11.0 Transport

Relevant DGRs: The EIS must address **Transport and Access** – including:

- Accurate predictions of the traffic generated by the development;
- A detailed assessment of the potential impacts of the development on the capacity, efficiency and safety of the road network including the cumulative traffic generated by all existing and proposed developments on the Rosehill/Camellia industrial precinct;
- Details of any upgrades to road infrastructure that would be required due to the development; and
- Site accesses, internal roads and vehicular parking required as a result of the development.

11.1 Existing Conditions

The Traffic Impact Assessment (TIA) was prepared for the Project and is summarised in this Section. The TIA is provided in **Appendix B** of **Volume 2** of this EIS. The results of the TIA were provided to Parramatta City Council in December 2012 at Council's request, and Council was satisfied with these results as well as AECOM's conclusion that the Project would not constitute traffic generating development under the Infrastructure SEPP (refer to **Sections 7.3** and **11.2.1**). At the request of Parramatta City Council, the TIA methodology included an assessment of traffic impacts emanating from the Project Area itself, as well as traffic impacts associated with the adjoining Parramatta Terminal which is also operated by Shell (in partnership with BP – refer to **Section 2.3.2**). In this respect, the methodology of the TIA differs from other assessments prepared as part of this EIS, with the exception of the PHA (refer to **Sections 19.2** and **19.3.5** for justification around why Parramatta Terminal and Clyde Terminal were considered cumulatively with respect to potential hazard and risk).

11.1.1 The Local Road Network

The Clyde Terminal is located at 9 Devon Street, Rosehill in the Camellia Industrial estate (refer to **Figure 11-1**), approximately 15 km west of Sydney CBD. There are currently approximately 83 operational personnel onsite at the Clyde Terminal. Until the recent cessation of refining activities in late 2012, the Clyde Terminal employed around 475 employees and contractors, of which 280 personnel were onsite at any one time.

The Project Area has established vehicular connections to nearby arterial roads and the Sydney motorway network (refer to **Figure 11-1**). The principal collector road for the Clyde Terminal is Grand Avenue, which also provides access for the surrounding Camellia Industrial estate onto Hassall Street, and onward to Parkes Street heading west to the Parramatta CBD. Hassall Street also provides access onto James Ruse Drive, the main arterial road in the surrounding area which provides connectivity south to the M4 Western Motorway and Parramatta Road, and north over the Parramatta River to Victoria Road and onward to the Cumberland Highway.

The Clyde Terminal can also be accessed from Parramatta Road via Wentworth Street, Kay Street and Unwin Street. The use of this route enables access to the Project Area without using James Ruse Drive or Grand Avenue.

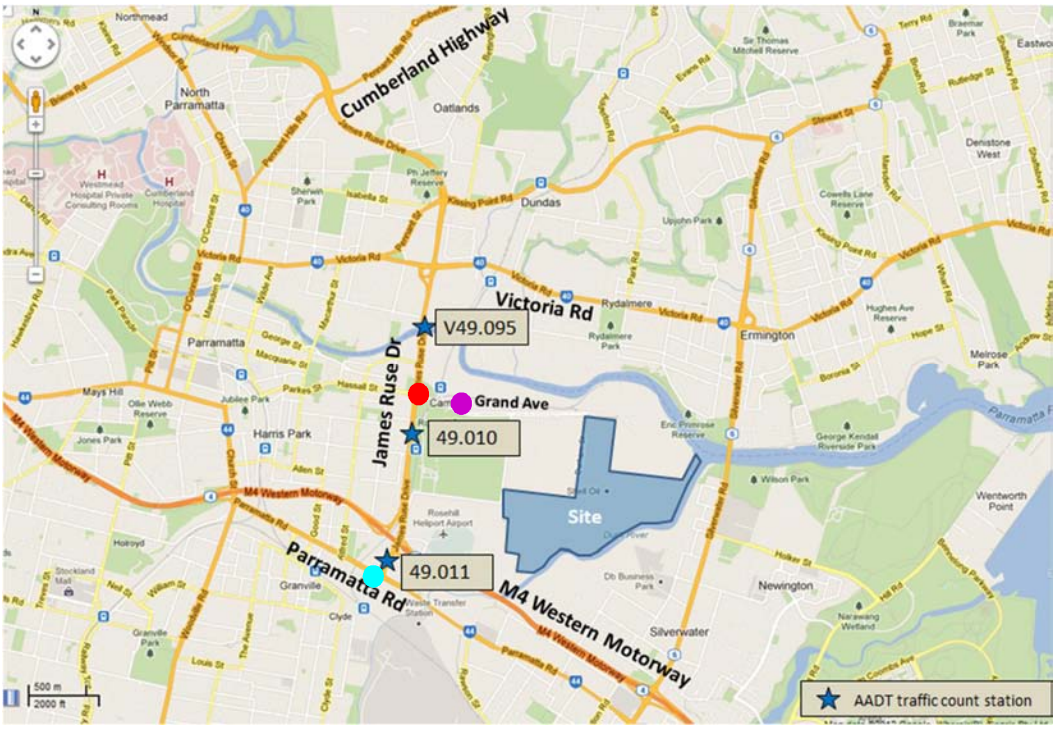


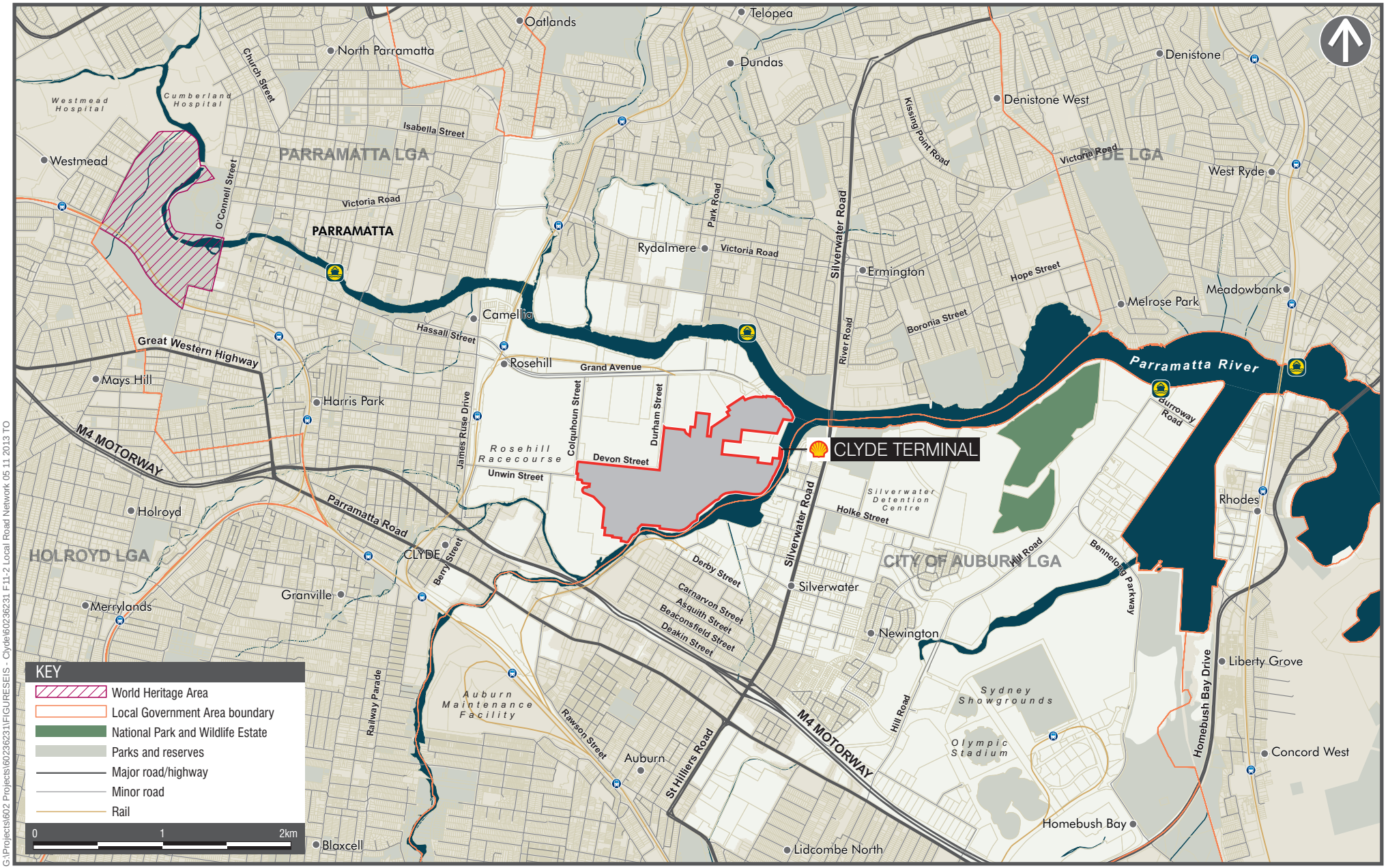
Figure 11-1 Road Network Surrounding the Project Area Showing Locations of RMS Traffic Count Stations (AADT)

Note: V = permanent traffic count station

= James Ruse Drive / Grand Avenue / Hassall Street intersection

= James Ruse Drive / Berry Street / Parramatta Road

= Grand Avenue / Grand Avenue North



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AECOM

LOCAL ROAD NETWORK

Clyde Terminal Conversion Project
Environmental Impact Statement

FIGURE 11-2

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11.1.2 The Surrounding Road Network

The surrounding road network in the vicinity of the Project Area is comprised of the following:

- Devon Street: A local road running east-west adjacent to the northern boundary of the Project Area, connecting to both Colquhoun Street and Durham Street. It is a two-lane road with a posted speed limit of 50 km/h;
- Durham Street: Provides the main access to the Project Area. It is located approximately halfway between Grand Avenue and Devon Street, and is two-lane local road with a posted speed limit of 50 km/h;
- Colquhoun Street: Provides access to the southern end of the Project Area and connects to Grand Avenue to the north, providing connectivity from the Project Area to the surrounding road network. Colquhoun Street is a two-lane local road with a speed limit of 50 km/h;
- Unwin Street / Kay Street: Provides access from Colquhoun Street to Wentworth Street, which is part of the route which allows secondary access to Parramatta Road from the Project Area. They are two-lane roads with a posted speed limit of 50 km/h;
- Wentworth Street: Links Kay Street to Parramatta Road. It is a two-lane road with a posted speed limit of 50 km/h;
- Grand Avenue: The collector road serving local roads which access the Project Area. It is a two-lane divided road with a large central median, and has a posted speed limit of 60 km/h;
- Hassall Street: Grand Avenue continues as Hassall Street to the west of James Ruse Drive, and provides a connection west to Parkes Street and onward to the Parramatta CBD. It is a four-lane collector road with a posted speed limit of 60 km/h;
- James Ruse Drive: The major arterial road providing access from Grand Avenue to important arterial routes and the motorway network. It provides connectivity south to the M4 Western Motorway and Parramatta Road, and north to Victoria Road and the Cumberland Highway. It is a six-lane road with a posted speed limit of 70 km/h;
- Parramatta Road: An arterial road which acts as a secondary east-west route to the M4 Western Motorway. It is a four-lane road with a posted speed limit of 60 km/h;
- M4 Western Motorway: The major highway route providing an east-west link between the foothills of the Blue Mountains and Strathfield. It can be accessed via an interchange with James Ruse Drive and is a six-lane motorway with a variable speed limit system in place, which would normally operate at 100 km/h;
- Victoria Road: Provides a major connection east toward Ryde and other arterial roads such as Lane Cove Road, connecting to other parts of Sydney. It is a four-lane road with a posted speed limit of 60 km/h; and
- Cumberland Highway: Provides an important connection to Sydney's North West and upper North Shore toward the F3. It a four-lane road with a posted speed limit of 60 km/h.

The local road network in the vicinity of the Project Area is centred on the principal collector road Grand Avenue. Durham Street provides access into the Project Area from Grand Avenue, with Devon Street also running adjacent to the Project Area along its northern boundary. Grand Avenue feeds onto James Ruse Drive to the west, which provides access to the wider road network. The main access to the Clyde Terminal is via Shell's Gate 4, located on Durham Street between Grand Avenue and Devon Street.

11.1.3 Daily Traffic Volumes

Average daily traffic volumes in the vicinity of the Project Area have been assessed using available Annual Average Daily Traffic (AADT) data provided by RMS. Three vehicle counting stations are located along James Ruse Drive, as shown in **Figure 11-1**. A summary of traffic volumes recorded at these stations over a period of nine years between 1996 and 2005 is presented in **Table 11-1**, with the latest available AADT data from 2005 (Roads and Traffic Authority, 2005).

Following analysis of the AADT data it is evident that traffic growth in the vicinity of the Project Area is low, ranging from 0.1 to 1.2 percent over the nine years to 2005. As only minimal traffic growth and traffic generating development has taken place within the vicinity of the Camellia Industrial Estate since 2005, and given that only minimal growth rates were experience over the period 1996 to 2005, the most recent AADT data was considered adequate for the purposes of the TIA.

Table 11-1 AADT on the Adjacent Road Network

Station Number	Station Location	AADT Volumes - Year				Annual Growth Rate (1996 – 2005)
		1996	1999	2002	2005	
49.010	James Ruse Drive south of Hope Street	57,992	63,098	62,988	64,666	1.2 percent
49.011	James Ruse Drive north of Parramatta Road	31,899	31,981	32,478	32,171	0.1 percent
V49.095*	James Ruse Drive north of River Road (bridge over Parramatta River)	60,242	63,009	63,346	64,085	0.7 percent

Source: *RMS Annual Average Daily Traffic Data (AADT) 2005 Sydney Regional Volume 1*

***Note: V = permanent traffic count station**

11.1.4 Peak Hour Traffic Volumes

To provide a better understanding of peak hour traffic conditions, classified intersection count data has been obtained by AECOM from a TIA previously prepared as part of the development of an integrated recycling park at Grand Avenue, Camellia (Traffix Traffic and Transport Planners, 2011). From this TIA, data for the following intersections are available (refer to **Figure 11-1**):

- James Ruse Drive/Grand Avenue / Hassall Street (west of the Project Area);
- James Ruse Drive/Berry Street / Parramatta Road (south-west of the Project Area); and
- Grand Avenue/Grand Avenue North (west of the Project Area, prior to the James Ruse Drive intersection).

For James Ruse Drive/Grand Avenue / Hassall Street, data was collected for two hours in the AM (7am to 9am) and PM (4pm to 6pm) peaks (refer to **Plate 6**), and two hours during the day (1.30pm to 3.30pm) during the inter-peak period (refer to **Plate 7**). Data for two hours in the PM peak (4pm to 6pm) was collected for James Ruse Drive / Berry Street / Parramatta Road, as illustrated in **Plate 8**, and Grand Avenue / Grand Avenue North, as illustrated in **Plate 9**. It is noted that at the time of these traffic counts, the Clyde Refinery was still in operation and the workforce onsite was substantially larger, with approximately 280 personnel onsite at any one time (after having regard to the shift nature of employee and contractor movements) (refer to **Table 6-2**).

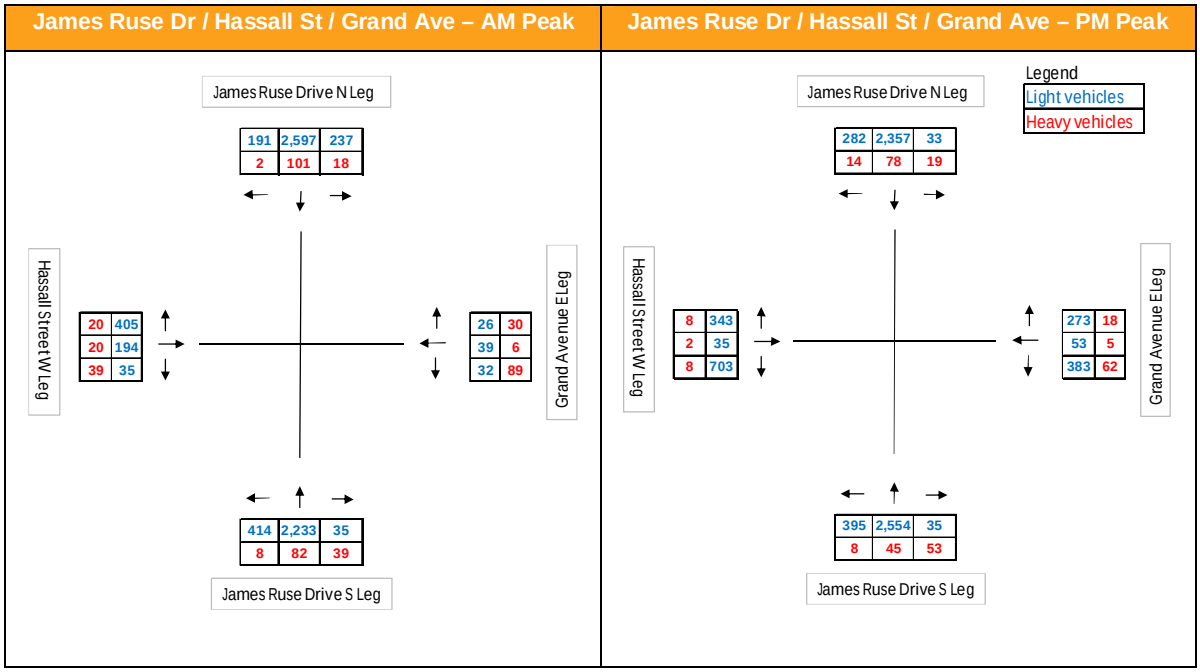

Plate 6 **Traffic Volumes on James Ruse Dr / Hassall St / Grand Ave Recorded in 2011- AM and PM Peaks (Source: AECOM, 2012)**

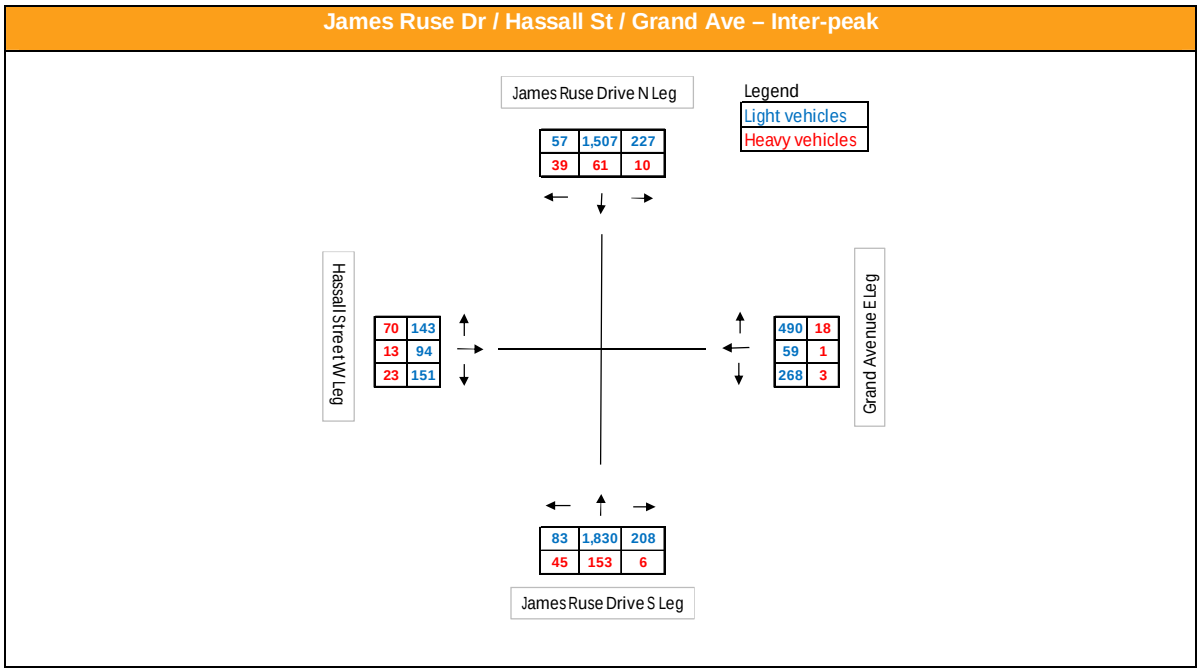

Plate 7 **Traffic Volumes on James Ruse Dr / Hassall St / Grand Ave Recorded in 2011 - Inter-Peak Period (Source: AECOM, 2012)**

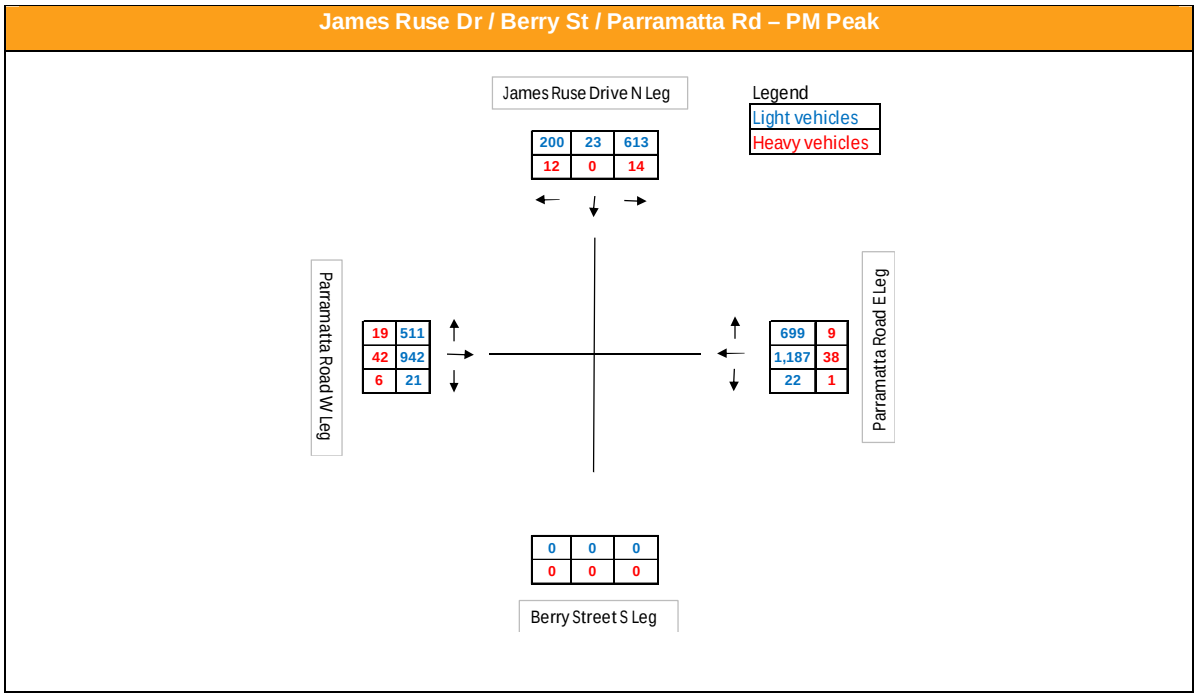

Plate 8 **Traffic Volumes on James Ruse Dr / Berry St / Parramatta Rd Recorded in 2011 (Source AECOM, 2012)**

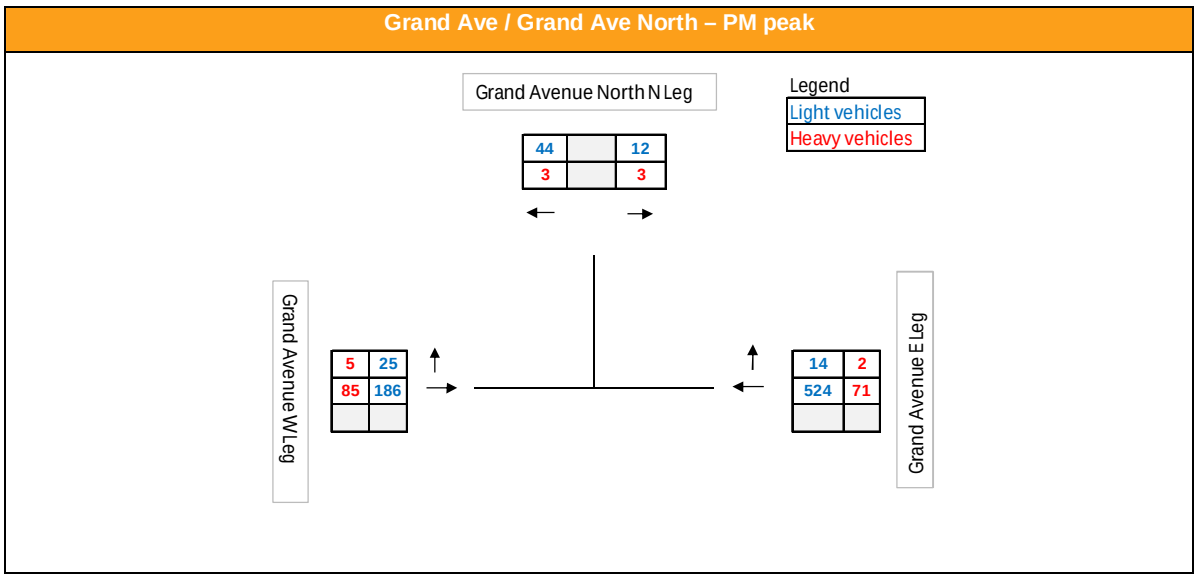

Plate 9 **Traffic Volumes on Grand Ave / Grand Ave North Recorded in 2011 (Source: AECOM, 2012)**

11.1.5 Operational Performance

As part of the current TIA, the performance of these three intersections has been evaluated using *SIDRA Intersection 5.1*, a computer based modelling package designed for calculating isolated intersection performance. Classified intersection count data was obtained from the TIA of an integrated recycling park at Grand Avenue, Camellia, prepared in 2011 by Traffix Traffic and Transport Planners.The main performance indicators for SIDRA 5.1 include:

- Degree of Saturation (DoS) – A measure of the ratio between traffic volumes and the capacity of the intersection to measure the performance of that intersection in isolation. As the DoS approaches 1.0, both queue length and delays increase. A satisfactory operational performance usually occurs with a DoS value of 0.8 or lower;
- Average Delay – Duration, in seconds, of the average vehicle waiting at an intersection; and
- Level of Service (LoS) – A measure of the overall performance of the intersection. A LoS indicates whether an intersection has good operational performance, or has reached its capacity. A rating of A indicates good intersection performance, with lower ratings indicating poorer intersection performance.

Additional details regarding performance criteria for intersections is provided in **Section 3.3.5** of **Appendix B**.

Table 11-2 shows the operational performance of the intersections in 2011 against the performance indicators. Both the James Ruse Drive/Berry Street/Parramatta Road and the Grand Avenue/Grand Avenue North intersections were operating with satisfactory results for delays and performance, whereas the James Ruse Drive/Hassall Street/Grand Avenue intersection was operating at capacity in 2011.

Table 11-2 Intersection Performance Recorded in 2011

Intersection	Peak Period	Level of Service	Degree of Saturation	Average Delay (sec)	95 Percent Back of Queue (m)
James Ruse Drive / Hassall Street / Grand Avenue	AM	F	1.221	201	1263
	Interpeak	F	1.000	76	439
	PM	F	1.347	288	1423
James Ruse Drive / Berry Street / Parramatta Road	PM	C	0.807	33	153
Grand Avenue / Grand Avenue North	PM	B	0.329	1	3

The layouts of the intersections subject to the SIDRA 5.1 analysis are provided in **Plate 10**, **Plate 11** and **Plate 12** below.

James Ruse Dr / Hassall St / Grand Ave

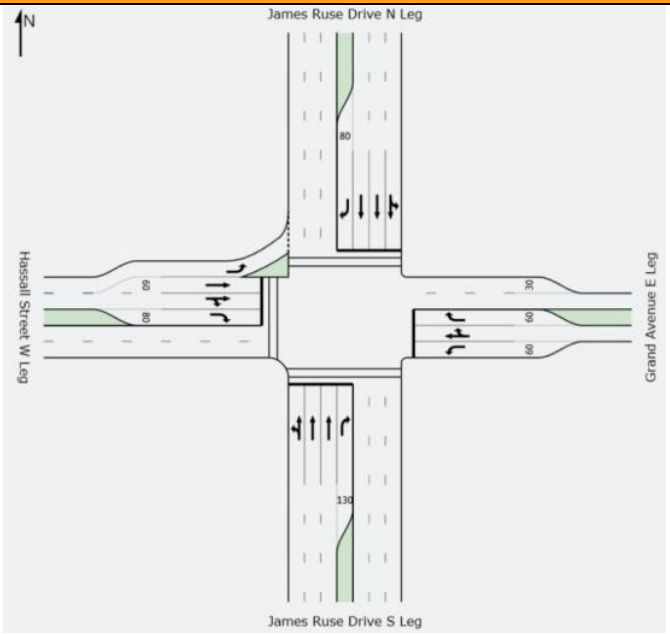

Plate 10 Intersection Layout - James Ruse Drive / Hassall Street / Grand Avenue (Source: AECOM, 2012)

James Ruse Drive / Parramatta Road / Berry Street

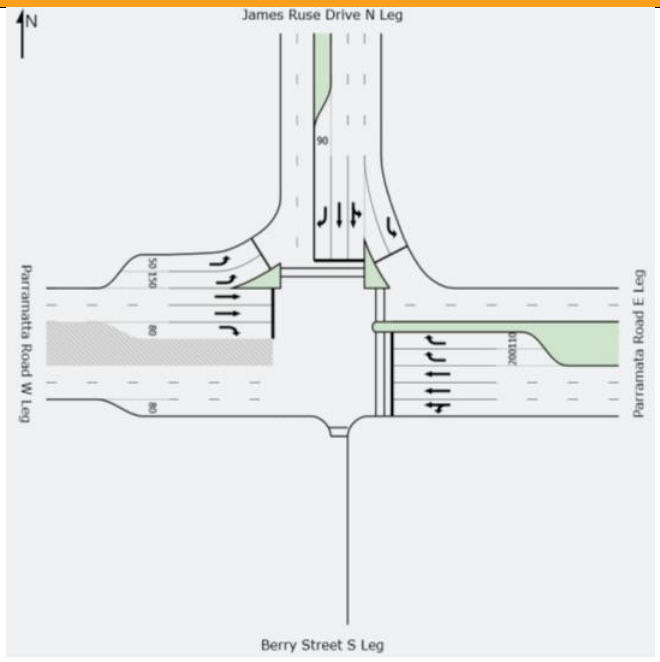

Plate 11 Intersection Layout - James Ruse Drive / Parramatta Road / Berry Street (Source: AECOM, 2012)

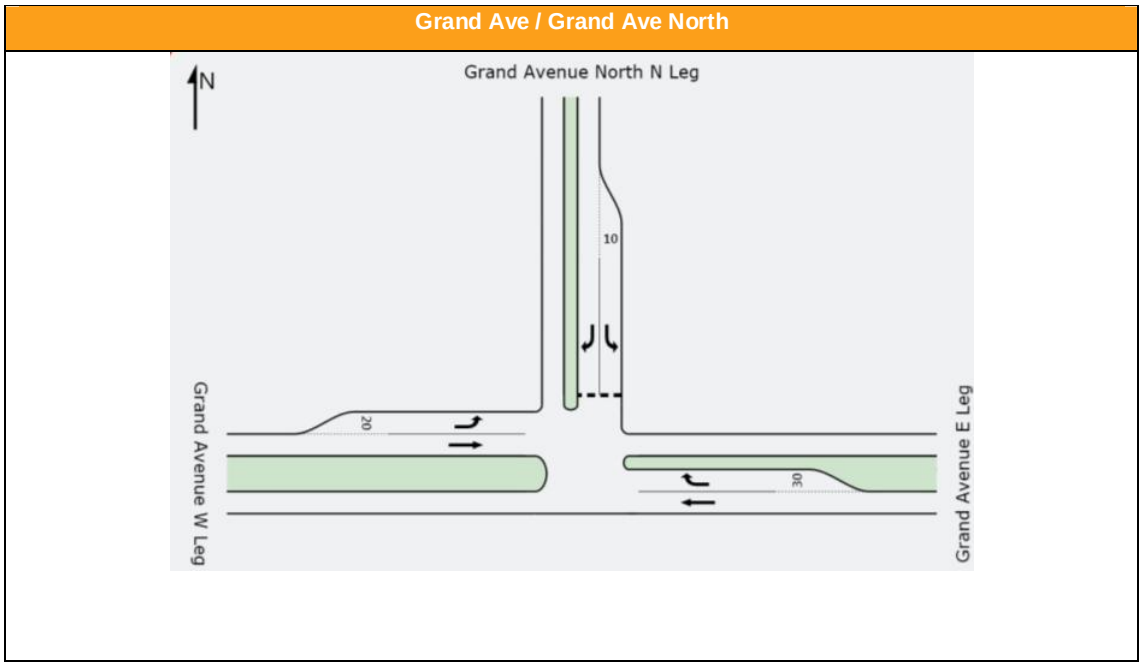

Plate 12 Intersection Layout - Grand Avenue / Grand Avenue North (Source: AECOM, 2012)

11.2 Predicted Impacts

11.2.1 Construction Hours, Workforce and Traffic Movements

A breakdown of onsite workforce numbers by project phase is summarised in **Table 11-3**. As shown in **Table 11-3**, employee numbers onsite during any single day would increase to 68 employees for the duration of the Project and would then return to the same as for current operations (i.e. 27 employees) once the works are completed. These are Shell's current expectations of future staff needs at the Clyde Terminal, and are subject to business needs and consultation with affected staff.

The number of contractors onsite during any single day would increase substantially to up to 198 once the demolition and construction works are underway. Contractor numbers would be reduced to 10 once the works are completed.

It is noted that these numbers reflect the number of employees that may be onsite in a given day for the purpose of this TIA. The numbers do not reflect the total number of staff employed by Shell (e.g. there are five shifts, however only two of them would commute to Clyde in a given day). For this reason, the staff numbers shown in **Table 11-3** differ from those presented in **Table 6-2** (which shows total staff numbers regardless of shift movements). It should be noted that these numbers indicate Shell's anticipated staff and contractor requirements, and are subject to further consultation.

Journey to Work data for the Clyde Peninsula industrial precinct (Travel Zone 1720) from the 2006 Census indicated that 85 percent of trips to work are taken by car. This data is gathered on the day of the census and reflects the typical mode of transport for all people travelling to work to the Clyde Peninsula on the day.

The distribution of petroleum products to customers would continue to be undertaken from the Parramatta Terminal only.. The heavy vehicle trip movements provided include fuel tanker movements associated with the Parramatta Terminal. Fuel Tanker movement numbers are anticipated to remain consistent throughout (i.e. 249 per day) with other waste disposal, delivery and courier vehicles making up the numbers (refer to **Appendix B** of **Volume 2** of this EIS).Demolition and construction activities would be undertaken from 7am to 6pm, Mondays to Fridays, and from 8am to 1pm on Saturdays. Some traffic associated with demolition and construction activities may arrive at the Project Area outside of these designated times. For example, some of this traffic might arrive before 7am during the week and before 8am on Saturdays, to ensure that staff can commence work on time, and to avoid peak hour traffic movements in other parts of the Sydney metropolitan road network.

The converted Clyde Terminal would operate 24 hours a day, seven days a week as per the current operations.

Table 11-3 Project Staff Numbers and Vehicle Movements

Phase	Employees	Contractors	Total	Estimated Light Vehicle Trips per day (*% change from current*)	Heavy Vehicle Trips per day (*% change from current*)
Current Operations	27	20	**47**	**40**	**257**
Demolition / Construction (including concurrent operating personnel)	68	130	**198**	**169 (+423%)**	**277 (+8%)**
Operation Phase – Final Configuration	27	10	**37**	**32 (-20%)**	**257 (0%)**

Note:

Heavy vehicle tanker movements associated with Parramatta Terminal operations are included in this table, and these operations at the Parramatta Terminal would not change significantly as a result of the proposed Project

These numbers reflect the number of employees that may be onsite in a given day for the purpose of this TIA. The numbers do not reflect the total number of staff employed by Shell (For this reason, the staff numbers shown in Table 11-3 differ from those presented in Table 6-2 (which shows total staff numbers regardless of shift movements).

Light Vehicle Movements

Since the cessation of refining at the Clyde Terminal, the number of light vehicles commuting to the Clyde Terminal has decreased to approximately 40 light vehicle trips per day compared to the previous 238 light vehicle trips per day (refer to **Table 11-3** and **Table 4** of **Appendix B**). The demolition and construction works would require approximately 169 light vehicle trips to the Clyde Terminal to accommodate the additional workforce. Once the works are completed, the number of light vehicle trips would be around 32 per day, which is approximately 20 percent fewer than the current number.

Delivery, Service and Heavy Vehicle Movements

As part of Shell's current operations at the Camellia Industrial Estate, there are approximately 257 heavy vehicles accessing the Project Area and its adjoining Parramatta Terminal, including fuel tankers, waste transport trucks, as well as other delivery and courier vehicles. Until 2016, current estimates of market-based fuel volume growth sees Gasoline demand to remain fairly static, diesel fuel growth of approximately four percent and Jet fuel growth of approximately four percent. The vast majority of Jet fuel is transferred to Sydney Airport via pipeline so does not impact on traffic patterns, whereas Gasoline and Diesel fuel is largely transported from the adjoining Parramatta Terminal by road tankers. Accordingly, the road tanker movements from Parramatta terminal would be expected to grow by approximately two percent until 2016.

Typically delivery and service vehicle movements to and from Shell's operations at the Camellia Industrial Estate (including both the Project Area and Shell's adjacent Parramatta Terminal) include:

- 250 round trips of fuel tankers each day accessing Parramatta Terminal;
- One round trip of a waste transport truck each day accessing the Clyde Terminal;
- Three round trips of butane delivery vehicles each day accessing the Clyde Terminal; and
- Three round trips of couriers each day accessing the Clyde Terminal.

Demolition activities would see the addition of 16 heavy vehicles in each direction during demolition works to transport waste materials. Construction activities would require approximately one heavy vehicle trip per day to deliver construction materials and initially to mobilise construction plant and equipment.

Impact of Demolition and Construction Traffic Movements

Subject to development consent, demolition activities are anticipated to commence within six to 12 months of the grant of development consent, and would be be undertaken in stages over a three year period to align with matching the construction schedule. Should it be more economic to have a lower intensity of demolition and associated transport, Shell would advise Parramatta Council and be able to offer a lower intensity program have a reduced daily impact on traffic. Construction activities are also due to begin within six to 12 months of the grant of development consent, and would take approximately three years to complete. Demolition and construction activities would therefore occur concurrently, in addition to the ongoing operations of the Clyde Terminal.

During this period, there would be up to approximately 169 light vehicle trips to the Clyde Terminal, representing an increase of approximately 129 light vehicle trips compared to the current 40 light vehicle trips (i.e. a 423 percent increase on current operations) (refer to **Table 11-3**). Although this number represents a significant increase on the current number of light vehicle trips, this would represent fewer light vehicle trips compared to those during the previous refining operations at the Project Area which occurred prior to the cessation of refining activities in late 2012 (refer to **Table 11-3**). Additionally, the bulk of traffic movements are anticipated to occur outside of the peak traffic period as demolition and construction activities are proposed to occur between 7am to 6pm, Mondays to Fridays, and 8am to 1pm Saturdays. Some traffic associated with demolition and construction activities may arrive at the Project Area outside of these designated times. For example, some of this traffic might arrive before 7am during the week and before 8am on Saturdays, to ensure that staff can commence work on time, and to avoid peak hour traffic movements in other parts of the Sydney metropolitan road network.

The converted Clyde Terminal would operate 24 hours a day, seven days a week. Light vehicles would be parked within the Clyde Terminal which already has sufficient car parking allocations to accommodate these additional vehicles. For these reasons, it is considered that the increase in light vehicle numbers during the demolition and construction works would not significantly impact the surrounding road network.

During the demolition and construction works, the overall number of delivery, service and heavy vehicle movements is predicted to be up to 277 trips per day, which represents an increase of approximately 20 heavy vehicle trips compared to the current 257 heavy vehicle trips (i.e. an eight percent increase) (refer to **Table 11-3**). The impact of demolition and construction heavy vehicle traffic on the surrounding road network is considered to be negligible due to the low levels of traffic generated by the works. The number of fuel tankers accessing the Parramatta Terminal would remain relatively consistent with current operations throughout the conversion works, and is anticipated to grow at approximately two percent per annum until at least 2016.

As the impacts on the surrounding road network are not considered to be significant, the Project is not considered to meet the definition of traffic generating development under clause 104 of the Infrastructure SEPP. Further, the Project does not involve the development of a new premises, nor the enlargement or extension of an existing premises. Furthermore, given the fact that daily traffic flow during the demolition and construction works is predicted to be substantially less than experienced at the Project Area under the recent refining operations scenario (when more staff and contractors were accessing the former Clyde Refinery on a daily basis), it is not considered necessary to undertake a quantified assessment of peak hour traffic movements to and from the Clyde Terminal for the proposed conversion activities. Overall, the impact of construction and demolition traffic on thr surrounding road network will not be significant, due to the low increase of trucks transporting materials to and from the site, as well as the overall reduction in staff and operating capacity at the site once the works are completed.

It is possible that for short periods during some demolition activities the roads immediately surrounding the Clyde Terminal may be temporarily closed to ensure the safety of personnel whilst certain activities are undertaken (e.g. if required during demolition blasting). Any road closure would be undertaken in consultation with the Parramatta City Council and local businesses.

11.2.2 Operation of the Converted Clyde Terminal

Once the demolition and construction works are completed, the continuing operation of the converted Clyde Terminal would see a similar number of heavy vehicle trips as those currently experienced, i.e. 7 heavy vehicles per day. Additionally, the adjacent Parramatta Terminal would continue to see 250 heavy vehicles per day.

There is anticipated to be approximately 32 light vehicles accessing the Project Area daily once the conversion works are complete which represents a 20 percent decrease on the current number of light vehicle trips. Similarly to conversion activities (refer to **Section 11.2.1**), operation of the converted Clyde Terminal would experience traffic flow substantially less than that which was experienced during the recent refining operations scenario

(when more staff and contractors were accessing the former Clyde Refinery on a daily basis), it was not considered necessary to undertake a quantified assessment of peak hour traffic movements to and from the Clyde Terminal for operation of the Clyde Terminal.

11.2.3 Capacity, Efficiency and Safety

Deliveries to and from the Project Area for demolition and construction activities are expected to be largely contained in the Sydney metropolitan area. Fuel tankers accessing the Parramatta Terminal would also use the major road network to transport fuel outside the metropolitan area. The main access to the Project Area and the adjoining Parramatta Terminal is located on Durham Street, which connects to Grand Avenue and subsequently James Ruse Drive. The majority of truck traffic transporting materials to and from the Project Area and Parramatta Terminal would then travel along James Ruse Drive to the M4 Western Motorway, which provides access to the Sydney motorway network.

Access provisions would remain unchanged for the demolition and construction works, and for the future operation of the converted Clyde Terminal, as site access is already designed to accommodate heavy articulated vehicle movements. There would not be a need for additional parking allocations, as existing car parking arrangements at the Project Area would be adequate to service the needs of the Clyde Terminal.

Since the cessation of refinery operations at the Clyde Terminal, there has been a reduction in the amount of heavy vehicle transport to and from the Clyde facility. LPG distribution has now been transferred to Botany, bitumen distribution has ceased, there are no service vehicle movements associated with refinery operations and the staffing numbers have significantly reduced. These changes have led to a reduction in the amount of traffic travelling to and from the Clyde Terminal, a reduction on the transport and road infrastructure surrounding the Clyde Terminal so have provided additional capacity for other users of this existing infrastructure.

As outlined in **Table 11-2**, the James Ruse Drive / Hassall Street / Grand Avenue intersection has a LoS rating of F, the James Ruse Drive / Berry Street / Parramatta Road intersection has a LoS rating of C, and the Grand Avenue / Grand Avenue North intersection has a LoS rating of B. Given that the Project is anticipated to result in minor increases to light vehicle movements and heavy vehicle movements to the Project Area it is considered that the two intersections would not experience significant changes to their LoS ratings of F, C and B as a result of any changes to traffic volumes. In particular, it is noted that the LoS rating calculations for these intersections were based on 2011 traffic counts, at which time refining operations were still being conducted on the site. The number of personnel and associated traffic movements to the Project Area have reduced since that time due to the cessation of refining activities (refer to **Table 11-3**). As such the increase in demolition and construction vehicles is expected to be no greater than traffic associated with the previous refining operations phase, with the net change in intersection performance likely to be an improvement on the 2011 LoS calculations.

The Project is not considered to have impacts for traffic safety due to the following (RTA, 2002):

- The Project would not result in a significant increase to pedestrian movements in the area;
- The Project would not result in an overall increase in the intensity of a current roadside development; and
- The Project does not involve direct access from the Project Area onto a major road.

11.2.4 Potential Cumulative Impacts

The potential for cumulative traffic impacts resulting from the Project and surrounding developments was considered as part of the TIA. An EIS was recently placed on public exhibition for the development of the Camellia Recycling Centre at 37 Grand Avenue. This EIS also includes a Traffic Impact Assessment undertaken by Halcrow (Halcrow, 2012), based on traffic count data collected specifically for that Halcrow assessment. Any slight differences between the LoS findings of the Halcrow assessment and the report prepared by Traffix Traffic and Transport Planners (which has been included in the current TIA) are therefore due to the fact that traffic count data relating to the nearby intersections was collected on different days and on behalf of different traffic engineers. The Halcrow report explains that the Camellia Recycling Centre 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. Wastes would therefore generally be received and distributed from the site with an even distribution over the 24 hour period. The key exception to this is predicted to be the delivery of non-transfer trailer wastes between 4:00am and 12:00pm. 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 hours at these intersections, respectively (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).

Based on the Halcrow assessment, the Camellia Recycling Centre is unlikely, in combination with the current Project, to create significant cumulative traffic-related impacts.

For a more detailed consideration of the potential for cumulative impacts as a result of the Project, refer to **Section 25.0**.

11.3 Mitigation Measures

The TIA prepared by AECOM has concluded that the Project would not create significant impacts for the surrounding road network. However, it is nevertheless proposed that:

- Vehicular traffic would be minimised during peak hour traffic periods where practical do to so;
- A Construction Traffic Management Plan (CTMP) would be prepared prior to the works commencing; and
- Demolition and construction generated traffic would be parked within the Project Area to limit the numbers of vehicles situated in the streets surrounding the Clyde Terminal.

11.4 Residual Impacts

The TIA prepared by AECOM has concluded that the Project would result in increases to light vehicle and heavy vehicle numbers during the demolition and construction works. However, these are not deemed to significantly impact the surrounding road network and show a significant reduction when compared to the previously operating Clyde Refinery. Once the proposed project works are completed, vehicle movements associated with the Clyde Terminal and the adjacent Parramatta Terminal would be similar to those currently experienced. These impacts would be minor, and the mitigation measures outlined in **Section 11.3** are considered sufficient to adequately manage traffic associated with the Project.

As such, the Project is considered unlikely to result in residual traffic impacts on the surrounding road network. Following the removal of refining assets, Shell plans to undertake significant investigation of the underlying soil and groundwater for historical contamination and develop a remediation plan if required in dialogue with the EPA. This is likely to proceed along with a further application for development consent to remediate and redevelop land surplus to the requirements of the converted Clyde Terminal (the Clyde Remediation and Redevelopment application). It is anticipated that the most likely use for the surplus land at the Project Area would be for some sort of industrial use in the coming years, and that any required remediation would be completed by the end of 2017. Any traffic impacts associated with that future development application would be considered by Shell at that time and are outside the scope of this EIS.

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12.0 Social and Economic Effects

Relevant DGRs: The EIS must address **Social and Economic**.

12.1 Existing Social and Economic Conditions

12.1.1 Parramatta Local Government Area

The Clyde Terminal is located within the Parramatta LGA, which is approximately 24 km west of the Sydney CBD. It is approximately 61 km^2, and has a population of approximately 170,000 (Parramatta City Council, 2012).

The LGA is bounded by the Ryde LGA to the east, the Auburn and Bankstown LGAs to the south, the Fairfield, Holroyd and Blacktown LGAs to the west, and the Hills and Hornsby LGAs to the north. Parramatta LGA comprises 29 suburbs. It is also considered to be the second CBD of Sydney, and includes residential, commercial, entertainment and industrial precincts. This role as a second CBD is considered vital to the overall long-term sustainability of Sydney.

According to the 2011 Australian Bureau of Statistics data, 87.7 percent of the working age group (15 to 60 years) is employed either part time or full time. The most common occupations in Parramatta LGA include professionals (25.9 percent), clerical and administrative workers (17.3 percent), technicians and trades workers (12.5 percent), managers (10.6 percent), and sales workers (8.7 percent) (Parramatta City Council, 2013). Of the employed people in Parramatta LGA, 4.2 percent worked in cafés, restaurants and takeaway food services. Other major industries of employment included hospitals (4.0 percent), school education (3.4 percent), computer system design and related services (3.1 percent) and depository financial intermediation (3.0 percent) (Parramatta City Council, 2013).

The *Parramatta Economic Development Strategy 2011-2016* (Parramatta City Council, 2011) (Parramatta Economic Strategy) recognises Parramatta as the second largest employment area for people who reside within the Western Sydney region. Parramatta has a growing 24-hour cycle of economic activity and an ever increasing inner city population. A snap shot of the local demographics shows a population that is young, well-educated and multi-cultural. The Parramatta LGA has a well-developed commercial centre that includes finance, insurance, accounting, law, business services, Government administration and health sectors in particular (Parramatta City Council, 2011).

Furthermore, the Parramatta LGA is currently undergoing a subtle economic shift whereby its population is gradually attaining greater levels of education, and higher education in particular. The Parramatta Economic Strategy therefore identifies an opportunity for Parramatta to move towards the provision of employment in the knowledge end of business, thereby increasing the number of managers, professionals, para-professionals, technical specialists and scientists within the area.

The Camellia Industrial Estate is identified as an existing employment area that would be suitable for renewal as an employment rich knowledge precinct, providing highly skilled and knowledge based employment concentrating on advanced construction and energy with a focus on renewables, and also perhaps on research and development (Parramatta City Council, 2011). It is predicted that this transformation of the Camellia Industrial Estate along with the renewal of the adjoining Rydalmere precinct could assist Parramatta meet and even exceed its target of 27,000 new jobs by 2036. The nearby Rosehill Gardens Racecourse has been identified by Parramatta City Council as an area that could be further improved upon to provide retail, food, ATM and recreational facilities to support this workforce at the Camellia Industrial Estate (Parramatta City Council, 2011).

12.2 Potential Impacts

12.2.1 Workforce

The current and future workforce numbers estimated to be required at the Clyde Terminal are provided in **Table 6-2**. The workforce numbers provided include a mixture of 24/7 continuous shift rosters and Monday to Friday day work roles.

The number of personnel would increase from the current 83 personnel to an estimated total of 224 personnel during the demolition and construction works (including concurrent operations). This would result in an increase in the total number of employees on site of 141 personnel. The contractor workforce is the estimated cumulative increase of workers required to undertake the construction and demolition works. Estimates have been produced for each component of the planned work and consolidated into a single peak workforce estimate.

Employment would be sourced from local sources, where possible, however this would be managed directly by the appointed contractor. As with historic demolition and construction activities at the Clyde Terminal, it is expected that very few, if any contractors or personnel would migrate to the Parramatta LGA purely for the purposes of this Project.

As previously detailed, the Clyde Terminal would remain operational as an import terminal receiving, storing, product dosing and distributing finished petroleum products, albeit more efficiently. Finished petroleum products would continue to be received from the Gore Bay Terminal via the existing pipeline.

Once the conversion works have been completed, the workforce is anticipated to be 58 personnel, representing a reduction of 25 personnel or approximately 30 percent of the workforce compared to current operations. The increase in the workforce at the Project Area during the demolition and construction activities of the Project would result in increased traffic volumes in the vicinity of the Clyde Terminal. Potential traffic, transport and parking impacts are discussed in **Section 11.0**. Even with the demolition and construction traffic, there is a net reduction in traffic on the surrounding road network in comparison to previous operations when the terminal was operating as a refinery which would be further beneficially reduced once the conversion works are complete.

12.2.2 Other Potential Socio-Economic Impacts during Demolition and Construction

The increase in workforce from the current operations for demolition and construction works, as well as the requirement for additional heavy vehicle movements associated with these works at the Project Area would result in greater traffic volumes in the vicinity of the Clyde Terminal than current operations. Potential traffic, transport and parking impacts are discussed in **Section 11.0**. The traffic assessment outlined in **Section 11.0** concluded that the additional vehicles during these works would not result in significant impacts to the surrounding road network.

The demolition and construction works have the potential to result in minor disturbances to surrounding receivers, such as noise and vibration, and visual impacts. These are discussed further in **Section 22.0** and **Section 24.0** respectively, and are not anticipated to result in significant impacts.

The Clyde Terminal is one of a few key fuel supply routes servicing the New South Wales economy and is located adjacent to the major distribution terminal (i.e. the Parramatta Terminal) at Rosehill in Western Sydney. There are multiple companies whose operations rely on fuel supplies from the Parramatta Terminal for distribution, particularly in Western Sydney but also throughout regional locations in New South Wales. The Project would retain a critical Jet fuel supply pipeline into Sydney Airport to meet current and future Jet fuel demand that is not otherwise easily met due to economic and transport logistics constraints.

Without converting the current Clyde Terminal into a more efficient finished petroleum products import terminal, the NSW economic growth forecast for fuels would not be able to be met by Shell. As Shell supplies around 40 percent of Sydney's fuel needs, and significant fuel resources to the NSW market generally, jeopardising the future of these facilities can be expected to threaten the security of the local fuel market and create periods of shortages as has occurred within the sector over the last decade. The Project is critical in supporting the current and future growth of the NSW economy in an efficient and effective manner.

12.2.3 Converted Terminal Impacts

The Parramatta Economic Strategy recognises the importance of maintaining the industrial character of the Camellia Industrial Estate by retaining scope for various points of the employment skills spectrum. As such, Shell's retention of the Clyde Terminal would continue to provide for employment of a broad range of industrial skills, and thereby maximise the employability of Parramatta residents with manufacturing experience and trade qualifications. The demolition and removal of infrastructure at the Clyde Terminal would also release approximately 44.5 ha of land in the western section of the Project Area for future use, and around 25 ha of land within the north-eastern portion of the Project Area for potential future redevelopment for employment-generating activities.

As outlined in **Section 4.0**, the Project maintains the commercial viability of the Gore Bay Terminal, Clyde Terminal and Parramatta Terminal for the receipt, storage, product dosing and distribution of finished products therefore ensuring that these facilities would continue to support a secure supply of fuels to NSW. Without the continued operation of these Terminals, the security of finished fuel imports would be hindered, as there is currently insufficient berthing and storage capacity within NSW to facilitate the scale of required imports elsewhere. This would have had the potential to lead to short term fuel shortages in the NSW market, and Jet fuel supply shortages at Sydney Airport. Wider social and econmic effects could result from such fuel shortages. This

Project provides the most efficient use of current assets and minimises the potential environmental impacts within the Sydney metropolitan area while supporting the growth of the NSW economy.

The Project can also be considered to have further positive social and economic effects as it would improve and maintain the visual amenity and land use of the Project Area (refer to **Sections 24.2** and **14.2**) and also coincides with a reduction in the hazard profile of the Project Area.

12.3 Mitigation Measures

The primary potential social and economic impacts identified during the demolition and construction works relate to increases in traffic volumes in comparison to current operation of the terminal, and temporary noise and vibration, and visual impacts. These are discussed further in **Section 11.0**, **Section 22.0** and **Section 24.0** respectively, and are not anticipated to result in significant impacts. Mitigation measures have been provided in these sections to ensure that potential impacts are avoided, minimised or managed appropriately.

Mitigation measures proposed to minimise potential social and economic impacts of the Project on the surrounding area during the demolition and construction works, and during the continued operation of the converted Clyde Terminal include:

- Shell would continue to undertake stakeholder engagement and consultation regarding the Project;
- Environmental reporting procedures would continue to be implemented, including a complaints register;
- A Construction Traffic Management Plan would be prepared to avoid and minimise potential impacts associated with access routes and major intersections;
- A CEMP would be prepared to minimise potential environmental, heritage and social impacts during the demolition and construction works (refer to **Section 28.1**; and
- An OEMP would be prepared to minimise potential environmental and social impacts during operation of the converted Clyde Terminal (refer to **Section 28.2**).

Shell would continue to communicate and consult with staff regarding possible alternative redeployment opportunities for those that would no longer be required at the Clyde Terminal once the conversion works have been completed, where this is reasonable and feasible. Further, mechanical trade and instrument electrical trade apprenticeship roles would be retained where possible to enable completion of those apprenticeships. Shell will also continue to support its Employee Assistance Program.

12.4 Residual Impacts

The Project is not anticipated to result in residual social and economic impacts. The mitigation measures provided in **Section 12.3** would avoid, minimise or manage the identified potential social and economic impacts.

The Project would result in positive social and economic impacts, as the Project would allow for the NSW fuel demand to continue to be met, including Jet fuel by direct pipeline to Sydney Airport. The hazard profile of the Project Area would also be decreased, and the visual amenity of the Project Area improved. The Project would also release portions of the Project Area for potential future uses, facilitating potential future social and economic benefits to the community, particularly within Western Sydney.

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13.0 Surface Water, Industrial Water and Flooding

Relevant DGRs: The EIS must address **Soil and Water** – including:

- An assessment of the potential soil, groundwater and surface water impacts of the development including potential impacts on the Parramatta River and Duck Rivers and their tributaries;
- Identification of any water licensing requirements or other approvals under the *Water Act 1912* and/or the *Water Management Act 2000*;
- Demonstration that water for the development can be obtained from an appropriately authorised and reliable water supply in accordance with the operating rules of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources
- A detailed description of the mitigation and management controls that would be put in place to manage erosion and sediment, stormwater and acid sulfate soils (if present);
- Ways to reduce water supply and increase water reuse; and
- Potential impacts of flooding, with consideration of climate change and projected sea level rises.

13.1 Existing Conditions

13.1.1 Water Catchment

The Project Area is located within the Parramatta River sub-catchment, one of eight sub-catchments in the Sydney catchment, and managed by the SMCMA.

The Parramatta River is the main tributary of Sydney Harbour, extending from Blacktown Creek in the west to the confluence of the Lane Cove River in the east. The Parramatta River catchment area is over 257 km², with the estuary covering 12 km². It is one of the most urbanised catchments in Australia. Historical land uses have highly modified the nature of the estuary, with a range of sediments and pollutants entering the estuary which have impacted on water quality and habitat values.

Water quality within the Parramatta River sub-catchment is varied across location and over time (Laxton et al, 2008). There are a number of environmental concerns with regards to the general health of the Parramatta River including turbid water, sickness from primary contact with the water, excessive algal and weed growth, unhealthy fauna, gross pollutants in waterways, oil and grease presence in the water and loss of creek habitats including vegetation and fauna shelters. **Table 13-1** details the factors affecting water quality of the Parramatta River between 1990 and 2007.

Table 13-1 Factors Affecting Water Quality in the Parramatta between 1990 and 2007 (Laxton et al, 2008)

Environmental Factor	Impact on Water Quality
Nitrogen and Phosphorous Presence	Nitrogen and Phosphorous concentrations in the Parramatta River range between 0.5 to 2 mg/L and 0.05 to 0.25 mg/L respectively. High nutrient concentrations have resulted in increases in weed and algal growth.
Turbidity	During wet weather, turbidity within the Parramatta River is considered to be poor.
Faecal Coliforms	Levels are generally safe for secondary contact during dry weather, but conditions are unsafe during wet weather due to significant sewer overflows.
Sediment	Sediment levels are higher than what would be expected in a natural system.
Oils	Oil concentrations are considered to be significant as a result of uncontrolled runoff from many roads and hardstand areas.
Heavy Metals	Heavy metal concentration is not considered to be detrimentally affecting water quality; however, levels are up to 12 times higher than acceptable limits in bottom sediments.

Table 13-2 summarises the water monitoring that Shell undertakes under EPL No. 570, with the majority of these licensed discharge points connecting to Duck River. The Environmental Conditions Summary Report prepared by ERM (ERM, 2012) has identified how only limited surface water quality data is available for Duck River, and that many of these ongoing water quality monitoring requirements were removed from the Clyde Refinery EPL No. 570 in 2002. However, historical information suggests that Duck River has been previously subject to contamination from the stormwater channels and sewer overflow structures that are located along the banks of Duck River and

its tributaries. During a study undertaken in 1991, the influence of this historical contamination was observed, including chronic pollution, boat wash and other potential contaminant sources that may have been washed ashore amongst the mangroves (such as drummed waste and larger pieces of rubbish). During the 1991 study it was concluded that the existing contamination in Duck River would complicate monitoring programs implemented at the former Clyde Refinery.

In 2003, Laxton and Griffiths examined the water quality data collected from the upper Parramatta River between 1992 and 2002, and made the following findings that have been summarised by NGH Environmental (2009):

- Mean water temperatures were similar over the sampling period;
- Saline sections of the upper Parramatta and Duck Rivers showed wide ranging salinity values in 2002;
- Large seasonal changes occurred in dissolved oxygen concentrations in the creeks and saline sections of water bodies during 2002;
- There were wide fluctuations for nutrient levels in all the water bodies sampled;
- Water clarity was generally higher than usual in tidal sections of the upper Parramatta and Duck Rivers;
- Mean chlorophyll concentrations rose in the saline reaches of the upper Parramatta and Duck Rivers;
- In 2002, faecal coliform bacteria concentrations were high during wet weather and low during dry weather;
- The ecology of the upper Parramatta system was found to be very productive and dynamic. Large fish populations were supported as were flocks of bids. The ecology, however, was considered to be too finely balanced to survive any upset such as prolonged cloudy weather or a chemical spill killing sensitive receivers. Dissolved oxygen depletion was thought to be the most likely result of any perturbation;
- As per the Australian and New Zealand Environmental Council (ANZECC) Guidelines, the Parramatta River system failed to meet most of the criteria for Primary Contact Recreation, Secondary Contact Recreation and Passive Recreation; and
- During minor rainfall events, accumulated garbage, soil, bacteria and dissolved substances were carried by the storm water drains and creeks to the upper Parramatta and Duck Rivers. Since there was not enough fresh water to flush this material into the lower reaches of Parramatta River or to sea, most of this stayed in the upper reaches of the river trapped in the mangroves along the river's edge.

Table 13-2 Monitoring Requirements for Water Discharged under EPL No. 570

Point No.	Pollutants	Pollutant Monitoring Frequency	Load Limits	Pollutants with Concentration Limits	Volume Limits	Volume Limit Sampling
1 **Discharge to Duck River**	Nitrogen (ammonia), total nitrogen, total petroleum hydrocarbons and total phosphorus – unfiltered sample.	Special frequency 1: fortnightly during any discharge. Daily monitoring then required if sampling indicates a possible breach of discharge limits for Point 1.	BOD: 30,000 kg/yr Oil and grease: 15,000 kg/yr Total Polycyclic aromatic hydrocarbons (PAHs): 100 kg/yr Total phenolics: 1,000 kg/yr Total suspended solids: 40,000 kg/yr	Biochemical oxygen demand, fluoride, nitrogen (ammonia), oil and grease, pH, phenols, total nitrogen, total phosphorus – unfiltered sample, and total suspended solids.	4,000 kL/day	Daily during any discharge
	Biochemical oxygen demand, fluoride, oil and grease, pH, phenols and total suspended solids.	Special frequency 2: weekly during any discharge. Daily monitoring then required if sampling indicates a possible breach of discharge limits for Point 1.				
2 **Discharge to Duck River**	Phenols, pH, total organic carbon and total suspended solids.	Daily during any discharge.		Phenols, pH, total organic carbon, and total suspended solids.	5,000 kL/day	Daily during any discharge
4 **Discharge to Duck River**	NA	NA		Phenols, pH, total organic carbon, and total suspended solids.	5,000 kL/day	Daily during any discharge
23 **Discharge to Parramatta River**	Total organic carbon, pH and total suspended solids.	Within 24 hours prior to the discharge.		Total organic carbon, pH, and total suspended solids.	NA	Daily during any discharge
24 **Discharge to Duck River**	Total organic carbon, pH and total suspended solids.	Within 24 hours prior to the discharge.		Total organic carbon, pH, and total suspended solids.	NA	Daily during any discharge

Point No.	Pollutants	Pollutant Monitoring Frequency	Load Limits	Pollutants with Concentration Limits	Volume Limits	Volume Limit Sampling
25 **Discharge to Duck River**	Total organic carbon, pH and total suspended solids.	Within 24 hours prior to the discharge.		Total organic carbon, pH, and total suspended solids.	NA	Daily during any discharge
26 **Discharge to Duck River**	Phenols, pH, total organic carbon, total petroleum hydrocarbons and total suspended solids.	Daily during any discharge.		NA	NA	NA
27 **Flexible Discharge Point**	Total organic carbon, pH, and total suspended solids.	Within 24 hours prior to the discharge.		Total organic carbon, pH, and total suspended solids.	NA	Daily during any discharge

13.1.2 Surface Water and Industrial Water

The Project Area is located at the confluence of the Parramatta and Duck Rivers, which are third and first order streams respectively as per the Strahler system of stream ordering (Industry and Investment NSW, 2008). Previously rehabilitated riparian vegetation runs along the southern and eastern borders of the Project Area as it follows the flow of the Parramatta and Duck River and there is a remnant wetland in the north-eastern section of the Project Area. Industrial and potable water within the Project Area is obtained as potable water supplied by Sydney Water.

Industrial water and stormwater from the Project Area are discharged either to Duck River or Parramatta River, to the remnant wetland, or via the trade waste water system under agreement with Sydney Water.

Water captured in the tank bunds at the Project Area is generally stormwater, and is drained from the bunds as soon as possible to ensure the ability of those tank bunds to operate in the unlikely event of a tank spill over event. This stormwater is then diverted to the AOC water systems. Water drained from storage tanks at the Clyde Terminal is diverted to the COC water systems. The water captured by both the AOC and COC systems undergoes primary treatment through waste water treatment facilities onsite. These have included both a biotreater and interceptor systems although post cessation of refining and site cleaning, the biotreater would not be required. The Project is proposing to upgrade the site drainage systems and interceptors and to add a phenol treatment facility to further improve treatment of water which may have come into contact with Gasoline products. The biotreater will be decommissioned and demolished when this unit is no longer required.

Stormwater is the main source of surface water that is discharged from the Clyde Terminal, whether captured by tank bunds or not. Clean stormwater at the Clyde Terminal is diverted and discharged directly to Duck Creek at the existing discharged points regulated under EPL No. 570, or to the remnant wetland in the north-east of the Project Area (refer to **Figure 13-1**). Any AOC stormwater (e.g. stormwater captured by the tank bunds) at the Clyde Terminal undergoes primary treatment before being discharged under EPL No. 570. Water discharge is undertaken as required (i.e. during stormwater events or once used process water has been treated and is ready for discharge). The demolition of assets within the Project Area would not impact on the catchment and diversion of surface water to the existing water treatment facilities at the site.

Potable water is used for staff amenities, and used potable water at the Clyde Terminal is discharged to the sewerage system.

Shell does not harvest captured rainwater for use within the Project Area. The Project Area does not include any specific water management structures or dams, apart from the remnant wetland. For more information about the history of these wetlands, refer to **Section 3.2.1** of **Appendix D**.

Shell has divided its operations at the Camellia Industrial Estate (i.e. the Clyde Terminal and the Parramatta Terminal) into seven catchment areas based on the need for various water capture and processing infrastructure (refer to **Figure 13-1**). Six of these catchment areas are located within the Project Area and one is located at the adjoining Parramatta Terminal. These seven catchment areas are detailed in **Table 13-3** below.

Table 13-3 Clyde Terminal Catchment Areas

Area No.	Description
1	West of the Project Area and containing the adjoining Parramatta Terminal, not considered as part of this Project. This area roughly equates to the Conceptual Site Model 4 area outlined in Conceptual Site Model 2012 (refer to **Section 17.1**).
2	In the north-eastern section of the Project Area, bordering the Parramatta River. It includes some areas that are currently under lease to third parties and is therefore not considered part of the current Project Area, as well as the remnant wetland. It includes the area designated as Conceptual Site Model 1 area in the Conceptual Site Model 2012, as well as a portion of the area designated as Conceptual Site Model 2 area.
3	In the south-eastern section of the Project Area, adjacent to Duck River. It contains much of the refinery related infrastructure that is to be retained and converted for use as part of the Clyde Terminal. Catchment area three roughly equates to the Conceptual Site Model 2 area designated in Conceptual Site Model 2012, as well as the eastern portion of the Conceptual Site Model 3 area.
4	Two select areas in the mid-section of the Project Area, which lie within Conceptual Site Model Area 3.

Area No.	Description
5	The bulk of the western section of the Project Area where refinery related infrastructure would be demolished, and where a future land use has yet to be established. Catchment area 5 is bounded by Duck River in the south and comprises much of the area designated as Conceptual Site Model Area 3 as per the Conceptual Site Model 2012.
6	The westernmost section of the Project Area, containing land that is currently leased to Autonexus, as well as a section of the Project Area that is under Shell operation in a location where refinery related infrastructure would be demolished to make way for future land use.
7	Immediately south of catchment area one, and contains Shell's NSW State Office Car Park and related infrastructure. It mainly lies within the area designated as Conceptual Site Model 2 area, as part of Conceptual Site Model 2012.

Data on the existing hydrological conditions of the Project Area and in particular, any historical contamination is described in **Section 17.1**. Both of the adjoining Parramatta and Duck Rivers experience tidal fluctuations. The surface of the Project Area has been reshaped over time with the use of fill, to provide a relatively flat site, and the majority, although not all, of the Project Area is sealed (refer to **Section 17.1.6** for more detail). The Project Area currently has an extensive stormwater management system which was substantially upgraded in the mid-1990s. Surface water runoff is directed towards the drainage network system, which is comprised of the following:

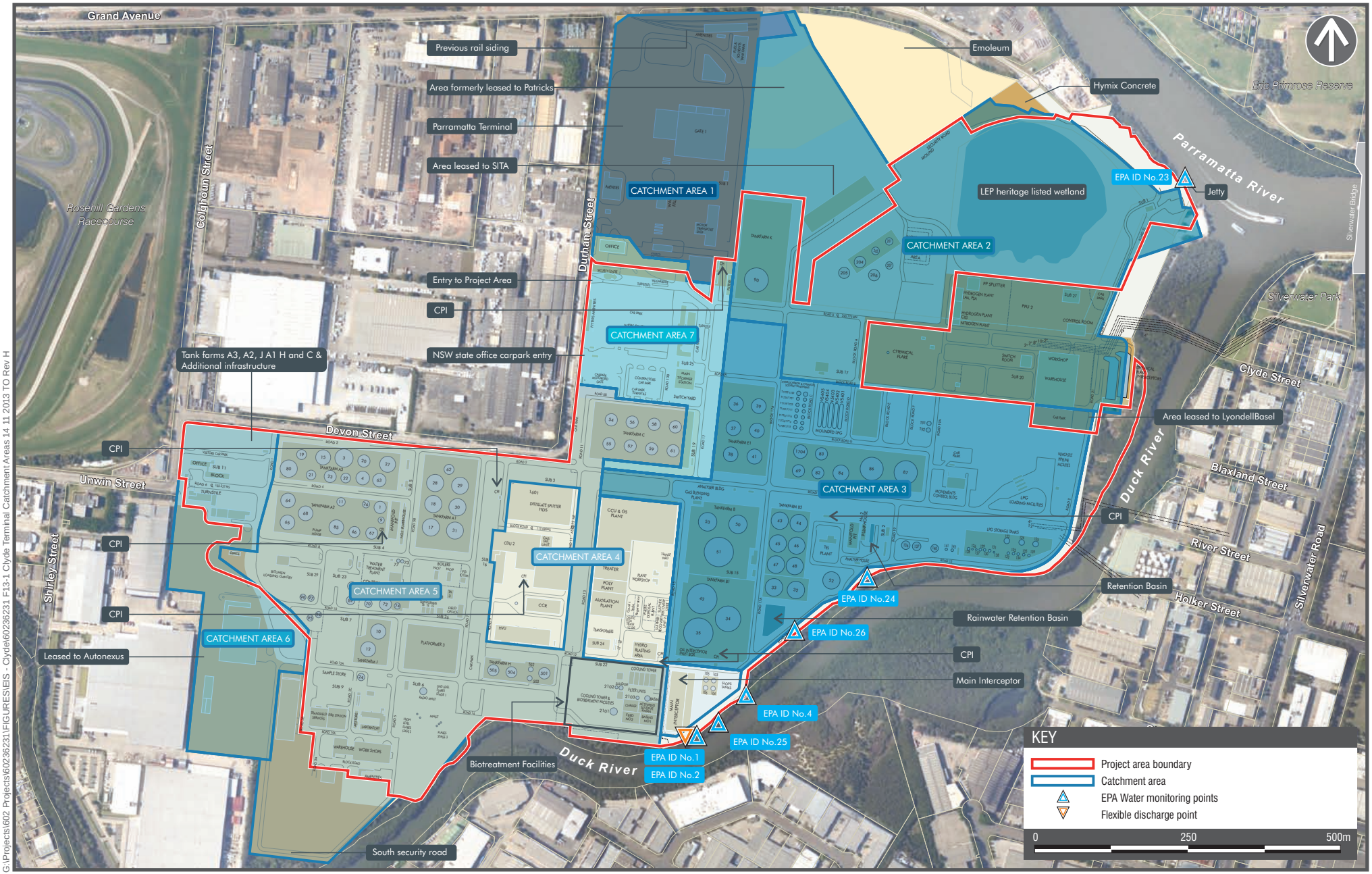
- Clean water drainage system that discharges clean stormwater to the remnant wetlands onsite or direct to the Parramatta River and Duck River, and
- The accidentally oil contaminated and continually oil contaminated drainage network to manage industrial water (ERM, 2012).

The AOC and COC drainage systems direct contaminated water from various locations around the Project Area via the drainage system to the interceptors for treatment before release to either the environment or the trade waste discharges. At this point, free oil and sediments are removed from the water, before biological processing removes further contaminants. The wetland in the north-eastern section of the Project Area would continue to receive stormwater. Detailed internal procedures have been produced by Shell for water management at the Project Area, including how surface water is managed under dry and wet weather conditions (ERM, 2012).

Sampling of discharged water is undertaken in accordance with the frequency and sampling methodology as prescribed by EPL No. 570 and as summarised in **Table 13-2**. The samples are analysed for a range of pollutants for each discharge point, with the concentrations of prescribed pollutants discharged, and annual loads to rivers, assessed against licence requirements. Details of compliance with concentration limits and load limits are submitted to the EPA as part of EPL No. 570's Annual Return (ERM, 2012). Compliance monitoring also takes place for the Trade Waste Sewer licence Shell has with Sydney Water to enable the discharge of trade waste water, including continuous online monitoring for temperature, pH and flow rate (CH2M HILL, 2007). It is important to note that as per condition O6 of EPL No. 570, discharges to Duck River include the following:

- From points 23, 24 and 25, discharge must only be as a result of dewatering from bunded areas in the tankfarms or from water pressure testing of chemical storage tanks within the premises; and
- From point 27:
    - Discharge must only be as a result of dewatering from bunded areas or from water pressure testing of chemical storage tanks within the western tankfarms;
    - Shell must notify the EPA at least seven days in advance of any such discharge; and
    - Shell must undertake water sampling of the subject chemical storage tank prior to any discharge and provide the laboratory results to the EPA.

The locations of water monitoring points under EPL No. 570 are provided in **Figure 13-1.**



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AECOM

CLYDE TERMINAL CATCHMENT AREAS

Clyde Terminal Conversion Project
Environmental Impact Statement

Note: Flexible monitoring point is not fixed at the location shown on this figure

FIGURE 13-1

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In the event there is an overflow event within the Project Area due to heavy rain, the EPA is notified and samples are taken at each overflow location during each shift over the course of the overflow event. These samples are analysed for a suite of pollutants. Results are provided to the EPA within seven days and any follow up data are provided as they become available (ERM, 2012).

In addition to the monitoring undertaken by Shell under EPL No. 570, ERM has on occasion undertaken surface and stormwater sampling as part of routine and non-routine events as dictated by the Soil and Groundwater Management Plan (SGMP, 2010). These works, most notably including an assessment of chromium conditions within stormwater and surface water drainage lines in 2010 at the request of EPA, have not identified conditions considered significant enough to warrant further investigation to characterise potential contributions to soil or groundwater impact, or offsite migration at unacceptable levels (ERM, 2012).

Current and historical soil and groundwater conditions within the Project Area, as well as the internal operating area and the Project Area's boundary groundwater monitoring network, indicates that no groundwater affected by Contaminants of Concern (COCs) in concentrations above applicable EPA criteria is migrating offsite, nor is it impacting adjacent sediments or river systems. As such, potential receivers are considered limited to those onsite and thus there has been no identified risk driver to investigate the adjacent rivers, sediments and surface water related to the offsite migration of soil and groundwater impacts (ERM, 2012). For a more detailed analysis of the extent of soil and groundwater contamination within the Project Area, refer to **Section 17.0**.

Soil and groundwater conditions within the Project Area are not considered to be affecting offsite environments above applicable regulatory criteria and do not represent a data gap that is considered to require investigation of offsite soil, sediments, groundwater or surface water conditions (ERM, 2012). There is only limited information on sediment and surface water investigations that have been conducted in areas adjacent to the Project Area.

13.1.3 Flooding

The Project Area and the Camellia Industrial Estate in general are relatively flat and less than 10 m AHD in elevation (CH2M HILL, 2007). The majority of the Project Area is hard surfaced (refer to **Section 17.1**) and provides for an existing stormwater capture and discharge system. Clean stormwater within the Project Area is currently discharged at the south-western boundary into two public stormwater channels, and into the retention basin and Parramatta River in the north-eastern section. The Project Area is situated at around 2 to 5 m AHD. This is above the NSW Government's projected sea level rises of 0.4 m and 0.9 m that are expected to take place before 2050 and 2100 respectively. Such sea level rise would also impact on both tidal regimes and flood events, potentially reducing the capacity of drainage systems to discharge into tidal waters (Department of Environment and Climate Change and Water, 2010).

The Project Area contains a strip of riparian vegetation along its southern and eastern boundary. There is a small wharf area located to the east of the Project Area that forms part of Shell's operations but which is not considered as part of the Project Area for the purposes of this EIS. At this wharf area, there is a gap in the riparian vegetation to allow access to the Parramatta River (refer to **Figure 1-3**). The *City of Parramatta Local Floodplain Risk Management Policy* (Parramatta City Council, 2006a) (Floodplain Risk Management Policy) recommends that industrial land users in flood prone areas maintain a vegetated buffer along the foreshore building line of at least 30 m of riparian vegetation. The riparian vegetation along the border of the Project Area is generally in good condition, and largely meets this requirement of 30 m in width.

The Floodplain Risk Management Policy provides for the occupation of the Parramatta LGA floodplain, and the use of land within this floodplain that is compatible with its relevant flooding hazard to a level acceptable by the community. Parramatta Council recognises three Flood Risk Precincts based on the flooding risks associated with particular land uses as follows:

- High Flood Risk Precinct: Identifies areas of land below the 1:100 year flood event that are either subject to high hydraulic hazards or where there are significant evacuation difficulties. These are areas that contain potential high flood damages, potential risks to life and evacuation problems, or are areas where development would significantly and adversely affect flooding patterns. There is a significant risk of flood damages without compliance with flood related building and planning controls, and the majority of development should be restricted;
- Medium Flood Risk Precinct: Identifies areas below the 1:100 year flood event that are not subject to high hydraulic hazards and might contain some evacuation difficulties. These are areas where a significant risk of flood damage exists, but where those damages can be minimised by applying appropriate development controls; and

- Low Flood Risk Precinct: Identifies all other areas within the extent of the probable maximum flood (PMF) but which are not identified as within either the High Flood Risk or Medium Flood Risk Precincts. Appropriate planning and building controls can generally minimise these risks to an acceptable level within the Low Flood Risk Precinct (Parramatta City Council, 2006a).

In 2004 a study was undertaken for the Project Area: *Flood Assessment for the Proposed Benzene Reduction Unit* (SKM, 2004) (SKM Flood Assessment). Most recently, a draft study has been prepared and furnished to Parramatta City Council of the Duck River catchment: *Duck River and Duck Creek Flood Study Review: Final Draft Report* (WMA, August 2011) (WMA Final Draft Report). The flood assessment included an assessment of the possible effects of climate change in accordance with the Floodplain Risk Management Guideline – Practical Consideration of Climate Change (DECC, 2007). In accordance with the DECC guidelines, a 10 percent, 20 percent and 30 percent increase in peak rainfall and storm volume by the year 2100 were considered as part of the assessment.

While it is important to note that this *Final Draft Report* is currently only in draft format, it provides an indicative overview of potential flooding impacts throughout the Duck River catchment.

The SKM Flood Assessment concluded that portions of the Project Area adjacent to the Duck and Parramatta Rivers lie within the 1:100 year flood event, and that the majority of the Project Area falls within the PMF area as outlined in the *City of Parramatta Local Floodplain Risk Management Policy* (Parramatta City Council, 2006a) (Floodplain Risk Management Policy).

The indicative findings of the WMA Final Draft Report tend to support these findings of the SKM Flood Assessment report. However the WMA Final Draft Report was collated using data from the entire Duck River catchment, and as such it provides a more accurate depiction of potential flooding impacts at the Project Area. The key findings of the WMA Final Draft Report for flooding at the Project Area are as follows:

- The majority of the eastern portion of the Project Area would be affected by a one percent AEP event (refer to **Figure 13-2**). Limited sections of the western portion of the Project Area would be affected by a one percent AEP event (refer to **Figure 13-3**), including the following pieces of existing infrastructure:
    - The area surrounding the high level flares near to Substation 6;
    - Roads 2, 9, 7, 11,12, 13 and 14;
    - Tankfarm H;
    - The HVU;
    - Substation 22;
    - Cooling tower and biotreatment facilities; and
    - Filter units.
- The entire Project Area would be inundated in the event of a PMF event (refer to **Figure 13-4** and **Figure 13-5**).

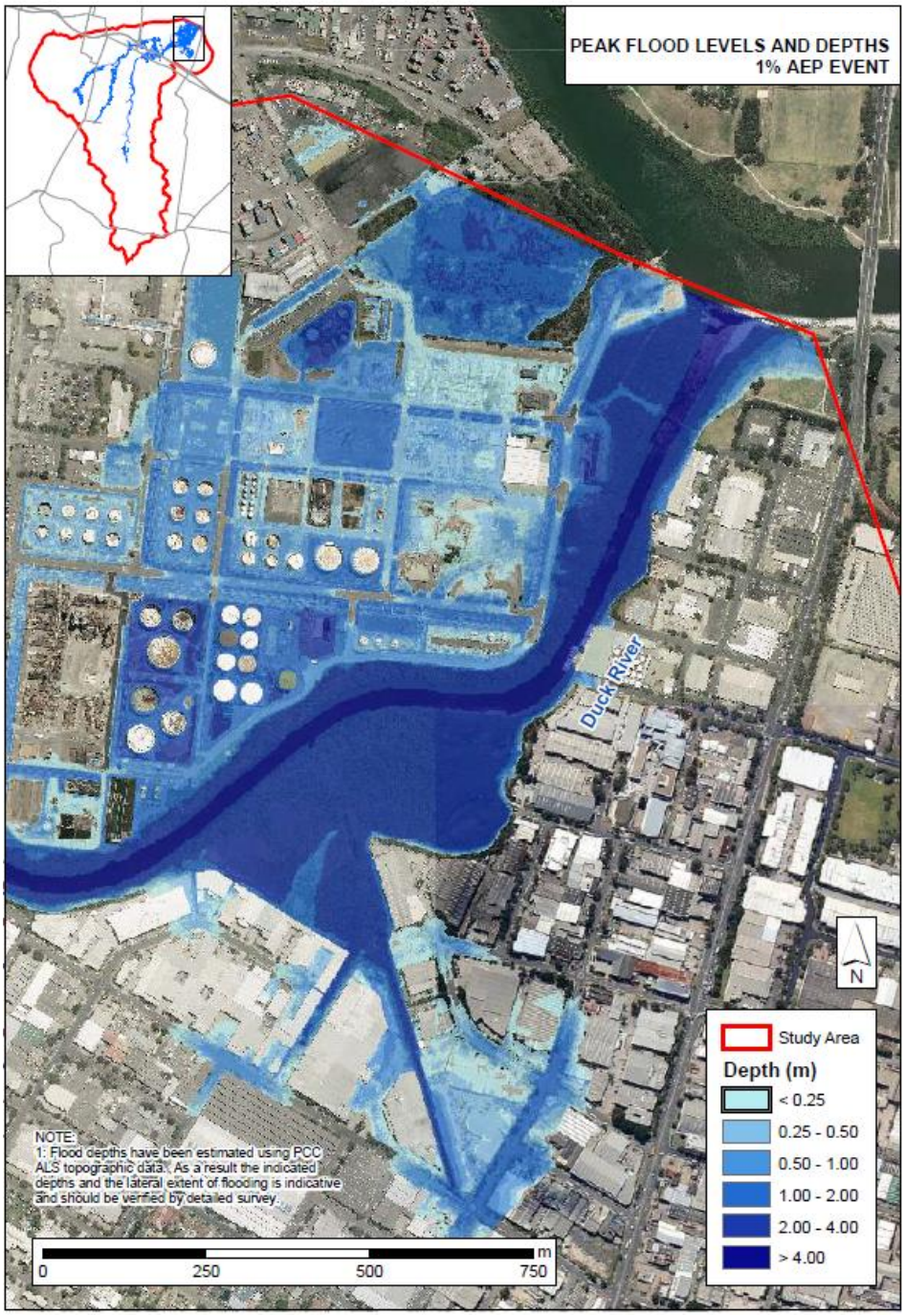

Figure 13-2 Peak Flood Levels and Depths – 1% AEP Event (Figure 14H, courtesy of WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report*)

Note: The report WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report* (WMA, August 2011) is in draft form, and should only be considered indicative of potential one percent AEP flooding impacts for the eastern section of the Project Area. This study was also not prepared with any input from Shell regarding the potential influence of tank bunds on flooding impacts; tank bunds may actually hold water out of flooded tankfarms.

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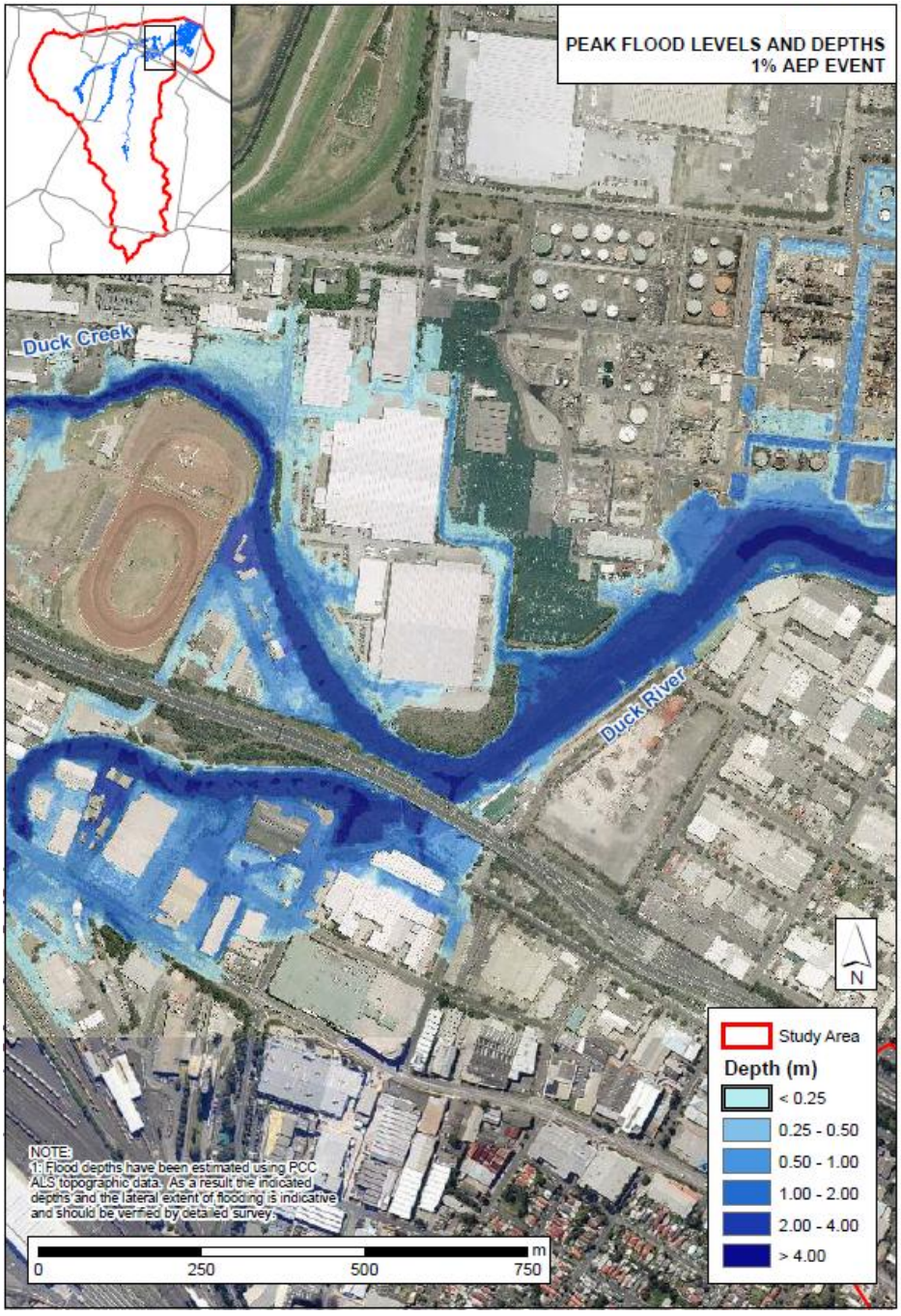

Figure 13-3 Peak Flood Levels and Depth – 1% AEP Event (Figure 14l, courtesy of WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report)*

Note: The report WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report* (WMA, August 2011) is in draft form, and should only be considered indicative of potential one percent AEP flooding impacts for the western section of the Project Area This study was also not prepared with any input from Shell regarding the potential influence of tank bunds on flooding impacts; tank bunds may actually hold water out of flooded tankfarms.

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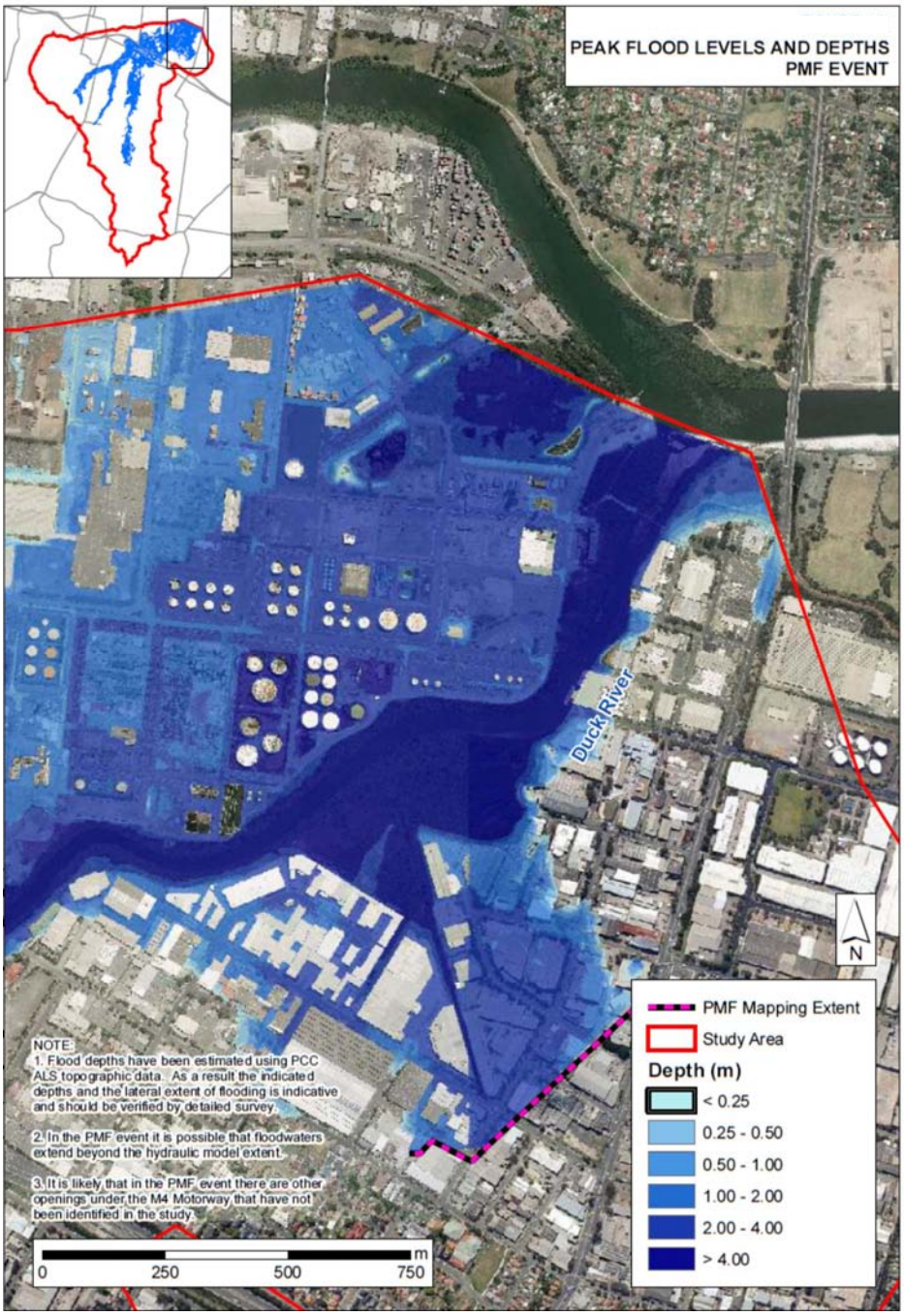

Figure 13-4 Peak Flood Levels and Depths – PMF Event (Figure 15l, courtesy of WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report*)

Note: The report WMA, August 2011. Duck River and Duck Creek Flood Study Review: Final Draft Report (WMA, August 2011) is in draft form, and should only be considered indicative of potential one percent AEP flooding impacts for the eastern section of the Project Area. This study was also not prepared with any input from Shell regarding the potential influence of tank bunds on flooding impacts. This study was also not prepared with any input from Shell regarding the potential influence of tank bunds on flooding impacts; tank bunds may actually hold water out of flooded tankfarms.

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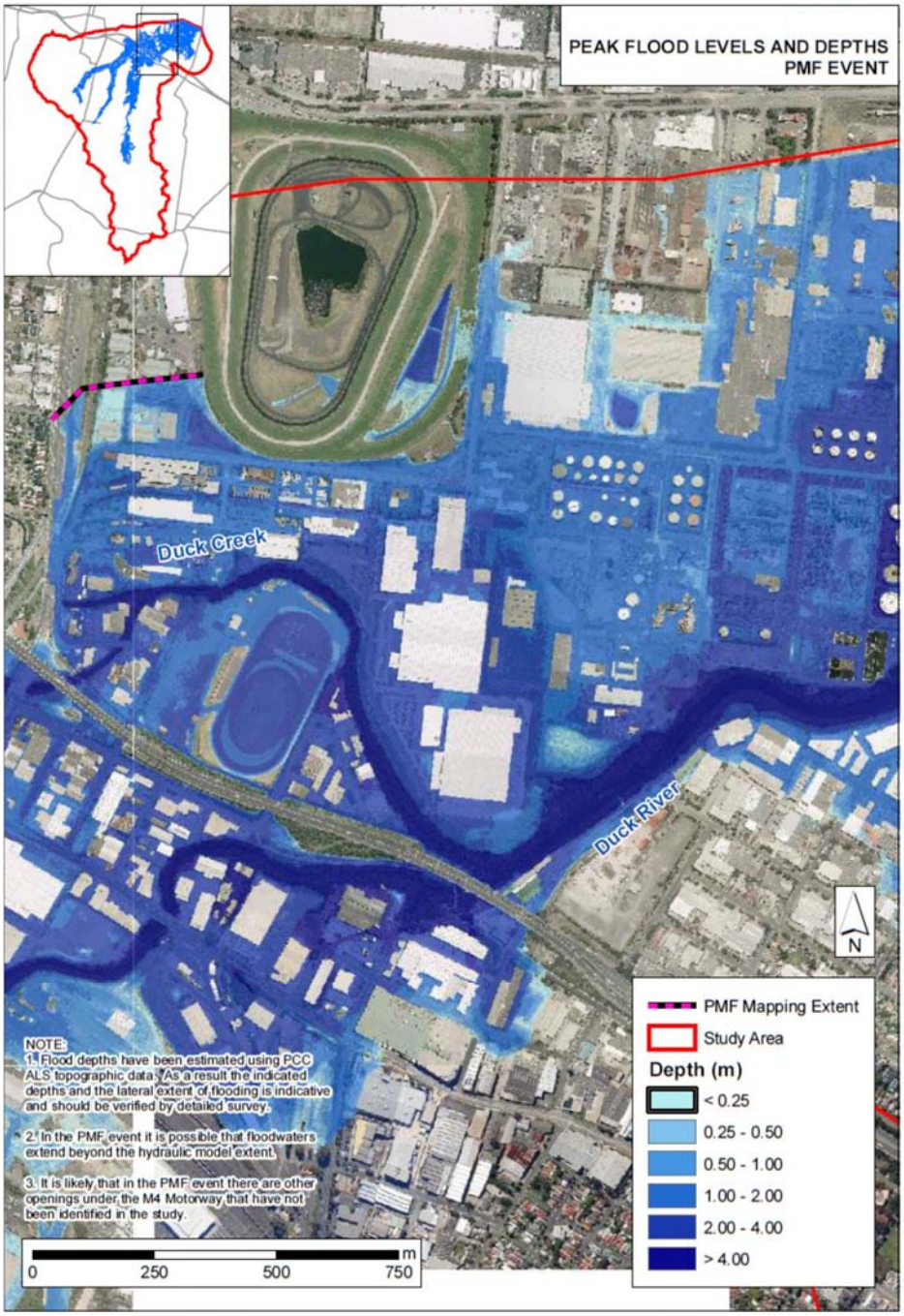

Figure 13-5 Peak Flood Levels and Depths – PMF Event (Figure 15H, courtesy of WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report*)

Note: The report WMA, August 2011. Duck River and Duck Creek Flood Study Review: Final Draft Report (WMA, August 2011) is in draft form, and should only be considered indicative of potential one percent AEP flooding impacts for the western section of the Project Area. This study was also not prepared with any input from Shell regarding the potential influence of tank bunds on flooding impacts; tank bunds may actually hold water out of flooded tankfarms.

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The indicative findings of the WMA Final Draft Report also support the conclusion that sections of the Project Area are classified as being in the high hydraulic hazard zone for a one percent AEP flooding event as follows (refer to **Figure 13-6** and **Figure 13-7**):

- A strip of land running along Duck and Parramatta Rivers;
- Areas surrounding but not encroaching onto, Tankfarm H;
- Areas surrounding Substation 16 and the adjacent carpark;
- Remnant wetland and adjoining road block 21 in the north-east;
- Area adjacent to substation 6 in the south-west adjoining Duck River;
- The entire area of Tankfarms B, B1 and B2, including the tetra ethyl plant, manifold pit, pumphouse No. 2 and retention basin, adjacent to Tankfarm B2;
- Around half of Tankfarm E2;
- The Main interceptor, current slops tanks 103, 104, 105 and 106, and a small section of land adjoining the current LPG storage tanks along the southern boundary of the Project Area in the vicinity of Duck River;
- Road block 0 which adjoins LyondellBasell's operations;
- The area surrounding Tanks 201, 203, 204, 205, 206 and 207;
- The area immediately south of the biotreater filter cake drying area;
- Road blocks G, 2, 17, 17A and 19A, and the security road running along the south-western boundary of the Project Area; and
- A strip of land running along the eastern-most portion of the Project Area. This particular strip of land within the 20 percent AEP level also encroaches on part of LyondellBasell's operations and onto the parcel of land (Lot 1 DP 534905) that Shell operates under lease from RMS (refer to **Section 1.3**).

Based on this characterisation indicated in the WMA Final Draft Report, it can be concluded that a significant portion of the eastern side of the Project Area will be classified as being within the High Flood Risk Precinct (labelled 'High Hazard' in **Figure 13-6**) as per the Floodplain Risk Management Policy, once the WMA Final Draft Report is adopted in full by Parramatta City Council. The remainder of the eastern portion of the Project Area would be classified as lying within the Medium Flood Risk Precinct (labelled 'Low Hazard' in **Figure 13-6**), whereas the majority of the western side of the Project Area lies above the one percent AEP flood event, and thus within the Low Flood Risk Precinct (refer to **Figure 13-7**). Only a small section of the western portion of the Project Area in the vicinity of Duck River would be classified as being within the High Flood Risk Precinct (labelled 'High Hazard' in **Figure 13-7**).

It is important to emphasise that the WMA Final Draft Report is still in draft format. It is therefore prudent to consider the potential impacts of flooding at the Project Area based on this study as it contain the most recent available data. However, as the WMA Final Draft Report has not been formally adopted by Parramatta City Council in a final format, it cannot be relied upon yet to make definitive land use decisions. Notwithstanding, for the purpose of completeness and in order to use the most recent floodplain data, this EIS has considered the Project in relation to the findings of the WMA Final Draft Report, despite that report not yet having been finalised and formally adopted.

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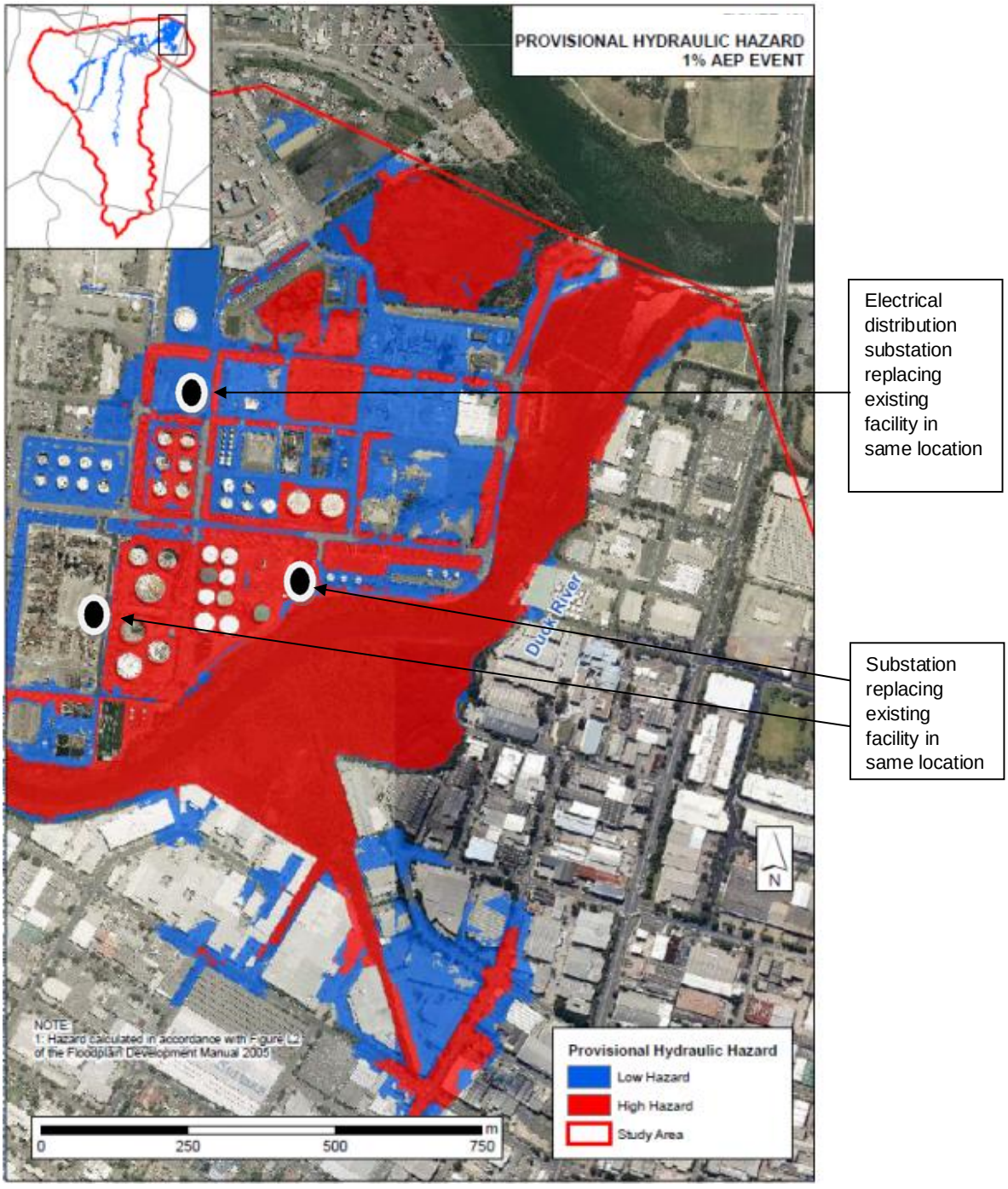

Figure 13-6 Provisional Hydraulic Hazard – 1% AEP Event (Figure 19H, courtesy of WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report)*

Note: The report WMA, August 2011. Duck River and Duck Creek Flood Study Review: Final Draft Report (WMA, August 2011) is in draft form, and should only be considered indicative of the provisional hydraulic hazard of a one percent AEP flood event for the eastern section of the Project Area. This study was also not prepared with any input from Shell regarding the potential influence of tank bunds on flooding impacts; tank bunds may actually hold water out of flooded tankfarms.

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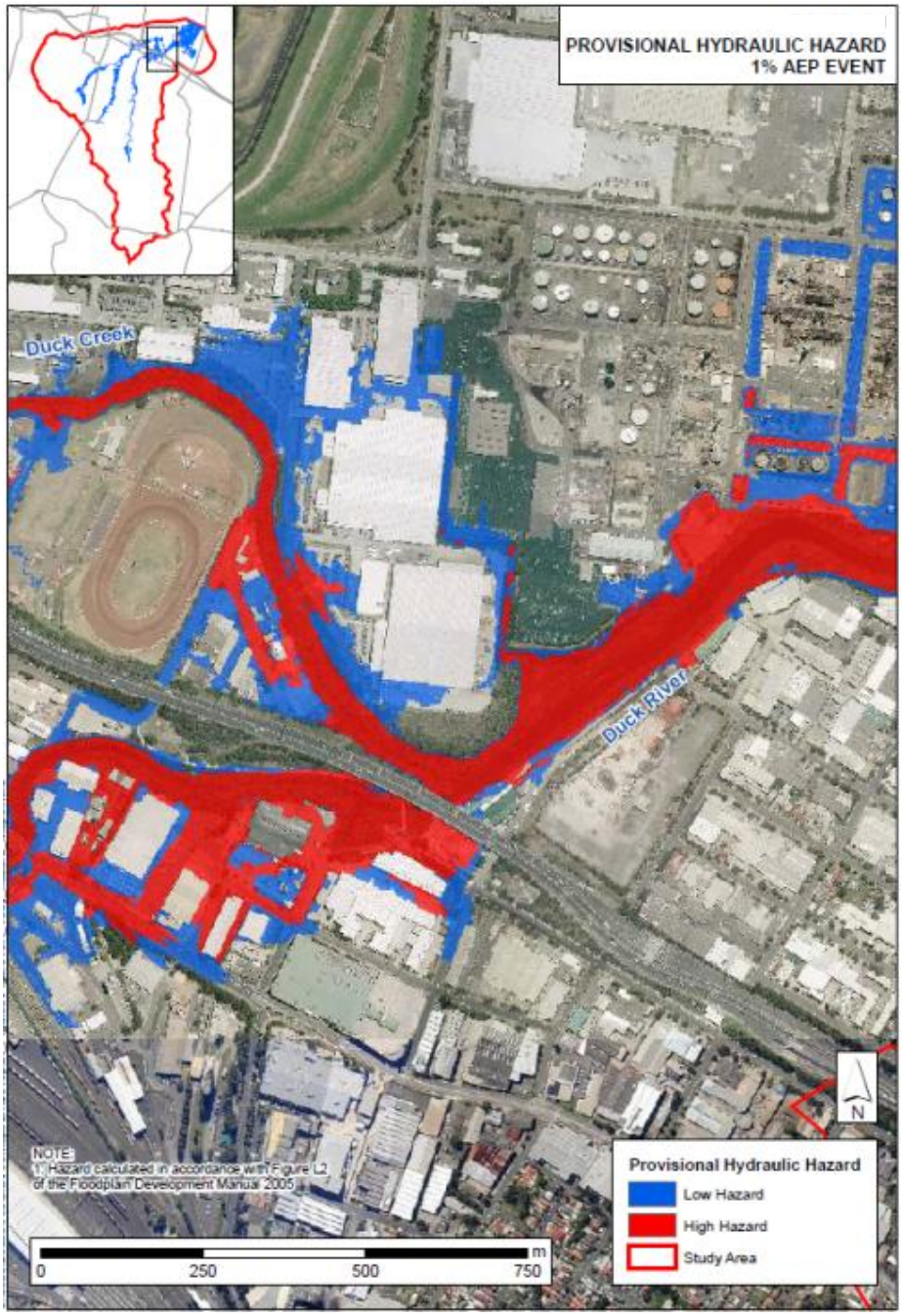

Figure 13-7 Provisional Hydraulic Hazard – 1% AEP Event (Figure 19I, courtesy of WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report)*

Note: The report WMA, August 2011. *Duck River and Duck Creek Flood Study Review: Final Draft Report* (WMA, August 2011) is in draft form, and should only be considered indicative of the provisional hydraulic hazard of a one percent AEP flood event for the western section of the Project Area. This study was also not prepared with any input from Shell regarding the potential influence of tank bunds on flooding impacts; tank bunds may actually hold water out of flooded tankfarms.

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13.1.4 Riparian Vegetation

The *NSW Wetlands Policy* (Department of Environment, Climate Change and Water, 2010) identifies the role of vegetation buffers in helping to combat the effects of climate change and associated sea level rise on wetlands themselves, as wetland areas would eventually need to migrate up-gradient in response to these effects. It also recognises the complementary role of wetlands to assist in combating the effect of sea level rise for other land uses. For instance, mangrove forests may help reduce storm surge as a result of severe weather events by slowing down flood waters and spreading them around the flood plain. The Wetlands Policy also identifies the principle of 'no net loss' for developments in areas containing wetlands. The *Guidelines for Riparian Corridors on Waterfront Land* (NOW, 2012) further explains that for third order streams, such as the Parramatta River, an ideal riparian buffer zone is 30 m. For first order streams such as Duck River, an ideal riparian buffer zone is 10 m. The riparian zone along Parramatta River generally meets this requirement of being 30 m wide. There is a gap in this riparian vegetation along Shell's wharf area to the east of the Project Area (refer to **Figure 1-3**). However, whilst this wharf area forms part of Shell's operations at Clyde, it is not considered to be part of the Project Area for the purposes of this EIS. The riparian zone along Duck River also meets the prescribed criterion.

13.2 Predicted Impacts

13.2.1 General Project Impacts

There is little scope to significantly reduce the industrial usage of water at the Clyde Terminal. As such, water usage is often linked to necessary site requirements, such as fire tank water. Water usage at the Clyde Terminal has reduced by 69.7 percent following the cessation of refining operations. Potable water usage has and industrial water use have reduced by 68.5 percent and 74.8 percent respectively. Upon completion of the Project, it is expected that potable water in comparison to refinery operations (which have now ceased) would be reduced by up to 78 percent for potable water and 84 percent for industrial water. The current monthly usage of water at the Clyde Terminal is around 36,000 kL of industrial/potable water. A conservative estimation of potable water consumption for personal use is around 97,000 kL per month during conversion activities. With an approximate 30 percent reduction in staff numbers once the conversion works are complete when compared to current operations, it is anticipated that around 25,000 kL of industrial/potable water would be used at the converted Clyde Terminal[2].

Potable water would continue to be used at the converted Clyde Terminal for personal consumption, in showers and change rooms, as well as for safety purposes such as eyewash and safety showers. These water demand figures are indicative only, and do not take into account for the actual usage of large volumes of water, for instance, in the highly unlikely instance of an emergency fire scenario at the Clyde Terminal. During the conversion works, water saving devices would be installed wherever possible to reduce wastage. Once the conversion works are complete, the water consumption of the Clyde Terminal would be reviewed again to confirm if any further savings can be made on the use of potable water.

Industrial and potable water for the converted Clyde Terminal would continue to be obtained as potable water from Sydney Water. Trade excess industrial water and stormwater at the Project Area would continue to be discharged either to Duck River or via the trade waste water system under agreement with Sydney Water. The Project does not involve the construction of any new water management structures or dams at the Clyde Terminal, but rather the refinement of existing facilities. Shell does not harvest captured rainwater for use at the Project Area, and the Project would not require any other form of surface water extraction.

Water discharged from the Project Area occurring under EPL No. 570 would continue to be heavily influenced by storm events. The Project Area currently discharges around 50 kL of water per month into the Duck and Parramatta Rivers. These volumes are not expected to change once the conversion works are complete, as the same volume of stormwater would continue to run onto the Project Area as before. Water discharge would continue to be undertaken as required (i.e. during stormwater events or once used process water has been treated and is ready for discharge).

The Project would involve minimal amendments to the existing site water treatment system (refer to **Sections 6.1.6** and **13.2.2**). The existing onsite water capture and offsite drainage systems would remain in place, as would the seven existing CPIs and the main interceptor (refer to **Figure 13-8**). The biotreater would be

[2] Water usage attributable to Shell's operations within the Camellia Industrial Estate would, however, be reduced further in the coming months due to reduced industrial and potable water requirements of third party tenants leasing Shell-owned land adjacent to the Clyde Terminal.

decommissioned and demolished, and Shell has already obtained amendments to its EPL No. 570 to allow surface water treatment at the Project Area without the use of the biotreater (refer to **Section 8.3.1**). As such, this conversion of the site drainage system during demolition and construction works is not anticipated to significantly impact on surface and industrial water at the Project Area or its surrounds.

Given the significant reduction in industrial/potable water usage at the Project Area since the cessation of refining activities in 2012, the existing CPIs and main interceptor would be adequate to process industrial water at the converted Clyde Terminal, and tertiary treatment of process water would therefore still be possible.

13.2.2 Changes to Surface Water and Industrial Water Management

The Project would involve the following surface water and industrial water management at the Project:

- The seven existing Corrugated Plate Interceptors (CPIs) (refer to **Figure 13-1**) would continue to be used to treat Continuously Oily Contaminated (COC) water from the continuing catchment areas;
- The existing main interceptor would continue to be used to treat surface water (refer to **Figure 13-8**);
- An additional phenol treatment facility would be constructed to aid in phenol removal from waste water; and
- The existing stormwater drainage system in the north-eastern section of the Project Area would continue to be used throughout the Project.

The catchment areas proposed for continued use would undergo minimal changes to their existing treatment facilities to ensure that wastewater continues to be effectively managed at the Project Area. Each catchment area currently in use has a combination of drainage classification as follows:

- Clean drain lines (both aboveground and underground) for clean stormwater would be directly discharged to the river;
- COC water would be captured via tank drainage; and
- AOC water would be captured by open drains or underground drains, and then directed towards retention basins or the main interceptor header box (Shell, 2012a).

Drainage arrangements would be upgraded where required as part of the Project to minimise both COC and AOC waters. In particular, each bulk storage tank would be fitted with a quick flush tank to ensure tank bottoms and sumps are kept water free particularly after transfer from Gore Bay. Any water found in sumps would be diverted into the corresponding CPI via pneumatic pumps. Clean and dry product would be returned to the tank from the quick flush tank via a sealed system and a separate pneumatic pump set (Shell, 2012a).

Despite the upgrades to wastewater management at the Project Area, there is anticipated to be little change in stormwater runoff overall as the Project Area is largely hard surfaced already, and the volume of stormwater runoff generated at the Project Area is therefore not anticipated to increase or decrease significantly as a result of the Project. Potentially contaminated stormwater at the Project Area would continue to be captured and treated onsite, before being subsequently discharged offsite.

13.2.3 Demolition and Construction Impacts

The demolition and construction works have the potential to generate dust and sediment runoff impacting on surface water quality at the Project Area. The Project has the potential to further directly impact on surface water quality as treated wastewater that cannot be reused at the Clyde Terminal would continue to be discharged offsite to Duck River and/or to the remnant wetland in the north-east of the Project Area. However it is anticipated that the management measures outlined in **Section 13.3** would be adequate to mitigate any such impacts such that discharges would pose a negligible impact on the environment.

The Project also has the potential to result in the release of contaminated water during demolition and construction works, for instance, as runoff from excavated materials. Any such runoff is likely to be captured by the existing or upgraded open AOC drainage system. If the released water is not captured in the AOC, Shell's standard procedures for a release event would be followed (refer to **Section 17.1.8**).

Table 13-4 provides an outline of the identified pollutants and related monitoring requirements that the EPA has stipulated within EPL No. 570 in relation to water quality management at the Project Area. It also outlines the EPL requirements for annual load limits, concentration limits for water quality parameters, and daily volume limits for water discharge from the Project Area. Shell would continue to undertake water quality and volume monitoring throughout the life of the Project as per these requirements of EPL No. 570 or any replacement/ amended EPL as provided under the POEO Act.

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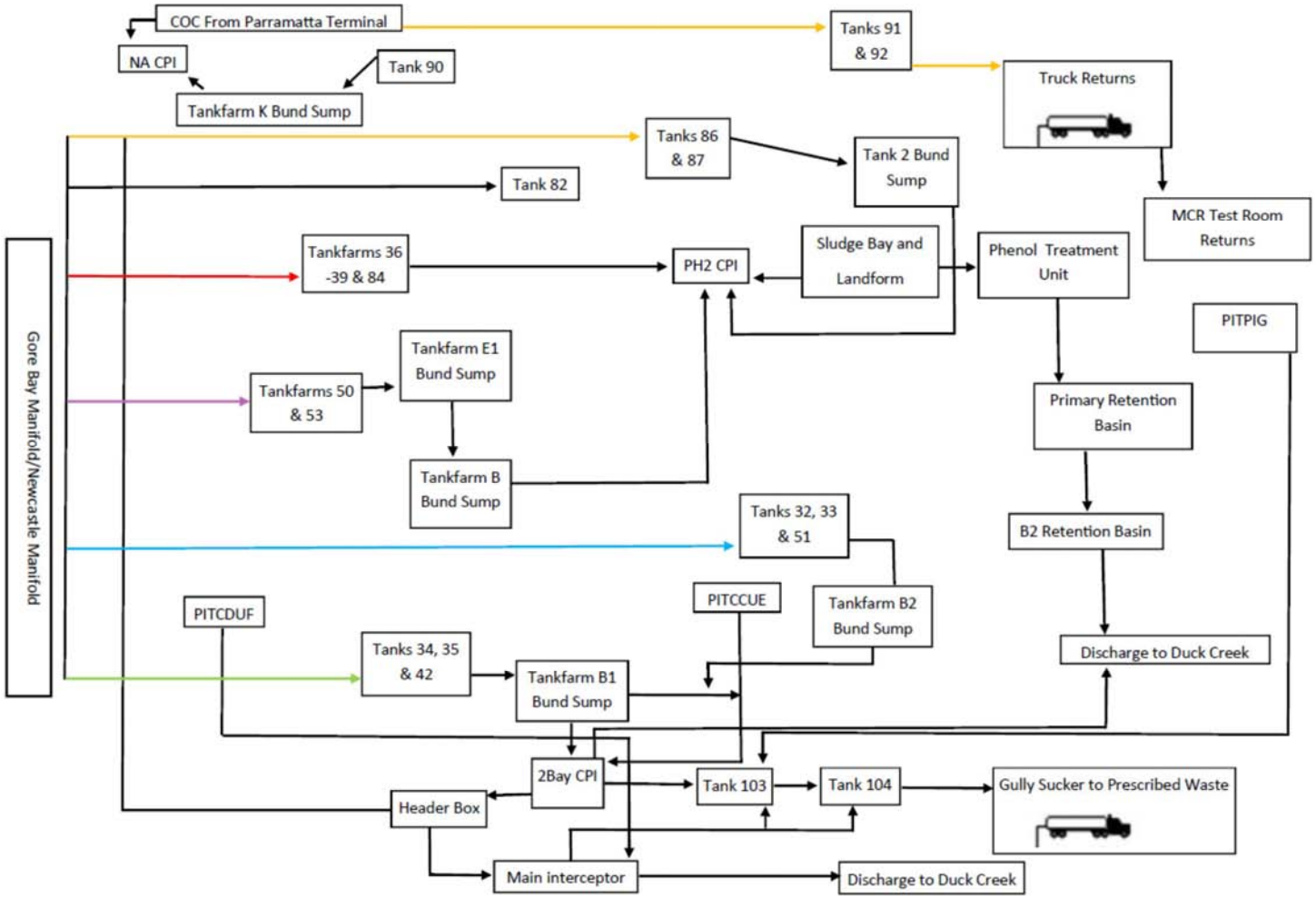

Figure 13-8 Proposed Wastewater Management System for the Converted Clyde Terminal

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13.2.4 Flooding

A large section of the eastern section of the Project Area would be classified as lying within the High Risk Flood Precinct, with the remainder of this eastern section lying within the Medium Flood Risk Precinct once the WMA Final Draft Report is adopted in full by Parramatta City Council. The majority of the western side of the Project Area would be classified as lying within the Low Flood Risk Precinct, with limited sections being classified as within the High and Medium Flood Risk Precincts. Parramatta City Council applies the development control guidelines outlined in **Table 13-4** to development on flood liable land (Parramatta City Council, 2006a).

Table 13-4 Parramatta City Council Development Control Guidelines for Flood Liable Land

Objective	Consideration
General Principles for Development on Flood Liable Land	
8.1.1 Objectives	
O.1 To ensure the proponents of development and the community in general are fully aware of the potential flood hazard and consequent risk associated with the use and development of land within the floodplain.	**Sections 13.1** and **17.1** of this EIS outline the risks posed by flooding at the Project Area. Adjoining industrial land users are aware of the Camellia Industrial Estate's location in the floodplain and the risks associated with this.
O.2 To require developments of high sensitivity to flood risk (e.g. critical public utilities) be located and designed such that they are subject to no or minimal risk from flooding and have reliable access.	New infrastructure that is commissioned as part of the Project would be designed so that the risks from flooding are minimised as far as possible, given the design principles and standards outlined in the Floodplain Risk Management Policy. Site access and the majority of internal roads within the Project Area would not be affected or would be affected to a minor extent during flood events as a result of their raised height. Access via the local road network (i.e. Durham Street, Grand Avenue and James Ruse Drive) would be largely unaffected by flooding. Demolition and conversion activities would be kept clear of the floodway, and the Project would not increase potential flood losses, risks or adverse impacts for adjoining properties.
O.3 Allow development with a lower sensitivity to the flood hazard to be located within the floodplain, subject to appropriate design and siting controls, provided that the potential consequences that could still arise from flooding remain acceptable having regard to the State Government's Flood Policy and the likely expectations of the community in general.	
O.4 To prevent any intensification of use within a High Flood Risk Precinct or floodway, and wherever appropriate and possible, allow for the conversion to natural waterway corridors.	The Project involves the demolition of a large proportion of the existing infrastructure at the Project Area, and would therefore constitute a significant reduction in intensity of use within the High Flood Risk Precinct. As outlined in **Section 13.2.2**, the Project is unlikely to impact significantly on the flow or volume surface water runoff from the Project Area. After the conversion works are complete, the Project Area would continue to allow for site drainage of clean stormwater to the remnant wetland onsite, or directly to the Parramatta and Duck Rivers.
O.5 To ensure that the proposed development does not expose existing development to increased risks associated with flooding.	The Project Area would not experience increases to flooding risk as a result of the Project. It would also not result in significantly different volumes of stormwater runoff from the Project Area, and is therefore not anticipated to increase flooding risks for surrounding areas.

Objective	Consideration
O.6 To ensure that design and siting controls required to address the flood hazard do not result in unreasonable impacts upon the character, amenity or ecology of an area.	Overall, and as outlined in **Section 24.2**, the Project is compatible with the special character of the Camellia and Rydalmere Strategic Precinct acknowledged in the *Parramatta Development Control Plan 2011*. **Section 16.3** further confirms that the Project would not have a significant impact on the ecology of the surrounding area. The specific design and siting controls that Shell proposes to implement at the Clyde Terminal to manage potential flooding impacts relate to limitations on the construction of certain types of infrastructure in flood-prone areas at the Clyde Terminal, and the storage of potentially hazardous substances. The Project would not involve the raising of structures or the construction of extensive new infrastructure. These controls are therefore unlikely to specifically impact on the character, amenity or ecology of the area.
O.7 To minimise the risk to life by ensuring the provision of appropriate access from areas affected by flooding up to extreme events.	In consultation with Parramatta City Council as the WMA Final Draft Report is finalised and is officially adopted by Council, Shell would develop a site specific Emergency Response Flood Plan demonstrating Shell's ability to secure or move plant, goods and substances above the one percent AEP flood level within the flood warning time that is likely to be available. This Emergency Response Flood Plan would also include requirements for personnel evacuation drills and procedures for equipment and product protection.
O.8 To minimise the damage to property, including motor vehicles, arising from flooding.	
8.1.2 Design Principles	
P.1 The proposed development should not result in any increased risk to human life.	The Project Area would not experience increases to flooding risk as a result of the Project. It would also not result in significantly different volumes of stormwater runoff from the Project Area, and is therefore not anticipated to increase flooding risks for surrounding areas.
P.2 The additional economic and social costs which may arise from damage to property from flooding should not be greater than that which can reasonably be managed by the property owner, property occupants and general community.	
P.2 The proposal should only be permitted where effective warning time and reliable access is available for the evacuation of an area potentially affected by floods to an area free of risk from flooding. Evacuation should be consistent with any relevant flood evacuation strategy where in existence.	In consultation with Parramatta City Council as the WMA Final Draft Report is finalised and is officially adopted by Council, Shell would develop a site specific Emergency Response Flood Plan demonstrating Shell's ability to secure or move plant, goods and substances above the one percent AEP flood level within the flood warning time that is likely to be available. This Emergency Response Flood Plan would also include requirements for personnel evacuation drills and procedures for equipment and product protection.
P.3 Development should not detrimentally increase the potential flood affectation on other development or properties, either individually or in combination with similar developments that are likely to occur within the same catchment.	The Project Area would not experience increases to flooding risk as a result of the Project. It would also not result in significantly different volumes of stormwater runoff from the Project Area, and is therefore not anticipated to increase flooding risks for surrounding areas.
P.4 Motor vehicles are able to be relocated, undamaged, to an area with substantially less risk from flooding, within an effective warning time	In consultation with Parramatta City Council as the WMA Final Draft Report is finalised and is officially adopted by Council, Shell would develop a site specific Emergency Response Flood Plan demonstrating Shell's ability to secure or move plant, goods and substances above the one percent AEP flood level within the flood warning time that is likely to
P.5 Procedures would be in place, if necessary, (such as warning systems, signage or evacuation	

Objective	Consideration
drills) so that people are aware of the need to evacuate and relocate motor vehicles during a flood and are capable of identifying the appropriate evacuation route.	be available. This Emergency Response Flood Plan would also include requirements for personnel evacuation drills and procedures for equipment and product protection.
P.6 Development should not result in significant impacts upon the amenity of an area by way of unacceptable overshadowing of adjoining properties, privacy impacts (e.g. by unsympathetic house raising) or by being incompatible with the streetscape or character of the locality (including heritage).	The Project does not involve the raising of structures or the construction of significant new infrastructure, and is therefore not anticipated to result in the overshadowing of adjoining properties. As outlined in **Section 24.2** and **Section 14.2**, the Project is not incompatible with the special character of the Camellia and Rydalmere Strategic Precinct acknowledged in the *Parramatta Development Control Plan 2011*. The Aboriginal heritage assessment undertaken as part of this EIS has demonstrated that the Project is not anticipated to impact on Aboriginal heritage in the vicinity of the Project Area (refer to **Section 16.2**). However, mitigation measures have been proposed so that any residual impacts to Aboriginal heritage can be managed in the unlikely event that they do arise (refer to **Section 21.2**). The assessment of European heritage undertaken as part of this EIS did identify that the conversion works would have significant impacts on the heritage values of the Project Area (refer to **Section 18.2**). However, the assessment concluded that, with the proposed mitigation measures in place (i.e. archival recording), these impacts can be managed to an appropriate level of impact (refer to **Section 18.3**).
P.7 Proposals for raising of structures must provide appropriate documentation including a report from a suitably qualified engineer to demonstrate the raised structure will not be at risk of failure from the forces of floodwaters.	The Project does not involve the raising of structures.
P.8 Proposed development must be consistent with Ecologically Sustainable Development (ESD) principles. The proposed design must ensure it does not compromise ecological function.	Refer to **Section 29.2.3** for a comprehensive consideration of the Project's consistency with the principles of ESD. Specifically, the Project is anticipated to have negligible impact on the ecological values of the surrounding area (refer to **Section 16.0**).
P.9 The proposal must not constrain the orderly and efficient utilisation of the waterways for multiple purposes.	No additional impacts to the use of surrounding waterways for commercial, recreational and ecological uses are anticipated as a result of the Project. As outlined in **Section 16.3** the Project would not significantly impact on the ecology of the surrounding area. The Project does not involve the use of marine traffic or the construction of marine structures that could impede other commercial or recreational uses of the adjoining Parramatta and Duck Rivers.

Objective	Consideration
8.1.3 Design Standards	
All proposals are to have regard to the planning matrix. The procedure to determine which designs standards apply to proposed development involves:	
- Identifying the land use category of the development from the Land Use Category Definitions table that follows;	The Project can be classified as "Critical Utilities and Uses" as per Table 2 of the Floodplain Risk Management Policy as it involves development for the purposes of a liquid fuel depot.
- Identifying the relevant floodplain and flood category of the land (refer to Catchment Management Unit of Council for the Flood Risk Precincts and relevant flood risk mapping); and	Based on this characterisation indicated in the WMA Final Draft Report, it can be concluded that a significant portion of the eastern side of the Project Area would be classified as being within the High Flood Risk Precinct (labelled 'High Hazard' in **Figure 13-6**) as per the Floodplain Risk Management Policy, once the WMA Final Draft Report is adopted in full by Parramatta City Council. Only a small section of the western portion of the Project Area in the vicinity of Duck River would be is classified as being within the High Flood Risk Precinct (labelled 'High Hazard' in **Figure 13-7**). The remainder of the eastern portion of the Project Area would be classified as lying within the Medium Flood Risk Precinct (labelled 'Low Hazard' in **Figure 13-6**), whereas the majority of the western side of the Project Area lies above the one percent AEP flood event, and thus within the Low Flood Risk Precinct (refer to **Figure 13-7**).
- Applying the objectives, design principles and design standards, as outlined in this section.	As outlined in this **Table 13-4**.

Based on this categorisation, and an analysis of the **Table 13-4** objectives, it can be concluded that there is risk of flooding impacts occurring at the Project Area. However, the Project itself is not anticipated to impact on flooding or tidal regimes in the area as it would not result in a net increase in built structures within the floodplain, and would therefore not divert water from the existing floodway into other less flood prone areas. The Project Area would continue to collect stormwater onsite and divert clean stormwater offsite, and the Project is also not anticipated to increase overall stormwater runoff from the Project Area as the majority of the Project Area is already hard stand. The riparian buffer zone along the border of the Project Area has the potential to further minimise the impacts of any such flooding at the Project Area by slowing down flood waters and helping them to spread around the floodplain (Department of Environment, Climate Change and Water, 2010). Bunds at the Clyde Terminal are designed to contain any tank spills and prevent these entering the wider environment, but also form a barrier against the ingress of water into the tankfarms from river flooding. It should be noted that this function is not accurately portrayed in the flood maps shown above (refer to **Figure 13-2** to **Figure 13-7**).

Under Parramatta City Council's Floodplain Risk Management Policy, the current and converted Clyde Terminal is, and would continue to be, classified as a critical utility or critical use under the Floodplain Risk Management Policy as a liquid fuel depot. Once the WMA Final Draft Report is adopted in full by Parramatta City Council, the eastern section of the Project Area in particular would be considered unsuitable for new development of this kind; for the purposes of a critical utility or critical use within the High and Medium Flood Risk Precinct. However, Shell's operations at the Project Area constitute a continuing use under the EP&A Act (refer to **Section 7.2.1**) that has been undertaken in some form or another since the early 1900s (refer to **Section 3.1**). On-going flooding risks would continue to be managed by Shell, as has historically been the case. This would be supplemented Shell with a site specific Emergency Response Flood Plan demonstrating Shell's ability to secure or move plant, goods and substances above the one percent AEP flood level within the flood warning time that is likely to be available.

13.2.5 Riparian Vegetation

The Project would not impact on the riparian vegetation along the southern and eastern borders of the Project Area. The Project would not involve the removal of riparian vegetation, and the mitigation measures outlined in **Section 13.3** would ensure that the Project does not otherwise impact on this riparian zone. This would also assist in maintaining the scenic qualities of those waterway corridors.

13.3 Mitigation Measures

In managing surface water, industrial water and flooding at the Project Area, Shell would implement the following mitigation measures:

- The *Clyde Terminal Conversion Project: Clyde Waste Water Management System* (Shell, 2012a) would be revised once the demolition and construction activities are complete, so that it is up to date for operation of the converted Clyde Terminal;
- A detailed sediment and erosion management plan is to be compiled and included in the Construction Environmental Management Plan;
- Demolition and construction waste would be stored in an undercover enclosed facility or on a sealed and bunded surface whilst awaiting transfer or processing;
- Dust suppression and sediment runoff prevention would be undertaken during the demolition and construction works to prevent impacts to surface water quality as follows:
    - Areas of demolition and construction activities would be watered down as required in order to suppress the migration of dust;
    - In the event that excess industrial water is required, e.g. for dust suppression, sediment traps would be employed around the Project Area to prevent runoff and ensure that any contaminated water is treated and managed appropriately;
    - Where excavation activities are undertaken soil exposure would be minimised where possible and land disturbance would occur for the shortest time possible. Access to the demolition and construction areas would be controlled and vehicles and machinery would be kept to well defined areas away from excavation sites;
    - Runoff generated outside of demolition and construction areas would be diverted away from those areas to decrease the potential for contaminated runoff to migrate throughout the Project Area; and
    - Stockpiles of excavated material would be clearly labelled, located away from trafficked areas and other potential disturbances, placed on geo-fabric lining to prevent leachate and erosion, be no more than 5 m tall, and would allow adequate room for transport around and management of each stockpile.
- Wastewater that has been potentially contaminated during the demolition and construction works would be directed via CPIs to allow for sediment and oil to be removed;
- Surface water quality and volume limits for discharge from the Project Area would continue to be monitored, for example as per the sampling of discharge points identified in EPL No. 570, or any replacement/ amended EPL as provided under the POEO Act;
- Temporary stormwater management measures (such as sandbags, sediment fences and berms), would be used to minimise the risks of sediment-laden runoff and other construction pollutants entering downstream systems;
- During demolition works, all potential chemical pollutants (e.g. fuels, oils, lubricants, paints, herbicides, etc.) are to be stored in appropriate containers within bunded areas within construction compounds to minimise the risk of spillages and mobilisation of these pollutants into aquatic environments;
- All fuel products and other potentially hazardous substances at the Project Area would continue to be stored in sealed, bunded areas that would prevent their migration offsite in the event that a storm surge or flood event impacts the Project Area;
- The Project would not involve the construction of extensive new infrastructure on land lying within the 1:100 year flood event;

- New development or infrastructure at the Project Area would be constructed with regard to the design principles and standards outlined in the Floodplain Matrix of Planning and Development Controls identified in the Floodplain Risk Management Policy;
- Shell would consult with Parramatta City Council and WMA concerning the results of *Duck River and Duck Creek Flood Study Review: Final Draft Report* (WMA, 2011) whilst this report is still in draft format;
- In consultation with Parramatta City Council as the WMA Final Draft Report is finalised and is officially adopted by Council, Shell would develop a site specific Emergency Response Flood Plan demonstrating Shell's ability to secure or move plant, goods and substances above the one percent AEP flood level within the flood warning time that is likely to be available. This Emergency Response Flood Plan would also include requirements for personnel evacuation drills and procedures for equipment and product protection;
- Water saving devices would be installed wherever possible during the conversion works to minimise wastage;
- Once the Clyde Terminal is converted, Shell would undertake an internal audit of the Project Area to take stock of how reduced operations have reduced water consumption and improved water efficiency. Recommendations of the audit would then be taken into consideration if further potential water resource savings or opportunities for reuse are identified; and
- The riparian buffer zone along the southern and eastern borders of the Project Area, which has the potential to further minimise the impacts of flooding at the Project Area, would continue to be preserved as follows:
    - Contaminated stormwater and wastewater generally would continue to be treated before being discharged in the vicinity of this riparian buffer zone;
    - Infrastructure at the Project Area would continue to be located outside of this riparian buffer zone; and
    - The Project would not result in a reduction of wetland or riparian vegetation.

13.4 Residual Impacts

With the mitigation measures outlined in **Section 13.3** in place, the Project is not anticipated to have significant residual impacts for surface water and industrial water. In the unlikely event that a discharge event occurs that contravenes the water quality or volume limits of EPL No. 570, Shell would notify the EPA and would continue to monitor the relevant discharge point as required under the EPL to confirm the extent of this exceedance. The Project Area would continue to be flood prone, as has historically been the case. This flooding risk would continue to be managed, including development of updated flood management and evacuation plans, and Shell would continue its dialogue with Parramatta City Council as the WMA Final Draft Report is finalised and is officially adopted by Council.

14.0 Land Use

14.1 Existing Conditions

14.1.1 LEP Land Use Context

The LEP land use context of the Project is outlined in **Section 7.3.1** and the Project Area is zoned IN3 Heavy Industrial. The southern and eastern boundary line of the Project Area runs along a strip of land adjacent to Duck River classified as Riparian Land and Waterways under LEP 2011. LEP 2011 further identifies this strip of land as a heritage listed wetland. There is another remnant wetland classified as a heritage item under LEP 2011 that lies within the north-eastern portion of the Project Area, but which would also fall outside the project footprint. This wetland consists of both remnant and regenerated vegetation, and natural and artificially constructed water flow regimes. This remnant wetland has also been altered so as to filter and receive clean waste water from the Project Area. **Sections 1.3** and **Section 18.1.1** further outline how the Project Area contains and is adjacent to several items zoned as Heritage under LEP 2011. Part of the Project Area is also affected by the 1:100 year flood event as outlined in the *City of Parramatta Local Floodplain Risk Management Policy* (Parramatta City Council, 2006a) (refer to **Section 13.1.3**).

14.1.2 Strategic Land Use Context

The strategic land use context for development within the Sydney region generally falls under the *Metropolitan Plan for Sydney 2036* (Department of Planning NSW, 2010), which replaced the former *Metropolitan Strategy for Sydney 2031* (Department of Planning NSW, 2005). The emergence of Parramatta as the premier regional city and the second CBD in the Sydney region are cited in the Metropolitan Plan as key components to Sydney's overall long term sustainability. The Metropolitan Plan proposes a medium-term employment capacity target of 27,000 in Parramatta before 2036, and a further long-term employment capacity target of 70,000.

The Parramatta Economic Strategy responds to the vision contained in the Metropolitan Plan to create 27,000 new jobs within Parramatta by 2036. Its overall vision is for Parramatta to become a city that is "the driving force and heart of Australia's most significant economic region; a vibrant home for diverse communities to prosper; and a centre of excellence in research, education and enterprise."

The Parramatta Economic Strategy also proposes that over the coming years the Camellia Industrial Estate is to become an eco-industrial precinct providing for the sustainable building and energy fields. The current Project in particular is noted as a key enabler of this vision. By ceasing refining activities and converting the Clyde Terminal, around 44.5 ha of land in the western section of the Project Area and around 25 ha of land in the north-east of the Project Area would be freed up for new usage. As explained in **Section 14.2**, a future use for this land has yet to be confirmed and Shell cannot commit to a preferred future use at this time. However, the Parramatta Economic Strategy highlights the potential for this land to be used for future enterprise creation, thereby significantly increasing highly skilled and knowledge based employment in the Parramatta LGA (Parramatta City Council, 2011).

The Parramatta Economic Strategy also recognises the importance of retaining the industrial character of the Camellia Industrial Estate by retaining scope for various points of the employment skills spectrum. As such, Shell's retention of the Clyde Terminal would continue to provide employment for a broad range of industrial skills, and thereby maximise the employability of Parramatta residents with manufacturing experience and trade qualifications (Parramatta City Council, 2011).

The strategic document, Parramatta Twenty38 (Parramatta City Council, 2013) identifies how Parramatta will manage the growth that it is expected to experience over the next 25 years whilst encouraging economic prosperity, environmental protection and community enhancement. Parramatta Twenty38 identifies six strategic objectives that Parramatta aspires to achieve:

- Parramatta's economic growth will help build the City as a centre of high, value-adding employment and the driving force behind the generation of new wealth for Western Sydney;
- Parramatta will be an eco-efficient city that effectively manages and uses the City's growth to improve and protect the environment;
- Parramatta will be a city with fast, reliable transport and digital networks that connect people to each other, to the information and services they need and to where they need to go;

- Parramatta will be a world-class city at the centre of Sydney that attracts a diversity of people: a city where people can learn, succeed and find what they need; a city where people live well, get together with others, feel like they belong and can reach their potential;
- Parramatta will be a place where people want to be: a place that provides opportunities to relate to one another, the City and the local area; a place that celebrates its cultural and sporting heritage; and a place that uses its energy and cultural richness to improve quality of life and drive positive growth and joy; and
- Parramatta will be widely known as a great city, a centre of excellence and an effective capital of Western Sydney, with inspirational leadership and good governance.

In addition, the *Parramatta Development Control Plan 2011* (DCP 2011) works in conjunction with LEP 2011 to provide detailed guidance for development applications and assessment. Section 79C of the EP&A Act provides that a consent authority is ordinarily required to consider relevant provisions of a DCP when determining a development. However, clause 11 of SRD SEPP provides that DCPs do not apply to SSD. As a result, the Parramatta DCP does not apply to the Project. However, as explained in **Section 14.2**, the Project is nevertheless considered to be consistent with the objectives of the DCP 2011.

14.2 Predicted Impacts

14.2.1 Land Use Compatibility

The Project is compatible with the current use of the Project Area by Shell, as it involves the conversion of current facilities on that land. The Project is also compatible with current uses of land surrounding the Project Area by other land users as outlined in **Table 2-2**, as these nearby land users can be characterised as industrial or light industrial.

The Project therefore capitalises on the Project Area as a valuable land asset, making it more efficient and allowing it to become economically productive in the future. This enhanced efficiency of the current Clyde Terminal infrastructure would ensure the continued use of the Project Area for economic benefit, while taking into account the environment within which it is located. .

The Project would involve the removal of Crude Oil refining infrastructure and other redundant infrastructure from the Clyde Terminal, and upgrades to safeguarding, electrical and control systems. These upgrades would enable Shell to operate the Clyde Terminal more efficiently, and with improved safety and environmental management. The Project would also involve the removal of hazardous substances from the Project Area. As outlined in **Section 20.0**, these wastes would be managed according to applicable legislation and Shell's management plans and procedures in order to eliminate potential risks to human health now and into the future.

There is potential for historical soil and groundwater contamination at the Clyde Terminal, particularly in the western portion of the Project Area. This is due to the long history of refining operations on the Project Area, both before and after Shell acquired the site. Current placement of infrastructure at the Clyde Terminal renders a full investigation of any potential soil and groundwater contamination impractical. Following the removal of refining assets, Shell would undertake further investigation of the underlying soil and groundwater for historical contamination and, if required, develop a remediation plan in dialogue with the EPA (the Clyde Remediation and Redevelopment application). If remediation is required, a separate environmental assessment and approvals process would be pursued consistent with the requirements of legislative requirements.

It is anticipated that the most likely use for the surplus land at the Project Area would be for some sort of industrial use in the coming years. A final preferred use for this land that is surplus to the converted Clyde Terminal requirements would need to be determined based on:

- The extent of any contamination that is discovered in the western and north-eastern sections of the Project Area;
- The extent of any remediation that is required subsequent to those contamination investigations;
- According to Shell's business requirements; and
- In consultation with relevant Government departments and agencies such as the EPA, DP&I and Parramatta City Council, and taking into account Council's desired strategic planning outcomes for the Camellia Industrial Estate and the classification of different parts of the western section of the Project Area as lying within the Low, Medium and High Risk Flood Precincts (*Parramatta Local Floodplain Risk Management Policy* (Parramatta City Council, 2006a – refer to **Sections 13.1.3** and **13.2.4**).

In terms of the future land use of areas adjacent to the Project Area that are currently under lease from Shell, Shell would continue dialogue with these land users throughout the Project. At the time when each of these individual leases expires, future land use of these areas would be considered. A change in land use or the development on these sites would be further considered at the relevant time in accordance with legislative requirements.

14.2.2 Compatibility with LEP Land Use Zoning

As outlined in **Section 7.3.1**, the Project is permissible with consent on the Project Area, which is zoned IN3 Heavy Industrial (the Project being properly characterised under LEP 2011 as development for the purposes of a liquid fuel depot). **Table 7-2** outlines how the Project meets the land use objectives of the IN3 Heavy Industrial zoning under LEP 2011.

Clause 6.5 of LEP 2011 provides that, before determining a development application for development on land that is zoned Riparian Land and Waterways, a consent authority must consider any adverse impacts of the proposed development on:

- The water quality of receiving waters;
- The natural flow regime;
- The natural flow paths of waterways;
- The stability of the bed, shore and banks of waterways; and
- The flows, capacity and quality of groundwater systems.

Development consent is not to be granted on land zoned as such, unless the consent authority is satisfied that:

- The development is designed, sited and will be managed to avoid any adverse environmental impact; or
- If that impact cannot be avoided – the development is designed, sited and will be managed to minimise that impact; or
- If that impact cannot be minimised – the development will be managed to mitigate that impact.

One of the overall aims of LEP 2011, stated in clause 1.2(l) is to "ensure development occurs in a manner that protects, conserves and enhances natural resources, including waterways, riparian land, surface and groundwater quality and flows and dependent ecosystems."

As the *City of Parramatta Local Floodplain Risk Management Policy* is triggered, LEP 2011 also provides that development consent must not be granted for the Project unless the consent authority is satisfied that the development is not likely to cause destruction of riparian vegetation (clause 6.3(d)).

The potential impacts of the Project on land zoned as Riparian Land and Waterways is provided in **Section 13.2**. From this analysis it has been determined that the Project is unlikely to significantly impact on this riparian and waterway land, and is thus not inconsistent with the objectives of that zoning.

14.2.3 Compatibility with Land Use Context

The DCP 2011, in conjunction with LEP 2011 provides detailed guidance for development applications and assessment. **Table 14-1** considers how the Project meets those objectives of DCP 2011 that are relevant to the Project.

Table 14-1 Objectives for Special Precincts under the DCP 2011

Objective	Consideration
Section 4 Special Precincts	
O.1 To ensure development in the Special Precincts is compatible with the particular character and significance of each Special Precinct.	The Project continues the industrial use of the Project Area and is therefore compatible with the special character and significance of the Camellia and Rydalmere Special Precinct.
O.2 To reinforce the special attributes and qualities of the built form of each Special Precinct.	

Objective	Consideration
Section 4.3.1 Camellia and Rydalmere Overall Precinct Objectives	
O.1 Protect and support one of Sydney's significant industrial and educational hubs.	The Project continues the industrial use of the Project Area and is therefore compatible with the special character and significance of the Camellia and Rydalmere Special Precinct, and is in keeping with surrounding land users.
O.2 Create a vibrant, attractive and mutually supportive industrial, educational and research precinct.	
O.3 Maintain and improve existing access to major public transport links outside the area.	The TIA prepared by AECOM (refer to **Appendix B** of **Volume 2** of this EIS) has concluded that the Project would result in a reduction in light and heavy vehicle movements relative to previous operation of the site for refining activities. The Project works would result in a slight increase to light and heavy vehicle movements during the demolition and construction works, however this additional traffic is not expected to significantly impact on the surrounding road network. Once the conversion works are complete, there would be a slight reduction in light vehicle movements, and heavy vehicle movements would remain consistent with those of the current operations (post cessation of refining). These changes are expected to have negligible impact on the surrounding road network (refer to **Section 11.2**).
O.4 Encourage industrial development that is innovative and incorporates into its business best practice environmental management.	As outlined in **Sections 8.1** and **8.2**, Shell operates the Project Area under its overarching Commitment and Policy on Health, Security, Safety and the Environment (HSSE) and Social Performance (SP). This systematic approach to HSSE and SP management is designed to ensure compliance with the law and to achieve continuous performance improvement.
O.5 Require development along the foreshore to be of a scale and character that is in keeping with its foreshore location, protection and enhancement of the unique visual and ecological qualities of the waterways and foreshore.	The Project is not anticipated to impact on the riparian corridor running along the southern and eastern boundaries of the Project Area, or to impact the quality of the adjoining Duck and Parramatta Rivers. The Project would also therefore not impact on the scenic qualities of those ecological features.
O.6 Improve the access and circulation for local traffic flows accessing the employment areas while protecting the level of service of James Ruse Drive and Victoria Road.	The TIA prepared by AECOM (refer to **Appendix B** of **Volume 2** of this EIS) has concluded that the Project would result in a reduction in light and heavy vehicle movements relative to previous operation of the site for refining activities. The Project works would result in a slight increase to light and heavy vehicle movements during the demolition and construction works, however this additional traffic is not expected to significantly impact on the surrounding road network. Once the conversion works are complete, there would be a slight reduction in light vehicle movements, and heavy vehicle movements would remain consistent with those of the current operations (post cessation of refining). These changes are expected to have negligible impact on the surrounding road network (refer to **Section 11.2**).
O.7 Improve public access along the foreshore to create a regional pedestrian and open space network.	The Project Area extends to the riparian buffer zone along the foreshore of the Parramatta and Duck Rivers. For safety reasons this foreshore area cannot be accessed by the public. However the Project does not impact on foreshore access along the opposite sides of the Parramatta and Duck Rivers.
O.8 Conserve and enhance identified views and encourage the conservation and adaptive reuse of heritage items within the	As outlined in **Section 24.2** the Project would improve the visual amenity of the surrounding area without substantially impacting on the significant district views afforded by the Camellia and

Objective	Consideration
Camellia and Rydalmere Precincts and wider community use and access of these assets.	Rydalmere Strategic Precinct. As explained in **Section 18.2.3**, adaptive reuse is not a possible option for the Project.
O.9 Maximise opportunities for new development to support tourism as well as the racing industry.	As identified in **Section 12.2.3**, the Parramatta Economic Strategy identifies that the Project would result in an improved outlook from the Rosehill Gardens Racecourse, further improving the amenity of Rosehill Gardens Racecourse as a key service and tourism provider in the area.
O.10 Require industry to operate using best practice environmental management techniques.	As outlined in **Section 8.0**, Shell operates the Project Area under its overarching Commitment and Policy on HSSE and SP. This systematic approach to HSSE and SP management is designed to ensure compliance with the law and to achieve continuous performance improvement.
O.11 Minimise energy and resource use and reduce impact to offsite air quality or disturbance by noise, odour, dust, water, soil and contamination.	As summarised in **Section 29.2.1**, the Project is considered to reduce the overall environmental footprint of Shell's operations at the Project Area, including a reduction in energy and resource use. With the mitigation measures summarised in **Table 27-1**, the Project is not anticipated to cause significant noise, odour, dust, water, soil, and contamination impacts.

As outlined in **Section 12.1.1**, the Parramatta LGA is currently undergoing a subtle economic shift whereby its population is gradually attaining greater levels of education, and higher education in particular. The Parramatta Economic Strategy therefore identifies an opportunity for Parramatta to move towards the provision of employment in the knowledge end of business, thereby increasing the number of managers, professionals, para-professionals, technical specialists and scientists within the area. Whilst manufacturing currently accounts for approximately 11 percent of all jobs within Parramatta, it is forecast that by 2036 this number will have fallen to around seven percent. It is further envisaged that Parramatta's CBD, Westmead, Rydalmere and Camellia precincts will continue as the four specialised and inter-connected employment centres of the LGA.

The Economic Strategy further proposes that over the coming years the Camellia Industrial Estate is to become an eco-industrial precinct providing for the sustainable building and energy fields. The current Project in particular is noted as a key enabler of this vision. By ceasing refining activities and converting the Clyde Terminal, approximately 44.5 ha of land in the western section and approximately 25 ha of land in the north-eastern section of the Project Area would be freed up for alternative use. As explained in this **Section 14.2**, a future use for this land has yet to be confirmed. However, the Parramatta Economic Strategy highlights the potential for this land to be used for future enterprise creation, thereby significantly increasing highly skilled and knowledge based employment in the Parramatta LGA (Parramatta City Council, 2011).

The Project is furthermore consistent with the objectives outlined in the strategic plan *Parramatta Twenty38*. In particular it is aligned with the objectives of economic growth , social responsibility and environmental protection, as follows:

- Improves the safety, efficiency and environmental performance of the Clyde Terminal; and
- Encouraging jobs and industries that provide security of tenure in employment and sustainable levels of work for individuals

14.3 Mitigation Measures

It is considered that the Project would not have any significant impacts on land use as it would involve the continued use of the Project Area for purposes similar to its current use. Shell would continue its dialogue with land users who are currently leasing land adjacent to the Project Area from Shell.

In considering a future use of the surplus land in the western and north-eastern sections of the Project Area, Shell would take into account:

- The extent of any contamination that is discovered in the western and north-eastern sections of the Project Area;
- The extent of any remediation that is required subsequent to those contamination investigations; and
- Consultation with relevant Government departments and agencies such as the EPA, DP&I and Parramatta City Council, and Council's desired strategic planning outcomes for the Camellia Industrial Estate.

14.4 Residual Impacts

It is unlikely that there would be any residual impacts to land use as a result of the Project. A future use of the surplus land in the western and north-eastern portions of the Project Area has yet to be determined. However, it is proposed that any such future use would be industrial in nature, and would thus be compatible with the strategic land use objectives of the Parramatta LGA. A separate development application would be prepared for remediation or redevelopment of this land (the Clyde Remediation and Redevelopment Application), consistent with legislative requirements.

15.0 Air Quality and Odour

Relevant DGRs: The EIS must address **Air Quality and Odour** – including a quantitative assessment of the air quality and odour impacts of the development on surrounding receivers.

15.1 Existing Conditions

A full version of the Air Quality Impact Assessment (AQIA) for the Project, along with supporting data is provided in **Appendix C** of **Volume 2** of this EIS. This **Section 15.0** presents a summary of those findings.

The Bureau of Meteorology operates a network of meteorological monitoring stations around the country. The closest station to the Project Area is located at Parramatta North, approximately 5 km north-west of the Project Area. A summary of the long-term data recorded at this station between 1967 and 2010 is shown in **Table 3** of **Appendix C**. The warmest temperatures occur during the summer months, with the highest average maximum temperature (28.3°C) occurring in January. July is the coldest month, with a recorded average minimum temperature of 6.2°C. February is the wettest month, with an average rainfall of 125.5 millimetres. Humidity follows a diurnal cycle, with higher humidity in the morning compared to the afternoon. Wind speeds are generally higher in the afternoon compared to the morning, with the highest average wind speeds occurring in November (15.6 km/h).

Clyde Refinery has received only a limited number of complaints regarding odour from the Project Area. In September 2012, Shell was issued with a penalty notice under the POEO Act for causing odour emissions from the former Clyde Refinery (note that this occurred when refining operations were still underway). The cessation of refining activities at the Clyde Terminal is considered to have removed the majority of odorous substances from the Project Area, and Shell's EPL No. 570 has been amended since that time to reflect the reduced requirements for air quality monitoring at the Clyde Terminal. However the following wastes generated through the ongoing operation of the converted Clyde Terminal may generate minor odours as follows:

- The Clyde Terminal continues to generate and process odorous organic chemicals (including mercaptans and acrylates); and
- The biotreatment facility continues to be used at the Project Area, including for the dewatering and weathering of slops. The landfarming and biofarming cake drying area adjacent to the biotreater may contribute to minor odour generation at the Project Area. Shell will decommission and demolish the biotreater as part of the proposed Project once there is no further requirement for this unit.

Nevertheless, all the available information suggests that odour is no longer an issue of concern for the Project Area (refer to **Section 15.1.2**).

The cessation of refining operations in late 2012 is likely to have resulted in a substantial decrease in Volatile Organic Compounds (VOCs) within the immediate vicinity of the Project Area, as Shell's previous refining operations would have been a more significant source of ambient VOC levels in the area. This is supported by the amendments made to Shell's EPL No. 570 following the cessation of refining activities which reflect reduced requirements for air quality monitoring at the Clyde Terminal, including for VOCs.

The quantitative analysis undertaken as part of the AQIA for the current Project was based on VOCs and benzene. The EPA operates a network of monitoring stations around the state, measuring various ambient pollutant levels. The closest station to the Project Area is located at Chullora (approximately 8 km south-east of the Project Area). The EPA does not measure VOC and benzene concentrations at monitoring stations either in the vicinity of the Project Area, or at other EPA monitoring stations further afield. As such, background data on VOC and benzene rates in the atmosphere were not available for inclusion in the AQIA. Given the low levels of emissions that are expected to result from the Project (refer to **Section 15.2**) this is not expected to impact on the completeness of the AQIA results.

15.1.1 Current Management of Air Quality

At the Clyde Terminal there are two types of storage tanks that are utilised: fixed roof/IFR tanks and EFR tanks. Fixed roof tanks are generally comprised of a cylindrical steel shell, with a permanently affixed cone or dome shaped roof. Fixed roof tanks are designed to an acceptable standard for the containment of liquids and are welded together. Of the key finished petroleum product storage tanks that are to be retained as part of the Project, six are fixed roof tanks and the additional 15 have EFRs. EFR tanks consist of an open-topped cylindrical steel shell, with a roof that floats on the liquid being stored, rising and falling with the liquid level. Components of the

floating roof include a deck, fittings and a rim seal system which is attached to the floating roof and rubs against the tank wall (Werner Sölken, 2010). The roof is typically constructed of welded steel plates, and is designed so that evaporative losses from stored liquid are limited to losses from the small apertures in the roof installed for tank fittings, minute gaps in the rim seal, and from any liquid sheen on the tank wall as the roof lowers with product being pumped from tanks (Werner Sölken, 2010). Any odour impacts resulting from such evaporative losses are likely to be negligible.

To date, Shell has been operating a leak detection and repair procedure for all of its tanks and associated equipment, which was a previous requirement of EPL No. 570. The purpose of this procedure is to provide guidance on the inspection of process components for leaks to atmosphere and remedial repair of any components found to be leaking. As a result of the implementation of this procedure, the emission rate from equipment is minimised, particularly in relation to fugitive emissions.

15.1.2 Methodology

The AQIA estimated ground level pollutant concentrations associated with operation of the converted Clyde Terminal, and discusses the potential impacts from the demolition and construction works. Overall, the methodology for the AQIA was developed in consultation with the EPA and the NSW Ministry of Health. On 25 September 2012, AECOM and Shell representatives met with EPA staff at the EPA Goulburn Street Office. The meeting was undertaken to discuss the proposed methodology for the AQIA to be included in the EIS and to gain any feedback from the EPA with respect to the methodology or other parts of the assessment. From this discussion measures were taken to develop the methodology in a manner consistent with the EPA's feedback. Further to that initial EPA meeting, there has been ongoing communication between Shell, AECOM, EPA, DP&I and NSW Ministry of Health regarding the refinement of the methodology to meet each stakeholder's requirements. These included meetings on the following dates:

- 18 February 2013 attended by Shell, AECOM, EPA and DP&I; and
- 13 March 2013 attended by Shell, AECOM and EPA.

The potential impacts of the Project on air quality were determined through comparison of modelling results against the impact assessment criteria published in the guideline *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Department of Environment and Conservation, 2005a) (Approved Methods). A review of the previously reported emissions from the Project Area and those proposed under the Project operations is also provided. Due to the fact that the USA EPA's TANKS emissions model was used for the AQIA, sampling was not required to be undertaken to gauge emissions rates, and therefore the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW 2005* was not considered relevant to the assessment.

The AQIA specifically targeted benzene, as this compound is not only likely to form a large proportion of the VOC emissions from the tanks, but also has a relatively stricter assessment criterion than other pollutants within the fuel blends stored at the Clyde Terminal. The benzene assessment criterion in the EPA's Approved Methods is provided in **Table 15-1** as a one-hour 99.9th percentile concentration.

Table 15-1 Benzene Impact Assessment Criterion 99.9th Percentile

Compound	Assessment Criterion	Units	Averaging Period
Benzene	29	µg/m^3	1 hour

The Approved Methods does not provide an assessment criterion for total cumulative VOC emissions. A screening level assessment of the total VOCs estimated in the dispersion modelling was undertaken, which reviewed the expected chemical composition of the different fuel blends, and estimated the proportion of individual VOC species in the emissions based on the fuel compositions. Further details are provided in **Section 15.2.6**.

The fact that the Project Area has experienced significant reductions in its scope for potential odour impacts since the cessation of refining activities in late 2012 suggests that odour is no longer an issue of concern. Therefore a quantitative analysis of odour has not been undertaken as part of the AQIA. AECOM confirmed this approach with the EPA before completing the AQIA for this Project. Given the fact that odour was not considered as part of the AQIA, the *Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework 2006* and the *Assessment and Management of Odour from Stationary Sources in NSW: Technical Notes 2006* were not considered relevant to this assessment.

The operational pollutant emission rates for the Project were estimated using the physical tank properties and throughput volumes as inputs into the TANKS emissions model. Pollutant emissions from operation of the converted Clyde Terminal were assessed quantitatively using the CALPUFF dispersion model. Sensitive receivers in the vicinity of the Project Area were identified and pollutant concentrations at sensitive receiver locations estimated.

The TANKS, TAPM (The Air Pollution Model), CALMET meteorological processers, and the CALPUFF dispersion models were used in the assessment. A description of each of these models is provided in **Section 5.1.1** of **Appendix C**. In the absence of suitable site-specific meteorological data for the Clyde Terminal, the TAPM prognostic model was used to predict local meteorology for use in the CALMET modelling. The meteorological data used in the assessment were from the year 2011. These data are the most recent full year available within the TAPM model.

Topography may influence the findings of this study. The terrain data were obtained from the NASA Shuttle Radar Topographic Mission (SRTM) at a resolution of approximately 90 m (standard resolution provided by NASA). Given the fact that the Project Area is generally flat, this resolution was considered appropriate for the current assessment. These were incorporated into the CALPUFF input files via TAPM and CALMET. Given the heights of the tanks modelled at the Clyde Refinery along with the location of surrounding buildings, plume dispersion is not predicted to occur, and as such not assessed as part of the AQIA.

The demolition and construction works would be undertaken with standard construction equipment and the resulting emissions would be managed using best practice construction management and mitigation processes. The demolition and construction works have the potential to generate combustion, dust and odour emissions. Airborne pollutants, for instance, could be caused during the demolition and construction works, including minor earthmoving during site preparation, demolition of tanks and handling of stockpiling of excavated and demolished materials. Emissions during demolition and construction works can be minimised and mitigated through the application of a CEMP, as outlined in **Section 15.3**. The potential emissions resulting from demolition and construction activities were therefore not assessed quantitatively in the AQIA.

For a full description of the AQIA methodology, refer to **Section 5.1** of **Appendix C**.

15.2 Predicted Impacts

15.2.1 Potential Pollutant Sources

A comparison of the annual emission rates calculated from the TANKS model against the annual emission rates from the Clyde Terminal for the previous four annual return periods shows a significant reduction in emissions from the Project Area due to the cessation of refining operations at the Clyde Terminal in 2012. The Project is therefore anticipated to significantly reduce the possible release of pollutants into the atmosphere from the Project Area.

The previous refining processes at the Project Area that were likely to have been major contributors to the Project Area's emissions have been removed, with fuel storage remaining as the primary operation and potential source of pollution. **Table 15-2** outlines the sources that were identified during the AQIA to have the potential for the release of pollutants from the Project Area into the atmosphere during operation of the converted Clyde Terminal. Each tank has various sources for emissions including breathing losses, working (filling) losses including tank wall exposure for floating roof tanks, rim seal losses, and deck seam and fitting losses. These various emission sources are included within the tank emissions estimation model and have been included in the dispersion model and air quality assessment.

Table 15-2 Potential Pollution Sources from the Project Operation

Potential Pollution Sources
2 x Unleaded 95 tanks
5 x Unleaded 98 tanks
3 x unleaded 91 tanks
3 x Jet fuel tanks
3 x AGO (Diesel) tanks
5 x Slops tanks
2 x Sampling slops tanks

Fugitive emissions from sources not included in **Table 15-2** may be present during operation of the converted Clyde Terminal and could include transfer pipe fixtures (gaskets, valves and manifolds), open ended lines, floor spillage, water/slops retention systems, and pressure relief valves. Such fugitive sources are expected to have a minor contribution to the total emissions from the Project Area.

Butane would continue to be dosed with winter grades of Gasoline. This dosing process is carried out in an enclosed system and is not exposed to the atmosphere. The process is therefore not considered a significant air quality emission source and, as such, has not been modelled in the assessment. The combined product holds Butane in solution to provide improved combustion qualities in vehicle engines.

Shell operates a leak detection and repair procedure for all its tanks and associated equipment. The purpose of this procedure is to provide guidance on the inspection of process components for leaks to atmosphere and remedial repair of any components found to be leaking. As a result of the implementation of this procedure, the emission rate from the tanks and equipment is minimised, particularly fugitive emissions. Fugitive VOC emissions were therefore considered to be minor and were not included in the dispersion modelling.

During the demolition and construction works, air emissions would be generated from plant, equipment and vehicles used for the works (refer to **Table 22-5**). The Project also has the potential to generate dust through excavations and other soil disturbances. Operation of the Clyde Terminal would also continue concurrently during the project works, therefore potential air quality impacts from tank emissions also apply to the demolition and construction works.

Odour has not previously been considered to be an issue of concern at the Project Area. The Project would furthermore result in a decrease of potential odour sources emanating from the Project Area.

15.2.2 Pollutants of Interest

For a project of this type, VOCs are the primary pollutants of interest. The World Health Organization definition of VOCs includes all organic compounds (substances made up of predominantly carbon and hydrogen) with boiling temperatures in the range of 50 – 260 °C, excluding pesticides. This means that they are likely to be present as a vapour or gas at normal ambient temperatures. Most fossil fuels consist mainly of a mixture of a number of different carbon compounds. Total VOCs are the cumulative concentration of all VOCs within a volume of material, in this assessment a volume of air.

Benzene, a VOC, is a natural constituent of crude oil, and is one of the most basic petrochemicals. Benzene is an aromatic hydrocarbon, and is a colorless and highly flammable liquid with a sweet smell.

In the atmosphere, benzene can react with other chemicals to produce phenol, nitrophenol, nitrobenzene, formic acid and peroxyacetyl nitrate. It is a “precursor” hydrocarbon leading to the formation of photochemical smog. It will usually decompose over a few days, with the products eventually ending up in the air. It can be washed out of the air by rain, but will evaporate and continue to contaminate the air. It can attach to rain or snow and be carried back down to the ground. Benzene in soil or water will decompose with the presence of oxygen. It does not build up concentration levels in plant or animal tissues. Benzene is expected to be a key component of emissions within the assessed fuel blends to be stored at the converted Clyde Terminal.

15.2.3 Emissions Estimation

The TANKS model was used to estimate the emissions of VOCs from storage tanks at the converted Clyde Terminal. TANKS uses chemical, meteorological, roof types and rim seal data as inputs to generate emissions estimates for the proposed types of storage tanks. The tank properties, working volumes, proposed throughputs and liquid chemical composition were provided by Shell and are reproduced in **Table 15-3**. The proposed throughputs were based on the Jet fuel, Diesel (AGO) and Gasoline (Unleaded Petroleum) product throughputs from the 2011 to 2012 (at the former Clyde Refinery) Annual Return and spread over those tanks that are proposed to hold the same product. **Table 15-3** provides a summary of the pertinent source parameters for input into the TANKS model to generate the emission estimates for each storage tank. The tank emissions were calculated for input into the dispersion model. Total VOCs and benzene emission rates for each tank are presented in **Appendix C** of **Volume 2** of this EIS.

Table 15-3 Source Parameters

Tank No.	Tank Type	Product Stored	Diameter (m)	Height (m)	Tank Working Volume (m^3)	Annual Turnover	Net Throughput (m^3/yr)
32	Vertical Fixed Roof/IFR	Diesel (AGO)	36.0	16	15,260	22.6	344,770
33	Vertical Fixed Roof/IFR	Diesel (AGO)	36.0	16	15,524	22.6	350,735
34	IFR	Jet fuel*	39.0	12.8	15,299	10.3	158,258
35	IFR	Jet fuel*	43.9	18.3	27,699	10.3	286,528
36	EFR	ULP-98	24.4	16.5	7,715	14.2	109,437
37	EFR	ULP-98	24.4	16.5	7,715	14.2	109,437
38	EFR	ULP-98	24.4	16.5	7,715	14.2	109,437
39	EFR	ULP-98	24.4	16.5	7,715	14.2	109,437
42	IFR	Jet fuel*	43.9	18.3	27,699	10.3	286,528
50	EFR	ULP-95	34.1	22.0	20,093	14.2	285,019
51	EFR	Diesel (AGO)	48.8	22.0	41,055	22.6	927,558
53	EFR	ULP-95	34.2	22.0	20,164	14.2	286,027
82	EFR	Slops	17.1	12.8	2,940	0.9	2,500
84	IFR	ULP-98	24.4	22.0	10,287	14.2	145,921
86	EFR	ULP-91	39.0	22.0	26,281	14.2	372,796
87	EFR	ULP-91	39.0	22.0	26,281	14.2	372,796
90	EFR	ULP-91	39.0	22.0	26,281	14.2	372,796
91	Vertical Fixed Roof/IFR	Slops	6.09	6.13	160	22.0	3,525
92	Vertical Fixed Roof/IFR	Slops	6.09	6.13	160	21.1	3,381
103	Vertical Fixed Roof/IFR	Slops/water	7.62	5.49	278	5.2	1,160[2]
104	Vertical Fixed Roof/IFR	Slops/water	6.1	7.62	116	10.0	1,160

Note* **Shell proposes to install fixed roof geodesmic domes for tanks containing Jet fuels at the converted Clyde Terminal. As the specifications for those geodesmic domes had not been confirmed at the time this EIS was prepared, the TANKS modelling undertaken in the AQIA assumed these Jet fuel storage tanks would be fitted with fixed roofs.**

15.2.4 Sensitive Receivers

Sensitive receivers are identified in the Approved Methods as anywhere someone works or resides or may work or reside, including residential areas, hospitals, hotels, shopping centres, play grounds, recreational centres, and the like. The primary sensitive receivers associated with the converted Clyde Terminal are commercial receivers located adjacent to the Project Area and residences located greater than 400 m from the Project Area.

The Project Area is adjacent to commercial and industrial receivers on all sides, although a river separates the Project from receivers to the south and east. The nearest residential receivers are located approximately 400 m to the north-east, 1.1 km to the south-east, 600 m to the south and 800 m to the west.

15.2.5 Annual VOC Emission Rates

The annual emission rates calculated from the TANKS model were compared against the annual emission rates from the former Clyde Refinery for the previous four Annual Return periods as shown in **Table 15-4**. This is as per the data presented on the NSW EPA webpage for Shell's EPL No. 570:
http://www.environment.nsw.gov.au/prpoeoapp/default.aspx

Where annual return data was not available on the EPA webpage, the Australian Government National Pollution Inventory (NPI) database available on the web was utilised:

http://www.npi.gov.au/npidata/action/load/browse-search

There may be slight differences in data provided for the EPA Annual Return when compared with the NPI return. This is due to the differences in State and Commonwealth annual return reporting periods, as well as data formatting (i.e. rounding up differently). The comparison has been made to show the relative reduction in volatile emissions as a result of the Project.

Table 15-4 Emission Rates for Annual Return Periods and Predicted Emissions from the Project

Period	Emission Rate (kg/yr)	
	Total VOCs	**Benzene**
2008 to 2009	229,278	4,749
2009 to 2010	263,470	8,657
2010 to 2011	260,000 [1]	12,000 [1]
2011 to 2012	219,342	20,870
The Project	40,688	148

[1] NPI Data for the Shell Clyde Refinery (SEWPAC, 2013),

The converted Clyde Terminal's predicted total VOC emission rate of 40,688 kg per year shows a reduction of approximately 85 percent from the 2009-2010 reporting period. The predicted benzene emission rate of 148 kg per year shows a reduction of approximately 99 percent when compared to the previous maximum annual total emission rate of benzene of 20,870 kg/year for 2011-2012. A comparison of the annual emission rates calculated from the TANKS model against the annual emission rates from the recent operations at the former Clyde Refinery's previous four Annual Return periods shows a significant reduction in emissions from the Project Area as a result of the Project.

15.2.6 Dispersion Modelling Results

Benzene

Modelled predictions for the maximum one hour average concentration (99.9th percentile) for benzene are presented in a contour plot in **Figure 5** of **Appendix C,** which shows that the benzene concentration contours do not exceed the EPA one hour maximum criterion (99.9th percentile) of 29 µg/m^3 at any point in the modelled area. The maximum one hour average concentration (99.9th percentile) for benzene was predicted to be 0.68 µg/m^3 which is well below the EPA criterion. The maximum predicted value (99.9th percentile) at any residential receiver is 0.20 µg/m^3 (at John Street, Rydalmere), less than a third of the maximum value reported and 0.7 percent of the EPA criterion.

Total VOCs

Modelled predictions for the maximum one hour average concentration (99.9th percentile) for total VOCs is presented in a contour plot in **Figure 4** of **Appendix C**. The maximum one-hour average concentration (99.9th percentile) for total VOCs was predicted to be 176 µg/m^3. The maximum predicted value (99.9th percentile) at any residential receiver is 63 µg/m^3 (John Street, Rydalmere), less than half of the maximum value reported.

As discussed in **Section 15.1.2** there is no criterion for total VOCs. The *National Pollution Inventory Emissions Estimation Technique Manual for Fuel and Organic Liquid Storage* (NPI, 2012), however, provides a breakdown of the typical fuel composition for Diesel, Unleaded Petrol and Jet Kerosene with regards to VOCs. For the purpose of this assessment, maximum one-hour average concentration (99.9th percentile) individual VOC pollutant concentrations were conservatively estimated based on the typical composition for the above mentioned fuels, and are presented in **Table 15-5**. The associated composition percentages were applied to the maximum ground level concentration of 176 µg/m^3, and the estimated worst case pollutant values were calculated for individual VOCs. This method is considered to be highly conservative as it assumes that 100 percent of the total VOC ground level concentration predicted is the one product, where in reality it is a mixture of all products.

Table 15-5 Maximum One Hour Average Concentration (99.9th percentile) for VOCs

VOC	Typical Fuel Composition from NPI (Percent)			Maximum One Hour Average Concentration (99.9th percentile) (µg/m^3)			EPA Criteria (µg/m^3)
	Diesel	Unleaded Petrol	Jet Kerosene	Diesel	Unleaded Petrol	Jet Kerosene	
Benzene	0.030	0.933	0.367	0.1	1.6	0.6	29
Cumene	0.975	0.100	2.830	1.7	0.2	5.0	21
Cyclohexane	0.010	0.765	1.200	0.0	1.3	2.1	260
Ethylbenzene	0.110	1.533	0.517	0.2	2.7	0.9	8000
n-Hexane	0.010	1.830	4.650	0.0	3.2	8.2	3200
PAH	0.360	0.610	0.985	0.6	1.1	1.7	440 [1]
Toluene	0.100	5.603	0.180	0.2	9.9	0.3	360
Xylenes	0.345	7.747	1.880	0.6	13.6	3.3	190

[1] A derived criterion for PAH as Naphthalene has been applied in the assessment as this is the most likely volatile PAH expected. The criterion derivation is detailed in **Appendix B** of **Appendix C**. The EPA criterion for PAH as benzo[a]pyrene is not considered appropriate for this assessment as it is semi-volatile and unlikely to be volatile at the storage temperatures.

The volume-weighted average calculated value for benzene from the table is 0.76 ug/m^3 which is comparable to the maximum modelled benzene concentration of 0.68 ug/m^3. The benzene data shows a close correspondence and validates the screening method employed for assessing total VOC impacts.

From **Table 15-5** it can be seen that for each fuel type the suite of VOCs is within the applicable maximum one hour average concentration (99.9th percentile) EPA criterion. These values are also based on a concentration predicted within the Project Area boundary and as such the likely impact at the nearest receivers would be significantly lower than these values.

15.2.7 Overall Project Impacts

Operation of the converted Clyde Terminal is not predicted to result in exceedances of applicable air quality criteria. Potential odour impacts from operation of the Clyde Terminal are also considered to be negligible. Operation of the Clyde Terminal would continue to yield significantly improved air quality and odour emissions from the Project Area compared to previous years due to the cessation of refining activities at the Clyde Terminal. As such, no additional mitigation measures are considered necessary for operation of the converted Clyde Terminal. Mitigation measures have been recommended to manage potential impacts to air quality resulting from the proposed demolition and construction activities, as suspended dust particles may otherwise impact on nearby receivers.

Given the lack of ambient background monitoring data for VOCs and benzene, an assessment of the cumulative impacts of the Project in conjunction with other nearby operations could not be undertaken. However since the cessation of refining activities at the Clyde Terminal, any such cumulative impacts would have already been significantly minimised. The predicted low air quality impacts associated with the proposed Project also suggests that the potential for significant cumulative impacts is low.

The ongoing operation of the converted Clyde Terminal would be undertaken in accordance with Shell's EPL No. 570 (or any superseding EPL) to ensure compliance with the POEO Act. The engineering design and upgrade works for tanks at the Clyde Terminal continue to be undertaken with reference to the requirements of the POEO Act and the *Protection of the Environment Operations (Clean Air) Regulation 2010*.

It is noted that the TANKS model takes into account discharges that result as evaporative losses from stored liquid, particularly during tank filling and transfers. Any such discharges would have negligible impacts for air quality and human health.

15.3 Mitigation Measures

Potential fugitive dust and odour impacts resulting from demolition and construction works would be managed by the CEMP which would include the following measures:

- Loads would be covered during transportation;
- Exposed surfaces and roads would be watered as required;
- Measures would be implemented to modify or suspend dust-generating activities during periods of high wind speeds or whenever dust plumes from the works are visible. A high wind value should be decided though discussions with regulators, however a typical value is 8 m/s averaged over a one hour period;
- Regularly trafficked surfaces would be sealed as soon as practicable after construction;
- Roadway use would be controlled i.e. through defined road access to minimise dust;
- Complaints management system would be in place; and
- Accidental spills would be immediately cleaned up.

Potential fuel combustion emissions resulting from vehicles and equipment associated with the demolition and construction works would be managed with the following measures:

- Engines would be turned off while parked onsite;
- Vehicular access would be confined to designated, sealed access roads;
- Equipment, plant and machinery would be regularly tuned, modified or maintained to minimise visible smoke and emissions;
- Project Area speed limits would be implemented; and
- Haul road lengths would be minimised.

15.4 Residual Impacts

Shell currently undertakes air quality monitoring in accordance with the conditions of EPL 570. The monitoring will continue during the conversion phase of the project and as well when the Terminal is completed subject to an application to the EPA to remove redundant monitoring requirements. It is predicted that benzene emissions would be well below the EPA criteria. The maximum one hour average concentration (99.9th percentile) for total VOCs was predicted to be 176 µg/m^3. The maximum predicted value (99.9th percentile) of VOCs at any residential receiver is 63 µg/m^3, less than half of the maximum value reported. The maximum one hour average concentration (99.9th percentile) for benzene was predicted to be 0.68 µg/m^3, which is well below the EPA criterion for residential receivers.

With the proposed mitigation measures outlined in **Section 15.3** in place, impacts to air quality resulting from demolition and construction generated dust at the Project are anticipated to be low. In the highly unlikely event that discharges to air from the converted Clyde Terminal are found to be in exceedance of EPA criteria, Shell would notify the EPA and implement further management strategies to ensure that the Project Area can continue to meet relevant air quality criteria.

16.0 Ecology

Relevant DGRs: The EIS must address **Biodiversity** – including impacts to terrestrial and aquatic ecology and ways to maintain and improve intact stands of riparian vegetation to the north-east and east of the refinery site.

16.1 Methodology

An Ecological Assessment was undertaken by AECOM in order to meet the DGRs, the requirements of the OEH and to more specifically:

- Determine if there would be, or is likely to be a significant impact to critical habitat, threatened species, populations or ecological communities, or their habitats protected under the EPBC Act, TSC Act, and/or the FM Act;
- Recommend mitigation measures that would minimise the risk of potential impacts to protected ecological values within the vicinity of the Project Area; and
- Recommend any additional assessments that may be required.

The Ecological Assessment is provided in **Appendix D** of **Volume 2** of this EIS and should be read in conjunction with this **Section 16.0**.

A comprehensive desktop study was undertaken which included the following activities:

- Database searches to compile a comprehensive list of matters protected under the EPBC Act, TSC Act and FM Act that are relevant to the environmental context of the Project Area, including the:
    - *NSW Office of Environment and Heritage's BioNet Atlas of Wildlife* in October 2012, and in 11 February 2013 to take note of any updated recorded locations of listed species (OEH's Atlas of Wildlife, OEH, 2013a);
    - *Commonwealth Department of Sustainability, Environment, Water, Population and Communities' (*Commonwealth Department of the Environment*) Protected Matters Search Tool* on 14 September 2012 (SEWPAC, 2012); and
    - *NSW Department of Primary Industries Fisheries threatened and protected species records viewer* (Department of Primary Industries Fisheries, 2013).

A preliminary habitat assessment was undertaken on 20 September 2012. During this habitat assessment, specific attention was paid to identifying known and potential areas of GGBF habitat within the Project Area and included:

- Each area where OEH's Atlas of Wildlife returned records for the species as well as additional drainage and bunded areas, which have water holding capacity; and
- Areas containing potential shelter habitat and aquatic vegetation were actively searched for sheltering and basking frogs and tadpoles.

Site investigations were conducted by two AECOM ecologists on 20 September 2012, which comprised the following:

- Ground truthing of vegetation mapping where access was permissible; and
- Habitat assessment, paying particular regard to potential GGBF habitat including field surveys which involved call playback and spotlighting for eye shine commencing at dusk and continuing into the night.

The *Significant Impact Guidelines for the vulnerable Green and Golden Bell Frog Litoria aurea*: *EPBC Act Policy Statement 3.19* (Commonwealth of Australia, 2009) recommends that surveys for this species be undertaken over at least four nights. However, given that survey work was performed during optimal frog calling and breeding conditions, two nights were considered sufficient to establish the presence of the GGBF at the Project Area. Any further information obtained from additional night surveys would therefore not have significantly aided the assessment.

During field surveys (10 and 11 October 2012) conversations with Shell personnel resulted in anecdotal evidence of the presence of small bats nesting in an area of external casing to a tall concrete stack within the Project Area. The bats were evident up to five years ago but have not been seen since.

Shell facilitated appropriately trained personnel to inspect the areas of potential bat habitat. This being the only practical course of action, given the significant risk posed due to 'working from heights' external to available safe working platforms. Further advice was subsequently undertaken on this matter from Eco Logical Australia Pty Ltd (Eco Logical) supporting the earlier view that there was no current evidence that the bats were present at the Clyde facility although monitoring would be required before demolition takes place (refer to **Appendix C** of **Appendix D**).

For a detailed explanation of the methodology of the Ecological Assessment, refer to **Section 1.3** of **Appendix D**.

The relevant terminology for ecological impact assessments which were used throughout the Ecological Assessment as follows:

- The 'Subject Area' – the area to be directly affected by the proposal, which includes the demolition and construction footprint as shown in **Figure 6-1** and **Figure 6-3**. For the purposes of the Ecological Assessment, the 'Project Area' was used as a synonym for the 'Subject Area';
- The 'Study Area' – includes the Project Area and any additional areas which may be indirectly affected by the proposal. For the sake of completeness, the Study Area in the Ecological Assessment was taken to be the area that lies within a 5 km radius, or 10 km diameter, of the Project Area (refer to **Figures 8** and **11** of **Appendix D**); and
- The 'Locality' – for the purpose of the Ecological Assessment, the Locality was taken to mean the area within 10 km of the Project Area, and also comprises those areas that were used for the purpose of data searches in threatened species databases (refer to **Figures 8** and **11** of **Appendix D**).

16.2 Existing Conditions

A summary of the marine and terrestrial fauna and flora identified in the Locality (within 10 km of the Project Area) from searches of the EPBC Protected Matters Search Tool and OEH's Atlas of Wildlife is provided in **Table 16-1** below. Some of the species returned by the Commonwealth search tool only were subsequently found to be listed under both the Commonwealth and NSW legislation, and vice versa. **Table 16-1** takes this overlap into account.

Table 16-1 Vulnerable, Endangered and Critically Endangered Terrestrial and Marine Flora and Fauna Identified within 10 km of the Project Area

Category	Listed Under Both the EPBC Act and TSC Act	Listed under the TSC Act only	Listed under the EPBC Act only	Total
Terrestrial Fauna (including Migratory Species)				
Birds	7	39	1	47
Frogs	5	3	0	8
Mammals	8	8	1	17
Reptiles	1	1	0	2
Gastropods	0	1	0	1
Fauna Communities	0	3	1	4
Total	**21**	**55**	**3**	**79**
Terrestrial Flora				
Flora Species	34	14	2	50
Flora Communities	3	15	0	18
Total	**37**	**29**	**2**	**68**

Category	Listed Under Both the EPBC Act and TSC Act	Listed under the TSC Act only	Listed under the EPBC Act only	Total
Marine Fauna (including Migratory Species)				
Birds	0	0	1	1
Reptiles	3	0	2	5
Bony Fish	0	0	3	3
Total	**3**	**0**	**6**	**9**
Migratory and Wetland Species not listed in any other category				
Birds	0	0	23	23
Sharks	0	0	1	1
Total	**0**	**0**	**24**	**24**

16.2.1 Local Vegetation

Vegetation within the boundaries of the Project Area comprises planted native and exotic trees and large shrubs which line external roadways, car parking areas and some buildings. Native species include Spotted Gum (*Corymbia maculata*), Prickly-leaf Paperbark (*Melaleuca styphelioides*), Swamp Oak (*Casuarina glauca*), and Bottlebrush species (*Callistemon* sp). There are numerous introduced planted species present at the Project Area include Monterey Pine Tree and *Camellia* and *Rhododendrum* species, with occasional grassed areas that are maintained by mowing.

Remnant vegetation present at the Project Area is limited to the following areas:

- Foreshore vegetation adjacent to the Project Area, which has been mapped (SMCMA, 2010) as containing the following vegetation communities:
    - Mangroves;
    - Coastal Saltmarsh;
    - Swamp Oak Forest;
    - Wetlands; and
    - Phragmites Reedland.
- The remnant 'wetland' located at the north-east boundary of the Project Area is described by Urban Bushland Management Consultants, 2007 as being comprised of:
    - A wetland, which is dominated by Cumbungi (*Typha* spp), and dense growth of the introduced Spiny Rush (*Juncus acutus*);
    - A low woodland which has been planted with species that are largely non-indigenous. Ordinarily such species would be regarded as weeds, however the majority of this vegetation provides habitat for other native fauna and enhances local landscape values. For these reason, this non-indigenous vegetation is conserved at the Project Area; and
    - Swamp Oak Floodplain Forest and sclerophyll vegetation on the more elevated land surrounding the wetland.
- The boundary fence line adjacent Duck River, in the south-western corner of the Project Area, is lined with mature Swamp Oak (*Casuarina glauca*) trees. These trees are often continuous with uneven aged stands of Swamp Oak within the foreshore of the river.

During a Baseline Biodiversity Assessment conducted in 2008, this remnant wetland was again confirmed to contain Swamp Oak Floodplain Forest, planted mixed Eucalyptus woodland, swamp/reedland and mangrove forest and saltmarsh. At that time the aquatic component of this remnant wetland was described as consisting of five large interconnected ponds as well as smaller ponds located to the west, with depth ranging from 40 cm to

over 1 m. Areas of open water were present as well as areas covered by dense emergent vegetation (mostly Typha). Around 75 percent of the aquatic environment was found to be covered by emergent vegetation. These reed beds were observed along the banks of the ponds and also within them. Submerged vegetation was also observed (NGH Environmental, 2009).

The remnant wetland system is moderately to highly disturbed, given the following factors (NGH Environmental, 2009):

- Poor water quality;
- High levels of garbage, especially along Duck River and the southern bank of Parramatta River adjacent to the Project Area;
- Weed infestations; and
- Presence of feral animals and pest species (e.g. plague minnow at the remnant wetlands).

16.2.2 Threatened and Endangered Ecological Communities

Five EEC's listed under either or both the EPBC Act and the TSC Act have been previously recorded within the Project Area:

- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This EEC occurs as intermittent stands along the foreshore and within the remnant wetland in the Project Area and as intermittent stands along the foreshore of both Duck and Parramatta Rivers (refer to **Figure 6** of **Appendix D**);
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as an EEC under the TSC Act. Sclerophyll vegetation has been previously recorded in the forested area of the remnant wetlands in the Project Area;
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion. These remnant EEC wetlands occur in the Project Area (refer to **Figure 6** of **Appendix D**); and
- Themeda Grassland on Seacliffs and Coastal Headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions. This riparian vegetation also meets characteristics of Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion. These EEC saltmarshes occur along the foreshore vegetation fringing the Project Area (refer to **Figure 6** of **Appendix D**).

16.2.3 Weeds

The following weeds listed under the EPBC Act and/or the *Noxious Weeds Act 1993* were identified during field surveys at the Project Area:

- Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*);
- Lantana (*Lantana camara*). This species was also recorded throughout most locations of the site that were surveyed during 2008 (NGH Environmental, 2009);
- Blackberry (*Rubus fruticosus* aggregate spp except cultivars);
- Asparagus Fern (*Asparagus aethiopicus, A. densiflorus, Protasparagus aethiopicus*). This species was also recorded around the perimeter fence at several locations during flora surveys conducted in 2008 (NGH Environmental, 2009);
- Balloon Vine (*Cardiospermum grandiflorum*). This species was also recorded around the perimeter fence growing up into the canopy of the Swamp Oak Forest within the remnant wetland during surveys conducted in 2008 (NGH Environmental, 2009);
- Bridal Creeper (*Asparagus asparagoides*); and
- Radiata Pine, Monterey Pine (*Pinus radiata*).

In addition, the following weed species were identified at the Project Area by Urban Bushland Management Consultants, in 2007:

- Pellitory (*Parietaria judacia*). This species was also recorded around the perimeter fence at several locations during flora surveys conducted in 2008 (NGH Environmental, 2009);
- Pampass Grass (*Cortaderia* species);
- Boneseed (*Chrysanthemoides moniliger* subspecies *monilifera*);
- Castor Oil Plant (*Ricinus communis*);
- Broad-leaved Privet (*Ligustrum lucidum*). This species was also recorded within the Swamp Oak Forest within the remnant wetland during surveys conducted in 2008 (NGH Environmental, 2009); and
- Green Cestrum (*Cestrum parqui*).

The Class 4 noxious weed Prickly Pear (*Opuntia stricta*) was also recorded by NGH Environmental during survey work conducted in 2008 (NGH Environmental, 2009). This weed was not captured in the Department of Primary Industries' Noxious Weeds Declaration database for the Parramatta LGA (Department of Primary Industries, 2013).

16.2.4 Threatened Flora

As per **Table 12** in **Appendix B** of **Appendix D**, there were total of 50 vulnerable, endangered or critically endangered flora species known or predicted to occur within the Locality (i.e. within 10 km of the Project Area), five of which have been recorded in the Study Area. Two of these five species are also known to have been previously recorded within the Project Area:

- The vulnerable Downy Wattle (*Acacia pubescens*). There are two known recorded locations of the species occurring within the foreshore fringing the Project Area (refer to **Figure 6** and **Figure 8** of **Appendix D**); and
- The vulnerable Narrow-leafed Wilsonia (*Wilsonia backhousei*). There are six known recorded locations of the species occurring in the intermittent areas of saltmarsh along the foreshore fringing the Project Area (refer to **Figure 6** and **Figure 8** of **Appendix D**).

16.2.5 Threatened Fauna

As per **Table 13** in **Appendix B** of **Appendix D**, there were 79 vulnerable, endangered or critically endangered fauna species known or predicted to occur within the Locality (i.e. within 10 km of the Project Area), nine of which have been previously recorded in the Study Area, and six of which that were considered to have a medium likelihood of occurring at the Project Area:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Southern Myotis (*Myotis macropus*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*); and
- Eastern Freetail-bat (*Mormopterus norfolkensis*).

An additional two listed terrestrial fauna species were found to have been previously recorded at the Project Area itself:

- The endangered GGBF (*Litoria aurea*) has been previously recorded as occurring in the Project Area, and the Project Area contains a known population of the species (refer to **Figure 9** of **Appendix D**); and
- The endangered Grey-headed Flying-fox (*Petaurus poliocephalus*) has been previously recorded in the remnant wetlands at the Project Area (refer to **Figure 11** of **Appendix D**).

An additional 15 listed terrestrial fauna species were found to have been previously recorded within the Locality, but not within the Project Area or the Study Area.

Two fauna populations have also been previously recorded in the Study Area:

- The endangered White-fronted Chat population in the Sydney Metropolitan Catchment Management Area (*Epthianura albifrons*). The closest known recorded location of this population is at Newington, around 1.3 km south-east of the Project Area (refer to **Figure 11** of **Appendix D**); and
- *Dasyurus maculatus maculatus* (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll. The closest known recorded location of the species is at Granville, around 2 km south-west of the Project Area (refer to **Figure 11** of **Appendix D**).

In addition, one listed fauna population has also been previously recorded in the Locality but not within the Study Area:

- The endangered Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai LGA's (*Callocephalon fimbriatum*) (refer to **Figure 11** of **Appendix D**).

Sections of the Project Area, particularly the remnant wetland, provide good quality habitat features for a range of fauna. Urban Bushland Management Consultants previously identified this remnant wetland as providing the following habitat types (Urban Bushland Management Consultants, 2007):

- An aquatic environment;
- A low woodland; and
- A Swamp Oak forest.

During previous surveys conducted at the Project Area, the aquatic features of this remnant wetland environment have been identified as providing a variety of habitat resources for several native wetland birds. In 2005 flora and fauna surveys also conducted by Urban Bushland Management Consultants (2006), water birds were observed foraging and sheltering within these remnant wetlands, and evidence of breeding was also detected.

During survey work conducted in 2008, NGH Environmental also described the following habitat values of the river system at the Project Area:

- The foreshore area surrounding the riparian vegetation and adjacent to open water (i.e. Duck and Parramatta Rivers) provides ideal foraging habitat for diving bird species such as Cormorants and Darters;
- At low tide the exposed muddy banks and mangrove roots provide foraging habitat for species such as Sharp-tailed Sandpiper, Herons, Egrets and Plovers;
- Habitat for fish species, particularly for breeding and juvenile fish within the mangroves;
- Saltmarsh supporting macroinvertebrates such as crabs and snails;
- Boulders present in some sections of the Project Area offer some limited habitat value for reptilian species. Tidal flushing prevents leaf litter build up, and so reptile habitat is limited in mangroves;
- Only limited numbers of hollow-bearing trees have been recorded at the Project Area, and where these do occur they tend to be small in size; and
- The remnant wetland area contains some logs and fallen branches which could provide some habitat value for certain species.

NGH Environmental also conducted a bird survey at the remnant wetland in 2008. The results of this survey as they relate to wetland bird species are as follows:

- Native insectivorous and nectivorous birds indicative of better quality remnant vegetation were recorded in the wetlands (i.e. Silvereye (*Zosterops lateralis*), Red-browed Finch (*Neochmia temporalis*), White-browed Scrub Wren (*Sericornis frontalis*), and White-plumed Honeyeater (*Lichenostomus penicillatus*));
- Common native species normally associated with urban and altered environments were recorded in the wetlands (e.g. Magpie (*Cracticus tibicen*), Raven (*Corvus coronoides*), Noisy Miner (*Manorina melanocephala*), Rainbow Lorikeet (*Trichoglossus haematodus*) and Red Wattlebird (*Anthochaera carunculata*)); and
- Introduced species not native to Australia and prone to excluding native birds were recorded in the wetlands (e.g. Indian Myna (*Acridotheres tristis*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Common Starling (*Sturnus vulgaris*), and Spotted Turtle-dove (*Spilopelia chinensis*)).

The low Eucalypt woodland within this remnant wetland environment has not changed significantly since survey work was performed during 2005 (Urban Bushland Management Consultants, 2007). This community is located to the east, south and west of the remnant wetlands themselves, and has resulted from plantings and landscaping undertaken on raised embankments. As the tree height within this low woodland environment is around 10 m, none of the flora present support suitable nesting hollows or other important breeding environments (Urban Bushland Management Consultants, 2007). The canopy of these trees is largely uniform, and provides connectivity with the adjacent Swamp Oak Floodplain Forest and other flora communities. The understorey and ground cover in the low woodlands is fairly dense, providing foraging opportunities for native bird species. Furthermore, seasonal foraging by nectivorous birds and mammals is also likely to take place in this area (Urban Bushland Management Consultants, 2007).

The Swamp Oak Floodplain Forest surrounding the remnant wetland appears to be comprised of a remnant stand of naturally occurring vegetation. These *Casuarina* trees are around 8 m tall, forming a continuous canopy. The understory and groundcover are limited due to this dense canopy shade, and the *Casuarina* needles which are known to suppress the growth of other flora species. This flora community contains a range of foraging, sheltering and nesting opportunities for fauna species (Urban Bushland Management Consultants, 2007).

Urban Bushland Management Consultants have previously concluded that the Project Area does not comprise a significant component of any regionally or locally important corridors for fauna dispersion. A band of Mangrove riparian vegetation does extend toward the south from the Project Area along Duck River, and also toward the west along Parramatta River for a few kilometres. However, only fauna species that are adaptable to surrounding urban conditions are likely to use this corridor for dispersion (Urban Bushland Management Consultants, 2007).

The remainder of the Project Area where the Clyde Terminal infrastructure is currently placed provides limited habitat for terrestrial fauna. Nevertheless, this highly modified area is also observed to contain some habitat for the GGBF, and birds have been observed perched on existing infrastructure at the Clyde Terminal whilst moving between habitat sites. Indeed, the Project Area's various drainage lines and ponded areas within tankfarms provide some limited habitat features for frogs and water birds. A range of water birds were also evident during field inspections, including: Purple Swamphen (*Porphyrio porphyria*); Eurasian Coot (*Fulica atra*); Australian White Ibis (*Threskiornis molucca*); Pacific Black Duck (*Anas superciliosa*); Spoonbill (*Platalea regia*); and Welcome Swallow (*Hirundo neoxena*).

Green and Golden Bell Frog

The Project Area is reported to contain a key Parramatta population of the GGBF (Department of Environment and Climate Change, 2008c). As per the *Significant Impact Guidelines for the vulnerable Green and Golden Bell Frog Litoria aurea*: *EPBC Act Policy Statement 3.19* (Department of Environment, Water, Heritage and Arts, 2009), a current population of GGBF is considered to be present on a site where one of more GGBF individuals have been detected on at least one occasion since 1995, even if they have not been recently discovered at the site. Of the eight records of GGBF occurring at the Project Area, four were recorded in 1999, two in 2000, and two in 2005 (OEH, 2013a; Urban Bushland Management Consultants, 2007). Two sites at the Project Area have also been found to contain live frogs during surveys conducted in October 2012. Operational management of tankfarm bunds requires these to be maintained in a dry state and drained as soon as possible following rain to preserve the bund capacities in case of spills. Consequently, these tankfarms do not contain natural habitats for frogs despite their presence having been previously recorded.

Sites within the Project Area, where the GGBF has been detected or where potential habitat may occur, include the areas shown in **Table 16-2** and **Figure 16-1**.

Table 16-2 Summary of GGBF Detected or Where Potential Habitat May Occur

Area	GGBF Previous Records	GGBF Potential Habitat
Remnant wetlands	Four male GGBFs were heard actively calling during surveys in October 2012. One GGBF individual was recorded at this location in in 1999, and another two in 2005 (OEH, 2013a; Urban Bushland Management Consultants, 2007).	Man-made and designed to receive clean waste water from the Project Area. Based on past and current records, the remnant wetland is the primary location of GGBF on the Project Area. This area was therefore used as a reference site during the October 2012 GGBF surveys.

Area	GGBF Previous Records	GGBF Potential Habitat
Tankfarm B	Two male GGBFs were heard actively calling during surveys in October 2012. There is anecdotal evidence of tadpoles (species unknown) previously occurring in the waters in the base of Tankfarm B.	Tankfarm B is one of the two tankfarms at the Project Area that retains ponded rain water because drainage appears to have been blocked by a small dense stand of *Typha orientalis* (Cumbungi). Sediment and soil waste on the floor of the tankfarm appears to have promoted creation of an artificial pool of water inside the northern bund wall, suggesting that the area may not provide suitable GGBF habitat. Tankfarm B is not hydrologically connected to the remnant wetland in the north-east of the Project Area. The closest native vegetation to Tankfarm B is a stand of Swamp Oak floodplain forest fringing Duck River, situated around 170 m to the south-east beyond the rainwater retention basin. However, GGBF are also known to move between sites that have terrestrial connections, and have a relatively large dispersion (the species is known to have travelled between 1 to 3 km in a single day or night: Department of Environment, Water, Heritage and Arts, 2009b). It is therefore possible that GGBF at Tankfarm B travel through terrestrial corridors (such as the mangroves along Duck and Parramatta Rivers, or throughout the Clyde Terminal site itself) as it moves throughout the Locality. The mangroves and riverside floodplain forest are not impacted by the works in the Clyde Terminal and would benefit from the improved environmental controls to be implemented as part of the Project.
Tank 52	No evidence of GGBF presence was recorded in this location during surveys in October 2012. There are no previous records of GGBFs occurring at this location (OEH, 2013a).	Tank 52 contains a very shallow ponded area with emergent vegetation dominated by the introduced (Umbrella Sedge (*Cyperus eragrostis*)). In the absence of rainfall, the ponded area appears to be fed by moisture venting from external tank pipes which condenses into the area as warm water. The surrounding non-ponded areas are a combination of concrete bunds and introduced grasses which are controlled during regular maintenance programs. Ponded water around Tank 52 is also known to be relatively oily (pers.comm. Ian Bell). Due to the presence of ponded water, and given the fact that the area seems to retain water between rainfall events, it is possible that the area is or has been used as GGBF habitat at some point, although this it is considered unlikely for the area to currently provide suitable habitat.
Mobil Tankfarm	No evidence of GGBF presence was recorded in this location during surveys in October 2012. The only signs observed of aquatic fauna were resting water birds. One GGBF individual was recorded at this location in 1999 (OEH, 2013a).	Tanks 201, 203 and 204 lie within a bund in the centre of the six tanks at this tankfarm. On occasion, shallow ponded water has been present at this Tankfarm. The condition of tanks 201 to 204 beneath the ground surface is unknown. Groundwater and surface waters at this location may contain chromium as a legacy of land use prior to Shell's use of the Project Area for refining and related activities. However visual observations and analytical sampling of the standing water within the bund do not indicate contamination (ERM, 2012a).

Area	GGBF Previous Records	GGBF Potential Habitat
		The degraded nature of the Mobil Tankfarm ponded water suggests that the area may not provide suitable GGBF habitat. This may be the reason that the GGBF was not detected during 2012 surveys, when animals were actively calling at two other locations within the Project Area.
Tankfarm E1 (including Tanks 36 to 41)	No evidence of GGBF presence was recorded in this location during surveys in October 2012. One individual GGBF was recorded in this location in 2000 (OEH, 2013a).	During survey work conducted in 2012, no suitable GGBF habitat was identified in Tankfarm E1.

Grey-headed Flying-fox

The Grey-headed Flying-fox is known to have been previously recorded at several locations near the Project Area. It has also potentially been observed overflying the Project Area (refer to **Figure 10** of **Appendix D**). This species is known to occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (OEH, 2013b). The remnant wetland and large Fig tree within the Project Area may provide foraging habitat for the species. This habitat would not be disturbed as a result of the Project. The report prepared by Eco Logical (refer to **Appendix C** of **Appendix D**) also found that, in relation to this species, the Project Area does not contain suitable roosting habitat. Overall this species is therefore unlikely to be affected directly or indirectly by the proposed Project. However individuals of this species may dwell opportunistically at the Project Area, and there is some residual potential for the species to use the limited habitat available in the remnant wetlands. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act (refer to **Appendix D** of **Appendix D**), and a significant impact criteria assessment pursuant to the EPBC Act were prepared for this species. Both of these additional assessments found that it is unlikely that the Project would significantly impact on this species.

Microbats

There is historical anecdotal evidence of small bats nesting in an area of external casing associated with a tall concrete stack within the Project Area. This was further investigated by Eco Logical (refer to **Appendix C** of **Appendix D**) who concluded that, based on the Project Area's location and the roosting habitat available there, it is likely that microbat species could occasionally roost within the towers at the Project Area. It was concluded that there is unlikely to be significant impacts to microbat habitat as a result of the Project, due to

- The stacks and buildings currently being absent of bats;
- The likely historic use of the stacks being opportunistic and in response to a local food source;
- The availability of other man-made or potential artificial bat roosts in the area (e.g. along Duck River); and
- The highly industrialised and urbanised context and lack of native vegetation in the vicinity of the Project Area.

Nevertheless, mitigation measures have been recommended for the Project (refer to **Section 16.3**), including monitoring for evidence of microbats prior to demolition works commencing, which, if found, would trigger the need for further investigation. An assessment of significance (seven-part test) test pursuant to the TSC Act (refer to **Appendix D** of **Appendix D**) was nevertheless prepared for these species.

16.2.6 Threatened Marine Fauna

In total, nine marine fauna species listed under the EPBC Act and the TSC Act that are known or likely to occur within the Locality (refer to **Section 3.3** of **Appendix D**). None of these marine species have been previously recorded in the Locality, and all of these species were ultimately designated a low likelihood of occurring at the Project Area.

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G:\Projects\602 Projects\60236231\FIGURES\Ecology - Clyde\60236231 F16-1 Green and Golden Bell Frog Records 06 11 2013 TO Rev E

AECOM

GREEN AND GOLDEN BELL FROG (GGBF) RECORDS

Clyde Terminal Conversion Project
Environmental Impact Statement

Data Sources: State of NSW through the Office of Environment and Heritage (Bionet)
Urban Bushland Management Consultants (UBMS, 2007)

FIGURE 16-1

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16.2.7 Migratory Fauna

Searches using the EPBC Protected Matters search tool identified eight migratory species in addition to those that were already captured in the search for vulnerable, endangered or critically endangered as occurring within 10 km of the Project Area comprising. An additional 15 migratory wetland species were also identified using the EPBC Protected Matters search tool.

The Great Egret, an EPBC Act listed migratory species has been previously recorded at the remnant wetlands in the north-east of the Project Area (refer to **Figure 11** of **Appendix D**) during surveys conducted by Urban Bushland Management Consultants in 2005 (Urban Bushland Management Consultants, 2007). Previous surveys conducted by Urban Bushland Management Consultants in 2005 also identified the Clamorous Reed-warbler (*Acrocephalus stentoreus*) as being present in these remnant wetlands (Urban Bushland Management Consultants, 2007). This species is listed as migratory under the EPBC Act, but was not returned by the EPBC Protected Matters search tool query of the Locality.

NGH Environmental also conducted a bird survey at the remnant wetlands in 2008. It was found that the remnant wetlands and riparian zone along the Project Area boundary may provide suitable habitat for a range of wetland birds and migratory shorebird species. However, the Project Area overall provides only limited habitat for these species.

None of the other migratory species listed above are known to have been previously recorded within the vicinity of the Project Area, and these remaining species were therefore all assigned a low likelihood of occurring at the Project Area.

16.3 Potential Impacts

16.3.1 Threatening Process

Schedule 3 of the TSC Act identifies key threatening processes in NSW that are most likely to jeopardise the survival of threatened species, populations and ecological communities within NSW. The Atlas of Wildlife, (OEH, 2013a) was searched to determine the key threatening processes that are relevant to the Locality. These are outlined in **Section 4.1.1** of **Appendix D**. Many of these listed threats relate to direct impacts to terrestrial flora and fauna species through, for example, vegetation and habitat clearing.

The proposed demolition and construction works would not involve significant vegetation clearing. It is possible that occasional trees or shrubs may however be impacted due to their proximity to buildings and structures that are to be demolished. However any such clearing or root damage of retained vegetation would:

- Only be minimal and does not include any significant flora species, and
- Not lead to increased fragmentation of vegetation communities within the locality.

The need for impacts to individual trees and shrubs would be assessed on a case-by-case basis and would only be undertaken in order to safely perform demolition and / or construction works. Opportunities to replace individually affected trees and shrubs would also be explored.

Likewise, habitat features beyond the boundary of the Project Area such as fallen timber, dead standing trees, termite mounds, deadwood and bushrocks would not be removed as part of the Project.

Staff and contractors would continue to access the Project Area using designated roads, as road access to the Clyde Terminal is well established, with the existing transport infrastructure adequate to service the construction activities that would occur at the Clyde Terminal during the demolition and construction activities. Project related traffic movements would be largely along the local high density industrial roads Durham Street, Colquhoun Street.

The Project would also involve improvements to existing drainage and wastewater treatment systems, and is therefore not anticipated to impact water quality in the vicinity of the Project Area, or for the Duck and Parramatta River catchments (refer to **Section 13.2**).

The demolition and construction activities have the potential to generate dust and sediment runoff impacting on surface water quality at the Project Area. This can reduce the primary productivity of nearby plants and trees (i.e. through coating of leaves and reducing photosynthesis). However, a temporary elevation of dust levels would be unlikely to have a significant impact on the health of individual plants or flora species. Dust levels generated through demolition and construction activities also have the potential to further directly impact on surface water quality as treated wastewater that cannot be reused at the Clyde Terminal would continue to be discharged offsite to Duck River. However it is anticipated that the management measures outlined in **Section 13.3** would be

adequate to mitigate any such impacts to a negligible level. Specific management measures to prevent asbestos dust being released at the Project Area are outlined in **Section 20.3**.

Soil borne pathogens include Root Rot Fungus *Phytophthora cinnamomi,* which is a Key Threatening Process under the TSC Act. Provided the recommended mitigation measures outlined in **Sections 16.4.3** and **16.4.4** are implemented, it is unlikely that the Project would result in the spread of potential pathogens.

Noise and vibration impacts of the proposed Project are considered in **Section 22.0**. Demolition and construction noise (including construction-generated traffic noise) is predicted to result in only minor temporary exceedances of relevant construction noise management levels, and demolition and construction vibration is predicted to be negligible. It is not expected that the proposed converted operation of the Clyde Terminal would increase the noise impact compared to the current operation of the Clyde Terminal. Furthermore, prior operation of the Clyde Refinery included more noise sources which have already been decommissioned. Therefore any resident fauna would be somewhat tolerant of the current level of noise. Therefore any impacts from noise during construction and ongoing operation of the Project Area for fauna would be minimal.

16.3.2 Potential Impacts to Terrestrial Flora and Fauna

The analysis conducted in **Table 12** and **Table 13** in **Appendix B** of **Appendix D** confirms that the majority of terrestrial species identified as being known or predicted to occur within the Locality have a low likelihood of actually occurring within the Project Area. However, two terrestrial fauna species have been previously recorded within the Project Area, and a further six were designated a medium likelihood of occurring at the Project Area. A further two listed flora species and five EECs have been previously recorded at the Project Area.

Downy Wattle (*Acacia pubescens*)

This species is known from the remnant wetland in the north-east of the Project Area and would therefore not be directly affected by the proposed demolition and ongoing operational activities of the Project. With the mitigation measures outlined in **Section 16.4.2** in place including the ongoing implementation of a bush regeneration program (Programmed Property Services, 2011), the Project is unlikely to directly impact on this species. With the mitigation measures outlined in **Sections 16.4.2**, **16.4.3**, and **16.4.4**, the conversion activities and the ongoing operation of the converted Clyde Terminal are unlikely to impact on this species. On this basis, an assessment of significance (seven-part test) pursuant to the TSC Act and a significant impact criteria assessment impact pursuant to the EPBC Act are not required for this species.

Narrow-leafed Wilsonia *(Wilsonia backhousei*)

This species occurs within the intermittent areas of saltmarsh along the foreshore fringing the Project Area (refer to **Figure 6** and **Figure 8** of **Appendix D**). The species would therefore not be directly impacted on by the Project. As per **Section 16.3.1** it is unlikely that this species would be impacted as a result of the conversion activities, or by the ongoing operation of the converted Clyde Terminal. The mitigation measures in **Sections 16.4.2**, **16.4.3**, and **16.4.4** would also ensure that the Project does not impact on this species. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this species.

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

This EEC occurs as intermittent stands along the foreshore and within the remnant wetland in the Project Area and as intermittent stands along the foreshore of both Duck and Parramatta Rivers (refer to **Figure 6** of **Appendix D**). Remnant Swamp Oak trees also line the boundary fence line adjacent Duck River, in the south-western corner of the Project Area. As these trees are continuous with vegetation within the foreshore, they are considered a constituent of this community. These trees would not be removed as part of the Project. As per **Section 16.3.1** it is unlikely that this community would be impacted as a result of the conversion activities, or by the ongoing operation of the converted Clyde Terminal. The mitigation measures in **Sections 16.4.2**, **16.4.3**, and **16.4.4** would also ensure that the Project does not impact on this community. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this EEC.

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as an EEC under the TSC Act.

Sclerophyll vegetation has been previously recorded in the forested area of the remnant wetlands in the Project Area. However this would not be removed as part of the Project. As per **Section 16.3.1** it is unlikely that this community would be impacted upon as a result of the conversion activities, or by the ongoing operation of the converted Clyde Terminal. The mitigation measures in **Sections 16.4.2**, **16.4.3**, and **16.4.4** would also ensure that

the Project does not impact on this community. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this EEC.

Sydney Freshwater Wetlands in the Sydney Basin Bioregion

Remnant wetlands occur in the north-east section of the Project Area (refer to **Figure 6** of **Appendix D**). This vegetation would not be directly impacted on during the Project as vegetation clearing at the remnant wetlands would not be undertaken. As outlined in **Sections 16.3.1** and **16.3.3,** clean water only would continue to be discharged to these remnant wetlands. With the mitigation measures outlined in **Section 16.4** the Project would not indirectly impact on this EEC. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this EEC.

Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion/Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

These saltmarshes occur as intermittent patches along the foreshore of both Duck and Parramatta rivers but not within the Project Area itself. As per **Sections 16.3.1** and **16.3.3** it is unlikely that this EEC would be indirectly impacted as a result of the Project. With the mitigation measures outlined in **Section 16.4** the Project would not indirectly impact on this EEC. Therefore an assessment of significance (seven-part test) a pursuant to the TSC Act is not required for this EEC.

Grey-headed Flying-fox (*Petaurus poliocephalus*)

Overall this species is unlikely to be affected directly or indirectly by the proposed Project. However individuals of this species may dwell opportunistically at the Project Area, use the limited habitat available in the remnant wetlands, and occasionally roost within the Project Area. An assessment of significance (seven-part test) pursuant to the TSC Act (refer to **Appendix D** of **Appendix D**) and an assessment of significant impact pursuant to the EPBC Act (refer to **Section 4.1.10** of **Appendix D**) were prepared for this species. These assessments found that the Project is unlikely to significantly impact on the species. A summary of these assessments is provided in **Table 16-3**.

Table 16-3 EPBC Act and TSC Act Tests for Grey-headed Flying-fox

Criteria	Impact
Significant Impact Criteria Assessment (EPBC Act)	
Would the Project:	
Lead to a long term decrease in the size of an important population of the species?	No/Unlikely: As per the assessment conducted by Eco Logical (refer to **Appendix C** of **Appendix D** and **Section 16.2.5**), the Project Area was not found to contain significant habitat for the Grey-headed Flying-fox, and therefore no important population of the species can be said to be reliant upon habitat at the Project Area. This species is therefore unlikely to be affected directly or indirectly by the proposed Project.
Reduce the area of occupancy of an important population?	
Fragment an existing important population into two or more populations?	
Adversely affect habitat critical to the survival of the species?	No: Given that Grey-headed Flying Foxes are likely to only use the Project Area opportunistically and also given the quality of alternative nearby habitat for the species.
Disrupt the breeding cycle of an important population?	No: There is limited potential breeding habitat for the species available at the Project Area. However, use of this habitat is considered unlikely. It is therefore highly unlikely that the Project would disrupt the breeding cycle of this species, and noting that no important population of Grey-headed Flying Fox has been recorded at the Project Area.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat?	No: The Project is not predicted to result in the increased presence of any invasive species that are harmful to the presence of Grey-headed Flying Fox.
Introduce disease that may cause the species to decline?	No: This is not considered to be relevant for Grey-headed Flying Fox at the Project Area.
Interfere substantially with the recovery of the species?	No: This is not considered to be relevant for Grey-headed Flying Fox at the Project Area.
Assessment of Significance (Seven-part Test) (TSC Act)	
Whether the Project is likely:	
To have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	The Project Area contains some suitable habitat that the species may be able to use for opportunistic roosting and foraging. The remnant wetlands in the Project Area may also provide limited breeding habitat for the species, however this is considered unlikely. There is no known local population of the species in the near vicinity of the Project Area that may otherwise be indirectly affected by the Project.

Criteria	Impact
In relation to the habitat of a threatened species: - The extent to which habitat is likely to be removed or modified as a result of the action proposed. - Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action. - The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	There is some residual potential for the Project to involve the demolition of old refinery infrastructure that is being used as Grey-headed Flying Fox as occasional roosting habitat. However this is considered unlikely given that Bats have not been sighted at the Project Area for some time. The remnant wetlands would, however, provide the best quality habitat at the Project Area and these wetlands would not be impacted on by the Project. The species is generally known to have the potential to disperse widely and through airborne movement. There are no specific corridors of movement for the Grey-headed Flying Fox throughout the Project Area and beyond. Any Grey-headed Flying Fox habitat in the area would therefore not become more fragmented or isolated from other habitats as a result of the Project. Any redundant refining infrastructure at the Project Area that may be found to house Grey-headed Flying Fox would not necessarily be the most suitable habitat for the species, and is likely to provide only opportunistic foraging or roosting habitat. The remnant wetlands at the Project Area provide superior habitat values for many species including Grey-headed Flying Fox, and these wetlands would not be impacted on by the Project.
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	The remnant wetlands and large Fig tree are the only habitat that can be considered to provide potentially significant habitat for the Grey-headed Flying Fox at the Project Area. This habitat is not considered critical for the species.
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	There are no specific recovery plans or threat abatement plans for the species. OEH has listed 31 priority actions to promote the recovery of threatened species and the abatement of key threatening processes in relation to Grey-headed Flying Fox (OEH, 2013), which include the need to monitor this species and obtain more information about it.
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Of the eight key threatening processes listed for Grey-headed Flying Fox by OEH (2013), the following are relevant to the location, the proposed Project and the species: - Loss of foraging habitat; - Loss of disturbance of roosting sites; - Electrocution on powerlines, entanglement in netting and on barbed wire; and - Negative public attitude and conflict with humans. The Project has some residual potential to contribute to these threatening processes. However, this is considered unlikely.

Microbats

The report provided by Eco Logical (refer to **Appendix C** of **Appendix D**) concluded that there is unlikely to be significant impacts to microbat habitat as a result of the Project. An assessment of significance (seven-part test) pursuant to the TSC Act has also been prepared for these species (refer to **Appendix D** of **Appendix D**). A summary of these assessments for microbat species is provided in **Table 16-4**. These assessments found that the Project is unlikely to significantly impact on the species. These assessments have concluded that there is unlikely to be significant impacts to microbat habitat as a result of the Project, due to the following factors:

- The stacks and buildings currently being absent of bats;
- The likely historic use of the stacks being opportunistic and in response to a local food source;
- The availability of other man-made or potential artificial bat roosts in the area (e.g. along Duck River); and
- The highly industrialised and urbanised context and lack of native vegetation in the vicinity.

Additionally, mitigation measures (refer to **Section 16.4.1**) including monitoring for evidence of microbats prior to demolition works commencing, which, if found, would trigger the need for further investigation. With these mitigation measures in place the conversion works and ongoing operation of the Clyde Terminal would not significantly impact on these species.

Table 16-4 TSC Act Test for Microbat Species

Criteria	Impact
Assessment of Significance (Seven-part Test) (TSC Act)	
Whether the Project is likely:	
To have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	The Project Area contains some suitable habitat that microbat species may be able to use for opportunistic roosting and foraging such as a large Fig tree, the remnant wetlands, and unused refinery infrastructure. The remnant wetlands in the Project Area may also provide limited breeding habitat for the species, however this is considered unlikely. There are no known local populations in the near vicinity of the Project Area that may otherwise be affected by the Project.
In relation to the habitat of a threatened species: The extent to which habitat is likely to be removed or modified as a result of the action proposed. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	There is some residual potential for the Project to involve the demolition of old refinery infrastructure that serves as microbat roosting habitat. There are anecdotal sightings of microbat species being present at the Project Area. However this is considered unlikely given that microbats have not been sighted at the project Area for some time. The remnant wetlands would, however, provide the best quality habitat at the Project Area and these wetlands would not be impacted on by the Project These species are generally known to have the potential to disperse widely and through airborne movement. There are no specific corridors of movement for microbats throughout the Project Area and beyond. Any microbat habitat in the area would therefore not become more fragmented or isolated from other habitats as a result of the Project. As such, this habitat would not become further isolated or fragmented as a result of the Project. Any redundant refining infrastructure at the Project Area that may be found to house microbats would not necessarily be the most suitable habitat for the species, and is likely to provide only opportunistic foraging or roosting habitat. The remnant wetlands at the Project Area provide superior habitat values for many species including microbats, and these wetlands would not be impacted on by the Project.
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	The remnant wetlands and large Fig tree are the only habitat that can be considered to provide potentially significant habitat for microbats at the Project Area. This habitat is not considered critical for the species.

Criteria	Impact
Assessment of Significance (Seven-part Test) (TSC Act)	
Whether the Project is likely:	
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	There are no specific recovery plans or threat abatement plans for these species OEH has listed numerous priority actions to promote the recovery of threatened species and the abatement of key threatening processes in relation to microbat species.
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Of the key threatening processes listed for microbats by OEH (2013), the following are relevant to the location, the proposed Project and the species: - Disturbance to winter roosting and breeding sites; - Application of pesticides in or adjacent to foraging areas; - Loss of foraging habitat; - Predation by feral cats and foxes; - Loss or disturbance of roosting sites; - Reduction in stream water quality affecting food resources; - Disturbance to roosting and summer breeding sites; and - Changes to water regimes are likely to impact food resources, as is the use of pesticides and herbicides near waterways. The Project has some residual potential to contribute to these threatening processes. However, this is considered unlikely.

Green and Golden Bell Frog (*Litoria aurea*)

As outlined in **Section 16.2.5**, the Project Area is reported to contain a key Parramatta population of the GGBF (Department of Environment and Climate Change NSW, 2008c). Several past records of the GGBF from within the Project Area were recorded in 1999, 2000 and 2005 (refer to **Figure 16-1**). Two sites were found to contain live frogs in October 2012. In the past, operational management has required that most bunded tanks and associated drainage lines are routinely drained following rainfall. Thus potential habitat for frogs is no longer present in a number of locations where they have been previously recorded. **Table 16-5** identifies the potential locations within the Project Area where GGBF may be impacted by the project activities.

Table 16-5 Summary of Impacts to Known and Potential Green and Golden Bell Frog Habitat at the Project Area

Area	Impact on GGBF
Remnant wetlands	Habitat would not be directly removed or degraded by the Project. No indirect impacts to habitat are anticipated, as clean water only would continue to be discharged to these remnant wetlands as part of the surface water management of the Clyde Terminal. Due to the groundwater barrier currently in place, it is not anticipated that potential groundwater contamination at the Camellia Industrial Estate would impact on these remnant wetlands. No in-soil contaminants migration is anticipated as there is underground barrier works existing between the remnant wetlands and the rest of the site.
Tankfarm B	Habitat removal through minor changes to improve water drainage within Tankfarm B.
Tank 52	Habitat removal due to the potential demolition of Tank 52. However, this area is currently considered unsuitable for GGBF.
Mobil Tankfarm	Habitat removal due to the removal of ponded water, and the demolition of all tanks.
Tankfarm E1 (including Tanks 36 to 41)	Tanks 40 and 41 are proposed to be demolished. However, this area is currently considered unsuitable for GGBF.

Area	Impact on GGBF
Eastern portion of the site subject to demolition	No impacts anticipated. No GGBF were identified during the surveys and no potential habitat is present. Current status of the site is sealed roads and hardstand. Demolition of infrastructure would be to grade with some works to remove existing foundations below grade, and the site would remain sealed and stable.
Shoreline comprising Clyde Terminal boundary along Duck River	No impacts anticipated as no direct works would be undertaken in this area and any potential secondary impacts (water run-off etc.) would be controlled as part of the works. In addition, there have been no previous sightings of the GGBF along this shoreline and the recent survey by AECOM did not identify any GGBF.

An assessment of significance (seven-part test) pursuant to the TSC Act (refer to **Appendix D** of **Appendix D**) and an assessment of significant impact pursuant to the EPBC Act (refer to **Section 4.1.12** of **Appendix D**) were prepared for this species. These assessments found that the Project is unlikely to significantly impact on the species. A summary of these assessments is provided in **Table 16-6**.

It is noted that the *Significant Impact Guidelines for the Vulnerable Green and Golden Bell Frog (Litoria aurea) Nationally Threatened Species and Ecological Communities EPBC Act Policy Statement 3.19* (Department of Environment, Water, Heritage and Arts, 2009b) recognises that relocation of GGBF individuals cannot be considered to be a mitigation measure, as it does not of itself reduce the impact of an action. This Project would involve the relocation of potentially impacted GGBFs, if identified, into the remnant wetlands at the Project Area as part of managing Project impacts to the species. Given the fact that the areas such as tankfarm bunds from where GGBF individual may be relocated do not provide particularly suitable habitat values, and that the maintenance of these areas of habitat would not be reasonable and feasible, relocation is considered a suitable management option for the species at this location. The action of relocation itself would not constitute a significant impact (i.e. controlled action) when compared against the significant impact assessment criteria outlined below.

Table 16-6 EPBC Act and TSC Act Tests for Green and Golden Bell Frog

Criteria	Impact
Significant Impact Criteria Assessment (EPBC Act)	
Would the Project:	
Lead to a long term decrease in the size of an important population of the species?	Unlikely: Based on the factors considered below, it is unlikely that the Project would lead to a long term decrease in the GGBF population size at the Project Area or within the Camellia Industrial Estate.
Reduce the area of occupancy of an important population?	Yes: Of the known and potential habitat areas for the GGBF (refer to **Table 16-5**), only Tank 52 and the Mobil Tankfarm lie within the proposed Project conversion footprint scheduled for demolition works. Tank 52 is unlikely to provide suitable ongoing habitat for GGBF, and no prior records of the species occurring at this location exist.
Fragment an existing important population into two or more populations?	No: The remnant wetlands in the north-east corner of the Project Area are known to be the primary location of GGBF. It is therefore most likely that the dispersion of GGBF within the Project Area is centred on the remnant wetlands in the north-east, and takes place throughout select sections of the eastern half of the Project Area on occasion. However there would be no breaking of the continuity of waterways or established terrestrial and aquatic corridors as a result of the Project.
Adversely affect habitat critical to the survival of the species?	No: The known and potential GGBF habitats at the Project Area that would be affected by the Project (refer to **Table 16-5**) are not considered to be critical to the survival of this species.
Disrupt the breeding cycle of an important population?	Unlikely: GGBF individuals would be relocated to the remnant wetlands which contain natural, suitable GGBF breeding habitats. The removal of artificial GGBF habitat that may be used for breeding purposes would not cause significant impacts.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No: The artificial GGBF habitat around tankfarms identified in **Table 16-5** is not compatible with supporting viable sub-populations of GGBF into the future. The remnant wetland is considered to provide better quality habitat for the species. As such, the species would not decline in the area as a result of the Project.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat?	There is some potential for the Project to result in the introduction of more weeds into the Project Area. However, with the mitigation measures outlined in **Section 16.4.3**, this is considered unlikely.
Introduce disease that may cause the species to decline?	Unlikely: Any type of demolition and construction activities has the potential to spread pathogens and diseases that may be harmful to native species, for instance Chytrid fungus in relation to frogs. However the Project would be undertaken in accordance with the *Frog Hygiene Protocol* (Department of Environment and Climate Change, 2008d) to minimise this risk.
Interfere substantially with the recovery of the species?	No: This is not considered to be relevant for GGBF at the Project Area, as there is no species recovery required to be taking place here.

Criteria	Impact
Assessment of Significance (Seven-part Test) (TSC Act)	
Whether the Project is likely:	
To have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	The proposed Project would not impact directly on aspects of this species' life cycle phases of migration and dispersion. The sections of the Project Area most commonly used as GGBF habitat (i.e. the remnant wetlands – refer to **Table 16-5**) are unlikely to be impacted. It is unlikely that significant breeding habitat of the species would be removed, or that access to breeding habitats would be significantly reduced as part of the Project, putting the species at risk of extinction.
In relation to the habitat of a threatened species: - The extent to which habitat is likely to be removed or modified as a result of the action proposed. - Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action. - The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The Project would involve modification works to improve tankfarm drainage or demolition of tankfarms at the Project Area that have the potential to be used as GGBF habitat. However, Shell commits to relocating individuals (if they are present) to the remnant wetlands in the north-east of the Project Area, which provides superior habitat values for the species, and which would not be impacted on by the Project. It is most likely that the dispersion of GGBF within the Project Area is centred on the remnant wetlands in the north-east, and takes place throughout select sections of the eastern half of the Project Area on occasion. The Project is therefore unlikely to impact on any established corridors of movement for the GGBF throughout the Project Area and beyond by fragmenting or isolating habitats further. The Project would involve the removal or degradation of some aquatic or ephemeral GGBF habitats as these tankfarms at the Project Area are currently providing some artificial GGBF habitat. However any such GGBF habitat around tankfarms as identified above is not compatible with supporting viable sub-populations of GGBF into the future.
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	The remnant wetlands are the only habitat that can be considered to be critical habitat for the GGBF at the Project Area. These remnant wetlands would not be impacted, either directly or indirectly, as a result of the Project.

Criteria	Impact
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	As part of the Project, Shell has committed to creating a GGBF-specific mitigation strategy, included as a sub-plan to the CEMP for the proposed Project, in accordance with the following documents: - *Green and Golden Bell Frog Litoria aurea (Lesson 1829) Draft Recovery Plan* (Department of Environment and Conservation, 2005a); - *Threatened Species Assessment Guidelines: the Assessment of Significance* (Department of Environment and Climate Change, 2007); - *Management Plan for the Green and Golden Bell Frog Key Population of the Georges River* (Department of Environment and Climate Change, 2008b); - *Best practice Guidelines Green and Golden Bell Frog Habitat* (Department of Environment and Climate Change, 2008a); and - *Threatened Species Management Information Circular No. 6: Hygiene Protocol for the Control of Disease in Frogs* (Department of Environment and Climate Change, 2008d). The mitigation measures incorporated into the Project would be consistent with the draft recovery plan for GGBF in NSW (DEC, 2005).
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Of the eight key threatening processes listed for NSW by OEH (2012), the following are relevant to the location, the proposed Project and the species: - Alteration of drainage patterns and stormwater runoff; and - A fungal pathogen known as Frog Chytrid Fungus. The Project has some potential for contributing to these key threatening processes, however this is considered unlikely.

16.3.3 Potential Impacts to Marine Species

Ultimately all of the nine marine species returned by the EPBC Protected Matters search were determined to have a low likelihood of occurring on the Project Area. It is unlikely that these marine species would commonly occur within the waters adjacent to the Project Area or, if they did, they would not be directly impacted by the Project during the demolition and construction works, or during operation of the converted Clyde Terminal.

16.3.4 Potential Impacts to Migratory and Wetland Species

Table 15 in **Appendix B** of **Appendix D** indicates the potential for each migratory and/or wetland species that was identified within the Locality, other than those that have already been assessed as threatened species, to actually occur within the Project Area. Of the 24 migratory and wetland species mapped as either predicted or being known to occur within the Locality, only two of them have been previously recorded at the Project Area.

Great Egret (Ardea alba)

The Great Egret has been previously recorded at the remnant wetlands in the north-east of the Project Area during surveys conducted by Urban Bushland Management Consultants in 2005 (Urban Bushland Management Consultants, 2007) (refer to **Figure 11** of **Appendix D**). The species is known to occur in freshwater wetland habitats. However with the mitigation measures in **Section 16.4** in place, the remnant wetland habitat that is likely to be used by this species would not be impacted during the Project, and therefore not on this species itself.

Clamorous Reed-warbler (Acrocephalus stentoreus)

The Clamorous Reed-warbler has been previously recorded at the remnant wetlands in the north-east of the Project Area during surveys conducted by Urban Bushland Management Consultants in 2005 (Urban Bushland Management Consultants, 2007) (refer to **Figure 11** of **Appendix D**). This species is also known to utilise wetland habitats. With the proposed mitigation measures in **Section 16.4** in place, the Project would not impact on the quality of this species' wetland habitat, and therefore not on this species itself.

None of the other identified migratory and wetland species have been previously recorded in the Locality, the Study Area or the Project Area. The Project Area does contain estuarine and other inland vegetated areas which provide some suitable habitat features for many migratory and migratory wetland species. The remainder of the Project Area contains limited habitat for these migratory bird species. Due to the wide-ranging nature of wetland and migratory species, it is acknowledged that individuals of these species may occur within the Project Area during movement between other sites, or occasionally for opportunistic foraging. In some circumstances, migratory bird species may also utilise the remnant wetlands for breeding and foraging habitat. However, no direct or indirect disturbance of these habitats would result from the conversion works. As a precaution, mitigation measures outlined in **Section 16.4** would be implemented to avoid indirect or residual impacts occurring for these species as a result of the conversion activities or operation of the converted Clyde Terminal.

16.3.5 Summary of Overall Impacts

Provided the recommended mitigation measures are implemented, the Project is not anticipated to result in significant impacts to any of the identified species, populations or communities that are known or predicted to occur within the Locality.

At the time of finalising this assessment, a referral to the Commonwealth is also being submitted to Commonwealth Department of the Environment, including a significant impact criteria assessment pursuant to the EPBC Act for the GGBF. This assessment also considers the potential for the Project to impact on the Grey-headed Flying Fox. The purpose of the referral is to determine whether the Project will need formal assessment and approval under the EPBC Act in relation to the potential for impacts, most specifically for GGBF. The referral has concluded that the Project would not significantly impact on the Grey-headed Flying Fox. The referral also found that the Project is not likely to have a significant impact on the GGBF if undertaken in a particular manner. This is due to a commitment by Shell to develop and implement a GGBF management strategy (refer to **Section 16.4.1**). The strategy would be developed in consultation with OEH and the Commonwealth Department of the Environment and prepared in accordance with relevant government guidelines and best practice. A formal systematic monitoring program would be implemented to ensure the efficacy of mitigation and management activities to the satisfaction of OEH.

Assessments of significance (seven-part tests) have been prepared for the Grey-headed Flying Fox, microbats and the GGBF (refer to **Appendix D** of **Appendix D**). These assessments of significance yielded similar results to those obtained from the significant impact criteria assessment pursuant to the EPBC Act; that the Project is unlikely to significantly impact on these species. Given the limited impacts of the Project overall for biodiversity, no offset packages are considered necessary.

16.4 Mitigation Measures

16.4.1 Protection of Fauna

Potential impacts on the GGBF and other biota likely to be within the Project Area would be managed through development of the following mitigation measures. For the conversion works, measures would be incorporated into a CEMP, which is to be developed specifically for the proposed conversion works. Shell would be responsible for ensuring that conversion works comply with the CEMP and that, during operations of the converted Clyde Terminal, plans are adopted for management of biota.

Green and Golden Bell Frog

Broadly, the key principles for mitigation measure in relation to GGBF in the *Significant Impact Guidelines for the Vulnerable Green and Golden Bell Frog (Litoria aurea) Nationally Threatened Species and Ecological Communities EPBC Act Policy Statement 3.19* (Department of Environment, Water, Heritage and Arts, 2009b) are:

- Avoid;
- Minimise; and
- Manage.

Avoidance of Impacts

The Project has been designed so as to avoid impacts to the remnant wetland in the north-east of the Project Area, and also to the riparian vegetation running along Duck and Parramatta Rivers. These remnant wetlands provide the most superior habitat values for GGBF within the Project Area, and the riparian vegetation along the rivers is likely to provide corridors for GGBF dispersion. As per **Figure 6-1**, these environments are located outside of the area of direct impact of the Project.

It is, however, not possible to avoid all of the anticipated impacts to GGBF habitat resulting from this Project, as it is impractical from an operational, environmental and safety point of view to continue to maintain redundant tank infrastructure providing artificial GGBF habitat, particularly given that the Project Area already contains more suitable GGBF habitat within the remnant wetland area. Existing habitat within the Project Area, external to the remnant wetland, appears incompatible with supporting viable populations of the GGBF into the future, and cannot feasibly be managed long term to balance species conservation and site operations through the use of tankfarm bunds.

Indeed, operational safeguards at the Clyde Terminal discourage the ponding of tankfarms as this decreases the ability of bunds to manage the risk of tank spills and overflows. The drainage and upgrading of these tank bunds is yet another safety improvement that Shell is seeking to implement during the proposed Project.

Minimisation of Impacts

It is, however, possible to minimise the predicted impacts of the proposed Project as outlined herein. The measures recommended here have been used successfully to mitigate impacts on the GGBF under similar circumstances (e.g. Sydney Olympic Park, Homebush Bay).

The proposed mitigation measures aim to:

- Improve upon existing known core habitat and known populations at the remnant wetland;
- Remove other threats to the long term viability of the species at the Project Area; and
- Promote the species' occupancy of a location which is isolated from the operations of the Clyde Terminal, while retaining linkages to littoral conditions and corridors within the security of the controlled tenure of the Project Area. Under these conditions the GGBFs present at the Project Area can be better managed over time.

A GGBF specific mitigation strategy would be prepared and included as a sub-plan to the CEMP for the proposed Project, in consultation with the OEH. The CEMP GGBF sub-plan shall include, but not be limited to:

- Design and implementation of pre-works surveys (conducted by a suitably qualified ecologist) to identify and, if necessary, relocate frogs found within the footprint of the actual conversion works; and
- Any frogs found would be relocated to the remnant wetland (within the Project Area boundary), by appropriately trained personnel adopting the *Frog Hygiene Protocol* (Department of Environment and Climate Change, 2008d). This would not require licensing for translocation of threatened species under the NSW TSC Act.

Compensatory actions considered to date for the loss of opportunistic habitat sites within certain tankfarm bunds include those in accordance with Shell's *Wetland Management Plan – Clyde Wetlands Shell Refinery Rosehill, 2007*. This management plan would be updated to include management measures for GGBF, and would continue to be applied to the remnant wetlands as follows:

- Creation and management of refuge habitat such as rock piles (being a less complicated refuge habitat option) for long term placement within the subject areas to provide over-wintering habitat;
- Replacement of non-endemic vegetation such as *Juncus acutus* (Spiny rush) within the remnant wetland with alternative native sedges, rushes and grasses to provide GGBF shelter habitat;
- Additional enhancement of land within the boundary of the remnant wetland to suit GGBF habitat such as developing additional pondage and/or by the placement of smaller prefabricated ponds to provide additional habitat during breeding season; and
- Design and implementation of a systematic monitoring, reporting and feedback program to assess GGBF relocation, mitigation measures undertaken, and population dynamics for this site.

Management of Impacts

A suitably qualified ecologist is to be engaged prior to the issue of plans for demolition and construction works to improve tankfarm drainage to advise on the following:

- Proposed works to reduce the risk of potential impacts to GGBF, and
- Proposed specific mitigation strategies contained within the CEMP.

The CEMP GGBF sub-plan is also to include:

- Management of site demolition and construction works such that disinfection of demolition and construction plant and equipment is carried out at a safe distance from the remnant wetland, so that excess disinfecting solution or material does not contaminate waterways; and
- Site inductions for all workers are to include emphasis on the special requirements for identifying and protecting GGBF. Inductions are to be mandatory prior to access permission to the construction site. Routine updates of the induction are to be provided at routine 'toolbox' meetings.

Grey-headed Flying-Fox/Microbat Species

Prior to demolition works, inspection of exterior casings and insulations on towers (i.e. potential habitat where microbats have historically been observed) is to be undertaken for signs of microbat presence. Inspections would also be undertaken of buildings scheduled for demolition. Evidence of Grey-headed Flying-fox/microbat presence, which would be reported and further investigated if found, is summarised in **Table 16-7**. In the even that Grey-headed Flying-fox/Microbat species are found during these inspections, a suitably qualified ecologist would be contacted for further advice.

Table 16-7 Grey-headed Flying-fox/Microbat Inspection Signs (Eco Logical, 2012)

Microbat Sign	Evidence
Visual	Obvious clusters of bats or singular dark spots should be investigated as potential roosting bats.
	Bats may be seen leaving and returning to roosts around dusk and dawn.
Audible	Bats, when roosting, will periodically emit a chatter type noise.
Guano	If bats are utilising a roost, even as an intermittent roost, guano will occur immediately under the roost site. Large permanent roosts will accumulate considerable volumes of material.
Staining	Where bats frequently access a roost this area becomes stained overtime by guano and urine.
Bird Nests	Earth constructed bird nests of swallow or fairy martin are relatively common structures as some bat species will utilise disused nests as an interim roost.

16.4.2 Protection of Flora

While it is recognised that the proposed Project would require negligible vegetation clearing, the following measures are proposed to ensure that minimal potential impacts occur to vegetation in and adjacent to the proposed works areas:

- The final demolition plan would minimise the construction footprint and the requirement for clearing of native vegetation wherever possible and within reason given the need to minimise fire hazard risks onsite;
- There is to be clear marking and delineation of the boundaries between the designated construction sites and “no-go” zones, including vegetation that is to be retained, prior to the commencement of construction. This is to include signage, barrier fencing and tree guards, wherever they would be appropriate. There is to be no storage of soil, building materials, tools, paints, fuel or contaminants, etc. within the no-go areas;
- The Australian Standard 4970 (AS4970) for the protection of trees on development sites would be adopted to reduce the impact of incursions into the root zone of trees to be retained;
- Shell would continue to undertake ongoing bush regeneration in and around the vicinity of the Project Area;
- If any damage occurs to vegetation beyond the nominated work area the Project Manager would be notified so that appropriate remediation strategies can be developed and implemented;
- Should the proposed demolition footprint be changed such that works would encroach into more densely vegetated areas, then a suitably qualified ecologist is to be engaged to:
    - Conduct pre-clearance surveys of the final footprint immediately prior to demolition commencing, and
    - Undertake additional impact assessment if required.
- The riparian vegetation along the southern and eastern borders of the Project Area would continue to be preserved.

16.4.3 Weed Management

Weed Management

The following measures would be put in place to manage weeds:

- Any weed infestations found within the Project Area would be removed or controlled prior to works commencing;
- Earth-working equipment and vehicles would be cleaned of excess soil by brushing and/or hosing at the start and finish of construction works to minimise the risk of spreading of weed seeds and plant pathogens;
- Sediment fences and sediment traps would be installed for the duration of the construction works and stabilisation of disturbed areas by rehabilitation works. This is to contain any sediments containing weed seeds, propagules or plant pathogens at the Project Area;

- Any soil and vegetation removed would be covered during transport and taken to an approved disposal sites to minimise the risks of spreading weeds and pathogens beyond the work sites;
- Weeds (including vegetation, fruit and seed) removed during clearance would be disposed at an approved green waste site. Weed seed heads or flowers should be carefully removed and bagged immediately onsite before appropriate disposal;
- Where applicable, weed control would be undertaken in accordance with the NSW Agriculture noxious and environmental weeds control handbook; and
- Contractors undertaking weed removal or control would be trained or experienced in weed identification and removal (as per the *Pesticide Act 1999*).

16.4.4 Plant Pathogen Hygiene

Phytophthora cinnamomi is not known to be present in the Project Area and there is little likelihood that the proposed Project would lead to its establishment or spread. However, the consequences of infection can be severe. Therefore, the mitigation proposed for weed management would also provide a precautionary measure for limiting the risk of spread of soils and vegetation from being tracked onto the site from other areas.

16.4.5 Protection of Aquatic Environments

The following additional measures would be implemented to minimise potential impacts to aquatic flora and fauna and water quality of the aquatic environment of the Duck and Parramatta Rivers.

- A detailed ESCP is to be prepared and included in the CEMP;
- Demolition and construction waste would be stored on a sealed and bunded surface whilst awaiting transfer or processing;
- Dust suppression and sediment runoff prevention would be undertaken during the demolition and construction works;
- Any wastewater that has been potentially contaminated during the demolition and construction works would be properly treated via the Clyde Terminal wastewater treatment facilities to ensure compliance with the conditions of EPL No. 570;
- Temporary stormwater management measures (such as sandbags, sediment fences and berms), are to be used to minimise the risks of sediment-laden runoff and other construction pollutants entering downstream systems;
- During demolition works, all potential chemical pollutants (e.g. fuels, oils, lubricants, paints, herbicides, etc.) are to be stored in appropriate containers within bunded areas within construction compounds to minimise the risk of spillages and mobilisation of these pollutants into aquatic environments;
- All fuel products and other potentially hazardous substances at the Project Area would continue to be stored in sealed, bunded areas that would prevent their migration offsite in the event that a storm surge or flood event impacts the Project Area;
- ASS would be managed according to an ASSMP section of the ESCP which would be incorporated into the existing *Soil and Groundwater Management Plan Shell Clyde Refinery and Parramatta Terminal, Durham Street, Rosehill, NSW* (Shell, 2010), the WMP 2013 and the CEMP to be prepared for the conversion works;
- ASS impacted soils would be identified within the Project Area before excavation activities are undertaken;
- ASS impacted soils excavated from the Project Area would be kept wet at all times until they are disposed of, and generally managed in accordance with the *Waste Classification Guidelines Part 4: Acid Sulphate Soils* (Department of Environment and Climate Change, 2008e);
- The ASSMP section of the ESCP would also include a contingency plan to manage impacts that have the potential to occur if specified management strategies fail, and to outline any remediation and restoration actions that may therefore be required; and
- The riparian buffer zone along the southern and eastern borders of the Project Area, which has the potential to further minimise the impacts of flooding at the Project Area, would continue to be preserved as follows:
    - Contaminated stormwater and wastewater generally would continue to be treated before being discharged in the vicinity of this riparian buffer zone;

- Infrastructure at the Project Area would continue to be located outside of this riparian buffer zone.

16.5 Residual Impacts

The proposed mitigation measures outlined in **Section 16.4** are considered sufficient to deal with residual impacts to biodiversity as a result of the Project. For instance, where GGBF, Grey-headed Flying Fox or microbat individuals are located within areas of Project impact, these mitigation measures would allow for those individuals to be managed appropriately, so as to avoid or minimise potential impacts to those species, individuals, their populations or habitat.

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17.0 Soil and Groundwater Contamination

Relevant DGRs: The EIS must address **Contamination** – including how ecological and human health risks posed by contaminants on the site would be mitigated and managed particularly as redundant tankage and other infrastructure is decommissioned, demolished and removed.

The EIS must address **Soil and Water** – including:

- An assessment of the potential soil, groundwater and surface water impacts of the development including potential impacts on the Parramatta River and Duck Rivers and their tributaries;
- Identification of any water licensing requirements or other approvals under the *Water Act 1912* and/or the *Water Management Act 2000*;
- Demonstration that water for the development can be obtained from an appropriately authorised and reliable water supply in accordance with the operating rules of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources;
- A detailed description of the mitigation and management controls that would be put in place to manage erosion and sediment, stormwater and acid sulfate soils (if present);
- Ways to reduce water supply and increase water reuse; and
- Potential impacts of flooding, with consideration of climate change and projected sea level rises.

17.1 Existing Conditions

ERM 2012 describes the current soil and groundwater conditions of the Project Area.

Currently, soil and groundwater conditions at the Clyde Terminal site are regulated by Condition U1 of EPL No. 570 which references the need for the SGMP 2010 and provides for an annual report on these investigations to be furnished to the EPA each year. Condition U1 of the EPL No. 570 provides that these reports are to include:

- A summary of the groundwater monitoring results for the previous 12 months;
- Details of any soil or groundwater investigations undertaken and the results of such investigations;
- Details of the progress against works proposed in the previous report;
- An update of the Conceptual Site Model 2012 (CSM 2012) (if conditions change significantly); and
- An update of the Soil and Groundwater Monitoring Program (SGMP) if required.

The project works where minor excavation would be required does not occur in any of the known areas of on-site contamination. This contamination is minor in nature and well profiled across the site as a result of monitoring wells installed across the site over the last 10 years and the sampling regime in place. Regardless, Shell already has a range of Occupational Hygiene plans for all works where workers have the potential to come in contact with potential contaminants and would continue to proactively manage workers' health equirements accordingly throughout the project works. Person Protective Equipment requirements are dictated by the potential risk compounds identified and the works areas are regularly inspected to ensure compliance with these requirements and to ensure new pathways are not opened during the works. Any area where footings need to be removed will be similarly managed in this way.

17.1.1 Topography

The Project Area and the surrounding general industrial area are located on a peninsula bounded by Parramatta River to the north and by Duck River to the south and east. The Project Area is considered to be generally flat and ranges from 2 to 5 m AHD in elevation (ERM, 2012).

17.1.2 Soil and Geology

The Project Area is located in the Central Lowlands topographic zone within the Sydney Basin geological province. According to Chapman and Murphy (1989), two soil landscapes are present within the Project Area: Disturbed Terrain (soil code: xx) and the Ettalong (soil code: et) swamp landscape (refer to **Table 17-1**). Almost all of the Project Area comprises Disturbed Terrain, with the exception of a small pocket of Ettalong soil landscape in the north-east corner (refer to **Plate 13**)

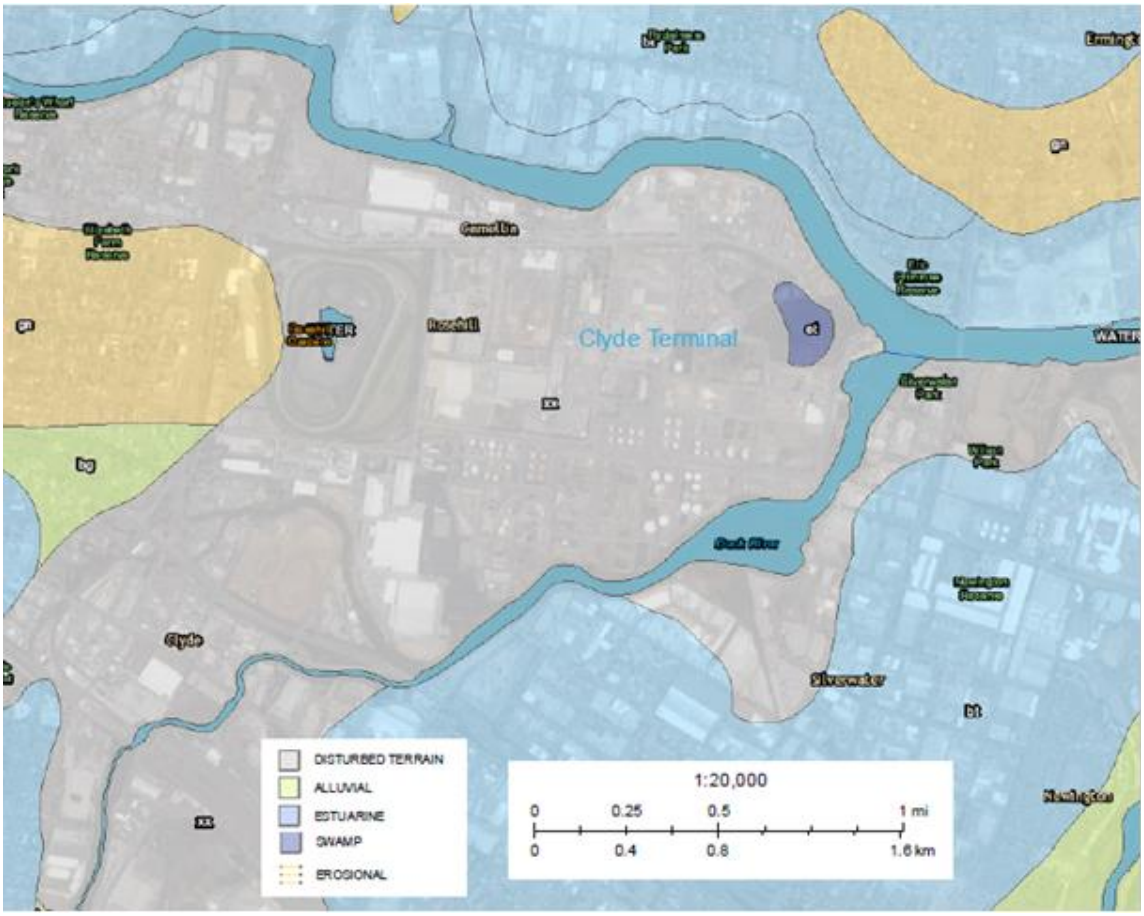

Plate 13 Soil Landscapes within the Project Area and surrounds

Table 17-1 summarises the key characteristics of soils associated with Disturbed Terrain and the Ettalong swamp landscape as well as their archaeological implications (Chapman and Murphy, 1989).

Table 17-1 Soil Landscapes within the Project Area

Soil Landscape	Soil Code	Dominant Soils	Surface Geology	Erosion Potential	Archaeological Implications
Disturbed Terrain	xx	Turf fill commonly capped with 40 – 60 cm of sandy loam over waste materials	Artificial fill	Dependent on fill materials	No archaeological potential within fill. Underlying soils likely to have been historically disturbed.
Ettalong	et	Deep (>150 cm) Organic Acid Peats, Peaty Podsols	Unconsolidated Quaternary sandy peats, peats and mud	Erosion absent. Swamps are depositional sites	Potential for Aboriginal midden sites.

The lithology across the Project Area generally consists of fill material to depths of approximately 1.0 to 1.5 mbgs and is underlain by low-permeability clay which has been observed at up to 8 mbgs, which is the maximum depth of previous investigations that have been undertaken by ERM. The geology of the Project Area has historically been characterised into four units, based on interpretation of soil bore log data obtained during previous investigations (ERM, 2012). A summary of these strata identified by ERM at the Project Area is as follows:

- Unit 1 (Fill Material) - Poorly compacted mixture of silt, clay and gravel, with localised areas of slag, furnace ash and concrete. Typically observed thickness approximately 1 m to 1.5 m with maximum reported thickness of 3 m. Used to raise the level of the surface of the low lying tidal swamp/ mangrove area along the Parramatta and Duck Rivers. Fill material pinches out to the west;
- Unit 2 (Estuarine Sediments) - Silty clay–clayey silt with occasional sandy lenses and shell fragments to a thickness of approximately 4 m. Generally thickens toward Parramatta River. Represents the natural profile prior to development and filling; and
- Units 3 and 4 (Alluvial Sediments and Residual Clay) - Tertiary alluvial sediments (up to 20 m thick, including clay with sandy lenses) and residual Ashfield Shale are reported.

17.1.3 Hydrogeology

Groundwater is represented as a shallow unconfined water zone within the fill material and estuarine-alluvial sediments at depths between 0.5–3 mbgs. As outlined in **Section 17.1.6**, the distribution of groundwater throughout the Project Area ranges from around 1 to 4.5 m AHD. Preferential pathways for groundwater flow have been stated as being in sandy lenses within the fill and estuarine units along with anthropogenic structures (ERM, 2012).

Hydrogeological data obtained from previous investigations also indicate the potential for semi-confined conditions in silts and sands at depths of 4–8.5 mbgs. The hydraulic connectivity between the geological units is not fully understood, and this separate water bearing zone has not been observed by ERM during recent intrusive investigations (ERM, 2012).

17.1.4 Acid Sulfate Soils

Potential acid sulfate soils (PASS) are waterlogged soil layers rich in iron sulfide, primarily pyrite. They generally occur in low lying coastal areas. When excavation or drainage exposes these soils to oxygen, pyrite becomes oxidised to form sulfuric acid. If this concentration of sulfuric acid is enough to exceed the neutralising capacity of the soil, the soil pH can become acidic. This is then known as actual ASS (Stone, Y. et al, 1998). As depicted in **Figure 17-1**, LEP 2011 characterises the Project Area as predominately containing Class 3 ASS. The western section of the Project Area contains Class 4 ASS, whilst the eastern section contains Class 3 ASS. A small strip of the Project Area running along Duck River contains Class 2 ASS. Clause 6.1 of LEP 2011 provides that development consent is required on land classified as containing these classes of ASS as follows:

- For Class 2 ASS where any works are to be undertaken below ground surface (bgs), or where the watertable is likely to be lowered;
- For Class 3 ASS where any works are to be undertaken more than 1 mbgs, or where the watertable is likely to be lowered by more than 1 mbgs; and
- For Class 4 ASS where any works are to be undertaken more than 2 mbgs, or where the watertable is likely to be lowered by more than 2 mbgs.

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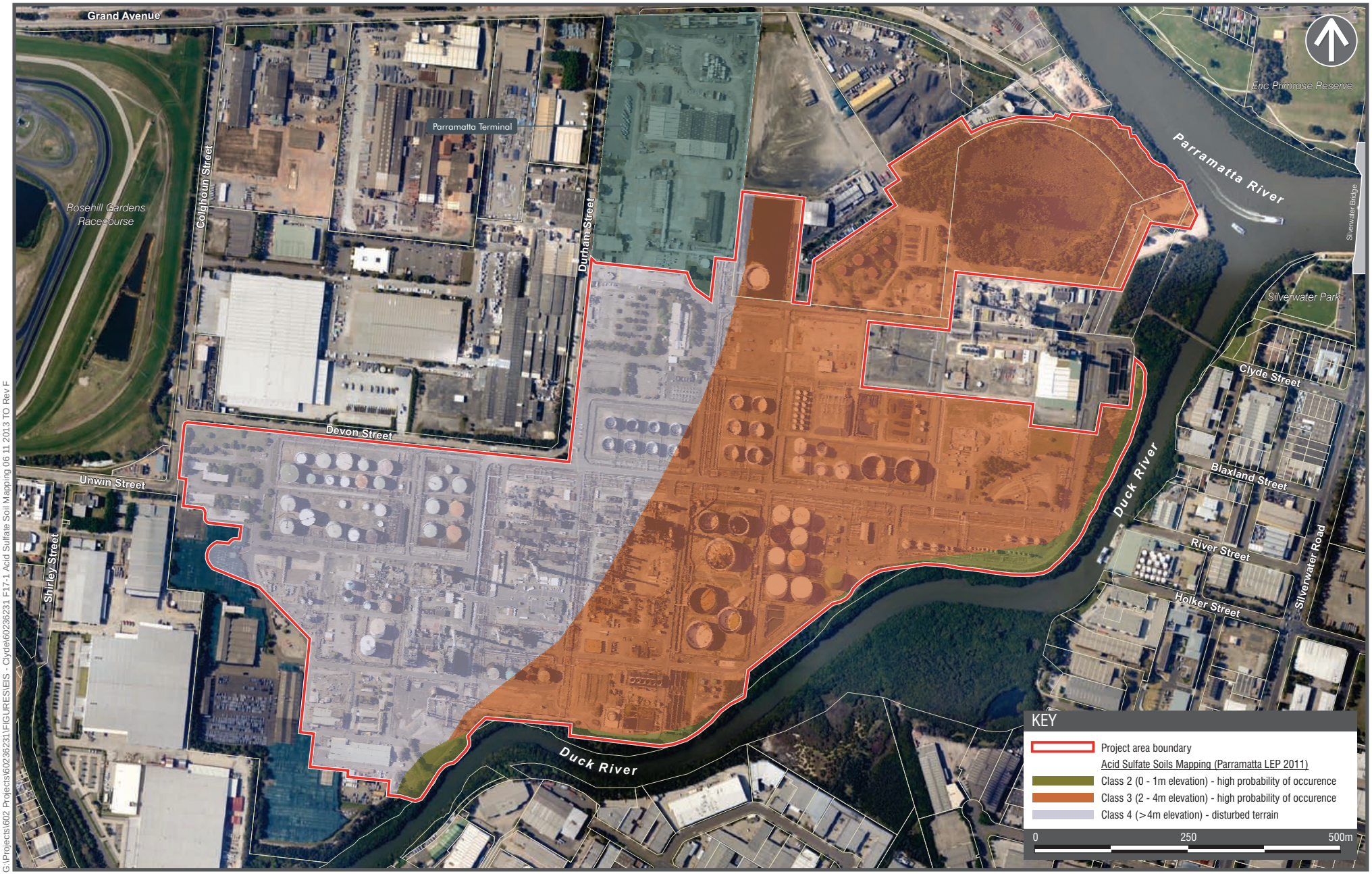

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ACID SULFATE SOIL MAPPING

Clyde Terminal Conversion Project
Environmental Impact Statement

FIGURE 17-1

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17.1.5 History of Investigations

Over a number of decades, environmental conditions resulting from onsite and offsite operations have been investigated. Soil and groundwater investigations in particular have been both proactive and compliance driven. Such information was generally provided to the EPA on an annual basis. In 2008, ERM collated this data and prepared an initial Conceptual Site Model (CSM 2008). ERM also proactively incorporated the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (Friebel and Nadebaum, 2011) for assessment works related to the project. These assessment levels were then adopted by the Assessment of Site Contamination National Environmental Protection Measure (NEPM) 2013. This includes use of the extension model calculation levels used by ERM to generate screening levels for groundwater shallower than 2mbgl at the site. New concepts within the NEPM that were not available at the time of the last ERM investigative work would be reviewed once a known use for the surplus land is identified. This would be included as part of the future Clyde Remediation and Redevelopment application.

Since then, a program of both routine and non-routine environmental site assessments has been undertaken, including a quarterly groundwater monitoring program. A Preliminary Investigation Order (PIO) was issued to Shell under section 10 of the CLM Act on 22 June 2012. By 1 August 2012, Shell was required to submit the following information to the EPA:

- A report summarising all potential contamination sources on or related to the Project Area and its surrounds;
- A report summarising available information about soil, water (including groundwater, stormwater and Duck River), and sediment contamination as a result of the previous operations of the former Clyde Refinery;
- A report identifying data gaps relating to the identification and management of contamination on, and related to, the Project Area and its surrounds. Any limitations of the investigation process were to be clearly identified and justified within this report; and
- A report outlining the proposed investigation plan to fill any data gaps including details of the staging of investigation activities and the expected timeframe for availability of reports following the completion of each stage (EPA, 2012).

In response to this request, Shell commissioned ERM to prepare the Environmental Conditions Summary Report (ERM, 2012). The Environmental Conditions Summary Report provides:

- A summary of potential contamination sources related to the Project Area, as well as all available information about soil, water and sediment contamination relating to the Project Area;
- An identification of data gaps relating to the identification and management of contamination at the Project Area, and a proposed investigation plan to fill those remaining data gaps; and
- A Conceptual Site Model (CSM 2012) that separates Shell's operations at the Camellia Industrial Estate into four sections to identify current site conditions, data gaps and potential risks to identified receivers.

The Environmental Conditions Summary Report also identifies some data gaps that are to be used to focus on upcoming data collection and site characterisation efforts so that aspects of the CSM 2012 can be refined. The key data gaps identified in the Environmental Conditions Summary Report can be summarised as follows (ERM, 2012):

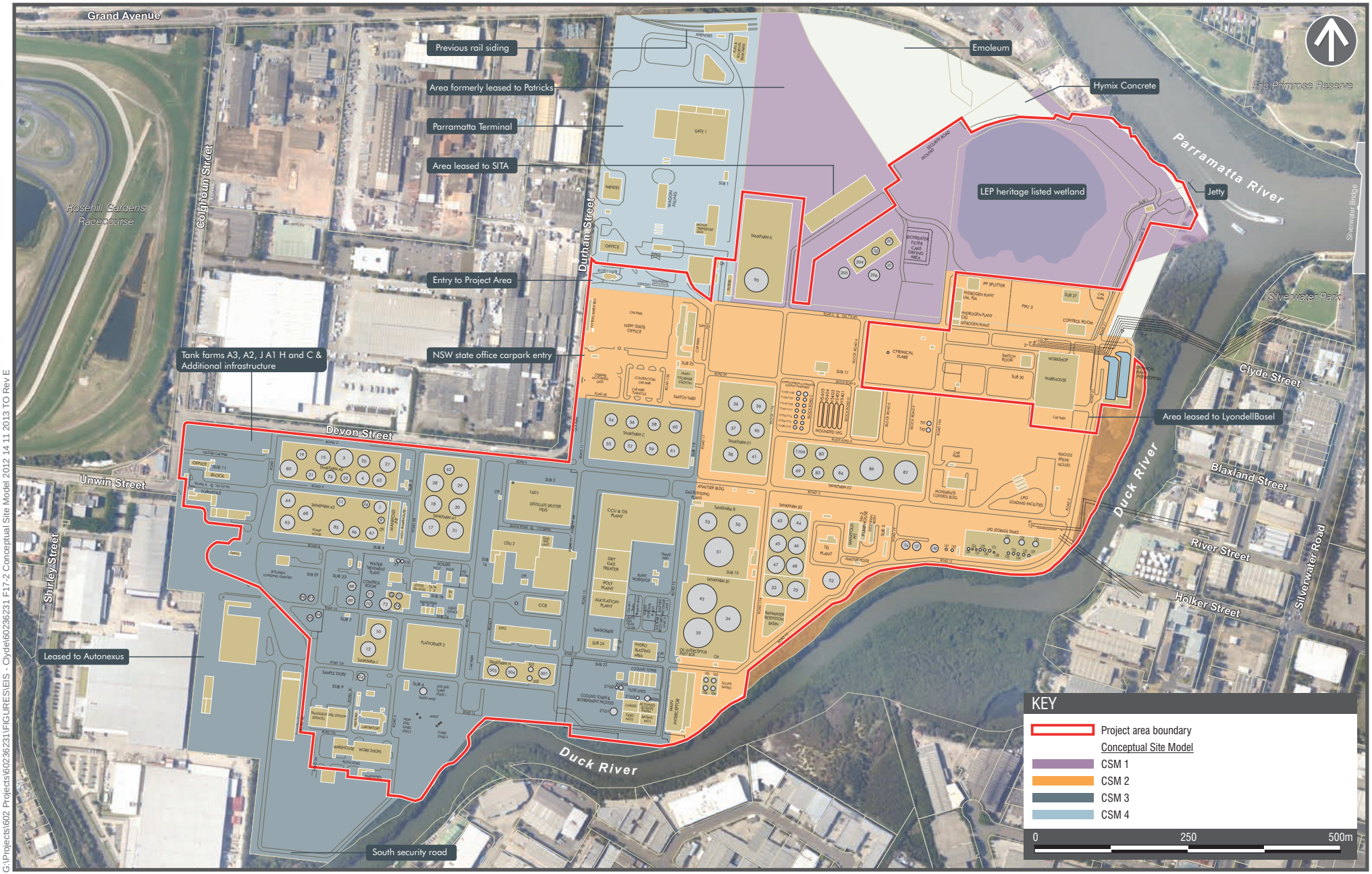
- The nature and extent of dissolved phase COCs in CSM2 and CSM3; and
- The characterisation of potential source areas in CSM1 and CSM3.

The information collected during closure of the data gaps will be supplied to the EPA either annually within the Annual Progress Report, or within standalone reports if requested.

In the western section of the Project Area where there is likely to be surplus lands following the conversion works, there are currently constraints that relate to the presence of infrastructure and operations that limit accessibility for the purposes of undertaking complete site characterisation. The need for additional investigation of this section of the Project Area would be determined following the proposed demolition works. The requirement for additional site assessment would also give consideration to potential future land use scenarios which are yet to be conclusively established (refer to **Section 14.2.1**). No potential change in land use or redevelopment of this land is proposed until such time as appropriate site assessments have been conducted to support such a change in land use or redevelopment.

The CSM 2012 provided by ERM in the Environmental Conditions Summary Report (ERM, 2012), divides Shell's historical operations at the Camellia Industrial Estate (including the Clyde Terminal and the adjoining Parramatta Terminal) into four sub-areas based on considerations such as geography, geology, potential contaminant sources, exposure pathways and receivers. This allows for a logical analysis of potential sources of contamination at the Clyde Terminal and its surrounds based on current and past operations. For instance, CSM1 largely contains areas of Shell-owned land that have been leased to third parties. CSM2 roughly equates to the eastern section of the Clyde Terminal, CSM3 to the western section, and CSM4 to the Parramatta Terminal. These areas, CSM1, CSM2, CSM3 and CSM4 are outlined below and shown on **Figure 17-2** (ERM, 2012):

- CSM1 – In the north-eastern portion of the Project Area, this area is bordered to the east by the Parramatta River (refer to **Figure 17-2**) and includes the remnant wetland. The area was historically divided into a number of smaller leased sites, generally for land use unrelated to the refining and storage of hydrocarbons (with the exception of the former Mobil Tankfarm, current Tankfarm K, and the fire training ground). A degree of infilling with materials sourced from offsite has occurred within the Camellia Peninsula area generally;
- CSM2 - In the central and south-eastern portion of the Project Area, this area is bordered to the east and south by Duck River. The area contains office space as well as a significant amount of refinery related infrastructure including currently operational tankfarms and pipe track areas, and a polypropylene plant and LPG storage and loading facilities operated by LyondellBasell. Historically the area contained the ethylene, chemical and hydrocarbon solvents plant and the tetraethyl lead plant;
- CSM3 – In the south-western portion of the Project Area, this area is bordered to the south by Duck River. The area contains the old refinery processing areas, tankfarms and pipe tracks along with numerous warehouses, workshops, office space and an area leased to Autonexus for the storage of imported vehicles; and
- CSM4 - To the west of the Project Area, this area covers the Parramatta Terminal. Current operations within CSM4 are described in detail in **Section 2.3.2**.



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CONCEPTUAL SITE MODEL 2012

Clyde Terminal Conversion Project
Environmental Impact Statement

FIGURE 17-2

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17.1.6 Groundwater

Groundwater conditions within the Project Area are monitored through an established groundwater monitoring well network that is suitable for assessing and managing those groundwater conditions, including internal operational areas and boundary containment. Groundwater is the primary contaminant transport mechanism, and as such, emphasis is placed on the collection and interpretation of groundwater data as indicators of broader site conditions (ERM, 2012).

Groundwater at the Project Area generally occurs at depths of between 1 to 4.5 m AHD, and has been previously encountered at the relatively shallow depth of 0.5 mbgs. This groundwater is generally found within the fill material, with its vertical gradient likely to be limited by the low-permeability clay underlying the fill material. The presence of hydraulic connectivity with a potential deeper aquifer is not fully understood, and there is no evidence to suggest it has existed during recent investigations. Groundwater has been identified at the Project Area and the adjoining Parramatta Terminal as follows (ERM, 2012):

- At CSM1 - Ranging from approximately 2.5 m AHD to 1.0 to 1.5 m AHD at the boundary with Duck River and Parramatta River, particularly around the remnant wetland. Groundwater is inferred to flow towards Parramatta River. The majority of CSM1 is unsealed;
- CSM2 – Ranging from approximately 2.0 to 2.5 m AHD in the central areas of the old refinery to 0.5 to 1.0 m AHD at the boundary with Duck River. Groundwater is inferred to flow to the south and east towards Duck River. The majority of CSM2 is sealed with the exception of a grassed area north of the LPG loading facilities;
- CSM3 – Ranging from approximately 4.5 to 4.0 m AHD in areas adjacent to Devon Street, to 1.5 m AHD at the boundary with Duck River. Groundwater is inferred to flow toward the south. CSM3 is generally sealed; and
- CSM4 – Ranging from approximately 2.5 to 3.0 m AHD. Groundwater is inferred to flow toward the east, north-east toward Parramatta River. CSM4 is almost entirely sealed.

The hydraulic gradient across the Project Area during previous investigations indicates that the direction of groundwater flow may be subject to rainfall events and localised groundwater mounding, but has generally been established to the east, south-east and south towards the bounding rivers, with a flat hydraulic gradient. Flow rates have been established to be low and appear to be locally influenced by anthropogenic subsurface features such as tank bunds and the butyl membrane barrier west of the remnant wetland area (CSM1). Groundwater likely discharges into Parramatta River and Duck River, however, previous investigations indicate that there is no influence on the shallow groundwater by tidal fluctuation within the adjacent rivers. As a result, the connectivity between shallow groundwater and surface water at the Project Area has not been conclusively established. Groundwater flow characteristics within the estuarine sediments (Unit 2), as estimated by *Biannual Groundwater Monitoring at Shell Clyde Refinery – June 1998 Monitoring* (Woodward Clyde, 1998) have been described as follows (ERM, 2012):

- Hydraulic gradient: ~0.004 m/m;
- Hydraulic conductivity: 0.001 m/d to 10 m/d;
- Porosity: 0.3 to 0.5;
- Seepage velocity: 0.005 m/year to 50 m/y; and
- Volume of groundwater discharging to the adjacent rivers: <1 m^3/day to 100 m^3/day.

In 2009, ERM reported that laboratory intrinsic permeability results were low for Project Area soils: 1.52 mD (1.27E-03 m/d) for Unit 1 (Fill) and 0.16 mD (1.4E-04 m/d) for Unit 2 (underlying clay). The wide range in the above parameters is likely due to the heterogeneity of subsurface conditions and localised influence on groundwater flow (ERM, 2012).

A butyl membrane was installed west, north-west and north of the remnant wetlands in the north-east of the Project Area during the 1980's. This membrane is 3 m deep, and was originally installed to prevent chromium impacted groundwater discharging into the remnant wetlands. Further investigations have shown that this membrane has been effective in reducing groundwater migration and discharge into these remnant wetlands (ERM, 2012).

Groundwater within the Project Area is not currently extracted for use nor is it likely to be extracted for future operational uses at the Clyde Terminal. There are no known groundwater users in the vicinity of the Project and groundwater is unlikely to be used for any beneficial purposes in the area. A search of the NSW Natural Resource Atlas identified several registered groundwater bores within 1 km of the Project Area. There are several registered groundwater bores within the Camellia Industrial Estate and the Project Area itself (ERM, 2012).

Petroleum hydrocarbons and metals are present in groundwater within the Project Area. However, groundwater monitoring results do not indicate the presence of a widespread plume of COCs. In general, the nature and extent of groundwater impacts can be summarised as follows based on the currently available data (ERM, 2012):

- Groundwater impacts are considered isolated and limited in extent, confined within the Project Area boundary (with concentrations of potential contaminants within boundary wells generally reported below the limit of laboratory detection), and tend to occur within current and historic locations of processing areas and fuel storage or transfer;
- Site-wide groundwater gauging that was completed subsequent to the environmental site analysis works in 2011 and 2012 reported measurable Light Non Aqueous Phase Liquid (LNAPL) within four monitoring wells of an approximate total of 152 gauged. The presence of LNAPL appears in isolated locations across the Project Area, with LNAPL thickness reported during 2011 not exceeding 40 cm. Quarterly gauging is undertaken for these wells to continually assess conditions;
- In locations where monitoring wells have been established for a period of time, the nature and extent of LNAPL observed during 2011 indicated that current site conditions are consistent (visual observations, thickness, location) with the previous four years, and improved and stable when compared to historical results;
- No widespread dissolved phase groundwater plumes indicative of a large source area are present onsite. There has been no identified offsite migration of COCs at concentrations exceeding applicable land use or adopted ecological groundwater screening criteria;
- Groundwater impacts are also considered limited in vertical extent given the presence of a layer of low permeability soil, predominantly consisting of clay, and the absence of COCs within wells screened deeper than 4 mbgs during current and historic sampling;
- Consistent with historic results, dissolved phase hydrocarbon impacts have been identified, mainly in the central portion of the Project Area in the location of the former solvent plant and Tankfarms K, E1 and E2 (CSM2). Dissolved phase concentrations have also been reported in isolated locations across the Project Area. This includes the recently investigated south-western (Autonexus and process area east at CSM3) and northern (biotreater filter cake drying area and former fire training ground at CSM1) area, and within LyondellBasell's operational footprint to the east of the Project Area (CSM2). Dissolved-phase hydrocarbon impacts to groundwater appear to demonstrate stable or reducing trends;
- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) concentrations have been observed across the Project Area. With a few minor exceptions, these concentrations are not in excess of adopted commercial or industrial screening criteria;
- Concentrations of dissolved metals above the adopted ecological screening criteria for marine water quality have been identified in numerous wells at the Project Area. Due to the extensive distribution of the heavy metals, the source is thought to be associated with leachate derived from imported fill material or potentially representative of regional background conditions. Concentrations of Hexavalent Chromium (Cr VI) above the adopted ecological screening criteria have been identified at a number of locations in the north-east portion of the Project Area (CSM1);
- Perfluorooctane sulfonate (PFOS) (a component of fire fighting foam) was reported to be present at concentrations above the laboratory limit of reporting in four of the 10 groundwater monitoring wells submitted for laboratory analysis. The results are not considered to indicate widespread gross contamination for this potential Contaminants of Concern; and
- No other constituents analysed for in groundwater samples (organochlorine pesticides: OCPs, organophosphorus pesticides: OPPs, PCBs and phenols) are present at concentrations exceeding the adopted commercial and industrial screening criteria.

17.1.7 Contaminants of Concern

The CSM 2012 provides a qualitative description of plausible mechanisms by which receivers may be exposed to contamination from the Project Area. For exposure to be considered possible, some mechanism ('pathway') must exist by which contamination from a given source can reach given receivers, i.e. there must be a 'source-pathway-receiver' link (SPR linkage). In the event that remedial action is required to mitigate the risk, the CSM 2012 would serve as a design basis for the remedial action (ERM, 2012).

Based on the understanding of geology and hydrogeology (refer to **Sections 17.1.2** and **17.1.3**), the migration potential of COCs in groundwater is limited by the low permeability of the lithology, relatively flat hydraulic gradient and low average groundwater velocity (ERM, 2012). Based on hydrogeological information, a low permeability clay layer appears to limit vertical migration of contaminants (ERM, 2012).

It is noted that soil impacts at the Project Area are generally considered isolated and limited in extent, related to petroleum hydrocarbons, limited to fill material and shallow soils (confined by underlying clay and influenced by shallow water table), and primarily associated with process areas and tankfarms (ERM, 2012). Site assessment works undertaken in 2011 also indicate that:

- Concentrations of metals (including speciated chromium and lead) were reported to be below the adopted commercial screening criteria for all samples collected as part of environmental site analysis work completed in 2011 to 2012;
- Asbestos has been identified within CSM1, with positive identification reported across the CSM area to depths of approximately 2.0 m within the fill material. Asbestos was not reported within CSM3 based on analytical results but nevertheless remains one of the COCs within CSM3; and
- No other contaminants analysed for soil samples (OCPs, OPPs, PCBs, phenols) are present at concentrations exceeding the adopted commercial and industrial screening criteria used for comparison (ERM, 2012).

Based on the isolated and limited extent of impacts and the magnitude of the concentrations measured in soil samples collected from investigation areas, the analytical soil results do not support the presence of large areas of impact as a result of the release of product from the process areas or tankfarms (ERM, 2012).

However a range of COCs continue to be analysed as part of the SGMP 2010. These COCs detected at the Project Area and their known locations are outlined in **Table 17-2** (ERM, 2012).

Table 17-2 Detected Locations of Contaminants of Potential Concern

Contaminants of Potential Concern	Known Location
LNAPL	Whole Project Area
BTEX	Whole Project Area
PAH	Whole Project Area
PCBs	CSM2 and CSM3
Metals (lead and chromium in sludge or imported fill)	CSM1 and CSM2
Metals (lead in buried sludge and chromium)	CSM3
Asbestos	CSM1, CSM2 and CSM3

Other COCs considered for the Project Area that have either historically been or currently form part of the monitoring of site conditions include phenols, OCPs, OPPs, OCPs, TEL and PFOS (ERM, 2012).

Through assessment of current site conditions, only petroleum hydrocarbons are known to be present at concentrations above their applicable screening criteria, and along with asbestos and LNAPL are considered to potentially pose a risk to identified receivers under commercial and industrial land use criteria. ERM therefore concludes that the COCs within the Project Area which have the potential to create a SPR linkage are (ERM, 2012):

- Total Recoverable Hydrocarbon (TRH) C_6-C_9;
- TRH C_{10}-C_{14};
- Benzene;
- Benzo[a]pyrene;
- Total PAH;
- Asbestos; and
- LNAPL.

Generally speaking, the fate and transport of LNAPL and petroleum hydrocarbons at the Project Area can be summarised as follows (ERM, 2012):

- No significant ongoing releases are occurring based on groundwater analytical results from the current groundwater monitoring program and other control measures performed by Shell during routine operations;
- The sporadic occurrence and limited extent of impacted soil and groundwater across the Project Area cannot be clearly linked to a specific source, but rather tends to be co-located with process areas and tankfarms. Observed conditions do not form a simple plume as might be expected from an underground storage tank release or single point spill, but indicate that an area has been subject to a number of both identified and unidentified release events, occurring at various locations over extended periods of time;
- Correlations can be drawn between the observed soil impacts (where available) and groundwater contamination plumes. Based on the soil and groundwater impacts identified in recently completed environmental site assessments, strong links can be made between observed soil conditions and resulting groundwater impacts;
- Plumes of impacted groundwater, including LNAPL, appear to be stable (in nature and extent) and limited to within the Project Area, with no indication of offsite migration. This observation is expected based on the limitations posed by the site specific geological and hydrogeological conditions limiting the migration of these plumes; and
- No vertical migration of Contaminantss of Concern appears to be occurring based on the analytical results of soil samples collected from within the low permeability clay layer and of groundwater samples collected from deeper monitoring wells, neither of which report detections of Contaminants of Concern.

ERM 2012 contained site maps presenting isoconcentration contours of TRH C_6-C_9 in groundwater from 2008 through 2012. While the plume configurations have changed over time due to the addition of new monitoring points and an enhanced ability to characterise conditions, the same observations summarised above apply (ERM, 2012).

While not specifically evaluated, attenuation through naturally occurring biodegradation is likely to at least be partially contributing to plume stability. Petroleum hydrocarbons are biodegradable under both aerobic and anaerobic conditions, and this biodegradation can stabilise groundwater plumes and control their migration (ERM, 2012).

17.1.8 Current Management of Soil and Groundwater

Soil and groundwater at the Project Area are currently managed under the CSM 2012 as outlined in **Section 17.1**, and the SGMP 2010. CSM 2012 provides details of the location of Contaminants of Concern at the Project Area, and an overview of monitoring, trigger and response actions that are required to maintain soil and groundwater quality. The SGMP 2010 provides further guidance as a long-term management tool through continued characterisation of site conditions. It identifies the three key barriers (refer to **Figure 17-3**) to receiver exposure to contaminants for managing residual and future impacts to soil and groundwater:

- Primary source management;
- Operational area (internal) monitoring; and
- Boundary containment monitoring.

The GWSAP forms part of the broader SGMP 2010 and provides the details of the monitoring that is key to the continued characterisation of the Project Area. In particular it provides guidance on:

- Frequency of monitoring;
- Contaminants of Concern for laboratory analysis; and
- List of wells to be used for gauging and sampling.

Primary source management relates to the primary sources of potential additional contamination at the Project Area, including spills and leaks of hydrocarbon products by loss of primary containment. Primary source management includes engineering design and operational procedures to reduce the potential for such additional contamination to occur, and to provide an immediate response where a release event does occur. When a release event occurs or is suspected to occur, the steps identified in **Figure 17-3** are implemented.

Where additional investigation is warranted, a suitable program of works would be developed to cover any data gaps in order to determine whether risks are within acceptable levels. Such investigations might include trial pit excavations, the advancement of soil bores monitoring well installations and analytical sampling of soil and groundwater conditions as appropriate. The following guidelines are relevant here:

- *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (Department of Environment and Climate Change, 2009);
- *Guidelines for the Assessment and Management of Groundwater* Contamination (Department of Environment and Conservation, 2007a);
- *Guidelines for the NSW Site Auditor Scheme (2nd edition*) (Department of Environment and Conservation, 2006);
- *Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011);
- *ANZECC/ARMCANZ, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000* (ANZECC, 2000);
- *National Environmental Protection (Assessment of Site Contamination) Measure – Schedule B guidelines* (National Environment Protection Council Service Corporation, 1999);
- *Sampling Design Guidelines* (EPA, 1995);
- *Guidelines for Assessing Service Station Sites* (OEH, 2012c); and
- *ANZECC/NHMRC Australian and New Zealand Guidelines of the Assessment and Management of Contaminated Sites* (ANZECC, 1992).

Where such additional investigation has been warranted, a determination would then be made on whether the identified risks are greater than acceptable levels. If this is the case, an appropriate remedial action plan is prepared. If this is not the case, residual impacts would nevertheless continue to be managed. Remediation triggered by such a release event might include:

- Excavation of surface soil and removal or treatment before reinstatement;
- Excavation of interception trenches and associated pumps as needed to remove and prevent further spread of shallow groundwater contamination;
- Installation of pumps in groundwater wells to remove or control the spread of contamination; and
- Emplacement of impermeable materials in soil trenches to contain the spread of contaminated groundwater.

Residual impacts would continue to be implemented via routine monitoring according to the Groundwater Sampling and Analysis Plan (GWSAP).

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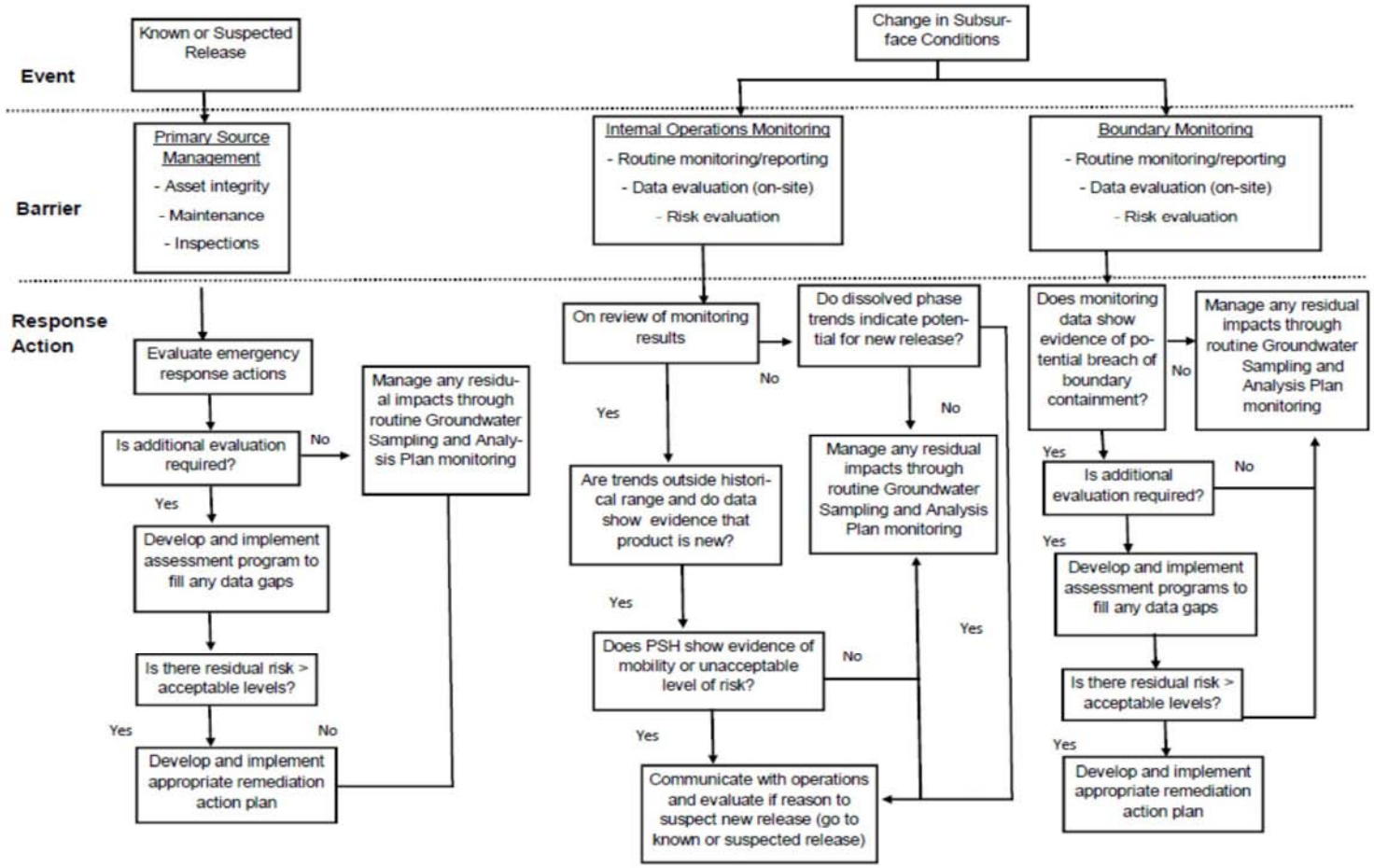

Figure 17-3 Soil and Groundwater Management Plan

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Internal operational area monitoring provides a means of routinely assessing potential primary contaminant source areas. This is a means of second line defence following primary source management and emergency response procedures for a release event. This is undertaken via the early detection of release events or the mobilisation of residual impacts, both of which become identifiable as changed subsurface conditions within the monitoring well network. If such a change in subsurface conditions is detected, the following procedures apply:

- Where free phase liquids are detected in a well, the SGMP 2010 triggers further investigation of their cause;
- The free phase liquids are evaluated to determine whether they are outside the range of previously identified impacts:
    - Confirming these results through repeat gauging; and
    - Completing a forensic assessment of the product for evidence of the age and type of product.
- If free phase liquids are considered the result of an unidentified event, further investigation is warranted;
- If free phase liquids show evidence of mobility or unacceptable risk, a more in-depth evaluation of mobility or receiver risk is considered. If there is evidence of mobility or potential for unacceptable risk, communications are generally undertaken with operations regarding the potential for a release event to have occurred;
- Communications with operations regarding the potential for an unknown release event to have occurred are undertaken to determine if Shell's operations could have plausibly caused the release. At this time, actions under the primary source management barrier are considered;
- If the free phase liquids are not identified in monitoring wells, the second tier of screening is applied to evaluate dissolved trends indicating new release or mobilisation of existing impacts. If results indicate potential for a new release or mobilisation of residual plume contamination, then communications with operations are undertaken to determine whether Shell's operations could have caused the release; and
- If there is no evidence of a new release event, or mobilisation of a residual contaminant plume within the Project Area based on phase separated hydrocarbons (PSHs) or dissolved phase data, and risks are determined to be within acceptable levels, management would be facilitated through a groundwater monitoring program under the GWSAP.

The boundary groundwater monitoring program is the key method of assessing containment of COCs onsite. It allows for the effectiveness of current site management to be evaluated, and for receivers to be protected throughout the life of Shell's operations. This boundary monitoring includes a set of triggers and responses facilitating containment of existing contamination onsite. Where these trigger criteria are met, the following are undertaken:

- Where an observed change in conditions reflects a potential breach of boundary containment, an assessment program is developed and implemented to fill identified data gaps, and to evaluate the suspected offsite migration of COCs at levels posing a risk to identified receivers. This may include:
    - Gauging and sampling activities;
    - Conducting a loss of primary containment investigation if initial detection of phase separated hydrocarbons (PSH) or dissolved phase constituents;
    - If PSHs are observed, forensic assessment is completed for evidence on the age and type of product, PSH bail down tests and additional characterisation to assist in recoverability evaluation and/or complete a quantitative assessment of the PSH mobility and recoverability;
    - If dissolved phase contamination is observed at concentrations exceeding or approaching adopted criteria, analysis is undertaken to compare against any potentially observed up-gradient PSHs;
    - Modifications to the current GWSAP (e.g. to expand monitoring networks offsite or increasing monitoring frequency) should the current monitoring plan be inadequate for delineation of changes in subsurface conditions; and
    - Risk assessment, including fate and transport modelling, offsite pore space analysis, sediment sampling and surface water sampling.
- A more in-depth evaluation of potential risks to receivers is conducted. If risks are above the acceptance criteria, a remedial action plan is prepared;

- Where remedial action is warranted, targets are set for mitigating actual or potential exposure routes and also to meet any regulatory requirements. Remediation following offsite migration of contaminants could involve a range of actions, including:
    - Excavation of interception trenches and pumps to remove and prevent further spread of shallow ground water contamination;
    - Installation of pumps in ground water wells to remove or control the spread of contamination;
    - Emplacement of impermeable materials in soil trenches to contain the spread of contaminated groundwater; and
    - Removal of any identified sources of contamination.
- If investigation findings indicate that migration of Contaminants of Concern has occurred at unacceptable levels but within the Project Area boundary, then the management of any residual contamination through a groundwater monitoring program under the GWSAP is undertaken.

Using CRC CARE Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (Friebel and Nadebaum, 2011) ERM assessed the works related to the project. NEPM (2013) has adopted many of these criteria but was not the available standard at the time of the 2012 ERM study. ERM will perform a thorough review of the site according to NEPM (2013) as part of any subsequent development application for alternative use of the surplus land released following the demolition and removal of redundant assets.

17.2 Potential Impacts

17.2.1 General Project Impacts

The demolition and construction components of the Project would only involve minimal excavation activities as follows:

- Grading works would be undertaken surrounding Tankfarms B, B1, E1, E2 and K, and also surrounding Tanks 32 and 52 (which are to be demolished) to improve tankfarm drainage and general site drainage (refer to **Figure 6-2**). Excavations as required as part of these works would be undertaken to an estimated depth of between 0.6 mbgs and 1 mbgs; and
- Excavations to 300 mm to lay load-spreading concrete slabs for the new substations.

Civil works will be required to remove some existing foundations below grade, however most demolition works would be to grade only. Where works are undertaken below ground surface, these would be undertaken according to the SGMP 2010 and ESCP. Throughout demolition works there is the possibility that excavation to more than 300 mm in depth may be warranted for the removal of some existing foundations. This would not be known until demolition works are being undertaken. In the unlikely circumstance that this is required, an assessment of likely contaminants to be encountered in groundwater within the location of these excavations would be conducted.

As outlined in **Sections 17.1.3** and **17.1.6**, groundwater at the Project Area generally occurs at depths of between 1 to 4.5 m AHD, which equates to around 0.5 to 3 mbgs in sections of the Project Area (ERM, 2012). Excavation works as detailed above are not expected to intercept groundwater.

Shell has commissioned a geotechnical investigation of the areas that are likely to be excavated as part of the Project. These investigations found that the Project is highly unlikely to involve the interception of groundwater at the Project Area although any stormwater entering excavated areas would still require removal. Whilst this is not anticipated to be required, there nevertheless remains some limited residual potential for the Project to intercept groundwater in the event of unforeseen circumstances. In the highly unlikely event that this is required, Shell would consult with NOW regarding the need for approval(s) under the WM Act.

As it is highly unlikely that the Project would intercept groundwater at the Project Area, it is also anticipated that the Project would not result in saline intrusion of existing groundwater, and would not involve the construction of groundwater bores in addition to the groundwater monitoring bores that Shell uses as part of its SGMP 2010. The Project is therefore also not predicted to result in the sterilisation of any existing groundwater source or aquifer underlying the Project Area.

Furthermore, given that the Project Area is known to contain Contaminants of Concern (refer to **Section 17.1.7**) there is potential for the Project to intercept, disturb, or mobilise contaminated soils, including ASS. This has the

further potential to impact both onsite and offsite receivers if not appropriately managed. During both the current and future operation of the Clyde Terminal, there is the potential for onsite and offsite soil and groundwater impacts to occur as a result of a release event, for example by the release of hydrocarbons through tank overfill. Consideration would also be given to the potential for additional contamination to occur as aboveground infrastructure is demolished during the conversion works (being released from areas that were not able to be adequately assessed prior to conversion works commencing). During demolition and construction activities, select ongoing monitoring requirements under the SGMP 2010 may not be fulfilled as access is temporarily suspended. Following the conversion works and when unimpeded site access is established, additional investigation and remediation can be completed as required.

With the management measures outlined in **Section 17.3**, it is unlikely that the Project would impact on either the short or long term groundwater conditions at the Project Area or its surrounds.

17.2.2 Acid Sulfate Soils

The Project would involve minimal excavation works as outlined in **Section 6.1** to an estimated maximum depth of 300mm on land classified in LEP 2011 as potentially containing Class 3 and 4 ASS. It is therefore necessary to consider PASS in relation to the Project.

The *Acid Sulphate Soils Assessment Guidelines* (NSW Acid Sulphate Soils Management Advisory Committee, 1998) provide that the construction or modification of drains should be assumed to impact on ASS in areas zoned as Class 1-3. The *Acid Sulphate Soils Assessment Guidelines* therefore trigger the preparation of a preliminary assessment to determine whether ASS is present and if the Project is likely to disturb those soils. Shell has commissioned the Environmental Conditions Summary Report to fulfil the requirements of a PIO issued under the CLM Act. This investigation established that low pH occurs at the Project Area, in particular within CSM4. Whilst low pH can be an indicator of the presence of ASS, the Environmental Conditions Summary Report did not specifically consider the potential for ASS at the Project Area. Given the geomorphic characteristics of the Project Area, such as its elevation, proximity to the Duck and Parramatta Rivers, relatively shallow soil horizons, and adjoining wetland vegetation as per the *Acid Sulphate Soils Assessment Guidelines*, it is likely that ASS are present at the Project Area.

Confirmation of the presence of ASS at the Project Area would therefore be considered a data gap which Shell would investigate further before excavation activities are undertaken as part of the Project and would address as part of the CEMP for the Project, in accordance with the guidelines in the *Acid Sulphate Soils Laboratory Methods Guidelines* (Ahern et al, 2004). An acid sulfate soils sub-management plan (ASSMP) would also be prepared as part of the ESCP for the Project, which would be included in the existing SGMP 2010, the WMP 2013, and the CEMP that is to be formed for the Project. The ASSMP section of the ESCP would include a soil and water analysis program to specifically monitor for the presence of ASS in accordance with the monitoring parameters specified in the *Acid Sulphate Soils Assessment Guidelines*. The ASSMP section of the ESCP would include a contingency plan to manage impacts that have the potential to occur if specified management strategies are unsuccessful, and to outline any remediation and restoration actions that may be required. This would ensure that the ASSMP section of the ESCP addresses its own effectiveness and reliability in managing any residual ASS impacts.

It is proposed that a comprehensive assessment of surplus land would be done once the existing assets have been demolished and removed once access is obtained to areas that are currently inaccessible. This will include ASS surveys as well as sa survey for other potential contaminants. To date, access has been limited to areas not occupied by refining assets that would be removed as part of this project.

17.2.3 Groundwater Management Policies in NSW

As explained in **Table 7-3**, the Project Area falls under the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* (WSP 2011). Therefore, the provisions of the WM Act apply to the Project Area, and the provisions of the *Water Act 1912* do not apply.

The WM Act provides the legislative basis for water use, management and planning. It is gradually replacing the planning and management frameworks in the *Water Act 1912.* Generally speaking, areas of NSW that have a water sharing plan in place would fall under the provisions of the WM Act. Those areas of NSW that do not have a water sharing plan continue to fall under the provisions of the *Water Act 1912*. The WSP 2011 applies to the Project Area, and as such the WM Act also applies but the *Water Act 1912* does not. **Table 7-3** further outlines the approvals under the WM Act that Shell would ordinarily be required to obtain for this Project, but which would

be incorporated into the consent authority's determination of the Project under section 89J of the EP&A Act. **Table 17-3** provides a consideration of the objects and relevant water management principles of, the WM Act.

Table 17-3 Objects and Relevant Water Management Principles under the WM Act

Objective	Consideration
Section 3 Objects	
The objects of this Act are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular:	
(a) to apply the principles of ecologically sustainable development;	The Project is considered to be consistent with the principles of ESD (refer to **Section 29.2.3**).
(b) to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality;	The Project is not predicted to significantly impact on water resources in the area (refer to **Sections 13.2** and **17.2**) and is therefore consistent with these objectives.
(c) to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including: (i) benefits to the environment; (ii) benefits to urban communities, agriculture, fisheries, industry and recreation; (iii) benefits to culture and heritage; and (iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water;	
(d) to recognise the role of the community, as a partner with Government, in resolving issues relating to the management of water sources;	
(e) to provide for the orderly, efficient and equitable sharing of water from water sources;	Significant excavation works would not be required as part of the Project, and the demolition and construction activities of the Project are considered highly unlikely to intercept existing groundwater. The ongoing operation of the converted Clyde Terminal would not require the extraction of groundwater for use at the Project Area. However in the highly unlikely event that groundwater interception is required during conversion works, Shell would liaise with NoW about the potential need to obtain an aquifer inference approval to intercept groundwater and undertake dewatering activities.
(f) to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna;	Shell has integrated the management of groundwater and soil at the Project Area, as per the SGMP 2010.
(g) to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users; and	In the highly unlikely event that groundwater interception is required during conversion works, Shell would liaise with NOW about the potential need to obtain an aquifer inference approval to intercept groundwater and undertake dewatering activities.
(h) to encourage best practice in the management and use of water.	The Project is not predicted to significantly impact on water resources in the area (refer to **Sections 13.2** and **17.2**) and is therefore consistent with these

Objective	Consideration
	objectives.
Section 5 Water Management Principles	
(2) Generally:	
(a) water sources, floodplains and dependent ecosystems (including groundwater and wetlands) should be protected and restored and, where possible, land should not be degraded;	The Project decreases the overall environmental footprint of the Project Area, and would not contribute to the further degradation of land in the area.
(b) habitats, animals and plants that benefit from water or are potentially affected by managed activities should be protected and (in the case of habitats) restored;	The Project decreases the overall environmental footprint of the Project Area, and would not contribute to the further degradation of land in the area.
(c) the water quality of all water sources should be protected and, wherever possible, enhanced;	
(d) the cumulative impacts of water management licences and approvals and other activities on water sources and their dependent ecosystems, should be considered and minimised;	There are no known groundwater users in the vicinity of the Project and groundwater is unlikely to be used for any beneficial purposes in the area. As outlined in **Section 17.2.4** below, the Project is not anticipated to impact on the remnant wetlands at the Project Area (which may be classified as partially GDE's). **Section 25.0** of this EIS outlines the potential for the Project to result in cumulative impacts in combination with other proposed developments in the area. Whilst it is unlikely that the Project would impact on groundwater, it is furthermore highly unlikely that the Project, in conjunction with other nearby developments and activities, would result in significant impacts to groundwater.
(e) geographical and other features of indigenous significance should be protected;	As per **Sections 18.0** and **21.2** the Project is not anticipated to significantly impact on Aboriginal and European heritage in the vicinity of the Project Area.
(f) geographical and other features of major cultural, heritage or spiritual significance should be protected;	
(g) the social and economic benefits to the community should be maximised; and	The Project is not predicted to significantly impact on water resources in the area (refer to **Sections 13.2** and **17.2**), and therefore maintains the quality of these water resources for the benefit of the community.
(h) the principles of adaptive management should be applied, which should be responsive to monitoring and improvements in understanding of ecological water requirements.	The SGMP 2010 provides for adaptive management in response to unpredicted water quality impacts.
(4) In Relation to Water Use:	
(a) water use should avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity and, where possible, land should be rehabilitated;	The demolition and construction activities of the Project are highly unlikely to intercept existing groundwater levels. The ongoing operation of the converted Clyde Terminal would not require the extraction of groundwater for use at the Project Area. In the highly unlikely event that this does occur, only minimal amounts of intercepted groundwater would require dewatering. The Project is also not predicted to significantly impact on water resources in the area
(b) water use should be consistent with the maintenance of productivity of land in the long term and should maximise the social and	

Objective	Consideration
economic benefits to the community; and	(refer to **Sections 13.2** and **17.2**). The Project is therefore consistent with the objectives of maintaining land productivity and avoiding impacts to nearby land users.
(c) the impacts of water use on other water users should be avoided or minimised.	
(5) In Relation to Drainage Management	
(a) drainage activities should avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity and, where possible, land should be rehabilitated; and	As outlined in **Sections 13.2.1** and **13.2.3**, demolition and construction activities have the potential to generate dust and sediment runoff impacting on surface water quality at the Project Area. The Project has the potential to further directly impact on surface water quality, as treated process water that cannot be reused at the Clyde Terminal would continue to be discharged offsite. However the management measures to be included in the Project CEMP and OEMP would prevent any significant impacts occurring during and after the conversion works. No native vegetation is to be removed as part of the Project works. The Project would also involve upgrades to surface and process water management at the Project Area. Notwithstanding, there is anticipated to be little change in stormwater runoff overall as the Project Area is largely hard surfaced already, and the volume of stormwater runoff generated at the Project Area is therefore not anticipated to increase or decrease significantly as a result of the Project. Whilst the drainage patterns of the Project Area would be altered, potentially contaminated stormwater at the Project Area would continue to be captured and processed onsite, before being subsequently discharged offsite. The Project would involve only minimal upgrades to existing surface water management, and the existing CPIs and main interceptor would continue to be used to treat process water at the Clyde Terminal. The existing onsite water capture and offsite drainage systems would therefore remain in place. As such, the Project is not anticipated to significantly impact on surface and process water at the Project Area or its surrounds. Overall the Project is not predicted to significantly impact on water resources in the area (refer to **Sections 13.2** and **17.2**). The Project is therefore consistent with the objectives of avoiding impacts on nearby land users.
(b) the impacts of drainage activities on other water users should be avoided or minimised.	

Objective	Consideration
(6) In Relation to Floodplain Management:	
(a) floodplain management must avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity and, where possible, land must be rehabilitated;	As per the *City of Parramatta Local Floodplain Risk Management Policy* (Parramatta City Council, 2006a), Shell would develop a site-specific Emergency Response Flood Plan demonstrating Shell's ability to secure or move plant, goods and substances above the one percent AEP flood level within the applicable flood warning time. This Emergency Response Flood Plan would also include requirements for flooding evacuation drills as well as procedures for equipment and product protection (refer to **Section 13.3**). Shell would also ensure that extensive new infrastructure is not constructed at the Project Area on land lying within the 1:100 year flood event (refer to **Section 13.1.3**), and would ensure that any new infrastructure erected on the Project Area is designed with regard to the Floodplain Matrix of Planning and Development Controls identified in the *Floodplain Risk Management Policy* (Parramatta City Council, 2006a). All fuel products and other potentially hazardous substances at the Project Area would continue to be stored in sealed, bunded areas that would prevent their migration offsite in the event that a storm surge or flood event impacts the Project Area (refer to **Section 13.3**). Shell would also implement measures to preserve the riparian buffer zone along the southern and eastern borders of the Project Area (refer to **Section 13.3**).
(b) the impacts of flood works on other water users should be avoided or minimised; and	
(c) the existing and future risk to human life and property arising from occupation of floodplains must be minimised.	As outlined in **Section 13.1.3**, there is risk of flooding impacts to occur at the Project Area. However, the Project itself is also not anticipated to impact on flooding or tidal regimes in the area as it would not result in a net increase in built structures within the floodplain, and would therefore not divert water from the existing floodway into other less flood prone areas. The Clyde Terminal would continue to collect stormwater onsite and divert clean stormwater offsite, and the Project is also not anticipated to increase overall stormwater runoff from the Project Area as the majority of the Project Area is already hard stand. The riparian buffer zone along the border of the Project Area also has the potential to further minimise the impacts of any such flooding at the Project Area by slowing down flood waters and helping them to spread around the floodplain (Department of Environment, Climate Change and Water, 2010). The mitigation measures detailed in **Section 13.3** would reduce the potential for flooding to cause significant impacts at the Project Area.

Objective	Consideration
(7) In Relation to Controlled Activities	
(a) the carrying out of controlled activities must avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity and, where possible, land must be rehabilitated; and	**Sections 13.3** and **17.3** outline the management measures that Shell would undertake to avoid these impacts.
(b) the impacts of the carrying out of controlled activities on other water users must be avoided or minimised.	

The WSP 2011 commenced on 1 July 2011, and relates to all identified groundwater sources and other aquifers that exist below the surface of the ground within the Sydney Basin Central Groundwater Source, within which the Project Area is located. It sets out environmental water rules for the region, landholder rights in relation to water, provides for water extraction under access licences, sets out a bulk water access regime for the region, and provides for other related issues related to water sharing. As detailed in **Section 17.2**, it is highly unlikely that the proposed demolition and construction activities would intercept existing groundwater levels. The Project itself would not require the extraction of groundwater for use at the Project Area. Despite being highly unlikely, there is nevertheless some limited residual potential for the Project to intercept groundwater in unforeseen circumstances. In the highly unlikely event that this does occur, small amounts of intercepted groundwater may need to be dewatered in order to allow construction works to take place. This is not anticipated to occur as part of the Project, but in the event that it does Shell would liaise with NOW about the need for relevant approval(s) under the WM Act.

There are no domestic and stock users in the vicinity of the Project Area that would be able to rely on basic landholder rights to groundwater. There are also no aquifer access licence holders in the vicinity of the Project Area. As outlined in **Section 17.1.6**, there are no known groundwater users in the vicinity of the Project and groundwater is unlikely to be used for any other beneficial purposes in the area.

The *NSW State Groundwater Policy Framework Document* (Department of Land and Water Conservation, 1997) provides an overview of groundwater management and outlines four key objectives that are generally consistent with the key objectives of the *NSW State Rivers and Estuaries Policy* (NSW Water Resources Council, 1993), and of the *NSW Groundwater Quality Protection Policy* (Department of Land and Water Conservation 1998), as follows:

- Slowing and halting, or reversing any degradation of groundwater resources;
- Ensuring the long term sustainability of the ecological support characteristics of groundwater systems;
- Maintaining the full range of beneficial uses of these resources; and
- Maximising economic benefit to the region, State and Nation.

The Project is consistent with these aims. In particular, the continued implementation of the SGMP 2010 and GWSAP 2010 at the Project Area focuses on identifying and managing the potential for offsite migration of soil and groundwater impacts, both from Shell's current activities and as a result of historical activities undertaken in the Camellia Industrial Estate. The Project is not anticipated to impact further on groundwater quality at the Camellia Industrial Estate, and would therefore also not affect the existing riparian vegetation along the Project Area boundary that might be considered to be a GDE (refer to **Section 17.2.4**) . It is highly unlikely that the Project would require the dewatering of intercepted groundwater. As such the Project is unlikely to impact on groundwater levels at the Project Area.

17.2.4 Groundwater Dependent Ecosystems

As both Parramatta and Duck Rivers are tidal, the riparian vegetation along the Project Area boundary (also identified as wetland under LEP 2011) cannot be completely classified as a GDE under the *NSW State Groundwater Dependent Ecosystem Policy* (NOW, 2002). However, this remnant wetland area may nevertheless be classed as partially groundwater dependent. The Groundwater Dependent Ecosystem Policy recognises the

role of groundwater dependent wetlands in low-lying coastal areas to help maintain the quality and level of groundwater. Maintaining groundwater levels is particularly important in preventing potential ASS from being oxidised. By not impacting on the riparian vegetation, the Project would preserve these beneficial impacts. The Project is furthermore anticipated not to impact on these remnant wetlands as:

- Whilst the Project has some residual potential to require the dewatering of intercepted groundwater (albeit highly unlikely), and Project would not involve the extraction of significant amounts of groundwater from the Project Area. As such the Project is unlikely to disrupt groundwater levels, flows and recharge;
- The Project would not involve the clearing of any riparian vegetation, and therefore would not result in loss of habitat or decreased habitat connectivity;
- Continued management of groundwater at the Project Area as per the SGMP 2010 and GWSAP 2010 is considered adequate to deal with current low levels of groundwater contamination that have been identified (refer to **Sections 17.1.6** and **17.1.7**), and to identify and manage any future groundwater contamination that occurs; and
- In the unlikely event that a release event occurs at the Project Area, additional assessment would be undertaken as per the SGMP 2010, and as detailed in **Sections 17.1.8 and 17.3**.

In the unlikely event that a release event does occur at the Project Area or in the highly unlikely event that excavation activities do intercept groundwater, there is some residual potential, albeit unlikely, for the Project to impact groundwater quality which may further impact on the health of these wetland systems. In the event that a release event does occur, or that groundwater interception and extraction is required, the mitigation measures outlined in **Sections 17.1.8** and **17.3** are likely to be adequate to would prevent such impacts from occurring. Furthermore, the butyl membrane would further mitigate any such impacts to the remnant wetlands in the north-east of the Project Area. The mitigation measures in **Sections 13.3** and **16.4.5** would also ensure the ongoing preservation of riparian vegetation.

17.2.5 Ecological and Human Health Risks

Pathways

The pathways for potential contaminant migration and potential exposure for receivers are controlled by the geological environment as well as the built environment overlying the Project Area and in adjacent areas. The identified pathways for Contaminants of Concern in soil, groundwater or soil vapours include the following (ERM, 2012):

- Contaminants on impacted soil and groundwater volatilising to vapours and vapour migration;
- Vapour migration through service lines or the floor slab onsite into buildings onsite;
- Soil impact or surface spills leaching to groundwater; and
- Groundwater migration offsite or to an underlying aquifer.

Receivers identified for potential impact from the Project Area can be divided into human health receivers and ecological and environmental receivers. The human receivers identified within the Project Area that may be impacted by the identified Contaminants of Concern in soil and groundwater includes onsite employees in both the indoor and outdoor settings, as well as onsite contractors (ERM, 2012).

Initially ERM considered the potential for offsite receivers to be impacted, including offsite employees in the indoor and outdoor setting, offsite contractors and recreational users of Parramatta and Duck Rivers (fisherman, rowers, etc.). There has been no indication that groundwater affected by Contaminants of Concern is migrating offsite nor impacting the adjacent river systems. Given this delineation, potential receivers are considered limited to those onsite. As such, extending investigations beyond the Project Area boundary has not been considered to be warranted to assess potential for risk (ERM, 2012).

Potential environmental and ecological receivers identified at and adjoining the Project Area, including the surface waters of Parramatta and Duck Rivers, sediments within the mangroves and Duck Rivers, and aquatic vertebrates and invertebrates, including shellfish and fish, are also not considered to be receivers given that the extent of Contaminants of Concern present in soil and groundwater has been delineated to onsite environments. As mentioned previously, beneficial groundwater use (potable or non-potable) has not been considered given its natural background quality and likely low yields. Potential offsite receivers therefore do not require further consideration (ERM, 2012).

Source – Pathway – Receiver Linkages

Potential exposure pathways have been evaluated for completeness based on the existence of the following (ERM, 2012):

- Contamination source;
- Release mechanism of contaminants from identified sources;
- Contaminant retention or transport medium (e.g. soil, air, groundwater, etc.);
- Potential receivers of contamination; and
- Mechanism for chemical intake by the receivers at the point of exposure (ingestion, dermal contact, inhalation or a combination thereof).

Whenever one or more of the above elements is missing, the exposure pathway is incomplete and therefore no risk to identified receivers exists. An exposure pathway can be either “direct”, where the receivers comes into direct contact with the affected environmental media (e.g. soil ingestion) or “indirect”, where exposure occurs at a different location or in a different medium than the source (e.g. groundwater vapours volatilising to ambient air) (ERM, 2012).

Pathways to Human Receivers

The Contaminants of Concern include LNAPL, TRH, BTEX, PAH and asbestos, with consideration also given to Cr VI and PFOS. The exposure pathways identified for human health across all four CSM areas are both direct and indirect, and consist of the following for onsite employees and contractors (ERM, 2012):

- Dermal contact or ingestion of contaminated soil, sediment or surface water in onsite environments; and
- Exposure to vapours derived from hydrocarbon impacted soil or sediment in onsite environments.

Exposure pathways for onsite employees and contractors were initially considered as part of the Environmental Conditions Summary Report to be potentially complete. However, previous investigations have demonstrated that the indicated SPR linkages are actually incomplete as follows:

- Detailed procedures specified in Shell’s Permit to Work System, in which hazards associated with work procedures are assessed prior to commencement, are considered by Shell to ensure necessary measures are implemented to eliminate identified risks. Adherence to these procedures has previously been considered to remove the pollutant linkage for onsite employees and contractors undertaking these activities;
- Contractors or visitors who may be exposed to impacted groundwater during the extraction and sampling process in groundwater monitoring events are required to work under the refinery Permit to Work System, which is designed to remove the potential for exposure to contaminated groundwater; and
- Indirect pathways such as inhalation of vapours derived from groundwater impacts, hydrocarbon impacted soils and LNAPL have previously been considered by Shell to be incomplete through existing OH&S procedures implemented at the Project Area. Shell monitors air quality and responds to reported gas leaks or odours of unknown origin.

Pathways to Environmental and Ecological Receivers

Current monitoring of groundwater along the boundary of the Project Area indicates that no offsite migration of contamination is occurring at levels that could potentially cause risk to the identified environmental and ecological receivers. As such, the exposure pathway is incomplete and no risk is presented to the potential receivers identified (ERM, 2012).

Findings

Based on the information outlined in this section, the SPR linkages for the Project Area can be summarised as follows (ERM, 2012):

- Soil and groundwater conditions considered to represent a potential risk to identified receivers are isolated and limited in extent, with management systems in place to render any potential source pathways linkages as incomplete;

- No specific contaminant sources have been linked to soil and groundwater impacts, which are considered likely to be associated with a number of sources over an extended period of time;
- Groundwater plumes appear to be stable and no offsite migration of contaminants has been identified at levels exceeding adopted site screening criteria; and
- Actual receivers are considered to be limited to onsite workers and contractors, and while a quantitative risk assessment has not been completed, complete exposure pathways are considered unlikely based on the nature and extent of contamination, current site conditions and operations, and measures Shell has in place to manage potential risks.

The potential risks to identified receivers from the ongoing operation of the converted Clyde Terminal are therefore well understood. The likelihood of such risks eventuating is further considered to be unlikely under current site conditions and land use practices (ERM, 2012).

The existing SGMP 2010 has been assessed by a Site Auditor accredited under the CLM Act as being effective in managing conditions within the Project Area and evaluating potential risks under ongoing operational activities (ERM, 2012). Throughout the conversion process, the SGMP would ensure that an ongoing program of soil and groundwater monitoring would be employed, and that action would be taken to further investigate and remediate Contaminants of Concern in the event that they are discovered to be migrating and/or presenting a risk to human health and the environment (ERM, 2012).

The project works are not expected to perform major excavation works. In the vast majority of areas, the ground is not expected to be disturbed so the potential sources of contamination in these areas would continue to be managed by the ongoing OEMP which is regularly discussed with the EPA. As such, the risks of exposure to human and ecological health risks is limited to those workers performing the minor excavation activities for which an occupational health plan would be part of the CEMP and OEMP.

17.3 Mitigation Measures

Currently, soil and groundwater conditions at the Clyde Terminal site are regulated by Condition U1 of EPL No. 570 which references the need for the SGMP 2010 and an associated annual report. The ongoing operations at the Project Area would also continue to be regulated by the requirements of the POEO Act and CLM Act.

17.3.1 Demolition and Construction Mitigation Measures

The project works are not expected to perform major excavation works that would come into contact with any contaminated soil or groundwater. The demolition activities are expected to remove assets to ground level and the minor excavation works for the installation of load sharing concrete slabs wiould not be expected to contact sources of contamination. The CEMP would address the potential to contact Contaminants of Concern and would include mitigation measures to deal with the human health and environmental risks associated with these activities.

- Prior to demolition and construction activities taking place, Shell would develop ESCP to manage those risks at the Project Area. The ESCP would be incorporated as part of the CEMP and would be developed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004);
- The SGMP 2010 would be revised as part of the conversion activities where necessary to take account of demolition and construction activities;
- Shell would undertake the following actions in accordance with the CEMP for the Project. During the limited excavation activities that are planned for the conversion works, the following management measures would be applied:
    - Reference would be made to the identification of certain Contaminants of Concern in specific areas of the Project Area as per CSM 2012;
    - With reference to the CSM 2012, soil and groundwater conditions at the Project Area would continue to be managed through a series of triggers and appropriately designed response mechanisms;
    - Occupational hygiene monitoring would be identified for demolition and construction personnel in relation to VOCs;
    - Any subsurface works would be designed to control and protect the health and safety of people onsite;

  - The use of geotextile liners or temporary capping would be used to reduce infiltration of surface water runoff where soil is to be excavated during demolition and construction;
  - Groundwater routine reporting would continue to be undertaken as per Shell's GWSAP, which would be revised as part of the Project; and
  - If trigger values are exceeded at the Project Area for soil and groundwater quality as outlined in the Environmental Conditions Summary Report (ERM, 2012), the CSM 2012 would be used to guide appropriate clarification or mitigation measures.

- If contaminated soils are discovered during excavations, they would be separated and managed in accordance with Shell's existing waste management system for the Project Area (refer to **Section 20.0**), which would be incorporated as part of the Project CEMP;
- Further investigations would be undertaken in areas that are currently unable to be accessed due to plant and equipment on these areas, once the aboveground infrastructure is removed and access to the relevant areas is available;
- Throughout the Project, Shell would continue to undertake the following management measures as part of the SGMP 2010:
  - Contaminants of Concern would continue to be monitored as part of the ongoing SGMP 2010. A data gap would be identified in the event that one or more of these Contaminants of Concern are detected at concentrations exceeding their applicable groundwater screening criteria and may have the potential to pose a risk to identified receivers. Additional evaluation would then be completed to fill in those data gaps to confirm whether there is a risk that warrants further action; and
  - In the event that remedial actions are required to mitigate the risk of pathway exposure to contamination, the CSM 2012 would serve as a design basis for that remedial action.
- In general, Shell would continue to use a hierarchy of controls, including engineering controls, to mitigate risks and prevent loss of containment during both the conversion works and operation of the converted Clyde Terminal. Shell would continue to focus its incident prevention at the Project Area on strengthening preventative barriers against spills. The infrastructure upgrades undertaken as part of the conversion works would assist in preventing loss of containment by:
  - Upgrading safeguards to prevent tank overfills; and
  - Ensuring pipelines continue to be designed to withstand greater pressures than the maximum pump discharge pressures.
- Existing bund walls at the Clyde Terminal would be inspected prior to the conversion works commencing to identify any necessary improvements. These improvements would include either:
  - The demolition of the existing bund walls; or
  - Injection of concrete into the existing bund walls to strengthen the structure or repair any faults.
- ASS would be managed according to an ASSMP which would be incorporated into the existing *Soil and Groundwater Management Plan Shell Clyde Refinery and Parramatta Terminal, Durham Street, Rosehill, NSW* (Shell, 2010), the WMP 2013 and the CEMP to be prepared for the conversion works;
- ASS impacted soils within the Project Area would be identified before excavation activities are undertaken;
- Any ASS impacted soils excavated from the Project Area would be kept wet at all times until it is disposed of and managed in accordance with the *Waste Classification Guidelines Part 4: Acid Sulphate Soils* (Department of Environment and Climate Change, 2008e); and
- The ASSMP would also include a contingency plan to manage impacts that have the potential to occur if specified management strategies fail, and to outline any remediation and restoration actions that may therefore be required. This would ensure that the ASSMP addresses its own effectiveness and reliability in managing any residual ASS impacts.

17.3.2 Ongoing Operational Mitigation Measures

Ongoing Operational Mitigation Measures

- The SGMP 2010 would be revised as part of the operation of the converted Clyde Terminal to take account of the upgraded operations;
- Following the conversion works and when unimpeded site access is re-established in certain areas, additional investigation and remediation can be completed as required;
- The three key barriers to receivers' exposure would be maintained: primary source management; operational area (internal) monitoring; and boundary containment monitoring. These three key barriers would continue monitoring to evaluate barrier effectiveness on a quarterly basis and when otherwise triggered;
- Shell's risk management systems would continue to be reviewed and amended before critical changes throughout the conversion works to identify and assess the risks that these changes pose both onsite and offsite, and to ensure multiple layers of controls exist to minimise the opportunity for incidents to occur;
- Shell would notify WorkCover of any changes to the levels of risk before critical changes occur throughout the conversion works and would submit safety reports to WorkCover as required, ensuring WorkCover's oversight of the risks and controls at the Clyde Terminal;
- Shell would periodically review and amend the Emergency Procedure Plans to account for the changes in risks and the changes in fire fighting equipment at the Clyde Terminal throughout the conversion activities, and consult with Fire and Rescue NSW during this process;
- The following management measures would be incorporated as part of the OEMP and undertaken to prevent and manage the implications of any loss of containment scenarios:
    - Current systems in place at the Project Area that would continue to prevent loss of primary containment and spill incidents include:
        - Log checklists carried out every shift by operators to ensure that equipment such as valves are in the correct position;
        - Water drains through quick flush tanks to separate water from fuels, returning fuel to tanks and draining water to wastewater treatment facility, thus minimising the opportunity for fuel to enter the interceptor system;
        - Decontaminate the tankfarms, drainage and wastewater systems across the Clyde Terminal area to ensure minimal opportunity for stormwater to be impacted by remnant hydrocarbon contact;
        - Re-profile tankfarm floors to ensure adequate and effective stormwater draining and bund capacity is preserved to serve its primary purpose of protection of the environment from hydrocarbon spillage; and
        - Review and repair tankfarm bund walls where required to ensure integrity in the event of a spill incident.
    - Tank overfill would continue to be prevented through a combination of:
        - An automatic tank level gauging system with multiple level alarms including: target fill level; high level alarm with time for appropriate operator action at each point and before the next level; an alarm point; and manual dips to provide accuracy of the tank level gauging system;
        - A final independent high-high level alarm system that provides an alarm independently from the other alarms and tank level gauging system. This system provides for sufficient response time before overfill is anticipated to occur and would trip inflow facility pumps shutting down product inflow to tanks;
        - The movement management system that provides for the analysis of data and tank movement management; and
        - Operational readiness planning with procedural support.
    - A series of facility integrity checklists would be developed consistent with other Shell terminal facilities to ensure inspections and maintenance of safety and environmentally critical equipment and repairs are undertaken in a timely manner;

- Shell's existing Permit to Work system would be changed to be appropriate for converted Clyde Terminal operations and would be introduced with appropriate training and mentoring to ensure controls are in place across the Clyde Terminal to control all works, and to integrate these with non-routine activities during operation of the converted Clyde Terminal;
- Operators would continue to be trained to look for spills and leaks in the course of their shift rounds;
- Operators would be trained in the new environmental controls appropriate for the converted Clyde Terminal operations and specifically in the use of newly installed environmental control equipment;
- Existing interceptors within the Project Area would continue to be maintained as a means of tertiary containment; and
- Spill incidents would be reported within the Shell incident reporting system and, where required, to the EPA and WorkCover.

- If a release event is known or suspected to have occurred, additional assessment may be justified to determine if there have been any soil and groundwater impacts under the SGMP 2010 as follows:
  - A program of works would be developed to cover any data gaps and determine whether any associated risks are within acceptable levels;
  - Investigation techniques to be employed would include, where relevant:
    - Trial pit excavations;
    - Advancement of soil bores;
    - Monitoring well installations; and
    - Analytical sampling of soil and groundwater quality.
  - If investigation shows that risks are greater than acceptable levels identified in the SGMP 2010, some form of remedial action would be warranted in order to eliminate or reduce potential exposure pathways. This would be likely to involve one or more of the following:
    - Excavation of surface soil and removal or treatment before reinstatement;
    - Excavation of interception trenches and associated pumps as needed to remove and prevent further spread of shallow groundwater contamination;
    - Installation of pumps in groundwater wells to remove or control the spread of contamination; and
    - Emplacement of impermeable materials in soil trenches to contain the spread of contaminated groundwater.

17.4 Residual Impact

As identified above, Shell has measures in place to deal with situations where soil and groundwater quality trigger criteria are exceeded, where a loss of containment scenario occurs or is suspected to have occurred, and if ASS are disturbed during the Project. Both the current and future operations of the Clyde Terminal would be undertaken in accordance with the CEMP and OEMP, incorporating the conditions of CSM 2012 and the SGMP 2010. It is considered that the adherence to these conditions would result in low residual impacts to soil and groundwater associated with the Project. The CSM 2012 and SGMP 2010 have procedures in place for managing exceedances of soil and groundwater trigger criteria, and would continue to be updated as new information is identified to fill in recognised data gaps. The potential for human and ecological receivers to be impacted by Contaminants of Concern emanating from the Project Area is also considered to be minimal, given that Shell's current management practices prevent the necessary source-pathway-receptor linkages from being complete.

Where a release event occurs and there is evidence of residual impacts, the management of site conditions would be facilitated through the GWSAP.

Given that Shell already has extensive management measures in place to deal with soil and groundwater issues at the Project Area, it is not considered necessary for Shell to provide any additional type of funding assurance to cover anticipated post-development maintenance costs. Current management measures would continue with relevant amendments as deemed necessary to take account of upgraded operations at the Clyde Terminal.