both the future suitable uses of the surplus land and the proximity of buildings to the Clyde Terminal.

# 20.0 Waste Management

**Relevant DGRs**: The EIS must address **Waste** – including accurate estimates of the quantity and classification of the potential liquid and non-liquid waste streams of the development and a description of the measures that would be implemented to ensure that any waste produced is appropriately handled, processed and disposed of.

## 20.1 Existing Conditions

The Clyde Terminal currently operates under EPL No. 570, which provides for the scheduled activity of waste processing by non-thermal treatment amongst other things. In particular, condition L5 of the EPL provides for the receipt, storage, processing and disposal of certain wastes scheduled under the POEO Waste Regulation, including wastes:

- Wastes from Shell's Parramatta Terminal adjacent to the Clyde Terminal;
- Wastes from Shell's Gore Bay Terminal; and
- Waste oil water, hydrocarbons/water mixtures or emulsions from the Sydney Metropolitan Pipeline as per EPL No. 1969 and the Joint User Hydrant Installation[3].

Waste tracking requirements under the POEO Waste Regulation are not applicable to the Gore Bay Terminal, Parramatta Terminal, Gore Bay/Clyde Pipeline or Joint User Hydrant Installation. However, records must be made of the wastes received at the Clyde Terminal from the Gore Bay Terminal.

Waste at the Project Area is generally managed in accordance with the WMP 2013, NSW and Commonwealth legislation, and Shell global standards. The WMP 2013 implements the *Waste Avoidance and Resource Recovery Strategy 2007* (Department of Environment and Conservation, 2007b) by providing a hierarchy of resource use as follows: prevention; minimisation; reuse; recycle; recovery measures; or disposal of waste.

### 20.1.1 Waste Management Guidelines

***Waste Classification Guidelines Part One: Classification of Waste***

The *Waste Classification Guidelines* (Department of Environment and Climate Change, 2008e) apply to waste generators, enabling them to correctly classify the wastes that they produce. The correct classification of waste aids identification of the way in which waste is managed, treated and disposed of to ensure that all associated environmental and human health risks are managed appropriately and in accordance with the requirements of the POEO Act and any other associated regulatory requirements.

Wastes generated at the converted Clyde Terminal would be classified in accordance with these guidelines, based on the chemical composition of the waste produced, and its potential environmental impacts. Waste streams generated at the Clyde Terminal would continue to require appropriate procedures and management for transportation and disposal, depending on their classification. Waste streams detailed in the Waste Classification Guidelines that are applicable to the Project include:

- Special waste, such as first aid waste, sharps and potential asbestos material;
- Hazardous and liquid wastes, such as wastewater, oil-based sludges and oily water;
- General solid wastes (putrescible), namely food wastes; and
- Non-putrescible general solid waste, such as building and demolition waste including glass, concrete, plastic, metal, paper etc.

It is expected that during the conversion of tanks, waste streams including oil-based sludges from the tanks to be demolished and those to be converted would be generated. These wastes are produced as part of the regular maintenance activities associated with ongoing operations of oil refineries and storage terminals and, as such, do not fall within the scope of the conversion activities themselves. They would, however, continue to be generated through the ongoing operational maintenance activities at the Clyde Terminal at the same time as the conversion works are taking place.

[3] EPL No. 570 also authorises treatment, processing, reprocessing or disposal of specific waste types from Basell Australia Pty Ltd

***Environmental Compliance Report: Liquid Chemical Storage, Handling and Spill Management***

The *Environmental Compliance Report: Liquid Chemical Storage, Handling and Spill Management* (Department of Environment and Conservation, 2005b) identifies practices that offer improved environmental performance at premises with regards to the storing and handling of liquid chemicals, as well as the management of spills. The storage of liquid chemicals and their handling creates the potential for soil, groundwater, surface water and air pollution to occur.

The *Environmental Compliance Report* outlines best practice environmental management measures to address the risks associated with such storage and handling. Incorporation of these measures for the Project includes:

- Implementing containment systems surrounding bulk storage tanks with adequate capacity to contain spills and leaks;
- Undertaking all unloading operations in areas with adequate spill containment capacity;
- Regular inspection of equipment;
- Training personnel in preventing spills during unloading operations;
- Providing tanks with level indicators and/or high level alarm systems with pump trip systems;
- “Closed circuit” tank water draining to separate water from product and return product to tank;
- Establishment of regular monitoring and inspection programs for wastewater;
- Ensuring water treatment systems are not overloaded;
- Developing and implementing emergency management plans; and
- Training staff in general spill management for operations at the converted Clyde Terminal.

Level indicators and alarm systems would be upgraded as part of the Project and quick flush vessels would be installed to provide closed circuit tank water draining. Other principles above would be considered further during updating of the existing WMP 2013 to take account of the demolition and construction activities, which would be incorporated into the CEMP. The existing operational WMP 2013 for the Clyde Terminal would be updated to align with the converted operation of the Clyde Terminal.

***Storage and Handling Liquids: Environmental Protection Participants Manual***

The management of environmental risks that are associated with the storage and handling of liquid substances is guided by the *Storage and Handling Liquids: Environmental Protection Participant’s Manual* (Department of Environment and Climate Change, 2007). The manual applies to any activity that uses, stores, or produces liquid substances and relates to bulk storage. The principles outlined in the Storage and Handling Liquids Manual would also be considered during the preparation and amendments to the WMP 2013 for the Clyde Terminal.

### 20.1.2 Current Waste Management Practices

**Table 20-1** summarises current waste management practices for the main waste streams generated at the Project Area and within surrounding areas of land that are leased by Shell to its industrial tenants. Potentially contaminated waste is classified in-situ by the Waste Coordinator by sampling the waste and sending for analysis to a third party laboratory. Based on laboratory results, wastes are classified as restricted (consistent with DECC Waste Classification Guidelines), hazardous or general solid.

Designated waste storage areas are bunded to prevent release events from occurring. In the event that waste materials or their leachate are released to the environment, the measures outlined in the SGMP 2010 are followed (refer to **Sections 17.1.7** and **17.3**).

Onsite transport is authorised by the Waste Coordinator. Offsite transport is coordinated through the Waste Coordinator and contractors. All of these personnel are provided with laboratory results for waste classification so specific trucks can be supplied and suitable disposal methods chosen appropriately for the specific stream to minimise environmental impacts. Personal Protective Equipment is assigned dependent on the waste type. NSW waste tracking requirements are followed up for all prescribed wastes from the moment the licensed contractor arrives onsite.

**Table 20-1 Current Waste Management at the Clyde Terminal**

| Waste Stream | Segregation | Temporary Storage | Onsite Treatment | Transportation | Reuse / Recycle | Disposal |
|---|---|---|---|---|---|---|
| **General waste, including asbestos, activated carbon, e-wastes, green wastes, tyres, timber, untreated timber, hydrofluoric acid and mercury contaminated wastes, rubber, fabric and waxes** | Collection bins located in plot areas for rubbish, paper and green waste[4]. Asbestos as per Chapter 8 of the WH&S Regulation. | Varies according to waste stream. | Varies according to waste stream. | Offsite transportation on covered skips by a licensed contractor. | Offsite recycling of paper, green waste and e-waste. | Currently disposed under contract with SITA. The majority of this waste currently goes to Elizabeth Drive Kemps Creek Landfill, in consideration of the *Waste Classification Guidelines* (Department of Environment and Climate Change, 2008e). |
| **Asbestos** | Asbestos as per Chapter 8 of the WH&S Regulation. | Bonded asbestos* material to be securely packaged<br>Friable asbestos** material must be kept in a sealed container<br>Asbestos-contaminated soil must be wetted down. | No on-site treatment | Transported in a covered, leak-proof vehicle. | It is illegal to re-use or recycle asbestos waste. | At a landfill site that can lawfully receive asbestos.<br>it is illegal to dispose of asbestos waste in domestic garbage bins. |
| **Scrap metal** | Contaminated / not contaminated scrap metal bins located onsite. | - | Hydroblasting in a bunded area. | Contaminated scrap metal - offsite transportation on covered skips by licensed | Offsite recycling. | Currently disposed under contract with Shell & Parker. The majority of this waste currently goes to the Yard & Shredder, 45 Tattersall Road, Blacktown. |

[4] Also occasionally e-wastes

| Waste Stream | Segregation | Temporary Storage | Onsite Treatment | Transportation | Reuse / Recycle | Disposal |
|---|---|---|---|---|---|---|
| | | | | contractor. | | |
| **Sludge** | - | Onsite bunded sludge bays. | Dewatering in bunded sludge bays.<br>Weathering in landfarm. | Onsite transportation subject to a waste permit and through a licensed contractor.<br>Offsite transportation on covered trucks by licensed contractor. | - | Currently disposed of under contract with Worth Recycling. The majority of this waste currently goes to Worth's licensed waste treatment facility at Windsor. |
| **Biotreater filtered cake** | - | Onsite drying bays. | - | Offsite transportation on covered trucks by licensed contractor. | - | Offsite disposal at a licensed facility. |
| **Contaminated soil** | - | - | Weathering in landfarm. | Offsite transportation on covered trucks by licensed contractor. | - | Onsite disposal if TPH is less than one percent weight. Otherwise, currently disposed of offsite under contract with Worth Recycling. |
| **Slops** | - | Slops tanks. | - | Offsite transportation on covered trucks by licensed contractor. | Reuse as part of product dosing activities | Offsite disposal at a licensed facility mainly for interceptor slops under contract with Worth Recycling. |

| Waste Stream | Segregation | Temporary Storage | Onsite Treatment | Transportation | Reuse / Recycle | Disposal |
|---|---|---|---|---|---|---|
| **Nuclear sources used in instrumentation** | - | - | - | Offsite transport and disposal by a contractor licensed under *Radiation Control Act* 1990 and the *Radiation Control Regulation 2003.* | - | Offsite disposal as per the *Radiation Control Act* 1990 and the *Radiation Control Regulation 2003*, ideally back to the manufacturer, but through a nuclear waste disposal contractor in any event. |
| **Chemical Wastes/Waste Oils/Batteries** | - | - | - | Offsite transportation on covered trucks by licensed contractor. | - | Currently disposed of under contract with Transpacific. The majority of these wastes currently go to the Glendenning (6 to 8 Rayben Street) and Homebush (Corner of Hill Road and Pondage Link), but disposal also takes place at other licensed sites via Transpacific. |

***any material (other than friable asbestos) that contains asbestos.**

****any asbestos-containing material that is in the form of a powder or can be crumbled, pulverised or reduced to powder by hand pressure when dry**.

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## 20.2 Predicted Impacts

The Project is anticipated to result in various streams of waste that are managed under separate regulatory requirements, and in particular under EPL No. 570 at the existing Clyde Terminal. It is anticipated that scrap and waste materials would be generated incrementally over a period of up to 10 years from the grant of development consent.

Significant changes to regular waste streams following the cessation of refining operations have already been observed. These include a reduction in spent catalysts and a range of processing chemicals and hazardous substances from the Project Area. During both the current operations phase and the future operation of the converted Clyde Terminal, the Clyde Terminal would continue to receive wastes from the Gore Bay Terminal, Parramatta Terminal and Sydney Metropolitan Pipeline as outlined in **Section 20.1**.

The waste streams estimated to be generated during the Project phases are summarised in **Table 20-2**.

**Table 20-2 Waste Generation during the Project**

| Source | Classification | Estimated Quantity | Proposed Management |
|---|---|---|---|
| **Demolition and Construction Waste Generation** | | | |
| Surplus demolition and construction waste such as:<br>- Scrap metal;<br>- Concrete;<br>- Spent erosion and sediment control materials/Geobags;<br>- Fencing;<br>- Soil;<br>- Contaminated soil; and<br>- Timber, glass and plastics. | General Solid<br>General Solid<br>Restricted Solid<br>General Solid<br>General Solid<br>Restricted Solid<br>General Solid | ~28,000 t<br>~50,000 $m^3$<br>~2 t<br>~10 t<br>~20 t<br>~1,000 $m^3$<br>~500 $m^3$ | - Recycle (refer to **Table 20-1**)<br>- Recycle<br>- Landfill<br>- Landfill<br>- Landfill (refer to **Table 20-1**)<br>- Onsite or offsite disposal (refer to **Table 20-1**)<br>- Recycle/landfill |
| Asbestos | Special waste | ~100 $m^3$ | - Offsite disposal by a licensed waste contractor |
| PCBs<br>Potentially PCB impacted oils | Special waste<br>Special waste | ~1 $m^3$<br>~160,000 L | - Offsite disposal by a licensed waste contractor<br>- Offsite disposal by a licensed waste contractor |
| Nuclear isotopes contained within sources used in instrumentation | Hazardous | ~2 kg | - Offsite transport and disposal by a contractor licensed under *Radiation Control Act* 1990 and the *Radiation Control Regulation 2003* |
| Wastes from toilets and bathrooms | Liquid | <50,800 (L per day)* | - Discharge to sewerage system |
| General waste including:<br>- Office waste;<br>- Domestic waste from staff and contractors; and<br>- Packaging waste. | General Solid | ~4,000 t | - Recycle<br>- Transport and disposal to landfill by a licensed contractor |

| Source | Classification | Estimated Quantity | Proposed Management |
|---|---|---|---|
| **Operation Phase Waste Generation (per Annum)** | | | |
| Sludge | Hazardous | ~50 t | - Offsite transport and disposal by a licensed waste contractors (refer to **Table 20-1**) |
| Oil filters and packing | Hazardous | ~5 t | - Offsite transport and disposal by a licensed waste contractor |
| Oily rags | Hazardous | <1 t | - Offsite transport and disposal by a licensed waste contractor |
| Chemicals (organic solvents) | Hazardous | ~5 t | - Recycle<br>- Offsite transport and disposal by a licensed waste contractor |
| Contaminated blue metal (from sludge drying bays) | Hazardous | ~10 t | - Offsite transport and disposal by a licensed waste contractor |
| Empty drums | Hazardous/ General Solid | ~5 t | - Recycle<br>- Offsite transport and disposal by a licensed waste contractor |
| Scrap metal | General Solid | ~50 t | - Recycle (refer to **Table 20-1**) |
| Spent erosion and sediment control materials | Restricted Solid | ~2 t | - Offsite transport and disposal by a licensed waste contractor |
| Contaminated soil | Restricted Solid | ~50 t | - Onsite or offsite disposal (refer to **Table 20-1**) |
| Soil | General Solid | <100 t | - Transport and disposal to landfill by a licensed contractor |
| Wastes from toilets and bathrooms | Liquid | <11,600 (L per day)* | - Discharge to sewerage system |
| General waste including<br>- Office waste;<br>- Domestic waste from staff and contractors; and<br>- Packaging waste. | General Solid | ~2,000 t | - Recycle<br>- Transport and disposal to landfill by a licensed contractor (refer to **Table 20-1**) |

**Note:*Projected waste water quantity is based on NSW Department of Health's general allowance of 200L of water per person per day.**

EPL No. 570 currently provides for the scheduled activity of waste processing by non-thermal treatment, amongst other things at the Clyde Terminal. Shell has undertaken dialogue with the EPA to amend the EPL to take account of revised operations at the Project Area and the EPL has been amended to reflect this. The operationally-generated waste streams have already reduced and would reduce further once the conversion is complete. EPL No. 570 would be further changed as necessary to reflect these changes once complete.

As detailed in **Table 20-2**, the demolition and construction works would generate:

- Substantial volumes of specific streams of waste such as asbestos, contaminated soil and scrap metal. The generation of these wastes would be limited to the demolition and construction works;
- Additional volumes of oily sludge waste would be generated throughout the decontamination process from tanks as these are cleaned ready for demolition or conversion. This waste stream is a normal operational waste stream although has been brought forward from the schedule that would have been the case had the refining operations continued so that the assets can be demolished and removed;
- Similar volumes of operational waste compared to the current operation of the Clyde Terminal as operations would continue concurrently during the demolition and construction works; and
- Minor quantities of equipment containing radioactive isotopes would be disposed of back to manufacturer or through nuclear waste disposal contractors.

Shell has existing agreements in place with waste contractors regarding the management and disposal of operational wastes. These providers have the capability to manage the majority of the wastes generated from the demolition and construction works, thereby minimising the potential strain on waste processing and transport infrastructure in the surrounding area.

During the demolition and construction works there is also potential for wastes to further impact on the environment whilst they are stored and stockpiled awaiting transport offsite, as unsecured stockpiled wastes or their leachate may be released into the environment. As outlined in **Sections 15.3** and **13.3**, Shell would prepare an ESCP to be incorporated into the CEMP for the Project, and would manage its stockpiled wastes according to the measures outlined in **Section 13.3**.

Operation of the Clyde Terminal once the conversion works are completed would generate:

- Similar volumes of waste compared to the current operation of the Clyde Terminal as the ongoing operations would be similar regarding the receipt, handling and distribution of finished petroleum products; and
- General wastes such as domestic, office and packing wastes and sewage waste would decrease slightly due to the reduced workforce required to operate the converted Clyde Terminal.

Shell would continue or modify waste management agreements in place with waste contractors to ensure that operational wastes generated from the converted Clyde Terminal are adequately managed.

## 20.3 Mitigation Measures

Shell has existing agreements in place with waste contractors regarding the management and disposal of operational wastes, and has developed new relationships as necessary to manage these anticipated streams of waste. Furthermore, the significant amounts of scrap metal and concrete wastes that would be generated during the demolition works (approximately 28,000 t and 2,500 $m^3$ respectively) would be generated incrementally over a period of up to 10 years from the grant of development consent. Those streams of waste whose generation would be increased during the demolition and construction operations are therefore capable of management by Shell without placing additional strain on waste processing and transport infrastructure in the surrounding area. The opportunity also exists to recycle some of these demolition wastes (e.g. waste concrete may be suitable for crushing and use as fill).

### 20.3.1 Demolition and Construction Waste Mitigation Measures

All demolition, construction and operational waste would be managed and disposed of in accordance with relevant State legislation and Government requirements. The existing WMP 2013 would be updated for demolition and construction works, and this would be incorporated into the CEMP. The following waste management mitigation measures would be incorporated as part of the CEMP for the Project to eliminate or reduce the risk of environmental impacts:

- Demolition and construction contractors would be required to provide a detailed waste management plan and tracking system that incorporates available recycling options;
- Before transfer to the designated locations as per the waste permit system, wastes may require stockpiling. Wastes would be:
    - Clearly labelled, to ensure that all such waste is clearly identified and stored separately from other types of materials and wastes, and in particular to ensure that contaminated and non-contaminated wastes are stockpiled separately;
    - Located away from trafficked areas and other potential disturbances;
    - Placed on geo-fabric lining and covered to prevent leachate and erosion; and
    - Be no more than three to five metres tall depending in the type of wastes stockpiled, and allow adequate room for transport around and management of each stockpile.
- Demolition and construction waste would be stored on a sealed and bunded surface whilst awaiting transfer or processing;
- Radioactive substances waste would be disposed of as per the requirements of the *Radiation Control Regulation 2003* and the *Waste Classification Guidelines Part 3: Waste Containing Radioactive Material* (Department of Environment and Climate Change, 2008e);

- A small amount of asbestos is present on the Project Area and would require removal during demolition activities. As such, Shell and its contractors would comply with the following obligations set out in Chapter 8 of the WH&S Regulation:
    - Ensure that exposure to asbestos at the Project Area is eliminated as far as reasonably practicable (clause 420);
    - Ensure an asbestos register is maintained (clause 425);
    - Ensure an asbestos management plan is in place for the Project Area (clause 429);
    - Engage a licensed asbestos contractor to carry out the removal of asbestos from the Clyde Terminal (clause 458);
    - Ensure that health monitoring is provided to those personnel undertaking asbestos works as part of the Project (clause 435);
    - Ensure access to the asbestos removal area is limited to those who are actually involved in the removal of the asbestos, including the placement of relevant signage and barriers (clauses 470 and 481);
    - If there is uncertainty as to whether the exposure standard is likely to be exceeded, Shell would engage a competent contractor to perform air quality monitoring in the area (clause 482);
    - Decontamination facilities would be provided at all times at the Project Area (clause 483); and
    - Ensure that asbestos waste, and asbestos contaminated plant or clothing is decontaminated, sealed and labelled before it is removed from the Project Area to a site that is authorised to receive asbestos waste (clauses 483 to 484).
- As per the requirements of the POEO Waste Regulation, asbestos waste would be securely packaged, be in a sealed container, be wetted down, or be contained in a covered, leak-proof vehicle.

#### 20.3.2 Operational Waste Mitigation Measures

Waste management mitigation measures for operation of the Clyde Terminal would be incorporated into an updated version of the WMP 2013. Operational waste management mitigation measures include:

- Waste management would continue to be undertaken in accordance with the *Waste Avoidance and Resource Recovery Act 2001* and the *Waste Avoidance and Resource Recovery Strategy 2007* (Department of Environment and Conservation, 2007), in that resources would be used efficiently, and the hierarchy of waste avoidance, recovery and disposal would be followed;
- Waste would continue to be identified, characterised, classified and separated in accordance with the *Waste Classification Guidelines* (Department of Environment and Climate Change, 2008e), and records of these procedures would be maintained for the life of the conversion works, and beyond that, for the required statutory period;
- The waste permit system for the onsite and offsite transfer and disposal of waste would continue to be followed;
- EPL No. 570 would continue to provide the key guidelines for waste management at the Project Area. In particular:
    - Waste designated for recycling would be stored separately from other wastes;
    - All above ground tanks containing material with the potential to cause environmental harm would be bunded or have an alternative spill containment system in place; and
    - Dewatered oily sludge would be treated in an onsite landfarm or disposed of offsite to a place that can lawfully accept that class of wastes.
- Waste materials would be stored in the designated locations as per EPL No. 570 and the WMP 2013;
- Wastes scheduled under the POEO Waste Regulation would continue to be subject to waste tracking requirements, except where an exemption exists under EPL No. 570. A record of these waste movements would nevertheless be maintained by Shell;

- Leachate or residual water from waste dewatering activities would be directed to the interceptors for treatment before being released as licensed discharge. Waste materials separated out at the interceptors would be disposed at an offsite licensed facility;
- In the unlikely event that waste or its leachate is released to the environment, the investigation and remediation measures outlined in the SGMP 2010 would be adhered to; and
- PCB wastes would be managed and disposed of according to the Chemical Control Order issued by the EPA for the handling of PCB wastes.

### 20.3.3 Hazardous Waste Mitigation Measures

Hazardous wastes generated during demolition and construction activities, and/or operation of the converted Clyde Terminal (refer to **Table 20-2**) would be treated or immobilised in the following manner before being transported offsite by a licensed waste contractor (refer to **Table 20-1**):

- Asbestos wastes according to the requirements of the POEO Waste Regulation, including securely packaged in a sealed container and wetted down or contained in a covered, leak-proof vehicle;
- PCB wastes according to the CCO issued by the EPA for the handling of PCB wastes;
- Oil filters and packing and used oily rags would be managed as prescribed waste. Any powdery used oil-absorbent materials are to be bagged or drummed or otherwise contained to facilitate their safe handling and disposal;
- Oily sludges (for example, from tank cleaning during the ongoing operation of the Clyde Terminal) would continue to be treated in the sludge dewatering facility and/or the landfarm area, as per EPL No. 570;
- Redundant equipment containing any radioactive isotopes would be disposed of as per the requirements of the *Radiation Control Regulation 2003* and the *Waste Classification Guidelines Part 3: Waste Containing Radioactive Material* (Department of Environment and Climate Change, 2008e); and
- Organic solvents, contaminated blue metal and empty drums would be managed by chemical fixation to convert the hazardous contaminants to a chemically stable form. Where this is not possible, macroencapsulation would be used to place a physical barrier between those contaminated wastes and the surrounding environment.

## 20.4 Residual Impacts

It is anticipated that all wastes likely to result from the Project are known at this point in time, and are capable of management under either the existing or proposed waste management processes at the Project Area. Specific prescribed wastes (e.g. asbestos) would be managed and disposed of offsite as appropriate. In the unlikely event that waste or its leachate is released into the environment, investigation and remediation activities would be triggered under the SGMP 2010 as outlined in **Sections 17.1.8** and **17.3**. With the implementation of the mitigation measures outlined in **Section 20.3** to manage the various streams of waste that have been identified, it is predicted that there would not be significant residual impacts associated with wastes generated from the Project.

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# 21.0 Aboriginal Heritage

**Relevant DGRs**: The EIS must address **Heritage** – including an Aboriginal cultural heritage assessment (including both cultural and archaeological significance), which must demonstrate effective consultation with relevant Aboriginal community groups.

## 21.1 Existing Conditions

This Section summarises the findings of the Aboriginal Cultural Heritage Assessment (ACHA) that was prepared by AECOM for inclusion in this EIS. The ACHA is provided in **Appendix G** of **Volume 3** of this EIS. The ACHA was prepared in accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (Department of Environment and Conservation, 2005c) and involved consultation with members of the local Aboriginal community.

### 21.1.1 Desktop Investigations

A search of the Aboriginal Heritage Information Management System database was conducted on 23 July 2012. A total of 20 registered Aboriginal sites were identified within a 4 x 4 km area centred on the Project Area, however none of these sites were recorded within the Project Area. The closest of these sites is a stone artefact site 45-6-2559 approximately 1.2 km north-west of the Project Area. The majority of these sites have been recorded within the Parramatta LGA.

The Project Area falls within the traditional country of the Darug (also spelt Dharuk, Dharruk, Dharug and Daruk) language group. Darug territory extended from the Hawkesbury River in the north, to Appin in the south, and west into the Blue Mountains.

A wide range of aquatic, terrestrial, arboreal and avian fauna were exploited by Darug-speaking peoples for food. Coastal groups are reported to have exploited a wide range of fish and shellfish, as well as crustacea such as crabs and crayfish, and marine mammals such as seals and whales (Attenbrow, 2010). Hinterland groups, on the other hand, relied heavily on land mammals such as kangaroos, wallabies, possums, fruit bats and echidnas, with freshwater fish, shellfish, crustacea and tortoises and mammals (e.g. platypus and water rats) also eaten. Complementing faunal resources in both areas were a range of plant foods, some of which were also used for medicine and implement manufacture.

As in other parts of south-eastern Australia, a wide range of hunting and gathering 'gear' was employed by Darug speaking peoples. Known tools and weapons include wooden fishing and hunting spears (variously barbed with shell, chipped stone tools, fish/shark teeth, sharpened fish or animal bone), wooden spear-throwers and boomerangs, fishing hooks (typically shell but also bird talons, bone and wood), lines and sinkers (small stones), ground stone hatchets, stone pounders and wedges, chipped stone tools such as 'bondi points' and scrapers, as well as wooden shields, clubs and digging sticks, bark baskets, net bags and wooden dishes (Attenbrow, 2010). Bark canoes were also widely used. Further background on the Darug language group is provided in **Appendix G** of **Volume 3** of this EIS.

The Aboriginal archaeological record of Port Jackson catchment is well-researched, with formal investigations of this record having been undertaken since the late 19th century (e.g. Etheridge and David, 1889a, 1989b, Etheridge and Whitelegge, 1907). Recent decades in particular have witnessed a dramatic increase in the number of Aboriginal archaeological investigations undertaken in the catchment, both in developer-funded and academic research contexts (Attenbrow 2010). Investigations to date have generated an enormous body of archaeological data concerning pre-contact Aboriginal settlement and subsistence patterns, with thousands of sites having been identified and recorded in varying degrees of detail (Attenbrow, 2010). Middens and rockshelter sites are particularly well represented, with the latter incorporating a variety of evidence of past Aboriginal activities including food preparation and consumption, organic and non-organic tool manufacture and maintenance, the production of rock art and the burial of the dead (Attenbrow, 2010; Donlan, 1995; McDonald, 2008). However, a variety of other site types (e.g. grinding groove and rock engraving sites, open artefact sites) are also known.

### 21.1.2 Site Inspection

As proposed in the draft assessment methodology circulated to the RAPs on 11 September 2012 (refer to **Section 9.3.2**), an inspection of proposed impact areas within the Project Area was undertaken on 2 October 2012. Formal archaeological survey of these areas was deemed unwarranted on the basis of known levels of past disturbance and their corresponding lack of archaeological potential. Primary inspection objectives, therefore, were to confirm predicted levels of high disturbance and to provide RAPs with an opportunity to visit proposed impact areas, to provide comment on the cultural value(s) of the Project Area and to raise any concerns they may have regarding the Project, cultural or otherwise.

The archaeological site inspection was undertaken by a combined field team of one AECOM archaeologist (Dr Andrew McLaren) and six RAP representatives. Shell representatives Erica Salazar (Shell Environment Team Lead - Clyde Project) and Jacqueline Roberts (Clyde Environmental Team Leader) acted as escorts.

Owing to OH&S considerations due to the Project Area still being an active industrial site, all but one of the proposed impact areas within the Project Area were inspected from vehicles driven by escorting Shell personnel. Tanks to the immediate west of the biotreater filter cake drying area in the north-east of the Project Area were viewed on foot from this area, which was accessed via a short walk from parked cars approximately 50 m to the south.

Throughout the inspection, proposed project impacts were discussed informally amongst the field team, with Shell representative Erica Salazar explaining the nature and location of these impacts to everyone present. RAP representatives were encouraged throughout to raise any concerns about the Project. Comments on the cultural values of proposed impact areas and the Project Area more generally were also encouraged.

No Aboriginal archaeological sites were identified during the field inspection. As predicted prior to visiting the Project Area, all proposed impact locations within the Project Area can be classified as grossly disturbed, with all observed to consist of active or redundant components of the Clyde Terminal's operation (i.e. existing infrastructure areas). A very large majority of the Project Area and all the operational areas have had significant quantities of fill material introduced to allow the current assets to be built on the surface. Some foundation works have also excavated the natural land in order to provide more stability for the larger refinery assets. Those portions of the southern boundary inspected on foot can similarly be classified as grossly disturbed. Both areas appear to have been heavily modified by earthworks associated with the construction of refinery infrastructure (e.g. south security road) and tree planting.

As to the cultural values of proposed impact areas within the Project Area, no specific cultural values or concerns pertaining to these areas were raised by RAP representatives during the field inspection. More broadly, however, RAP representatives Gordon Workman (of DACHA), Gordon Morton (of DLO) and Des Dyer (of DLC) all commented on the pre-disturbance richness of the Clyde Terminal site in terms of faunal resources.

The scale of landscape modification that has occurred within the Project Area is such that AECOM considers the Clyde Terminal site to have no remaining scientific research potential with respect to Aboriginal archaeology.

Verbal and written comments provided by RAPs have indicated that, regardless of levels of historic disturbance, the Project Area remains a culturally significant and important part of Darug Country. RAPs have also indicated that the Project Area would have formed an important resource area for Darug people, with the waters of the bordering Parramatta and Duck Rivers, in particular, containing a wide range of edible fauna. No further specific cultural values regarding proposed impact areas within the Project Area were raised by RAPs.

Key observations to be drawn from a review of the existing environment of the Project Area can therefore be summarised as follows:

- Prior to historic land use disturbances, the Project Area likely comprised a highly productive and by extension, attractive resource zone for Aboriginal people occupying or passing through the Rosehill area;
- The inferred pre-disturbance topography of the Project Area (i.e. low lying wetland subject to regular inundation) is unlikely to have encouraged sustained Aboriginal activity or occupation. Aboriginal use of the Project area is likely to have taken the form of visits for resource collection;
- Disturbances resulting from the historical construction of the former Clyde Refinery, including dredging, filling and native vegetation clearance, are likely to have destroyed any evidence of past Aboriginal activity within the Project Area;

- No known source of stone suitable for the production of chipped and groundstone implements have been identified within the Project Area. Nonetheless, quartz is known to occur locally as pebbles in Hawkesbury Sandstone and silcrete regionally from the St Marys Formation; and
- Native vegetation within the Project Area has been extensively cleared as a result of the historical development of the former Clyde Refinery. Aboriginal scarred trees are unlikely to occur within the Project Area.

## 21.2 Predicted Impacts

No impacts to the identified Aboriginal cultural heritage values of the Project Area are anticipated. Proposed development works are to be conducted in areas that have been grossly modified by the construction of the refinery and, by extension, are considered to retain no potential for the preservation of Aboriginal archaeological materials. In addition, none of the proposed impact areas within the Project Area have been flagged by RAPs as culturally sensitive or valuable.

Accordingly, AECOM recommends that, with respect to Aboriginal cultural heritage, no further Aboriginal heritage investigations are deemed warranted for the Project.

## 21.3 Mitigation Measures

Whilst the ACHA predicts that the Project would not impact on the Aboriginal heritage values of the area, the following management measures would nevertheless be implemented if any potential Aboriginal objects or human remains are discovered at the Project Area:

- Should any suspected Aboriginal objects be uncovered during demolition or construction works, all works in the vicinity should cease immediately to prevent any further impacts and a qualified archaeologist be brought onsite to make an assessment. If the object is found to be an Aboriginal object, it would be notified under the *National Parks and Wildlife Act* as soon as possible;
- If suspected human remains are exposed, all construction work is to cease immediately in the near vicinity of the find location and the Project Manager is to be immediately notified to allow assessment and management:
    - An area of 20 m radius is to be cordoned off by temporary fencing around the exposed human remains site - construction work can continue outside of this area as long as there is no risk of interference to the human remains or the assessment of human remains;
    - The Police and OEH are to be contacted immediately; and
    - A physical or forensic anthropologist would be commissioned by the Police to inspect the remains *in situ* (organised by the Police unless otherwise directed), and make a determination of ancestry (Aboriginal or non-Aboriginal) and antiquity (pre-contact, historic or modern).
- Subsequent management actions would be dependent on the findings of the forensic anthropologist:
    - If the remains are identified as modern and human, the area would become a crime scene under the jurisdiction of the NSW Police;
    - If the remains are identified as pre-contact or historic Aboriginal, the site would be secured and OEH and all Registered Aboriginal Parties notified in writing. Where impacts to exposed Aboriginal skeletal remains cannot be avoided, remains would be retrieved via controlled archaeological excavation and reburied outside of the Disturbance Boundary in a manner and location determined by Registered Aboriginal Parties;
    - If the remains are identified as historic non-Aboriginal, the site is to be secured and the NSW Heritage Branch contacted; and
    - If the remains are identified as non-human, work can recommence immediately.
- The above process functions only to appropriately identify the remains and secure the site. From this time, the management of the area and remains is to be determined through one of the following means:
    - If the remains are identified as a modern matter liaise with the Police;
    - If the remains are identified as Aboriginal liaise with the proponent, OEH and Aboriginal stakeholders;

- If the remains are identified as non-Aboriginal (historical) liaise with the DP&I and the Heritage Office; and
- If the remains are identified as not being human then work can recommence immediately.

## 21.4 Residual Impacts

It is extremely unlikely that Aboriginal objects would be found on the Project Area due to the high level of past disturbance. However, in the unlikely event that such a site or item is discovered, the mitigation measures outlined in **Section 21.3** would minimise potential impacts. The Project is not predicted to result in any additional residual impacts for Aboriginal heritage at the Project Area or its surrounds.

# 22.0 Noise and Vibration

**Relevant DGRs**: The EIS must address **Noise and Vibration** – including all demolition, construction and operational noise and onsite and offsite road noise.

## 22.1 Existing Conditions

This Section summarises the findings of the Noise Impact Assessment prepared by AECOM for inclusion in this EIS. The detailed Noise Impact Assessment is provided in **Appendix H** of **Volume 3** of this EIS.

### 22.1.1 Noise and Vibration Criteria

***Construction Noise***

The *Interim Construction Noise Guidelines* (ICNG: EPA, 2009) aims to manage noise from construction works regulated by the EPA. Construction noise includes not only noise from building works but also from demolition, remediation, renewal and maintenance.

The ICNG recommends that a quantitative assessment is carried out for all *"major construction projects that are typically subject to the EIA process."* A quantitative assessment, based on a likely 'worst case' construction scenario, has been carried out for the Project.

Predicted noise levels at nearby noise sensitive receivers (residential and industrial premises) are compared to the levels provided in Section 4 of the ICNG. Where an exceedance of the noise management levels is predicted the ICNG advises that the proponent should apply all feasible and reasonable work practices to minimise the noise impact.

***Construction Vibration***

Due to large distances between the Project Area and receivers, as well as the absence of any construction plant which produce significant levels of vibration, adverse effects of construction vibration are extremely unlikely, with respect to either human comfort or structural damage. Therefore construction vibration is not considered to be an issue of concern within the Noise Impact Assessment, and no specific construction vibration mitigation measures have been considered for the Project.

The distance a large 1600kg hydraulic hammer can safely operate from an occupied building to comply with human comfort criteria in the EPA document *Assessing Vibration – A Technical Guideline* is 73m. A distance of 22m will typically comply with cosmetic structural damage criteria detailed in BS7385-*2 Evaluation and measurement for vibration in buildings - Guide to damage levels from groundborne vibration*. Since the closest residential receiver to the Project Area is approximately 400m away, and no vibration intensive plant is proposed to be used during construction or demolition works, it is highly unlikely any adverse vibrational impacts will be experienced at this receiver or those further away, and no further assessment of the vibrational impact of demolition or construction activities is considered necessary.

***Construction Blasting***

Construction blasting can result in two adverse environmental effects: airblast vibration, and ground vibration. The airblast and ground vibration produced may cause human discomfort and have the potential to cause damage to structures, architectural elements and services.

The Australian and New Zealand Environment Council (ANZEC, 1990) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* has been adopted by the EPA as comfort criteria. The guidelines are not intended to be structural damage criteria. However, they do provide a conservative approach to assessing blasting impacts.

***Operational Noise Criteria***

The main acoustic requirement of the POEO Act is to ensure that "a noise is not offensive." The definition for an offensive noise is included below.

*offensive noise is:*

*(d) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:*

*(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*

*(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*

*(e) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.*

To determine if a source of noise is offensive, a primary consideration is to determine whether the noise is intrusive. The EPA provides guidelines for external noise emissions from developments in the *NSW Industrial Noise Policy* (INP: EPA, 2000). The INP recommends a method which can be used to ascertain the intrusiveness of noise emissions.

EPA states that the relationship between the statutory definition of offensive noise and intrusive noise is that intrusive noise can represent offensive noise, but whether this is always true can depend on the source of the noise, noise characteristics and cumulative noise levels. Therefore to avoid the emission of an offensive noise, noise emissions should not be intrusive as defined by the EPA in the following manner:

*"A noise source is generally considered to be intrusive if noise from the source, when measured over a 15 minute period, exceeds the background noise by more than 5 dB(A)."*

Any noise generated within the Project Area boundary, including noise from mechanical services or associated with site buildings would be assessed in accordance with the INP. This means the assessment procedure for industrial noise sources has two components, which are:

- Controlling *intrusive noise* impacts in the short term for residences; and
- Containing *noise level amenity* for particular land uses for residences and other land uses.

A summary of the environmental noise criteria for the current Project based on the INP are provided in **Table 22-1**.

**Table 22-1 Final Environmental Noise Criteria, dB(A)**

| Catchment Area | Period | RBL, $L_{A90}$[1] | Intrusive Criterion RBL+5 | Estimated $L_{eq(15min)}$ Industrial Noise Only | Amenity Criterion[2] | EPA Noise Goals, $L_{eq(15min)}$ |
|---|---|---|---|---|---|---|
| Residents East of James Ruse Drive (Rydalmere, Silverwater & Newington) | Day[4] | 36 | 41 | 50 | 60 | 41 |
| | Evening[5] | 40 | 41[3] | 45 | 48 | 41 |
| | Night[6] | 31 | 36 | 41 | 43 | 36 |
| Residents West of James Ruse Drive (Rosehill) | Day | 37 | 42 | 52 | 60 | 42 |
| | Evening | 40 | 42[2] | 39 | 50 | 42 |
| | Night | 35 | 40 | 39 | 44 | 40 |

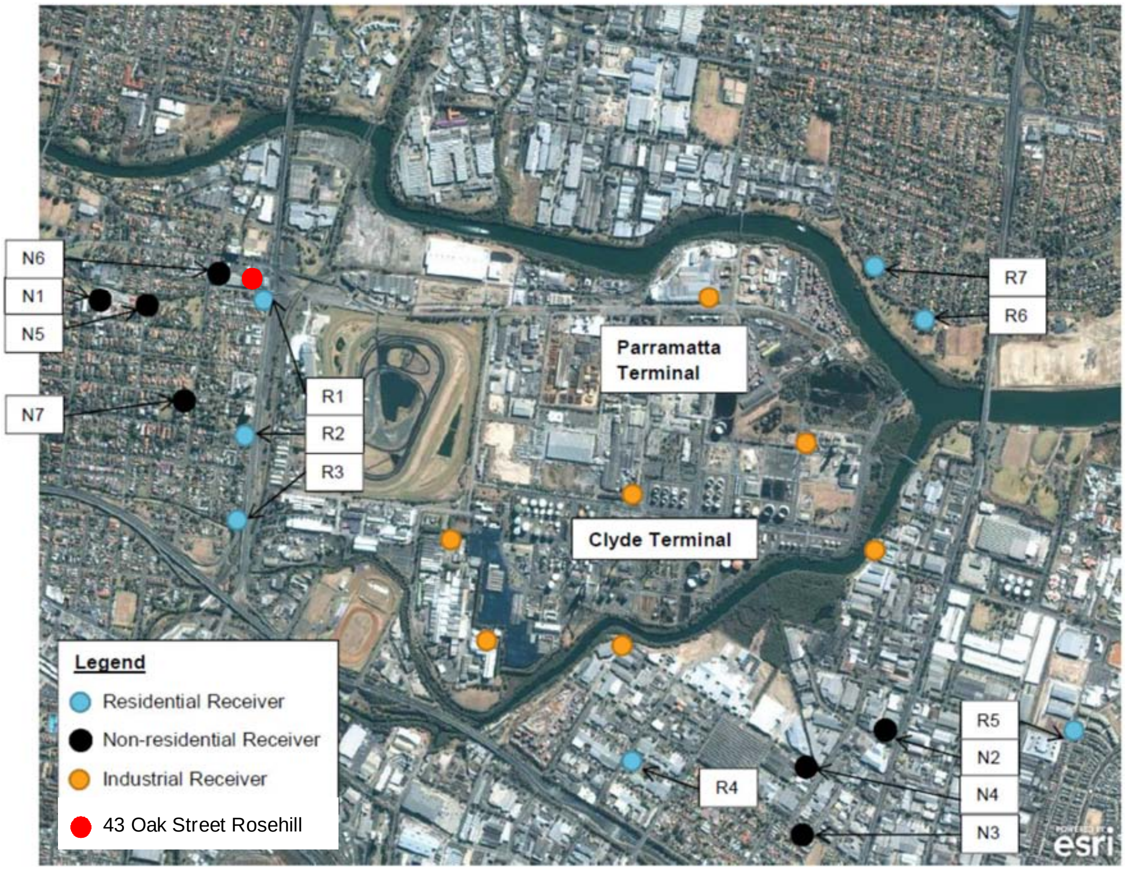
**Notes:**
**[1]RBL refers to the Rating Background Level within the INP 2000, which recognises the noise impacts of sources other than the development to which the community is exposed. This is particularly relevant for new and expanded projects where the noise levels are likely to increase beyond that which the community has previously been subjected to.**
**[2]Amenity criterion have been calculated in accordance with Table 2.2 of the INP 2000.**
**[3]Intrusiveness Criterion for Evening and Night have been set to no greater than Daytime levels in accordance with the INP Application Notes.**
**[4]Day is defined as 7:00 am to 6:00 pm, Monday to Saturday and 8:00 am to 6:00 pm Sundays and Public Holidays.**
**[5]Evening is defined as 6:00 pm to 10:00 pm, Monday to Sunday and Public Holidays.**
**[6]Night is defined as 10:00 pm to 7:00 am, Monday to Saturday and 10:00 pm to 8:00 am Sundays and Public Holidays.**

### 22.1.2 Receivers

Residential areas have been divided into receiver catchment areas, which are represented by residences identified as the likely worst affected residence in the area. These residences have been listed in **Table 22-2** and shown in **Figure 22-1**. Potentially affected non-residential receivers have also been identified and are listed in **Table 22-2**.

**Table 22-2 Residential and Non-residential Receivers**

| Receiver Number | Address | Approximate Distance and Direction from Project Area Boundary |
|---|---|---|
| **Residential Receivers** | | |
| R1 | 128 James Ruse Dr, Rosehill | 1 km north-west |
| R2 | 82–100 James Rue Dr, Rosehill | 850 m west |
| R3 | 71 James Ruse Dr, Rosehill | 850 m west |
| R4 | 92 Asquith St, Silverwater | 600 m south |
| R5 | 1 to 9 Mockridge Ave, Newington | 1.1 km south-east |
| R6 | 529 John St, Rydalmere | 400 m north-east |
| R7 | 35 John St, Rydalmere | 400 m north-east |
| **Non-Residential Receivers** | | |
| N1 | Our Lady of Lebanon Maronite Church | 1.6 km north-west |
| N2 | C3 Church, Silverwater | 830 m south-east |
| N3 | Sydney Korean Catholic Community Church | 880 m south |
| N4 | Sydney Baha'I Centre | 670 m south-east |
| N5 | Our Lady of Lebanon Aged Care Hostel | 1.4 km north-west |
| N6 | Rosehill Child Care Centre | 1.3 km north-west |
| N7 | Rosehill Public School | 1.1 km west |
| N8 | Bordering Industrial Premises | Adjacent in all directions |




***43 Oak Street, Rosehill is likely to be most affected by noise from traffic generated by the proposed Project**

**Figure 22-1 Receiver and Project Area Locations**

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### 22.1.3 Noise Monitoring

Unattended and attended noise monitoring was conducted at two locations in order to quantify background and ambient noise levels, and to also identify contribution from existing industrial noise sources. The noise monitoring locations are shown in **Figure 22-2**.

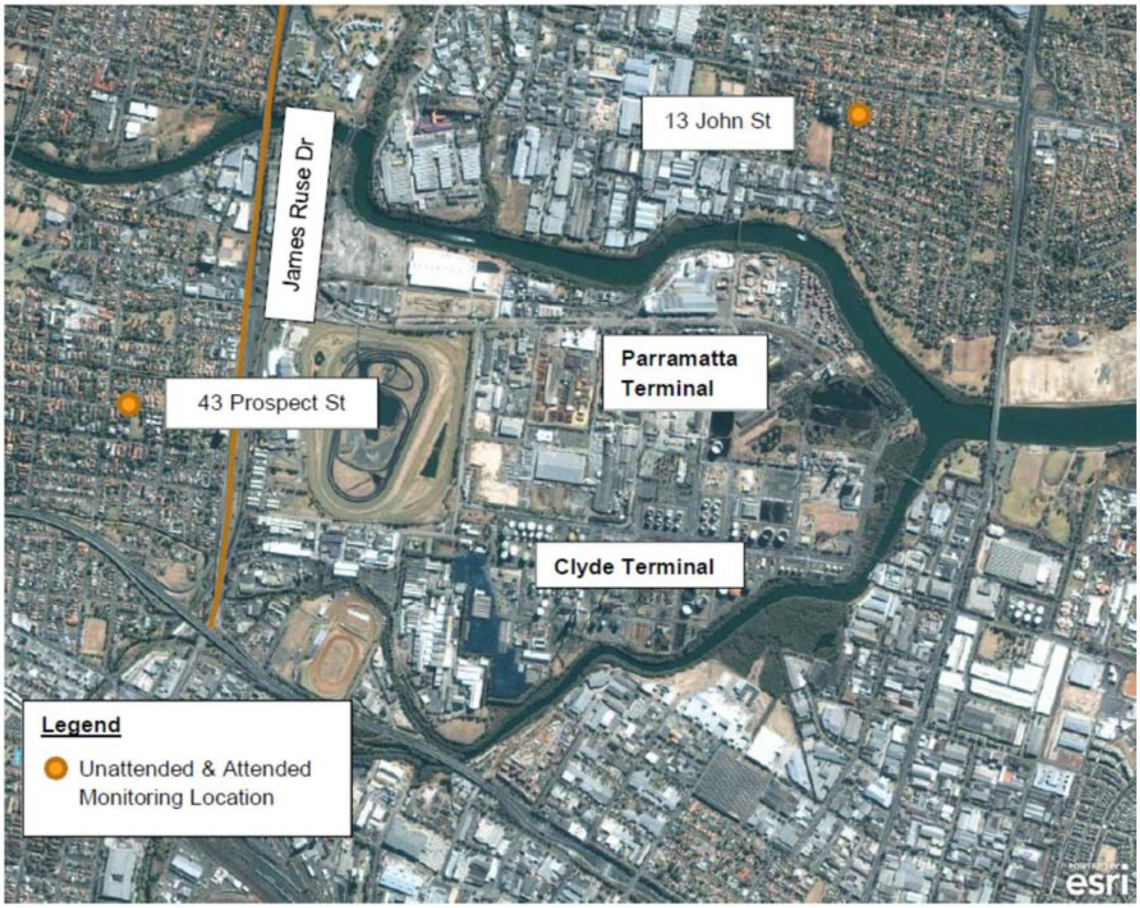


**Figure 22-2 Noise Monitoring Locations**

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### 22.1.4 Unattended Noise Monitoring

Noise logging was conducted from 15 August 2012 to 29 August 2012. Loggers were set up at two locations to represent receivers affected by noise from the proposed Project, shown in **Figure 22-2**. The locations were:

- 13 John St, Rydalmere; and
- 43 Prospect St, Rosehill.

The background noise level is defined by the EPA in the INP as "the underlying level of noise present in ambient noise when all unusual extraneous noise is removed." It can include sounds that are normal features of a location and may include birds, traffic, insects etc. The background noise level is represented by the $L_{A90}$ descriptor. The noise levels measured at the proposed Project Area were analysed to determine a single assessment background level (ABL) for each day, evening and night period in accordance with the INP, for each monitoring location.

The ABL is established by determining the lowest ten-percentile level of the $L_{A90}$ noise data acquired over each period of interest.

The background noise level or rating background level (RBL) representing the day, evening and night-time assessment periods is based on the median of individual ABLs determined over the entire monitoring period. **Table 22-3** also presents the existing $L_{Aeq}$ ambient noise level selected for each day, evening and night-time period, in accordance with the INP. An overall representative $L_{Aeq}$ noise level is determined by logarithmically averaging each assessment period for the entire monitoring period. A summary of the unattended monitoring results is provided in **Table 22-3**.

Periods which were affected by noise from extraneous wind and rain were omitted from results as noise from blowing trees, falling rain and increased tyre noise from wet roads may affect results.

**Table 22-3 Existing Background ($L_{A90}$) and Ambient ($L_{Aeq}$) Noise Levels, dB(A)**

| Measurement Data | $L_{A90}$ Background Noise Levels | | | $L_{Aeq}$ Ambient Noise Levels | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| **13 John St, Rydalmere** | | | | | | |
| RBL | 36 | 40 | 31 | - | - | - |
| Log Average $L_{Aeq}$ | - | - | - | 55 | 50 | 43 |
| **43 Prospect St, Rosehill** | | | | | | |
| RBL | 37 | 40 | 35 | - | - | - |
| Log Average $L_{Aeq}$ | - | - | - | 56 | 49 | 44 |

**Notes:**

**Day is defined as 7:00 am to 6:00 pm, Monday to Saturday and 8:00 am to 6:00 pm Sundays and Public Holidays.**

**Evening is defined as 6:00 pm to 10:00 pm, Monday to Sunday and Public Holidays.**

**Night is defined as 10:00 pm to 7:00 am, Monday to Saturday and 10:00 pm to 8:00 am Sundays and Public Holidays.**

### 22.1.5 Attended Noise Monitoring

Attended monitoring was conducted at the same monitoring locations on 24 and 31 August 2012. The purpose of these measurements was to qualify and quantify the noise environment in the vicinity of the Project Area. Monitoring locations were chosen to best represent background noise levels in absence of noise from the Project Area and traffic noise. **Table 22-4** presents a summary of these measurements.

Weather conditions were generally fine with little to no wind on the days and nights of monitoring. Differences in attended and unattended levels (refer to **Table 22-4**) were measured. These differences are attributed to a heavier traffic flow during the short term monitoring periods than over the total seven day logging period, as well as noise from trees blowing and insects. It was noted during attended monitoring that industrial noise impacts were noticed during the night at Rydalmere, and less so during the day, and faintly during the night at Rosehill, but not during the day. Industrial noise heard was characterised by a constant hiss or hum coming from the south at Rydalmere, and the east at Rosehill.

**Table 22-4 Attended Noise Monitoring 24 August and 31 August 2012, dB(A)**

| Monitoring Location | Period | Date / Time | Description | Attended Meas. Levels | | Unattended Meas. Levels* | |
|---|---|---|---|---|---|---|---|
| | | | | $L_{Aeq, 15min}$ | $L_{A90, 15min}$ | $L_{Aeq, 15min}$ | $L_{A90, 15min}$ |
| 13 John St, Rydalmere | Day | 24/08/12 13:07 | Local traffic and as well as a class of children within the school yard were the major contributors to the noise level. Industry noise was barely noticeable. | 55 | 49 | 57 | 41 |
| | Night | 31/08/12 00:14 | Light traffic main contributor to noise level. Insects also noted. Industry noise noticeable. | 49 | 46 | 41 | 36 |
| 43 Prospect St, Rosehill | Day | 24/08/12 13:42 | Noise from local traffic is dominant. Rustling of trees is heard constantly. Children within the school yard are also minor contributors. Industrial noise could not be heard. | 62 | 55 | 57 | 42 |
| | Night | 31/08/12 00:41 | Intermittent local traffic main contributor to noise. Insects and bats also noted. Industry faint in distance. | 49 | 41 | 40 | 36 |

**Note:** ***Unattended measurement levels show the average of unattended logged $L_{Aeq(15min)}$ at the closest 15 minute interval to the attended measurement period.**

Differences in attended and unattended levels were measured. The large differences in levels during both the day and night at 43 Prospect Street and the night at 13 John Street were attributed mainly to the constant rustling of trees or cricket noise which controlled the background noise level during the monitoring period but would not be present during the entire long-term monitoring period. These noise sources would affect the entire 15 minute measurement and due to their constant nature would raise both the $L_{eq}$ and $L_{90}$ levels of the attended measurements. During day time monitoring at 13 John Street differences in unattended and attended measured levels were attributed to schoolyard noise being louder during the short term monitoring periods than over the entire logging period, which was noted as the largest contributor during measurements. Discrepancies may also be due to heavier traffic flow during the short term monitoring period, and differences in activity in the area during attended measurements.

## 22.2 Potential Impacts

### 22.2.1 Demolition and Construction Noise

The predicted impact from demolition and construction noise at the representative receivers during each stage of the works has been assessed. It has been assumed that these activities would take place during standard working hours only (i.e. 7am and 6pm Monday to Friday and 8am to 1pm Saturday). The assessment assumes no noise mitigation at the demolition and construction site and is representative of a worst case assessment i.e. all plant is operating concurrently for the entire 15 minutes. The plant and equipment that were considered in the assessment are provided in **Table 22-5**.

**Table 22-5 Construction Equipment Usage and Sound Power Levels**

| Construction Plant | $L_{eq}$ Sound Power Level dB(A) | Plant Usage | |
|---|---|---|---|
| | | Demolition | Construction |
| Excavator equipped with mechanical shears | 107 | 2 | - |
| Excavator equipped with hydraulic shears | 107 | 2 | - |
| Trucks | 108 | 4 | 4 |
| Crane | 105 | 2 | 2 |
| Air compressors | 94 | | 3 |
| Pneumatic wrenches | 107 | | 3 |
| Cutting torches | 110 | 3 | - |

Predicted demolition and construction noise impacts are shown in **Table 22-6**. These predict exceedances of construction noise management levels of up to 4 dB(A) at three residential receivers, however this is assuming all included plant is operating simultaneously and is therefore an extremely conservative prediction. Mitigation measures and management procedures have been recommended to reduce construction noise impacts and minimise disturbance to these residences, including not using all equipment simultaneously. In the context of temporary construction and demolition noise impacts, a conservative exceedance of construction noise management levels of up to 4 dB(A) is considered to lie comfortable within the scope of measures to manage and mitigate noise impacts.

This assessment has also conservatively considered the worst case scenario of all equipment operating for a full 15 minute period. This is unlikely to occur for an extended period of time.

Mitigation and management measures have been recommended in **Section 22.3** to reduce the impact of the noise on sensitive receivers.

**Table 22-6 Predicted Demolition and Construction Noise Impacts**

| Rec | Address | Floor | NML[1] | Demolition | | Construction | | Construction & Demolition | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Predicted $L_{eq\,(15min)}$ | Exceed. | Predicted $L_{eq\,(15min)}$ | Exceed. | Predicted $L_{eq\,(15min)}$ | Exceed. |
| **Residential Receivers** | | | | | | | | | |
| R1 | 128 James Ruse Dr, Rosehill | 1 | 47 | 41 | - | 39 | - | 43 | - |
| R2 | 82–100 James Ruse Dr, Rosehill | 1 | 47 | 41 | - | 40 | - | 44 | - |
| | | 2 | 47 | 41 | - | 40 | - | 44 | - |
| | | 3 | 47 | 41 | - | 40 | - | 44 | - |
| | | 4 | 47 | 41 | - | 40 | - | 44 | - |
| | | 5 | 47 | 41 | - | 40 | - | 44 | - |
| | | 6 | 47 | 41 | - | 40 | - | 44 | - |
| R3 | 71 James Ruse Dr, Rosehill | 1 | 47 | 41 | - | 40 | - | 44 | - |
| | | 2 | 47 | 41 | - | 40 | - | 44 | - |
| R4 | 92 Asquith St, Silverwater | 1 | 46 | 47 | **1** | 45 | - | 49 | **3** |

| Rec | Address | Floor | NML[1] | Demolition | | Construction | | Construction & Demolition | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Predicted $L_{eq\ (15min)}$ | Exceed. | Predicted $L_{eq\ (15min)}$ | Exceed. | Predicted $L_{eq\ (15min)}$ | Exceed. |
| R5 | 1 to 9 Mockridge Ave, Newington | 1 | 46 | 42 | - | 37 | - | 43 | - |
| | | 2 | 46 | 42 | - | 37 | - | 43 | - |
| | | 3 | 46 | 42 | - | 37 | - | 43 | - |
| | | 4 | 46 | 42 | - | 37 | - | 43 | - |
| R6 | 529 John St, Rydalmere | 1 | 46 | 49 | **3** | 43 | - | 50 | **4** |
| R7 | 35 John St, Rydalmere | 1 | 46 | 48 | **2** | 43 | - | 49 | **3** |
| **Non-Residential Receivers** | | | | | | | | | |
| N1 | Our Lady of Lebanon Maronite Church[2] | 1 | 45 (internal) | 27 (internal)[1] | - | 25 (internal)[1] | - | 19 (internal)[1] | - |
| N2 | C3 Church, Silverwater | 1 | 45 (internal) | 36 (internal)[1] | - | 32 (internal)[1] | - | 28 (internal)[1] | - |
| N3 | Sydney Korean Catholic Communit y Church | 1 | 45 (internal) | 34 (internal)[1] | - | 31 (internal)[1] | - | 25 (internal)[1] | - |
| N4 | Sydney Baha'I Centre | 1 | 45 (internal) | 36 (internal)[1] | - | 32 (internal)[1] | - | 27 (internal)[1] | - |
| | | 2 | 45 (internal) | 36 (internal)[1] | - | 32 (internal)[1] | - | 27 (internal)[1] | - |
| | | 3 | 45 (internal) | 36 (internal)[1] | - | 32 (internal)[1] | - | 27 (internal)[1] | - |
| N5 | Our Lady of Lebanon Aged Care Hostel | 1 | 47[2] | 35 | - | 35 | - | 28 | - |
| N6 | Rosehill Child Care Centre[2] | 1 | 47[2] | 39 | - | 37 | - | 31 | - |
| N7 | Rosehill Public School | 1 | 45 (internal) | 39 (internal)[1] | - | 28 (internal)[1] | - | 30 (internal)[1] | - |
| N8 | Bordering Industrial Premises - East | 1 | 75 | 65 | - | 59 | - | 66 | - |
| N8 | Bordering Industrial Premises – North | 1 | 75 | 61 | - | 49 | - | 61 | - |

| Rec | Address | Floor | NML[1] | Demolition | | Construction | | Construction & Demolition | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Predicted $L_{eq\ (15min)}$ | Exceed. | Predicted $L_{eq\ (15min)}$ | Exceed. | Predicted $L_{eq\ (15min)}$ | Exceed. |
| N8 | Bordering Industrial Premises – North-east | 1 | 75 | 61 | - | 60 | - | 64 | - |
| N8 | Bordering Industrial Premises – North-west | 1 | 75 | 60 | - | 60 | - | 63 | - |
| N8 | Bordering Industrial Premises – South | 1 | 75 | 49 | - | 48 | - | 51 | - |
| N8 | Bordering Industrial Premises – South-east | 1 | 75 | 55 | - | 48 | - | 56 | - |
| N8 | Bordering Industrial Premises – South-west | 1 | 75 | 50 | - | 50 | - | 53 | - |
| N8 | Bordering Industrial Premises – West | 1 | 75 | 54 | - | 54 | - | 57 | - |

**Notes:**

**1. Noise management level (NML) is based on internal noise levels, which are determined in accordance with ICNG criteria. Generally a 10 dB reduction can be achieved with an open window and 20 dB with a closed window**

**2. In the absence of a NML for aged care facilities or child care facilities, the Our Lady of Lebanon Aged Care Hostel and Rosehill Child Care Centre has been assessed against the residential NML.**

### 22.2.2 Traffic Noise

The impact of increased road traffic noise from construction traffic generated by the Project has been assessed in accordance with the *Environmental Criteria for Road Traffic Noise* (RNP: EPA, 1999a). Traffic data was obtained from a Traffic Impact Assessment of an integrated recycling park at Grand Avenue, Camellia, prepared in 2011 by Traffix Traffic and Transport Planners.

The residential property likely to be most affected by noise from traffic generated by the proposed Project is 43 Oak St, Rosehill, affected by traffic leaving the Clyde Terminal along James Ruse Drive. Noise impacts have been calculated at 1 m from the most affected facade of this property in accordance with the RNP. No traffic noise measurements were conducted due to the low volumes of site generated traffic and low likelihood of issues with traffic noise increases.

Traffic noise impacts have been calculated using the Calculation of Road Traffic Noise (CoRTN) algorithm. Existing and increased traffic flows as well as noise level increases are detailed in **Table 22-7**. Only AM and PM peak hourly traffic volumes were available for this area. Peak hourly compliance with $L_{Aeq}$ noise goals would ensure daytime 15-hour levels also comply.

It is noted that the traffic counts taken to determine existing traffic flows included traffic from the previously operating Clyde Refinery, which account for 238 light vehicles and 265 heavy vehicles per day, including heavy vehicle movements associated with the adjoining Parramatta Terminal which are expected to not change significantly as a result of the Project (refer to **Section 11.1** and **Table 11-3**).

In the absence of peak hour traffic generated at the Clyde Terminal, it has been assumed that light vehicles, associated predominantly with workers, arrive and depart in the same hour at the beginning or end of a working day and largely outside of peak traffic hours for the surrounding road network. Heavy vehicles associated with the Project would predominantly be used for deliveries spread evenly across an eight-hour working day.

**Table 22-7 Existing and Proposed Traffic Volumes**

| Data Type | Previous Refinery Operations | Existing traffic flows | Construction and Demolition | | Operation | |
|---|---|---|---|---|---|---|
| | | | Overall traffic flow | Change in traffic flow | Overall traffic flow | Change in traffic flow |
| Average annual daily traffic[1] | 238LV 265HV | 40LV 257HV | 169 LV 277 HV | - | 32 LV 257 HV | - |
| Peak hour traffic[2] | 119 LV 33 HV | 20LV 32HV | 85 LV 35 HV | -34 LV +2 HV | 16 LV 32 HV | -103 LV -1 HV |

**Note:** [1] Heavy vehicle traffic volumes include traffic flows generated by the Clyde Terminal as well as the Parramatta Terminal other supply terminals.

[2] Peak hour traffic volumes assume 50% of light vehicles arrive in 1 hour in morning and 50% in 1 hour in afternoon. Heavy vehicle deliveries would be spread evenly over an 8 hour day.

The construction and demolition activities at the Clyde Terminal will produce daily traffic flows of approximately 169 light vehicles and 277 heavy vehicles. This results in a peak hourly increase of 65 light vehicles and an increase of 3 heavy vehicles.

The operation of the fully converted Clyde Terminal will produce daily traffic flows of 32 light vehicles and 257 heavy vehicles per day. This results in a peak hourly decrease of 4 light vehicles and no change in heavy vehicles.

**Table 22-8** shows resultant noise levels from each scenario.

**Table 22-8 Summary of Traffic Flow Increase in the Peak Periods (Vehicles/hr)**

| Period | Traffic Noise Criteria (Daytime) | Existing Traffic Flow (including Traffic generated by Previously Operating Refinery) | | Proposed Construction and Demolition Traffic Flow | | Increase in Noise Levels, dB(A) | Proposed Operation Traffic Flow | | Increase in Noise Levels, dB(A) |
|---|---|---|---|---|---|---|---|---|---|
| | | Volume | Noise Impact at Most Affected Resident* $L_{Aeq}$ dB(A) | Volume | Noise Impact at Most Affected Resident* $L_{Aeq}$ dB(A) | | Volume | Noise Impact at Most Affected Resident* $L_{Aeq}$ dB(A) | |
| **James Ruse Dr, south of Grand Ave** | | | | | | | | | |
| AM | 60 | 5704 | 79 | 5672 | 79 | 0 | 5600 | 79 | 0 |
| PM | 60 | 6681 | 80 | 6649 | 80 | 0 | 6577 | 80 | 0 |

**Notes:** * Most affected resident from traffic noise from Project is 43 Oak Street, Rosehill.

Data source: Traffic Impact Assessment of an integrated recycling park at Grand Avenue, Camellia, Traffix Traffic and Transport Planners, 2011.

Existing noise levels are calculated to be 79 dB(A) during the AM peak hour and 80 dB(A) during the PM peak hour, which are above the noise assessment criteria. Noise levels resulting from peak hour traffic flow are not predicted to increase existing noise levels. The RNP states *"In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person",* hence no mitigation measures are considered necessary.

### 22.2.3 Blasting Noise and Vibration

The use of blasting has been proposed in the demolition of a maximum of five chimney stacks within the Project Area. Blasting has been proposed as the preferred method of removal due to greater safety benefits and reduced costs in comparison with deconstructing the stacks. The locations of these stacks are shown on **Plate 14** below and described in **Table 22-9**. The possible fall radius for each stack is outlined in red and the safe arc is shaded in green. The demolition of these chimney stacks would be completed once all other demolition activities have been undertaken, and the ground area is cleared. At the time of writing of this EIS, demolition using blasting is scheduled for October 2015, and would comprise five single events.

**Table 22-9 Chimney Stack Details Proposed for Demolition**

| Stack number (as shown in Plate 14) | Stack name | Height (m) | Total explosives (kg) | Maximum instantaneous charge (kg) | Time Delay (25 ms intervals) |
|---|---|---|---|---|---|
| 1 | Catalytic cracking unit | 100 | 21.62 | 1.38 | 19 |
| 2 | Crude distillation unit | 82 | 14.018 | 1.062 | 16 |
| 3 | Boilers Stack | 80 | 11.484 | 0.812 | 17 |
| 4 | High vacuum unit | 100 | 11.716 | 0.812 | 18 |
| 5 | Platformer 3 | 102 | 38.098 | 1.72 | 29 |

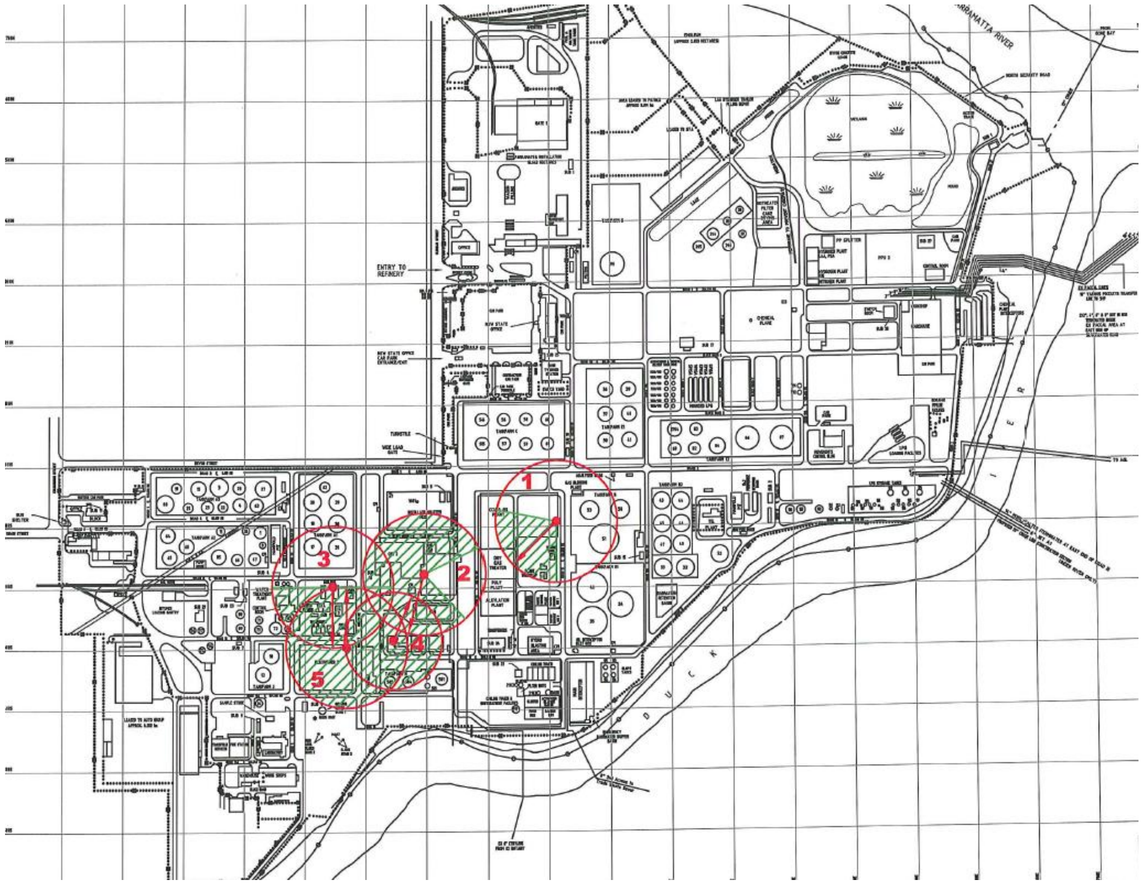


**Plate 14 Location of chimneys for which blasting works are required**

### Blasting Vibration

The blasting impact at nearby residential and industrial receivers has been assessed. As no trial blasts have yet taken place the assessment uses generic values recommended in *AS2187.2:2006 Explosives – Storage and use – Use of explosives*. The values used are considered to be conservative.

The ground vibration arriving at a point remote from a blast is a function of many factors, including:

- Charge mass of explosive per delay;
- Explosive type and coupling;
- Distance from blast;
- Ground transmission characteristics;
- Firing sequence;
- Origin of the rock mass;
- Presence of bedding and joints; and
- Degree and depth of weathering of surface at the point.

Some of these factors are difficult to accurately quantify without specific site knowledge. Many site factors will affect the transmission of vibration through the ground. The most accurate predication graph for a site will be that generated from vibration measurements taken at the site. However, in the absence of such site data, ground vibration can be estimated using the following equation:

$$PPV = K_g \left( \frac{R}{\sqrt{Q}} \right)^{-B}$$

where: PPV = peak particle velocity (mm/s)

Q = Maximum instantaneous charge(kg)

R = distance (m)

$K_g$, B = Constants related to site and rock properties for estimation purposes

Ground vibration levels depend on the maximum instantaneous charge (effective charge weight per delay), and not the total charge weight, provided the effective delay interval is appropriate.

Constants of $K_g$ 1140 and B 1.6 will provide an estimate of vibration levels in 'average' conditions. In practice, due to variations in ground conditions and other factors, the resulting ground vibration levels can vary from two fifths to four times that estimated. In cases where the site parameters have not been reliably determined from prior experience, advice should be obtained from suitably qualified and experienced persons, who may recommend initial trial blasts with conservative charge quantities.

Vibration levels have been predicted for the smallest maximum instantaneous charge of 0.812kg and the largest maximum instantaneous charge of 1.72kg. Results at sensitive receivers are shown in **Table 22-10**.

**Table 22-10 Predicted Vibration at Sensitive Receivers with a $K_g$ Value = 1140**

| Site Number | Minimum Distance to Blasting (m) | Criteria | Predicted PPV (mm/s) | |
|---|---|---|---|---|
| | | | 0.812kg Charge | 1.72 kg Charge |
| Residential | | | | |
| R1 | 1500 | 5 | 0.0 | 0.0 |
| R2 | 1300 | 5 | 0.0 | 0.0 |
| R3 | 1300 | 5 | 0.0 | 0.0 |
| R4 | 800 | 5 | 0.0 | 0.0 |
| R5 | 1700 | 5 | 0.0 | 0.0 |
| R6 | 1100 | 5 | 0.0 | 0.0 |
| R7 | 1100 | 5 | 0.0 | 0.0 |
| Non - Residential | | | | |
| N1 | 2000 | 5 | 0.0 | 0.0 |
| N2 | 1000 | 5 | 0.0 | 0.0 |
| N3 | 1100 | 5 | 0.0 | 0.0 |
| N4 | 860 | 5 | 0.0 | 0.0 |
| N5 | 1900 | 5 | 0.0 | 0.0 |
| N6 | 1600 | 5 | 0.0 | 0.0 |
| N7 | 1600 | 5 | 0.0 | 0.0 |
| N8 – east | 400 | 5 | 0.1 | 0.1 |
| N8 – north | 780 | 5 | 0.0 | 0.0 |
| N8 – north-east | 180 | 5 | 0.2 | 0.4 |
| N8 – north-west | 450 | 5 | 0.1 | 0.1 |
| N8 – south | 210 | 5 | 0.2 | 0.3 |
| N8 – south-east | 740 | 5 | 0.0 | 0.0 |

| Site Number | Minimum Distance to Blasting (m) | Criteria | Predicted PPV (mm/s) | |
|---|---|---|---|---|
| | | | 0.812kg Charge | 1.72 kg Charge |
| N8 – south-west | 310 | 5 | 0.1 | 0.2 |
| N8 – west | 510 | 5 | 0.0 | 0.1 |

**Table 22-10** indicates that blast vibration levels from the largest proposed maximum instantaneous charge of 1.72kg would comply with the appropriate criteria at all sensitive receiver locations under "average" conditions.

**Blasting Noise Levels**

Air-blast overpressure noise levels have been calculated based on Australian Standard 2187.2 - 2006 Explosives – Storage and Use Part 2: Use of Explosives. The Standard uses the following equation to calculate blast overpressure (AS2187.2 – 2006, J7.2):

$$P = K_a \left( \frac{R}{Q^{\frac{1}{3}}} \right)^a$$

Where $P$ = pressure, in kilopascals

$Q$ = explosive charge mass, in kilograms

$R$ = distance from charge, in meters

$K_a$ = site constant

$a$ = site exponent

It has been assumed that confined blasthole charges will be used. Australian Standard 2187.2 recommends that a good estimation can be gained by using a site exponent value of $a$ = -1.45. For confined blasthole charges when using an exponent of $a$ = -1.45, the site constant $K_a$, is commonly in the range 10 to 100.

The results of the calculations for the smallest maximum instantaneous charge of 0.812kg and the largest maximum instantaneous charge of 1.72kg are provided in **Table 22-11** and **Table 22-12** using varying values for $K_a$.

**Table 22-11 Predicted Noise at Receivers from Blasting ($K_a$ = 100)**

| Site Number | Minimum Distance to Blasting (m) | Criteria | Predicted Airblast Overpressure dB(lin) | |
|---|---|---|---|---|
| | | | 0.812kg Charge | 1.72 kg Charge |
| Residential | | | | |
| R1 | 1500 | 115 | 101 | 104 |
| R2 | 1300 | 115 | 103 | 106 |
| R3 | 1300 | 115 | 103 | 106 |
| R4 | 800 | 115 | 109 | 112 |
| R5 | 1700 | 115 | 99 | 103 |
| R6 | 1100 | 115 | 105 | 108 |
| R7 | 1100 | 115 | 105 | 108 |
| Non - Residential | | | | |
| N1 | 2000 | 115 | 97 | 101 |
| N2 | 1000 | 115 | 106 | 109 |
| N3 | 1100 | 115 | 105 | 108 |
| N4 | 860 | 115 | 108 | 111 |

| Site Number | Minimum Distance to Blasting (m) | Criteria | Predicted Airblast Overpressure dB(lin) | |
|---|---|---|---|---|
| | | | 0.812kg Charge | 1.72 kg Charge |
| N5 | 1900 | 115 | 98 | 101 |
| N6 | 1600 | 115 | 100 | 103 |
| N7 | 1600 | 115 | 100 | 103 |
| N8 – east | 400 | 115 | 118 | 121 |
| N8 – north | 780 | 115 | 109 | 112 |
| N8 – north-east | 180 | 115 | 128 | 131 |
| N8 – north-west | 450 | 115 | 116 | 119 |
| N8 – south | 210 | 115 | 126 | 129 |
| N8 – south-east | 740 | 115 | 110 | 113 |
| N8 – south-west | 310 | 115 | 121 | 124 |
| N8 – west | 510 | 115 | 115 | 118 |

**Note:** Red values signify an exceedance of the criteria.

**Table 22-12 Predicted noise at receivers from blasting ($K_a$ = 10)**

| Site Number | Minimum Distance to Blasting (m) | Criteria | Predicted Airblast Overpressure dB(lin) | |
|---|---|---|---|---|
| | | | 0.812kg Charge | 1.72 kg Charge |
| Residential | | | | |
| R1 | 1500 | 115 | 81 | 84 |
| R2 | 1300 | 115 | 83 | 86 |
| R3 | 1300 | 115 | 83 | 86 |
| R4 | 800 | 115 | 89 | 92 |
| R5 | 1700 | 115 | 79 | 83 |
| R6 | 1100 | 115 | 85 | 88 |
| R7 | 1100 | 115 | 85 | 88 |
| Non - Residential | | | | |
| N1 | 2000 | 115 | 77 | 81 |
| N2 | 1000 | 115 | 86 | 89 |
| N3 | 1100 | 115 | 85 | 88 |
| N4 | 860 | 115 | 88 | 91 |
| N5 | 1900 | 115 | 78 | 81 |
| N6 | 1600 | 115 | 80 | 83 |
| N7 | 1600 | 115 | 80 | 83 |
| N8 – east | 400 | 115 | 98 | 101 |
| N8 – north | 780 | 115 | 89 | 92 |
| N8 – north-east | 180 | 115 | 108 | 111 |
| N8 – north-west | 450 | 115 | 96 | 99 |
| N8 – south | 210 | 115 | 106 | 109 |

| Site Number | Minimum Distance to Blasting (m) | Criteria | Predicted Airblast Overpressure dB(lin) | |
|---|---|---|---|---|
| | | | 0.812kg Charge | 1.72 kg Charge |
| N8 – south-east | 740 | 115 | 90 | 93 |
| N8 – south-west | 310 | 115 | 101 | 104 |
| N8 – west | 510 | 115 | 95 | 98 |

The results in Table 22-11 indicate that blast overpressure levels from a 1.72 kg charge would comply with the appropriate criteria at all residential locations and all non-residential except for some industrial premises adjacent to the Project Area with a $K_a$ value of 100. **Table 22-12** indicates that a 1.72 kg charge would comply with the appropriate criteria at all residential locations and all non-residential locations with a $K_a$ value of 10.

Site constant $K_a$, and site exponent $a$, are highly dependent on individual site characteristics. For this reason it is recommended that test blasts are used and monitoring is conducted at a sensitive receiver location to determine the exposure to noise. Sensitive receivers close to the Project Area include residential premises and places of worship.

### 22.2.4 Operational Noise

Noise emissions from operation of mechanical plant at the converted Clyde Terminal have been modelled in SoundPLAN Version 7.0. Onsite noise sources were identified by site inspections and measured sound power levels are presented in **Table 16** of **Appendix H**, including the use of light and heavy vehicles onsite at the Project Area. Meteorological conditions can increase the impacts at noise sensitive receivers. To provide a worst case scenario, meteorological effects of a 3 m/s source to receiver wind and an F-class temperature inversion were included in the model.

Predicted operational noise impacts are presented in **Table 22-13**. Results show that no exceedances of INP noise criteria are predicted at any affected receivers during the day or night under a worst-case operational scenario. Noise impacts at both R4 – 92 Asquith Street, Silverwater to the south, and R7 – 35 John Street, Rydalmere, to the north-east, are predicted to equal the night time noise criterion for these locations of 36dB(A).

Since no exceedances are predicted, no further mitigation measures are considered necessary for operations at the Clyde Terminal.

Noise emissions from the Clyde Terminal were not identified as being impulsive, intermittent or irregular. Noise emissions have been assessed at the receivers for tonality and low-frequency using modelled predictions. No results showed tonal characteristics or low-frequency components in noise emissions.

**Table 22-13 Predicted Operational Noise Impacts, dB(A)**

| Rec | Address | Day | | | Night | | |
|---|---|---|---|---|---|---|---|
| | | EPA Noise Goals | Predicted $L_{eq\ (15min)}$ | Exceedance | EPA Noise Goals | Predicted $L_{eq\ (15min)}$ | Exceedance |
| **Residential Receivers** | | | | | | | |
| R1 | 128 James Ruse Dr, Rosehill | 42 | 36 | - | 40 | 31 | - |
| R2 | 82–100 James Ruse Dr, Rosehill | 42 | 38 | - | 40 | 32 | - |
| R3 | 71 James Ruse Dr, Rosehill | 42 | 38 | - | 40 | 31 | - |
| R4 | 92 Asquith St, Silverwater | 41 | 37 | - | 36 | 36 | - |
| R5 | 1 to 9 Mockridge Ave, Newington | 41 | 36 | - | 36 | 33 | - |

| Rec | Address | Day | | | Night | | |
|---|---|---|---|---|---|---|---|
| | | EPA Noise Goals | Predicted $L_{eq\ (15min)}$ | Exceedance | EPA Noise Goals | Predicted $L_{eq\ (15min)}$ | Exceedance |
| R6 | 529 John St, Rydalmere | 41 | 38 | - | 36 | 34 | - |
| R7 | 35 John St, Rydalmere | 41 | 40 | - | 36 | 36 | - |
| **Non-Residential Receivers** | | | | | | | |
| N1 | Our Lady of Lebanon Maronite Church | 45 (internal) | 18 (internal)[1] | - | - | 15 (internal)[1] | - |
| N2 | C3 Church, Silverwater | 45 (internal) | 31 (internal)[1] | - | - | 28 (internal)[1] | - |
| N3 | Sydney Korean Catholic Community Church | 45 (internal) | 28 (internal)[1] | - | - | 25 (internal)[1] | - |
| N4 | Sydney Baha'I Centre | 45 (internal) | 31 (internal)[1] | - | - | 28 (internal)[1] | - |
| N5 | Our Lady of Lebanon Aged Care Hostel | 41[2] | 32 | - | 36[2] | 26 | - |
| N6 | Rosehill Child Care Centre | 41[2] | 35 | - | 36[2] | 29 | - |
| N7 | Rosehill Public School | 45 (internal) | 25 (internal)[1] | - | - | 19 (internal)[1] | - |
| N8 | Bordering Industrial Premises - East | 75 | 52 | - | - | 48 | - |
| N8 | Bordering Industrial Premises – North | 75 | 46 | - | - | 41 | - |
| N8 | Bordering Industrial Premises – North-east | 75 | 51 | - | - | 48 | - |
| N8 | Bordering Industrial Premises – North-west | 75 | 60 | - | - | 51 | - |
| N8 | Bordering Industrial Premises – South | 75 | 44 | - | - | 45 | - |
| N8 | Bordering Industrial Premises – South-east | 75 | 50 | - | - | 49 | - |
| N8 | Bordering Industrial Premises – South-west | 75 | 49 | - | - | 43 | - |

| Rec | Address | Day | | | Night | | |
|---|---|---|---|---|---|---|---|
| | | EPA Noise Goals | Predicted $L_{eq\ (15min)}$ | Exceedance | EPA Noise Goals | Predicted $L_{eq\ (15min)}$ | Exceedance |
| N8 | Bordering Industrial Premises – West | 75 | 52 | - | - | 45 | - |

**Notes:**

1. **NML is internal noise level. Generally a 10 dB reduction can be achieved with an open window and 20 dB with a closed window.**
2. **In the absence of a NML for aged care facilities or child care facilities, the Our Lady of Lebanon Aged Care Hostel and Rosehill Child Care Centre has been assessed against the residential noise goals.**

## 22.3 Mitigation Measures

Mitigation and management measures would be implemented to avoid, minimise and/or manage potential noise impacts arising from demolition and construction works (including blasting), traffic and from the ongoing operation of the Clyde Terminal. These are provided in the following sections.

### 22.3.1 Demolition and Construction

Contractors would demonstrate best practicable means and include noise mitigation measures in the CEMP for the Project, which could include:

- Construction activities to be limited to between 7am and 6pm Monday to Friday and 8am to 1pm Saturday;
- Where work is undertaken outside of the standard working hours it would be in accordance with the *Interim Construction Noise Guideline* (EPA, 2009);
- Construction of noise bunds or barriers, where feasible and effective for noise suppression, at the early demolition and construction stage;
- Use of temporary barriers for stationary noisy equipment;
- Possible restrictions to construction hours (beyond the above hours) where noise impacts are significant;
- All plant items should be properly maintained and operated according to manufacturers' recommendations in such a manner as to avoid causing excessive noise;
- All pneumatic tools should be fitted with silencers or mufflers;
- Any compressors brought on to site should be silenced or sound reduced models fitted with acoustic enclosures;
- Consultation with property owners likely to be affected prior to works should be carried out; and
- Noise monitoring at sensitive locations as agreed with EPA for any excessive noise or noise complaints being assessed with appropriate action taken.

### 22.3.2 Traffic Noise

The existing OEMP includes provisions for vehicle protocols in and around the Clyde Terminal and the Parramatta Terminal. This would be revised for operations once the demolition and construction works have been completed.

### 22.3.3 Blasting

The CEMP would include a blast plan and control measures to minimise the impact of ground vibration and noise as a result of blasting. Items to be considered in the development of this part of the CEMP are:

- Reducing maximum instantaneous charge, for example by reducing blasthole diameter or deck loading;
- Using a combination of appropriate delays;
- Allowing for excessive humps or toe in the blast design;
- Optimising blast design by altering drilling patterns, delaying layout or altering blasthole inclination from the vertical;

- Exercising strict control over the location, spacing and orientation of all blastholes and using the minimum practicable sub-drilling that gives satisfactory to conditions;
- Establishing times of blasting to suit the situation;
- Using experienced blast contractors;
- Carrying out a series of test blasts to determine site specific conditions. As a result of these tests the maximum instantaneous charge should be determined;
- Restricting or ceasing blasting if the predictions indicate that air blast overpressure levels are likely to be exceeded at neighbouring dwellings unless agreed with the owner(s);
- Ensuring all reasonable attempts are made to contact sensitive receivers located within 500 m of a blast location;
- Using linear enclosures or shielding to assist in airblast attenuation if required;
- Ensuring stemming type and length is adequate;
- Eliminating exposed detonating cord and investigating alternative initiation method;
- Making extra efforts to eliminate the need for two shots (e.g. better control of drill patterns);
- Using survey methods, as appropriate, to ensure burden is adequate;
- Considering delaying or cancelling the blast by not loading if the weather forecast is unfavourable;
- Allowing for the effects of temperature inversion and wind speed and direction on the propagation of airblast to surrounding areas;
- Orientating faces where possible so that they do not directly face residences;
- Varying the direction of initiation;
- Exercising strict control over the burden, spacing and orientation of all blastholes;
- Taking particular care where the face is already broken or where it is strongly jointed, sheared or faulted;
- Considering deck loading where appropriate to avoid broken ground or cavities in the face (e.g. from back break);
- Monitoring all blasts would to help minimise complaints and providing documentation of the blast in the event of any claims for damages arising from blasting; and
- Compiling records of any complaints associated with blasting, identifying the nature of the complaint, the particular operation that initiated the complaint, and documenting action taken.

#### 22.3.4 Operational Noise

Since no exceedances are predicted, no further mitigation measures are considered necessary for operations at the Clyde Terminal.

## 22.4 Residual Impacts

The demolition and construction works may result in minor exceedances of construction noise management levels of up to 4dB(A) at three residential receivers, however this is assuming that included plant is operating simultaneously and is a conservative prediction. Mitigation measures and management procedures have been recommended to reduce construction noise impacts and minimise disturbance to residences. Demolition blasting is anticipated to comply with the relevant criteria. Increased noise from demolition and construction traffic is predicted to give rise to elevated existing traffic noise levels of less than 1 dB(A), representing a minor impact that is considered barely perceptible to the average person. Construction vibration impacts for surrounding receivers are considered to be highly unlikely, and blasting impacts are also predicted to be minimal.

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# 23.0 Greenhouse Gas Emissions

**Relevant DGRs**: The EIS must address **Greenhouse Gas** – including:

A quantitative analysis of the Scope 1, 2 and 3 greenhouse gas emissions of the development;
A qualitative analysis of the impacts of these emissions; and
Details of the measures that would be employed to improve energy efficiency.

## 23.1 Existing Conditions

This Section outlines the findings of the Greenhouse Gas (GHG) Assessment that was prepared by AECOM for inclusion in this EIS. The GHG assessment is provided in **Appendix I** of **Volume 3** of this EIS.

Greenhouse gases are gases found in the atmosphere that absorb outgoing heat that is reflected from the sun. The primary GHG is carbon dioxide ($CO_2$). Different GHGs have different heat absorbing capacities. In order to achieve a basic unit of measurement, each GHG is compared to the absorptive capacity of $CO_2$, and measurements and estimates of GHG levels are reported in terms of $CO_2$ equivalent emissions ($CO_2$-e).

Australia's National GHG Inventories are designed to provide estimates of Australia's net GHG emissions and track Australia's progress towards its internationally-agreed GHG reduction targets. Australia has published annual national GHG inventories for each year from 1990 to 2010 inclusive. In 2010 (the latest available data), Australia's total GHG emissions were estimated to be 560.8 Mt $CO_2$-e (Department of Climate Change and Energy Efficiency, 2012d).

For organisations accounting and reporting their GHG emissions, regard must be given to the *National Greenhouse and Energy Reporting System, Technical Guidelines*, which are updated for each new financial year (SEWPAC, 2012). Reported GHG emissions data are available for public viewing via the *Australian Greenhouse Emissions Information System* (Department of Climate Change and Energy Efficiency, 2012a).

An analysis of GHG emissions associated with the current operations at the Clyde Terminal and the proposed converted Clyde Terminal was undertaken using the emission factors and methods outlined in the *Australian National Greenhouse Accounts - National Greenhouse Accounts Factors* (Department of Climate Change and Energy Efficiency, 2012b) (NGA Factors). The NGA Factors provide three types of assessment categories:

- **Scope 1** which covers direct emissions from sources within the boundary of an organisation, such as fuel combustion and manufacturing processes;
- **Scope 2** which covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation; and
- **Scope 3** which includes all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation.

The emissions of end fuel use combustion were not included in the Scope 3 GHG assessment, as the Clyde Terminal is an interim transfer point and is not the final distribution point of the fuels. Additionally, Shell does include the GHG emitted from product end use under its global greenhouse reporting protocols. The focus for this report was the emissions associated with the Clyde Terminal itself.

The main operations that have been associated with the generation of GHGs from the current operations at the Clyde Terminal are:

- Scope 1:
  - Natural gas consumption;
  - Stationary energy consumption of liquid fuels; and
  - Transport energy consumption of liquid fuels.
- Scope 2:
  - Externally purchased electricity.
- Scope 3:
  - Externally purchased electricity;

- Natural gas production, transmission and distribution;
- Passenger vehicle movements of commuting staff and contractors;
- Extraction, production and transport of consumed liquid fuels; and
- Waste disposed to landfill.

## 23.2 Predicted Impacts

The *Greenhouse Gas Protocol: Corporate Standard* (World Council for Sustainable Business Development and World Resources Institute, 2001) emphasises the importance of companies accounting for and reporting on their GHG emissions in a manner that follows global standards, as issues of global warming and climate change have become increasingly important as key components of ESD.

The converted Clyde Terminal would continue to consume around 62,000 megawatts of electricity per annum. Shell would continue to report its emissions under the NGER Act after the conversion works have been completed, as the fully operational Clyde Terminal would continue contributing to the overall emissions generated by Shell within Australia. As Shell's overall domestic emissions are anticipated to continue above the 25 kilotonne reportable threshold under section 13(1)(d)(i) of the NGER Act) (refer to **Sections 7.6.2** and **23.2**). Shell would continue to report the Clyde Terminal GHG emissions reporting under the NGER Act. Shell further benefits from reporting its GHG emissions as this assists Shell in understanding its energy consumption, therefore enabling it to consider areas for ESD improvement in continuing its operations.

Existing baseline data was obtained from the data submitted by Shell for the 2010 to 2011 NGER requirements for fuels, electricity and process emissions. Existing facility waste data was taken from Shell's internally reported tonnages of wastes produced at the Project Area during the most recent refining operations. Shell has provided estimates for the changes to this baseline data for the current and proposed future operations of the Clyde Terminal. This data is provided in **Sections 23.2.1** to **23.2.3** below. From these results it can be concluded that the converted Clyde Terminal would yield similar volumes of GHGs compared to those for the current operations at the Clyde Terminal.

The Climate Commission's report *the Critical Decade: Climate Science, Risks and Responses* (2011) argues that the budget, or cumulative emissions approach is becoming the most favoured amongst climate scientists globally. This budget approach provides that humanity globally cannot emit more than 1 trillion t of $CO_2$ between 2000 and 2050 to have a probability of 75 percent of limited temperature rises to $2^oC$ or less. A specific timetable for emissions has not been outlined, rather the budget approach stipulates that the overall $CO_2$ budget must not exceed this target. This $2^oC$ temperature rise is considered to be the critical point at which the risk of large scale emissions from the terrestrial biosphere could also occur, which could prove to be a tipping point for irreversible climate change impacts (Climate Commission, 2011). The Project, however, is considered to have a somewhat neutral impact overall for this global GHG emissions budget.

As the current and converted Clyde Terminal does not and would not actually produce any goods or products (i.e. fuel products received at the Clyde Terminal are already finished), it is not necessary or possible to provide an estimate of the GHG emissions intensity per unit of production.

### 23.2.1 Scope 1 Emissions

There are not anticipated to be changes to Scope 1 emissions throughout the duration of the Project or once the conversion works have been completed. The current operations would continue throughout the demolition and construction works and would remain consistent once the works are completed. Scope 1 GHG emissions are estimated to remain at 501 $tCO_{2}$-e per annum. A detailed breakdown of total Scope 1 GHG emissions for the Project Area's current and future operations of the Clyde Terminal, in addition to those generated during the demolition and construction works are provided in **Table 1** of **Appendix I**.

### 23.2.2 Scope 2 Emissions

There are not anticipated to be changes to Scope 2 emissions throughout the duration of the Project or once the conversion works have been completed when compared to current emissions. The current operations would continue throughout the demolition and construction works and would remain consistent once the works are completed. Scope 2 GHG emissions are estimated to remain at 54,846 $tCO_{2}$-e per annum, created from the consumption of externally purchased electricity.

### 23.2.3 Scope 3 Emissions

Scope 3 GHG emissions are anticipated to increase by approximately eight percent to 12,652 $tCO_2$-e per annum during the demolition and construction works compared to current scope 3 GHG emissions at the Clyde Terminal. The increase of Scope 3 GHG emissions during the proposed demolition and construction works can be attributed to:

- Increased employee and contractor vehicle movements;
- Increased generation of municipal waste due to the greater number of employees and contractors onsite; and
- Generation of demolition and construction waste.

The current workforce at the Project Area is approximately 83 personnel. The workforce would increase to approximately 224 personnel during the peak of the demolition and construction works and would then reduce to 58 personnel once the conversion works are completed.

Once the project works are completed, Scope 3 GHG emissions are anticipated to decrease slightly below current Scope 3 GHG emissions to 11,583 $tCO_2$-e per annum, which represents a reduction of approximately one percent. The slight decrease in Scope 3 GHG emissions can be attributed to a decrease in the total workforce resulting in a reduction in Scope 3 GHG emissions relating to vehicle movements and municipal waste generation when compared to the current emissions.

A detailed breakdown of total Scope 3 GHG emissions generated by the current and future operations of the Clyde Terminal, in addition to those generated during the demolition and construction works is shown in **Plate 2** of **Appendix I**.

Ongoing emissions associated with the extraction, production and transport of other consumed liquid fuels (gasoline, kerosene and LPG) are expected to remain unchanged as a result of the Project.

## 23.3 Mitigation Measures

As outlined in **Section 23.2**, the Project is anticipated to result in minimal changes to GHG emissions. As a result, no specific management measures are considered necessary to manage project related impacts during the demolition and construction works.

Shell would undertake an internal energy audit of the Project Area following completion of the demolition and construction activities to take stock of how reduced operations have reduced electricity consumption and improved energy efficiency. Recommendations arising from the audit would then be taken into consideration where significant further energy savings can be made.

## 23.4 Residual Impacts

The Project is not anticipated to result in significant residual GHG impacts. The Project is considered to present a neutral impact on the overall GHG emissions of the Project Area.

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# 24.0 Landscape and Visual Amenity

The EIS must address **Visual** impacts on surrounding receivers and from public areas.

## 24.1 Existing Conditions

The Project Area is located in the Camellia Industrial Estate, which supports a range of industrial and light industrial uses. Industrial users in proximity or adjacent to the Project Area are identified in **Table 2-2**. Across the Parramatta River and to the north and north-east of the Project, land use is predominately light industrial, recreational and low density residential. The Eric Primrose Reserve in particular is located on the opposite side of the Parramatta River, approximately 200 m to the north-east of the Project Area along a strip of land bordering the northern bank of Parramatta River. Silverwater Park is located across Duck River approximately 200 m to the east of the Project Area. The nearest residential areas are Rydalmere and Silverwater, approximately 400 m north-east and 1.1 m south-east from the Project Area across the across Parramatta River, and Rosehill, approximately 850 m to the west of the Project Area. The Rosehill Gardens Racecourse and Sydney Speedway are both located approximately 250 m north-west and 550 m south-west of the Project Area respectively.

The DCP 2011 describes the topographical setting of Parramatta as being located within a river basin and bordered by hills to the north and west. As a result, there are significant views and vistas contributing to the sense of place for Parramatta.

The overall character of the area surrounding the Project Area is industrial. In the vicinity of the Project Area there are heavy trucks using the Camellia Industrial Estate for freight movement, including for the distribution of fuels via the Parramatta Terminal that adjoins the Project Area. Vehicular access to the Camellia Industrial Estate is largely obtained from Grand Avenue, which is the main thoroughfare carrying heavy traffic from the Estate to the M4 Western Motorway. The existing Clyde Terminal is accessed via the main gate on Durham Street which is operational each day of the year. Various parcels of land within the Camellia Industrial Estate are accessed from a network of adjoining local roads such as Durham, Devon, Unwin, Colquhoun, Shirely and Yorkshire Streets.

The Project Area is low-lying at approximately 2 to 5 m AHD, and is predominantly level. A strip of wetlands, ranging in height from around 5 m to 10 m (NGH Environmental, 2009), traverses the southern and eastern boundary of the Project Area as it follows the flow of Duck River. The north-eastern section of the Project Area contains a remnant wetland. The boundary fence line adjacent to Duck River, in the south-western corner of the Project Area is lined with mature Swamp Oak trees. The remainder of the Project Area does not contain any remnant vegetation. The current infrastructure at the Clyde Terminal has been commissioned in a grid-like manner, running roughly north-to-south and east-to-west (refer to **Figure 6-1**). This placement of infrastructure has assisted in reducing its visibility by other land users. For instance, the most eastern storage tank at the Project Area (Tank 87) essentially masks those tanks directly to its west (e.g. Tanks 86 and 84) from being visible to commercial land users to the east of the Project Area across Duck River.

The tallest units of infrastructure at the Clyde Terminal are the boiler stacks (refer to **Plate 15**) and flare towers, which range in height up to around 100 m. These pieces of infrastructure are visible from various vantage points surrounding the Project Area as well as from topographically elevated suburbs of Parramatta further afield. The height of the riparian vegetation means that views in close proximity to the Clyde Terminal are limited: the tops of the stacks are all that can be viewed from the opposite side of Duck River, in Silverwater and from the John Street, Rydalmere Ferry wharf (refer to **Plate 16**). The predominant views from the ferry wharf area across Parramatta River are of the LyondellBasell polypropylene plant, which is not considered to be part of the Project Area. The industrial park to the north and west of the Clyde Terminal also precludes views of the Project Area for the most part. Glimpses of the Clyde Terminal stacks are available at interspersed points along Grand Avenue and adjacent streets.

It is only with elevation that the Refinery becomes more visible. Such vantage points are available on the M4 Western Motorway (refer to **Plate 17**) and within Ermington (refer to **Plate 18**). Views from the M4 Western Motorway are fleeting, due to the speed at which vehicles travel and other traffic, which inhibits a driver's ability to appreciate the Clyde Terminal. Views from Ermington towards the Clyde Terminal are constrained by the warehouses located in the area, meaning views can only be obtained when looking down a north-south aligned road. Even within these view lines, the LyondellBasell facility is more apparent than the Clyde Terminal (refer to **Plate 18**).

**Plate 15 Boiler Stacks at the Project Area**

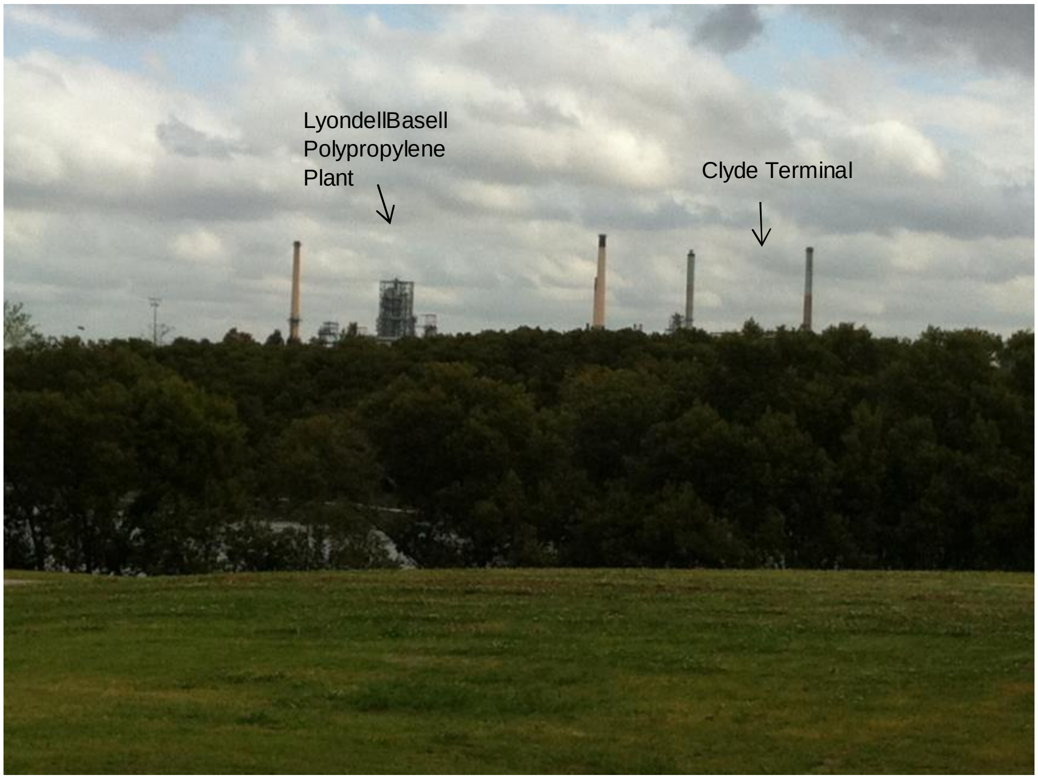


**Plate 16 Views of the Clyde Terminal from the John Street Ferry Wharf Rydalmere, looking through Vegetation Screen**

**Plate 17 Views of the Clyde Terminal from the M4 Western Motorway toward the Project Area**

**Plate 18 Significant District View of the Clyde Terminal from Ermington, view taken from South Street, Ermington**

The closest viewing locations to the Project Area are from:

- Existing adjacent industrial land users to the west and north-east of the Project Area (refer to **Plate 18**);
- The adjoining Unwin, Devon and Durham streets to the west of the Project Area, from Grand Avenue to the north. The Project Area is also visible from the M4 Western Motorway to the south-west (refer to **Plate 17**);
- Passing views of recreational users of the Duck and Parramatta Rivers, to the south, south-east and north-east of the Project Area respectively (for example, refer to **Plate 19**). However, at most of the vantage points from the southern bank of Duck River, the Project Area is not clearly visible; and
- From further afield, the Project Area is visible from elevated grand stand points at the Rosehill Gardens Racecourse approximately 250 m to the north-east. It is also visible from the topographically elevated Dundas and Ermington suburbs of Parramatta to the north-east of the Project Area. Indeed, the DCP 2011 identifies the Project Area as part of the Camellia and Rydalmere Strategic Precinct that provides significant district views, particularly from the Ermington and Dundas suburbs of Parramatta that are 1 km and 4 km north-east of the Project Area respectively. **Plate 18** provides an example of this significant district view from the suburb of Ermington.


**Plate 19 Views of the Clyde Terminal from the John Street Ferry Wharf Rydalmere, looking past Native Vegetation Screen**

The Project Area is clearly visible for nearby industrial land users. Refinery related infrastructure is also clearly visible from the adjoining local roads. For passing recreational users of Duck River and Parramatta Rivers, much of the Project Area is screened by the bordering strip of riparian vegetation running along the Duck and Parramatta Rivers. However, taller refinery related infrastructure continues to be visible for these recreational users as the riparian screening vegetation is approximately 5 m to 10 m in height.

For the closest residential areas, and at the Eric Primrose Reserve and Silverwater Park and adjoining public recreation areas, much of the Project Area is again not visible due to the riparian vegetation that borders the Project Area along the southern bank of Parramatta River, the riparian vegetation along the northern bank of Parramatta River, and further by plantings of mature trees along those public recreation area. Views of Shell's activities at the Project Area are also blocked to a certain extent by other industrial land uses in the north-eastern section of the Project Area. However, taller refinery related infrastructure including the boiler stacks and flares continue to be visible at these residential and public recreation areas above the vegetation screen, particularly from the opposite bank of Parramatta River.

## 24.2 Predicted Impacts

***Demolition and Construction Works***

Cranes would be used temporarily during both the demolition and construction works for the removal of infrastructure as required. These cranes have the potential to be visible to surrounding residential, recreational and commercial land users although the existing riparian vegetation lining the banks of the Parramatta and Duck River provide a visual buffer for low-lying machinery and infrastructure at the Clyde Terminal.

The demolition and construction works also have the potential to release dust into the atmosphere, potentially resulting in visual nuisance to nearby receptors. It is not anticipated that the works would generate substantial dust emissions as mitigation measures have been recommended in **Section 13.3** to avoid, minimise and/or manage dust emissions.

Considering the current industrial nature of the Clyde Terminal and the temporary requirement for cranes during the demolition and construction works, the works would have a negligible impact on the surrounding visual amenity.

***Converted Terminal Operations***

The proposed works would involve the removal of the redundant infrastructure in the western section of the Project Area. This would include the removal of five stacks and the elevated flare system having a maximum height of around 100 m. This would result in the removal of the stacks from the skyline at selected vantage points, being mainly isolated to fleeting views from the M4 Western Motorway and along north-south road view corridors in Ermington. As such, it is anticipated that the Project would result in improved views and vistas for nearby residents and from surrounding recreational areas and commercial users.

**Table 15-3** also outlines how the Project is likely to involve the installation of fixed geodesmic tank roofs for three tanks that are proposed to store Jet fuel. Given the maximum height of these tanks at around 18.3 m tall and their location between riparian vegetation and other tankfarms at the Project Area (refer to **Figure 6-1**) it is unlikely that these geodesmic domes would be visible from many vantage points available to the public. In any event, the installation of these geodesmic domes would not interfere with the DCP 2011's objectives relating to views and vistas of the Significant District View.

As identified in the Parramatta Economic Strategy, the Project is anticipated to specifically result in an improved outlook from the Rosehill Gardens Racecourse, further improving the amenity of the racecourse as a key service provider in the Camellia Industrial Estate (Parramatta City Council, 2011). Improving the visual amenity of the Project Area is also consistent with the DCP 2011 objectives relating to views and vistas, as demonstrated in **Table 24-1**.

**Table 24-1 Design Objectives and Principles under the DCP 2011**

| Objective | Consideration |
|---|---|
| **Section 2.4.1 Views and Vistas** | |
| O.1 To preserve and enhance district and local views which reinforce and protect the City's urban form and enhance legibility. | The Project would not substantially impact on the significant district views of the Camellia and Rydalmere Strategic Precinct that the Project Area contributes to. It therefore would not detract from the urban form of the area as select infrastructure currently at the Project Area would be retained and continue to be visible from some surrounding locations. The Project retains the character of the Project Area as part of an industrial precinct, and therefore does not detract from the legibility of the area as being part of the Camellia Industrial Precinct. |
| O.2 To encourage view sharing through complementary siting of buildings, responsive design and well-positioned landscaping. | The Project does not involve the design and construction of additional buildings or infrastructure that would be visible to surrounding land users. |
| O.3 To ensure highly visible sites are designed in scale with the City's setting and encourage visual integration and connectivity between places. | |

| Objective | Consideration |
|---|---|
| **Section 2.4.1 Design Principles** | |
| P.1 Development is to preserve views of significant topographical features such as ridges and natural corridors, the urban skyline, landmark buildings, sites of historical significance and areas of high visibility, particularly those identified in Appendix 2 Views and Vistas. Refer also to Views and Vistas in the Harris Park Heritage Conservation Area in Part 4. | The Project would not impact on the morphology of topographical features such as ridges and natural corridors (for instance, the riparian vegetation along the Duck and Parramatta Rivers). The removal of stacks from the skyline would improve the visual appearance of the Project Area. Potential visual impacts and mitigation measures associated with the European heritage values of the Clyde Terminal are further discussed in **Section 18.0**. |
| P.2 Buildings should reinforce the landform of the City and be designed to preserve and strengthen areas of high visibility. In some locations, this may be achieved through uniform heights and street walls as a means of delineating the public view corridor. | The Project does not involve the design and construction of additional buildings or infrastructure, or the use of additional landscaping that would be visible to surrounding land users. |
| P.3 Landscaping of streets and parks is to reinforce public view corridors. | |
| P.4 Building design, location and landscaping is to encourage view sharing between properties. | |
| P.5 Views to and from the public domain are to be protected. | |

The continued use of the Clyde Terminal for the receipt, handling and distribution of finished petroleum products would be consistent with the industrial character and historic use of Project Area. Potential visual impacts and mitigation measures associated with the European heritage values of the Clyde Terminal are further discussed in **Section 18.3**.

The riparian buffer zones along the southern and north-eastern boundaries of the Project Area would not be impacted on by the Project, and would therefore continue to provide visual screening for nearby recreational and residential land users as well as preserve the existing scenic qualities of this vegetation.

Overall the Project is considered to result in improved views and vistas for surrounding land users.

## 24.3 Mitigation Measures

Mitigation measures to avoid, minimise and/or manage potential detrimental visual impacts during the demolition and construction works include the implementing of dust control measures as recommended in **Section 13.3**. Mitigation measures associated with the removal of European heritage values associated with the Clyde Terminal are further discussed in **Section 18.3**, and would include photographic and archival recording of the Clyde Terminal. The riparian vegetation within the wetlands would also be retained, thereby conserving the visual amenity and landscape character of the area.

Due to the limited nature of views to the Project Area as a result of riparian vegetation, and the temporary nature of the demolition and construction works, it is not considered necessary to implement additional mitigation measures regarding visual amenity.

Overall the Project is considered to result in improved views and vistas for surrounding land users. As such, it is not considered necessary to implement additional mitigation measures regarding visual amenity during operation of the converted Clyde Terminal.

## 24.4 Residual Impacts

The Project would not result in detrimental residual visual impacts. On the contrary, it is anticipated that the Project would result in overall positive visual impacts as the removal of redundant infrastructure would result in improved views and vistas for surrounding land users.

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# 25.0 Cumulative Impacts

**Relevant DGRs**: The EIS must address **Cumulative Impacts**.

## 25.1 Existing Conditions

Consistent with the aims of the Metropolitan Plan, Parramatta LGA is currently experiencing strong growth with a number of building and development approvals having been recently granted. The Camellia Industrial Precinct is itself a strategic industrial area that continues to support a wide range of processing and industrial service based industries.

The impacts of existing developments in the vicinity of the Project Area on the Project have been inherently covered as part of this EIS through the consideration of background data, to which the predicted impacts of the Project have been added.

A search of the Major Projects Register on the DP&I webpage was conducted on 19 March 2013. This search indicated that numerous major project development approvals have been granted within the Parramatta LGA over the past two years. Many of those consents relate to modifications of existing development consents, or additional development approvals relating to the same sites. **Table 25-1** provides a summary of those approvals that have been obtained since 2010, and explains how they do or do not have the potential to result in cumulative impacts for the current Project.

**Table 25-1 Other Development Consents/Approvals and Development Applications within the Parramatta LGA since 2010**

| Development | Distance From Project Area | Status of Consent/Approval |
|---|---|---|
| Channel 7, Epping, Part 3A Major Project | 9 km | There are 30 separate approvals that have been granted in relation to this development between 2010 and 2013, concerning:<br>- Modification of the concept plan and related planning regulation of this site;<br>- The demolition of existing structures and construction of residential flats, townhouses and associated commercial structures; and<br>- Associated civil infrastructure works and landscaping to final landform.<br><br>It is unlikely that there would be any cumulative impacts associated with the Channel 7 Epping development and the current Project. This is due to:<br>- The distance of this development from the Project Area; and<br>- The overall nature of this development, being for residential purposes, would not put undue strain on the goods and services required for Shell to undertake the Project. |
| Rosehill Recycled Water Scheme<br><br>Part 3A Major Project | >3 km | There are four separate approvals that have been granted in relation to this development between 2010 and 2012, relating to:<br>- The discharge of recycled water from the distribution pipeline during network dewatering;<br>- Modification of a 2.2 km section of recycled water pipeline along Landon Street and Malta Street from Fairfield Park to Woodville Road, Villawood;<br>- The installation of transformers and associated upgrades;<br>- Changes to the pipeline route from Tangerine Street to Orchardleigh Street, Fairfield; and<br>- Increases in building height for plant.<br><br>Industrial water at the Project Area is largely obtained as potable water supplied by Sydney Water. These modifications to the Rosehill Recycled Water Scheme would therefore not affect the water sources used by the Clyde Terminal. Furthermore these development modifications have not and would not impact on the Project Area given:<br>- Their distance from the Project Area; and<br>- The nature of these modifications meaning that they would not put undue strain on the goods and services required for Shell to undertake the Project. |

| Development | Distance From Project Area | Status of Consent/Approval |
|---|---|---|
| Telopea Urban Renewal Project<br>Part 3A Major Project | 3 km | The Telopea Urban Renewal Project Concept Plan was approved on 29 August 2010 (MP09_0170). On that same date, approval was also obtained to demolish existing structures at the site and construct 102 residential flat units on Shortland Precinct and 52 residential flats on Moffats Precinct. It is understood that stage 1 of this development was completed in early 2012 (Housing NSW, 2012), and that further stages are yet to be approved and completed. However further development of this site is not anticipated to impact on the Project given:<br>- The distance of the Telopea Urban Renewal Project from the Project Area; and<br>- That the overall nature of the Telopea Urban Renewal Project being for residential purposes, would not put undue strain on the goods and services required for Shell to undertake the Project. |
| The Children's Hospital at Westmead,<br>Hawkesbury Road, Westmead Part 3A Major Project | 8 km | The Children's Hospital at Westmead obtained two development approvals in 2011 to facilitate the construction of a new medical research building and associated infrastructure. DGRs have also been requested by the proponent, and are currently being prepared by DP&I for Stage 2 of the campus development. These works would not result in cumulative impacts for the current Project given:<br>- The time that would lapse between those development approvals being granted and the demolition component of the current Project commencing;<br>- The distance of the Children's Hospital at Westmead from the current Project Area; and<br>- These hospital upgrades are unlikely to require the same goods and services as are required to complete the current Project. |
| 45 to 47 Macquarie Street and 134-140 Marsden Street<br>Part 3A Major Project | 3 km | Two development approvals have been provided for this mixed use development. The proponent is also collating submissions received during the public exhibition period for a new development application to modify approved building heights and apartment mix. This development is not anticipated to result in cumulative impacts for the current Project given:<br>- The time that would lapse between those development approvals being granted and the demolition component of the current Project commencing;<br>- The distance of Macquarie and Marsden Streets from the Project Area; and<br>- That the overall nature of this development being for mixed use (largely residential) would not put undue strain on the goods and services required for Shell to undertake the Project. |
| 89 George Street, Parramatta<br>Part 3A Major Project | 3 km | Two development approvals have been recently obtained, on 21 November 2011 and in October 2012, for commercial retail development at the George Street site. This includes the demolition of existing buildings and the construction of commercial buildings. This development would not result in cumulative impacts for the current Project due to:<br>- The time that would lapse between those development approvals being granted and the demolition component of the current Project commencing;<br>- The distance of George Street from the Project Area; and<br>- The fact that this commercial retail development is unlikely to require the same goods and services as are required to complete the current Project. |

| Development | Distance From Project Area | Status of Consent/Approval |
|---|---|---|
| North West Rail Link<br><br>State Significant Infrastructure | >8 km | Four development approvals have recently been approved for the North West Rail Link (NWRL) in September 2012. These development applications have sought/are seeking development approval for:<br>- Modification of NWRL's definition, relocating Kellyville station, adding provisional stations at Bella Vista and Cudgegong Road, minor changes to the location of the Hills Centre station, changing Area 20 route alignment, and vertical alignment changes between Bella Vista and Rouse Hill;<br>- Major civil construction works;<br>- Minor changes to location of Showground Station, and associated works; and<br>- Seeking approval for an electrified passenger railway between Chatswood and Tallawong Road, Rouse Hill.<br><br>It is unlikely that there would be any cumulative impacts associated with the NWRL development and the current Project. This is due to:<br>- The distance of the NWRL development activities from the Project Area; and<br>- The fact that the NWRL project, being for rail purposes, would not put undue strain on the goods and services required for Shell to undertake the Project. |
| 330 Church Street<br><br>Part 3A Major Project | 3 km | Development approval was obtained on 19 October 2012 for a mixed use residential development (MP 10_0171). Two modifications have also been approved for the development since this time. However the Church Street development would not result cumulative impacts for the current Project given:<br>- The distance of Church Street from the Project Area; and<br>- That the overall nature of this development being for mixed use residential purposes would not put undue strain on the goods and services required for Shell to undertake the Project. |
| Ermington Former Naval Stores Site, 2 Spurway Street, Ermington<br><br>Part 3A Major Project | 2 km | Three development approvals have been obtained for modifications to the Ermington former Naval Stores site (for residential and associated civil infrastructure purposes). The most recent development approval (114-04-2002 MOD 2) was obtained on 25 October 2012. However these modifications at the Ermington site would not impact on the Project due to the:<br>- Relatively minor nature of these works;<br>- The distance of the Ermington former Naval Stores site from the Project Area; and<br>- That the overall nature of these modifications would not put undue strain on the goods and services required for Shell to undertake the Project. |
| Westfield Shopping Centre, Argyle Street and Church Street, Parramatta<br><br>Part 3A Major Project | 3 km | An application is being progressed and the proponent is currently reviewing submissions for the approval of a commercial development at the Westfield Shopping Centre in Parramatta. Approval is being sought to add a level of retail floor space over the existing shopping centre, a 20 storey commercial tower above retail podium, additional 1,100 above ground parking spaces, and for associated public domain works. However, these modifications to the Westfield Shopping Centre in Parramatta would not result in cumulative impacts for the Project given:<br>- The distance of the Westfield Shopping Centre Parramatta from the Project Area; and<br>- That the overall nature of this development being for addition to commercial premises being construction focused, whereas the current Project would require more demolition-type contractors. Overall this commercial development would not put undue strain on the goods and services required for Shell to undertake the Project. |

| Development | Distance From Project Area | Status of Consent/Approval |
|---|---|---|
| Coca Cola Plant, Northmead<br><br>Part 3A Major Project | 8 km | Approval was obtained on 26 March 2010 (05_0121 MOD 4) for the addition of a new canteen and office training facility at the Coca Cola plant training facility. This development would not result in cumulative impacts for the current Project given:<br>- The time that has lapsed/would lapse between that development being approved and the demolition component of the current Project commencing;<br>- The distance of the Coca Cola plant from the Project Area; and<br>- That the overall nature of this development being for addition to commercial premises being construction focused, whereas the current Project would require more demolition-type contractors. Overall this commercial development would not put undue strain on the goods and services required for Shell to undertake the Project. |
| Camellia Recycling Centre, 37 Grand Avenue, Camellia<br><br>SSD | 400 m | An application is being progressed, and the proponent is currently reviewing submissions for development application (SSD-4964) in relation to the Camellia Waste Recycling Project. The proponent, Veolia, is seeking approval to develop a materials recycling facility to process up to 150,000 tonnes per annum of non-putrescible waste into recycled products. This development has the potential to result in cumulative impacts for the current Project given:<br>- The distance of the proposed Camellia Recycling Centre from the Project Area and therefore the Camellia Recycling Centre's reliance on the same road network;<br>- The nature of this proposed development requiring both demolition and construction services; and<br>- The potential for cumulative impacts for traffic, noise and visual amenity, and also in relation to air, soil and water quality impacts.<br><br>The nature of these potentially cumulative impacts is considered in more detail in **Section 25.2** below. |
| 61 Mobbs Lane, Epping<br><br>Part 3A Major Project | 5 km | Concept Plan approval was initially provided on 22 August 2008 (MP 05_0086) for the construction of residential townhouses within several buildings at 61 Mobbs Lane, Epping. Several modifications have since been approved for this Major Project. This development would not result in cumulative impacts for the current Project given:<br>- The time that has lapsed/would lapse between that development being approved and the demolition component of the current Project commencing;<br>- The distance of 61 Mobbs Lane from the Project Area; and<br>- The overall nature of this development, being for residential purposes, would not put undue strain on the goods and services required for Shell to undertake the Project. |

## 25.2 Predicted Impacts

As **Table 25-1** explains, the majority of recent development approvals and current applications would not result in cumulative impacts for the current Project. A key reason for this is that most of these other development approvals and applications relate to sites that are more than 3 km from the current Project Area. Some of these approvals also relate to developments that would be completed by the time the demolition and construction activities for the current Project are expected to commence. Furthermore, the current Project would rely on the services of more specialised contractors who are familiar with industrial sites in particular to complete the demolition and construction works as part of the current Project. There is thus unlikely to be a shortage of labour or materials as a result of these developments progressing alongside each other.

This **Section 25.0** provides further details about the potential for cumulative impacts as a result of the development applications that are currently being progressed for the Camellia Recycling Centre at 37 Grand Avenue.

***Camellia Recycling Centre***

Veolia Environmental Services is proposing to develop a Materials Recycling Facility capable of processing up to 150,000 t per annum of non-putrescible waste at 37 Grand Avenue, Camellia, approximately 300 m east of the intersection of Grand Avenue and Durham Street. The Veolia site has historically been used as a waste management facility, and currently supports a liquid waste treatment plant and associated infrastructure. An EIS has been prepared by CH2MHILL for this SSD Application (SSD-4964), (CH2MHILL, 2013). This EIS has undergone public exhibition, and Veolia is currently reviewing submissions made during this exhibition period.

Subject to approval, these facilities would be constructed during 2014, and would also become fully operational some time during 2014 (CH2MHILL, 2013).

The EIS prepared for the proposed Camellia Recycling Centre development also includes a Traffic Impact Assessment undertaken by Harlcrow (Halcrow, 2012). These reports explain that the site currently supports around 11 truck movements per day, or around one departure and arrival per hour. In addition, around 15 staff car trips are undertaken per day, with around 15 movements occurring before 6:00am, and around 15 movements occurring after 3:30pm. The main access to the northern boundary of this site is from Grand Avenue via James Ruse Drive. The main access to the southern boundary of this site is from Parramatta Road via Rosehill Gardens Racecourse (CH2MHILL, 2013; Halcrow, 2012).

The construction of the Camellia Recycling Centre would take place over around nine months. The volumes of traffic generated during these construction activities are expected to be similar to those experienced at the site currently, and it is not expected that these construction works would significantly impact on the surrounding road network (CH2MHILL, 2013; Halcrow, 2012).

The Camellia Recycling Centre would operate 24 hours a day, seven days a week. A total of nine trips would occur on the surrounding road network during the morning peak hour (i.e. around one vehicle every six to seven minutes). An additional two trips would occur each hour during the evening peak period (i.e. around one vehicle every 30 minutes). Compared to the existing peak hour traffic volumes of the two closest affected intersections (James Ruse Drive with Grand Avenue and Parramatta Road with Wentworth Street), the additional nine trucks during the morning peak represents around 0.13 percent and 0.24 percent of the total intersection peak hour traffic at these intersections (CH2MHILL, 2013; Halcrow, 2012).

An additional 16 car parking spaces would also be constructed as part of the Camellia Recycling Centre development, to complement the existing 30 car parking spaces at the site (CH2MHILL, 2013; Halcrow, 2012).

During the construction of the Camellia Recycling Centre the local air quality has the potential to be impacted on by: dust generated by construction activities, including plant and vehicle movements; dust generated from disturbances to fill material; and exhaust emissions. Regular construction management measures are considered sufficient to manage these impacts to an acceptable level (CH2MHILL, 2013). During operation of the fully commissioned Camellia Recycling Centre, the main air quality related impact is odour. However, air quality modelling has indicated that the operational Camellia Recycling Centre would continue to meet the EPA's odour criterion of two odour units at the nearest residential receivers (CH2MHILL, 2013).

A Noise Impact Assessment was also prepared by Bridges Acoustics (2013) for inclusion in the EIS for the proposed Camellia Recycling Centre. Worst-case construction noise and vibration impacts were assessed. This worst-case scenario modelled for construction noise has predicted very slight exceedances of applicable noise criteria. However, these worst case scenario impacts may not actually occur during construction works and, if they do occur, their duration would be short. Operational noise impacts from the Camellia Recycling Centre may arise from both traffic movements to and from the site, and as a result of waste processing activities themselves (Bridges Acoustics, 2013; CH2MHILL, 2013).

Noise emitted from the operational Camellia Recycling Centre would generally be inaudible to nearby sensitive receivers during both the day and night. The key exception to this is the noise from rare occurrences of truck brakes being used at the north and north-eastern section of the site. This would be mitigated by the installation of a steel fence along the northern and north-eastern boundary of the truck route (Bridges Acoustics, 2013; CH2MHILL, 2013).

Overall the Camellia Recycling Centre development is considered unlikely to cause significant cumulative impacts for the current Project.

***Kurnell Refinery Closure***

On 26 July 2012, Caltex announced its decision to close the Kurnell oil refinery in Sydney and convert it into a major transport fuel import terminal. The closure has been confirmed to take place in the second half of 2014, and is expected to coincide with increased investment by Caltex in its Lytton refinery which is located in Brisbane (Caltex Australia, 2012). This is expected to result in a loss of at least 300 jobs at the Kurnell site (ABC News, 2012). The rationale that Caltex cites in its decision to cease refining at Kurnell mirrors that of Shell in ceasing refining operations at the Project Area in late 2012 (refer to **Section 4.2**): both refineries were faced with increased competition from mega refineries in Asia making them commercially unsustainable. As part of this conversion project at Kurnell, Caltex has committed to undertaking consultation with its impacted workforce to identify opportunities for retention, redeployment and retraining, and the provision of redundancy packages where these are not viable options (Caltex Australia, 2012). The Kurnell refinery, located in the Sutherland Shire LGA, lies within the Sydney region approximately 43 km south-east of Shell's operations at the Camellia Industrial Estate. This refinery closure would, however, impact on the same skills-set that was already affected by the cessation of refining at Shell's former Clyde Refinery. However, as the Kurnell refinery is not anticipated to be converted until mid-2014, there already has been, and would continue to be, time between the cessation of refining activities at the current Project Area and the cessation of refining activities at Kurnell for the impacts on this particular employment sector to stabilise.

The actual conversion of the Kurnell refinery infrastructure would also utilise the same skill-sets required for the current Project. However, it is understood that the timing of the proposed conversion activities at each refinery would not overlap to the extent that a significant drain on these resources would be experienced by either project.

***Gore Bay Terminal Modification Project***

Demolition and construction activities associated with the Gore Bay Terminal Modification Project have the potential to occur concurrently with the Clyde Terminal Conversion Project's demolition and construction activities. Therefore along with other major projects in the area that also have the potential to occur at the same time, the Gore Bay Terminal Modification Project is considered within this section. The Gore Bay Terminal Modification Project is located approximately 19 km to the east of the Clyde Terminal.

The distance between the two sites is considered such that the Gore Bay Terminal Modification Project would have negligible cumulative impacts to the Clyde Terminal Conversion Project. Additionally, the Gore Bay Terminal Modification Project would be required to adhere to an independent set of environmental mitigation measures relevant to that particular project application.

## 25.3 Mitigation Measures

Given that other proposed developments in the vicinity of the Project Area - even the Camellia Recycling Centre around 300 m to the east - are not predicted to result in significant cumulative impacts for the current Project, it is not necessary for Shell to undertake specific mitigation measures to lessen any such impacts.

However Shell would continue its dialogue with Parramatta City Council over the coming years in relation to determining a future land use for surplus land in the western and north-eastern sections of the Project Area. This is to ensure that Council's strategic vision for the Camellia Industrial Precinct is considered as Shell decides on a future use for this land. Consideration of strategic plans would further decrease the possibility of cumulative impacts occurring in the future as a result of the Project.

## 25.4 Residual Impacts

There is the potential for residual cumulative impacts that cannot be anticipated in this EIS, as further development applications may be progressed in the Parramatta LGA. Nevertheless, Shell would continue to undertake consultation with other members of the business community in the Camellia Industrial Precinct to ensure any cumulative impacts that do arise are anticipated and addressed.